DOE/EIS-0552

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

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COVER SHEET

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TITLE: Draft Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory (LANL SWEIS) (DOE/EIS-0552)

LOCATION: Los Alamos, New Mexico

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Abstract: Los Alamos National Laboratory (Laboratory or LANL) supports several NNSA missions, including enhancing U.S. national security through the military application of nuclear energy; maintaining and enhancing the safety, reliability, and effectiveness of the U.S. nuclear weapons; promoting international nuclear safety and nonproliferation; reducing global danger from weapons of mass destruction; and supporting U.S. leadership in science and technology. The continued operation of the Laboratory includes the DOE Office of Environmental Management (DOE-EM) legacy cleanup efforts at the LANL.

This SWEIS analyzes the potential environmental impacts of the reasonable alternatives for continuing LANL operations for approximately the next 15 years and has been prepared in accordance with Section 102(2)(C) of NEPA (42 U.S.C. §§ 4321–4336(e), as amended), regulations promulgated by the Council on Environmental Quality (40 *Code of Federal Regulations* [CFR] Parts 1500–1508, effective May 20, 2022), DOE's NEPA implementing procedures (10 CFR Part 1021), and NNSA Policy 451.1. The regulations (40 CFR 1502.7) state "… proposals of unusual scope or complexity, shall be 300 pages or fewer …" A page is 500 words and does not include explanatory maps, diagrams, graphs, tables, and other means of graphically displaying quantitative or geospatial information (40 CFR 1508.1(v)). **Per the definition of a page, this Draft SWEIS is approximately 285 pages.**

This LANL SWEIS analyzes three alternatives: (1) No-Action, (2) Modernized Operations, and (3) Expanded Operations. Under the No-Action Alternative, NNSA would continue current facility operations throughout LANL in support of assigned missions. The No-Action Alternative activities have previously completed NEPA reviews and include construction of new facilities; modernization, upgrade, and utility projects; and decontamination, decommissioning, and demolition (DD&D) of excess and aging facilities. The No-Action Alternative includes the continued legacy cleanup and environmental remediation. The alternative includes 87 new

projects, totaling almost 1.5 million square feet. Under the No-Action Alternative, NNSA would implement 11 projects involving facility upgrades, utilities, and infrastructure, affecting about 216 acres of the LANL site, and about 1.6 million square feet of excess or aging facilities would undergo DD&D. It also includes changes in operations, examples of which include increased plutonium pit production and the remediation of a hexavalent chromium plume in Mortandad Canyon.

The Modernized Operations Alternative includes the scope of the No-Action Alternative plus additional modernization activities, including (1) construction of replacement facilities; (2) upgrades to existing facilities, utilities, and infrastructure; and (3) DD&D projects. Under Modernized Operations, NNSA would replace facilities that are approaching their end of life, upgrade facilities to extend their lifetimes, and improve work environments to enable NNSA to meet operational requirements. The alternative also includes proposed projects to reduce greenhouse gases and other emissions. The Modernized Operations Alternative includes 139 new projects, totaling over 3.4 million square feet. Under the Modernized Operations Alternative, NNSA would implement 27 projects involving facility upgrades, utilities, and infrastructure, affecting about 925 acres (more than 40 million square feet) of the LANL site. Of this 925 acres, up to 795 acres are proposed for installation of up to 159 megawatts of solar photovoltaic arrays across the site. Over 1.2 million square feet of excess or aging facilities would undergo DD&D.

The Expanded Operations Alternative includes the actions proposed under the Modernized Operations Alternative plus actions that would expand operations and missions to respond to future national security challenges and meet increasing requirements. This alternative includes construction and operation of new facilities that would expand capabilities at LANL beyond those that currently exist. The Expanded Operations Alternative includes 18 new projects, totaling about 947,000 square feet. NNSA would implement four projects involving utilities and infrastructure affecting about 46 acres of the LANL site. The Expanded Operations Alternative also includes changes in operations, examples of which include revised wildland fire risk reduction treatments and management of feral cattle.

Decisions about future operations at the Laboratory will be provided in an NNSA Record of Decision published in the *Federal Register*, which will be issued no sooner than 30 days after the U.S. Environmental Protection Agency publishes its Notice of Availability (NOA) in the *Federal Register* of the Final LANL SWEIS.

Public Comments: DOE issued a Notice of Intent in the *Federal Register* (87 FR 51083) on August 19, 2022, announcing a 45-day SWEIS scoping period to receive input on the preparation of this Draft SWEIS. In response to comments, NNSA extended that comment period until October 18, 2022. Comments received during that scoping period were considered in the preparation of this Draft SWEIS. Comments on this Draft SWEIS will be accepted following publication of the U.S. Environmental Protection Agency's NOA in the *Federal Register* for a period of 60 days and will be considered in the preparation of the Final SWEIS. Any comments received after the comment period will be considered to the extent practicable. During the public comment period for this Draft SWEIS, NNSA will hold in-person and online public hearings. The dates and times of those public hearings will be announced on the DOE NEPA web page and the NNSA NEPA Reading Room (https://www.energy.gov/nepa, https://www.energy.gov/nnsa/nnsa-nepa-reading-room), as well as in local newspapers, and in *Federal Register Notices of Availability*.

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°C	degree(s) Celsius
°F	degree(s) Fahrenheit
1999 LANL SWEIS	Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory
2008 LANL SWEIS	Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory
2020 LANL SWEIS SA	Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory
ADT	average daily traffic
AADT	annual average daily traffic
ACAM	Air Conformity Applicability Model
aCi	attocurie
ACM	asbestos-containing material
AEI	Area of Environmental Interest
ALARA	as low as reasonably achievable
Am-241	americium-241
AOC	Area of Concern
ARIES	Advanced Recovery and Integrated Extraction System
ATWIR	Annual Transuranic Waste Inventory Report
B20	bio-diesel blend
BEA	Bureau of Economic Analysis
BGEPA	Bald and Golden Eagle Protection Act
BLM	U.S. Bureau of Land Management
BLS	U.S. Bureau of Labor Statistics
BMP	best management practice
BSL	biosafety level
BTF	Beryllium Technology Facility
C&D	construction and debris
CDC	U.S. Centers for Disease Control and Prevention
CEQ	U.S. Council on Environmental Quality
CFR	Code of Federal Regulations
CGP	Construction General Permit
CGTG	combustion gas turbine generator
CH	contact-handled
Chromium Plume EA	Final Environmental Assessment for Chromium Plume Control Interim Measure and Plume-Center Characterization, Los Alamos National Laboratory, Los Alamos, New Mexico
Chromium Final Remedy EA	Final Chromium Interim Measure and Final Remedy Environmental Assessment, Los Alamos National Laboratory, Los Alamos, New Mexico
Ci	curies
CMP	Campus Master Plan
CMR	Chemistry and Metallurgy Research Building

CMRR SEIS	Final Supplemental Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico
CO	carbon monoxide
CO_2e	carbon dioxide equivalent
COC	certificate of completion
Complex Transformation SPEIS	Complex Transformation Supplemental Programmatic Environmental Impact Statement
Consent Order	Compliance Order on Consent between the State of New Mexico Environment Department (NMED) and the DOE
COVID-19	Coronavirus 2019
CR	County Road
CRADA	Cooperative Research and Development Agreement
CRMP	*A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico*
CT EIS	Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico
CWF	Consolidated Waste Facility
CY	calendar year
D&D	decontamination and decommissioning
DARHT	Dual Axis Radiographic Hydrodynamic Test
DART	days away, restricted time
dB	decibel
dBA	A-weighted decibel
DBA	design-basis accident
DD&D	decontamination, decommissioning, and demolition
dec/d	decatherms per day
DECP	Pueblo de San Ildefonso Department of Environmental and Cultural Preservation
DMMSC	Dynamic Mesoscale Materials Science Capability
DNFSB	Defense Nuclear Facilities Safety Board
DoD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOE-EM	DOE Office of Environmental Management
DOE-IN	DOE Office of Intelligence and Counterintelligence
DOE-LM	DOE Office of Legacy Management
DSA	documented safety analysis
DU	depleted uranium
E85	ethanol blend
EA	environmental assessment
ECA	Electric Coordination Agreement
EIS	environmental impact statement
ELF	Explosives and Lasers Facility
EMCF	Energetic Materials Characterization Facility

EM-LA	DOE-EM LANL site office
EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPCU	Electric Power Capacity Upgrade
EPCU Draft EA	Los Alamos National Laboratory Electric Power Capacity Upgrade Project Draft Environmental Assessment
ES&H	environment, safety, and health
ESA	Endangered Species Act
ETA	Eastern Technical Area
ETC	Environmental Test Complex
ETF	Environmental Test Facility
EV	electric vehicle
fCi	femtocurie
FEMA	U.S. Federal Emergency Management Agency
FFRDC	Federally Funded Research and Development Center
FONSI	Finding of No Significant Impact
FR	Federal Register
FSI	future supercomputing infrastructure
FSI WTF	FSI Water Treatment Facility
FTWC	Flanged Tritium Waste Container
FY	fiscal year
gal/d	gallons per day
gal/yr	gallons per day
GHG	greenhouse gas
GMAP	gaseous mixed activation products
GPOB	general-purpose office building
GSA	General Services Agency
GSF	gross square feet
HALEU	high-assay low-enriched uranium
HAP	hazardous air pollutant
HC	hazard category
HE	high explosives
HEMMF	HE Modernized Manufacturing Facility
HENC	high-efficiency neutron counter
HEPA	high-efficiency particulate air
HEWTF	High Explosives Wastewater Treatment Facility
HEU	high-enriched uranium
HMP	Threatened and Endangered Species Habitat Management Plan
HPC	high-performance computing
HS Pu	heat source plutonium
HVAC	heating, ventilation, and air conditioning
I-25	U.S. Interstate 25
IMPROVE	Interagency Monitoring of Protected Environments
INL	Idaho National Laboratory
IPF	Isotope Production Facility
ISPS	Industrial and Sanitary Point Source

kg	kilogram
klb	thousands of pounds
kV	kilovolt
kW	kilowatt
Laboratory	Los Alamos National Laboratory
LAMP	LANSCE Modernization Project
LANL	Los Alamos National Laboratory
LANL BSL-3 EA	Environmental Assessment for the Proposed Construction and Operation of a Biosafety Level 3 Facility at Los Alamos National Laboratory
LANL MAP	Mitigation Action Plan for Los Alamos National Laboratory Operations
LANL SWEIS	Site-wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LAPP	Los Alamos Power Pool
LCF	latent cancer fatality
LD	light duty
LEFFF	Low-Enriched Uranium Fuel Fabrication Facility
LEV	low-emission vehicle
LID	low-impact development
LINAC	linear proton accelerator
LLCC	Los Alamos Legacy Cleanup Contract
LLW	low-level radioactive waste
LOS	level of service
LWA	Land Withdrawal Act
M&O	Management and Operating
m^3	cubic meters
MAPR	Manhattan Project National Historical Park
MAR	material at risk
MBTA	Migratory Bird Treaty Act
MCL	maximum contaminant level
MDA	material disposal area
MEI	maximally exposed individual
MeV	mega electron-volt
MFP	mixed fission products
mg	milligram
MGY	million gallons per year
MkW-hr/yr	million kilowatt-hours per year
MLLW	mixed low-level radioactive waste
MOT-ME	Microwave Oven Thermo-Mechanical Experimentation
MOX	mixed-oxide
mph	miles per hour
MLU	mobile loading unit
MSGP	Multi-Sector General Permit
MT	metric ton
$MTCO_2e$	metric tons of carbon dioxide equivalents
MTRU	mixed transuranic (waste)

MVA	megavolt-amperes
MW	megawatt
MWh	megawatt-hour
MWth	megawatts thermal
N/A	not available
N3B	Newport News Nuclear BWXT Los Alamos
NA	not applicable
NAA	No-Action Alternative
NA-LA	NNSA Los Alamos Field Office
National Register	National Register of Historic Places
NCRTD	North Central Regional Transit District
ND	no data
NDA	no detectable activity
NEEWC	National Energetic and Engineering Weapons Complex
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NGTS/S	National Gas Transfer System and Surety
NH_3	ammonia
NHNM	Natural Heritage New Mexico
NIH	U.S. National Institutes of Health
NL	Norton Line
NM	not measureable
NM-4	New Mexico State Road 4
NMAC	New Mexico Administrative Code
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMSW	New Mexico Special Waste
NNSA	National Nuclear Security Administration
NNSS	Nevada Nuclear Security Site
NOA	Notice of Availability
NOI	Notice of Intent
NO_x	nitrogen oxides
NPDES	National Pollutant Distribution Elimination System
NPR	Nuclear Posture Review
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
NSE	Nuclear Security Enterprise
OB/OD	open burning/open detonation
OSHA	U.S. Occupational Safety and Health Administration
P/VAP	particulate/vapor activation products
PAC	protective action criteria
Pb	lead
PC	Performance Category
PCBs	polychlorinated biphenyls
pCi	picocurie
PETN	pentaerythritol tetranitrate

PF	Plutonium Facility
PF-4	Plutonium Facility building 4
PFAS	per- and polyfluoroalkyl substances
PFHxS	perfluorohexanesulfonic acid
PGA	peak ground acceleration
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PIFWL	Partners in Flight watch list
PM	particulate matter
PM_{10}	particulate matter less than 10 microns in diameter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PNM	Public Service Company of New Mexico
PRP	Production-Based Resilience Program
PSHA	probabilistic seismic hazard analysis
Pu	plutonium
Pu-239	plutonium-239
PuEq	plutonium equivalent
PV	photovoltaic
R&D	research and development
RACR	Radiography/Assembly Capability Replacement
Rad Lab	Radiological Laboratory
RANT	Radioassay and Nondestructive Testing Facility
RCRA	Resource Conservation and Recovery Act
RCT	radiological control technician
RDX	Royal demolition explosives
RG	risk group
RIMS-II	Regional Input-Output Modeling System
RL	Reeves Line
RLUOB	Radiological Laboratory Utility Office Building
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
ROI	region of influence
ROW	right-of-way
RTG	Radioisotope Thermoelectric Generator
SAD	Safety Assessment Document
SCC	Strategic Computing Complex
SC-GHG	social cost of GHG
SDC	seismic design category
Second Fiber Optic Line EA	Final Environmental Assessment: Construction and Operation of a Second Fiber Optic Line to Los Alamos National Laboratory, Los Alamos, New Mexico
SERF	Sanitary Effluent Reclamation Facility
SFNF	Santa Fe National Forest
SHPO	State Historic Preservation Officer
SMA	site monitoring area
SNF	spent nuclear fuel

SNL/NM	Sandia National Laboratories/New Mexico
SNM	special nuclear material
SO_2	sulfur dioxide
SOx	sulfur oxides
SPCC	spill prevention, control, and countermeasures
SPD SEIS	Surplus Plutonium Disposition Final Supplemental Environmental Impact Statement
SPDP	Surplus Plutonium Disposition Program
SPDP EIS	Surplus Plutonium Disposition Program Final Environmental Impact Statement
SPIRe	Shock Phusics Integrated Research Facility
SR	State Route
SRS	Savannah River Site
SSMP	Stockpile Stewardship Management Plan
STD	Standard (as in DOE-STD-1027)
SWAP	State Wildlife Action Plan
SWEIS	Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory
SWMU	solid waste management unit
SWPPP	stormwater pollution prevention plan
SWWS	Sanitary Wastewater System
TA	technical area
TLW	transuranic liquid waste
TLWTF	Transuranic (TRU) Liquid Waste Treatment Facility
TRC	total recordable case
Triad	Triad National Security, LLC
TRU	transuranic (waste)
TSCA	Toxic Substances Control Act
TSD	treatment, storage, and disposal
TWF	Transuranic Waste Facility
TWS	TRU waste staging
U	uranium
U.S.	United States
U-235	uranium-235
UAS	unmanned aircraft system
UCN	ultracold neutron
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USCB	U.S. Census Bureau
USDOT	U.S. Department of Transportation
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
VA	U.S. Department of Veterans Affairs
VOC	volatile organic compound
VRM	Visual Resource Management

WCATS	Waste Compliance and Tracking System
WCRRF	Waste Characterization, Reduction, and Repackaging Facility
WCS	Waste Control Specialists LLC
WETF	Weapons Engineering Tritium Facility
Wildfire Hazard Reduction EA	Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico
Wildfire Hazard Reduction SEA	Final Supplemental Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at LANL
WIPP	Waste Isolation Pilot Plant
WNR	Weapons Neutron Research Facility
WTF	Water Treatment Facility
WTA	Western Technical Area
ZEV	zero-emission vehicle

CONVERSION CHART

To Convert Into Metric			To Convert Into English		
If You Know	**Multiple By**	**To Get**	**If you Know**	**Multiple By**	**To Get**
Length					
Inch	2.54	Centimeter	Centimeter	0.3937	Inch
Foot	30.48	Centimeter	Centimeter	0.0328	Foot
Foot	0.3048	Meter	Meter	3.281	Foot
Yard	0.9144	Meter	Meter	1.0936	Yard
Mile	1.60934	Kilometer	Kilometer	0.62414	Mile
Area					
Square inch	6.4516	Square centimeter	Square centimeter	0.155	Square inch
Square foot	0.092903	Square meter	Square meter	10.7639	Square foot
Square yard	0.8361	Square meter	Square meter	1.196	Square yard
Acre	0.40469	Hectare	Hectare	2.471	Acre
Square mile	2.58999	Square kilometer	Square kilometer	0.3861	Square mile
Volume					
Fluid ounce	29.574	Milliliter	Milliliter	0.0338	Fluid ounce
Gallon	3.7854	Liter	Liter	0.26417	Gallon
Cubic foot	0.028317	Cubic meter	Cubic meter	35.315	Cubic foot
Cubic yard	0.76455	Cubic meter	Cubic meter	1.308	Cubic yard
Weight					
Ounce	28.3495	Gram	Gram	0.03527	Ounce
Pound	0.45360	Kilogram	Kilogram	2.2046	Pound
Short ton	0.90718	Metric ton	Metric ton	1.1023	Short ton
Force					
Dyne	0.00001	Newton	Newton	0.00001	Dyne
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5th then add 32	Fahrenheit

METRIC PREFIXES

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

CHAPTER 1
INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

1.0 INTRODUCTION AND PURPOSE AND NEED FOR AGENCY ACTION

1.1 Introduction

The Los Alamos National Laboratory (Laboratory or LANL) is a Federally Funded Research and Development Center (FFRDC) sponsored by the National Nuclear Security Administration (NNSA). FFRDC sites are owned by the Federal Government but operated by contractors and provide federal agencies with research and development (R&D) capabilities that could not otherwise be met effectively by the Federal Government or the private sector alone. FFRDCs "enable agencies to use private sector resources to accomplish tasks that are integral to the mission and operation of the sponsoring agency" (*see* Federal Acquisition Regulation 35.017). The continued operation of the Laboratory is critical to NNSA's primary missions of maintaining the United States (U.S.) nuclear stockpile, nonproliferation, and counterterrorism and counterproliferation.

The missions of the NNSA, which is a semi-autonomous agency within the U.S. Department of Energy (DOE), include: (1) enhancing U.S. national security through the military application of nuclear energy; (2) maintaining and enhancing the safety, reliability, and performance of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test, in order to meet national security requirements; (3) providing the U.S. Navy with safe, militarily effective nuclear propulsion plants and to ensure the safe and reliable operation of those plants; (4) promoting international nuclear safety and nonproliferation; (5) reducing global danger from weapons of mass destruction; and (6) supporting U.S. leadership in science and technology (*see* the *National Nuclear Security Administration Act* [Title 50 *United States Code* Section 2401 (50 U.S.C. § 2401) et seq.]). The Laboratory aligns its strategic plan with priorities set by the NNSA and key national strategy guidance documents.

NNSA has prepared this *Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory* (DOE/EIS-0552) (LANL SWEIS or SWEIS) in accordance with the *National Environmental Policy Act of 1969* (42 U.S.C. §§ 4321–4336(e); NEPA), to analyze the potential environmental impacts of the continued operation of the Laboratory. The SWEIS is a "site-wide NEPA document," which means that it is a broad-scope environmental impact statement that is programmatic in nature and identifies and assesses the individual and cumulative impacts of ongoing and reasonably foreseeable future actions at the Laboratory (*see* Title 10 *Code of Federal Regulations* Section 1021.104 [10 CFR 1021.104]). DOE/NNSA prepared SWEISs to evaluate operations at the Laboratory in 1979, 1999, and 2008 (*see* Section 1.5).

NNSA seeks comment on this Draft SWEIS from the public, tribal and local governments, other federal agencies, and interested stakeholders. This input will allow NNSA to make appropriate adjustments prior to publishing a Final SWEIS. Following completion of a Final SWEIS, NNSA will issue a Record of Decision (ROD), which will state NNSA's decision and identify alternatives considered in reaching its decision, specifying the alternative or alternatives considered environmentally preferable. NNSA may discuss preferences among alternatives based on relevant factors including economic and technical considerations and NNSA's statutory missions. NNSA will identify and discuss all such factors, including any essential considerations of national policy, that NNSA balances in making its decision and will state how those considerations entered into its decision. In the ROD, NNSA will state whether it has adopted all practicable means to avoid or minimize environmental harm from the alternative selected, and if not, why not. NNSA will adopt and summarize, where applicable, a monitoring and enforcement program for any enforceable mitigation requirements or commitments. This monitoring and enforcement program likely would include a revision to the existing Mitigation Action Plan (DOE 2020).

1.2 Background

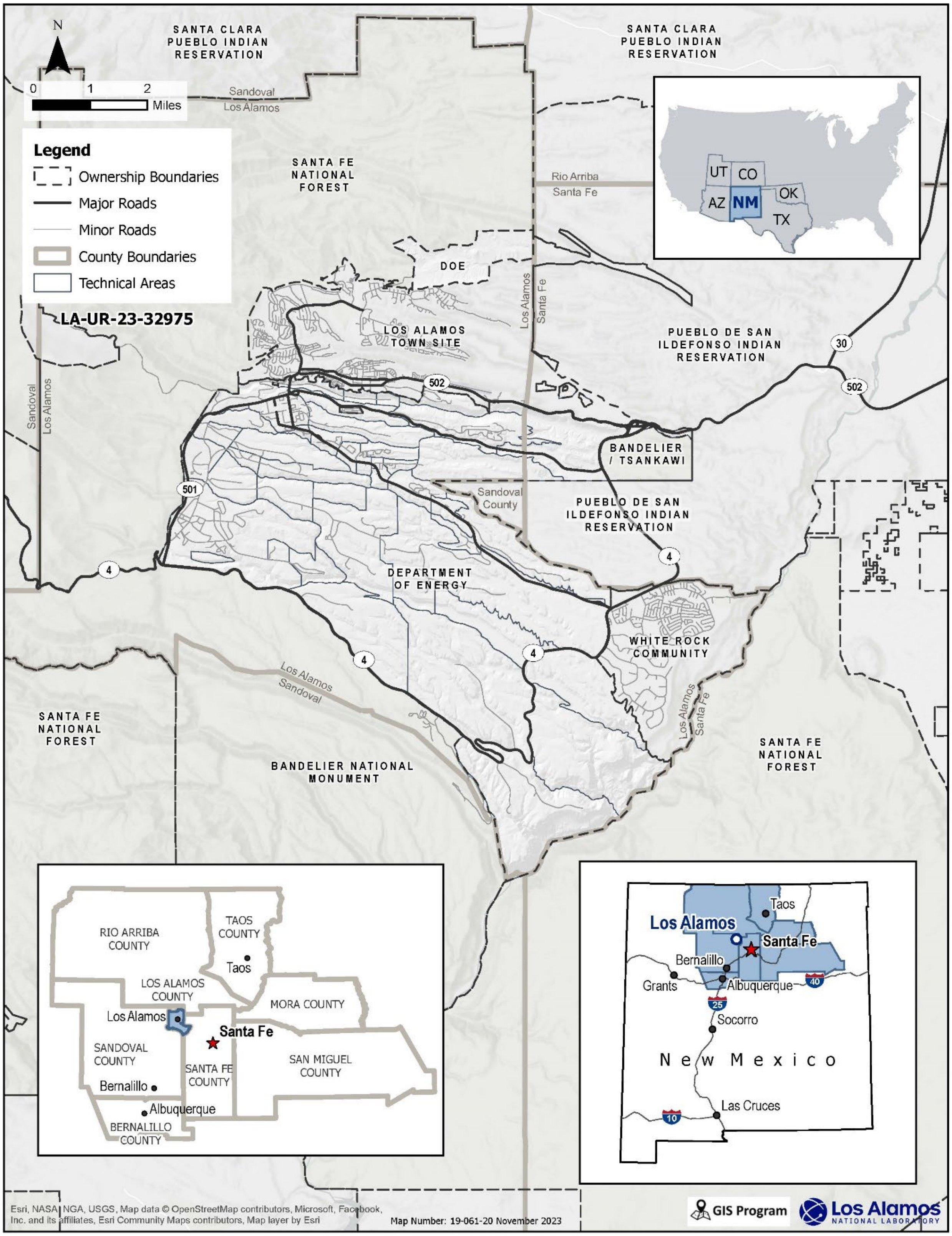
As an FFRDC, LANL is required to conduct its business in a manner befitting its special relationship with the U.S. Government and to operate in the public interest with objectivity and independence (*see* 48 CFR 35.017). The U.S. Government has owned the LANL site since 1943, and over time the Laboratory has been operated by three different Management and Operating (M&O) contractors. Triad National Security, LLC (Triad)[1] has been the M&O contractor for the Laboratory since November 1, 2018. Whereas at the time of the 2008 LANL SWEIS, the Laboratory employed about 13,500 people and had an annual budget of about $2 billion, the Laboratory now employs more than 15,000 people (federal staff, contractors, subcontractors) and has an annual budget of about $4.6 billion. For context, the collective budget for federal R&D is nearly $200 billion and national R&D expenditures are over $700 billion (NCSES 2021, Table 1).

In addition to its work supporting NNSA missions, the Laboratory conducts other important work for DOE and in partnership with other federal and non-federal entities, including significant work in support of DOE's Office of Science. The Laboratory is host to national user facilities such as the Los Alamos Neutron Science Center (LANSCE), including one of the nation's most powerful linear accelerators, and the National High Magnetic Field Laboratory.

In 2015, DOE's Office of Environmental Management (DOE-EM) was assigned the mission to safely, efficiently, and with full transparency complete the cleanup of legacy contamination and waste resulting from nuclear weapons development and government-sponsored nuclear research at LANL. These environmental remediation activities were analyzed in Appendix I of the *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (2008 LANL SWEIS) (NNSA 2008b). The DOE-EM mission at LANL continues today with details presented in Section 2.3 of this SWEIS.

The LANL site is located in northern New Mexico, largely within incorporated Los Alamos County and, in part, Santa Fe County, and adjacent to a segment of Sandoval County (Figure 1.2-1). The two primary residential areas within Los Alamos County are the Los Alamos townsite and the White Rock residential area. Whereas in 2008, Los Alamos County was home to about 18,400 people, today it is home to about 19,330 people (USCB 2022a). Of the staff who worked at LANL at the end of 2022, about 38 percent reside within Los Alamos County (LANL 2024a). Although the Laboratory has locations in Santa Fe, the main Laboratory campus is located approximately 40 road-miles from the city of Santa Fe, and the nearest residential communities to the main campus that are located within Santa Fe County include the Pueblo de San Ildefonso, the census-designated community of El Rancho, the Pueblo of Pojoaque, the Pueblo of Nambe, and the Pueblo of Tesuque. Other nearby residential communities include the Pueblo of Santa Clara and the city of Española in Rio Arriba County, and the Pueblo of Jemez and Jemez Springs communities in Sandoval County.

[1] Although Triad is incorporated as a limited liability company, Triad is equally owned by three member, non-profit organizations with missions that support developing new knowledge and translating scientific discovery, knowledge, and technology advances into societal benefits through public service: Battelle Memorial Institute, The Texas A&M University System, and The Regents of the University of California.



Source: LANL (2024c)

Figure 1.2-1 Location of the Los Alamos National Laboratory Site

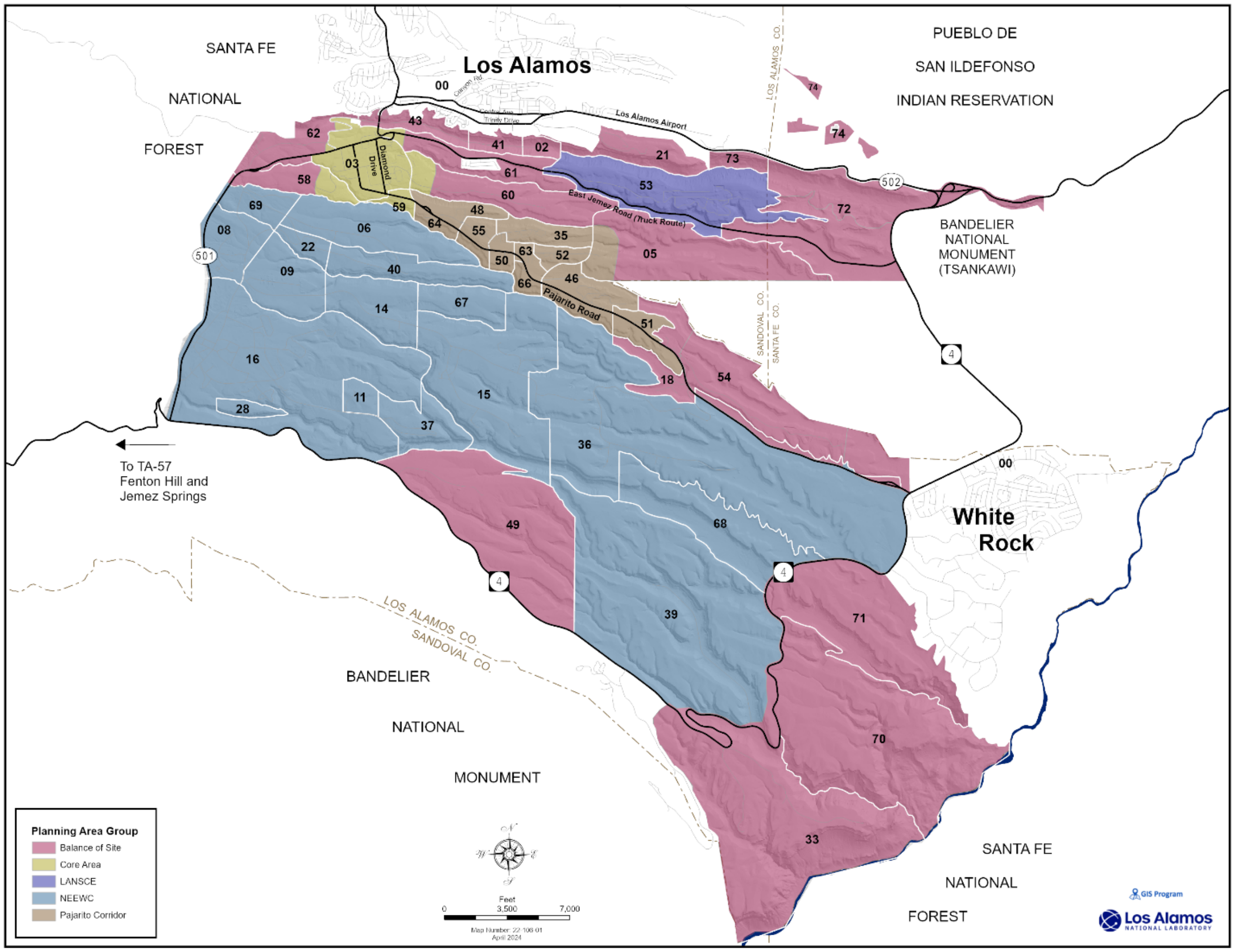
Of the staff who worked at LANL in 2022, approximately 43 percent reside in neighboring Sandoval County, Santa Fe County, and Rio Arriba County. The remaining 19 percent of employees work remotely or commute occasionally from outside of these three counties.

LANL occupies about 40 square miles (26,058 acres) of land on the eastern flank of the Jemez Mountains along the area known as the Pajarito Plateau (LANL 2024a). The terrain in the LANL area consists of mesa tops and canyon bottoms that trend in a west-to-east manner, with the canyons intersecting the Rio Grande to the east of LANL. Elevations at LANL range from about 7,800 feet at the highest elevation on the western side of the site to about 6,200 feet at the lowest point along the eastern boundary at the Rio Grande. LANL operations are conducted within numerous facilities located in 50 designated technical areas, which include other noncontiguous properties situated near LANL. The leased properties within the Los Alamos townsite and White Rock are designated “TA-0.” TA-47 refers to leased properties in the city of Santa Fe. TA-57 is located about 20 miles west of LANL at Fenton Hill in the Jemez Mountains, which is administered by the U.S. Department of Agriculture, Forest Service. The 47 other TAs (which are not numbered sequentially) have been established so that together they comprise the entirety of the LANL site (Figure 1.2-2). Figure 1.2-2 includes color coding to reflect the different planning areas identified in this SWEIS. The planning areas are defined and described in Chapter 3, Section 3.1.

Most of the LANL site area is undeveloped grassland, shrubland, woodland, and forest that serve to provide a buffer for security and safety, and space for future development and expansion. As of the end of 2022, LANL’s facilities comprised 8.2 million square feet of laboratory, production, administrative, storage, service, and miscellaneous space; the total space available for operational use changes frequently as structures are demolished or built at LANL (LANL 2024a).

This LANL SWEIS describes facilities and activities on a mission basis and organizes the description of the alternatives consistent with the planning areas identified in the Laboratory’s *Campus Master Plan* (CMP) (LANL 2021a, 2022b). The CMP and associated planning processes provide the framework for facility and infrastructure development to make sure that the Laboratory can meet future national security challenges. The “key facilities” identified the 1999 LANL SWEIS (DOE 1999a) and 2008 LANL SWEIS (NNSA 2008b) are located in one or more of the planning areas of the CMP. The planning areas are utilized in this SWEIS to facilitate analysis of environmental impacts across the Laboratory. More details about the CMP, planning areas, and future development at LANL are provided in Chapter 3, Section 3.1.

The Laboratory has almost 900 individual facilities, including nuclear and radiological facilities. Nuclear and radiological facilities are identified by a hazard category (HC), which relates to the potential consequences of an accident event (10 CFR Part 830). At the Laboratory, there are no HC-1 nuclear facilities, which are the type of nuclear facilities with the potential for significant offsite consequences. Rather, the nuclear facilities at LANL are either HC-2 or HC-3 (LANL 2018a). Facilities that handle less than HC-3 threshold quantities of radioactive materials but require identification of “radiological areas” under 10 CFR Part 835 are designated as radiological facilities. All facilities are evaluated in this SWEIS. All nuclear HC-2 and HC-3 operating facilities and most radiological facilities are specifically identified as major facilities in Table 2.2-1 in Chapter 2. Hazard categories are defined in the Glossary (Chapter 9). The Laboratory also includes accelerator facilities, which are operated in accordance with DOE Order 420.2D, “Safety of Accelerators.”



Source: LANL (2024c)

Figure 1.2-2 Identification and Location of Technical Areas Comprising the Los Alamos National Laboratory

1.3 Purpose and Need for Agency Action

NNSA proposes to continue managing the Laboratory and its resources in a manner that meets evolving national security missions and that responds to the concerns of affected and interested individuals and agencies. This SWEIS describes the environmental impacts of three alternatives for the continued operation of LANL (*see* Chapter 3).

The purpose of the continued operation of the Laboratory has not changed since issuance of the 2008 LANL SWEIS and continues to be to provide support for DOE/NNSA's core missions as directed by Congress and the President. NNSA's need to continue operating the Laboratory is focused on its obligation to ensure a safe and reliable nuclear stockpile and fulfilment of agency missions. For the foreseeable future, NNSA, on behalf of the U.S. Government, will need to continue its nuclear weapons R&D, surveillance, computational analysis, components manufacturing, and nonnuclear aboveground experimentation. Currently, many of these activities are conducted solely at the Laboratory. A curtailment or cessation of these activities would run counter to national security policy as established by Congress and the President.

The Laboratory plays vital roles in NNSA missions, including enhancing U.S. national security through the military application of nuclear energy; maintaining and enhancing the safety, reliability, and effectiveness of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test, in order to meet national security requirements; promoting international nuclear safety and nonproliferation; reducing global danger from weapons of mass destruction; and supporting U.S. leadership in science and technology.

The continued operation of the Laboratory includes operating while DOE executes legacy cleanup efforts at the LANL site, regardless of the lead federal program office or supporting contractor performing cleanup activities. The current *Compliance Order on Consent between the State of New Mexico Environment Department (NMED) and the DOE* (Consent Order) is the principal regulatory driver for legacy waste cleanup at LANL.[2] At a site-wide level, this SWEIS continues to consider the legacy cleanup activities at LANL as part of the Proposed Action. The majority of these activities are performed as part of the DOE-EM mission as described in Chapter 2, Section 2.3.

1.3.1 National Security Considerations and Requirements

1.3.1.1 Nuclear Posture Review

The Nuclear Posture Review (NPR) is a legislatively mandated, comprehensive review of the U.S. nuclear deterrence policy, strategy, and force posture. NPRs have been prepared in 1994, 2002, 2010, 2018, and most recently in 2022. On October 27, 2022, the U.S. Department of Defense (DoD) published the *2022 National Defense Strategy*, which included the 2022 NPR and the 2022 Missile Defense Review. The 2022 NPR reaffirmed the continued commitment to a safe, secure, and effective nuclear deterrent and strong and capable extended deterrence (DoD 2018, 2022). The NPR acknowledges that deterrence alone will not reduce nuclear dangers. The U.S. will pursue a comprehensive and balanced approach that places renewed emphasis on arms control, nonproliferation, and risk reduction to strengthen stability. As part of the comprehensive and balanced approach, the NPR included a decision to deliver a modern, adaptive Nuclear Security Enterprise (NSE) based on an integrated strategy for risk management, production-based resilience, science and technology innovation, and workforce initiatives. The 2022 NPR identified three pillars necessary to implement the resilient and adaptive NSE (DoD 2022):

1. Improve coordination between DoD and NNSA by developing and implementing a Nuclear Deterrent Risk Management Strategy to identify, prioritize, and recommend actions across the portfolio of nuclear programs and monitor the overall health of the nuclear deterrent as they sustain current capabilities and transition to modernized systems.
2. Institute a Production-Based Resilience Program (PRP) to complement the science-based stewardship program and ensure the NSE is capable of full-scale production. The PRP will establish the capabilities and infrastructure that can produce weapons required in the near term and beyond, and that are sufficiently resilient to adapt to additional or new requirements. The PRP will address all elements of the enterprise, including production of primaries, secondaries, tritium, and nonnuclear components; domestic uranium

[2] The *Compliance Order on Consent between the State of New Mexico Environment Department (NMED) and the DOE* (Consent Order) defines a process to establish annual milestones to achieve desired remediation end states. Information on the current Consent Order and Settlement Agreement can be found at: https://www.env.nm.gov/wp-content/uploads/sites/12/2016/05/LANL-Consent-Order-June-2016.pdf and at https://www.env.nm.gov/hazardous-waste/wp-content/uploads/sites/10/2024/09/NzcxOWIxNWEzOWE1OTZiMjcxNTcwNTY1YV8xNjc5MzE.pdf.

enrichment; and system assembly and disassembly. Restoring the ability to produce plutonium pits for primaries will guard against the uncertainties of plutonium aging in today's stockpile and will allow new pit designs to be manufactured, if necessary for future weapons. Modernizing development and production capabilities of high-explosives and energetic materials will eliminate single points of failure.

3. Establish a Science and Technology Innovation Initiative to accelerate the integration of science and technology throughout the NSE's activities. This initiative will add to the existing science portfolio an increased focus on leveraging science and technology to support weapons design and production phases and modernize the production complex. This initiative will include new and replacement science facilities.

The Laboratory is an integral part of the NSE and operates in support of national strategies discussed in the NPR.

1.3.1.2 Deterrent Requirements by Growing Threats

Nuclear weapons have played, and will continue to play for the foreseeable future, a critical role in deterring nuclear attack and in preventing large-scale conventional warfare between nuclear-armed states. U.S. nuclear weapons not only defend the U.S. and our allies against conventional and nuclear threats, but also help allies avoid the need to develop their own nuclear arsenals. This, in turn, furthers global security. While the U.S. has continued to reduce the number and prominence of nuclear weapons, others, including Russia and China, have moved in the opposite direction. They have added new types of nuclear capabilities to their arsenals, increased the prominence of nuclear forces in their strategies and plans, and engaged in increasingly aggressive behavior, including in outer- and cyberspace. By the 2030s, the U.S. will, for the first time in history, face two major nuclear powers as strategic competitors and potential adversaries. This will create new stresses on stability and new challenges for deterrence, assurance, arms control, and risk reduction (DoD 2018, 2022).

An effective, responsive, and resilient NSE offers tangible evidence to both allies and potential adversaries of U.S. nuclear weapons capabilities. This contributes to deterrence, assurance, and hedging against adverse developments. It also discourages adversary interest in arms competition (DoD 2018). As an integral part of the NSE, the Laboratory supports the advancement of these capabilities.

Additionally, nuclear terrorism continues to pose a threat to the U.S. and our allies and partners. Terrorists remain interested in using weapons of mass destruction in attacks against U.S. interests and possibly the U.S. homeland. The 2022 NPR includes the core elements of the U.S. counterterrorism strategy, some of which include improving forensic capabilities to identify the origin of material outside of regulatory control or used in a nuclear device, and maintaining an incident response posture to detect, interdict, and defeat nuclear threats or minimize the consequences of nuclear events. This strategy is supported by the Laboratory's Global Security Program (DoD 2022) (*see* Appendix A, Section A.2.2.2).

1.3.1.3 Vital Support of Stockpile Stewardship

The Laboratory's weapons activities represent foundational elements of the Stockpile Stewardship Management Plan (SSMP; NNSA 2023a). LANL designed five of the seven types of nuclear warheads in the deployed stockpile and is responsible for the continued safety, security, and effectiveness of several deployed weapons systems. The Laboratory is leading the life extension programs for two of the weapons systems. LANL's production agency responsibility includes the manufacturing of pits, detonators, detonator cables, and radioisotope thermoelectric generators, which are used for the space program. The Laboratory's weapons programs provide design expertise, production expertise, and tools, including advanced experimental capabilities; modeling and simulation; processing, prototyping, and testing of weapons materials; and components and warhead assemblies (without nuclear materials).

Specifically, for the manufacturing of plutonium pits, federal law and national policy require that NNSA produce no fewer than 30 pits per year at LANL during 2026 and implement surge efforts to exceed 30 pits per year to meet NPR and national policy (50 U.S.C. § 2538a). Additionally, federal law requires that the Secretary of Energy ensure that the NSE began production of qualification plutonium pits during 2021 and produces not less than 10 war reserve plutonium pits during 2024. The 2026 pit production milestone is delayed until 2028 (NNSA 2023a).

1.3.1.4 Nonproliferation and Treaty Compliance

As discussed in this section, NNSA missions are conducted fully consistent with current treaty obligations. The SSMP is fully consistent with and supports the U.S. commitment to the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and enables the U.S. to continue the 1992 moratorium on underground nuclear explosive testing. Another benefit of the SSMP is that by preventing the loss of credibility in the U.S. nuclear stockpile, it avoids creating an incentive within nonweapon states, whose security relies on the U.S. nuclear deterrent, to develop their own nuclear weapons. In addition to stockpile stewardship responsibilities, Laboratory operations also support nonproliferation objectives and nuclear materials stewardship.

Nuclear Nonproliferation Treaty. The Nuclear Nonproliferation Treaty was ratified by the Senate in 1969 and officially entered into force as a Treaty of the U.S. in 1970. In 2022, the leaders of the five declared Nuclear Weapons States (France, People's Republic of China, Russian Federation, United Kingdom, and the U.S.) reaffirmed their commitment to their disarmament-related obligations under the NPT and their intent to strengthen stability and prevent an arms race. As the 2022 NPR states, "[t]he United States remains dedicated to preserving and strengthening the nuclear non-proliferation regime and reaffirms its commitment to the NPT." In Article VI of the NPT, treaty parties "undertake to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early date and to nuclear disarmament, and on a treaty on general and complete disarmament under strict and effective international control." The U.S. takes this commitment seriously and has emphasized dedication to both the long-term goal of eliminating nuclear weapons and the requirement that the U.S. has modern, flexible, and resilient nuclear capabilities that are safe and secure, until such a time as nuclear weapons can prudently be eliminated from the world (DoD 2018). The NPT does not provide any specific date for achieving the ultimate goal of nuclear disarmament, nor does it preclude the maintenance of nuclear weapons until their disposition. Continued operations at LANL enable NNSA to maintain the safety, reliability, and performance of the U.S. nuclear weapons stockpile until the ultimate goals of the NPT are attained and are consistent with the NPT.

The nonproliferation and treaty compliance aspects of the SSMP were evaluated in the 1996 *Stockpile Stewardship and Management Programmatic Environmental Impact Statement* (DOE/EIS-0236) (DOE 1996) and in the *Complex Transformation Supplemental Programmatic*

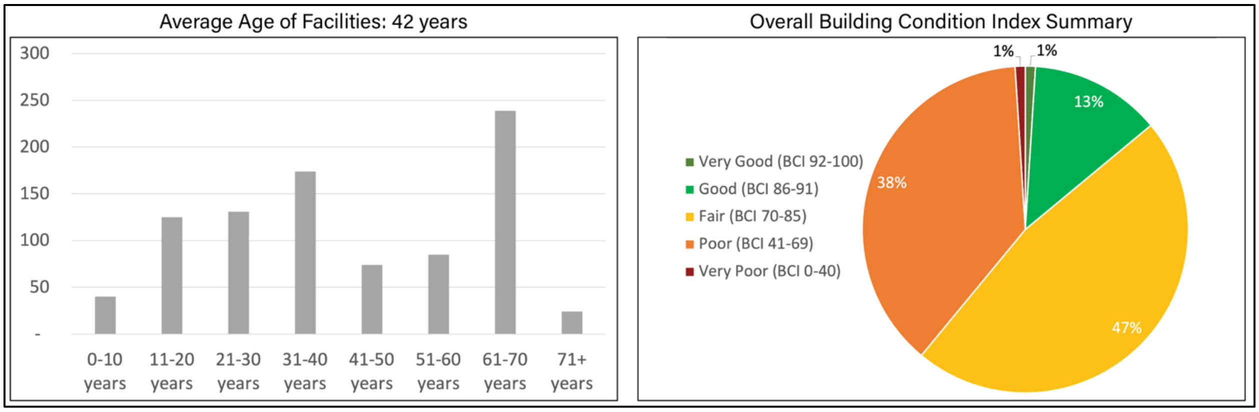
Environmental Impact Statement (DOE/EIS-0236-S4) (Complex Transformation SPEIS) (NNSA 2008a). These documents analyze the nonproliferation aspects of the SSMP and conclude that implementation of the SSMP is consistent with the NPT while maintaining nuclear weapons competencies and capabilities at the weapons laboratories. Those evaluations included the operation of LANL and its responsibilities under the SSMP for several weapons systems. The activities identified in this SWEIS for the continued operation of LANL are consistent with the Laboratory's work in support of SSMP mission and do not adversely affect U.S. compliance with any treaty now in force.

Comprehensive Test Ban Treaty. The U.S. signed the Comprehensive Test Ban Treaty, which bans all nuclear explosions for civilian or military purposes, on September 24, 1996, but treaty has not entered effect given that the Senate has not ratified it. Nonetheless, the U.S. has been observing a moratorium on nuclear explosive testing since 1992, and the NPR strategy discussed in Section 1.3.1.1 reflects this policy. The stated policy of the U.S. is to not resume underground nuclear explosives testing unless necessary to ensure the safety and effectiveness of the U.S. nuclear arsenal (NNSA 2023a). The Proposed Action in this SWEIS (*see* Chapter 3) would support certification of the safety, reliability, and performance of the U.S. nuclear weapons stockpile to the President without the use of nuclear explosives testing. As such, it would be consistent with a continuing U.S. moratorium and the Comprehensive Test Ban Treaty.

1.3.2 Other LANL Program Considerations and Needs

The NNSA is charged with supporting U.S. leadership in science and technology. Funded by a broad contingent of the scientific community—including NNSA, the DOE Office of Science, academic and industry partners, and Laboratory Directed Research and Development investments—basic science ensures that the Laboratory's research capabilities remain at the cutting edge and that LANL scientists and engineers are prepared to solve critical challenges. As discussed in more detail in Chapter 2 and Appendix A, the Laboratory works in many areas, such as counterterrorism, energy security and long-term energy needs, advancing bioscience and biosecurity, and breakthroughs in fundamental sciences and applied technology. Additionally, the Laboratory supports other government organizations, the advancement of science, and industry through the transfer of technology. All of these missions require infrastructure investments.

As shown on Figure 1.3-1, approximately 30 percent of LANL facilities are more than 60 years old, and approximately 56 percent are more than 50 years old. About 40 percent of the Laboratory's assets (buildings and trailers) are considered to be in poor or very poor condition (LANL 2022b). The figure illustrates the number of facilities within each age category. Older buildings are less efficient and require more maintenance, including utility replacements and other large-scale refurbishments that are weighed against replacement with newer, more efficient, and better-designed buildings. Although the Laboratory maintains these facilities and conducts operations safely with appropriate environmental and safety controls, there is a need to both maintain and reinvest in a modern infrastructure for the future.



Source: LANL (2024a)

Figure 1.3-1 Age of Facilities and Infrastructure Conditions at LANL

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

NEPA ensures that information regarding potential environmental impacts is available to public officials and citizens before agencies make certain decisions and take corresponding actions. This SWEIS has been prepared in accordance with Section 102(2)(C) of NEPA, CEQ regulations (40 CFR Parts 1500–1508), DOE's NEPA implementing procedures (10 CFR Part 1021), and NNSA Policy 451.1. The primary purpose of an environmental impact statement prepared pursuant to Section 102(2) of NEPA is to ensure agencies consider the environmental impacts of their actions in decisionmaking. In accordance with 10 CFR 1021.330, NNSA has a policy to prepare a SWEIS for certain large, multiple-facility sites such as LANL.

For preparation of this SWEIS, NNSA references several previous NEPA documents that are relevant to the analysis. Information from these documents provides additional context for understanding the current status of NEPA compliance, which forms the foundation for preparing this SWEIS. Table 1.4-1 lists programmatic and site-specific NEPA documents and other documents that are most relevant to this SWEIS analysis. Descriptions of the documents and how they relate to this SWEIS are provided in Appendix A, Section A.1.4.

Table 1.4-1 Relevant NEPA Documents

Document Title
Programmatic NEPA Documents
Stockpile Stewardship and Management Programmatic Environmental Impact Statement (DOE/EIS-0236) (DOE 1996)
Final Complex Transformation Supplemental Programmatic Environmental Impact Statement (DOE/EIS-0236-S4) (Complex Transformation SPEIS) (NNSA 2008a)
Final Supplement Analysis of the Complex Transformation Supplemental Programmatic Impact Statement (DOE/EIS-0236-S4-SA-02) (NNSA 2019a)
Surplus Plutonium Disposition Final Supplemental Environmental Impact Statement (DOE/EIS-0283-S2) (SPD SEIS) (NNSA 2015)
Surplus Plutonium Disposition Program Final Environmental Impact Statement (DOE/EIS-0549) (NNSA 2024a)
Site-Specific NEPA Documents
Continued Operation of Los Alamos Scientific Laboratory, Los Alamos, New Mexico (DOE/EIS-0018) (DOE 1979)

Document Title
Final Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EIS-0238) (1999 LANL SWEIS) (DOE 1999a)
Final Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EIS-0380) (2008 LANL SWEIS) (NNSA 2008b) and subsequent supplement analyses (NNSA 2009, 2011a, 2016a, 2016b, 2018a, 2020a)
Final Environmental Impact Statement for the Dual-Axis Radiographic Hydrodynamic Test Facility (DOE/EIS-0228) (DOE 1995)
Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico (NNSA 2003a)
Final Supplemental Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico (CMRR SEIS) (NNSA 2011b)
Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico (CT EIS) (DOE/EIS-0293) (DOE 1999b)
Waste-Related Environmental Impact Statements
Waste Isolation Pilot Plant (WIPP) Final Environmental Impact Statement) (DOE/EIS-0026) (DOE 1980)
Supplement Environmental Impact Statement Waste Isolation Pilot Plant (DOE/EIS-0026-FS) (DOE 1990)
Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement (DOE/EIS-0026-S2) (DOE 1997a)
*Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste (*DOE/EIS-0200) (DOE 1997b)
Environmental Assessments
*Environmental Assessments for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico (*DOE/EA-1431) (Trails Management EA) (NNSA 2003b)
Final Environmental Assessment for the Expansion of the Sanitary Effluent Reclamation Facility and Environmental Restoration of Reach S-2 of Sandia Canyon at Los Alamos National Laboratory (DOE/EA-1736) (NNSA 2010)
Final Environmental Assessment for Chromium Plume Control Interim Measure and Plume-Center Characterization, Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EA-2005) (Chromium Plume EA) (DOE 2015)
Final Environmental Assessment of Proposed Changes for Analytical Chemistry and Materials Characterization at the Radiological Laboratory/Utility/Office Building, Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EA-2052) (NNSA 2018b)
Final Environmental Assessment for the Proposed Construction and Operation of a Solar Photovoltaic Array at Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EA-2101) (NNSA 2019b)
Final Supplemental Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory (DOE/EA-1329-S1) (Wildland Fire Mitigation and Forest Health Plan Supplemental EA) (NNSA 2019c)
Final Environmental Assessment: Construction and Operation of a Second Fiber Optic Line to Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EA-2122) (Second Fiber Optic Line EA) (NNSA 2020b, 2020c)
Los Alamos National Laboratory Electric Power Capacity Upgrade Project Draft Environmental Assessment (DOE/EA-2199) (EPCU Draft EA) (NNSA 2023b)
Final Chromium Interim Measure and Final Remedy Environmental Assessment, Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EA-2216) (Chromium Final Remedy EA) (DOE 2024a)
Other Documents
Fiscal Year 2024 Stockpile Stewardship and Management Plan – Report to Congress (NNSA 2023a)
Nuclear Posture Review (2018 and 2022 NPR) (DoD 2018, 2022)

1.5 Public Involvement

The NEPA process includes two opportunities during which DOE/NNSA specifically requests public involvement: the scoping process and the public comment period for the Draft SWEIS. Scoping is a process in which the public and stakeholders provide comments directly to the federal agency on the scope of an EIS or SWEIS. This process begins with the publication of a Notice of Intent (NOI) in the *Federal Register*. On August 19, 2022, NNSA published an NOI to prepare this LANL SWEIS (87 FR 51083) and announced a 45-day SWEIS scoping period that was scheduled to end on October 3, 2022. In response to public comments, NNSA extended the comment period to October 18, 2022. NNSA sent initial notifications via the GovDelivery mailing list. The notice of the extension to the scoping period was also sent to the same stakeholders. DOE/NNSA also sent letters and participated in meetings with local tribes and pueblos to notify these stakeholders of the plans to prepare this SWEIS.

Due to ongoing health concerns associated with the Coronavirus Disease 2019 (COVID-19), NNSA elected to hold online public scoping meetings instead of in-person meetings. This approach allowed NNSA to reach a broader audience with the same presentation. Online NEPA meetings have previously been implemented within DOE and other federal agencies and are consistent with CEQ regulations and/or DOE NEPA implementing procedures.

NNSA held the online public scoping meetings on September 13 and 14, 2022, to discuss the SWEIS and to receive comments on the potential scope. NNSA notified the public of the extension of the comment period during the scoping meeting presentation. In addition to the online scoping meetings, NNSA provided other methods (i.e., email or postal mail) for submitting comments on the SWEIS scope.

A court reporter provided a transcript of the comments made at the online scoping meetings. Twelve people spoke at the first scoping meeting and eleven people spoke at the second meeting; in several instances, people spoke more than one time at a meeting. In addition to the oral comments made at the scoping meetings, NNSA received 74 documents with comments. NNSA considered all comments received during the scoping process for this SWEIS, including comments received after the close of the comment period. Comments were systematically reviewed by NNSA. Where possible, comments on similar or related topics were grouped under comment issue categories as a means of considering and summarizing the comments. The comment issue categories were used to identify specific issues. The summary of the comments, including an indication of how NNSA considered the comments, along with a more detailed discussion of the public scoping process, is provided in Appendix B of this SWEIS. The transcripts from the scoping meetings and all comment documents received are included in the Administrative Record for this SWEIS.

This Draft SWEIS is subject to public review and a comment period, which will not be less than 45 days, and begins with the U.S. Environmental Protection Agency's (EPA) publication of the Notice of Availability (NOA) for this Draft SWEIS in the *Federal Register*. During the public comment period, NNSA will hold at least one public hearing (and may hold more than one public hearing), which will be announced at least 15 days in advance on the DOE NEPA web page and NNSA NEPA Reading Room (https://www.energy.gov/nepa, https://www.energy.gov/nnsa/nnsa-nepa-reading-room), in local New Mexico newspapers, in a notice sent via the GovDelivery mailing list, in letters and meetings with local tribes and pueblos, and via a *Federal Register* NOA. NNSA will consider all comments received during that public comment period in preparing the

Final SWEIS and will append or otherwise publish all substantive comments received on the Draft SWEIS, or summaries thereof if the number of comments is exceptionally voluminous. Additionally, after an NOA for the Final SWEIS is published in the *Federal Register*, there is a 30-day waiting period before NNSA may issue a ROD.

1.6 Content of this Site-Wide Environmental Impact Statement

Volume 1 of this Draft LANL SWEIS contains 10 chapters and 13 appendices as presented in Table 1.6-1. This SWEIS complies with the CEQ implementing regulations at 40 CFR Part 1502 that became effective May 2022.[3] The material in Volume 1 focuses on current and future actions that NNSA will use to form the basis of its ROD. Supplemental, supporting information that provides additional background related to the NEPA process, Laboratory missions, detailed descriptions of the activities in the Proposed Action, the affected environment, and potential environmental impacts is contained in Volume 2, Appendix A.

Table 1.6-1 Content of Volumes 1 and 2 of this SWEIS

Volume 1 - Chapters
Chapter 1, Introduction and Purpose and Need for Agency Action – Contains background information and provides reasons for NNSA action and purposes to be achieved. The chapter also includes a list of relevant NEPA documents and describes the public involvement process.
Chapter 2, Los Alamos National Laboratory: Missions, Programs, and Major Facilities – Provides an overview of LANL history, organization, missions, operations, programs, and facilities. Primary changes that have occurred since issuance of the 2008 LANL SWEIS are described in Appendix A.
Chapter 3, Proposed Action and Alternatives – Describes how NNSA proposes to meet the specified need and achieve its objectives. This chapter describes alternatives analyzed and those considered but eliminated from detailed analysis, includes a summary comparison of the potential environmental impacts of the SWEIS alternatives, and identifies any preferred alternative.
Chapter 4, Affected Environment – Discusses the current condition of the existing environment that might be affected by the alternatives.
Chapter 5, Environmental Consequences – Presents analyses of the potential impacts on the environment that could result from the various alternatives. Impacts are compared to the projected environmental conditions that would be expected if NNSA selected the No-Action Alternative.
Chapter 6, Cumulative Impacts – Provides analyses of the potential cumulative impacts on the environment from the alternatives when combined with other past, present, and reasonably foreseeable future actions within the region of influence for each resource area.
Chapter 7, References – Provides complete citations for references used in this SWEIS. Hyperlinks are provided for references available online.
Chapter 8, Index – Includes an alphabetical listing of terms and topics used in this SWEIS along with the page numbers on which they are mentioned or discussed.
Chapter 9, Glossary – Provides definitions of terms to aid the reader and decisionmaker in understanding the content of the SWEIS.
Chapter 10, List of Preparers – Presents an accounting of the federal and contractor personnel primarily responsible for the development and review of the SWEIS.

[3] On July 28, 2023, CEQ announced a Phase 2 Notice of Proposed Rulemaking—the "Bipartisan Permitting Reform Implementation Rule"—to revise its regulations for implementing the procedural provisions of NEPA, including to implement the amendments to NEPA by the *Fiscal Responsibility Act of 2023* (88 FR 49924). Phase 2 regulations were published on May 1, 2024, at 89 FR 35442, but did not go into effect until July 1, 2024.

Volume 2 - Appendices
Appendix A Supplemental Supporting Information – Presents additional information to support the descriptions presented in Volume 1.
Appendix B Scoping Process Summary – Provides a summary of the scoping process that DOE/NNSA undertook after publication of the Notice of Intent, a summary of the scoping comments received, and DOE/NNSA's response to those comment summaries.
Appendix C Methodologies – Describes the methodologies used to describe the existing environment and to assess the potential direct and indirect impacts of the alternatives in this SWEIS. The methodologies are presented for each environmental resource area.
Appendix D Human Health, Safety Accidents, Intentional Destructive Acts, and Emergency Management – Provides supporting technical information about the potential consequences to workers and members of the public from normal operations, accident scenarios, and intentional destructive acts. The appendix also includes a discussion of emergency management at LANL. These analyses support the analysis in Chapter 5.
Appendix E LANL Facility Information – Provides descriptions and technical information about facilities and existing activities at LANL to facilitate the analysis of alternatives in this SWEIS.
Appendix F Transportation – Includes supporting technical information about the analysis of potential impacts to traffic and human health from continued operations of the Laboratory and transportation of radiological and nonradiological materials to support the analysis in Chapter 5.
Appendix G Environmental Remediation – Contains background information related to the current status of environmental remediation activities at LANL and a projection of potential environmental impacts associated with the current planning basis, a capping option, and a removal option.
Appendix H Air Quality and Greenhouse Gas Emissions – Provides supporting technical information about the analysis of potential impacts to radiological and nonradiological air quality and the release of greenhouse gas emissions to support the analysis in Chapter 5.
Appendix I Categorical Exclusion Summary – Describes the range and types of activities that are performed at LANL that would typically receive a categorical exclusion. This information is used to document the LANL ongoing NEPA process after publication of this SWEIS.
Appendix J Public Notices – Presents copies of *Federal Register* notices related to this SWEIS.
Appendix K Contractor Disclosure Statements – Presents disclosure statements from each of the contractors that prepared this SWEIS to document any potential conflicts of interest.

In addition to the publicly available appendices in Volume 2, DOE/NNSA has prepared two appendices that support analysis of the Proposed Action that cannot be released to the public. One of the appendices (Appendix L) contains export-controlled information that cannot be made available to the public and the other appendix (Appendix M) provides an analysis of intentional destructive acts associated with LANL facilities and during transportation activities that could occur on the nation's highways. Appendix M is classified, as described in Chapter 5, Section 5.14.6. These appendices are available to the decisionmakers with applicable clearance. A SWEIS Summary has also been prepared and is available to the public.

Following the public comment period on this Draft SWEIS, NNSA will prepare Volume 3 (Comment-Response Document), which will include all comments received on the Draft SWEIS, or summaries thereof if the comments are exceptionally voluminous, and NNSA's responses to those comments. NNSA would revise the current Mitigation Action Plan for LANL (DOE 2020) after completion of the Final SWEIS to incorporate any additional mitigation measures identified in Section 5.16.15.

CHAPTER 2
LOS ALAMOS NATIONAL LABORATORY: MISSIONS, PROGRAMS, AND MAJOR FACILITIES

2.0 LOS ALAMOS NATIONAL LABORATORY: MISSIONS, PROGRAMS, AND MAJOR FACILITIES

This chapter describes the programs, activities, capabilities, and major facilities at the Laboratory that support NNSA, DOE, and other federal and non-federal missions. While the continued operation of the Laboratory is critical to NNSA's Stockpile Stewardship, Modernization, and Sustainment Programs; the prevention of the spread and use of nuclear weapons worldwide; and to many other areas that impact national security and global stability, as an FFRDC, the Laboratory also supports other important missions, such as energy security and long-term energy needs; transportation research and development; homeland infrastructure security and resiliency; and advanced science and technology. Much of the same infrastructure used to support national security supports these other missions. A more detailed discussion of the missions and the work conducted by the Laboratory is provided in this chapter. Definitions of the terminology used in this SWEIS (e.g., mission, program, capability, and project) are included in the Glossary (Chapter 9).

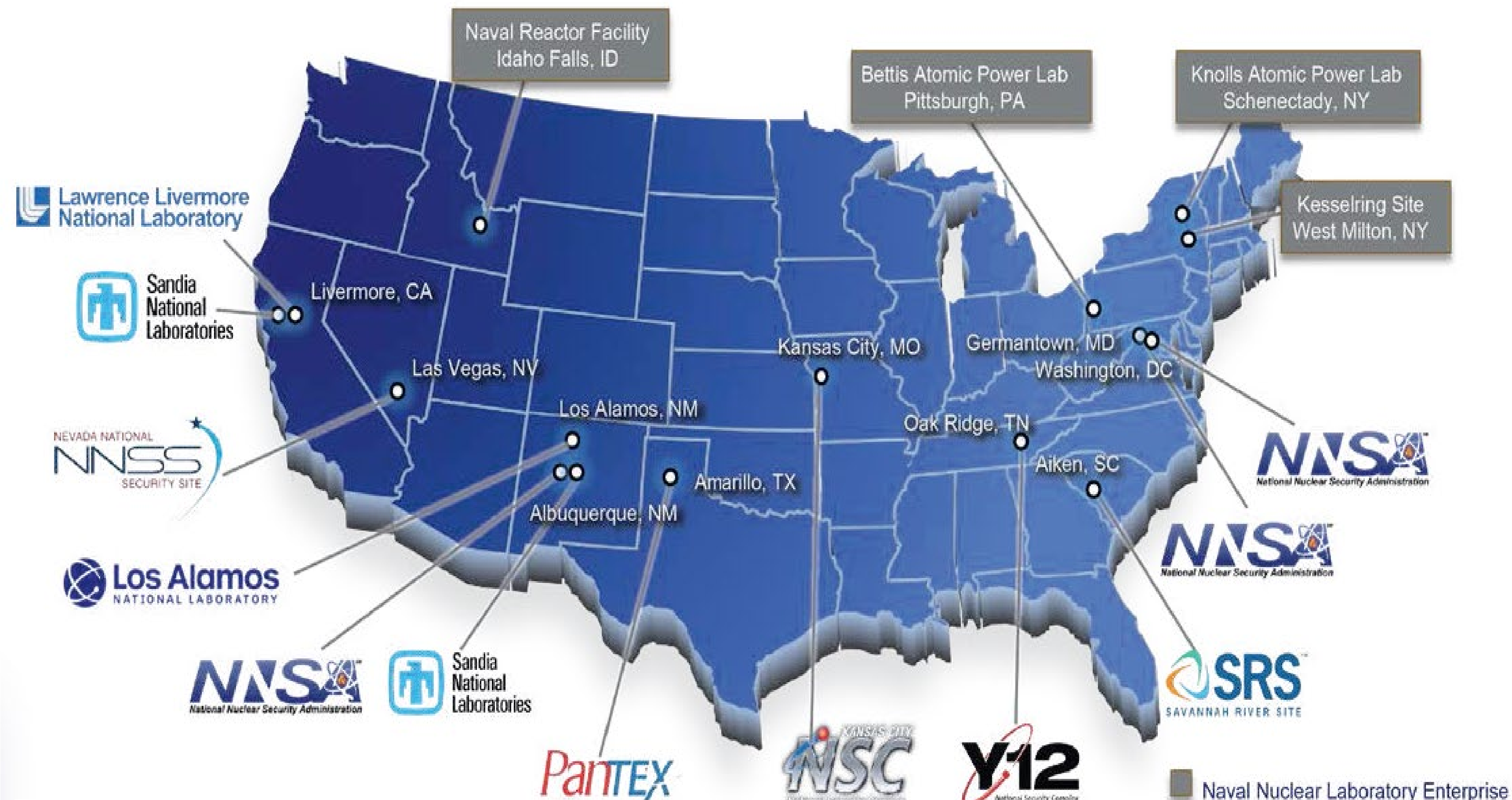
2.1 Overarching DOE and NNSA Missions

2.1.1 NNSA Missions

To accomplish the NNSA mission priorities discussed in Chapter 1, NNSA uses world-class science, technology, and engineering; employs an adaptive workforce; manages a resilient infrastructure; and conducts operations in an integrated NSE (NNSA 2022a). As shown in Figure 2.1-1, the NSE consists of laboratories, production facilities, and sites. NNSA owns and is responsible for contractor oversight for the NSE portfolio, including LANL. The Laboratory is an integral part of the NSE.

As one of only three nuclear weapons laboratories in the U.S., LANL contributes significantly to the core intellectual, scientific, and technical competencies of the U.S. related to nuclear weapons. These competencies embody over 80 years of weapons and related knowledge and experience.

In support of NNSA mission priorities, the Laboratory maintains specific core competencies in activities associated with research, development, design, and surveillance of nuclear weapons; supports the assessment and certification of their safety, reliability, and performance; produces plutonium pits for the stockpile; supports efforts to promote international nuclear safety and nonproliferation; and works to reduce global danger from weapons of mass destruction. The continued operation of the Laboratory is integral to NNSA's ability to meet its missions.



Source: NNSA 2022b

Figure 2.1-1 NNSA's Nuclear Security Enterprise

2.1.2 DOE Missions

Although LANL is an NNSA-sponsored national laboratory, it provides significant support to other DOE elements beyond NNSA to help achieve the DOE mission. The mission of DOE is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions, as follows (DOE 2022a):

- **Nuclear Safety and Security –** Enhance nuclear security through defense, nonproliferation, and environmental efforts;
- **Science and Innovation –** Maintain a vibrant U.S. effort in science and engineering as a cornerstone of the nation's economic prosperity with clear leadership in strategic areas;
- **Energy** – Catalyze and support the timely and efficient transformation of the nation's energy system and secure U.S. leadership in energy technologies; and
- **Management and Operational Excellence –** Establish an operational and adaptable framework that combines the best wisdom of all DOE stakeholders to maximize mission success.

DOE's three undersecretaries—the Undersecretary for Nuclear Security, the Undersecretary for Science and Innovation, and the Undersecretary for Infrastructure—manage most of the core functions that carry out the DOE mission with significant cross-cutting work spanning across the enterprise. DOE's Assistant Secretary for Environmental Management and Assistant Secretary for Legacy Management are also charged with crucial missions. The Laboratory supports the DOE Office of Science, DOE Office of Legacy Management (DOE-LM), DOE Office of Intelligence and Counterintelligence (DOE-IN), and other DOE office missions. The NNSA Los Alamos Field Office (NA-LA) oversees LANL and engages on behalf of NNSA with other field offices and stakeholders, including leaders and members of surrounding communities, cities, local and tribal governments, and business and non-governmental organizations.

The Laboratory supports significant work for the DOE Office of Science and other DOE offices. The mission of DOE's Office of Science is to deliver scientific discoveries and major scientific tools to transform the nation's understanding of nature and advance the energy, economic, and national security of the U.S. Through the DOE Office of Science, the Laboratory conducts long-term, national-security-inspired, fundamental science. DOE-IN funds work at the Laboratory related to global security. The DOE-LM mission includes DOE support for the Manhattan Project National Historical Park (MAPR), which is, in part, located at the Laboratory.

The Laboratory conducts R&D on behalf of the U.S. Government for public and private partnerships as an FFRDC. This includes work facilitated through partnerships with industry, academia, and research institutions through Cooperative Research and Development Agreements (CRADAs). Results from CRADA relationships are designed to accelerate the CRADA partner's ability to impact industry. LANL also uses Strategic Partnership Projects with other entities to bring the Laboratory's technologies, processes, scientific capabilities, and special technical expertise to solve problems for large and small businesses, local and state governments, universities, and non-profit organizations.

The LANL site is also host to DOE-EM mission activities. DOE-EM was established in 1989 with the mission to complete the safe cleanup of the environmental legacy resulting from decades of nuclear weapons development and government-sponsored nuclear energy research at nuclear weapons manufacturing and testing sites across the U.S. On March 22, 2015, DOE established a separate federal site office (referred to as EM-LA), with the mission to safely, efficiently, and with full transparency complete the cleanup of legacy contamination and waste resulting from nuclear weapons development and government-sponsored nuclear research at LANL (DOE 2022b). Currently, EM-LA achieves its mission through a contract known as the LANL Legacy Cleanup Contract.

The principal regulatory driver for legacy environmental cleanup at LANL is the Consent Order (as discussed in Chapter 1), while legacy waste management and disposition is conducted in accordance with DOE Orders and other federal requirements. This SWEIS considers legacy cleanup activities at LANL at a site-wide level. Sections 2.3 and 4.14 provide additional details on the DOE-EM legacy cleanup program at LANL.

2.2 Overview of Laboratory Programs and Capabilities

The Laboratory is a large and complex site. From an operational perspective, the Laboratory defines its work through the strategic objectives identified in the Laboratory Agenda (LANL 2024b), which include:

1. **Nuclear deterrence** – Lead the nation in evaluating, developing, and ensuring effectiveness of the country's nuclear deterrent, including the design, production, and certification of current and future nuclear weapons.
2. **Threat reduction** – Anticipate persistent and emerging threats to global security; develop and deploy revolutionary tools to detect, deter, and respond proactively.
3. **Technical leadership –** Deliver scientific discoveries and technical breakthroughs to advance relevant research frontiers and anticipate emerging national security risks.
4. **Trustworthy operations –** Consistently demonstrate and be recognized by diverse stakeholders for trusted and trustworthy operations.

The Laboratory M&O contractor uses an organization that is separated into various directorates to support these objectives. To effectively describe and analyze the key activities at the LANL site (including activities managed by other DOE offices that are not part of the Laboratory contractor organization), NNSA has organized this SWEIS to present the activities associated with continued and future operations at LANL by the following programs and capabilities:

- Stockpile Stewardship and Weapons
- Global Security
- Science, Technology, and Engineering
- Mission-Enabling Operations

Descriptions of these programs and capabilities are presented in Appendix A, Section A.2.2. Examples of specific infrastructure for each program are also provided by TA in the appendix.

Many capabilities and facilities at the Laboratory support multiple missions and programs. For example, high-performance computing (HPC) primarily supports stockpile stewardship and weapons by modeling the performance of weapon systems and components and physical processes critical to nuclear operation; however, HPC also supports global security by modeling chemical, biological, radiological, nuclear, and/or explosive events; and supports science, technology, and engineering through modeling of phenomena, such as climate change and the COVID-19 pandemic. Similarly, accelerator science and materials and physical sciences capabilities support stockpile stewardship and weapons, global security, and science, technology, and engineering. For purposes of this SWEIS, the LANL programs and facilities are generally discussed under the primary NNSA mission area supported; in some cases, they are discussed in multiple mission areas. The Laboratory's mission-enabling operations support multiple missions and programs across the site.

As discussed in Chapter 1, LANL consists of 50 designated technical areas, with approximately 8.2 million square feet of facilities (*see* Figure 1.2-2). Table 2.2-1 identifies the major operating facilities at LANL. Select Laboratory facilities are pictured on Figure 2.2-1 with a map that provides locations of the facilities. Appendix E provides a more detailed description of the LANL facilities and operations.

The parallel mission of DOE for environmental management and legacy cleanup is described in Section 2.3.

2.3 DOE-Environmental Management/Legacy Cleanup Mission

2.3.1 Division of NNSA and DOE-EM for Environmental Cleanup at LANL

As noted previously, in September 2014, the Secretary of Energy directed NNSA and DOE-EM to transition the acquisition and management of EM-funded legacy cleanup work from NNSA to DOE-EM to facilitate cleanup efforts at LANL. To achieve a smooth turnover, the Secretary of Energy approved a transition plan, developed jointly by NNSA and DOE-EM, that provided for a federal workforce transition and establishment of EM-LA on March 22, 2015 (DOE 2022b).

In addition to establishment of EM-LA and reassignment of incumbent EM employees, the transition plan provided for determining and fully staffing the new field office and transitioning the legacy cleanup scope at LANL from the NNSA-managed M&O contract to a DOE-EM-managed contract vehicle(s) in a two-phase process. The first phase was a sole source, short-term "bridge" contract, known as the Los Alamos Legacy Cleanup Bridge Contract, between EM-LA and the incumbent M&O contractor, Los Alamos National Security, LLC. The second phase, the Los Alamos Legacy Cleanup Contract[4] awarded in December 2017 to N3B[5] (turnover completed in April 2018), is the current DOE-EM-managed legacy environmental cleanup contract.

Descriptions of the DOE-EM programs and capabilities are presented in Appendix A, Section A.2.2.5. Examples of specific infrastructure for each program are also provided by TA in the appendix.

[4] https://www.energy.gov/em-la/information-center/contracts
[5] Newport News Nuclear BWXT Los Alamos (N3B) https://n3b-la.com/

Table 2.2-1 Overview of Major Operating Facilities at the Laboratory

Facility[a]	Facility Location	Area (gross ft^2)	Primary Mission/ Program	Radiological Facility Classification[b]
Chemistry and Metallurgy Research	TA-3	563,601	ST&E	HC-2
Sigma Complex	TA-3	186,500	SS/W	Radiological Facility
Materials Science Laboratory	TA-3	70,000	SS/W	Radiological Facility
Machine Shops	TA-3	181,500	SS/W	Radiological Facility
Strategic Computing Complex (Nicholas C. Metropolis Center)	TA-3	300,000	SS/W	No
Dual Axis Radiographic Hydrodynamic Test	TA-15	54,000	SS/W	Accelerator Facility[c]
High Explosives Processing Facilities	Multiple TAs	534,000	SS/W	Radiological Facilities
High Explosives Testing Facilities	Multiple TAs	301,500	SS/W	Radiological Facilities
Weapons Engineering Tritium Facility	TA-16	9,400	SS/W	HC-2
Target Fabrication Facility	TA-35	84,900	SS/W	Radiological Facility
Radiochemistry and Hot Cell Facility	TA-48	105,000	SS/W	Radiological Facility
Los Alamos Neutron Science Center	TA-53	338,803	SS/W	Accelerator Facility
Plutonium Facility 4	TA-55	236,192	SS/W	HC-2
Radiological Laboratory Utility Office Building	TA-55	203,686	SS/W	HC-3
Bioscience Facilities	TA-43, TA-3, TA-00, TA-35, TA-46, and TA-51	168,000	GS	Radiological Facilities
Radioactive Waste Management Facilities				
Radioactive Liquid Waste Treatment Facility	TA-50	42,285	M-E Operations	HC-3
Waste Characterization Reduction and Repackaging Facility	TA-50	3,749	M-E Operations	HC-3
Radioactive Assay Nondestructive Testing	TA-54	7,564	M-E Operations	HC-2
Transuranic Waste Facility	TA-63	79,239	M-E Operations	HC-2
Material Disposal Area G (DOE)	TA-54	61 acres	Legacy Cleanup	HC-2

ft^2 = square feet; GS = Global Security; HC = Hazard Category; M-E = Mission-Enabling; SS/W = stockpile stewardship and weapons; ST&E = Science, Technology, and Engineering; TA = technical area

a. Appendix E contains a detailed description of the facilities in this table with the exception of the radioactive and waste management facilities, which are described in Section 4.11.

b. Radiological facility classification, as defined in DOE-STD-1027: (1) A Hazard Category 2 (HC-2) Nuclear Facility is one with the potential for nuclear criticality events, or, with sufficient quantities of hazardous materials and energy, could require onsite emergency planning activities; (2) A HC-3 nuclear facility is one with the potential for significant but localized consequences, and has quantities of hazardous radioactive materials which meet or exceed Table A.1 values in the standard; (3) Facilities that do not meet or exceed HC-3 threshold criteria but still possess some amount of radioactive material may be considered Radiological Facilities.

c. Accelerator Facilities are regulated under DOE Order 420.2D, "Safety of Accelerators."

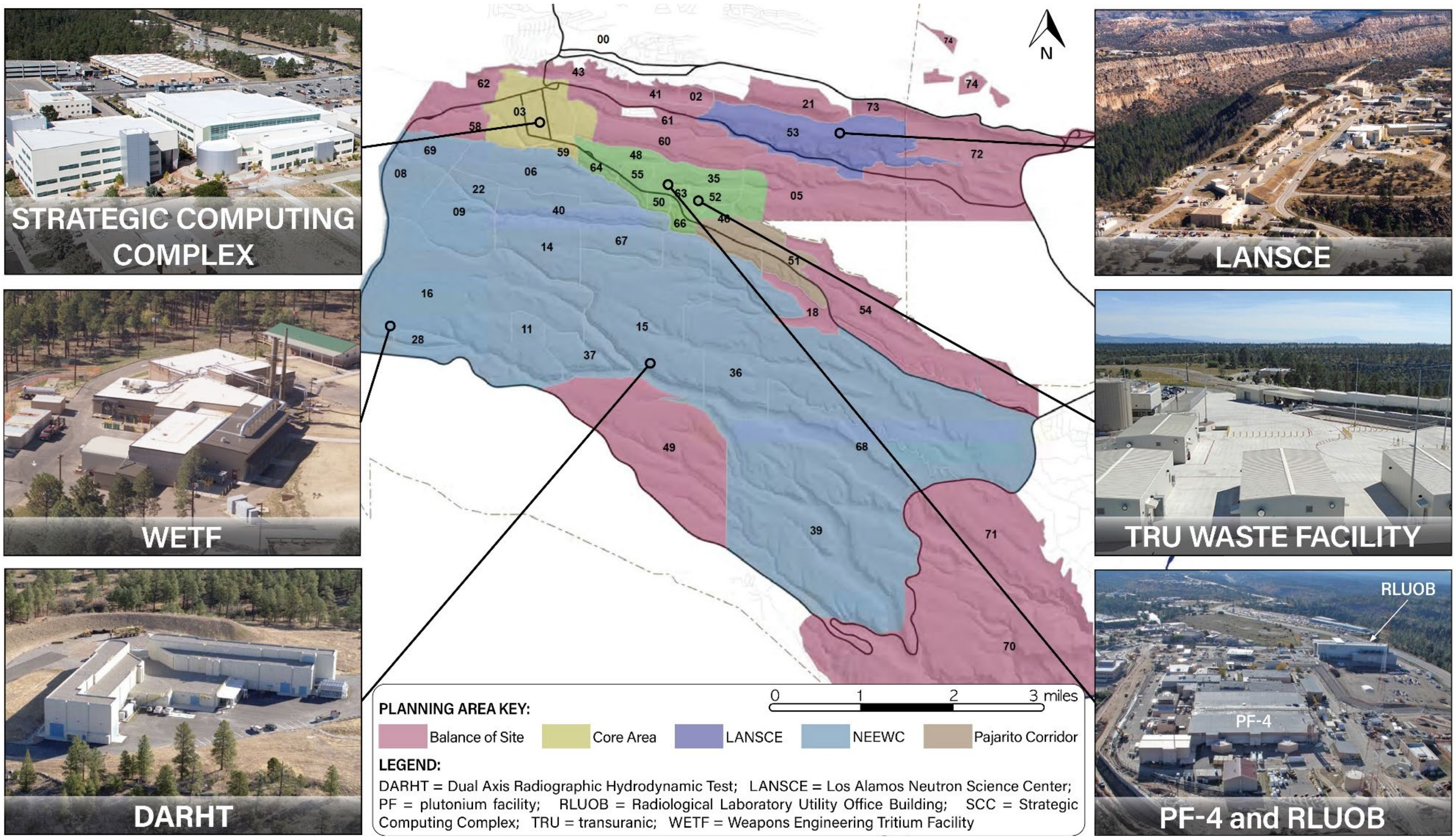


Figure 2.2-1 Select Facilities at the Laboratory

CHAPTER 3
PROPOSED ACTION AND ALTERNATIVES

3.0 PROPOSED ACTION AND ALTERNATIVES

3.1 Introduction and Development of the SWEIS Alternatives

This chapter describes the three alternatives that NNSA is evaluating for continued operation of LANL: (1) the No-Action Alternative, described in Section 3.2; (2) the Modernized Operations Alternative, described in Section 3.3; and (3) the Expanded Operations Alternative, described in Section 3.4. To evaluate the potential environmental impacts, NNSA developed construction and operational parameters for each alternative, as described in Section 3.5. This chapter also discusses alternatives that were considered but eliminated from detailed study (Section 3.6); identifies NNSA's preferred alternative (Section 3.7); and provides a comparison of the potential consequences of the three alternatives (Section 3.8). In some instances, additional information supporting Chapter 3 is included in Appendix A, Section A.3 (e.g., maps of project locations by alternative). Chapter 5 provides more detailed analyses of the potential consequences of the alternatives. A Record of Decision (ROD) would be prepared by NNSA with decisions on the projects and activities that would go forward through approximately the next 15 years. The names of proposed projects or facilities could change as each proposal goes through detailed design and development. The evaluation in this SWEIS is focused on the technical attributes of the project and is independent of the nomenclature.

3.1.1 Campus Master Plan

In September 2021, LANL published the 2021 CMP (LANL 2021c), which was the Laboratory's first comprehensive site plan in more than 20 years. In addition to providing the framework for facility and infrastructure development, the CMP established an integrated, site-wide process for ongoing collaborative planning efforts. The 2021 CMP established a long-term, mission-driven vision for the Laboratory based on principles of sustainability, resilience, environmental stewardship, preservation of cultural and historical resources, and the Laboratory's commitment to excellence. The CMP was undertaken to guide planning for the facilities and infrastructure needed to best support the missions at LANL. The plan also created a roadmap regarding future development efforts at LANL. In September 2022, the Laboratory published an update to the CMP, which concentrated on the progress and changes made in specific planning areas (LANL 2022b). The CMP is the foundation for the alternatives developed and analyzed in this SWEIS. The CMP has identified the need for more than 4 million square feet of new office, laboratory, and specialized equipment space to meet the requirements of mission growth over the next three decades.[6] The 2021 CMP projected 158 new construction projects and 2.4 million square feet of new construction in the next 10 years.[7] The 2022 update projected no significant changes to these numbers and continues to refine siting and timing of projects. The Laboratory continues to update

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[6] The CMP planning timeframe is more than three decades. In contrast, this SWEIS has a planning timeframe of approximately 15 years. Consequently, not all of the needs identified in the CMP are specifically addressed as proposed actions in this SWEIS. However, in terms of the next 15 years, there is general agreement between the CMP and this SWEIS regarding LANL's needs and the proposed actions presented in this SWEIS. In several instances, NNSA has included potential projects in this SWEIS that have not yet been included in the CMP (e.g., up to 795 acres of solar PV arrays).

[7] Many of the individual construction projects in the CMP are combined for evaluation in this SWEIS (e.g., warehouses, offices, security facilities). As a result, there is not a direct correlation between the number of proposed projects and associated development footprint from the CMP proposed projects and those addressed in this SWEIS.

the CMP as the planning efforts continue. The following principles are the foundation for future site design guidelines (LANL 2021c):

- Implement the Laboratory's desire to create a true campus core and an attractive cohesive site.
- Establish clear and attractive entrances and effective wayfinding systems.
- Enhance functional relationships among users through informed land use and siting decisions.
- Incorporate security, safety, and environmental needs early in project planning.
- Apply Low-Impact Development (LID) standards for stormwater management to the greatest extent possible.
- Promote a Complete Streets approach to circulation and mobility.
- Establish a Laboratory-wide approach to environmental planning, including documentation and remediation.
- Incorporate environmental, historical, and cultural resources protection considerations and processes at the beginning of all site planning processes.
- Establish and use consistent design palettes for buildings, landscapes, site furnishings, and lighting.
- Develop a transit system and related facilities that improve circulation within the Laboratory and link with Los Alamos County and other regional transit systems.
- Adopt effective development standards that will be consistently applied to all construction and redevelopment at LANL.

The CMP divides LANL into five planning areas, shown earlier in Chapter 1, Figure 1.1-2 and discussed below.

The Core Area Planning Area, primarily TA-3, is considered the heart of the Laboratory. It contains most of the key administrative functions and personnel from the three directorates: Science, Technology, and Engineering; Operations; and Weapons. Other TAs included in the Core Area are portions of TAs-43, -58, -59, -61, and -62. The CMP concentrates on TA-3, which contains the majority of the Laboratory's population, buildings, and infrastructure. This area is also the primary gateway into the site and represents the "public face" of the Laboratory. The Core Area contains major co-located missions and capabilities in a dense development setting with complex constraints, including hazardous materials operations. As one of the oldest developed areas of the Laboratory, the Core Area also contains some of the newest and most modern buildings and facilities. Its location at the edge of the LANL site places it next to non-LANL properties and land use, further complicating development constraints (LANL 2021c).

The Pajarito Corridor Planning Area is the physical center of nuclear research and production at the Laboratory and is located at the northern entrance to the site. Weapons production, testing, verification activities, and science functions are located in the Pajarito Corridor. At TA-55, plutonium work at PF-4 necessitates the presence of protective force personnel for security and mission support. Other functions in support of science research and development activities are located in the Pajarito Corridor, including radiological hot cells, high-energy laboratories, and fabrication. Warehousing, office space, and light laboratories also support the core missions in the

Pajarito Corridor. In addition to TA-55, the Pajarito Corridor includes TAs-35, -46, -48, -50, -51, -52, -63, -64, and -66. The Pajarito Corridor supports the second largest population at the Laboratory, which is growing in response to increasing plutonium missions at LANL. The increase in population necessitates additional office, light laboratory, and parking facilities. The combination of additional population and construction present a challenge for pedestrian circulation and traffic management (LANL 2021c).

The NEEWC Planning Area is the HE, engineering, and environmental testing site for the weapons programs at the Laboratory. HE operations and capabilities at LANL are central and critical to the success of the Laboratory's mission to ensure the safety, security, and reliability of the nuclear stockpile. LANL serves as both the design and production agency for nuclear weapons, relying on the integrated capabilities of scientific research, engineering, and testing—including unique properties associated with HE.

The NEEWC Planning Area provides four primary capability sets (LANL 2021c):

1. **HE Research, Development, Test, and Evaluation and Shock Physics –** Understanding of materials needed for weapon codes and weapon physics designers, both in HE and non-HE (inert) weapons;
2. **Weapons Engineering and Inspection, Fabrication, Training, and Testing** – Design and fabrication of items for training and testing;
3. **Detonator Research, Development, and Production –** LANL serves as the design and production agency for parts used in the stockpile; and
4. **DARHT Facility and Experimental Testing –** Hydrodynamic tests and other explosives testing, including firing sites and testing facilities for vibration, shock, mechanical, thermal, and other experiments.

The NEEWC is the largest of the planning areas, at approximately 17 square miles. In general, operations within the NEEWC Planning Area are divided into three groups of TAs based on the scale (e.g., amount of HE used) and nature of operations that take place (LANL 2021c). For instance:

- **Small- to mid-scale operations** – TAs-6, -22, -40, and a portion of TA-67
- **Support and fabrication operations** – TAs-8, -9, -11, -16, -28, -37, and -69
- **Large-scale dynamic testing** – TAs-14, -15, -36, -39, and -68

The LANSCE Planning Area at TA-53 comprises the LANSCE, a National User Facility with one of the nation's most powerful linear proton accelerators (LINACs). LANSCE supports three of NNSA's core scientific capabilities—hydrodynamics, weapons nuclear science, and materials science—and generates isotopes that are used for medical applications. The material and nuclear data provided by LANSCE have been—and for the next several decades will be—critical to understanding nuclear weapons performance, reliability, and safety, as well as providing capability for basic and applied neutron science research to academia, national security, and industry (LANL 2021c).

Situated on South Mesa, LANSCE is entirely contained within TA-53. Bounded by East Jemez Road to the south, TA-53 is accessed via its own guard station for access control. The majority of the personnel in TA-53 are directly associated with accelerator programs and the scientific capabilities and programs of experimental physics. Personnel from other TAs have recently been consolidated at TA-53, which has led to a need for new office, laboratory, and storage space, as well as maintenance and refurbishment of existing aged facilities (LANL 2021c).

The Balance of Site Planning Area includes the remaining TAs not specifically addressed in the other four planning areas (i.e., Core, Pajarito, NEEWC, and LANSCE) and includes offsite leased space. The CMP is focused on NNSA planning and does not include DOE-EM activities; however, this SWEIS evaluates potential impacts of activities across the entire LANL site. Therefore, for this SWEIS, the Balance of Site Planning Area includes the primary locations for the DOE-EM remediation mission (e.g., TA-54) and the ongoing efforts associated with the Manhattan Project National Historical Park, operated as a collaboration between DOE and the National Park Service. The Balance of Site Planning Area includes 22 TAs and leased space, grouped into the following eight categories (LANL 2021c):

1. Northeast (TAs-21, -72, -73, and -74);
2. Los Alamos Canyon (TAs-2, -41, and -43);
3. Industrial Support (TAs-5, -60 [partial], and -61 [partial]);
4. Northwest (TAs-58 and -62);
5. Rio Grande Corridor (TAs-33, -70, and -71);
6. East Entry (TAs-18, -36 [partial], and -54);
7. Other (Rendija Canyon, TA-49, and TA-57 [Fenton Hill]); and
8. Leased Space (e.g., TA-47 in Santa Fe and TA-0 in Los Alamos and White Rock). The Laboratory also leases office space in Carlsbad, New Mexico.

3.1.2 SWEIS Alternatives Overview

The No-Action Alternative reflects the use of existing facilities to continue operations at levels consistent with those experienced since 2008, as well as those anticipated by NEPA analyses and agency decisions that have been made since 2008. As described in Section 3.2, the No-Action Alternative includes the construction and operation of new facilities, implementation of facility upgrades and utility/ infrastructure projects, and decontamination, decommissioning, and demolition (DD&D) of excess and aging facilities. The two action alternatives include the actions described for the No-Action Alternative, as well as additional actions which are described in detail in Sections 3.3 and 3.4. In addition, because of the recent increase in telework at LANL, this SWEIS analyzes the changes in potential impacts associated with increased teleworking under a hybrid work environment as discussed in Section 3.2.5.

Decontamination, Decommissioning, and Demolition (DD&D)

DD&D are those actions taken at the end of the useful life of a building or structure to reduce or remove substances that pose a substantial hazard to human health or the environment, retire it from service, and ultimately eliminate all or a portion of the building or structure. In this SWEIS, DD&D also includes removal of buildings or structures that do not have any radiological or hazardous components (e.g., offices or warehouses). In several instances for projects evaluated in this SWEIS, DD&D of existing facilities must precede implementation of a proposed project to provide the necessary space for the construction.

Figure 3.1-1 provides a high-level illustration of the comparative level of operations for the three alternatives. The analysis in this LANL SWEIS considers ongoing activities and proposed activities that could occur over approximately the next 15 years (2024–2038). To assess the potential environmental impacts that could occur as a result of the alternatives, NNSA developed site-wide estimates of construction and operational parameters, such as the potential area of land disturbance or the amount of utilities that may be required. NNSA incorporated these site-wide estimates, along with information on ongoing and future activities, into the analysis of impacts. For example, estimated areas of land disturbance for proposed activities were used in determining impacts on resources such as soils (area of disturbance and erosion), cultural resources (number of sites potentially affected), and biological resources (vegetation/habitat loss).

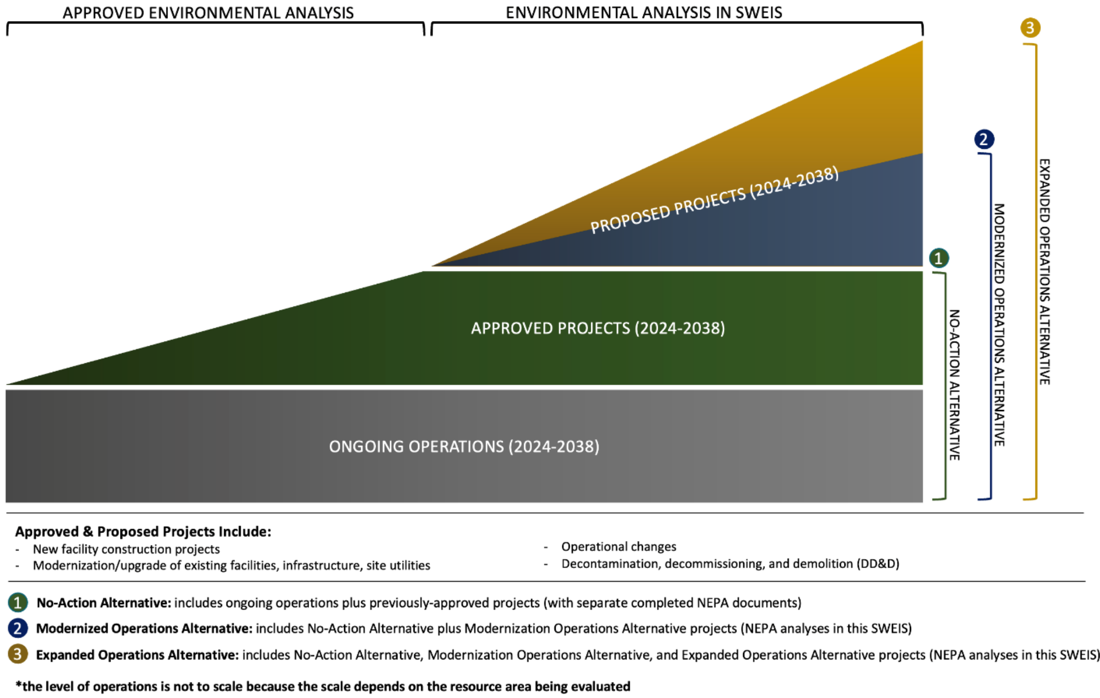


Figure 3.1-1 Level of Operations for the LANL Alternatives

3.2 No-Action Alternative

NNSA analyzed the No-Action Alternative to comply with the CEQ's NEPA implementing regulations (40 CFR Parts 1500–1508) and to provide a baseline against which the impacts of the Proposed Action can be compared. As illustrated in Figure 3.1-1, the No-Action Alternative reflects continuation of current, ongoing operations and implementation of approved projects (those with current, or in-process, NEPA coverage), which include decisions NNSA made based on the 2008 LANL SWEIS and subsequent SAs (*see* Chapter 1, Section 1.4) and implementation of decisions made on actions evaluated in other relevant NEPA documents (*see* Section 1.4).

An example of an approved action based on an earlier NEPA document is NNSA's 2020 decision to implement elements of the Expanded Operations Alternative from the 2008 SWEIS as needed to produce a minimum of 30 war reserve plutonium pits per year for the national pit production mission and to implement surge efforts up to the analyzed limit to meet the previous and current NPRs (DoD 2018, 2022) and national policy (85 FR 54544, September 2, 2020). The No-Action Alternative also includes projects or actions for which NEPA has or will be completed during preparation of this SWEIS, which is expected to be finalized in 2025.

The projects identified in Table 3.2-1 and Table 3.2-2, and described in Sections 3.2.1 and 3.2.2, define the No-Action Alternative projects that are expected to be constructed at LANL in the near term (by 2029). Implementation of these projects would result in changes to some of the environmental parameters at the Laboratory. Section 3.5, and Appendix A, Tables A.3.5-1 and

A.3.5-2, identify the construction and operational parameters associated with the No-Action Alternative, respectively.

Under the No-Action Alternative, LANL would use existing and enhanced capabilities through 2024 to continue to support major DOE/NNSA capabilities/programs described in Chapter 2 of this LANL SWEIS. This would involve projects that have been approved, or are in the process of being approved, for implementation. As defined in this SWEIS, the No-Action Alternative reflects the use of existing facilities and ongoing projects to meet national security and other laboratory mission requirements. The approved projects to be implemented under the No-Action Alternative include: (1) construction of new facilities; (2) upgrade of existing facilities and infrastructure projects (including utility and transportation projects); and (3) DD&D of excess and aging facilities for which NEPA analysis/documentation already exists or would be completed before publication of a ROD on the Proposed Action presented in this SWEIS. Therefore, as shown on Figure 3.1-2, the No-Action Alternative includes a level of construction and operation at LANL greater than ongoing operations. Under the No-Action Alternative, operations would continue at a steady-state into the future, but at a level lower than would be needed to fully support the growing NNSA mission requirements.

The major capabilities, facilities, and operations included in the No-Action Alternative are described in Chapter 2, with additional details provided in Appendix E. In addition, Tables 3.2-1–3.2-3 identify new facilities, upgrade/utility/infrastructure projects, and DD&D projects associated with the No-Action Alternative. The tables also represent the size of the assumed development footprint for each project.[8] Figures A.3.2-10–A.3.2-14 in Appendix A provide planning area maps for locating the projects included in the No-Action Alternative at LANL.[9] The numbered bubbles on the maps correspond to the MAP ID numbers in Tables 3.2-1 and 3.2-2. Baseline data for all environmental resource areas were collected for 2022 (or in most cases, 2017–2022) as part of the Affected Environment (Chapter 4). Operational impacts associated with the No-Action Alternative were estimated based on operations since 2008, as well as any notable changes in operations resulting from the actions identified in Tables 3.2-1–3.2-3 (e.g., the operational parameters in Table A.3.5-2 in Appendix A for the No-Action Alternative reflect increased pit production at LANL and increased waste projections from environmental remediation and DD&D).

Additional activities that are included in the No-Action Alternative are those that may undergo a future NEPA review and be categorically excluded from the need for preparation of either an EA or EIS or that are determined to fall within the scope of this SWEIS. A list of DOE categorical exclusions is codified in appendices to 10 CFR Part 1021; activities conducted at LANL that are categorically excluded from further NEPA review are discussed in Appendix I. Typically, hundreds of proposed activities at LANL are reviewed each year and either categorically excluded from the need to prepare an EA or EIS or determined to fall within the scope of activities described in Appendix I.

[8] The term "development footprint" represents the estimated square footage of a project/facility plus any construction areas that may be required. After construction, these areas may be converted to parking areas or landscaped areas, or restored to a pre-construction state. To be conservative, this SWEIS assumes that the development footprint represents the maximum amount of land that could be disturbed.

[9] Figures A.3.3-2–A.3.3-6 in Appendix A can be used to find the approximate location of new facilities for the No-Action Alternative using the grid coordinates provided in Tables 3.2-1 and 3.2-2. The Map ID numbers are used in the figures to indicate the proposed location of the projects. In some cases (e.g., offices, warehouses), the Map ID numbers will show up in multiple locations, indicating multiple instances of the same project type.

Table 3.2-1 No-Action Alternative – New Facilities

Map ID #	Name[a]	Grid Location[b]	Size (ft^2)	Year	NNSA Capability[c]	Description
1	Warehouses (22)	various	189,000	2023–2029	Multi-mission	NNSA plans to construct approximately 22 warehouses (*see* Appendix A, Figures A.3.2-10–A.3.2-14 for the locations). Most warehouses utilize a standard design and will be single-story structures approximately 4,000 square feet in size.
2	Office buildings (23)	various	612,000	2023–2029	Multi-mission	NNSA plans to construct approximately 23 office buildings (*see* Appendix A, Figures A.3.2-10–A.3.2-14 for the locations). The office buildings will range in size from single-story, 4,000-square-foot structures to three-story, 42,000-square-foot structures.
3	Light Manufacturing Laboratory	B-2 (13)	10,000	2026	Science, Technology, and Engineering	NNSA has started construction on a new facility to support radiological operations of both LANL's Low Energy Nuclear Physics Program and LANL's Isotope Program.
4	Asphalt batch plant	C-1 (14)	5,600	2023	Mission-Enabling Operations	The replacement plant was recently constructed and is a self-contained operation that produces sufficient quality material for LANL projects.
5	Environmental Test Complex	C-2 (12)	18,000	2023–2027	Stockpile Stewardship/Weapons	The Environmental Test Complex will comprise three HE-certified laboratories: the Flight Instrumentation and Test Laboratory, the Shock and Vibration Test Laboratory, and the Thermal Test Laboratory.
6	Detonator Storage Facility and detonator production magazines	B-1 (12)	13,000	2023–2025	Stockpile Stewardship/Weapons	This project consists of a new 9,000-square-foot facility in TA-22 and includes four munitions storage magazines (each approximately 1,000 square feet).
7	Fire stations (3)	C-2 (11) A-2 (12) B-1 (14)	52,200	2023–2025	Mission-Enabling Operations	NNSA plans to construct three new fire station facilities. Two of the stations will be at TA-61 and TA-63 to provide emergency response coverage in the highest-density areas to meet National Fire Protection Association requirements.
8	Security facilities (6)	various	88,000	2023–2024	Mission-Enabling Operations	New security facilities will provide space for the LANL protective force and support the plutonium infrastructure to facilitate personnel and vehicle access control at LANL.
9	HE Transfer Facility	A-1 (12)	2,400	2023	Stockpile Stewardship/Weapons	This facility has been constructed at TA-8 to improve HE transportation safety, security, and efficiency.
10	Armored magazines (13)	various	8,700	2023–2024	Stockpile Stewardship/Weapons and Global Security	The Laboratory plans to add more armored magazines in various TAs, such as TA-9, TA-15, TA-16, TA-33, TA-36, and TA-39, to support multiple missions and programs.

Map ID #	Name[a]	Grid Location[b]	Size (ft²)	Year	NNSA Capability[c]	Description
11	Radioactive TRU Liquid Waste Facility	B-2 (11)	15,000	2024	Stockpile Stewardship/Weapons	NNSA is constructing this facility to replace the existing Radioactive Liquid Waste Treatment Facility, which is nearing the end of its functional and operational life.
12	TA-48 parking structure	A-1 (11)	150,000	2025	Mission-Enabling Operations	New parking structure is planned in TA-48.
13	RC-45 Annex lab/office	B-1 (11)	18,000	2027	Mission-Enabling Operations	New RC-45 Annex lab/office is planned.
14	Training and Development Center	C-2 (11)	130,000	2028	Stockpile Stewardship/Weapons	NNSA plans to construct this facility for operator training to support plutonium operations in PF-4.
15	Weapons Archiving and Records Facility	B-2 (10)	6,000	2025	Stockpile Stewardship/Weapons	Small new facility for records management is planned.
16	Training and test facilities (2)	D-4 (14)	8,000	2025–2028	Global Security	NNSA intends to construct and operate a new training complex in TA-33 to support the Global Security Program.
17	Cafeterias (3)	B-2 (11) C-2 (11)	31,000	2025–2026	Mission-Enabling Operations	Three new cafeterias to support the LANL workforce are planned.
18	Cold Test Facility	A-2 (12)	14,000	2028	Stockpile Stewardship/Weapons	This facility will consolidate laboratory space for design, engineering, and technology groups, creating a streamlined flow of process equipment destined for use at TA-55.
19	Energetic Materials Characterization Facility	B-1 (12)	75,000	2028	Stockpile Stewardship/Weapons	NNSA plans to construct and operate a new, consolidated Energetic Materials Characterization Facility that includes dedicated laboratory buildings, an administrative support building, HE magazines, a chemical storage building, and supporting utilities.
20	Helicopter pad replacement at TA-49	B-2 (14)	2,000	2023	Mission-Enabling Operations	Replacement of helicopter pad is planned.
21	DARHT Vessel Repair Facility	C-2 (12)	10,000	2023	Stockpile Stewardship/Weapons	This facility will supplement existing capability to decontaminate, inspect, and repair test vessels after each use.
22	Lab office with BSL-2 capabilities	D-4 (14)	12,000	2025	Global Security	This project includes office space, light laboratory space, and BSL-2 capabilities.
23	Kelly Field Interagency UAS training upgrade	C-3 (14)	1,400	2023	Mission-Enabling Operations	This project will create a new LANL interagency UAS training facility in an area that is currently undeveloped.
NEW FACILITIES TOTAL			**1,471,400 (33.8 acres)**			

BSL = biosafety level; DARHT = Dual-Axis Radiographic Hydrodynamic Test; HE = high explosives; TRU = transuranic; UAS = unmanned aircraft system

a Throughout this SWEIS, NNSA acknowledges that facility names are subject to change in the future.

b In general, for each new facility at LANL, alphabetical-numerical grid coordinates are provided to aid in locating the facility on Figures A.3.2-10–A.3.2-14 in Appendix A. The figure number is provided in parentheses (e.g., Figure A.3.2-10 is referred to as (10)).

c NNSA capabilities as defined in Chapter 2. In some instances (e.g., warehouses and offices), the projects would support multiple NNSA capabilities, however, are described only in one location (e.g., Section 3.2.1.4).

Source: LANL (2024c)

Table 3.2-2 No-Action Alternative – Upgrade/Utility/Infrastructure Projects

Map ID #	Name[a]	Site; Grid Location[b]	Size (ft^2)	Year	NNSA Capability[c]	Description
24	Steam plant upgrade	C-2, D-2 (10)	80,000	2023–2028	Mission-Enabling Operations	The existing steam system is aged, inefficient, and expensive to maintain and operate. The upgrade/refurbishment of the steam system will significantly reduce maintenance and operation costs.
25	DARHT battery project	C-3 (12)	3,500	2023	Stockpile Stewardship/Weapons	This project will install a utility-scale back-up power supply for the DARHT facility.
26	Electric Power Capacity Upgrade transmission line and onsite electrical upgrades	various	58,500 ft^2 onsite facility 8 acres offsite roads[d]	2025–2026	Mission-Enabling Operations	In 2023, NNSA prepared a Draft EA (NNSA 2023b) to evaluate a proposal to provide DOE/NNSA with a reliable and redundant electrical power supply to meet existing mission requirements. The project would construct an approximately 14-mile-long electric power transmission line that would cross land administered by the BLM, SFNF, and ultimately span White Rock Canyon onto DOE/NNSA-managed lands at LANL. Because the Electric Power Capacity Upgrade project is undergoing its own NEPA review in parallel with this LANL SWEIS, elements of this description will potentially change as part of the development of the Final EA to address comments from the public and state and federal agencies. The Final LANL SWEIS will include updated information, if available.
27	Offsite parking and shuttle service – pilot project	Offsite leased location	Existing location	2023	Mission-Enabling Operations	NNSA has initiated a pilot project to provide shuttle service from an offsite parking location to the Pajarito Corridor. The goal of the pilot project is to evaluate the effectiveness of a long-term commuter bus plan. The pilot project has two buses in operation on any day of service.
28	Sigma Building modification	D-2 (10)	4,400	2025	Stockpile Stewardship/Weapons	Installation of new equipment and systems within the Sigma Building are necessary to continue to support pit production.
29	Deploy a second fiber optic line	Offsite and various	0	2025	Mission-Enabling Operations	This project would construct and operate a second fiber optic line and associated routing that would provide redundant voice, data, and internet services.
30	Institutional laydown areas	Site-wide	~29 acres	2023–2029	Mission-Enabling Operations	LANL requires the use of several institutional laydown and construction support areas to be centrally located on the site.
31	Telecommunications building 50-0184 modular annex	B-2 (11)	2,700	2024	Mission-Enabling Operations	This project would make a small addition to the telecommunications facility.

Map ID #	Name[a]	Site; Grid Location[b]	Size (ft^2)	Year	NNSA Capability[c]	Description
32	10-MW solar PV array	A-2 (12)	45 acres	2025	Mission-Enabling Operations	This project would construct and operate a ground-mounted solar PV system (up to 10 megawatts) and power distribution line.
33	Site-wide transportation projects and parking	Site-wide	~26 acres roads; ~18 acres parking	2023–2029	Mission-Enabling Operations	NNSA plans to construct approximately 1.15 million square feet (approximately 26 acres) of roadway projects and approximately 773,000 square feet (18 acres) of new parking lots.
34	Wood yard	A-1 (12)	3 acres	2024	Mission-Enabling Operations	NNSA is developing a wood yard in TA-69 for processing wood materials removed during wildfire prevention activities and general maintenance of the LANL site.
TOTAL			**149,100 ft^2 facilities ~129 acres of other projects**			

BLM = U.S. Bureau of Land Management; DARHT = Dual-Axis Radiographic Hydrodynamic Test; MW = megawatt; PV = photovoltaic; SFNF = Santa Fe National Forest

a This list comprises large projects greater than $1million; there are hundreds of smaller upgrade projects less than $1 million that are not included in this list. These smaller projects would likely be implemented through categorical exclusions as described in Appendix I. Other utility upgrades would be included as required (with any associated NEPA review) to support construction of the new facilities identified in Table 3.2-1.

b In general, for each new facility at LANL, alphabetical-numerical grid coordinates are provided to aid in locating the facility on Figures A.3.2-10–A.3.2-14 in Appendix A. The figure number is provided in parentheses (e.g., Figure A.3.2-10 is referred to as (10)).

c NNSA capabilities as defined in Chapter 2.

d. This represents the permanent footprint. Additional temporary disturbance includes up to 84 acres of disturbance during construction consisting of staging areas of up to 70 acres (up to 45 acres onsite), temporary roads on BLM and SFNF land (7 acres), and onsite construction of underground distribution lines (7 acres).

Source: LANL (2024c) NNSA (2019b, 2020b, 2023b)

Table 3.2-3 No-Action Alternative – DD&D Projects

Facilities to Undergo DD&D[a]	Size (ft^2)	Year
Warehouses, office buildings, Ion Beam Facility, Fire Station 1, transportables, laboratories, sheds, trailers, support buildings	~731,000	Near term (2023–2029)
Warehouses, office buildings, CMR Facility, steam plant, Physics Building, transportables, magazines, laboratories, sheds, trailers, support buildings	~899,000	Mid-term (2030–2038)
TOTAL	**1,630,000**	

CMR = Chemistry and Metallurgy Research

a The complete list of facilities to undergo DD&D is contained in Appendix E.

Source: LANL (2024c)

3.2.1 New Facilities and Upgrade/Infrastructure Projects

As shown on Table 3.2-1 above, 23 new facilities, representing a development footprint of almost 1.5 million square feet (33.8 acres), are being constructed under the No-Action Alternative. Several of these projects represent multiple proposals for similar facilities in different locations. For instance, the Laboratory is constructing 22 storage warehouses. This SWEIS combines similar projects to present a more efficient analysis of potential impacts. In addition to the new facilities, as shown in Table 3.2-2 above, the Laboratory is upgrading existing facilities, potentially installing a 10-megawatt (MW) solar photovoltaic (PV) array and a proposed electric power transmission line, and implementing institutional construction laydown areas and site-wide transportation and parking projects. These utility/infrastructure projects have a projected total footprint of about 216 acres, 84 of which will be temporary construction areas (onsite and offsite) that will be restored after construction.

In addition to the projects identified in Tables 3.2-1–3.2-3, DOE will continue actively remediating contaminated areas at LANL under the No-Action Alternative and in accordance with the 2016 Consent Order. Chapter 4, Section 4.14, of this SWEIS also discusses ongoing and pending remediation efforts. Appendix G of this SWEIS presents details on the current status of material disposal areas (MDAs) and identifies the range of potential environmental remediation actions (including capping and removal options) and the associated potential environmental impacts. The potential impacts of the baseline planning for remediation are included in Chapter 5 as an element of the No-Action Alternative.

With regard to NNSA missions identified in Chapter 2, most of the projects evaluated under the No-Action Alternative are associated with the Stockpile Stewardship/Weapons Program and Mission-Enabling Operations. Several of the projects identified in the tables are being constructed specifically to support plutonium pit production or plutonium infrastructure at the Laboratory. For instance, there have been four warehouses constructed in TA-51. An empty drum storage facility is planned for construction in TA-36. The pit production program will also require construction of new office buildings in TA-48 (four buildings), TA-50 (two buildings), and TA 63 (four buildings) that will each range from 20,000 to 42,000 square feet in size; additional security facilities for TA-46 and TA-55; new cafeterias in TA-48, TA-50, and TA-52; one parking garage in TA-48 and implementation of a pilot project for offsite parking and bus shuttle service. Detailed descriptions of the notable new facilities, upgrade/utility/infrastructure projects and environmental remediation activities are provided for the No-Action Alternative in Appendix A, Section A.3.2.1.

3.2.2 Decontamination, Decommissioning, and Demolition Projects

A total of 186 facilities, with a total footprint of 1,630,000 square feet (37.4 acres), would undergo DD&D under the No-Action Alternative. The list of facilities is included in Appendix E. Many of these facilities would be uncontaminated warehouses, office buildings, sheds, trailers, and support buildings. The most notable facility that would undergo DD&D under the No-Action Alternative is the CMR Facility, which is scheduled for DD&D in approximately 2031. The CMR Facility is approximately 565,000 square feet in size and has radiological contamination. As identified in Chapter 1, Section 1.4 and described in Appendix A, Section A.1.4, the potential impacts associated with DD&D of the CMR Facility were evaluated in the CMRR SEIS (NNSA 2011b).

The Laboratory maintains a database of potential contaminants in each building. Contaminants include various severity levels of radiological, chemical, or asbestos contamination. The severity levels for each contaminant are classified as either 100 percent contaminated, 50 percent contaminated, or 5 percent contaminated. Based on available information regarding the facilities proposed for DD&D under the No-Action Alternative:

- There are 13 facilities that are radiologically contaminated (about 954,000 square feet, 58 percent of the total footprint);
- There are 17 facilities that are chemically contaminated (about 67,000 square feet, 4 percent of the total footprint);
- There are 27 facilities that have some level of asbestos contamination (about 334,000 square feet, 21 percent of the total footprint); and
- There are 129 facilities that do not contain contamination, which represents 17 percent of the total footprint proposed for DD&D (272,000 square feet) (LANL 2024c).

The Laboratory is also considering an option to the No-Action Alternative that would allow continued use of elements of the CMR Facility beyond the planned DD&D date of 2031. Wing 9 has two banks of hot cells, a high-efficiency particulate air filtered enclosure, drum storage space, floor wells, high bays, and cranes. Some of these features made Wing 9 uniquely capable of performing the confined vessel cleanout and a TRUPACT-III loading demonstration. Other uses could include dealing with legacy issues, storage of drums, loading shipping containers and limited analytical chemistry activities. Chapter 5 of this SWEIS identifies changes to impacts should the Laboratory implement this option (i.e., land use, waste management, and facility accidents).

3.2.3 Operational Changes

This section identifies changes in current baseline operations that may or may not be associated with construction or upgrade of facilities, utilities, or infrastructure. These are notable changes that have the potential to affect the potential environmental impacts of Laboratory operations under the No-Action Alternative.

- **Increased plutonium pit production** – As discussed in Chapter 1, Section 1.4 of this SWEIS (and described in more detail in Appendix A, Section A.1.4), in September 2020, NNSA prepared a supplement analysis (NNSA 2020a) to evaluate NNSA's proposal to implement elements of the Expanded Operations Alternative from the 2008 SWEIS as needed to increase pit production at LANL. Based on that analysis, NNSA published an amended ROD in the *Federal Register* (85 FR 54544, September 2, 2020) to document the decision to implement elements of the Expanded Operations Alternative in the 2008 LANL SWEIS, as needed, to produce a minimum of 30 war reserve pits per year for the national pit production mission and to implement surge efforts to exceed 30 pits per year up to the analyzed limit to meet NPR and national policy.[10] As discussed in Section 3.2.1, some of the projects listed in Table 3.2-1 will support increased pit production at LANL. The potential impacts of constructing those projects (along with other actions identified in Section 3.2) are included in the impact analysis in Chapter 5. Increased pit production at LANL will also change some environmental impacts at LANL during operations. For example, compared to current operations, increased pit production will increase the LANL workforce, radiological emissions, collective worker dose, waste generation, and radiological transportation. Appendix A, Table A.3.5-2 presents the operational parameters

[10] For further understanding of pit production, please see the article *Pit Production Explained* at https://discover.lanl.gov/publications/national-security-science/2021-winter/pit-production-explained/

for the No-Action Alternative, which account for increases associated with the pit production mission.

- **Potential use of CMR Wing 9 hot cells to support the Isotope Production Program –** As part of the Isotope Production Program at TA-53, the Laboratory currently sends irradiated targets from TA-53 to the Oak Ridge National Laboratory for processing and recovery of the product isotopes. Under this operational change, the Laboratory could use existing hot cell capabilities available in Wing 9 of the CMR on an interim basis until that facility undergoes material cleanout and DD&D (cleanout expected in 2030 and DD&D in 2034). Use of these onsite capabilities is expected to reduce offsite transportation of these radiological materials and improve the efficiency of the isotope recovery process since many of these isotopes have short half-lives. These actions are within the capabilities and activity levels of the CMR analyzed in the 2008 SWEIS.
- **Venting of Flanged Tritium Waste Containers (FTWCs) –** The Laboratory plans to vent headspace gases from specialized high-pressure storage vessels called FTWCs at TA-54, Building 1028. After venting, the FTWCs will be transported to the WETF for further treatment in preparation for shipment to off-site waste disposal facilities. The Laboratory and NNSA have been integrating with the EPA and NMED to obtain approval to move forward with the plan. The Laboratory maintains a public website to provide updated information about the plan (https://environment.lanl.gov/resources/ftwc/).
- **Installation of ATS-5 in the SCC –** The HPC network in the SCC is currently using Advanced Technology System (ATS)-3, referred to as Crossroads. In 2027, the Laboratory expects to install the newest supercomputer (ATS-5) in the existing building. The additional cooling water and electricity consumption associated with ATS-5 have been included in the site-wide forecasts under the No-Action Alternative in Appendix A, Table A.3.5-2.
- **Reactivation of I-J Firing Site –** The Laboratory has identified the need for re-establishing the capability for firing shots at the I-J firing site and associated bunker TA-36 Building 107 to support ongoing work and requirements by the dynamic experiments program. Re-establishing the I-J firing site involves reuse of existing operational land (approximately 1 acre) that does not require additional development in undeveloped areas. Operations at the I-J firing site will be similar to HE operations currently conducted at other firing sites on the site. Since the I-J firing site has not been used in over 20 years, some wildfire reduction treatments may be required (e.g. tree removal); however, any treatments will be consistent with the wildland fire risk reduction and forest health objectives identified in the *Final Supplemental Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at LANL* (Wildfire Hazard Reduction SEA) (NNSA 2019c).
- **Chromium Interim Measures and Final Remedy –** As identified in Sections 1.4 and A.1.4, DOE prepared the Chromium Final Remedy EA to evaluate alternatives for interim measures and a final remedy for the hexavalent chromium contamination in Sandia and Mortandad Canyons (DOE 2024a). More details can be found in the EA. The Chromium Final Remedy EA provides four options representing different remediation methods and technologies that provide flexibility to adjust to potential or unanticipated events. Details regarding these options and methods/technologies are provided in Appendix A, Section A.3.2.3.

- **Repackaging Mixed-Oxide (MOX) Fuel Rods** – Unirradiated MOX fuel rods were shipped to LANL in 2005 and are being stored at PF-4. With the cancellation of the MOX program in 2018, the MOX fuel rods will be dispositioned and removed from PF-4. The specific disposition activities are in the planning phase but are expected to be conducted within PF-4. The Laboratory is considering two options for these fuel rods; (1) process the material as waste by separating the fuel pellets from the zircalloy cladding, or (2) recover the radiological material pending suitability for other NNSA programs. Under Option 1, the fuel pellets would be managed as TRU waste for disposal at WIPP, cladding would be managed as LLW. Under Option 2, the recovered materials could support activities such as the National Criticality Experiments Research Center at the Nevada National Security Site (NNSS). In Option 2, the fuel rods would be size-reduced with the fuel pellets remaining inside the cladding and sealed for shipping. These activities were evaluated in the 2008 SWEIS and included in a ROD (85 FR 54544, September 2, 2020) after the 2020 LANL SWEIS SA (*see* Section 1.4) (NNSA 2020a).
- **Continuation of Land Conveyance and Transfer –** Since 1999, approximately 3,176 acres of developed and undeveloped land resources from the LANL site have been transferred to other federal or local governments (P.L. 105-119, as amended; 42 U.S.C. § 2391). Approximately 2,100 acres of land were transferred to the Secretary of Interior to be held in trust for the Pueblo de San Ildefonso, and approximately 1,076 acres have been conveyed to Los Alamos County and the Los Alamos School District. As of December 2021, approximately 1,280 acres remain to be conveyed (LANL 2023a). The CT EIS is described in Section 1.4 and Appendix A, Section A.1.4.2 of this SWEIS. The CT EIS evaluated the potential direct and indirect impacts of conveyance and transfer of about 4,800 acres based on the planned use of the land after transfer. This SWEIS evaluates the potential impacts of the conveyance of the remaining acreage consistent with the assumptions in the CT EIS (DOE 1999b). Evaluation of this action as an element of the No-Action Alternative is not a commitment to convey or transfer these lands within a defined schedule or at all. It is included in this LANL SWEIS for completeness and to describe the potential impacts if the actions were implemented. More details regarding the status of remaining lands that could be conveyed under the No-Action Alternative are presented in Appendix A, Section A.3.2.3.

3.2.4 Notable Attributes

As shown on Table 3.2-4, a slight net decrease in facility square footage at LANL is expected under the No-Action Alternative, as projected construction associated with new facilities is slightly smaller than the projected facility DD&D actions. The net effect is a minor decrease in the total facility square footage at LANL. Most new facility construction will occur in the Pajarito Corridor Planning Area. Of the new facilities that are planned for construction, approximately 74 percent (1,081,000 square feet) is associated with warehouses, office buildings, parking structures, and a training and development center. Many of the new facilities are replacements for existing facilities, and operations associated with those replacement facilities would not change substantively compared to existing operations. However, implementation of the increased pit production mission will introduce notable operational changes compared to existing operations. For example, there will be changes in employment, radiological doses to workers and the public, radiological waste quantities, and transportation of nuclear materials/wastes. There will also be an increase in wastes associated with DD&D activities. The DD&D wastes include construction and demolition debris, radioactive wastes (LLW, MLLW, and TRU waste), and hazardous wastes (including asbestos-contaminated wastes). These analytical parameters are included in Appendix A, Table A.3.5-2 and Chapter 5 of this SWEIS presents the potential environmental impacts

Table 3.2-4 No-Action Alternative – Summary of Construction and DD&D

CMP Planning Area	Construction Footprint (ft^2)	Upgrade/Utility/ Infrastructure Footprint[a] (acres)[b]	DD&D Footprint (ft^2)
Core Area	221,000	11.8	1,176,000
Pajarito Corridor	954,400	44	316,000
NEEWC	197,000	62.7	103,000
LANSCE	42,000	1.1	16,000
Balance of Site	57,000[a]	96.8[c]	19,000
TOTALS	**1,471,400 (33.8 acres)**	**216 acres**	**1,630,000 (37.4 acres)**

BLM = U.S. Bureau of Land Management; DD&D = decontamination, decommissioning, and demolition; EPCU = Electric Power Capacity Upgrade; LANL = Los Alamos National Laboratory; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex; SFNF = Santa Fe National Forest

a Upgrade/utility/infrastructure includes associated roads and parking, institutional laydown areas, 10-MW solar PV array, the wood yard, and the EPCU project.

b 1 acre = 43,560 square feet.

c This value is from the Draft EA (NNSA 2023b) and includes the potential EPCU land development associated with permanent roads (8 acres on BLM and SFNF land) and temporary disturbance for staging (up to 70 total acres; up to 40 acres of which would be on LANL), temporary roads (7 acres on BLM and SFNF land), and construction of an underground distribution line on LANL (7.2 acres). All temporary disturbances (up to 84 acres) would be restored after construction. A 4.8-acre laydown area is also included in this planning area.

3.2.5 Hybrid Work Environment

Since 2020, the amount of time that Laboratory personnel work remotely has increased. This remote work (teleworking) is implemented through a combination of personnel that telework nearly 100 percent of the time (remote workers) and those that split their time between teleworking and onsite work (hybrid workforce). In 2022, about 9.6 percent of the Laboratory workforce was remote and about 12.9 percent were hybrid. The amount of time the workforce spends at LANL has a direct correlation to several environmental resource areas (e.g., socioeconomics, wastewater generation, traffic and air emissions from commuting). The baseline environmental parameters presented in Chapter 4 reflect the current, stabilizing trend for teleworking.

The analysis of impacts presented in Chapter 5 of this SWEIS assumes that the additional workers all work onsite, thus maximizing the potential environmental impacts. However, this SWEIS also includes a sensitivity analysis of how potential environmental impacts could change if 10-20 percent of the additional workforce were hybrid workers and teleworked 50 percent of the time. The analyzed hybrid work environment does not change the fundamental NNSA or DOE mission requirements, overall facility operations, or remediation commitments.

Section 5.15 of this SWEIS provides an analysis of the potential environmental impacts associated with an increased hybrid work environment at LANL and quantifies the change in impacts where possible. The hybrid work environment would be applicable to the No-Action Alternative or either of the two action alternatives as discussed in Section 5.15 and includes the following assumptions:

- Although consolidation of personnel could help accelerate DD&D and minimize construction activities, the number of facilities and offices are assumed to remain as proposed for each alternative; a reduction in the total proposed office space could underestimate potential impacts for offices that may be required in the future.

- Reduced worker commuting and reduced travel would decrease air emissions. However, some of this decrease would be offset by workers using their home heating and air conditioning systems.
- Reduced worker commuting would reduce potential traffic and adverse impacts on the level of service (LOS) of area roads.
- Reduced onsite worker population would reduce onsite vehicle circulation, parking, and domestic water use as well as the additional wastewater discharge attributable to onsite personnel. The impacts of water use or wastewater discharge would essentially transfer to the systems supporting the workers' residences.
- There would be no net change in safety, health, and waste generation because facility and laboratory personnel would continue to operate facilities and conduct the same types and amounts of production, experiments, tests, and environmental remediation.

3.3 Modernized Operations Alternative

The programmatic context for the Modernized Operations Alternative is the continued support of existing programs and activities by modernizing facilities, as necessary. This alternative includes the scope of the No-Action Alternative, as described in Section 3.2, plus additional modernization activities, including (1) construction of replacement facilities; (2) upgrades to existing facilities, utilities, and infrastructure; and (3) DD&D projects. Under this alternative, NNSA would replace facilities that are approaching their end of life, upgrade facilities to extend their lifetimes, and improve work environments to enable NNSA to meet operational requirements. The Modernized Operations Alternative also includes proposed projects to reduce greenhouse gases and other emissions (e.g., the Net-Zero Project, increased implementation of electric vehicle charging stations, and development of up to 795 acres of solar energy facilities). The proposed DD&D of additional facilities under the Modernized Operations Alternative would eliminate excess facilities and reduce costs and risk. This alternative would not expand capabilities or operations at LANL beyond those that currently exist. The schedule for implementation of the individual projects would be dependent on several factors including, among other things, funding priorities and availability of the proposed land area (e.g., completion of planned DD&D of excess facilities).

Tables 3.3-1–3.3-3 identify proposed new facilities, upgrade/utility/infrastructure projects, and DD&D projects, respectively, associated with the Modernized Operations Alternative. Figures A.3.3-2–A.3.3-6 in Appendix A provide maps for each planning area for locating the new facilities for the Modernized Operations Alternative at LANL.[11] Construction and operational parameters associated with the Modernized Operations Alternative are presented in Appendix A, Tables A.3.5-1 and A.3.5-2 (*see* Section 3.5).

[11] Figures A.3.3-2–A.3.3-6 in Appendix A can be used to find the approximate location of new facilities for the Modernized Operations Alternative using the grid coordinates provided in Tables 3.3-1 and 3.3-2. The Map ID numbers are used in the figures to indicate the proposed location of the projects. In some cases (e.g., offices, warehouses), the Map ID numbers will show up in multiple locations, indicating multiple instances of the same project type.

Table 3.3-1 Modernized Operations Alternative – New Facilities

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
1	**Storage warehouses (34)**	various	261,400	2025–2038	Multi-mission	See description in Section 3.3.1.
2	**Office buildings (33)**	various	527,900	2025–2038	Multi-mission	See description in Section 3.3.1.
3	Security facilities (8)	various	111,400	2025–2038	Mission-Enabling Operations	NNSA would construct eight new security facilities: (1) a second 42,000-square foot security building at TA-46 to provide office space for the protective force subcontractor and facilities for badging and access control; (2) two security office facilities at TA-64; (3) additional access control facilities at TA-16, including a new pedestrian gate; (4) two additional security facilities in TA-72, including a new guardhouse and a dog kennel. Of the projected layout of the proposed security facilities, approximately 85 percent of the footprint would be within areas that are not currently disturbed.
4	**Lab offices; secured offices and light labs; and mixed-use labs (27)**	various	1,229,000	2025–2038	Mission-Enabling Operations	See description in Section 3.3.1.
5	Parking structures and additions (5)	various	606,000	2025–2038	Mission-Enabling Operations	Parking structures in multiple locations across LANL.
6	Cafeteria	A-2 (4)	10,000	2038	Mission-Enabling Operations	An additional cafeteria to support the increased workforce.
7	Operations center/ office/part storage	C-2 (2)	8,000	2034	Mission-Enabling Operations	Additional storage facility in the Core Area.
8	Maintenance center	D-2 (2)	10,000	2035	Mission-Enabling Operations	A maintenance facility would be constructed.
9	Machine shops (3)	D-2 (2) D-4 (6)	15,500	2025–2028	Mission-Enabling Operations	Three machine shops across LANL.
10	DARHT Vessel Inspection Facility	C-2 (4)	8,000	2027	Stockpile Stewardship/ Weapons	This facility would be constructed in an area that is mostly undeveloped for use near the DARHT at TA-15 for the management of test vessels. The facility would contain a 30-ton overhead crane (LANL 2024c).
11	Explosives and Lasers Facility (ELF)	B-1 (4)	14,000	2027	Stockpile Stewardship/ Weapons	The ELF would consolidate laser laboratories currently located at TA-16, TA-35, and TA-40. Two of these existing laser laboratories are not located in an HE area, so this proposal would serve to move all HE work into the TA-40

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
						HE area. This facility would be constructed in an area that is currently undeveloped. Operations in the ELF would be similar in nature to existing operations and would comply with the same HE limit (470 grams, or approximately one pound). HE and chemicals would be stored and tested in the facility; however, because this work currently takes place at other locations at LANL, there would be no additional hazards introduced as a result of this project.
12	Armored magazine	C-2 (4) D-4 (6)	1,120	2025	Stockpile Stewardship/ Weapons and Global Security	Eight armored magazines would be installed to support various missions.
13	Test Cell #129 replacement	D-4 (6)	200	2027	Global Security	A small test cell would be replaced.
14	Maintenance shop replacement	D-2 (5)	3,800	2028	Mission-Enabling Operations	A maintenance facility would be constructed.
15	Materials Testing Facility	D-4 (6)	6,000	2028	Global Security	A materials testing facility would be constructed.
16	Shock Physics Integrated Research Facility (SPIRe)	B-1 (4)	17,000	2030	Stockpile Stewardship/ Weapons	The SPIRe would be a gas gun facility for explosives and organic materials. The facility would be constructed in an area that is currently undeveloped at TA-40, immediately east of the newly constructed Dynamic Equations-of-State Facility. All SPIRe operations would be conducted indoors. This gas gun facility would be a replacement gas gun facility for TA-40 Chamber 9.
17	**Sanitary Effluent Reclamation Facility expansion**	C-2, D-2 (2)	10,000	2025–2028	Mission-Enabling Operations	See description in Section 3.3.1.
18	Detonator Production Facility	B-1 (4)	34,000	2029–2031	Stockpile Stewardship/ Weapons	This project would construct and operate multiple buildings in developed areas of TA-22 and TA-6 to support production, manufacturing, quality control, storage, and packaging and transportation of detonators.
19	**Radiography/ Assembly Complex**	C-2 (4)	70,000	2029–2035	Stockpile Stewardship/ Weapons	See description in Section 3.3.1.
20	Visitor/training center building	B-2 (4)	14,800	2036	Mission-Enabling Operations	A visitor/training center would be constructed.
21	**Consolidated Waste Facility**	B-1 (6) C-2 (6)	38,000	2028	Mission-Enabling Operations	See description in Section 3.3.1.

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
22	Microwave Oven Thermo-Mechanical Experimentation (MOT-ME)	B-1 (4)	8,000	2034	Stockpile Stewardship/ Weapons	This project would construct and operate a new multi-bay facility in an area that is currently undeveloped in TA-6, dedicated to thermal and mechanical testing of smaller components, electro-magnetic (microwave) HE heating, sub-shock mechanical testing (Taylor Gun), and non-HE machining of parts. These capabilities are currently performed at TA-9 and TA-16.
23	Radiological Laboratory	C-3 (2)	16,000	2028	Stockpile Stewardship/ Weapons	This laboratory, which would be built in a developed area in TA-3, would be used to conduct material characterization capabilities, including radiochemistry, trace-element analysis, mass spectrometry, sample preparation and distribution, and research and development. The laboratory would be a replacement radiological facility and would have an inventory limit of no more than the HC-3 threshold quantity of plutonium equivalent (PuEq) material from DOE-STD-1027.
24	Beryllium Technology Facility (BTF) replacement	C-1 (3)	45,000	2038	Stockpile Stewardship/ Weapons	The existing BTF (TA-3-141) at TA-3 has reached its end of life. The replacement facility would be constructed in a developed area in TA-35 and would provide process improvements and consolidate the beryllium operations at LANL.
25	Counting house replacement	D-2 (5)	4,000	2027	Mission-Enabling Operations	A counting house replacement would be constructed.
26	Visitor and conference center	C-2 (2)	50,000	2038	Mission-Enabling Operations	A visitor and conference center would be constructed.
27	Concrete batch plant	C-1 (6)	200,800	2025	Mission-Enabling Operations	A concrete batch plant would provide an onsite capability to produce concrete for construction activities.
28	Utilities building	C-2 (2)	10,000	2037	Mission-Enabling Operations	A utilities building would be constructed.
29	Pentaerythritol tetranitrate (PETN) Plant	B-1 (4)	6,000	2034	Stockpile Stewardship/ Weapons	This facility would replace the capabilities for production of this explosive material currently performed in TA-9 and would largely support HE (i.e., PETN) production. The PETN plant would be the cradle-to-grave HE R&D facility to serve both the Design Agency and Production Authority. The facility and its operations would be necessary to support mission-critical work for the enduring stockpile and future new weapons systems. No new capabilities would be added. The proposed TA-6 location is undeveloped.

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
30	High Explosives (HE) Pilot Plant	A-2 (4)	6,000	2034	Stockpile Stewardship/ Weapons	This building would replace capabilities currently performed in TA-9, including multi-kilogram-scale production of HE synthesis, formulation, filtering, and drying in which the streamlined process would eventually be adopted by the Production Authority. No new capabilities or capacity would be added. The building would be constructed in TA-16 and would support chemical analysis of explosives and associated materials.
31	**Biomass generator**	Site-wide	600	2025	Mission-Enabling Operations	See description in Section 3.3.1.
32	National Gas Transfer Systems and Surety (NGTS/S) Laboratory	A-2 (4)	65,000	2038	Stockpile Stewardship/ Weapons	The proposed NGTS/S Laboratory would be a replacement facility constructed in an area that is currently undeveloped in TA-16 to meet gas transfer system mission needs in the future. The current facility, TA-16-202, is over 60 years old. The proposed NGTS/S would provide a modern, lower maintenance structure capable of meeting the future demands of the weapons program and would support weapon life-extension programs and new design development. The facility would include offices, storage area (i.e., vault type room), classroom area, and light laboratories. Operations could include a variety of small-scale experiments and activities (such as pressure testing) related to hydrogen, deuterium, and tritium. Similar to the existing facility, this replacement facility would also be a radiological (below HC-3) facility.
33	Heat pipe and Robotics Facility	A-2 (4)	8,000	2036	Stockpile Stewardship/ Weapons	The Laboratory operates two of the nation's leading technologies in both heat pipe work and applications of robotics. Heat pipes are thermal transfer devices capable of transferring heat and energy hundreds of times faster than conventional methods. NNSA would construct a multi-purpose facility to co-locate these operations from TA-46 to a developed area in TA-16.
34	LANSCE Water Treatment Facility	C-2 (5)	5,000[e]	2029	Mission-Enabling Operations	This project would construct a new water treatment facility near LANSCE. The facility design would be based on the design of the existing SERF and have a 5,000-square-foot footprint in a developed area in TA-53. Construction of the project would include trenching for approximately 2,700 linear feet to install the pipeline for potable water to the treatment facility.

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
35	Live fire shoot house	A-1 (4)	10,000	2038	Mission-Enabling Operations	NNSA would construct a live fire shoot house consisting of a 10,000-square-foot pre-engineered steel building in a developed area near the TA-16 Indoor Range and Tactical Training Facility. The shoot house would consist of rooms and connecting hallways where security individuals and teams would conduct live-fire dynamic entry training in a realistic environment. The facility would utilize frangible, lead-free munitions that would be contained within the building. Other types of ammunition would not be permitted. The shoot house would have 12-foot-high armor plate walls to provide 360 degrees of ballistic protection outside the facility.
TOTAL			**3,430,500 (~79 acres)**			

BTF = Beryllium Technology Facility; DARHT = Dual-Axis Radiographic Hydrodynamic Test Facility; ELF = Explosives and Lasers Facility; HC = Hazard Category; HE = high explosives; LANSCE = Los Alamos Neutron Science Center; NGTS/S = National Gas Transfer Systems and Surety; PETN = pentaerythritol tetranitrate; PuEq = plutonium equivalent; R&D = research and development; SERF = Sanitary Effluent Reclamation Facility; SPIRe = Shock Physics Integrated Research Facility; TA = Technical Area

a Throughout this SWEIS, NNSA acknowledges that facility names are subject to change in the future.

b **Bolded** projects in this table and Table 3.3-2 are described in Section 3.3.1.and/or Appendix A, Section A.3.3.1.

c In general, for each new facility at LANL, alphabetical-numerical grid coordinates are provided to aid in locating the facility on Figures A.3.3-2–A.3.3-6 in Appendix A. The figure number is provided in parentheses (e.g., Figure A.3.3-2 is referred to as (2)).

d NNSA capabilities as defined in Chapter 2. In some instances (e.g., warehouses, offices, security facilities, and light laboratories), the projects would support multiple NNSA capabilities, however, are described only in one location (e.g., Section 3.3.1.3).

e In addition to the permanent facility footprint, the project would include about 54,000 square feet of temporary land disturbance associated with pipeline construction to the water treatment facility in TA-53.

Source: LANL (2024c)

Table 3.3-2 Upgrade/Utility/Infrastructure Projects – Modernized Operations Alternative

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
36	**LANSCE modernization**	C-2, D-2 (5)	0	2030	Science, Technology, and Engineering	See description in Section 3.3.1.
37	Fire Station 5 upgrade	A-2 (4)	0	2028	Mission-Enabling Operations	NNSA would upgrade and repurpose the existing Fire Station 5 in TA-16, which is being replaced by a new fire station immediately north of the existing building as one of the projects in the No-Action Alternative. Fire Station 5 has been declared eligible for inclusion in the *National Register of Historic Places* as a historic building, and its upgrade and adaptive reuse would be implemented in accordance with

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
						LANL's Plan for the Management of the Cultural Heritage (LANL 2019c).
38	Blast tube relocation	D-2 (4)	0	2028	Stockpile Stewardship/ Weapons	The current blast tube capability is 150 feet in length and 8-foot in diameter; made from steel and located at the Lower Slobbovia firing site. The Laboratory utilizes the blast tube to simulate environmental conditions that could be experienced by weapons. The blast tube, which would be disassembled and relocated to the Meenie Bravo firing site in TA-36, could be extended an additional 60 feet to improve the capability's effectiveness.
39	DARHT modernization	C-2 (4)	10,000	2037	Stockpile Stewardship/ Weapons	In addition to the other projects involving DARHT (i.e., warehouses, Vessel Repair Facility, and battery project under the No-Action Alternative and the Vessel Inspection Facility under the Modernized Operations Alternative), the Laboratory would modify one of the halls of the DARHT building to better support access to the A2 accelerator. The Laboratory would extend the A2 hall, which would improve A2 accelerator systems maintenance and allow major components to be removed/installed in a safe indoor environment; make room for additional accelerator cells; and provide additional internal space. Extending the A2 hall would require underground utility relocations and re-routing of the current DARHT entrance road to an existing dirt road on the A1 side of the facility.
40	**Net-Zero project**	Site-wide	N/A	2025–2038	Mission-Enabling Operations	See description in Section 3.3.1.
41	**Electric Vehicle charging stations**	Site-wide	N/A	2025–2038	Mission-Enabling Operations	See description in Section 3.3.1.
42	Hydrogen fueling station	D-3 (2)	25,000	2025	Mission-Enabling Operations	NNSA would install and operate a hydrogen fueling station in a developed area in TA-3. It would generate and dispense hydrogen to vehicles. The Laboratory would extend minor utilities and place a foundation pad for anchoring the new equipment.
43	Switchgear replacement – upgrade to the TA-53 substation	B-2 (5)	106,000	2025	Mission-Enabling Operations	NNSA would replace the switchgear and other electrical equipment while relocating the TA-53 electrical substation from its current location to a nearby area. The replacement substation would involve the development of a new footprint of about 106,000 square feet, of which about 50

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
						percent is currently undeveloped. This modernization of the TA-53 electrical system would improve its reliability and performance prior to other facility installations in TA-53 are implemented.
44	Renovation of the steam plant for a Clean Energy Test Bed Facility	C-2 (2)	0	2027–2030	Mission-Enabling Operations	As identified in Section 3.2.1, under the No-Action Alternative, the TA-3 steam plant and associated steam and condensate distribution system is being upgraded. As an additional upgrade to the steam plant, under the Modernized Operations Alternative, the Laboratory proposes to implement a clean energy test bed facility that would install capabilities within the upgraded footprint that align with the Net-Zero Project. These capabilities would include electrolysis hydrogen generation, a stationary fuel cell, and a carbon capture unit to collect carbon dioxide emissions from the combustion gas turbine generator exhausts. The estimated quantity of carbon dioxide that could be captured annually is approximately 75,000 tons. The end state for the captured carbon has not yet been determined, however, it would likely be managed in a regional or state-wide sequestration initiative.
45	Light laboratory renovations	C-2 (4)	7,000	2031	Stockpile Stewardship/ Weapons	Minor upgrades to light laboratories.
46	**Solar photovoltaic arrays**	see Figure 3.3-1 in Section 3.3.1.3	Up to 795 total acres[e]	2026–2038	Mission-Enabling Operations	See description in Section 3.3.1.
47	TA-46 Sanitary Wastewater System Treatment (SWWS) Plant replacement	D-3 (3)	20,000	2038	Mission-Enabling Operations	The SWWS treatment plant at TA-46 serves the Laboratory's sanitary wastewater treatment needs. The SWWS is permitted to discharge to Cañada del Buey or Sandia Canyon. Currently, the effluent is piped to TA-3 and either recycled though the SERF for reuse at SCC or discharged to Sandia Canyon via Outfall 001. The replacement SWWS treatment plant would be located within a mostly undeveloped area in TA-46.
48	Building 40-23 electrical, mechanical	B-1 (4)	0	2030	Stockpile Stewardship/ Weapons	In-place upgrades to utilities are proposed.

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
	refurbishment and site improvements					
49	Building 22-1 renovation for office space	B-1 (4)	0	2030	Stockpile Stewardship/ Weapons	In-place upgrades to this building are proposed.
50	**Weapons Engineering Tritium Facility Modernization**	A-2 (4)	0	2025–2030	Stockpile Stewardship/ Weapons	See description in Section 3.3.1.
51	**Water tank upgrades**	Site-wide	0	2035	Mission-Enabling Operations	See description in Section 3.3.1.
52	**Gas line upgrades and reroutes**	Site-wide	0	2035	Mission-Enabling Operations	See description in Section 3.3.1.
53	**Electrical project upgrades**	Site-wide	0	2035	Mission-Enabling Operations	See description in Section 3.3.1.
54	**Water line upgrades, extensions, and relocations**	Site-wide	0	2035	Mission-Enabling Operations	See description in Section 3.3.1.
55	**Duct bank upgrades**	Site-wide	0	2035	Mission-Enabling Operations	See description in Section 3.3.1.
56	**Sewer project upgrades**	Site-wide	0	2035	Mission-Enabling Operations	See description in Section 3.3.1.
57	**Telecom/ communication project upgrades**	Site-wide	0	2035	Mission-Enabling Operations	See description in Section 3.3.1.
58	**Los Alamos Canyon Bridge replacement**	C-1 (2)	11.5 acres	2035	Mission-Enabling Operations	See description in Section 3.3.1.
59	**TA-72 remote parking and bus station**	D-1 (6)	~25 acres	2028	Mission-Enabling Operations	See description in Section 3.3.1.
60	Manhattan Project National Historical Park infrastructure	C-2 (6)	20,000	2030	Mission-Enabling Operations	Installation of additional infrastructure to TA-18 to support the Manhattan Project National Historical Park as recommended via a Cultural Landscape Inventory report (NPS 2019). The infrastructure planning is in the preliminary stages and would include input from associated area tribal communities via an Ethnographic Study expected to be completed no later than calendar year 2028. Initial infrastructure recommendations received to date include a security walkway with a reception area and restroom

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2)	Year	NNSA Capability[d]	Description
						facilities. The proposal would also include walkways, parking, and shade structures. To avoid or minimize any potential impacts to historical buildings or archaeological sites, installation and construction would be performed in accordance with LANL's Cultural Resources Management Plan (LANL 2019c).
61	**Institutional laydown areas**	various	~38 acres	2025–2030	Mission-Enabling Operations	See description in Section 3.3.1.
62	**Site-wide transportation projects and parking**	Site-wide	~41 acres of roads; ~13 acres of parking	2025–2038	Mission-Enabling Operations	See description in Section 3.3.1.
TOTAL			**188,000 ft^2 facilities ~923 acres of other projects (solar arrays represent up to 795 acres of this value)**			

DARHT = Dual-Axis Radiographic Hydrodynamic Test; LANSCE = Los Alamos Neutron Science Center

a Upgrades list only comprises of large projects greater than $1million; there are many smaller upgrade projects less than $1 million that are not included in this list. These smaller projects would likely be implemented through categorical exclusions as described in Appendix I. Other utility upgrades would be included as required (with any required NEPA review) to support construction of the new facilities identified in Table 3.3-1.

b **Bolded** projects in this table and Table 3.3-1 are described in Section 3.3.1 and/or Appendix A, Section A.3.3.1.

c In general, for each new facility or major upgrade at LANL, alphabetical-numerical grid coordinates are provided to aid in locating the project on Figures A.3.3-2–A.3.3-6 in Appendix A. The figure number is provided in parentheses (e.g., Figure A.3.3-2 is referred to as (2)).

d NNSA capabilities as defined in Chapter 2.

e There are nine site options being considered for solar PV arrays that range in footprint from 11 to 245 acres each. This SWEIS assumes that all options could be implemented.

Source: LANL (2024c)

Table 3.3-3 DD&D Projects – Modernized Operations Alternative

Facilities to Undergo DD&D[a]	Size (ft2)	Year
Warehouses, office buildings, transportables, laboratories, sheds, trailers, support buildings, and Health Research Laboratory	~543,000	Near term (2024–2029)
Warehouses, office buildings, transportables, RLWTF, Pulsed High-Energy Radiographic Machine Emitting X-rays, magazines, laboratories, sheds, trailers, support buildings, and Central Computing Facility	~673,000	Mid-term (2030–2038)
TOTAL	**1,216,000**	

DD&D = decontamination, decommissioning, and demolition; RLWTF = Radioactive Liquid Waste Treatment Facility

a The complete list of facilities to undergo DD&D is contained in Appendix E.

Source: LANL (2024c)

3.3.1 New Facilities and Upgrade/Infrastructure Projects

As shown on Table 3.3-1, 35 new facility projects, totaling over 3.4 million square feet (79 acres), would be constructed under the Modernized Operations Alternative (in addition to the projects included in the No-Action Alternative). Most of the new facilities would be replacements for existing facilities that have reached their end of life. With regard to NNSA missions, most of the projects are related to the Stockpile Stewardship/Weapons Program and Mission-Enabling Operations. There are no additional proposals related to the EM Remediation Mission and the actions described in Section 3.2.1 would continue under the Modernized Operations Alternative. As shown in Table 3.3-2, there are 27 upgrade/utility/ infrastructure projects proposed under the Modernized Operations Alternative, which represent about 188,000 square feet of proposed facilities and up to 923 acres of other projects (primarily the solar PV arrays [up to 795 acres], replacement of the Los Alamos Canyon Bridge [11.5 acres], remote parking in TA-72 [25 acres], institutional laydown areas [38 acres], and roads and parking [54 acres]). Brief descriptions of notable new facilities and upgrade/utility/infrastructure projects for the Modernized Operations Alternative are presented below (see also Appendix A, Section A.3.3, for additional project descriptions).

Warehouses. NNSA would construct approximately 34 warehouses between 2024 and 2038 (*see* Appendix A, Figures A.3.3-2–A.3.3-6 for the locations). Most warehouses would utilize a standard design and would be single-story structures approximately 4,000 square feet in size. Some would be climate controlled. The largest proposed warehouse would be a distribution center in TA-72, which is proposed to be approximately 98,000 square feet in size. By planning area, the number of projected warehouses includes:

- Core Area – 4 (16,000 square feet),
- Pajarito Corridor – 12 (48,200 square feet),
- NEEWC – 9 (67,200 square feet),
- LANSCE – 7 (28,000 square feet), and
- Balance of Site – 2 (102,000 square feet).

Of the projected layout of the proposed warehouses, approximately 63 percent of the footprint would be within areas that are not currently disturbed.

Office buildings. NNSA would construct 33 office buildings across the site between 2025 and 2038 (*see* Appendix A, Figures A.3.3-2–A.3.3-6 for the locations). The office buildings would range in size from 2,500-square-foot control rooms to single-story, 4,000-square-foot office buildings to multi-story office buildings that range from 20,000 to 23,000 square feet. By planning area, the number of projected office buildings includes:

- Core Area – 9 (183,500 square feet),
- Pajarito Corridor – 9 (157,700 square feet),
- NEEWC – 6 (76,500 square feet),
- LANSCE – 3 (51,700 square feet), and
- Balance of Site – 6 (59,000 square feet).

Of the projected layout of the proposed office buildings, approximately 41 percent of the footprint would be within areas that are not currently disturbed.

Lab offices/light laboratories/multi-use laboratories. NNSA would construct and operate 27 new lab offices, light laboratories, and multi-use laboratories to replace existing laboratory space that has outlived its design life or to efficiently consolidate operations. Lab offices are buildings with a combination of office space and laboratory space. Light laboratories are typically characterized by small equipment and apparatus that are typically used for direct bench-scale research. By far, the largest lab office proposed under the Modernized Operations Alternative is the Space Systems Instrumentation Building proposed for TA-3. Most of the current facilities/laboratories utilized to meet the space missions are located in the SM-40 complex at LANL, which is approaching 70 years old. These aged facilities are hard to maintain and are hampering LANL's ability to perform R&D activities and maintain required production capabilities. Additionally, there is a strong need at LANL for an unclassified conference facility. As a national laboratory, being able to host and conduct key conferences to increase collaboration is a key mission. The facility is expected to be approximately 240,000 square feet and would be located next to the Nonproliferation and International Security Center. Nonhazardous operations would be conducted in the facility (LANL 2024c).

One of the laboratory facilities included with this group is the 10,000-square-foot Chemical Receiving and Distribution Center proposed for TA-72 in the Balance of Site Planning Area. This facility would be a central receiving location for laboratory chemicals. Chemicals received by LANL in bulk would be stored and distributed as needed to other laboratories on site. This facility is grouped with other light laboratories because containers of laboratory chemicals would be opened in the facility to measure precise quantities for further distribution.

Of the projected layout of the proposed laboratory facilities, approximately 22 percent of the footprint would be within areas that are not currently disturbed. By planning area, the number and footprint of proposed laboratory facilities includes:

- Core Area – 9 (895,000 square feet),
- Pajarito Corridor – 9 (154,700 square feet),
- NEEWC – 4 (92,000 square feet),
- LANSCE – 4 (77,300 square feet), and
- Balance of Site – 1 (10,000 square feet).

Sanitary Effluent Reclamation Facility (SERF) expansion. NNSA proposes to renovate the existing SERF in TA-3 to increase the efficiency of blended water generation. The expansion would both increase the amount of available water (currently SERF only treats about 30 percent of the water that is provided to it), as well as reduce the concentrations of total dissolved solids and conductivity, allowing locations like the SCC to increase the cycles of concentrations for cooling purposes. Expansion activities would require some demolition and include the addition of portable reverse osmosis units and mixing basins within an expanded facility area of approximately 1,200 square feet. The existing water reuse tank (TA-3-0336) would be demolished and is included in totals presented in Table 3.3-3. The new tank would be larger than the existing tank (375,000–475,000 gallons) and be constructed east of the existing tank location or at another nearby location. Expansion of the SERF could more than double its capacity from 50 million gallons per year to being able to treat 120 million gallons per year (LANL 2024c). The proposed SERF expansion may include the development of a new, National Pollutant Distribution Elimination System (NPDES)-permitted outfall into Sandia Canyon downstream of current outfalls in TA-3 and upstream of the current wetlands in the canyon; however, the total discharge (when combined with the other TA-3 outfalls) would not be expected to notably change (*see* Appendix A, Figure A.3.3-1).

Radiography/Assembly Capability Replacement (RACR) project. This 70,000-square-foot project would modernize assembly, disassembly, and radiography capabilities to accommodate increasing workload and continue stockpile certification without the need for underground testing. This new project would be constructed in an area that is currently undeveloped and include a nondestructive testing laboratory with radiography areas, a device assembly area, an auxiliary assembly area, administrative support building, HE and parts storage areas, and site/supporting utilities. The RACR would consolidate the capabilities of more than seven existing separate facilities into one building located in TA-15. This facility would be a radiological facility and would also include an inventory of HE. Consolidating functions closer together would reduce the risks currently associated with driving HE and device assemblies around the site as the environmental test areas, dynamic experimental areas, and DARHT are all near each other. The Laboratory would also consider implementing the RACR capability through a series of smaller projects as opposed to one large project (LANL 2024c).

Consolidated Waste Facility (CWF). The Laboratory would construct and operate a CWF to effectively and compliantly manage LANL enduring mission regulated, hazardous and radioactive waste operations into a unified footprint or a combination of facilities. The facility(ies) would include modern capabilities that can operate safely, securely, and effectively into the foreseeable future. In December 2023, the Laboratory added the TA-60-0017 south building into the NMED-issued RCRA hazardous waste permit as a new waste management unit allowing storage of RCRA hazardous waste and MLLW on site for up to 1 year. TA-60-0017 south building is approximately 3,500 square feet and at fiscal year (FY) 2023 waste generation rates would not provide a long-term solution. While permitting TA-60-0017 south building added onsite storage time capability, it did not address the long-term projected waste generation and conceptual space requirements of a modern CWF. The selected CWF footprint would require assessment of existing facilities and/or vacant property throughout the LANL footprint and development of detailed programmatic and technical plans for the CWF. Consideration would include interim staging opportunities including cohabitating or sharing a building with existing scheduled activities. The project could utilize existing facilities but would also construct and operate approximately 8,000 square feet of Butler-type buildings for regulated, hazardous and radioactive waste storage. The proposal would also include about 28,500 square feet of covered storage space for transportainers, containers, and drums. In addition to the waste storage facility and storage areas, the CWF would include about 1,500 square feet of administrative space. The total footprint of the proposed CWF would be about 38,000 square feet. The CWF likely would be sited in TA-60, TA-54, or TA-36 (LANL 2024c).

Biomass generator. In accordance with the site-wide Wildfire Mitigation and Forest Health Plan (LANL 2019a), the Laboratory is actively implementing fuel reduction treatments wherein most treatment byproducts are mulched and deposited on site. The Laboratory has previously burned these byproducts in an air curtain destructor. Installation of a modular biomass energy generating system (biomass system) would utilize forest fuels cut down to reduce wildfire vulnerability at LANL by converting those forest fuels to energy. Removing byproducts from the fuels treatments reduces site vulnerabilities to wildfire by reducing fuel accumulation while also providing a renewable energy source. Biomass systems convert biomass waste (from fuel reduction treatments) into usable electricity through incineration in a controlled environment, as opposed to open burning. The biomass system could connect directly to the Laboratory power grid or use batteries or other type of energy storage technology, potentially offsetting 100 kW–1 MW of power generation needs. Forest fuel treatments are increasing across LANL's property, providing a consistent fuel. The typical biomass system would be modular and consist of modules for a firebox, cooling, and power generation. The combination of these modules for a 100kW unit would require a footprint of less than 600 square feet and could be moved to different locations across the site as fuel treatment projects progress. Operation of the biomass generator would be included as an element of the Laboratory air permit prior to use.

LANSCE Modernization Project (LAMP). The LAMP would replace the existing LANSCE accelerator Front End, consisting of the Cockcroft-Walton Injector and the Drift Tube LINAC, with modern equipment with similar operating characteristics in order to address LANSCE operational risks due to equipment obsolescence and single-point-of failure risks. The LAMP would also modernize the Proton Storage Ring. LAMP would decrease beam down time and increase the ability of the accelerator to perform closer to its design capacity.

The project would include the following elements: (1) design and test new technologies in appropriate test stands; (2) outfit the existing Building 53-0365 with a 4.5-mega electron-volt (MeV) radio-frequency quadruple accelerator coupled to a 18.3-MeV output energy drift tube LINAC accelerator; (3) procure, fabricate, assemble, install, and test the new front end in Building 53-0365; (4) decommission and remove old front end systems from LANSCE; (5) determine and implement facility interfaces to accept the new Front End; (6) install new Front End from Building 53-0365 to LANSCE; and (7) commission the new Front End at LANSCE and demonstrate its operability against performance criteria. The existing Proton Storage Ring is a risk to consistent and reliable beam delivery for material science and nuclear physics at the LANSCE Lujan Center.

The LAMP upgrades would be internal to existing facilities and would not increase the overall footprint of LANSCE or Building 53-0365. Once operational, the upgrades would affect baseline consumables (e.g., water use and electricity) and potential radiological emissions. The Laboratory estimates that the LAMP project would increase the operational availability of the accelerator by approximately 30 percent over its availability for the past few years. Therefore, this SWEIS assumes that water and electricity use for LANSCE could increase by approximately 30 percent over the current baseline if LAMP were implemented in the 2030 timeframe. In addition, radioactive air emissions from LANSCE would also be expected to increase by the same percentage.

Net-Zero Project. The Laboratory is taking proactive steps to harness and produce technology to drive down its carbon emissions. LANL's carbon footprint includes energy purchased from power plants that consume fossil fuels, as well as a much smaller footprint generated on site. Due in part to recent federal green energy directives, in early 2022, the Laboratory began phase one of a three-step plan to reduce its carbon emissions by 50 percent by 2030. By 2050, LANL hopes to reach net-zero emissions. In support of this effort, NNSA would need to decarbonize the LANL heating systems currently powered by fossil fuels. Generally, this would involve the conversion of natural gas-fired equipment to electric alternatives such as heat pumps. The project would encompass the entire site and would require work in nearly every building on campus. The first electrification projects began in 2023 and would likely continue for 15-20 years. Under the Net-Zero Project, the Laboratory could reduce fossil fuel heating use by more than 88 percent over the next 15 years. Opportunities to implement other projects that would support net-zero emissions would continue to be identified (LANL 2024c).

Electric vehicle (EV) charging stations. To support the growing battery electric and plug-in hybrid fleet required by the federal green energy directives, the Laboratory would install 500–1,000 EV charging stations across the site. These may be Level 1, 2, or 3 chargers[12] and locations would be selected based on fleet vehicle needs and available infrastructure. Some of these chargers would be centralized hubs with multiple stations and may require new or upgraded transformers and electrical conduit. Site-wide, up to 800 ports could be installed by 2035 (date when all new acquisitions are required to be Zero Emissions Vehicles). There could also be a charging hub for buses at TA-3 and a hydrogen fueling station (*see* below). The EV charging station construction likely would take 10–15 years to complete (LANL 2024c).

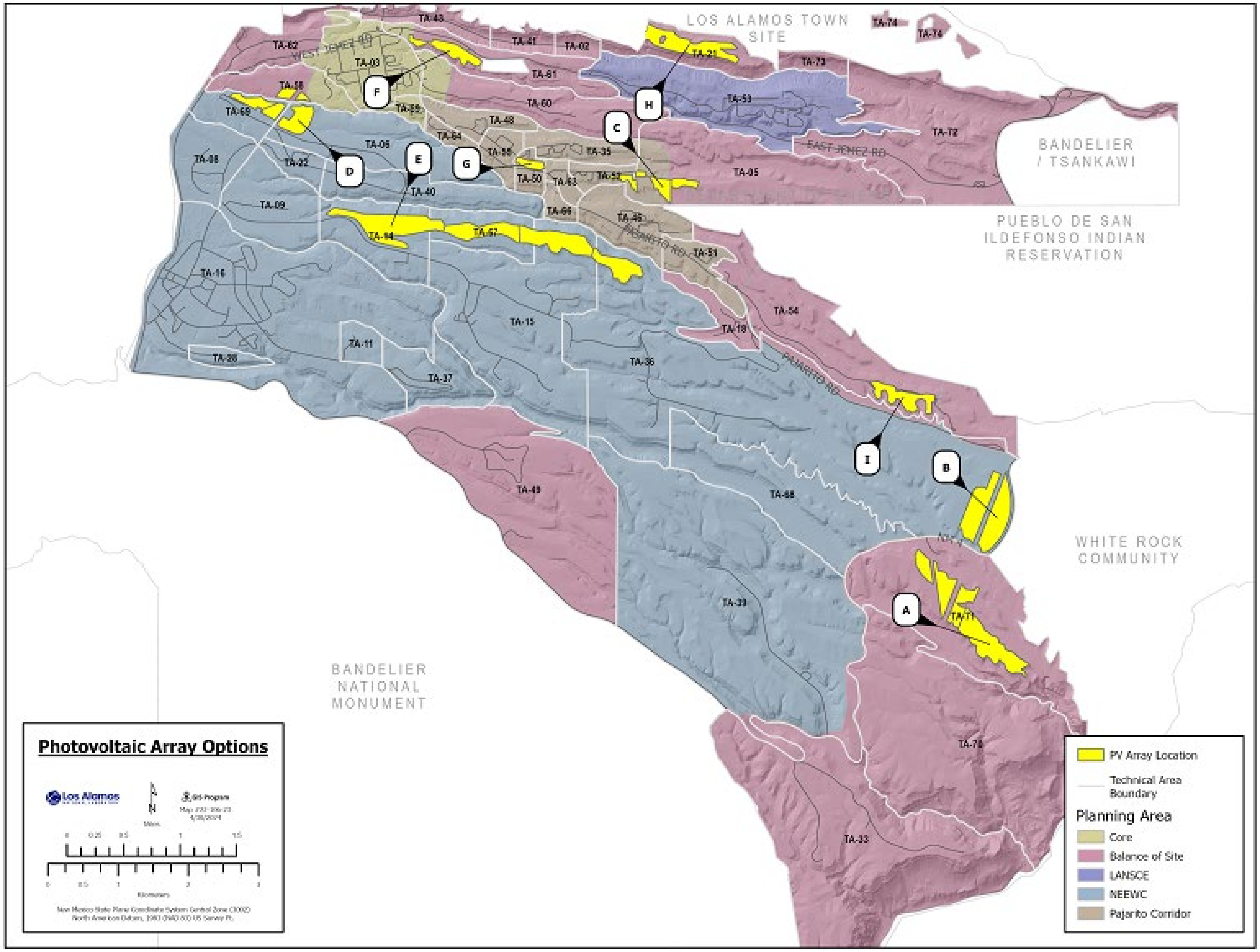
Solar PV arrays. NNSA is considering potential sites to install solar PV arrays to meet the projected demand at LANL in the coming years. Solar PV arrays across the site would not only help to meet the projected future LANL electric load but would also help satisfy the greenhouse gas emissions goal for federal facilities. Technology and equipment involved in meeting this goal could include but would not be limited to PV arrays, inverters, direct current and alternating current disconnects, transformers, combiner boxes, battery storage, and metering/control systems. Modifications to the current electrical infrastructure would include interconnection to the existing electric grid. Table 3.3-4 provides the estimated size (in acres) and the electricity generation capacities for each solar PV array site (LANL 2024c). Figure 3.3-1 identifies the preliminary locations of the nine solar PV array sites across LANL that are being considered. Sites could be as small as 11 acres and as large as 245 acres. The Laboratory has performed an initial evaluation of each of the potential array sites for opportunities and constraints (e.g., amount of open, flat land with good accessibility versus proximity to sensitive cultural or ecological resources) to develop a weighted prioritization for comparison. Based on the initial evaluation, Sites C, D, E, and F would be the most likely choices for implementation (these sites represent about 50 percent of the proposed land area). This SWEIS evaluates the potential impacts associated with implementation of all nine array sites (up to 795 acres), although the Laboratory would evaluate the feasibility of each site separately prior to implementation. Although the sites included below were initially evaluated, it is unlikely that all the sites and their acreage would be available for PV arrays. Of the 795 acres that make up the nine array sites, 641 acres are currently undeveloped.

Table 3.3-4 Size and Electrical Generation Capacity for Solar PV Array Sites

Site	Size (acres)	Electric Generating Capacity (MW)
A	151	30.2
B	117	23.6
C	37	7.4
D	72	14.4
E	247	49
F	33	6.6
G	11	2.2
H	86	17.2
I	41	8.2
TOTALS	**795**	**158.8**

MW = megawatts; PV = photovoltaic

[12] Information about the variety of EV chargers can be found at https://www.transportation.gov/rural/ev/toolkit/ev-basics/charging-speeds



Source: LANL (2024c)

Figure 3.3-1 Solar PV Array Location Options

WETF modernization. The WETF is a HC-2 nuclear facility that supports weapons engineering operations. The building is approximately 30 years old and because of its age and condition, there are a number of smaller maintenance activities planned to ensure that the facility supports the program for decades to come. WETF would have a new uninterruptable power system installed in about 2025 and many of the original gloveboxes would be replaced before 2030. Additionally, installation of other equipment and systems within WETF is necessary to support mission work. New systems/equipment would consist of in-kind replacements of removed legacy systems, and new equipment/systems would be similar to those being replaced and would not result in changes in the processes or capabilities currently conducted at WETF.

Site-wide utility infrastructure. Across the LANL site, the Laboratory would relocate, install, or upgrade water tanks, natural gas lines, electrical infrastructure (transmission and distribution), potable and fire water lines, underground duct banks, sanitary sewer infrastructure, and telecommunications systems. These infrastructure projects would generally be conducted in previously disturbed areas of the LANL site. A brief description and examples of these infrastructure projects include:

- <u>Water tanks</u> – LANL's site-wide water distribution system supplies both domestic and fire-protection requirements and the system distributes approximately 270 million gallons of water per year. The Laboratory has 16 distribution water tanks that provide storage of water at the high points and at intermediate storage points within the system. Upgrade projects are planned for water tanks in TA-14, TA-16, TA-59, TA-64, and TA-69. Upgrades could include raising the tanks to increase the necessary downstream water pressure.
- <u>Natural gas lines</u> – The Laboratory operates a system of natural gas–distribution pipelines, pressure-regulating stations, and meters. The Laboratory would replace much of the older natural gas pipelines. Multiple new lines would be installed or rerouted across the site to support planned new facilities and improve redundancy. For example, a new loop would be constructed in anticipation of growth at TA-16, and a new line would also be constructed on Two-Mile Mesa to serve facilities planned at TA-6, TA-22 and TA-40. Another new 4-inch gas line would serve facilities in the Core Area. The Pajarito Corridor Planning Area has a planned natural gas line upgrade in TA-46/50.
- <u>Electrical</u> – In addition to the proposed EPCU project, there are several electrical upgrade projects proposed under the Modernized Operations Alternative. These include overhead power line extensions or relocations and circuit upgrades to support proposed new facilities or to upgrade or replace the existing electrical transmission and distribution infrastructure. Examples of the upgrades include a new circuit from the Eastern Technical Area (ETA) Substation to feed facilities in the Pajarito Corridor (TA-50, TA-52, TA-63, and TA-66), another new circuit from the WTA for other facilities (TA-48, TA-55, and TA-64), and a line to connect these two circuits to provide maintenance flexibility and service reliability.
- <u>Water lines</u> – Many of the proposed upgrades to potable and fire water lines would install new pipes to replace the existing cast iron pipes and in many cases, increase the capacity of the lines. For example, the existing 6-inch water line from TA-16 to TA-33 along West Jemez Road and NM-4 was installed in 1962 and is currently undersized to meet future growth requirements at TA-33. Another planned water line project in the TA-3 area would replace approximately 2,300 feet of cast iron pipe installed in 1950 with a larger pipe, which will improve flow capacity. This section of pipe is some of the oldest at LANL.

- Underground duct banks – LANL uses a combination of direct-buried, aerial, and underground duct bank systems to provide electrical distribution and communications services across the Laboratory. Communications infrastructure and cabling continues to expand to meet mission requirements for new and existing facilities. As new fiber is extended into existing buildings, older fiber cables are removed, recovering additional duct space for future cable placements. The Laboratory would extend or upgrade existing duct banks to support new facilities proposed under the Modernized Operations Alternative.
- Sanitary sewer system – In addition to replacing the SWWS in TA-46, the Laboratory has identified other potential sewer system relocations, upgrades, and installations. For example, the gravity and force main lines between TA-6 and TA-22 would be upgraded and to include a new lift station. Facilities in TA-46 that support SWWS would also benefit from upgrades. Additional sewer upgrades are also proposed in TAs-15, -33, -40, -48, and -52.
- Telecommunications – In addition to the second fiber optic line, examples of upgrades to telecommunications systems include those proposed in the CMP for the NEEWC Planning Area on Two-Mile Mesa and in TA-53. The Pajarito Corridor Planning Area has installations proposed in TAs-46, -48, -50, -51, -52, and -64.

Los Alamos Canyon Bridge replacement. The Los Alamos Canyon Bridge, sometimes referred to as the Omega Bridge, was built in 1951 and provides access to the Laboratory from the town of Los Alamos on Diamond Drive. Because of aging and normal wear, the bridge will need to be replaced. Planning and engineering studies are ongoing, and actual replacement would be anticipated to start in the late 2030s. The proposed location for the bridge would align with a new entryway to the Laboratory and with a location in TA-43 on the north side of the canyon (Figure 3.3-2). Construction of the new bridge would also require the reconfiguration of the intersection with West Road and Diamond Drive. During the construction of the new bridge, other improvements to West Road would also be necessary to accommodate vehicle traffic to the Laboratory. These improvements would address three curves to accommodate large vehicles and allow an increase in design speed. The Laboratory would install a temporary vehicle access portal near the intersection of West Road and West Jemez Road.

The new bridge would have an average daily traffic (ADT) capacity of 20,000 vehicles per day, including large trucks hauling freight, tankers, and fire trucks. The bridge would also accommodate pedestrians and bicycles in both directions. The existing bridge would remain in place through 2038 and would be expected to continue to provide access for pedestrian and bicycle traffic.

There is no preliminary design for the replacement bridge at this time; however, NNSA anticipates that the general design configuration of the bridge would be similar to that of the existing arch-type bridge. The estimated construction footprint of 10.5 acres would include large flat areas on either end of the proposed bridge and an area under the bridge that would be disturbed to construct the columns on both sides of the canyon. It would also include a 1-acre construction laydown area that would become a parking lot. The existing Health Research Laboratory in TA-43 would need to undergo DD&D prior to initiation of bridge construction.

The proposed bridge replacement would be implemented in parallel with other transportation projects as discussed below to ensure a coordinated design and continued availability of access to the site from the town of Los Alamos.

Figure 3.3-2 Los Alamos Canyon Bridge Replacement

TA-72 remote parking and transfer bus station. The TA-3 Transit Center serves as the primary LANL and Los Alamos County transportation hub serving commuters transferring to and from regional park-and-ride and other offsite commuting options. The TA-3 Transit Center is already at capacity and has limited area for expansion. In order to mitigate ongoing onsite parking and traffic issues, the Laboratory is in the early stages of planning a remote parking lot and bus transfer hub in TA-72 at the entrance to LANL. The planning would consider stormwater, environmental, cultural, traffic, site constructability, and existing infrastructure during its evolving design. The proposed transfer hub would serve passenger cars, park-and-ride shuttle buses, and public and LANL transit buses. Passenger vehicle parking would be restricted to LANL bound travelers. The facility would include area lighting, public restrooms, and potentially require security cameras. The transfer hub would need access to power, water, and sewer.

The conceptual design includes a single vehicular entrance with a single transfer station/bus depot centrally located between two parking lots. The bus depot would have 15 to 20 bus hub terminals where large buses would load and unload commuters. This central area would serve the typical bus sizes that currently service surrounding communities such as Española, Santa Fe, and Taos. This central area would be surrounded by an outer single one-way road where a minimum of 10 smaller buses could be parked at any given time. This area would be intended to serve the Los Alamos, White Rock and LANL bound transfer buses. The conceptual design would not be expected to require modifications to the NM-4 and East Jemez Road intersection or the additional of any traffic signals, however, that conclusion would be made through consultation with the New Mexico Department of Transportation.

The proposed transfer hub would provide parking spaces for 2,000 passenger cars in addition to the bus transfer service and parking. The initial estimate of the proposed footprint is about 25 acres, of which approximately 90 percent is currently undeveloped.

Institutional laydown areas. As a result of the construction and DD&D activities planned under the Modernized Operations Alternative, the Laboratory would require the use of several potential institutional laydown and construction support areas. The laydown areas that could be implemented under the Modernized Operations Alternative would be in addition to those constructed under the

No-Action Alternative and mostly be centrally located on the site but some areas would also be dispersed across the site. There is more uncertainty for the precise location of the institutional laydown areas for the Modernized Operations Alternative than for those proposed under the No-Action Alternative. The tentative siting of these laydown areas would: (1) provide consolidated laydown areas that could support multiple projects over multiple years; (2) minimize the need for excess laydown areas in TAs and minimize construction costs; (3) minimize potential environmental impacts by collocating construction activities; and (4) provide separation between the necessary laydown areas and densely populated TAs to minimize impacts to ongoing operations and improve safety. As shown in Table 3.3-5, the initial planning has identified 13 potential laydown areas that could be developed under the Modernized Operations Alternative that would have a combined footprint of about 38 acres (about 3.9 acres in Balance of Site, 19 acres in the Pajarito Corridor Planning Area, 12.7 acres in NEEWC, and 2.5 acres in LANSCE). About one-half of the affected land is currently undeveloped. As the Laboratory determines that individual laydown areas are no longer necessary, the areas would be remediated and returned to their original condition. Because these potential institutional laydown areas are in the early stages of planning, the potential locations and sizes would continue to be reviewed to consider environmental constraints (e.g., cultural sites, ecological habitat, and Consent Order sites).

Table 3.3-5 Modernized Operations Alternative – Institutional Laydown Areas

Laydown and Construction Area	Currently Developed (acres)	Currently Undeveloped (acres)	Total Area
TA-05-LDA-01	0.4	2.5	2.9
TA-06-LDA-01	0.3	1.1	1.4
TA-09-LDA-01	0.3	1.8	2.1
TA-15-LDA-01	2.7	0.7	3.4
TA-15-LDA-02	0.9	0	0.9
TA-16-LDA-01	1.7	0.1	1.8
TA-16-LDA-02	1.3	0	1.3
TA-33-LDA-01	0.2	0.8	1.0
TA-52-LDA-02	3.4	6.7	10.1
TA-53-LDA-01	0.1	2.4	2.5
TA-63-LDA-01	0.7	0.1	0.8
TA-63-LDA-03	6.0	2.1	8.1
TOTALS	**19.5**	**18.5**	**38.0**

Source: LANL (2024c)

Site-wide transportation projects and parking. NNSA would construct approximately 41 acres of roadway projects under the Modernized Operations Alternative. In addition, approximately 13 acres of new parking lots would be constructed, mostly associated with new facilities identified in Table 3.3-1. These 13 acres of parking areas would be in addition to the nearly 14 acres of parking structures identified in Table 3.3-1 and the TA-72 remote parking area discussed above. Of these transportation and parking projects, approximately 69 percent would be within an existing disturbed area (e.g., existing road ROW or location of previous development). Key site-wide transportation projects under the Modernized Operations Alternative include the following (LANL 2021b):

- Reconstruct the Laboratory's main entrance area transportation facilities at the northeast corner of the main campus, including the following elements:
  - Redesign and reorientation of the vehicle access portal lanes and badge-verification facilities to streamline access while providing required levels of security and capacity;
  - Widen Diamond Drive in TA-3 to improve traffic operations for all intersections on Diamond Drive to accommodate forecast traffic growth in that corridor;
  - Construct a new roadway around the south side of the vehicle access portal and transit center area to facilitate efficient outflow traffic flow and reduce late afternoon peak traffic congestion; and
  - Redesign and reconstruction of the Transit Center in TA-3 to increase capacity for commuter vehicle parking and bus service, to support efficient bus flows, and to ensure the safety of pedestrians.
- Upgrade the existing TA-54 East Road to support eventual closure of TA-54. The upgrade would be necessary to allow access by semi-tractor trailers, tri-axle dump trucks, and emergency vehicles from Pajarito Road to the domes at the top of the plateau. The upgrade would include widening of the existing road, modification of the intersection with Pajarito Road, and the expansion of parking in TA-54. Between the road improvements and the parking, the upgrade would involve less than 2 acres of previously disturbed land.
- Upgrade key intersections and provide limited vehicular access points from Pajarito Road to maintain peak traffic flow and provide safe access.
- Make key intersection improvements on Pajarito Road to reduce traffic congestion during the critical commuting hours. Additional improvements to keep traffic moving include signal synchronization and a reduced speed limit of 35 miles per hour throughout the corridor.
- Make upgrades to the TA-40 Bypass Road to provide direct/internal access to proposed buildings through Two-Mile Mesa Road and TD Site Road and improve overall mobility and safe connectivity to facilities within TA-22 and TA-40.
- Make upgrades to TA-16 Castle Road to improve access from West Jemez Road to the new fire station and improve access for emergency vehicles from the fire station to TA-16. An automated vehicle entry gate would be added at TA-16.
- Upgrade the TA-72 north entrance, including a guardhouse.
- Upgrade pedestrian and bicycle facilities across the site to meet *Americans with Disabilities Act* access criteria and to improve overall mobility and safe connectivity to facilities.

3.3.2 Decontamination, Decommissioning, and Demolition Projects

A total of 156 facilities, with a total footprint of about 1,216,000 square feet, would undergo DD&D under the Modernized Operations Alternative (in addition to the facilities planned for DD&D under the No-Action Alternative). The list of facilities is included in Appendix E. Many of these facilities would be uncontaminated warehouses, office buildings, sheds, trailers, and support buildings. In terms of size, the two most notable facilities that would undergo DD&D would be the Health Research Laboratory in TA-43 (approximately 115,000 square feet) and the Central Computing Facility in TA-3 (approximately 104,000 square feet). All other facilities that would undergo DD&D are less than 50,000 square feet in size.

As noted in Section 3.2.2 and based on available information regarding the facilities proposed for DD&D under the Modernized Operations Alternative (LANL 2024c):

- There are 29 facilities that are radiologically contaminated (about 390,000 square feet, 33 percent of the total footprint);
- There are 21 facilities that are chemically contaminated (about 313,000 square feet, 26 percent of the total footprint);
- There are 26 facilities that have some level of asbestos contamination (about 322,000 square feet, 26 percent of the total footprint); and
- There are 68 facilities that do not contain contamination, which represents 15 percent of the total footprint proposed for DD&D.

3.3.3 Notable Attributes

This section identifies notable attributes associated with the Modernized Operations Alternative. As shown on Table 3.3-6, there would be a net increase in facility square footage at LANL under the Modernized Operations Alternative, as construction actions would exceed DD&D actions. The net effect would be an increase in facilities of over 2.2 million square feet at LANL in addition to that identified for the No-Action Alternative. Most new facility construction would occur in the Core and Pajarito Corridor planning areas. Of the new facilities that would be constructed, about 78 percent (over 2.6 million square feet) would be associated with storage warehouses, office buildings, light laboratory/office facilities, and parking structures. In addition to the construction footprint in Table 3.3-6 for new facilities, there are proposed utility and infrastructure projects, which include solar PV arrays (a footprint of up to 795 acres), a remote parking area in TA-72 (25 acres), institutional laydown areas (38 acres), Los Alamos Canyon Bridge replacement (11.5 acres), and other site-wide roads and parking (54 acres).

Table 3.3-6 Modernized Operations Alternative – Summary of Construction and DD&D

CMP Planning Area	Construction Footprint (ft^2)[a]	Upgrade/Utility/ Infrastructure Footprint[a] (acres)	DD&D Footprint (ft^2)
Core Area	1,448,500	24.6[b]	544,400
Pajarito Corridor	847,600	82.8[c]	329,900
NEEWC	518,800	463[d]	122,400
LANSCE	184,600	8.5[e]	79,100
Balance of Site	431,000	349[f]	140,000
TOTALS	**3,430,500 (79 acres)**	**up to 928 acres**	**1,216,000 (27.9 acres)**

DD&D = decontamination, decommissioning, and demolition; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex

a Utilities and infrastructure project facilities in Table 3.3-2 are reflected in the planning area totals (25,000 ft^2 in Core, 17,000 ft^2 in NEEWC, 20,000 ft^2 in Pajarito Corridor, 106,000 ft^2 in LANSCE, and 20,000 ft^2 in Balance of Site).

b This value for Core Area Planning Area includes 11.5 acres associated with the bridge replacement across Los Alamos Canyon and 12.5 acres of transportation-related projects.

c This value for Pajarito Corridor Planning Area includes about 19 acres of institutional laydown areas, 48 acres of solar projects, and 15.3 acres of transportation-related projects.

d This value for NEEWC Planning Area includes 12.7 acres of institutional laydown areas, 436 acres of solar projects, and 13.8 acres of transportation-related projects.

e This value for the LANSCE Planning Area includes about 2.5 acres of institutional laydown areas and 3.5 acres of transportation-related projects.

f This value for Balance of Site includes 3.9 acres of institutional laydown areas, 311 acres of solar projects, 8.5 acres of transportation-related projects, and 25 acres for parking facilities proposed for TA-72.

Because most of the new facilities are replacements for existing facilities, operations associated with the Modernized Operations Alternative would be similar to existing operations at LANL. In most cases, there would not be notable changes in infrastructure requirements, effluents, or hazards at LANL. Depending on the degree of implementation of the Net-Zero Project and the solar PV arrays, there could be an overall decrease in the electricity use and air emissions associated with the Modernized Operations Alternative. With implementation of the LAMP, there would be increases in consumables (e.g., water and electricity) and potential radiological air emissions. There would be an increase in wastes associated with DD&D activities. The DD&D wastes would include construction debris, radioactive wastes (LLW and MLLW), and hazardous wastes (including asbestos-contaminated wastes). These analytical parameters are included in Appendix A, Table A.3.5-2 and Chapter 5 of this SWEIS presents the potential environmental impacts.

3.4 Expanded Operations Alternative

The Expanded Operations Alternative includes the actions proposed under the Modernized Operations Alternative, as described above, plus actions that would expand operations and missions to respond to future national security challenges and meet increasing requirements. This alternative includes construction and operation of new facilities that would expand capabilities at LANL beyond those that currently exist. For example, under the Expanded Operations Alternative NNSA is proposing to construct and operate an additional supercomputing complex that would enable NNSA to expand the capabilities of that program. The schedule for implementation of these projects would include the same constraints as identified in Section 3.3. Table 3.4-1 identifies proposed new facilities that are unique to the Expanded Operations Alternative (not included in the Modernized Operations Alternative). Table 3.4-2 identifies proposed utility and infrastructure projects unique to this alternative. Appendix A, Figures A.3.4-2–A.3.4-6 provide maps for locating these proposed new facilities within each planning area at LANL.[13] Construction and operational parameters associated with the Expanded Operations Alternative are presented in Appendix A, Tables A.3.5-1 and A.3.5-2 (*see* Section 3.5).

3.4.1 New Facilities and Utility/Infrastructure Projects

As shown on Table 3.4-1, 18 new projects, totaling about 926,500 square feet (21.3 acres), would be constructed under the Expanded Operations Alternative (in addition to the Modernized Operations Alternative projects). There are projects supporting the Stockpile Stewardship/Weapons Program; Global Security; Science, Technology, and Engineering; and Mission-Enabling Operations. There are no additional proposals related to the EM Remediation Mission and the remediation actions described in Section 3.2.1 would continue under the Expanded Operations Alternative. There are also no additional DD&D actions associated with the Expanded Operations Alternative. As shown in Table 3.4-2, there are 4 utility/infrastructure projects proposed under the Expanded Operations Alternative, which represent about 8,000 square feet for a proposed cooling tower addition and about 46 acres of other projects (pumped hydropower and roads and parking). Brief descriptions of the notable proposed facilities and utility/infrastructure projects for the Expanded Operations Alternative are presented below (see also Appendix A, Section A.3.4.1 for additional information).

[13] Figures 3.4-1–3.4-5 can be used to find the approximate location of new facilities for the Expanded Operations Alternative using the grid coordinates provided in Tables 3.4-1 and 3.4-2. The Map ID numbers are used in the figures to indicate the proposed location of the projects.

Table 3.4-1 Expanded Operations Alternative – New Facilities

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2) Facility Type	Year	NNSA Capability[d]	Description
1	**Low-Enriched Uranium Fuel Fabrication Facility**	C-1 (3)	Within an existing facility	2027	Science, Technology, and Engineering	See description in Section 3.4.1.
2	**Future Supercomputing Infrastructure/High-Performance Computing mission expansion**	B-1 (4)	125,000	2029–2031	Stockpile Stewardship/ Weapons	See description in Section 3.4.1.
3	**Future Supercomputing Infrastructure Water Treatment Facility**	B-1 (4)	5,000[e]	2029	Mission-Enabling Operations	See description in Section 3.4.1.
4	Indoor Firing Site	D-3 (4)	6,800	2030	Stockpile Stewardship/ Weapons	Install a new indoor firing facility in a mostly undeveloped area in TA-36 (or possibly at TA-15) dedicated to HE firing operations. This facility would not replace any of the existing firing sites at LANL and therefore would expand the overall large-scale firing capacity for the Laboratory. The amount of HE during firing operations would be limited to 20–25 pounds.
5	Formulation Additive Manufacturing Explosive	B-1 (4)	8,000	2033	Stockpile Stewardship/ Weapons	Constructed in a currently undeveloped area in TA-9 (or possibly TA-6), the facility would include several bays dedicated to additive manufacturing of energetic materials, mid- to large-scale mixing, roll milling, explosive production, vacuum thermal forming, melt casting, and similar advance manufacturing techniques. The facility would integrate work currently conducted within Buildings 38 and 42 at TA-9. This capability would provide expansion for overall operations and would supplement the existing capabilities. The HE limit in the facility would be approximately 245 pounds.
6	TA-40 Performance Oriented Weapons Explosives Research (POWER) Bomb Proof Facility	B-2 (4)	7,000	2036	Stockpile Stewardship/ Weapons	POWER would be an indoor firing facility constructed in an undeveloped area at TA-40. The facility would support indoor intentional detonations regardless of external environmental factors. Similar to the other indoor firing site described above, POWER would not replace any of the existing firing sites at LANL and therefore would expand the overall firing capacity. The HE limit in the facility

Map ID #	Name[a,b]	Grid Location[c]	Size (ft^2) Facility Type	Year	NNSA Capability[d]	Description
						would be approximately 155 pounds. The amount of HE used during firing operations would be limited to 20–25 pounds; however, the average shot would include about 10 pounds of HE. The impact estimates for POWER are based on the expectation of about 100 annual detonations.
7	**Dynamic Mesoscale Materials Science Capability**	TA-53 (5)	192,000	2034–2038	Science, Technology, and Engineering	See description in Section 3.4.1.
8	**LANSCE enhancements**	D-2 (5)	Within existing facilities	2030–2035	Science, Technology, and Engineering	See description in Section 3.4.1.
9	**Microreactor**	D-3 (2) or C-2 (5)	10,000	2035	Mission-Enabling Operations	See description in Section 3.4.1.
10	**Surplus plutonium disposition**	various	221,700	2028[f]	Global Security	See description in Section 3.4.1.
11	**HE Modernized Manufacturing Facility**	C-2 (4)	12,000	By 2038	Stockpile Stewardship/ Weapons	See description in Section 3.4.1.
12	**BSL-3 facility at TA-51**	E-3 (3)	5,000	2028	Global Security	See description in Section 3.4.1.
13	Advanced Separations of Plutonium Radiological Laboratory	E-2 (5)	5,000	2025	Stockpile Stewardship/ Weapons	Construct and operate a modular laboratory that would process radiological materials and hazardous chemicals to support the current Advanced Separations of Plutonium project. The project would be a radiological facility (less than HC-3) in a developed area in TA-53. The space would accommodate wet chemistry as well as solids handling and would include chemical fume hoods. The modular laboratory would require connections to existing utilities, including potable water, sanitary sewer, electrical (480 volts minimum), natural gas, and communications. The Laboratory would also connect the new facility to the existing radioactive liquid waste lines to manage liquid effluents.
14	**Environmental Test Facility**	B-1 (3)	1,000	2027	Stockpile Stewardship/ Weapons	See description in Section 3.4.1.
15	**Open burn/open detonation waste treatment facility**	B-2 (4)	1,000	2030	Stockpile Stewardship/ Weapons	See description in Section 3.4.1.

Map ID #	Name[a,b]	Grid Location[c]	Size (ft²) Facility Type	Year	NNSA Capability[d]	Description
16	**TRU waste staging**	B-2 (3) A-3 (4) B-1 (6) D-2 (6)	240,000	2030	Stockpile Stewardship/ Weapons	See description in Section 3.4.1.
17	Firing site expansion	TA-33	0	2027	Global Security	NNSA proposes two options to increase the outdoor firing site capacity for the Global Security Program. Both options are addressed as separate proposals under the Expanded Operations Alternative; however, NNSA does not anticipate implementing both options. The first option would entail increasing the current HE limit for shots at firing point 88 in TA-33. The current HE limit for shots at this firing point is 1 pound. Under this expansion, the Laboratory proposes to increase the HE limit to 200 pounds. The firing site expansion would be operated in accordance with the DOE Explosives Safety Standard (DOE-STD-1212-2019) and would include an Explosive Safety Site Plan, which would establish HE mass limits and limits on the number of personnel that can be in the facility or area to manage the risks of an accident.
18	TA-68 firing site	D-3 (4)	87,000	2027	Global Security	As an option to the TA-33 Firing Site expansion discussed directly above, NNSA would include the development of a new firing site at Water Canyon in TA-68. The new firing site would require the development of approximately 2 acres of currently undeveloped land in Water Canyon to facilitate shots involving up to 200 pounds of HE. Like the TA-33 expansion, the new firing site in TA-68 would be operated in accordance with DOE-STD-1212.
TOTAL			**926,600**			

BSL = biosafety level; HC = hazard classification; HE = high explosives; LANSCE = Los Alamos Neutron Science Center; POWER = Performance Oriented Weapons Explosives Research; TA = technical area; TRU = transuranic waste

a Throughout this SWEIS, NNSA acknowledges that facility names are subject to change in the future.

b **Bolded** projects in this table and Table 3.4-2 are described in Section 3.4.1 and/or Appendix A, Section A.3.4.1.

c In general, for each new facility at LANL, alphabetical-numerical grid coordinates are provided to aid in locating the facility on Figures A.3.4-2–A.3.4-6 in Appendix A. The figure number is provided in parentheses (e.g., Figure A.3.4-2 is referred to as (2)).

d NNSA capabilities as defined in Chapter 2.

e In addition to the 5,000 square foot facility footprint, approximately 27.5 acres could temporarily be disturbed for construction of the facility, the non-potable water inlet pipeline, the return pipeline to the SERF, and the discharge pipeline to the proposed outfall. These temporary construction areas would be restored after construction. Of the 27.5 acres, about 7.7 acres are currently undeveloped.

f See the discussion in Section 3.4.1 regarding the announced delay in implementation of this program.

Source: LANL (2024c)

Table 3.4-2 Utility/Infrastructure Projects – Expanded Operations Alternative

Map ID #	Name[a,b]	Site; Grid Location[c]	Size (ft^2)/ Facility Type	Year	NNSA Capability[d]	Description
19	Cooling tower addition to support Dynamic Mesoscale Materials Science Capability (DMMSC)	B-2 (5) C-2 (5)	8,000	2029	Science, Technology, and Engineering	If the DMMSC project were implemented as part of the Expanded Operations Alternative, NNSA would also require an increased capacity for cooling water beyond the current baseline. The proposal for added cooling towers includes two locations of four cooling towers each (a total of eight additional cooling towers) located near the DMMSC facilities. The additional estimated cooling water demand from DMMSC and the LANSCE enhancements discussed above would be about 150 million gallons a year. These cooling towers would tie in to and utilize the LANSCE Water Treatment Facility, which is a project proposed under the Modernized Operations Alternative (see Section 3.3.1).
20	**Pumped hydropower**	C-3 (6)	20 acres	2026	Science, Technology, and Engineering	See description in Section 3.4.1.
21	Utility line burial	Site-wide	Case by case	By 2038	Mission-Enabling Operations	As part of the wildfire risk reduction efforts, NNSA would systematically consider burial of existing or new utility lines (e.g., electric, telecommunications) to mitigate the potential for damage during natural phenomena events (i.e., severe weather or wildfire). Utility line burial would typically use underground duct banks, as described in Section 3.3.1. While burial of utility lines has the mitigative benefits discussed above, the resultant land disturbance must be considered on a case-by-case basis to ensure that sensitive resources (i.e., cultural site or sensitive ecological habitat) are not impacted. There are no current defined locations proposed for utility line burial.
22	**Site-wide transportation projects and parking**	Site-wide	20 acres of roads; 6 acres of parking	By 2038	Mission-Enabling Operations	See description in Section 3.4.1.
TOTAL			**~46 acres**			

DMMSC = Dynamic Mesoscale Materials Science Capability; LANSCE = Los Alamos Neutron Science Center

a This list comprises standalone utility and transportation projects. Utility projects that support the new facilities listed in Table 3.4-1 would be implemented with those projects.

b **Bolded** projects in this table and Table 3.4-1 are described in Section 3.4.1 and/or Appendix A, Section A.3.4.1.

c In general, for each new facility at LANL, alphabetical-numerical grid coordinates are provided to aid in locating the facility on Figures A.3.4-2–A.3.4-6 in Appendix A. The figure number is provided in parentheses (e.g., Figure A.3.4-2 is referred to as (2)).

d NNSA capabilities as defined in Chapter 2.

Source: LANL (2024c)

Low-Enriched Uranium Fuel Fabrication Facility (LEFFF). The LEFFF would fabricate high-assay low-enriched uranium (HALEU) fuels at the scale of hundreds of kilograms per year. The facility would provide fuel (including both depleted and enriched uranium-based material systems) in quantities significantly above the capacity of LANL's current ceramic fuel capabilities. In addition to uranium nitride fuel, the facility could develop metallic, oxide, silicide, and composite fuels. LEFFF is proposed to serve as the fuel fabrication facility to support technology demonstration needs, and the fuel fabrication campaigns would be limited in nature for each customer.

The baseline design for the facility would have a facility limit of 896 grams of uranium 235 (U-235) or 4.5 kilograms of HALEU (19.9 percent enriched U-235). Increased facility limits for U-235 likely would be evaluated in the future. This future expansion could increase the facility limit to about 4.0 kilograms of U-235 or an estimated 30 kilograms of HALEU (19.9 percent enriched U-235). This increased facility limit would enable this facility to produce approximately 200 kilograms of 19.75 percent enriched U-235 fuel per year or approximately 200 kilograms of depleted uranium fuel. The LEFFF would be installed in multiple existing buildings in TA-35, which are being cleared. The LEFFF would repurpose rooms within the buildings. LEFFF would be a radiological facility and would be an expansion of work currently performed at LANL. Once operational, the LEFFF is expected to require about 20 workers and would generate solid LLW and MLLW, which would be shipped offsite for disposal. Any liquid radioactive waste would be expected to meet the waste acceptance criteria and be treated at the RLWTF. The feedstock for the LEFFF would be obtained through a domestic supply, likely within the DOE Complex. The HALEU fuels produced by the facility would be shipped to DOE's Oak Ridge Reservation or to a customer's site, estimated at 20 shipments per month and 2 kilograms of fuel per shipment (LANL 2024c).

Future supercomputing infrastructure (FSI)/HPC mission expansion. The FSI/HPC mission expansion would include the construction of at least a 100,000-square-foot facility, a 25,000-square-foot staging facility, and parking lot in a currently undeveloped area in TA-6 adjacent to the WTA substation to provide new high sustainability facility systems for powering and cooling the ATS-7 or artificial intelligence supercomputers to replace or supplement the current HPC at the SCC. The facility would use evaporative cooling and could require up to 162 million gallons of cooling water per year. Of this amount of cooling water, approximately 100 million gallons of non-potable water (from Los Alamos County) and 62 million gallons of potable water would be required. An additional water treatment facility may be required to supply treated water for supercomputer cooling operations at the new facility (*see* below). The facility electrical demand is expected to be 60 megavolt-amperes (MVA) load by 2030, with a future demand of up to 100 MVA. Electrical service would be provided via the Reeves Line and Norton Line import transmission lines, expansion of the WTA substation, extension of a new onsite transmission line, and reconductor of two existing lines (LANL 2024c).

FSI Water Treatment Facility (FSI WTF) and associated water lines. To support the water-cooling needs of the FSI/HPC, LANL would construct a water treatment facility like the water treatment facility proposed under the Modernized Operations Alternative for LANSCE. The project would include the installation of three water pipelines as shown in Figure 3.4-1: (1) a water pipeline from a feasible location, such as the non-potable water hydrant in Los Alamos County within Los Alamos Canyon; (2) a discharge pipeline to recover blowdown water by sending it from the water treatment facility to the SERF facility in TA-3; and (3) a discharge pipeline to a new, NPDES-permitted outfall in Two-Mile Canyon. Additional details about this project are presented in Appendix A, Section A.3.4.1.

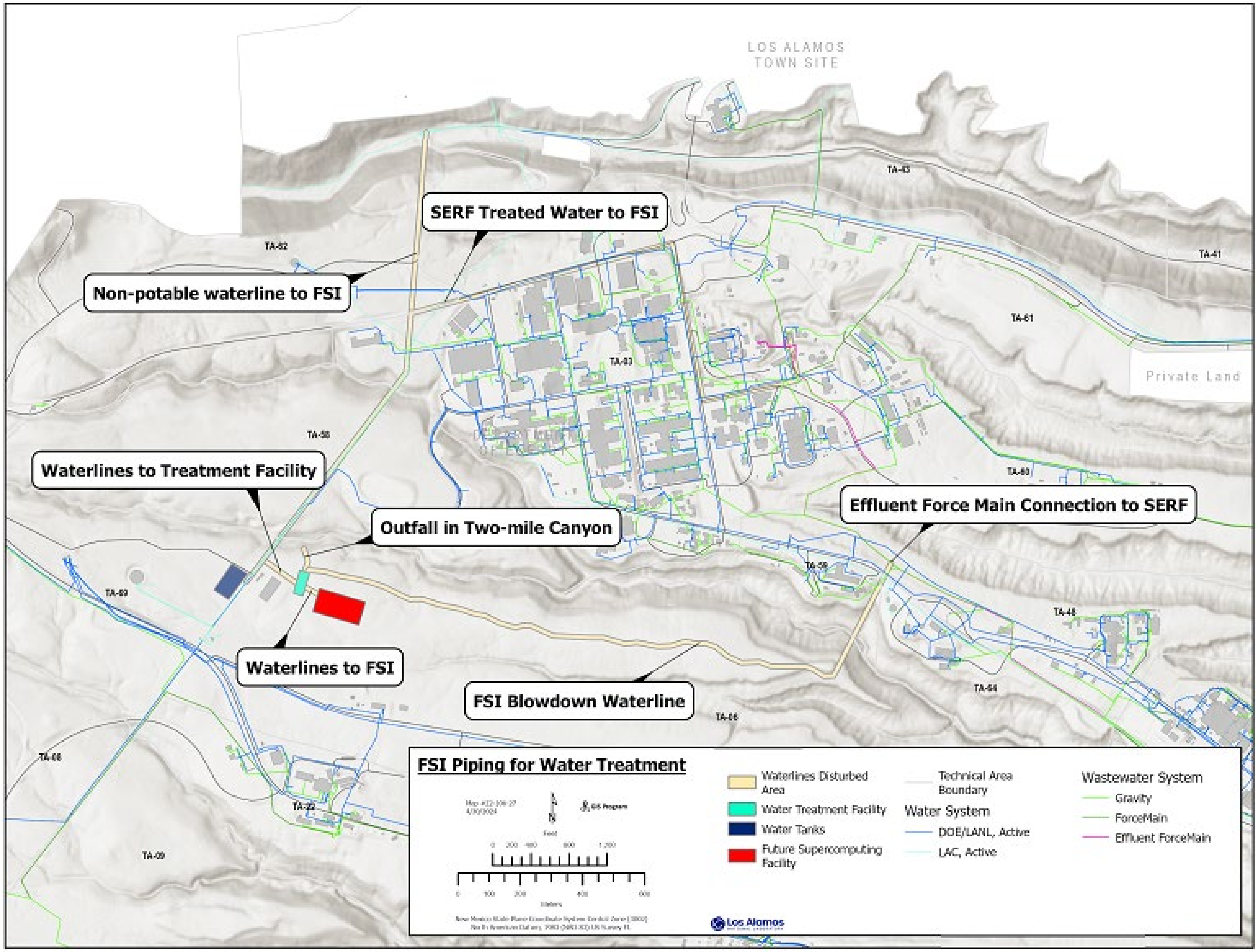


Figure 3.4-1 Proposed FSI WTF Water Pipeline Routes

Dynamic Mesoscale Materials Science Capability (DMMSC) Facility. The DMMSC (also referred to as the Matter Radiation Interactions in Extremes) would be a new x-ray-free electron laser facility focused on the control of performance and production of materials at the mesoscale.[14] It would also require high-energy protons for proton radiography. The DMMSC would fill a critical gap in materials data in length scale between the integral scale probed at both the DARHT and the U1a Complex (the underground laboratory at NNSS) and the atomic scale studied at Lawrence Livermore's National Ignition Facility and Sandia's Z-machine. Locating the DMMSC near the LANSCE would allow the facility to benefit from LANSCE's proton radiography capability that contributes extensively to resolving weapons issues as well as other accelerator infrastructure. The current LINAC at LANSCE is more than a half-mile in length and the beam tunnel is located 35 feet below grade to provide radiation protection. The DMMSC would have similar construction requirements and the facilities would encompass approximately 192,000 square feet, about 50 percent of which would be previously developed. This project would be classified as a radiological, beryllium, and nanoparticle accelerator facility.[15]

Operations of the DMMSC would be expected to generate radioactive air emissions, much like operations of the current LINAC at LANSCE. Because the Laboratory is in the early stages in design, the projected emissions are not yet available. Based on the similarity of the DMMSC to the existing LANSCE facilities, this SWEIS assumes that the annual air emissions would be about twice the five-year average released from the LINAC at LANSCE, or about 419 curies of activation products each year. These estimated emissions are included in Appendix A, Table A.3.5-2.

The overall project area required for construction of the DMMSC facilities in TA-53 would be approximately 44.5 acres, of which about 13 acres have previously been developed or disturbed. Construction of the facilities would be expected to last about 4 years. Once operational, DMMSC would employ approximately 150 workers in TA-53.

LANSCE enhancements. LANSCE has been operating for over 50 years and has a long and successful history of delivering high-impact science for NNSA missions. The Laboratory has outlined six key enhancements to be implemented within the next 15 years. These enhancements would be implemented within existing structures; therefore, the LANSCE enhancements would not increase the footprint at TA-53. Collectively, they would be expected to increase the LANSCE consumption of electricity and need for additional cooling water by approximately 20 percent. They would also potentially increase radioactive air emissions by about 20 percent above the five-year average from TA-53. The LANSCE enhancements are described in Appendix A, Section A.3.4.1.

Microreactor. Microreactors are factory manufactured, easily transported, and designed to produce up to 20 megawatts thermal (MWth) energy (approximately 1–5 MW of electrical power) for at least 3 years in full operation. This power limit allows microreactors to be classified as HC-2 nuclear facilities and would be evaluated in accordance with 10 CFR Part 830 and DOE-STD-1027. These reactors are decentralized energy sources that have the ability to provide sustainable and affordable heat and power to remote communities and to industrial users, while having self-contained geometry that requires very low maintenance. Microreactors are safe because they are self-regulating and do not rely on engineered systems to ensure safe shutdown and removal of decay heat. A typical microreactor would be fueled with uranium enriched with 19.75 percent U-235 (HALEU), similar to fuel that would be produced in the LEFFF described above (DOE 2021).

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[14] The mesoscale covers spatial dimensions bridging the nano- and macroscopic scales.

[15] Additional information about DMMSC can be found at https://science-innovation.lanl.gov/science-facilities/dmmsc/

A nuclear microreactor would arrive fully assembled, pre-fueled, and ready to connect to LANL's electric grid. Although the building size could vary (but is expected to be less than 10,000 square feet), the reactors are the size of a tractor trailer. Potential locations could be near the Sigma Building (TA-3-0066) or in TA-53 to support the LANSCE power needs. The microreactor may also be used to create thermal energy to serve the TA-3 steam system. Because the microreactors are prefabricated, onsite construction activities are expected to be minimal and are likely to last less than 12 months. Once operational, the microreactor system is a closed system and does not have any liquid or gaseous discharges into the environment during normal operation. The microreactor would generate approximately 2.72 cubic meters of LLW annually. Typically, microreactors are swapped-out when fuel is depleted in 5–10 years. NNSA expects that spent nuclear fuel could be managed in existing facilities in the DOE Complex (DOE 2021; LANL 2024c).

Implementation of the Surplus Plutonium Disposition Program. Chapter 2, Section 2.4.5 of this SWEIS describes the currently approved activities associated with the ARIES capability as related to SPDP. As identified in Chapter 1, Section 1.5, NNSA published the Final SPDP EIS on January 19, 2024 (89 FR 3644), which evaluated several sub-alternatives for implementing the proposal to dilute and dispose of 34 metric tons of surplus plutonium made up of both pit and non-pit plutonium. The ROD (89 FR 28763; April 19, 2024) selected the base approach of the preferred alternative for the SPDP, which is to use the dilute and dispose strategy. However, the ROD also described a replanning effort to revisit the initiation of the pit disassembly and processing project (part of SPDP supported by LANL) in approximately 10 years. When NNSA implements the pit disassembly and processing project at LANL, construction would occur in TA-52 and TA-55 and would consist of a warehouse, security structures, weather enclosure, parking and road modifications, office buildings, and laydown areas. The total potential footprint of these modifications would be about 221,700 square feet, or just over 5 acres. This SWEIS analyzes the implementation of the pit disassembly and processing project, as presented in the SPDP EIS, whereby dilution activities would occur at SRS.

As a result of the announced delay in implementation of the SPDP project as analyzed in the SPDP EIS, this SWEIS also analyzes the potential limited enhancement of operations of the ARIES processing line in PF-4. This limited enhancement would take advantage of efficiencies in the process and would increase the amount of actinides processed in support of surplus plutonium disposition from the current limit of 400 kilograms per year to 700 kilograms per year. This increase in annual throughput was previously analyzed as part of the Expanded Operations Alternative in the 2008 LANL SWEIS. There would be no change to the existing building footprint for the limited enhancement (no new construction) nor would any additional floor space be required in PF-4 for ARIES operations. This limited enhancement of operations of the ARIES processing line would not violate the prohibition on ARIES expansion as expressed in Section 3116 of the 2024 *National Defense Authorization Act*, codified at 50 U.S.C. § 2538a(f). The effects of this limited enhancement (as compared to the overall impacts of the Expanded Operations Alternative) are addressed in Chapter 5.

HE Modernized Manufacturing Facility (HEMMF). NNSA proposes to construct and operate a new HEMMF for advanced manufacturing of HE, using modern technologies. The project would use similar processes as Formulation Additive Manufacturing Explosive (*see* Table 3.4-1); however, HEMMF would focus on the production of larger quantities of HE and would be sited near an existing firing site. The HEMMF would require up to 15 operations personnel, however, the actual operations of the facility would be done remotely. The specific location for the 12,000-square-foot proposed HEMMF has not been established but would likely be sited in a developed area at either

TA-15, TA-36, or TA-39. Because of the advanced manufacturing techniques employed, waste generation would be limited to small quantities of solvents and other cleaning solutions associated with cleaning of process equipment. No radiological waste or materials would be associated with the HEMFF (LANL 2024c).

Development and operation of a BSL-3 facility at TA-51. Within the next decade, the Laboratory has identified a need for BSL-3 facilities at LANL to work with pathogens or toxins that require a higher level of safety and security considerations than are currently available on site. As identified in Appendix A, Section A.2.2.2, the Laboratory currently has labs that perform BSL-1 and BSL-2 work in TA-3 and TA-43. The Laboratory is currently building multiple warehouses in TA-51. NNSA would acquire self-contained laboratory trailers that could be placed within the warehouse space (when available) and used for BSL-3 activities. This proposal could also be implemented in TAs other than TA-51 and would be dependent on warehouse availability at the time of implementation. Once operational, the BSL-3 facility would require a dedicated staff of three to five workers specifically trained to work at the BSL-3 level. The BSL-3 facility would generate chemical and biological wastes. Chemicals used in the process would include phenol, ethanol, and other chemicals used for biological analysis. Biological wastes (e.g., cell and microbial cultures, nucleic acids, and protein) would be autoclaved prior to disposal.

Environmental Test Facility (ETF). Certification of pits for the stockpile requires examination of components using destructive and nondestructive techniques to examine the behavior of materials and their properties in various environmental conditions. LANL maintains a capability as a base ETF for some weapons components. Base ETFs are facilities and laboratory scale (or “table-top”) items used to evaluate components or subassemblies in the environments defined by the Stockpile-to-Target Sequence and the Military Characteristics requirements for each nuclear weapon in the stockpile. Every laboratory within the NNSA complex has some base capability essential for day-to-day operations. LANL conducts environmental testing of weapons components at several locations, including TA-55.

To support the pit certification capability at TA-55, the Laboratory proposes to construct an ETF inside the Perimeter Intrusion, Detection, and Assessment System at TA-55 that would conduct non-destructive testing of plutonium components designed at LANL for stockpile stewardship. Specific actions to support this would include construction of a hardened facility and control room; install equipment necessary for testing components in specific environmental conditions; and upgrade utilities to support the testing facility. Operations of the facility would not generate radiological wastes because the nondestructive testing would use sealed components. There would be a potential for generation of relatively small amounts of hazardous waste (i.e., a few drums per year).

Open burning/open detonation (OB/OD) waste treatment. Since the 1950s, LANL has treated certain HE wastes by thermal treatment processes, generally referred to as OB/OD, at various units. Over the years, LANL has consolidated and upgraded its OB/OD treatment units and has reduced its OB/OD to the maximum extent possible. LANL implements technology at these units that fully controls the burning and detonation processes, and its units are safe, efficient, effectively produce no byproducts or residuals, and are protective of human health and the environment. Today, except for the TA-16-388 Flash Pad, all OB treatment units are undergoing closure or have been closed. LANL maintains two OD units for waste treatment in TA-36 and TA-39.

Under current federal regulation, OB/OD of hazardous wastes is prohibited except for the OB/OD of waste explosives. Waste explosives include: (a) waste which has the potential to detonate; and (b) bulk military propellants, which cannot be safely disposed of through other modes of treatment. This provision exempts from the prohibition on OB/OD of hazardous waste which has the potential to detonate, provided the OB/OD treatment does not threaten human health or the environment. Although the exemption is clear, EPA has, more recently, interpreted this regulation as authorizing the permitting and operation of OB/OD units where no alternative mode of treatment is safe and available. EPA acknowledges that there are circumstances and types of energetic waste that necessitate the continued use of OB/OD based upon safety and other site-specific factors.

The Laboratory has conducted several evaluations of alternative treatment technologies and continues to evaluate alternatives to OB/OD. LANL-specific factors (e.g., properties of LANL's specialized explosives wastes are significantly more energetic and sensitive to insult) are considered when evaluating whether alternative technologies are safe and available to treat LANL's specialized explosives waste. To date, no alternative treatment technology has been identified that is safe and available for LANL's specialized explosives waste. As alternative treatment technologies evolve, the Laboratory will continue to consider additional alternative technologies for explosives waste treatment.

The No-Action Alternative includes continued operation of LANL's current OB/OD units for waste treatment. LANL's current, controlled OB/OD waste treatment operations do not produce hazardous secondary waste streams and do not have measurable adverse environmental impacts. Under the Expanded Operations Alternative, the Laboratory's current OB/OD operations would continue, however, new units (or expansions of, or increased treatment at, existing units) may be sited within appropriate areas of the NEEWC Planning Area over time. As HE operations are relocated in the future, associated OB/OD waste treatment units may likewise be relocated.

This SWEIS assumes that at some point in the future, one or more alternative treatment technologies would become safe and available to be implemented at LANL under the Expanded Operations Alternative to treat some of LANL's hazardous explosives waste. For purposes of analysis of environmental impacts, the three technologies that are analyzed in this SWEIS include (LANL 2024c):

- Contained detonation – would involve the detonation of explosive wastes inside a steel chamber constructed to dampen the blast. After-burning reactions would be suppressed to protect the integrity of the chamber. Particulates would be filtered from the detonation gases, producing secondary waste streams. This technology would be best suited for small pieces of certain explosives. Residuals may transform into toxic or more complex compounds than those created when treating the same waste by OB/OD. If a safe and available alternative existed that could treat the Laboratory's specialized explosives waste, the Laboratory estimates that this technology could treat about 5 percent of the current OB waste stream at LANL and about 50 percent of the current LANL OD waste stream.
- Flashing furnace – would thermally decontaminate metal parts with explosive contamination. Up to 10,000 pounds of contaminated metal could be flashed per hour. The furnace could be installed in a fixed location or could be trailer-mounted for field applications. Because this technology would be enclosed and have a controlled flame device, permitting of the unit may require adherence to 40 CFR Part 264, Subpart O (incinerator) requirements. If a safe and available alternative existed that could treat the Laboratory's specialized explosives waste, the Laboratory estimates that this technology could treat about 30 percent of the current OB waste stream but would not have the capability to treat the current OD waste stream.

- Rotary kiln incinerator – would be an enclosed incinerator treatment technology. The rotary kiln would slowly move waste from one end to the other and the waste would detonate or combust within the heated chamber. Only small amounts of explosive waste would be able to be treated at one time. Emissions would be filtered and/or neutralized prior to release to the atmosphere, producing secondary waste streams. Small explosive items with casings (i.e., less than 40 grams of energetic material) could also be treated with this technology. Uniform explosive waste streams are treated most efficiently. If a safe and available alternative existed that could treat the Laboratory's specialized explosives waste, the Laboratory estimates that this technology could treat about 70 percent of the current LANL OB waste stream and less than one percent of the current OD waste stream.

For the purposes of the analysis in this SWEIS, the potential footprint of each alternative treatment technology unit is assumed to be about 1,000 square feet. These units would be located either within TA-16, TA-36, or TA-39, or within appropriate areas of the NEEWC Planning Area. Selection of one or more alternative treatment technologies would not eliminate the continued need for OB/OD waste treatment operations into the foreseeable future.

TRU waste staging. NNSA proposes to construct and operate up to four additional staging locations for TRU waste generated from PF-4, primarily associated with pit production operations. The potential staging facilities would be constructed to minimize the potential for a long-term WIPP shutdown to affect pit production activities at LANL. Specific locations for the staging areas have not yet been identified, however, the likely locations include developed areas in TA-16 (near the WETF), TA-54, TA-55 (adjacent to RLUOB), and TA-60. Conceptually, the design and layout for these facilities would be similar, but larger, than the current TWF in TA-63. The total estimated footprint of the TRU waste staging areas would be about 240,000 square feet. For the analysis in this SWEIS, a 60,000-square-foot staging area would be located at each of the aforementioned TAs. The project would provide the additional capacity to stage the equivalent of approximately 6,700 TRU waste drums. Unlike the TWF, these facilities would be used only for staging TRU waste drums as opposed to repackaging or preparing TRU waste for shipment to the WIPP facility. The staging areas would require permitting under RCRA.

Pumped hydropower. To support its energy security mission, the Laboratory proposes to construct and operate a pumped hydropower facility to evaluate and demonstrate how construction and operational risks associated with pumped hydropower facilities may be minimized. The premise is that pumped hydropower has been effectively utilized for over 100 years, but has many risks associated with construction and operation that need to be minimized to encourage new uses of this technology. Such a demonstration facility would address these risks and help enable the buildout of new pumped hydropower facilities in a distributed manner (smaller 100–300 MW units, with more diverse locations that allow interfacing with existing or new infrastructure) across the nation to meet the needs of a growing renewable grid. Specifically, with the incorporation of new design features, the facility would illustrate the ability to utilize multiple sources of water from nontraditional sources, reduce or eliminate the need for refilling of the reservoirs over long periods of time (i.e., multiple decades); allow for multiple uses of the water beyond energy storage applications (i.e., wildland fire fighting, material science experiments with water, verification of grid modeling analysis, training and user facility opportunities for staff and guests, and community outreach engagement); and illustrate through appropriate construction techniques minimum disturbance to the local landscape where 12 archaeology sites have been identified from preliminary analysis. The demonstration facility would be located in a mostly undeveloped area in TA-39 and TA-49 along NM-4 (Figure 3.4-2).

Figure 3.4-2 Pumped Hydropower Upper and Lower Reservoirs

The conceptual proposal would be to build a closed-loop pumped hydropower facility that includes four reservoirs (filled with fire suppression water)—two lower reservoirs and two upper reservoirs, side by side. The upper and lower reservoirs would be connected by three separate 12-inch-diameter water conveyance pipelines (penstocks).[16] The two pairs of reservoirs would hold approximately 80 acre-feet of water, allowing the project to segregate different water quality types. Each reservoir

[16] Penstocks are pipes or long channels that carry water down from the hydroelectric reservoir to the turbines.

would be lined and covered to control seepage and evaporation. Initial fill would take place over a period of approximately 2 years, allowing to spread out the demand of fire suppression source water. The demonstration facility would include three skid-mounted pump-as-turbine units for easier deployment and operational flexibility. A pump-as-turbine assembly can be used to pump water uphill to store kinetic energy and produce electricity when water is released from the reservoir to run back through the turbine via gravity. This design approach would provide operational flexibility, ease of maintenance, resilience with natural back-up in the event of partial system breakdown, and eventually provide for permitting to utilize the facility as a test facility as mentioned in the previous paragraph. The initial facility design would support a minimum of 500 kW hydropower generation with a minimum release duration of 24 hours and would require an overall footprint of approximately 20 acres. The initial plans for construction include utilizing camouflage techniques to help the facility fit into the natural environment and minimize visibility from offsite locations.

Site-wide transportation projects. NNSA would construct approximately 880,000 square feet (approximately 20 acres) of roadway projects under the Expanded Operations Alternative. In addition, approximately 230,000 square feet (6 acres) of new parking lots would be constructed—mostly associated with new facilities identified in Table 3.4-1. Of these transportation and parking projects, approximately 69 percent (18 acres) would be within an existing disturbed area (e.g., existing road ROW or location of previous development). Key site-wide transportation projects under the Expanded Operations Alternative include the following:

- Construction of access roads for new facilities such as DMMSC (TA-53) and the new FSI/HPC (TA-6);
- Construction of a connector road between TA-3 and TA-6; and
- Miscellaneous site-wide roads and improvements.

3.4.2 Operational Changes

This section identifies changes in operations (above those proposed in the No-Action Alternative) that may or may not be associated with construction of facilities, utilities, or infrastructure. These notable changes have the potential to affect the potential environmental impacts of Laboratory operations under the Expanded Operations Alternative.

Wildland fire risk reduction treatments. In 2019, NNSA prepared the Wildfire Hazard Reduction SEA (NNSA 2019cd). The SEA identified potential impacts associated with implementing the revised Wildfire Mitigation and Forest Health Plan (LANL 2019a) that included wildland fire risk reduction and forest health objectives, which would be accomplished through treatments for forest thinning, life safety actions, open space forest health, and the implementation of new treatment practices. Within the complex landscape of Los Alamos County, wildfire presents a persistent threat to Laboratory personnel, structures, infrastructure, and the adjacent communities. Under the Expanded Operations Alternative, NNSA proposes to revise fire mitigation treatment standards to minimize wildfire risk on LANL property and promote forest health and resilience. New standards would be designed to more aggressively address an increasing wildfire threat due to changing climate and a history of fire suppression that has led to overgrown forests. The details of the proposed wildfire treatment standards are provided in LANL (2024d). The thinning projects that would be considered over the next 15 years are listed in Table 3.4-3. The desired conditions for each project would be approximately 60–80 stems (mature trees) per acre to create a mosaic landscape.

Light Manufacturing Laboratory. The Laboratory would modify the operations of this facility to be able to increase the isotope production capacity. The primary changes in operations would include using chemicals as part of the radioisotope separations process. As a result of this change in processing, the Light Manufacturing Laboratory would no longer be regulated under DOE Order 420.2D, "Safety of Accelerators." The facility would be designated as an HC-3 facility under DOE-STD-1027-2018. The Laboratory expects that the radioactive air emissions of the facility operations would increase slightly but stay within the estimated 100 curies of mixed fission products projected under the No-Action Alternative.

Table 3.4-3 Potential Forest Thinning Projects

Location	Potential Area
Rendija Canyon	approximately 1,000 acres
Los Alamos Canyon	approximately 835 acres
TA-69–TA-16 along NM-4	approximately 100 acres
Large-scale treatment bounded by West Jemez Road and NM-4	approximately 1,250 acres
North boundary of Canon De Valle north to Two-Mile Canyon, from NM-4 east to the intersection of Two-Mile and Pajarito canyons	approximately 1,500 acres
Mortandad Canyon north to East Jemez Road and from Diamond Drive east to TA-60 boundary	approximately 800 acres
TA-14 and TA-67	approximately 1,000 acres
TA-49	approximately 1,250 acres
TA-15	approximately 800 acres
TA-39	approximately 1,500 acres
TA-36 and T-68	approximately 200 acres
TA-33	approximately 1,000 acres
TA-70	approximately 1,200 acres
TA-71	approximately 700 acres
TA-53 and TA-72	approximately 800 acres

Feral/invasive cattle management. Feral cattle have been impacting the natural and likely have been impacting cultural resources along the Rio Grande for Los Alamos County, LANL, and Bandelier National Monument lands since the 1960s. This area is known as White Rock Canyon and the portion on LANL was designated as a reserve in October 1999 by the Secretary of Energy. The cattle currently roam freely through Los Alamos County and LANL segments of White Rock Canyon. Impacts from feral cattle have been seen in various areas across the site but are primarily down along the river. Cultural sites continue to be damaged by trampling, erosion, and scattering of artifacts. The movement of the cattle has resulted in a variety of impacts to resources including destruction of native vegetation, soil erosion, and disturbance to associated wildlife including federally listed threatened and endangered species. The cattle have highly degraded critical riparian vegetation, stream banks, and have polluted waterways with their defecations. As a result of the damaging effects that are

> **Feral species:** Species that have been established from intentional or accidental release of domestic stock that results in a self-sustaining population(s). Feral species are generally non-indigenous and often invasive.
>
> **Invasive species:** An established plant or animal species that causes direct or indirect economic or environmental harm within an ecosystem, or a species that would likely cause such harm if introduced to an ecosystem in which it is non-indigenous as determined through objective, scientific risk assessment tools and analyses.

occurring from feral cattle, NNSA proposes to adopt the following management strategies for addressing the issues across NNSA property:

- Live trapping and relocation – This strategy would be used for animals in more easily accessible areas on LANL property assuming a suitable relocation area has been identified and adequate staff is on hand to set and monitor corralling throughout the day. Live trapped animals would be transferred to the New Mexico Farm and Livestock Board for final disposition.
- Lethal control for reduction or elimination – Lethal control would be used to remove feral cattle from LANL property where live-trapping methods are not feasible. This method would involve using a direct head shot or a heart/lung shot using an appropriately sized firearm under conditions of good visibility, with the intention of the immediate death to the individual animal. Other methods of euthanasia may be considered as appropriate.

NNSA prepared a report to Congress in January 2025 (NNSA 2024d), which identifies potential methods and management options that can be used to control and eliminate feral cattle in White Rock Canyon, outlines logistical considerations and compliance requirements for cattle removal, and summarizes roles and responsibilities. The report describes both nonlethal and lethal options for removal. DOE/NNSA's plan for removing the feral cattle includes working closely with neighbors to identify potential methods that can be used to control or remove feral cattle populations across the landscape. Successful management would include habitat restoration and protection of cultural and other resources in areas impacted by feral cattle activity.

Research and development for Radioisotope Thermoelectric Generator (RTG) programs. The Laboratory currently performs the research and production of RTGs in support of the space program in PF-4. Continued operations within PF-4 associated with heat-source plutonium is addressed under the No-Action Alternative. Under the Expanded Operations Alternative, the Laboratory would expand the R&D associated with RTGs to improve efficiency and reliability of RTGs for future applications. Details associated with the expanded RTG R&D include export-controlled information and are provided in a separate appendix (Appendix L) that accompanies this SWEIS. Export-controlled information is not disseminated to the public.

3.4.3 Notable Attributes

This section identifies notable attributes uniquely associated with the Expanded Operations Alternative. As shown on Table 3.4-4, there would be an increase in facility square footage at LANL under the Expanded Alternative, as there are only construction actions and no DD&D actions. There would be an increase in facilities of about 927,000 square feet above the Modernized Operations Alternative.

Although most operations associated with the Expanded Operations Alternative would be similar to existing operations at LANL, there would be notable changes in operations as a result of several new facilities at LANL. For example, the FSI/HPC mission expansion, DMMSC, and LANSCE enhancements would increase annual electricity and water requirements. The LEFFF, SPDP, DMMSC, and LANSCE enhancements would all involve nuclear material operations that could increase radiological air emissions, radiological waste quantities, worker and public radiological doses, and hazards at LANL. These analytical parameters are included in Appendix A, Table A.3.5-2, and Chapter 5 of this SWEIS presents the potential environmental impacts.

Table 3.4-4 Summary of Construction and DD&D – Expanded Operations Alternative

CMP Planning Area	Construction Footprint (ft^2)	Utility and Infrastructure Footprint[a] (ft^2)
Core Area	10,000	590,000
Pajarito Corridor	287,700	7,100
NEEWC	306,800	36,000
LANSCE	197,100[b]	482,000
Balance of Site	125,000[b]	871,000
TOTALS	**926,600[c]**	**1,986,000**

ARIES = Advanced Recovery and Integrated Extraction System; DD&D = decontamination, decommissioning, and demolition; DMMSC = Dynamic Mesoscale Materials Science Capability; FSI WTF = Future Supercomputing Infrastructure Waste Treatment Facility; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex; SERF = Sanitary Effluent Reclamation Facility

a In addition to proposed roads and parking, these values include 20 acres for proposed pumped hydropower demonstration in Balance of Site and the cooling towers for LANSCE (8,000 square feet).

b Construction of the DMMSC and FSI WTF would require temporary development that would be restored after construction. For DMMSC, approximately 40 acres (31 of which are currently undeveloped) would be used as a construction laydown area. For the FSI WTF, approximately 27.5 acres (7.8 of which are currently undeveloped) would be used to construct pipelines to connect non-potable water, return to SERF, and discharge to a new, permitted outfall.

c If NNSA were to implement the limited enhancement of ARIES instead of the full implementation SPDP, there would not be 221,700 square feet of development in the Pajarito Corridor. The Pajarito Corridor construction footprint would decrease to 66,000 square feet and the total construction footprint for the Expanded Operations Alternative would decrease to 704,900 square feet.

3.5 Analytical Parameters for the Alternatives

As discussed in Sections 3.2–3.4, the alternatives encompass a multitude of discrete projects/actions that could give rise to environmental impacts. By addressing all projects/actions in a site-wide analysis, NNSA is able to (DOE 1994):

- Consolidate impact analyses and public participation activities, which streamlines the NEPA process to make it more efficient and useful;
- Present impact information so decisionmakers and the public have a clear understanding of the totality of impacts from past, present, and reasonably foreseeable future activities at a site;
- Avoid segmentation (division of actions with significant impacts into smaller actions, thereby hiding significance); and
- Effectively and efficiently respond to stakeholders by presenting information on past, present, and future activities at DOE sites in order to better understand the impacts that DOE's activities have had or may have on their health and environmental quality.

A primary challenge in preparing a site-wide analysis is to address the impacts of the individual projects/actions while also addressing the totality of impacts. To accomplish those dual goals, NNSA defined and accumulated data for each of the projects/actions proposed for each of the alternatives. For each project/action, NNSA consulted with subject matter experts from the Laboratory to quantify key parameters. The accumulated parameters are presented in Appendix A, Table A.3.5.1 (for construction) and Table A.3.5-2 (for operations) for each of the alternatives. For example, for each of the alternatives, construction activities associated with new facilities

(Tables 3.2-1, 3.3-1, and 3.4-1), upgrade/utility/infrastructure projects (Tables 3.2-2, 3.3-2, and 3.4-2), and DD&D activities (Tables 3.2-3 and 3.3-3) have the potential to result in land disturbance. Table A.3.5-1 shows the results of accumulating those land disturbances for all of the projects/actions for each alternative (e.g., a range of total disturbance of 250 acres for the No-Action Alternative to as much as 1,142 acres for the Expanded Operations Alternative).

This same process was utilized to develop other parameters such as workforce, water use, and waste generation. In some instances, the accumulated parameters presented in Tables A.3.5-1 and A.3.5-2 are largely driven by the contribution of one or two projects/actions. For example, as shown in Table A.3.5-2, increased water and electricity usage at LANL in the future would be primarily associated with cooling water usage for the expanded FSI/HPC and operation of the DMMSC at TA-53. Similarly, for the No-Action Alternative, operational increases would largely result from implementation of the increased pit production mission. As these examples illustrate, in developing the key parameters for the SWEIS analysis, NNSA can account for projects/actions both individually and in totality, and the analysis in this SWEIS addresses each of these aspects.

As shown in Table A.3.5-1, for most construction parameters associated with the alternatives, NNSA developed estimates for the average year of construction/DD&D. The SWEIS acknowledges that the annual rates of construction and DD&D would depend on annual budget authorizations and the evolution and prioritization of NNSA's needs. Where construction parameters are based on personnel (e.g., workforce, wastewater generation), the analysis uses a value of twice the annual average to address the potential variability of those parameters.

Because the operations of the Laboratory are closer to steady-state conditions, most parameters in Table A.3.5-2 were estimated to reflect operations at a given level. One exception to this is waste generation; Table A.3.5-2 presents "routine" operational wastes for Triad (operations of the Laboratory) and N3B (ongoing environmental remediation activities) and also presents "non-routine" wastes from projected DD&D activities. The N3B and non-routine wastes, because they have the potential to fluctuate from year to year, are presented and analyzed as an annual average

Chapter 5 of this SWEIS provides more detail on development of waste parameters listed in Table A.3.5-2, acknowledges and analyzes the potential excursions or annual increases that are currently projected for alternatives. Once the key construction and operational parameters were developed, resource experts utilized those parameters to conduct the impact analysis presented in Chapter 5 of this SWEIS.

3.6 Alternatives Considered but Eliminated from Detailed Study

NNSA considered public input and comments received during the scoping process in determining the range of alternatives in this Draft LANL SWEIS. NNSA only considered reasonable alternatives that would meet the purpose and need described in Chapter 1, Section 1.3 of this SWEIS. The following alternatives were considered in developing this Draft SWEIS but were eliminated from detailed analysis because they did not allow LANL to fulfill the NNSA mission requirements. The specific reasons for elimination are detailed below.

Complete closure of LANL. This alternative is inconsistent with the LANL mission defined by NNSA. Such a possibility was considered as recently as 2008 when NNSA prepared the Complex Transformation SPEIS (NNSA 2008a). In that document, NNSA concluded that, "as a result of the continuing challenges of certification [of nuclear weapons] without underground nuclear testing, the need for robust peer review, benefits of intellectual diversity from competing physics design laboratories, and uncertainty over the details [of] future stockpiles, NNSA does not consider it reasonable to evaluate laboratory consolidation [or elimination] at this time" (NNSA 2008a). That conclusion has not changed today. While this could be considered as a reasonable alternative at some time in the future, NNSA does not consider it reasonable within the 15-year analytical window being evaluated in this SWEIS. In addition, as one of only three nuclear weapons laboratories, LANL contributes significantly to the core intellectual and technical competencies of the U.S. related to nuclear weapons. These competencies embody more than 75 years of weapons knowledge and experience. The laboratories perform the basic research, design, system engineering, development testing, reliability and assessment, and certification of nuclear weapon safety, reliability, and performance. From a broader national security perspective, the core intellectual and technical competencies of LANL (as well as the Lawrence Livermore National Laboratory and Sandia National Laboratories, NNSA's other nuclear weapons laboratories) provide the technical basis for the pursuit of U.S. arms control and nuclear nonproliferation objectives.

Transfer of current missions/operations from LANL to other sites. The Complex Transformation SPEIS also considered and evaluated the transfer of missions/operations to and/or from LANL, and NNSA has implemented, as appropriate, decisions that followed preparation of that document. NNSA has not identified any new proposals for current missions/operations that are reasonable for transfer to and/or from LANL (NNSA 2008a; 85 FR 47362; 73 FR 77644).

Conversion of LANL to an academic laboratory and/or an environmental research laboratory. Under this alternative, LANL would cease nuclear weapons-related work and instead perform academic/environmental research work. Under this alternative, NNSA would remove nuclear materials from LANL and remove all waste. LANL would use existing facilities and staff for academic research and/or environmental research. Such an alternative would not allow NNSA to meet the purpose and need discussed in Chapter 1, Section 1.3, of this LANL SWEIS (85 FR 47362; 73 FR 77644).

Relocation of all nuclear materials and nuclear research to another site. Under this alternative, LANL would cease its work involving nuclear materials and would relocate all nuclear materials to another DOE/NNSA site. Such an alternative would not allow NNSA to meet the purpose and need discussed in Chapter 1, Section 1.3, of this LANL SWEIS (85 FR 47362; 73 FR 77644).

Reduced operations at LANL. Under this alternative, LANL would reduce operations to a level below the operations defined under the No-Action Alternative. Such an alternative would not allow NNSA to meet the purpose and need discussed in Chapter 1, Section 1.3, of this LANL SWEIS.

Shift funding from weapons work to environmental cleanup. Such an alternative would not allow NNSA to meet the purpose and need discussed in Chapter 1, Section 1.3, of this LANL SWEIS (85 FR 47362; 73 FR 77644).

3.7 Preferred Alternative

CEQ NEPA regulations require that an agency identify its preferred alternative, if one or more exists, in a Draft EIS and identify such an alternative in the Final EIS (40 CFR 1502.14 (d)). The preferred alternative is the alternative that NNSA believes would fulfill its statutory missions and responsibilities, considering economic, environmental, technical, and other factors. This Draft LANL SWEIS provides information on the potential environmental impacts under the No-Action Alternative and the action alternatives. NNSA prepares cost, schedule, and technical analyses separately, and NNSA will consider all relevant factors in preparation of its ROD. NNSA had determined that LANL is critical to the Stockpile Stewardship/Weapons mission; Global Security Program; and Science, Technology, and Engineering, which are best supported by the Expanded Operations Alternative. Therefore, NNSA has identified the Expanded Operations Alternative as the preferred alternative for the continuing operations of LANL.

3.8 Comparison of the Potential Consequences of the Alternatives

A summary comparison of the environmental consequences for the continued operation of LANL is provided in Table 3.8-1 (Table 3.8-2 provides additional details regarding infrastructure). The tables compare the potential impacts to environmental resources associated with the continued operation of LANL under the No-Action Alternative and the two action alternatives. The information in Table 3.8-1 includes data for both construction and operations. Detailed analyses supporting the summary comparisons in Table 3.8-1 are provided in Chapter 5 of this SWEIS.

Table 3.8-3 summarizes potential accident risks associated with LANL's nuclear facilities. Consistent with the 2008 SWEIS, two site-wide seismic events and a site-wide wildfire event were analyzed to estimate the impacts of potential accidents that could involve multiple facilities. The potential releases are evaluated for Seismic Design Category (SDC)-2 and SDC-3 seismic events. SDC-3 seismic events have a lower probability of occurrence (return period of once every 2,500 to 10,000 years) than SDC-2 seismic events (return period of once every 1,000–2,500 years); however, the magnitude of the ground accelerations and potential effects of an SDC-3 event would be more severe. The safety basis documents determined that some LANL facilities with radiological material could withstand an SDC-2 seismic event without damage, while other facilities or areas would sustain damage during an SDC-2 seismic event. The wildfire event is assumed to involve virtually all of the facilities containing radiological materials. This result would be extremely conservative since many of these facilities are several miles apart and separated by canyons and industrial areas. The risks of these site-wide events are presented in Table 3.8-4.

Table 3.8-1 Comparison of Environmental Consequences

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
***Land Use and Visual Resources* (*see* Section 5.2)**		
Total permanent land development for all five planning areas would be 129 acres (34 acres of facilities, 132 acres of infrastructure, and 37 acres recovered through DD&D). Site-wide development footprint would be 3,415 acres (4% more than the baseline). No change to the current or future land use designation. Activities represent a continuation of existing land uses and would be compatible with existing and approved future land uses at and surrounding the site.	Total permanent land development for all five planning areas would be 979 acres (79 acres of facilities, 928 acres of infrastructure, and 28 acres recovered through DD&D). Site-wide development footprint would be 4,393 acres; an increase of 29% over the NAA. No change to the current or future land use designation. Activities represent a continuation of existing land uses and would be compatible with existing and approved future land uses at and surrounding the site.	Total permanent land disturbance for all five planning areas would be 1,046 acres (100 acres of facilities, 974 acres of infrastructure, and 28 acres recovered through DD&D). Site-wide development footprint would be 4,460 acres, an increase of 31% over the NAA. No change to the current or future land use designation. Activities represent a continuation of existing land uses and would be compatible with existing and approved future land uses at and surrounding the site.
Construction activities would result in temporary changes to the visual appearance due to the presence of cranes, construction equipment, demolition, facilities in various stages of construction/DD&D, and possibly increased dust. All planning areas would retain their existing VRM classes. The EPCU project would construct transmission lines and structures across the Rio Grande.	Construction activities would result in additional temporary changes to the visual appearance due to the presence of cranes, construction equipment, demolition, facilities in various stages of construction/DD&D, and possibly increased dust. All planning areas except Balance of Site would retain their existing VRM classes. Potential solar PV arrays in locations near the site boundary would cause a degradation in the VRM class for Balance of Site. The replacement bridge would cause short-term adverse visual impacts from construction and staging areas. Long-term, no adverse visual impacts are anticipated.	Construction activities would result in additional temporary changes to the visual appearance due to the presence of cranes, construction equipment, demolition, facilities in various stages of construction/DD&D, and possibly increased dust. All planning areas except Balance of Site would retain their existing VRM classes. The proposed 20-acre pumped hydropower demonstration near the site boundary would be visible from Bandelier National Monument and cause a degradation in the VRM class for Balance of Site. Impacts would include those identified for the Modernized Operations Alternative.
***Geology and Soils* (*see* Section 5.3)**		
Disturbance of about 62 acres of previously undisturbed soil would occur; no prime farmland exists on LANL; all offsite development would be in previously disturbed areas. Ongoing remediation efforts would continue to improve soil conditions at LANL. Faulting and seismic events could result in potential hazards to existing and planned facilities	Disturbance of about 731 acres of previously undisturbed soil would occur (above the NAA); no prime farmland exists on LANL. Ongoing remediation efforts would continue to improve soil conditions at LANL.	Disturbance of about 806 acres of previously undisturbed soil would occur (above the NAA); no prime farmland exists on LANL. Ongoing remediation efforts would continue to improve soil conditions at LANL.

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
at the LANL site. Any new facility would be designed and constructed to meet seismic design criteria commensurate with the risk category requirements. Potential impacts from geologic hazards (i.e., seismic events) are discussed under "accidents."	There would be extensive grading of soils for site preparation and installation of the solar arrays (641 acres are currently undisturbed), which could result in wind and water erosion of native soils if graded areas remain uncovered for long periods of time. Faulting and seismic conditions are the same as under the NAA.	The Laboratory would apply wildland fire risk reduction treatments to certain high-risk areas, which would have the potential to destabilize soils and increase erosion and runoff. The risks associated with extensive grading (from Modernized Operations) also apply to Expanded Operations. Faulting and seismic conditions are the same as under the NAA.
***Water Resources* (*see* Section 5.4)**		
Surface Water: Approximately 62 acres of impervious surfaces would be newly introduced from new facilities and infrastructure projects. New facilities would increase impervious surfaces, which could increase stormwater runoff. LANL meets stormwater compliance monitoring requirements and implementation of a stormwater pollution prevention plan would minimize any pollution that might leave the site by stormwater. There would be no construction and operations projects that would affect the floodplains at LANL. Groundwater: Any discharge from septic tanks to groundwater would be monitored, managed, and subject to the requirements of applicable permits. Groundwater quality in the Sandia and Mortandad canyons would continue to improve as an effective groundwater treatment plan associated with the Final Remedy for remediation of the hexavalent chromium plume would be implemented.	Surface Water: In addition to the NAA, approximately 90 acres of impervious surface would be newly introduced from the new facilities and infrastructure projects. Stormwater permitting would be the same as under the NAA. There would be no construction and operations projects that would affect the floodplains at LANL. There may be a newly permitted outfall in TA-3, however, discharges would be within current permit limits. Groundwater: No changes from the NAA.	Surface Water: In addition to the NAA, approximately 121 acres of impervious surface would be newly introduced from the new facilities and infrastructure projects. Stormwater permitting would be the same as under the NAA. Water lines supporting the FSI/HPC WTF would cross streams and floodplains during construction, which would be subject to the *Clean Water Act* Section 404/401 requirements. Floodplain assessment would be required per Executive Order 11988, "Floodplain Management," prior to any construction. This project would also implement a new NPDES-permitted outfall into Two-Mile Canyon. Groundwater: No changes from the NAA.

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Air Quality and Noise **(*see* Section 5.5)**		
Fugitive dust would be generated during clearing, grading, and other earth-moving operations. Construction emissions would exceed the *de minimis* thresholds for PM_{10}. The Laboratory would use measures to reduce below the threshold. No radiological emissions would be expected during construction activities; radiological emissions during operations include 2,753 Ci/ year, made up of: • 1,850 Ci of tritium • 800 Ci GMAP • 100 Ci MFP • 3 P/VAP • 8.9×10^{-6} americium • 8.9×10^{-4} plutonium • 1.5×10^{-1} uranium Venting of FTWCs (a one-time event) could release as much as 30,000 curies of tritium. Potential health effects of radiological releases are presented below under "human health." There is a potential for short-term radiological air emissions during DD&D of 13 radiologically contaminated facilities, however, the activities would be performed in accordance with an NNSA-approved DD&D plan to protect the environment, workers, and the public. An increase of GHG emissions of roughly 10,500 metric tons of carbon dioxide equivalent (CO_2e) annually during construction would be a negligible (~3 percent) increase from 2022 site-wide emissions.	Fugitive dust would be generated during clearing, grading, and other earth-moving operations. Construction emissions would exceed the *de minimis* thresholds for PM_{10}. The Laboratory would use measures to reduce below the threshold. No radiological emissions would be expected during construction activities; radiological emissions during operations would include 150 Ci/ year GMAP (in addition to the NAA); potential health effects of radiological emissions are presented below under "human health." There is the potential for short-term radiological air emissions for DD&D of 29 radiologically contaminated facilities; however, the activities would be performed in accordance with an NNSA-approved DD&D plan to protect the environment, workers, and the public. An increase of roughly 17,000 metric tons of CO_2e annually during the peak of construction would be a minor adverse (~5 percent) increase from the NAA. The annualized value of these GHG emissions would be roughly $6,600,000 from construction and operation of new facilities over the 15-year period. Annualized social benefits from implementation of half of the proposed solar PV arrays (about 89 MW) was estimated at $37,000,000.	Fugitive dust would be generated during clearing, grading, and other earth-moving operations. Construction emissions would exceed the *de minimis* thresholds for PM_{10}. The Laboratory would use measures to reduce below the threshold. No radiological emissions would be expected during construction activities; radiological emissions during operations would include about 650 Ci/year in addition to the Modernized Operations Alternative made up of: • 650 Ci GMAP • 7.5×10^{-6} americium • 6.9×10^{-5} plutonium • 1.4×10^{-2} uranium Potential health effects of radiological emissions are presented below under "human health." There would be no additional DD&D activities from those presented under the No-Action and Modernized Operations alternatives. An increase by roughly 18,100 metric tons annually during the peak of construction would be a minor adverse (~5 percent) increase from the NAA. The annualized value of GHG emissions would be $7,400,000 from construction and operations of new facilities over the 15-year period. Social benefits would be similar to the Modernized Operations Alternative.

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
The 2024 present value of the social cost of GHG would be about $1,930,000,000 in 2020 dollars at a 1.5-percent discount rate, an annualized value of $145,000,000 site-wide with roughly $3,000,000 expected from construction and operations of new facilities and transport of waste and materials over the 15-year period. Present value social benefits from operating solar PV arrays were estimated at $6,120,000. Although construction, remediation, and DD&D activities would cause temporary noise impacts, almost all activities would be confined to the LANL property boundary and more than 800 feet from residential areas or businesses. Impacts from a 10% increase in the workforce would result in a negligible increase in traffic noise.	The Los Alamos Canyon Bridge Replacement and DD&D of the Health Research Laboratory would be within 400 feet of private residences, within 800 feet of two churches, and more than 1,000 feet from Los Alamos High School. Noise would be noticeable but would abate after construction. Construction of solar PV arrays at Site B would be near the site boundary and could temporarily impact residences in the White Rock community. Impacts from a 15% increase in the workforce during construction would result in a negligible increase in traffic noise.	In addition to the other alternatives, the pumped hydropower demonstration at TA-39 and TA-49 would be within 800 feet from the LANL site boundary. The project would be north of the Bandelier National Monument, about 1.5 miles to the northwest of the Juniper Family Campground. Impacts from a 21% increase in the workforce during construction would result in a negligible increase in traffic noise.
Ecological Resources **(*see* Section 5.6)**		
Nine projects could occur in undeveloped sites in habitat for the Mexican spotted owl, a federally listed threatened species. The projects would require review under the LANL HMP and individual Section 7 consultation with the USFWS. Construction would have no appreciable impact on native vegetation, plant species of concern, or wetlands. Operations would be consistent with current activities and would have no appreciable impact on ecological resources.	Fifteen projects would potentially occur in undeveloped habitat for the Mexican spotted owl. The projects would require review under the LANL HMP and individual Section 7 consultation with the USFWS. The proposed Los Alamos Canyon Bridge replacement would cross both core and buffer habitat for the Jemez Mountains salamander, a federally listed endangered species. The project would require review under the LANL HMP as well as USFWS consultation.	In addition to the projects under the Modernized Operations Alternative, 8 projects would potentially occur in undeveloped habitat for the Mexican spotted owl. The projects would require review under the LANL HMP and individual Section 7 consultation with the USFWS. The proposed FSI/HPC would require new power lines and the supporting water treatment facility would require new water lines. Any powerlines would be constructed in accordance with industry guidelines for protecting raptors. The water lines

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
		would traverse core and buffer habitat for the Jemez Mountains salamander and require review under the LANL HMP as well as USFWS consultation. Expansion of the OB/OD would decrease pollutants and risks to birds and other animals and plants in the region. Thinning or clearing of forest land to reduce the risk of wildfire could potentially affect the Mexican spotted owl and Jemez Mountains salamander. The Laboratory would continue following the HMP and protected species guidelines, giving greater allowance for removal of damaged or diseased high-risk trees within the species' habitats. Management actions to reduce invasive feral cattle would reduce existing impacts, such as trampling and overgrazing of riparian vegetation, degradation of water quality from cattle defecations, and increased soil erosion from degradation of vegetation cover.
Human Health **(*see* Section 5.7)**		
Nonradiological impacts: • Lost days due to injury/illness per year: 483 • Number of occupational fatalities per year: 1.3 Radiological Impacts: <u>Public</u>: • Collective dose to 50-mile population: 6.11 person-rem • Population risk: 3.7×10^{-3} LCF • Offsite MEI dose: 3.07 millirem • MEI risk: 1.8×10^{-6} LCF	Nonradiological impacts (including the NAA): • Lost days due to injury/illness per year: 499 • Number of occupational fatalities per year: 1.3 Radiological Impacts (including the NAA): <u>Public</u>: • Collective dose to 50-mile population: 6.18 person-rem • Population risk: 3.7×10^{-3} LCF • Offsite MEI dose: 3.18 millirem • MEI risk: 1.9×10^{-6} LCF	Nonradiological impacts (including the NAA): • Lost days due to injury/illness per year: 527 • Number of occupational fatalities per year: 1.4 Radiological Impacts (including the NAA): <u>Public</u>: • Collective dose to 50-mile population: 6.73 person-rem • Population risk: 4.0×10^{-3} LCF • Offsite MEI dose: 3.66 millirem • MEI risk: 2.2×10^{-6} LCF

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Workers: • Number of radiation workers: 4,450 • Average annual dose to individual radiation worker: 115 millirem • Average annual radiation worker risk: 7×10^{-5} LCF • Collective annual dose to radiation workers: 512 person-rem • Total annual radiation worker risk: 0.31 LCF A one-time event of venting FTWCs could result in a dose to the MEI of up to 8 millirem, however, the total annual dose to the MEI from all sources would be controlled to be less than 10 millirem for any 12-month period.	Workers: • Number of radiation workers: 4,530 • Average annual dose to individual radiation worker: 115 millirem • Average annual radiation worker risk: 7×10^{-5} LCF • Collective annual dose to radiation workers: 521 person-rem • Total annual radiation worker risk: 0.31 LCF	Workers: • Number of radiation workers: 4,912 • Average annual dose to individual radiation worker: 130 millirem • Average annual radiation worker risk: 7.8×10^{-5} LCF • Collective annual dose to radiation workers: 639 person-rem • Total annual radiation worker risk: 0.38 LCF
Cultural and Paleontological Resources **(*see* Section 5.8)**		
Potential impacts to cultural resources would be avoided or reduced by locating projects in areas previously disturbed and with modern developments already present; rerouting construction to avoid resources; marking or fencing cultural resources that are at risk; and monitoring construction activities to ensure erosion is controlled and inadvertent impacts do not happen. The LANL site has undergone a comprehensive review to identify significant historic buildings, structures, and objects, in accordance with its CRMP. The Manhattan Project National Historical Park properties would see beneficial impacts from relocating operations that work with explosives away from those properties.	Eleven known cultural resources could be physically impacted; four are considered significant and would require mitigation prior to construction. It is anticipated that four new facilities in the Pajarito Corridor Planning Area as well as the increased worker activity in the area could result in impacts to the settings of traditional cultural properties and associated practices. In addition, two of the nine potential solar PV array areas and the TA-72 parking area and bus transfer station are likely to impact the settings of traditional cultural properties. Additional tribal consultations would be required for these projects. Fire Station 5 in TA-16 has been declared eligible for listing on the *National Register of Historic Places* as a historic building. Its upgrade and adaptive reuse would be implemented in accordance with LANL's CRMP.	Twenty-two known cultural resources could be physically impacted (in addition to those identified in the Modernized Operations Alternative); fifteen are considered significant and would require mitigation prior to construction. Twelve of the known resources would be impacted by the 20-acre pumped hydropower facility in TA-39 and TA-49. Proposals without specific locations (e.g., burial of site utility lines, forest thinning and wildland fire risk reduction treatments, and feral/invasive cattle management) would be managed in accordance with the CRMP and Section 106 Programmatic Agreement, as necessary.

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Consultation for the Chromium Final Remedy EA is ongoing. Cultural resources in the area of potential effect are within the Pueblo de San Ildefonso Reservation, and the Pueblo cultural resources concerns for the hexavalent chromium plume area have yet to be identified.		
***Socioeconomics* (*see* Section 5.9)**		
The following socioeconomic impacts are in addition to the baseline described in Section 4.9. • Additional direct employment: 1,530 • Additional indirect employment: 700 • Additional direct earnings: $163.6M • Anticipated value added from LANL: $246.8M There would be an average of 650 construction/ DD&D workers per year, peaking at 1,300 workers in any given year, through 2029; DD&D would continue through 2038. Due to the low potential for impacts on the ROI population, steady-state operations would not be expected to affect community services and schools.	The following socioeconomic impacts are in addition to the NAA. • Additional direct employment: 780 • Additional indirect employment: 284 • Additional direct earnings: $69.8M • Anticipated value added from LANL: $102.9M There would be an average of 530 construction/ DD&D workers per year, peaking at 1,060 workers in any given year. Construction and DD&D would continue in parallel with operations until 2038. Due to the low potential for impacts on the ROI population, steady-state operations would not be expected to affect community services and schools.	The following socioeconomic impacts are in addition to the NAA. • Additional direct employment: 915 • Additional indirect employment: 495 • Additional direct earnings: $112M • Anticipated value added from LANL: $171.7M There would be an average of 710 construction/ DD&D workers per year, peaking at 1,420 workers in any given year. Construction and DD&D would continue in parallel with operations until 2038. There would be no additional DD&D than that proposed under the Modernized Operations Alternative. Due to the low potential for impacts on the ROI population, steady-state operations would not be expected to affect community services and schools.
***Infrastructure* (*see* Section 5.10)**		
Existing infrastructure would be adequate to meet all requirements (*see* Table 3.8-2).	Existing infrastructure would be adequate to meet all requirements after implementation of EPCU project under the NAA (*see* Table 3.8-2).	Existing infrastructure would be adequate to meet all requirements after implementation of EPCU project under the NAA (*see* Table 3.8-2).

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Waste Management **(*see* Section 5.11)**		
Construction, environmental remediation, DD&D, and operations would generate the following projected annual quantities of waste: • LLW (m^3/yr): 9,754 • MLLW (m^3/yr): 280 • TRU/ waste (m^3/yr): 652 • Hazardous (MT/yr): 2,989 • NMSW (MT/yr):838 • Nonhazardous (MT/yr): 6,995	Operations (including construction and DD&D) would generate the following projected annual quantities of waste including that generated under the NAA: • LLW (m^3/yr): 10,680 • MLLW (m^3/yr): 296 • TRU/ waste (m^3/yr): 655 • Hazardous (MT/yr): 3,157 • NMSW (MT/yr): 1,636 • Nonhazardous (MT/yr): 11,385	Operations (including construction and DD&D) would generate the following projected annual quantities of waste including that generated under the NAA: • LLW (m^3/yr): 12,051 • MLLW (m^3/yr): 323 • TRU/ waste (m^3/yr): 670 • Hazardous (MT/yr): 3,312 • NMSW (MT/yr): 4,514 • Nonhazardous (MT/yr): 11,485
Transportation and Traffic **(*see* Section 5.12)**		
Traffic and Parking: Construction/DD&D activities would utilize the existing transportation infrastructure in the region and could potentially cause periodic light-to-moderate adverse impacts to local traffic flows from construction-worker commuting and the intermittent presence of additional construction vehicles. A gradual increase (i.e., less than or equal to 2.1 percent per year in the first 4 years) in the LANL workforce under the No-Action Alternative would not be expected to significantly, adversely impact operation of the primary and secondary road networks at LANL. The proposed parking structure in TA-48 and the offsite parking and shuttle service would help accommodate increased levels of onsite traffic and parking. The Laboratory would deploy 26 acres of new or reconfigured roads and 18 additional acres of parking, both of which would improve onsite vehicular flows and address parking space shortages.	Traffic and parking: The impacts to traffic and local transportation would not be notably different than under the NAA. Construction of five parking structures, a 25-acre remote parking and bus transfer station, 41 acres of new or reconfigured roads, and 11 acres of parking associated with the new facilities. The Los Alamos Canyon Bridge replacement should improve traffic flow, although during construction, traffic congestion would be expected in the area. Radiological Transport: • Dose to transport-crews: 1,171 person-rem per year • LCF risk to transport crews: 0.70 LCF • Incident-free dose to general public: 159 person-rem • LCF risk to public: 0.096 LCF • Accident risk to public: 5.6×10^{-4} LCF • Number of traffic fatalities from accidents: 0.041	Traffic and parking: The impacts to traffic and local transportation would not be notably different than under the NAA. Construction of 20 acres of new or reconfigured roads and 6 acres of parking associated with new facilities, beyond that described for the Modernized Operations Alternative Radiological Transport: • Dose to transport-crews: 1,200 person-rem per year • LCF risk to transport crews: 0.72 LCF • Incident-free dose to general public: 172 person-rem • LCF risk to public: 0.10 LCF • Accident risk to public: 5.6×10^{-4} LCF • Number of traffic fatalities from accidents: 0.045

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Radiological Transport: During operations, DD&D, and environmental remediation, LANL would regularly transport radiological waste, SNM, and other nuclear materials to and from the LANL site. The estimated impacts of these shipments would be: • Dose to transport-crews: 1,153 person-rem per year • LCF Risk to transport crews: 0.69 LCF • Incident-free dose to general public: 154 person-rem • LCF Risk to Public: 0.092 LCF • Accident Risk to Public: 5.6×10-4 LCF • Number of Traffic Fatalities from Accidents: 0.038 An estimated annual total of 210 SNM/high-activity material shipments (including pits to and from Pantex) would be made between 2024 and 2038 to and from LANL. About 886 LLW/MLLW offsite shipments (assumed for analytical purposes to go to NNSS) and 166 TRU waste shipments to WIPP would occur annually. Annual offsite shipments of hazardous waste would increase by approximately 4% over baseline conditions.	Approximately 975 LLW/MLLW offsite shipments to NNSS and 167 TRU waste shipments to WIPP would occur annually, an increase of 10% and 0.6%, respectively, over the NAA. Annual offsite shipments of hazardous waste would increase by about 5% over that projected for the NAA.	An estimated total of 219 SNM/high-activity material shipments would be made annually between 2024 and 2038 to and from LANL, an increase of nine annual shipments, or 4%, over the NAA. Approximately 1,107 offsite shipments of LLW/MLLW (assumed for analytical purposes to go to NNSS) and 172 TRU waste shipments to WIPP would occur annually, an increase of 25% and 3.6%, respectively, over the No-Action Alternative. Annual offsite shipments of hazardous waste would increase by about 10% over that projected for the NAA.
Environmental Justice **(*see* Section 5.13)**		
NNSA evaluated the potential impacts from construction, environmental remediation, DD&D, and operational activities at LANL in all resource areas and identified no disproportionate and adverse impacts to communities with environmental justice concerns.	NNSA evaluated the potential impacts from construction, environmental remediation, DD&D, and operational activities at LANL in all resource areas and identified no disproportionate and adverse impacts to communities with environmental justice concerns.	NNSA evaluated the potential impacts from construction, environmental remediation, DD&D, and operational activities at LANL in all resource areas and identified no disproportionate and adverse impacts to communities with environmental justice concerns.

No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Potential conveyance and transfer of 570 acres in Rendija Canyon could be developed into residential housing. Based on the CT EIS, restricting public use of roads and trails in Rendija Canyon would hinder public access to National Forest lands, which serve as traditional firewood gathering and collection areas for other forest products by local Hispanic and Native American populations. Restricted access to this area could have a disproportionate adverse impact on minority populations.		
***Accidents and Intentional Destructive Acts* (*see* Section 5.14)**		
The range of potential accident risks from operating facilities under the NAA are presented in Table 3.8-3. Impacts of potential site-wide events (seismic, wildfire) assumed to affect multiple facilities are presented in Table 3.8-4. Potential impacts from intentional destructive acts may be similar to or could exceed the range of potential accident impacts presented in this SWEIS. Analysis of these potential impacts are presented in a classified appendix.	The range of accidents presented for the NAA would also be representative of operations under the Modernized Operations Alternative, which are presented in Table 3.8-3. The impacts of potential site-wide events would be the same as under the NAA. Potential impacts from intentional destructive acts may be similar to or could exceed the range of potential accident impacts presented in this SWEIS. Analysis of these potential impacts are presented in a classified appendix.	The range of accidents presented for the NAA would also be representative of operations under the Expanded Operations Alternative, which are presented in Table 3.8-3. Specific accidents associated with Expanded Operations are discussed in Appendix D, Section D.3.5.3. Because of the addition of proposed TRU waste staging areas, impacts of potential site-wide events would be higher than the NAA. These impacts are presented in Table 3.8-4. Potential impacts from intentional destructive acts may be similar to or could exceed the range of potential accident impacts presented in this SWEIS. Analysis of these potential impacts are presented in a classified appendix.

Ci = curie; CO_2e = carbon dioxide equivalent; CRMP = Cultural Resources Management Plan; CT EIS = *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico*; DD&D = decontamination, decommissioning, and demolition; EPCU = Electric Power Capacity Upgrade; FSI - future supercomputing infrastructure; FTWC = flanged tritium waste container; GHG = greenhouse gas; GMAP = gaseous mixed activation products; HMP = Threatened and Endangered Species Habitat Management Plan; HPC = high-performance computing; LANL = Los Alamos National Laboratory; LCF = latent cancer fatality; m^3/yr = cubic meters per year; MEI = maximally exposed individual; MFP = mixed fission products; MT/yr = metric ton per year; MW = megawatt; NAA = No-Action Alternative; NMSW = New Mexico Special Waste; NNSA = National Nuclear Security Administration; NNSS = Nevada National Security Site; NPDES = National Pollutant Discharge Elimination System; OB/OD = open burning/open detonation; PM_{10} = particulate matter less than 10 microns in diameter; PV = photovoltaic; P/VAP = particulate/vapor activation products; ROI = region of influence; SWEIS = supplemental environmental impact statement; TA = technical area; TRU = transuranic; USFWS = U.S. Fish and Wildlife Service; VRM = Visual Resource Management; WTF = water treatment facility

Table 3.8-2 Summary of Consequences Related to Infrastructure

Resource Parameter	Existing Capacity	Baseline Average (2017-2022)	No-Action Demand	Modernized Operations	Expanded Operations
Domestic water (MGY)	542	266	290	300	495
Sanitary wastewater (gal/d)	602,800	312,600	371,400	387,650	409,275
Electricity – power consumption (MkW-hr/yr)	651[a]	451 average	621 average; 730 peak[b]	658 average; 774 peak[b]	810 average; 1,174 peak[b]
Electricity – average annual peak demand (MW)	116.0[a]	70.0 average	86.7 average; 111.4 peak[b]	92 average; 132 peak[b]	110 average; 171 peak[b]
Natural gas (dec/d)	22,110	4,755	4,155	3,913	3,913
Petroleum fuel (gal/yr)	Not Applicable	525,130	426,000	440,000	483,000

DD&D = decontamination, decommissioning, and demolition; dec/d = decatherms per day; EPCU = electric power capacity upgrade; gal/d = gallons per day; gal/yr = gallons per year; MGY = million gallons per year; MkW-hr/yr = million kilowatt-hours per year; MW = megawatt

a Electrical consumption and import capacity are expected to increase from 651 to 1,100 million kw-hr per year and from 116 MW to 200 MW, respectively, upon completion of the EPCU project under the No-Action Alternative.

b Monthly peak.

Table 3.8-3 Summary of Accident Risks Applicable to All Alternatives

Accident Scenario	Conservative Meteorology[a]		Average Meteorology	
	MEI (LCF)	Offsite Population (LCF)	MEI (LCF)	Offsite Population (LCF)
DBA-1: TA-55, PF-4: Plutonium Facility glovebox fire	1.15×10^{-6}	1.13×10^{-4}	1.64×10^{-7}	2.01×10^{-5}
DBA-2: TA-55, PF-4: Plutonium Facility fire involving heat source plutonium	2.48×10^{-8}	1.21×10^{-6}	1.74×10^{-9}	2.12×10^{-7}
DBA-3: TA-54, Area G: Vehicle impact while transporting TRU waste containers with ensuing fuel pool fire	1.01×10^{-7}	2.25×10^{-6}	2.06×10^{-8}	4.12×10^{-7}
DBA-4: TA-54, Area G: Refueling vehicle impacts TRU Storage Array with ensuing fuel pool fire	8.28×10^{-7}	1.08×10^{-5}	9.12×10^{-8}	1.95×10^{-6}
DBA-5: TA-54, Area G: Large combustible fire in TRU Storage Array	1.02×10^{-7}	3.37×10^{-6}	2.65×10^{-8}	6.00×10^{-7}
DBA-6: TA-54, Area G: FTWC explosion causing sympathetic explosion of the other FTWCs resulting in a pressurized release of tritium	1.32×10^{-8}	2.70×10^{-6}	3.77×10^{-9}	2.72×10^{-7}
DBA-7: TA-3, CMR: Explosion in CMR Wing 9	4.98×10^{-7}	1.63×10^{-4}	1.51×10^{-7}	3.00×10^{-5}
DBA-8: TA-54, RANT: Vehicle impacts waste containers inside RANT with ensuing pool fire	2.90×10^{-7}	1.41×10^{-5}	8.22×10^{-8}	2.95×10^{-6}
DBA-9: TA-16, WETF: Process Room fire	6.63×10^{-7}	2.82×10^{-4}	3.55×10^{-7}	3.09×10^{-5}
DBA-10: TA-63, TWF: Vehicle impact in Shipping/Receiving Area with ensuing pool fire	1.11×10^{-8}	2.76×10^{-6}	1.64×10^{-9}	4.76×10^{-7}
DBA-11: TA-50, WCRRF: High impact seismic event and fire inside building	5.52×10^{-7}	1.12×10^{-4}	8.46×10^{-8}	1.92×10^{-5}
DBA-12: TA-50, TLW: External fire spreads into the TLW Treatment Facility	3.48×10^{-8}	4.62×10^{-6}	4.79×10^{-9}	8.21×10^{-7}
DBA-13: TA-53, LANSCE: Explosion due to deflagration from natural gas leak	7.80×10^{-8}	2.79×10^{-6}	1.81×10^{-8}	5.42×10^{-7}

CMR = Chemistry and Metallurgy Research Facility; ER = Experimental Room in Lujan Center; FTWC = flanged tritium waste container; LANSCE = Los Alamos Neutron Science Center; LCF = latent cancer fatality; MEI = maximally exposed individual; RANT = Radioassay and Nondestructive Testing Facility; TA = technical area; TLW = TRU Liquid Waste Treatment Facility; TRU = transuranic; TWF = Transuranic Waste Facility; WCRRF = Waste Characterization, Reduction, and Repackaging Facility; WETF = Weapons Engineering Tritium Facility

a Conservative meteorology is based on five years of site meteorological data (i.e., 2016–2020). Stability Class F is the most stable condition reported in the site meteorological data and, combined with a low wind speed of 1 meter/second, would result in the highest public dose. The representative public exposure from a release under these conservative meteorology conditions is not expected to be exceeded more than 5 percent of the time (i.e., 95th percentile weather statistics) for a randomly initiated accident. Actual site meteorological data over the period 2016–2020 reflect that wind speeds less than 1 meter/second and Stability Class F occurs less than 2.5 percent of the time.

Table 3.8-4 Summary of Impacts from Potential Site-Wide Events

Site-wide Event	Average Meteorology	
	MEI (LCF)	Offsite Population (LCF)
No-Action Alternative		
Annual Risk Totals for SDC-2 Seismic/Fire involved Facilities	3.36×10^{-7}	1.38×10^{-5}
Annual Risk Totals for SDC-3 Seismic/Fire involved Facilities – Entire Site (SDC-2 plus SDC-3)	5.30×10^{-7}	3.35×10^{-5}
Annual Risk Totals for Site-wide Wildfire Event	2.66×10^{-6}	2.85×10^{-4}
Modernized Operations Alternative		
Annual Risk Totals for SDC-2 Seismic/Fire involved Facilities	3.36×10^{-7}	1.38×10^{-5}
Annual Risk Totals for SDC-3 Seismic/Fire involved Facilities – Entire Site (SDC-2 plus SDC-3)	5.30×10^{-7}	3.35×10^{-5}
Annual Risk Totals for Site-wide Wildfire Event	2.66×10^{-6}	2.85×10^{-4}
Expanded Operations Alternative		
Annual Risk Totals for SDC-2 Seismic/Fire involved Facilities – Expanded Operations Alternative	4.47×10^{-7}	2.51×10^{-5}
Annual Risk Totals for SDC-3 Seismic/Fire involving SDC-3 Seismic/Fire Involving Entire Site (SDC-2 plus SDC-3 Seismic/Fire Events)	8.55×10^{-7}	4.89×10^{-5}
Annual Risk Totals for Site-wide Wildfire Event	3.53×10^{-6}	3.75×10^{-4}

LCF = latent cancer fatality; MEI = maximally exposed individual; SDC = seismic design category

CHAPTER 4
AFFECTED ENVIRONMENT

4.0 AFFECTED ENVIRONMENT

4.1 Introduction

LANL is located in north-central New Mexico, 60 miles north-northeast of Albuquerque, 25 miles northwest of Santa Fe, and 20 miles southwest of Española in Los Alamos and Santa Fe counties (*see* Chapter 1, Figure 1.2-1). LANL and the surrounding region are characterized by forested areas with mountains, canyons, and valleys, as well as diverse cultures and ecosystems. The area is dominated by the Jemez Mountains to the west and the Sangre de Cristo Mountains to the east. These two mountain ranges are divided north to south by the Rio Grande. LANL is located on the Pajarito Plateau, which is cut by 13 steeply sloped and deeply eroded canyons that have formed isolated finger-like mesas running west to east. Most structures at LANL are located on these mesas.

In accordance with the CEQ NEPA implementing regulations (40 CFR Parts 1500–1508) for preparing an EIS, the affected environment is "interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment." The affected environment descriptions in this chapter provide the context for understanding the potential environmental consequences described in Chapter 5. The descriptions serve as reference points for evaluating any environmental changes that could result from implementing the alternatives. The existing conditions for each environmental resource area were determined for ongoing operations from information provided in previous environmental studies and other reports and databases.

This SWEIS evaluates the environmental impacts of the alternatives within defined regions of influence (ROIs). The ROIs are specific to the type of effect evaluated and encompass geographic areas within which any significant impact would be expected to occur. For example, human health risks to the general public from exposure to airborne contaminant emissions are assessed for an area within a 50-mile radius of the center of the LANL site.

Most LANL operations are conducted within the contiguous LANL site, as noted on Figure 1.2-2 in Chapter 1. LANL also conducts limited activities at TA-57 at Fenton Hill (20 miles west of the LANL site) and several leased properties, including but not limited to storage facilities and office space (referred to as TA-0). Other offsite properties associated with LANL include the Rendija Canyon Tract (TA-74), which has been evaluated for conveyance to Los Alamos County and consists of about 910 acres (DOE 1999b). As described below in Section 4.2.1.2, the Laboratory leases office space in Santa Fe, New Mexico. This is included in the TA-47 designation. Other offsite locations may include limited activities on federal, state, and private properties, such as national security projects throughout the U.S. and overseas.

Many of LANL's missions are Many of LANL's missions are fulfilled through collaborations, both on site and off site, with scientific and institutional support organizations throughout the world. LANL also provides support and guidance nationally and internationally for emergency assessments in response to chemical, nuclear, and biological incidents, joining with other similar teams across the DOE complex (as described for the Global Security Program in Appendix A, Section A.2.2.2).

Table 4.1-1 provides brief descriptions of the ROIs for the resource areas analyzed in this SWEIS. Descriptions of the methodology used to evaluate impacts are presented in Appendix C.

Table 4.1-1 General Regions of Influence for the Existing Environment

Environmental Resource	Region of Influence
Land and visual resources	LANL site and nearby offsite areas
Geology and soils	LANL site and nearby offsite areas
Water resources	LANL site and adjacent surface water and groundwater under the LANL site, nearby offsite areas, and extending northward into southern Colorado
Climate, air quality, and noise	LANL site, nearby offsite areas within local air quality control regions
Noise	LANL site, nearby offsite areas, and access routes to and from the site
Ecological resources	LANL site and nearby offsite areas
Human health and safety	LANL site and nearby offsite areas within 50 miles
Cultural and paleontological resources	LANL site and nearby offsite areas
Socioeconomics	The five-county region where the majority of LANL employees reside
Infrastructure	LANL site and nearby offsite areas
Waste management	LANL site and nearby offsite areas, plus offsite waste disposal areas
Transportation	Transportation corridors between LANL and other sites where wastes/materials are transported
Environmental justice	Minority and low-income populations within 50 miles of the LANL site
Environmental restoration	LANL site and nearby offsite areas

4.2 Land Resources

This section summarizes and analyzes existing onsite land uses at LANL and offsite leased properties (Section 4.2.1) and the overall visual character and distinct visual features on and in the viewshed of LANL (Section 4.2.2).

4.2.1 Land Use

Land use describes the human use of land. It represents current use and plans and programs that guide the future use and development of an area. Categories of land use include agricultural, commercial, industrial, military, mixed-use, natural, recreational, and residential.

In addition to discussing existing onsite land uses at LANL, this section also addresses adopted land use designations, ownership, and management of the surrounding areas. Owners and managers of land in the LANL ROI include federal, tribal, and local governments as well as private organizations and individuals.

Land uses in the vicinity of LANL are identified through a review of existing federal, tribal, state, county, and community-level land use plans. There are no comprehensive federal regulations that address all land use categories. Communities limit allowable land uses in certain areas by implementing general plans and zoning codes. Land use planning ensures compatible land uses and predictable future development. City or county organizations have no planning jurisdiction at the Laboratory because it is a federal facility owned by DOE. Nevertheless, the Laboratory does consider and engage in local planning policies, to the extent practicable, in its land use decisions to promote common land use goals and to resolve cross-jurisdictional issues. Section 4.2.1.5

discusses surrounding land uses and ownership and provides a graphical representation of the region.

4.2.1.1 LANL Location and Setting

LANL is sited on the Pajarito Plateau, part of the Jemez Mountains—the southernmost reach of the Rocky Mountains. The Pajarito Plateau features a series of mesas separated by deep, east-to-west-trending canyons. Development of LANL is concentrated on the flat mesa tops with onsite elevations ranging from approximately 6,200 to 7,800 feet above sea level. LANL is physically bounded to the west by the Sierra de los Valles range of the Jemez Mountains and to the east by White Rock Canyon, containing the Rio Grande.

LANL encompasses approximately 40 square miles[17] (25,536 acres) across both Los Alamos and Santa Fe counties and is divided into TAs (*see* Figure 1.2-2 in Chapter 1). Portions of Sandoval County border the site. LANL is surrounded by land managed by other federal agencies, including the National Park Service (NPS), the USFS, and U.S. Bureau of Land Management (BLM), as well as the Pueblo de San Ildefonso. The towns of Los Alamos and White Rock border the site to the north and east, respectively.

4.2.1.2 Existing Onsite Land Uses

In 1943, Los Alamos was chosen as the site of the Manhattan Project's Project Y for its isolated location and nearby recreational access. Development of Project Y (now LANL) began with the construction of approximately 93,000 square feet of space. At the end of 2022, LANL operations comprised 898 buildings containing about 8,200,000 square feet of space (LANL 2024a). While the number of structures changes with time (due to frequent addition or removal of temporary structures and miscellaneous buildings), the breakdown of structures as of 2022 is 728 permanent structures, 126 temporary structures (e.g., trailers, transportables, and transportainers), and 44 buildings and trailers off site within Los Alamos County, Santa Fe County, and Carlsbad, New Mexico (LANL 2024a). Appendix A, Section A.6.2.8 of this SWEIS provides information on the amount of offsite leased office and warehouse space in Los Alamos and Santa Fe counties.

The Laboratory is divided into 50 TAs including TA-0, which comprises leased space within the Los Alamos townsite and White Rock; TA-47, which comprises leased space in Santa Fe; and TA-57 at Fenton Hill in the Jemez Mountains, about 20 miles west of LANL. The locations and spacing of the built environment reflect the Laboratory's historical development patterns, regional topography, and functional relationships. LANL's development is crucial but geographically limited to a few key areas due to rugged terrain, imposing physical constraints on future growth. Nearly 71 percent of LANL's land area is categorized as unbuildable (*see* Figure 4.2-6 and the discussion on planning areas below). There are no agricultural activities on LANL, nor are there any prime farmlands in the near vicinity (USDA 2021a).

[17] The current site footprint reflects all past land transfers and conveyances as identified in Section 4.2.1.5 and shown on Figure 4.2-5.

As shown in Figure 4.2-1, there are six land use designations at LANL:

- Administrative/Service
- Experimental Science
- High Explosives R&D and Testing
- Nuclear Materials R&D
- Theoretical Computational Science
- Undeveloped

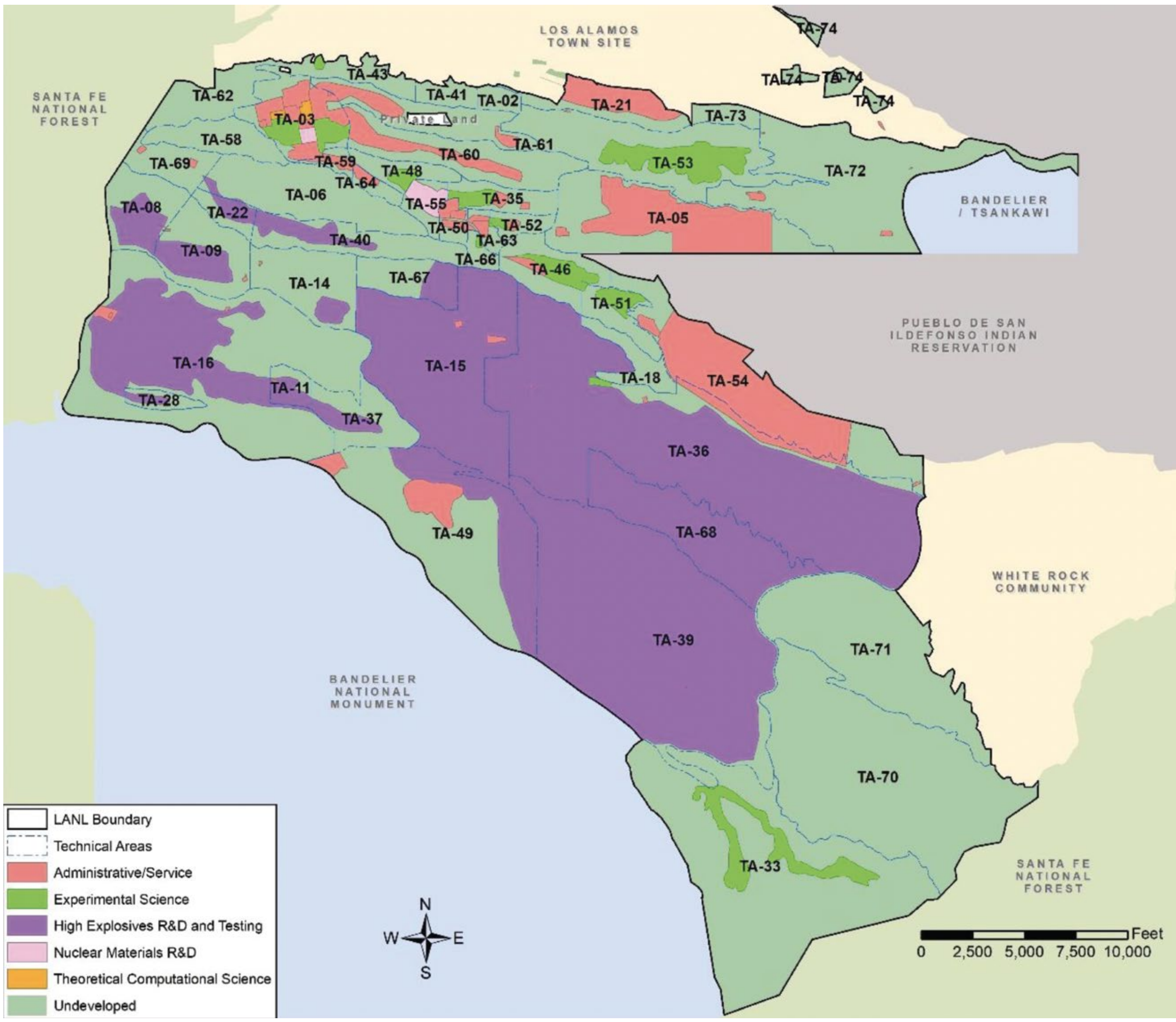
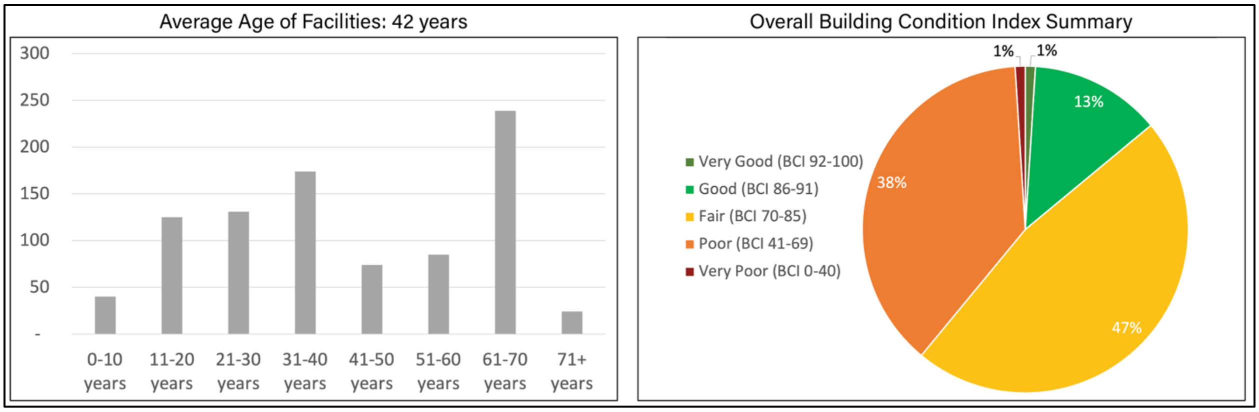


Figure 4.2-1 LANL Land Use Designations

A significant number of LANL's facilities are nearing their end-of-life. In 2021, the average age of a structure at LANL was 42 years (Figure 4.2-2). More than 30 percent of the facilities were 61 years or older, and 56 percent were more than 50 years old. A Building Condition Index of LANL's facilities found that 39 percent were graded "poor" or "very poor" and only 14 percent of the portfolio were classified as "good" or better (LANL 2021c). As new facilities come online to replace aging structures, both the average age and condition of the built environment will improve.



Source: LANL (2024a)

Figure 4.2-2 LANL Facility Age and Building Condition Index

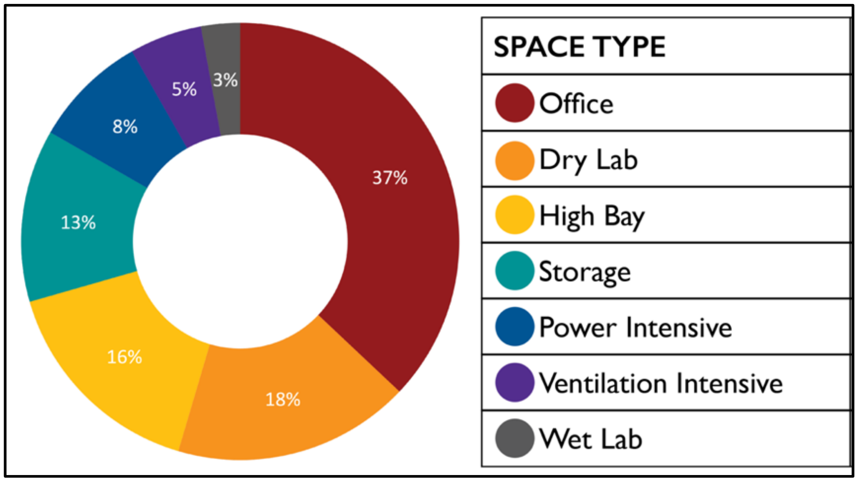
In 2008, the built environment at LANL totaled approximately 8.6 million square feet. As the building portfolio at LANL ages, the Laboratory engages in DD&D activities to remove structures that are past the end of their useful life. Table 4.2-1 shows the annual elimination of these buildings and the cumulative DD&D. Although the Laboratory has engaged in the DD&D of approximately 1.1 million square feet of its facilities, the total site footprint has only decreased by approximately 400,000 square feet due to enduring construction actions offsetting the loss of facilities.

Table 4.2-1 Decontamination, Decommissioning, and Demolition Since 2008 (square feet)

Year	Annual DD&D	Cumulative DD&D
2008	79,000	79,000
2009	53,835	132,835
2010	268,902	401,737
2011	425,343	827,080
2012	46,407	873,487
2013	49,032	922,519
2014	36,672	959,191
2015	29,025	988,216
2016	27,345	1,015,561
2017	25,925	1,041,486
2018	25,021	1,066,507
2019	29,588	1,096,095
2020	513	1,096,513
2021	14,902	1,111,510
2022	24,597	1,136,107

DD&D = decontamination, decommissioning, and demolition
Source: LANL (2024a)

As outlined in Figure 4.2-3, LANL includes a mix of space types; offices make up the biggest space use type, totaling 37 percent of the built environment (LANL 2021c).



Source: LANL (2021c)

Figure 4.2-3 LANL Built Environment Space Types by Occupied Net Square Footage

4.2.1.3 LANL Planning Areas

As described in Chapter 3, Section 3.1, the Laboratory developed a comprehensive CMP to facilitate the modernization of the LANL site. Development of the CMP was a significant undertaking and required changes in how the Laboratory evaluates, prioritizes, communicates, and executes site infrastructure and land use planning to support the mission and operations (near-, mid-, and long-term) of the LANL site. As depicted in Chapter 1, Figure 1.2-2, the CMP grouped the onsite TAs into five major planning areas based on aggregated capabilities and physical location:

1. Core Area,
2. Pajarito Corridor,
3. NEEWC,
4. LANSCE, and
5. Balance of Site.

DOE-EM, through EM-LA, has responsibility for environmental cleanup of legacy contamination, TRU waste disposition, and the DD&D of assigned process-contaminated excess facilities at LANL. The majority of these activities are ongoing in TA-21 and TA-54. For analytical purposes in this SWEIS, these TAs are considered part of the Balance of Site Planning Area.

The CMP provides a mission-driven road map for the future growth and development of LANL. Table 4.2-2 details the five planning areas by TA, total land area, buildable land area, and developed land area. About 29 percent of the approximately 40-square-mile LANL site is considered buildable, and about 13 percent is currently developed with facilities and infrastructure.

Table 4.2-3 outlines the built environment and development patterns within each planning area. It highlights the gross square footage and development density (LANL 2024c).

Table 4.2-2 LANL Planning Area Development Footprint (acres)

Planning Area	Technical Area[a]	Total Land Area	Buildable Land Area[b]	Developed Land Area	Percent of Buildable Developed
Core Area	3, **43**, **58**, **59**, **60**, **61**, **62**	564	382	354	93%
Pajarito Corridor	35, 46, 48, 50, 51, 52, 55, **59**, 63, 64, 66	1,148	616	383	62%
NEEWC	6, 8, 9, 11, 14, 15, 16, 22, 28, **36**, 37, 39, 40, 67, 68, 69	11,438	3,685	1,366	37%
LANSCE	53	751	272	224	82%
Balance of Site	2, 5, 18, 21, 33, **36**, 41, **43**, 49, 54, 57, **58**, **60**, **61, 62**, 70, 71, 72, 73, 74	11,635	2,351	959	41%
TOTALS		**25,536**	**7,305**	**3,286**	**45%**

a. Bolded text indicates technical areas that are split between two planning areas.
b. The amount of buildable area was determined using geographic information system data and represents areas with minimal constraints to development (e.g., areas of less than 20-precent slope).
Source: LANL (2024c)

Table 4.2-3 LANL Development Density[a] by Planning Area

Planning Area	Gross Square Feet	Development Density (GSF/buildable acre)
Core Area	3,805,000	9,961
Pajarito Corridor	1,966,000	3,192
NEEWC	1,136,000	308
LANSCE	983,000	3,614
Balance of Site	298,000	127
TOTALS	**8,188,000**	**1,121**

GSF = gross square feet; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Campus
a. Development density is defined as the gross square footage of facilities per acre of buildable land.
Source: LANL (2024c)

Core Area. The Core Area Planning Area is the heart of LANL operations and acts as the "public face" of the Laboratory. It is the oldest developed area of LANL and contains a mix of both old and obsolete facilities and modern structures. Its location close to the Los Alamos townsite reflects the historical development patterns that occurred during the early years of the Manhattan Project. It contains all of TA-3 and the portions of the surrounding TAs identified in Table 4.2-2. It is host to most of the key administrative functions and personnel from three associate lab directorates: Science, Technology, and Engineering; Operations; and Weapons.

Despite a relatively small land area, the Core Area Planning Area is home to the greatest concentration of development, housing approximately 3.8 million square feet of facilities. The Core Area features a development density of 9,961 gross square feet per buildable acre, roughly two-and-a-half times greater than the next most densely developed planning area, LANSCE. Past and future development in the Core Area is guided on a "campus-style" collection of facilities and site circulation. The area is fully built out with few greenfield[18] building sites remaining. Approximately 93 percent of the buildable land has been developed. Future development will be mostly constrained to brownfields[19] and redevelopment activity. Its close proximity to the Los Alamos townsite further limits future mission uses and development (LANL 2021c).

Pajarito Corridor. The CMP divides the Pajarito Corridor into "east" and "west" areas; for the purposes of this SWEIS, the two sub-areas are combined into one planning area. Similar to the Core Area, the Pajarito Corridor's total land area is relatively modest but highly developed. It is the third largest planning area in terms of gross square feet per buildable acre, at approximately 2.0 million square feet of facility footprint.

Located east of the Core Area, the Pajarito Corridor Planning Area is the physical center of nuclear research and production at the Laboratory. It houses facilities that support weapons production, testing, verification activities, and science functions. The area also enables science research and development activities including radiological hot cells, high-energy laboratories, and fabrication. The built environment features large-scale warehousing, office space, and light laboratories to support Laboratory core missions. Approximately 62 percent of the planning area's buildable footprint is developed, with a development density of 3,192 gross square feet per buildable acre. New development in the Pajarito Corridor may be limited by topography, existing infrastructure, and transportation network constraints (LANL 2021c).

National Energetic and Engineering Weapons Campus. The NEEWC Planning Area is the HE, engineering, and environmental testing site for LANL weapons programs. The NEEWC is the second largest of the planning areas by land area, at approximately 18 square miles (11,438 acres). The large geographic area reflects its past and current use as a test site and security considerations that prevent a dense campus-like development. It comprises many TAs that support small- to mid-scale operations, support and fabrication operations, and large-scale dynamic testing. The NEEWC plays a critical role in the Laboratory's mission to ensure the safety, security, and reliability of the nuclear stockpile.

The built environment in the NEEWC Planning Area is a collection of aging structures, the majority of which were built in the 1950s, some dating back to the Laboratory's earliest days in the 1940s. The sprawling planning area houses 1.1 million square feet of facilities across its vast area, resulting in a low development density of 308 gross square feet per buildable acre. With just 37 percent of its buildable land area developed, the NEEWC Planning Area features more than 2,300 acres of buildable undeveloped land, more than all of the other planning areas combined (LANL 2021c).

Los Alamos Neutron Science Center. Situated on South Mesa, the LANSCE Planning Area comprises a single TA, TA-53. It supports three of NNSA's core scientific capabilities: hydrodynamics, weapons nuclear science, and materials science. At 751 acres, it is a geographically small but highly developed planning area, with 983,000 gross square feet of facilities and a development density of 3,614 gross square feet per buildable acre. Approximately 224 of its 272 acres or 82 percent of its buildable lands are developed. It is physically separated

[18] Greenfields are raw land, unconstrained and uncontaminated by previous development activity.
[19] Brownfields are lands that have been previously developed and may include underutilized, abandoned, or idled facilities.

from the main LANL site by East Jemez Road and accessible via a single point of access at La Mesita Road with its own guard station.

LANSCE is a National User Facility with one of the nation's most powerful LINACs. The facilities within the LANSCE Planning Area exist and function to support LINAC operations. Representative of the Laboratory's portfolio, the facilities at the LANSCE Planning Area are aging and maintenance needs are challenging because the portfolio was largely constructed in the 1960s and early 1970s. Similar to the Pajarito Corridor Planning Area, development at LANSCE is constrained by topography and available utilities and infrastructure (LANL 2021c).

Balance of Site. The Balance of Site Planning Area includes the remaining TAs that do not fall under the scope of the other defined planning areas. It includes parcels recently or scheduled for transfer (*see* Section 4.2.1.5), offsite leases, White Rock Canyon Reserve,[20] and many of the legacy cleanup sites (NMED 2016a). The Balance of Site Planning Area spans the entire reach of LANL and encompasses most of the buffer zones along LANL's perimeter. It features a diverse mix of topography, missions, and functions. It is the largest planning area by land area (11,635 acres) and the smallest planning area by gross square feet of development (298,000). While it boasts the largest land area, due to the restrictions on development described above (i.e., reserves, buffer zones, cleanup sites, and topography), only 2,351 acres are considered buildable. Approximately 41 percent of the buildable land area is currently considered developed.

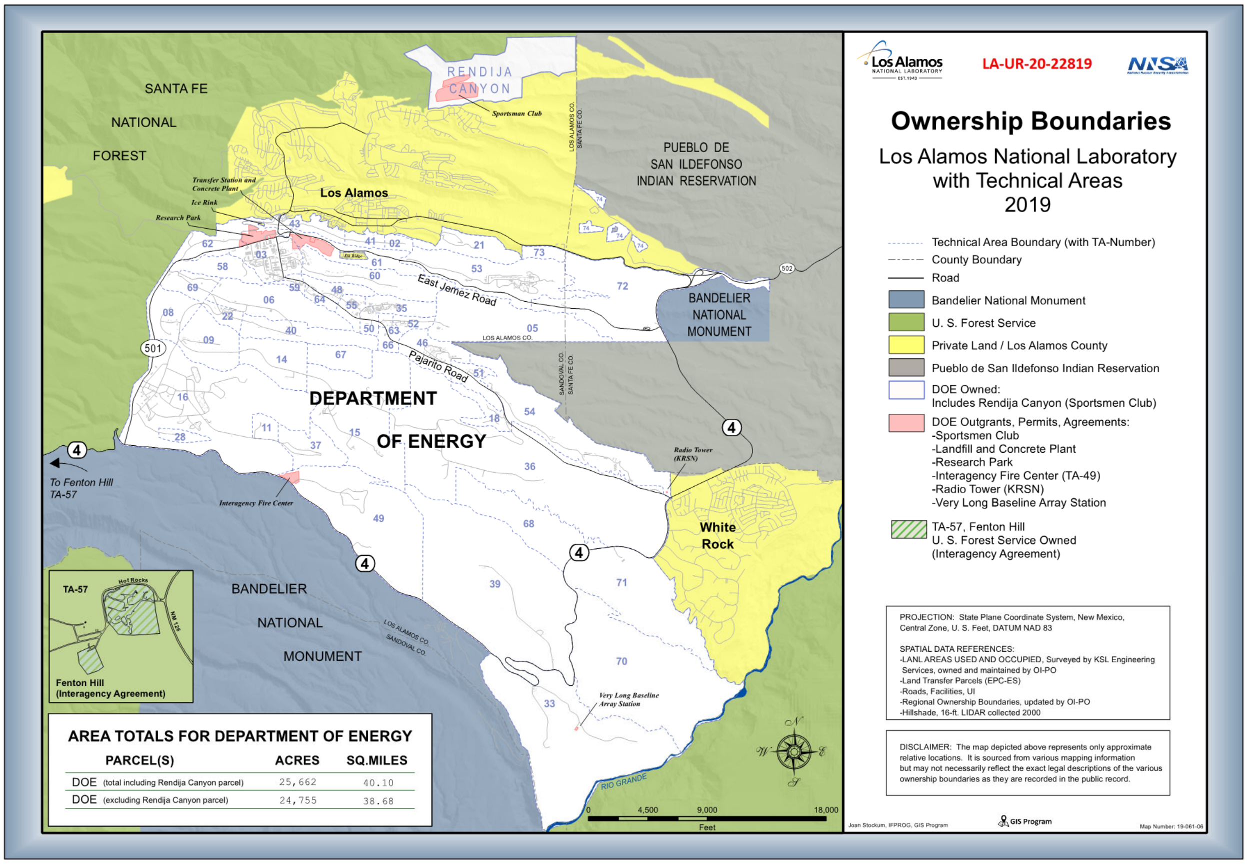
For planning purposes, offsite leases are also grouped within this planning area. As described in Appendix A, Section A.2.2.4.7 of this SWEIS, the Laboratory leases more than 450,000 square feet of office and warehouse space off site. The Balance of Site Planning Area includes TA-21 and TA-54. Portions of these TAs are managed by EM-LA, which is tasked with prioritizing the environmental cleanup of these TAs including the DD&D of shuttered facilities and remediation of MDAs. As identified in Section 4.2.1.5, portions of TA-21 have been transferred to Los Alamos County since the publication of the 2008 SWEIS and, as identified in Appendix A, Section A.3.2.2, 220 acres remain to be transferred following the completion of cleanup activities.

4.2.1.4 Surrounding Land Uses, Plans, and Programs in the ROI

Lands in the vicinity of LANL are largely undeveloped and left in a natural state. These are categorized into three classes (Figure 4.2-4):

- **Private Land** – including the population centers of Los Alamos and White Rock;
- **Pueblo Lands (i.e., Indian reservations)** – Pueblo de San Ildefonso (abutting LANL) and Santa Clara Pueblo (noncontiguous to LANL but a nearby stakeholder) are shown on the figure. Pueblo de Cochiti and Pueblo of Jemez, also Accord Pueblos (*see* Section 4.8.5), are outside of the figure boundaries to the south and southwest, respectively; and
- **Federal Land** – Santa Fe National Forest, managed by USFS, and Bandelier National Monument, managed by the NPS.

[20] In 1999, approximately 1,000 acres of LANL's southeast perimeter along the Rio Grande was dedicated as the White Rock Canyon Reserve. Managed jointly by DOE and NPS, the reserve was created to conserve, protect, and enhance the area's significant ecological and cultural resources.



Source: LANL (2024c)

Figure 4.2-4 LANL Location and Ownership Boundaries

The towns of Los Alamos and White Rock are located within Los Alamos County. The county has a total land area of 109 square miles, of which 94 square miles, or nearly 86 percent, is owned by the Federal Government (Table 4.2-4). The land area that falls under the county's purview is largely located in the two communities of Los Alamos and White Rock. Land use for these two communities

Table 4.2-4 Land Ownership within Los Alamos County[a]

Ownership/ Management Type	Area (square miles)	Area (acres)	Percentage of County
U.S. Forest Service	45.25	28,960	41.4
U.S. Department of Energy	38.31	24,518	35.0
National Park Service	10.41	6,662	9.5
Indian/Tribal	0.06	38	0.1
Private	15.29	9,786	14.0
County Open Space[b]	~6.25	4,000	5.7
TOTALS[c]	**109.32**	**69,965**	**100.0**

a Data are current as of 2016. Does not reflect lands conveyed to the county since 2016, as identified in Section 4.2.1.8.
b Falls under "Private" ownership and is not counted again in Total row calculations.
c Totals may differ due to rounding.
Source: LAC (2016)

is managed through the *Comprehensive Plan – Los Alamos County* (LAC 2016). The comprehensive plan focuses on three core themes: (1) housing, neighborhood, and growth; (2) development and redevelopment; and (3) downtown, open space, trails, and mobility (LAC 2016). The Los Alamos County Office of Planning and Zoning has also developed a Los Alamos Downtown Master Plan and White Rock Town Center Master Plan to manage the projected economic and population growth for these population centers (LAC 2021a, 2021b). These plans were adopted by the Los Alamos County Council in October 2021.

A mobile home community is within the LANL site boundaries, Elk Ridge (labeled as "Private Land" in TA-61 in Figure 4.2-4). Elk Ridge is located at 2025 East Jemez Road in TA-61 and features 299 home lots. The site is managed by YES Communities (YES 2023). This development is not included in the LANL planning areas as it is private land within the LANL site.

Pueblo Accords

DOE entered into Accords with four pueblos (Cochiti, Jemez, San Ildefonso, and Santa Clara, collectively the Accord Pueblos) which formalize the government-to-government relationship between DOE and the four pueblos. The accords came about to build confidence and trust between the Pueblos and the Laboratory; they formally established a cooperative working relationship between the parties. The Pueblo Accords were originally executed in 1992. DOE and the Pueblos entered into Restatements of the Accords in 2005 and 2006.

The LANL M&O contractor entered into Cooperative Agreements with the four Accord Pueblos, with provisions similar to the DOE/Pueblo Accords. The cooperative agreements formalized the relationship between the M&O contractor and the pueblos, consistent with federal law as well as the provisions of the DOE Accords.

Pueblo de San Ildefonso Monitoring

The Pueblo de San Ildefonso's Department of Environmental and Cultural Preservation (DECP), through various grants and in cooperation with DOE and the LANL operating contractor, conducts a program of environmental monitoring and assessment of associated risks. Under this program, the DECP obtains environmental samples and monitors Pueblo de San Ildefonso lands. Environmental sampling and monitoring activities are conducted for air, water (both groundwater and surface water), sediment, biota, and radiation exposure. In addition, the DECP tracks sampling sites on Pueblo de San Ildefonso lands that are used by federal and state agencies, assists with maintaining these sites and collecting samples, and incorporates the sampling results from these external groups into the Pueblo's database. Monitoring activities are reported to DOE on a quarterly basis.

The lands of the Pueblo de San Ildefonso are located immediately east of LANL (*see* Figure 4.2-4). As neighbors of LANL, the Pueblo has a continuing interest in the site and its impact on Pueblo lands. The Pueblo owns or has use of more than 60,000 acres of land and is home to approximately 1,500 residents (Pueblo de San Ildefonso 2022). Pueblo land use is a mixture of residential, gardening and farming, cattle grazing, hunting, fishing, food and medicinal plant gathering, and firewood production, along with general cultural and resource preservation. Most of the inhabitants of Pueblo de San Ildefonso live along New Mexico 30 in Santa Fe County, about 3 miles northeast of the LANL boundary. The Pueblo de San Ildefonso has not adopted a formal land use plan.

The federal lands surrounding LANL include both the Santa Fe National Forest and the Bandelier National Monument. The USFS manages the Santa Fe National Forest, which encompasses approximately 1.6 million acres in the Sangre de Cristo Mountains to the east and Jemez Mountains to the west of LANL. The national forests were established as "working forests," and management activities in the Santa Fe National Forest include logging, cattle grazing, hiking, fishing, hunting, camping, and skiing (USFS 2022a). The forest contains more than 300,000 acres of dedicated

"Wilderness."[21] Wilderness Areas are federally protected places where natural biological processes are allowed to occur unhindered by human interference (USFS 2022b).

The NPS is responsible for the management of Bandelier National Monument,[22] which was established in 1916. Bandelier consists of two units: the Main Unit (32,937 acres), located immediately south of LANL, and the Tsankawi Unit (826 acres), located to the northeast of LANL near White Rock (NPS 2017). Only a small portion of the Main Unit has been developed for visitors; about 71 percent (23,267 acres) of this unit has been designated a Wilderness Area. The Tsankawi Unit is undeveloped (NPS 2017).

The Valles Caldera National Preserve is located approximately 20 miles west of LANL (NPS 2018). The preserve was created for the preservation and protection of a volcanic eruption that occurred 1.25 million years ago, which left a 13-mile circular depression now known as the Volcanic Caldera. The landscape is studded with eruptive domes, including Redondo Peak, a resurgent dome reaching 11,254 feet. The ownership and management of the Valles Caldera National Preserve have undergone significant changes over the years. In 2000, the Federal Government acquired the private, 89,000-acre Baca Ranch, marking the first step toward establishing the preserve. Fourteen years later, in 2014, the Valles Caldera National Preserve was officially dedicated as a unit of the National Park System. The following year, in 2015, the NPS took over the management of the preserve from the Valles Caldera Trust, solidifying the NPS's responsibility for the protection and preservation of this unique natural landscape (NPS 2018). The NPS is currently developing a general management plan for the preserve, which will be the primary guiding document for the national park unit. The plan will set long-term goals for the park and provide broad direction for resource preservation and visitor use. The plan will provide management direction at the broadest level and provide a framework for decisionmaking and serve as a basis for future implementation planning. According to the NPS, development and implementation of the plan is expected to run through 2025 (NPS 2023).

4.2.1.5 Land Transfers and Conveyance

In 1997, Section 632 of Public Law 105-119[23] directed DOE to convey excess land at LANL to Los Alamos County and transfer lands to the Secretary of the Interior in trust for the Pueblo de San Ildefonso. For tracts to be considered eligible, they had to meet several criteria, including that they were no longer needed by DOE for the national security mission and that they could be environmentally restored or remediated for conveyance or transfer by November 26, 2007 (subsequently extended to September 30, 2032). Prior to the most recent land conveyance and transfer initiative, LANL occupied approximately 45 square miles. To date, approximately 5.1 square miles have been conveyed or transferred. This includes about 2,100 acres for the Pueblo de San Ildefonso and 1,076 acres for Los Alamos County and the Los Alamos School District (LANL 2023a). Figure 4.2-5 highlights LANL land conveyed since issuance of the 2008 SWEIS.

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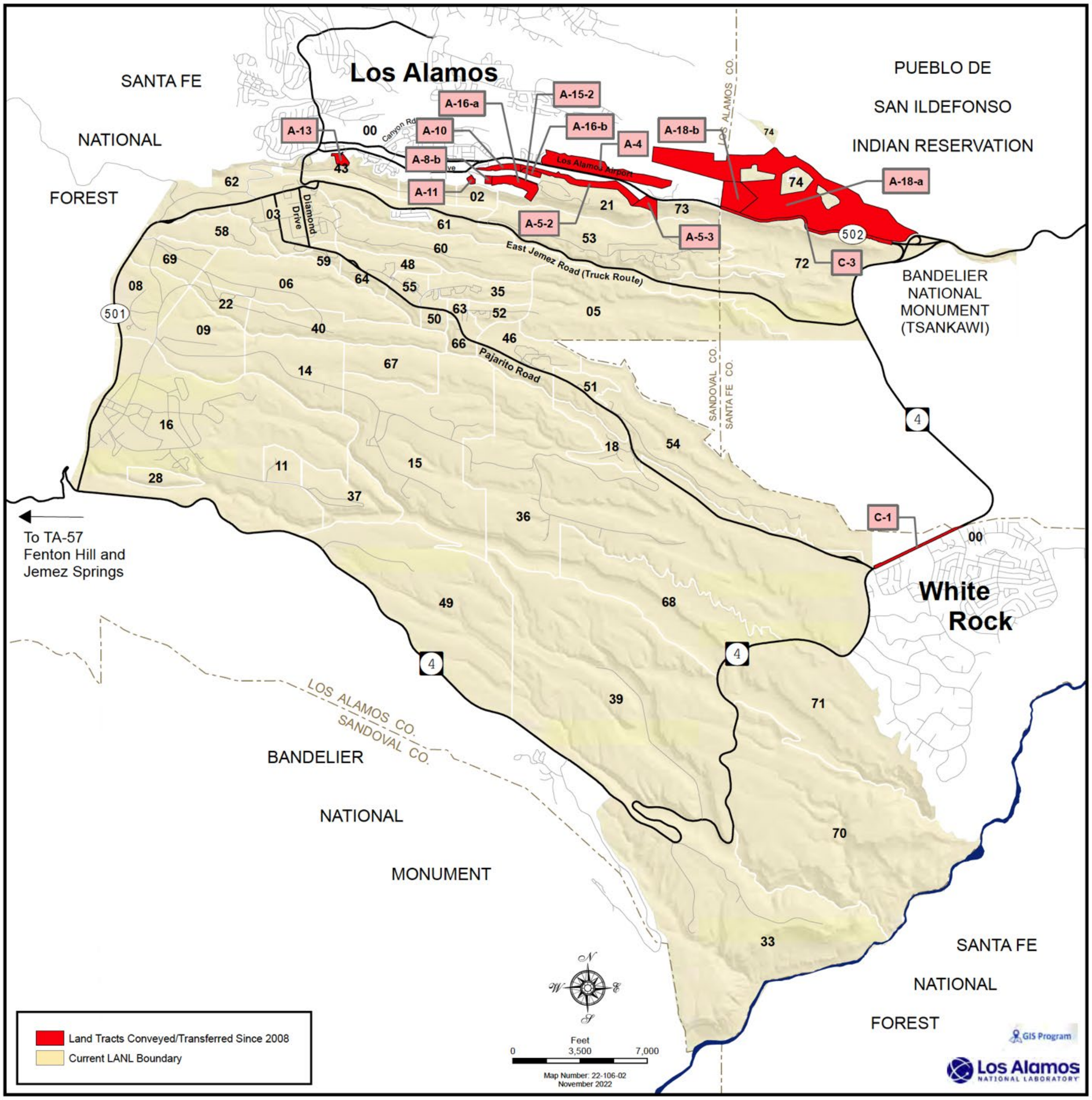
[21] *The Wilderness Act of 1964* defines wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain."

[22] National monuments differ from national parks with respect to protection: National parks are protected for their scenic, inspirational, education, and recreational value; national monuments are protected because they contain objects of historic, prehistoric, or scientific interest (NPS 2002).

[23] https://www.congress.gov/105/plaws/publ119/PLAW-105publ119.pdf



Source: LANL 2024c

Figure 4.2-5 Land Tracts Conveyed/Transferred since 2008

Several previously conveyed tracts near White Rock and the Los Alamos townsite, are being developed for nearly 500 housing units. These units include market rate, senior and low-income apartments, and single-family homes at the White Rock location. Other tracts are being planned for commercial and light-industrial development.

Conveyance or transfer of the remaining tracts that were analyzed in the CT EIS (approximately 1,280 acres) are included in the analysis of the No-Action Alternative, as identified in Chapter 3, Section 3.2.3. Under 10 CFR Part 770, "Transfer of Real Property at Defense Nuclear Facilities for Economic Development," DOE is required to further assess the potential for the transfer or conveyance of real property to local governments, tribal nations, or community reuse organizations for economic development. In 2006, DOE conducted an analysis of the remaining lands at LANL and determined that there were no additional properties that could be considered excess and recommended for conveyance and transfer (LANL 2021c).

4.2.2 Visual Resources

Visual resources are natural and manmade features that give a particular "landscape" (visible features of an area of land) or "viewshed" (view on an area from a vantage point) its character and aesthetic quality. The natural environment in the Jemez Mountains is rugged and panoramic, boasting scenic vistas of ochre tones, evergreen forests, and white summits. Mountains and mesas bisected by steeply cut canyons define the regional viewshed. The natural vegetation is varied, consisting of pine and juniper forests, low shrubs, and grasslands. Much of the site still remains in its natural state with limited land management activities. This severe landscape and undeveloped lands serve as buffer zones between LANL and the adjacent Bandelier National Monument, Santa Fe National Forest, and Pueblo de San Ildefonso.

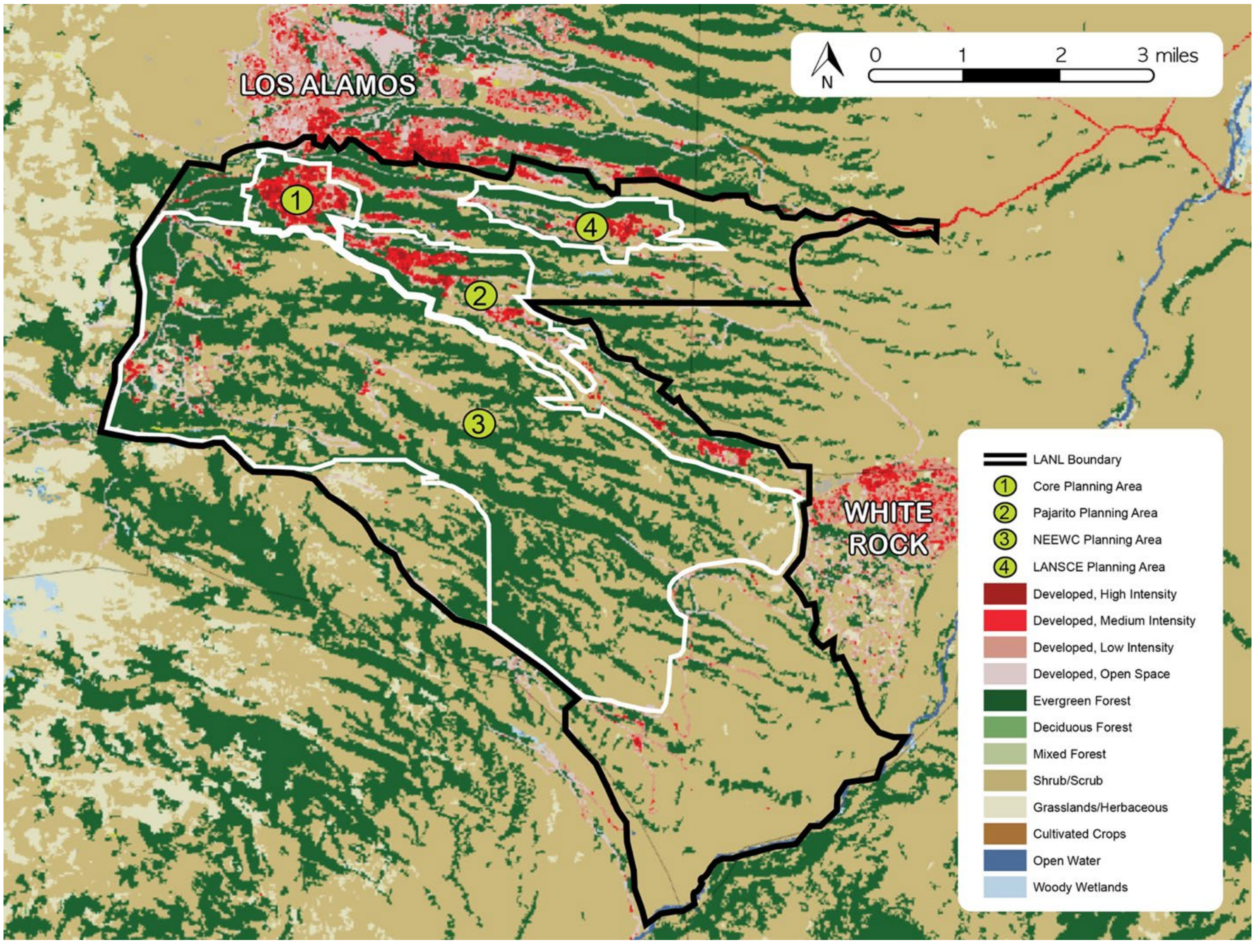
The Laboratory's mission requires developed areas and major modifications to its landscape. However, the rugged terrain has confined the LANL built environment to the mesa tops with the sharp topography acting as open space and softening the transition between LANL and adjoining lands.

Views of the developed portions of LANL from off the site portray a campus-like setting with buildings, internal roadways and pathways, and open space. Views from LANL to offsite areas are highly varied depending on the location of the onsite viewer. They range from the communities of Los Alamos and White Rock to the natural areas of Santa Fe National Forest and Bandelier National Monument.

Land cover plays a role in visual resources. The U.S. Geological Survey (USGS) maintains the National Land Cover Database, which inventories the existing character of a landscape, level of development, and degree of contrast. This SWEIS used this online database to prepare Figure 4.2-6, which shows that LANL's footprint is marked by undeveloped evergreen forests, shrublands, and grasslands that serve as a security, safety, and visual buffer zone. The database is updated every two to three years; the figure reflects data current as of 2021 and highlights the medium- and high-intensity development of the Core Area and Pajarito Corridor planning areas and pockets of development in the other planning areas.

4.2.2.1 Visual Environment at LANL

To rate the scenic quality of LANL and the surrounding areas, NNSA uses the BLM Visual Resource Management (VRM) Classification System. Although this classification system is designed for undeveloped and open land managed by BLM, this system is valid in the analysis of visual resource management and planning activities. NNSA selected the VRM system as the basis for this analysis because it is a proven and established means for determining visual values based on a set of objectives. The system is frequently used for environmental analysis and reporting across the DOE complex. Table 4.2-5 outlines the objectives of the four VRM classes.



Note: Areas within the LANL boundary but not within a labeled planning area are included in the Balance of Site.
Source: https://www.mrlc.gov/viewer/

Figure 4.2-6 Land Cover Types on LANL and Surrounding Areas

The degree to which development affects the aesthetic quality of a landscape depends on the contrast created between the project elements and the existing landscape. This SWEIS uses the BLM's degree of contrast criteria to assess the level of contrast between the proposed or existing element and the landscape in which it sits (Table 4.2-6). The four levels of contrast (i.e., none, weak, moderate, and strong) correspond to the VRM class objectives, I, II, III, and IV, respectively. For example, a "moderate" contrast rating is generally acceptable in a Class III area but may also meet the VRM objectives for a Class IV area when there are accumulating elements.

A sensitivity level analysis is an important component of the VRM. Sensitivity levels are a measure of public concern, and lands are assigned high, medium, or low sensitivity levels. A sensitivity analysis is conducted by evaluating the following factors: types of users, amount of use, public interest, adjacent land use, special areas, distance zones (foreground to midground, background, and seldom seen), and other dynamics.

Table 4.2-5 Bureau of Land Management Visual Resource Management Class Objectives

Class	Objective	Change Allowed (relative level)	Relationship to the Casual Observer
I	Preserves the existing character of the landscape. This class provides for natural ecological changes; however, it does not preclude very limited management activity.	Very Low	Activities should not be visible and **must not attract attention**.
II	Retains the existing character of the landscape. Management activities may be seen but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.	Low	Activities may be visible but **should not attract attention**.
III	Partially retains the existing character of the landscape. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.	Moderate	Activities may attract attention but **should not dominate the view**.
IV	Provides for management activities which require major modification of the existing character of the landscape. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.	High	Activities may attract attention, **may dominate the view but are still mitigated**.

Source: BLM (1986)

Table 4.2-6 Bureau of Land Management Degree of Contrast Criteria

Degree of Contrast	Criteria
None	The element contrast is not visible or perceived.
Weak	The element contrast can be seen but does not attract attention.
Moderate	The element contrast begins to attract attention and begins to dominate the characteristic landscape.
Strong	The element contrast demands attention, will not be overlooked, and is dominant in the landscape.

Source: BLM (1986)

Because LANL is not a BLM-administered site, there are no BLM classifications for LANL. The VRM class designations in the following sections were assigned using the methods and criteria described above.

LANL's planned and proposed activities would be primarily located on site.[24] The visual ROI is the location of the facilities outlined in Chapter 3 and views of the facilities from on site and public viewpoints from off the site. Special consideration is given to actions within visually sensitive locations and viewpoints from visually sensitive locations.

The bulk of land at LANL is largely undeveloped and isolated, consistent with a VRM Class I or II rating. The developed areas present a high level of contrast between the mountainous landscape and the physical improvements to the land and are more consistent with VRM Classes III and IV. Given LANL's immense land area and diverse development patterns, a single VRM class rating would not be appropriate; instead, a rating was assigned to each distinct planning area. Table 4.2-7 outlines the planning area by existing VRM class; the classes range from I to IV. Figure 4.2-7 shows the visual conditions of the four defined planning areas.[25]

Table 4.2-7 Existing Visual Resource Management Class by Planning Area

Planning Area	Existing VRM Class	Degree of Contrast	Description
Core Area	IV	High	The Core Area Planning Area is the oldest and most heavily developed area of LANL. It has the highest concentration of high- and medium-intensity development at LANL. The development pattern in the Core Area is illustrative of the typical mesa-top development found throughout LANL. There are major modifications to the landscape that dominate views on and off site. Offsite views of the Core Area portray a campus-like setting with buildings, internal roadways and pathways, and open space. Its proximity to the Los Alamos townsite opens it to the greatest amount of public interaction and scrutiny.
Pajarito Corridor	IV	High	The Pajarito Corridor Planning Area is marked by high- and medium-intensity development and major modifications to the landscape. It is one of the most developed planning areas. Development of the Pajarito Corridor dominates the landscape. It is located toward the interior of LANL and is essentially obscured from public viewpoints offsite by distance and topography. Pajarito Road through the corridor is now open to the public, so once onsite, motor vehicle users and occupants are privy to the development and operations in the planning area.
NEEWC	II	Weak to moderate	The NEEWC Planning Area is geographically sprawling, spanning from LANL's western boundary to White Rock in the east. Due to the nature of its mission, the NEEWC is mostly undeveloped, with large concentrations of evergreen forests and shrublands. There are pockets of medium- and low-intensity development scattered about this planning area, with the largest grouping of development in the western corner. The natural site character is largely preserved

[24] Exceptions would include offsite office and warehouse leases and offsite rights-of-way for power and communications corridors.
[25] Because Balance of Site represents the remainder of the site not included within one of the other planning areas, a representative picture is not included in Figure 4.2-7.

Planning Area	Existing VRM Class	Degree of Contrast	Description
			although islands of development present moderate degrees of contrast. While the degree of contrast is moderate in places, the NEEWC was assigned a VRM Class II rating because of the overall limited and dispersed development, interior siting, and intervening topography obscuring the built improvements from offsite viewpoints.
LANSCE	IV	High	Development in the LANSCE Planning Area is similar to the development in the Core Area and Pajarito Corridor; it features a highly concentrated cluster of high- and medium-intensity development. Though somewhat shielded from the public view by buffer zones in the Balance of Site, development activities are visible from public viewpoints off the site, attract attention, and are not easily overlooked. The LANSCE Planning Area is located farther from the Los Alamos townsite than the Core Area; the distance mitigating some of the visual effects from its development.
Balance of Site	I	None to weak	The Balance of Site Planning Area is characterized by large swaths of forests and shrubland. It consists of largely undeveloped buffer zones around LANL's perimeter and developed areas. White Rock Canyon Reserve, dedicated open space, and biological and environmental research areas are located in the Balance of Site. Although the planning area is approximately 92 percent undeveloped, environmental remediation facilities and activities in TA-21 and TA-54 may be visible from public viewpoints from offsite locations on the Pueblo de San Ildefonso. Overall, there is very little change to the natural environment, and management activities are limited and restrained.

Wildfires have left a lasting visual impact at LANL. In 2000, the Cerro Grande fire burned 43,000 acres including 7,403 acres on LANL. The fire permanently changed the visual landscape and future land management practices at the Laboratory. LANL studied the effects of fires in the 2000 *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory* (Wildfire Hazard Reduction EA) (NNSA 2000). The Cerro Grande fire and EA led to enhanced forest management practices.

In 2011, the Las Conchas fire struck the LANL area, burning more than 150,000 acres. Due in part to stepped-up fire management practices put in place after the Cerro Grande fire, the Las Conchas fire, then the largest fire in New Mexico history, burned less than 1 acre of LANL property with no LANL infrastructure losses.

Since the publication of the 2000 EA and 2011 Las Conchas fire, environmental and wildland fire conditions have changed at LANL including longer fire seasons, changes in vegetation, and global climate change. To address those changes, LANL issued a 2019 Supplemental Environmental Assessment to the 2000 EA (NNSA 2019c). The 2019 Supplemental EA concluded that wildland fire risk reduction and forest health objectives would be accomplished through treatments for forest thinning, life safety actions, open space forest health, and the implementation of new treatment practices.

In 2022, the Cerro Pelado fire burned more than 45,000 acres in the Jemez Mountains and came within 3 miles of LANL's western boundary. Ongoing forest management practices (on and off site) have an enduring impact on the visual environment at LANL.

Source: LANL (2021c)

Figure 4.2-7 Photos Representative of the Visual Conditions by Planning Area

4.2.2.2 Offsite Visual Environment and Visually Sensitive Locations within the Region of Influence

The visual environment surrounding LANL is an extension of the onsite landscape. Neighboring properties include the Bandelier National Monument, Pueblo de San Ildefonso, Santa Fe National Forest, and the communities of Los Alamos and White Rock. Topography and vegetation throughout the viewshed generally constrain sightlines, although there are vantage points with sweeping vistas.

Of the identified neighboring properties, Bandelier National Monument, Pueblo de San Ildefonso, and the Santa Fe National Forest are considered visually sensitive locations for the purposes of this analysis. Bandelier National Monument has two units: the Main Unit along LANL's southern boundary and the Tsankawi Unit to the east. The Main Unit borders natural buffer zones in the Balance of Site Planning Area. A herd of feral cattle currently inhabits the area between Bandelier's Main Unit and White Rock Canyon Reserve, causing disruptions to the visual environment on and off site through overgrazing and trampling (Sanchez 2021). There are few adverse visual effects from LANL's built environment to visitors of Bandelier's Main Unit. The Tsankawi Unit is located physically closer to the three heavily developed planning areas (Core Area, Pajarito Corridor, and LANSCE) in comparison to the main unit. While LANL infrastructure is physically closer, the Tsankawi Unit sits at a lower elevation and views are mostly restricted by topography.

Santa Fe National Forest is contiguous to LANL on both its northwestern and southeastern boundaries (*see* Figure 4.2-4). The portion along LANL's southeastern boundary runs adjacent to the White Rock Canyon Reserve with few adverse visual impacts. The northwestern section sits closer to the Jemez Mountains at a higher elevation. Views to the east from this northwestern district are sweeping with obvious views of the LANL's infrastructure.

Pueblo de San Ildefonso lands wrap around Bandelier's Tsankawi Unit and are bounded to the west by LANL property. The Pueblo's lands between NM-4 and the Pajarito Corridor are adjacent to some of the highest-developed areas of LANL. There are no permanent residential developments in this section of the Pueblo and vehicular access is controlled from NM-4. Although there are no permanent residents in this portion of Pueblo land, it is a significant area of cultural importance from a visual environment perspective. The Pueblo's developed areas are located several miles farther from the LANL site along NM-30 and NM-502. As such, current Laboratory operations do not have any significant adverse visual impacts to the Pueblo's residences.

4.3 Geology and Soils

This section describes the general geology, geologic conditions, soils, and mineral resources present on the LANL site and in the surrounding area. The 2008 SWEIS included a description of paleontological resources as part of the geology and soils affected environment. For this LANL SWEIS, the description of paleontological resources is included with cultural resources in Section 4.8. The geology and soils information presented in the following sections is consistent with information provided in the 1999 and 2008 SWEISs, updated as applicable. This SWEIS describes the ROI for geology and soils in a broader aerial and regional extent. Recent soil-sampling results are included in Section 4.3.3 as part of the ongoing environmental monitoring program at LANL.

4.3.1 General Geology

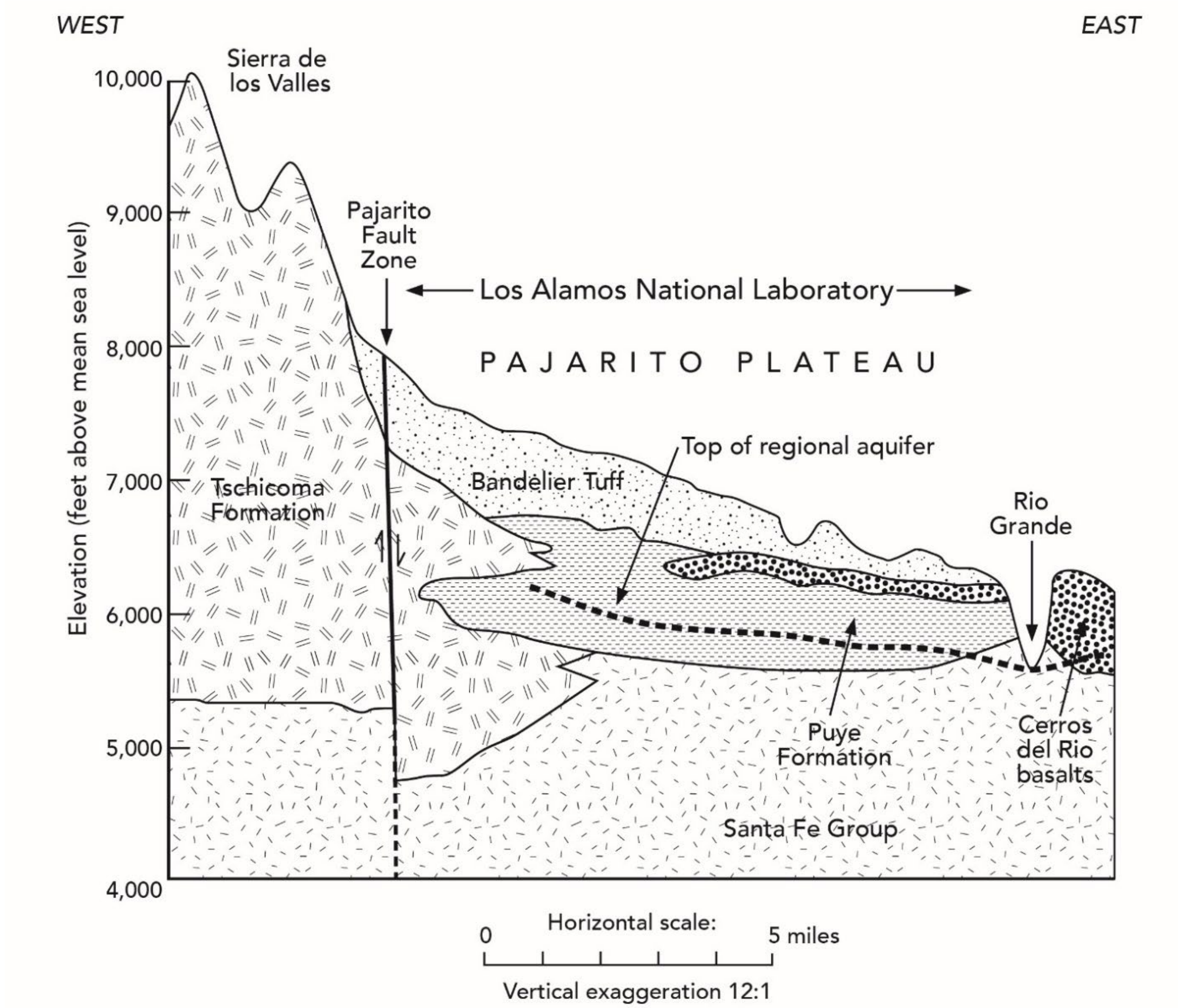
The geology of the LANL region is the result of complex faulting, sedimentation, volcanism, and erosion over the past 35 million years. LANL lies on the Pajarito Plateau, which is formed of volcanic tuffs (welded volcanic ash) deposited by past volcanic eruptions from the Jemez Mountains to the west. The plateau is deeply dissected and consists of numerous mesas separated by deep canyons containing streams that drain to the east and southeast and that flow across the plateau from the Jemez Mountains to the Rio Grande River.

4.3.2 Geologic Conditions

This section describes the geologic conditions that could affect the stability of buildings and infrastructure at LANL. It includes stratigraphy, volcanic activity, and faulting and seismicity.

4.3.2.1 Stratigraphy

Figure 4.3-1 provides an illustrative cross section of the stratigraphy of the LANL area. The upper stratigraphic sequence of rocks that underlie LANL are exposed in the 600- to 1,000-foot-deep, steep-sided canyons cut into the surface of the Pajarito Plateau. The layers vary in hardness and resistance to erosion; the light-colored units tend to be softer and form slopes on canyon walls, while darker-colored units tend to be harder and form vertical cliffs. The following discussion briefly describes the geologic formations in relation to LANL.



Source: LANL (2024e)

Figure 4.3-1 Generalized Cross Section of the Los Alamos National Laboratory Area

The Santa Fe Group is the deepest sedimentary sequence beneath the site. These formations extend between the Jemez and Sangre de Cristo mountains and are more than 3,300 feet thick in places. The Puye Formation overlies the Santa Fe Group beneath the western and central Pajarito Plateau and thins beneath the eastern plateau. It consists of coalescing alluvial fans that were shed eastward from the domes and flows of the Jemez Mountains.

The Bandelier Tuff is the uppermost stratigraphic unit on the Pajarito Plateau. It forms the ground surface under most LANL facilities and is well exposed in the canyon walls within the Pajarito Plateau. The Bandelier Tuff is more than 1,000 feet thick in the western part of the plateau and thins to about 260 feet thick on the eastern edge of the plateau above the Rio Grande. Unconsolidated Quaternary sediments form surficial, localized deposits across LANL. These deposits include colluvium and alluvium consisting of gravels, sands, and clays.

Most LANL facility foundations are either on or within the upper member of the Bandelier Tuff. It contains several subunits, all of which are recognizable due to differences in physical and weathering properties. More detailed descriptions of each of the subunits are presented in stratigraphy discussions in Section 4.2.2.1 of the 2008 SWEIS.

4.3.2.2 Volcanism

Eruptions of 34 volcanic units have occurred since the Valles Caldera formed about 1.2 million years ago. The eruptive frequency is 1 event per 5,500 years for when the Valles Caldera enters periods of resurgence, which is constrained between approximately 74,000 and 42,000 years (Nasholds and Zimmerer 2022). However, the length of time between these eruptions is highly irregular, so predicting the next eruption on simple frequency is not realistic (NMBGMR 2010). The expected return period (probability) for volcanic events is much longer than the return periods for natural phenomena hazard resistance goals specified for DOE facilities (on the order of thousands of years) (LANL 2011).

The El Cajete pumice fallout, which forms the youngest pyroclastic (explosive) volcanic eruption within the Valles Caldera, erupted about 74,000 years ago (Zimmerer et al. 2016). The youngest lava flow eruption within the caldera is the Banco Bonito lava flow dated at roughly 40,000 years ago. Most volcanologists classify the Valles Caldera complex as dormant (NMBGMR 2010).

4.3.2.3 Faulting and Seismicity

The Pajarito Fault is the main element of the north-south trending Pajarito Fault system (Figure 4.3-2) and contributes most of the seismic risk to LANL due to its proximity and level of seismic activity (LANL 2007). This seismically active fault system is a complex zone of deformation, consisting of many laterally discontinuous faults and associated folds and fractures.

The Pajarito Fault system extends for about 31 miles along the western margin of LANL and consists of the Pajarito, North Pajarito (formerly named the Santa Clara Fault), Rendija Canyon, Guaje Mountain, and Sawyer Canyon faults. (The North Pajarito and Sawyer Canyon faults occur to the north of the area depicted in Figure 4.3-2.) These are all roughly north-to-south-striking, nearly parallel, and interconnected normal slip faults that overall accommodate extension in the earth's crust. Of the above faults, the Pajarito is the longest, has the largest Quaternary displacement and, together with the North Pajarito, delineates the boundary between the Pajarito Plateau and Jemez Mountains (NNSA 2011b).

Numerous paleoseismic trench studies have been conducted on several different traces of the Pajarito fault system. Based on these studies, the current interpretation of recent fault activity is that the Pajarito Fault last ruptured younger than 1,700 years ago, the Guaje Mountain Fault between 4,200 and 6,500 years ago, and the Rendija Canyon Fault before 9,000 years ago. No trench on any of these faults displays evidence for more than one rupture in the Holocene (less than 11,700 years before present), making constraining the number and size of recent earthquakes difficult. Recent paleoseismic investigations (Lettis et al. 2019) further suggest that only one Holocene event is recorded on the main Pajarito fault. Studies at LANL have suggested a possibility for movement on the Pajarito Fault to be linked to the events identified in the other fault segments in the Pajarito Fault system (LANL 2007; Lewis et al. 2009).

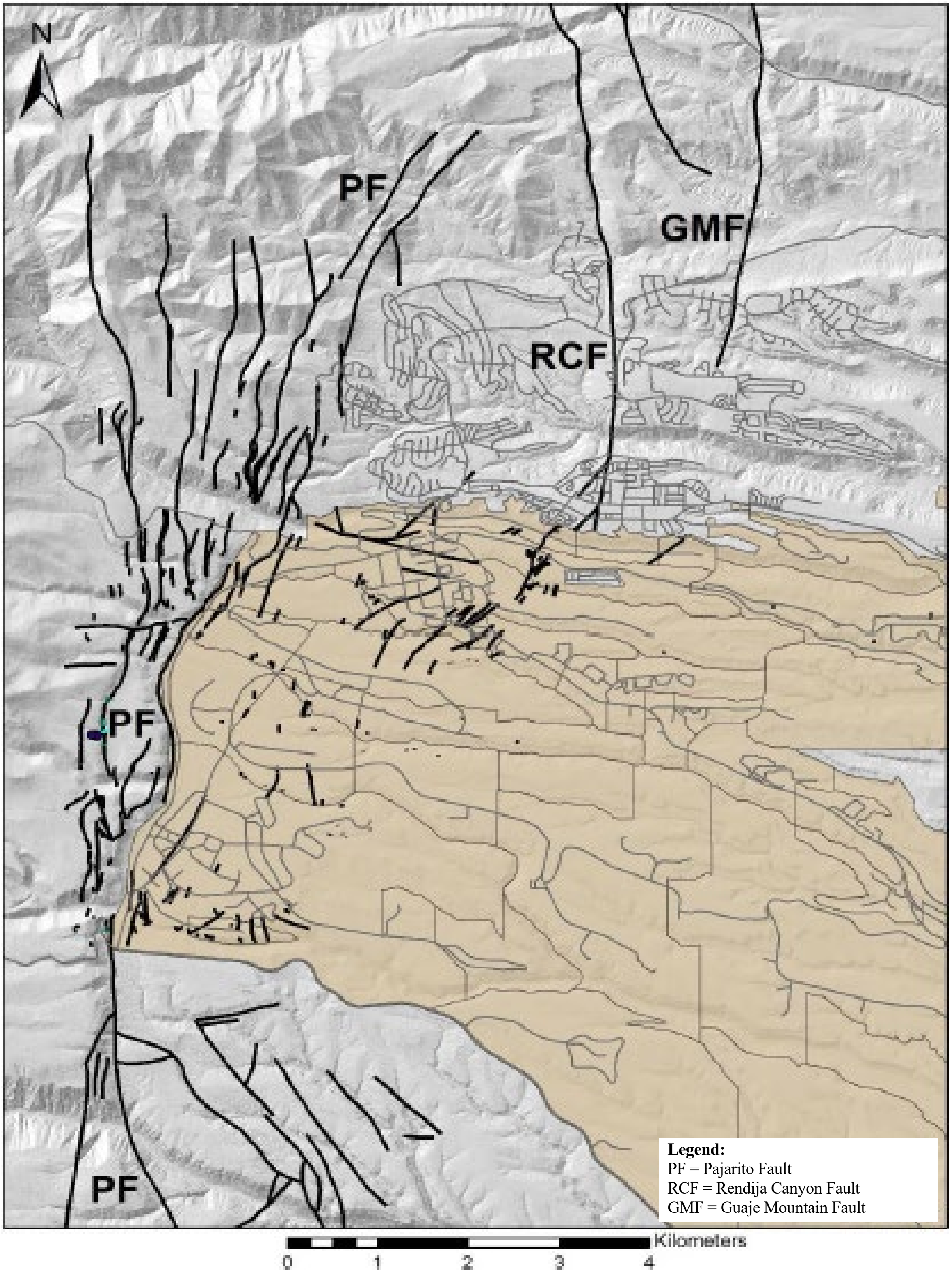


Figure 4.3-2 Seismic Faults in the LANL Area

Although large, historical earthquakes have not occurred on the Pajarito Fault system since the creation of LANL, geologic evidence indicates that it is seismically active and capable of producing large surface-faulting earthquakes of Richter magnitude[26] 6.5 to 7.3 (LANL 2007). Early Quaternary deposits have been displaced down to the east by as much as 650 feet along this fault zone, which also shows compelling evidence for repeated, late Quaternary faulting (LANL 2007; Lewis et al. 2009).

NNSA considered data available from the USGS when evaluating seismic conditions at LANL. The USGS reported 32 minor earthquakes (ranging in magnitude from 1.6 to 4.5) within a 62-mile radius of TA-55 from 1973 to May 2021 (USGS 2021); however, none occurred within the LANL site boundary. The latest probabilistic peak (horizontal) ground acceleration (PGA) map from the USGS, used to indicate seismic hazard, shows a maximum PGA between 0.2 and 0.3 *g*[27] for the central LANL area (USGS 2019). The PGA values cited are based on a 2-percent probability of exceedance in 50 years, corresponding to an annual occurrence probability of about 1 in 2,500.

DOE requires a site-specific Probabilistic Seismic Hazard Analysis (PSHA) for the design of SDC 3–5 facilities as defined in DOE-STD-1020-2016. In 2007, a comprehensive update to the 1995 seismic hazard analysis of LANL was completed and incorporated in the 2008 SWEIS analysis. The 2007 comprehensive update indicated that the seismic hazard was higher than previously understood from the initial 1995 PSHA. The 2007 seismic hazard study was updated in 2009 to incorporate a new set of ground motion attenuation relationships and to examine potential conservatism in the 2007 study (LANL 2009). LANL is currently engaged in an update to the 2007 PSHA, which is scheduled for completion in 2025.

The PSHA process uses information available to the USGS, but also incorporates more detailed, site-specific geologic, geophysical, and geotechnical information to determine seismic hazard curves (NNSA 2020a). Site-specific seismic hazard analysis at LANL estimated horizontal and vertical PGAs (NNSA 2011b). Until an updated LANL sitewide PSHA is completed, SDC are based on information from the 2007 LANL PSHA and subsequent 2009 update.

The potential for seismically induced land subsidence at LANL is considered to be low and, for soil liquefaction, negligible (NNSA 2003a).

4.3.3 Soils

Several distinct soils have developed in Los Alamos County as a result of interactions between the bedrock, topography, and local climate resulting in the decomposition of volcanic and sedimentary rocks. They range in texture from clay and clay loam to gravel. The soils that formed on mesa tops of the Pajarito Plateau are well drained and range from very shallow (0–10 inches) to moderately deep (20–40 inches), with the greatest depth to the underlying Bandelier Tuff being 40 to 60 inches (DOE 1999a).

The general soil map unit that characterizes the LANL site includes approximately 52-percent rock outcrop, which occurs on the edges and sides of mesas (NRCS 2009). Soils that develop in canyon settings can be much thicker locally than those on the mesa tops. Most surface soils within LANL

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[26] The Richter scale reflects the relative strength or size of an earthquake. The magnitude is based on the logarithmic measurement of the maximum motion recorded by a seismograph. An increase of one unit of magnitude represents a 10-fold increase in wave amplitude on a seismograph.

[27] "g" is a measure of the maximum horizontal acceleration (as a percentage of the acceleration due to Earth's gravity) experienced by a particle on the surface of the earth during the course of earthquake ground motion.

developed areas have been disturbed to accommodate buildings, parking lots, and roadways, or have been otherwise affected by previous construction activities.

Soil erosion rates vary considerably at LANL due to the mesa and canyon topography. The highest erosion rates occur in drainage channels and on steep slopes. Wildland fires within and adjacent to LANL in 2000 and 2011, respectively, resulted in increased soil erosion due to vegetation removal. In 2013, the Pajarito Plateau was subjected to a major flooding event, which also resulted in channel and bank erosion. Additional information on these wildfire and flooding events is presented in Section 4.4.3 of this SWEIS. Roads, structures, and paved parking lots concentrate runoff, resulting in increased soil erosion adjacent to and downgradient from these engineered features. High erosion rates are also caused by past area logging practices, livestock grazing, loss of vegetative cover, and decreased precipitation. The lowest erosion rates occur at the gently sloping central portions of the mesas, away from the drainage channels. Mesa and canyon erosion status is monitored and evaluated as part of the wildland fire, forest health, and stormwater management programs at the LANL site.

Soils at LANL are acceptable for standard construction techniques (NNSA 2003a). No prime farmland soils have been designated in Los Alamos County (USDA 2021a). The closest areas of prime farmland are located approximately 7.5 miles east and 10 miles south of LANL, adjacent to the Rio Grande (NRCS 2011).

Soil Monitoring

Institutional surface soil samples are collected once every three years in addition to soils data collected annually for specific projects, when necessary. Sediment monitoring and sampling associated with watersheds in canyons, rivers, and reservoirs is discussed in Section 4.4.1.5 of this SWEIS. The majority of onsite, institutional soil-sampling stations are located on undisturbed mesa tops close to and, if possible, downwind from major facilities or operations at the Laboratory. In 2021, surface soil and vegetation samples were collected from 16 onsite locations, 14 perimeter locations, and 6 regional background locations as part of the institutional monitoring program. All but one of the perimeter stations are located within 2.5 miles of the LANL boundary. Most of these locations are in inhabited or publicly accessible areas to the north and east of LANL. Many locations have been sampled for radionuclides since the early 1970s (LANL 2022h).

Soil sampling locations, as well as detailed descriptions of soil monitoring results, are presented in the 2021 LANL Annual Site Environmental Report and associated data tables. The 2021 Annual Site Environmental Report presents soil monitoring results at 36 sites for the latest institutional evaluation period.[28] Results include data for radionuclides, inorganic elements, dioxin and furan, polychlorinated biphenyls (PCBs), semi-volatile organic compounds (VOCs), VOCs, HE, and per- and polyfluoroalkyl substances (PFAS) (LANL 2022h). Levels of constituents in soil samples collected at or near LANL are compared with regional statistical reference levels. A summary of soil monitoring results is provided in Appendix A, Section A.4.3.

[28] The next triennial institutional soil monitoring program results are expected to be published in the 2024 LANL Annual Site Environmental Report, which is scheduled for completion in 2025.

4.3.4 Mineral Resources

Potential mineral resources at LANL consist of rock and soil for use as backfill or borrow material, or for construction of waste unit covers. Sand and gravel are primarily used at LANL for road building, and pumice is used for landscaping. The only borrow pit currently in use on site is the 2.5-acre East Jemez Road Borrow Pit in TA-61, which is also used for storing asphalt milling material, and soil and rubble storage and retrieval. This borrow pit is cut into the upper Bandelier Tuff. Numerous commercial offsite borrow pits and quarries in the vicinity of LANL produce sand, gravel, and volcanic pumice. Eleven pits or quarries are located within 30 miles of LANL, which is the distance considered the upper economically viable limit for hauling borrow material to the LANL site. In general, these nearby pits and quarries produce sand and gravel (NNSA 2008b). LANL also participates in a concrete and asphalt recycling program where materials from demolition activities are combined, stored, and eventually made available for engineered foundation fill material for new upgrade and construction projects.

4.4 Water Resources

This section addresses surface water, groundwater, sediments, and floodplains located on the LANL site and on adjacent properties. Wetlands are discussed in Section 4.6.2 of this SWEIS as part of ecological resources. Water resources in the LANL region are used for human consumption, traditional and ceremonial uses by American Indians, aquatic and wildlife habitat, domestic livestock watering, irrigation, industry, and commercial purposes. Water resources in proximity to LANL may be affected by water withdrawals, effluent discharges, waste disposal, spills and unplanned releases, soil erosion, or stormwater runoff from LANL operations. The LANL area contains all or parts of seven watersheds that drain into the Rio Grande basin. The watersheds are named for the canyons that receive their runoff (Figure 4.4-1) (LANL 2024e). The consumption of domestic water is addressed in Section 4.10.3 as an element of infrastructure.

Surface Water Terms

For the purposes of this SWEIS, the following terms apply to various forms of surface water.

Effluent or discharge applies only to industrial wastewater released to the environment through a National Pollutant Discharge Elimination System (NPDES) outfall permit.

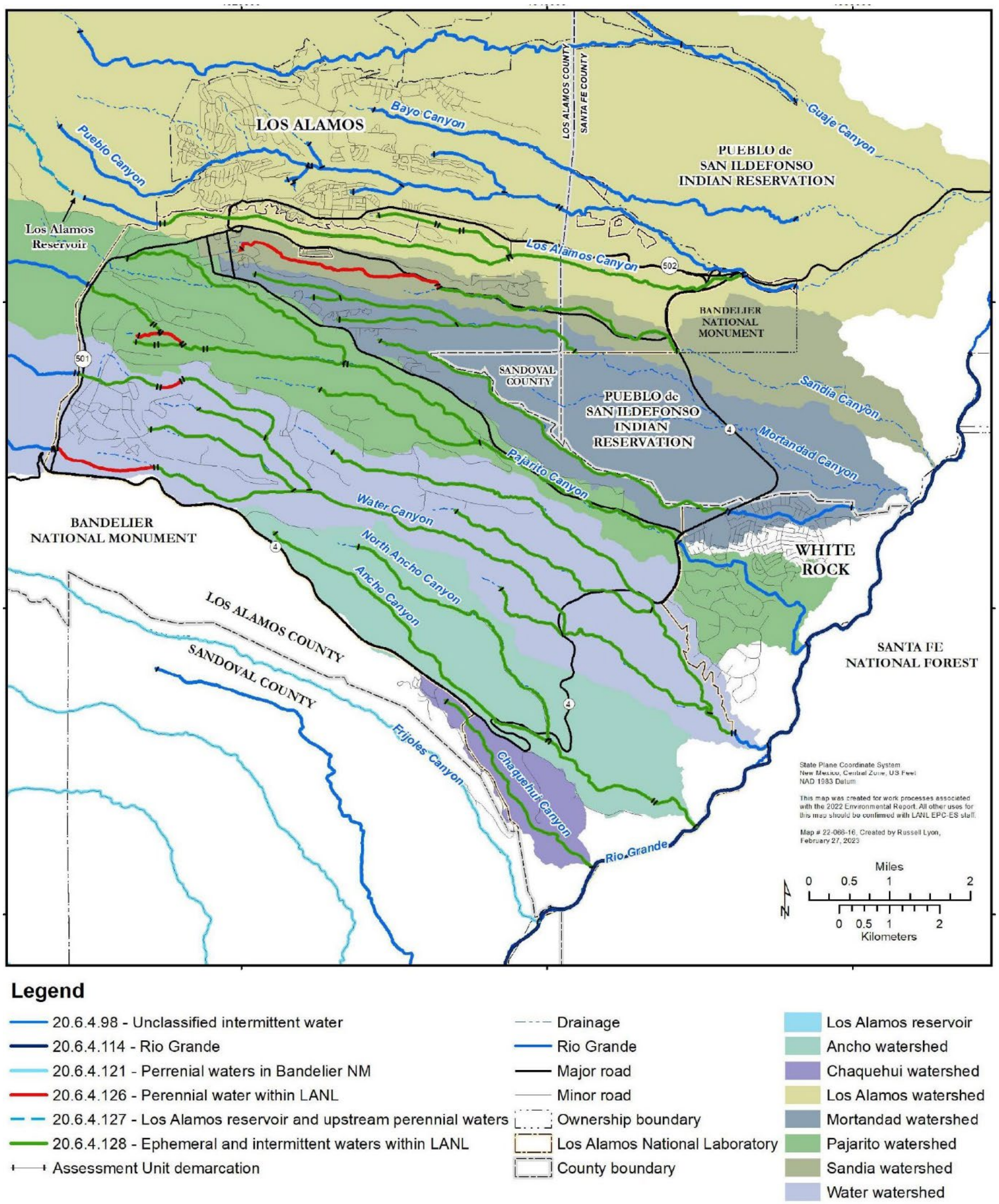
Flow applies to streams, springs, stormwater, or effluents, regardless of whether the water flows over an industrial site, a construction site, a natural landscape, or out of an outfall pipe.

Runoff applies only to stormwater because the precipitation runs off the surface instead of infiltrating into the ground. Runoff is considered a "discharge" within the NPDES Multi-Sector General Permit and Construction General Permit programs, but that term is not used in reference to stormwater in this SWEIS for clarity.

Perennial applies to streams that flow continuously due to natural springs or industrial effluents throughout the year in all years.

Ephemeral applies to streams that flow only in response to local precipitation or snowmelt in the immediate area.

Intermittent applies to streams that surface because the water table is higher than the streambed at certain times of the year.



Source: LANL (2024e)

Figure 4.4-1 Stream Reaches and Watersheds within and around LANL

4.4.1 Surface Water

Surface water may be affected by Laboratory operations when streams and springs receive industrial effluents discharged from LANL, stormwater flows over the site, and sediments are mobilized by stormwater runoff. At certain times of the year and under certain precipitation and flow conditions, surface water flowing through and from LANL can reach the Rio Grande, where contaminants could flow downstream. Streams that drain the LANL area are dry for most of the year, and the area's surface water flows primarily in intermittent streams in response to local precipitation or snowmelt (LANL 2024e).

Some of the surface water at LANL comes from shallow groundwater discharging as springs into canyons. Surface waters on and off site provide recharge to subsurface groundwater via infiltration to alluvial groundwater, intermediate-perched groundwater, and the regional aquifer. Surface water is not a source of municipal, industrial, irrigation, or recreational water, though it is used by wildlife. While there is minimal direct use of the surface water within LANL, flows may extend beyond the site boundaries, where there is more potential use of the water. Certain stream flows extend onto Pueblo de San Ildefonso land and may be used by the community for traditional or ceremonial purposes, including ingestion or direct contact.

4.4.1.1 Surface Water and Sediment Quality

The NMED assessed DOE's surface water data during the decision-making process for listing and delisting causes of impairment of the state's stream reaches (delineated as assessment units) under Section 303(d) of the *Clean Water Act*. Within the boundaries of LANL, NMED identified 39 assessment units: 35 are impaired for one or more designated uses. Some of the constituents (i.e., gross alpha activity[29] and aluminum) causing the impairment can be attributed to natural background sources and from developed areas at LANL not necessarily associated with historical operations. Most samples of 200 possible constituents have concentrations far below regulatory standards or risk-based advisory levels. Water resources are regulated by federal standards (including the *Clean Water Act*, 33 U.S.C. § 1251 et seq., and the *Safe Drinking Water Act*, 42 U.S.C. Chapter 6A, Subchapter XII), DOE-derived concentration guides, and the New Mexico state regulations, including Title 20, Chapter 6, Part 2 of the *New Mexico Administrative Code* (20.6.2 NMAC), "Ground and Surface Water Protection," administered by the New Mexico Water Quality Control Commission. As New Mexico stream water quality standards have become more stringent, LANL programs are emphasizing improved management of the site's stormwater runoff (NNSA 2018a).

Laboratory personnel routinely monitor surface water, stormwater, and sediments as part of the Laboratory's ongoing environmental monitoring and surveillance program. Most surface water within LANL is designated for use as wildlife habitat, livestock watering, and aquatic life habitat. Some reaches have aquatic life designations. Impairment causes are generally related to levels of gross alpha, aluminum, copper, mercury, PCBs, and selenium, further detailed in the LANL annual site environmental reports. There were minimal exceedances of screening levels for sediment samples collected in 2022 (LANL 2024e). The results from the monitoring of surface water and sediment are discussed in Section 4.4.1.5 of this SWEIS.

Sources of Impacts to Surface Water Resources

Laboratory personnel recognize and manage the following sources that have the potential to impact local surface water resources:

- Industrial effluents discharged under the National Pollutant Discharge Elimination System (NPDES) Industrial and Sanitary Point Source (ISPS) Outfall Permit NM002835. This

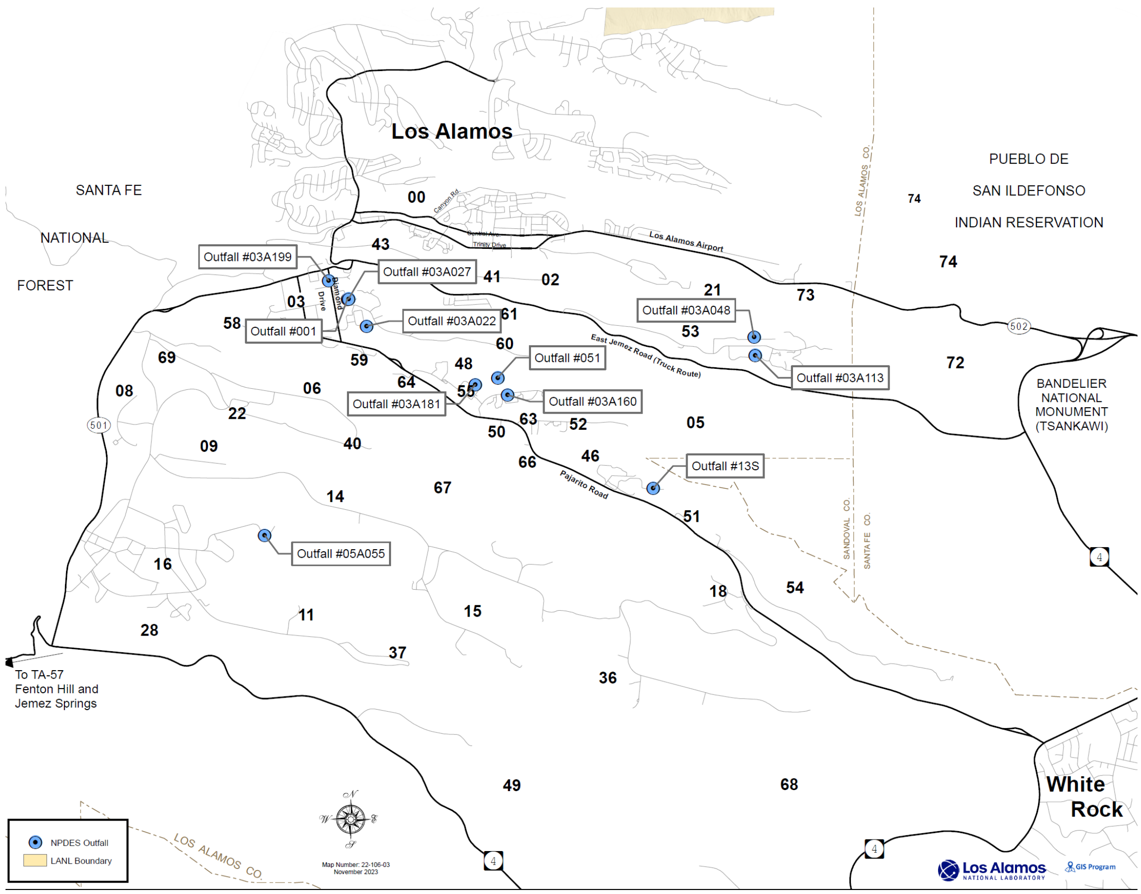
[29] Gross alpha activity is the sum of the radioactivity from alpha particle emissions from radioactive materials.

source includes point-source discharges from LANL wastewater treatment plants and cooling towers (*see* Section 4.4.1.2);

- Stormwater runoff, including stormwater runoff from certain industrial activities, construction activities, and solid waste management units (SWMUs) (*see* Section 4.4.1.3);
- Dredge and fill activities or other work within perennial, intermittent, or ephemeral water courses (*see* Section 4.4.1.4); and
- Sediment transport (*see* Section 4.4.1.5).

4.4.1.2 Industrial Effluents

Liquid effluents from LANL's industrial and sanitary outfalls are permitted under the NPDES ISPS Outfall Permit NM002835 (Figure 4.4-2). This LANL-wide permit requires routine monitoring of discharges and reporting of sampling results. The permit specifies the parameters to be measured and the sampling frequency (NNSA 2018a).



NPDES = National Pollutant Discharge Elimination System; TA = technical area

Figure 4.4-2 NPDES Industrial and Sanitary Point Source Permitted Outfalls

The Laboratory has had an approved NPDES ISPS Outfall Permit for liquid effluents since 1978, which included more than 141 outfalls and multiple small water treatment facilities. In the 1990s, the Laboratory started an outfall reduction project designed to either eliminate outfalls or consolidate/collect the discharges for treatment at one of three onsite wastewater treatment plants. Between 1990 and 2007, the outfall reduction project reduced the total number of permitted outfalls from 141 to the 21 outfalls identified in the 2008 SWEIS and (from 2007 to the present) the 11 outfalls currently permitted by NPDES ISPS Permit NM0028355 (Table 4.4-1). Outfall closures included, but were not limited to, those located at the Tritium Facility (TA-16), Chemistry and Metallurgy Research Facility (TA-3), the Sigma Complex (TA-3, one outfall remains), High-Explosives Processing Facility (TA-16, one outfall remains), High-Explosives Testing Facility (TA-15), and the LANSCE (TA-53, two outfalls remain) (LANL 2024a).

Table 4.4-1 NPDES ISPS Outfall Permit Annual Discharges by Watershed

Watershed	No. of Outfalls 2008 SWEIS	No. of Permitted Outfalls 2022	Discharge 2008 SWEIS (million gallons)	Discharge 2022 (million gallons)
Guaje	0	0	0	0
Los Alamos	5	1	45.6	26.2
Mortandad	5	4	44.3	5.6
Pajarito	0	0	0	0
Pueblo	0	0	0	0
Sandia	6[a]	5[a]	187.3	99.1
Water[b]	5	1	2.3	0
TOTALS	**21**	**11**	**279.5**	130.9

ISPS = Industrial and Sanitary Point Source; NPDES = National Pollution Discharge Elimination System

a Includes Outfall 13S from the Sanitary Wastewater Systems Plant, which is permitted as a discharge to Cañada del Buey or Sandia Canyon. The effluent is piped to TA-3 and ultimately discharged to Sandia Canyon via Outfall 001.

b Includes 05A055 discharge to Cañon de Valle, a tributary to Water Canyon.

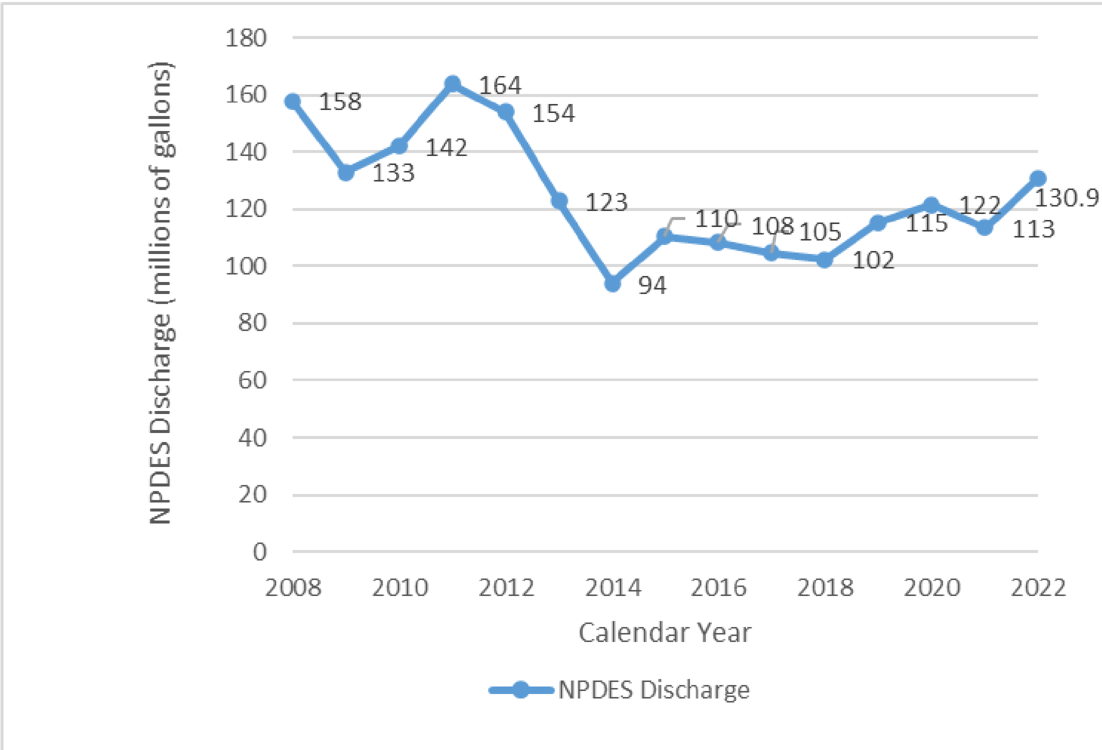
Source: LANL (2024e)

The SERF expansion was completed in 2012. The SERF is a water treatment facility located on the south rim of Sandia Canyon that treats sanitary effluent for reuse as makeup water in cooling towers. The expansion project increased the capacity of the SERF and involved installation of additional water treatment equipment and storage tanks and piping to redistribute the treated effluent for reuse at appropriate LANL facilities within TA-3. Improvements to the SERF operations have led to increased use of recycled effluent in the cooling towers since 2012. In 2022, the SERF provided more than 32 million gallons of makeup water to the cooling towers for the SCC and the Trinity supercomputer (LANL 2024a). Figure 4.4-3 shows effluent discharge in millions of gallons of water from 2008 through 2022 and demonstrates the reduction in potable water demand through sustainable reuse efforts.

The current NPDES ISPS NM0028355 permit includes 11 outfalls (10 industrial outfalls and 1 sanitary outfall) that discharge effluent from seven technical areas distributed across the entire LANL site. Based on Laboratory discharge monitoring reports, seven permitted outfalls recorded flows in 2022, totaling approximately 130.9 million gallons. This amount is approximately 17.4 million gallons more than calendar year (CY) 2021. Discharges in 2022 are summarized by watershed and compared with watershed totals projected in the 2008 SWEIS (LANL 2024a, Table 4.4-1). In CY 2022, the majority of effluent discharged to the environment came from TA-3 (Outfall 001 at 65 percent) and LANSCE (Outfall 03A048 at 20 percent).

LANL has three principal wastewater treatment facilities: the SWWS Plant (TA-46), which discharges to Outfall 001 in Sandia Canyon, the RLWTF (TA-50), which discharges to Outfall

051 in Mortandad Canyon, and the High Explosives Wastewater Treatment Facility (HEWTF) (TA-16), which discharges to Canyon de Valle.



Source: LANL (2022a, 2024a)

Figure 4.4-3 Total NPDES ISPS Outfall Discharges from LANL Facilities, 2008–2022

4.4.1.3 Stormwater Runoff

During New Mexico's summer monsoon season, there can be a large volume of stormwater runoff flowing over LANL facilities and construction sites potentially picking up sediment and pollutants. The most common pollutants transported in stormwater flows are radionuclides, PCBs, and metals. LANL continues to benefit from ongoing program improvements resulting from changes in the EPA NPDES stormwater permitting program, increased regulatory attention on stormwater flows from SWMUs, and programmatic changes to monitoring activities and implementation of best management practices (BMPs) and/or stormwater control measures for stormwater pollution prevention.

The Laboratory maintains several permits related to stormwater runoff. The permits are described in Appendix A, Section A.4.4.1.1 and include the:

- Multi-Sector General Permit (MSGP), which regulates stormwater runoff from the industrial activities and sites at LANL;
- Individual Permit, which authorizes discharges of stormwater from certain SWMUs and areas of concern (hereinafter site monitoring areas [SMAs]) at the Laboratory; and
- Construction General Permit (CGP), which requires all LANL construction activities and projects that disturb 1 acre or more of land to be permitted.

4.4.1.4 Watercourse Protection

Section 404 of the *Clean Water Act* requires that the Laboratory receive verification from the U.S. Army Corps of Engineers (USACE) that proposed projects within perennial or intermittent watercourses comply with *Clean Water Act* nationwide permit conditions. Section 401 of the *Clean Water Act* requires states to certify that Section 404 permits issued by the USACE comply with state water quality standards. The NMED reviews Section 404/401 permit applications and issues separate Section 401 certification letters, which may include additional requirements to meet state stream standards (LANL 2024e).

LANL has constructed engineered controls within watercourses to prevent or minimize the migration of sediment and contaminants to the Rio Grande for which Section 401/404 permits are required. The details associated with these engineered controls and a figure identifying their locations are provided in Appendix A, Section A.4.4.1.2.

4.4.1.5 Watershed and Sediment Monitoring

DOE monitors watersheds and sediments on site, off site, and at regional locations. Sediments are sampled from all major canyons that cross LANL (on site and off site), as well as from the Rio Grande and area reservoirs, along tributary canyons, in major canyons upstream and downstream of LANL, and at watercourse junctions with the Rio Grande. Additionally, the Laboratory samples groundwater monitoring wells, springs, and surface water (*see* Section 4.4.2.2). Locations of the surface water monitoring infrastructure and information about monitoring results for 2022 can be found in Appendix A, Section A.4.4.1.3. Detailed information about sampling activities and monitoring results are published annually in Laboratory environmental surveillance reports.

Watershed – the area of land that contributes water flow to a particular stream or river.

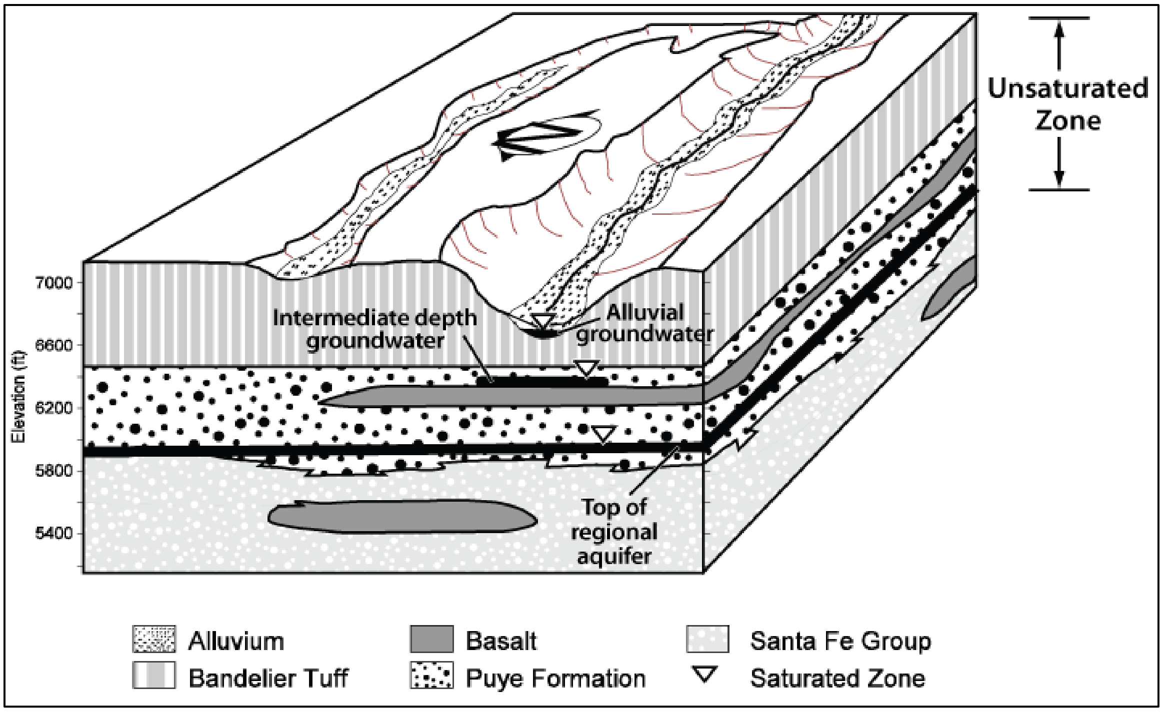
Stormwater – water that comes as runoff from rain and snowmelt events.

Base flow – the portion of a perennial stream's flow that is sustained between precipitation events.

4.4.2 Groundwater

Groundwater in the LANL region occurs in three characteristic locations: (1) perched alluvial groundwater in canyon-bottom sediments, (2) zones of intermediate-depth perched groundwater whose location is controlled by availability of recharge and by changes in rock permeability, and (3) the regional aquifer beneath the Pajarito Plateau (Figure 4.4-4). In wet canyons, stream runoff percolates through the alluvium until downward flow is impeded by less-permeable layers of tuff, maintaining shallow bodies of perched groundwater within the alluvium. If not impeded by less-permeable layers, surface water will eventually reach the regional aquifer.

Perched groundwater occurs in alluvium (sediment deposited by streams), found in the canyon bottoms, or at greater depths in the Bandelier Tuff or Puye Formation. The zones of perched water are typically not continuous but are created where rock layers with low permeability impede downward water movement. These rock layers vary greatly in their ability to transmit water in saturated and unsaturated states. None of these perched water zones (shallow or intermediate) provide enough water to be a source for municipal drinking water.



Source: LANL (2024e)

Figure 4.4-4 Geologic and Hydrologic Relationships on the Pajarito Plateau

Underneath portions of Pueblo, Los Alamos, Mortandad, and Sandia canyons, intermediate-perched groundwater occurs within the lower part of the Bandelier Tuff and within the underlying Puye Formation and Cerros del Rio Basalt. These intermediate-depth groundwater bodies are formed in part by recharge from the overlying perched alluvial groundwater. Intermediate groundwater occurrence is controlled by availability of recharge and variations in permeability of the rocks underlying the plateau. Depths of the intermediate-perched groundwater vary. For example, intermediate-perched groundwater has been found as shallow as 120 feet in Pueblo Canyon and as deep as 750 feet in Mortandad Canyon. About 350–620 feet of unsaturated tuff, basalt, and low moisture content sediments separate the alluvial and perched groundwater zones and the regional aquifer (LANL 2022h).

The regional aquifer of the Los Alamos area occurs at a depth of approximately 1,200 feet along the western edge of the Pajarito Plateau and about 600 feet along the eastern edge. The regional aquifer lies about 1,000 feet beneath the mesa tops in the central part of the plateau. Water in the aquifer flows generally east or southeast toward the Rio Grande, and groundwater model studies indicate that underflow of groundwater from the Sierra de los Valles in the Jemez Mountains is the main source of recharge for the regional aquifer. Groundwater flow from the Sierra de los Valles to the Pajarito Plateau may be affected by the Pajarito Fault.

The regional aquifer is the only aquifer in the area capable of serving as a municipal water supply; the regional aquifer supplies various customers including LANL, Los Alamos County, and others located in parts of Santa Fe and Rio Arriba counties. The EPA has designated this aquifer as a sole-source aquifer (73 FR 3723, January 22, 2008), indicating that the aquifer supplies at least 50 percent of the drinking water for its service area and there are no reasonably available alternative drinking water sources if the aquifer becomes contaminated (LANL 2022a).

4.4.2.1 Flow and Transport of Groundwater

The Bandelier Tuff is an important rock formation due to its resistance to downward flow and its ability to capture and hold contamination. The tuff is a complex of several volcanic ash and pumice falls that occurred at different periods during the history of the region (*see* Section 4.3.2).

Volcanic glass in the tuff captures some contaminants by chemically attaching them to mineral surfaces (adsorbing) or by taking them into the structure of the minerals themselves (absorbing). As a result, large volumes of contaminants can be trapped, some permanently and some temporarily. The combination of these physical and chemical processes in the unsaturated tuff slows the movement of some contaminants toward the regional groundwater table (NNSA 2008b).

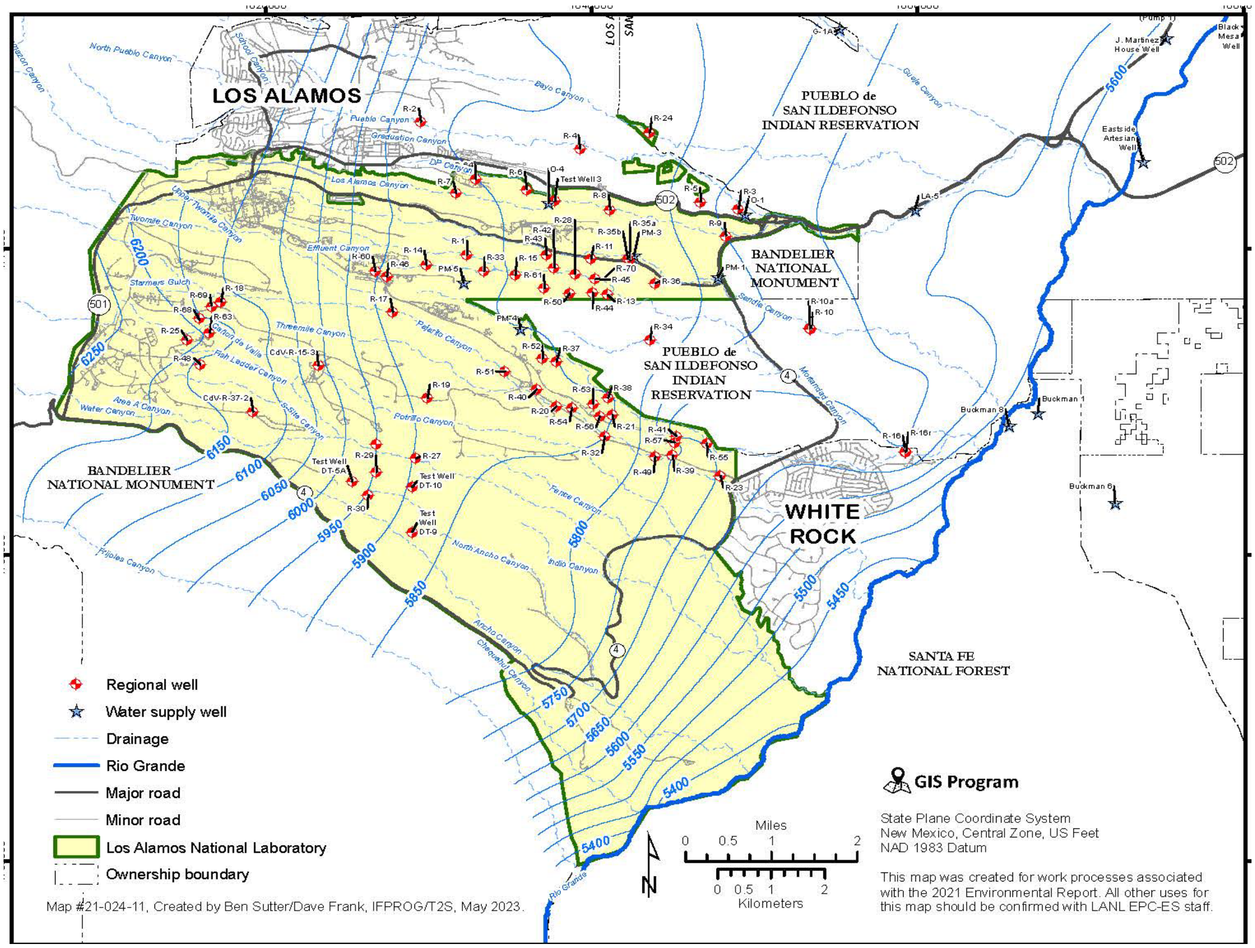
Most of the alluvium in the canyon channels is composed of weathered tuff and pumice fragments that strongly hold some of the contaminants. Some of the contaminants introduced to the canyons by LANL outfalls during historical operations are held in these perched water zones by adsorption to the sediments. Lateral movement of contaminants in the canyon channels and movement of contaminants downward into local perched water bodies underlying the canyon channels are being monitored (*see* Sections 4.4.1.5 and 4.4.2.2).

Groundwater near the water table generally flows eastward toward the Rio Grande, with local northeast or southeast flows observed (Figure 4.4-5). The speed of groundwater flow varies but is typically around 30 feet per year. The regional aquifer is separated from alluvial and perched-intermediate groundwater by layers of unsaturated tuff, basalt, and sediment. The limited extent of the alluvial and intermediate groundwater bodies, along with unsaturated rock and sediment that underlies them, restricts their contribution to recharging the regional aquifer, although locally they are important parts of the complete hydrologic pathway to the regional aquifer. Water from the Sierra de los Valles range is the main source of recharge for the regional aquifer (LANL 2022e).

4.4.2.2 Groundwater Quality in the Los Alamos National Laboratory Area

Groundwater chemistry varies with some general properties of the groundwater environment, such as the acidity of the water and the chemistry of local rock. Uranium, silicon, sodium, arsenic, and other chemical constituents that are common in the volcanic rocks of the LANL area appear as natural constituents in the groundwater of the Jemez Mountains region. Of interest for regional groundwater quality are levels of contaminants larger than those expected from naturally occurring groundwater constituents (LANL 2024e).

Since the 1940s, liquid effluent disposal by the Laboratory has degraded water quality in the shallow perched groundwater that lies beneath the floor of several canyons (NNSA 2008b). Treatments to reduce contaminants in these effluents began in the 1950s. Effluent discharges at LANL have been conducted under permits from regulatory agencies since 1978. These water quality impacts extend, in a few cases, to perched groundwater at depths of a few hundred feet beneath these canyons. Recharge to the regional aquifer from the shallow contaminated perched groundwater bodies occurs slowly (over a period of decades) because the perched water is separated from the regional aquifer by hundreds of feet of unsaturated rock. As a result, little contamination reaches the regional aquifer from the shallow perched groundwater bodies, and water quality impacts on the regional aquifer, although present, are small (LANL 2024e).



Source: LANL (2024e)

Figure 4.4-5 Contour Map of Average Water Table Elevations for the Regional Aquifer

Drainages that received some Laboratory effluents in the past include Mortandad Canyon, Pueblo Canyon from its tributary Acid Canyon, and Los Alamos Canyon from its tributary DP Canyon. Water Canyon and its tributary Cañon de Valle received effluents produced by HE processing and experimentation. Sandia Canyon received discharges of power plant cooling water, other cooling-tower water, and water from the Laboratory's SWWS Plant. Over the years, Los Alamos County has operated several SWWS plants in the area, and currently operates one in Pueblo Canyon (LANL 2022e).

Since the early 1990s, the Laboratory has significantly reduced both the number of industrial outfalls and the volume of water discharged (*see* Section 4.4.1.2). The remaining discharge amounts have been reduced through treatment process upgrades so that they meet applicable standards (LANL 2022e).

Groundwater Quality Standards

Groundwater standards and screening levels are set by three regulatory agencies. DOE has authority under the *Atomic Energy Act of 1954* to set standards for certain nuclear materials. The EPA and the New Mexico Water Quality Control Commission set screening levels and standards for other constituents (LANL 2022h).

DOE Order 458.1 Chg 4, "Radiation Protection of the Public and the Environment," establishes dose limits for radiation exposure and provides derived concentration technical standards for radionuclide levels in air and water based on those dose limits. For drinking water, DOE's derived concentration technical standards are calculated based on the EPA's 4-millirem-per-year drinking water dose limit (LANL 2022e).

The EPA *Safe Drinking Water Act's* maximum contaminant levels (MCLs) are the maximum permissible level of a contaminant in water delivered to any user of a public water system.

The New Mexico Water Quality Control Commission groundwater standards, found in 20.6.2 NMAC, apply to all groundwater with a total dissolved solids concentration of 10,000 milligrams per liter or less. These standards include numeric criteria for many substances. In addition, the standards contain a separate list of toxic pollutants (LANL 2024e).

The Consent Order between DOE and NMED requires the Laboratory to submit an annual Interim Facility-Wide Groundwater Monitoring Plan to NMED for approval (NMED 2016a). The Consent Order requires screening and reporting of groundwater data and describes the screening criteria. In general, the screening levels are the lower of either the New Mexico groundwater quality standard or the federal MCL. If neither of these exists for a given chemical, the NMED's tap water screening levels apply. If no NMED tap water screening level has been established for the chemical, then EPA's regional human health medium-specific screening level for tap water, adjusted to a 1×10^{-5} excess risk for carcinogenic contaminants, is used. The EPA updates the regional screening levels for tap water periodically. Updated New Mexico Water Quality Control Commission groundwater standards went into effect December 2018, with revised standards for some additional constituents effective July 2020 (LANL 2024e).

The New Mexico Water Quality Control Commission numeric criteria for contaminant concentrations mostly apply to filtered water samples, which represent the concentration of a constituent dissolved in groundwater. However, the standards for mercury, organic compounds, and nonaqueous phase liquids apply to unfiltered samples, which represent both the dissolved concentration of the constituent and the concentration associated with suspended sediments in the groundwater sample. The EPA MCLs and regional screening levels for tap water are applied to both filtered and unfiltered sample results, depending on the standard (LANL 2024e).

For radioactivity in groundwater, the Laboratory compares sample results with screening levels including the New Mexico Water Quality Control Commission groundwater standards for combined radium-226 and radium-228, DOE's drinking water concentration technical standards (derived from DOE's 4-millirem-per-year dose limit), and the EPA's MCL drinking water standards (LANL 2024e).

PFAS are groundwater contaminants of emerging concern. Contaminants of emerging concern are those chemicals that recently have been shown to occur in the environment and have been identified as a potential environmental or public health risk. PFAS are manufactured compounds used for a variety of purposes in various industrial, commercial, and consumer applications. As of December 2018, three PFAS compounds have been identified as toxic pollutants under 20.6.2 NMAC: perfluorohexanesulfonic acid (PFHxS), perfluorooctanoic acid (PFOA), and perfluorooctanesulfonic acid (PFOS). A LANL-wide sampling program for PFAS took place during 2020 and 2021. During this period, the Laboratory sampled for these three PFAS constituents at all interim facility-wide groundwater monitoring locations. A handful of locations had results above the NMED tap water screening, which prior to June 2022 was 70 nanograms per liter for the combined total concentration of the three PFAS compounds; none of these locations were in the regional aquifer (which serves as the water supply for LANL and community). Beginning in 2022, LANL sampled only for PFAS compounds at locations where two rounds of PFAS sampling were not completed or where a regulatory standard was exceeded. As of June 2022, the regulatory standards for the PFAS compounds in groundwater were revised to 401 nanograms per liter for PFHxS, 60 nanograms per liter for PFOA, and 60 nanograms per liter for PFOS. During the sampling conducted in 2022, alluvial groundwater monitoring well, LAUZ-1 (within DP Canyon, *see* Figure A.4.4-6), slightly exceeded the regulatory standard for PFOA and PFOS (LANL 2024e).

In April 2024, the EPA announced the first-ever national drinking water standards for several PFAS in drinking water (89 FR 32532; April 26, 2024). The final rule, establishes MCLs as follows: PFOA (4.0 nanograms per liter), PFOS (4.0 nanograms per liter), perfluorononanoic acid (10 nanograms per liter), PFHxS (10 nanograms per liter), and hexafluoropropylene oxide dimer acid (GenX chemicals) (10 nanograms per liter) as individual contaminants, and will regulate perfluorononanoic acid, PFHxS, hexafluoropropylene oxide dimer acid, and perfluorobutanesulfonic acid – as a mixture through a Hazard Index (EPA 2024a).

The new PFAS rules also require public water systems to (1) Conduct initial and ongoing compliance monitoring for the regulated PFAS; (2) Implement solutions to reduce regulated PFAS in their drinking water if levels exceed the MCLs; and (3) Inform the public of the levels of regulated PFAS measured in their drinking water and if an MCL is exceeded. The *Safe Drinking Water Act* generally provides a three-year timeframe for compliance with new rules. Because of the additional time required for capital improvements for systems to comply with the PFAS MCLs, the EPA is extending the typical three-year timeline for compliance to five years (NMED 2024a).

Given the understanding that PFAS health effects are rapidly evolving in tandem with increasing regulatory attention to PFAS, the Laboratory will continue to evaluate and consult with NMED on whether additional sampling for PFAS constituents is required.

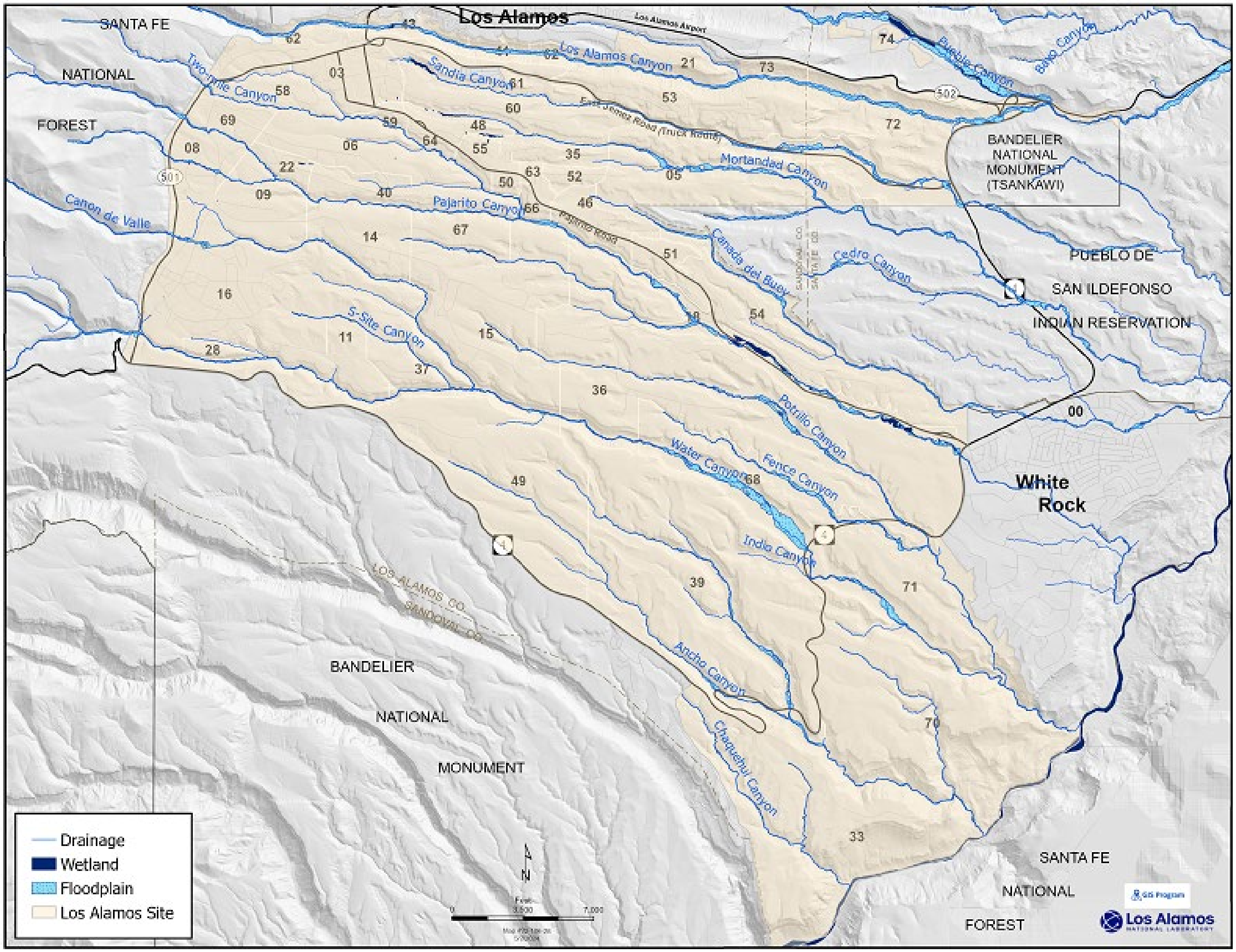
Groundwater Monitoring Program

The annual Interim Facility-Wide Groundwater Monitoring Plan identifies the monitoring locations, frequency of monitoring, and substances to be monitored. LANL monitors water quality and other characteristics by taking samples from wells in alluvial groundwater, perched-intermediate groundwater, and the regional aquifer; springs that discharge perched-intermediate and regional aquifer groundwater; and streams that maintain perennial base flow. Some wells have multiple screens (entry points for water) at different depths (LANL 2024e).

In addition, LANL monitors groundwater quality at three alluvial, two intermediate, and four regional aquifer wells for compliance with LANL's groundwater discharge permits (LANL 2024e). Details associated with the Laboratory's groundwater monitoring locations (on the LANL site and surrounding areas) and results are provided in Appendix A, Section A.4.4.2.

4.4.3 Floodplains

Floodplains are areas adjacent to watercourses that can become inundated with surface waters during high flows from runoff due to precipitation or snowmelt. At LANL, the floodplains are generally located in the canyons that lie between the mesa fingers (Figure 4.4-6). DOE regulations (10 CFR Part 1022) consider the critical action floodplain to be those areas affected during a



Source: LANL (2024c)

Figure 4.4-6 Wetlands and 100-Year Floodplains at LANL

500-year flood (with a 0.2-percent chance of occurrence in any given year). The base floodplain is defined as the 100-year floodplain, which has a 1.0-percent chance of flooding in any year. The RCRA permit for LANL also utilizes the 100-year floodplain definition (NNSA 2018a).

The Cerro Grande fire (2000) changed the extent and elevation of the floodplains in the canyons that traverse LANL. The Cerro Grande fire created hydrophobic soils on the lands uphill from LANL and removed vegetation, so surface water runoff and soil erosion were increased over pre-fire levels. Due to concerns about the increased potential for flooding of LANL facilities and homes down-canyon from the burned areas, several flood and sediment retention structures were constructed as part of the emergency response. The 2008 SWEIS stated that there would be few impacts to the floodplains at LANL from the proposed actions. The only impact discussed was a reduction in potential contaminant sources associated with TA-18 operations, which were eliminated when the Solution High-Energy Burst Assembly was removed (NNSA 2018a).

Since issuance of the 2008 SWEIS, significant work within floodplains has occurred in DP, Pueblo, Los Alamos, Sandia, and Water canyons as part of the Consent Order implementation and to mitigate the impacts of 2013 flooding. Grade-control structures were constructed in DP, Pueblo, and Sandia canyons (NNSA 2018a).

The grade-control structures in DP and Pueblo canyons were installed to stabilize watercourse channels and maximize the retention of sediment within the watercourses (*see* Section 4.4.1.4). Floodplain assessments were prepared for these projects in 2009, with the determinations that the grade-control structures would have minimal initial impacts and positive long-term effects for the canyons. Sediment removal at the Los Alamos Canyon weir is conducted to mitigate flooding.

To mitigate damage from erosion in Water Canyon at the crossing of NM-502, and to protect the integrity of the roadway, an existing culvert was replaced with a new box culvert and associated infrastructure to dissipate energy in runoff flows. The Sandia Canyon grade-control structure was installed to stabilize the existing wetland and to mitigate headcutting.[30] A floodplain assessment was prepared in 2012 to evaluate the impacts of these erosion controls in Sandia Canyon. The long-term effects for the 100-year floodplain in Sandia Canyon were determined to be positive. The floodplain would be initially disturbed, but ultimately, structures would reduce the amount of potentially contaminated soil leaving LANL property (NNSA 2018a).

Wildland Fire

The 2000 Cerro Grande fire changed the water resources environment by removing vegetation and decreasing infiltration of water into the soils at LANL. These changes caused increased surface water runoff and soil erosion, which impacted water quality. These impacts were analyzed in the 2008 SWEIS, which states that stormwaters and sediment transport would diminish over time as infiltration increases with the growth of new vegetation in the burn areas (NNSA 2008b).

In 2011, the Las Conchas fire burned more than 150,000 acres in areas adjacent to LANL. This changed the hydrologic conditions and potential sediment yield within these areas. Stormwater runoff volumes and velocities and associated sediment transfer increased in the burned areas and

[30] A headcut in a stream or gully is an abrupt vertical drop or a sharp change in slope that often forms as a result of erosion processes. Headcutting refers to the process of this vertical drop progressively migrating upstream. This can lead to significant changes in the landscape and hydrology of the area. The primary factors contributing to headcutting include concentrated water flow, changes in land use, removal of vegetation, and other disturbances that increase the velocity and volume of water flow.

affected areas of LANL. The increased flows caused flooding and erosion damage, including damage to multiple sections of security fencing, along LANL's western boundary (NNSA 2018a).

On September 13, 2013, the LANL region was subjected to what has been classified as a greater-than-1,000-year rainfall event. Approximately 2.49–3.52 inches of rain fell at different locations around the Laboratory within a 24-hour period. All of the local canyons flooded and some experienced substantial channel and bank erosion and widespread sediment deposition. There was also significant damage to infrastructure, including roads, gauging stations, and other sampling equipment. Environmental impacts from this flooding were mitigated through actions discussed in the 2008 SWEIS. Activities included cleanout of culverts and channels conveying stormwater from USFS property onto LANL and the installation of new culverts. No permitted NPDES outfalls were impacted (NNSA 2018a).

4.5 Climate, Air Quality, and Noise

4.5.1 Climatology and Meteorology

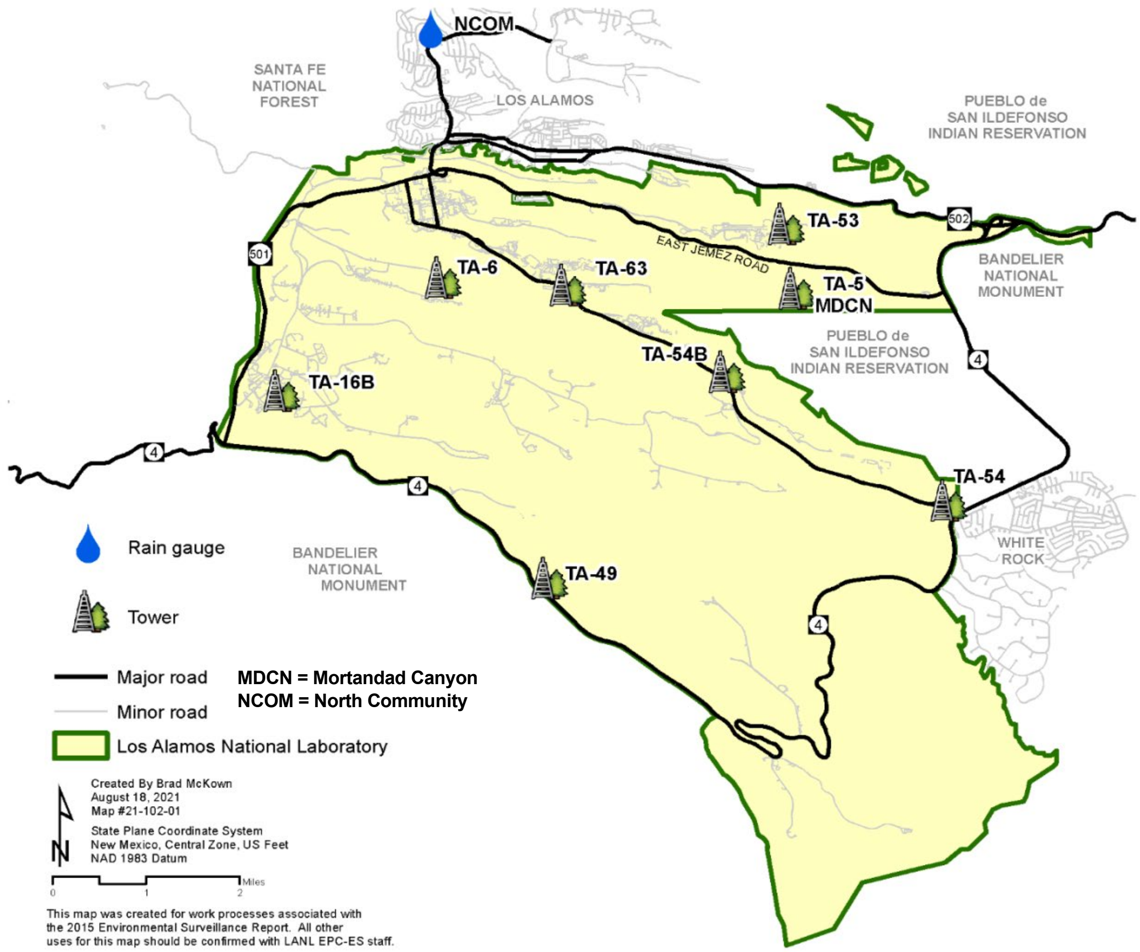
The information in this section provides supporting data that are used for analysis in other environmental resource areas (e.g., human health and safety and accident analysis). Chapter 5 of this SWEIS presents potential impacts to climate change from greenhouse gas (GHG) emissions and the potential impacts associated with climate change as appropriate in other resource areas.

The climatological and meteorological conditions at LANL and in the surrounding area are characterized as semiarid. The water lost through evaporation and transpiration is more than annual precipitation. Annual average (water equivalent) precipitation is about 17 inches and daily air temperatures range from 30 degrees Fahrenheit (°F) in the winter to near 90°F in the summer. The Laboratory monitors meteorological conditions (e.g., wind speed and direction, temperature, atmospheric pressure, relative humidity, dew point, precipitation, and solar and terrestrial radiation) from nine onsite locations to obtain these data (Figure 4.5-1).

Annual precipitation includes both rain and frozen precipitation from snow and hail. The rainy season is July–September when thunderstorms produce short-duration, high-intensity rainfall. Snowfall in the winter has an annual average of 43 inches; however, the water equivalent is much less as previously stated.

The LANL annual site environmental reports present an analysis of past climatic conditions to understand site resilience and recent trends in climate. The average annual precipitation from 1924 through 2010 was 18 inches, with a standard deviation of 4.4 inches. The analysis illustrates a long-term drought beginning in 1998 and a decrease in annual average snowfall since 1950. Precipitation was less than 15 inches between 2000 and 2003 and again in 2011 and 2012. Annual precipitation values were as low as 10 inches in 2003 and 2012 (LANL 2022h). Total precipitation in 2022 (18.75 inches) was the highest since 2015. Total snowfall in 2022 totaled 29.5 inches, 13.9 inches less than the climatological average from 1991 to 2022 (LANL 2024e).

From an air temperature perspective, temperatures between 1960 and 2000 were relatively constant year to year. The years 2001–2010 were approximately 1.5°F warmer than the previous 40 years, and the years 2011–2018 were approximately 3°F warmer than the 1960–2000 averages (LANL 2022h). The average annual temperature in 2022 was 0.8°F warmer than the climatological average from 1991 to 2022. The highest monthly temperature was 92°F in June. Temperatures in September and December averaged 3.8°F and 2.8°F more than the climatological average (LANL 2024e).



Source: LANL (2024e)

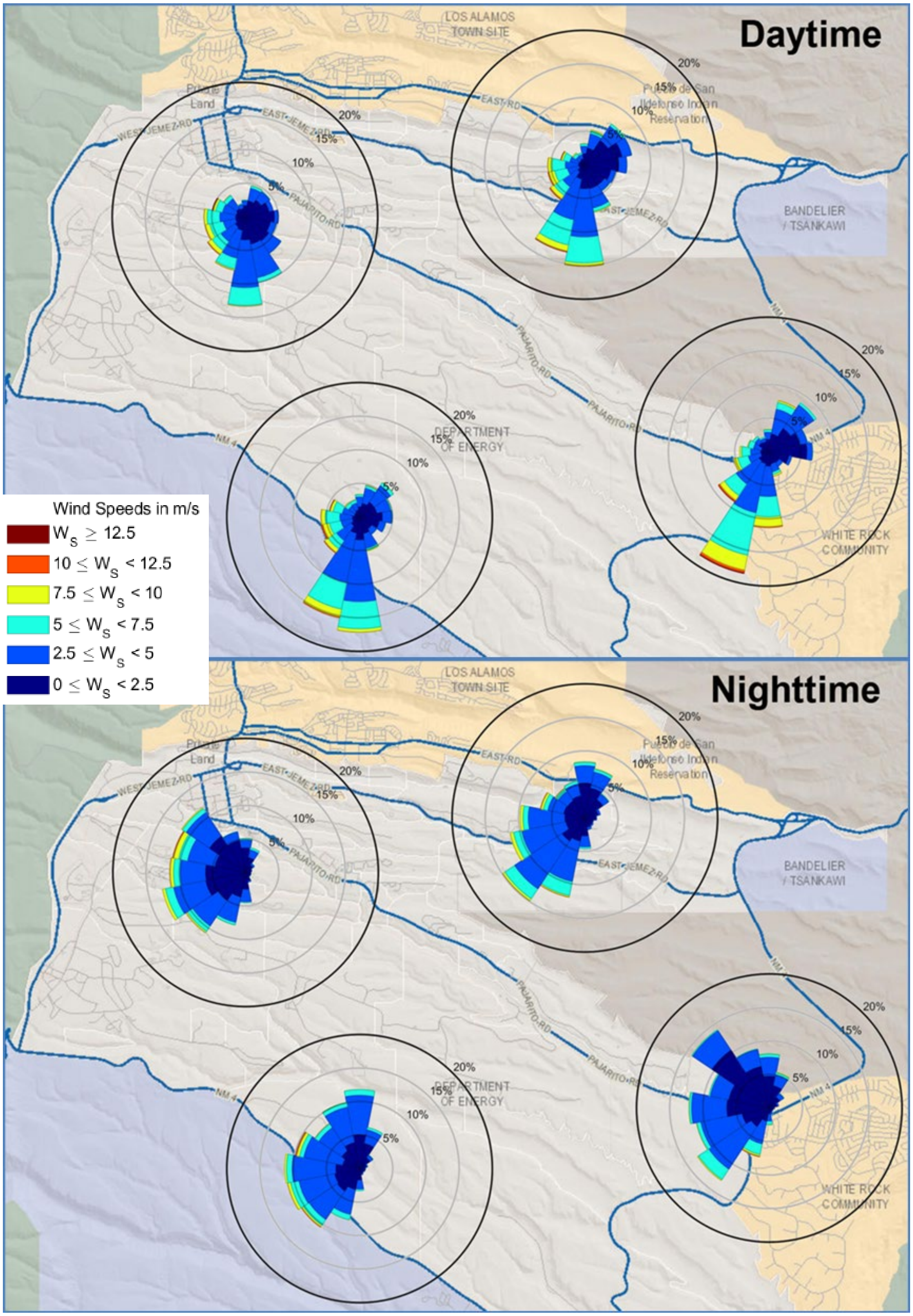
Figure 4.5-1 Locations of Nine LANL Meteorological Monitoring Stations

4.5.1.1 Wind Conditions

Low- and high-pressure systems moving across New Mexico produce winds. Wind conditions at LANL are also influenced by topography (*see* Figure 4.2-1). The canyons of the Pajarito Plateau typically have easterly winds during the day and westerly winds at night, while the Rio Grande Valley to the east of LANL brings southerly daytime breezes.

Wind roses depict patterns of wind direction. Wind roses at LANL historically indicate that daytime winds are from the south and southwest and night winds are from the west and northwest. Figure 4.5-2 illustrates wind roses at four LANL mesa-top meteorological towers.

The windiest season is spring. Average spring winds measured at about 39 feet above ground in 2022 were between 6.9 to 9.7 miles per hour (mph); the annual average wind speed was 6.4 mph at the same height. The largest gusts in 2022 were recorded in April and December. Wind gusts were 60 mph during both events at TA-6. High winds in April occurred on the same day the Cerro Pelado fire started (LANL 2024e). Conditions reported in the 2008 SWEIS were greater than conditions reported in 2022; the average annual reported wind speed was 7 mph and the highest wind speed on record was 77 mph as of 2008 (NNSA 2008b).



Source: LANL (2024e)

Figure 4.5-2 Annual 15-Minute Average Wind Roses for 2021 at Four LANL Mesa-Top Meteorological Towers

4.5.1.2 Severe Weather

Severe weather that has the potential to cause destructive effects on the ground include thunderstorms, tornados, and hail. No tornado activity was reported in Los Alamos County between 1883 to present (NWS 2023). Severe weather at LANL includes thunderstorms and hail. Summer thunderstorms in the afternoon bring lightning. Local lightning density at LANL is estimated at 15 strikes per square mile, one of the highest densities in the U.S. (LANL 2022h). Hail also occurs frequently. Los Alamos County had 33 reports of hail between 1955 and 2021 with more than 35 percent of those events occurring in July (NWS 2022).

Other less-severe weather conditions can cause destructive effects on the ground when they occur in combination. The National Weather Service issues a Red Flag Warning when a combination of warm temperatures, low relative humidity, and strong winds occur. These conditions are fire weather conditions (NWS 2023). The occurrence of these conditions varies annually. The Laboratory has tracked the number of Red Flag Warning days since 2012; the minimum number of days tracked was zero in 2019. The maximum number of 41 occurred in 2022 (LANL 2024e).

4.5.1.3 Climate Change

The 2017 National Climate Assessment projects annual average temperature over the contiguous U.S. will continue to rise in the future (USGCRP 2017). The 2023 National Climate Assessment states temperatures in the contiguous U.S. have risen by 2.5°F since 1970, compared to a global temperature rise of around 1.7°F over the same period. This reflects a broader global pattern in which land is warming faster than the ocean and higher latitudes are warming faster than lower latitudes. There are substantial seasonal and regional variations in temperature trends across the U.S. and its territories. Winter is warming nearly twice as fast as summer in many northern states. Annual average temperatures in some areas (including parts of the Southwest) are more than 2°F warmer than they were in the first half of the 20th century (USGCRP 2023).

The Southwest region is historically arid and marked by episodes of intense drought and precipitation. Climate change is exacerbating these conditions, as increasing temperatures are leading to hotter extreme heat events, drier soils, greater atmospheric evaporative demand, and reduced flows in major river basins such as the Colorado River and Rio Grande. Additionally, since 2000 the Southwest has experienced an exceptional "megadrought"—defined as an episode of intense aridity that persists for multiple decades—that is recognized as the driest 22-year period in 1,200 years (USGCRP 2023).

Across New Mexico, average and summer seasonal precipitation is projected to decrease, droughts are projected to intensify, and streamflow in major river basins is projected to decline. Spring thaws are projected to occur earlier, and a greater fraction of precipitation is projected to fall as rain rather than as snow, reducing mountain snowpack. The risk of wildfire and the average annual area burned is expected to increase across the region (USGCRP 2023).

Executive Order (EO) 14008, "Tackling the Climate Crisis at Home and Abroad," outlines policies to reduce GHG emissions and to bolster resilience to the impacts of climate change. The Laboratory completes annual site sustainability plans and a vulnerability assessment and resilience plan consistent with EO 14008. The vulnerability assessment and resilience plan describes climate change hazards and defines a range of resilience solutions. Wildfire was found to cause the greatest risk to LANL. Other hazards identified were increased frequency and intensity of extreme heat events;

increased frequency, intensity, and duration of extreme precipitation events; thunderstorms; and increased flooding and erosion events.

4.5.2 Air Quality

4.5.2.1 Nonradiological Air Quality

Air quality is defined by the level of overall air pollution; nonradiological air quality is air pollution not related to radiological materials. Air pollution is the presence of one or more contaminants (e.g., dust, fumes, gas, mist, odor, smoke, or vapor) in the outdoor atmosphere in quantities and duration that could harm human, plant, or animal life, or unreasonably interfere with the enjoyment of life and property. Appendix H, Section H.1.1 provides a regulatory overview of nonradiological air quality and a discussion of current LANL permit limits.

4.5.2.2 Sources of Nonradiological Emissions

The Laboratory reports emissions that are subject to the air operating permit on an annual and semiannual basis to NMED to document compliance with permit limits. Table 4.5-1 presents a comparison of multi-year average facility-wide emissions for the periods 2001–2005 and 2017–2022 for criteria pollutants reported on LANL's Title V Operating Permit. The data indicate a general decline of the average facility-wide emissions. Annual emissions vary based on construction of new facilities, facility upgrades, and other environmental factors but are generally lower over the multi-year period 2017–2022 (LANL 2019b, 2020d, 2021b, 2022a, 2023a, 2024a). The 2008 SWEIS reported increases in emissions during the 2000 Cerro Grande fire through 2004 because of fire mitigation activities.

Table 4.5-1 Facility-Wide Emissions (tons per year)

Multi-year Average	NO_x	CO	VOC	SO_2	PM	HAP
2001–2005	61.8	31.9	12.8	1.4	10.6	6.7
2017–2022	40.8	25.8	9.7	0.9	4.5	5.3
Annual Average	**NO_x**	**CO**	**VOC**	**SO_2**	**PM**	**HAP**
2017[a]	30.9	23	10.3	0.32	3.5	5.2
2018[a]	36.3	25.8	11.3	0.6	4	5.9
2019[a]	35	24.6	12	0.5	3.5	4.9
2020[a]	41.9	26.1	6.1	0.8	4.2	4.4
2021[a]	54.3	29	6.8	1.9	6.4	5.7
2022[a]	46.3	26	11.85	1.4	5.4	5.7
Permit limits	245	225	200	150	120	24 total, 8 individual

CO = carbon monoxide, HAP = hazardous air pollutant, NO_x = oxides of nitrogen, SO_2 = sulfur dioxide, VOC = volatile organic compound, PM = particulate matter

a Annual facility-wide emission totals include stationary standby generators, which are no longer in LANL's Title V Operating Permit; however, values presented are based on emissions reported for LANL's Title V Operating Permit.

Source: NNSA (2008b); LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

Facility-wide annual emissions reported from LANL are consistently well below facility-wide permitted emissions. Emissions for the multi-year period 2017–2022 are reported from the TA-3 power plant, boilers and heaters, TA-60 asphalt plant, data disintegrator, degreasers, five beryllium-machining operations, 11 internal combustion engines (generators), the combustion turbine at the TA-3 power plant, chemical use from research and development activities, and six evaporative sprayers.

The Laboratory uses the ChemDB chemical tracking system to calculate emissions for VOCs and HAPs at the Laboratory. VOCs and HAPs purchased and received are inventoried; as a conservative estimate, 100 percent are assumed to be emitted to air. Annual variations in VOCs and HAPs emissions are attributed to fluctuations in purchases.

Carbon monoxide, nitrogen oxides, and particulate matter were lower than permit limits by 12, 21, and 5 percent respectively, in 2022. The Laboratory has used a combustion turbine to generate more onsite energy since 2019 causing an increase in nitrogen oxides from past years (LANL 2024e). Other deviations in emissions between the years included the addition of a spray evaporator at the SERF in 2019 and the dismantling and removal of the asphalt plant in 2021. A new General Construction Permit was obtained in December 2021 to run the new asphalt plant (LANL 2022c).

4.5.2.3 Existing Ambient Air Conditions

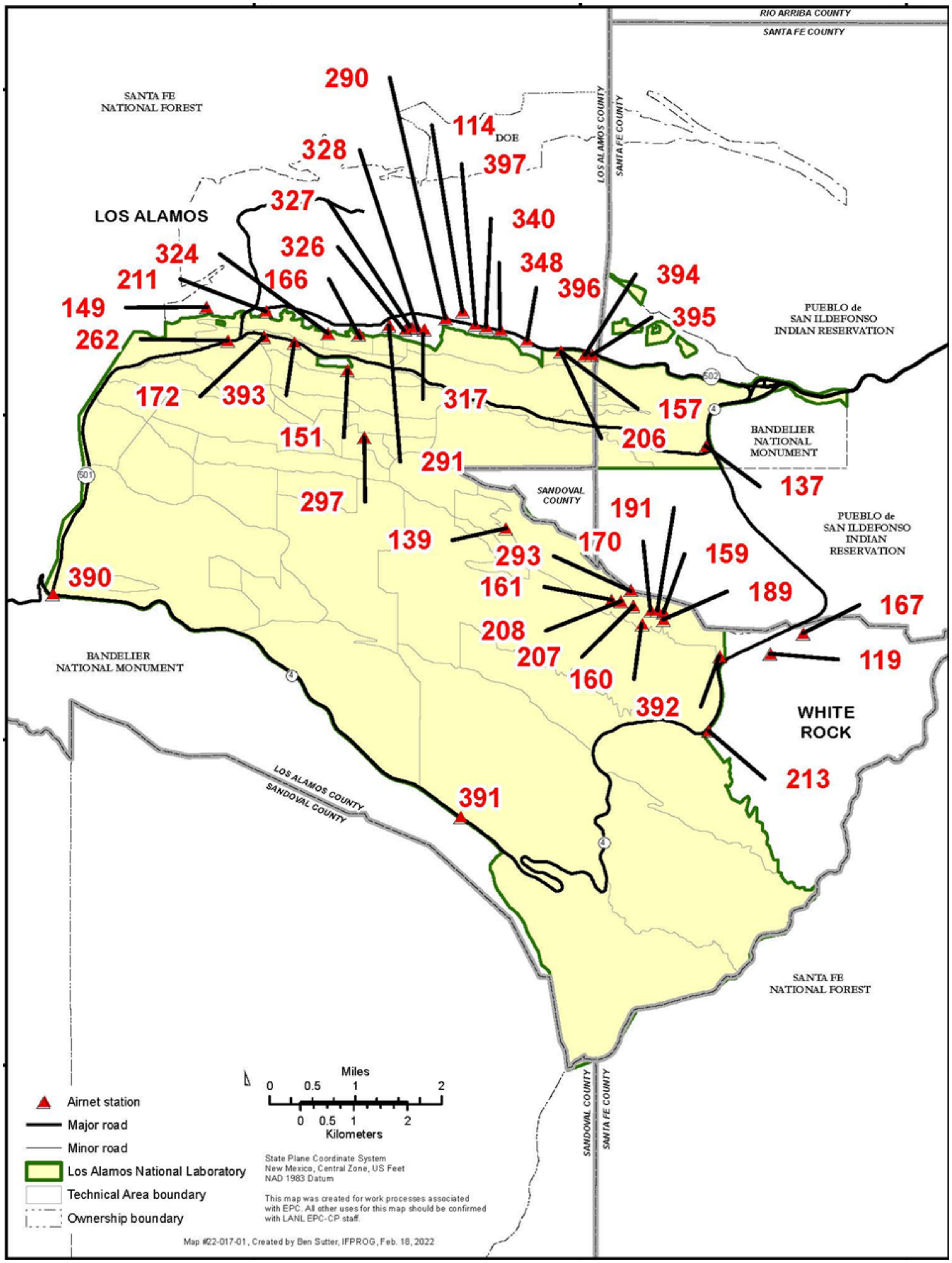
The Laboratory focuses its ambient air sampling on radiological air quality (*see* Section 4.5.2.4). NMED monitors nonradiological ambient air conditions with the exception of particulate matter. NMED discontinued a DOE-operated ambient air quality monitoring station near LANL in the 1990s because recorded values were well below applicable standards. Current active NMED monitoring stations are more than 100 miles from LANL in Taos and Santa Fe and only record $PM_{2.5}$ (NMED 2022; EPA 2022b). The Laboratory monitors particulate matter in White Rock and Los Alamos. Concentrations monitored in 2022 were typically less than 10 micrograms per cubic meter, well below EPA standards of 35 micrograms per cubic meter for $PM_{2.5}$ (LANL 2024e).

4.5.2.4 Radiological Air Quality

Individuals are continuously exposed to airborne radioactive materials. These materials come primarily from natural resources found worldwide, such as the short-lived decay products of radon. However, airborne radioactive materials can also be emitted by manmade operations. Some Laboratory operations may result in the release of radioactive materials to the air from point sources, such as stacks or vents, or from nonpoint (area) sources, such as radioactive materials in contaminated soils. The concentrations of radionuclides in point-source releases are continuously sampled or estimated based on knowledge of the materials used and the activities performed. Nonpoint-source emissions are directly monitored or sampled or estimated from airborne concentrations outdoors. The section below discusses radiological air quality on the basis of data collected between 2017 and 2022. Radiation doses from Laboratory airborne emissions and radiological emissions standards are discussed in Section 4.7 of this SWEIS.

4.5.2.5 Radiological Monitoring

The LANL environmental air monitoring stations measure environmental levels of airborne radionuclides, such as plutonium, americium, uranium, tritium, and activation products that could be released from Laboratory operations (Figure 4.5-3). Most regional airborne radioactivity comes



Source: LANL (2024a)

Figure 4.5-3 Environmental Air Monitoring Stations at and Near LANL

from the following background sources: (1) natural radioactive constituents in particulate matter (such as uranium and thorium), (2) terrestrial radon diffusion out of the earth and its subsequent decay products, (3) material formation from interaction with cosmic radiation, and (4) fallout from past atmospheric nuclear weapons tests conducted by several countries.

Radioactive materials from background sources, contaminated soils, and unmonitored sources are nonpoint sources; also referred to as diffuse emissions. The Laboratory uses ambient air measurements at public receptor locations to evaluate compliance from diffuse emissions. Table 4.5-2 summarizes regional levels of radioactivity in the atmosphere over the period 2017–2022. The multi-year annual average of all estimated releases from nonpoint sources was 66 curies over the period. The Laboratory monitors exhaust stacks from buildings with operations that may vent radioactive materials that could result in offsite doses greater than 0.1 millirem during any one-year period. Laboratory staff categorizes these radioactive stack emissions into four types: (1) particulate matter, (2) vaporous activation products, (3) tritium, and (4) gaseous mixed activation products. Sample methods vary for each of these four types of emissions consistent with NESHAP, Appendix B, Method 114. Table 4.5-3 summarizes stack emissions during the period 2017–2022.

The total annual radiological emissions from stack emissions (i.e., point sources) averaged over the period 2017–2022 was about 250 curies; these emissions consisted primarily of activation products from LANSCE operations and tritium from tritium facilities.

Measured stack emissions in 2022 included tritium emissions of approximately 63 curies; gaseous mixed activation products from LANSCE stacks contributed 107 curies. Combined airborne materials in 2022 such as plutonium, uranium, americium, and thorium were less than 0.0000003 curie. Emissions of particulate/vapor activation products totaled less than 1 curie. Overall, radiological air emissions at LANL tend to be dominated by emissions from LANSCE stacks. Results from facilities for particulates such as plutonium and uranium remain very low, illustrating that emissions control systems are working as designed and emissions of short-lived gases and vapors over the past 10 years have been similar (LANL 2024e).

LANL began managing the Isotope Production Facility in TA-53 as a major source of radiological emissions in January 2023. The facility had been operated as a minor source since 2004 but increased demand for radioisotopes for medical diagnostic and therapeutic use has increased operations. As a major source, stack emissions from the facility are being monitored as a point source. The projected controlled dose from projected operations of the facility is 0.074 millirem per year, less than the 0.1 millirem per year that requires EPA pre-construction approval. Stack emissions from this new source are included in future annual emissions reports beginning in 2023.

Table 4.5-2 Background Concentration of Radioactivity in the Regional Atmosphere, 2001–2005 and 2017–2022

Constituent	Units	EPA Concentration Limit	2001	2002	2003	2004	2005	5-yr average (2001–2005)	2017	2018	2019	2020	2021	2022	Multi-yr average (2017–2022)
Gross Alpha	fCi/m^3	N/A	0.8	0.8	0.8	1.1	0.9	0.9	ND	ND	ND	ND	ND	ND	ND
Gross Beta	fCi/m^3	N/A	13.9	13.3	13.7	18.3	16.3	15.1	ND	ND	ND	ND	ND	ND	ND
Tritium	pCi/m^3	1,500	NM	NM	NM	0.1	0.1	0.1	1 ± 1	1 ± 1	1 ± 1	0 ± 1	0 ± 1	0 ± 1	1
Strontium-90	aCi/m^3	19,000	N/A	4	11	N/A	N/A	7.5	ND	ND	ND	ND	ND	ND	ND
Plutonium-238	aCi/m^3	2,100	0	0	NM	0.09	0	0.0	0 ± 1	0 ± 1	0 ± 1	0 ± 1	0 ± 1	1 ± 1	<1
Plutonium-239/240	aCi/m^3	2,000	0.1	0.3	NM	NM	0.1	0.2	0 ± 1	1 ± 1	0 ± 1	0 ± 1	0 ± 1	0 ± 1	<1
Americium-241	aCi/m^3	1,900	NM	0.3	NM	NM	0.1	0.2	0 ± 1	0 ± 1	0 ± 1	0 ± 1	0 ± 1	0 ± 1	<1
Uranium-234	aCi/m^3	7,700	17.9	21.7	20.9	17.4	12.4	18	11 ± 4	17 ± 5	10 ± 4	9 ± 5	13 ± 3	17 ± 4	12
Uranium-235	aCi/m^3	7,100	1.3	2.4	1.8	1.17	1.2	1.6	1 ± 1	1 ± 1	1 ± 1	1 ± 1	1 ± 1	2 ± 2	1
Uranium-238	aCi/m^3	8,300	17.7	21.8	20.1	17.0	13.2	18	12 ± 5	17 ± 4	7 ± 3	9 ± 6	12 ± 5	15 ± 3	11

aCi = attocurie = 10^{-18} curie; EPA = U.S. Environmental Protection Agency; fCi = femtocurie = 10^{-15} curie; m^3 = cubic meter; N/A = not available, ND = no data; NM = not measurable; pCi = picocurie = 10^{-12} curie

Source: NNSA (2008b); LANL (2018c, 2019d, 2020b, 2022e, 2022h, 2024e)

Table 4.5-3 Ranges of Annual Airbourne Radioactive Emissions and Averages from Los Alamos National Laboratory Buildings with Sampled Stacks, 2017–2022 (curies)[a]

Technical Area/ Building Number	Tritium	Americium-241	Plutonium	Uranium	Thorium	Particulate Matter plus Vapor Activation Products	Gaseous Mixed Activation Products
TA-3/29	ND	6.3×10^{-8}–8.9×10^{-6}	5.6×10^{-7}–1.9×10^{-5}	2.1×10^{-6}–4.3×10^{-6}	6.9×10^{-8}–4.3×10^{-7}	1.7×10^{-5}	ND
	ND	2.6×10^{-6}	7.2×10^{-6}	3.5×10^{-6}	3.2×10^{-7}	1.7×10^{-5}	ND
TA-16/ 205/450	24–82	ND	ND	ND	ND	ND	ND
	44.4	ND	ND	ND	ND	ND	ND
TA-48/001	ND	$2.8x10^{-8}$	4.2×10^{-10}–1.4×10^{-7}	4.8×10^{-9}–6.7×10^{-9}	1.6×10^{-9}–4.6×10^{-9}	1.8×10^{-5}–1.9×10^{-2}	ND
	ND	$2.8x10^{-8}$	7.0×10^{-8}	5.9×10^{-9}	3.1×10^{-9}	6.7×10^{-3}	ND
TA-50/001	ND	ND	1.7×10^{-8}–3.1×10^{-8}	7.9×10^{-8}–2.9×10^{-7}	2.5×10^{-8}–4.1×10^{-8}	ND	ND
	ND	ND	2.4×10^{-8}	1.7×10^{-7}	3.0×10^{-8}	ND	ND
TA-50/069	ND	1.6×10^{-10}	2.9×10^{-11}–6.8×10^{-10}	6.7×10^{-10}	2.4×10^{-10}–3.8×10^{-10}	2.1×10^{-8}	ND
	ND	1.6×10^{-10}	2.1×10^{-10}	6.7×10^{-10}	2.9×10^{-10}	2.1×10^{-8}	ND
TA-53/003	5.1–19	ND	ND	ND	ND	5.1×10^{-5}–3.1×10^{-1}	15–55
	11.7	ND	ND	ND	ND	5.2×10^{-2}	34
TA-53/007	1.3–4.7	ND	ND	ND	ND	2.1×10^{-3}–8.6×10^{-1}	86–251
	3.5	ND	ND	ND	ND	2.7×10^{-1}	152
TA-54/ 231/375/412	ND	ND	1.6×10^{-10}	3.3×10^{-9}–2.6×10^{-8}	4.1×10^{-9}–1.4×10^{-8}	ND	ND
	ND	ND	1.6×10^{-10}	1.3×10^{-8}	7.9×10^{-9}	ND	ND
TA-55/004	0.3–13	ND	3.0×10^{-10}–1.1×10^{-7}	2.0×10^{-8}–2.2×10^{-7}	7.1×10^{-9}–2.4×10^{-8}	ND	ND
	3.5	ND	2.4×10^{-8}	6.7×10^{-8}	2.0×10^{-8}	ND	ND
TA-55/400	ND	ND	2.5×10^{-9}–3.0×10^{-9}	5.3×10^{-8}	1.8×10^{-8}	ND	ND
	ND	ND	2.8×10^{-9}	5.3×10^{-8}	1.8×10^{-8}	ND	ND

ND = no data; TA = technical area

a The first line of data for each TA/building number is the range; the second line is the average for that range.

Source: LANL (2018c, 2019d, 2020b, 2022e, 2022h, 2024e)

4.5.2.6 Greenhouse Gas Emissions

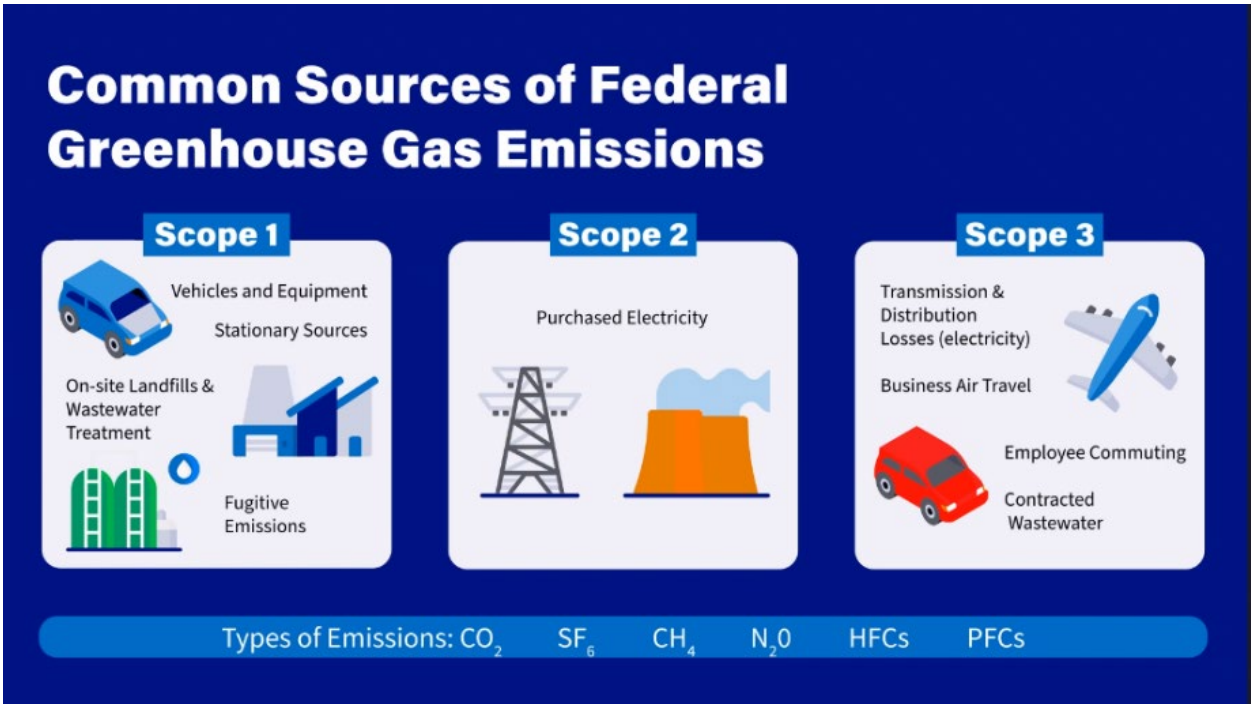
GHGs (e.g., carbon dioxide, methane, nitrous oxide) are components of the atmosphere that trap heat near the surface of the earth and contribute to climate change. Global GHG emissions have increased steadily since the onset of the Industrial Revolution around 250 years ago, with the rate of emissions accelerating rapidly in the 20th century (Climate Watch 2022). Within the U.S., overall anthropogenic GHG emissions[31] in 2020 totaled approximately 5,981 million metric tons carbon dioxide equivalent (CO_2e) (EPA 2022c). In 2018, New Mexico produced approximately 113.6 million metric tons of GHG emissions—an amount equal to approximately 1.8 percent of total U.S. GHG emissions (6,457 million metric tons) (New Mexico Office of the Governor 2021).

New Mexico's emissions are generated primarily by the oil and natural gas industry, cars and trucks, electricity production, industrial sources, and agriculture. New Mexico produces more than twice the national average of GHG emissions per capita at 50 tons per person per year, whereas the average in the U.S. is 18 tons per person per year. New Mexico's high per-capita emissions are largely the result of GHG-intensive oil and gas industry, which makes up a significant portion of the overall GHG emissions profile. Carbon dioxide makes up 62 percent of New Mexico's emissions profile, followed by methane at 35 percent. Nationally, carbon dioxide makes up 82 percent of the emissions profile, followed by methane at 10 percent (NM 2021).

In December 2021, the President signed EO 14057 "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability," aiming to create a more robust, climate-ready economy and job force while supporting the goal of reaching net-zero emissions economy-wide by 2050. This goal is intended to be in line with the Paris Agreement's mandate to limit global temperature increase to well below 2 degrees Celsius (°C) (3.6°F) and to pursue efforts to hold the rise to 1.5 °C (2.7°F) (UNFCC 2024). EO 14057 sets requirements for federal agencies to reduce their impact on the environment and to reduce the impact of climate change. The goal is to have the Federal Government lead by example to achieve a carbon-pollution-free electricity sector by 2035 and net-zero emissions economy-wide by no later than 2050.

In accordance with the EO, when considering GHG emissions and their significance, agencies should use appropriate tools and methodologies for quantifying GHG emissions reported in the 2023 Site Sustainability Plan. Figure 4.5-4 illustrates the sources of emissions quantified to meet corporate standards for reporting GHG emission; these three standard scopes are consistent with DOE's reporting requirements: direct emissions occurring on site are Scope 1, indirect emissions associated with purchased and used electricity are Scope 2, and indirect emissions from purchased electricity affected by an organization like business travel are Scope 3. Table 4.5-4 summarizes the GHG emissions for each scope for FY 2023. Details about the sustainability plan are provided in Section 4.5.2.7.

[31] Anthropogenic GHG emissions are human caused emissions of carbon dioxide, nitrous oxide, methane, and chlorofluorocarbons. https://www.e-education.psu.edu/meteo469/node/181.



Source: LANL (2024f)

Figure 4.5-4 Greenhouse Gas Emissions Scopes and Emissions

Table 4.5-4 Greenhouse Gas Emissions for Fiscal Year 2023 from LANL (MT per year)[a]

Scope	Total ($MTCO_2e$)[a]
Scope 1	155,293
Scope 2	106,488
Scope 3	98,234
TOTAL	**360,015**

$MTCO_2e$ = metric ton of carbon dioxide equivalent
a GHG emissions are reported as CO_2e (carbon dioxide equivalent) in metric tons per year.
Source: LANL (2024f)

4.5.2.7 Sustainability

As previously mentioned, the Laboratory completes an annual site sustainability plan and has completed a vulnerability assessment and resilience plan consistent with EO 14008. Recognizing EO 14057 sets government-wide goals, LANL has interpreted them as goals for the Laboratory as well. The site sustainability plan describes changes over the last 10 years and actions underway at the Laboratory to improve efficiency and conserve energy. The Laboratory has taken 13 actions over the last decade to make substantive improvements in energy and water efficiency including through development of more than 30 EV charging stations; improvement or development of energy-efficient heating, ventilation, and air conditioning (HVAC); decommissioning 1.5 million square feet of facilities; and insulating steam pits using infrared technology (LANL 2022h).

DOE issued DOE Order 436.1A, "Departmental Sustainability," in April 2023. It establishes "an agency-wide integrated, performance-based approach to implement sustainability in DOE operations." The Order ensures that the Department conducts its missions that address national energy security and global environmental challenges in a sustainable manner; advances sustainable, efficient, reliable, and resilient energy for the future; promotes the conservation of natural resources; and ensures DOE achieves sustainability goals pursuant to applicable laws, regulations, and EOs.

In 2019, the Governor of New Mexico signed New Mexico EO 2019-003 for the State of New Mexico to join the "United States Climate Alliance" and set a state-wide GHG emissions target of 45 percent below 2005 levels by 2030 (New Mexico Office of the Governor 2019). EO 2019-003 directs NMED and the New Mexico Energy, Minerals, and Natural Resources Department to increase the state Renewable Portfolio Standard and develop a comprehensive, statewide, enforceable regulatory framework to reduce oil- and gas-sector methane emissions and prevent waste from new and existing sources. The EO also established a Climate Change Task Force to evaluate policies and strategies to achieve the target, including implementing low-emission vehicle (LEV) and zero-emission vehicle (ZEV) standards and adopting building codes (NMED 2024b).

Development of the *2019 New Mexico Energy Transition Act* was a collaboration of community organizations, unions, energy groups, and advocates. It "sets a statewide renewable energy standard of 50 percent by 2030 for New Mexico investor-owned utilities and rural electric cooperatives and a goal of 80 percent by 2040, in addition to setting zero-carbon resources standards for investor-owned utilities by 2045 and rural electric cooperatives by 2050" (Propst 2019).

As of 2024, Los Alamos County is developing a formal strategy aimed at fulfilling the County Council's strategic objective of environmental stewardship, ensuring that the county stays on track to reduce GHG emissions. In December 2023, Los Alamos County conducted an extensive baseline study of GHG emissions for the entire community and county operations, utilizing data from the 2022 inventory year to guide the development of its Climate Action Plan (LAC 2023).

In addition to this section, Sections 4.10 and 5.10 of this SWEIS describe sustainability goals at the Laboratory and how alternatives meet those goals. Therefore, a sustainability subsection was not carried forward into Section 5.5.

4.5.2.8 Visibility

Visibility is a measure of how well a person views a scene. A person's view can be obstructed by haze resulting from naturally occurring dust in the air or from human sources of air pollution. Visibility is influenced by how pollutants (as gases or particles) interact with light, but visibility can also be influenced by people's perception. Visibility is measured in Deciview as a unitless metric of haze proportional to the logarithm of light extinction (b_{ext}) (IMPROVE 2022a).

The *Clean Air Act* established a national visibility goal as "prevention of any future, and the remedying of any existing, impairment of visibility in mandatory Class I federal areas which impairment results from manmade air pollution." The *Clean Air Act* gave special protections for air quality and scenic views to national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres, i.e., Class I federal areas (Jacobs et al. 2015). The EPA published the Regional Haze Rule, which requires states to work with federal agencies to improve visibility in federal Class I national parks and wilderness areas (IMPROVE 2022b).

Bandelier National Monument, to the southwest of LANL, protects more than 33,000 acres of wilderness; as such, it is a Class I federal area. The NPS, the federal agency that manages Bandelier National Monument, has monitored visibility in the national monument since 1988. The

Interagency Monitoring of Protected Environments (IMPROVE) manages and analyzes more recent visibility data collected at Bandelier National Monument. Data from Bandelier National Monument demonstrates a trend of improved visibility at the national monument since 2000 (IMPROVE 2022c).

4.5.3 Noise, Air Blasts, and Vibration

Noise is defined as undesirable sound. Noise, air blasts (or air pressure wave), and vibrations are all sounds that occur intermittently at LANL. Sound results from vibrations introduced into a medium, like air, that stimulate the auditory nerves of a receptor to produce the sensation of hearing. Sound is undesirable if it interferes with communication, is intense enough to damage hearing, or diminishes the quality of the environment. Activities essential to a community's quality of life, such as construction or vehicular traffic, make noise. The type and characteristics, distance from source, individual sensitivity, and time of day influence human response to noise.

Although the receptor most often considered for these environmental conditions is human, sound and vibrations are also perceived by animals in the LANL vicinity. More is known about how different wildlife species are impacted by noise since the 2008 SWEIS. Noise impacts to the Mexican spotted owl are documented in the 2012 recovery plan (USFWS 2012; LANL 2020a). A 2018 study found that noise levels in key Mexican spotted owl habitat had not changed since 2005, prior to the construction of the asphalt plant (LANL 2018d). The vigor and well-being of area wildlife and sensitive, federally protected bird populations suggest that these environmental conditions are present at levels within an acceptable tolerance range for most wildlife species and sensitive nesting birds found along the Pajarito Plateau (NNSA 2008b). Ecological resources affected by noise are described in Section 4.6 of this SWEIS.

"Public noise" is the noise present outside LANL site boundaries. It is from the combined effect of the existing Laboratory traffic and site activities and the noise generated by activities around the Los Alamos and White Rock communities. "Worker-generated noise" is the noise generated by activities within LANL boundaries. Air blasts consist of a higher-frequency portion of air pressure waves that are audible and that accompany an explosives detonation. This noise can be heard by both workers and the area public. The lower-frequency portion of air pressure waves is not audible but may cause a secondary and audible noise within a testing structure that may be heard by workers. Air blasts and most ground vibrations generated at the Laboratory result from testing activities involving aboveground explosives research (NNSA 2008b).

Sound varies by both intensity and frequency. Intensity is a sound pressure level quantified in decibels (dB). The dB is a logarithmic unit that expresses the ratio of a sound pressure level to a standard reference level. Hertz are used to quantify sound frequency. The human ear responds differently to different frequencies. *A-weighting*, measured in A-weighted decibels (dBA), approximates sound frequency most readily heard by the human ear. Table 4.5-5 lists typical sounds encountered in daily life and their respective average dBA levels representative of what a human ear might experience. Noise levels vary widely depending on where measurements are taken.

Limited data exist on the levels of routine background ambient noise levels, air blasts, or ground vibrations produced by Laboratory operations. The following discussions of noise level limitations are provided to identify applicable regulatory limits or administrative controls regarding the Laboratory's noise, air blast, and vibration environment.

Table 4.5-5 Common Sounds and Their Levels

Outdoor	Average Sound Level (dBA)	Indoor
Jackhammer	110	Rock band
Lawnmower	90	Shouted conversation
Heavy traffic	80	Garbage disposal
Inside car at 60 miles per hour	70	Dishwasher
Air conditioner	60	Conversational speech
Light traffic	50	Refrigerator

dBA = a-weighted decibel
Source: Sound Proofing Guide (2024)

4.5.3.1 Noise Level Regulatory Limits and Los Alamos National Laboratory Administrative Requirements

LANL and the surrounding communities of Los Alamos and White Rock are in Los Alamos County. Los Alamos County has a noise ordinance for residential areas. Noise levels in residential areas are limited to a maximum of 65 dBA during daytime hours and 53 dBA during nighttime hours (9 p.m. to 7 a.m.). Daytime noise is allowed to increase to 75 dBA for 10 minutes in any 1 hour. Some exemptions are allowed for safety warnings, emergency vehicles, and other emergency work. Noise that is temporary in duration is granted by permit from Los Alamos County (Los Alamos County, New Mexico, Code of Ordinance, Chapter 18, Article III, Section 18-73.).

LANL also has an occupational exposure limit for an accumulated daily (eight-hour) steady-state noise exposure of 85 dBA. Higher exposure is allowed for shorter durations. High peak noise exposure is limited, and no unprotected ear exposure is allowed for a peak sound pressure greater than 140 dB (NNSA 2008b). Worker safety affected by noise is described in Section 4.7 of this SWEIS.

4.5.3.2 Existing Los Alamos National Laboratory Noise, Air Blast, and Vibration Environment

Noise at LANL is from daily operations and ongoing construction activities including truck and automobile movement. Air blasts and vibrations at the Laboratory accompany explosives detonations. HE testing facilities are located in TAs-14, -15, -36, -39, and -40. They include 16 firing sites designed for explosive experiments (LANL 2023a). These HE testing areas are forested within the interior of LANL, requiring air blasts and ground vibrations to travel long distances, and subsequently losing much power in the process, before being perceived by the public. Studies performed for the DARHT facility found no need for county noise permits because noise was not prolonged and would be less than 75 dBA at key LANL boundaries (NNSA 2008b).

4.6 Ecological Resources

Ecological resources include terrestrial resources, wetlands, aquatic resources, and federally protected and sensitive species. This section addresses each of these areas, as well as biodiversity. Field investigations and monitoring studies are an important element in the evaluation of ecological conditions at LANL. Such studies, which are conducted by Laboratory staff and may involve handling animals in the field, help determine species presence and density, seasonal trends in biological resources, and overall health through biota dose assessments. Special ecological studies, such as the evaluation of site wetlands, may be undertaken by outside experts.

4.6.1 Terrestrial Ecology

LANL is located on the Pajarito Plateau on the east side of the Jemez Mountains. Elevations in the region range from approximately 5,400 feet along the Rio Grande to more than 10,000 feet in the Jemez Mountains west of the LANL property. Elevations within the LANL property range from 5,400 feet to approximately 8,000 feet along the west property boundary. The Pajarito Plateau is bisected by a series of canyons that run west to east that create a landscape of relatively flat mesas separated by canyons. The canyon/mesa topography creates a variety of microclimates on north- and south-facing slopes. The combination of these landscape features, past and present human use, human-caused and natural wildland fires, and climatic events such as droughts and floods has given rise to diverse, and often unique, biological communities and ecological relationships at LANL and the region as a whole (NNSA 2008b).

4.6.1.1 Vegetation Associations

The LANL region includes five vegetation zones along a gradient of the increasing elevation, decreasing temperature, and increasing moisture from the Rio Grande to the Jemez Mountains. These vegetation zones include oneseed juniper (*Juniperus monosperma*) savannas; pinyon pine (*Pinus edulis*)-juniper woodlands; grasslands; Ponderosa pine (*Pinus ponderosa*) forests; and mixed-conifer forests (Douglas fir [*Pseudotsuga menziesii*], ponderosa pine, and white fir [*Abies concolor*]) (LANL 2022d). This general classification does not reflect the complexity of the vegetation communities present within LANL created by the effects of topography, past human disturbances, wildland fires, and climate. In 2018, the Laboratory published an updated land cover map of the LANL site and the surrounding area (Hansen et al. 2018). This updated classification reflects effects of local topography and changes in vegetation since 2003 from factors such as widespread tree mortality from bark beetle outbreaks and drought, wildland fire, and human activity.

The updated land cover map identified 20 vegetation cover types and 6 non-vegetation land cover classes. Seventeen vegetation cover types and five non-vegetation cover types occur on LANL. Appendix A, Table A.4.6-1, provides a list of land cover types and a distribution (in acres) across the LANL site. A full description of the vegetation cover types is provided in Hansen et al. (2018). The non-vegetation cover types include asphalt roads, developed areas, golf course, bare rock, bare soil, and water. The classification of vegetation cover types based on dominant species and physiognomy (e.g., growth form, density, and canopy cover) represents important differences in potential habitat suitability for wildlife species. The five most abundant cover types on the LANL site, in order of decreasing area, are dense juniper woodland (27.9 percent), ponderosa pine woodland (14.5 percent), sparse juniper woodland (14.5 percent), mixed-conifer (10.1 percent), and developed areas (6.1 percent). These cover types account for 73.1 percent of the land cover. Juniper woodland (both dense and sparse stands) is the dominant vegetation cover on the LANL site, comprising about 42.4 percent of the land area. Juniper woodland occurs primarily at lower elevations and extends from the eastern boundary along the Rio Grande to about 7,500 feet in elevation into the central part of LANL. Ponderosa pine woodland is the dominant land cover on the western part of LANL extending from about 6,200 feet in elevation to about 8,500 feet. Mixed-conifer vegetation found along north-facing canyon slopes, which have cooler and moister microclimates, consists of ponderosa pine and other conifer species such as Douglas fir, limber pine, and white fir, which typically occur at higher elevations. Developed areas include buildings, structures, parking lots, and cleared areas. Each of the remaining vegetation cover types comprise less than 5 percent of the land cover and together comprise 26.9 percent of the site. Some of the vegetation cover types are a result of vegetation recovery from the 2000 Cerro Grande and 2011 Las Conchas wildland fires, effects of insect outbreaks, and tree mortality from drought. Between 2002 and 2005, more than 90 percent of the mature piñon trees in the Los Alamos area died from a combination of drought stress and bark beetle infestation (Breshears et al. 2005).

Land cover types that occur west of LANL at higher elevations include aspen in different stages of growth from fire recovery, oak shrubland, mixed conifers, New Mexico locust shrubland, ponderosa pine, and montane grassland. This area was impacted by both the Cerro Grande and Las Conchas wildland fires. Although this area is outside the LANL site, it is important to the ecological resources on LANL through seasonal elevational migrations of wildlife.

4.6.1.2 Wildlife

The diversity of vegetation, topographic features, and range of elevations on the LANL site provides habitat for a diversity of wildlife. These include approximately 57 species of mammals, 200 species of birds, 28 species of reptiles, 9 species of amphibians, and over 1,200 species of arthropods (NNSA 2008b). Large mammals include elk and mule deer that are either year-round residents or winter migrants from higher elevations, especially in years of higher snowfall (Bennett et al. 2014). Studies have documented large game movement corridors across LANL and onto Pueblo de San Ildefonso at lower elevations east of LANL, especially during the fall, spring, and winter months (Bennett et al. 2014; Abeyta and Hathcock 2020). Large-mammal vehicle collisions have occurred on LANL (Bennett et al. 2014; Gadek et al. 2023). Bighorn sheep may occur along the Rio Grande on cliffs and open areas above White Rock Canyon. The presence of feral cattle (*Bos taurus*) on LANL property has been documented in White Rock Canyon in TA-33 and TA-70 (Sanchez 2021). Based on photographic evidence, the cattle have damaged areas of the riparian zone that may provide habitat for the federally listed southwestern willow flycatcher (*Empidonax traillii extimus*) and the yellow-billed cuckoo (*Coccyzus americanus*).

Mammalian carnivores are represented by black bears (*Ursus americanus*), mountain lions (*Puma concolor*), coyotes (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), and a variety of smaller carnivore species such as skunks, weasels, raccoons, ringtails, and badgers. Approximately 15 species of bats have been documented. Cottontail rabbits (*Sylvilagus* spp.) and a wide variety of smaller mammalian species, primarily rodents, occur throughout LANL and vary in occurrence and abundance according to habitat preferences and requirements. Smaller mammalian species represent the major component in the prey base that supports larger mammalian and avian predators.

4.6.2 Wetlands

Wetlands are areas inundated or saturated by surface- or groundwater at a frequency and duration sufficient to support, under normal circumstances, vegetation typically adapted for life in saturated soil conditions. Wetlands include swamps, marshes, bogs, and similar areas. Diagnostic criteria used to identify wetlands include vegetation, soil, and hydrology (Environmental Laboratory 1987; USACE 2008).

Approximately 22 acres of wetlands occur within LANL boundaries. Wetlands on the LANL site are associated with canyon stream channels that cross the site from west to east. The majority (73 percent) of wetlands are less than 0.3 acre. The largest wetlands are in Pajarito Canyon (8.3 acres). Dominant wetland plants include reed canary grass (*Phalaris arundinacea*), narrow-leaf cattail (*Typha angustifolia*), coyote willow (*Salix exigua*), Baltic rush (*Juncus balticus*), wooly sedge (*Carex lanuginose*), American speedwell (*Veronica americana*), common spike rush (*Eleocharis macrostachya*), and curly dock (*Rumex crispus*) (USACE 2005). Wetlands in the general LANL region provide habitat for reptiles, amphibians, and invertebrates, and contribute to the overall habitat requirements of a number of species. In September 2013, the Pueblo Canyon wetlands were severely eroded during an unusually large monsoon rainfall and flooding event (LANL 2014). Restoration efforts were designed to stabilize erosion and encourage deposition of sediment by installing water control structures and replanting native floodplain and wetland vegetation (Hathcock 2014). Most of the land that formerly comprised TA-74, including the Pueblo Canyon wetlands (11.9 acres), have been conveyed to Los Alamos County (LANL 2021c).

The majority of the wetland acreage (16 acres) is located within the NEEWC Planning Area, with most occurring in Pajarito Canyon (LANL 2022d). The NEEWC covers much of the southern part of LANL. The Core Planning Area contains about 3 acres of wetlands, nearly all within Sandia Canyon. The Pajarito Corridor Planning Area contains 2.4 acres of wetlands, all associated with Mortandad Canyon. The Balance of Site and LANSCE Planning Area contain about 0.27 and 0.01 acre of wetlands, respectively.

4.6.3 Aquatic Resources

Aquatic resources on LANL property are limited. The Rio Grande and Rito de los Frijoles in Bandelier National Monument are the only truly perennial streams in the immediate vicinity. The canyons crossing the Pajarito Plateau through LANL drain the Jemez Mountain watersheds to the Rio Grande. Some of the canyon floors contain reaches of perennial surface water, such as the streams draining LANL property from lower Pajarito and Ancho canyons to the Rio Grande. No fish species have been found within LANL boundaries (NNSA 2008b). The wetlands and limited reaches of perennial water contain a variety of aquatic invertebrate species (LANL 1997, Table 9). Several species of semi-aquatic amphibians that depend on wetlands and perennial or intermittent streams for part of their life cycle, such as reproduction, occur on LANL. These species include the tiger salamander (*Ambystoma tigrinum*), Woodhouse's toad (*Bufo woodhousei*), red spotted toad (*Bufo punctatus*), striped chorus frog (*Pseudacris triseriata)*, canyon treefrog (*Hyla arenicolor*), Couch's spadefoot toad (*Scaphiopus couchi*), and southern spadefoot (*Scaphiopus multiplicatus*). Approximately 11 miles of the eastern boundary of LANL border the rim of White Rock Canyon or descend to the Rio Grande. The riverine, lake, and canyon environment of the Rio Grande as it flows through White Rock Canyon makes a major contribution to the biological resources and influence ecological processes of the LANL region. The construction of Cochiti Dam at the mouth of White Rock Canyon approximately 12 river miles south of LANL for flood and sediment control, recreation, and fish and wildlife purposes in the late 1960s significantly changed the features of White Rock Canyon and introduced new ecological components and processes. Twelve species of fish (found in the Rio Grande, Cochiti Lake, and the Rito de los Frijoles) have been identified in the LANL region and include several game fish such as walleye, bass, catfish, crappie, bluegill, and yellow perch (NNSA 2008b).

4.6.4 Protected and Sensitive or At-Risk Species

Protected species are plant and animal species that receive specific protection under federal or state regulations. Federal regulations applicable to LANL include the *Endangered Species Act of 1973*, as amended (ESA; 16 U.S.C. § 1531 et seq.), *Migratory Bird Treaty Act of 1918*, as amended (MBTA; 16 U.S.C. §§ 703–712), and the *Bald and Golden Eagle Protection Act of 1973*, as amended (BGEPA; 16 U.S.C. §§ 668–668d). State of New Mexico regulations include the *Wildlife Conservation Act* (Chapter 17, Article 2, Sections 37–46 of the New Mexico Statutes Annotated).

Sensitive species is a general term often used to refer to species recognized by federal and state natural resources management agencies as species that may be vulnerable to future declines in population status. Terms used for sensitive species may include "threatened and endangered," "conservation concern," "sensitive," and "species of concern." Sensitive species may not be directly protected by federal or state statutes but may be considered "at-risk" for future protection under the ESA. Species "at-risk" that have the potential to be listed under the ESA may have future impacts on development and operations at LANL because of their federal protections (Ditmanson and Sanchez 2022). It is important to manage "at-risk" species that occur on LANL property to reduce future risk to the mission and promote conservation of declining species. The species considered "sensitive" at LANL are defined in the *Sensitive Species Best Management Practices Source Document*, most recently updated in July 2020 (Berryhill et al. 2020). DOE coordinates with the New Mexico Department of Game and Fish and the U.S. Fish and Wildlife Service (USFWS) to locate and conserve protected and at-risk species.

4.6.4.1 Federal Threatened and Endangered Species

Threatened and endangered species on the LANL site are managed in accordance with the LANL *Threatened and Endangered Species Habitat Management Plan* (HMP) (LANL 2022l). The HMP received USFWS concurrence in 1999 (USFWS consultation numbers 2-22-98-I-336 and 2-22-95-I-108) and is periodically reviewed to update the status of species or changes in management strategies; the most recent update was January 2022. The HMP provides a strategy for compliance with the ESA through site plans for the management of each threatened and endangered species that occurs or has a high probability of occurring on the LANL site. Site plans have been prepared for three federally listed threatened and endangered species that occur on LANL: Mexican spotted owl (*Strix occidentalis lucida*), southwestern willow flycatcher, and Jemez Mountains salamander (*Plethodon neomexicanus*) (LANL 2022l).

Three species that could potentially occur in the surrounding region do not have associated site plans. The black-footed ferret (*Mustela nigripes*) is federally listed as endangered; however, no sightings of black-footed ferrets have been reported in Los Alamos County for more than 90 years. In addition, no large prairie dog towns—prime habitat for black-footed ferrets—have been observed at LANL; therefore, there is no site plan for this species. The USFWS listed the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*) as endangered (79 FR 33119, June 10, 2014) and the western distinct population segment of the yellow-billed cuckoo as threatened (79 FR 59992, October 3, 2014) in 2014. Neither species requires a site plan because neither has suitable habitat on LANL property. In 2022, surveys were conducted for the yellow-billed cuckoo along the Rio Grande in potential habitat. The first cuckoo at LANL was detected during a single survey, but it was determined to be using the habitat as stopover habitat during migration (LANL 2024a). No other detections occurred during subsequent surveys. Site plans would be prepared in the future if LANL activities could potentially affect these species (LANL 2022l).

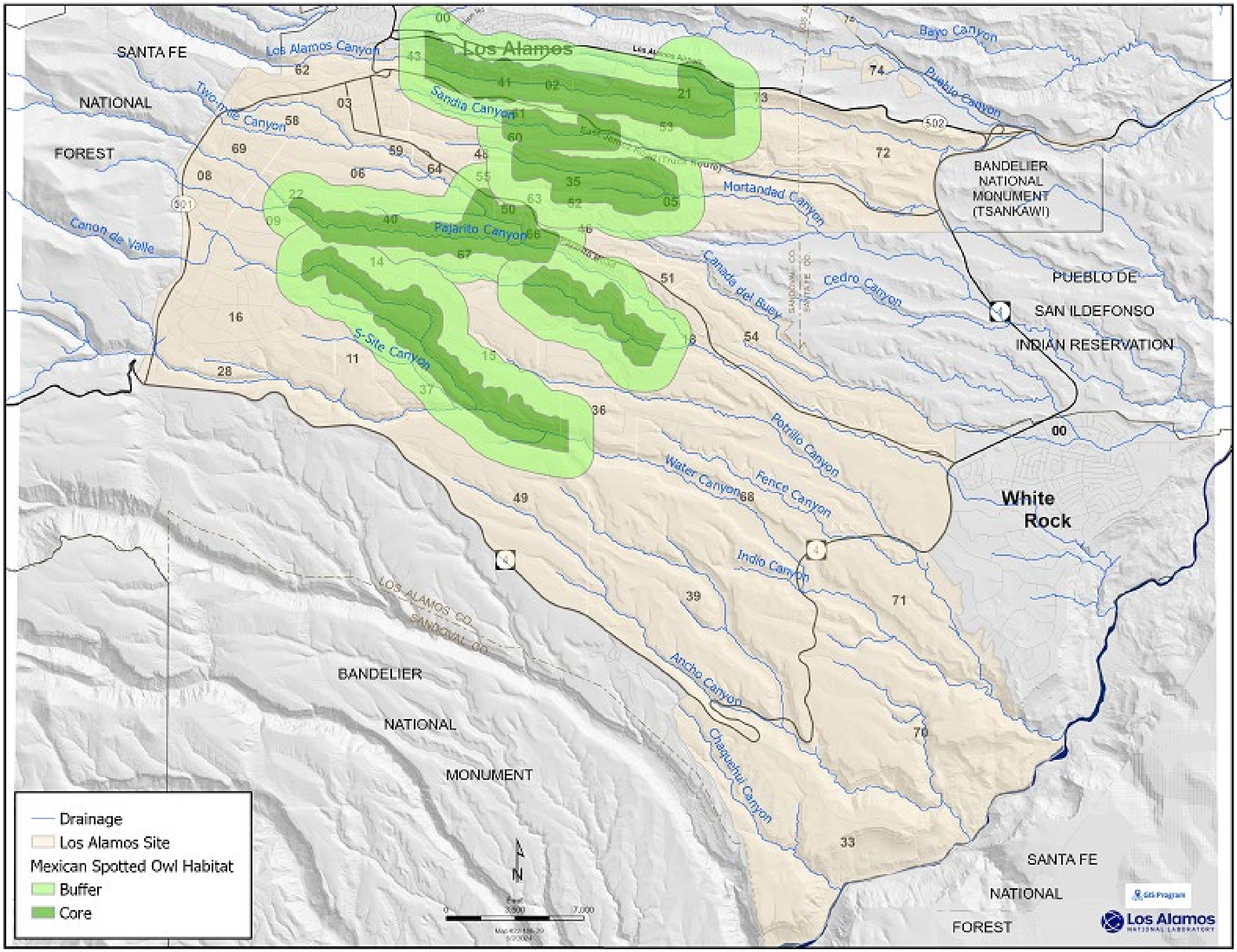
More detailed descriptions of threatened and endangered species management on the LANL site and information on the status of each species can be found in the LANL HMP (LANL 2022l). The following paragraphs provide a brief summary of the current status of the three threatened and endangered species that could potentially occur on the LANL site. Suitable habitat for each threatened and endangered species has been designated as a geographic Area of Environmental Interest (AEI). Each AEI consists of core habitat that provides protected areas essential to the persistence of the species including breeding and foraging habitat and areas with necessary microclimatic conditions. A buffer area surrounds the core habitat to protect it from disturbance and habitat degradation. Developed areas occur in the core and/or buffer of all AEIs; however, developed areas do not constitute suitable habitat for federally listed species (LANL 2022l). Current ongoing activities in developed areas constitute a baseline condition for the AEIs and are not restricted.

Mexican Spotted Owl

The Mexican spotted owl, listed as threatened, is found in northern Arizona, southeastern Utah, and southwestern Colorado south through New Mexico, west Texas, and into Mexico. The Mexican spotted owl inhabits mixed-conifer, ponderosa pine, and Gambel's oak (*Quercus gambelli*) forests in mountains and canyons. Characteristics of Mexican spotted owl habitat include high canopy closure, high stand diversity, multilayered canopy resulting from an uneven-aged stand, large mature trees, downed logs, snags, and stand decadence as indicated by the presence of mistletoe. Mexican spotted owls in the Jemez Mountains prefer cliff faces in canyons for their nest sites (Johnson and Johnson 1985, *as cited in* LANL 2022l). The AEIs for the Mexican spotted owl on the LANL site consist of the core habitat area, which is defined as suitable canyon habitat from rim to rim and extending 330 feet out from the canyon rim. The buffer area extends 1,300 feet beyond the core habitat. The core canyon habitat typically is canyon cliffs, mixed-conifer forest on the north-facing canyon slopes, and ponderosa pine woodland/juniper woodland on drier, south-facing slopes with dense or sparse juniper woodland on upland sites. Five Mexican spotted owl AEIs have been mapped on the LANL property centered on the Cañon de Valle, Water, Pajarito, Los Alamos, Sandia, Mortandad, and Three-mile canyons on the western side of LANL (Figure 4.6-1). The area of suitable breeding habitat to ensure reproductive success for a pair of owls varies by vegetation Surveys for breeding Mexican spotted owls have been conducted at LANL since 1994 (Thompson et al. 2021). A nesting territory in Cañon de Valle was occupied from 1995 through 2011 with young fledged in multiple years. Mexican spotted owls have consistently occupied nesting territories and fledged young in multiple years in Three-mile Canyon since 2007 and in the Mortandad Canyon since 2013 (Thompson et al. 2021).

Southwestern Willow Flycatcher

The southwestern willow flycatcher is one of four subspecies of the willow flycatcher and is listed as endangered. The historic range of the southwestern willow flycatcher included Arizona, California, Colorado, New Mexico, Texas, Utah, and Mexico. Currently, this flycatcher breeds in riparian habitats from southern California to Arizona and New Mexico, as well as southern Colorado, Utah, Nevada, and far western Texas (LANL 2022l). Southwestern willow flycatchers are present in New Mexico from early May through mid-September and breed from late May through late July (USFWS 2002; Yong and Finch 1997). In winter, this species is found in southern Mexico, Central America, and northern South America (USFWS 2002).



Source: LANL (2024c)

Figure 4.6-1 Mexican Spotted Owl Areas of Environmental Interest

composition and type and ranges from 500 to 1,350 acres (Ganey et al. 1999, 2005; Willey and van Riper 2007). The diet of Mexican spotted owls that nest in canyons consists primarily of woodrats (*Neotoma* spp.) and deer mice (*Peromyscus* spp.), with fewer numbers of rabbits, birds, reptiles, and arthropods (Willey 2013).

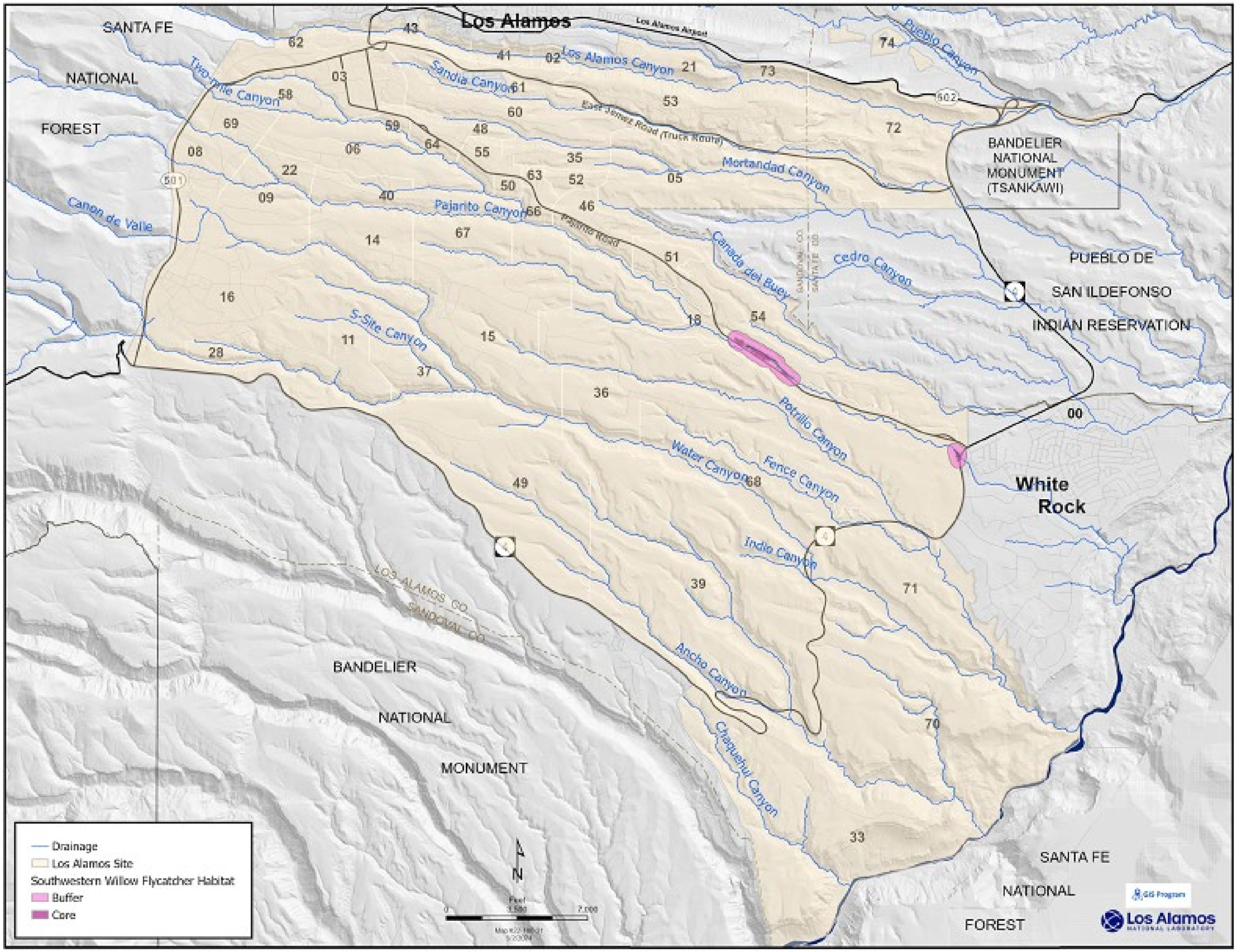
The southwestern willow flycatcher nests only along rivers, streams, and other wetlands. It is found in close association with dense stands of willows (*Salix* spp.), arrowweed (*Pluchea* spp.), buttonbush (*Cephalanthus* spp.), tamarisk (*Tamarix* spp.), Russian olive (*Eleagnus angustifolia*), and other riparian vegetation, often with a scattered overstory of cottonwood (*Populus* spp.) (USFWS 2002). The size of vegetation patches used by southwestern willow flycatchers varies and ranges from as small as 1.9 acres to several hundred acres (Hatten and Paradzick 2003). The southwestern willow flycatcher nests in thickets of trees and shrubs approximately 6–49 feet tall, with a high percentage of canopy cover and dense foliage 0–13 feet above ground. Regardless of the plant species composition or height, occupied sites always have dense vegetation in the patch interior (Allison et al. 2003; USFWS 2002).

One AEI for the southwestern willow flycatcher has been identified on the LANL site, composed of two core areas, both in Pajarito Canyon. The AEI core areas are located on the east side of LANL adjacent to Pajarito Road and NM-4 (Figure 4.6-2). The buffer area surrounding the AEI core areas extends 330 feet out from Core Area habitat, typically dense willows. Both AEI core areas are in TA-36 in the NEEWC Planning Area. Surveys conducted by LANL biologists have not detected any southwestern willow flycatchers. Willow flycatchers of unknown subspecies have been caught during bird-banding operations since 2010 in the Pajarito and Sandia wetlands (Thompson et al. 2021).

Jemez Mountains Salamander

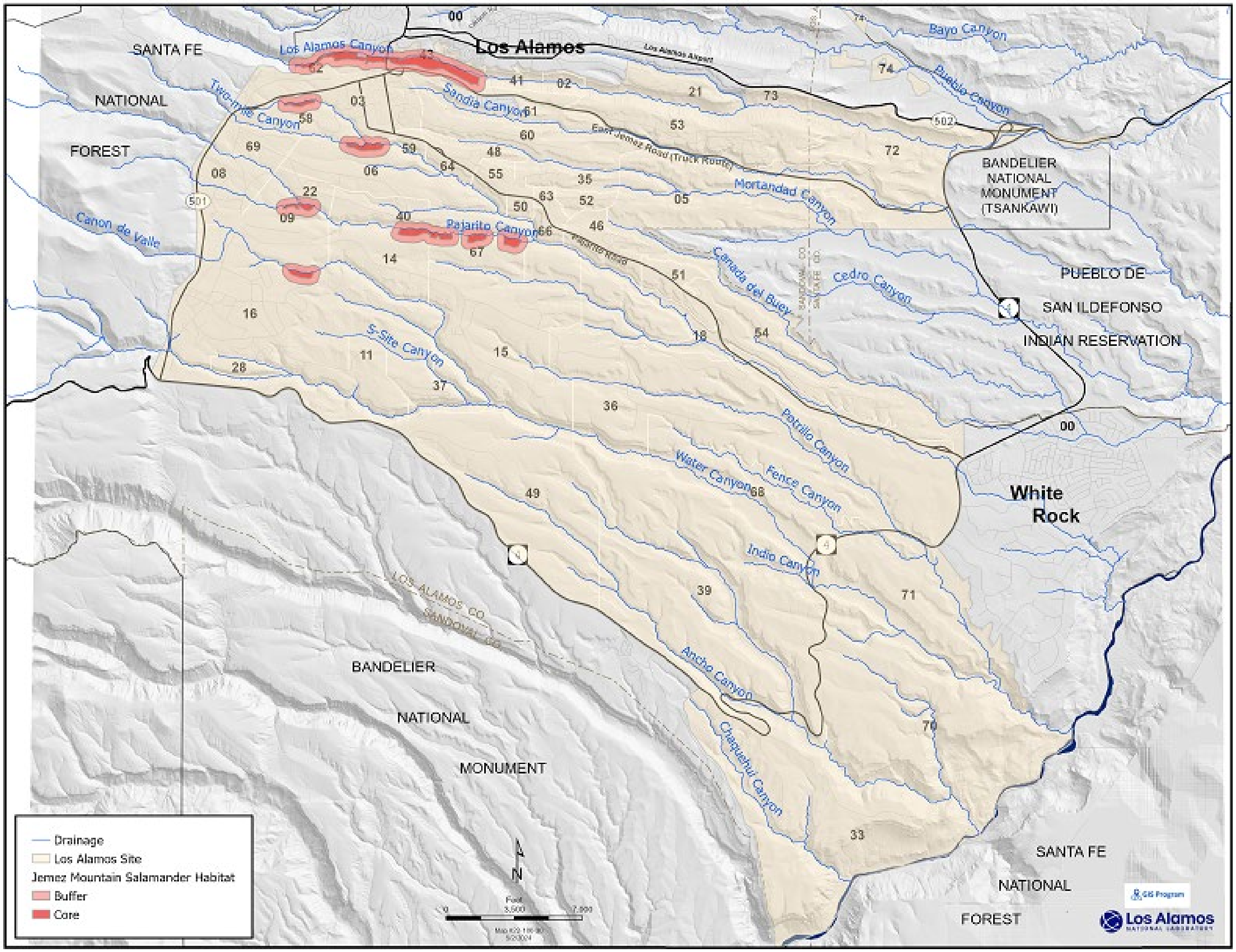
Jemez Mountains salamanders were listed as endangered in 2013 (78 FR 55600, September 10). The Jemez Mountains salamander is an amphibian endemic to the Jemez Mountains of north-central New Mexico. It is found in Los Alamos, Rio Arriba, and Sandoval counties, and occurs at elevations between 6,988 and 11,254 feet in mixed-conifer forests with greater than 50-percent canopy cover (LANL 2022l). The ground-surface habitat typically has moderate-to-high volumes of large fallen trees (greater than 10 inches in diameter) and other woody debris in varying stages of decay and other structural features, such as rocks, bark, and moss mats, that provide food and cover. The salamander spends most of its time underground, using spaces provided by rocks with fractures or loose rocky soils, rotted tree root channels, or burrows of rodents or large invertebrates (78 FR 9876; February 12, 2013). The Jemez Mountains salamander is completely terrestrial and does not use surface water for any life stage.

The AEIs for the Jemez Mountains salamander consist of sections of north-facing canyon slopes on the western half of LANL where suitable levels of mixed-conifer cover occurs (Figure 4.6-3). The core habitat areas have been grouped by canyon systems into AEIs (LANL 2022l). The AEIs contain contiguous and noncontiguous habitat areas. The buffer is 300 feet, extending from the edge of the core habitat. The largest AEI for the Jemez Mountain salamander occurs in Los Alamos Canyon north of the Core Area Planning Area and in part of the Balance of Site Planning Area. It includes TA-43, the very north edge of TA-3, and TA-62. The Two-Mile Canyon AEI is located south and west of the Core Area Planning Area mostly in the Balance of Site Planning Area. The AEI consists of two noncontiguous areas. The Pajarito Canyon AEI for the Jemez Mountains salamander includes four noncontiguous blocks of habitat, all in the NEEWC Planning Area. The



Source: LANL (2024c)

Figure 4.6-2 Southwestern Willow Flycatcher Areas of Environmental Interest



Source: LANL (2024c)

Figure 4.6-3 Jemez Mountain Salamander Areas of Environmental Interest

Cañon de Valle AEI consists of one block of core habitat, also in the NEEWC Planning Area. A fifth AEI is mapped on the Fenton Hill site (TA-57), 22 miles west of the main LANL site in the Jemez Mountains.

Jemez Mountains salamanders are difficult to detect because much of their life is spent underground. Because Jemez Mountains salamanders have been found on LANL, the Laboratory assumes that the AEIs are occupied. However, occupancy surveys are not conducted on a yearly basis unless the site has received sufficient moisture to warrant a survey. The only positive surveys on LANL property have occurred in Los Alamos Canyon in 1985, 2008, and 2015 (Thompson et al. 2021). In 2016, one salamander was found within a planned access route for a paleoseismic trenching study west of LANL on USFS land. The most recent survey on LANL in 2023 was negative.

4.6.4.2 Migratory Birds

Migratory birds are protected under the MBTA, which generally covers the native migratory birds in the U.S. except for some game species that are managed by states. Under the MBTA, it is unlawful by any means or manner to pursue, hunt, take, capture, or kill any migratory bird including any part, nest, or egg of any migratory bird except as permitted per USFWS regulation. LANL manages migratory birds through the *Migratory Bird Best Management Practices Source Document for Los Alamos National Laboratory* (Stanek et al. 2020b). This document contains BMPs for the protection of migratory birds.

Laboratory biologists have conducted seasonal (breeding and winter) surveys to monitor patterns and trends in resident and migratory bird abundance (Hathcock and Keller 2012; Stanek et al. 2020a). Seventy-six bird species were detected during summer (breeding) surveys in four habitat types: mixed-conifer forest, ponderosa pine forest, pinyon-juniper woodland, and riparian/wetland (Hathcock and Keller 2012). Since 2013, biologists have surveyed bird communities at two open detonation sites (TA-36 and 39), one open burn site (TA-16), and control sites (no project activity) during the breeding season (Gadek and Velardi 2021). Firing site survey results indicate that project activities are not negatively affecting bird populations. Laboratory biologists also participate in an international bird-monitoring program called Monitoring Avian Productivity and Survivorship protocol (Stanek et al. 2020b). From 2014 to present day, biologists have captured and banded birds in the Sandia wetlands in TA-60 and TA-61 under this protocol. Fall migration of birds has been monitored through a similar capture and release banding program in the Pajarito wetlands since 2010 (Hathcock et al. 2013; Stanek and Hathcock 2019). Fall banding is typically conducted from August through October.

4.6.4.3 Bald and Golden Eagles

Bald and golden eagles are currently protected under both the MBTA and the BGEPA. Migratory eagles are known to occur at LANL during the winter (November 1–March 31), most commonly along the Rio Grande. Golden eagles are not known to nest on LANL but occur regionally in New Mexico. Golden eagles nest on cliffs or large trees in open woodland and typically avoid developed areas (USFWS 2011).

4.6.4.4 Sensitive or At-Risk Species

Species classified as sensitive typically are not protected by laws or regulations, although some may be recognized as threatened or endangered under state law. Sensitive species may be on a trajectory to be listed under the ESA in the future. Threatened and endangered species present an uncertainty to LANL because of the potential constraints that a listing action may have on operations and future development. For example, since the 2008 SWEIS was issued, three species listed as sensitive in 2008 have since been listed as threatened and endangered: Jemez Mountains salamander, yellow-billed cuckoo, and the New Mexico meadow jumping mouse. Of these, only the salamander occurs on LANL; however, the other two species occur in the surrounding region. Further, two at-risk species that occur on LANL are currently undergoing actions: The Monarch butterfly (*Danaus plexippus*) is a candidate species currently proposed for listing as threatened and endangered, and the USFWS is conducting a status review of the pinyon jay (*Gymnorhinus cyanocephalus*) to determine whether the petition to list the pinyon jay as a threatened or endangered species is warranted (88 FR 55991, August 17, 2023). Appendix A, Table A.4.6-2, lists those species that occur on or near LANL that are classified as sensitive and provides additional information regarding these species.

The species considered sensitive or at-risk for the analysis in this SWEIS are consistent with those identified in Berryhill et al. (2020, Table 1). These species are managed through implementation of BMPs. Species considered at-risk are potential opportunities for prelisting conservation efforts that may help prevent the need for future listing or help mitigate future impacts on LANL operations (USFWS 2018; Ditmanson and Sanchez 2022). Eight of the birds on the current list of LANL sensitive species were observed or banded and released during the LANL avian monitoring surveys (*see* Section 4.6.4.2). These eight species are the flammulated owl (*Psiloscops flammeolus*), pinyon jay, juniper titmouse (*Baeolophus ridgwayi*), evening grosbeak (*Coccothraustes vespertinus*), Cassin's finch (*Haemorhous cassinii*), Virginia's warbler (*Leiothlypis virginiae*), gray vireo (*Vireo vicinior*), and Grace's warbler (*Setophaga graciae*). Since monitoring of Monarch butterfly eggs and caterpillars began in 2018, more than 50 larvae have been protected that were found on milkweed that was scheduled to be mowed.

4.6.5 Biodiversity

Biodiversity refers to the variety and variability among living organisms and the ecological complexes in which they occur. Biodiversity is influenced by natural and human-caused factors. Among natural factors are landscape features, wildfires, flooding, and global climate change. Landscape features that contribute to biodiversity at LANL include the elevation gradient from the Rio Grande to the site's west boundary and the canyon/mesa topography that creates a variety of microclimates in conjunction with the changes in elevation. Natural processes that affect biodiversity include floods, fire, seasonal rainfall, longer-term climate events such droughts, and insect outbreaks. Human-caused disturbances that affect biodiversity include physical alteration of landscape (e.g., industrial development and impediments to migratory corridors), increase in wildland fire frequency, introduction of nonnative species, and pollution. The overall effect of natural and human factors on existing biodiversity at LANL is expressed not only from individual factors but interactions among factors.

At LANL, the Cerro Grande and Las Conchas wildland fires burned large areas of vegetation on LANL and adjacent property. Wildfires have changed the species composition and physical structure of vegetation communities on and adjacent to LANL, which in turn affects habitat available for various wildlife species. Fire may have either positive or negative impacts on biodiversity depending on its frequency and intensity.

Development of facilities and roads have altered available habitat to wildlife through physical removal of vegetation. Increased human disturbance (i.e., avoidance of areas), and introduction of nonnative plant species both could affect native biodiversity. The potential release of pollutants into the environment may have lethal, sub-lethal, and reproductive effects. These effects may be expressed either through direct loss (i.e., mortality) of species and habitat or manifested through changes in ecological organization such as food webs. The Laboratory conducts long-term monitoring of soils, sediment, water, air, and biomonitoring to ensure that potential contaminants do not pose a risk to biodiversity. Results of monitoring are reported in the annual site environmental reports. Monitoring results reported in the 2022 Annual Site Environmental Report for vegetation and animal samples indicate that biota concentrations of radionuclides, inorganics elements, and chemicals are below levels considered harmful (LANL 2024e). The 2022 radionuclide biota dose assessment concluded that biota doses at LANL are far below the DOE limits and confirms the previous assessments and shows that there are no harmful effects from radionuclides released by Laboratory operations on the health of biota populations at LANL.

4.7 Human Health and Safety

In accordance with DOE Order 450.2 and DOE Order 440.1B, operations at LANL are required to be conducted in a manner that protects the health and safety of workers and the public, preserves the quality of the environment, and prevents property damage. In addition, DOE Order 452.3 requires LANL operations to comply with applicable environment, safety, and health (ES&H) laws, regulations, and requirements and with directives promulgated by NNSA and DOE regarding occupational safety and health.

Routine operations at LANL have the potential to affect public and worker health. Air emissions at LANL can lead to exposure to radioactive and nonradioactive materials. Liquid effluents discharged into waterbodies may affect downstream populations who use the water for drinking or recreation. Additionally, workers are exposed to radiation and occupational hazards similar to those experienced at many industrial work sites. This section characterizes the human health impacts from current operations at the Laboratory. It is against this baseline that the potential incremental and cumulative impacts associated with the alternatives are compared and evaluated.

4.7.1 Public Health

4.7.1.1 Radiological

Table 4.7-1 shows the major sources and levels of background radiation doses to an average individual in the vicinity of LANL, as well as the collective dose to the population within 50 miles of the site. Background radiation is attributed to naturally occurring radiation such as cosmic radiation from space and terrestrial gamma radiation and from radionuclides naturally in the environment, including radon. In addition, members of the population receive radiation doses from medical and dental uses of radiation and from manmade products. These sources and background radiation doses are unrelated to LANL operations.

> **Radiation Dose Measurement**
>
> In this SWEIS, radiation doses are measured in units of either “person-rem” or “rem.”
>
> **Person-rem** is used to measure the total collective radiation dose for a group of people. To determine the population dose, this SWEIS sums up the individual dose of every person within a 50-mile radius of LANL. Statistically, approximately 1,667 person-rem would result in one latent cancer fatality (LCF).
>
> **Rem** is used to measure the radiation dose for a single individual. Individual doses are converted to LCFs by multiplying the dose by 0.0006 (DOE 2003a). For example, an individual who receives a dose of 1.5 rem would have a 0.0009 chance of developing an LCF.

Table 4.7-1 Background Radiation Dose Unrelated to LANL Operations

Source	Individual Dose[a] (millirem per year)	Collective Dose[b] (person-rem per year)
Natural Background Radiation at LANL		
Cosmic radiation	66	24,420
Terrestrial radiation	100	37,000
Internal (food and water consumption)	30	11,100
Radon and Thoron in homes (inhaled)	270	99,900
Other Background Radiation		
Diagnostic x-rays and nuclear medicine	300	111,000
Consumer products	13	4,810
Industrial plus occupational	1	370
TOTALS	**780**	**288,600**

a The average background radiation dose to a Los Alamos County resident is approximately 780 millirem per year. In comparison, the average background radiation dose to the average U.S. resident is approximately 625 millirem per year. The higher background dose at Los Alamos County is largely due to higher natural background radiation (e.g., cosmic radiation, terrestrial radiation, and radon/thoron).

b The collective dose is the combined dose for all individuals residing within a 50-mile radius of LANL (approximately 370,000 people).

Source: LANL (2022e, 2024e)

Releases of radionuclides to the environment from Laboratory operations are another source of radiation dose to individuals in the vicinity of LANL. The environment potentially affected by radiological site releases includes air, water, and soil. These transport pathways (the environmental medium through which a contaminant moves) require an associated exposure pathway (e.g., inhaling air, drinking water, or dermal contact with soil) to affect human health. Monitoring of materials released from LANL and environmental monitoring and surveillance on and around the site are discussed in Sections 4.3.3 (soils), 4.4 (water resources), and 4.5.2 (air quality) of this SWEIS. A radiation dose is calculated to determine the health impact from exposure to radiation. Health impacts (LCFs) are calculated from the risk factor of 0.0006 LCF to the general population expected per rem (or person-rem) of radiation dose (DOE 2003a). Table 4.7-2 provides the various dose limits set for exposure pathways by DOE and the EPA for radiation workers and members of the public.

Table 4.7-3 presents the annual doses to the public from LANL emissions of radioactive materials to the air for the period 2017–2022. Doses are presented for an MEI[32] and the population within a 50-mile radius of LANL. These doses fall within radiological exposure limits presented in Table 4.7-2 and are much lower than the background radiation dose presented in Table 4.7-1.

[32] The MEI is a hypothetical member of the public who receives the greatest possible dose from Laboratory operations. In 2022, the offsite location of the hypothetical maximally exposed individual was at 95 Entrada Drive, close to environmental air-monitoring station 396, as shown on Figure 4.5-3.

Table 4.7-2 Dose Limits for Members of the Public and Radiation Workers

Guidance Criteria (organization)	Public Dose Limit	Worker Dose Limit
10 CFR Part 835 (DOE)	NA	5,000 millirem per year[a,b]
DOE Order 458.1 (DOE)[c]	10 millirem per year (all air pathways) 4 millirem per year (drinking water pathways) 100 millirem per year (all pathways)	NA
40 CFR Part 61 (EPA)	10 millirem per year (all air pathways)	NA
40 CFR Part 141 (EPA)	4 millirem per year (drinking water pathways)	NA

DOE = U.S. Department of Energy; EPA = U.S. Environmental Protection Agency; NA = not applicable

a Although this is a limit (or level) that is enforced by DOE, worker doses must be managed in accordance with "as low as reasonably achievable" (ALARA) principles. Refer to footnote b.

b The regulatory dose limit for an individual worker is 5,000 millirem/year (10 CFR Part 835). At LANL, an administrative control level of 2,000 millirem per year has been established for external exposures (LANL 2020c).

c Derived from 40 CFR Part 61, 40 CFR Part 141, and 10 CFR Part 20.

Table 4.7-3 Annual Radiation Doses to Public from LANL Operations, 2017–2022

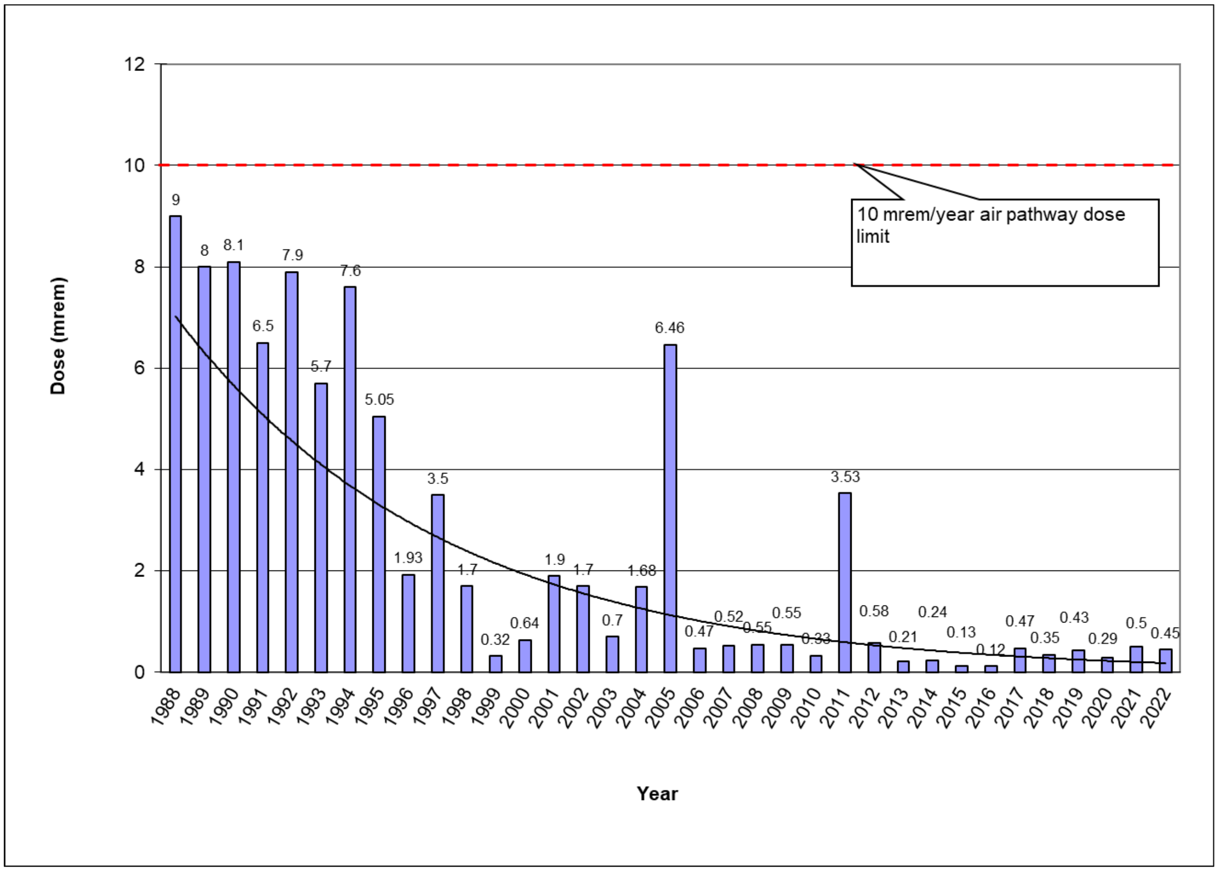
Members of the Public	Year	Dose
Dose to MEI (millirem)	2017	0.47
	2018	0.35
	2019	0.43
	2020	0.29
	2021	0.50
	2022	**0.40**
	2017–2022 Average	**0.41**
Dose to population within 50 miles (person-rem)[a]	2017	0.20
	2018	0.09
	2019	0.07
	2020	0.08
	2021	0.08
	2022	0.12
	2017–2022 Average	**0.11**
Average annual dose to a person within 50 miles (millirem)	2017	5.4×10^{-4}
	2018	2.4×10^{-4}
	2019	1.9×10^{-4}
	2020	2.2×10^{-4}
	2021	2.2×10^{-4}
	2022	3.3×10^{-4}
	2017–2022 Average	**2.9×10^{-4}**

MEI = maximally exposed individual

a The population dose is the combined dose for all individuals residing within a 50-mile radius of LANL (approximately 370,000 people), calculated with respect to distance and direction from the site.

Source: LANL (2024e)

Figure 4.7-1 shows the annual MEI doses for more than 30 years of LANL operations. The general downward trend is the result of improved engineering controls and ongoing remediation.[33] Figure 4.7-2 shows collective population doses from LANL activities for the period 2008–2022. The trend-line for the past 10 years shows a general decrease, which is the result of improved engineering controls at the LANSCE and the tritium facilities (LANL 2024e).



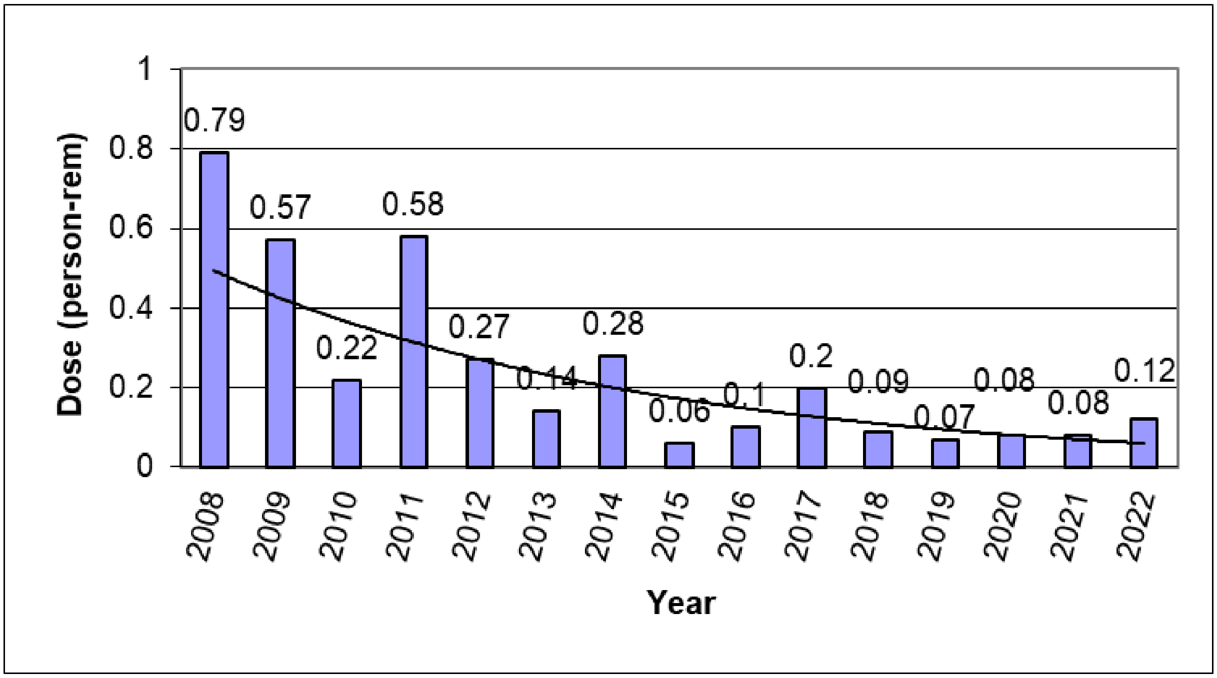
Source: LANL (2024e)

Figure 4.7-1 Trend in Annual MEI Dose at LANL

Based on the information presented in Table 4.7-2 above, the risk of the hypothetical MEI member of the public developing an LCF from exposure to LANL radiological air emissions would be a maximum of 3.0×10^{-7} (or about 1 chance in 3.3 million). The projected number of LCFs to the population within a 50-mile radius of LANL would be about 6.0×10^{-5} (or about 1 chance in about 17,000). For perspective, this number may be compared with the number of fatal cancers expected in the same population from all causes. The latest mortality rate associated with cancer for the entire U.S. population in 2019 (for which final data are available) was 146 per 100,000 people (USCSWG 2022).[34] Based on this national cancer mortality rate, approximately 540 fatal cancers would be expected to occur annually in the population of approximately 370,000 people living within 50 miles of LANL.

[33] The 6.46-millirem dose in 2005 resulted from a leak at TA-53, and the 3.53-millirem dose in 2011 was from the remediation of Material Disposal Area B (LANL 2024e).

[34] In 2019, the latest year for which incidence data are available, for every 100,000 people, 146 died of cancer (USCSWG 2022).



Source: LANL (2024e)

Figure 4.7-2 Trend in Annual Collective Dose to the Population within 50 Miles of LANL

As shown in Table 4.7-2, the annual radiological dose from LANL is well below the applicable limits for radiation protection of the public. The dose to the MEI resulting from LANL operations is less than 1 percent of the NESHAP standard of 10 millirem per year. For all six years, the measured radionuclide concentrations in ambient air at LANL were all less than 1 percent of the radiation protection standard for the public (LANL 2018c, 2019d, 2020b, 2022e, 2022h, 2024e). The dose to the MEI from LANL operations is also much less than one-tenth of one percent of the total dose from sources of natural radioactivity shown in Table 4.7-1.

4.7.1.2 Nonradiological

The background chemical environment important to human health consists of the atmosphere, which may contain hazardous chemicals that can be inhaled; drinking water, which may contain hazardous chemicals that can be ingested; and other environmental media through which people may come in contact with hazardous chemicals (e.g., surface water during swimming or food through ingestion). Hazardous chemicals can cause cancer and noncancerous health effects. Sections 4.3.3 (soils), 4.4 (water resources), and 4.5.2 (air quality) of this SWEIS present the baseline data for assessing potential health impacts from the chemical environment.

Effective administrative and design controls that decrease hazardous chemical releases to the environment and help achieve compliance with permit requirements (e.g., via NPDES and NESHAP permits) contribute to minimizing health impacts on the public. The effectiveness of these controls is verified through the use of environmental monitoring information and inspection of mitigation measures. Health impacts on the public may occur through inhalation of air containing hazardous chemicals released to the atmosphere during normal LANL operations. Risks to public health from other pathways, such as ingestion of contaminated drinking water or direct exposure, are lower than those from inhalation (LANL 2018c, 2019d, 2020b, 2022e, 2022h, 2024e). Los Alamos County monitors its water supply in compliance with the *Safe Drinking Water*

Act, and LANL analyzed additional samples from Los Alamos County water supply wells in 2020. No water supply wells showed detections of Laboratory-related constituents above an applicable drinking water standard. The drinking water supply meets NMED and EPA drinking water standards, and no adverse health impacts are expected. With regard to soil, plants, and animals, 2021 sampling results for contaminants were similar to previous years and no chemical concentrations above human-health-based screening criteria were detected at any offsite locations (LANL 2024e).

Section 4.5 of this SWEIS addresses the baseline air emission concentrations and applicable standards for hazardous chemicals. The baseline concentrations are estimates of the highest existing offsite concentrations and represent the highest concentrations to which members of the public could be exposed. The Laboratory's emissions of regulated pollutants are below the amounts allowed in LANL's *Clean Air Act* Title V Operating Permit. There are no measurable health effects to the public from the Laboratory's current air emissions (LANL 2024e).

Beryllium metal, alloys, and compounds are used at LANL. Beryllium is identified with respiratory and immune system toxicity and is regulated under both state and federal programs. Although the State of New Mexico does not have an ambient air quality standard for beryllium, beryllium concentrations are monitored at over 20 sites located near potential beryllium sources at LANL or in nearby communities. For comparison purposes, the results are compared to the ambient standard from the NESHAP standard for beryllium of 10 nanograms per cubic meter (40 CFR Part 61, Subpart C). DOE is not required to monitor to this standard because all beryllium-permitted sources meet the emission standards, but it is used in this case for comparative purposes. In 2022, all monitored beryllium values were less than the NESHAP standard (LANL 2024e).

4.7.1.3 Cancer Incidences

The National Cancer Institute publishes national, state, and county incidence rates of various types of cancer (NCI 2024). However, the published information does not provide an association of these rates with their causes, (e.g., specific facility operations and human lifestyles). Table 4.7-4 presents incidence rates for the U.S., New Mexico, and the four counties surrounding LANL

Table 4.7-4 Cancer Incidence Rates[a] for the U.S., New Mexico, and Counties Adjacent to LANL, 2016–2020

Location	All Cancers	Thyroid	Breast	Lung and Bronchus	Leukemia	Prostate	Colon and Rectum
U.S.	**442.3**	**13.3**	**127.0**	**54.0**	**13.9**	**110.5**	**36.5**
New Mexico	**369.0**	**14.8**	**113.8**	**33.7**	**12.7**	**85.6**	**33.0**
Los Alamos County	391.1	(b)	137.7	24.3	14.9	133.6	26.1
Rio Arriba County	310.9	11.5	88.4	25.2	6.9	82.2	36.5
Sandoval County	403.7	17.5	127.3	31.7	13.4	92.5	34.0
Santa Fe County	349.2	14.2	129.4	26.4	9.4	87.6	30.3

a Age-adjusted incidence rates; cases per 100,000 persons per year.
b Data has been suppressed to ensure confidentiality and stability of rate estimates. Counts are suppressed if fewer than 16 records were reported in a specific area-sex-race category.
Source: NCI (2024)

(Los Alamos County, Rio Arriba County, Sandoval County, and Santa Fe County). As shown in the table, most cancer incidence rates in New Mexico and the counties surrounding LANL are lower than the rates for the U.S. Within the four counties surrounding LANL, Los Alamos County and Sandoval County generally have higher cancer incidence rates for most cancer types.

4.7.2 Worker Health

All employees at LANL are required to know and understand the ES&H requirements of their assignment, the potential hazards in the work area, and the controls necessary for working safely. Employees must participate in all required ES&H training and health monitoring programs. All work assignments must be performed in full compliance with applicable ES&H requirements as published in LANL policies and procedures, and established in safety procedures. All employees are responsible for working in a manner that produces high-quality results, preserves environmental quality, and protects the health and safety of workers and members of the public.

The LANL Integrated Safety Management System addresses the identification of workplace hazards, control measures, safe work practices, and feedback and continuous improvement functions necessary to perform work safely at LANL. This program articulates the institutional requirements for all operations at LANL or at any other sites where LANL personnel and contractors are working.

When the LANL mission is fulfilled through collaborations, both onsite and offsite, potential impacts could also include worker exposure to electrical, low-level radiological, and transportation hazards. However, work activities would be performed in accordance with federal and state regulations, and the personnel safety exposures to radiological sources would be maintained to as low as reasonably achievable (ALARA). Additionally, offsite transport of radiological materials and wastes are performed in accordance with U.S. Department of Transportation (USDOT) regulations, as well as DOE/NNSA and LANL procedures.

The regulations at 10 CFR Part 835 establish radiation protection standards, limits, and program requirements for protecting workers from ionizing radiation resulting from the conduct of DOE/NNSA activities and requires DOE/NNSA contractors to develop and maintain an approved radiation protection program. LANL's Radiation Protection Program governs radiological activities at LANL and offsite locations. As noted in the Program, LANL's radiological support operations may include, when requested by DOE/NNSA, support of offsite activities or events involving radiation-generating devices and sealed radioactive sources.

Additionally, DOE Order 458.1 establishes requirements to protect the public and the environment against undue risk from radiation associated with DOE/NNSA-directed activities. Public radiological doses at LANL, as well as for offsite DOE/NNSA-directed activities, are reported in the LANL annual site environmental reports. Radiological doses generated by these operations are consistently found to be well below the applicable limits for radiation protection of the public.

4.7.2.1 Radiological

LANL workers receive the same dose as the general public from background radiation, but also receive an additional dose from working in facilities with radiological materials and radiation-generating devices, such as accelerators or from performing environmental remediation activities. Table 4.7-5 presents the annual average individual and collective worker doses from LANL operations during the period 2017–2022. These doses fall within the regulatory limits presented in Table 4.7-2 above.

Table 4.7-5 Radiation Doses to LANL Workers from Operations, 2017–2022

Occupational Personnel	From Outside Releases and Direct Radiation by Year						
	2017	2018	2019	2020	2021	2022	Average
Number of workers receiving a measurable dose	1,828	1,930	1,983	2,523	4,206	4,444	2,819
Total (collective) worker dose (person-rem)	159	200	224	233	303	366	248
Average worker dose (millirem)[a]	87	104	113	92	72	82	91.7

a No standard is specified for an "average radiation worker"; however, the radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). The DOE/NNSA goal is to maintain radiological exposure to ALARA. At LANL, an administrative control level of 2 rem per year has been established for external exposures (LANL 2020c).

Source: DOE (2023); LANL (2022h, 2019b)

Based on the dose-to-risk conversion factor of 0.0006 LCF per 1 person-rem, the annual LCF risk to an average LANL worker due to radiation exposure from LANL operations is estimated to be 5.5×10^{-5}. That is, the estimated probability of a worker developing a fatal cancer at some point in the future from radiation exposure associated with one year of LANL operations is about 1 in 18,000. No excess fatal cancers are projected in the total worker population from one year of normal operations. In 2022, no worker exceeded the 2 rem per year LANL administrative control level established for external exposures; however, a total effective dose of 2 rem was exceeded by one worker due to an abnormal event on June 8, 2020 (*see* text box below). No worker exceeded DOE's 5-rem-per-year dose limit (LANL 2022a, 2024a).

Airborne Release on June 8, 2020

On June 8, 2020, at Technical Area 55, Building 4, a portable continuous air monitor alarm sounded after an employee ("E1") had exited the glovebox gloves the employee had been working in and was securing the glovebox gloves together. At the sound of the alarm, the 14 employees in the room immediately exited to the corridor. As the employees exited the room, additional CAMs alarmed.

Radiological control technicians (RCTs) immediately responded, surveyed all employees, and detected contamination on E1's anti-contamination (anti-C) coveralls. No detectable activity (NDA) was found on the other 13 employees who were in the room. RCTs immediately placed another set of anti-C coveralls on E1 to contain the contamination. Further surveys detected contamination on E1's neck and on the back of E1's head. RCTs took E1 to the decontamination room and the contamination was removed to NDA with soap and water. RCTs also obtained nasal swipes from all 14 employees. E1's results were positive for alpha contamination. All other nasal swipes were NDA. E1 was taken to the Laboratory's Occupational Medicine Facility to consult with an internal dosimetrist. It was determined that E1 received an internal dose of approximately 2.59 rem from this contamination event.

Changes in workload and types of work at nuclear facilities—particularly the TA-55 Plutonium Facility, TA-53 LANSCE, and the TA-50 and TA-54 waste facilities—tend to drive increases or decreases in the LANL annual collective dose. Worker exposure under the 2008 SWEIS No-Action Alternative was projected to increase because of the dose associated with achieving a production level of 20 pits per year at TA-55. In addition, collective worker dose and annual average worker dose were projected to increase because of the implementation of the environmental remediation actions related to the Consent Order, but the long-term effect of MDA cleanup and closure of waste management facilities at TA-54 would tend to reduce worker dose for those operations (LANL 2024a).

The TA-55 Plutonium Facility operations accounted for the majority of occupational dose at LANL in 2022—historically consistent for LANL. Occupational dose was accrued from plutonium 238 work that produces general-purpose heat sources and radioisotope thermoelectric generators, weapons stewardship and manufacturing work, materials recovery and repackaging, and construction and maintenance and provides radiological control technician and other infrastructure support for radiological work at the TA-55 Plutonium Facility. Of the top 25 doses at LANL in 2022, 22 were accrued by individuals who conducted these plutonium facility operations. An increase in work at TA-55 led to an increase in the number of personnel across multiple shifts, contributing to the increase in the annual collective dose. Three of the top 25 doses at LANL in 2022 were received by individuals at TA-53 LANSCE who were involved in an off-normal event while troubleshooting a vacuum leak (LANL 2024a).

ALARA Program

LANL occupational exposure continues to be deliberately managed under an aggressive ALARA Program within the LANL Radiation Protection Program, with emphasis on dose optimization during design, work control, training, ALARA goals, performance measurement, line management engagement, and oversight by the ALARA Committee and LANL senior management. Based on established ALARA goals, dose accrued to date, and expected workload, CY 2023 collective doses are expected to increase, particularly as TA-55 operations continue at anticipated productivity and the weapons-related workforce grows. Improvements in maintaining radiation exposures to ALARA—such as improved dose tracking during work activities, additional shielding, better radiological safety designs, worker involvement, and innovative solutions—should result in continually lower LANL radiological worker doses relative to the work conducted (LANL 2024a).

4.7.2.2 Nonradiological

LANL is a research site in which a large variety of hazardous materials are used. LANL operations represent a potential for exposure of some workers to hazardous materials (such as solvents, metals, and carcinogens). Typically, operations are controlled through specific work control documents so that those workers may be exposed to low levels of a wide variety of chemicals that are below a threshold of concern throughout the duration of their research.

Workers are provided with information and training on identified hazards and follow requirements in specific work control documents to protect them and minimize hazards and exposures. LANL has several programs and procedures in place to provide direction for monitoring, handling, storing, and using hazardous materials. Work activities are periodically monitored with measurements performed at personal breathing zones and general work areas. ES&H monitoring records indicate that personnel exposure to hazardous materials is maintained well below established regulatory requirements and exposure guidelines.

Biohazards

Biological operations at LANL include using and safely handling biohazardous materials, agents, or their components (e.g., microbial agents, bloodborne pathogens, recombinant deoxyribonucleic acid, and human or primate cell cultures), and research proposals and activities concerning animal or human subjects. Biological materials can cause illness and infection. Examples of potential sources of exposure to biological hazards are as follows:

- Human fluids, secretions, or feces;
- Infectious agents from animal infestation or droppings;

- Biological toxins;
- Human cell and tissue culture systems;
- Research involving animals;
- Research involving allergens of biological origin (e.g., certain plants and animal products, danders, urine, and some enzymes);
- Laundry soiled with blood or other potentially infectious materials;
- Contaminated sharps; and
- Unfixed human tissues or organs.

Personnel exposure to biological hazards is minimized by use of administrative controls, engineered controls, and personal protective equipment. By analyzing the hazards for each specific operation, Laboratory personnel develop and implement the appropriate controls to protect themselves, the community, and the environment from potential exposure.

Carcinogens

Carcinogens are only used in LANL operations when it is not possible to use a noncarcinogenic material. Any use of carcinogens requires stringent controls to be in place to prevent exposures to workers, the public, and the environment. Examples of operations where carcinogenic materials may be encountered include:

- Work with cadmium-containing alloys;
- Work that generates or involves contact with soot and tar;
- Use of mineral oil products that may contain polyaromatic hydrocarbons;
- Electric arc discharge machining;
- Discharging of gas propellants in a vacuum;
- Handling refractory ceramic fibers;
- Chromium plating and other operations that disperse hexavalent chromium compounds or irritatingly strong concentrations of sulfuric acid into the air;
- Generating hardwood dust, including carpentry and cabinet-making activities;
- Spraying hexavalent chromium compounds, including, but not limited to, primers, paints, and sealants containing barium, calcium, sodium, strontium, or zinc chromate;
- Handling inorganic arsenic compounds and arsenic metal, including gallium arsenide, in a manner that can result in exposure to arsenic;
- Using or synthesizing carcinogens in laser chemistry or biochemistry laboratories; and
- Using asbestos, beryllium, laser dyes, or lead and lead compounds.

At LANL, employees use carcinogens only when required by a specific research project. Worker exposures to certain hazardous materials are monitored by industrial hygiene staff and tracked using an occupational exposure database. Likewise, personnel may be monitored for certain chemical agents by way of routine medical examinations performed by the LANL Health Services Department. All employees who work with carcinogens must receive sufficient information and training so that they may work safely and understand the relative significance of the potential hazard they may encounter.

4.7.2.3 Occupational Injuries

LANL's occupational health and safety performance is measured by injury and illness rates (total recordable case and days away, restricted, or transferred) pursuant to DOE Orders that use Occupational Safety and Health Administration (OSHA) criteria. As shown on Table 4.7-6, the number of total recordable cases at LANL has varied between 91 and 227 over the past six years, averaging approximately 159 work-related injuries or illnesses annually that result in either death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, or loss of consciousness. "Days away, restricted, or transferred" represent severe injuries annually. As shown in Table 4.7-6, the number of "days away, restricted, or transferred" cases at LANL has varied between 20 and 106 over the past six years, averaging approximately 63 work-related severe injuries or illnesses annually that result in days away from work or days of job restriction or transfer.

Table 4.7-6 Occupational Injury Statistics for LANL, 2017–2022

Parameter	2017	2018	2019	2020[c]	2021[c]	2022	Average
Number of TRCs[a]	102	91	147	187	227	201	159
Number of DART Cases[b]	20	26	67	106	101	59	63

DART = days away, restricted time; TRCs = total recordable cases

a Number of TRCs: The total number of work-related injuries or illnesses that resulted in either death, days away from work, days of restricted work activity, or days of job transfer.

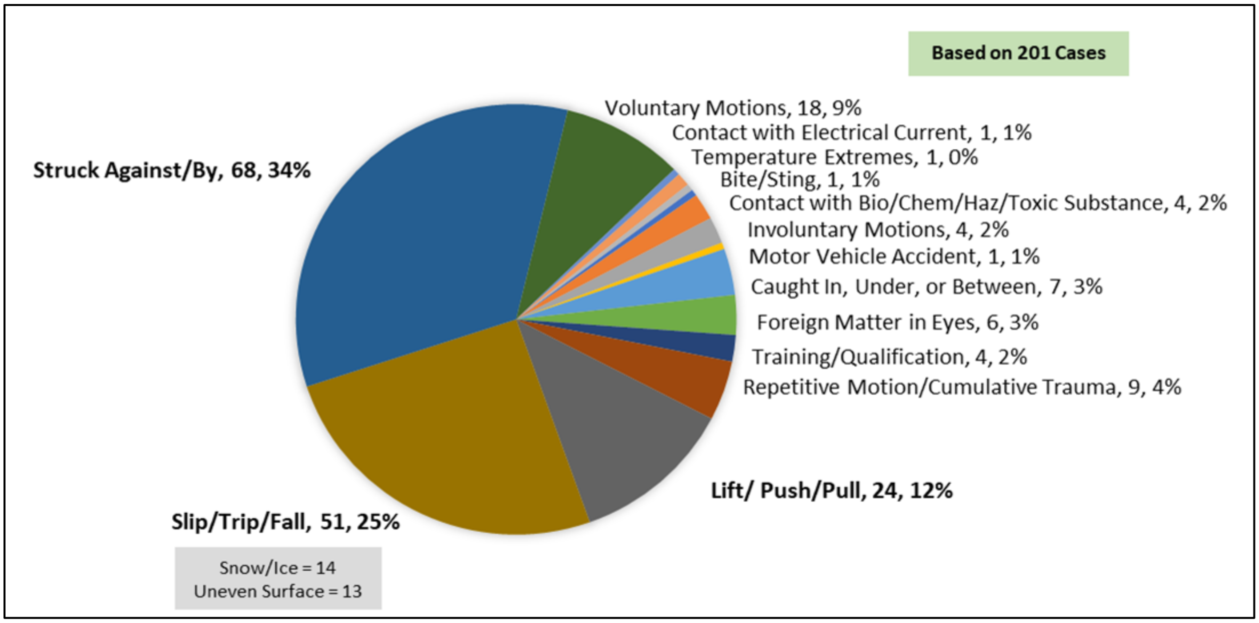
b DART Case: An injury or illness case where the most serious outcome of the case resulted in days away from work or days of job restriction or transfer.

c Cases from 2020 and 2021 include work-related COVID-19 cases.

Source: LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

During normal operations, LANL workers may be exposed to hazardous conditions that can cause injury or death. The potential for health impacts varies among facilities and workers. Figure 4.7-3 depicts the types of occupational injuries at LANL for the TRCs in 2021. In 2021 work-related injuries included Slips, trips, and falls resulting in fractures, sprains, and strains, struck against/by injuries resulting in lacerations and abrasions, and lift/push/pull injuries resulting primarily in strains. No work-related fatalities occurred at LANL between 2017 and 2022 (LANL 2019b, 2020d, 2021b, 2022a, 2023a, 2024a).

Workers are protected from workplace hazards through appropriate training, protective equipment, monitoring, materials substitution, and engineering and management controls. Under 10 CFR Part 851, DOE lists the requirements for a worker safety and health program to ensure that DOE contractors and their workers operate a safe workplace. DOE establishes procedures for investigating whether a violation of a requirement of this part has occurred, for determining the nature and extent of any such violation, and for imposing an appropriate remedy. In addition, 10 CFR Part 851 incorporates many OSHA requirements and other protections. Appropriate monitoring that reflects the frequency and quantity of chemicals used in the operational processes ensures that these standards are not exceeded. DOE also requires that conditions in the workplace minimize hazards that cause, or are likely to cause, illness or physical harm.



Source: LANL (2024a)

Figure 4.7-3 LANL Recordable Injury Data for 2022

4.8 Cultural and Paleontological Resources

4.8.1 Definition of the Resources

Cultural resources are physical manifestations of culture, specifically archaeological sites, architectural properties, ethnographic resources, and other historical resources relating to human activities, society, and cultural institutions that define communities and link them to their surroundings. They include expressions of human culture and history in the physical environment, such as pre-contact and historic archaeological sites, buildings, structures, objects, and districts, considered important to a culture or community. Cultural resources also include locations of important historic events, places that are important to continuing traditional cultural practices and use, and aspects of the natural environment, such as natural features of the land or biota, that can be part of traditional lifeways and practices. The NPS maintains the *National Register of Historic Places* (National Register), a listing of pre-contact, historic, and ethnographic buildings, structures, sites, districts, and objects considered significant at a national, state, or local level.

Paleontology is the study of life in past geological time and the chronology of Earth's history. Paleontological resources are the fossilized remains of past life forms and the remains of once-living organisms such as plants, animals, fungi, and bacteria that have been replaced by rock material. Fossils also include imprints or traces of organisms preserved in rock, such as impressions, burrows, and trackways, and are typically preserved in sedimentary rocks. Paleontological resources are considered a fragile and nonrenewable scientific record of the history of life on Earth, and therefore represent an important component of America's natural heritage. Significant paleontological resources are important because they are used to examine evolutionary relationships, provide insight on the development of and interaction between biological communities, establish time scales for geologic studies, and for many other scientific purposes (SVP 2010).

4.8.2 Cultural Resource Management at LANL

Management of cultural resources at LANL is conducted in accordance with the *Programmatic Agreement among the U.S. Department of Energy, National Nuclear Security Administration, Los Alamos Field Office, the New Mexico State Historic Preservation Office and the Advisory Council on History Preservation Concerning Management of the Historic Properties of Los Alamos National Laboratory, Los Alamos, New Mexico* (LANL 2022j) and *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* (LANL 2019c). For projects and undertakings occurring at LANL, the documents address consideration and identification of cultural resources; assessment of potential effects to significant resources (historic properties); and development and implementation of measures to avoid or minimize effects or measures to mitigate effects to historic properties. LANL (2019c) also outlines the responsibilities and requirements for long-term management of the cultural heritage at LANL.

As part of its efforts to manage cultural resources at LANL, NNSA conducts consultation with 24 tribes with traditional ties to the region that includes LANL (LANL 2022j). NNSA consults with the tribes regarding planned actions at LANL by notifying them of NNSA undertakings and providing them with information about the actions and known cultural resources in the vicinity. NNSA conducts such consultation with the tribes on an ongoing basis. NNSA is currently consulting with potentially affected tribes under Section 106 of the *National Historic Preservation Act* (54 U.S.C. § 300101) in parallel with preparation of the SWEIS.

For paleontological resources, standard LANL practice requires that if any previously unknown resources are discovered during ground-disturbing activities, all work is halted and a qualified paleontologist assesses the discovered resource. A determination is made of the resource's significance, the extent of any adverse effect, and the appropriate actions required to avoid, reduce, or mitigate further adverse effects.

Additional information about the cultural and paleontological resources at LANL and the NNSA's responsibilities for and management of those resources can be found in Appendix A, Section A.4.8.

4.8.3 Archaeological Resources

Surveys of approximately 90 percent of the LANL property have identified more than 1,900 archaeological sites. Archaeological sites at LANL refer to locations containing items used or modified by people, or other physical evidence of the use by people. The majority of archaeological sites at LANL date to time periods before the establishment of a European presence in the upper Rio Grande Valley in the middle of the 17th century. Other archaeological sites at LANL date to the Homestead, Manhattan Project, and Cold War periods, and typically include trash scatters and other nonstructural remains.

4.8.4 Historic Buildings and Structures

More than 300 buildings and structures at LANL that remain from the Manhattan Project and the Cold War periods have been fully evaluated for listing on the National Register (LANL 2022h). As of December 31, 2023, 162 are historically significant and eligible for listing. LANL actively monitors and protects 52 facilities, which are part of the MAPR and/or are considered a LANL Protected Historical Facility (formerly Candidate for Preservation), a DOE Headquarters Heritage Asset, and/or a DOE Headquarters-acknowledged Cold War Signature Facility.

4.8.5 Traditional Cultural Properties

Traditional cultural properties are places of special heritage value to contemporary communities (often, but not necessarily, American Indian groups) because of their association with the cultural practices and beliefs that are rooted in the histories of those communities and are important in maintaining the cultural identity of the communities (LANL 2019c). Such properties may or may not include some visible evidence of human use or alteration. Traditional cultural properties are usually identified through consultation with the communities who have a history of use within a particular area.

NNSA has established cooperative agreements with tribal nations that are located near LANL to enhance their involvement in project planning and environmental assessments while protecting tribal rights and resources. Four Pueblo governments in the vicinity of LANL have signed individual Accord Agreements with NNSA (Santa Clara, San Ildefonso, Cochiti, and Jemez). The Accord Agreements provide a basis for conducting government-to-government relations and serve as a foundation for addressing issues of mutual concern between NNSA and the Pueblos.

4.8.6 Paleontological Resources

The potential for paleontological resources depends on the geological formations present, which determine the age, type, abundance, and distribution of fossils, and the topography of the area under scrutiny, which determines the access to those formations. A single paleontological fossil has been reported within LANL boundaries (NNSA 2003a). The fossil is described as a 50,000-to 100,000-year-old bison bone (Drakos et al. 2007). It was found in the White Rock-Y area (LANL 2002f, *as cited in* NNSA 2008b). Paleontological artifacts are generally not expected at LANL because near-surface stratigraphy is not conducive to preserving plant and animal remains. The near-surface materials are volcanic ash and pumice that were extremely hot when deposited; most carbon-based materials (such as bones or plant remains) likely would have been vaporized or burned if present.

4.9 Socioeconomics

Socioeconomics considers the attributes of human social and economic interactions of a proposed action, alternatives, and the impacts such actions may have on a ROI. Socioeconomic impacts are defined in terms of changes to the demographic and economic characteristics within the ROI. The socioeconomic ROI is defined based on the current residential location of LANL full-time employees and encompasses the area in which most of these workers reside and spend a portion of their wages and salaries. The socioeconomic ROI for this SWEIS includes Los Alamos, Santa Fe, Rio Arriba, Bernalillo, and Sandoval counties. Table 4.9-1 provides the residence information for the LANL employees as of 2022 that reside within the five-county ROI. In 2022, approximately 15,326 persons were directly employed by LANL or by LANL site-related affiliates, contractors, or partners; 13,773 reside in New Mexico (approximately 90 percent), and 13,112 (approximately 86 percent) reside within the five-county ROI (LANL 2023b). Of those that reside in New Mexico, more than 95 percent live in the five-county ROI.

This section discusses regional and local economy, local demographics, local housing, and community services within the five-county ROI.

Table 4.9-1 Los Alamos National Laboratory Employees by County, 2022

County	Number of Employees	Percent of Total Site Employment
Los Alamos	5,551	36.2
Santa Fe	3,533	23.1
Rio Arriba	2,419	15.8
Bernalillo	972	6.3
Sandoval	637	4.2
Other counties in NM	660	4.3
Non-NM and unknown	1,553	10.1
TOTALS	**15,326**	**100.0**

Source: Derived from LANL (2023b)

4.9.1 Regional Economic Characteristics

Between 2010 and 2022, the labor force in the ROI increased by 3.4 percent to 504,330 persons. During the same period, the number of unemployed people in the ROI decreased by 48.5 percent, reflecting the economic recovery after the recession of 2008–2010. The unemployment rate declined by 3.7 percentage points, from 7.3 percent to 3.6 percent. The state of New Mexico experienced a similar trend in unemployment rates, decreasing by 3.7 percentage points (BLS 2024). Table 4.9-2 presents the employment profile in the ROI and New Mexico for 2010 and 2021.

Table 4.9-2 Employment Profile in the Five-County Region of Influence

County/Area	Labor Force		Employed		Unemployed		Unemployment Rate	
	2010	2022	2010	2022	2010	2022	2010	2022
Los Alamos	9,405	10,637	9,076	10,405	329	232	3.5	2.2
Santa Fe	73,742	72,319	68,957	69,720	4,785	2,599	6.5	3.6
Rio Arriba	17,861	16,518	16,291	15,800	1,570	718	8.8	4.3
Bernalillo	324,142	336,801	300,114	324,606	24,028	12,195	7.4	3.6
Sandoval	60,446	68,055	55,563	65,476	4,883	2,579	8.1	3.8
ROI TOTALS	**485,596**	**504,330**	**450,001**	**486,007**	**35,595**	**18,323**	**7.3**	**3.6**
New Mexico	928,862	947,411	856,602	908,878	72,260	38,533	7.8	4.1

ROI = region of influence
Source: BLS (2024)

Los Alamos County. Approximately 5,551 LANL employees reside in Los Alamos County, accounting for approximately 53.4 percent of 2022 employment within the county. Between 2010 and 2022, the labor force increased 13.1 percent to 10,637 persons, and the number of unemployed people decreased by 29.5 percent. The unemployment rate declined by 1.3 percentage points, from 3.5 percent to 2.2 percent over that same period.

Santa Fe County. Approximately 3,533 LANL employees reside in Santa Fe County, accounting for approximately 5.1 percent of 2022 employment within the county. Between 2010 and 2022, the labor force decreased 1.9 percent to 72,319 persons, and the number of unemployed people decreased by 45.7 percent. The unemployment rate declined by 2.9 percentage points, from 6.5 percent to 3.6 percent over that same period.

Rio Arriba County. Approximately 2,419 LANL employees reside in Rio Arriba County, accounting for approximately 15.3 percent of 2022 employment within the county. Between 2010 and 2022, the labor force decreased 7.5 percent to 16,518 persons, and the number of unemployed people decreased by 54.3 percent. The unemployment rate declined by 4.5 percentage points, from 8.8 percent to 4.4 percent over that same period.

Bernalillo County. Approximately 972 LANL employees reside in Bernalillo County, accounting for approximately 0.3 percent of 2022 employment within the county. Between 2010 and 2022, the labor force increased 3.9 percent to 336,801 persons, and the number of unemployed people decreased by 49.3 percent. The unemployment rate declined by 3.8 percentage points, from 7.4 percent to 3.6 percent over that same period.

Sandoval County. Approximately 637 LANL employees reside in Sandoval County, accounting for approximately 1.0 percent of 2022 employment within the county. Between 2010 and 2022, the labor force increased 12.6 percent to 68,055 persons, and the number of unemployed people decreased by 47.2 percent. The unemployment rate declined by 4.3 percentage points, from 8.1 percent to 3.8 percent over that same period.

4.9.2 Demographic Characteristics

In 2022, the population in the ROI was estimated at 1,038,171 people. From 2010 to 2022, the total population in the ROI increased at an average annual rate of 0.4 percent to 1,038,171 people, which was higher than the statewide growth rate. Over the same period, the total population of New Mexico increased at an average rate of approximately 0.2 percent to 2,112,463 people (USCB 2024a, 2024b).

Over the last decade, New Mexico’s population growth stagnated compared with the U.S. and neighboring states. It is projected that New Mexico’s population will not grow above 2.2 million and will likely peak within the next 20 years under the current trends (New Mexico 2021). From 2022 to 2040, the population of New Mexico is projected to increase at an average annual rate of approximately less than 1 percent. During this same period, the total population in the ROI is also projected to increase at an average annual rate of approximately less than 1 percent. Table 4.9-3 summarizes the historical and projected populations of New Mexico and the five-county ROI.

Table 4.9-3 Historical and Projected Population within the Five-County Region of Influence and New Mexico

County	2010	2015	2020	2022	2025	2030	2035	2040
Los Alamos	17,950	17,939	19,419	19,253	19,164	19,501	19,753	19,941
Santa Fe	144,170	147,108	154,823	154,481	153,311	155,641	157,291	158,420
Rio Arriba	40,246	39,949	40,363	40,285	37,883	36,903	35,752	34,485
Bernalillo	662,564	673,943	676,444	674,692	688,329	693,134	694,874	694,327
Sandoval	131,561	136,638	148,834	149,460	154,322	161,141	167,281	172,862
ROI TOTALS	**996,491**	**1,015,577**	**1,039,883**	**1,038,171**	**1,053,009**	**1,066,320**	**1,074,951**	**1,080,035**

ROI = region of influence
Source: USCB (2022b, 2022c, 2022d, 2024a); New Mexico (2021)

Persons self-designated as minority individuals in the ROI comprise 62.1 percent of the total population. This minority population is composed largely of Hispanic or Latino and American Indian residents. Sixteen Pueblo and tribal lands are included in the ROI and include the Pueblos of San Ildefonso, Santa Clara, San Juan, Nambe, Pojoaque, Tesuque, Picuris, Taos, Jemez, Zia, Santa Ana, San Felipe Santa Domingo, Cochiti, Sandia, and part of the Jicarilla Apache Indian Reservation. Table 4.9-4 summarizes the 2022 demographic profile of the ROI population.

Table 4.9-4 Demographic Profile of the Five-County Region of Influence and New Mexico (percent), 2022

Population Group	New Mexico	Los Alamos	Santa Fe	Rio Arriba	Bernalillo	Sandoval
Hispanic or Latino	49.8	18.3	50.8	71.3	50.7	40.6
Black or African American alone	1.8	1.2	0.8	0.6	2.4	2.1
American Indian or Alaska Native alone	8.5	0.9	2.4	14.0	3.9	11.3
Asian alone	1.5	5.3	1.3	0.5	2.6	1.4
Native Hawaiian or Pacific Islander alone	0.1	0	0.1	0.0	0.1	0.1
Some other race alone	0.4	0.2	0.4	0.7	0.5	0.2
Two or more races	2.4	3.7	2.2	0.9	3.1	2.8
MINORITY TOTALS	**64.4**	**29.5**	**58.0**	**88.0**	**63.3**	**58.6**
White alone	35.6	70.5	42.0	12.0	36.7	41.4
TOTALS	**100**	**100**	**100**	**100**	**100**	**100**

Source: USCB (2024a)

Los Alamos County. In 2022, the population of Los Alamos County was 19,253. Persons self-designated as minority individuals comprise 29.5 percent of the total population. This minority population is composed largely of Hispanic or Latino and Asian residents. From 2010 to 2022, the population increased 7.3 percent. From 2022 to 2040, Los Alamos County is expected to increase by approximately 688 residents, an increase of 3.6 percent.

Santa Fe County. In 2022, the population of Santa Fe County was 154,481. Persons self-designated as minority individuals comprise 58.0 percent of the total population. This minority population is composed largely of Hispanic or Latino residents. From 2010 to 2022, the population increased by 7.2 percent. From 2022 to 2040, Santa Fe County is expected to increase by approximately 3,939 residents, an increase of 2.5 percent.

Rio Arriba County. In 2022, the population of Rio Arriba County was 40,285. Rio Arriba County has the smallest population within the five-county ROI. Persons self-designated as minority individuals comprise 88 percent of the total population. This minority population is composed largely of Hispanic or Latino and American Indian or Alaska Native residents. From 2010 to 2022, the population increased 0.1 percent, the smallest increase within the ROI. From 2022 to 2040 the Rio Arriba County population is expected to experience the least growth within the ROI with a decrease of 5,800 residents, a decrease of 14.4 percent.

Bernalillo County. In 2022, the population of Bernalillo County was 674,692. Bernalillo County has the largest population within the five-county ROI. Persons self-designated as minority individuals comprise 63.3 percent of the total population. This minority population is composed largely of Hispanic or Latino residents. From 2010 to 2022, the population increased 1.8 percent.

From 2022 to 2040, the Bernalillo County population is expected to increase by approximately 19,635 residents, an increase of 2.9 percent.

Sandoval County. In 2022, the population of Sandoval County was 149,460. Sandoval County has the second-largest population within the five-county ROI. Persons self-designated as minority individuals comprise 58.6 percent of the total population. This minority population is composed largely of Hispanic or Latino and American Indian or Alaska Native residents. From 2010 to 2022, the population increased by 13.6 percent, the largest increase within the ROI. From 2022 to 2040, Sandoval County is expected to experience the largest growth within the ROI with an increase of 23,402 residents, an increase of 15.7 percent.

4.9.3 Regional Income

There are major differences in the income levels among the five counties within the ROI, especially between Rio Arriba County at the low end, with a median income in 2022 of $65,388 and a per-capita income of $27,878, and Los Alamos County at the upper end, with a median family income of $158,708 and a per-capita income of $71,527. The median family income in Los Alamos County is more than twice that of the New Mexico average (USCB 2024b). From 2010 to 2022, the median family income in the ROI increased by an average of 3.0 percent per year, from $64,041 to $84,058 dollars in 2022. Table 4.9-5 presents income information for the ROI.

Table 4.9-5 Income Information for the Five-County Region of Influence, 2022

County/Area	Median Family Income	Per-Capita Personal Income	Percent Below Poverty
Los Alamos	$158,708	$71,527	5.4
Santa Fe	$84,058	$45,402	12.5
Rio Arriba	$65,388	$27,878	20.7
Bernalillo	$79,674	$36,996	16.2
Sandoval	$86,062	$36,603	9.7
New Mexico	$72,422	$32,667	17.7

Note: Poverty thresholds are determined by the USCB annually and are dependent on the number and age of persons in the household.
Source: USCB (2024b, 2024c)

4.9.4 Los Alamos National Laboratory-Affiliated Work Force

LANL-affiliated employment includes federal employees, M&O contractor employees, and subcontractors. In 2022, the total direct LANL employment was 15,326 persons (*see* Table 4.9-1). The total number of LANL workers residing in the ROI was approximately 13,112 (*see* Table 4.9-1) (LANL 2023b). Within the ROI, the largest percentage of employees reside in Los Alamos County (approximately 5,551 employees). As of December 2022, approximately 3,533 employees reside in Santa Fe County, with the remaining employees residing in surrounding counties. In 2022, direct LANL employment accounted for approximately 2.7 percent of employment in the ROI.

As reported in Chapter 3, Section 3.5, in 2022, about 9.6 percent of the Laboratory workforce was remote (generally did not work on the LANL site) and about 12.9 percent were hybrid (worked at LANL about half time). The baseline environmental parameters presented in other resource areas in this chapter reflect the current, stabilizing trend for teleworking.

4.9.5 Housing

Table 4.9-6 lists the distribution of housing units in the ROI and New Mexico. The 2022 housing stock statistics from the U.S. Census Bureau (USCB 2024d) estimated housing occupancy by type (owned or rented). Of interest for impact analysis is the capacity of the ROI to absorb any new housing demand created by the Proposed Action. As of 2022, the ROI had 463,569 housing units, of which 91.9 percent were occupied and 8.1 percent were vacant. Of the estimated 37,472 vacant units, 8,678 were estimated to be vacant rental units or 1.9 percent of the housing stock in the ROI. All other vacant housing makes up 6.2 percent of the stock, or 28,794 units, in the ROI. The vacancy rate was the smallest in Los Alamos County and highest in Rio Arriba County. In New Mexico, an estimated 13.8 percent of housing stock is vacant. Vacant rental stock makes up 2.0 percent of the stock in the state.

Table 4.9-6 Housing Characteristics for the Five-County Region of Influence

County/Area	2010					2022				
	Total Housing Units	Occupied Housing Units	Vacant Housing Units	Vacant Rental Units	All Other Vacant Units	Total Housing Units	Occupied Housing Units	Vacant Housing Units	Vacant Rental Units	All Other Vacant Units
Los Alamos	8,397	7,566	831	283	548	8,631	8,149	482	54	428
Santa Fe	69,527	60,144	9,383	1,775	7,608	76,714	67,866	8,848	999	7,849
Rio Arriba	19,385	14,934	4,451	398	4,053	19,616	14,076	5,540	174	5,366
Bernalillo	280,435	259,165	21,270	6,523	14,747	299,693	281,095	18,598	6,495	12,103
Sandoval	50,314	44,860	5,454	726	4,728	58,915	54,911	4,004	956	3,048
ROI TOTALS	**428,058**	**386,669**	**41,389**	**9,705**	**31,684**	**463,569**	**426,097**	**37,472**	**8,678**	**28,794**
New Mexico	887,890	756,112	131,778	21,182	110,596	943,149	812,852	130,297	18,578	111,719

ROI – region of influence
Source: USCB (2022f, 2024d, 2024e)

The Comprehensive Plan – Los Alamos County (LAC 2016) states that based on known vacancies, including housing and vacant land, Los Alamos County could accommodate a population growth of 2,000 people within its existing development boundaries. However, the study conducted to support the comprehensive plan does not correlate the amount of housing types to demographic distribution, and housing availability and the trends in hiring within the county indicate that there is a projected shortage of some specific types of housing. The Santa Fe Association of Realtors estimates that the recent housing market for Santa Fe has been trending into an undersupply situation, as characterized by the average supply of inventory for sale of 1.9 months (SFAR 2021). A "normal" housing market is characterized by having a three-to-nine-month supply of inventory for sale.

The Los Alamos Housing Program conducted a housing market needs analysis, which estimated an unmet need of 1,312 rental units and 388 owner-occupied units (LAC 2019). The study indicated that the majority of households with unmet needs are commuters who rent elsewhere. There is limited land available for the construction of new single-family homes in the Los Alamos area. Los Alamos and White Rock are considering the development of high-density, mixed-use housing units in the town center areas that would include a transit center to the LANL site. The plans include up to 363 housing units in White Rock and 2,591 units in Los Alamos (LAC 2019, 2021a, 2021b).

Los Alamos County. The Los Alamos County housing stock totaled 8,631 units as of 2022. The vacancy rate was 5.6 percent, indicating a low percentage of available housing. The total number of housing units increased by 2.8 percent between 2010 and 2022. The median value of owner-occupied homes (in 2022) in the county was $412,700.

Santa Fe County. The Santa Fe County housing stock totaled 76,714 units as of 2022. The vacancy rate was 11.5 percent, indicating a low percentage of available housing. The total number of housing units increased by 10.3 percent between 2010 and 2022. The median value of owner-occupied homes (in 2022) in the county was $374,200.

Rio Arriba County. The Rio Arriba County housing stock totaled 19,616 units as of 2022. The vacancy rate was 28.2 percent. The total number of housing units increased by 1.2 percent between 2010 and 2022. The median value of owner-occupied homes (in 2022) in the county was $212,700.

Bernalillo County. The Bernalillo County housing stock totaled 299,693 units as of 2022. The vacancy rate was 6.2 percent, indicating a low percentage of available housing. The total number of housing units increased by 6.9 percent between 2010 and 2022. The median value of owner-occupied homes (in 2022) in the county was $247,300.

Sandoval County. The Sandoval County housing stock totaled 58,915 units as of 2022. The vacancy rate was 6.8 percent, indicating a low percentage of available housing. The total number of housing units increased by 17.1 percent between 2010 and 2022. The median value of owner-occupied homes (in 2022) in the county was $258,100.

4.9.6 Local Government Finances

LANL has a substantial impact on the economy of New Mexico. If there is a change in employment, employee incomes, or procurement at LANL, these changes would be expected to have a direct effect on city and county revenues, such as the gross receipts tax.

Table 4.9-7 summarizes the general funds revenues for the five-county ROI. The general funds of these counties support the ongoing operations of their governments as well as community services such as police protection and parks and recreation. In Los Alamos County, the fire department serving LANL and the community is funded through a separate fund derived from DOE contract payments (shown as intergovernmental revenue in the table).

Table 4.9-7 General Funds Revenues for the Five-County Region of Influence

Revenue Source	Los Alamos	Santa Fe	Rio Arriba	Bernalillo	Sandoval
Property taxes	8,262,390	54,082,851	6,491,350	145,751,530	29,658,277
Gross receipt taxes	41,487,425	23,119,723	5,031,501	266,673,330	9,161,825
Other taxes	1,134,025	1,856,566	6,462,550	221,540,664	2,750,140
Licenses and permits	310,007	1,309,108	1,142,424	6,264,598	0
Intergovernmental	25,375,236	880,903	3,802,645	1,839,003	33,986
Charges for services	1,188,249	1,845,123	232,690	6,923,062	1,333,532
Investment Income	-5,846,777	-13,824,185	1,898	-9,068,947	-798,320
Other revenue	20,887,863	4,228,951	14,073	6,589,408	4,258,491
REVENUE TOTALS	**92,798,418**	**73,499,040**	**23,179,131**	**646,512,648**	**46,397,931**

Source: Sandoval County (2023); Bernalillo County (2022); LAC (2022c); Rio Arriba County (2022a); Santa Fe County (2022a)

4.9.7 Services

This section describes the existing demands on fire protection services, police protection services, public education, and health care within the ROI. Providers of these services in the ROI are fire and police departments, hospitals and clinics, and public school districts.

Fire Protection. There are 53 fire districts within the five-county ROI. The Los Alamos County Fire Department is one of the largest career fire departments in New Mexico and provides fire suppression, medical, rescue, wildland fire suppression, and fire prevention services to both LANL and the Los Alamos County community. There are five manned fire stations with 150 budgeted positions, including 140 uniformed personnel (LAC 2022a). The LANL Fire Department is operated under contract with the Los Alamos County Fire Department that provides personnel and equipment to man Fire Stations 1 and 5.

Rio Arriba County has 17 fire districts, the greatest number of districts within the ROI, followed by Santa Fe County with 15 districts, Bernalillo County with 12 districts, and Sandoval County with 8 districts (Rio Arriba County 2022b; Santa Fe County 2022b; Sandoval County 2022; Bernalillo County 2023).

Police Protection Services. Police protection in the ROI is provided by county sheriff's departments and various local police departments. There are approximately 14 police departments within the ROI employing more than 1,800 officers (FBI 2022). Each department provides law enforcement services in conjunction with other law enforcement agencies, including the New Mexico State Police. The Los Alamos County Police Department has 33 officers and 16 detention staff (LAC 2022b).

Medical Services. Medical services in the ROI include 23 full-service hospitals and clinics. These facilities provide a wide array of medical services, including physical examinations; treatment of illness; emergency, intensive, and coronary care; internal medicine; x-ray and laboratory; infertility, obstetrics, and gynecology; neonatal intensive care; inpatient and outpatient surgery; pharmaceuticals; optometry; dental; respiratory therapy; and skilled nursing and long-term care.

Los Alamos Medical Center located in Los Alamos County is a 47-bed acute-care facility, major health care institution, and the only hospital in the community. There are four medical service facilities in Santa Fe County that include the Christus St. Vincent Regional Medical Center, a 203-bed hospital that provides an array of medical services including 24-hour emergency care. Other medical facilities in Santa Fe County include the Christus St. Vincent Physicians Medical Center, the Santa Fe Indian Hospital, and the Presbyterian Santa Fe Medical Center. There are 17 hospitals in Bernalillo County, with a majority located in in vicinity of the City of Albuquerque including the Presbyterian Hospital, a 716-bed short term acute care facility. In addition to offsite medical facilities, LANL has an onsite medical facility that is available to all Laboratory workers and provides comprehensive services and programs to promote worker physical and mental wellness (AHD 2022).

School Services. New Mexico is divided into 153 school districts, 57 of which are within the ROI. For the 2022/2023 school year, total public school enrollment in the ROI was 138,787 students. Total students within the ROI make up approximately 44.1 percent of the state student population. Bernalillo County has the greatest number of schools (206) and the largest student population (89,222), and Los Alamos County has the least number of schools (8) and smallest student population (3,724) within the ROI. The ROI has an average student-to-teacher ratio of 16 to 1. Table 4.9-8 summarizes school enrollment in the ROI.

Table 4.9-8 School Enrollment for the Five-County Region of Influence

County/Area	School Districts	Number of Schools	Number of Students	Student-to-Teacher Ratio
Los Alamos	1	8	3,724	13:1
Santa Fe	14	57	19,440	15:1
Rio Arriba	6	29	4,347	12:1
Bernalillo	28	206	89,222	14:1
Sandoval	8	42	22,054	15:1
ROI TOTALS	**57**	**342**	**138,787**	**16:1**

ROI = region of influence
Source: NCES (2024)

4.10 Infrastructure

Site infrastructure includes the physical resources and services required to support the construction and operation of LANL facilities. Utility infrastructure at LANL encompasses electrical power, fuel (natural gas and petroleum), water supply, SWWS, and telecommunications. DOE/NNSA owns and distributes most utility services to LANL facilities, and Los Alamos County provides utility services to the communities of White Rock and Los Alamos (LANL 2024a). Roads and parking at LANL are addressed in Section 4.12 of this SWEIS.

4.10.1 Electricity

The Electric Coordination Agreement (ECA) was signed in 1985 between the DOE/NNSA, and Los Alamos County. Under the ECA, the DOE/NNSA and Los Alamos County share power-generation resources and infrastructure through the Los Alamos Power Pool (LAPP). The ECA is set to expire in 2025. The parties are currently working on a new agreement (LANL 2021f). Historically, LANL has used approximately 80 percent of the energy from the LAPP, but projections show the Laboratory's energy use doubling in the next 10 years, so this will likely to change the percentage allocation (LANL 2021f). The LAPP supplies LANL with electricity primarily through hydroelectric, coal, and natural gas power generators throughout the western U.S. Import capacity is limited by the physical capability (thermal rating) of the Norton Transmission line import capacity of 116 MVA (LANL 2024a).

Within LANL, NNSA operates a natural-gas-fired steam and electrical power generating plant at TA-3 (i.e., the TA-3 Co-Generation Complex or Power Plant), which is capable of generating 27 MW from a combustion turbine generator and up to 10 MW from steam-driven turbine generators #1 and #2, for a total of 37 MW, all shared by LAPP. However, the two steam-driven turbine generators are currently unavailable and have not been used for several years. A third steam-driven turbine generator is also out of service due to a condenser failure. Therefore, onsite electricity generation capability for the LAPP is limited to the 20–27 megawatts from the combustion gas turbine generator. Phase I of the Steam Plant Replacement Project construction was completed in FY 2023. Operation of Phase 1 equipment is planned for FY 2024. This will eventually replace the existing central steam plant with upgrades to the combustion turbine and the addition of conventional gas-fire steam boilers, providing up to 40 MW on average to the Laboratory. Los Alamos County operates a 1-MW solar PV unit on the TA-61 old landfill site (LANL 2024a).

In 2011, Los Alamos County completed construction of a 3-MW, low-flow hydro-turbine on the USACE's Abiquiu Dam. In 2013, to diversify the power portfolio for LANL and in accordance with the site sustainability goals, DOE partnered with Los Alamos County and the USACE to adjust the water flow at Abiquiu Dam to provide 1–2 MW of reserve power (NNSA 2018a).

There are two 115-kilovolt (kV) transmission lines that import power from the Public Service Company of New Mexico (PNM) system into LANL. Ownership of one of the transmission lines (Norton Line [NL]) is split between PNM and DOE/NNSA, with operations coordinated between both parties; PNM owns and operates the second line (Reeves Line [RL]). Currently, the 115-kV transmission infrastructure has sufficient capacity to serve baseload requirements for the entire Los Alamos Service Area, which includes LANL and the county. Although the RL and the NL provide some redundancy, the transmission import capacity of 116 MVA is expected to be exceeded before 2027 due to increased demand loads at LANL (NNSA 2023b). The installation of a third transmission line as part of the EPCU would increase the import capacity from 116 to 200 MVA, thereby allowing loads to be fully served by offsite generation and enable future mission growth (LANL 2024a). The EPCU would include additional improvements to onsite transmission, upgrades for the Western Technical Area Substation, and expansion of several distribution feeder circuits. The EPCU project is being evaluated in the EPCU EA and is included in the No Action Alternative (*see* Section 3.2.1.4). Until the EPCU is implemented, onsite generation can be used to supplement import capacity to meet LANL power needs as necessary (LANL 2024a).

The DOE-maintained electric distribution system at LANL consists of various low-voltage transformers at LANL facilities and approximately 34 miles of 13.8-kV distribution lines. It also consists of several power distribution substations, the ETA Substation, the TA-3 Substation, the Western Technical Area Substation, and the Southern Technical Area Substation. The TA-3 Substation was replaced from 2016 through 2021. The new TA-3 Substation provides power to much of LANL and the Los Alamos townsite. The old TA-3 Substation was demolished in May 2022. The new substation features power circuit breakers, increased carrying capacity, and safety improvements (LANL 2021d). The TA-3 Substation replacement improves system reliability and resiliency of the 13.8-kV distribution and 115-kV transmission systems for both LANL and Los Alamos County (LANL 2023a).

In the 2008 SWEIS No Action Alternative, total electricity consumption was reported as 495,000 MW-hours per year. In addition, the electricity peak load under the No Action Alternative was reported as 91,200 kilowatts per year. The Laboratory has implemented some elements of the expanded operations alternative analyzed in the 2008 SWEIS that affect electricity use since the 2008 SWEIS was issued. Expansion of the capabilities and operational levels at the SCC has impacted the total electricity peak demand and the total electricity consumption at LANL. Also, the multi-year LANSCE Risk Mitigation Project was approved by DOE/NNSA in 2010. The scope of this project encompasses the restoration of the LANSCE 800-MeV LINAC to historic performance levels (LANL 2022a).

Tables 4.10-1 and 4.10-2 show the trends in peak electric load demand and total electrical energy consumption within the LAPP, respectively. From 2017 through 2022, electrical peak demand ranged from 66 to 73 MW, and total annual electrical consumption ranged from 432,000 to 466,000 MW-hours for LANL, below site capacity and 2008 SWEIS projections, as shown in Figures 4.10-1 and 4.10-2, respectively.

Table 4.10-1 Electricity Peak Demand Within the LAPP by Year (kilowatts)

Category	LANL Base	LANSCE	SCC	LANL Total	County Total	Pool Total
2008 SWEIS	57,200	51,000[a]	18,000[a]	120,200	19,800	140,000[b]
CY 2022	32,879	22,794	11,256	66,929	20,790	87,719
CY 2021	35,010	23,755	14,732	73,137	17,450	90,587
CY 2020	32,927	22,494	10,805	66,226	19,136	85,362
CY 2019	35,473	24,028	10,663	70,164	20,058	90,222
CY 2018	35,174	23,951	11,328	70,453	20,893	91,346
CY 2017	41,823	23,387	7,586	72,796	16,567	89,613
Average (2017–2022)	35,548	23,402	11,062	69,951	19,149	89,142

CY = calendar year; LANL = Los Alamos National Laboratory; LANSCE = Los Alamos Neutron Science Center; SCC = Strategic Computing Center

a Included in the 2008 SWEIS Expanded Operations Alternative.

b The total power pool number was updated to reflect the addition of the elements of the Expanded Operations Alternative in the 2008 SWEIS.

Source: LANL (2018b, 2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

Table 4.10-2 Total Electrical Energy Consumption by Year (megawatt-hours)

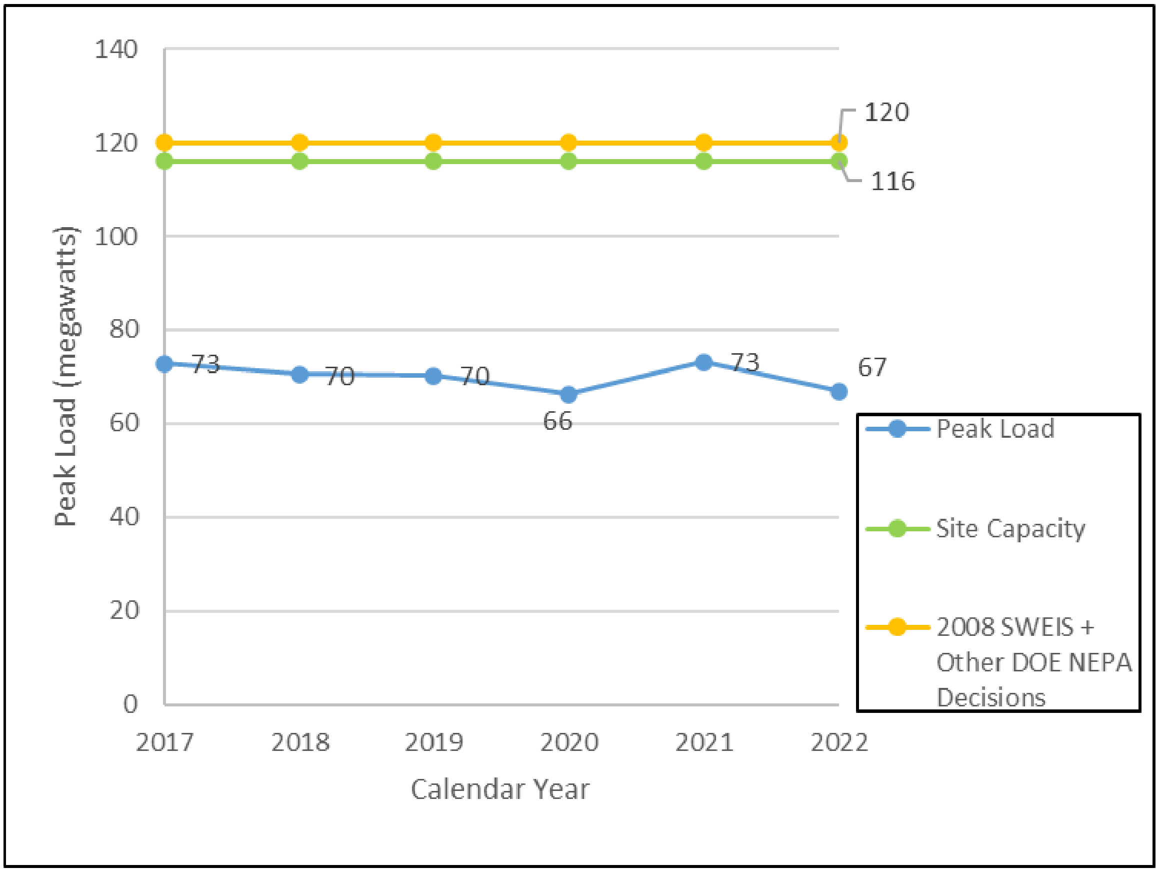
Category	LANL Base	LANSCE	SCC	LANL Total	County Total	Pool Total
2008 SWEIS	356,000	208,000[a]	131,400[a]	651,400	150,000	801,400[b]
CY 2022	240,497	118,973	90,109	449,579	119,367	568,946
CY 2021	237,553	115,142	100,383	453,078	118,732	571,810
CY 2020	221,050	111,929	98,710	431,689	118,648	550,337
CY 2019	223,199	115,885	99,180	438,264	121,504	559,768
CY 2018	233,276	137,529	95,180	465,984	120,777	586,761
CY 2017	235,127	137,515	93,578	466,220	121,233	589,643
Average (2017–2022)	231,784	122,829	96,190	450,802	120,044	571,211

CY = calendar year; LANL = Los Alamos National Laboratory; LANSCE = Los Alamos Neutron Science Center; SCC = Strategic Computing Center

a Included in the 2008 SWEIS Expanded Operations Alternative.

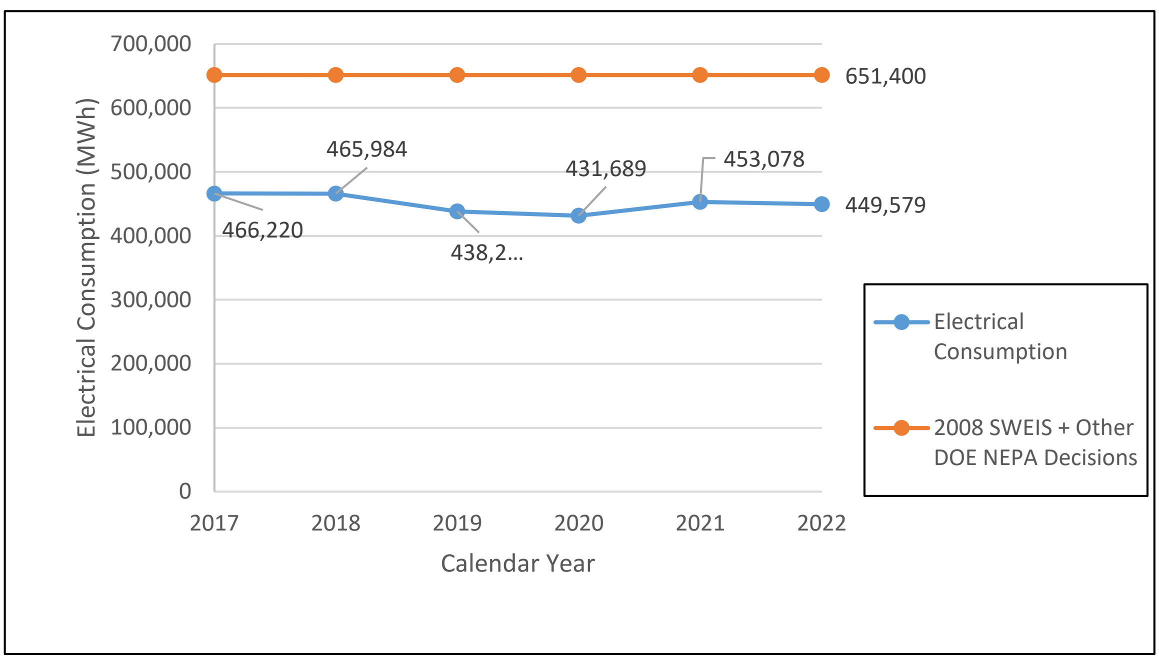
b The total power pool number was updated to reflect the addition of the elements of the Expanded Operations Alternative in the 2008 SWEIS.

Source: LANL (2018b, 2019b, 2020d, 2021b, 2022a, 2023a, 2024a)



Source: NNSA (2018a); LANL (2018b, 2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

Figure 4.10-1 Electrical Peak Load at LANL, 2017–2022



Source: NNSA (2018a); LANL (2018b, 2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

Figure 4.10-2 Electrical Consumption at LANL, 2017–2022

Energy Efficiency. LANL continues to invest in many energy-reduction initiatives, including:

- building automation system upgrades,
- monitoring via energy analytics software,
- HVAC recommissioning,
- insulation of LANL steam pits using thermal system insulation infrared technology,
- electric-vehicle charging station installation,
- smart labs program, and
- light-emitting diode lighting upgrades.

Based on DOE/NNSA sustainability goals, LANL has worked toward an energy intensity-reduction goal of 25 percent by the end of FY 2025 from a 2015 baseline. By the end of FY 2021, LANL reduced energy intensity (British thermal unit per square foot) by 7.4 percent, largely attributed to implementation of high-performance, sustainable building including HVAC recommissioning and building automation system upgrades for night setback capability. Footprint-reduction efforts continue to contribute toward energy, water, and GHG goals (LANL 2023a, 2022f). The footprint-reduction efforts and trends are discussed in Section 4.2.1 of this SWEIS.

4.10.2 Fuel

4.10.2.1 Natural Gas

Natural gas is the primary heating fuel used at LANL and in Los Alamos County. The natural gas system includes a high-pressure main and distribution system to Los Alamos County and pressure-reducing stations at LANL buildings. LANL and Los Alamos County both have delivery points where gas is monitored and measured. Approximately 4 miles of the gas pipeline are within LANL boundaries. From the four miles of mains, natural gas is distributed to the point of use via approximately 42 miles of distribution piping (DOE 2011).

LANL receives natural gas through the New Mexico Gas Company transmission system. Natural gas used by LANL is currently used for heating (both steam and hot air), with the TA-3 Co-Generation Complex the principal user of natural gas on site (DOE 2011). The combustion gas turbine generator (within the TA-3 Co-Generation Complex) serves as one of the onsite energy sources by producing electricity from the combustion of natural gas. The combustion gas turbine generator is capable of producing 20–27 MW and is available on an as-required basis to meet peak-load and back-up situations (LANL 2024a).

Table 4.10-3 and Figure 4.10-3 present gas consumption during CY 2022 and recent years since the 2008 SWEIS was issued. Approximately 52 percent of the gas used by LANL in 2022 was for heat production. The remainder was for electricity production, mainly by the combustion gas turbine generator. Total gas consumption for CY 2021 was about 500,000 decatherms more than projected in the 2008 SWEIS due to increased usage of the combustion gas turbine generator, which ran for 3,459 hours at a usage of approximately 743,000 decatherms (LANL 2023a). Total natural gas consumption for CY 2022 was about 253,000 decatherms more than projected in the 2008 SWEIS due to increased usage of the combustion gas turbine generator, which ran for 3,000 hours at a usage of about 699,784 decatherms (LANL 2024a).

4.10.2.2 Petroleum and Alternative Fuels

Fuels, such as oil, diesel, and gasoline, are used at LANL and are brought on site as needed (LANL 2022f). LANL used 508,363 gallons of fuel (petroleum-based and alternative) during FY 2021.

Annual fuel consumption at LANL decreased by more than 26 percent between 2010 and 2021 (Figure 4.10-4). As part of the General Services Agency lease-vehicle replacement cycle (conducted annually), LANL has been and will continue to transition to smaller, more fuel-efficient, and low GHG-emitting vehicles (LANL 2021f, 2022f, 2024g). Plug-in hybrid EVs and ZEVs are the standard replacement type for all light-duty vehicles in the fleet, with the goal of transitioning most of the vehicles to ZEV over the next six years (LANL 2024f).

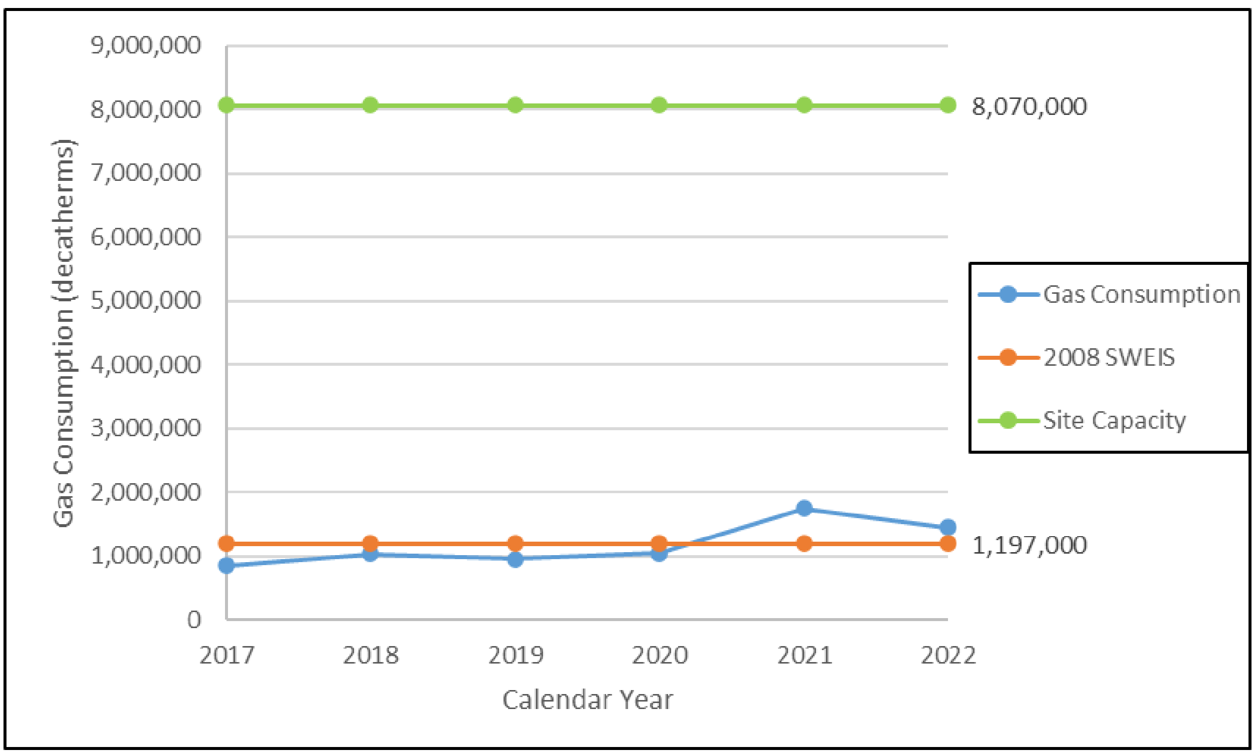
Table 4.10-3 Gas Consumption (decatherms[a]) at LANL, 2017–2022

Category	Total LANL Consumption Base	Total Used for Electricity Production	Total Used for Heat Production	Total Steam Production (klb)
2008 SWEIS	1,197,000	Not projected	Not projected	Not projected
2022	1,449,908	699,784	750,123	224,904
2021	1,742,808	962,206	780,603	209,470
2020	1,046,272	145,461	900,811	225,734
2019	947,718	94,123	853,594	228,205
2018	1,029,543	180,597	848,946	242,957
2017	847,023	52,605	794,418	241,507
Average (2017–2022)	1,177,212	355,796	821,416	228,796

klb = thousands of pounds

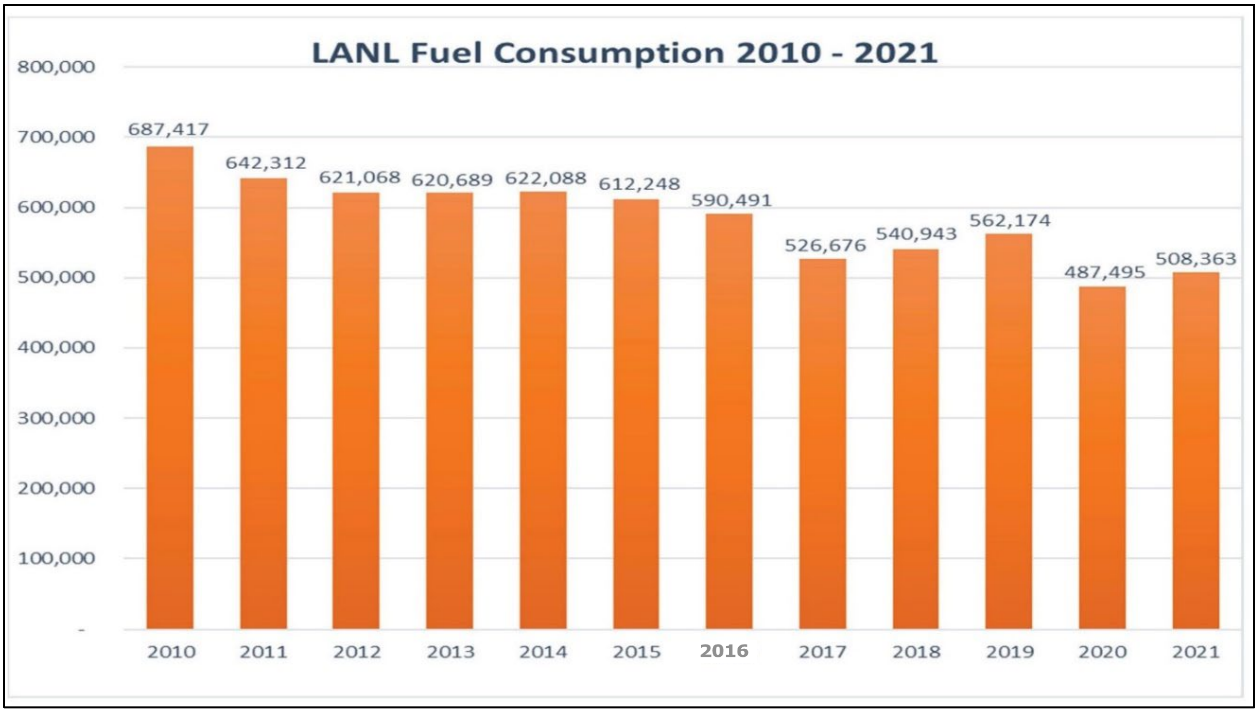
a A decatherm is equivalent to 1,000 cubic feet of natural gas.

Source: LANL (2018b, 2019b, 2020d, 2021b, 2022a, 2023a, 2024a)



Source: NNSA (2018a); LANL (2018b, 2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

Figure 4.10-3 Natural Gas Consumption at LANL, 2017–2022



Source: LANL (2022f)

Figure 4.10-4 Total Fuel Consumption (gallons per year), Petroleum and Alternative Fuel Combined, 2010–2021

During FY 2020, LANL used a combined total of 29,773 gallons of alternative fuels consisting of ethanol gasoline blend (E85) and bio-diesel blend (B20) (LANL 2021f). Because of LANL's remote location, E85 and B20 are not available at local, private fueling stations. Therefore, LANL subcontracts with a Pueblo-owned business to use mobile fueling trucks to haul E85 from a bulk fuel plant, a 40-mile round trip from LANL, and dispense fuel directly into vehicles. LANL vehicles operating on B20 drive to the bulk plant to fill up. During FY 2021, LANL used approximately 53,613 gallons of E85 (LANL 2022f).

4.10.3 Domestic Water

The Los Alamos County water production system consists of deep wells, main distribution lines, pump stations, and storage tanks. The system supplies potable water to all of Los Alamos County, LANL, and Bandelier National Monument. The deep wells are located in three well fields (Guaje, Otowi, and Pajarito). Water is pumped into production lines, and booster pump stations lift this water to reservoir tanks for distribution. Prior to distribution, the entire water supply is disinfected (DOE 2011; LANL 2023a).

DOE/NNSA has a contract with Los Alamos County to supply water to the Laboratory. The County owns and operates the main water production system, while LANL owns and maintains an internal distribution system. The distribution system used to supply water to LANL facilities consists of a series of storage tanks, pipelines, and fire pumps. The LANL distribution system is primarily gravity fed, with pumps available for high-demand fire situations at select locations (LANL 2022a). LANL continues to maintain the distribution system by replacing those portions of the system in need of repair identified during leak detection surveys (LANL 2021f). The largest end users are cooling towers across the site, including those for the SCC and LANSCE, which collectively account for approximately 45 percent of LANL's annual consumption. Other notable users include building domestic water and site-wide distribution (32 percent) and the TA-3 power plant and satellite steam plants (14 percent) (LANL 2022f).

The Laboratory has installed water meters on high-user facilities at LANL and has a supervisory control and data acquisition/equipment surveillance system on the water distribution to keep track of water-tank levels and usage (LANL 2024a).

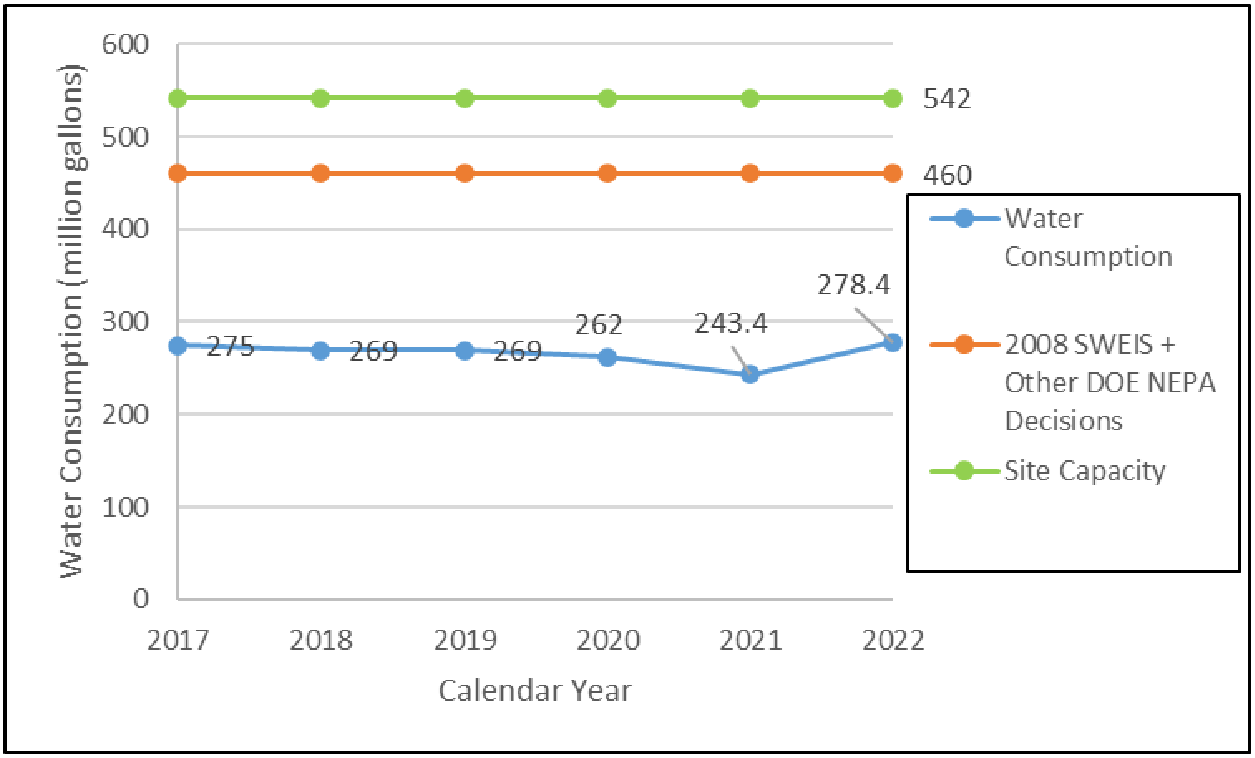
In 2011 and 2012, while the SERF was offline for expansion and improvements, water consumption at LANL was 445 million gallons. The water needs for the SCC prior to operation of the SERF were a major factor for the increase in water use. The LANSCE water requirements, approximately 40 million gallons per year at the time, were not projected in the 2008 SWEIS, but approved in 2010 as a categorical exclusion. Thus, the 2008 SWEIS water consumption bounding limit was increased in 2011 by 42.2 million gallons per year to 460 million gallons per year. In 2013, when the SERF resumed operations, water consumption dropped to almost 90 million gallons below the 2008 SWEIS records of decision projection (NNSA 2018a).

In the 2008 SWEIS, expansion of the SCC to support projected future supercomputing was projected to increase water usage at LANL by up to 51 million gallons per year due to cooling-tower evaporation and blowdown. Improvements to the SERF operations have led to increased use of recycled effluent in the cooling towers since CY 2012, leading to a significant decrease in SCC potable water use. In CY 2022, cooling-tower water demand was 31 million gallons at the SCC and 14 million gallons for the Trinity supercomputer. The SERF provided more than 32 million gallons of makeup water. Because of the SERF, the total potable water consumption was 11.3 million gallons at the SCC and 14 million gallon for Trinity. Table 4.10-4 and Figure 4.10-5 summarize the potable water consumption for CY 2022. Under the 2008 SWEIS, water use at LANL was projected to be 459.8 million gallons per year from the No Action Alternative plus elements of the expanded operations alternative. LANL consumed approximately 278 million gallons of potable water in CY 2022. Total use by LANL in 2022 was about 181 million gallons less than the 2008 SWEIS projection of 459.8 million gallons per year (LANL 2024a).

Table 4.10-4 Annual Water Consumption (million gallons)

Category	LANL Total	SCC	LANSCE
2008 SWEIS	459.8	51	119
CY 2022	278.4	11.3	62.2
CY 2021	243.4	1.0	72.9
CY 2020	261.7	7.3	61.5
CY 2019	269.1	2.2	58.8
CY 2018	269.1	16.5	64.1
CY 2017	274.8	10.7	60.7
Average (2017–2022)	266.1	8.2	63.4

CY = calendar year; LANL = Los Alamos National Laboratory; LANSCE = Los Alamos Neutron Science Center; SCC = Strategic Computing Center
Source: LANL (2018b, 2019b, 2020d, 2021b, 2022a, 2023a, 2024a)



Source: NNSA (2018a); LANL (2018b, 2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

Figure 4.10-5 Water Consumption at LANL, 2017–2022

LANL's annual water use ceiling is 542 million gallons (NNSA 2018a). Any water use exceeding this ceiling can be considered an indicator of an environmental impact, requiring further NEPA analysis. Water use below this ceiling is not expected to have any impacts to the regional aquifer (LANL 2021f).

In addition, as projected in the 2008 SWEIS, trends in water levels in wells reflect a plateau-wide decline in regional aquifer water levels starting in 1977 in response to municipal water production, typically by several feet each year. No unexplained changes in patterns have occurred since this time. The decline is gradual and does not exceed 1 to 2 feet per year for most production wells. In areas where pumping has been reduced, water levels show some recovery. When pumping stops, the static water level returns in about 6 to 12 months (LANL 2021f).

Changes to climatic condition and variability in the high desert of the U.S. Southwest are shifting the water balance, with impacts on runoff, infiltration, and aridity that may affect the region's ability to sustainably manage water resources within the next 30 years. A multi-year research effort was continued in FY 2021 to better understand infiltration, runoff, and effects on groundwater resources as affected by various climate change impacts such as increased temperature, changes in precipitation, and altered vegetation from wildfires and intense weather events on the Pajarito Plateau. The development of the ParFlow Model for the Pajarito Plateau is ongoing and incorporates climate data, vegetation input, soil, and geology to predict surface water and groundwater flow conditions under different climate scenarios. This important effort will be carried forward to understand how site water resources may be affected by climate change impacts on the Pajarito Plateau. With many mission-critical facilities relying on a plentiful supply of water, the modeling will provide information for future decisionmaking. It will also help the Laboratory continue to be a good neighbor of surrounding communities in the face of climate change (LANL 2022f). Further, LANL recently completed the *2022 Climate Change Vulnerability Assessment and Resilience Plan* to assess and manage climate change-related risks to the Laboratory's assets and operations (LANL 2022g). When models in the resilience plan consider both the impact of climate predictions on water inputs and increasing social demand (full usage of water rights), water availability consistently comes up short. With both pressures in place, annual stream flows in the San Juan River basin are projected to be 33 percent lower than historical values. Conversely, deep groundwater aquifers that provide water resources to LANL and Los Alamos County are not anticipated to be at risk from climate change impact (LANL 2022g).

Water conservation efforts at LANL include a cost-effective, life-cycle approach that emphasizes energy efficiency and minimal regional impacts associated with water use. In addition to water conservation efforts, the Laboratory is implementing the following projects to reduce water consumption (NNSA 2018a):

- effluent reuse projects through the SERF expansion project. The effluent capacity of the SERF is currently estimated to be 72 million gallons per year;
- replacement of a once-through cooling system at the TA-3 power plant;
- leak detection and repair of waterlines across the LANL site;
- installation of water meters at facilities that are large consumers (e.g., the TA-3 power plant, cooling towers, and satellite steam plants) to measure water use at LANL;
- replacement of the 60-year-old-plus water distribution system; and
- planting of native grass and landscaping, which requires less water.

4.10.4 Sanitary Wastewater

DOE operates the TA-46 SWWS to treat liquid sanitary wastes. The SWWS is designed to treat up to 220 million gallons per year of wastewater (NNSA 2008b). A portion of the treated SWWS effluent is pumped to the SERF, where it is treated for reuse as cooling-tower makeup water. Treated water is reused in LANL cooling towers and is ultimately released at permitted Outfall 001 in the Sandia Canyon (*see* Section 4.4.1.2 of this SWEIS). Discharge Permit DP-857 applies to combined effluent discharges from the TA-46 SWWS and the SERF.

LANL has six active septic tank disposal systems (a combined septic tank and leach field) in remote areas of the site (LANL 2024a). Discharge from the septic systems is covered under the NMED-issued Discharge Permit DP-1589. These septic systems and wastes generated from the SWWS Plant are addressed in Section 4.11.6.

4.10.5 Telecommunications

Currently, there is one fiber optic line that serves and transmits voice, data, and Internet service to LANL and Los Alamos County. To support access and maintain the reliability of LANL's communication and data capabilities, LANL evaluated construction of a redundant, geographically separate, and equivalent-capacity fiber optic line in 2019. The Second Fiber Optic Line EA (NNSA 2020b) and subsequent Finding of No Significant Impact (FONSI) were published in 2020 (*see* Section 1.5 of this SWEIS). The second fiber optic line would provide the same level of service to LANL and Los Alamos County residents and businesses. The entire project will require the installation of approximately 18.9 linear miles of new fiber optic line and supporting infrastructure on lands owned and managed by the BLM, DOE, USFS, Santa Fe County, and Los Alamos County White Rock community. Redundancy service will diversify the existing telecommunications network by providing an alternate route for the network, and it will enhance and protect critical customer traffic routing on the network. Installation of the new fiber optic cable by CenturyLink will require approximately 11.6 linear miles of underground installation, supported by an estimated nine maintenance vaults and 6.3 linear miles of aerial collocation on the PNM RL support structures, replacing the existing aerial ground wire and a separate 1.1 linear miles of White Rock Canyon aerial crossing on dedicated fiber optic monopoles (NNSA 2020b). This project is included in the No-Action Alternative discussed in Chapter 3, Section 3.2 of this SWEIS.

4.11 Waste Management

4.11.1 Introduction

This section discusses existing waste management at LANL. Laboratory operations (including environmental remediation) generate radioactive and nonradioactive wastes. Radioactive wastes are classified as LLW, MLLW, TRU waste, and mixed TRU (MTRU) waste (*see* text box). Nonradioactive wastes include hazardous waste,[35] municipal solid waste, construction waste, and sanitary waste. This section is grouped by the following general waste categories: (1) radioactive waste; (2) hazardous waste; (3) New Mexico Special Waste (NMSW); (4) municipal solid waste and construction/demolition waste; and (5) sanitary waste. These categories are further divided into subcategories in a few cases to better address activities.

Radioactive Waste Categories at LANL

Low-Level Radioactive Waste (LLW) – Radioactive waste that is not high-level radioactive waste; spent nuclear fuel; TRU waste; byproduct material (as defined in Section 11e.(2) of the *Atomic Energy Act of 1954*, as amended), or naturally occurring radioactive material (DOE Manual 435.1-1).

Mixed Low-Level Waste (MLLW) – Mixed low-level waste is low-level waste along with at least one waste defined as hazardous under RCRA.

Transuranic (TRU) Waste – Per the *WIPP Land Withdrawal Act*, TRU waste is radioactive waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the EPA, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; or (3) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61.

Mixed TRU Waste – Mixed transuranic waste is transuranic waste along with at least one waste defined as hazardous under RCRA.

Wastes from LANL operations are regulated by federal and state regulations, applicable to specific waste classifications. Institutional requirements for waste management activities are determined and documented by the Laboratory Implementation Requirements Program. This program provides details on proper management of all process wastes and contaminated environmental media. The Waste Compliance and Tracking System (WCATS) was specifically designed to manage LANL's waste from generation to disposition. WCATS tracks the following information:

- the waste generating process,
- the quantity and location,
- the chemical and physical characteristics of the waste,
- the regulatory status of the waste,
- applicable treatment and disposal standards, and
- the final disposition of the waste.

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[35] The 2008 SWEIS categorized hazardous waste as "chemical waste." As discussed in Section 4.11.3, chemical waste is a subset of "hazardous waste" in this SWEIS.

These data are ultimately used to assess operational efficiency, to help ensure environmental protection, and to demonstrate regulatory compliance.

As discussed in Sections 4.11.2 through 4.11.6, a significant portion of waste management operations takes place in facilities designed for and dedicated to waste management. Liquid wastes are treated in the SWWS Plant, the HEWTF, and the RLWTF. Specialized facilities in TA-3, TA-50, TA-54, and TA-60 house a variety of chemical and radioactive waste management operations, including size reduction, compaction, assaying, and storage.

Waste minimization and pollution prevention efforts at LANL are coordinated by the Pollution Prevention Program. The goal of the Laboratory's pollution prevention efforts is to reduce or eliminate waste whenever possible. However, when waste elimination is not possible, the Laboratory reduces potential adverse environmental impacts by taking the following measures:

- treating waste to reduce its toxicity;
- segregating waste (separating it into different types) to reduce its overall volume; and
- disposing of waste in a responsible manner.

Source reduction, including materials substitution and process improvements, is the preferred method of reducing waste. Recycling and reuse practices are also considered for wastes, together with volume reduction and treatment options. The Pollution Prevention Program activities include, but are not limited to, (1) reducing all types of radioactive waste, (2) funding and supporting projects that reduce or eliminate the use of hazardous chemicals, and (3) identifying and researching emerging contaminants. Program staff support the Laboratory's Site Sustainability Plan and prepare an annual hazardous waste minimization report for submittal to NMED (LANL 2022h).

4.11.2 Radioactive Waste

The *Atomic Energy Act of 1954* gave DOE regulatory authority for the management of its own radioactive waste. Subsequent rulings have limited or clarified that this authority is specific only to the radioactive component of its waste; other elements of waste streams are subject to other regulatory requirements as applicable. A common example of this clarification is that DOE-generated LLW that also qualifies as hazardous waste under RCRA is subject to both DOE waste management rules and those established pursuant to RCRA.

Laboratory operations generate LLW, MLLW, TRU waste, and MTRU waste. LANL is not involved in reprocessing spent nuclear fuel and, accordingly, does not generate high-level radioactive waste. The discussion of TRU waste addresses both TRU waste and MTRU waste because the quantity of MTRU waste generated is small and both types are managed similarly and are disposed of at the same location. The overriding set of requirements the Laboratory must meet in its management of LLW and TRU waste is established in DOE Order 435.1. Waste transported off site must also be packaged and shipped in accordance with USDOT regulations, and the waste itself must meet the waste acceptance criteria of the receiving waste management facility, whether a commercial or government facility.

Wastes from current and recent operations at the Laboratory are managed by the M&O contractor (Triad), while legacy wastes—defined as the wastes generated before July 1999—are managed by the legacy waste cleanup contractor (N3B), which assumed responsibility as the legacy cleanup contractor for DOE-EM in 2018.

4.11.2.1 Low-Level Radioactive Waste

Overview of LANL Management of LLW

LLW is generated from research and development, facility operations, maintenance and decontamination; facility deactivation and demolition; and environmental remediation. These wastes are generated at LANL when materials, equipment, and water are used in radiological control areas as part of the work activities; when these contaminated items are no longer useable, they are removed from the area as LLW. Typical LLW streams include laboratory equipment, service and utility equipment, plastic bottles, disposable wipes, plastic sheeting and bags, paper, and electronic equipment. Environmental remediation and DD&D activities generate LLW primarily in the form of contaminated soils and debris.

Both solid LLW and liquid LLW are generated at LANL. The Laboratory sends almost all of its solid LLW off site to the NNSS and to commercial, licensed treatment, storage, and disposal (TSD) facilities (Table 4.11-1). In 2022, LANL made 357 shipments of LLW to offsite disposal facilities (LANL 2024a).

Table 4.11-1 Offsite Facilities that Accepted LANL LLW in 2022

Facility Name	Location	No. of Shipments
Energy*Solutions*	Utah	130
Nevada National Security Site	Nevada	45
Perma-Fix Environmental Services	Washington	24
Waste Control Specialists LLC	Texas	150
Perma-Fix Environmental Services	Florida	7
Southwest Research Institute	Texas	1
TOTAL		**357**

Source: LANL (2024a)

Historically, some LLW generated at LANL was disposed of on site at TA-54 in the MDAs G (Area G), which is the only active waste disposal facility at LANL. Operations began at Area G in 1957 and included the disposal of LLW, certain infectious waste containing radioactive materials, asbestos-containing material (ACM), wastes containing PCBs, and temporary storage of TRU waste. Mixed LLW and MTRU waste have been stored in surface structures at Area G. The capacity to dispose of LLW at Area G is limited; waste is accepted for disposal only under special circumstances and with prior authorization. In 2022, no LLW was disposed of in Area G (LANL 2024e).

Planning for the closure of Area G has been underway since 1992. EM-LA is working with the NMED Hazardous Waste Bureau under the Consent Order to develop and implement corrective measures for the SWMUs at Area G. Environmental monitoring at Area G currently includes (1) a direct radiation thermoluminescent dosimeter monitoring network; (2) an environmental air station monitoring network; (3) a groundwater monitoring network; and (4) periodic soil, vegetation, and small mammal sampling (LANL 2022h). In addition to Area G, LANL has a storage capacity of 100,000 cubic feet for LLW at Pad 480 at TA-55 (LANL 2023d).

Most radioactive liquid waste at LANL is conveyed through an underground pipeline system directly to the RLWTF at TA-50. The RLWTF is the largest structure in TA-50, with 40,000 square feet under roof. The RLWTF treats radioactive liquid waste generated by other LANL facilities and houses analytical laboratories to support waste treatment. Pipelines for liquid radioactive waste exist in TA-3, TA-35, TA-48, TA-50, TA-55, and TA-59.[36] Waste from generators not connected by the underground pipeline system is transferred by tanker truck to the RLWTF. Generators of small quantities of radioactive liquid waste collect their waste in containers, which are then trucked to TA-50.

The RLWTF consists of six primary structures:

- RLWTF building (TA-50-0001);
- Influent storage building for TRU radioactive liquid waste (TA-50-0066);
- A facility for the storage of secondary liquid waste (TA-50-0248);
- Waste Mitigation Risk Management Facility (TA-50-0250);
- Low-Level Waste Facility (TA-50-0230); and
- Transuranic Liquid Waste Facility (TA-50-0269).

Five of the six structures are listed as HC-3 Nuclear Facilities. The sixth structure, TA-50-0250, does not have a nuclear facility classification (LANL 2023a). TA-50-0250 has the capacity to store 300,000 gallons of low-level influent during an emergency such as a wildfire.

Liquid LLW is treated at the RLWTF in sequential steps to remove and reduce the radioactive components of the liquid waste stream. Neutralization, precipitation, filtration, ion exchange, and reverse osmosis are among the treatment steps that can be used, depending on individual waste-stream characteristics. The treated water from the RLWTF is either evaporated or released at permitted NPDES Outfall 051 (LANL 2022h). To meet discharge limits, tritium-contaminated liquid LLW is collected in storage tanks and, as needed, is pretreated on site by adjusting its acidity prior to transfer to TA-50 or TA-53 for further disposition. Resultant LLW sludges are packaged and sent off site for disposal.

During 2022, the RLWTF received over 315,056 gallons of radioactive waste influent. Almost 59,000 gallons of treated water was discharged to the environment via the effluent evaporator. Approximately 221,000 gallons of treated water was discharged to the NPDES outfall at Mortandad Canyon. Six waste transfers (approximately 208 gallons) were received from TA-55 (LANL 2024a).

As described in Appendix A, Section A.2.2.4.13.4, construction of a replacement RLWTF began in 2015. The project ended in 2018; however, the new facility will not be utilized until after implementation of post-project modifications (LANL 2023a).

<u>LLW Generation Rates</u>

LANL tracks its LLW generation as "Triad operational waste" from laboratory operations (i.e., research, production, maintenance, construction, and demolition) and "N3B waste" from legacy cleanup operations. Legacy cleanup operations include the DD&D of certain sites and facilities that were transferred to DOE-EM and formerly involved in weapons research and development and that require remediation under the 2016 Consent Order.

Table 4.11-2 presents a summary of the LLW volumes generated within LANL over the last six years. For comparison, Table 4.11-2 also shows the volume of operational and legacy cleanup LLW projected in the 2008 SWEIS.

[36] The pipelines in TA-53 move waste only within that TA (as part of LANSCE) and do not connect to or pump radioactive liquid waste to the RLWTF.

Table 4.11-2 Low-Level Radioactive Waste Generation at LANL, 2017–2022

LLW Split (m^3/yr)	2008 SWEIS Projection[a]	2017	2018	2019	2020	2021	2022	Average (2017–2022)
Laboratory Operations LLW	9,175	5,211	3,534	1,830	2,074	2,631	3,044	**3,054**
Legacy Cleanup LLW	19,674	114	0	203	1,745	1,664	2,658	**1,064**
TOTALS (actual)		**5,324**	**3,534**	**2,033**	**3,819**	**4,295**	**5,702**	**4,118**

LANL = Los Alamos National Laboratory; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; SWEIS = Site-Wide Environmental Impact Statement

a The projected laboratory operations annual LLW volumes are identified in Table 5-39 of the 2008 SWEIS; total (not annual) projections for legacy cleanup are identified in Table I-70 of the 2008 SWEIS (NNSA 2008b). Note: laboratory operations and legacy cleanup LLW containers are allowed to be co-mingled when stored and shipped.

Source: LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

4.11.2.2 Mixed Low-Level Waste

Overview of LANL MLLW Management

MLLW is waste that contains both LLW and hazardous waste as defined by the RCRA. Most of the operational MLLW is generated by the stockpile stewardship and research and development programs. Typical waste streams include contaminated lead shielding bricks and debris, spent chemical solutions, fluorescent light bulbs, copper solder joints, and used oil. Environmental remediation and DD&D activities also produce some MLLW.

MLLW is subject to the regulatory requirements for both hazardous waste and radioactive waste, and is managed at LANL in the same manner as described for hazardous waste (*see* Section 4.11.3) with the exception of modified storage time limits for certain wastes with no or limited offsite treatment options. The *Federal Facility Compliance Act* (P.L. 102-386) requires federal facilities that generate or store MLLW to submit a site treatment plan that includes a schedule for developing capacities and technologies to treat all MLLW. In October 1995, the State of New Mexico issued a Federal Facility Compliance Order to the Laboratory requiring a site treatment plan for MLLW. While identifying treatment and disposal options for the MLLW inventory, the Laboratory's site treatment plan allows the Laboratory to store accumulated MLLW at permitted storage units for more than one year, which is otherwise prohibited by the RCRA land disposal restrictions provision. The site treatment plan provides enforceable time periods in which the facility is required to treat or otherwise meet land disposal restriction requirements for the accumulated waste (LANL 2024e).

The Laboratory updates its site treatment plan every year. An annual report describes the amount of MLLW that has been stored at LANL under the plan provisions during the previous fiscal year (i.e., October 1 to September 30) and the amount shipped to approved TSD facilities. The Site Treatment Plan Report must be submitted to the NMED on March 31 each year (LANL 2024e). During the period 2020–2022, LANL did not transfer any MLLW waste to Area G for storage or disposal (LANL 2022e, 2022h, 2024e).

LANL is responsible for sending MLLW to appropriately permitted offsite commercial TSD facilities for treatment and disposal actions. Compliance status described in Section 4.11.3 for hazardous waste actions at LANL is also applicable to the management of mixed waste. LANL typically ships MLLW to facilities in Utah, Tennessee, Texas, and Washington (Table 4.11-3). In 2022, the Laboratory made 86 shipments of MLLW to five offsite TSD facilities (LANL 2024a).

Table 4.11-3 Offsite Facilities that Accepted LANL MLLW in 2022

Facility Name	Location	No. of Shipments
Energy*Solutions*	Utah	48
Diversified Scientific Solutions Inc.	Tennessee	7
Waste Control Specialists LLC	Texas	18
Perma-Fix Environmental Services	Florida	10
Perma-Fix Environmental Services	Washington	3
TOTAL		**86**

Source: LANL (2024a)

MLLW facilities are located at TAs-3, -50, -54, -55, -60, and -63. In 2018, Triad established a 90-day storage area, in accordance with its hazardous waste permit, at TA-60-0017 to store waste generated LANL-wide. This includes hazardous and MLLW. In December 2023, the Laboratory added the TA-60-0017 south building into the NMED-issued RCRA hazardous waste permit as a new waste management unit allowing storage of RCRA hazardous waste and MLLW on site for up to one year (LANL 2024c).

Some LLW and MLLW generated at LANL are difficult to handle, transport, and treat for disposal. These wastes are stored until an appropriate disposal path is identified. Difficult-to-treat waste streams include waste with high levels of tritium contamination, high-activity/high-dose waste from medical isotope production, targets from LANSCE beam operations, and waste with classified components or constituents. Disposal of these wastes is covered by previous NEPA documentation (NNSA 2018a).

<u>MLLW Generation Rates</u>

As with LLW, the Laboratory tracks its MLLW generation as "Triad operational waste" and "N3B waste" from legacy cleanup operations.

Table 4.11-4 presents a summary of the MLLW volumes generated within LANL over the last six years. For comparison, Table 4.11-4 also shows the volume of operational and legacy cleanup MLLW projected in the 2008 SWEIS.

Table 4.11-4 Mixed Low-Level Radioactive Waste Generation at LANL, 2017–2022

MLLW Split (m^3/yr)	2008 SWEIS Projection[a]	2017	2018	2019	2020	2021	2022	Average (2017–2022)
Laboratory Operations MLLW	100	245.3	62	63	53.3	137	150	118
Legacy Cleanup MLLW	13,620	0	0	2,065	4.3	120	147	389
TOTALS (actual)		245.3	62	2,128	57.6	257	297	507

LANL = Los Alamos National Laboratory; m^3/yr = cubic meters per year; MLLW = mixed low-level radioactive waste; SWEIS = Site-Wide Environmental Impact Statement

a The projected annual MLLW volumes for laboratory operations are identified in Table 5-39 of the 2008 SWEIS; total (not annual) projections for legacy cleanup MLLW are identified in Table I-70 of the 2008 SWEIS (NNSA 2008b). Note: Laboratory operations and legacy cleanup MLLW containers are allowed to be co-mingled when stored and shipped.

Source: LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

4.11.2.3 Transuranic Waste and Mixed Transuranic Waste

Overview of LANL Management of TRU Waste and MTRU Waste

TRU waste is radioactive waste that is not high-level radioactive waste; spent nuclear fuel; byproduct material (as defined in Section 11e.(2) of the *Atomic Energy Act of 1954*, as amended); or naturally occurring radioactive material (DOE Manual 435.1-1). TRU wastes contain manmade elements heavier than uranium on the periodic table (such as plutonium). MTRU waste contains TRU waste and hazardous waste as defined by RCRA. MTRU waste comprises a small fraction of the total TRU waste generated, so the following discussion includes both TRU and MTRU waste. LANL TRU waste is generated primarily in laboratory experiments, facility production, and component tests. The 2008 SWEIS and this SWEIS combine TRU and MTRU waste into one waste category because they are both managed for disposal as MTRU waste at the WIPP facility near Carlsbad, New Mexico. The Laboratory sends solid TRU and MTRU wastes off site to the WIPP facility when the waste meets WIPP's waste acceptance criteria. Some TRU and MTRU waste is stored at LANL while waiting for an acceptable disposal pathway to be identified. In 2017, the Laboratory began operating the TRU Waste Facility (Figure 4.11-1) at TA-63 that stages TRU waste for offsite shipment to WIPP. The TRU Waste Facility is a specialized mini-campus consisting of a 4,180-square-feet operations support building, six storage buildings, and a utility building, where TRU wastes can be safely and efficiently repackaged and prepared for shipping.

The TA-63 TRU Waste Facility permitted operating storage capacity is 105,875 gallons of waste in a variety of approved waste containers. In addition to the capabilities at the TRU Waste Facility, the Radioassay and Nondestructive Testing facility allows LANL to load TRU waste trucks in inclement weather, thereby increasing shipments to WIPP. Mobile loading capabilities are fully operational at TA-55 and the Radioassay and Nondestructive Testing facility, enabling TRU waste to be shipped to WIPP, weather and schedule permitting. In 2022, Triad made 67 shipments of TRU and MTRU waste to WIPP.

Figure 4.11-1 TRU Waste Facility at TA-63

Legacy TRU waste is stored in containers in Area G. The TRU waste containers are stored in domes equipped with fire detection and air monitoring systems. The containers are routinely monitored and inspected. Mobile loading capabilities are also fully operational at Area G, enabling TRU waste to be shipped to WIPP, weather and schedule permitting. TRU waste containers destined for WIPP—such as drums, standard waste boxes, and 10-drum overpacks—secured inside robust shipping casks meet strict U.S. Nuclear Regulatory Commission (NRC) requirements and testing under extreme conditions. In 2022, N3B made 64 shipments of legacy TRU waste to WIPP. The shipments included more than 470 cubic meters of TRU waste (LANL 2024e). Approximately 67 shipments to WIPP were made from October 2020 through April 2023. After April 2023, approximately 500 shipments would be made to WIPP, which should enable N3B to complete the Area G TRU waste shipping campaign in approximately 2028. In 2020 and 2021, the Laboratory did not transfer any TRU waste or MTRU waste to Area G for storage (LANL 2022h, 2023a, 2024e).

TRU Waste Generation Rates

As with LLW, the Laboratory tracks its TRU and MTRU waste generation as "Triad operational waste" from laboratory operations and "N3B waste" from legacy cleanup operations.

Table 4.11-5 presents a summary of the TRU waste volumes generated within LANL over the last six years. For comparison, Table 4.11-5 also shows the volume of operational and N3B TRU/MTRU projected in the 2008 SWEIS.

Table 4.11-5 Transuranic Waste (including MTRU) Waste Generation at LANL, 2017–2022

TRU Waste Split (m^3/yr)	2008 SWEIS Projection[a]	2017	2018	2019	2020	2021	2022	Average (2017–2022)
Laboratory operations TRU waste	100	243.5	149	121	149.4	279	661	**267**
Legacy cleanup TRU waste	13,620	0	0	0	422	0	151	**96**
TOTALS (actual)		**243.5**	**149**	**121**	**571.4**	**279**	**812**	**363**

LANL = Los Alamos National Laboratory; m^3/yr = cubic meters per year; SWEIS = Site-Wide Environmental Impact Statement; TRU = transuranic

a The projected annual TRU waste volumes for Laboratory operations are identified in Table 5-39 of the 2008 SWEIS; total (not annual) projections for legacy cleanup are identified in Table I-70 of the 2008 SWEIS (NNSA 2008b). Note: Laboratory operations and legacy cleanup TRU containers waste are allowed to be co-mingled when stored and shipped.

Source: LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

4.11.3 Hazardous Waste

LANL performs a broad range of research activities that can generate a variety of waste, including hazardous waste. Commonly generated hazardous waste includes many types of research chemicals, solvents, acids, bases, carcinogens, compressed gases, metals, and other solid waste contaminated with hazardous material. Hazardous waste may include equipment, containers, structures, and other items intended for disposal that are considered hazardous (e.g., compressed gas cylinders, contaminated cleanup materials or protective gear). Some waste waters that cannot be sent to the SWWS Plant or to the HE wastewater treatment plant may also qualify as hazardous waste (LANL 2021e). The nature of the LANL mission is also such that research activities often change over time, either by small amounts or in their entirety, and the wastes produced can likewise change. As a result, the Laboratory's approach to managing hazardous waste is designed to accommodate a wide variety of waste generators and waste types. This is also reflected in LANL's hazardous waste permits with NMED.

Overview of LANL Hazardous Waste Management

After material is declared a hazardous waste, the waste is characterized, labeled, and collected in appropriate storage areas. Many hazardous wastes are accumulated for up to 90 days at consolidated storage facilities. The waste is ultimately shipped to offsite RCRA-permitted hazardous waste TSD facilities for final treatment or disposal. Some hazardous wastes can be recycled. These include aerosol cans, light bulbs, batteries, mercury, and ferric chloride solution (LANL 2021e).

The Laboratory collects and maintains data on each of the containers it accepts in a waste management database. This information is used to track wastes from cradle to grave and includes the following elements:

- waste generation process and location;
- physical characteristics (e.g., waste volume and weight, container type and volume);
- characterization information:
  - chemical constituents (for hazardous wastes);
  - radiological constituents (for radioactive wastes); and
- any other information required for safe storage of the waste.

RCRA regulates wastes from generation to disposal. Hazardous wastes include all solid wastes that are (1) listed as hazardous by the EPA (listed wastes) or (2) ignitable, corrosive, reactive, or toxic (characteristic wastes). Mixed radioactive waste (also called mixed waste) is listed or characteristic hazardous waste commingled with radioactive waste. Under RCRA, facilities that treat, store, or dispose of hazardous wastes, including mixed radioactive wastes, must obtain a permit from their regulatory authority (LANL 2024e).

The State of New Mexico is authorized by the EPA to administer its hazardous waste management program and issue and enforce hazardous waste facility permits. On November 8, 1989, NMED issued the first LANL Hazardous Waste Facility Permit for the storage and treatment of hazardous and mixed radioactive waste at LANL. The permit includes requirements that allow for the storage and sometimes treatment of hazardous and mixed radioactive wastes at 27 separate hazardous waste management units (sites) at LANL. It also contains requirements for waste management, sampling, reporting, inspection, training; waste minimization, preparedness, and prevention; and emergencies and contingency planning. In addition, the permit also requires the Laboratory to post certain information for public review in an electronic information repository (i.e., online public reading room). The permit is issued to the DOE, Triad, and N3B. On June 29, 2020, the Laboratory submitted an application to NMED to renew and modify the 2010 LANL Hazardous Waste Facility Permit. The 2010 Permit has been administratively continued pending issuance of the renewed Permit (LANL 2024e).

The LANL Hazardous Waste Facility Permit requires that the Laboratory provide advance written notice to NMED of any changes to any permitted unit or activity that may result in noncompliance with the permit. Further, the permit requires verbal and written reports of the discovery of any noncompliance that may endanger human health or the environment. Instances of permit noncompliance that do not threaten human health or the environment, such as an exceedance of a storage holding time, are compiled and reported annually to the NMED. The Laboratory submitted its 2022 noncompliance report to the NMED in accordance with permit requirements. NMED conducted its annual compliance inspection for the Laboratory's permit from November 14–17,

2022. As of December 2023, NMED had not issued its Compliance Evaluation Inspection Report and Findings for the 2022 annual compliance inspections (LANL 2024e).

The *Toxic Substances Control Act* (TSCA) addresses the production, import, use, and disposal of specific chemicals, including PCBs and ACM. The Laboratory is responsible for recordkeeping and reporting the import or export of small quantities of chemicals used for LANL research activities and the disposal of PCB-containing substances. PCB-containing substances include dielectric fluids, solvents, oils, waste oils, heat-transfer fluids, hydraulic fluids, slurries, soil, and materials contaminated by spills (LANL 2024e).

Laboratory staff conducted 25 TSCA reviews for regulated chemicals imported or exported by the Laboratory's Property Management Group Customs Office in 2022. These reviews ensure that the regulated chemicals follow TSCA requirements before being imported in or exported out of the country. These shipments were all properly categorized, and the chemical compound samples were sent to collaborative researchers in other countries (LANL 2024e).

LANL also generates and manages HE-contaminated liquid waste. The HEWTF, located in TA-16, treats process waters containing HE compounds, using three treatment technologies. Sand filtration is used to remove particulate HE, activated carbon is used to remove organic compounds and dissolved HE, and ion exchange units are used to remove perchlorate and barium. The HEWTF receives some wastewaters by truck from processing facilities located outside TA-16. In 2022, HE processing and HE laboratory operations generated approximately 5,238 gallons of explosives-contaminated water, which was treated at the HEWTF. All HE burning operations are conducted at TA-16-0388. Approximately 3,676 pounds of water-saturated HE and 97 pounds of HE-contaminated scrap metal were treated annually. No explosives-contaminated solvents were treated. Approximately 4,424 gallons of propane were expended annually to treat these materials. Non-detonable, explosives-contaminated equipment was steam cleaned in TA-16-0260 and salvaged or sent for recycling (LANL 2024a).

Waste containing PCBs, including transformers and objects contaminated with at least 50 parts per million PCBs, were sent to EPA-authorized treatment and disposal facilities. In 2021, LANL disposed of approximately 418 pounds of PCB wastes (LANL 2024e).

LANL sends hazardous waste to a variety of offsite commercial TSD facilities. In 2022, LANL made 243 shipments of hazardous waste to a variety of commercial offsite facilities (Table 4.11-6).

Table 4.11-6 Offsite Facilities that Accepted LANL Hazardous Waste in 2021

Facility Name	Location	# of Shipments
Veolia	Colorado	47
Waste Management	New Mexico	44
Mesa Oil	New Mexico	38
U.S. Ecology	Nevada	31
Clean Harbors	Colorado	27
Waste Management (Colorado Springs)	Colorado	19
Solid Waste Disposal	New Mexico	13
Los Alamos County Government Landfill Operations	New Mexico	11
Medical Systems of Denver, Inc.	Colorado	5

Facility Name	Location	# of Shipments
Lightning Resources	Texas	2
National Nuclear Security Site	Nevada	2
Veolia	Utah	1
Veolia	Arizona	1
Veolia	Illinois	1
Liquid Environmental Solutions	Arizona	1
TOTAL		**243**

Source: LANL (2024a)

Hazardous Waste Generation Rates

As with radioactive wastes, LANL tracks its hazardous waste generation as "Triad operational waste" from Laboratory operations and "N3B waste" from legacy cleanup operations.

Table 4.11-7 presents a summary of the hazardous waste volumes generated within LANL over the last six years. For comparison, Table 4.11-7 also shows the volume of operational and legacy cleanup hazardous waste projected in the 2008 SWEIS.

Table 4.11-7 Hazardous Waste Generation at LANL, 2017–2022

Hazardous Waste Split (kg/yr)	2008 SWEIS Projection[a]	2017	2018	2019	2020	2021	2022	Average (2017–2022)
Laboratory operations hazardous waste	1,246	4,083	1,587	2,330	1,480	1,386	1,616	2,080
Legacy cleanup hazardous waste	2,064	27	113	<1	1,477	<1	3	270
TOTALS	**3,250**	**4,110**	**1,700**	**2,330**	**2,957**	**1,386**	**1,619**	**2,350**

kg/yr = kilograms per year; LANL = Los Alamos National Laboratory; SWEIS = Site-Wide Environmental Impact Statement

a The 2008 SWEIS baseline annual hazardous waste volumes for Laboratory operations and legacy cleanup are presented in the 2015–2016 Yearbook (LANL 2018b). Note: Laboratory operations and legacy cleanup hazardous waste containers are allowed to be co-mingled when shipped.

Source: LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

4.11.4 New Mexico Special Waste

New Mexico Special Waste (NMSW) is a nonhazardous solid waste that has unique handling, transportation, and/or disposal requirements to assure protection of the environment and the public health, welfare, and safety. NMSW includes treated formerly characteristic hazardous waste, asbestos waste, ash, infectious waste, sludge, industrial solid waste, spill of a commercial chemical product, dry chemicals that become characteristic hazardous waste when wetted, and petroleum-contaminated soil.

LANL generates NMSW in various facilities and processes. The largest quantities of NMSW generated at LANL are the filter cakes from treating the effluent of the TA-46 SWWS for cooling-tower makeup water. This filter cake is a solid material consisting principally of magnesium silicates and iron oxy-hydroxides, along with other minor chemically co-precipitated constituents, associated with the filtration process of the SERF. In 2021, these filter cakes were disposed of at the Waste Management (Midway Landfill) in Colorado. Table 4.11-8 shows quantities of SERF filter cake and other NMSW generated over the past five years.

Waste containing asbestos is also considered NMSW and is deposited at any of several waste disposal sites operated in accordance with 40 CFR 61.154. In 2021, LANL disposed of 199 cubic meters of asbestos wastes (LANL 2024e).

Table 4.11-8 Quantities of SERF Filter Cake and NMSW Generated, 2017–2021

Calendar Year	Quantity of SERF Filter Cake (pounds)	Total Quantity of NMSW (pounds)
2017	1,871,000	2,028,000
2018	1,912,000	2,014,000
2019	946,000	1,166,000
2020	1,087,000	2,228,000
2021	1,167,000	1,804,000
Averages	**1,396,600 (633 metric tons)**	**1,848,000 (838 metric tons)**

NMSW = New Mexico Special Waste; SERF = Sanitary Effluent Reclamation Facility

4.11.5 Municipal Solid Waste and Construction/Demolition Waste

LANL uses several different approaches to manage waste materials that are not radioactive or hazardous. First, LANL has an active Pollution Prevention Program that includes efforts to evaluate materials used on site to determine if there are alternatives that generate less waste or waste that is easier to manage or that involves fewer adverse impacts. Programs have also been established to recycle, often for reuse, items such as computers, monitors, laptops, tablets, batteries, and cell phones. Onsite food services promote the use of compostable products and provide means for employees to support material separation. Several other categories of waste materials are segregated and diverted from landfill disposal, with paper and cardboard, metals, and green waste (e.g., chips, compost, mulch, and clean wood) as larger-quantity contributors. LANL's stated goal is to reduce at least 50 percent of nonhazardous solid waste, excluding construction and demolition debris, that is sent to treatment and disposal facilities (LANL 2021f). As shown on Figure 4.11-2 (LANL 202, in recent years, LANL has diverted 18 to 52 percent of nonhazardous solid waste.

Waste materials not diverted for reuse or recycling are collected through a normal trash collection system operated by Laboratory personnel. Filled garbage trucks take the waste to offsite commercial landfills that have the appropriate permits to receive the waste. Waste not amenable to recovery is sent through the facility's transfer station to another facility with disposal capabilities.

In the past, solid waste generated at LANL was disposed of at the Los Alamos County Landfill, located within LANL boundaries at TA-61 but operated by Los Alamos County. That landfill is now closed and capped. Today, the Laboratory sends solid waste to the Los Alamos County Eco Station for transfer to municipal landfills. Los Alamos County operates this transfer station and is responsible to the State of New Mexico for obtaining all related permits for these activities. In 2022, LANL sent approximately 1,750 tons of waste to the Eco Station (LANL 2024e).

Source: LANL (2022m)

Figure 4.11-2 Waste Recycling at LANL (2017–2021)

Construction and demolition debris is regulated as a separate category of solid waste under the New Mexico Solid Waste Regulations. Construction and demolition debris is not hazardous and may be disposed of in a municipal landfill or a construction and demolition debris landfill (20.9.1 NMAC). Construction and demolition waste typically consists of soils, broken-up concrete, scrap metals, and various building material waste or rubble. The Laboratory segregates and tracks construction and demolition waste, and, as described above, LANL has implemented actions to reuse or recycle these materials when feasible rather than send them for landfill disposal. Scrap metals are sent for recycling; soils are reused on site or arrangements are made for the landfill to use it as cover; and broken-up concrete is used at the landfill for roads, pads, or cover. As shown on Figure 4.11-2 and summarized in Table 4.11-9, LANL has recycled up to 45 percent of its construction and demolition waste between 2017 and 2021.

Table 4.11-9 Construction/Demolition Debris at LANL, 2017–2022[a]

Year	Waste Volumes (cubic meters)				
	Construction Demolition Debris[a]	Asbestos	Universal Waste	Recyclable Metal	Recyclable Asphalt/ Concrete
2017	494	61	1	953	345
2018	386	183	6	1,348	2,978
2019	2,532	19	1	195	169
2020	0	0	0	<1	0
2021	7,015	148	0	395	1,147
2022	2,450	56	0	234	429
Averages	**2,146**	**78**	**1.3**	**521**	**845**

a For waste volumes that are tracked in tons, cubic meters volume was calculated using the conversion factors as identified in the Volume-to-Weight Conversion Factors, EPA Office of Resource Conservation and Recovery (EPA 2016).

Source: LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

4.11.6 Sanitary Waste

The Laboratory treats liquid sanitary waste on site at the Sanitary Wastewater Treatment Plant, located at TA-46. Treated water is reused in LANL cooling towers and is ultimately released at permitted Outfall 001. In 2021, LANL treated over 806,000 gallons of liquid sanitary waste (LANL 2022h). Section 4.10.4 of this SWEIS presents additional information on the sanitary waste infrastructure at LANL.

On March 24, 2014, the NMED Solid Waste Bureau approved LANL's application to operate a facility to compost solid wastes produced by the Laboratory's SWWS Plant. The goal of this project is to eliminate the transport of sewage biosolids off site for landfill disposal. Full-scale operations at the TA-46 SWWS Compost Facility began in late 2014. On April 18, 2018, the NMED approved a registration renewal. The compost is intended for land application at LANL for beneficial use, including landscaping, post-construction remediation, and range land restoration. Before compost can be land-applied, it must meet pollutant concentration limits, Class A pathogen requirements, and EPA vector attraction reduction requirements as specified at 40 CFR Part 503. In 2021, the Sanitary Wastewater System Compost Facility produced about 41 tons of composted biosolids (LANL 2024e).

On May 17, 2023, the NMED issued Discharge Permit DP-1589 to the Laboratory for discharges from six septic tank disposal systems (i.e., a combined septic tank and leach field). These septic systems are located in remote areas of LANL where access to the SWWS Plant's collection system is not practicable.

Discharge Permit DP-857 applies to combined effluent discharges from the TA-46 SWWS Plant, the SERF, and the Sigma Mesa evaporation basins. The permit conditions require quarterly, semiannual, and annual sampling of the Sanitary Wastewater System Plant's treated water; effluent from Outfalls 001, 03A027, and 13S; and alluvial groundwater well SCA-3 in Sandia Canyon (LANL 2022h). The DP-857 permit expired in December of 2021 and is administratively continued. NMED conducted a site inspection in support of the permit renewal process in March 2022. NMED inspectors did not identify any major issues during the site inspection (LANL 2024e).

4.12 Transportation

This section presents the primary methods and routes used to transport Laboratory-affiliated employees, commercial shipments, hazardous and radioactive material shipments, transportation packaging, transportation accidents, and onsite/offsite traffic volumes. In addition, the section presents a description of the Laboratory's transportation infrastructure, including its onsite parking and roadway configurations.

4.12.1 Regional and Site Transportation Routes

The primary means of transportation to LANL is via motor vehicle. The nearest commercial bus terminal is in the city of Santa Fe, approximately 35 miles driving distance from LANL. The nearest commercial rail connection is in Lamy, New Mexico, 52 miles southeast of LANL; however, the New Mexico Rail Runner Express is a widely utilized rail line/system that commuting LANL employees may use which provides a direct rail-based connection between Albuquerque and Santa Fe. Moreover, there is a rail spur into central Santa Fe used by the Santa Fe Southern Railway. The Laboratory does not currently use rail for any commercial shipping.

Commuters use park-and-ride service provided by a commercial corporation in conjunction with the New Mexico Department of Transportation (NMDOT). There are numerous daily departures between Santa Fe and Española, Santa Fe and Los Alamos, and Española and Los Alamos. Monthly passes are available for unlimited use of most park-and-ride services. Typical weekday ridership options for the two park- and-ride routes directly serving Los Alamos include the Purple Route (Santa Fe–Los Alamos) and the Green Route (Española–Los Alamos), together typically serving approximately 500 riders daily (All Aboard America 2022; NMDOT 2022a).

The primary commercial international airport in New Mexico is located in Albuquerque. There are two smaller airports in the Los Alamos vicinity. The Los Alamos County Airport is owned and operated by the County of Los Alamos. The airport parallels East Road at the southern edge of the Los Alamos community. The airport has one runway running east to west at an elevation of 7,150 feet. Takeoffs are predominantly from west to east, and all landings are from east to west. The airport was historically owned by the Federal Government from its inception until October 2008, when it was officially transferred to county ownership and categorized as a public-use facility. The Santa Fe Municipal Airport is located about 20 miles southeast of LANL. This airport has three runway strips at an elevation of 6,350 feet.

Northern New Mexico is bisected by Interstate (I)-25 in a generally northeast-to-southwest direction. This interstate highway connects Santa Fe with Albuquerque. Figure 1.2-1 (in Chapter 1) and Figure 4.12-1 show the regional highway system and major roads within the LANL vicinity. Regional transportation routes connecting LANL with Albuquerque and Santa Fe are I-25 to U.S. Route 84/285 to NM-502; LANL with Española, NM-30 to NM-502; and LANL with Jemez Springs and western communities, NM-4. Hazardous and radioactive material shipments primarily leave or enter LANL from East Jemez Road to NM-4 to NM-502. East Jemez Road, as designated by the State of New Mexico and governed by 49 CFR 177.804, is the primary route for the transportation of hazardous and radioactive materials. Table 4.12-1 summarizes ADT rates at LANL's main access points based on recent legacy traffic flow information.

Two major roads, NM-502 and NM-4, access Los Alamos County; Los Alamos County traffic volume on these two segments of highway is primarily associated with Laboratory activities. Of note, the completion of a recent major construction project at the intersection of the two roads in March 2024 has helped further facilitate/ease the migration of Laboratory traffic through the area. Most commuter traffic originates from Los Alamos County or east of Los Alamos County (Rio Grande Valley and Santa Fe), as the majority of Laboratory employees live in these areas (*see* Table 4.9-1 in Section 4.9). A small number of Laboratory employees commute to LANL from the west along NM-4. Table 4.12-2 summarizes NMDOT average weekday traffic volume counts at various points along NM-502 and NM-4. This information is consistent with traffic data presented in the recent SPDP Final EIS (NNSA 2024a).

The nearest Interstate highway is I-25 located in Santa Fe, approximately 39 miles by road via NM-502 (east) and US-84 (south).

Pajarito Road is a principal roadway on LANL used for accessing TA-55 and other major site areas. During CY 2019, the estimated annual ADT for weekday trips anywhere along the length of Pajarito Road between NM-4/White Rock and Diamond Drive was 8,780. This value was estimated based on the average staff counts for facilities accessed via Pajarito Road, assumptions about transit and carpooling use, and making a single roundtrip (two trips) using this route each weekday.

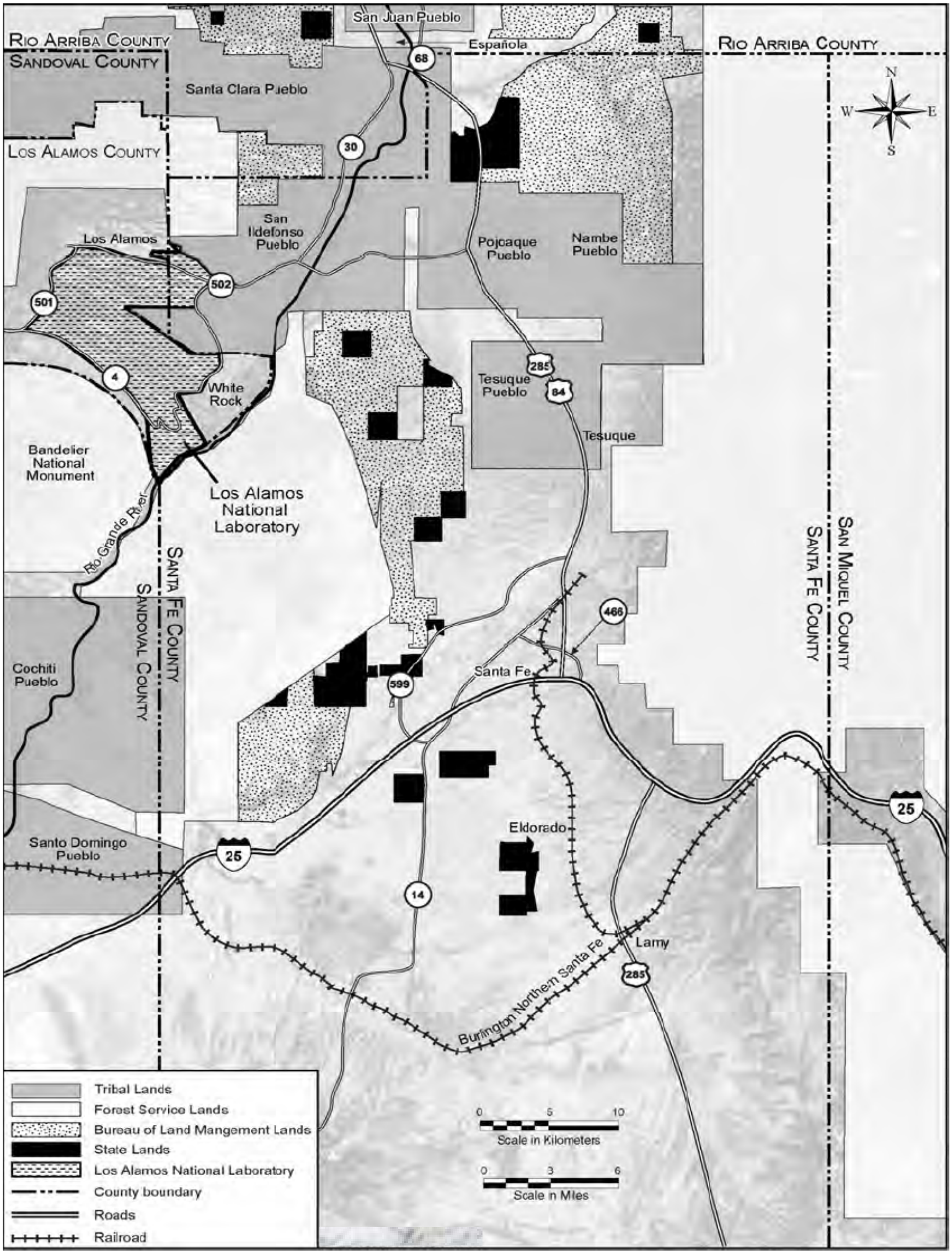

Figure 4.12-1 LANL Vicinity Regional Highway System and State Roads

Table 4.12-1 Annual Average Daily Traffic for Principal LANL Access Routes

Access Route	AADT 2009[a]	AADT 2017[b]	2009–2017 & Change	2017 % Trucks[a]	LOS[a]
SR-4 at Los Alamos County Line to SR-501	734	492[c]	-33	12	A
SR-4 at Bandelier Park Entrance	681	2,126	212	13	A
SR-4 at Junction of Pajarito Road–White Rock	9,302	10,652	15	5	D
SR-4 at Jemez Road	9,358	11,931	27	13	D
SR-501 at Junction of SR-4 and Diamond Drive	11,848	1,943[c]	-84	13	D
SR-501 at Junction of Diamond Drive	21,211	8,265[c]	-61	13	C
SR-501 at SR-502	11,407[c]	7,961[c]	-30	14	C
SR-502 at Oppenheimer Street	2,671[c]	2,755[c]	3	€	C
SR-502 at Los Alamos/Santa Fe County Line	12,256	12,017	-2	7	A
Pajarito Road between SR-4 and Diamond Drive (2019 data)	N/A	8,780[d]	N/A	N/A	N/A

AADT = annual average daily traffic; LOS = level of service (*see* definitions on the following page); N/A = not available; SR = State Route

a NNSA (2023a).

b NMDOT (2018).

c Years 2009 and 2017 counts at these locations were recently revised downward due to the updated NMDOT AADT traffic model.

d LANL (2023d).

e Newly derived value pending in NMDOT database per model update.

Table 4.12-2 Average Weekday Traffic Volumes in the Vicinity of NM-502 and NM-4, CY 2021

Location	Average Daily Vehicle Trip Count
Eastbound on NM-502, east of the NM-502 / NM-4 intersection	9,242
Westbound on NM-502, east of the NM-502 / NM-4 intersection	8,792
Eastbound on NM-502, west of the NM-502 / NM-4 intersection	5,336
Westbound on NM-502, west of the NM-502 / NM-4 intersection	5,033
Westbound on NM-4 between E. Jemez Road and NM-502/4	5,447
Eastbound on NM-4 between E. Jemez Road and NM-502/4	5,524
Transition road from northbound NM-4 to eastbound NM-502	3,775
Transition road from eastbound NM-502 to southbound NM-4	1,031

NM = New Mexico State Road (as in NM-4)

Source: NMDOT (2021)

As discussed above, LANL is accessible only by road; there is no rail or water access to the site. The site is bounded by NM-4 to the south and east, NM-501 (West Jemez Road) to the northeast, and NM-502 to the north. Approximately 83 miles of paved roads have been developed on the site.

The primary route designated by the State of New Mexico to be used for radioactive and other hazardous material shipments to and from LANL is the approximately 40-mile corridor between LANL and I-25 at Santa Fe. This route passes through the Pueblos of San Ildefonso, Pojoaque, Nambe, and Tesuque and is adjacent to the northern segment of Bandelier National Monument (*see* Figure 4.12-1). This primary transportation route uses NM-599, which bypasses the city of Santa Fe on the way to I-25.

Road usage performance/efficiency is measured via LOS ratings. LOS ratings range from "A" to "F," with "A" being the best travel conditions and "F" being the worst. Transportation planners typically aim for a LOS of "C." At LOS C, roads are below but close to capacity, and traffic generally flows at the posted speed. Traffic on arterial roadway segments is generally described by assigning LOS categories that reflect peak-hour traffic conditions, as defined below:

- **LOS A** describes the highest quality of traffic service, when motorists are consistently able to travel at their desired speed. Most drivers find operating a vehicle on a LOS A roadway to be stress free.
- **LOS B** describes a condition in which drivers have some restrictions on their speed of travel. Most drivers find operating a vehicle on a LOS B roadway slightly stressful.
- **LOS C** describes a condition of stable traffic flow that has significant restrictions on the ability of motorists to travel at their desired speed. Most drivers find operating a vehicle on a LOS C roadway somewhat stressful.
- **LOS D** describes unstable traffic flow. Drivers are restricted in slow-moving platoons and disruptions in the traffic flow can cause significant congestion. There is little or no opportunity to pass slower-moving traffic. Most drivers find operating a vehicle on a LOS D roadway stressful.
- **LOS E** represents the highest volume of traffic that can move on the roadway without a complete shutdown. Most drivers find operating a vehicle on a LOS E roadway very stressful.
- **LOS F** represents heavily congested flow, with traffic demand exceeding capacity. Traffic flows are slow and discontinuous. Most drivers find operating a vehicle on a LOS F roadway extremely stressful.

The Laboratory began preparing a transit implementation study during FY 2022 with a goal to improve commuting options to LANL. While no recent LOS ratings are available for LANL site roadways or for principal public routes accessing the site, given the modest-to-heavy traffic volumes presented above in Table 4.12-2 for critical roadways close to the site, a rating of LOS "C" and/or "D" in most cases is likely applicable for LANL's surrounding thoroughfares, especially during peak-travel (i.e., rush-hour) periods. Traffic metrics have been estimated for CY 2021 for Pajarito Road, within the LANL site, using employee counts for the TA's accessed using that route. Pajarito Road provides the site's primary vehicular access to TA-55, where many DOE/NNSA project activities considered in this SWEIS are or would be occurring. Recent traffic data for other principal routes into Los Alamos County (and LANL) were obtained from the NMDOT, as summarized above in Tables 4.12-2 and 4.12-3. Workers also commute to/from LANL using local public transit buses and via bicycle.

At present, the Laboratory maintains a metrics program to gauge the status and use of important LANL site transportation mechanisms that include the following aspects: public transit ridership, LANL taxi ridership, on-time performance, bus purchases, bus seating capacity, bus capacity per the *American with Disabilities Act*, parking lot capacity, parking permits issued for high-occupancy vehicles, number of vanpools, number of carpools, number of passengers per carpool/vanpool, vehicle miles traveled reduced, GHG emissions reduced, miles of bike lanes available, miles of bike lanes added, miles of paved roads, miles of paved roads added, bike rack and bike locker capacity, bike rack and bike locker usage, electric-bike use, incentives implemented, incentives used, and employee satisfaction (LANL 2022k).

The Laboratory has piloted a telework program and expanded bus options to reduce emissions from commuting. This has been primarily accomplished through the successful implementation of a sitewide transportation plan that has promoted various teleworking options for employees, as well as the continued installation of additional onsite electric-vehicle charging stations (LANL 2022k).

4.12.2 LANL Electric-Vehicle Fleet and Supporting Infrastructure

The FY 2022 LANL fleet profile was as follows:

- 858 light-duty vehicles of which 56 are zero-emission vehicles,
- 544 medium-duty vehicles of which none are zero-emission vehicles, and
- 115 high-duty vehicles of which none are zero-emission vehicles.

In accordance with NNSA's *Five-Year Electric Vehicle Infrastructure Plan*, LANL's electric-vehicle goals are as follows and summarized in Table 4.12-3 (LANL 2023c):

> *"All fleet replacements or new acquisitions of light duty (LD) vehicles should be zero-emission-vehicles (ZEVs) with the goal of having all (100%) such replacements be strictly ZEV by 2027. All remaining vehicle types (medium duty, heavy duty, or special use) will have a target of replacements or new acquisitions to be ZEV whenever possible with the goal of having all (100%) such replacements be strictly ZEV by 2035. Replacements will be based on retirement of existing vehicles for age, mileage, repair status, expiration of GSA lease, or any combination of these conditions."*

Table 4.12-3 LANL Zero-Emission Vehicle Acquisition Plans by Fiscal Year, 2023–2027

Vehicle Type	FY 2023	FY 2024	FY 2025	FY 2026	FY 2027
Light Duty	208	83	139	37	125
Medium Duty	TBD	TBD	TBD	TBD	TBD
High Duty	TBD	TBD	TBD	TBD	TBD

FY = fiscal year; TBD = to be determined
Source: LANL (2024g)

Acquisitions of light-duty zero-electric vehicles for the period FY 2023–2027 are anticipated to total 592 vehicles; some replacements will be for vehicles less than seven years old (LANL 2023c). Support of the planned additional 208 light-duty ZEVs by the end of FY 2023 requires ongoing infrastructure changes. Accordingly, TA priority will be dictated by need. Table 4.12-4 summarizes the initial location of the 208 light-duty zero-emission vehicle replacements.

Table 4.12-4 Initial Distribution of Light-Duty Zero-Emission Vehicles

Technical Area	Number of Light-Duty Zero-Emission Vehicles
TA-3	103
TA-16	23
TA-0	19
TA-53	12
TA-64	10
TA-60	9
TA-55	7
TA-46	6
The remaining 19 will be located throughout LANL next to buildings or in parking lot hubs.	

Source: LANL (2024g)

The Laboratory has budgeted for installation of approximately 15 additional commercial charging stations (30 ports) (or equivalents) for FY 2023 to accommodate the planned 208 additional light-duty zero-emission vehicles. The Laboratory is expecting to install 10 additional charging stations in FY 2023 as funding permits (LANL 2023c).

4.12.3 Onsite Parking

As of CY 2019, there were approximately 7,350 parking stalls at LANL designated as available to serve approximately 15,000 employees (i.e., Laboratory employees, contract employees, DOE personnel, visitors with LANL offices, and others, not including construction workers and consultants with sporadic presence). These stalls are provided throughout numerous designated institutional parking lots and structures distributed across the site and were placed with a goal of minimizing walking distances from vehicles to work locations to the greatest extent practicable. Very few parking lots have a surplus of stalls, with many exhibiting a notable deficit (LANL 2022k). In response to this concern, the Laboratory has recently completed new, multi-level parking garages in TA-3 and TA-50, providing an additional 900 total parking stalls (450 in each garage). The garages also feature *smart-parking* indicators that show open stalls via overhead green/red lighting, as well as numerous electric-vehicle charging stations.

4.12.4 Traffic Accident Historical Data

Table 4.12-5 lists historical data related to motor vehicle accidents in Los Alamos County and nearby counties. In 2019 (the most recent NMDOT data), there were more than 4,300 motor vehicle accidents in Los Alamos, Rio Arriba, and Santa Fe counties, resulting in 28 total fatalities. When accidents are considered per 100 million vehicle miles traveled, travel in Santa Fe County was the most dangerous in the transportation ROI during 2019, although Rio Arriba County had the highest fatality rate. Since the 2008 SWEIS was issued, there have been several serious traffic accidents on or near LANL. Four very recent severe incidents (not reflected in the historical summary tables below for 2015–2019) include two multi-vehicle collisions (including two fatalities) in 2024, a vehicle collision with a bicyclist in 2022, and a head-on collision fatality event in 2021 (O'Neill 2022; Clark 2021, 2024).

Table 4.12-5 New Mexico Traffic Accidents in Los Alamos and Nearby Counties, 2019

County	Total Accidents	Crash Rate[a]	Fatalities	Death Rate[b]
Los Alamos	136	86	1	0.63
Rio Arriba	804	174	12	2.59
Santa Fe	3,406	180	15	0.84
New Mexico (state)	48,124	173	425	1.53

a Crash rate represents crashes per 100-million vehicle miles traveled.
b Death rate represents deaths per 100-million vehicle miles traveled.
Source: NMDOT (2022b)

Table 4.12-6 summarizes the accident history for Los Alamos County for 2015–2019. As shown in the table, the crash and death rates in the county were significantly lower than New Mexico state averages during this period. Adding together the single fatal accident that occurred in 2019 (noted in the table) along with the fatal head-on fatality in 2021 discussed above, a total of two fatal crash incidents have occurred in Los Alamos County during the inclusive seven-year span 2015–2021.

Table 4.12-6 Los Alamos County Traffic Accidents, 2015–2019

Year	Total Accidents	Crash Rate[a]	Fatalities	Death Rate[b]
2015	125	79	0	0
2016	125	79	0	0
2017	135	85	0	0
2018	149	94	0	0
2019	136	86	1	0.63
County Average 2015–2019	134	85	0.2 (0)	0.13
State Average 2015–2019	46,239	164	380	1.36

a Crash rate measures crashes per 100-million vehicle miles traveled.
b Death rate measures deaths per 100-million vehicle miles traveled.
Source: NMDOT (2022b)

4.12.5 Los Alamos National Laboratory Shipments

Hazardous, radioactive, industrial, commercial, and recyclable materials, including wastes, are transported to, from, and on LANL during routine operations. Hazardous materials include nonradioactive commercial chemical products that are regulated and controlled based on whether they are listed materials or if they exhibit the hazardous characteristics of ignitability, toxicity, corrosivity, or reactivity. Radioactive materials include SNM (e.g., plutonium, enriched uranium), medical radioisotopes, and other miscellaneous radioactive materials. Offsite shipments, both to and from LANL, are carried out by commercial carriers (including standard commercial truck, air-freight, and DOE secure tractor-trailer). Numerous regulations and requirements govern the transportation of hazardous and radioactive materials, including those of the USDOT, NRC, DOE, Federal Aviation Administration, International Air Transport Association, and LANL.

4.12.5.1 Onsite Shipments

Onsite hazardous and radioactive material shipments are transported in conformance with USDOT regulations. A shipment is considered an onsite shipment if both the origin and destination are at LANL. These shipments are transported in a variety of Laboratory-operated vehicles depending on the quantity and radioactivity of the material shipped and range from Laboratory-owned pick-up trucks to DOE-owned safe-secure trailers. Maintenance of these vehicles is closely monitored for physical performance as well as security.

Hazardous material shipments vary from bulk gases and liquids to small quantities of laboratory chemicals. Hazardous waste shipments are generally made to the hazardous waste storage facility at TA-60 or directly to an offsite TSD facility. Radioactive and mixed waste shipments (including TRU, MTRU, LLW, and MLLW) are generally made to the waste management area (Area G) within TA-54, as well as to TA-63 (TRU and MTRU only). The overall capacity to dispose of LLW at Area G is limited; such wastes are accepted for disposal only under special circumstances and with prior authorization. In 2020, the Laboratory did not transfer any LLW or TRU wastes to Area G for storage or disposal; however, in 2021, the Laboratory transferred 106 cubic yards of LLW to Area G for disposal. No waste was disposed of in Area G in 2022 (LANL 2022e, 2022h, 2024e).

As discussed in Section 4.11.2, most radioactive liquid waste at LANL is conveyed through an underground pipeline system directly to the RLWTF at TA-50. Pipelines for transporting liquid radioactive waste exist in TAs-3, -35, -48, -50, -55, and -59. Waste from generators not connected by the underground pipeline system is transferred by tanker truck to the RLWTF. Generators of small quantities of radioactive liquid waste collect their waste in drums, which are then trucked to TA-50.

Onsite radioactive material shipments are transported in conformance with federal regulations. A primary feature of these regulations is stringent packaging requirements governing shipments on public roads, and in most cases, onsite public roads are temporarily closed during such shipments. In all shipping cases, LANL/DOE safety requirements always fully apply.

Onsite transport constitutes the majority of activities that comprise routine operations in support of various programs. The radioactive materials transported on site between and among LANL TAs are mainly of limited quantities, short travel distances, and mostly on closed roads. The impacts of these transportation activities are part of normal operations. For example, worker doses from handling and transporting radioactive materials are included as part of operational activities. Historical measurements have regularly shown that radiation doses to Laboratory drivers are, on average, less than 1 millirem per onsite transport/shipping endeavor (NNSA 2008b). Recent onsite radioactive material transportation activities are lower than those previously projected in the 2008 SWEIS (NNSA 2008b; LANL 2019b, 2020d, 2021b, 2022a, 2024a).

4.12.5.2 Offsite Shipments

Offsite transport of radioactive materials occurs using trucks and, to a limited extent, air-freight. The radioactive materials transported include, but are not limited to, tritium, plutonium (e.g., pits), uranium (both depleted and enriched), offsite source recovery, medical isotopes, small quantities of activation products, LLW and MLLW, TRU and MTRU waste, as well as well as HE that may be comingled with radioactive material. At LANL, DOE transports and receives radioactive and other hazardous materials and waste shipments to and from other DOE facilities and commercial facilities nationwide. As discussed above, shipments meet applicable USDOT, NRC, DOE, and Federal Aviation Administration regulations and requirements. Most unclassified shipments are transported via commercial carriers.

Strategic-relocation and/or material processing destinations within the DOE-wide complex (e.g., SRS, Pantex, Lawrence Livermore National Laboratory, or Y-12) are candidate locations for the Laboratory's offsite shipping of pits, tritium, highly enriched uranium, low enriched uranium, depleted uranium, non-SNM isotopic source recovery, medical isotopes, long-lived activation product materials, and HE (NNSA 2020a). During 2021, the Laboratory completed 252 non-waste shipments of radiological materials (incoming and outgoing) (LANL 2024c).

During CY 2017–CY 2022, the Laboratory conducted an annual average of 639 total offsite waste shipments collectively of LLW, MLLW, hazardous (chemical) waste, and TRU waste. These shipments averaged 196 annual shipments of hazardous materials and 443 annual shipments of radioactive materials (i.e., LLW+MLLW+TRU), as shown in Tables 4.12-7–4.12-10 (LANL 2019b, 2020d, 2021b, 2022a, 2023a, 2024a).

As discussed earlier in Section 4.11 of this SWEIS, the Laboratory sends almost all of its solid LLW off site to the NNSS and to commercial licensed TSD facilities. During the period 2017–2022, the Laboratory averaged 325 annual offsite shipments of LLW (Table 4.12-7), somewhat conservatively biased by the atypically larger shipment campaigns during CY 2021 and CY 2022 as compared with the more characteristic average of about 170 LLW shipments per year over recent years (likely due to contemporaneous upward deviations from normal material-throughput and transportation-budgetary factors during that period).

The Laboratory sends MLLW to appropriately licensed and permitted offsite commercial TSD facilities for necessary treatment and disposal. Compliance status described in Section 4.11.2 for hazardous waste actions at LANL is also applicable to the management of MLLW. The Laboratory typically ships MLLW to facilities in Utah, Texas, Florida, Tennessee, and Washington. During the period 2017–2022, the Laboratory averaged 61 annual shipments of MLLW to six offsite TSD facilities (Table 4.12-8).

The Laboratory sends hazardous waste to a variety of permitted, offsite commercial TSD facilities. During the period 2017–2022, the Laboratory averaged 196 annual shipments of hazardous waste to a variety of commercial offsite facilities (Table 4.12-9).

Table 4.12-7 Offsite Facilities that Accepted LANL LLW, 2017–2022

Facility Name	Location	Number of Offsite Shipments					
		2017	2018	2019	2020	2021	2022
Energy*Solutions*	Utah	33	20	16	80	200	130
Nevada National Security Site	Nevada	24	46	38	37	562	45
Perma-Fix Environmental Services	Washington	23	13	35	19	80	24
Waste Control Specialists LLC	Texas	96	68	41	14	59	150
Perma-Fix Environmental Services	Florida	1	34	3	1	8	7
Perma-Fix Environmental Services	Tennessee	0	0	0	1	0	0
Omegatech	Tennessee	13	10	0	0	0	0
Unitech	Tennessee	1	13	4	0	0	0
Southwest Research Institute	Texas	0	0	0	0	0	1
TOTALS		**191**	**204**	**137**	**152**	**909**	**357**

Source: LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

Table 4.12-8 Offsite Facilities that Accepted LANL MLLW, 2017–2022

Facility Name	Location	Number of Offsite Shipments					
		2017	2018	2019	2020	2021	2022
Energy*Solutions*	Utah	7	13	20	59	77	48
Waste Control Specialists LLC	Texas	1	5	2	9	10	18
Perma-Fix Environmental Services	Washington	2	0	0	6	9	3
Perma-Fix Environmental Services	Florida	1	15	9	0	0	10
Diversified Scientific Solutions Incorporated	Tennessee	0	0	0	0	31	7
Veolia	Colorado	0	0	0	0	1	0
TOTALS		**11**	**33**	**31**	**74**	**128**	**86**

Source: LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

Table 4.12-9 Offsite Facilities that Accepted LANL Hazardous Waste, 2017–2022

Facility Name	Location	Number of Offsite Shipments					
		2017	2018	2019	2020[a]	2021[a]	2022
Mesa	Arizona	3	22	0	0	0	38
Clean Harbors	Arizona	1	1	1	0	0	0
Veolia	Arizona	0	0	0	1	1	1
Evoqua Water Technologies	Arizona	1	0	0	0	0	0
Painted	Arizona	0	4	0	0	0	0
Liquid Environmental Solutions	Arizona	0	0	0	0	0	1
Veolia	Colorado	5	94	45	41	41	47
Waste Management (Colorado Springs)	Colorado	0	0	0	36	36	19
Clean Harbors	Colorado	3	4	4	19	19	27
Waste Management (Midway Landfill)	Colorado	0	0	0	14	14	0
Liquid Environmental Solutions	Colorado	68	0	64	0	0	0
Medical Systems of Denver	Colorado	0	0	0	0	0	5
Veolia	Illinois	0	0	0	0	0	1
Clean Harbors	Nebraska	0	0	1	0	0	0

Facility Name	Location	Number of Offsite Shipments					
		2017	2018	2019	2020[a]	2021[a]	2022
U.S. Ecology	Nevada	0	0	0	6	6	31
Nevada National Security Site	Nevada	0	0	0	0	0	2
Waste Management	New Mexico	68	129	98	10	10	44
Los Alamos County Government Landfill	New Mexico	0	0	0	0	0	11
Stericycle	New Mexico	1	5	4	2	2	0
Solid Waste Disposal	New Mexico	0	0	12	1	1	13
Keers	New Mexico	2	14	0	0	0	0
ACTenviro	New Mexico	1	0	0	0	0	0
Lighting Resources	Texas	2	2	1	3	3	2
Clean Harbors	Utah	0	0	0	2	2	0
Veolia	Utah	0	0	0	0	0	1
TOTALS		**155**	**275**	**230**	**135**	**135**	**243**

a Identical hazardous waste shipping data were reported for CYs 2020 and 2021 (LANL 2022a, 2023a).
Source: LANL (2019b, 2020d, 2021b, 2022a, 2023a, 2024a)

During the period FY 2017–2022, the Laboratory averaged 58 annual shipments of TRU to the WIPP (Table 4.12-10). As of October 2020, there were approximately 3,500 remaining containers of aboveground TRU waste designated for eventual removal from Area G; accordingly, about 60 to 100 corresponding additional shipments to WIPP were estimated to occur between October 2020 and April 2023 to successfully meet the shipment campaign's critical path during that period. During the bulk of this timeline, N3B successfully sent 33 shipments of legacy TRU waste to WIPP during CY 2021 and 52 during CY 2022, which far exceeded EM-LA's goal for those periods. The shipments included more than 213 cubic meters of waste in total, or the equivalent of approximately 1,020 55-gallon drums. Altogether, during the period 2008–2021, approximately 1,347 shipments of TRU and MTRU waste were made from LANL to WIPP. During CY 2022, an additional 131 shipments of TRU and MTRU waste were made from LANL to WIPP, bringing the net shipment total to 1,478 through the end of 2022 (LANL 2020d, 2021b, 2023a, 2024a).

Table 4.12-10 Offsite Facilities that Accepted LANL TRU Waste, 2017–2022

Facility Name	Location	Number of Shipments					
		2017	2018	2019	2020	2021	2022
Waste Isolation Pilot Plant	New Mexico	1[a]	17[a]	42	69	89	131

a This facility was in the process of resuming full operational status 2017–2018.
Source: LANL (2019b, 2020d, 2021b, 2022a, 2022e, 2022h, 2023a, 2024a)

DOE regulations require that safe-secure trailers be used for offsite shipments of SNM, weapons components, and explosive-like assemblies in DOE custody. Safe-secure trailers are similar in appearance to commercial tractor-trailers but are equipped with unique security and safeguard features that prevent unauthorized cargo removal and minimize the likelihood of an accidental radioactive materials release as a result of a vehicle accident. Classified shipments are made in safe-secure trailers.

The primary regulatory approach to promote safety from radiological exposure during transportation is the specification of standards for the packaging of radioactive materials. Packaging represents the primary barrier between the radioactive material being transported and radiation exposure to the public, workers, and the environment. Transportation packaging for radioactive materials must be designed, constructed, and maintained to contain and shield its contents during normal transport conditions. As an example, for safely transporting highly radioactive material such as plutonium metal, packagings must contain and shield their contents in the event of severe accident conditions. The type of packaging used is determined by the total radioactive hazard presented by the material within the packaging. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. Additional details with regard to packaging requirements are discussed in Appendix F.

4.13 Environmental Justice

Under EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations,"[37] federal agencies are responsible for identifying and addressing the possibility of disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations and low-income populations (59 FR 7629, February 16, 1994). In 2021, the President issued EO 14008, "Tackling the Climate Crisis at Home and Abroad" (86 FR 7619, February 1, 2021), which formalizes federal agencies' commitment to make environmental justice a part of their mission and to develop programs, policies, and activities to address the disproportionate health, environmental, economic, and climate impacts on disadvantaged communities and required federal agencies to "make achieving environmental justice part of their missions." EO 14008 also established the Justice40 Initiative, in which federal investments, including remediation and reduction of legacy pollution, would demonstrate a goal for 40 percent of benefits directly benefiting disadvantaged communities. In April 2023, the President issued EO 14096, "Revitalizing Our Nation's Commitment to Environmental Justice for All" (88 FR 25251, April 21, 2023), which re-emphasizes the expectations of EO 12898 and includes an emphasis on the importance of trial consultation and consideration of Indigenous Knowledge in decisionmaking. The EO also emphasizes a whole-of-government approach that builds upon the principles of environmental justice outlined in EO, including EO 12898, EO 13985 (86 FR 7009, January 25, 2021), EO 13990 (86 FR 7037, January 25, 2021), and EO 14008.

Regardless of alternatives considered in this SWEIS, DOE will continue to implement its environmental justice requirements and obligations in accordance with DOE's trust responsibilities to tribal nations; EOs on environmental justice; guidance from the CEQ (CEQ 1997); DOE's *Environmental Justice Strategy* (DOE 2017b); DOE Order 144.1, "Department of Energy American Indian Tribal Government Interactions and Policy"; EO 13175, "Consultation and Coordination with Indian Tribal Governments"; the Accord Agreements with the Pueblo de San Ildefonso, Santa Clara

[37] The term minority populations refers to persons of any race self-designated as Asian, Black, Native American, or Hispanic. Low-income populations refer to households with incomes below the federal poverty thresholds.

Pueblo, Pueblo de Cochiti, and Jemez Pueblo; and the DOE Justice40 pilot program for remediation of legacy pollution at LANL in accordance with the Consent Order (DOE 2000).[38]

DOE's trust responsibilities to tribal nations include:

- Consulting, to the greatest extent practicable and to the extent permitted by law, with tribal governments prior to taking actions that affect federally recognized tribal governments.
- Protecting tribal people and their resources—land, air, water, vegetation, wildlife and fisheries—from DOE actions that could harm their health, safety, or sustainability.
- Protecting "reserved" rights (such as hunting and fishing rights that were specified in treaties as retained or reserved even though the lands are not part of the reservation).
- Protecting Indian cultural and religious artifacts and sites on land now managed by DOE, and avoiding any unnecessary interference with traditional religious practices, which includes providing appropriate access to sacred sites on DOE lands.
- Protecting the sovereignty of tribal governments.

Environmental justice concerns the environmental impacts that proposed actions may have on minority and low-income populations, and whether such impacts are disproportionate when compared to the general population in the potentially affected area. The ROI for environmental justice in this SWEIS is a 50-mile radius from the LANSCE in TA-53, which represents the highest potential radiological exposure to the public from operations. Figure 4.13-1 shows areas that may be impacted by missions performed at LANL. These areas include portions or entireties of the counties of Bernalillo, Los Alamos, Mora, Rio Arriba, Sandoval, San Miguel, Santa Fe, and Taos. Additionally, LANL shares a property boundary with the Pueblo de San Ildefonso—one of several sovereign federally recognized tribes with a government-to-government relationship with DOE. Other federally recognized tribes within the ROI include portions or entireties of the Pueblos of Cochiti, Jemez, Nambé, Ohkay Owingeh, Picuris, Pojoaque, Sandia, Santa Ana, Santa Clara, San Felipe, Santo Domingo, Taos, Tesuque, Zia, and a portion of the Jicarilla Apache Indian Reservation.

The threshold used for identifying minority communities surrounding LANL was developed consistent with CEQ guidance (CEQ 1997) and the Environmental Justice Interagency Working Group (EJIWG 2019) for identifying minority populations using either the 50-percent threshold or a "meaningfully greater"[39] percentage of minority individuals in the general population. The average minority population percentage of New Mexico is 64 percent, and the average minority population percentage of the counties in the ROI is 62 percent (USCB 2022e). For this SWEIS, a meaningfully greater minority population percentage relative to the general population of the state and surrounding counties would exceed the CEQ's 50-percent threshold. Therefore, this SWEIS uses the CEQ threshold of 50 percent to identify areas with minority populations in the ROI. To evaluate the potential impacts on populations in closer proximity to LANL, additional radial distances were also analyzed. Table 4.13-1 summarizes the demographic composition within a 50-mile radius of LANL. The center of the area under the Proposed Action in this SWEIS is the LANSCE in TA-53.

[38] See Appendix A, Section A.4.13 for additional discussion of the DOE-EM Justice40 pilot program.
[39] The "meaningfully greater" approach is derived from EJIWG (2019). *See* Appendix A, Section A.4.13 for additional discussion.

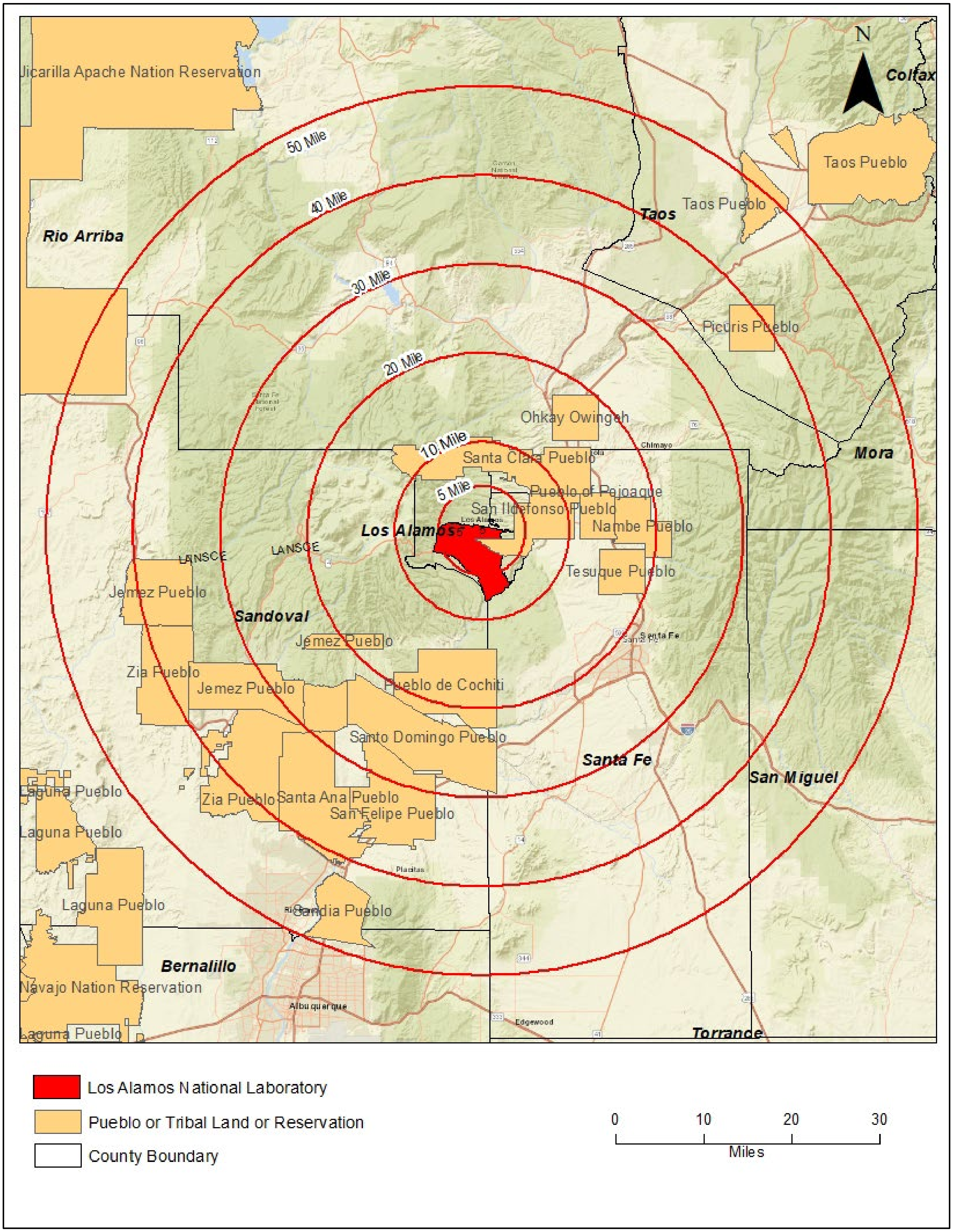

Figure 4.13-1 Pueblos, Tribal Lands, and Reservations within 50 Miles of LANL

Table 4.13-1 Estimated Population in the Potentially Affected Area within a 50-Mile Radius of LANL

Population Group	5-Mile Population	5-Mile % of Total	10-Mile Population	10-Mile % of Total	20-Mile Population	20-Mile % of Total	30-Mile Population	30-Mile % of Total	40-Mile Population	40-Mile % of Total	50-Mile Population	50-Mile % of Total
Non-Minority	12,953	68.7	13,706	65.0	26,735	34.1	75,098	38.7	84,396	38.2	156,320	42.3
Hispanic or Latino	3,349	17.8	4,177	19.8	41,488	52.9	97,453	50.2	107,529	48.6	167,196	45.2
Black or African American	156	0.8	160	0.8	377	0.5	1,383	0.7	1,514	0.7	4,247	1.1
American Indian or Alaska Native	168	0.9	160	0.8	5,930	7.6	10,781	5.5	17,206	7.8	21,921	5.9
Asian	1,216	6.4	1,233	5.8	1,641	2.1	3,500	1.8	3,635	1.6	7,111	1.9
Native Hawaiian and Other Pacific Islander	15	0.1	15	0.1	35	0.0	87	0.04	97	0.04	262	0.1
Other Race	128	0.7	136	0.6	392	0.5	1,118	0.58	1,287	0.6	2,036	0.6
Two or More Races	868	4.6	1,501	7.1	1,830	2.3	4,858	2.50	5,432	2.5	10,693	2.9
Total Minority	5,900	31.3	7,382	35.0	51,693	65.9	119,180	61.3	136,700	61.8	213,466	57.7
Total Population[a]	18,853	100.0	21,088	100.0	78,428	100.0	194,278	100.0	221,096	100.0	369,786	100.0
Low-Income[b,c]	2,790	13.2	6,284	19.4	30,400	31.4	64,426	32.3	71,463	32.5	117,191	29.9

a Minority population estimates are based on the 2020 Census. Population of Census Blocks that intersect or were within the 50-mile radius were wholly included in population counts.

b Low-income population estimates are based on the U.S. Census Bureau's American Community Survey five-year estimates (2016–2020). Populations of Census Block groups that intersect or were within the 50-mile radius were wholly included in population counts.

c NNSA defines low-income as households below twice the federal poverty level.

Source: USCB (2022e, 2022g)

As can be seen in the table, the area within 5 miles contains the lowest percentage of minority populations. The overall composition of the 10-mile radius is predominantly non-minority. The area within 20 miles contains the highest concentration of minority populations in the 50-mile radius. The percent of minority populations decreases slightly within the 30- to 50-mile radius, but still exceeds 50 percent. The Hispanic or Latino population is the largest minority population within each radial distance.

The current estimated population residing within a 50-mile radius of LANL is approximately 369,786 persons, of which 58 percent are considered minority (USCB 2022e). This percentage is less than the state of New Mexico as a whole (64 percent). This analysis used the Census Block Group-level spatial resolution (the smallest geographic area used by the U.S. Census Bureau). The Hispanic population is the largest minority group and makes up 45 percent of the population within this area. Los Alamos County, where the LANL site is located, has an average minority population of 31 percent and contains 17 Census Block groups; of the 17 Census Block groups, none were identified as containing minority populations that exceed the 50-percent threshold. Figure 4.13-2 shows minority populations within the 50-mile radius of LANL.

The low-income threshold[40] for low-income populations in the ROI is identified using the same methodology described above for identifying meaningfully greater minority populations (EJIWG 2019) but uses the definition of low-income in 10 CFR 440.3,[41] i.e., those households living below twice the federal poverty level. The low-income population in New Mexico is 39 percent, and the average low-income population percentage of the counties surrounding LANL is 40 percent. Comparatively, a meaningfully greater low-income population percentage using these statistics would be 20 percentage points above the low-income population percentage for the state population or 50 percent, whichever is most inclusive. This SWEIS analysis used a meaningful greater threshold to identify areas that have low-income populations within a 50-mile radius of LANL. Meaningfully greater low-income populations were identified using Census Block group-level spatial resolution. There are 284 Census Block groups within a 50-mile radius of LANL.

This SWEIS analysis used the U.S. Census Bureau's American Community Survey five-year estimates (2016–2020) to identify low-income populations within the 50-mile radius of LANL. Of the 284 Census Block groups within a 50-mile radius of LANL, 48 contained meaningfully greater low-income threshold populations. Of the current estimated population residing within a 50-mile radius of the LANL site for whom poverty status is determined, 30 percent are low-income (USCB 2022g). This percentage is less than the state of New Mexico as a whole (39 percent) and the average low-income population percentage of the counties surrounding LANL (40 percent). Figure 4.13-3 shows low-income populations within the 50-mile radius of the LANL site.

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[40] "Low-income threshold criteria" approaches are derived from EJIWG (2019). *See* Appendix A, Section A.4.13 for additional discussion.

[41] The Office of Management and Budget defines low-income as being "at or below 200 percent of the poverty level determined in accordance with criteria established by the Director of the Office of Management and Budget."

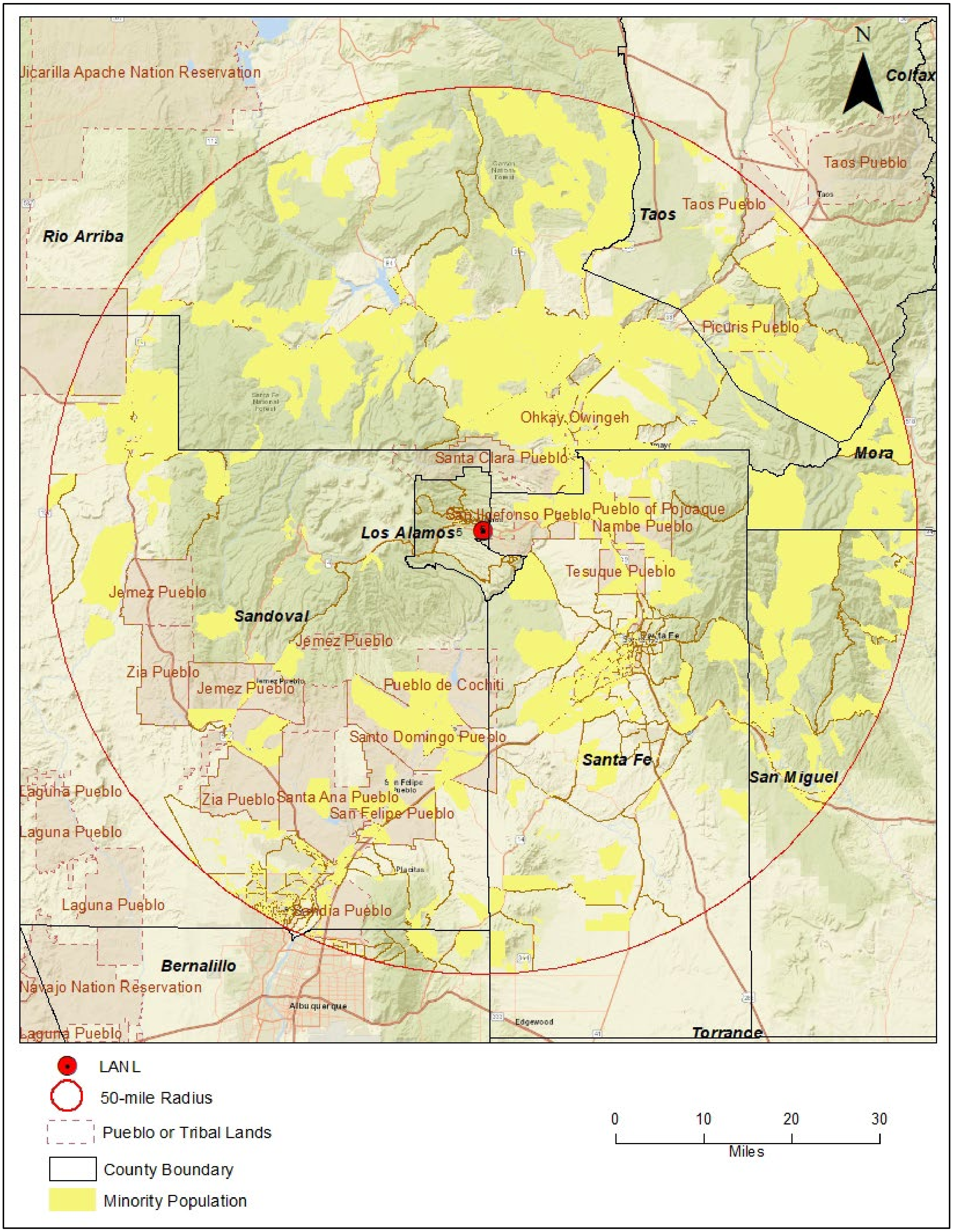


Figure 4.13-2 Minority Populations within 50 Miles of LANL

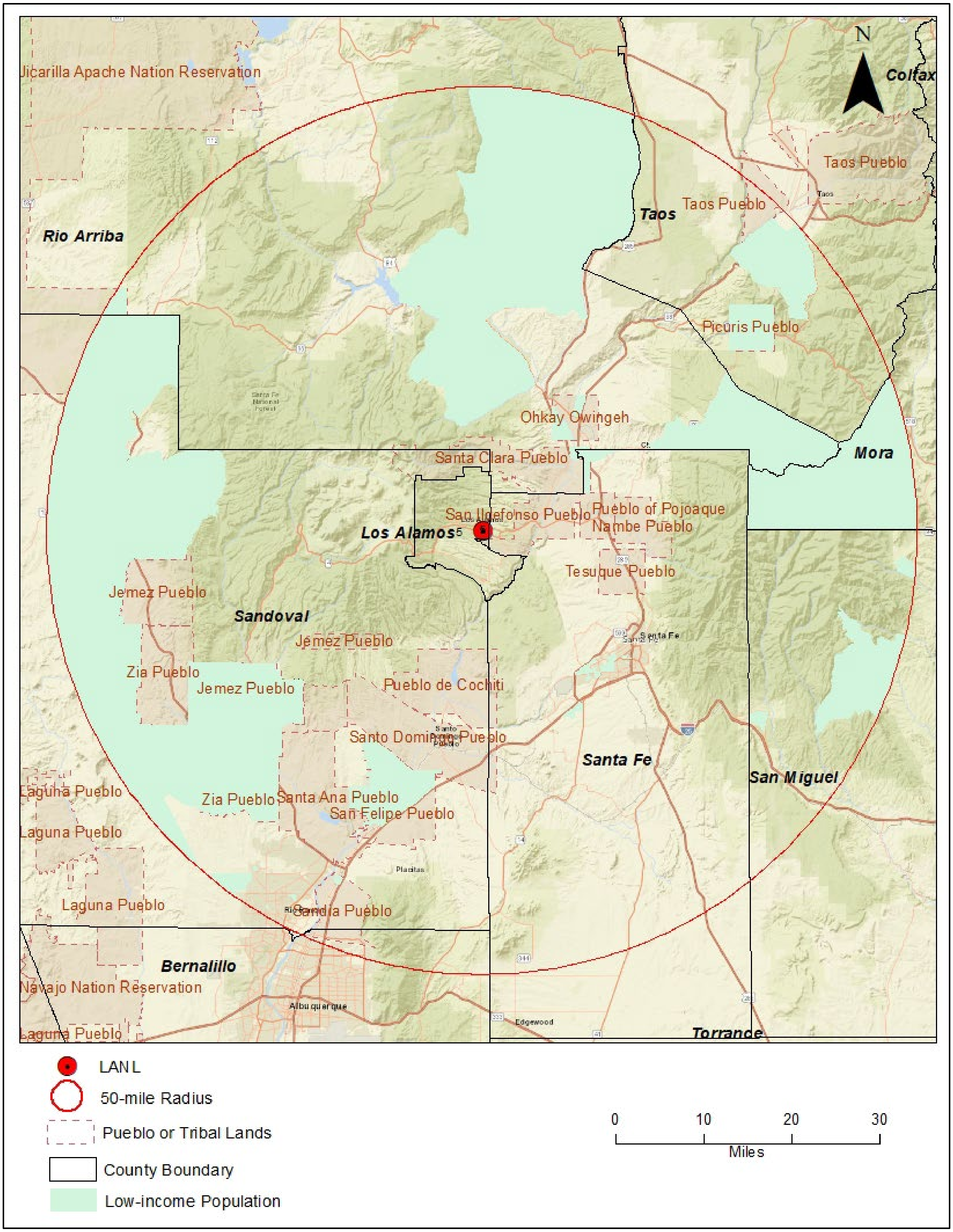


Figure 4.13-3 Low-Income Populations within 50 Miles of LANL

In accordance with EO 14008, economic impacts are evaluated for potential disproportionate and adverse impacts to minority and low-income populations in the ROI surrounding LANL. In the *2023 Economic Impact on New Mexico*, LANL identified its economic impacts on New Mexico (LANL 2023e). The report identifies the distribution of economic benefits for counties where LANL employees reside. Table 4.13-2 shows the distribution in percentages of salaries for counties where the majority of LANL employees live, including the populations within the ROI for environmental justice. This distribution shows that most of the salaries individually per county are attributed to Los Alamos County, indicating an overall lower percentage of populations below the federal poverty level compared to other counties in the ROI, as LANL employees make up approximately 57.2 of the employed workforce that reside in Los Alamos County compared to the other counties in the ROI (between 0.3 and 15.8 percent of workers in other counties) (Table 4.13-3). Based on the employment profiles for the five-county socioeconomic ROI, the distribution of LANL workers per county is evaluated to identify potentially disproportionate and adverse impacts to counties with higher numbers of low-income populations living below the federal poverty level.

Based on the appreciable difference in the number of currently employed people in the five-county ROI, the higher percentage of LANL employees residing in Los Alamos County is consistent with the Laboratory being the primary employer in Los Alamos County. The other counties in the five-county ROI (e.g., Santa Fe, Rio Arriba, Bernalillo, and Sandoval Counties) have from 1.5 to over 30 times the number of employable residents than Los Alamos County. The percentages of LANL workers from each county do not demonstrate a direct correlation to percentages of populations below the poverty level, except for Los Alamos County. Los Alamos County has relied on the Laboratory as a primary economic source since its inception and as such has a positive impact on the relatively low poverty levels compared to other counties in the ROI.

Table 4.13-2 Distribution of LANL Salaries for Counties with Low-income Populations in the ROI

County	Number of Employees per County[a]	Percentage of LANL Salaries per County[b]	Percentage of Populations below Poverty Level per County[c]
Los Alamos	5,551	42.1	5.4
Santa Fe	3,533	25.6	12.5
Rio Arriba	2,419	11.2	20.7
Bernalillo	972	5.8	16.2
Sandoval	637	4.1	9.7

a From Table 4.9-1.
b Source: LANL (2023d). Salaries for other counties in NM and outside of NM are outside of the ROI for socioeconomics.
c From Table 4.9-5. NNSA defines low-income as households below twice the federal poverty level.

Table 4.13-3 Labor Force Distribution of LANL Employees in the ROI

County	Labor Force Currently Employed per County[a]	Percentage of LANL Workers per County Labor Force[b]	Percentage of Populations Below Poverty Level per County[c]
Los Alamos	10,405	53.4	5.4
Santa Fe	69,720	5.1	12.5
Rio Arriba	15,800	15.3	20.7
Bernalillo	324,606	0.3	16.2
Sandoval	65,476	1.0	10.1

a From Table 4.9-2.
b Source: LANL (2023d). Percentages of LANL workers for other counties in NM and outside of NM are outside of the ROI for socioeconomics.
c From Table 4.9-5. NNSA defines low-income as households below twice the federal poverty level.

4.14 Environmental Cleanup of Legacy Contamination, Transuranic Waste Disposition and Decontamination, Decommissioning, and Demolition of Process-Contaminated Excess Facilities

4.14.1 Introduction

This section discusses existing activities associated with environmental cleanup of legacy contamination, TRU waste disposition, and DD&D of process-contaminated excess facilities at LANL. EM-LA is responsible for overseeing the cleanup of legacy contamination left behind by nuclear weapons production and research during the Manhattan Project and Cold War era at LANL. In 2014, DOE/NNSA decided to separate the cleanup of legacy contamination, TRU waste disposition, and DD&D of process-contaminated excess facilities from the M&O contract. In October 2015, legacy cleanup work was transitioned to EM-LA utilizing a bridge contract with the existing Laboratory M&O contractor. In April 2018, a new contractor, Newport News Nuclear BWXT-Los Alamos, LLC (N3B), was selected for the Los Alamos Legacy Cleanup Contract and became responsible for legacy cleanup operations at LANL. EM-LA's cleanup mission includes TRU waste disposition, soil and groundwater investigation and remediation (where required), and DD&D of process-contaminated excess facilities. This section discusses environmental cleanup of legacy contamination and TRU waste disposition (Section 4.14.2) and DD&D activities (Section 4.14.3).

4.14.2 Environmental Cleanup of Legacy Contamination and Transuranic Waste Disposition

4.14.2.1 Environmental Cleanup of Legacy Contamination

Approximately 500,000 cubic meters of legacy hazardous and radioactive waste are located at LANL. Most of this waste is buried in 26 MDAs dispersed throughout the site (Figure 4.14-1). As of 2023, nine of the MDAs are either closed, deferred, or in post-closure monitoring. Seven of the MDAs (A, T, C, AB, H, G, and L) are in the process of remedy evaluation and closure; the remaining 10 MDAs have been incorporated into Consent Order campaigns. Table 4.14-1 provides the current status of the MDAs. DOE regulates the cleanup of radioactive waste pursuant to the *Atomic Energy Act of 1954*, as amended. EPA regulates air and stormwater. The New Mexico.

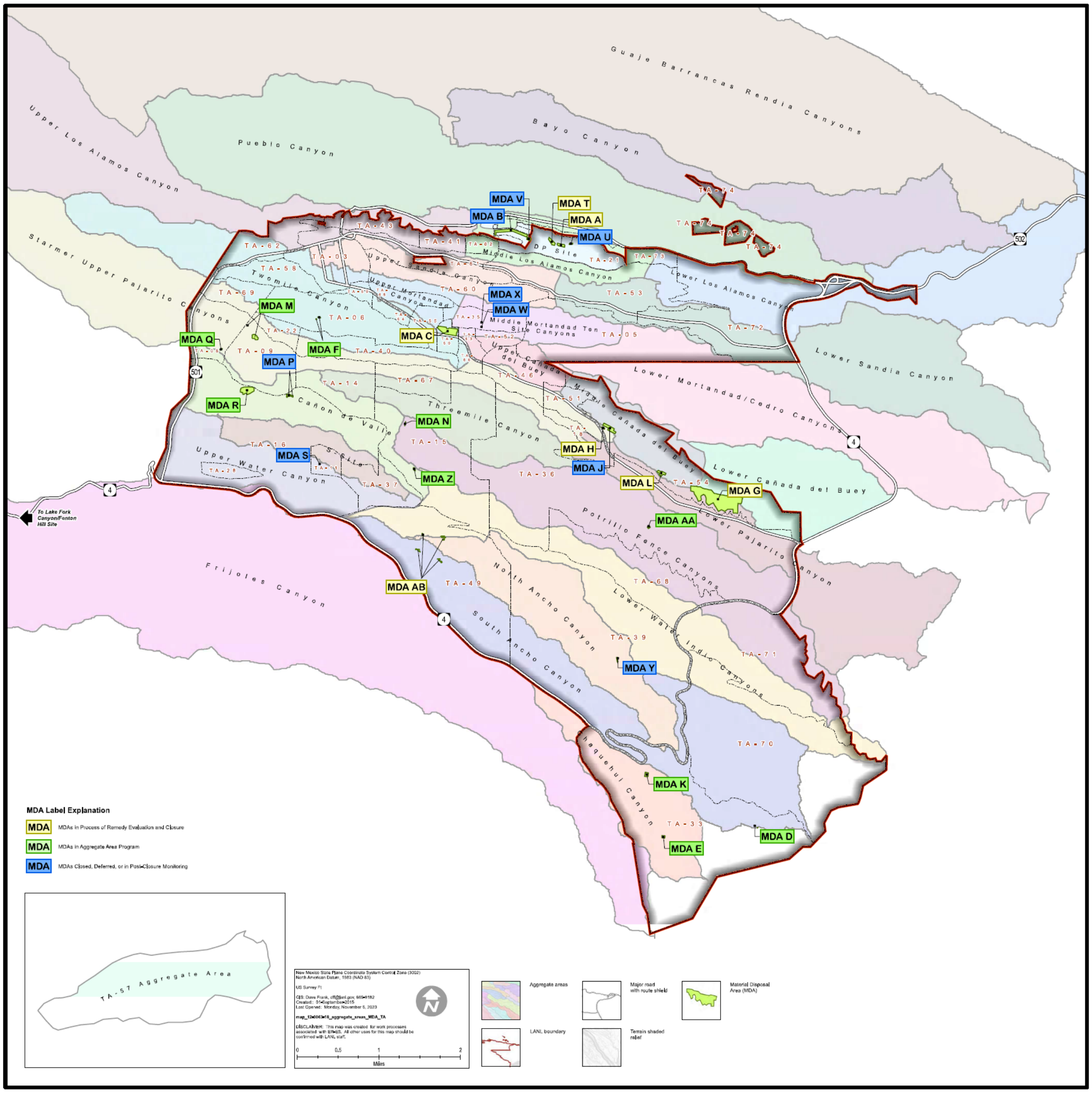


Figure 4.14-1 Location of the MDAs Across the LANL Site

Office of the State Engineer regulates water rights, well drilling, and well plugging and abandonment (DOE 2022b).

The Consent Order is a settlement agreement for the purpose of addressing: (1) corrective actions for releases of hazardous waste; (2) corrective actions for releases of groundwater contaminants, toxic pollutants, and explosive compounds; and (3) groundwater monitoring, groundwater characterization, and groundwater corrective action activities, including NMAC requirements for regulated units.

Table 4.14-1 Status Summary of LANL Material Disposal Areas as of 2023

MDA	Size (acres)	TA	Disposal Operation Period	Status
A	1.80	21	1945–1977	In Process of Remedy Evaluation and Closure
AA	1.40	36	1960s–1989	In Aggregate Area Program
AB	0.45	49	1959–1961	In Process of Remedy Evaluation and Closure
B	6.03	21	1944–1948	**Closed,** Deferred, or in Post-Closure Monitoring
C	12.30	50	1948–1974	In Process of Remedy Evaluation and Closure
D	0.03	33	1948–1952	In Aggregate Area Program
E	1.40	33	1949–1955 1950–1963	In Aggregate Area Program
F	1.40	6	1946–1952	In Aggregate Area Program
G	65.00	54	1957–Present	In Process of Remedy Evaluation and Closure
H	0.30	54	1960–1986	In Process of Remedy Evaluation and Closure
J	2.65	54	1961–2002	**Closed**, Deferred, or in Post-Closure Monitoring
K	1.00	33	1954–1990	In Aggregate Area Program
L	2.58	54	1950–1985	In Process of Remedy Evaluation and Closure
M	3.00	9	1949–1965	In Aggregate Area Program
N	0.28	15	1962–1965	In Aggregate Area Program
P	1.40	16	1950–1984	**Closed**, Deferred, or in Post-Closure Monitoring
Q	0.20	8	1946	In Aggregate Area Program
R	11.50	16	1945–1951	In Aggregate Area Program
S	0.002	11	1965–Present	Closed, **Deferred**, or in Post-Closure Monitoring
T	2.21	21	1945–1983	In Process of Remedy Evaluation and Closure
U	0.20	21	1948–1968	**Closed**, Deferred, or in Post-Closure Monitoring
V	0.88	21	1945–1961	**Closed**, Deferred, or in Post-Closure Monitoring
W	0.001	35	1957–1964	**Closed**, Deferred, or in Post-Closure Monitoring
X	0.05	35	1959	**Closed**, Deferred, or in Post-Closure Monitoring
Y	0.20	39	1960s–1989	**Closed**, Deferred, or in Post-Closure Monitoring
Z	0.40	15	1965–1981	In Aggregate Area Program

MDA = material disposal area; TA = technical area

The Consent Order addresses two types of legacy waste corrective action sites existing at the Laboratory: (1) SWMUs and (2) Areas of Concern (AOCs). SWMUs are any discernable unit at which solid waste has been placed at any time and from which NMED determines there may be a risk of hazardous waste or hazardous waste constituent release, regardless of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at the facility at which solid wastes have been routinely and systematically released; they do not include one-time spills (NMED 2016a). Examples of these units include certain septic tanks, firing sites, landfills, sumps, and areas that historically received liquid effluents from outfalls.

AOCs are any areas with known or suspected releases of hazardous waste or hazardous waste constituents that are not from a SWMU and that the Secretary of NMED has determined may pose a current or potential threat to human health or the environment, pursuant to 20.4.1.500 NMAC (incorporating 40 CFR 270.32(b)(2)). An AOC may include buildings and structures at which releases of hazardous waste or constituents were not remediated, including one-time and accidental events (NMED 2016a). Examples include canyon bottoms downstream from historical outfalls.

To efficiently carry out the 2016 Consent Order, DOE and NMED agreed to use a structure called the "campaign approach," in which corrective action activities required by the 2016 Consent Order are organized into campaigns, generally based on a risk-based approach to grouping, prioritizing, and accomplishing corrective action activities at SWMUs and AOCs. A campaign may consist of one or more projects, requiring one or more tasks and deliverables.

> **2016 Consent Order**
>
> - Settlement agreement that addresses cleanup of legacy waste at LANL.
> - Supersedes the 2005 Compliance Order on Consent.
> - Established 17 cleanup campaigns using a risk-based approach to grouping, prioritizing, and completing corrective action activities.
> - Uses an annual planning process that allows for revisions to cleanup campaigns based on actual work progress, changed conditions, and funding.
> - Work is ongoing in numerous campaigns simultaneously; one campaign has been completed.
> - The 2016 Consent Order is available at https://www.env.nm.gov/wp-content/uploads/sites/12/2016/05/LANL-Consent-Order-June-2016.pdf
> - The Settlement Agreement was modified August 30, 2024, to improve public participation, improve the dispute resolution process, and improve enforcement of deadlines. The new Settlement Agreement is available at https://cloud.env.nm.gov/resources/_translator.php/NzcxOWIxNWEzOWE1OTZiMjcxNTcwNTY1YV8xNjc5MzE~.pdf

Appendix A of the 2016 Consent Order identifies 1,405 SWMUs and AOCs (additional SWMUs/AOCs may be added when identified) requiring action, shows campaign assignments, and provides the status of corrective action activities. Appendix C of the Consent Order describes the 17 campaigns. Work is ongoing in numerous campaigns. One campaign has been completed.

The 2016 Consent Order establishes an annual process by which DOE and NMED jointly determine cleanup activities. The annual planning process allows for revisions to cleanup campaigns, accounting for such factors as actual work progress, changed conditions, and changes in anticipated funding levels. During the annual planning process, DOE and NMED mutually establish between 10 and 20 enforceable milestones to be completed during the fiscal year. DOE and NMED also mutually establish between 10 and 20 targets for each of the next two fiscal years. Targets are non-enforceable deadlines for the two fiscal years. In addition to enforceable annual milestones, DOE completes a significant number of other deliverables during the fiscal year per the Consent Order (DOE 2022c; LANL 2022e).

At the end of FY 2023, of the 1,405 SWMUs and AOCs, 94 sites have certificates of completion (COCs) with controls; 293 sites have COCs without controls; and 134 sites have been deferred until they no longer have active operations. In addition, DOE has requested COCs from NMED for 221 sites and is awaiting a response. The remaining 663 SWMUs and AOCs have investigations or corrective actions (or both) in progress or pending.

The Consent Order addresses remediation of groundwater containing contaminants that resulted from LANL operations. EM-LA is currently characterizing two legacy groundwater contamination plumes. One plume contains hexavalent chromium and is being managed by a pump-and-treat system on an interim basis while a final remedy is under development. The second plume has chemical constituents, including Royal demolition explosives (RDX), which were used widely in World War II (DOE 2022c). Section 4.3.3 of this SWEIS describes the soil contamination at LANL. Section 4.4.2 describes the groundwater contamination.

Table 4.14-2 summarizes EM-LA's cleanup accomplishments between 2020 and 2022. Appendix G of this SWEIS discusses EM-LA's remaining cleanup scope at LANL, which includes soil and groundwater remediation and retrieval, management, and disposal of TRU waste and

Table 4.14-2 EM Cleanup and Transuranic Waste Disposition Accomplishments at LANL, 2020–2022

Performance Activity	2020	2021	2022	Additional Notes
Transuranic Waste Disposition				
TRU waste shipments to WIPP executed	5	33	64	Since April 2018, DOE completed 131 shipments of 462 cubic meters of TRU waste.
LLW dispositioned (cubic meters)	895	1,284	705	Since April 2018, DOE completed 114 total shipments of 2,099 cubic meters of LLW.
Hazardous waste dispositioned (cubic meters)	17	12.6	0	Since April 2018, DOE completed 14 total shipments of 32 cubic meters of hazardous waste.
Nuclear waste remediation process lines started	0	1	2	
Waste characterization activities in advance of remediation and/or shipment	994	430	1,472	
Legacy TRU waste containers remediated in advance of disposal	354	264	73	Entails sorting and repackaging waste to meet disposal facility acceptance criteria.
Environmental Cleanup of Legacy Contamination				
Consent Order campaigns underway (17 total)	11	10	7	
Consent Order milestones completed	16/16	13/13	18/18	
Water, soil, and vapor samples collected	4,974	6,414	6,352	Samples collected for characterization and to support site remediation and final remedies.
Groundwater treated and injected at Chromium Plume Control Interim Measure (million gallons)	65.7	114.2	104.6	System operational along the southern boundary since mid-2018 and fully operational along plume's eastern boundary in November 2019.
Hexavalent chromium removed from regional aquifer (pounds)	113.5	206.8	157.1	Removed through extraction and treatment via ion exchange.
Stormwater control inspections conducted under Individual Permit	664	1,332	875	Stormwater controls mitigate erosion and potential contaminant transport.
Aggregate area waste dispositioned (cubic meters)	122	194	535	Soil and debris excavated as part of environmental remediation activities.
Certificates of completion from NMED for contaminated sites associated with historical LANL operations	4	14	13	Enables status change under RCRA permit.
Transition water shipped (gallons)	106,870	146,690	0	Consists of purged well water and well drilling development water stored at well locations around LANL and on Los Alamos County lands.
Transition soil, metal, and debris shipped (cubic meters)	145	16.4	0	Nonhazardous waste and New Mexico Special Waste; final shipment of transition materials.

NMED = New Mexico Environment Department; LANL = Los Alamos National Laboratory; LLW = low-level radioactive waste; RCRA = Resource Conservation and Recovery Act; WIPP = Waste Isolation Pilot Plant

Source: N3B (2022)

LLW/MLLW. The appendix also identifies the current state of the remediation efforts and the current planning basis for the end state that DOE-EM has planned for each MDA. The activities and the potential environmental impacts expected to get to this end state are included in Chapter 5 of this SWEIS for each affected resource area. The ultimate end state for LANL involves completion of legacy waste cleanup to environmental standards or stabilization that is protective of the public and environment. Once that end state is achieved, NNSA would manage long-term stewardship activities (DOE 2022c).

4.14.2.2 Contact-Handled Transuranic Waste Disposition

As of October 2020, there were approximately 3,500 cubic meters of above-ground CH TRU waste stored at TA-54 destined for disposal at the WIPP facility. The waste is stored in configurations protective of the environment, workers, and the public (DOE 2022c). Section 4.11.2 describes waste management storage and operations at LANL. Section 4.11.2.3 describes TRU waste management operations at LANL.

4.14.3 Decontamination, Decommissioning, and Demolition

EM-LA is responsible for DD&D of process-contaminated excess facilities existing at time of transition, as well as DD&D of process-contaminated excess facilities transferred from NA-LA in 2022. The current work scope is focused on TA-21, which is one of the early sites of the Manhattan Project and Cold War-era work conducted at LANL. TA-21 was the location of the world's first plutonium processing facility and where groundbreaking tritium research took place. Buildings, such as a warehouse and a sewage treatment facility, have been demolished, and approximately 10 slabs and structures remain to be removed prior to land transfer. Upon removal and investigation, remediation (where required), and closure of the SWMUs and AOCs at TA-21, the land is expected to be transferred from NA-LA to Los Alamos County (DOE 2022d, 1999b).

Once CH TRU waste disposition is complete at TA-54, EM-LA will begin DD&D of structures, such as office buildings, warehouses, and domes, at Area L and TA-54. DD&D at TA-54 and Area L is the last step before the final remedy at MDAs G and L can commence (DOE 2022d). The potential impacts of the DD&D actions are included in Chapter 5 as part of the No-Action Alternative and the Modernized Operations Alternative, and are independent of the DOE office or contractor performing the DD&D.

CHAPTER 5
ENVIRONMENTAL CONSEQUENCES

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 Introduction

In this chapter, NNSA discusses the potential direct and indirect environmental impacts of the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative based on the descriptions of those alternatives in Chapter 3 and compared with the affected environment as described in Chapter 4. The potential impacts are presented using the methodologies described in Appendix C to this SWEIS. The potential impacts (Sections 5.2 through 5.13) are presented in the same order as the resource descriptions in Chapter 4 (Sections 4.2 through 4.13).

As discussed in Chapter 3, Sections 3.2, 3.3, and 3.4, there are hundreds of discrete projects associated with these alternatives. To assess the potential environmental impacts from all such projects, NNSA defined and accumulated data for each of the projects under each alternative (*see* Section 3.5). For each project/action, NNSA quantified the contribution to key analytical parameters (e.g., workforce estimates, total land disturbed, waste generation). The accumulated analytical parameters are presented in Appendix A, Table A.3.5-1 (for construction) and Table A.3.5-2 (for operations) for each alternative. NNSA incorporated these site-wide analytical parameters, along with more detailed information for specific projects, into the analysis of impacts. The analysis in this SWEIS addresses the construction and operation of new facilities, upgrades and utility/infrastructure projects, site-wide transportation and parking projects, DD&D of excess and aging facilities, operational changes, and continued operations of the Laboratory through approximately 2038. Additionally, DOE-EM would continue environmental remediation activities to comply with the Consent Order under the No-Action Alternative, which would, by definition, be included as part of other action alternatives.

As discussed in Chapter 3, Section 3.5, for construction parameters, NNSA developed annual averages for construction and DD&D activities. The annual rates of construction and DD&D would depend on annual budget authorizations and the evolution and prioritization of NNSA's needs. Where construction parameters are based on the estimated number of workers (e.g., workforce, wastewater generation, traffic), the analysis doubled the annual average construction workforce to account for the potential variability of those parameters. Such an approach acknowledges the non-linear characteristics of construction and DD&D and provides a conservative analysis to account for future uncertainties. For each resource, NNSA analyzes construction, DD&D, and operational impacts concurrently, which acknowledges that any construction and DD&D activities would occur simultaneously with operations. For the No-Action Alternative, the Laboratory likely would complete construction of new facilities by 2029; however, DD&D activities would be expected to continue for the full duration of the analytical period (i.e., 2038). For the action alternatives (Modernized and Expanded), construction would be expected to continue for the full duration of the analytical period.

Chapter 3, Section 3.2.2 acknowledges that the Laboratory is considering an option that would allow continued use of elements of the CMR facility beyond the planned DD&D date of 2031. CMR is currently planned for DD&D under the No-Action Alternative. As appropriate, individual resource areas evaluate whether impacts would change under this option. Additionally, Section 3.4.1 identifies the possibility that the Laboratory could implement a limited enhancement of ARIES in PF-4 if surplus plutonium disposition was not implemented as proposed in the SPDP EIS (NNSA 2024a). As appropriate, resource areas in Chapter 5 assess how the Expanded

Operations Alternative impacts may change with the implementation of a limited ARIES enhancement.

5.2 Land Resources

5.2.1 Land Use

Key metrics in the analysis of land use include: (1) number and footprint of new facilities and infrastructure; (2) total area of land disturbance and the conversion of currently undeveloped land; and (3) a qualitative analysis of consistency with current land use plans, classifications, and policies.

As discussed in Chapter 4, Section 4.2, development at LANL is generally concentrated to sites along mesa tops and other flat sites hospitable to building. As a result of the site's unique topography, only 29 percent of LANL's total area is considered "buildable." This does not preclude development of the remaining 71 percent, but generally, building and development would be sited on land deemed buildable, as defined in Section 4.2. As of 2022, 45 percent of LANL's buildable area, or approximately 3,286 acres, is considered developed; this represents 13 percent of LANL's total land area. This section applies both total land area and buildable land area as the basis for analysis in the evaluation of the three alternatives.

To assess the effects on land use, this analysis uses a conservative approach and is based on the highest estimated land disturbance identified in Chapter 3 of this SWEIS. For example, the analysis of solar PV installation under the Modernized Operations Alternative uses a maximum disturbance of up to 795 acres of land, even though the actual disturbance likely would be far less. This analysis also specifically analyzes "notable" or "large" projects/facilities, that is, projects that individually or in aggregate (e.g., multiple office buildings, warehouses, or laboratories) disturb more than 50,000 square feet (building and land). Individual actions less than 50,000 square feet are aggregated for each alternative to assess site-wide land use impacts.

5.2.1.1 No-Action Alternative

Table 5.2-1 summarizes the permanent changes to the facility and infrastructure footprint for each planning area under the No-Action Alternative. As shown on the table, approximately 34 acres of new facilities would be constructed, and 37 acres would undergo DD&D. Approximately 132 acres would be required for new utility and infrastructure projects on site. In addition to the permanent land disturbances, there would be up to 84 acres of temporary land disturbance under the No-Action Alternative. Temporary land disturbances encompass construction staging areas, temporary access roads, and land areas altered for the interment of subterranean infrastructure. These lands would be reverted to their original state upon each project's completion. Of the 166-acre permanent onsite development footprint, 104 acres would occur on previously developed land and 62 acres would occur on greenfields.[42]

[42] Greenfields are lands on which no development has previously taken place.

Table 5.2-1 No-Action Alternative Permanent Land Disturbances (in acres)[a,b,c]

Planning Area	Facility Construction Footprint	Infrastructure Construction Footprint	Total Development Footprint	DD&D Footprint	Net Change in Footprint[d]
Core Area	5.1	11.8	16.9	27.0	(10.1)
Pajarito Corridor	21.9	44.0	65.9	7.3	58.7
NEEWC	4.5	62.7	67.2	2.4	64.9
LANSCE	1.0	1.1	2.1	0.4	1.7
Balance of Site	1.3	12.6	13.9	0.4	13.5
TOTALS	**33.8**	**132.2**	**166.0**	**37.5**	**128.7**

DD&D = decontamination, decommissioning, and demolition; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex

a Developed land area outlined in this table includes all permanent facility, utility, infrastructure, and institutional laydown areas on site; temporary and/or offsite land disturbances and developments are not reflected in the end-state figures presented.

b The institutional laydown areas developed for the No-Action Alternative (29 acres) are assumed to be continually used to meet future laydown requirements. While these laydown areas may eventually be reclaimed, this SWEIS does not credit that reclamation in its land use impacts evaluation.

c Under the No-Action Alternative, there would be 52 acres of temporary land disturbance on site and 32 acres of offsite, temporary land disturbance from the EPCU (NNSA 2023b). The EPCU project would permanently disturb 8 acres off site for roads. These temporary and offsite figures are not reflected in this table.

d Parenthesis indicates a negative change.

Table 5.2-2 provides the total developed land area after accounting for actions under the No-Action Alternative. Under this alternative, LANL's footprint would increase by an additional 129 acres over existing conditions to about 3,415 acres, which results in an end-state development footprint of 13 percent of LANL's total land area and 47 percent of the buildable land area. This is a 4-percent increase over the existing environment.

Table 5.2-2 No-Action Alternative Developed Land Area (in acres)[a]

Planning Area	Total Land Area	Buildable Land Area	Developed Land Area		
			Existing	No-Action Alternative	Percent Change[b]
Core Area	564	382	354	344	(3)
Pajarito Corridor	1,148	616	383	442	15
NEEWC	11,438	3,685	1,366	1,431	5
LANSCE	751	272	224	226	1
Balance of Site	11,635	2,351	959	972	1
TOTALS	**25,536**	**7,306**	**3,286**	**3,415**	**4**

LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex

a Developed land area outlined in this table includes all permanent facility, utility, infrastructure, and institutional laydown areas on site; temporary and/or offsite land disturbances and developments are not reflected in the end-state figures presented.

b Parenthesis indicates a negative change.

Table 5.2-3 highlights the changes to the facility footprint (area and development density) for each planning area under the No-Action Alternative. Net, the facility footprint at LANL under the No-Action Alternative would decrease by 158,000 square feet, or 2 percent.

Table 5.2-3 No-Action Alternative Facility (gross square feet) and Development Density[a]

Planning Area	Existing Environment		No-Action Alternative		
	GSF	Development Density	GSF	Development Density	Percent Change[a,b]
Core Area	3,805,000	9,961 GSF / buildable acre	2,850,000	7,461 GSF / buildable acre	(25)
Pajarito Corridor	1,966,000	3,192 GSF / buildable acre	2,605,000	4,229 GSF / buildable acre	33
NEEWC	1,136,000	308 GSF / buildable acre	1,230,000	334 GSF / buildable acre	8
LANSCE	983,000	3,614 GSF / buildable acre	1,009,000	3,710 GSF / buildable acre	3
Balance of Site	298,000	127 GSF / buildable acre	336,000	143 GSF / buildable acre	13
TOTALS	**8,188,000**	**1,121 GSF / buildable acre**	**8,030,000**	**1,099 GSF / buildable acre**	**(2)**

GSF = gross square feet; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex

a Percentage change is calculated from the change in GSF.

b Parenthesis indicates a negative change.

Under the No-Action Alternative, LANL would experience moderate changes to its land use from the construction of new facilities and infrastructure and DD&D activities. Facility area and development density would decrease by 2 percent and developed land area would increase by 4 percent. Development and DD&D actions would be a continuation of past land uses and not represent a notable departure from historical uses.

Continuing LANL's environmental remediation would reduce the area of land and property at LANL that is contaminated with radioactive or hazardous constituents. There would be a wider range of options for future use of this land and property. However, many, if not most, of the potential release sites being addressed as part of the Consent Order are near other operating facilities. Operation of these facilities, and the missions conducted within the TAs containing these facilities, are largely independent of remediation actions for individual sites. Therefore, continuing the environmental remediation would probably not change many basic restrictions such as control of access to LANL and particular TAs. Restrictions would likely continue consistent with security or safety needs. Within the context of the overall Laboratory mission, continuing the environmental remediation could result in expanded options for some lands and property.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in direct impacts to land use. Completion of environmental remediation activities, including potential DD&D of facilities, may allow possible changes in future land use. Environmental remediation activities would proceed in accordance with existing and developing plans. The potential indirect impacts of the conveyance and transfer of the tracts would include regional changes in land use, such as the development of forest, grazing, and open-space land for residential and commercial uses. Future land use patterns could change on several tracts.

Approximately 625 acres of the remaining acreage proposed for transfer and conveyance could be developed or redeveloped for other uses. This estimate is based on the remaining tracts in Rendija Canyon (570 acres) and TA-21 (55 acres) that were considered for residential, commercial, or industrial development in the CT EIS. There is the potential for the introduction of land uses that would be incompatible with adjacent landowners' resource protection efforts. There may be loss of recreational opportunities currently enjoyed on some tracts (DOE 1999b). For TA-74 and White Rock "Y" tracts, no development beyond utility and transportation corridors would be expected.

Core Area

The notable projects slated for the Core Area Planning Area under the No-Action Alternative include the construction of 23 office buildings totaling 207,000 square feet and an 80,000-square-foot upgrade to the existing steam plant. As the oldest developed area of LANL, many of its facilities are well past the end of their useful life and are scheduled for DD&D. Accordingly, facility area and development density for the No-Action Alternative would decrease by 25 percent over existing conditions. Notwithstanding a net reduction of 955,000 square feet of facility space, under the No-Action Alternative, the Core Area Planning Area would still house the greatest overall amount and concentration of development in the smallest planning area (as measured by land area). If all projects under the No-Action Alternative were implemented, the Core Area Planning Area's buildable land area would be considered 93-percent developed. Land use actions in the Core Area Planning Area, whether development or DD&D, would be consistent with past activity in this area.

As identified in Chapter 3, Section 3.2.2, the Laboratory is considering an option that would allow continued use of elements of the CMR facility beyond the planned DD&D date of 2031. If that were to occur, there would be about 565,000 square feet of DD&D that would be delayed until after 2038; therefore, the removal of facilities from that land would not occur. The land would continue to be used for the existing CMR building. Any future facilities planned for the CMR site would be required to relocate to available real estate on site.

Pajarito Corridor

The notable projects slated for the Pajarito Corridor Planning Area under the No-Action Alternative are the construction of 13 office buildings totaling 385,000 square feet, the 150,000-square-foot TA-48 parking structure, a 130,000 square-foot training and development center, and seven warehouses totaling 118,000 square feet. These projects account for the bulk of the proposed development under this alternative. Facility square footage and development density under the No-Action Alternative would increase by 33 percent over existing conditions; this is the highest increase among the planning areas and is caused primarily by the increase in pit production.

In addition to facility development, 24 of the 29 acres of infrastructure projects are designated for the development of institutional construction laydown areas in the Pajarito Corridor Planning Area. Unlike traditional laydown areas that are typically sited in close proximity to a single project and reclaimed after a project's completion, these institutional areas were selected for their proximity to support multiple projects at LANL and could be used past the end of the analytical period for this SWEIS. If all projects under the No-Action Alternative were implemented, the Pajarito Corridor Planning Area's buildable land area would be considered 62-percent developed.

NEEWC

The single notable facility slated for the NEEWC Planning Area under the No-Action Alternative is the 75,000-square-foot EMCF project. In addition to the 1.7-acre disturbance for the EMCF, a 10-MW solar PV array would disturb 45 acres (40 acres of greenfields and 5 acres of previously disturbed land). This is the single-largest project in this planning area under this alternative and accounts for 72 percent of the total 62.7-acre development footprint. A 3-acre wood yard is also slated to be located within the NEEWC. The NEEWC Planning Area would experience increases for both development density and developed land area of 8 percent and 5 percent, respectively. If all projects under the No-Action Alternative were implemented, the NEEWC Planning Area's buildable land area would be considered 37-percent developed.

LANSCE

No notable facility construction is planned for the LANSCE Planning Area under the No-Action Alternative. The facility footprint in the LANSCE Planning Area would increase by 26,000 square feet, a 3-percent increase in facility area and development density. The construction of the Light Manufacturing Laboratory is expected to be completed and begin operations in 2026. If all projects under the No-Action Alternative were implemented, the LANSCE Planning Area's buildable land area would be considered 82-percent developed.

Balance of Site

Other than the construction of the East Jemez Road Fire Station in TA-61 (about 15,000 square feet), no notable facility construction is planned under the No-Action Alternative in the Balance of Site Planning Area. The East Jemez Road Fire Station would introduce a new facility on previously undeveloped land adjacent to the Elk Ridge Community, an onsite residential development. The siting of the station would result in reduced emergency response times and enhanced public safety to the residents of Elk Ridge. Under the No-Action Alternative, the facility footprint in the Balance of Site Planning Area would increase by 38,000 square feet, representing a 13-percent increase in facility area and development density. Development would be spread among multiple projects with no single structure posing notable impacts. If all projects under the No-Action Alternative were implemented, the Balance of Site Planning Area's buildable land area would be considered 41-percent developed. As the planning area is the least densely developed, at only 143 square feet of facilities per buildable acre, with implementation of the No-Action projects, the minimal site disturbance would not change current or future land use designations.

The Balance of Site Planning Area includes actions and facilities located off site. A notable utility and infrastructure action that has both on- and offsite components would be the EPCU project. As shown on Figure A.3.2-5 in Appendix A, this project would construct a 14-mile-long transmission line across the Santa Fe National Forest off site to the southeast of LANL, and would require the conversion of approximately 170 acres of land as a new ROW for the transmission lines. Additionally, there would be 52 acres of temporary land disturbance on site and 32 acres of offsite temporary land disturbance. The EPCU project would also permanently disturb 8 acres off site for roads. The impacts to land use from this project were separately analyzed in the 2023 EPCU Draft EA; however, the project would use previously disturbed land for temporary and permanent disturbance to the extent practicable (NNSA 2023b). Implementation of the EPCU project under the No-Action Alternative would not occur until completion of the separate, parallel NEPA process. The No-Action Alternative also includes the installation of a second fiber optic line;

because that line would use existing rights of way, it would not result in additional land use impacts.

An additional offsite action that potentially could affect land use is the park-and-ride pilot project between an offsite location near US-285 in Pojoaque and the Pajarito Corridor. The pilot project would use an existing lot; depending on adoption rates, this project has potential to produce minor short- and long-term land use impacts in Pojoaque during operations.

5.2.1.2 Modernized Operations Alternative

Table 5.2-4 summarizes the permanent changes to the facility and infrastructure footprint for each planning area under the Modernized Operations Alternative. As shown on the table, approximately 79 acres of new facilities would be constructed, and 28 acres of excess facilities would undergo DD&D. Approximately 928 acres would be required for new utility and infrastructure projects. Of the 1,007-acre permanent development footprint, 266 acres would occur on previously developed land and 731 acres could occur on greenfields.

Table 5.2-4 Modernized Operations Alternative Permanent Land Disturbances (in acres)[a,b,c]

Planning Area	Facility Construction Footprint	Infrastructure Construction Footprint [b]	Total Development Footprint	DD&D Footprint	Net Change in Footprint
Core	33.3	24.6	57.9	12.5	45.4
Pajarito Corridor	19.5	82.8	102.3	7.6	94.7
NEEWC	11.9	463.0	447.9	2.8	472.1
LANSCE	4.2	8.5	12.7	1.8	10.9
Balance of site	9.9	349.0	358.9	3.2	355.7
TOTALS	**78.8**	**927.9**	**1,006.7**	**27.9**	**978.6**

DD&D = decontamination, decommissioning, and demolition; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex; PV = photovoltaic

a Developed land area outlined in this table includes all permanent facility, utility, infrastructure, and institutional laydown areas on site; temporary and/or offsite land disturbances and developments are not reflected in the end-state figures presented.

b The institutional laydown areas developed for the Modernized Operations Alternative (38 acres) are assumed to be continually used to meet future laydown requirements. While these laydown areas may eventually be reclaimed, this SWEIS does not credit that reclamation in its land use impacts evaluation.

c Under the Modernized Operations Alternative, there would be up to 795 acres of land disturbance for solar PV arrays.

Table 5.2-5 details the total developed land area after accounting for facility construction, utility installations, infrastructure projects, and DD&D actions under the Modernized Operations Alternative. Under this alternative, LANL's footprint would increase by an additional 979 acres over the No-Action Alternative to 4,393 acres, which results in an end-state development footprint of 17 percent of LANL's total land area and 60 percent of the buildable land area, which is a 29-percent increase over the buildable land area under the No-Action Alternative.

Table 5.2-5 Modernized Operations Alternative Developed Land Area (in acres)[a]

Planning Area	Total Land Area	Buildable Land Area	Developed Land Area		
			No-Action Alternative	Modernized Operations Alternative	Percent Change
Core Area	564	382	344	389	13
Pajarito Corridor	1,148	616	442	536	21
NEEWC	11,438	3,685	1,431	1,903	33
LANSCE	751	272	226	237	5
Balance of Site	11,635	2,351	972	1,328	37
TOTALS	**25,536**	**7,306**	**3,415**	**4,393**	**29**

LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex

a Developed land area outlined in this table includes all permanent facility, utility, infrastructure, and institutional laydown areas on site; temporary and/or offsite land disturbances and developments are not reflected in the end-state figures presented.

Table 5.2-6 highlights the changes to the facility footprint (area and development density) for each planning area. Net, the facility footprint at LANL under the Modernized Operations Alternative would increase by 2,214,000 square feet, or 28 percent.

Table 5.2-6 Modernized Operations Alternative Facility (gross square feet) and Development Density

Planning Area	No-Action Alternative		Modernized Operations Alternative		
	GSF	Development Density	GSF	Development Density	Percent Change[a]
Core Area	2,850,000	7,461 GSF / buildable acre	3,754,000	9,827 GSF / buildable acre	32
Pajarito Corridor	2,605,000	4,229 GSF / buildable acre	3,123,000	5,070 GSF / buildable acre	20
NEEWC	1,230,000	334 GSF / buildable acre	1,626,000	441 GSF / buildable acre	32
LANSCE	1,009,000	3,710 GSF / buildable acre	1,114,000	4,096 GSF / buildable acre	10
Balance of Site	336,000	143 GSF / buildable acre	627,000	267 GSF / buildable acre	87
TOTALS	**8,021,000**	**1,099 GSF / buildable acre**	**10,244,000**	**1,402 GSF / buildable acre**	**28**

GSF = gross square feet; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex

a Percentage change is calculated from the change in GSF.

The projects proposed under the Modernized Operations Alternative are described in Chapter 3, Section 3.3. Land uses at LANL are compatible with the existing land uses and approved land use designations and policies surrounding the site. The types of land uses at LANL are not proposed to change, and the general development patterns at the site would be retained. No major alterations in the types of land uses would result from implementing the Modernized Operations Alternative.

Core Area

The Core Area Planning Area would grow its facility footprint by 904,000 square feet, or 32 percent, under the Modernized Operations Alternative. This accounts for 41 percent of all of the square footage added under this alternative. The notable facilities include nine office buildings totaling 183,500 square feet, nine laboratories totaling 895,000 square feet, two parking facilities totaling 246,000 square feet, and a 50,000-square-foot visitor and conference center. Although these represent a large overall area of development and land disturbance, the annualized percentage increase over the No-Action Alternative levels is in line with the site average at 2 percent. As the Core Area Planning Area is the oldest area of the site, nearly all development would occur on previously developed land. Development proposed for the Core Area Planning Area would be consistent with historical patterns, current uses, and the future vision for a densely developed mini-campus that encourages collaboration.

The largest infrastructure project proposed for the Core Area Planning Area under the Modernized Operations Alternative is the Los Alamos Canyon Bridge replacement. This project would replace the existing bridge and disturb an estimated 11.5 acres of land. The north side of the bridge would be on land currently occupied by the Health Research Laboratory, which would undergo DD&D prior to bridge construction. No enduring land use effects are expected, as it is a like-kind replacement for the existing bridge although there would be a reconfiguration of traffic patterns that correspond to the new bridge location. The existing bridge would be expected to be retained after the new bridge is operational and could be used for bicycles and pedestrians.

If all projects under the Modernized Operations Alternative were implemented, the Core Area Planning Area's already dense development footprint would be considered more than fully developed at 102 percent. Although the conservatively estimated footprint surpasses the total area of land classified as buildable, this is still in keeping with the long-term land planning for the Core Area Planning Area as outlined in the CMP. As the buildable area of the Core Area Planning Area is exhausted, future facility and infrastructure construction would occur on harder-to-develop sites. Additionally, many of the facilities proposed under the Modernized Operations Alternative are not planned for construction for several years and there are no current proposals to build facilities on the "harder-to-develop" sites. As planning evolves, the specific facility sizes (more accurate as a result of increased certainty of design) would be accommodated within available locations.

Pajarito Corridor

Under the Modernized Operations Alternative, the Pajarito Corridor Planning Area would see the construction of nine office buildings totaling about 158,000 square feet, nine laboratories totaling 154,700 square feet, and three parking structures totaling 360,000 square feet. Another large facility proposed for the Pajarito Corridor Planning Area is the 45,000-square-foot BTF replacement; all other development would be smaller facilities dispersed throughout the planning area. Facility square footage and development density under the Modernized Operations Alternative would increase by 20 percent over the No-Action Alternative. Under the Modernized Operations Alternative, 19 acres of land in TA-52 and TA-63 would be disturbed for the development of institutional construction laydown areas, as reflected in Tables 5.2-5 and 5.2-6. If all projects under the Modernized Operations Alternative were implemented, the Pajarito Corridor Planning Area's buildable land area would be considered 87-percent developed. This represents a 40-percent change from the No-Action Alternative; the site average is 33 percent.

NEEWC

Facility square footage and development density for the NEEWC Planning Area under the Modernized Operations Alternative would increase by 32 percent over the No-Action Alternative, in line with the site average for this alternative. The two notable facilities accounting for this change are the RACR at 70,000 square feet and the NGTS/S at 65,000 square feet. The NEEWC Planning Area would also see the construction of six office buildings totaling 76,000 square feet and four laboratories totaling 92,000 square feet.

The largest infrastructure and utility project proposed under the Modernized Operations Alternative is the solar PV array project. This project has the potential to disturb up to 795 acres across four planning areas, 426 acres of which would be in the NEEWC Planning Area. This would be the largest single project affecting land use in the NEEWC Planning Area. The 426 acres would be dispersed among three large installations; this project would account for 94 percent of the total disturbance analyzed for the NEEWC Planning Area under this alternative. As noted in Section 3.3.1, although the 795 acres of potential sites were initially evaluated, it is unlikely that all the sites and their acreage would be available for solar PV arrays (the Laboratory expects about half would be implemented).

If all projects under the Modernized Operations Alternative were implemented, the NEEWC Planning Area's buildable land area would be considered 52-percent developed. Because the NEEWC Planning Area is on more than 11,000 acres of largely undeveloped land, and the fact that the major facilities would be dispersed in different areas throughout the site, the projects would not represent a substantial change of land uses, and the existing open character of the planning area would remain unaltered.

LANSCE

No notable facility construction is proposed under the Modernized Operations Alternative in the LANSCE Planning Area. Under the No-Action Alternative, the facility footprint at LANSCE would increase by 105,000 square feet. This represents the lowest-percent change for facility square footage and development density under the No-Action Alternative, at 10 percent or less than 1 percent annually. The relocation and upgrade of the TA-53 substation is the sole notable infrastructure project proposed under the Modernized Operations Alternative in the LANSCE Planning Area. The project would disturb approximately 2.4 acres of land. If all the proposed utility and infrastructure projects are implemented, 8.5 acres of land would be disturbed (0.6 acres annually). With implementation of this alternative, the LANSCE Planning Area's buildable land area would be considered 87-percent developed, a 6-percent increase over the No-Action Alternative.

Balance of Site

Under the Modernized Operations Alternative, the Balance of Site Planning Area would experience the highest percent increases to both facility square footage and developed land area at 87 and 38 percent, respectively. The high percentage increases to facility square footage and development density are chiefly because the Balance of Site Planning Area has the lowest existing square footage of facilities by a wide margin (roughly one-third as much as the next-smallest planning area) and a moderate increase in facilities of 291,000 over the 15-year analytical period results in a high percentage change.

The change to developed land area stems primarily from two potential infrastructure projects: the solar PV array system, with a maximum land disturbance of 334 acres, and the TA-72 remote parking and bus transfer station, with an estimated 25 acres of land disturbance. As identified in Chapter 3, Section 3.3.1, the solar PV installations in the Balance of Site Planning Area would be dispersed throughout the planning area at six separate sites. Renewable energy projects represent a new land use for the Balance of Site Planning Area but would be necessary to achieve the NNSA's goal to lower GHG emissions and reduce reliance on offsite power. The remote parking and bus transfer station would help to alleviate congestion in the Core Area Planning Area and would change the character of the land from currently undeveloped to part of the transportation and parking infrastructure. If all projects under the Modernized Operations Alternative were implemented, the Balance of Site Planning Area's buildable land area would be considered 56-percent developed. Although it would experience the highest percentage change to facility footprint and developed area, the Balance of Site Planning Area would remain the least developed planning area at only 267 square feet of facilities per buildable acre. The Balance of Site Planning Area would retain its characteristic open space and overall restrained development patterns.

5.2.1.3 Expanded Operations Alternative

Table 5.2-7 summarizes the permanent changes to the facility and infrastructure footprint for each planning area under the Expanded Operations Alternative. In addition to the land disturbances outlined for the Modernized Operations Alternative, the approximately 21 acres of new facilities would be constructed with no additional DD&D. Approximately 46 acres would be required for new utility and infrastructure projects. Of the 67-acre permanent development footprint, 31 acres would occur on previously developed land and 36 acres would occur on greenfields. In addition to the permanent land disturbances, there would be 68 acres of temporary onsite land disturbances.

Table 5.2-7 Expanded Operations Alternative Permanent Land Disturbances (in acres)[a,b,c]

Planning Area	Facility Construction Footprint	Infrastructure Construction Footprint	Total Development Footprint	DD&D Footprint	Net Change in Footprint
Core Area	0.2	13.5	13.8	0	13.8
Pajarito Corridor	6.6	0.2	6.8	0	6.8
NEEWC	7.0	0.8	7.9	0	7.9
LANSCE	4.5	11.1	15.6	0	15.6
Balance of Site	2.9	20.0	22.9	0	22.9
TOTALS	**21.2**	**45.6**	**67.0**	**0**	**67.0**

DD&D = decontamination, decommissioning, and demolition; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex; PV = photovoltaic

a The data in this table represent the increase above the Modernized Operations Alternative and **do not** include the Modernized Operations Alternative figures.

b Developed land area outlined in this table includes all permanent facility, utility and infrastructure areas on site; temporary land disturbances are not reflected in the end-state figures presented.

c Under the Expanded Operations Alternative, there would be 68 acres of temporary land disturbance not reflected in this table.

Table 5.2-8 details the total developed land area after accounting for facility construction, utility installations, infrastructure projects, and DD&D actions under the Expanded Operations Alternative. Under this alternative, LANL's footprint would increase by an additional 1,045 acres over the No-Action Alternative to 4,460 acres, which results in an end-state development footprint of 17 percent of LANL's total land area and 61 percent of the buildable land area. This is a 31-percent increase over the No-Action Alternative.

Table 5.2-8 Expanded Operations Alternative Developed Land Area (in acres)[a,b]

Planning Area	Total Land Area	Buildable Land Area	Developed Land Area		
			No-Action Alternative	Expanded Operations Alternative[b]	Percent Change
Core Area	564	382	344	403	17
Pajarito Corridor	1,148	616	442	543	23
NEEWC	11,438	3,685	1,431	1,911	34
LANSCE	751	272	226	252	12
Balance of Site	11,635	2,351	972	1,351	39
TOTALS	**25,536**	**7,306**	**3,415**	**4,460**	**31**

LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex

a The data in this table include all figures from the Modernized Operations Alternative as well as the Expanded Operations Alternative, showing the cumulative totals.

b Developed land area outlined in this table includes all permanent facility, utility, infrastructure, and institutional laydown areas on site; temporary and/or offsite land disturbances and developments are not reflected in the end-state figures presented.

Table 5.2-9 highlights the changes to the facility footprint by square feet and the development density for each planning area under the Expanded Operations Alternative. Net, the facility footprint at LANL under the Modernized Operations Alternative would increase by 3,140,000 square feet, or 39 percent.

Table 5.2-9 Expanded Operations Alternative Facility (gross square feet) and Development Density[a,b]

Planning Area	No-Action Alternative		Expanded Operations Alternative		
	GSF	Development Density	GSF	Development Density	Percent Change[a]
Core Area	2,850,000	7,461 GSF / buildable acre	3,764,000	9,853 GSF / buildable acre	32
Pajarito Corridor	2,605,000	4,229 GSF / buildable acre	3,410,000	5,536 GSF / buildable acre	31
NEEWC	1,230,000	334 GSF / buildable acre	1,933,000	525 GSF / buildable acre	57
LANSCE	1,009,000	3,710 GSF / buildable acre	1,311,000	4,820 GSF / buildable acre	30
Balance of Site	336,000	143 GSF / buildable acre	752,000	320 GSF / buildable acre	124
TOTALS	**8,030,000**	**1,099 GSF / buildable acre**	**11,170,000**	**1,529 GSF / buildable acre**	**39**

GSF = gross square feet; LANSCE = Los Alamos Neutron Science Center; NEEWC = National Energetic and Engineering Weapons Complex

a The data in this table include all figures from the Modernized Operations Alternative as well as the Expanded Operations Alternative, showing the cumulative totals.

b Percentage change is calculated from the change in GSF.

The proposed Wildland Fire and Forest Management Program would affect land use in every planning area under the Expanded Operations Alternative (LANL 2024d). This program would affect lands throughout LANL along evacuation corridors and fire roads, around every facility and infrastructure installations, and in existing forested lands. The program was established to create revised site-wide fire mitigation treatment standards to meet the current climate and wildland fire conditions. The program would strive to create a mosaic landscape of openings, groups, and clumps in LANL's undeveloped areas to achieve a maximizing diversity of species, age classes, and age groups. Forested areas would generally remain forested though increased management activity would change their appearance over time to meet the program's goals.

Core Area

Under the Expanded Operations Alternative, the Core Area Planning Area's facility footprint would not grow appreciably above the Modernized Operations Alternative. Facility square footage and development density under the Expanded Operations Alternative would increase by less than 1 percent above the Modernized Operations Alternative, or 32 percent over the No-Action Alternative. Utility and infrastructure projects would add 13.5 acres to the already fully built-out Core Area Planning Area. If the proposed Microreactor Project were to be sited in the Core Area Planning Area, the land use would include power production in addition to administrative and weapons support. Additionally, many of the facilities proposed under the Modernized and Expanded Operations alternatives are not planned for construction for several years. As planning evolves, the specific facility sizes would be accommodated within available locations.

Pajarito Corridor

The majority of new development area proposed under the Expanded Operations Alternative for the Pajarito Corridor Planning Area is related to the SPDP, as detailed in Chapter 3, Section 3.4.1. This program would require 221,700 square feet of new facilities. As noted in Section 3.4.1, SPDP SPDP is currently delayed by 10 years. The Laboratory could implement a limited enhancement of ARIES instead. If that enhancement and increased throughput were to occur, it would be contained within existing structures and there would be no new construction or changes to land use.

Another notable project would be TRU waste staging, which includes four 60,000-square-foot staging areas, one of which could be in the Pajarito Corridor. Facility square footage and development density under the Expanded Operations Alternative would increase by 33 percent over the No-Action Alternative. No notable utility or infrastructure projects are proposed for this planning area under this alternative. If all projects proposed under the Expanded Operations Alternative were implemented, the Pajarito Corridor Planning Area's buildable land area would be considered 88-percent developed.

NEEWC

Four projects with large potential land disturbances proposed for the NEEWC Planning Area under the Expanded Operations Alternative are the FSI/HPC mission expansion and the associated WTF and supporting water pipelines, the potential development of a new firing site in TA-68, and a new 60,000-square-foot TRU waste staging location. The FSI/HPC would require a 100,000-square-foot main facility and 25,000-square-foot staging facility. The proposed FSI WTF would support the water needs for this facility. The WTF would require three pipelines with approximately 27.5 acres of temporary land disturbance for pipeline construction. After construction of the pipelines, all disturbed land would be regraded and restored to pre-construction conditions. The only permanent land use impacts would be the 5,000-square-foot WTF and associated infrastructure. The Laboratory is considering options for additional firing site capability. As identified in Chapter 3, Section 3.4.1, there are two options that are being considered in this SWEIS. One option would increase the current HE limit for shots at the firing point 88 in TA-33, but would not expand or develop additional land. The other option would be to develop a new firing site at Water Canyon in TA-68. The new firing site would require approximately 2 acres of currently undeveloped land in Water Canyon, which would change its current land use.

Facility area and development density under the Expanded Operations Alternative would increase by 57 percent over the No-Action Alternative. No large utility or infrastructure projects are proposed for the NEEWC Planning Area. If all projects under the Expanded Operations Alternative were implemented, the NEEWC Planning Area's buildable land area would be considered 52-percent developed.

LANSCE

The single large project proposed in the LANSCE Planning Area under the Expanded Operations Alternative is the 192,000-square-foot DMMSC, which would require 40 acres of temporary laydown areas to support its construction. These would not be considered institutional laydown areas and would be restored post-construction. The project would be co-located with the existing LINAC and would be a complimentary structure with negligible effects to land use in the LANSCE Planning Area. The LANSCE Planning Area is another possible location for the siting of the Microreactor Project; the effects on land use would be the same as described for the Core Area Planning Area. Facility square footage and development density under the Expanded Operations Alternative would increase by 30 percent over the No-Action Alternative. If all projects under the Expanded Operations Alternative were implemented, the NEEWC Planning Area's buildable land area would be considered 91-percent developed.

Balance of Site

While no notable new facilities are proposed in the Balance of Site Planning Area under the Expanded Operations Alternative, two TRU waste staging locations totaling 120,000 square feet are proposed under this alternative. Facility square footage and development density under the Expanded Operations Alternative would increase by 124 percent over the No-Action Alternative. The reason behind this large percentage increase is the large projects described for the Modernized Operations Alternative in Section 5.2.1.2. The largest utility project proposed under the Expanded Operations Alternative is the Pumped Hydropower Demonstration, which would span between the NEEWC Planning Area and Balance of Site Planning Area in TA-49 and TA-39. This project would disturb 20 acres of mostly previously undisturbed land. The proposed location on the southwestern side of LANL is mostly undisturbed open space and borders Bandelier National Monument. This project would be similar to previous and current uses of the NEEWC and Balance of Site planning areas as a testing site and proving grounds. If all projects proposed under the Expanded Operations Alternative were implemented, the Balance of Site Planning Area's buildable land area would be considered 57-percent developed.

5.2.1.4 Summary of Land Use Impacts

The three alternatives represent a continuation of land uses at LANL. In the three highest-density planning areas (Core Area, Pajarito Corridor, and LANSCE), actions would occur within the context of existing development. In the lower-density planning areas (NEEWC and Balance of Site), operations would be dispersed throughout the areas. None of the planning areas would experience an appreciable change to its established land use patterns; the high-density planning areas would retain their development patterns, and the open space character of the low-density planning areas would be retained. No land acquisitions would occur under any alternative. Tables 5.2-10 and 5.2-11 and Figures 5.2-1 and 5.2-2 present a summary of the impacts for each alternative.

Table 5.2-10 Summary of Land Development Impacts for each Alternative (in acres)[a]

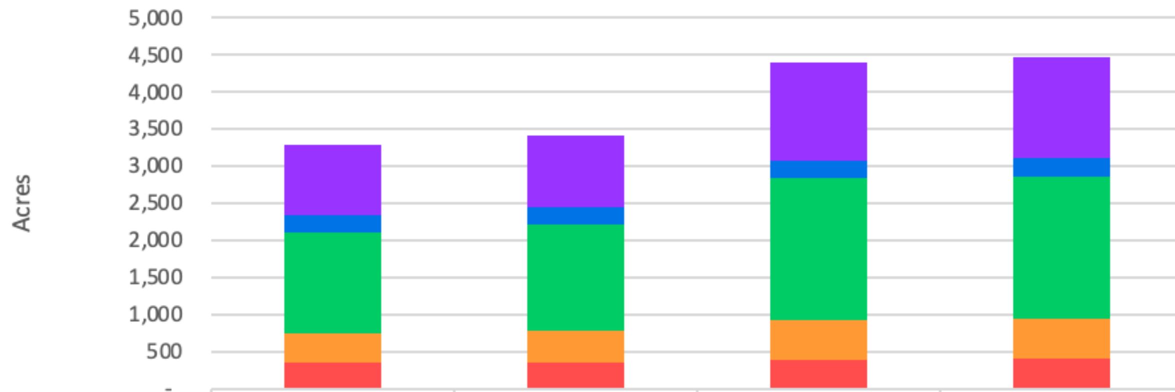
Planning Area	Total Land Area	Buildable Land Area	No-Action Alternative		Modernized Operations Alternative		Expanded Operations Alternative	
			Developed Land Area	Percent Developed [b]	Developed Land Area	Percent Developed [b]	Developed Land Area	Percent Developed [b]
Core Area	564	382	344	90	389	102[c]	403	105[c]
Pajarito Corridor	1,148	616	442	72	536	87	543	88
NEEWC	11,438	3,685	1,431	39	1,903	52	1,911	52
LANSCE	751	272	226	83	237	87	252	93
Balance of Site	11,635	2,351	972	41	1,328	56	1,351	57
TOTALS	**25,536**	**7,306**	**3,415**	**47**	**4,375**	**60**	**4,460**	**61**

a As illustrated in Figure 3.1-2, the Modernized Operations Alternative includes the No-Action Alternative, and the Expanded Operations Alternative includes both the Modernized Operations Alternative and the No-Action Alternative.
b Based on “buildable land area.”
c The amount of “buildable land area” was determined using geographic information system data and represents areas with minimal constraints to development (e.g., areas of less than 20-precent slope). As the buildable area of the Core Area Planning Area is exhausted, future building would occur on harder-to-develop sites. See subsection “Core Area"’ under Section 5.2.1.2 for a detailed explanation.

Table 5.2-11 Summary of Facility Development Impacts for each Alternative (square feet)[a]

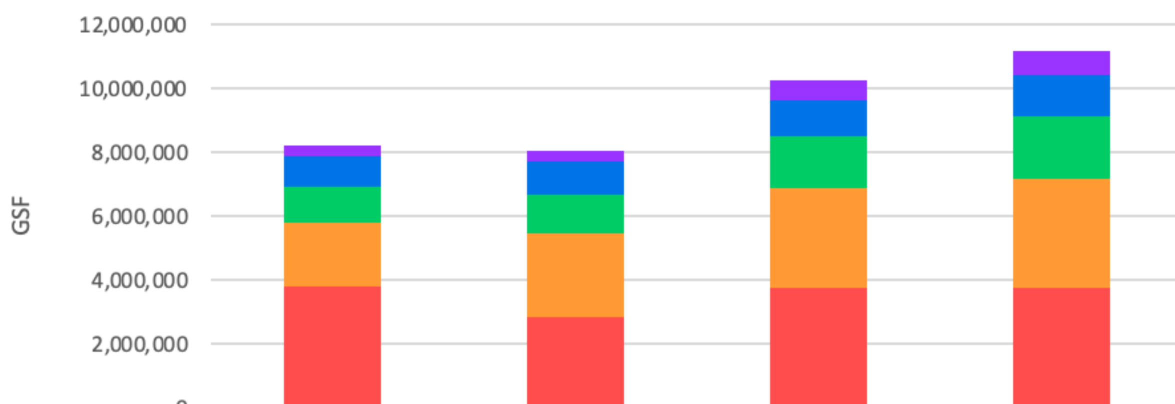
Planning Area	Existing Environment	No-Action Alternative		Modernized Operations Alternative		Expanded Operations Alternative	
		GSF	Percent Change[a,b]	GSF	Percent Change[c]	GSF	Percent Change[c]
Core Area	3,805,000	2,850,000	(25)	3,754,000	32	3,764,000	32
Pajarito Corridor	1,966,000	2,605,000	33	3,123,000	20	3,410,000	31
NEEWC	1,136,000	1,230,000	8	1,626,000	32	1,933,000	57
LANSCE	983,000	1,009,000	3	1,114,000	10	1,311,000	30
Balance of Site	298,000	336,000	13	627,000	87	752,000	124
TOTALS	**8,188,000**	**8,030,000**	**(2)**	**10,241,000**	**28**	**11,128,000**	**39**

a Percentage change is calculated from the Existing Environment.
b Parenthesis indicates a negative change.
c Percentage change is calculated from the No-Action Alternative.



	Existing Environment	No-Action	Modernized Operations	Expanded Operations
Balance	959	972	1,328	1,351
LANSCE	224	226	237	252
NEEWC	1,366	1,431	1,903	1,911
Pajarito Corridor	383	442	536	543
Core	354	344	389	403

Figure 5.2-1 Total Developed Land Area for each Alternative (acres)



	Existing Environment	No-Action	Modernized Operations	Expanded Operations
Balance	298,000	336,000	627,000	752,000
LANSCE	983,000	1,009,000	1,114,000	1,311,000
NEEWC	1,136,000	1,230,000	1,626,000	1,933,000
Pajarito Corridor	1,966,000	2,605,000	3,123,000	3,410,000
Core	3,805,000	2,850,000	3,754,000	3,764,000

Figure 5.2-2 Total Facility Gross Square Footage for each Alternative

Under the No-Action Alternative, the built environment would shrink in size due to more planned DD&D than facility construction; however, due to new infrastructure and utility projects, the total developed land area would increase. Under the No-Action Alternative, the buildable land area at LANL would be considered 45-percent developed. Under both the Modernized Operations and

Expanded Operations alternatives, the facility footprint and developed land area would increase. Not all new projects would affect land use; many would involve actions within or modifications to existing structures or construction of new facilities that lie within previously developed areas of LANL; Figure 5.2-3 shows the total disturbed acreage of greenfields versus previously developed lands under each alternative. As mentioned earlier, the primary project that would contribute to new land development would be the solar PV arrays. The Modernized Operations and Expanded Operations alternatives would not represent a change in land uses nor lead to a conflict with existing uses. With implementation of the Modernized Operations and Expanded Operations alternatives, the buildable land area at LANL would be considered 60-percent and 61-percent developed, respectively.

LANL property is predominately open space, and none of the alternatives would change the current or future land use designation. Because activities under each alternative represent a continuation of existing land uses, they would be compatible with existing and approved future land uses at and surrounding the site. The enduring land disturbance from permanent facilities is compatible with existing and planned land uses at LANL. There would be no conflicts with established land uses on or off site, no land acquisition, and no conflicts with land use control plans. The increase in square footage and total area of land disturbance is not negligible but is consistent with past and current uses. Due to this continuation of land uses, impacts are expected to be minimal. As most of the proposed projects under the three alternatives are replacements for aging facilities and infrastructure, land use impacts during operations, including increased employment (discussed in Section 5.9) also would be negligible.

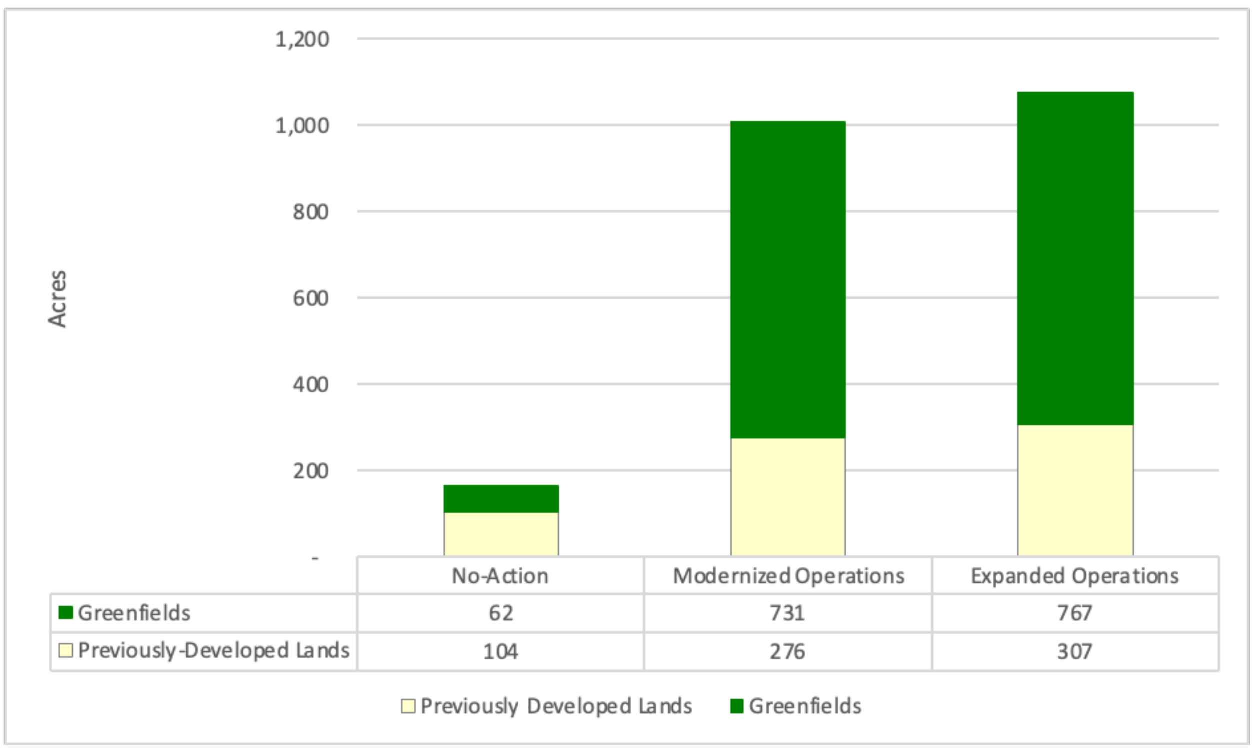


Figure 5.2-3 Permanent Development Siting by Land Type (acres)

5.2.2 Visual Resources

The analysis in this section presents the potential impacts to aesthetics and visual resources for the alternatives due to construction, DD&D, modernization or upgrade of utility projects, environmental remediation, and operations. The key metric in this analysis is visual compatibility.

5.2.2.1 No-Action Alternative

Under the No-Action Alternative, there would be 88 facilities built at LANL, with a total footprint of about 34 acres. In addition to the facility development, construction of infrastructure and utility projects would disturb about 132 acres. Under the No-Action Alternative, DD&D actions would remove 37 acres of excess or aging facilities. Net, the site's facility footprint would shrink by 4 acres, though its total developed footprint (accounting for new infrastructure and utility installations) would grow by about 129 acres.

Development and modifications would generally occur within the context of existing development, would be similar in character to existing infrastructure, and would be largely screened from the public view by the surrounding fences, vegetation/topography, and physical distance from offsite land. Notable actions with the potential to introduce visual changes under the No-Action Alternative planning period include the following:

- **EPCU Transmission Lines** – As depicted on Figure A.3.2-5 in Appendix A, the project would cross BLM lands and the SFNF to reach LANL. This project would require towers to carry the lines and the conversion of approximately 170 acres of land as a new ROW for the transmission lines. The visual impacts for this project would chiefly stem from the 14-mile-long, 100-foot-wide ROW and towers (visual impacts from the towers would depend on the material selection and implementation of best management practices, which are described in Section 5.16.2). The impacts from this project are further analyzed in the EPCU Draft EA (NNSA 2023b). The Final SWEIS will incorporate any changes that are made in the Final EPCU EA as a result of public and agency comments.
- **10-MW Solar PV Array** – This 45-acre project is planned for the NEEWC (LANL 2019b). At 45-acres, it is the second largest project under the No Action Alternative after the EPCU Transmission line project. Utility-scale solar facilities in the southwestern U.S. create unique and obvious visual impacts because of their large size, strong regular geometry, highly reflective surfaces, and contrast with the natural brown tones of the landscape. Impacts from this project are somewhat mitigated by its location in the interior of the site.
- **DD&D of the CMR** – This 565,000-square-foot facility accounts for 7 percent of the total built environment at LANL. The DD&D of the facility would be a large undertaking that would create short-term negative visual impacts from the presence of heavy equipment, trucks to haul the debris, and potentially dust. Long-term, the DD&D of this facility would create space for modern structures to be developed on its old footprint. As identified in Chapter 3, Section 3.2.2, the Laboratory is considering an option that would allow continued use of elements of the CMR facility beyond the planned DD&D date of 2031. If this were to occur, there would be no disruption of visual resources from this DD&D and the existing facility would remain.

- **East Jemez Road Fire Station** – This station would create short- and long-term visual non-significant adverse impacts from construction and the introduction of a new structure adjacent to the residences of the Elk Ridge Community.
- **Roadway and Parking Projects** – This collection of projects would permanently disturb a total of 44 acres of both undisturbed and previously disturbed lands. Heavy road construction would create short-term adverse visual impacts and long-term adverse impacts would result from the newly disturbed lands.

Notwithstanding the actions outlined above, the primary visual impacts during the No-Action Alternative planning period stem from the large number of facilities, infrastructure projects, and DD&D. In aggregate, these projects would disturb 203 acres. Figures 3.2-1 through 3.2-5 show the locations of the proposed facilities and actions. Proposed offices and warehouses make up the bulk of new facility construction and roadways, parking lots, and a solar PV array make up the bulk of new infrastructure.

Construction of these facilities and infrastructure would result in short-term visual impacts due to the presence of heavy construction equipment, new buildings in various stages of construction and demolition, and possibly increased dust. Cranes used during construction and temporary construction laydown areas would also create short-term visual impacts but would not be out of character for LANL. Many of these projects would be located in the interior of LANL and construction-related activities would not be noticeable at or beyond the LANL boundary. Site visitors and employees observing construction would find these activities similar to the past construction activities or other developed areas at LANL.

After construction and DD&D actions conclude, long-term visual impacts are not anticipated. Development would be driven by function and purpose and would be similar in visual appearance to the existing built environment. As outlined in Table 5.2-2 only the Pajarito Corridor would experience a double-digit percent change to its developed acreage, but this would not result in changes to the existing VRM class. Pajarito Corridor, along with the Core Area and LANSCE are all classified as the top VRM class, Class IV. These areas feature high-intensity and dense development; the introduction of new and replacement facilities and infrastructure would be in character for these planning areas. Long-term, the NEEWC and Balance of Site would retain their existing VRM Classes, II and I respectively, due to the overall restrained nature of the proposed construction activities.

Continuing environmental remediation activities generally improve visual resources as older structures and signage warning of possible hazards are removed for lack of need, and areas are revegetated. But there could be some temporary, short-term reductions in the visual environment. For example, vegetative covers over small portions of land being remediated may be removed. But this visual effect would be temporary until vegetation is restored. Small quantities of dust could be generated, which could slightly reduce visual quality. But dust generation would be localized, temporary, and could be controlled.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in direct impacts to visual resources. Most of the tracts would maintain their current level of visual aesthetic value after conveyance and transfer and any subsequent development. However, the development of currently undeveloped areas, such as the Rendija Canyon and White Rock “Y” Tracts, would typically degrade the visual landscape. The reduction in visual quality would not be substantial on a regional scale, but local diminished viewsheds could impact resources important to maintaining a positive visitor experience on adjacent NPS lands (DOE 1999b). The remaining TA-21 and TA-74 tracts would maintain their current VRM class.

5.2.2.2 Modernized Operations Alternative

Under the Modernized Operations Alternative, there would be 139 additional facilities built at LANL, totaling about 79 acres. In addition to the facility development, construction of infrastructure and utility projects would permanently disturb 928 acres. Under the Modernized Operations Alternative, DD&D actions would remove 28 acres of facilities. Net, the site's facility footprint would grow by 51 acres, and its total developed footprint (accounting for new infrastructure and utility installations) would grow by 979 acres.

Developments and modifications would generally occur within the context of existing development, would be similar in character to existing infrastructure, and would be largely screened from the public view by the surrounding fences, vegetation/topography, and physical distance from offsite land. Notable actions with the potential to introduce visual changes under the Modernized Operations Alternative include the following:

- **Los Alamos Canyon Bridge Replacement** – The existing Los Alamos Canyon Bridge is a riveted steel arch bridge spanning 820 feet across the eponymous Los Alamos Canyon. The replacement bridge would cause short-term adverse visual impacts from construction and staging areas. Long-term, no adverse visual impacts are anticipated as the replacement bridge would be constructed parallel to the existing structure with a complimentary design. The historic Los Alamos Canyon Bridge would remain in place and be utilized for pedestrian and bicycle traffic.
- **Solar PV Arrays** – This assemblage of solar installations could disturb up-to 795-acres at different sites (*see* Figure 3.3-1) throughout LANL. Though it would not introduce a new visual element at LANL, as there is an existing solar installation along East Jemez Road, the aggregate size of the installations would result in both short- and long-term visual impacts. If built, the proposed solar sites 'A', 'C', 'D', 'H', and 'I' all located in the Balance of Site Planning Area would disturb 334 acres of lands on LANL (*see* Section 3.3.1). These areas likely would be visible from off-site locations and would raise the long-term VRM classification of the planning area from I to II. The adverse visual impacts would stem from the same effects as described for the 10-MW solar PV array under the No-Action Alternative. Although 426 acres of solar arrays are planned for the NEEWC, this would not cause a change in NEEWC's VRM classification due to the proposed location in the site's interior and the existing VRM Class II rating.
- **Water Tank Raisings** – As part of the proposed infrastructure work, NNSA may increase the elevation of three water tanks in the Core Area, Pajarito, and NEEWC planning areas to boost downstream water pressure. Increasing the height of this infrastructure would make the tanks visible from greater distances and new locations.

Notwithstanding the actions outlined above, the primary visual impacts under the Modernized Operations Alternative planning period stem from the large number of facility construction, infrastructure projects, and DD&D. In aggregate, these projects would disturb 1,035 acres, which represents 4 percent of the total land area (25,536 acres) of LANL. The new solar PV arrays (if fully implemented) would account for 77 percent of the total land disturbances under the Modernized Operations Alternative. Figures A.3.3-2–A.3.3-6 in Appendix A show the locations of the proposed facilities and actions. Aside from those projects called out above, sitewide transportation projects, i.e., roads and parking, and institutional laydown areas make up the bulk of land disturbances. These projects represent a continuation of past and present uses and would not introduce new visual impacts. Short-term impacts would be similar to those described above for the No-Action Alternative. Aside from the change in VRM class to the Balance of Site Planning Area due to new solar installations, no other planning area would experience a long-term change to its existing VRM class.

5.2.2.3 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would be 18 additional facilities built at LANL totaling about 21 acres. In addition to the facility development, construction of infrastructure and utility projects would disturb 46 acres. There is no additional DD&D planned for the Expanded Operations Alternative. Net, the site's total developed footprint (accounting for new infrastructure and utility installations) would grow by 67 acres above that proposed under the Modernized Operations Alternative.

Developments and modifications would generally occur within the context of existing development, would be similar in character to existing infrastructure, and would be largely screened from the public view by the surrounding fences, vegetation/topography, and physical distance from offsite land. Notable actions with the potential to introduce visual changes under the Expanded Operations Alternative planning period include the following:

- **Wildland Fire Risk Reduction Program** – This site-wide action includes expanded management of existing flora, vegetation removal, utility line burial, and stepped-up defensible zones around facilities and infrastructure. As this action would be site-wide, it's effects would be felt in every planning area. The expanded management and vegetation removal would be conducted to create more open areas and a mosaic of openings, groups, and clumps that would more closely mimic the structure of western forests prior to excess widespread fire suppression, over grazing, and logging that occurred during the 20th century. Utility line burials would result in short-term adverse visual impacts from the presence of heavy equipment but would ultimately net long-term beneficial visual impacts. Moving existing utilities underground would remove man-made visual contrasts from the site. All actions related to reducing wildland fire risks would be intended to improve the health and resiliency of the forests. As the program would not introduce new uses or create any permanent land disturbances, there would be no long-term visual impacts or changes to VRM classes; the landscape of the site would be altered as described above but ultimately developed areas would remain developed and undeveloped areas would remain in their "natural," albeit human-managed, state.
- **Pumped Hydropower Demonstration** – This action would disturb 20 acres on-site along LANL's southwestern border and near the entrance of Bandelier of National Monument. The proposed site is largely undisturbed land left in a natural state and the construction and operations of this facility would have short- and long-term adverse visual effects. These effects can be lessened through mitigation techniques as described in the mitigation section (*see* Section 5.16.2).
- **FSI WTF** – This action includes the construction of three pipelines with approximately 27.5 acres of temporary land disturbance. After construction of the pipelines, all disturbed land would be regraded and restored to pre-construction conditions. The only permanent

structure would be the 5,000-square-foot WTF and associated infrastructure, which is internal to the site and not visible from offsite.

- **TRU Waste Staging** – This project would disturb a total of 6 acres across four different locations on LANL. It would feature staging facilities similar to the existing TWF in TA-63. No visual impacts are anticipated as it would be dispersed in various planning areas and collocated adjacent to existing facilities and developed areas.
- **Surplus Plutonium Disposition** – If this project is implemented, it would disturb approximately 6 acres in TA-52 and -55 within the Pajarito Corridor. This area is already heavily developed and an additional 6 acres of land disturbance and increased operations would not introduce a novel visual impact to this planning area. As was noted in Section 5.2.1.3, the additional facilities associated with the project may not be constructed within the analytical period defined in this SWEIS. Without the new construction, there would be no additional visual impacts from SPDP.

Notwithstanding the actions outlined above, the Expanded Operations Alternative would have few visual impacts above those described for the Modernized Operations Alternative. There would be an additional 26 acres of site-wide transportation projects and nine of the 18 projects are small projects of 10,000 square feet or under per facility. These projects represent a continuation of past and present uses and would not introduce new visual impacts. Short-term impacts would be similar to those described above for the No-Action and Modernized Operations alternatives. No other planning area would experience a long-term change to its existing VRM class resulting from the projects proposed for the Expanded Operations Alternative.

5.2.2.4 Summary of Visual Resources Impacts

Table 5.2-12 provides a summary of the VRM ratings assigned to the different LANL planning areas. Ratings were assigned for existing conditions, and short-term effects and long-term effects for each alternative. The Core Area, Pajarito Corridor, and LANSCE are all heavily developed, consistent with VRM Class IV. They were assigned this rating because their development represents a major modification to the natural landscape, dominates the landscape, demands attention, and is highly visible from public and/or visually sensitive viewpoints. The NEEWC was assigned a Class II rating because while there are developed portions of the site, it is located in a remote setting far from public view and is balanced by vast undeveloped lands. Although the Balance of Site consists of largely undeveloped buffer zones around LANL's perimeter and limited

Table 5.2-12 Summary of VRM Ratings

Planning Area	Existing Class	No-Action		Modernized Operations		Expanded Operations		Long-term Change
		Short-term Class	Long-term Class	Short-term Class	Long-term Class	Short-term Class	Long-term Class	
Core Area	IV	IV	IV	IV	IV	IV	IV	No
Pajarito Corridor	IV	IV	IV	IV	IV	IV	IV	No
NEEWC	II	III	II	III	II	III	II	No
LANSCE	IV	IV	IV	IV	IV	IV	IV	No
Balance of Site	I	III	I	III	II	III	II	Yes

management activities, it was assigned a long-term Class II rating due to the impacts from the solar sites visible from off-site locations.

Aside from the Balance of Site, the remaining four planning areas would retain their existing classes in the long-term under each alternative. As the three developed planning areas already hold the highest VRM class, the effects of the construction activities planned under each alternative would be moot on VRM classifications. The two remaining planning areas, the NEEWC and Balance of Site, would experience short-term rises to their VRM classes due to the presence of increased construction and management activities, but would revert to a lower VRM class once steady-state operations are reached.

Short-term visual effects would be associated with an increase in construction and DD&D activity. Construction activity for the NEEWC and Balance of Site would result in short-term, minor adverse effects but these planning areas would ultimately be largely restored to their pre-construction VRM classifications. Furthermore, many projects are supporting facilities, annexes, extensions, modifications and/or replacements to existing facilities. These projects are located within, connecting, or adjacent to their ‘parent’ or ‘sister’ facility and would not be noticeable to the casual viewer. The three alternatives feature projects that largely adhere to the existing development patterns at LANL. Those projects that deviate from normal development patterns were specifically called out and analyzed on a case-by-case basis for each alternative.

5.3 Geology and Soils

The following analysis presents the potential impacts on geology and soils as well as hazards to facilities and infrastructure from geologic conditions for the alternatives described in Chapter 3. Key metrics in this analysis include: (1) the total area of soil disturbance; (2) the potential for causing erosion, soil loss, or impacts to prime farmland; and (3) analysis of whether soils and geologic features would support new facilities (e.g., potential for landslides). In addition, the analysis identifies and discusses seismic requirements for new facilities.

The geology and soils impact analyses address potential impacts across the LANL site as a whole rather than within specific planning or technical areas of the site and are applicable to all three alternatives being considered. In general, present LANL operations have limited impact on geology and soils, except in specific circumstances. Although LANL activities do not significantly impact geology and soils, there are some geological hazards that apply to LANL facilities such as the potential for seismic events.

The information for the geology and soils sections feeds into other sections within this SWEIS, including human health and accidents. The following sections address each of the subject areas previously described for the affected environment in Chapter 4, Section 4.3.

5.3.1 No-Action Alternative

Consistent with the analytical parameters discussed in Section 3.5, land disturbance impacts under the No-Action Alternative were estimated for 23 new facilities (each could consist of multiple buildings and support structures) totaling approximately 1.5 million square feet (34 acres), utility and infrastructure projects totaling 216 acres, and DD&D of facilities and infrastructure features totaling approximately 37 acres. The total disturbance of land is expected to involve 250 acres (does not include DD&D of facilities), of which 62 acres of disturbance would occur on undeveloped land. The projects disturbing the largest amounts of previously undeveloped land would be the institutional laydown areas (about 21 acres) and new roads and parking (about 15 acres).

Continued environmental remediation for MDAs (*see* Section 4.14) would impact geology and soils but would be dependent on the specific planning basis for the specific MDA being considered. For those MDAs subject to site investigations conducted under the Consent Order, as well as LANL surveillance and maintenance programs for nuclear environmental sites, there should be little or no effect to geology and soils. For those MDAs that would be subject to the capping option in the future, there could be impacts related to the covers and soil contamination, which are addressed in Appendix G.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS (*see* Section 3.2.3) would not result in direct impacts to geology and soils. Indirect impacts related to future development of conveyed tracts would include soil disturbance from construction, building new roads, and installing utilities. Removal of vegetation and increased runoff from new impermeable surfaces could increase erosion, however, the new development would use standard BMPs to minimize impacts (DOE 1999b).

5.3.1.1 Slope Stability, Subsidence, and Liquefaction

The No-Action Alternative does not include any new activities that would result in additional slope stability or other soil movement impacts. Ground and slope stability evaluations are important considerations in siting facilities. The majority of existing and ongoing facilities and activities associated with the No-Action Alternative have occurred on previously disturbed land that has been engineered for necessary foundation stability to ensure facility and infrastructure integrity. Project planning would ensure that future facilities and activities would not be sited in areas with these concerns or in areas where engineering practices could not mitigate potential foundation stability issues. Therefore, potential impacts involving slope stability, subsidence, or liquefaction are considered negligible.

5.3.1.2 Volcanism, Faulting, and Seismic Activity

LANL construction and operation activities, including utilities and infrastructure, environmental remediation, and DD&D activities, do not include activities that could activate or modify the movement of magma, initiate volcanic activity or movement of faults, or increase the probability of seismic events at the LANL site or in the region.

Faulting and seismic events, however, could result in potential hazards to existing and planned facilities at the LANL site. A site-specific, comprehensive update to the 2007 and 2009 probabilistic seismic hazard analyses to be used for input to design of critical facilities and infrastructure is currently underway for new construction and for evaluating upgrades and modifications to existing facilities to ensure safe parameters during operations and potential accidents. Potential accidents and subsequent impacts applicable to all alternatives resulting from seismic events are evaluated in Section 5.14.5.

The DNFSB has been engaged with NNSA on seismic safety of the Plutonium Facility (PF-4) since the Laboratory first identified elevated potential seismic hazards in 2009. In a letter in August 2023, the DNFSB acknowledged that the Laboratory had completed a probabilistic risk analysis and concluded that the seismic safety risk of PF-4 is acceptable until the site-specific PSHA is updated in 2025. The DNFSB found that NNSA's conclusion was technically defensible and that the accompanying peer review process was robust (DNFSB 2023).

5.3.1.3 Soils and Soil Monitoring

Most of LANL is not industrialized, so the majority of the soil column is not disturbed, and few LANL processes involve subsurface work, so there is limited interaction with geological materials. Although approximately 62 acres of undisturbed soils could be affected, the No-Action Alternative does not include any activities that would significantly impact the potential for soil erosion or the level of past chemical or radiological contamination from legacy activities. The highest erosion rates generally occur in drainage channels and on steep slopes from natural events such as flooding and wildfires. Existing and future LANL facilities are generally not sited or planned for these types of locations.

One noteworthy remediation activity at LANL involves hexavalent chromium contamination and the introduction of surface fluids to area soils as part of remediation efforts. DOE prepared an EA to evaluate corrective measures to remediate the hexavalent chromium contaminated groundwater below Mortandad and Sandia canyons. The proposed action in that EA provided four options representing a range of remediation methods and technologies. The options could include mass removal of contamination, *in situ* treatment, injection of clean or treated groundwater, surface application of fluids, monitored natural attenuation of contamination, or combinations of the above (DOE 2024a). These remediation activities are considered important aspects of environmental cleanup of legacy contamination at LANL. Nevertheless, soil runoff, erosion, or movement of hexavalent chromium contamination within soils and deeper geologic formations would be possible from surface and subsurface applications of fluids. BMPs for controlling runoff and erosion would be implemented to minimize impacts while remediation efforts are underway. These BMPs are presented in Section 5.16.3.

The levels of existing contamination generally are decreasing over time as contaminant decay, improved work practices, and environmental remediation continue. Approximately 500,000 cubic meters of legacy hazardous and radioactive waste is located at LANL with most of it buried in MDAs. NMED regulates the cleanup of legacy hazardous waste at LANL pursuant to the *New Mexico Hazardous Waste Act* (74 NMSA 4) (NMSA 1978) and in accordance with the 2016 Consent Order (NMED 2016a). Continued soil monitoring and remediation are integral components of the Consent Order that help ensure effective cleanup of legacy wastes at LANL. Section 4.14 of this SWEIS contains detailed information on the Consent Order and associated cleanup of legacy contamination.

DD&D of legacy facilities would contribute to ongoing environmental remediation of soils and would be considered a positive impact/outcome. No prime farmlands have been identified on the LANL site. Ongoing soil monitoring on the LANL site and in strategic offsite locations will continue to help ensure existing and potential contaminants are identified and remediated.

5.3.1.4 Mineral Resources

The No-Action Alternative would not affect the mineral resources in use at LANL. The potential mineral resources at LANL and nearby locations include sand, gravel, and pumice. These materials are used for backfill and grading, cover material during remediation efforts, concrete preparation, and landscaping. The activities associated with the No-Action Alternative are not expected to impact the availability of borrow material.

5.3.2 Modernized Operations Alternative

Consistent with the analytical parameters discussed in Section 3.5, potential impacts under the Modernized Operations Alternative were estimated for 35 new facilities totaling approximately 3.4 million square feet (79 acres), utility and infrastructure projects totaling 928 acres, and DD&D of facilities and infrastructure features totaling approximately 28 acres. The total disturbance of land is expected to involve about 1,007 acres, of which 731 acres of disturbance would occur on undeveloped land. Except for the increased potential acreage of soil disturbance, potential impacts under the Modernized Operations Alternative related to slope stability, subsidence, and liquefaction; volcanism, faulting, and seismicity; soils and soil monitoring; and mineral resources would be expected to be the same as the No-Action Alternative. This is due to a broader definition of the geology and soils ROI as opposed to specific technical areas or existing or proposed facilities on the LANL site.

The largest of the projects added under the Modernized Operations Alternative includes up to 795 acres (641 acres of which are currently undeveloped) of solar PV arrays distributed onto nine potential sites across LANL (*see* Chapter 3, Section 3.3.1.3). Extensive grading of soils for site preparation and installation of the solar arrays could result in wind and water erosion of native soils if graded areas remain uncovered for long periods of time (*see* air quality discussion in Section 5.5.1.2). Other large disturbances include 25 acres of mostly undeveloped land in TA-72 for a remote parking and bus transfer station, about 17 acres of undeveloped land for roads and parking, and about 19 acres of undeveloped land for additional construction laydown areas.

The impacts to soils from potential disturbance of 731 acres of undeveloped land would be minimized through appropriate mitigation and BMPs (as identified in Section 5.16.3).

5.3.3 Expanded Operations Alternative

Consistent with the analytical parameters discussed in Section 3.5, potential impacts under the Expanded Operations Alternative were estimated for 18 new projects and temporary development for construction activities totaling approximately 100 acres. Including land disturbance from the Modernized Operations Alternative, the total disturbance of land is expected to involve 1,142 acres, of which 806 acres of disturbance would occur on undeveloped land. As with the Modernized Operations Alternative, except for the increased potential acreage of soil disturbance, potential impacts related to slope stability, subsidence, and liquefaction; volcanism, faulting, and seismicity; soils and soil monitoring; and mineral resources are expected to be the same as the No-Action Alternative.

In addition to those projects identified above for the Modernized Operation Alternative, the projects with the largest disturbance of previously undeveloped land include 20 acres for a Pumped Hydropower Demonstration in TA-39 and TA-49, disturbance of 18 acres of undeveloped land for roads and parking, and 8 acres of temporary disturbance associated with installation of the proposed pipelines for the WTF supporting the FSI/HPC in TA-6.

Under the Expanded Operations Alternative, the Laboratory proposes to increase the practice of utility line burial to minimize potential impacts from wildland fire and severe weather. This would include installing underground duct banks consisting of reinforced concrete or metal containers housing the utility lines. The construction process for burial of utility lines would include trenching using heavy equipment, stockpiling of soil, and backfilling and grading of the surface. BMPs for soil management and engineering of slopes for minimizing erosion and runoff would be implemented during and after construction.

Another notable operational change associated with the Expanded Operations Alternative that has the potential to impact soils at LANL involves wildland fire risk reduction treatments of certain high-risk areas. These treatments are designed to reduce potential operational impacts from wildland fires through forest thinning among other things (LANL 2019a). Section 3.4.2 of this SWEIS provides additional detail of this risk-reduction program. Forest thinning (i.e., removal of trees and other vegetation) has the potential to destabilize soils and increase erosion and runoff. BMPs (as identified in Section 5.16.3) for soil management would be followed to minimize erosion and runoff during operations in the treated areas.

The impacts to soils from potential disturbance of 806 acres of undeveloped land would be minimized through appropriate mitigation measures and BMPs.

5.3.4 Summary of Geology and Soils Impacts for the Alternatives

Table 5.3-1 summarizes the potential geology and soils impacts for the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative.

Table 5.3-1 Potential Impacts to Geology and Soils for the Alternatives

Resource Parameter	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Volcanism	No known centers of active volcanic activity at LANL. No impacts expected.		
Slope stability, subsidence, and liquefaction	Activities to be located on prior disturbed lands or other stable lands that have been, or would be, engineered for necessary foundation integrity. No impacts would be expected.		
Faulting and seismic activity	Facilities and infrastructure would be designed and constructed to meet seismic design criteria commensurate with risk category requirements and an updated probabilistic seismic hazard analysis. No activities would increase the probability of seismic events.		
Soil disturbance on undeveloped land (acres)	62	731	806
Prime farmlands	No prime farmland exists on the LANL site. No impacts expected.		
Soil erosion	No activities that would significantly impact the potential for soil erosion. No facilities would be located in drainage channels or on steep slopes. No impacts would be expected.		
Soil contamination	No increase in the level of legacy contamination expected. Overall decrease in soil contamination due to soil monitoring, remediation, and DD&D activities. Any recovered contaminated soil would be managed and disposed of according to requirements and procedures.		
Mineral resources	No known mineral resources would be adversely affected by construction and operations. Sufficient mineral resources necessary for construction activities are available on the LANL site and at nearby commercial locations. No impacts would be expected.		

5.4 Water Resources

The analysis in this section presents the potential impacts on water resources for the alternatives described in Chapter 3. The water resources section analyzes both surface water and groundwater. Key metrics presented in this analysis include: (1) increases in impervious areas and effects on stormwater; (2) analysis of effluents and the potential for surface/groundwater contamination; and (3) potential floodplain impacts. Potential impacts to wetlands are discussed in Section 5.6 of this SWEIS. Potential impacts associated with water use (consumption) are discussed in Section 5.10.

5.4.1 No-Action Alternative

Water resource impacts were estimated for constructing approximately 23 new facilities (land disturbance of about 34 acres), utility and infrastructure upgrades (land disturbance of 216 acres), and DD&D (affecting about 37 acres of facilities).

Construction and DD&D under the No-Action Alternative would lead to soil disturbance, removal of protective vegetative cover, and both loosened and compacted soil conditions on and off the LANL site, which potentially could lead to impacts to existing surface water hydrology. Impacts to surface water hydrology include increased stormwater runoff, sediment transport, and impacts to stormwater quality such as changes in water temperature and sediment load. Once operational, the new facilities could cause long-term alteration of the existing surface water hydrology. For example, the alteration of pre-construction drainage patterns may lead to increases in stormwater runoff (increased flow rates and volumes, and decreased flow duration) coupled with decreased infiltration and evapotranspiration. Water resource impacts were based on total and net land disturbance and the introduction of additional impervious surface. Under the No-Action Alternative, total land disturbance would be about 250 acres (34 acres new facilities and 216 acres utility/infrastructure, including roads and parking). Demolition of excess facilities would result in reclamation of about 37 acres over 15 years. In addition, restoration of laydown and staging areas post-construction for the proposed EPCU project would result in reclamation of about 84 acres of this total land disturbance. As such, the net land disturbance would be about 129 acres (total disturbance reduced by sum of DD&D and reclamation of temporary construction areas). The net land disturbance (129 acres), of which about 62 acres are currently undeveloped, would be representative of new facilities/infrastructure. In the long-term, the potential for impacts to stormwater would most be associated with the 62 acres of undeveloped land that is converted to facility and infrastructure use due to the introduction of new impervious surface.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in direct impacts to water resources. The potential indirect impacts of the conveyance and transfer of the tracts would include the potential reduction of supplies of groundwater, if groundwater is used as a water source. Placement of new water supply wells could impact groundwater quality. New development potentially could degrade the surface water quality by increasing the pollutant loads and surface runoff volumes from construction activity, and by creating additional impermeable surfaces such as roads and parking lots (DOE 1999b). This would apply primarily to the TA-21 and Rendija Canyon tracts. No indirect impacts would be expected for the TA-74 or White Rock "Y" tracts.

5.4.1.1 Surface Water

For construction projects that disturb 1 acre of land or more, the Laboratory meets stormwater compliance monitoring requirements of the NPDES CGP. A stormwater pollution prevention plan

(SWPPP) is required under the NPDES CGP to help minimize any pollution that might leave the site by stormwater. The SWPPP would contain a detailed site plan and schematics for the installation of temporary and permanent stormwater and erosion control devices to effectively manage the site during construction and facility operation. Additionally, Section 438 of the *Energy Independence and Security Act of 2007* specifically calls for federal development that has a footprint that exceeds 5,000 square feet to maintain or restore pre-development hydrology. As such, facility design would incorporate LID controls to maintain water temperatures, flow rates, flow volumes, and durations that were present before development. Examples of appropriate controls include vegetated swales, infiltration basins, permeable pavement, vegetated strips, rain barrels, and cisterns. The goal would be to manage runoff through infiltration, evapotranspiration, or harvest and reuse. The implementation of the CGP, SWPPP, and LID controls would minimize potential erosion, impacts to stormwater quality from sediment, and alteration of existing drainage patterns during construction and operations.

Surface water resources would be protected from potential contaminant releases during construction and operation of facilities under the No-Action Alternative. Potential contaminant sources could include construction materials; hydraulic fluid, oil, and diesel fuel; and releases from transportation or waste-handling accidents. The Laboratory would follow mitigation steps outlined in its spill prevention, control, and countermeasures (SPCC) plan in the event of a spill of petroleum product. Implementation of SPCC plans would minimize any impacts from spills during construction and operations. During operations, impacts to surface water from aboveground storage tanks for petroleum would not be expected since the Laboratory complies with EPA and NMED requirements, which enforce the use of tank and piping primary and secondary containment, detection and monitoring systems, and SPCC plans.

Potential impacts to surface waters from environmental remediation actions, including the implementation of the final remedy for remediation of hexavalent chromium contamination in Mortandad and Sandia canyons, would generally be minor (DOE 2024a). See Appendix G of this SWEIS for additional details related to the potential impacts to surface waters from environmental remediation actions.

Surface water monitoring would continue in accordance with the Laboratory's ongoing environmental monitoring and surveillance program and permit requirements to determine whether any radioactive or nonradioactive constituents released on the LANL site might have a negative impact on public health and the environment. Stormwater monitoring would continue in accordance with the Laboratory's MSGP and Individual Permit. Wastewater monitoring would continue as discussed in Chapter 4, Section 4.4.1.2 in accordance with the NPDES Industrial Point-Source Outfall Program (NPDES-permitted outfalls). Because the new facilities associated with the No-Action Alternative support ongoing missions and operations, there would be no notable changes in liquid effluents. No impacts to downstream receiving surface waters would be expected.

5.4.1.2 Groundwater

Groundwater resources would be protected from potential contaminant releases during construction and operations of facilities under the No-Action Alternative. Potential contaminant sources could include construction materials; spills of hydraulic fluid, oil, and diesel fuel; and releases from transportation or waste handling accidents. The potential for spills of hazardous materials to impact groundwater largely depends on the depth to groundwater where the spill occurs. The Laboratory would follow prevention and mitigation steps from its SPCC plan in the event of a hazardous material spill. As described in Chapter 4, Section 4.4.2, the depth to groundwater within the regional aquifer varies from approximately 600 feet to 1,200 feet across LANL's operational areas. Perched groundwater can occur at shallow depths in canyon bottoms, and intermediate perched water can be found as shallow as 120 feet to 750 feet. However, perched water is separated from the regional aquifer by more than 350 feet of unsaturated tuff, basalt and low moisture content sediments. Since employees are trained in spill response procedures, any spills likely would be cleaned up before they reach perched groundwater or the regional aquifer.

During operations, groundwater monitoring would continue under the No-Action Alternative to ensure that remediation of contamination already present continues to be effective and that contaminant fate and transport is fully understood. Further characterization and remediation of RDX contamination in the vicinity of TA-16, and hexavalent chromium contamination beneath Sandia and Mortandad canyons would be conducted as required by the 2016 Consent Order. In addition, DOE-EM has prepared the Chromium Final Remedy EA (DOE 2024a) to evaluate the final remedy for the hexavalent chromium plume in Mortandad Canyon. Implementation of this final remedy is included as an element of the No-Action Alternative as part of the environmental remediation. As such, groundwater quality in the Sandia and Mortandad canyons would continue to improve as an effective groundwater treatment plan would be further developed and implemented. Additionally, other environmental remediation, as detailed in Chapter 4, Section 4.14 and Appendix G of this SWEIS, would also result in improvements to groundwater quality over time.

Discharge from septic tanks and treated groundwater would be monitored, managed, and subject to the requirements of their applicable discharge permits. Impacts to groundwater quality from surface water recharge would be minimized by complying with NPDES and Wastewater Discharge Permit limits and requirements.

5.4.1.3 Floodplains

The 100-year floodplain, as defined by the Federal Emergency Management Agency (FEMA), at the LANL site is presented in Chapter 4, Section 4.4.3. At LANL, the floodplains are generally located in the canyons that lie between the mesa fingers (*see* Figure 4.4-11). There are no projects under the No-Action Alternative, other than ongoing environmental remediation and watercourse protection/maintenance actions, that would affect the floodplains at LANL. Construction within or near floodplains would require compliance with EO 11988, "Floodplain Management," which requires floodplain assessment and floodplain protection measures. Construction would also be subject to Section 404 and 401 requirements of the *Clean Water Act*.

The project area for the Chromium Final Remedy EA lies within the 100-year floodplains of Mortandad and Sandia canyons (DOE 2024a). A floodplain assessment (N3B 2024) was prepared as part of that NEPA review to support this project.[43]

5.4.2 Modernized Operations Alternative

Under the Modernized Operations Alternative, there would be 35 new facilities (land disturbance of about 79 acres) in addition to those identified under the No-Action Alternative. Utility/infrastructure projects (excluding solar PV arrays) are expected to represent an additional land disturbance of about 133 acres. Lastly, solar PV arrays could disturb approximately 795 acres

[43] The floodplain and wetland assessment was prepared in accordance with 10 CFR Part 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements."

of land, depending on the number and potential sites selected for implementation. DD&D projects would result in the reclamation of about 28 acres of land.

Construction activity under the Modernized Operations Alternative would lead to soil disturbance, removal of protective vegetative cover, and both loosened and compacted soil conditions at LANL, which potentially could lead to impacts to the existing surface water hydrology. During construction, potential impacts to surface water hydrology include increased stormwater runoff, sediment transport, and impacts to stormwater quality such as changes in water temperature and sediment load. Once operational, the new facilities, which generally would be constructed of impervious surfaces, could cause long-term alteration of the existing surface water hydrology such as increased stormwater flow rates, increased volumes, and decreased flow duration coupled with decreased infiltration and evapotranspiration. Under the Modernized Operations Alternative, the total land disturbance would be about 1,007 acres (79 acres for new facilities, 133 acres for utility/infrastructure projects, and 795 acres for solar PV arrays). DD&D would result in approximately 28 acres of reclaimed land resulting in a net land disturbance of 979 acres. The land disturbance for new facilities and utility/infrastructure projects (excluding solar PV arrays) would be approximately 212 acres, of which about 90 acres are currently undeveloped. For the solar PV arrays, disturbance of currently undeveloped land would be 641 acres. Ultimately, about 90 acres of impervious surface would be newly introduced resulting from the new facilities and infrastructure projects. In the long term, the potential impacts to stormwater mostly would be associated with the conversion of 90 acres of undeveloped land to facility and infrastructure use, due to the introduction of new impervious surface, and potential for permanent alteration of the existing hydrology. As compared to the No-Action Alternative, the Modernized Operations Alternative would result in the addition of 28 acres of impervious surface.

The notable projects proposed under the Modernized Operations Alternative that could affect water resources include the following:

- **Solar PV Arrays** – There would be up to 795 acres of potential soil disturbance from the proposed construction of solar PV arrays. During construction, potential impacts to water resources would be similar to new facility construction. Soil disturbance, removal of vegetative cover, potential for increased erosion and stormwater runoff, sediment transport in stormwater, and alteration of drainage patterns would all be potential impacts. However, the solar arrays likely would be constructed on piles, and the creation of impervious surface would be much less than that of a similarly sized new facility. The existing land contours generally would be maintained, which would reduce impacts to existing drainage patterns. After construction, native revegetation would be re-established within open areas of the array, which would also help restore pre-construction evapotranspiration and stormwater infiltration rates. The solar PV arrays would be sited to avoid watercourses and floodplains.
- **LANSCE WTF** – This project involves construction of a new water treatment facility near LANSCE. The facility design would be based on the design of the existing SERF and have a 5,000-square-foot footprint in a developed area in TA-53. The water treatment facility would allow the existing LANSCE cooling towers to reuse potable water and increase the cycles of concentration. The facility blowdown would continue to discharge to the existing NPDES permitted Outfall #03A048 in TA-53. The discharge rate is expected to decrease because the same volume of cooling water is required but can be reused more often, thereby reducing the discharge. Because water discharged from the water treatment facility would

meet the same NPDES permit limits as currently met for Outfall #03A048, no significant impacts to receiving surface water are expected.

- **SWWS Project** – The Laboratory would replace the SWWS within a mostly undeveloped area in TA-46. The SWWS at TA-46 serves the Laboratory's sanitary wastewater treatment needs. The SWWS is permitted to discharge to Cañada del Buey or Sandia Canyon. Currently, the effluent is piped to TA-3 and ultimately discharged to Sandia Canyon via Outfall 001. Because water discharged from the SWWS would meet NPDES permit limits, no significant impacts to receiving surface water are expected.
- **SERF Expansion** – NNSA would renovate the existing SERF in TA-3 to increase the efficiency of blended water generation, and more than double its capacity from 50 million gallons per year to 120 million gallons per year. The SERF expansion project would both increase the volume of available water (currently SERF only treats about 30 percent of the water that is provided to it), as well as reduce the concentrations of total dissolved solids and conductivity, allowing locations like the SCC to increase the cycles of concentrations for cooling purposes. Although most of the water from the SERF is used by facility cooling towers, some water would be discharged via Outfall 001, and would be subject to NPDES permit limits. The proposed SERF expansion may include the development of a new, NPDES-permitted outfall into Sandia Canyon downstream of current outfalls in TA-3 and upstream of the current wetlands in the canyon, however, the total discharge (when combined with the other TA-3 outfalls) would not be expected to notably change. No significant impacts to receiving surface water are expected.

5.4.2.1 Surface Water

Protection measures for surface water resources generally would be the same as those discussed under the No-Action Alternative. During construction, the Laboratory would comply with its CGP and would develop and implement a site-specific SWPPP to help minimize erosion and any pollution that might leave the site by stormwater. Additionally, the Laboratory would comply with Section 438 of the *Energy Independence and Security Act* by employing LID controls, and facility design would incorporate permanent controls for the proper management of stormwater and minimize any impacts to receiving waterbodies and existing hydrology, during construction and operations.

Surface water monitoring would continue in accordance with LANL's ongoing environmental monitoring and surveillance program and MSGP and Individual Permit requirements. Wastewater monitoring would continue as discussed in Chapter 4, Section 4.4.1.2 in accordance with the NPDES-permitted outfalls. Wastewater discharges from LANSCE via Outfall #03A048 in TA-53 would decrease due to the LANSCE WTF project. Otherwise, there would not be notable changes in liquid effluents. During operations, impacts to surface water from aboveground storage tanks for petroleum would not be expected since the Laboratory complies with EPA and NMED requirements, which enforce the use of tank and piping primary and secondary containment, detection and monitoring systems, and SPCC plans. In the event of a spill of petroleum product, the Laboratory would follow mitigation steps outlined in its SPCC plan. No impacts to downstream receiving surface waters would be expected.

5.4.2.2 Groundwater

Protection of groundwater resources would be the same as discussed under the No-Action Alternative. Groundwater monitoring would continue under the Modernized Operations

Alternative to ensure that remediation of contamination already present continues to be effective and that contaminant fate and transport is fully understood. Groundwater quality would be expected to continue to improve because interim treatment of contaminated groundwater beneath Sandia and Mortandad canyons would continue and a final treatment remedy would be fully implemented.

Discharge from septic tanks and treated groundwater would be monitored, managed, and subject to the requirements of their groundwater discharge permits. Impacts to groundwater quality from NPDES outfalls would be minimized by complying with NPDES and Wastewater Discharge Permit limits and requirements.

5.4.2.3 Floodplains

The 100-year floodplain, as defined by FEMA, at LANL is presented in Chapter 4, Section 4.4.3. At LANL, the floodplains are generally located in the canyons that lie between the mesa fingers (*see* Figure 4.4-11). There are no projects under the Modernized Operations Alternative that would affect the floodplains on the LANL site.

5.4.3 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would be 18 new facility projects (land disturbance of about 21 acres in addition to the projects under the Modernized Operations Alternative) and 4 utility/infrastructure projects (land disturbance of about 46 acres in addition to the utility/infrastructure projects under the Modernized Operations Alternative).

Construction activity under the Expanded Operations Alternative would lead to soil disturbance, removal of protective vegetative cover, and both loosened and compacted soil conditions at LANL, which potentially could lead to impacts to the existing surface water hydrology. During construction, potential impacts to surface water hydrology include increased stormwater runoff, sediment transport, and impacts to stormwater quality such as changes in water temperature and sediment load. Once operational, the new facilities, which generally would be constructed of impervious surfaces, could cause long-term alteration of the existing surface water hydrology, such as increased stormwater flow rates, increased volumes, and decreased flow duration coupled with decreased infiltration and evapotranspiration. As shown in Table 5.4-1, the total land disturbance would be 1,142 acres (347 acres for new facilities, utility/infrastructure, and associated temporary construction areas, and 795 acres for solar PV arrays). After reclamation of DD&D projects and temporary construction areas, the net land disturbance would be about 1,046 acres. New facilities and utility/infrastructure projects would disturb about 279 acres; associated temporary workspace would disturb 68 acres. Ultimately, about 121 acres of impervious surface would be newly introduced as a result of the new facilities and infrastructure projects. In the long term, potential impacts to stormwater mostly would be associated with the conversion of 121 acres undeveloped land to operational use, due to the potential for permanent alteration of the existing hydrology. As compared to the Modernized Operation Alternative, the Expanded Operations Alternative would result in the addition of 31 acres of impervious surface.

The notable projects proposed under the Expanded Operations Alternative that could affect water resources include the following:

- **FSI WTF** – The proposed FSI WTF and associated water lines would be constructed to support the cooling water needs of the FSI/HPC. The project would include the installation of three water pipelines: (1) a water pipeline from a feasible location, such as the nonpotable water hydrant in Los Alamos County; (2) a discharge pipeline to recover blowdown water by sending it from the water treatment facility to the SERF; and (3) a discharge pipeline to a new, NPDES permitted outfall. Potential impacts to surface water and floodplains are described later in this section.

- **Pumped Hydropower Demonstration Project** – This project would be located in a mostly undeveloped area in TA-39 and TA-49 along NM-4. The facility would illustrate the ability to reduce or eliminate refilling of the reservoirs over long periods of time, and allow for multiple uses of the water beyond energy storage applications. The conceptual proposal would be to build a closed-loop pumped hydropower facility that includes four reservoirs (filled with fire suppression water)—two lower reservoirs and two upper reservoirs, side by side. The upper and lower reservoirs would be connected by 12-inch diameter water conveyance pipelines. The initial filling of the reservoirs would be sourced from a fire suppression line and would take place over a period of approximately two years to spread out the water demand. The initial facility design would support a minimum of 500 kW hydropower generation with a minimum release duration of 24 hours and would require an overall footprint of approximately 20 acres. The project would be sited on a mesa south of Ancho Canyon and would not overlap with surface water or floodplain. Protection measures for surface water and groundwater would generally be the same as described in Section 5.4.1. No significant impacts to water resources are expected from this project.
- **DMMSC Project** – This project would also require an increased capacity for cooling water beyond the current baseline. The proposal for added cooling towers includes two locations of four cooling towers each (a total of eight additional cooling towers) located near the DMMSC facilities in TA-53, representing an estimated footprint of about 8,000 square feet. The additional cooling water demand from DMMSC and the LANSCE enhancements would be estimated at 150 million gallons per year. These cooling towers would tie in to and utilize the LANSCE WTF, which is a project proposed under the Modernized Operations Alternative. Wastewater discharges from LANSCE via Outfall #03A048 in TA-53 would increase as compared to the Modernized Operations Alternative, but would be within permit limits. No significant impacts to receiving surface water are expected.
- **Wildland Fire Risk Reduction Treatments Project** – This project would revise fire mitigation treatment standards to minimize wildfire risk on LANL property and promote forest health and resilience (LANL 2024d). The proposed treatment revisions have the intent to address ignition risk from roads, power lines, and other ROW infrastructure, while using restoration thinning treatments to align the current forest structure more closely with historical conditions before fire suppression drove dangerous fuel accumulation. As documented in the Wildfire Hazard Reduction SEA (NNSA 2019c), potential impacts to water resources from wildfire treatments are primarily related to erosion and sediment transport from stormwater at fire roads and firebreaks, which are mitigated through a fire road and firebreak sustainability plan including a monitoring plan and controls to limit stormwater runoff and soil erosion. Mechanical thinning potentially could increase soil erosion, however with the use of best management practices, rehabilitating soil, and revegetation actions these potential impacts would be short term. The revised wildland fire treatments would not be expected to introduce new impacts to surface water. Overall, the proposed changes would potentially improve ground cover, which would lessen soil erosion across LANL.

- **Feral/Invasive Livestock Management** – This activity would result in fewer feral livestock in areas like the White Canyon Reserve and would protect the surface water (i.e., Rio Grande) from continued destruction of native vegetation, soil erosion, and disturbance. It would also reduce surface water pollution that has resulted from defecation and sedimentation.

5.4.3.1 Surface Water

Protection measures for surface water resources would generally be the same as those discussed under the No-Action Alternative.

For the proposed FSI/HPC WTF and associated water lines, the source water pipeline and SERF pipeline (for return water) would cross stream and floodplain within Two-Mile Canyon. Potential impacts would include increases in local sediment loading and turbidity from in-waterbody construction activities or from construction in adjacent areas. Clearing and grading of waterbody banks and in-waterbody construction could result in temporary modifications of aquatic habitat and modified contours that lead to minor changes in waterbody flow patterns and velocity. In general, impacts would be minimized by completing crossing as expeditiously as possible during drier months, restoring stream bed and banks to pre-construction conditions, installing equipment bridges and equipment mats, and installing and maintaining erosion controls during construction and through restoration. The project would be subject to the CGP, SWPPP, and *Clean Water Act* Section 404/401 requirements. As mentioned above, the conceptual design for the FSI/HPC WTF would include a pipeline to the existing SERF and a new outfall into Two-Mile Canyon. If the pipeline to the SERF was constructed, discharges to the outfall would occur only periodically and would generally be minor. If the line to SERF was not constructed or the SERF was not available for an extended period, the project would result in approximately 24 million gallons of annual wastewater discharges to the new outfall.[44] Discharge water from the FSI WTP would be subject to NPDES-permitted outfall requirements; therefore, no adverse impacts to the receiving surface water would be expected.

5.4.3.2 Groundwater

Protection of groundwater resources would be the same as discussed under the No-Action Alternative.

5.4.3.3 Floodplains

The 100-year floodplain, as defined by FEMA, at LANL is presented in Chapter 4, Section 4.4.3. At LANL, the floodplains are generally located in the canyons that lie between the mesa fingers (*see* Figure 4.4-11).

As part of the FSI WTF project, the proposed source water pipeline would run approximately 5,500 feet from the WTA substation area to the non-potable fire hydrant located near the ice rink in Los Alamos Canyon (*see* Chapter 3, Figure 3.4-1). The pipeline route crosses a stream and floodplain within the Two-Mile Canyon. The return water pipeline (to SERF) would also cross the Two-Mile Canyon. Depending on the construction method, there likely would be soil disturbance within the watercourse and its floodplain. There could be negative, short-term effects to the floodplain from vehicle and heavy-equipment access that could compact the soil and cause vegetation loss. In

[44] The annual wastewater discharge assumes six cycles of concentration for the FSI WTF. If the cycles of concentration were reduced to less than three cycles, the annual discharge to the new outfall would increase to about 66 million gallons.

general, impacts would be minimized by completing crossing as expeditiously as possible, restoring floodplain contours, revegetating disturbed areas with an appropriate native seed mix, and installing and maintaining erosion controls during construction and through restoration. In addition, hazardous materials, chemicals, fuels, and oils would not be stored within the floodplain. Work in a floodplain would not take place when the soil is too wet to adequately support equipment. Floodplain assessment would be required per EO 11988 prior to any construction. The project would be subject to CGP, SWPPP, and *Clean Water Act* Section 404/401 requirements.

5.4.4 Summary of Water Resources Impacts for the Alternatives

Table 5.4-1 summarizes the potential impacts to water resources under the No-Action Alternative, Modernized Operations Alternative, and Expanded Operations Alternative.

Table 5.4-1 Potential Impacts to Water Resources for the Alternatives

Resource Parameter	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Total land disturbance from construction (acres)	250	1,007	1,142
Net land disturbance (acres)	129	979	1,046
Footprint of new facilities, utility infrastructure (excluding solar PV array), roads, and parking (acres)	84	212	347
Land disturbance from solar PV arrays (acres)	45	795	795
Previously undeveloped land that would be converted to facility/ infrastructure (acres)	62	731	806
Introduction of new impervious surface (acres)	62	90	121
Potential for contaminant releases during construction, DD&D, and operations (acres)	Minimal	Minimal	Minimal
NPDES Outfalls	No Change	SERF expansion may include the development of a new, NPDES-permitted outfall into Sandia Canyon.	FSI WTF would include the development of a new, NPDES-permitted outfall into Two-Mile Canyon.
Potential Impacts to Floodplains	No adverse impacts expected. Projects within water courses would continue as planned and would comply with Clean Water Act Section 404/401	Same as No-Action Alternative	No adverse impacts expected. The FSI WTF project pipelines would cross the stream and floodplain within the Two-Mile Canyon. Floodplain

Resource Parameter	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
	requirements, and floodplain assessment requirements. The remediation of hexavalent chromium in groundwater would continue and would not impact floodplains within the Sandia and Mortandad canyons.		assessment would be required per EO 11988 prior to any construction. The project would be subject to CGP, SWPPP, and Clean Water Act Section 404/401 requirements.

CGP = construction general permit; DD&D = decontamination, decommissioning, and demolition; FSI = Future Supercomputer Infrastructure; NPDES = National Pollutant Discharge Elimination System; PV = photovoltaic; SERF = Sanitary Effluent Reclamation Facility; SWPPP = stormwater pollution prevention plan; WTF = water treatment facility

5.5 Air Quality and Noise

This section addresses potential impacts to air quality (Section 5.5.1), GHG emissions (Section 5.5.2), and the noise (Section 5.5.3) from each of the analyzed alternatives. GHG emissions are presented separately from air quality for clarity.

5.5.1 Air Quality

This section describes the potential air quality impacts from the alternatives for both nonradiological and radiological sources. Key metrics presented in the air quality analysis for air emissions include quantities of projected air emissions (both nonradiological and radiological) and comparisons to air quality standards. Potential human health impacts from radiological emissions are presented in Section 5.7.

The methods applied to evaluate potential impacts under each alternative are described in detail in Appendix H. A variety of models and tools were applied to analyze effects over the 15-year period 2024–2038. The methods used to calculate emissions were selected based on the source of the air emissions, available data, and regulatory guidance. The analyses were compared to air quality standards.

Sources of nonradiological criteria air pollutant emissions at the Laboratory include the operation of facilities and laboratory testing; heating and cooling; use of construction equipment during construction, DD&D and remediation; land disturbance; commuting personnel; and transporting waste and other materials. NNSA used the Air Conformity Applicability Model (ACAM)[45] to calculate emissions from construction, operations, DD&D, and commuting. Emissions from transporting waste and other material were calculated separately.

Radiological sources of air emissions at the Laboratory are reported annually in SWEIS yearbooks, as presented in Chapter 4, Section 4.5.2.2. Radioactive air emissions from proposed facilities, and

[45] https://www.aqhelp.com/acam.html

changes to existing operations, were estimated based on best professional judgement from ongoing operations, technology specifications, and previous studies. Emissions from previous studies were used to provide operational flexibility, capture potential emissions from approved missions that could occur from existing facilities, and to address the uncertainty associated with possible emissions from DD&D of radiologically contaminated buildings and ongoing remediation activities.

5.5.1.1 No-Action Alternative

Nonradiological Air Emissions

Nonradiological criteria air pollutant emissions associated with ongoing operations were assumed to remain consistent with the multi-year period (2017–2022) presented in Chapter 4, Table 4.5-3. Planned upgrades would be expected to reduce annual emissions under the No-Action Alternative. Steam plant upgrades would replace two existing boilers and add a heat recovery steam generator. The heat recovery steam generator would capture exhaust heat from the combustion gas turbine generator thus reducing emissions. The replacement of the two existing steam boilers, which is scheduled for 2025 and would reduce site-wide natural gas use by approximately 16 percent, has not been credited in the estimated emissions associated with continued operation of existing facilities.

Nonradiological criteria air pollutant emissions for the projects implemented under the No-Action Alternative were estimated in Appendix H, Table H-7.

Two simulations of ACAM were performed for the No-Action Alternative—total emissions in a single year and 20 percent of the total annually for five years. Details of the ACAM methods are described in Appendix H. The estimated air pollutant emissions from construction, DD&D, and operational activities under the No-Action Alternative projects are presented in Table 5.5-1, which also includes the least restrictive *de minimis* thresholds for criteria pollutants to determine the level of effects of these emission sources. Operational emissions include a reduction from heating of buildings since the demolished area would be more than the area of new facilities.

Table 5.5-1 indicates that pollutants would be expected to meet the *de minimis* threshold if all construction activities were to occur in a single year except for PM_{10}. Total site grading under the No-Action Alternative was assumed to be roughly 11 million square feet (*see* Table H-7). Reasonable precautions would be taken to prevent dust from becoming airborne. Reasonable precautions might include using water to control dust from building construction and demolition, road grading, or land clearing. Cleared or graded land would be seeded and/or vegetated in a timely manner to reduce fugitive dust.

Nonradiological and radiological material and waste shipments would travel nearly 1 million miles per year under the No-Action Alternative; the equivalent of nine trucks working full time (FreightWaves 2021). Shipments of SNM would also be accompanied by escort vehicles, which would contribute nearly 79,000 miles annually. Table 5.5-2 presents the estimated exhaust emissions generated from transporting material and waste shipments under the No-Action Alternative based on 2020 and projected 2030 emission rates.

Table 5.5-1 ACAM-Estimated Emissions from the No-Action Alternative Projects[a,b] (tons per year)

Pollutant	*de minimis* Threshold	Single-Year Total Construction Emissions	5-Year Construction Emissions	Operations Emissions[c]
VOC	250	24	9	4
NO_x	250	24	12	2.7
CO	250	78	72	60
SO_x	250	0.1	0.06	0.04
PM_{10}	250	>250	137	0.1
$PM_{2.5}$	250	0.5	0.3	0.1
Pb	25	0.0	0.0	0.0
NH_3	250	0.7	0.5	0.4

CO = carbon monoxide; NH_3 = ammonia; NO_x = nitrogen oxides; Pb = lead; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_x = sulfur oxides; VOC = volatile organic compound

a The operational emissions presented in this table assume additional sources of emissions from the heating of new building space and personnel vehicles.

b Criteria pollutants are reported in tons per year unless otherwise noted.

c Modeled steady state, or operations conditions for the single year simulation were slightly higher than for the five-year simulation. Therefore, the more conservative, single-year simulation is presented for the analysis of effects.

Table 5.5-2 2020 and Projected 2030 Exhaust Emissions Under the No-Action Alternative based the Proposed Annual Mileage (metric tons per year)

Exhaust Pollutant	Heavy-Duty Diesel		Light-Duty Gasoline	
	2020	2030 Projected	2020	2030 Projected
Carbon monoxide	2.1	1.7	0.4	0.3
Nitrogen oxides	4.4	2.9	0.03	0.02
$PM_{2.5}$	0.1	0.0	0.0	0.0

$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
Source: BTS (2023)

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in direct impacts to air quality. The potential indirect impacts of the conveyance and transfer of the tracts would include potential increases in criteria pollutants from mobile sources and homes using natural gas or propane. Slight increases in emissions of hazardous air pollutants would be expected from the development of new industrial facilities in the TA-21 tracts. The contributions to GHG emissions associated with the land tracts could increase from the current baseline for the TA-21 and Rendija Canyon tracts due to the increase in motor vehicle traffic and residential and industrial use of fossil fuels (DOE 1999b). Additional indirect air quality impacts would not be expected for the conveyance of TA-74 and White Rock "Y" tracts. Implementation of these actions would reduce potential air emissions associated with development of these conveyed tracts.

Radiological Air Emissions

No radiological emissions would be expected during construction activities under the No-Action Alternative; nor would there be any radiological emissions associated with the conveyance of the remaining 1,280 acres from the CT EIS (DOE 1999b). Thirteen facilities identified for DD&D are known to have radiological contamination. The potential for short-term radiological air emissions exists for DD&D of these facilities. LANL would prepare a DD&D plan for NNSA approval of the adequacy of actions to protect the environment as well as health and safety of workers and the public.

The 2008 SWEIS estimated 34,000 curies of annual radioactive air emissions. Over 30,000 curies per year were associated with LANSCE. Consistent with the information reported in Chapter 4, Table 4.5-6, the site has reported an annual release of approximately 300 curies from monitored stacks over the past 14 years. The Laboratory analyzes an increase in annual radioactive air emissions to approximately 2,750 curies per year (Table 5.5-3). These estimates include contributions from the following projects (*see* details in Appendix H, Section H.1.3.1):

- Increased pit production to at least 30 pits per year,
- Light Manufacturing Laboratory operations,
- DD&D of radiologically contaminated buildings, and
- Environmental remediation activities.

As shown in Table 5.5-3, tritium would account for 67 percent of the emissions and gaseous mixed activation products (GMAP) would account for 29 percent. As described in Appendix H, venting of FTWCs would be a one-time event that could occur under the No-Action Alternative. During this singular action, up to 30,000 curies of tritium could be released. The potential health effects of these releases are addressed in Section 5.7 of this SWEIS.

Table 5.5-3 Potential Radiological Emissions for the No-Action Alternative (curies)

Tritium[a]	GMAP	MFP	P/VAP	Am-241	PuEq	U-235
1,850	800	100	3	1.3×10^{-5}	8.9×10^{-4}	1.5×10^{-1}

Am-241 = americium-241; GMAP = gaseous mixed activation products; MFP = mixed fission products; P/VAP = particulate and vapor activation products; PuEq = plutonium equivalent; U-235 = uranium-235

a The Laboratory could have a one-time release of up to 30,000 curies of tritium from venting flanged tritium waste containers.

5.5.1.2 Modernized Operations Alternative

Nonradiological Air Emissions

Nonradiological criteria air pollutant emissions would be less than current emissions because planned upgrades would be implemented. The Laboratory would continue to report annual emissions to comply with their Title V permit. As new facilities were constructed federal, state, and local regulations and permitting requirements would be implemented.

LANL is currently permitted to operate an air curtain destructor to burn wood waste resulting from wildland fire treatments. The operations of the air curtain destructor would be similar to the biomass generator proposed in the Modernized Operations Alternative. The biomass generator reduces air pollutant emissions that would normally be generated by open burning. The potential impacts of operating the air curtain destructor were evaluated in the Wildfire Hazard Reduction EA and subsequent FONSI (NNSA 2000, 2001). Per the Laboratory's Title V air permit, operation of the current equipment is limited to 35 tons of wood or wood waste per day. Operation of the proposed biomass generator could either replace or supplement the operation of the air curtain destructor. The limits from the existing air permit would be expected to remain in effect. Therefore, the emissions from the biomass generator would be expected to be within the existing permitted baseline emissions.

Nonradiological criteria air pollutant emissions for the Modernized Operations Alternative were estimated in Appendix H, Table H-11, and include activities such as site grading associated with construction of 795 acres of solar PV arrays. This area may, or may not, be developed during the period of analysis but was included in the ACAM assumptions to account for air emissions from construction activities. ACAM inputs were also included in the model runs for the Modernized Operations Alternative, as described in Appendix H.

Table 5.5-4 indicates that pollutants would be expected to meet the *de minimis* threshold if all construction activities were to occur in a single year except for PM_{10}. Total site grading under the Modernized Operations Alternative was assumed to be more than 40 million square feet (*see* Table H-11), about half of which would be associated with the 795 acres of proposed solar arrays. It is unrealistic to expect that such a large area would be left as bare soil for a six-month period.

Table 5.5-4 ACAM-Estimated Emissions from the Modernized Operations Alternative Projects (including emissions from the No-Action Alternative)[a] (tons per year)

Pollutant	*de minimis* Threshold	Single-Year Total Construction Emissions	5-Year Construction Emissions	Operations Emissions[b]
VOC	250	52	16	7
NO_x	250	78	29	17
CO	250	143	114	97
SO_x	250	0.26	0.2	0.1
PM_{10}	250	>250	>250	1.1
$PM_{2.5}$	250	1.9	1.1	1.1
Pb	25	0.0	0.0	0.0
NH_3	250	1.5	0.9	0.7

CO = carbon monoxide; NH_3 = ammonia; NO_x = nitrogen oxides; Pb = lead; PM_{10} = particulate matter less than 10 microns in diameter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; SO_x = sulfur oxides; VOC = volatile organic compound

a The operational emissions presented in this table assume additional sources of emissions from the heating of new building space and personnel vehicles. They are reported in tons per year unless otherwise noted.

b Modeled steady state, or operations conditions for the single year simulation were slightly higher than for the five-year simulation. Therefore, the more conservative, single year simulation is presented for the analysis of effects.

Exceedances would not be expected if less than 2 million square feet of soil was left graded and bare for less than three consecutive months. However, the same reasonable precautions described in Section 5.5.1.1 would be taken to prevent dust from becoming airborne.

Nonradiological and radiological material and waste shipments would travel more than 1 million miles per year under the Modernized Operations Alternative the equivalent of nine trucks working full time; the same number of trucks as the No-Action Alternative (FreightWaves 2021).

<u>**Radiological Air Emissions**</u>

No radiological emissions would be expected during construction activities from the Modernized Operations Alternative. Twenty-nine additional facilities identified for DD&D under the Modernized Operations Alternative are known to have radiological contamination. The following projects have the potential to increase radioactive air emissions at LANL under the Modernized Operations Alternative:

- LANSCE modernization, and
- DD&D of radiologically contaminated buildings.

Several radiological facilities proposed under the Modernized Operations Alternative are replacing existing capabilities and facilities and would not be expected to add radioactive air emissions above those of the No-Action Alternative. The potential for radioactive air emissions associated with DD&D is not quantifiable at this time, similar to the No-Action Alternative. Therefore, LANL would prepare a DD&D plan for NNSA approval of the adequacy of actions to protect the environment as well as health and safety.

The Modernized Operations Alternative would include similar radiological emissions as those of the No-Action Alterative with additional releases from LANSCE modernization and uncertainties (primarily related to DD&D). This SWEIS analyzes a potential increase of 150 curies of GMAP above the No-Action Alternative for potential radiological air emissions under the Modernized Operations Alternative.

5.5.1.3 Expanded Operations Alternative

Nonradiological Air Emissions

Planned upgrades would be implemented that may reduce existing nonradiological criteria air pollutant emissions. The Expanded Operations Alternative would include construction and three potential alternative treatment technologies for OB/OD. Alternatives to existing treatments are described in LANL's General Part B RCRA Permit (EPA ID# NM0890010515, HWB-LANL-20-001) and in Chapter 3, Section 3.4.1.

Emissions from an OB/OD project would be quantified prior to construction as part of the construction application process for both air and waste modifications to existing permits. Each of these technologies would reduce the potential air emissions from the current OB/OD treatments performed at LANL. For the purpose of this analysis, no credit is taken for the expected reduction in OB/OD emissions and the emissions are assumed to be consistent with those included in the No-Action Alternative.

Nonradiological criteria air pollutant emissions for the Expanded Operations Alternative were estimated in Table H-15. The projects associated with all three alternatives were simulated in the model runs for this alternative.

The ACAM air quality emissions from activities under the Expanded Operations Alternative are presented in Table 5.5-5, which indicates that pollutants would be expected to meet the *de minimis* threshold if all construction activities were to occur in a single year except for PM_{10}. Total site grading under the Expanded Operations Alternative was projected to be more than 5 million square feet (*see* Table H-15). Similar to other alternatives, exceedances would not be expected if less than 2 million square feet of soil was left graded and bare for less than three consecutive months. Reasonable precautions would be taken to prevent dust from becoming airborne.

A conservative simulation assumed all activities for all three alternatives would be completed within the same five-year period. These results are presented in Appendix H, Table H-17. The results indicate that all pollutants would be expected to meet the *de minimis* threshold except for PM_{10}.

Material and waste shipments would travel 1.2 million miles per year under the Expanded Operations Alternative. The distance would be the equivalent to 10 trucks working annually. The Expanded Operations Alternative would add one additional heavy-duty truck when compared to the No-Action Alternative.

Table 5.5-5 ACAM-Estimated Emissions from the Expanded Operations Alternative Projects (including emissions from the No-Action and Modernized Operations Alternatives)[a] (tons per year)

Pollutant	*de minimis* Threshold	Single-Year Total Construction Emissions	5-Year Construction Emissions	Operations Emissions[b]
VOC	250	20	12	9
NO_x	250	34	22	17
CO	250	140	135	127
SO_x	250	0.2	0.2	0.2
PM_{10}	250	>250	72	1.1
$PM_{2.5}$	250	1.7	1.2	1.1
Pb	25	0.0	0.0	0.0
NH_3	250	1.0	0.9	0.9

CO = carbon monoxide; NH_3 = ammonia; NO_x = nitrogen oxides; Pb = lead; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; SO_x = sulfur oxides; VOC = volatile organic compound

a The operational emissions presented in this table assume additional sources of emissions from the heating of new building space and personnel vehicles.

b Modeled steady state, or operations conditions for the single year simulation were slightly higher than for the five-year simulation. Therefore, the more conservative, single year simulation is presented for the analysis of effects.

Radiological Air Emissions

No radiological emissions would be expected during construction activities from the Expanded Operations Alternative. No additional facilities would be demolished so there would be no potential for additional radiological air emissions during additional DD&D. Several projects under the Expanded Operations Alternative would have the potential to increase radioactive air emissions in addition to those presented in the No-Action Alternative and the Modernized Operations Alternative. Projects with the potential to increase radioactive air emissions include:

- LEFFF,
- DMMSC,
- LANSCE enhancements,
- Microreactor,
- SPDP, and
- Advanced Separations of Plutonium Radiological Laboratory.

Table 5.5-6 lists the expected changes in radiological emissions associated with projects proposed under the Expanded Operations Alternative. The proposed microreactor, radiological laboratory and TRU waste staging area would not be expected to contribute radioactive air emissions beyond the conservative assumptions already considered for sitewide radiological emissions. The expected annual increase in radiological emissions for the Expanded Operations Alternative compared to the Modernized Operations Alternative would be 0.014 curies of uranium, 650 curies of GMAP,

Table 5.5-6 Radiological Emissions for the Expanded Operations Alternative in Addition to the Modernized Operations Alternative by Project (curies)

Project	GMAP	Am-241	Pu-239	U-235
LEFFF	-	-	-	1.4×10^{-2} (8.2×10^{-4} depleted)
DMMSC	420	-	-	-
LANSCE Enhancements	84	-	-	-
SPDP[a]	-	7.5×10^{-6}	6.9×10^{-5}	-

ARIES = Advanced Recovery and Integrated Extraction System; DMMSC = Dynamic Mesoscale Materials Science Capability; GMAP = gaseous mixed activation products; LEFFF = Low Enriched Uranium Fuel Fabrication Facility; SPDP = Surplus Plutonium Disposition Program; Am-241 = americium-241; Pu-239 = plutonium-239; U-235 = uranium-235

Note: "-" means zero or no notable contribution.

a The estimated emissions for SPDP are based on an annual throughput of 2,000 kilograms per year (NNSA 2024a). Per Section 3.4.1, if SPDP is not implemented within the analytical period addressed in this SWEIS (by 2038), a limited ARIES enhancement could be expected to process up to 700 kilograms per year, or 35 percent of SPDP. If the limited ARIES enhancement were implemented, emissions of Am-241 and Pu-239 would be expected to be limited to 35 percent of the values shown in this table.

0.000069 curie of plutonium, and 0.0000075 curie of americium. The projects, for example, would add approximately 500 curies per year of GMAP to the additional 150 curies added by the Modernized Operations Alternative. Therefore, the Expanded Operations Alternative would account for an additional 650 curies released compared to the No-Action Alternative. The total projected releases for the Expanded Operations Alternative are presented in Table 5.5-7.

Table 5.5-7 Total Potential Radiological Emissions for the Expanded Operations Alternative (curies)

Tritium[a]	GMAP	MFP	P/VAP	Am-241	PuEq	U-235
1,850	1,454	100	3	2.05×10^{-5}	9.6×10^{-4}	0.164

Am-241 = americium-241; GMAP = gaseous mixed activation products; MFP = mixed fission products; P/VAP = particulate and vapor activation products; PuEq = plutonium equivalent; U-235 = uranium-235

a The Laboratory could have a one-time release of up to 30,000 curies of tritium from venting flanged tritium waste containers.

5.5.1.4 Summary of Air Quality Impacts for the Alternatives

Table 5.5-8 summarizes the potential air quality impacts for the alternatives.

Table 5.5-8 Potential Air Quality Impacts for the Alternatives

Resource Parameter	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
de minimis threshold exceeded	Yes, for PM_{10} only. Mitigation measures would be needed to reduce below threshold.	Yes, for PM_{10} only. Mitigation measures would be needed to reduce below threshold.	Yes, for PM_{10} only. Mitigation measures would be needed to reduce below threshold.
Radiological emissions	Tritium[a] = 1,850 curies GMAP = 800 curies MFP = 100 curies P/VAP = 3 curies Am-241 = 1.3×10^{-5} curies PuEq = 8.9×10^{-4} curies U-235 = 0.15 curies	Tritium[a] = 1,850 curies GMAP = 950 curies MFP = 100 curies P/VAP = 3 curies Am-241 = 1.3×10^{-5} curies PuEq = 8.9×10^{-4} curies U-235 = 0.15 curies	Tritium[a] = 1,850 curies GMAP = 1,454 curies MFP = 100 curies P/VAP = 3 curies Am-241 = 2.05×10^{-5} curies PuEq = 9.6×10^{-4} curies U-235 = 0.164 curies

Am-241 = americium-241, GMAP = gaseous mixed activation products, MFP = mixed fission products, P/VAP = Particulate and vapor activation products, PM_{10} = particulate matter less than 10 microns in diameter; PuEq = plutonium equivalent, U-235 = uranium-235

a The Laboratory could have a one-time release of up to 30,000 curies of tritium from venting flanged tritium waste containers.

5.5.2 Greenhouse Gas Emissions

This section describes the potential GHG impacts from the alternatives. Key metrics presented in the analysis include quantities of projected GHG emissions and their social cost along with the social benefits of implementing renewable energy projects (e.g., solar PV arrays). Costs presented in this section refer to the social costs of increasing GHG emissions. The social cost of greenhouse gases (SC-GHG) incorporates literature on the economic impacts of changes in climate inclusive of changes in net agricultural productivity, human health effects, property damage from flooding and other natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services (EPA 2023a).

Benefits, conversely, are presented to monetize the social benefits of reducing emissions of GHGs from proposed renewable energy projects. These benefits demonstrate the potential offset of GHGs that would have otherwise been generated during the production of electricity. These benefits would be realized for the SC-GHG, thereby offsetting their impact (EPA 2023a).

5.5.2.1 No-Action Alternative

The GHG emissions produced from the operation of existing site-wide facilities, the construction and operation of new facilities including solar PV arrays, and transport of waste and materials were combined to quantify project life GHG emissions as detailed in Appendix H, Section H.2.3.1. GHG emissions were assumed to be fixed from the first year of the project life. These fixed annual loads were added to the annual loads from construction and operation of new facilities to present total annual GHG emissions for the No-Action Alternative as CO_2e. These annual totals range from about 366,000 to 371,000 MT CO_2e (*see* Table H-28).

Emissions from Table H-28 were applied to the SC-GHG annual rates at a 1.5-percent discount rate to calculate present value and annualized value site-wide SC-GHG for the No-Action Alternative. Of this total, roughly $3 million of the annualized value at a 1.5-percent discount rate would be expected from construction and operation of new facilities and transport of waste and materials.

Implementation of the solar PV arrays could provide a benefit by displacing, or not requiring, electricity that would have otherwise been generated by burning fossil fuels. Displaced (offset) electricity from solar PV arrays would also provide a net reduction of GHG emissions. The emissions would be expected to be offset by 15,548 metric tons of CO_2e per year from implementation of a 10 MW solar PV array. The offset would total roughly 233,000 metric tons of CO_2e over the 15-year analytical period. The benefit expected from the 10 MW solar PV array would be an estimated present value in 2024, based on 2020 dollars and a 1.5-percent discount rate, of $81.61 million with an annualized value over the 15-year analytical period of $6.12 million at a 1.5-percent discount rate.

5.5.2.2 Modernized Operations Alternative

The GHGs produced from existing site-wide emissions, construction and operation of new facilities, and transport of waste and materials were combined to quantify GHG emissions for the Modernized Operations Alternative for the 15-year analytical period. Loads (emissions) from existing site-wide activities and transporting waste and materials were assumed to be equal to the No-Action Alternative for the first five years of the project life (2024–2028). Details of the GHG analysis for the Modernized Operations Alternative are provided in Appendix H, Section H.2.3.2.

Implementation of the Modernized Operations Alternative was assumed to occur in a five-year period. GHG emissions from existing site-wide activities and from the No-Action Alternative were added to the transport of waste and materials shipments and the ACAM outputs for the Modernized Operations Alternative. GHG emissions from construction and operation of new facilities and transport of waste and materials for the Modernized Operations Alternative would account for a four to five percent annual increase in site-wide GHG emissions compared to the No-Action Alternative. These annual totals range from about 366,000 to 387,000 MT CO_2e (*see* Table H-31).

Emissions from Table H-31 were applied to the SC-GHG annual rates at a 1.5-percent discount rate to calculate site-wide the SC-GHG for the Modernized Operations Alternative at a 2024 present value in 2020 dollars of $1,978 million and an annualized value over the 15-year period of $148 million. Of this total, roughly $7 million of the annualized values would be expected from construction and operation of new facilities and transport of waste and materials.

Displaced (offset) electricity from solar PV arrays would provide a reduction of GHG emissions. The analysis used conservative assumptions to calculate the benefits of solar PV arrays, acknowledging that the total proposed area, 795 acres (and associated 158.8 MW), may not be constructed in the 15-year analytical period. Instead, the analysis assumed that only 50 percent of the solar generation would be implemented and only half of the electricity would be offset (79.4 MW). An estimated 136,568 MWh/year would be associated with the 79.4 MW. Once the solar PV arrays were operational, 123,451 metric tons of CO_2e would be offset by renewable energy projects proposed under the Modernized Operations Alternative.

Instead of assuming all 79.4 MW from solar PV arrays went online in a single year, the emissions reductions from these arrays were distributed across a five-year period (2029–2032). Spreading these benefits over this five-year period would result in an offset by nearly 988,000 metric tons of CO_2e over the 15-year analytical period. An estimated 2024 present value $342 million benefit (2020 dollars) and $37 million annually over the 15-year analytical period would be expected assuming a 1.5-percent discount rate from implementing 79.4 MW of solar PV arrays, more than offsetting the potential increase in costs from the alternative.

5.5.2.3 Expanded Operations Alternative

The GHG emissions produced site-wide, construction and operation of new facilities, and transport of waste and materials were combined to quantify GHG emissions expected under the Expanded Operations Alternative for the 15-year analytical period. Details of the GHG analysis for the Expanded Operations Alternative are provided in Appendix H, Section H.2.3.3.

GHG emissions from existing facilities and transporting waste and materials were assumed to be equal to the No-Action Alternative for the first four years of the project life (2024–2028); for the Modernized Operations Alternative, 2029–2033. GHG emissions from the transport of waste and materials for the Expanded Operations Alternative were applied beginning in 2034. Annual loads from existing site-wide activities and transport of waste and materials were added to the annual loads from construction and operation of new facilities to present total annual GHG emissions (Table 5.5-14). GHG emissions from construction and operation of new facilities and transport of waste and materials for the Expanded Operations Alternative would account for a roughly 5-percent annual increase in site-wide GHG emissions compared to the No-Action Alternative. These annual totals range from about 366,000 to 389,000 MT CO_2e (*see* Table H-33).

Emissions from Table H-33 were applied to the SC-GHG annual rates at a 1.5-percent discount rate to calculate a site-wide SC-GHG for the Expanded Operations Alternative at a 2024 present value with a 1.5-percent discount rate in 2020 dollars of $1,988 million and an annualized value over the 15-year period at a 1.5-percent discount rate of $149 million. Of this total, roughly $7 million of the annualized value would be expected from construction and operation of new facilities and transport of waste and materials.

Offset electricity from solar PV arrays would provide a reduction of GHG emissions under the Expanded Operations Alternative that would be equal to that of the Modernized Operations Alternative—an estimated 107,900 metric tons of CO_2e per year more benefit would be expected when compared with the No-Action Alternative. No additional benefits would be expected because additional solar PV arrays were not proposed for the Expanded Operations Alternative.

5.5.2.4 Summary of Greenhouse Gas Impacts for the Alternatives

Table 5.5-9 summarizes the potential GHG impacts for the alternatives.

Table 5.5-9 Potential Greenhouse Gas Impacts for the Alternatives

Resource Parameter	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
GHG emissions	An increase of roughly 10,5000 MT of CO_2e annually during the peak of construction would be a negligible (~3 percent) increase from 2022 site-wide emissions.	An increase of roughly 17,000 MT of CO_2e annually during the peak of construction would be a minor adverse (~5 percent) increase from the No-Action Alternative.	An increase by roughly 18,100 MT of CO_2e annually during the peak of construction would be a minor adverse (~5 percent) increase from the No-Action Alternative.
SC-GHG	The 2024 present value of the social cost of GHG would be about $1,930,000,000 in 2020 dollars at a 1.5-percent discount rate, an annualized value of $145,000,000 site-wide with roughly 3,000,000 expected from construction and operations of new facilities and transport of waste and materials over the 15-year period. Present value social benefits from operating solar PV arrays were estimated at $6,120,000.	The annualized value of the GHG emissions would be roughly $6,600,000 from construction and operation of new facilities over the 15-year period. Annualized social benefits from implementation of half of the proposed solar PV arrays (about 89 MW) was estimated at $37,000,000.	The annualized value of these GHG emissions would be roughly $7,400,000 from construction and operation of new facilities over the 15-year period. Annualized social benefits from implementation of half of the proposed solar PV arrays (about 89 MW) was estimated at $37,000,000.

CO_2e = carbon dioxide equivalent; GHG = greenhouse gas; MT = metric ton; PV = photovoltaic; SC-GHG = social cost of greenhouse gas emissions

5.5.3 Noise

This section describes the potential noise impacts from the alternatives. Overall, LANL would remain compliant with all local noise regulations at all times.

5.5.3.1 No-Action Alternative

Noise impacts under the No-Action Alternative would be associated with new project construction (approximately 34 acres), utility infrastructure project construction (about 132 acres), environmental remediation, and DD&D (1,630,000 square feet) (collectively referred to as construction and remediation). Temporary noise impacts would be expected from these activities in their immediate vicinity. Noise from construction equipment, as well as increased traffic, would be expected.

Table 5.5-10 provides the attenuation of construction noise over a specified distance. Noise 400 to 800 feet away from a load noise—noise in the range of 120 dB—would be reduced to the level of normal speech. However, with multiple items of equipment operating concurrently, noise levels can be relatively high within 400 to 800 feet from the site of construction and remediation. Although construction and remediation activities would cause temporary noise impacts, most activities under the No-Action Alternative would be confined to the LANL property boundary and more than 800 feet from residential areas or businesses. Thirty-six facilities within 800 feet of the

LANL property boundary would be demolished. Construction of a new fire station would take place in TA-16 within 800 feet of the LANL property boundary and the Santa Fe National Forest. Construction and remediation noise from these activities would be far from residential areas. Noise may affect wildlife but obstructions from trees would attenuate noise.

Table 5.5-10 Peak Noise Levels Expected from Construction Equipment

Source	Noise level (decibels as dBA)					
	Peak	Distance from source (feet)				
		50	100	200	400	800
Dump trucks	108	88	82	76	70	64
Jackhammer	108	88	82	76	70	64
Grader	108	88–91	82–85	76–79	70–73	64–67
Dozer	107	87–102	81–96	75–90	69–84	63–78
Concrete mixer	105	85	79	73	67	61
Dragline	105	85	79	73	67	61
Pile driver	105	95	89	83	77	71
Crane	104	75–88	69–82	63–76	55–70	49–64
Loader	104	73–86	67–80	61–74	55–68	49–62
Forklift	100	95	89	83	77	71
Generator	96	76	70	64	58	52
Heavy trucks	95	84–89	78–83	72–77	66–71	60–65
Scraper	93	80–89	74–82	68–77	60–71	54–65

Source: Golden et al. (1979)

Construction and remediation activities could also generate ground-borne vibrations. These effects would be expected to be confined to the area immediately around equipment and not beyond the LANL property boundary. No blasting or other airborne vibrations would be generated during construction and remediation. Therefore, no offsite vibrational effects would be expected from construction and remediation.

Traffic noise from construction, remediation, DD&D, and operations would be another source of noise. Under the No-Action Alternative, the workforce at LANL would be expected to increase by nearly 10 percent with the addition of 1,530 workers to the total workforce. This increase in workers would be expected to have a similar (10-percent) increase in traffic, which would be expected to lead to less than a 1-decibel increase in traffic noise. A 1-dB increase would be imperceptible; therefore, impacts to traffic noise from the No-Action Alternative would be negligible.

Operations associated with the No-Action Alternative would be expected to be similar to existing noise and contained within the LANL property boundary. Noise generated from HE testing facilities and OB/OD waste treatment would be expected to continue to attenuate before being perceived by the public. Intermittent, offsite noise impacts from fire station sirens and alarms may also be expected in the Santa Fe National Forest outside TA-16. Some new facilities may include emergency generators that would operate, and make noise, during power outages and periodic testing.

Continued environmental remediation would cause noise from heavy equipment and truck traffic; however, it would be expected to be similar to existing noise and would fluctuate depending on where the remediation activities are occurring across the site.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in direct impacts to noise. The potential indirect impacts of the conveyance and transfer of the tracts would include an increase in ambient noise levels above current levels for the areas with the potential for residential, commercial, or industrial development (Rendija Canton and TA-21 tracts). Ambient noise levels associated with tracts planned for cultural preservation may decrease, and noise levels associated with those planned as natural areas would be expected to remain the same or increase slightly. Demolition and construction activities would be expected to temporarily elevate noise levels on the tracts. Residential uses typically would result in ambient noise levels between 50 and 70 dBA depending on traffic, density, and location. Commercial and industrial land uses typically would be slightly higher. Noise would be present during a greater part of the day than currently on the tracts that are developed for residential, commercial, and industrial land uses. Overall noise from vehicular traffic would increase (DOE 1999b).

5.5.3.2 Modernized Operations Alternative

Temporary noise impacts under the Modernized Operations Alternative would be expected from construction and DD&D in the vicinity of these activities. Noise from construction equipment, as well as increased traffic, would be expected.

Construction and DD&D activities from the Modernized Operations Alternative would cause temporary noise impacts in the area of construction. Most of the proposed projects would not be within 800 feet of the LANL property boundary; *see* Appendix C.5.2 for a description of the logarithmic scale of noise. Load noise would be near background levels at 800 feet or more from its source. Some construction and as many as 36 DD&D activities would be within 800 feet of the LANL property boundary. Obstructions from trees would attenuate noise and BMPs would be implemented as needed to reduce the impacts to surrounding wildlife.

Two construction projects would be within 800 feet of the LANL property boundary: Los Alamos Canyon Bridge replacement and associated building DD&D and the Option B solar PV array. Bridge construction and DD&D of the Health Research Laboratory at the LANL entrance with the Los Alamos townsite in TA-43 would be adjacent to the Los Alamos Medical Center Emergency Room. Construction and DD&D would be within 400 feet of private residences, within 800 feet of two churches, and more than 1,000 feet from Los Alamos High School. Construction of solar PV array Site B could impact residences in the White Rock community. The 117-acre solar PV array in Site B would be constructed along NM-4 and within 800 feet of residential housing. The landscape has few trees, and noise from construction equipment would be expected to travel with few obstructions. Given the temporary and intermittent nature of proposed construction activities and the limited amount of noise that heavy equipment would generate, these effects would not be loud enough to interfere with communication at the hospital or in homes when the windows are closed. Therefore, these effects would be minor.

Construction and DD&D activities could also generate ground-borne vibrations. These effects would be expected to be confined to the area immediately around equipment. Ground-borne vibrations would be expected to extend beyond the LANL property boundary during bridge construction and DD&D of the Health Research Laboratory. No blasting or other airborne vibrations would be generated during construction and DD&D of other facilities.

Traffic noise from construction, DD&D, and operations would be another source of noise. Under the Modernized Operations Alternative, the workforce at LANL would be expected to increase by nearly 15 percent over the 2022 workforce (780 workers more than the No-Action Alternative). This increase in workers would be expected to have a similar (15-percent) increase in traffic, which would be expected to lead to an increase of nearly 1 dB from traffic noise. This increase would be imperceptible; therefore, impacts to traffic noises from the Modernized Operations Alternative would be negligible.

Most noise at LANL occurs inside facilities. Operations associated with the Modernized Operations Alternative would be expected to be similar to existing noise and contained within the LANL property boundary. Noise generated from HE testing facilities would be expected to continue to attenuate before being perceived by the public. Some facilities may include emergency generators that would generate operational noise during power outages and periodic testing.

5.5.3.3 Expanded Operations Alternative

No additional DD&D would be expected to occur under the Expanded Operations Alternative beyond that proposed under the Modernized Operations Alternative. Noise impacts would be associated with an additional 927,000 square feet of construction of new facilities and about 46 acres of utility/infrastructure projects. Temporary noise impacts would be expected from construction activities in their vicinity. Noise from construction equipment, as well as increased traffic, would be expected.

Most of the proposed projects would not be within 800 feet of the LANL property boundary. The only additional project not evaluated by the No-Action Alternative or Modernized Operations Alternative that would be within 800 feet of the LANL property boundary is the Pumped Hydropower Demonstration at TA-39 and TA-49. This project would be north of the Bandelier National Monument, about 1.5 miles to the northwest of the Juniper Family Campground. Noise from construction of the facility would not be expected to be heard at that distance.

Construction activities could generate ground-borne vibrations. However, these effects would be expected to be confined to the area immediately around equipment.

Traffic noise from construction and operations would be another source of noise. Under the Expanded Operations Alternative, the workforce at LANL would be expected to increase by about 21 percent over the 2022 workforce (1,695 workers more than the No-Action Alternative). This increase in workers would be expected to have a similar (21-percent) increase in traffic, which would be expected to lead to an increase of 1 dB from traffic noise. This increase would be imperceptible; therefore, impacts to traffic noises from the Expanded Operations Alternative would be negligible.

If additional OB/OD waste treatment is implemented under the Expanded Operations Alternative, new technology designed to dampen noise and/or contain waste would be evaluated at the specific location and for the specific technology. Noise monitoring may be performed during initial use to establish operating procedures.

Most noise at LANL occurs inside facilities. Operations associated with the Expanded Operations Alternative would be expected to be similar to existing noise and contained within the LANL property boundary. Noise generated from OB/OD waste treatment and HE testing facilities would be expected to attenuate before being perceived by the public. Some new facilities may include emergency generators that would operate, and make noise, during power outages and periodic testing.

5.5.3.4 Summary of Noise Impacts for the Alternatives

Table 5.5-11 summarizes the potential noise impacts for the alternatives.

Table 5.5-11 Potential Noise Impacts for the Alternatives

Resource Parameter	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Number of new projects within 800 feet of the site boundary[a]	1 – TA-16 fire station (7)	6 (plus the No-Action Alternative) – security facilities (3), National Gas Transfer Systems and Surety Laboratory (32), LANSCE WTF (34), bridge replacement (58), remote parking and bus station (59) and solar PV siting option B	1 (plus the No-Action and Modernized Operations alternatives) – Pumped Hydropower Demonstration at TA-39 and TA-49 (20)
Number of DD&D actions within 800 feet of the site boundary	36 – 1 fire station; 26 trailers, transportable, shed, and/or storage; 3 warehouses; 3 labs and offices; and 3 inspection, disposal or magazines	36 (plus the No-Action Alternative) – various facilities used for operations and maintenance including a test building, labs and offices, guard stations and security, and utility facilities	0 (plus the No-Action and Modernized Operations alternatives)
Noise increase from traffic increases	A 10-percent increase in traffic would be expected to increase noise by less than 1 dB; imperceptible	A 15-percent increase in traffic would be expected to increase noise by nearly 1 dB; imperceptible	Nearly 21-percent increase in traffic would be expected to increase noise by 1 dB; imperceptible
Exceedance of noise regulations	No	No	No

DD&D = decontamination, decommissioning, and demolition; LANCSE = Los Alamos Neutron Science Center; WTF = water treatment facility

a Numbers in parentheses refer to the project number in the facility and infrastructure tables in Section 3.2 (No-Action), Section 3.3 (Modernized Operations), and Section 3.4 (Expanded Operations).

5.6 Ecological Resources

5.6.1 Introduction

Key metrics presented in this analysis include: (1) identify disturbances to land/vegetation and discuss impact on habitats, fish and wildlife, and special status species; and (2) identify and discuss wetland impacts. Impacts to ecological resources would occur from loss of habitat from land disturbance and removal of vegetation, human activity, noise associated with project development and operation, and potential water runoff and sedimentation from new impervious surfaces sites and construction. For construction of new facilities, utilities, and infrastructure, direct impacts were based on the approximate area of previously undisturbed vegetation that could be disturbed and the type of vegetation that would be disturbed. Impacts from human activity, noise, erosion, and sedimentation were evaluated qualitatively considering location relative to ecological resources and the type of project.

Vegetation

The proposed projects under the alternatives would disturb previously undisturbed areas of vegetation. Vegetation types are based on the LANL land cover map updated in 2018 (Hansen et.al. 2018). NNSA estimated an approximate total area of new land disturbance for each alternative. The type of vegetation that most likely would be disturbed was based on the location of proposed projects.

Terrestrial Wildlife

The most direct impact to terrestrial wildlife would be the loss of habitat and fragmentation from clearing of previously undisturbed vegetation. In addition, human activity, light pollution, and noise from construction or during operations could create an area of wildlife avoidance surrounding the projects. Avoidance would be most pronounced for projects that have outdoor human activity or noise generation and occur in less developed regions of LANL. Noise effects without human presence may result in fewer impacts than the presence of human activity (Hathcock et al. 2010; Gadek and Velardi 2021).

Vehicle collisions with deer and elk during seasonal migration occur along the primary commuter routes through the Pajarito Corridor, the LANSCE Planning Area, and the Los Alamos Canyon into the Core Area Planning Area. The additional development of projects under the alternatives and increases in staffing and commuter traffic (LANL 2022o) likely would increase collisions with deer and elk along the main access routes, particularly through the Pajarito Corridor (Bennett et al. 2014; Gadek et al. 2023). Recent studies have shown that deer and elk continue to move between the LANL site and the Pueblo de San Ildefonso on the east side of the site, with many animals remaining in the area year-round (Abeyta and Hathcock 2020; Berryhill et al. 2020). Gadek et al. (2023) discusses various mitigation measures to reduce wildlife vehicle collisions, including wildlife jump-outs, overpasses, and animal detection systems. When well designed and implemented, wildlife overpasses are generally considered to be one of the most effective means of reconnecting habitat fragmented by roads. Overpasses mimic surrounding habitat by including natural elements, such as local vegetation, and link habitats by allowing for the movement of a wide range of wildlife.

The conservation of habitat for the Mexican spotted owl, Jemez Mountains salamander, and Southwestern willow flycatcher (all federally listed threatened and endangered species) would continue to provide open space and movement corridors for a variety of wildlife including deer, elk, black bear, mountain lions, bobcat, and coyotes (Bennett et al. 2014; Gadek et al. 2023), although there could be localized areas of corridor restrictions from development and human activity.

Wetlands and Aquatic Resources

Aquatic resources and wetlands are limited on the LANL site. Wetlands and limited reaches of perennial streams on LANL do not contain fish populations. None of the alternatives would directly impact aquatic resources in the Rio Grande that borders the southeastern side of the LANL site. Wetlands represent high-value habitats in this semiarid environment because they provide surface water, are unique habitats, and contribute to the biodiversity of the region. Wetlands on the LANL site are located in canyon bottoms. None of the alternatives would directly impact wetlands. Specific projects that occur upstream from wetland areas and that would cross the canyon bottoms potentially could create runoff and sedimentation of wetland areas. However, the Laboratory would follow 10 CFR Part 1022 and implement standard BMPs for erosion control to minimize sediment runoff from construction sites. Impacts to wetlands from implementation of the alternatives are not expected.

Protected and Special-Status Species and Habitats

Federally Threatened or Endangered Species. As identified in Chapter 4, Section 4.6.4.1 of this SWEIS, the Laboratory manages threatened and endangered species in accordance with the HMP (LANL 2022l). LANL has established AEIs for three species: Mexican spotted owl, Southwestern willow flycatcher, and Jemez Mountains salamander. Core habitat and buffer habitat have been identified and mapped within each AEI for each species.

Core habitat is defined as areas essential for the existence of the species. Buffer habitat includes areas designed to protect core habitat from undue disturbance and habitat degradation. No further development is allowed in previously undisturbed core habitat without an individual ESA consultation. Allowable development in buffer habitat for the Mexican spotted owl in all AEIs was set through consultation with USFWS in the original 1999 HMP. In the 2022 update of the HMP, LANL biologists analyzed development in all AEIs for the Mexican spotted owl. Over time, AEI boundaries have changed through consultation, so development was analyzed using percentages of allowable development from 1999 to 2022. During this analysis, it was determined that allowable development in Mexican spotted owl buffer habitat has reached or exceeded the 1999 levels in all AEIs at LANL, except for the Three-mile AEI. Any further development or habitat alteration in buffer habitat in the exceeded AEIs requires individual Section 7 consultation with the USFWS for ESA compliance. Therefore, buffer and core habitat for the Mexican spotted owl are treated the same for development and habitat alteration, except for the Three-mile AEI (LANL 2022l). Other limitations defined in the HMP, such as noise or access restrictions, still follow the original HMP framework and vary between core and buffer habitat. For the Southwestern willow flycatcher and Jemez Mountains salamander, core and buffer habitats are still considered separately for purposes of compliance. Previously disturbed areas exist in both core and buffer habitat areas and are not considered suitable habitat. New activities, including further development within existing developed areas are not restricted unless they impact undeveloped areas of core habitat. Light and noise are examples of impacts that might extend into an undeveloped core habitat. Recent measurements indicate that the ambient noise levels in the vicinity of existing operations in the Pajarito Corridor do not extend into the canyon bottoms where Mexican spotted owls are known to nest (LANL 2022l). Measures of background levels of light near existing light sources in the Pajarito Corridor detected very little ambient light above the expected background levels for different moon phases (LANL 2022l). To assess potential impacts to these three species, NNSA compared locations of projects under each alternative to mapped core and buffer habitats. The proposed projects that occur within either core or buffer habitat would be reviewed before implementation to ensure compliance with the HMP, and further consultation would be conducted, if required.

Migratory Birds/Bald and Golden Eagles. Potential impacts to migratory birds and large raptors (hawks and eagles) include loss or alteration of habitat, mortality from collisions with building windows, collisions with powerlines or guyed wires, electrocution on powerlines, take of eggs and nestling during vegetation clearing for construction, and entrapment in open-top pipes. The

Laboratory manages migratory birds in accordance with the *Migratory Bird Best Management Practices Source Document for Los Alamos National Laboratory* (Stanek et al. 2020b). Vegetation clearing during the nesting season could disturb eggs and nestlings. The peak nesting season for song birds is May 15–July 15 and March–August for raptors. Potential impacts would be reduced by clearing vegetation during the nonbreeding season or conducting clearance surveys for nests during the nesting season. Potential mortality from collisions with new or renovated buildings would be minimized with design features to reduce visibility into transparent windows and turning off or dimming lights near windows at night.

Potential impacts to large raptors include collisions with powerlines and electrocutions. Bald eagles are known to occur at LANL during the winter (November 1–March 31), most commonly along the Rio Grande. The proposed projects would use power poles designed to minimize electrocutions. The use of powerline markers for flight diversion may reduce potential collisions.

Open-top pipes such as bollards, fence or gate posts, and open vent pipes represent entrapment hazards not only to migratory birds but also small mammals and reptiles and have been documented as hazards on LANL (Hathcock and Fair 2014). To minimize this potential hazard, any open pipes installed under the alternatives in this SWEIS would be either covered or screened to prevent accidental entrapment of birds, mammals, or reptiles.

Special-Status Species. Berryhill et al. (2020) addresses species of concern that may not receive regulatory protection. The Monarch butterfly is currently proposed for threatened and endangered listing, and the pinyon jay has been petitioned for listing. Projects in undeveloped areas would be evaluated to determine if habitat for either species is present. Monarchs are known to occur on site, breeding from July through October. Monitoring for Monarch eggs and caterpillars on milkweeds has been conducted since 2018. Monarch caterpillars eat only milkweed plants (*Asclepias* spp.). Milkweed removal and roadside mowing during the breeding season are the main impacts to Monarchs on site. Impacts would be reduced by prioritizing mowing to occur outside of the breeding season or checking milkweed for eggs and caterpillars prior to mowing if within the breeding season. The pinyon jay relies on the pinyon pine as a primary food source. A large percentage of pinyon pines at LANL have died from a combination of drought stress and bark beetle infestation. Projects in the juniper woodland (dense and sparse) associations have the potential to impact surviving or young pinyon pines during land clearing. Projects would be evaluated to ensure that cutting and clearing of pinyon pines, particularly large, mature trees, is avoided to the extent practical.

The Monarch and the pinyon jay are just two examples of sensitive species that may have future federal listing requirements and would have the potential to impact development and operations. Monitoring special-status and at-risk species that have the potential to become federally protected is important for risk management and enabling the mission if future listing is warranted.

5.6.2 No-Action Alternative

The development of previously undeveloped land would be about 62 acres (Table 5.6-1). Most of the development would occur in juniper woodland (sparse and dense) with smaller areas of regenerating ponderosa pine, mixed conifer, and submontane grassland.

Table 5.6-1 Area of Potential Development (acres) and Number of Projects in Threatened or Endangered Species Habitat by Alternative

Resource Parameter	No Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Vegetation			
Footprint of Projects (acres)	250	1,007[a]	1,142
Previously Developed Area (acres)	188	276	336
Undeveloped Area (acres)	62	731	806
Threatened or Endangered Species			
Number of Projects			
Mexican Spotted Owl			
Core Habitat			
Developed Site	5	6	3
Undeveloped Site	0	4	2
Buffer Habitat			
Developed Site	20	16	9
Undeveloped Site	9	11	6
Jemez Mountains Salamander			
Core Habitat			
Developed Site	0	0	0
Undeveloped Site	0	1	1
Buffer Habitat			
Developed Site	0	0	0
Undeveloped Site	0	1	1
Southwestern Willow Flycatcher			
Core Habitat			
Developed Site	0	0	0
Undeveloped Site	0	0	0
Buffer Habitat			
Developed Site	0	0	0
Undeveloped Site	0	0	0

a Assumes a full build out of the solar PV array system.

Notable projects include the actions evaluated in the Chromium Final Remedy EA (DOE 2024a) in Mortandad and Sandia canyons. The hexavalent chromium contaminated water treatment would be outside Mexican spotted owl habitat, but various elements of the project may occur within habitat of the owl. A replacement asphalt plant has been constructed on Sigma Mesa between Mortandad and Sandia canyons on the site of the existing asphalt plant. Potential impacts to Mexican spotted owls known to successfully nest southeast of the project site in Mortandad Canyon have been evaluated in a Biological Assessment (LANL 2018f). Analysis of potential noise impacts concluded that the project may affect, but is not likely to adversely affect, the Mexican spotted owl.

Another project involves a 10-MW solar PV array and associated transmission lines that would be constructed in the northwestern corner of TA-16 on largely previously disturbed land. The Laboratory evaluated this project in a project-specific EA (NNSA 2019b). As part of the project mitigation plan, LANL would conduct a long-term avian monitoring study to evaluate potential impacts of solar PV arrays on bird populations. These mitigations are described in Section 5.16.6.

As proposed in the EPCU Draft EA, the EPCU project would originate on BLM land and cross SFNF land and the White Rock Canyon before arriving on DOE/NNSA land. It would then cross approximately 3 miles of an area largely covered with dense juniper woodland with smaller areas of sparse juniper woodland, bare soil, and bare rock. The project would also include upgrades to LANL electrical infrastructure including 12 miles of overhead distribution lines and 3 miles of underground lines. An estimated eight staging areas of 2–5 acres would also be developed on the LANL site and use previously disturbed areas to the extent practicable. Small areas cleared around transmission structures and approximately 1.4 acres for expansion of the ETA Substation would be permanent disturbances in juniper woodland vegetation. The EPCU project would create approximately 8 acres of permanent access roads for line maintenance on BLM and SFNF land. The remaining acreage would be temporary disturbances and be reclaimed after construction. LANL conducted a Biological Evaluation of the EPCU project and concluded that the project would have no effect on any federally listed species, low potential of impacts on two state-listed species, no impact on 18 state-listed species, and no impact on BLM sensitive species (Thompson 2023). NNSA is currently evaluating the specific impacts of the project in the EPCU Draft EA (NNSA 2023b).

The institutional construction laydown areas are estimated to be about 29 acres. Approximately 8 acres would be on previously disturbed land and about 21 acres on undisturbed vegetation. Most of the institutional construction laydown areas would occur in sparse juniper woodland vegetation with one occurring in primarily ponderosa pine woodland. The construction laydown areas would extend along and adjacent to the main highway through the Pajarito Corridor Planning Area and into the Core Area Planning Area.

Potential impacts to threatened or endangered species under the No-Action Alternative would be limited to the Mexican spotted owl (Table 5.6-1). Nine projects would occur in undeveloped sites in areas mapped as buffer habitat and would require review under the HMP (LANL 2022l). Most of the projects within owl habitat would occur in existing developed areas.

Continued environmental remediation would include continuing site investigations and potential installation of caps in some MDAs. Installation of exploratory and monitoring wells (or similar investigative features) in compliance with the Consent Order would cause some impacts such as clearing of vegetation. Well-drilling equipment typically would be mounted on trucks that must be positioned at the drilling locations. Well installation could require several days or more. Following well installation, vegetation would return. Sampling of wells would require periodic, but brief, occupation of the sampling locations. Installation of caps would disturb terrestrial resources during clearing of vegetation and MDA capping. At most MDAs, this activity would have minimal direct impact because the MDAs are generally grassy areas enclosed by fencing. However, siting and operating temporary support facilities could disrupt some nearby habitat over the short term, and noise and human presence during remediation could also disturb wildlife in nearby areas. DOE would ensure proper maintenance of equipment and implement restrictions preventing workers from entering adjacent undisturbed areas, as appropriate, to lessen impacts on ecological resources. Once the MDAs are capped and revegetated, they would provide habitat similar to pre-existing conditions.

The direct impacts to ecological resources from conveyance of the remaining approximately 1,280 acres identified in the CT EIS would be limited to the changes in responsibility for resource protection. Environmental review and protection processes and procedures for future activities would be different from those that are currently governing the subject tracts and may not be as rigorous. The HMP would no longer be in effect for those tracts occupied by or containing suitable habitat for threatened and endangered species (LANL 2022l).

The potential development footprints evaluated in 1999 for the remaining tracts included approximately 575 acres of relatively undisturbed habitat, primarily ponderosa pine forest and pinyon-juniper woodland (Rendija Canyon [570 acres] and TA-21 [5 acres]) (DOE 1999b). Indirect impacts associated with contemplated uses include the degradation of large amounts adjacent habitat, including preferred habitat for the Mexican spotted owl. NNSA would consult with the USFWS prior to transfer of any land that could have potential adverse consequences to threatened and endangered species.

Development in Rendija Canyon could result in direct loss of wetland structure and function with potential increased downstream and offsite sedimentation. The current lack of a natural resources management plan by either the County of Los Alamos or the Pueblo de San Ildefonso would impede the development of an integrated, multiagency approach to short- or long-term natural resource management strategies. The 1999 CT EIS indicated that transfer of the land tracts may result in a much less rigorous environmental review and protection review process for future activities because neither the County of Los Alamos nor the Pueblo de San Ildefonso are subject to regulations that would match the federal review and protection process. The future development could result in additional fragmentation of habitat and disruption of wildlife migration corridors (DOE 1999b). In 2015, Los Alamos County approved an Open Space Management Plan and implements strategies to manage other natural resources.[46]

5.6.3 Modernized Operations Alternative

Impacts to ecological resources under the Modernized Operations Alternative would be similar to the No-Action Alternative, with potential development of an additional 731 acres of previously undisturbed land and wildlife habitat. Most of the area (641 acres) would be associated with nine potential locations of additional solar PV arrays. Other notable projects that would contribute to disturbed land area include additional institutional laydown areas (18.5 acres of which are undeveloped), a remote parking area and bus transfer station (23 acres undeveloped), multiple site-wide transportation and parking projects (37 acres undeveloped), and a new bridge spanning Los Alamos Canyon to replace the existing bridge (about 10 acres of undeveloped land in the canyon). The solar PV array sites would include dense and sparse juniper woodland, ponderosa pine woodland, sparse oak woodland, and smaller areas of several other vegetation associations. The remote parking area and bus transfer station would disturb approximately 22 acres of dense and sparse juniper woodland. The institutional laydown areas would disturb about 19 acres including areas of sparse juniper woodland and ponderosa pine woodland. The Los Alamos Canyon Bridge replacement project would potentially disturb mixed conifer vegetation within the canyon.

[46] https://www.losalamosnm.us/Parks-and-Recreation/Open-Space-Trails/Natural-Resources#section-1

Potential impacts could occur to both Mexican spotted owl and Jemez Mountains salamander habitat (Table 5.6-1). Four and 11 projects, respectively, would potentially occur in undeveloped core and buffer habitat for the Mexican spotted owl. The proposed Los Alamos Canyon Bridge replacement would cross both core and buffer habitat for the Jemez Mountains salamander. These projects would require review under the LANL HMP and likely require consultation with the USFWS (LANL 2022l). Future consultations would occur after the development of the design for the bridge replacement.

5.6.4 Expanded Operations Alternative

Impacts to ecological resources under the Expanded Operations Alternative would include potential impacts from the No-Action and Modernized Operations alternatives. The Expanded Operations Alternative would construct and operate an additional 18 new facilities and 4 utility and infrastructure projects that would disturb approximately 75 acres of undeveloped land. The largest disturbance of vegetation would be 20 acres in blue grama grassland for the pumped hydropower storage demonstration project. Design and construction of this demonstration project would minimize disturbance as much as practicable, and would be part of the demonstration project objectives. Pipelines for the FSI WTF would disturb about 8 acres of undisturbed land in the Los Alamos Canyon near the ice rink. The vegetation eventually would be restored. However, much of this area is mixed conifer vegetation and currently mapped as core and buffer habitat for the Jemez Mountains salamander. Other vegetation disturbances would include about 2.5 acres of dense juniper woodland for the DMMSC project in TA-53 and 3.7 acres of ponderosa pine woodland for several projects, including the new supercomputing facility in TA-6 and the DMMSC project. Three proposed projects under the Expanded Operations Alternative would potentially occur in undeveloped areas mapped as habitat for the Mexican spotted owl. These projects would require evaluation under the HMP (LANL 2022l).

Additional OB/OD operation sites could be developed under the Expanded Operations Alternative. LANL has conducted long-term monitoring of existing OB/OD sites in TA-36 and TA-39 for potential impacts to bird populations. No evidence of negative effects on bird populations has been detected (Gadek and Velardi 2021). As identified in Chapter 3, Section 3.4.1, the expansion of OB/OD at LANL would include the implementation of alternative treatment technologies, all of which would decrease the pollutants released to the atmosphere and likely decrease risks to birds and other animals and plants in the region. Additional powerlines could be constructed to support the development of the supercomputing infrastructure under the Expanded Operations Alternative. LANL would construct powerlines in accordance with industry guidelines for protecting raptors from electrocution.

Operational Changes

Under the Expanded Operations Alternative, operational changes would be implemented that would potentially impact ecological resources. These include programs to reduce the risk to LANL assets from wildland fires and control the effects of feral cattle living on the LANL site.

Wildland Fire Risk Reduction Treatments. Wildland fires are an ever-present risk to Laboratory facilities, employees, surrounding communities, and the ecological resources on the LANL site. Past fires have affected Laboratory assets and operations, risked employee safety, and altered the vegetation and wildlife communities on the LANL site. As described in Chapter 3, Section 3.4.2, LANL proposes to revise the fire mitigation treatment standards (LANL 2024d) in the existing *Wildfire Mitigation and Forest Health Plan* (LANL 2019a).

Under the revised standards, approximately 14,000 acres of forest land would be thinned or cleared over 15 years. Threatened and endangered species habitat would continue to be protected by following the guidelines and processes in the HMP and allowances from the USFWS, although greater allowance would be made for removal of damaged or diseased high-risk trees in Mexican spotted owl and Jemez Mountains salamander habitat, which are primarily mixed conifer (LANL 2022l). Both species depend on habitat with larger, mature trees. Fire management prescriptions that would reduce fuel loads and minimize potential crown fires in remaining mature forest areas would benefit both species in the long term by preventing stand replacement fires. Thinning forests and removing continuous understory vegetation in defensible open space would alter habitat for migratory birds. Because the proposed thinning projects would occur over a 15-year period, species would adjust to the change in composition of the plant community; change in the composition of bird communities may occur (Fair et al. 2018). The Laboratory would follow guidance documents (Berryhill et al. 2020; Stanek et al. 2020b) to reduce impacts to these species. Migratory birds are protected by the MBTA, and projects would require environmental review throughout their operation. Disturbance impacts from noise and human activity during forest-thinning operations would be short term. Increasing the ROW clearance along the main evacuation routes may increase visibility and potentially reduce deer and elk collisions along the main access roads, particularly in the Pajarito Corridor.

Removal of Invasive Feral Cattle from DOE Property. Feral cattle have been impacting natural resources along the Rio Grande on Los Alamos County, LANL, and Bandelier National Monument land since the 1980s. Under the Expanded Operations Alternative, several management strategies would be implemented to address impacts of feral cattle on DOE/NNSA property. These strategies include, but are not limited to, live trapping, relocation, and lethal control for reduction or elimination.

Removal action that would reduce or eliminate feral cattle would have beneficial impacts on ecological resources along the Rio Grande by reducing existing impacts, such as trampling and overgrazing of riparian vegetation, degradation of water quality from cattle defecations, and increased soil erosion from degradation of vegetation cover (Sanchez 2021). The riparian habitat along the Rio Grande is important for a wide variety of wildlife species, including migratory birds and possibly the Southwestern willow flycatcher and yellow-billed cuckoo. The general degradation of the riparian habitat may also affect a variety of large and small mammals that would typically use the area. The feral cattle also use side canyons where grazing removes forage resources that would otherwise be used by native species such as deer, elk, and bighorn sheep. Removal of the feral cattle would allow vegetation to recover and potentially restore the wildlife species that would typically use the riparian habitat and lower canyon areas.

5.6.5 Summary of Ecological Resources Impacts for the Alternatives

The primary impact to ecological resources under all three alternatives would be clearing of previously undisturbed vegetation for the construction of facilities and infrastructure, as summarized in Table 5.6-1. Vegetation clearing would reduce usable habitat for a variety of wildlife species that inhabit the LANL site. Because many of the projects are relatively small and distributed throughout the LANL site, impacts from individual projects may not be readily observable but may occur cumulatively from loss of habitat and fragmentation of remaining habitat. Additional impacts would occur through wildlife avoidance of areas surrounding new facilities and infrastructure constructed in previously undisturbed areas. The extent of the avoidance factor would depend on the type of activity occurring at each project site. Projects with more outdoor human activity or noise (e.g., equipment operation or detonations) would have greater impacts. Impacts to threatened and endangered species would depend on the location of each project in relation to identified core habitat and buffer habitat for each species and whether the project would disturb previously undisturbed habitat. Projects occurring in undisturbed core or buffer habitat for any threatened and endangered species would be evaluated in accordance with the HMP (LANL 2022l).

No-Action Alternative. The No-Action Alternative would disturb about 62 acres of previously undisturbed vegetation and wildlife habitat. Most of the projects would be constructed on previously disturbed areas. No core habitat mapped for any of the three threatened and endangered species would be disturbed. Nine projects would disturb vegetation in areas mapped as habitat for the Mexican spotted owl. Recent measurements indicate that ambient noise levels do not extend into the canyon bottoms where Mexican spotted owls are known to nest (LANL 2022l).

Modernized Operations Alternative. The projects proposed under the Modernized Operations Alternative would potentially have the largest impact on ecological resources with the possible disturbance of 731 acres of previously undisturbed vegetation and wildlife habitat. Most this land disturbance (641 acres) would occur if the solar PV array system was fully built on the nine proposed sites. Fifteen projects would potentially impact undeveloped Mexican spotted owl habitat. The proposed replacement for the existing bridge across Los Alamos Canyon would potentially impact Jemez Mountains salamander core and/or buffer habitat depending on final design features. The impacts to ecological resources from the Modernized Operation Alternative would be in addition to the impacts for the No Action Alternative.

Expanded Operations Alternative. The projects proposed under the Expanded Operations Alternative would potentially disturb an additional 75 acres of previously undisturbed vegetation and wildlife habitat. The impacts to ecological resources under the Expanded Operations Alternative would be in addition to the impacts for the No Action and Modernized Operations alternatives. The largest impact would be the disturbance of 20 acres of blue grama grassland for the Pumped Hydropower Demonstration Project. Eight projects would disturb undeveloped areas in Mexican spotted owl habitat. The FSI WTF would potentially disturb land in Los Alamos Canyon that would be reclaimed after project implementation but would occur in core and/or buffer habitat for the Jemez Mountains salamander.

Proposed operational changes under the Expanded Operations Alternative include implementing revised wildfire risk reduction standards and removing feral cattle on DOE/NNSA land in White Rock Canyon and other locations as necessary for safety reasons. Implementing the revised wildfire risk reduction treatments would modify habitat on the LANL site, potentially changing available habitat for wildlife which could have adverse and beneficial impacts on different species. The wildfire risk reduction treatment also could have long-term beneficial impacts on wildlife habitat by reducing the frequency of severe fire and conserving the mature ponderosa pine woodland, juniper woodland, and mixed forest vegetation. The removal of feral cattle in White Rock Canyon would have beneficial impacts by allowing natural recovery of overgrazed riparian vegetation.

5.7 Human Health and Safety

The analysis in this section presents the potential human health impacts for the alternatives. Key metrics presented in the human health analysis are: (1) radiological doses and potential LCFs to the public and workers from normal operations, (2) occupational injuries/deaths to workers, and

(3) health impacts to workers and the public from normal operations involving chemical and biological materials. Section 5.7.5 provides information regarding potential health impacts to specific receptors from special pathways that may not exist for the average individual.

5.7.1 No-Action Alternative

In accordance with DOE Order 450.2 and DOE Order 440.1B, operations at LANL would continue to be conducted in a manner that protects the health and safety of workers and the public, preserves the quality of the environment, and prevents property damage. In addition, LANL operations would continue to be conducted in accordance with DOE Order 452.3, which requires compliance with applicable ES&H laws, regulations, and requirements, and with NNSA and DOE directives regarding occupational safety and health.

5.7.1.1 Radiological Impacts

It is anticipated that facility construction and utility/infrastructure projects would not occur in areas that would pose radiological risks to workers or the public. However, prior to construction, soils in construction areas would be sampled and tested for any contaminants. If any contamination is found, remediation of the area would be conducted prior to construction. Consequently, construction activities would not be expected to result in any radiological health impacts to the public or workers.

NNSA regulates the releases of radioactive materials for its facilities and the potential level of radiation doses to workers and the public. Environmental radiation protection is currently regulated by DOE Order 458.1, which sets annual dose standards from routine DOE operations of 100 millirem per year through all exposure pathways to members of the public. The order requires that no member of the public receive an effective dose in a single year greater than 10 millirem from airborne emissions of radionuclides and 4 millirem from ingestion of drinking water. In addition, the dose requirements in 40 CFR Part 61, Subpart H, limit exposure to the MEI from all air emissions to 10 millirem per year.

In this SWEIS, dose calculations from normal operations were made based on the CAP-88 package of computer codes, version 4.1.1,[47] which was developed under EPA sponsorship to demonstrate compliance with 40 CFR Part 61 (Subpart H), which governs the emissions of radionuclides other than radon from DOE facilities. This package implements a steady-state Gaussian plume atmospheric dispersion model to calculate concentrations of radionuclides in the air.

Under normal operations, public radiation doses would occur from airborne releases from continued operations. In addition, under the No-Action Alternative, the following projects from Chapter 3, Section 3.2 have the potential to increase the radioactive air emissions, the number of radiation workers, and the dose to workers at LANL: (1) increased pit production; (2) Light Manufacturing Laboratory operations; (3) RLWTF operations; (4) CMR Hot Cell operations in support of isotope production; (5) DD&D of radiologically contaminated buildings; and (6) environmental remediation activities.

As identified in Section 5.5.1.1, NNSA estimates that 2,753 curies (consisting of mostly tritium and mixed fission and activation products) could be released to the air under the No-Action Alternative. These potential annual airborne radioactive emissions would result in radiological doses to the public. Table 5.7-1 lists incremental radiation doses estimated for the public (offsite

[47] https://www.epa.gov/radiation/forms/cap88-pc-version-411-downloads-and-supporting-documents

MEI and collective population) and corresponding incremental LCFs in that population. As shown in the table, the annual radiation dose to the offsite MEI would be much less than the limit of 10 millirem per year set by both the EPA (40 CFR Part 61, Subpart H) and DOE (DOE Order 458.1) for airborne releases of radioactivity. The risk of an LCF to the MEI from operations would be 1.8×10^{-6} per year. The projected number of annual LCFs to the population within a 50-mile radius would be 3.7×10^{-3}.

Table 5.7-1 Annual Radiological Impacts to the Public from Potential Operational Radiological Emissions under the No-Action Alternative

Receptor/Dose/Risk	Baseline (existing environment)	No-Action Alternative
Offsite MEI[a]		
Dose (millirem)	0.41	3.07
LCF risk[b]	2.5×10^{-7}	1.8×10^{-6}
Population Within 50 Miles[c]		
Collective dose (person-rem)[e]	0.12	6.11
LCF[c]	7.2×10^{-5}	3.7×10^{-3}

LCF = latent cancer facility; MEI = maximally exposed individual

a The highest offsite dose at LANL was measured at 95 Entrada Drive, close to environmental air-monitoring station 396, as shown on Figure 4.7-1. The hypothetical MEI for the projected impacts is located at 769 meters north-northeast of the 48000160 stack.

b Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem (DOE 2003a).

c Based on projection of about 371,000 people living within 50 miles of LANL in the year 2020. Note: The 50-mile population is expected to continue to increase by 0.7 percent per year, reaching over 414,000 people by 2038. If the population increase is assumed to be uniform across all distances and directions, then the collective dose in 2038 would increase by approximately 12.6 percent compared to the collective dose for 2020 presented above.

Source: LANL (2023f)

In addition to the reoccurring radiological releases from the projects discussed above, this SWEIS analyzes the venting of four FTWCs currently stored at TA-54. This venting project, which was planned to be completed years ago, is now expected to be completed during the analytical period of this SWEIS. Because FTWC venting is not a recurring operation, this SWEIS presents the potential dose from the FTWC venting project as a one-time event. The potential tritium releases associated with this project could be as high as 30,000 curies, which would result in a potential offsite dose contribution to an MEI of up to 8 millirem.[48]

The increase in the number of radiation workers and the dose to these workers would be dominated by the increase in pit production in PF-4. NNSA estimates that the number of radiation workers would increase from 2,819 (average from 2017–2022) to 4,450 under the No-Action Alternative. The average worker dose is estimated to increase from 91.7 millirem per year (average over 2017–2022) to 115 millirem per year.

[48] The actual release of tritium would be dependent on the efficiency of the tritium capture system but not exceed 30,000 curies for any 12-month period. NNSA would limit annual tritium releases from FTWC venting to ensure that the total annual MEI dose (considering all site-wide releases) would remain less than 10 millirem per year.

A total of 186 facilities, with a total footprint of 1,630,000 square feet, would be scheduled to undergo DD&D under the No-Action Alternative. Prior to the initiation of DD&D activities, LANL would prepare a detailed DD&D plan that would contain a detailed description of the project-specific DD&D activities to be performed and actions to protect workers, the public, and the environment. DD&D planning would implement ALARA objectives and follow radiological protection guidelines to ensure that radiation doses to workers and the public are kept to ALARA levels. Lessons learned from DD&D at LANL and other DOE sites would be applied to minimize impacts to workers.

LANL's ALARA Policy

LANL conducts its radiological activities in a manner that protects the health and safety of all its employees, contractors, the general public, and the environment. In achieving this policy, LANL takes efforts to reduce radiological exposures and releases to as low as reasonably achievable (ALARA), taking into account social, technical, economic, practical and public policy considerations.

Source: DOE Order 458.1.

Table 5.7-2 provides the estimates of annual radiological doses to workers under the No-Action Alternative. The annual doses to individual workers would be well below the DOE limit of 5,000 millirem (10 CFR Part 835) and the LANL administrative control level of 2 rem per year that has been established for external exposures (LANL 2024a). The total annual collective dose to all LANL radiological workers would be about 512 person-rem, which would result in 0.31 LCF annually.

Table 5.7-2 Annual Radiological Impacts to Workers from Operations under the No-Action Alternative

Receptor/Dose/Risk	Baseline (existing environment)	No-Action Alternative
Number of radiological workers who receive a measurable dose	2,819	4,450
Average annual dose to radiological worker (millirem)	91.7	115
Average annual radiological worker risk (LCFs)[a]	5.5×10^{-5}	7.0×10^{-5}
Collective annual dose to radiological workers (person-rem)	248	512
Total Annual Radiological Worker Risk (LCFs)[a]	0.15	0.31

LCF = latent cancer fatality

a Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem (DOE 2003a).

5.7.1.2 Nonradiological Hazards and Occupational Health Impacts

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in direct impacts to human health. The potential indirect impacts of the conveyance and transfer of the tracts would depend on the proximity of the new development to the Laboratory. Based on the CT EIS, development of the Rendija Canyon Tract could add approximately 3,500 residents and would increase the total number of people within the 50-mile radius of the Laboratory. Similarly, development of the TA-21 Tract could add as many as 1,900 private sector employees within close proximity of Laboratory facilities. While the estimated MEI doses would not increase, development of these areas would mean increased total population exposures to radiological and chemical emissions from normal LANL operations and hypothetical accidents. An increase in the public collective radiation dose and resultant LCFs would result (DOE 1999b). The proposed land uses for the TA-74 and White Rock "Y" tracts would not result in any additional radiological risks to the population.

Potential human health impacts to workers were evaluated using Bureau of Labor Statistics (BLS) occupational injury/ illness/fatality rates. Injury/illness/fatality rates at DOE/NNSA sites are historically lower than BLS values due to the increased focus on safety fostered by ongoing health and safety processes. Table 5.7-3 lists the potential estimates of injuries/illness/fatalities estimated in an average year under the No-Action Alternative. As shown in the table, in an average year, approximately 483 days of lost work from illness/injury and 1.3 fatalities would be expected from LANL operations under the No-Action Alternative. For illness/injury, this would represent an increase of 18.7 percent compared to the existing baseline. For fatalities, the increase would be 19.6 percent above the existing baseline.

Table 5.7-3 Occupational Injury/Illness and Fatality Estimates at LANL for Construction, DD&D, and Operations under the No-Action Alternative

Injury, Illness, and Fatality Categories	Baseline (existing environment)			No-Action Alternative			Percent Change versus Baseline[f]
	Construction and DD&D[c]	Operations[c]	Total	Construction and DD&D[d]	Operations[e]	Total	
Lost days due to injury/illness[a]	21	386	407	27	456	483	18.7%
Number of fatalities[b]	0.18	0.89	1.1	0.23	1.05	1.3	19.6%

DD&D = decontamination, decommissioning, and demolition

a Based on 2.1 injuries in New Mexico per 100 workers for construction/DD&D and 2.7 injuries in New Mexico per 100 workers for manufacturing (operations).

b Based on 18.4 fatalities in New Mexico per 100,000 workers for construction/DD&D and 6.2 fatalities in New Mexico per 100,000 workers for all occupations (operations). Note: Data for manufacturing-related fatalities is not available for New Mexico.

c Existing workforce of 15,326 workers is assumed to have 14,326 operational workers and 1,000 construction/DD&D workers.

d Based on peak construction/DD&D workforce of 1,300 workers.

e Based on 16,900 operational workers.

f Percent change is presented for the "Total."

Source: BLS (2021)

Development of the Rendija Canyon and TA-21 tracts would involve construction activities with the attendant risks to workers. The development in TA-21 would include industrial activities, which would involve commensurately greater worker risks (DOE 1999b).

Nonradiological Air Emissions and Chemicals. With regard to health impacts associated with nonradiological air emissions, the Laboratory's emissions of regulated pollutants are below the limits allowed in LANL's Title V Operating Permit (LANL 2022e). As shown in Table 5.7-4, emissions of hazardous air pollutants and VOCs were significantly below Title V Operating Permit limits.

Table 5.7-4 Emissions of Volatile Organic Compounds and Hazardous Air Pollutants from Chemical Use in Research and Development Activities at LANL

Pollutant	Emissions (ton/year)	
	Title V Operating Permit Limits	Laboratory Releases, 2021
Hazardous air pollutants	24	5.7
Volatile organic compounds	200	6.8

Source: LANL (2024a)

There are no measurable nonradiological health effects to the public from LANL air emissions (LANL 2022e). With regard to health impacts associated with nonradiological effluents, based on annual analyses, NNSA has concluded that there is no measurable risk to the public from exposure to surface water and sediment resulting from either current or legacy LANL releases (LANL 2022e).

Workers would be protected from overexposure to hazardous chemicals by adherence to regulatory occupational standards that limit concentrations of potentially hazardous chemicals. DD&D activities have the potential to cause exposure to chemical hazards. Of the 186 facilities scheduled to undergo DD&D under the No-Action Alternative, 17 facilities are chemically contaminated (about 67,000 square feet, or 4 percent of the total footprint) and 27 facilities have some level of asbestos contamination (about 334,000 square feet, or 21 percent of the total footprint) (LANL 2024b). Prior to DD&D, facilities would be characterized to identify waste types (e.g., radioactive and hazardous waste), construction material types (e.g., steel, roofing, concrete), presence of equipment, levels of contamination, expected waste volumes, and other information to support safe demolition. Some facilities that would undergo DD&D could contain regulated ACM. Pre-demolition surveys would identify any ACM present and ACM would be handled and disposed of according to applicable regulations.

Overall site usage of chemicals would increase under the No-Action Alternative as activity levels increase at existing facilities and as new facilities are constructed and begin operation. As discussed in Chapter 3, Section 3.2, the square footage associated with new facilities with expanded or new laboratory or research functions could increase under the No-Action Alternative compared to existing operations at LANL. However, no notable chemical-related health impacts are associated with normal operations at LANL. Initial hazard screens did not identify any additional controls necessary to protect the public from direct chemical exposures during normal operations. Potential impacts from chemical accidents are presented in Section 5.14 of this SWEIS.

Appendix H, Section H.2.2 provides general information relative to the potential human health effects associated with climate change and the relationship to emissions of GHGs. This information is applicable to all alternatives.

Non-ionizing Radiation. Technologies used at LANL that generate non-ionizing radiation[49] include lasers, microwave-generating and radiofrequency devices, technologies that generate ultraviolet radiation, video displays and instrumentation, welding, and security-related devices. Devices that generate non-ionizing radiation are regulated by the U.S. Food and Drug

[49] Non-ionizing radiation refers to any type of electromagnetic radiation that does not carry enough energy to ionize living material; that is, to completely remove an electron from an atom. Because non-ionizing radiation has lower energy than ionizing radiation, it has fewer health risks than ionizing radiation.

Administration, while worker exposures are regulated by the OSHA. Public exposures are not expected, as any non-ionizing radiation generated by site operations are localized in nature. Devices that can generate larger amounts of non-ionizing radiation, such as some lasers, can cause skin burns or eye injury to anyone who looks directly into the beam or its mirror reflection. Worker exposures can occur because of equipment failure, improper use of equipment, or non-adherence to procedures.

Biological Hazards. The hazards associated with working with biological materials (agents) range from personal exposure to accidental environmental releases.[50] Biological operations at LANL are categorized into the following two risk groups (RGs) based on their relative risk to human health (WHO 2020):

- **RG1** – Agents not associated with disease in healthy adult humans.
- **RG2** – Agents associated with human disease that is rarely serious and for which preventive or therapeutic interventions are often available.

LANL currently operates BSL-1 and BSL-2 facilities. DOE has determined that operations involving BSL-1 and BSL-2 facilities would not result in significant impacts to workers or the public (10 CFR Part 1021, Subpart D, Appendix B).

5.7.2 Modernized Operations Alternative

5.7.2.1 Radiological Impacts

As was discussed for the No-Action Alternative, it is anticipated that facility and utility/ infrastructure construction activities would not occur in areas that would pose radiological risks to workers or the public. The same practices (e.g., identification of contaminated areas prior to construction) as described in Section 5.7.1.1 would be implemented under the Modernized Operations Alternative.

Under normal operations, public radiation doses would occur from airborne releases from continued operations and No-Action Alternative projects/operations. In addition, under the Modernized Operations Alternative (as described in Section 3.3), the following projects have the potential to increase the radioactive air emissions, the number or radiation workers, and the dose to workers at LANL: (1) the RACR; (2) Rad Lab; (3) replacement office/lab and light lab facilities; (4) CWF; (5) NGTS/S Laboratory; (6) LANSCE modernization; and (7) DD&D of radiologically contaminated buildings.

NNSA estimates that the Modernized Operations Alternative would add about 150 curies of radioactive air emissions (consisting of mostly activation products) above and in addition to the No-Action Alternative estimate of 2,753 curies. More information about these potential releases is provided in Section 5.5.1.2 of this SWEIS. Table 5.7-5 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs in that population. As shown in the table, the annual radiation dose to the offsite MEI would be much less than the limit of 10 millirem per year set by both the EPA (40 CFR Part 61, Subpart H) and DOE (DOE Order 458.1) for airborne releases of radioactivity. The risk of an LCF to the MEI from operations would be 1.9×10^{-6} per year. The projected number of annual LCFs to the population within a 50-mile radius of LANL would be 3.7×10^{-3}. As shown in Table 5.7-5, the MEI

[50] Potential impacts associated with accidental releases of biological materials are presented in Section 5.14.

and public dose would be slightly higher under the Modernized Operations Alternative compared to the No-Action Alternative. However, the increases would be minimal.

Table 5.7-5 Annual Radiological Impacts to the Public from Operations under the Modernized Operations Alternative

Receptor/Dose/Risk	No-Action Alternative	Modernized Operations Alternative
Offsite MEI[a]		
Dose (millirem)	3.07	3.18
LCF risk[b]	1.8×10^{-6}	1.9×10^{-6}
Population Within 50 Miles[c]		
Collective dose (person-rem)	6.11	6.18
LCF[c]	3.7×10^{-3}	3.7×10^{-3}

LCF = latent cancer facility; MEI = maximally exposed individual

a The hypothetical MEI for the projected impacts is located at 769 meters north-northeast of the 48000160 stack.

b Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem (DOE 2003a).

c Based on projection of about 371,000 people living within 50 miles of LANL in the year 2020. Note: The 50-mile population is expected to continue to increase by 0.7 percent per year, reaching over 414,000 people by 2038. If the population increase is assumed to be uniform across all distances and directions, then the collective dose in 2038 would increase by approximately 12.6 percent compared to the collective dose for 2020 presented above.

Source: LANL (2023f)

NNSA has estimated that the number of radiation workers would increase from 4,450 to 4,530 under the Modernized Operations Alternative. The projects associated with the Modernized Operations Alternative would be unlikely to notably change the average worker dose as compared to the No-Action Alternative. Consequently, the average worker dose is expected to remain at 115 millirem per year.

A total of 156 facilities, for a total footprint of 1,216,000 square feet, would be scheduled to undergo DD&D under the Modernized Operations Alternative. Of these, 29 additional facilities are radiologically contaminated (about 390,000 square feet, or 33 percent of the total footprint). As was discussed for the No-Action Alternative, prior to the initiation of DD&D activities, LANL would prepare a detailed DD&D plan for NNSA approval and implement ALARA objectives.

Table 5.7-6 provides the estimates of annual radiological doses to workers under the Modernized Operations Alternative. Under the Modernized Operations Alternative, the total annual collective dose to all LANL radiological workers would be 521 person-rem, which would result in 0.31 LCF annually to the LANL radiological workforce.

5.7.2.2 Nonradiological Hazards and Occupational Health Impacts

Table 5.7-7 lists the potential estimates of injuries/illnesses/fatalities estimated in an average year under the Modernized Operations Alternative. As shown in the table, in an average year, approximately 499 days of lost work from illness/injury and 1.1 fatality would be expected from LANL operations under the Modernized Operations Alternative. For illness/injury, this would represent an increase of 3 percent compared to the No-Action Alternative. For fatalities, there would be no change compared to the No-Action Alternative.

Table 5.7-6 Annual Radiological Impacts to Workers from Operations under the Modernized Operations Alternative

Receptor/Dose/Risk	No-Action Alternative	Modernized Operations Alternative
Number of radiological workers who receive a measurable dose	4,450	4,530
Average annual dose to radiological worker (millirem)	115	115
Average annual radiological worker risk (LCFs)[a]	7.0×10^{-5}	7.0×10^{-5}
Collective annual dose to radiological workers (person-rem)	512	521
Total Annual Radiological Worker Risk (LCFs)[a]	0.31	0.31

LCF = latent cancer fatality
a Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem (DOE 2003a).

Table 5.7-7 Occupational Injury/Illness and Fatality Estimates at LANL for Construction, DD&D, and Operations under the Modernized Operations Alternative

Injury, Illness, and Fatality Categories	No-Action Alternative			Modernized Operations Alternative			Percent Increase over No-Action Alternative[f]
	Construction and DD&D[c]	Operations[c]	Total	Construction and DD&D[d]	Operations[e]	Total	
Lost days due to injury/ illness[a]	27	456	483	22	477	499	3.1%
Number of fatalities[b]	0.23	1.05	1.3	0.19	1.10	1.3	0%

DD&D = decontamination, decommissioning, and demolition
a Based on 2.1 injuries in New Mexico per 100 workers for construction/DD&D and 2.7 injuries in New Mexico per 100 workers for manufacturing (operations).
b Based on 18.4 fatalities in New Mexico per 100,000 workers for construction/DD&D and 6.2 fatalities in New Mexico per 100,000 workers for all occupations (operations). Note: Data for manufacturing-related fatalities is not available for New Mexico.
c No-Action Alternative workforce would have 1,300 construction workers (peak) and 16,900 operational workers.
d Based on 1,060 construction workers (peak) annually.
e Based on 17,680 operational workers annually.
f Percent change is presented for the "Total."
Source: BLS (2021)

Nonradiological Air Emissions and Chemicals. As shown in Section 5.5.1.2, none of the actions proposed under the Modernized Operations Alternative would result in emissions of regulated pollutants above amounts allowed in LANL's Title V Operating Permit and/or nonradiological effluents. Consequently, NNSA concluded that there would be no measurable risk to the public from exposure to nonradiological air emissions and/or nonradiological effluents. Overall site usage of chemicals would increase under the Modernized Operations Alternative as activity levels increase at existing facilities and as new facilities are constructed and begin operation. However, no notable chemical-related health impacts are associated with normal (accident-free) operations at LANL. Potential impacts from chemical accidents are presented in Section 5.14.

5.7.3 Expanded Operations Alternative

5.7.3.1 Radiological Impacts

As was discussed for the Modernized Operations Alternative and the No-Action Alternative, it is anticipated that facility construction and utility/infrastructure projects would not occur in areas that would pose radiological risks to workers or the public. The same practices (e.g., identification of contaminated areas prior to construction) as described in Section 5.7.1.1 would be implemented under the Expanded Operations Alternative.

Under normal operations, public radiation doses would occur from airborne releases from continued operations. In addition, under the Expanded Operations Alternative (as described in Section 3.4), the following projects have the potential to increase the radioactive air emissions, the number or radiation workers, and the dose to workers at LANL: (1) LEFFF; (2) DMMSC; (3) LANSCE enhancements; (4) microreactor; (5) SPDP; (6) Advanced Separations of Plutonium Radiological Laboratory; and (7) TRU waste staging.

Including the 150 curies associated with the Modernized Operations Alternative, NNSA estimates that 650 curies would be released annually as compared to the No-Action Alternative. The specific details and isotopic content of these release are included in Section 5.5.1.3 of this SWEIS. Table 5.7-8 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs in that population. The risk of an LCF to the MEI from operations would be 2.2×10^{-6} per year. The projected number of LCFs to the population within a 50-mile radius would be 4.0×10^{-3}. As shown in the table, the MEI and public dose would be slightly higher under the Expanded Operations Alternative compared to the No-Action Alternative. However, the increases would be minimal.

NNSA has estimated that the number of radiation workers would increase from 4,450 under the No-Action Alternative to 4,912 under the Expanded Operations Alternative. The projects associated with the Expanded Operations Alternative would increase the average worker dose to 130 mrem/year. The DD&D activities under the Expanded Operations Alternative would be the same as those proposed under the Modernized Operations Alternative.

Table 5.7-9 provides the estimates of annual radiological doses to workers under the Expanded Operations Alternative. The total annual collective dose to all LANL radiological workers would be 639 person-rem under the Expanded Operations Alternative. Statistically, a total annual dose of 639 person-rem would result in 0.38 LCF annually to the LANL radiological workforce.

For limited ARIES enhancement (*see* Section 3.4.1), there would be a reduction in the number of additional radiation workers compared to the values presented in Table 5.7-9. Enhancement of ARIES within the existing building would be unlikely to add more than approximately 40 workers (compared to 180 workers under the SPDP) considering additional shifts and limited space. In that event, the total number of radiation workers under the Expanded Operations Alternative would be reduced from 4,912 to 4,772 workers.

Table 5.7-8 Annual Radiological Impacts to the Public from Operations under the Expanded Operations Alternative Compared with the No-Action Alternative

Receptor/Dose/Risk	No-Action Alternative	Expanded Operations Alternative
Offsite MEI[a]		
Dose (millirem)	3.07	3.66
LCF risk[b]	1.8×10^{-6}	2.2×10^{-6}
Population Within 50 Miles[c]		
Collective dose (person-rem)	6.11	6.73
LCF[c]	3.7×10^{-3}	4.0×10^{-3}

LCF = latent cancer facility; MEI = maximally exposed individual

a The hypothetical MEI for the projected impacts is located at 769 meters north-northeast of the 48000160 stack.

b Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem (DOE 2003a).

c Based on projection of about 371,000 people living within 50 miles of LANL in the year 2020. Note: The 50-mile population is expected to continue to increase by 0.7 percent per year, reaching over 414,000 people by 2038. If the population increase is assumed to be uniform across all distances and directions, then the collective dose in 2038 would increase by approximately 12.6 percent compared to the collective dose for 2020 presented above.

Source: LANL (2023f)

Table 5.7-9 Annual Radiological Impacts to Workers from Operations under the Expanded Operations Alternative

Receptor/Dose/Risk	No-Action Alternative	Expanded Operations Alternative
Number of radiological workers who receive a measurable dose	4,450	4,912
Average annual dose to radiological worker (millirem)	115	130
Average annual radiological worker risk (LCFs)[a]	7.0×10^{-5}	7.8×10^{-5}
Collective annual dose to radiological workers (person-rem)	512	639
Total Annual Radiological Worker Risk (LCFs)[a]	0.31	0.38

LCF = latent cancer facility

a Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem (DOE 2003a).

5.7.3.2 Nonradiological Hazards and Occupational Health Impacts

Table 5.7-10 lists the potential estimates of injuries/illnesses/fatalities estimated in an average year under the Expanded Operations Alternative. As shown in the table, in an average year, approximately 527 days of lost work from illness/injury and 1.4 fatalities would be expected from LANL operations under the Expanded Operations Alternative. For illness/injury, this would represent an increase of 9.1 percent compared to the No-Action Alternative. For fatalities, there would be a 6.2 percent increase compared to the No-Action Alternative.

As identified in Section 5.5.1, none of the actions proposed under the Expanded Operations Alternative would result in emissions of regulated pollutants above amounts allowed in the Laboratory's Title V Operating Permit and/or nonradiological effluents. Consequently, NNSA has concluded that there is no measurable risk to the public from exposure to nonradiological air emissions and/or effluents. Overall site usage of chemicals would increase under the Expanded Operations Alternative as activity levels increase at existing facilities and as new facilities are constructed and begin operation. However, no notable chemical-related health impacts are associated with normal (accident-free) operations at LANL. Potential impacts from chemical accidents are presented in Section 5.14.

Table 5.7-10 Occupational Injury/Illness and Fatality Estimates at LANL for Construction and Operations under the Expanded Operations Alternative

Injury, Illness, and Fatality Categories	No-Action Alternative			Expanded Operations Alternative			Percent Increase over No-Action Alternative[f]
	Construction and DD&D[c]	Operations[c]	Total	Construction and DD&D[d]	Operations[e]	Total	
Lost days due to injury/ illness[a]	27	456	483	25	502	527	9.1%
Number of fatalities[b]	0.23	1.05	1.3	0.21	1.15	1.4	6.2%

DD&D = decontamination, decommissioning, and demolition
a Based on 2.1 injuries in New Mexico per 100 workers for construction/DD&D and 2.7 injuries in New Mexico per 100 workers for manufacturing (operations).
b Based on 18.4 fatalities in New Mexico per 100,000 workers for construction/DD&D and 6.2 fatalities in New Mexico per 100,000 workers for all occupations (operations). Note: Data for manufacturing-related fatalities is not available for New Mexico.
c No-Action Alternative workforce would have 1,300 construction workers (peak) and 16,900 operational workers.
d Based on 1,200 construction workers (peak) annually. There is no additional DD&D for Expanded Operations beyond that proposed under the Modernized Operations Alternative.
e Based on 18,595 operational workers annually.
f Percent change is presented for the "Total."
Source: BLS (2021)

Biological Hazards. A BSL-3 facility is proposed at TA-51. The Centers for Disease Control and Prevention (CDC) and National Institutes of Health have established standards for operating BSL-3 labs. These require that before infectious microorganisms may be handled, a risk analysis must be prepared and the local medical community informed of the agent, how to identify it, and treat its associated diseases. Prior to using a CDC-designated select agent, the facility must register with the CDC and show that it meets biosafety-level requirements for working with that agent. In general, personal exposure may result from the direct handling of biological materials, which may enter the body, cause infection/intoxication, and result in an illness. Illness may occur from direct inhalation (however, personnel wear a powered air purifying respirator with high-efficiency particulate air (HEPA) filtration, which should prevent exposure from an accidental release outside of a containment device), ingestion, skin, or parenteral contact through the mucous membranes and/or by indirect exposure from aerosol-generating equipment. The degree of exposure or injury will depend on the source, the individual's immune or health status, and the efficiency of transmission. Personal exposure may have benign results or may cause a disease requiring medical treatment. Potential accidents involving biological materials are presented in Section 5.14.

5.7.4 Summary of Human Health Impacts for the Alternatives

Table 5.7-11 summarizes the potential impacts to human health and safety for the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative.

5.7.5 Potential Human Health Impacts to Specific Receptors

The 1999 and 2008 SWEIS analyses included a discussion and evaluation of additional risks associated with special exposure pathways. NNSA analyzed the potential risk due to radiological exposure through subsistence consumption of fish, native vegetation, surface waters, sediments, and local produce; absorption of contaminants in sediments through the skin; and inhalation of plant materials. Risks from radionuclides and chemicals in the environment were evaluated for three receptors and ingestion exposure scenarios, collectively referred to as "specific receptors." The specific receptors and the rationale for the selection of ingestion exposure parameters for the previous analyses were as follows.

Table 5.7-11 Potential Impacts to Human Health and Safety for the Alternatives

Resource Parameter	Baseline (existing environment)	No-Action	Modernized Operations	Expanded Operations
MEI risk (LCF)	3.0×10^{-7}	1.8×10^{-6}	1.9×10^{-6}	2.2×10^{-6}
Population risk (LCF)	7.2×10^{-5}	3.7×10^{-3}	3.7×10^{-3}	4.0×10^{-3}
Collective annual dose to radiological workers (person-rem)	248	512	521	639
Total annual radiological worker risk (LCFs)	0.15	0.31	0.31	0.38
Lost days due to injury/illness per year	407	483	499	527
Number of occupational fatalities per year	1.1	1.3	1.3	1.4

LCF = latent cancer fatality; MEI = maximally exposed individual

Offsite Resident. This receptor represents the resident of Los Alamos County whose living habits and diet tend to produce higher than average exposures to radioactive materials and chemicals in the local environment. The resident also was assumed to use water from the Los Alamos County water supply and to have a garden at their home that produced the fruit and vegetables that they consumed. The resident also was assumed to consume local game animals, game fish, honey, and pinyon nuts, as well as beef and milk produced on local farms and ranches. The assumption that the offsite resident consumes all components of the diet and that all the foodstuffs are produced locally (e.g., no dilution by store-bought or processed foods from outside the area) tends to raise the potential intake of contaminants well above that of the average person living near LANL.

Recreational User of Wildlands. The recreational user represents a hypothetical outdoor enthusiast who regularly uses the canyons on and near LANL for recreation (e.g., as a hiker, rockhound, photographer). This receptor was assumed to make an average of two visits per month to the canyons, spending 8 hours per visit. This receptor was assumed to be exposed to environmental contaminants by consumption of surface water and the incidental ingestion of soils and sediments at concentrations typical of the LANL canyons. It is reasonable to assume that the recreational user is a local resident and that, in the extreme case, exposures received in the course of outdoor recreation might be *additional to* those depicted by the offsite resident.

Special Pathways – Subsistence Consumption of Fish and Wildlife. Section 4-4 of EO 12898 directs that "Federal agencies whenever practicable and appropriate, shall collect, maintain, and analyze information on the consumption patterns of populations who principally rely on fish and/or wildlife for subsistence" and that "Federal agencies shall communicate to the public the risks of those consumption patterns." Therefore, special exposure and diet pathways were evaluated to assess the potential impacts to Native American, Hispanic, and other residents whose traditional living habits and diets could cause larger exposures to environmental contaminants than those experienced by the hypothetical offsite resident. The foodstuffs and pathways of specific interest for this group are ingestion of game animals, including consumption of some organ meats not assumed for the "resident" receptor, ingestion of game fish and other fish taken from local waters, and ingestion of native vegetation through use of Indian Tea (Cota). In general, these intakes can be assumed to be *in addition to* the meat, milk, produce, water, and soil and sediment consumption reflected in the offsite resident plus recreational user pathway assumptions.

In order to perform this analysis, NNSA evaluated radionuclide releases to the environment (air and water) and radionuclide concentrations in soils, vegetation, biota, water, and air using data from the 2022 NEPA Yearbook (LANL 2024a) and the 2022 Annual Site Environmental Report (LANL 2024e). NNSA compared these releases and concentrations to past levels and determined that the levels presented in the 2008 SWEIS represented reasonable values. However, to not underestimate any potential future impacts, NNSA conservatively assumed that future levels could increase by 50 percent compared to historic levels. Table 5.7-12 presents the projected doses and risks of developing a fatal cancer for each of the three specific receptors using that conservative assumption.

Table 5.7-12 Annual Ingestion Pathway Dose for Average Consumption Rates by Specific Receptors

Receptor	Dose (millirem)[a]	Cancer Fatality Risk[b]
Offsite Resident	4.1	2.5×10^{-6}
Recreational User of Wildlands	6.0	3.6×10^{-6}
Special Pathways – Subsistence Consumption of Fish and Wildlife	6.8	4.1×10^{-6}

a These values represent a 50-percent increase from the values presented in the 2008 SWEIS to provide additional conservatism.
b Based on the dose-to-risk conversion factor of 0.0006 LCF per rem (DOE 2003a).

The associated LCF risks resulting from the doses shown in Table 5.7-12 would be about 1 in 400,000 for the offsite county resident, 1 in 278,000 for the recreational resources user, and 1 in 245,000 for the special pathways receptor per year. These doses from ingestion would be almost entirely due to naturally occurring radioactivity in the environment and contamination in water and soils from worldwide fallout and past LANL operations. The contribution to ingestion pathway doses from current and projected future LANL operations tends to be extremely small by comparison, largely due to the more stringent effluent control and waste management practices now in use. Accordingly, these ingestion pathway dose and risk values are expected to remain essentially unchanged for some time and would apply equally to all three alternatives evaluated in this SWEIS.

5.8 Cultural and Paleontological Resources Impacts

This section presents a qualitative analysis of the potential for impacts to cultural and paleontological resources for each of the alternatives. Types of potential direct and indirect impacts analyzed for cultural resources include physical destruction or damage from ground disturbance, erosion (*see* text box) or changes to buildings or structures. These physical impacts could be to the whole resource, or could damage a portion of the resource, leaving some portions intact. Other impact analyses include changes to the historic setting of resources for which setting is important, and reduced access by practitioners to traditional resources. Both adverse and beneficial impacts are discussed in the sections below.

> During rain events, stormwater runoff can cause erosion through sheetwash across the ground surface or by forming gullies and arroyos. When the ground surface of a project site is changed, it allows the potential for new erosion patterns to develop. This new erosion can impact cultural resources, in particular archaeological deposits or traditional cultural properties, by moving artifacts, undercutting features or structures, or washing away the soil.

Physical destruction or damage are the types of potential impacts that could affect paleontological resources. However, as described in Chapter 4, Section 4.8.6, paleontological specimens are generally not expected at LANL because near-surface stratigraphy, composed of volcanic ash and pumice that were extremely hot when deposited, is not conducive to preserving plant and animal remains. Thus, impacts to paleontological resources are unlikely from the alternatives, and were not carried forward for analysis.

5.8.1 No-Action Alternative

Most of the projects under the No-Action Alternative have NEPA reviews completed and any impacts to cultural resources have been identified. Many of the new facilities, upgrades, infrastructure, utilities, environmental remediation, and DD&D projects under the No-Action Alternative would be located in areas previously disturbed and with modern buildings and structures already present. This greatly reduces the potential for impacts to cultural resources because (1) cultural resources likely are not present, or, if previously present, have already been mitigated or no longer have integrity; (2) stormwater runoff may already have been addressed through onsite engineered systems and thus changes to erosion patterns are more unlikely; (3) new buildings or structures would not change the setting, as modern buildings and structures currently exist; and (4) any restrictions on access are already in place. Thus, many projects (construction or operations) are at no risk for impacts to cultural resources.

Other projects, such as the EPCU (NNSA 2023b), the Chromium Final Remedy (DOE 2024a), the solar PV array (NNSA 2019b), and the second fiber-optic line (NNSA 2020b), would avoid impacts to cultural resources by locating construction areas to avoid resources, marking or fencing resources for avoidance, implementing erosion control measures, and monitoring ground disturbing activities to ensure no physical damage occurs to resources. Because the Training and Test Facilities and the RLWTF include upgrades, remodeling, or demolition of historic buildings, effects would be mitigated through implementation of standard mitigation measures found in *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* (Cultural Resources Management plan; CRMP) (LANL 2019c). Other projects would have beneficial impacts to cultural resources. The ETC and EMCF would have no construction impacts to resources but would move operations involving HE and other dangerous materials away from their current location, which is close to properties included in the MAPR. Moving to a different location would mitigate the risk to the park properties and park visitors.

For any project involving ground disturbance, erosion patterns can change when the topography of a project site is modified, and stormwater runoff could then impact resources that previously were not impacted. In addition, ground-disturbing activities have the potential to inadvertently impact cultural resources that are nearby or located subsurface and thus were not identified during survey prior to the start of the activities. For all projects included in the No-Action Alternative, DOE/NNSA would monitor construction activities in accordance with procedures in the CRMP to ensure erosion is controlled and inadvertent impacts to cultural resources are avoided or mitigated.

Continued environmental remediation projects would design their activities and temporary remediation support infrastructure to ensure that impacts to cultural resources are avoided. Remediation activities conducted within previously disturbed soils would be unlikely to have adverse impacts to resources. There would be the potential for erosional changes from clearing, capping, removal, or contamination recovery which could impact cultural resources onsite or nearby.

Operational activities would generally occur within areas previously disturbed by construction activities, thus it would be unlikely that physical destruction or damage would occur to cultural resources from operations. No additional restrictions on access would be anticipated during operations beyond those needed during construction.

Most of the No-Action Alternative projects have undergone NEPA reviews; however, the specific project designs may not yet be completed, such as for some of the site-wide transportation projects. The analysis of impacts to cultural resources at this early stage in planning for these projects is limited to some degree due to unavailable information. As individual project planning evolves and plans and locations become available, DOE/NNSA would comply with the Section 106 Programmatic Agreement (LANL 2022j) to identify significant cultural resources that would be impacted by the project and work with project developers to alter project design to avoid or reduce the impacts. These efforts would include consultation with interested parties, especially tribes. For any impacts that could not be avoided or minimized, DOE/NNSA would implement steps in the Programmatic Agreement and CRMP (LANL 2019c) to develop and implement appropriate mitigation measures.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would result in limited direct impacts to cultural resources. The conveyance could result in the potential transfer of known and unidentified cultural resources and historic properties out of the responsibility and protection of the DOE. Under the Criteria of Adverse Effects (36 CFR 800.5(a)(1)), the transfer, lease, or sale of resources eligible for listing on the National Register is an adverse effect. National Register-eligible resources are present on the majority of the tracts and would be directly impacted by the Federal action. A Programmatic Agreement that addresses and resolves the potential impacts through implementation of measures to avoid, minimize, or mitigate the impacts was signed in 2002 (DOE 2002). The disposition of each of the remaining tracts also may affect the protection and accessibility to Native American sacred sites or sites needed for the practice of traditional religion by removing them from consideration under the *American Indian Religious Freedom Act*, the *Religious Freedom Restoration Act*, and EO 13007, "Indian Sacred Sites." In addition, the disposition of the tracts would potentially affect the treatment and disposition of any human remains, funerary objects, sacred objects, and objects of cultural patrimony that may be discovered on the tracts under the *Native American Graves Protection and Repatriation Act* (DOE 1999b).

The conveyance of these tracts could also result in indirect impacts to cultural resources. The development of approximately 625 acres (*see* Section 5.2.1) and use of tracts for recreation could result in physical destruction, damage, or alteration of cultural resources on the subject tracts and in adjacent areas and disturbance of traditional religious practices.

5.8.2 Modernized Operations Alternative

Similar to the projects included in the No-Action Alternative, many of the projects that would be added under the Modernized Operations Alternative would be located in areas previously disturbed and with modern buildings and structures already present. This would greatly reduce the potential for impacts to cultural resources. The following analysis addresses only those projects added under the Modernized Operations Alternative. The full impacts for this alternative would be those impacts discussed in Section 5.8.1 for the No-Action Alternative plus the impacts discussed in this section.

The analysis of impacts to cultural resources at this early stage in planning under the Modernized Operations Alternative is limited to some degree due to unavailable information. As individual project planning proceeds, plans could change and additional information could become available, including:

- Some project areas may not have been previously surveyed or were surveyed so long ago that re-survey is needed;
- Additional cultural resources could be identified through survey or tribal consultation;
- Boundaries of known archaeological sites could expand, both on the surface and subsurface;
- Currently defined project areas could change;
- Building or structure height could change; and
- New erosion patterns could develop after construction activities are finished.

Prior to moving forward with each proposed project under the Modernized Operations Alternative, once specific project plans have been developed, DOE would comply with the Section 106 Programmatic Agreement (LANL 2022j) to identify significant cultural resources that would be impacted by the project and work with project developers to alter project design to avoid or reduce the impacts. These efforts would include consultation with interested parties, especially tribes. For any impacts that could not be avoided or minimized, DOE would implement steps in the Programmatic Agreement and CRMP (LANL 2019c) to develop and implement appropriate mitigation measures. This process would also apply to the projects included in the Expanded Operations Alternative.

5.8.2.1 Physical Destruction or Damage

The current proposed locations of the projects under the Modernized Operations Alternative were compared with locations of known cultural resources to identify potential intersections, indicating the potential for the projects to physically impact or damage cultural resources. The analysis indicates that the projects under this alternative could impact 11 cultural resources, 4 of which are considered significant.

In the Core Area Planning Area, the Los Alamos Canyon Bridge replacement could impact the Cold War-era Bench Trail that is considered potentially eligible for the National Register, though additional information would be needed to make an evaluation. A parking facility in the Balance of Site Planning Area could impact a Coalition Period artifact scatter that is considered potentially eligible for the National Register, though additional information would be needed to make an evaluation. In the LANSCE Planning Area, a building replacement and four warehouses could impact the locations of four Coalition/Early Classic Period Pueblo roomblocks. These four resources were scientifically excavated in the 1960s and have been determined as not eligible for the National Register; however, because excavation usually does not remove all of a resource, there are likely remnants of the resources remaining. A facility in the NEEWC Planning Area could impact a historic homestead that has been determined not eligible for the National Register. Five projects in the Pajarito Corridor Planning Area—a laboratory building, office building, two warehouses, and an institutional laydown area—could impact four cultural resources, two Pueblo roomblocks that have been determined eligible and a lithic scatter and historic homestead road that have been determined not eligible for the National Register.

Upgrades and additions to site utilities to accommodate the new facilities under the Modernized Operations Alternative would include water tanks, natural gas distribution pipelines, electrical power lines, water pipelines, sewer pipelines and a new lift station, and telecommunications and associated duct banks. Site-wide transportation projects, including roadway development and parking areas, would also occur under this alternative. Some of these utility and transportation projects would be conducted within their current disturbed corridors, where no impacts to cultural resources would be anticipated. However, there would be some new corridors, project areas, and supporting infrastructure where ground disturbance could result in physical impacts or damage to cultural resources. These projects are not currently well defined, thus the extent of impacts to cultural resources would not be known until project areas are selected and studies completed to identify cultural resources and potential impacts to them.

The installation of solar PV arrays would include ground-disturbing activities but there are no specific locations selected yet. There are nine sites being considered that include 795 acres, 641 of which are currently undisturbed. Arrays would be placed within portions of these nine sites. Because these arrays would include ground-disturbing activities, the potential for physical destruction or damage to cultural resources exists but cannot be specifically known until project areas are selected and studies completed to identify cultural resources and potential impacts to them.

As discussed in Section 5.8.1, changes to erosion patterns have the potential to disturb cultural resources. An estimated 90 acres of currently undisturbed land, plus whatever acreage is disturbed for development of the solar PV arrays, would be subject to ground disturbance under the Modernized Operations Alternative, and impacts to cultural resources could occur from activities in these areas.

Fire Station 5 in TA-16 has been declared eligible for the National Register as a historic building. Its upgrade and adaptive reuse would be implemented in accordance with LANL's CRMP (LANL 2019c), thus no adverse impacts would result to this cultural resource. No other buildings or structures of historic significance would be upgraded or demolished under the Modernized Operations Alternative. No properties included in or eligible for inclusion in the MAPR would be impacted by activities included in the alternative. Following recommendations in the Cultural Landscape Inventory report (NPS 2019) prepared for the MAPR, a security walkway with a reception area and restroom facilities, additional walkways, parking, and shade structures would be developed at TA-18 to help interpret the park for the public; these activities would not adversely impact the properties, but rather would provide a positive impact by improving a visitor's ability to access the resource.

Tribal consultation regarding specific projects under the Modernized Operations Alternative would be needed to determine the potential for physical impacts or damage to traditional cultural properties. However, input received from the Pueblo de San Ildefonso during tribal consultation conducted for the Chromium Plume Interim Measure EA (DOE 2015) provides insight into and examples of the types of impacts and concerns that could be identified for projects under this alternative when DOE/NNSA conducts consultation with tribes for each of the proposed projects. This tribal input is discussed here for the Modernized Operations Alternative and in Section 5.8.3 for the Expanded Operations Alternative.

The Pueblo de San Ildefonso considers the entire area on which LANL is located to be part of a larger sacred landscape that has been used and inhabited by their ancestors for thousands of years. This landscape is of great importance to the Pueblo and thus continues to be used to the extent possible by Pueblo members today. The resources located therein that contribute to its importance include naturally occurring water, animals, plants, springs, rocks, and soil as well as cultural-defined places such as archaeological sites and deposits; religious or ceremonial features and places; traditional areas used for gathering plants, clay, or other materials; hunting areas; and viewsheds. Important traditional activities conducted in the landscape include hunting, gathering, collecting, and ceremonial practices. During the consultation (DOE 2015), the Pueblo representatives explained that because all resources within the landscape are culturally meaningful and connected to one another, a change or impact to one resource in one location would simultaneously impact all resources, resulting in a holistic impact to the resources and associated practices within the landscape. This detrimental impact would extend to the people depending on those resources and practices as well as to their traditional culture. The associated mental and emotional effects to the people would, in turn, affect their ceremonies and rituals. As an example, a specific impact anticipated by the Pueblo for the Chromium Plume EA (DOE 2015), which could apply to projects included in the Modernized Operations Alternative, included concern for damage or destruction of archaeological resources.

5.8.2.2 Changes to Setting

Setting impacts can occur to cultural resources when their surroundings contribute to why the resource is significant and help tell the history of the resource. Changes to these important settings, such as removing or adding to the visible surroundings or viewshed or the introduction of noise, may impact the cultural resource. Setting impacts are analyzed for historic buildings and structures and traditional cultural properties with associations to historic events, historic people or beings, or traditional cultural beliefs or practices. Construction and DD&D projects under the Modernized Operations Alternative would be unlikely to change the settings of historic buildings and structures at LANL, including those associated with the Manhattan Project and the Cold War historical periods. Those resources are of modern-age and were built in a laboratory setting to support scientific and technological research and development. The new projects would also be designed in this same laboratory style and would not result in a substantial dominant visual change to the surroundings or interruption of unique historic viewsheds. Noise and activity associated with development of the proposed projects would match the activities continually occurring at LANL and would not result in changes to the setting for these resources.

Setting impacts are of particular concern for tribes, as the setting is often a contributing element to the significance of traditional cultural properties. The landscape encompassed by LANL is likely part of the setting for traditional cultural properties located not only on LANL but also on neighboring lands, in particular, Bandelier National Monument, the Tsankawi Unit of Bandelier National Monument, and the Pueblo de San Ildefonso Indian Reservation. As examples, during consultations related to the Chromium Plume EA (DOE 2015), the Pueblo de San Ildefonso explained that the new facilities for that project would result in visual impacts to the viewshed over the landscape from important places on reservation lands, and that the development and presence of additional facilities and infrastructure would impact animal movement across the landscape, therein affecting traditional hunts on reservation lands. These examples of project impacts to the settings of cultural resources could be identified under the Modernized Operations Alternative when DOE/NNSA conducts consultation with tribes for the proposed projects. Due to the heavily forested nature of much of LANL, it is expected that some new facilities that are one or two stories in height would be screened from sight by the ponderosa pine trees. However, facilities that would be three or more stories tall could be seen. New facilities that are proposed to be three or more stories in height include two parking structures, three laboratory buildings, and two office buildings in the Core Area Planning Area, which is already densely developed and not located near sensitive areas; an office building in the LANSCE Planning Area, which would not be near sensitive areas; and the security contractor's facility and three parking garages in the Pajarito Corridor Planning Area, which is located near the reservation. Setting impacts could occur for the Pajarito Corridor Planning Area resulting from these new facility projects. Two of the potential solar PV array sites, in TA-5 and TA-54, would be located close to the reservation and could impact the settings of traditional cultural properties. A parking area and bus transfer station proposed for TA-72 in the Balance of Site Planning Area would be very close to the reservation as well as the Tsankawi Unit of Bandelier National Monument. Impacts to the settings of traditional cultural properties could occur from this project. Thus, there could be setting impacts to cultural resources from those projects and possibly for others located near the boundaries of LANL. As described above, tribal consultation regarding specific projects would be needed to determine potential impacts to the settings of traditional cultural properties under the Modernized Operations Alternative.

5.8.2.3 Impacts to Access

Restriction of access to traditional cultural properties is an impact to cultural resources. Although access to LANL as a whole is restricted administratively, additional development of new facilities, infrastructure, and utilities under the Modernized Operations Alternative likely would add to the restrictions due to safety and security reasons during construction and facility operations. As with setting impacts, proposed projects occurring on LANL could impact access to traditional cultural properties located on neighboring lands. These types of project impacts to cultural resources due to access restrictions could be identified for projects under the Modernized Operations Alternative when DOE/NNSA conducts consultation with tribes for the proposed projects. Tribal consultation regarding specific projects would be implemented as needed to determine such impacts to traditional cultural properties from the proposed projects.

5.8.2.4 Operations

Operational activities would generally occur within areas previously disturbed by construction activities, thus it would be unlikely that physical destruction or damage would occur to cultural resources from operations. However, under the Modernized Operations Alternative, an additional 780 personnel are expected to work on site, and the presence of workers at new project areas and additional workers at currently developed areas, particularly during construction activities, would increase the chances that inadvertent damage could occur to cultural resources that are located nearby and planned for avoidance. Noise from traffic and worker activities could impact the settings of traditional cultural properties and traditional practices. An example of this type of impact comes from the tribal consultation done during the Chromium Plume Interim Measure Project (DOE 2015). During that consultation, the Pueblo de San Ildefonso expressed concern that the noise, lighting, and worker activity associated with the new developments would affect animal movement and successful breeding throughout the landscape and result in effects to traditional hunting activities occurring outside LANL. This type of project impact to cultural resources could be identified under the Modernized Operations Alternative when DOE/NNSA conducts consultation with tribes for the proposed projects. This type of impact would be likely for the projects in the Pajarito Corridor Planning Area, in particular, for the proposed construction laydown areas located close to the Pueblo de San Ildefonso reservation. No additional restrictions on access would be anticipated during operations beyond those needed during construction.

5.8.3 Expanded Operations Alternative

Like the projects included in the Modernized Operations Alternative, many of the new projects that would be added under the Expanded Operations Alternative would be located in areas previously disturbed and with modern buildings and structures already present. This would greatly reduce the potential for impacts to cultural resources. The following analysis addresses only those projects added under the Expanded Operations Alternative. The full impacts for this alternative would be those impacts discussed in Section 5.8.1 for the No-Action Alternative and Section 5.8.2 for the Modernized Operations Alternative plus the impacts discussed in this section.

The analysis of impacts to cultural resources at this early stage in planning under the Expanded Operations Alternative is limited to some degree due to unavailable information, as described in Section 5.8.2 for the Modernized Operations Alternative. Prior to moving forward with each proposed project under the Expanded Operations Alternative, once specific project plans have been developed, DOE/NNSA would comply with the Section 106 Programmatic Agreement (LANL 2022j) to identify significant cultural resources that could be impacted by the project and work with project developers to alter project design to avoid or reduce the impacts. These efforts would include consultation with interested parties, especially tribes. For any impacts that could not be avoided or minimized, DOE/NNSA would implement steps in the Programmatic Agreement and CRMP (LANL 2019c) to develop and implement appropriate mitigation measures.

5.8.3.1 Physical Destruction or Damage

The proposed locations of the new projects were compared with locations of known cultural resources to identify potential intersections, indicating the potential for the projects to physically impact or damage cultural resources. The analysis indicates that the projects under this alternative could impact 22 cultural resources, 15 of which are considered significant or potentially so.

The current potential footprint of the Pumped Hydropower Demonstration Project in the Balance of Site Planning Area (TA-39 and TA-49) would intersect with, and have the potential to impact, 12 cultural resources (Table 5.8-1).

The current potential footprint of the DMMSC Facility in TA-53 would intersect with, and have the potential to impact, six cultural resources (Table 5.8-2).

The current potential footprint of the Advanced Separations of Plutonium Radiological Laboratory in TA-53 could impact two Pueblo roomblocks, one dating to the Coalition Period and the other to the Late Coalition/Early Classic Periods. Both were excavated in the 1960s and have been determined not eligible for the National Register, with the New Mexico State Historic Preservation Officer (SHPO) concurrence. Finally, the current potential footprint of the TRU waste staging facilities in the Pajarito Corridor Planning Area could impact a lithic scatter of unknown prehistoric age and an historic homestead that has been scientifically excavated. Both have been determined not eligible for the National Register, with SHPO concurrence.

Burial of site utility lines (e.g., electrical, communications, fiber optic) would occur site-wide under the Expanded Operations Alternative. Site-wide transportation projects, including roadway development and parking areas, would also occur under this alternative. Some of these utility burial and transportation projects would be conducted within their current disturbed corridors, where no impacts to cultural resources would be anticipated. However, there would be some new corridors and project areas where ground disturbance could result in physical impacts or damage to cultural resources. These projects are not currently defined, thus the extent of impacts to cultural resources would not be known until project areas are selected and studies completed to identify cultural resources and potential impacts to them.

Table 5.8-1 Cultural Resources Intersected by the Potential Footprint of the Pumped Hydropower Demonstration Project

Description	Cultural Period	National Register Eligibility
Pueblo roomblock	Coalition/Classic Period	Determined eligible with NM SHPO concurrence
Three Pueblo roomblocks	Coalition/Classic Periods	Evaluated as eligible
Two Pueblo roomblocks	Coalition/Classic Periods	Considered potentially eligible; more information is needed
Pueblo 1 to 3 room structure	Undetermined prehistoric	Evaluated as eligible
Two Pueblo 1 to 3 room structures	Undetermined prehistoric	Considered potentially eligible; more information is needed
Grid garden	Coalition Period	Determined eligible with NM SHPO concurrence
Artifact scatter	Coalition Period	Evaluated as eligible; could not be re-located during 2001 survey
Lithic scatter	Undetermined age	Evaluated as eligible; could not be re-located during 2001 survey

NM SHPO = New Mexico State Historic Preservation Officer

Table 5.8-2 Cultural Resources Intersected by the Potential Footprint of the DMMSC Facility

Description	Cultural Period	National Register Eligibility
Two Pueblo roomblocks	Coalition to Early Classic Periods	Determined not eligible with NM SHPO concurrence; scientifically excavated in the 1960s
Lithic scatter	Archaic Period	Undetermined eligibility; more information needed
Pueblo 1 to 3 room structure	Coalition Period	Determined not eligible with NM SHPO concurrence; scientifically excavated in the 1960s
Two Pueblo 1 to 3 room structures	Undetermined prehistoric	Evaluated as eligible

NM SHPO = New Mexico State Historic Preservation Officer

Changes to erosion patterns and inadvertent damage to subsurface cultural resources, as described in Section 5.8.2.1, could occur for projects under the Expanded Operations Alternative. About 75 acres of currently undisturbed land (in addition to that described for the Modernized Operations Alternative) would be subject to ground disturbance under this alternative and impacts to cultural resources could occur from activities in these areas.

As explained in Section 5.8.2.1, tribal consultation regarding specific projects under the Expanded Operations Alternative would be needed to determine the potential for physical impacts or damage to traditional cultural properties. The input received from the Pueblo de San Ildefonso on the Chromium Plume Interim Measure Project (DOE 2015) providing examples of potential impacts, as described in Section 5.8.2.1, would also apply to the projects under the Expanded Operations Alternative and provides insight into the types of impacts and concerns that could be identified for projects under this alternative.

5.8.3.2 Changes to Setting

Construction of new facilities and utility/infrastructure projects under the Expanded Operations Alternative would be unlikely to change the settings of historic buildings and structures at LANL, including those associated with the Manhattan Project and the Cold War historical periods, for the same reasons as described in Section 5.8.2.2. Input received from the Pueblo de San Ildefonso regarding setting impacts to traditional cultural properties (DOE 2015), as described in Section 5.8.2.2, provides examples of the types of impacts that could be expected for new facility projects that are proposed to be three more or stories in height under the Expanded Operations Alternative. However, none of the new facilities proposed in this alternative would be over two stories. Thus, it would be unlikely for this alternative to result in adverse impacts to the settings of traditional cultural properties. Burial of currently aboveground site utility lines would remove a modern intrusion into the natural setting, and thus could result in restoration of some traditional cultural property settings. Tribal consultation regarding specific projects would be needed to determine potential impacts, beneficial or adverse, to the settings of traditional cultural properties under the Expanded Operations Alternative.

5.8.3.3 Impacts to Access

For the same reasons as described in Section 5.8.1.3, additional development of new facilities, infrastructure, and utilities as proposed under the Expanded Operations Alternative likely would add to the administrative restrictions on access already in place at LANL. As with setting impacts, proposed projects occurring on LANL could also impact access to traditional cultural properties located on neighboring lands. Tribal consultation regarding specific projects would be needed to determine such impacts to access to traditional cultural properties from the proposed projects.

5.8.3.4 Operations

Operational activities would generally occur within areas previously disturbed by construction activities, thus it would be unlikely that physical destruction or damage would occur to cultural resources from operations. However, under the Expanded Operations Alternative, an additional 915 personnel are expected on site, and the presence of workers at new project areas and additional workers at currently developed areas, particularly during construction activities, would increase the chances that inadvertent impacts could occur to cultural resources that are planned for avoidance. Increased noise from traffic and worker activities could have the potential to impact the settings of traditional cultural properties and traditional practices, especially in areas near LANL boundaries; however, because traffic noise is expected to increase by only 1 dB (*see* Section 5.5.3.3), such an impact to resource settings would be unlikely. An example of this type of impact is described in Section 5.8.2.4. No additional restrictions on access would be anticipated during operations beyond those needed during construction.

Another proposed change to operations would be modifications to wildland fire risk reduction treatments conducted at LANL. Under the Expanded Operations Alternative, DOE/NNSA would revise treatment standards by implementing additional wildfire risk reduction techniques beyond those currently used (LANL 2024d). Many of these treatments would involve ground-disturbing activities and removal of trees, which could result in changes to erosion patterns, both of which could result in impacts to cultural resources. However, because the CRMP (LANL 2019c) includes measures to consider and protect cultural resources from fire risk reduction treatments, including site marking, fencing, monitoring, and installation of erosion controls surrounding cultural resources, adverse impacts would be unlikely. Reducing the potential for high-severity wildland fire through fuel reduction would be beneficial for historic buildings and structures, as well as archaeological sites and traditional cultural properties, all of which can be severely impacted by such fire activity. Because these activities would include ground disturbance, the potential for physical destruction or damage to cultural resources exists but cannot be specifically evaluated until project areas are selected and studies completed to identify cultural resources and potential impacts to them.

The Expanded Operations Alternative includes feral/invasive cattle management. This effort would involve removal of feral cattle from White Rock Canyon, where their movements have resulted in damage to cultural resources located not only in the White Rock Canyon Reserve on LANL, but also in neighboring lands along the canyon. The cattle have trampled cultural resources, scattering artifacts, and the damage has promoted erosion through the resources. Removal of the cattle would result in beneficial impacts to cultural resources by stopping future damage by cattle.

5.8.4 Summary of Cultural and Paleontological Resources Impacts for the Alternatives

Because NEPA reviews have been completed previously for projects under the No-Action Alternative, potential impacts to cultural resources have been avoided or reduced by locating projects in areas previously disturbed and with modern developments already present; rerouting construction to avoid resources; marking or fencing cultural resources that are at risk; and monitoring construction activities to ensure erosion is controlled and inadvertent impacts do not happen. Beneficial impacts would occur for some properties included in the Manhattan Project National Historical Park by moving operations that work with explosives and other high-risk materials away from these properties.

Under the Modernized Operations Alternative, 11 known cultural resources could be physically impacted or damaged by the proposed projects. Of these resources, four are considered significant and likely would require mitigation prior to construction. Projects under this alternative that could result in physical impacts, but whose project areas are not currently well-defined, include site-wide transportation projects, site utility upgrades and additions, and solar PV arrays. Impacts from erosion and inadvertent impacts are possible whenever the ground is being disturbed; for this alternative, 212 acres plus up to 795 acres for the solar PV arrays would be disturbed (731 acres of which are currently undisturbed). Consultation with tribes would be needed on specific projects to determine the potential for physical impacts, setting impacts, and access impacts to traditional cultural properties. It is anticipated that four new facilities in the Pajarito Corridor Planning Area as well as the increased worker activity in the area from the large number of projects that would occur there could result in impacts to the settings of traditional cultural properties and associated practices. In addition, two of the nine potential solar PV array areas and the TA-72 parking area and bus transfer station are likely to impact the settings of traditional cultural properties.

Under the Expanded Operations Alternative, 22 known cultural resources could be physically impacted or damaged by the proposed projects. Of these resources, 15 are considered significant and likely would require mitigation prior to construction. Projects under this alternative that could result in physical impacts, but whose project areas are not currently well-defined, include burial of site utility lines, site-wide transportation projects, forest thinning and wildland fire risk reduction treatments, and feral/invasive livestock management. Impacts from erosion and inadvertent impacts are possible whenever the ground is being disturbed; for this alternative, an additional 135 acres would be disturbed (above that identified for the Modernized Operations Alternative). Consultation with tribes would be needed on specific projects to determine the potential for physical impacts, setting impacts, and access impacts to traditional cultural properties. However, there are no anticipated adverse impacts to the settings of traditional cultural properties and associated practices from this alternative. Beneficial impacts to cultural resources and their settings could occur from burial of site utility lines, more aggressive wildland fire risk reduction treatments, and feral/invasive livestock management.

As described in Chapter 4, Section 4.8.6, paleontological specimens are not expected at LANL because near-surface stratigraphy, composed of volcanic ash and pumice that were extremely hot when deposited, is not conducive to preserving plant and animal remains. Thus, impacts to paleontological resources are unlikely from any of the alternatives.

5.9 Socioeconomics

The socioeconomic analysis presents the potential impacts from changes in employment and economic activity for each alternative. Approximately 90 percent of the LANL workforce reside in New Mexico. The ROI, as described in Chapter 4, Section 4.9, is a five-county area surrounding LANL. Key metrics presented in the socioeconomics analysis are: (1) employment and population changes; (2) changes in economic activity (e.g. earnings/monetary value added); and (3) impacts to housing and community services.

5.9.1 No-Action Alternative

Activities under the No-Action Alternative would result in potential impacts on employment, population, and economic activity. The estimates of potential impacts are provided in Table 5.9-1.

5.9.1.1 Employment and Economic Activity

As shown in Table 5.9-1, implementation of the No-Action Alternative would require an average of 650 construction/DD&D workers per year with a potential peak of 1,300 construction workers in any given year by 2029. DD&D activities would continue through 2038. In addition, by the end of 2029, the total direct workforce is expected to increase by approximately 1,530 persons to approximately 16,856. Overall, direct employment at LANL would increase by approximately 10 percent compared to the baseline 2022 workforce.

Impacts to employment and economic activity include direct, indirect, and induced economic impacts that potentially could result from project activities. As project-related direct expenditures are made in the ROI, these dollars begin to circulate in the economy. As funds are expended to pay employees and to buy goods and services, the recipients then make purchases, causing successive rounds of local spending, until the original expenditures eventually exit the ROI.

Increases in direct employment at LANL may also cause increases in indirect employment and associated economic activity such as project-related expenditures, local spending, and revenue from taxes. These indirect increases were derived using multipliers provided from the Bureau of Economic Analysis (BEA)-developed Regional Input-Output Modeling System (RIMS II) for a select region (BEA 2023). The multiplier of 1.6142 was used for indirect employment for total workforce increases under the No-Action Alternative; a multiplier of 1.2462 was used for construction/DD&D workforce increases (BEA 2023). These multipliers were developed for an aggregation of the five-county ROI. As a result, approximately 700 additional indirect jobs would be created in the ROI by the end of 2029. Overall, this would create a total of 2,230 jobs (1,530 direct and 700 indirect). This represents approximately 0.5 percent of the projected 2029 ROI labor force.

From 2022 to 2029, the total labor force in the ROI is expected to increase from 504,330 persons to 521,555 persons, which would equate to a 3.4 percent increase (BLS 2022). More than 99 percent of the projected labor force would be associated with non-LANL-related employment increases in the ROI. By 2029, the total employment impact associated with the No-Action Alternative (26,969 total workers, consisting of 16,856 direct and 10,113 indirect) represents approximately 9.0 percent increase in total direct and indirect employment from 2022 and would account for 5.2 percent of the projected 2029 ROI labor force.

The anticipated value added from the direct economic activity to the local economy includes employee compensation, tax on production and imports, and proprietary and other property income and indirect employment compensation. Total anticipated value added under the No-Action Alternative equates to approximately $247 million in the ROI. The direct labor income impact potentially could result in a total income impact of over $164 million in the ROI. A portion of this increased payroll likely would enter the local economy as the new workers purchase additional goods and services. It is anticipated that some portion of construction and operational materials would be purchased locally and that most construction/DD&D and operational workers would be

Table 5.9-1 Socioeconomic Impacts from Activities at LANL Under the No-Action Alternative

Resource/Metric	Baseline (existing environment) 2022	Change as a Result of the No-Action Alternative				No-Action Alternative (by end of 2029)	Percentage Increase Over Baseline
		Construction and DD&D (peak year)	Operations (by the end of 2029)	Construction (by the end of 2029)	Total Workforce (by the end of 2029)		
Jobs							
Direct jobs at LANL (persons)	15,326[a]	1,300	880	650	1,530	16,856	10.0
Indirect jobs from LANL (persons)	9,413[b]	320[bc]	540[b]	160[c]	700	10,113	7.4
Total Direct and Indirect employment	24,739	1,620	1,420	810	2,230	26,969	9.0
Total ROI labor force (persons)	504,330	-	-	-	-	521,555[d]	3.4[e]
Earnings/Value Added							
Earnings from direct jobs at LANL (millions of dollars)	$2,083.9[f]	$87.7[g]	$117.9[f]	$43.9[g]	$163.6	$2,247.5	7.9
Earnings from indirect jobs from LANL in ROI (millions of dollars)[gh]	$1,280.0	$21.6	$73.5	$10.8	$84.3	$1,364.3	6.6
Anticipated value added from LANL (millions of dollars)	$3,223.0[i]	$123.4[j]	$185.1[i]	$61.7[j]	$246.8	$3,469.8	7.7
Population							
TOTAL ROI POPULATION	**1,035,394**	**4,860**[k]	**4,260**[k]	**2,430**[k]	**6,690**[k]	**1,063,658**[l]	**2.7**[m]

a Direct LANL employment is based on 2022 employment.
b Indirect employment for operational workforce was estimated using a direct-effect employment multiplier of 1.6142 (BEA 2023).

c Indirect employment for construction/DD&D was estimated using a direct-effect employment multiplier of 1.2462 (BEA 2023).
d Calculated using the average labor force growth rate of historic labor force in the ROI (BLS 2022).
e ROI labor force increase of 4.1 percent would largely occur independent of LANL activities. The direct and indirect employment increase from LANL activities would contribute a 0.4-percent increase.
f Earnings were estimated using a final-demand earnings multiplier of 0.4684 applied to the change in jobs / change in final demand multiplier of 3.4449 (BEA 2023).
g Earnings were estimated using a final-demand earnings multiplier of 0.4812 applied to the change in jobs / change in final demand multiplier of 7.1322 (BEA 2023).
h Derived from earnings from direct jobs / indirect jobs.
i Value added was estimated using a final-demand value added multiplier of 0.7245 applied to the change in jobs / change in final demand multiplier of 3.4449 (BEA 2023).
j Value added was estimated using a final-demand value added multiplier of 0.6768 applied to the change in jobs / change in final demand multiplier of 7.1322 (BEA 2023).
k Based on an average of three persons per household for the ROI (USCB 2021) and the conservative assumption that new direct LANL workers and indirect workers would move with their families.
l Population projection for year 2029 for counties in the ROI derived from New Mexico "state Population Trends" (New Mexico 2021).
m ROI population increase of 2.7 percent would largely occur independent of LANL activities. The population increase from LANL activities would contribute a 0.6-percent increase.

Source: BEA (2023); USCB (2024a)

drawn from within the ROI, resulting in regional increases in jobs. The additional anticipated expenditures by workers potentially could generate additional income and employment opportunities within the ROI if the expenditures filter throughout the economy.

5.9.1.2 Population and Housing

The population in the ROI in 2029 is projected to be 1,063,658 persons, which would be a 2.5 percent increase compared to the 2022 baseline population of 1,038,171 (USCB 2024a; New Mexico 2021). The total employment associated with the No-Action Alternative would be 26,969 workers (16,856 direct and 10,113 indirect workers), which would represent approximately 2.5 percent of the projected 2029 ROI population. The increase in direct and indirect jobs associated with the No-Action Alternative would be 2,230, which is less than one percent of the projected ROI population in 2029. Because the increase in direct and indirect jobs would be less than one percent of the projected population, a large influx of workers/families due to LANL employment into the ROI is not expected. However, if these 2,230 new jobs were completely filled by workers migrating into the ROI, the projected population increase in the ROI would be approximately 6,690 persons assuming three persons per household (or 2,230 new jobs multiplied by three persons per household),[7] or 0.6 percent of the projected 2029 ROI population.

In 2022, there were 37,472 vacant housing units in the ROI (USCB 2024d). For context, there were 482 vacant housing units in Los Alamos County in 2022. The additional workforce (by the end of 2029) under the No-Action Alternative is 2,230 workers (1,530 direct and 700 indirect). It is anticipated that direct workers relocating to the ROI would settle in all counties within the ROI, likely in proportion to current LANL workforce residence patterns. Table 5.9-2 presents the anticipated workforce housing distribution within the ROI under the No-Action Alternative.

Table 5.9-2 Anticipated Workforce Housing Distribution Under the No-Action Alternative

County/Area	2022 Percent of Total Site Employment[a]	2022 Vacant Housing Units[b]	Anticipated Direct Workforce Housing Distribution
Los Alamos	36.2	482	554
Santa Fe	23.1	8,848	353
Rio Arriba	15.8	5,540	242
Bernalillo	6.3	18,598	96
Sandoval	4.2	4,004	64
Other counties in NM	4.3	92,825	66

a From Table 4.9-1.
b From Table 4.9-6.
c Distribution is based on 1,530 direct jobs at LANL under the No-Action Alternative.

This influx of direct employees may further increase housing needs within the Los Alamos County or change the future distribution; indicating that future personnel may be forced to reside farther from the Laboratory. Approximately 36.2 percent, or 554, direct workers would be expected to settle in Los Alamos County, splitting between the Los Alamos townsite or White Rock. Current housing statistics discussed in Section 4.9.5 suggest that the current housing market in the ROI and Los Alamos County, specifically, have unmet needs; this influx of direct employees may

[7] Assumes one worker per household and an average of three persons per household for the ROI (USCB 2021).

further increase housing needs. There would be adequate housing within the ROI, just not potentially in Los Alamos County.

Section 4.9.5 presents the median value of owner-occupied homes (in 2022) in each county within the ROI. This SWEIS does not predict changes in housing prices, however, the latest trends in New Mexico are following those of other states as median housing prices increase. Because of the smaller inventory of available housing in Los Alamos County versus other counties in the ROI, it stands to reason that housing prices in Los Alamos County could increase more than other counties.

5.9.1.3 Community Services and Schools

Due to the low potential for impacts on the population, the No-Action Alternative would not affect fire protection, police protection services, or medical services. As discussed above, the No-Action Alternative would result in a population increase in the ROI of 6,690 persons,[51] or less than one percent of the projected 2029 ROI population of 1,063,658 (New Mexico 2021). This increase would not change demand for these services compared to current conditions.

Regarding schools, assuming an average of 0.34 school-age children per housing unit (NAHB 2020), the maximum number of school-age children associated with the additional direct and indirect workforce of 2,230 workers potentially migrating into the ROI would be 758 children (2,230 multiplied by 0.34 average school-age children per housing unit) by 2029. Compared to the 2022/2023 school year, the increase in school enrollment would be less than one percent and would represent a smaller proportion of future enrollment. This minimal increase in school enrollment would have a negligible effect on school services in the ROI.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in direct impacts to socioeconomics. The potential indirect impacts of the conveyance and transfer of the tracts would be expected to result in short-term economic gains from employment due to construction activities for new development. Long-term gains would depend on the intensity and success of the development. For the potential residential development of Rendija Canyon, residential development would not impact overall stable growth within the ROI. For commercial and industrial development in TA-21, the CT EIS projected that after construction was completed, approximately 1,900 workers could be employed within the tract and a total of 3,100 jobs would be created within the ROI.

Overall impacts to employment, income, population, and housing would be minor within the ROI, but would be concentrated in the Los Alamos area. Improvements would be expected in the Los Alamos County tax base but according to information cited in the CT EIS, these improvements may not offset the loss of assistance payments (DOE 1999b).

5.9.2 Modernized Operations Alternative

Implementation of the Modernized Operations Alternative includes the scope of the No-Action Alternative; therefore, potential impacts under this alternative includes increases in employment, population, and economic activity associated with the No-Action Alternative. Construction, DD&D, modernization, and operational activities under the Modernized Operations Alternative would result in additional potential impacts on employment, population, and economic activity. The estimates of potential impacts are provided in Table 5.9-3.

[51] Assumes 2,230 new jobs created under the No-Action Alternative with one worker per household and an average of three persons per household for the ROI (USCB 2021).

5.9.2.1 Employment and Economic Activity

Impacts to employment and economic activity include direct, indirect, and induced economic impacts that potentially could result from project activities (*see* Section 5.9.1.1).

As shown in Table 5.9-3, implementation of the Modernized Operations Alternative is assumed to require 530 construction/DD&D workers per year with a potential peak of approximately 1,060 construction workers. In addition, by the end of 2038, the total direct workforce is expected to increase from the No-Action Alternative baseline by approximately 780 persons to approximately 17,636 workers by the end of 2038. Overall, direct employment at LANL would increase by approximately 5 percent compared to the No-Action Alternative.

Increases in direct employment at LANL may also cause increases in indirect employment and associated economic activity such as project-related expenditures, local spending, and revenue from taxes. As was done for the No-Action Alternative, these indirect increases were derived using the RIMS II multipliers for the five-county ROI. Based on the same multipliers, approximately 284 additional indirect jobs would be created in the ROI by the end of 2038. Overall, there would be an increase of 1,064 jobs (780 direct and 284 indirect), which would represent 0.2 percent of the projected 2038 ROI labor force.

From 2022 to 2038, the total labor force in the ROI is expected to increase from 504,330 persons to 545,289 workers in 2038, which would equate to an 8.1 percent increase (BLS 2022). By 2038, the total employment impact associated with the Modernized Operations Alternative (28,033 total workers, consisting of 17,636 direct and 10,397 indirect) represents approximately 4.0 percent increase in total direct and indirect employment compared to the No-Action Alternative and would account for 5.1 percent of the projected 2038 ROI labor force.

The anticipated value added from the direct economic activity to the local economy includes employee compensation, tax on production and imports, and proprietary and other property income and indirect employment compensation. Total value added under the Modernized Operations Alternative equates to approximately $103 million in the ROI. The direct labor income impact potentially could result in a total income impact of approximately $70 million in the ROI. A portion of this increased payroll likely would enter the local economy as the new workers purchase additional goods and services. It is anticipated that some portion of construction and operational materials would be purchased locally and that most construction/DD&D and operational workers would be drawn from within the ROI, resulting in regional increases in jobs. The additional anticipated expenditures by workers potentially could generate additional income and employment opportunities within the ROI if the expenditures filter throughout the economy.

Table 5.9-3 Socioeconomic Impacts from Activities at LANL Under the Modernized Operations Alternative

Resource/Metric	No-Action Alternative (by end of 2029)	Change as a Result of the Modernized Operations Alternative				Modernized Operations Alternative (by end of 2038)	Percentage Increase Over No-Action Alternative
		Construction and DD&D (Peak year)	Operations (by the end of 2038)	Construction (by the end of 2038)	Total Workforce (by the end of 2038)		
Jobs							
Direct jobs at LANL (persons)	16,856	1,060	250	530	780	17,636	4.6
Indirect jobs from LANL (persons)	10,113[a]	261[b]	154[a]	130[b]	284	10,397	2.8
Total Direct and Indirect employment	26,969	1,321	404	660	1,064	28,003	3.9
Total ROI labor force (persons)	521,555	-	-	-	-	545,289[c]	4.6[d]
Earnings/Value Added							
Earnings from direct jobs at LANL (millions of dollars)	$2,247.5[e]	$71.5[f]	$34.0[e]	$35.8[f]	$69.8	$2,317.3	3.1
Earnings from indirect jobs from LANL in ROI (millions of dollars)[g]	$1,364.3	$17.6	$20.9	$8.8	$29.7	$1,394.0	2.2
Anticipated value added from LANL (millions of dollars)	$3,469.8[h]	$100.6[i]	$52.6[h]	$50.3[i]	$102.9	$3,572.7	3.0
Population							
TOTAL ROI POPULATION	**1,063,658**	**3,963**[j]	**1,212**[j]	**1,980**[j]	**3,192**[j]	**1,078,001**[k]	**1.3**[l]

a Indirect employment for operational workforce was estimated using a direct-effect employment multiplier of 1.6142 (BEA 2023).
b Indirect employment for construction/DD&D was estimated using a direct-effect employment multiplier of 1.2462 (BEA 2023).

c Calculated using the average labor force growth rate of historic labor force in the ROI (BLS 2022).
d ROI labor force increase of 4.6 percent would largely occur independent of LANL activities. The direct and indirect employment increase from LANL activities would contribute a 0.2-percent increase.
e Earnings were estimated using a final-demand earnings multiplier of 0.4684 applied to the change in jobs / change in final demand multiplier of 3.4449 (BEA 2023).
f Earnings were estimated using a final-demand earnings multiplier of 0.4812 applied to the change in jobs / change in final demand multiplier of 7.1322 (BEA 2023).
g Derived from earnings from direct jobs / indirect jobs.
h Value added was estimated using a final-demand value added multiplier of 0.7245 applied to the change in jobs / change in final demand multiplier of 3.4449 (BEA 2023).
i Value added was estimated using a final-demand value added multiplier of 0.6768 applied to the change in jobs / change in final demand multiplier of 7.1322 (BEA 2023).
j Based on an average of three persons per household for the ROI (USCB 2021) and the conservative assumption that new direct LANL workers and indirect workers would move with their families.
k Population projection for year 2038 for counties in the ROI derived from New Mexico "state Population Trends" (New Mexico 2021).
l ROI population increase of 1.3 percent would largely occur independent of LANL activities. The population increase from LANL activities would contribute a 0.3-percent increase.

Source: BEA (2023); USCB (2023a)

5.9.2.2 Population and Housing

The population in the ROI in 2038 is projected to be 1,078,001 persons, which would be a 3.8 percent increase compared to the 2022 population of 1,038,171 (USCB 2024a; New Mexico 2021). The total employment associated with the Modernized Operations Alternative would be 28,033 total workers (17,636 direct and 10,397 indirect), which would represent approximately 2.6 percent of the projected 2038 ROI population. The increase in direct and indirect jobs associated with the Modernized Operations Alternative would be 3,294, which is less than one percent of the projected 2038 ROI population. Because the increase in direct and indirect jobs would be less than one percent of the projected population, a large influx of workers/families into the ROI is not expected. However, if these 3,294 new jobs were completely filled by workers migrating into the ROI, the projected population increase in the ROI would be approximately 9,882 persons assuming three persons per household (or 3,294 multiplied by three persons per household),[52] or 0.9 percent of the projected 2038 ROI population.

In 2022, there were 37,472 vacant housing units in the ROI (USCB 2024d). The additional workforce (by the end of 2038) under this alternative is 3,294 workers (2,310 direct and 984 indirect). It is anticipated that direct workers relocating to the ROI would settle in all counties within the ROI, likely in proportion to current LANL workforce residence patterns. Table 5.9-4 presents the anticipated workforce housing distribution within the ROI under the Modernized Operations Alternative.

This influx of direct employees may further increase housing needs within the Los Alamos County or change the future distribution; indicating that future personnel may be forced to reside farther from the Laboratory. Approximately 36.2 percent, or 836, direct workers would be expected to settle in Los Alamos County, splitting between the Los Alamos townsite or White Rock. Current housing statistics discussed in Section 4.9.5 suggest that the current housing market in the ROI and Los Alamos County, specifically, have unmet needs; this influx of direct employees may further increase housing needs. There would be adequate housing within the ROI, just not potentially in Los Alamos County. The discussion about median housing prices in Section 5.9.1.2 is also applicable to the Modernized Operations Alternative.

Table 5.9-4 Anticipated Workforce Housing Distribution Under the Modernized Operations Alternative

County/Area	2022 Percent of Total Site Employment[a]	2022 Vacant Housing Units[b]	Anticipated Workforce Housing Distribution[c]
Los Alamos	36.2	482	836
Santa Fe	23.1	8,848	534
Rio Arriba	15.8	5,540	365
Bernalillo	6.3	18,598	146
Sandoval	4.2	4,004	97
Other counties in NM	4.3	92,825	99

a From Table 4.9-1.
b From Table 4.9-6.
c Distribution is based on 2,310 direct jobs at LANL under the Modernized Operations Alternative.

52 Assumes one worker per household and an average of three persons per household for the ROI (USCB 2021).

5.9.2.3 Community Services and Schools

Due to the low potential for impacts on the population, the Modernized Operations Alternative would not affect fire protection, police protection services, or medical services. As discussed above, the Modernized Operations Alternative would result in a population increase in the ROI of 9,882 persons, or less than one percent of the projected 2038 ROI population of 1,078,001 (New Mexico 2021). This increase would not change demand for these services compared to current conditions.

With regard to schools, assuming an average of 0.34 school-age children per housing unit (NAHB 2020), the maximum number of school-age children associated with the additional direct and indirect workforce of 3,294 workers potentially migrating into the ROI would be 1,120 children (3,294 multiplied by 0.34 average school-age children per housing unit) by 2038. Compared to the 2022/2023 school year, the increase in school enrollment would be less than one percent and would represent a smaller proportion of future enrollment. This minimal increase in school enrollment would have a negligible effect on school services in the ROI.

5.9.3 Expanded Operations Alternative

The Expanded Operations Alternative includes the actions included in the Modernized Operations Alternative; therefore, potential impacts under this alternative include increases in employment, population, and economic activity associated with the Modernized Operations Alternative. Construction and operational activities under the Expanded Operations Alternative would result in additional potential impacts on employment, population, and economic activity. The estimates of potential impacts are provided in Table 5.9-5.

5.9.3.1 Employment and Economic Activity

Impacts to employment and economic activity include direct, indirect, and induced economic impacts that potentially could result from project activities (*see* Section 5.9.1.1).

As shown in Table 5.9-5, implementation of the Expanded Operations Alternative is assumed to require 710 construction workers per year with a potential peak of approximately 1,420 construction workers. In addition, by the end of 2038, the total direct workforce is expected to increase from the No-Action Alternative baseline by approximately 1,695 persons to approximately 18,551 workers by the end of 2038. Overall, direct employment at LANL would increase by approximately 10.1 percent compared to the No-Action Alternative workforce.

Increases in direct employment at LANL may also cause increases in indirect employment and associated economic activity such as project-related expenditures, local spending, and revenue from taxes. As was done for the No-Action Alternative, these indirect increases were derived using the RIMS II multipliers for the five-county ROI. Based on the same multipliers, approximately 495 additional indirect jobs would be created in the ROI by the end of 2038. Overall, there would be an increase of 1,410 jobs (915 direct and 495 indirect), which would represent 0.3 percent of the projected 2038 ROI labor force.

Table 5.9-5 Socioeconomic Impacts from Activities at LANL Under the Expanded Operations Alternative

Resource/Metric	No-Action Alternative (by end of 2029)	Change as a Result of the Expanded Operations Alternative				Expanded Operations Alternative (by end of 2038)	Percentage Increase Over No-Action Alternative
		Construction and DD&D (Peak year)	Operations (by the end of 2038)	Construction (by the end of 2038)	Total Workforce (by the end of 2038)		
Jobs							
Direct jobs at LANL (persons)	16,856	1,420	735	180	915	18,551	10.1
Indirect jobs from LANL (persons)	10,273[a]	350[b]	451[a]	44[b]	495	11,052	9.3
Total Direct and Indirect employment	26,969	1,770	1,186	224	1,410	29,603	9.8
Total ROI labor force (persons)	521,555	-	-	-	-	545,289[c]	4.6[d]
Earnings/Value Added							
Earnings from direct jobs at LANL (millions of dollars)	$2,247.5[e]	$95.8[f]	$99.9[e]	$12.1[f]	$112.0	$2,429.3	8.1
Earnings from indirect jobs from LANL in ROI (millions of dollars)[g]	$1,364.3	$23.6	$61.4	$3.0	$64.4	$1,469.2	7.7
Anticipated value added from LANL (millions of dollars)	$3,469.8[h]	$1,134.7[i]	$154.6[h]	$17.1[i]	$171.7	$3,744.4	7.9
Population							
TOTAL ROI POPULATION	**1,063,658**	**5,310**[j]	**3,558**[j]	**672**[j]	**4,230**[j]	**1,078,001**[k]	**1.3**[l]

a Indirect employment for operational workforce was estimated using a direct-effect employment multiplier of 1.6142 (BEA 2023).
b Indirect employment for construction/DD&D was estimated using a direct-effect employment multiplier of 1.2462 (BEA 2023).

c Calculated using the average labor force growth rate of historic labor force in the ROI (BLS 2022).
d ROI labor force increase of 4.6 percent would largely occur independent of LANL activities. The direct and indirect employment increase from LANL activities would contribute a 0.3-percent increase.
e Earnings were estimated using a final-demand earnings multiplier of 0.4684 applied to the change in jobs / change in final demand multiplier of 3.4449 (BEA 2023).
f Earnings were estimated using a final-demand earnings multiplier of 0.4812 applied to the change in jobs / change in final demand multiplier of 7.1322 (BEA 2023).
g Derived from earnings from direct jobs / indirect jobs.
h Value added was estimated using a final-demand value added multiplier of 0.7245 applied to the change in jobs / change in final demand multiplier of 3.4449 (BEA 2023).
i Value added was estimated using a final-demand value added multiplier of 0.6768 applied to the change in jobs / change in final demand multiplier of 7.1322 (BEA 2023).
j Based on an average of three persons per household for the ROI (USCB 2021) and the conservative assumption that new direct LANL workers and indirect workers would move with their families.
k Population projection for year 2038 for counties in the ROI derived from New Mexico "state Population Trends" (New Mexico 2021).
l ROI population increase of 1.3 percent would largely occur independent of LANL activities. The population increase from LANL activities would contribute a 0.4-percent increase.

Source: BEA (2023); USCB (2023a)

From 2022 to 2038, the total labor force in the ROI is expected to increase from 504,330 workers in 2022 to 545,289 workers in 2038, which would equate to a 7.5 percent increase (BLS 2022). By 2038, the total employment impact associated with the Expanded Operations Alternative (29,603 total workers, consisting of 18,551 direct and 11,052 indirect) represents approximately 9.8 percent increase in total direct and indirect employment compared to the No-Action Alternative and would account for 5.4 percent of the projected 2029 ROI labor force.

The anticipated value added from the direct economic activity to the local economy includes employee compensation, tax on production and imports, and proprietary and other property income and indirect employment compensation. Total value added under the Expanded Operations Alternative equates to approximately $172 million in the ROI. The direct labor income impact potentially could result in a total income impact of approximately $112 million in the ROI. A portion of this increased payroll likely would enter the local economy as the new workers purchase additional goods and services. It is anticipated that some portion of construction and operational materials would be purchased locally and that most construction/DD&D and operational workers would be drawn from within the ROI, resulting in regional increases in jobs. The additional anticipated expenditures by workers potentially could generate additional income and employment opportunities within the ROI if the expenditures filter throughout the economy.

5.9.3.2 Population and Housing

The total employment associated with the Expanded Operations Alternative would be 29,603 total workers (18,551 direct and 11,052 indirect), which would represent approximately 2.8 percent of the projected 2038 ROI population. The increase in direct and indirect jobs associated with the Expanded Operations Alternative would be 4,704[53], which is less than one percent of the projected 2038 ROI population. Because the increase in direct and indirect jobs would be less than one percent of the projected population, a large influx of workers/families into the ROI is not expected. However, if these 4,704 new jobs were completely filled by workers migrating into the ROI, the projected population increase in the ROI would be approximately 14,112 persons assuming three persons per household (or 4,704 multiplied by three persons per household),[54] or 1.3 percent of the projected 2038 ROI population.

In 2022, there were 37,472 vacant housing units in the ROI (USCB 2024d). For context, there were 482 vacant housing units in Los Alamos County in 2022. The additional workforce (by the end of 2038) under this alternative is 4,704 workers (3,225 direct and 1,479 indirect). It is anticipated that direct workers relocating to the ROI would settle in all counties within the ROI, likely in proportion to current LANL workforce residence patterns. Table 5.9-6 presents the anticipated workforce housing distribution within the ROI under the Expanded Operations Alternative.

This influx of direct employees may further increase housing needs within Los Alamos County. Approximately 36.2 percent or 1,167 direct workers would be expected to settle in Los Alamos County, splitting between the Los Alamos townsite or White Rock. Current housing statistics discussed in Section 4.9.5 suggest that the current housing market in the ROI and Los Alamos County, specifically, have unmet needs; this influx of direct employees may further increase housing needs. There would be adequate housing within the ROI, just not potentially in Los

[53] NNSA has identified that SPDP may be delayed by 10 years. If so, up to 120 construction workers and 140 operational workers would not be realized. The SWEIS assumes that the limited enhancement of ARIES likely would result in about 140 fewer total workers than projected; however, this reduction would account for less than 1 percent of the overall Expanded Operations Alternative workforce by 2038.

[54] Assumes one worker per household and an average of three persons per household for the ROI (USCB 2021).

Alamos County. The discussion about median housing prices in Section 5.9.1.2 is also applicable to the Expanded Operations Alternative.

Table 5.9-6 Anticipated Workforce Housing Distribution Under the Expanded Operations Alternative

County/Area	2022 Percent of Total Site Employment[a]	2022 Vacant Housing Units[b]	Anticipated Workforce Housing Distribution
Los Alamos	36.2	482	1,167
Santa Fe	23.1	8,848	745
Rio Arriba	15.8	5,540	510
Bernalillo	6.3	18,598	203
Sandoval	4.2	4,004	135
Other counties in NM	4.3	92,825	139

a From Table 4.9-1.
b From Table 4.9-6.
c Distribution is based on 2,310 direct jobs at LANL under the Expanded Operations Alternative.

5.9.3.3 Community Services and Schools

Due to the low potential for impacts on the population, the Expanded Operations Alternative would not affect fire protection, police protection services, or medical services. As discussed above, the Expanded Operations Alternative would result in a population increase in the ROI of 4,230 persons, or less than one percent of the projected 2038 ROI population of 1,078,001 (New Mexico 2021). This increase would not change demand for these services compared to current conditions.

Regarding schools, assuming an average of 0.34 school-age children per housing unit (NAHB 2020), the maximum number of school-age children associated with the additional direct and indirect workforce of 4,704 potentially migrating into the ROI would be 1,599 children (4,704 multiplied by 0.34 average school-age children per housing unit) by 2038. Compared to the current 2022/2023 school year, the increase in school enrollment would be approximately 1.2 percent and would represent a smaller proportion of future enrollment. This minimal increase in school enrollment would have a negligible effect on school services in the ROI.

5.9.4 Summary of Socioeconomics Impacts for the Alternatives

The No-Action Alternative, Modernized Operations Alternative, and the Expanded Operations Alternative would produce positive socioeconomic impacts in the ROI. Table 5.9-7 summarizes the impacts of the three alternatives.

Table 5.9-7 Potential Socioeconomic Impacts for the Alternatives

Resource/Metric	Existing Environment (2022 Baseline)	No-Action Alternative (by end of 2029)	No-Action Increase over 2022 Baseline (%)	Modernized Operations Alternative (by end of 2038)	Modernized Operations increase over the No-Action Alternative (%)	Expanded Operations Alternative (by end of 2038)	Expanded Operations increase over the No-Action Alternative (%)
Net Increase in Direct LANL Jobs	15,326[a]	16,856	10.0	17,636	4.6	18,551	10.1
Net increase in Indirect Jobs	9,413	10,113	7.4	10,397	2.8	11,052	9.3
Total ROI Labor Force	504,330	521,555	3.4	545,289	4.6	545,289	4.6
Annual Earnings from Direct Jobs at LANL (millions of dollars)	$2,084	$2,247	7.8	$2,317	3.1	$2,429	8.1
Annual Earnings from indirect jobs (millions of dollars)	$1,280	$1,364	6.6	$1,394	2.2	$1,469	7.7
Anticipated Value Added to ROI Economy (millions of dollars)	$3,223	$3,470	7.7	$3,573	3.0	$3,744	7.9
Additional School Children Added to ROI	4,988	758	15.2	1,120	1.5	1,599	2.1
Total Housing units occupied by LANL Workforce[b]	15,326	16,856	10.0	17,636	4.6	18,551	10.1

a Direct LANL employment is based on 2022 employment.
b Assuming one LANL worker per household.
c Source: BEA (2023), USCB (2024a)

5.10 Infrastructure

This section discusses the potential impacts on utilities and energy supplies. Key metrics presented in the infrastructure analysis are: (1) quantities of water, sanitary wastewater, electricity, and fuel (petroleum and natural gas) associated with the alternatives; and (2) analysis of the current infrastructure to meet demands. Site-wide transportation and parking are discussed in Section 5.12.

5.10.1 No-Action Alternative

Construction, DD&D, remediation, and operational activities under the No-Action Alternative would result in additional demands on the infrastructure in the region. Table 5.10-1 summarizes the existing infrastructure capacities, current demands, and projected demands under the No-Action Alternative.

Notable projects under the No-Action Alternative, as described in Section 3.2, that would affect infrastructure include the EPCU (as proposed in the Draft EPCU EA) and steam plant upgrade; both would increase electrical power capacity at LANL. The installation of the newest supercomputer in the SCC (ATS-5), expected in 2027, would also increase the electricity and water consumption under the No-Action Alternative. These uses are included in the forecast estimate for the No-Action Alternative.

The installation of a second fiber optic line would result in beneficial impacts to LANL as it would provide redundancy for high-performance voice, data, and internet service, which is essential to support NNSA's mission. The entire route of the new fiber optic line would be within an existing utility corridor or easement (NNSA 2020b, 2020c).

The use of institutional laydown and construction support areas would result in beneficial impacts to onsite construction/DD&D infrastructure by providing centralized and consolidated laydown areas that would: (1) support multiple projects over multiple years; (2) minimize the need for excess laydown areas in TAs and minimize construction costs; (3) minimize potential environmental impacts by collocating construction activities; and (4) provide separation between the necessary laydown areas and densely populated TAs to minimize impacts to ongoing operations and improve safety. There are up to seven laydown areas in six TAs that could be developed under the No-Action Alternative that have a combined footprint of about 29 acres (*see* Appendix A, Table A.3.2-1).

5.10.1.1 Electricity Consumption

As discussed in Chapter 4, Section 4.10.1, DOE/NNSA, LANL, and Los Alamos County commit their generation, transmission, and distribution resources in accordance with the LAPP. From 2017 to 2022, LANL used approximately 451 million kilowatt-hours per year of electricity. During the same period, the average annual peak electrical demand was 70.0 MW. Under the No-Action Alternative, there would be no notable changes in electricity consumption associated with construction, remediation, and DD&D activities. During facility operations, electricity consumption at LANL would be expected to increase to approximately 621 million kilowatt hours per year (38 percent increase); peak year consumption would be 730 million kilowatt hours.

Table 5.10-1 Comparison of the No-Action Alternative with the Existing Baseline

Resource/ Metric	Existing Capacity	Existing Environment Baseline Demand[a]	Change to Baseline from the No-Action Alternative		No-Action Alternative Demand[b,c]	Percentage Change
			Construction/ DD&D	Operation		
Domestic water (MGY)	542	266	7.0	26	290	+9.0%
Sanitary wastewater (gal/d)	602,800	303,400	19,000	68,000	371,400	+18.8%
Electricity – power consumption (MkW-hr/yr)	651	451	No notable change	170	621 average; 730 peak	+38%
Electricity – average annual peak demand (MW)	116	70.0	No notable change	16.1	86.7 average; 111.4 peak[d]	+24%
Natural gas (dec/d)	22,110	4,755[f]	No notable change	-600	4,155	-12.6%
Petroleum fuel (gal/yr)	Not Applicable	525,130[g]	Fuel use for construction is included in the total site-wide fuel use during operations	-99,130	426,000[e]	-18.9%

DD&D = decontamination, decommissioning, and demolition; dec/d = decatherms per day; gal/d = gallons per day; gal/yr = gallons per year; MGY = million gallons per year; MkW-hr/yr = million kilowatt-hours per year; MW = megawatt

a Average value from 2017 to 2022.
b No-Action Alternative construction assumed to be completed by 2029.
c DD&D projects included in the No-Action Alternative are scheduled through 2038.
d Monthly peak demand.
e Average value, fuel consumption reduced to 350,000 gallon per year by 2038.
f The amount of natural gas consumed in 2021 increased significantly because of the installation of the new combustion gas turbine generator. Therefore, the baseline for the SWEIS uses the 2021 peak value as opposed to the five-year average.
g Average value from 2017 to 2021 (LANL 2022f).

Average annual peak demand is projected to be 86.7 MW (24 percent increase); peak monthly demand would be 111.4 MW. The projected electrical demands reflect continued operations of existing facilities plus those identified in Tables 3.2-1 and 3.2-2. Major electrical consumers include DARHT, SCC, and operations in TA-53 (LANSCE) and TA-55 (National High Magnetic Field Laboratory). There would be sufficient electrical capacity to handle demands from projects implemented under the No-Action Alternative.

Under the No-Action Alternative, the installation of a third transmission line as part of the EPCU project would increase the import capacity from 116 MW to 200 MW. In addition, the steam plant upgrade would replace the existing central steam plant with upgrades to the combustion turbine and the addition of conventional gas-fire steam boilers, providing up to 40 MW, on average, to the Laboratory.

Under the No-Action Alternative, a solar PV array would be constructed and operated within a former borrow pit in TA-16, and associated power transmission lines would be constructed within an existing transmission corridor. This project would have beneficial impact by adding up to 10 MW of renewable power to the LAPP. The project would help meet future electrical load requirements and could meet an increasing or decreasing electricity demand quickly by providing the ability to start and stop multiple times per day. NNSA published the EA and FONSI for this project in 2019 (NNSA 2019b).

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in direct impacts to electricity usage. The potential indirect impacts of the conveyance and transfer of the tracts would represent the total estimated increases in utility usage associated with the development of the Rendija Canon and TA-21 tracts. Based on the data provided in the CT EIS, the future development of these tracts could result in the annual use of 12 million kilowatt-hours of electricity and a peak power requirement of 2.1 MW. This would represent an additional 1.9 percent above the electricity and 2.4 percent additional peak power demand than projected for other projects under the No-Action Alternative.

Chapter 6, Section 6.4.10, identifies a project in which Los Alamos County expects to begin receiving energy into the LAPP from the Foxtail Flats solar and battery storage project near Farmington, New Mexico, in 2026 (LAC 2024). This project will add 120 MW/hour to the LAPP and would help ensure sufficient available capacity. The project consists of one agreement between Los Alamos County and Foxtail Flats Solar, LLC, and a second agreement between Los Alamos County and Foxtail Flats Storage, LLC.

5.10.1.2 Fuel Consumption (Fuel and Natural Gas)

There would be no notable changes associated with natural gas during construction, remediation, or DD&D. Natural gas consumption for the Laboratory averaged 4,755 decatherms per day in 2021 after installation of the combustion gas turbine generator. Under the No-Action Alternative, the annual average natural gas consumption rates are expected to decrease by 12.6 percent to an average of approximately 4,155 decatherms per day as projects become operational. The largest contribution to this reduction would be the replacement of boilers in TA-3 planned for 2025. The projected demand would represent approximately 22 percent of the capacity of the natural gas system (22,110 decatherms per day). Even though there would be new construction, most newer buildings would not include natural gas loads (other than steam heat, which is provided by the boilers in TA-3).

About 525,130 gallons of petroleum was consumed yearly at LANL (annual average 2017–2021). Under the No-Action Alternative, petroleum usage would be expected to decrease to 426,000 gallons per year (annual average 2023–2029). The Site Sustainability Plan (LANL 2021g) projects a 2 percent reduction in fuel use year-over-year. If other alternatives are not implemented, this SWEIS assumes that reductions could be as high as 2.5 percent year-over-year. By 2038, petroleum usage would drop to approximately 350,000 gallons per year under the No-Action Alternative. Changing to electric vehicles in the fleet is a primary driver for the reduction of fossil fuel use.

Future land conveyance would not result in direct impacts to fuel usage. The potential indirect impacts from development in Rendija Canyon and TA-21 tracts could result in the daily use of about 560 decatherms per day of natural gas. This would represent an additional 12 percent above the baseline natural gas demand. Considering that DOE/NNSA would implement reduction measures in accordance with the LANL Site Sustainability Plan, there is currently no such commitment from developers of these conveyed tracts. However, as described in Section 6.4.5, Los Alamos County is considering recommendations to reduce the use of natural gas. Examples of higher priority recommendations in the report related to natural gas reductions include: (1) set a community goal to reduce natural gas use by at least 2 percent per year; (2) encourage compact architecture in new construction; (3) require new construction to have solar access, if feasible; and (4) adopt the 2021 International Energy Conservation Codes as the standard for new construction and guidelines for remodeling. Implementation of these recommendations would reduce potential impacts to this infrastructure resource.

5.10.1.3 Water Consumption

The Laboratory uses approximately 266 million gallons of water per year (annual average 2017–2022). Construction, remediation, and DD&D activities under the No-Action Alternative would require an additional 7 million gallons per year for the period 2023–2029 (when construction is assumed to be completed), after which approximately an additional 100,000 gallons per year would be required for dust suppression during DD&D for the period 2030–2038. Under the No-Action Alternative, the average annual water demand would be 290 million gallons, which is 9.0 percent greater than the baseline demand. Increased water usage attributed to the No-Action Alternative includes construction activities, three cafeterias, three fire stations, and added personnel. The capacity of the LANL domestic water system is approximately 542 million gallons per year, which is adequate to meet the water demand under the No-Action Alternative.

Future land conveyance would not result in direct impacts to domestic water use. Based on water use estimates from the CT EIS, the potential indirect impacts of development in Rendija Canyon and TA-21 tracts could result in the annual water use of 161 million gallons. This would represent an additional 55 percent above the No-Action Alternative water consumption projection. As described in Section 6.4.5, Los Alamos County is considering recommendations for overall management of natural resources including water consumption. Examples of higher priority recommendations in the report related to water and wastewater include: (1) develop and adopt a comprehensive water conservation and watershed stewardship plan to maintain and enhance the quality and quantity of the county's water supply; and (2) develop and implement a plan to capture stormwater runoff and reduce contamination through green infrastructure approaches (LARES 2022). Implementation of these recommendations would reduce potential impacts to this infrastructure resource.

5.10.1.4 Sanitary Wastewater

From 2017 to 2022, the Laboratory generated an average of 312,600 gallons per day of sanitary wastewater. During construction, under the No-Action Alternative, additional construction workers would result in increased wastewater discharges by an additional 16,000 gallons per day. Typically, portable toilets are used during construction, remediation, and DD&D activities, which would reduce the quantity of sanitary wastewater disposed on site. During operations, because of increased personnel, wastewater discharge would increase to approximately 371,400 gallons per day. The overall increase in wastewater would be 18.8 percent above the baseline use. The SWWS Plant is designed to treat up to 602,800 gallons per day of wastewater. There is sufficient capacity within the LANL system to handle the increased wastewater discharges.

Future land conveyance would not result in direct impacts to sanitary wastewater. The potential indirect impacts from development of Rendija Canyon and TA-21 tracts could result in increased wastewater discharge in the county of about 82 million gallons per year, or 225,000 gallons per day. This would represent about 60 percent additional wastewater discharge than the No-Action Alternative; however, these wastewater discharges would not be treated by the SWWS. The county would ensure that its wastewater infrastructure was adequately sized to accommodate the increase. As described in Chapter 6, Section 6.4.10, Los Alamos County is considering recommendations for overall management of natural resources including water consumption. Implementation of these recommendations would minimize the potential impacts to sanitary wastewater from development of conveyed lands. Also reported in Section 6.3, the county is already developing projects to treat and reuse additional wastewater to minimize discharges.

5.10.2 Modernized Operations Alternative

Table 5.10-2 summarizes the existing infrastructure capacities and compares Modernized Operations Alternative projected demands to the No-Action Alternative.

Notable projects under the Modernized Operations Alternative (*see* Section 3.3) include the LANSCE WTF, TA-46 SWWS replacement, and SERF expansion, all of which would increase wastewater treatment and water reclamation capacity. Site-wide utility upgrades would result in beneficial impacts to infrastructure as various improvements to water tanks, gas lines, electrical, water lines, sewer system, and telecommunications would be implemented. The biomass generator (*see* Section 3.3.1) could provide additional power generation (up to 1 MW) that could be connected directly to the electrical grid or through batteries or other energy storage technology.

The use of institutional laydown and construction support areas would result in beneficial impacts to onsite construction/DD&D infrastructure by providing centralized and consolidated laydown areas. Beneficial impacts are as described under the No-Action Alternative. Section 3.3.1 (Table 3.3-5) describes the 38 acres of potential institutional laydown areas that could be developed under the Modernized Operations Alternative.

5.10.2.1 Electricity Consumption

There would be no changes associated with electricity consumption for construction and DD&D activities. During operations, electricity demand at LANL would be expected to increase as new facilities become operational. In addition, LANSCE modernization would be implemented and result in increased electrical consumption from operations. Under the Modernized Operations Alternative, steady-state electricity consumption would increase from approximately 621 million

Table 5.10-2 Comparison of the Modernized Operations Alternative with the No-Action Alternative

Resource/ Metric	Existing Capacity	No-Action Alternative Demand	Change to the No-Action Alternative from the Modernized Operations Alternative		Modernized Operations Demand[a]	Percentage Change
			Construction/ DD&D	Operation		
Domestic water (MGY)	542	290	6.9 average; 13.8 peak	10	300	+3.4%
Sanitary wastewater (gal/d)	602,800	371,400	13,000 average; 26,500 peak	16,250	387,650	+4.4%
Electricity—Power Consumption (MkW-hr/yr)	651[e]	621 average; 730 peak	No notable change	37.0	658 average; 774 peak	+6%
Electricity–average annual peak demand (MW)	116.0[e]	86.7 average; 111.4 peak[d]	No notable change	5.3	92 average; 132 peak[d]	+6%
Natural gas (dec/d)	22,110	4,155	No notable change	-242	3,913[b]	-5.8%
Petroleum fuel (gal/yr)	Not Applicable	426,000	Fuel use for construction is included in the total site-wide fuel use during operations	18,000	444,000[c]	4.2%[f]

DD&D = decontamination, decommissioning, and demolition; dec/d = decatherms per day; gal/d = gallons per day; gal/yr = gallons per year; MGY = million gallons per year; MkW-hr/yr = million kilowatt-hours per year; MW = megawatt

a Modernized Operations Alternative implemented from 2024 to 2038.

b Average from 2025 to 2031.

c Average value, fuel consumption reduced to 380,000 gallon per year by 2038.

d Monthly peak demand.

e Presuming completion of the EPCU project under the No-Action Alternative, import capacity would increase from 116 MW to 200 MW; capacity for electrical consumption would increase from 651 to 1,440 million kWh per year (based on 7,200 hrs/year and 200 MW import capacity).

f Petroleum usage for the Modernized Operations Alternative decreases by 19 percent compared to baseline.

kilowatt hours per year to approximately 658 million kilowatt hours per year (6-percent increase); peak year consumption would be 774 million kW hours. The average annual peak demand would be expected to increase from 86.7 MW to approximately 92 MW (6-percent increase); peak monthly demand would be 132 MW. The LANL distribution system would have sufficient capacity to adequately meet the electrical power requirements under the Modernized Operations Alternative. Note that the peak electrical monthly demand of 132 MW exceeds the existing import capacity of 116 MW but could currently be met by using supplementary power from the TA-3 Co-Generation Complex. In addition, the EPCU project (under the No-Action Alternative) would increase import capacity to 200 MW. The EPCU project would also increase consumption capacity to 1,440 million kilowatt hours per year. If the EPCU were not implemented, the electrical power requirements for the Modernized Operations Alternative could still be met using supplementary power from the combined gas turbine generator. At present, the existing import capacity (116 MW) combined with onsite generation (20–27 MW) is 143 MW, which would meet the peak monthly demand (132 MW), but remaining headroom would be minimal. The existing import capacity (116 MW) is sufficient to meet the average electrical demand (92 MW).

Under the Modernized Operations Alternative, the biomass generator could provide an additional 1 MW of electrical power that could be available to the site. This additional power source could add to the generation capacity; however, the capacity is not credited in this SWEIS.

Under the Modernized Operations Alternative, NNSA is considering potential sites within LANL for installation of solar PV arrays to meet the projected electricity demand in the coming years. Nine sites, totaling 795 acres, are being considered for the development of solar PV arrays. The areal extent of the sites ranges from 11 to 245 acres. If all 795 acres were developed, an additional 159 MW of electrical power could be available to LANL; annually electricity available for consumption could increase by approximately 341 million kilowatt hours. However, it is unlikely that all the sites would be available, and based on the initial evaluation, about 50 percent of the proposed land area, appears viable for development, which equates to approximately 79 MW of additional electrical power and 170 million kilowatt hours annually for consumption. Due to the uncertainty in the scale of implementation for this project, potential additional capacity is not credited in this SWEIS.

5.10.2.2 Fuel Consumption (Fuel and Natural Gas)

Construction and operations would be occurring simultaneously and the total projected use for fuel and natural gas would be 444,000 gallons per year (fuel) and 3,913 decatherms per day (natural gas). The annual average for the No-Action Alternative was based on the seven-year period 2023–2029 (the primary construction period), while the annual average for the Modernized Operations Alternative accounts for continued reductions through 2038.

For the Modernized Operations Alternative, natural gas consumption would decrease from 4,155 decatherms per day (No-Action Alternative) to approximately 3,913 decatherms per day, a 5.8-percent decrease. None of the proposed projects would be a notable user of natural gas other than for heating and electricity generation. Because there is sufficient available capacity (22,110 decatherms per day), impacts would not be expected.

For the Modernized Operations Alternative, petroleum usage would increase from 426,000 gallons per year (under the No-Action Alternative) to 444,000 gallons per year (average from 2024–2038), a 4.2 percent increase, due to increased construction, operations, and DD&D. As identified in Section 4.10.2.2, LANL used 508,363 gallons of fuel (petroleum-based and alternative) during FY

2021. The LANL Site Sustainability Plan (LANL 2021g) establishes a goal of a 2-percent reduction in fuel use year-over-year from the baseline. This SWEIS assumes that the goal would be achieved for the Modernized Operations Alternative; the installation of a hydrogen fueling station, EV charging stations, and fleet conversion to electric vehicles would help reduce reliance on petroleum fuels. By 2038, petroleum usage would decrease to approximately 380,00 gallons per year.

5.10.2.3 Water Consumption

Construction and DD&D activities under the Modernized Operations Alternative would require an average of 6.9 million gallons of water annually for the period 2024–2038. During operations, annual water consumption at LANL is estimated to increase as new facilities are brought into operation. Under the Modernized Operations Alternative, steady-state water usage would increase from approximately 290 million gallons annually (under the No-Action Alternative) to approximately 300 million gallons annually, a 3.4-percent increase. This increase primarily would be due to additional personnel, construction activity, and the addition of one cafeteria. The existing capacity of the LANL domestic water system (approximately 542 million gallons per year) has adequate capacity to meet future water demand.

Increased water consumption from increased operations under the Modernized Operations Alternative would be partially offset by proposed water treatment projects including the SERF expansion and LANSCE WTF. Under the Modernized Operations Alternative, NNSA would renovate the existing SERF in TA-3 to increase the efficiency of blended water generation and more than double its capacity from 50 million gallons per year to 120 million gallons per year. The LANSCE WTF would save about 18 million gallons of potable water annually.

5.10.2.4 Sanitary Wastewater

During construction under the Modernized Operations Alternative, the average daily wastewater generated by the construction workforce would increase by 13,000 gallons per day over the amount generated under the No-Action Alternative. During peak-year construction, up to 26,500 gallons per day over the No-Action Alternative could be generated. Typically, portable toilets are used during construction activity, which would also decrease the demand for onsite disposal of sanitary wastewater. During operations under the Modernized Operations Alternative, total site-wide wastewater discharges would increase to 387,650 gallons per day at LANL, an increase of 4.4 percent (16,250 gallons per day) compared to the No-Action Alternative. The SWWS Plant, which is proposed for replacement under this alternative, is designed to treat up to 602,800 gallons per day of wastewater. Because of the sufficient available capacity of the existing SWWS, no adverse impacts would be expected from increased wastewater discharges.

Under the Modernized Operations Alternative, the Laboratory would replace the SWWS Plant within a mostly undeveloped area in TA-46 resulting in increased treatment capacity and system reliability. In addition, the SERF expansion project would both increase the volume of available water (currently SERF only treats about 30 percent of the water that it receives) and reduce the concentrations of total dissolved solids and conductivity, allowing locations like the SCC to increase the cycles of concentrations for cooling purposes. The LANSCE WTF would also reclaim water and reduce effluent generation from TA-53 cooling tower operations. Because these water treatment projects would increase water reuse, there would be no notable increases in effluent generation despite increased operations. These water treatment projects notably reduce the demand for fresh source water.

5.10.3 Expanded Operations Alternative

Under the Expanded Operations Alternative, there would be 18 new facility projects and 4 utility/infrastructure projects in addition to the projects identified for the Modernized Operations Alternative. Table 5.10-3 summarizes the existing infrastructure capacities and compares Expanded Operations Alternative-projected demands to the No-Action Alternative.

Notable projects that could affect infrastructure under the Expanded Operations Alternative include the FSI/HPC and the FSI WTF in TA-6; DMMSC, LANSCE enhancements, and a water treatment facility in TA-53; a self-contained microreactor that could generate 1–5 MW of electrical power; and a Pumped Hydropower Demonstration Project in TA-39 and TA-49. The addition of the FSI/HPC and DMMSC projects would notably increase consumption of electricity and water. The Microreactor and Pumped Hydropower Demonstration projects would provide additional power generation capacity to the LAPP and provide a form of energy security resilience.

5.10.3.1 Electricity Consumption

There would be no changes associated with electricity consumption for construction and DD&D activities. During operations, electricity demand at LANL would be expected to increase as new facilities become operational. Under the Expanded Operations Alternative, steady-state electricity usage would increase from approximately 621 million kilowatt hours per year (under the No-Action Alternative) to approximately 810 million kilowatt hours per year, a 30.4-percent increase; at peak year, annual consumption would be 1,174 million kilowatt hours. The average annual peak demand would increase from 86.7 MW (under the No-Action Alternative) to approximately 110 MW, a 26.9-percent increase. The site-wide projection for demand includes DMMSC, FSI, and LANSCE enhancements and reflects the average annual peak demand for the period 2024–2038. Based on the current forecast, the peak monthly demand would occur in December 2038 (171 MW). It should be noted that the present import capacity for LANL's distribution system is 116 MW. Assuming completion of the EPCU project, which is included under the No-Action Alternative, import capacity would increase to 200 MW, which would be sufficient to adequately meet the electrical power requirements under the Expanded Operations Alternative at peak load. Electrical power generation would also be increased from the microreactor (1–5 MW) and Pumped Hydropower Demonstration (initially 500 kW). Without implementation of the EPCU project, the Laboratory would need to identify additional capacity (for transmission and consumption) before implementing the full complement of projects proposed under the Expanded Operations Alternative. As noted in Section 5.10.1.1, the import of power from the Foxtail Flats project into the LAPP could also help alleviate these potential impacts.

As discussed in Section 5.10.2.1, the Laboratory is considering development of up to 795 acres of solar PV arrays. The previous discussion is also applicable to the Expanded Operations Alternative.

The Laboratory would consider burial of select electrical and telecommunication lines in underground duct banks under the Expanded Operations Alternative. As described in Chapter 3, Section 3.4.1 of this SWEIS, this action would be part of the wildfire risk reduction efforts to protect electrical and telecommunications lines from wildfire and severe weather events. While this action would not affect electrical consumption, it would have a beneficial impact on the availability and reliability of the electrical and telecommunications systems.

Table 5.10-3 Comparison of the Expanded Operations Alternative with the No-Action Alternative

Resource/ Metric	Existing Capacity	No-Action Alternative Demand	Change to the No-Action Alternative from the Expanded Operations Alternative		Expanded Operations Demand[a]	Percentage Change
			Construction/ DD&D	Operation		
Domestic water (Mgal/yr)	542	290	8.2 average; 16.4 peak	205	495	+70.7%
Sanitary wastewater (gal/d)	602,800	371,400	14,500 average; 29,000 peak	37,875	409,275	+10.2%
Electricity – power consumption (MkW-hr/yr)	651[e]	621 average; 730 peak	No notable change	189.0	810 average; 1,174 peak	+30.4%
Electricity – average annual peak demand (MW)	116.0[e]	86.7 average; 111.4 peak	No notable change	23.3	110 average; 171 peak[b]	+26.9%
Natural gas (dec/d)	22,110	4,155	No notable change	-242	3,913[c]	-5.8%
Petroleum fuel (gal/yr)	Not Applicable	426,000[d]	Fuel use for construction is included in the total site-wide fuel use during operations	57,000	483,000[d]	+13.4%[f]

DD&D = decontamination, decommissioning, and demolition; dec/d = decatherms per day; gal/d = gallons per day; gal/yr = gallons per year; Mgal/yr = million gallons per year; MkW-hr/yr = million kilowatt-hours per year; MW = megawatt

a Expanded operations implemented from 2024 to 2038.

b Peak monthly demand.

c Average from 2025 to 2031.

d Average value, fuel consumption reduced to 447,000 gallon per year by 2038.

e Presuming completion of the EPCU project under the No-Action Alternative, import capacity would increase from 116 MW to 200 MW; and capacity for electrical consumption would increase from 651 to 1,440 million kWh per year (based on 7,200 hrs/year and 200 MW import capacity).

f Petroleum usage for the Expanded Operations Alternative decreases by 8 percent compared to baseline.

5.10.3.2 Fuel Consumption (Fuel and Natural Gas)

There are no notable differences in natural gas consumption under the Expanded Operations Alternative when compared to the Modernized Operations Alternative; impacts would not be expected.

Under the Expanded Operations Alternative, petroleum usage would increase from an average of 426,000 gallons per year (under the No-Action Alternative) to 483,000 gallons per year due to increased operations (over a 15-year period). The petroleum usage projection is based on one percent reduction in fuel use year-over-year from the baseline as opposed to the 2-percent reduction goal established by the LANL Site Sustainability Plan (LANL 2021g). As identified in Section 4.10.2.2, LANL used 508,363 gallons of fuel (petroleum-based and alternative) during FY 2021. By 2038, petroleum usage would decrease to approximately 447,000 gallons per year.

5.10.3.3 Water Consumption

Construction and DD&D activities associated with the Expanded Operations Alternative would increase water consumption, on average, by 8.2 million gallons of water annually (2024–2038) and 16.4 million gallons at peak year over the No-Action Alternative. During operations, annual water consumption at LANL is estimated to increase as new facilities are brought into operation.

Under the Expanded Operations Alternative, average water consumption would increase from approximately 290 million gallons annually (under the No-Action Alternative) to 495 million gallons annually, a 70.7-percent increase. The existing capacity of the LANL domestic water system (approximately 542 million gallons per year) has adequate capacity to meet future water demand.

The Pumped Hydropower Demonstration Project would be a closed-loop system and would not be an annual consumer of potable water. The initial filling of the reservoirs would require approximately 26 million gallons, which would occur over a two-year period to spread out the demand, and would be sourced from a fire suppression line. The water within the reservoirs would be used for energy storage and would also be available for fighting wildfire. Experiments involving life of materials interacting with water would also be conducted. The design strategy is to cover the reservoirs to reduce evaporation loss and to allow water replenishment from local precipitation. One of the major goals of this project is to demonstrate that over periods of many years (i.e., multiple decades), evaporation can be offset by local precipitation. After the initial fill, it is expected that no new water would be needed to re-fill the reservoirs.

The microreactor would use very little water. The primary coolant/heat transfer fluid is typically a sodium potassium alloy liquid. As such, increased water usage under the Expanded Operations Alternative primarily would be attributed to increased personnel (1.9 million gallons per year), construction (1.3 million gallons per year), the FSI (40 million gallons per year), and the cooling water needed for LANSCE enhancement and DMMSC (150 million gallons per year). Adding these contributions to the 10 million gallons per year under the Modernized Operations Alternative would yield an estimate for the Expanded Operations Alternative of approximately 205 million gallons per year above the No-Action Alternative.

5.10.3.4 Sanitary Wastewater

During construction under the Expanded Operations Alternative, the average daily wastewater generated by the construction workforce would increase by 17,750 gallons per day over the amount generated under the No-Action Alternative. During peak-year construction, up to 35,500 gallons per day over the No-Action Alternative could be generated. Typically, portable toilets are used during construction activity, which would also decrease the demand for onsite disposal of sanitary wastewater. During operations under the Expanded Operations Alternative, total site-wide wastewater discharges would increase to 409,275 gallons per day, an increase of 10.2 percent compared to the No-Action Alternative. The existing (and the replacement) SWWS Plant is (would be) designed to treat 602,800 gallons per day of wastewater. Because of the sufficient available and future capacity, no adverse impacts would be expected from increased sewer discharges.

5.10.4 Summary of Infrastructure Impacts for the Alternatives

Table 5.10-4 summarizes the potential impacts to infrastructure under the No-Action Alternative, Modernized Operations Alternative, and the Expanded Operations Alternative.

Table 5.10-4 Potential Impacts to Infrastructure for the Alternatives

Resource Parameter	Existing Capacity	Baseline (existing environment)[a]	No-Action Demand[b,c]	Modernized Operations[d]	Expanded Operations[d]
Domestic water (MGY)	542	266	290	300	495
Sanitary wastewater (gal/d)	602,800	312,600	371,400	387,650	409,275
Electricity – power consumption (MkW-hr/yr)	651[f]	451 average	621 average; 730 peak	658 average; 774 peak	810 average; 1,174 peak
Electricity – average annual peak demand (MW)	116.0[f]	70.0 average	86.7 average; 111.4 peak[e]	92 average; 132 peak[e]	110 average; 171 peak[e]
Natural gas (dec/d)	22,110	4,755	4,155	3,913	3,913
Petroleum fuel (gal/yr)	Not Applicable	525,130[g]	426,000	440,000	483,000

DD&D = decontamination, decommissioning, and demolition; dec/d = decatherms per day; gal/d = gallons per day; gal/yr = gallons per year; MGY = million gallons per year; MkW-hr/yr = million kilowatt-hours per year; MW = megawatt

a Average value from 2017 to 2022.
b No-Action Alternative implemented between 2023 and 2029.
c DD&D projects included in the No-Action Alternative are scheduled through 2038.
d Modernized and expanded operations implemented from 2024 to 2038.
e Monthly peak.
f Presuming completion of the EPCU project under the No-Action Alternative, import capacity would increase from 116 MW to 200 MW; capacity for electrical consumption would increase from 651 to 1,440 million kWh per year (based on 7,200 hours/year and 200 MW import capacity).
g Average value from 2017 to 2021 (LANL 2022f).

5.11 Waste Management and Materials Management

The waste and materials management analysis presents the potential impacts associated with waste generation and management for each alternative. This section also addresses the impacts of managing radioactive and hazardous materials used at LANL. NNSA does not expect waste or hazardous materials associated with these activities to be unique or substantially different from the types of waste and materials already managed at LANL, although quantities could increase. Key metrics for the waste analysis include: (1) the capacity of the existing LANL waste management system to appropriately manage any expected increases in waste quantities, and (2) the capacity of offsite facilities to receive additional LANL waste for subsequent treatment and/or disposal. Key metrics for the radioactive/hazardous materials use analysis are the capacity and capability of the existing LANL materials management system to accommodate any expected increases in radioactive/hazardous material quantities.

5.11.1 No-Action Alternative

Waste projections presented in this section include wastes from existing LANL operations as well as those associated with No-Action Alternative projects. The following sections address waste and material categories in the same order as presented in Chapter 4, Section 4.11 of this SWEIS.

5.11.1.1 Radioactive Waste

The discussion of radioactive waste is categorized by LLW, MLLW, and TRU waste (including mixed-TRU waste). Under the No-Action Alternative, the following projects have the potential to increase the amount of routine radioactive waste generated at LANL:

- increased pit production,
- Light Manufacturing Laboratory operations,
- RLWTF operations, and
- CMR Hot Cell operations in support of isotope production.

In addition, the DD&D of radiologically contaminated buildings is addressed as a nonroutine waste.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not directly or indirectly generate radiological waste (DOE 1999b).

LLW. Table 5.11-1 summarizes the estimates of LLW that would be generated annually under the No-Action Alternative. For comparison, the table also shows the average quantity of LLW generated at LANL over the past six years. Nonroutine LLW generated from DD&D activities of excess facilities may fall under the responsibility of either contractor or other contractors as awarded by DOE/NNSA. The estimates presented in Table 5.11-1 are annual averages; NNSA notes that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period covered by this SWEIS.

The 27-percent increase in laboratory operations LLW is dominated by the additional LLW associated with increased pit production. The increases in legacy cleanup LLW and DD&D LLW generation should be seen in the context of a decrease in long-term risks due to the removal of legacy contaminated facilities and increased remediation activities.

Per the discussion in Section 3.2.2, DD&D of CMR could be delayed until after 2038. If this delay occurred, the projected volume of LLW generated from DD&D would be reduced by a total volume of about 29,000 cubic meters, or an average of 1,933 cubic meters per year over 15 years.

Table 5.11-1 LANL Generation of LLW Under the No-Action Alternative

LLW Category	Baseline/Existing Environment 6-year Average, 2017–2022 (m^3/yr)	No-Action Alternative Projection[a] (m^3/yr)	Percent Increase Over Baseline/Existing Environment, 6-year average
Laboratory operations LLW	3,054[b]	3,879	27
Legacy cleanup LLW	1,064[b]	2,615	146
DD&D LLW (nonroutine)	Included in legacy cleanup LLW	3,260[c]	NA
TOTALS	**4,118**	**9,754**	**137**

DD&D = decontamination, decommissioning, and demolition; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; NA = not applicable

a From Table A.3.5-2.

b From Table 4.11-2.

c This volume assumes DD&D of CMR prior to 2038, as currently planned.

NNSA expects that final disposition of the LLW generated under the No-Action Alternative would be the same as described for current operations. As discussed in Chapter 4, Section 4.11.2, LANL sends almost all of its solid LLW off site to the NNSS and to commercial, licensed TSD facilities (*see* Table 4.11-1). As shown in Table 4.11-1, approximately 37 percent of the LLW was sent to NNSS in 2022; 28 percent to Waste Control Specialists LLC (WCS) in Texas; 22 percent to the Energy*Solutions* facility in Utah; and the remaining 13 percent was sent to TSD facilities in Washington and Florida. From 2015 through 2021, the NNSS disposed of an average of 838,000 cubic feet (NNSS 2016, 2017, 2018, 2019, 2020, 2021, 2022), or 23,700 cubic meters, of LLW per year in its land-based disposal cells. Currently, LANL LLW accounts for approximately 16 percent of the LLW disposed of at NNSS annually. If 37 percent of LANL's future LLW generated under the No-Action Alternative (3,610 cubic meters) is sent to NNSS, it would account for approximately 15 percent of the LLW disposed of at NNSS annually.

The Energy*Solutions* facility is a commercial facility licensed as a Class A LLW disposal facility by the Utah Department of Environmental Quality, which has this authority under agreement with the NRC (UDEQ 2023). During the five-year span 2018–2022, Energy*Solutions* received an average of 3,420,000 cubic feet (96,800 cubic meters) of LLW per year. There was a marked increase in the volume of LLW received in the last three years of that span, resulting in a three-year average of 4,750,000 cubic feet (134,000 cubic meters) per year (NRC 2023). The 22 percent of LANL LLW estimated under the No-Action Alternative would be 2,146 cubic meters per year and would account for approximately 1.6 percent of the waste managed by the Energy*Solutions*' Utah facility. Projected amounts of waste shipped to WCS in Andrews County, Texas, would be similar to that of Energy*Solutions*, in that LANL LLW disposed of annually would only represent a small percentage of total waste received by the facility.

Compared to the amounts that would be sent to NNSS, WCS, and Energy*Solutions*, relatively small amounts of LLW would also be sent to other offsite facilities.

MLLW. LANL generates routine MLLW from Laboratory operations and from legacy cleanup operations. In addition, there could be nonroutine MLLW generated from DD&D activities of excess facilities. Table 5.11-2 summarizes the total MLLW generation projections for the No-Action Alternative. As with LLW, the MLLW estimates are presented as annual averages with the acknowledgement that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period covered by the SWEIS.

Table 5.11-2 LANL Generation of MLLW Under the No-Action Alternative

MLLW Category	Baseline/Existing Environment 6-year Average, 2017–2022 (m^3/yr)	No-Action Alternative Projection (m^3/yr)	Percent Change Over Baseline/Existing Environment 6-year Average[a]
Laboratory operations MLLW	118[a]	122	3.4
Legacy cleanup MLLW	389[b,c]	132	(66)
DD&D MLLW (nonroutine)	Included in Legacy Cleanup MLLW	26[d]	NA
TOTALS	**507**	**280**	**(45)**

DD&D = decontamination, decommissioning, and demolition; m^3/yr = cubic meters per year; MLLW = mixed low-level radioactive waste; NA = not applicable

Note: Parentheses indicates a negative change.

a From Table A.3.5-2.

b From Table 4.11-4.

c The legacy cleanup six-year average is heavily skewed by a single year (2019) in which 2,065 m^3 of MLLW was generated. The annual average for 2017, 2018, 2020, 2021, and 2022 was 45 $m^3$of MLLW. N3B currently estimates that 132 m^3/yr of legacy cleanup MLLW would be generated.

d This volume assumes DD&D of CMR prior to 2038, as currently planned.

As shown in Table 5.11-2, Laboratory operations MLLW quantities would decrease by 1.8 percent compared to the six-year average (2017–2022) presented for the baseline/existing environment. The projects that are primary contributors to MLLW generation under the No-Action Alternative include increased pit production, Light Manufacturing Laboratory operations, RLWTF operations, and CMR Hot Cell operations in support of isotope production. Although there would be a decrease in legacy cleanup MLLW generation compared to the baseline/existing environment quantities, NNSA notes that the baseline/existing environment quantities are skewed by the large quantity of MLLW generated in 2019.

Per the discussion in Section 3.2.2, DD&D of CMR could be delayed until after 2038. If this delay occurred, the projected volume of MLLW generated from DD&D would be reduced by a total volume of about 210 cubic meters or an average of 14 cubic meters per year over 15 years.

LANL manages its MLLW through a combination of onsite treatment followed by disposal as LLW, or shipment to commercial facilities for treatment and/or disposal. Use of commercial facilities is limited to those able to show adequate capacity and compliance with applicable permitting and regulatory requirements. As noted in Chapter 4, Section 4.11.2, the commercial facilities most recently used by LANL for MLLW include the Energy*Solutions* facility in Utah WCS in Andrews County, Texas, and Diversified Scientific Services Inc. in Kingston, Tennessee. These three facilities, which account for approximately 92 percent of LANL's MLLW treatment and disposal, have permits with their applicable states allowing them to receive MLLW for treatment and/or disposal.

NNSA expects that final disposition of the MLLW generated under the No-Action Alternative would be consistent with current operations. In the biennial reporting required under RCRA for hazardous waste facilities, Energy*Solutions,* WCS, and Diversified Scientific Services Inc. reported receiving or managing 1,286 tons (EPA 2024b), 1,228 tons (EPA 2024c), and 234 tons (EPA 2024d), respectively, of MLLW in 2021. Based on approximately 600 pounds per cubic yard (EPA 2016), the MLLW received or managed by Energy*Solutions*, WCS, and Diversified Scientific Services Inc, in 2021 equate to about 3,600 cubic meters. The 280 cubic meters of MLLW projected to be generated annually at LANL under the No-Action Alternative would represent a decrease of about 45 percent from the baseline and represent about 7 percent of the total volume sent to all three facilities in 2021.

TRU and mixed TRU waste. LANL generates TRU waste and, in smaller quantities, mixed TRU waste. Whether TRU waste or mixed TRU waste, all of the waste goes to DOE's WIPP facility, where it is all managed as mixed TRU waste. For purposes of analysis, the combined TRU waste and mixed TRU waste is simply referred to as "TRU waste." Under the No-Action Alternative, NNSA estimates that TRU waste could be generated within LANL at the annual rate shown in Table 5.11-3. For comparison, the table also shows the average quantity of TRU waste generated within LANL over the past six years.

Table 5.11-3 LANL Generation of TRU Waste Under the No-Action Alternative

TRU Waste Category	Baseline/Existing Environment 6-year Average, 2017–2021 (m^3/yr)	No-Action Alternative Projection[a] (m^3/yr)	Percent Increase Over Baseline/Existing Environment, 6-year Average
Laboratory operations TRU waste	267[b]	408	53
Legacy cleanup TRU waste	96 [b]	233	142
DD&D TRU waste (nonroutine)	Included in Legacy Cleanup TRU	11[c]	NA
TOTALS	**363**	**652**	**80**

DD&D = decontamination, decommissioning, and demolition; m^3/yr = cubic meters per year; NA = not applicable; TRU = transuranic

a From Table A.3.5-2.

b From Table 4.11-5.

c This volume assumes DD&D of CMR prior to 2038, as currently planned.

For the No-Action Alternative, the estimated generation rate is grouped into contributions from "laboratory operations" and "legacy cleanup." As for LLW and MLLW, the TRU waste estimates are presented as annual averages with the acknowledgement that there could be temporary excursions or increases in any given year; these higher projections have been accounted for in the total waste projected for the 15-year analytical period covered by this SWEIS.As shown in Table 5.11-3, the total volume of TRU waste projected for the No-Action Alternative would increase by 80 percent compared to the six-year average (2017–2022) presented for the baseline/existing environment. The increase in Laboratory operations TRU waste is dominated by the additional TRU waste—estimated at 107 cubic meters/year—associated with producing 30 pits per year. In the event that pit production under the No-Action Alternative increased to 80 pits per year, annual TRU generation would also increase from 107 cubic meters per year to 306 cubic meters per year. The increase in legacy cleanup TRU waste generation should be seen in the context of a decrease in long-term risks due to removal of legacy contaminated facilities and increased remediation activities.

Per the discussion in Section 3.2.2, DD&D of CMR could be delayed until after 2038. If this delay occurred, the projected volume of TRU waste generated from DD&D would be reduced by a total volume of about 115 cubic meters or an average of 7.7 cubic meters per year over 15 years.

The WIPP Land Withdrawal Act (LWA) includes provisions that allow no more than 175,600 cubic meters of total TRU waste volume and 5.1 million curies of remote-handled TRU waste to be disposed of at the WIPP facility. WIPP is DOE's only authorized repository for TRU waste and also has an NMED-issued Hazardous Waste Facility Permit for the management of mixed TRU waste. In January 2018, DOE and the M&O Contractor (Permittees) submitted a request to modify the NMED WIPP permit to clarify TRU mixed waste disposal volume reporting (DOE 2018). In December 2018, NMED approved the Permittees' request to modify the existing WIPP permit (NMED 2018), and in January 2019, the Permittees fully implemented the change in the method of tracking and reporting the defense-related TRU waste disposal volumes. On October 4, 2023, the NMED signed a Final Order approving a 10-year renewal of the WIPP permit (NMED 2023). As of December 2022, about 41 percent of the total TRU waste volume capacity limit authorized in the WIPP LWA has been disposed of in eight disposal panels at the WIPP facility.

The volume of TRU waste projected for the LANL No-Action Alternative (652 cubic meters per year) is consistent with LANL's recent projections of TRU waste generation, and it would remain a small contributor to the total TRU waste sent to WIPP. The TRU waste inventory estimates from DOE sites that would send TRU waste to WIPP change frequently due to retrieval, treatment, characterization, and shipping activities. Consequently, TRU waste inventory estimates are collected annually from generator/storage sites and the DOE prepares an Annual Transuranic Waste Inventory Report (ATWIR). The ATWIR provides updated TRU waste inventory estimates, is used for strategic planning, and supports the DOE Carlsbad Field Office input into documents (e.g., WIPP documented safety analysis [DSA], NEPA evaluations), performance assessments, planned changes, and other design changes as needed for the WIPP facility. The most recent ATWIR was completed in February 2024, with a data cutoff date of December 31, 2022 (DOE 2024b). The 2023 ATWIR provides the best estimate of TRU waste inventories at generator sites and is used to support the analyses in this SWEIS. Chapter 6 of this SWEIS includes a cumulative impact analysis of TRU waste disposal at WIPP.

5.11.1.2 Nonradiological Waste

Hazardous Waste. Under the No-Action Alternative, hazardous waste would be generated within LANL at the annual rate shown in Table 5.11-4. That generation rate grouped into contributions from "Laboratory operations hazardous waste" from laboratory operations (i.e., research, production, maintenance, construction, and demolition) and "legacy cleanup hazardous waste" from legacy cleanup operations. For direct comparison as a baseline, the table also shows the average quantity of hazardous waste generated at LANL over the past six years. The hazardous waste volumes presented in Table 5.11-4 include PCBs, ACM, and waste from explosives operations.

No projects proposed under the No-Action Alternative, other than increased pit production, would result in a notable increase to routine hazardous waste generation from sitewide operations. Per the 2020 LANL SWEIS SA (NNSA 2020a), hazardous waste generation could increase by 141 metric tons per year for production of 30 pits per year. For conservatism and to account for uncertainties, this SWEIS assumes that the six-year average sitewide generation rate could increase by 20 percent plus the increase attributed to increased pit production, which would result in a No-Action Alternative projection for generation of routine hazardous waste of 3,136 metric tons per year. Hazardous waste from legacy cleanup operations is estimated at 1 metric ton per year and nonroutine hazardous waste from DD&D activities is estimated at 27 metric tons per year. As was true for radiological waste, the hazardous waste estimates are presented as annual averages with the acknowledgement that there could be temporary excursions or increases in any given year; these higher projections have been accounted for in the total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5.11-4 LANL Generation of Hazardous Waste Under the No-Action Alternative

Hazardous Waste Category	Baseline/Existing Environment 6-year Average 2017–2022 (MT/yr)[a]	No-Action Alternative Projection[b] (MT/yr)	Percent Change Over Baseline/Existing Environment 6-year Average
Laboratory operations hazardous waste	2,080	2,961	43
Legacy cleanup hazardous waste	270[c]	1	(99.6)[d]
DD&D hazardous waste (nonroutine)	Included in Legacy Cleanup Haz Waste	27[e]	NA
TOTALS	**2,350**	**2,989**	**27**

DD&D = decontamination, decommissioning, and demolition; MT/yr = metric tons per year; NA = not applicable

a Metric ton equals 1,000 kilograms. Metric tons multiplied by 1.1023 equals tons.
b From Table A.3.5-2.
c From Table 4.11-7.
d Parenthesis indicates a negative change.
e This value assumes DD&D of CMR prior to 2038, as currently planned.

Per the discussion in Section 3.2.2, DD&D of CMR could be delayed until after 2038. If this delay occurred, the projected volume of hazardous waste generated from DD&D would be reduced by a total of about 235 metric tons, or an average of 15.7 metric tons per year over 15 years.

As shown in Table 5.11-4, the total volume of hazardous waste projected for the No-Action Alternative would increase by 27 percent compared to the six-year average (2017–2022) presented for the baseline/existing environment. Using a rough approximation of 1 cubic yard of hazardous waste weighing 600 pounds (or about twice the density of typical uncompacted mixed municipal solid waste [EPA 2016]), the 2,989 metric tons per year of total hazardous waste equates to 10,416 cubic yards or about 281,228 cubic feet per year. (If it is assumed that the waste is heavier than 600 pounds per cubic yard, the amount of storage space required decreases.)

After material is declared a hazardous waste, the waste is characterized, labeled, and collected in appropriate storage areas. Many hazardous wastes are accumulated for up to 90 days at consolidated storage facilities. LANL sends hazardous waste to a variety of offsite commercial

TSD facilities (*see* Chapter 4, Table 4.11-6). Approximately 200 shipments of hazardous waste would be made annually to a variety of commercial offsite facilities.

Based on EPA's biennial reports for hazardous waste, there were 39.6 million metric tons of hazardous waste generated nationally in 2021, with 4,204 tons generated in New Mexico in that year (EPA 2023b). The 3,164 metric tons per year projected for LANL represents a small portion (less than 1 percent) of the hazardous waste quantities nationally but would comprise about 75 percent of the hazardous waste generated in New Mexico.

As discussed in Chapter 4, Section 4.11.4, NMSW is a nonhazardous solid waste with unique handling, transportation, and/or disposal requirements to ensure protection of the environment and the public health, welfare, and safety. LANL generates NMSW in various facilities and processes. The largest quantities generated at LANL are the filter cakes from treating the effluent of the TA-46 SWWS for cooling tower makeup water. Under the No-Action Alternative, the filter cakes and other NMSW would continue to be generated in approximately the same quantities as presented in Table 4.11-8, which would be approximately 838 metric tons per year. Management of these wastes would continue as described in Section 4.11.4.

Nonhazardous Solid Waste. Under the No-Action Alternative, nonhazardous solid waste could be generated within LANL at the annual rate shown in Table 5.11-5. For direct comparison, the table also presents a summary of the quantities of nonhazardous solid waste generated at LANL over the past six years. The increase in nonhazardous waste is attributed to the increase in workers at LANL and large increases of construction and demolition debris from proposed DD&D activities.

Table 5.11-5 LANL Generation of Nonhazardous Solid Waste Under the No-Action Alternative

Nonhazardous Solid Waste Category	Baseline/Existing Environment 6-year Average, 2017–2022, (MT/yr)[a]	No-Action Alternative[b] (MT/yr)	Percent Increase Over Baseline/Existing Environment 6-year Average
Site-wide nonhazardous solid waste	3,896 – includes both routine (e.g., sanitary solid waste) and nonroutine (e.g., C&D waste)	6,995 – includes both routine (1,895 MT/yr) and nonroutine (5,100 MT/yr)[c]	80

C&D = construction and demolition; MT/yr = metric tons per year
a Metric ton equals 1,000 kilograms. Metric tons multiplied by 1.1023 equals tons.
b From Table A.3.5-2.
c This value assumes DD&D of CMR prior to 2038, as currently planned.

Waste materials not diverted for reuse or recycling are collected through a normal trash collection system operated by LANL personnel. Filled garbage trucks take the waste to offsite commercial landfills over the past six years. The increase in nonhazardous waste is attributed to the increase in workers at LANL and large increases of construction and demolition debris from proposed DD&D activities.

Per the discussion in Section 3.2.2, DD&D of CMR could be delayed until after 2038. If this delay occurred, the projected volume of nonhazardous demolition debris generated from DD&D would be reduced by a total of about 24,000 metric tons, or an average of 1,600 metric tons per year over 15 years.

Waste materials not diverted for reuse or recycling are collected through a normal trash collection system operated by LANL personnel. Filled garbage trucks take the waste to offsite commercial landfills that have the appropriate permits to receive the waste. Waste not amenable to recovery is sent through the facility's transfer station to another facility with disposal capabilities. Other than the accumulation bins and containers, there are no storage facilities for this waste, and it is expected that existing bins and containers would be adequate for waste generated under the No-Action Alternative. The Laboratory sends solid waste to the Los Alamos County Eco Station for transfer to municipal landfills. Los Alamos County operates this transfer station and is responsible to NMED for obtaining all related permits for these activities. In 2022, LANL sent approximately 1,750 tons to the Los Alamos County Eco Station (LANL 2024h).

Construction and demolition debris is regulated as a separate category of solid waste under the New Mexico solid waste regulations. Construction and demolition debris is not hazardous and may be disposed of in a municipal landfill or a construction and demolition debris landfill (20.9.1 NMAC). Construction and demolition waste typically consist of soils, broken-up concrete, scrap metals, and various building material waste or rubble. LANL segregates and tracks construction and demolition waste, and, as described above, has implemented actions to reuse or recycle these materials where feasible rather than send them for landfill disposal. Soils are reused on site or arrangements are made for the landfill to use it as cover; broken up concrete is used at the landfill for roads, pads, or cover; and scrap metals are sent for recycling. As shown in Chapter 4, LANL has recycled up to 45 percent of its construction and demolition waste over the past five years.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not direct impacts to waste management; however, the CT EIS projected that indirect impacts associated with the development of Rendija Canyon and TA-21 tracts would result in an increase of about 1,210 tons per year of municipal solid waste, or roughly a 10 percent increase over the No-Action Alternative (DOE 1999b).

5.11.1.3 Materials Management

The Laboratory's materials management operations are conducted pursuant to DOE orders and to various applicable federal, state, and local laws and regulations. Regulatory oversight lies with various federal, state, and local agencies. The Laboratory uses radioactive materials, chemicals, and explosive materials in a wide variety of operations including scientific and weapons R&D, diagnostic research, research on the properties of materials, and isotope separation.

Regarding radioactive materials, the NRC categorizes quantities of SNM into three main levels according to the risk and potential for its use in a fissile explosive or in production of nuclear material for use in a fissile explosive. These safeguard categories are: SNM Category I designating strategic quantities; SNM Category II designating quantities of moderate strategic significance; and SNM Category III designating quantities of low strategic significance (NRC 2017). DOE/NNSA uses a similar approach to categorize the SNM managed at its locations. These groupings, again based on the mass and form of SNM present, are designated Security Categories I through IV, and are used to establish the types and levels of security, control, and accounting measures required in the management of these materials.

Regarding chemicals, the Laboratory uses a broad range of hazardous chemicals in both small and large quantities. The nature of LANL activities is also such that chemical inventories can change significantly over time and from facility to facility as programs change or research findings dictate changes in direction. The general following chemical types, many using DOE designations, are used and stored at LANL:

- corrosives (liquids, solids, and gases);
- toxic substances (including gases);
- flammables and combustibles (including solids, liquids, and gases);
- nonflammable gases;
- water reactives/pyrophorics/spontaneously combustibles;
- oxidizing substances;
- organic peroxides; and
- explosives.

Some of the toxic substances used within the Laboratory are considered to be carcinogens and some of the gases, both flammable and nonflammable, are asphyxiants.

The Laboratory uses explosives in various R&D and test applications. These applications involve a wide range of activities including synthesis and formulation, characterizations, and machining as well as detonations. LANL uses a comprehensive explosives safety program to manage explosives, with DOE Explosives Safety Standard (DOE-STD-1212) as the controlling document.

The No-Action Alternative would involve construction of new facilities, including some with new or expanded laboratory or research functions. As a result, it is expected that the use and presence of radioactive/hazardous materials at LANL would increase to some extent. The additional radioactive/hazardous materials likely would be similar to materials already used within LANL; any new radioactive/hazardous materials would not be allowed on site without appropriate equipment, facilities, procedures, and training necessary to safely manage those materials.

Notable new facilities under the No-Action Alternative with radioactive/hazardous material inventories include:

- ETC,
- Detonator Storage Facility and detonator storage magazines,
- HE Transfer Facility,
- armored magazines,
- RLWTF,
- Cold Test Facility,
- EMCF, and
- Light Manufacturing Laboratory.

A key element of the Laboratory's strategy in managing its radioactive/hazardous inventory is to ensure that those materials are used safely and appropriately. For new or planned actions, this is done largely through implementing the following hierarchy of controls, in order of preference: (1) select materials and process designs that avoid or minimize use of radioactive/hazardous materials; (2) use engineered controls to confine, shield, or remove hazards; (3) use administrative or procedural controls; and (4) use personal protective equipment.

By conducting operations in accordance with DOE orders and the applicable federal, state, and local laws and regulations, NNSA does not expect any significant impacts associated with radioactive/ hazardous material management. Potential impacts on human health from operations are presented in Section 5.7. Potential impacts from accidents involving radioactive/hazardous material are presented in Section 5.14.

5.11.2 Modernized Operations Alternative

5.11.2.1 Radioactive Waste

Under the Modernized Operations Alternative, the following projects have the potential to increase the annual average amount of radioactive waste generated at LANL:

- RACR,
- Rad Lab,
- CWF,
- NGTS/S, and
- LAMP.

In addition, the DD&D of radiologically contaminated buildings (in addition to those addressed under the No-Action Alternative) is addressed as a nonroutine waste.

LLW. Table 5.11-6 provides estimates of LLW that would be generated annually under the Modernized Operations Alternative. For comparison, the table also shows the LLW estimates for the No-Action Alternative. The estimates presented in Table 5.11-6 are annual averages; NNSA notes that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period.

Table 5.11-6 LANL Generation of LLW Under the Modernized Operations Alternative

LLW Category	No-Action Alternative[a] (m^3/yr)	Modernized Operations Alternative Projection[b] (m^3/yr)	Percent Increase Over No-Action Alternative
Laboratory operations LLW	3,879	3,979	2.6
Legacy cleanup LLW	2,615	2,615	0
D&D LLW (nonroutine)	3,260	4,086	25.3
TOTALS	**9,754**	**10,680**	**9.5**

DD&D = decontamination, decommissioning, and demolition; LLW = low-level radioactive waste; m^3/yr = cubic meters per year

a From Table 5.11-1.

b From Table A.3.5-2.

NNSA makes the same assumptions for waste management as in Section 5.11.1.1. If 37 percent of LANL's future LLW generated under the Modernized Operations Alternative (3,952 cubic meters) is sent to NNSS, it would account for approximately 17 percent of the LLW disposed of at NNSS annually.

The 22 percent of LANL LLW that could be sent to Energy*Solutions* under the Modernized Operations Alternative would be 2,350 cubic meters per year and would account for approximately 1.8 percent of the waste managed by the Utah facility. Projected amounts of waste shipped to WCS in Andrews County, Texas, would be similar to that of Energy*Solutions*, in that LANL LLW disposed of annually would comprise a small percentage of total waste received by the facility.

Compared to the amounts that would be sent to NNSS and Energy*Solutions*, relatively small amounts of LLW would also be sent to other offsite facilities.

MLLW. Table 5.11-7 summarizes the total MLLW generation projections under the Modernized Operations Alternative. As with LLW, the MLLW estimates are presented as annual averages with the acknowledgement that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period.

Table 5.11-7 LANL Generation of MLLW Under the Modernized Operations Alternative

MLLW Category	No-Action Alternative[a] (m^3/yr)	Modernized Operations Alternative Projection[b] (m^3/yr)	Percent Increase Over No-Action Alternative
Laboratory operations MLLW	122	132	8.2
Legacy cleanup MLLW	132	132	0
DD&D MLLW (nonroutine)	26	32	23.1
TOTALS	**280**	**296**	**5.7**

DD&D = decontamination, decommissioning, and demolition; m^3/yr = cubic meters per year; MLLW = mixed low-level radioactive waste

a From Table 5.11-2.

b From Table A.3.5-2.

LANL manages its MLLW through a combination of onsite treatment followed by disposal as LLW, or shipment to commercial facilities for treatment and/or disposal. It is expected that final disposition of the MLLW generated under the Modernized Operations Alternative would be the same as described for current operations. The 296 cubic meters of MLLW generated annually at LANL under the Modernized Operations Alternative would represent a decrease of about 41 percent from the baseline and represent about 8 percent of the total volume sent to all three facilities in 2021.

TRU and mixed TRU waste. Under the Modernized Operations Alternative, it is estimated that TRU waste could be generated within LANL at the annual rate shown in Table 5.11-8. For comparison, the table also shows the estimated quantity of TRU waste that would be generated under the No-Action Alternative. As with LLW and MLLW, the TRU waste estimates are presented as annual averages with the acknowledgement that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period.

As shown in Table 5.11-8, the total volume of TRU waste projected under the Modernized Operations Alternative would increase by 0.1 percent compared to the No-Action Alternative. Routine TRU wastes would be the same as the No-Action Alternative. The increase in DD&D TRU waste generation should be seen in the context of a decrease in long-term risks due to the removal of excess facilities that are contaminated.

Table 5.11-8 LANL Generation of TRU Waste Under the Modernized Operations Alternative

TRU Waste Category	No-Action Alternative[a] (m^3/yr)	Modernized Operations Alternative Projection[b] (m^3/yr)	Percent Increase Over No-Action Alternative
Laboratory operations TRU waste	408	408	0
Legacy cleanup TRU waste	233	233	0
DD&D TRU waste (nonroutine)	11	14.3	30
TOTALS	**652**	**655**	**0.1**

DD&D = decontamination, decommissioning, and demolition; m^3/yr = cubic meters per year; TRU = transuranic
a From Table 5.11-3.
b From Table A.3.5-2.

The volume of TRU waste projected for the LANL Modernized Operations Alternative (655 cubic meters per year) is consistent with LANL's recent projections of TRU waste generation, and it would remain a small contributor to the total TRU waste sent to WIPP. Chapter 6 of this SWEIS includes a cumulative impact analysis of TRU waste disposal at WIPP.

5.11.2.2 Nonradiological Waste

Hazardous Waste. Under the Modernized Operations Alternative, hazardous waste would be generated within LANL at the annual rate shown in Table 5.11-9. There are no projects identified for the Modernized Operations Alternative that would be a large generator of hazardous waste. One or more CWFs would centralize hazardous waste storage and management but would not notably increase the amount of waste sent off site. Because the majority of the proposed facilities would be replacements for existing facilities and operations, there would not be a large increase in

Table 5.11-9 LANL Generation of Hazardous Waste Under the Modernized Operations Alternative

Hazardous Waste Category	No-Action Alternative[a] (MT/yr)[b]	Modernized Operations Alternative Projection[c] (MT/yr)	Percent Change Over No-Action Alternative
Laboratory operations hazardous waste	2,961	3,109	5.0
Legacy cleanup hazardous waste	1	1	0
DD&D hazardous waste (nonroutine)	27	47	74.1
TOTALS	**2,989**	**3,157**	**5.6**

DD&D = decontamination, decommissioning, and demolition; MT/yr = metric tons per year
a From Table 5.11-4.
b Metric tons equals 1,000 kilograms. Metric tons multiplied by 1.1023 equals tons.
c From Table A.3.5-2.

hazardous waste generation. For conservatism and to account for uncertainties, NNSA has estimated that hazardous waste generation could be approximately 5 percent higher than the No-Action Alternative. DOE does not have any additional proposed actions above the No-Action Alternative that would increase hazardous waste generation. Estimates of nonroutine hazardous waste for DD&D are 20 metric tons per year. As was true for radiological waste, the hazardous waste estimates are presented as annual averages with the acknowledgement that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period covered by this SWEIS.

The 3,157 metric tons per year of total hazardous waste equates to 11,002 cubic yards or about 297,048 cubic feet per year. (If it is assumed that the waste is heavier than 600 pounds per cubic yard, the amount of storage space required decreases.)

After material is declared a hazardous waste, the waste is characterized, labeled, and collected in appropriate storage areas. Many hazardous wastes are accumulated for up to 90 days at consolidated storage facilities. LANL sends hazardous waste to a variety of offsite commercial TSD facilities (*see* Chapter 4, Table 4.11-6). Approximately 315 shipments of hazardous waste would be made to a variety of commercial offsite facilities.

The 3,157 metric tons per year projected for LANL represents a small portion (less than 1 percent) of the hazardous waste quantities nationally but would comprise about 75 percent of the hazardous waste generated in New Mexico.

As discussed in Chapter 4, Section 4.11.4, NMSW is a nonhazardous solid waste that has unique handling, transportation, and/or disposal requirements to ensure protection of the environment and the public health, welfare, and safety. LANL generates NMSW in various facilities and processes. The largest quantities of NMSW generated at LANL are the filter cakes from treating the effluent of the TA-46 SWWS for cooling tower makeup water. Under the Modernized Operations Alternative, additional filter cake and other NMSW would be generated as a result of the SERF expansion and operation of the LANSCE WTF. These projects are projected to generate approximately 1,640 metric tons of filter cake annually, which would represent an increase of 195 percent over the five-year average presented in Chapter 4, Table 4.11-8.

Nonhazardous Solid Waste. Under the Modernized Operations Alternative, nonhazardous solid waste could be generated within LANL at the annual rate shown in Table 5.11-10. For direct comparison, the table also presents the estimated quantities of nonhazardous solid waste that would be generated at LANL under the No-Action Alternative. The increase in nonhazardous waste is attributed to the increase in workers at LANL and additional DD&D activities proposed under the Modernized Operations Alternative.

Waste materials not diverted for reuse or recycling would be handled similar to the No-Action Alternative, as would construction and demolition debris.

Table 5.11-10 LANL Generation of Nonhazardous Solid Waste Under the Modernized Operations Alternative

Nonhazardous Solid Waste Category	No-Action Alternative (MT/yr)[a]	Modernized Operations Alternative[b] (MT/yr)	Percent Increase Over No-Action Alternative
Site-wide nonhazardous solid waste	6,995 – includes both routine (1,895 MT/yr) and nonroutine (5,100 MT/yr)	11,385 – includes both routine (1,985 MT/yr) and nonroutine (9,400 MT/yr)	63

MT/yr = metric tons per year
a Metric tons equals 1,000 kilograms. Metric tons multiplied by 1.1023 equals tons.
b From Table A.3.5-2.

5.11.2.3 Materials Management

The Modernized Operations Alternative would involve construction of new facilities (*see* Chapter 3, Section 3.3), but most proposed facilities are replacement facilities that would not expand operations. Although the use and presence of radioactive/hazardous materials at LANL would increase to some extent, the additional radioactive/hazardous materials likely would be the same or similar to materials already used within LANL. Any new radioactive/hazardous materials would not be allowed on site without appropriate equipment, facilities, procedures, and training necessary to safely manage those materials.

Notable new facilities under the Modernized Operations Alternative with radioactive/hazardous materials inventories include:

- ELF,
- SPIRe,
- Detonator Production Facility complex,
- RACR,
- BTF replacement, and
- CWF.

By conducting operations in accordance with DOE orders and the applicable federal, state, and local laws and regulations, NNSA does not expect any significant impacts associated with radioactive/hazardous material management. Potential impacts on human health from operations are presented in Section 5.7. Potential impacts from accidents involving radioactive/hazardous material are presented in Section 5.14.

5.11.3 Expanded Operations Alternative

5.11.3.1 Radioactive Waste

Under the Expanded Operations Alternative, the following projects have the potential to increase the annual average amount of radioactive waste generated at LANL:

- LEFFF,
- DMMSC,

- LANSCE enhancements,
- microreactor,
- SPDP,
- Advanced Separations of Plutonium Radiological Laboratory,
- ETF at TA-55, and
- TRU waste staging.

In addition, the DD&D of radiologically contaminated buildings is addressed as a nonroutine waste. There would not be any additional DD&D activities beyond those included in the Modernized Operation Alternative.

As identified in Chapter 3, Section 3.4.1, NNSA may not implement the SPDP project as proposed and analyzed in the SPDP Final EIS (NNSA 2024a). As an alternative to implementation of SPDP, the Laboratory could implement limited enhancement of operations of the ARIES processing line in PF-4. This limited enhancement would increase the amount of actinides processed in support of surplus plutonium disposition from the current limit of 400 kilograms per year to 700 kilograms per year, but would not achieve the SPDP proposed throughput of 2,000 kilograms per year. If this option were implemented instead of SPDP, the amount of radiological and hazardous waste projected to be generated for the Expanded Operations Alternative would be about 35 percent of the waste attributable to the SPDP project. This possible reduction is identified for each of the waste types discussed below.

LLW. Table 5.11-11 provides estimates of LLW that would be generated annually under the Expanded Operations Alternative. For comparison, the table also shows the LLW estimates for the No-Action Alternative. The estimates presented in Table 5.11-11 are annual averages; NNSA notes that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period.

As shown in Table 5.11-11, Laboratory operations LLW quantities would increase by 38 percent compared to the No-Action Alternative. The nonroutine DD&D waste would be the same as the Modernized Operations Alternative.

Table 5.11-11 LANL Generation of LLW Under the Expanded Operations Alternative

LLW Category	No-Action Alternative[a] (m^3/yr)	Expanded Operations Alternative Projection[b] (m^3/yr)	Percent Increase Over No-Action Alternative
Laboratory operations LLW	3,879	5,350	38
Legacy cleanup LLW	2,615	2,615	0
DD&D LLW (nonroutine)	3,260	4,086	25.3
TOTALS	**9,754**	**12,051**	**23.5**

DD&D = decontamination, decommissioning, and demolition; LLW = low-level radioactive waste; m^3/yr = cubic meters per year

a From Table 5.11-1.

b From Table 3.5-2.

NNSA expects that final disposition of the LLW generated under the Expanded Operations Alternative would be the same as described for current operations and the No-Action Alternative in Section 5.11.1.1. If 37 percent of LANL's future LLW generated under the Expanded

Operations Alternative (4,459 cubic meters) is sent to NNSS, it would account for approximately 19 percent of the LLW disposed of at NNSS annually.

The 22 percent of LANL LLW estimated under the Expanded Operations Alternative to be sent to Energy*Solutions* would be 2,651 cubic meters per year and would account for approximately 2.7 percent of the waste managed by the Utah facility. Projected amounts of waste shipped to WCS in Andrews County, Texas, would be similar to that of Energy*Solutions*, in that LANL LLW disposed of annually would only comprise a small percentage of total waste received by the facility.

Compared to the amounts that would be sent to NNSS and Energy*Solutions*, relatively small amounts of LLW would also be sent to other offsite facilities.

The implementation of limited ARIES enhancement instead of SPDP would potentially reduce the amount of LLW generated under the Expanded Operations Alternative by about 36 cubic meters per year.

MLLW. Table 5.11-12 summarizes the total MLLW generation projections under the Expanded Operations Alternative. As with LLW, the MLLW estimates are presented as annual averages with the acknowledgement that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5.11-12 LANL Generation of MLLW Under the Expanded Operations Alternative

MLLW Category	No-Action Alternative[a] (m^3/yr)	Expanded Operations Alternative Projection[b] (m^3/yr)	Percent Increase Over No-Action Alternative
Laboratory operations MLLW	122	159	30.3
Legacy cleanup MLLW	132	132	0
DD&D MLLW (nonroutine)	26	32	23.1
TOTALS	**280**	**323**	**15.4**

DD&D = decontamination, decommissioning, and demolition; m^3/yr = cubic meters per year; MLLW = mixed low-level radioactive waste
a From Table 5.11-2.
b From Table A.3.5-2.

The largest contributor to the 15.4-percent increase is the increase in Laboratory operations MLLW quantities, which would increase by 30.3 percent compared to the No-Action Alternative. The increase in DD&D LLW generation should be seen in the context of a decrease in long-term risks due to the removal of excess facilities that are contaminated.

LANL manages its MLLW through a combination of onsite treatment followed by disposal as LLW, or shipment to commercial facilities for treatment and/or disposal. It is expected that final disposition of the MLLW generated under the Expanded Operations Alternative would be the same as described for current operations. The 323 cubic meters of MLLW generated annually at LANL under the Expanded Operations Alternative would represent a decrease of about 36 percent from the baseline and represent about 9 percent of the total volume sent to all three facilities in 2021.

The implementation of limited ARIES enhancement instead of SPDP would potentially reduce the amount of MLLW generated under the Expanded Operations Alternative by about 0.6 cubic meter per year.

TRU and mixed TRU Waste. Under the Expanded Operations Alternative, NNSA estimates that TRU waste could be generated within LANL at the annual rate shown in Table 5.11-13. For comparison, the table also shows the estimated quantity of TRU waste that would be generated under the No-Action Alternative. As with LLW and MLLW, the TRU waste estimates are presented as annual averages with the acknowledgement that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period covered by this SWEIS.

Table 5.11-13 LANL Generation of TRU Waste Under the Expanded Operations Alternative

TRU Waste Category	No-Action Alternative[a] (m^3/yr)	Expanded Operations Alternative Projection[b] (m^3/yr)	Percent Increase Over No-Action Alternative
Laboratory operations TRU waste	408	423	3.7
Legacy cleanup TRU waste	233	233	0
DD&D TRU waste (nonroutine)	11	14.3	30
TOTALS	**652**	**670**	**2.7**

DD&D = decontamination, decommissioning, and demolition; m^3/yr = cubic meters per year; TRU = transuranic
a From Table 5.11-3.
b From Table A.3.5-2.

The implementation of limited ARIES enhancement instead of SPDP (*see* Section 3.4.1) would potentially reduce the amount of TRU waste generated under the Expanded Operations Alternative by about 10 cubic meters per year.

The volume of TRU waste projected for the LANL Expanded Operations Alternative (670 cubic meters per year) is consistent with LANL's recent projections of TRU waste generation, and it would remain a small contributor to the total TRU waste sent to WIPP. Chapter 6 of this SWEIS includes a cumulative impact analysis of TRU waste disposal at WIPP.

5.11.3.2 Nonradiological Waste

Hazardous Waste. Under the Expanded Operations Alternative, hazardous waste would be generated within LANL at the annual rate shown in Table 5.11-14. The DMMSC project would increase hazardous waste by approximately 80 metric tons per year. Several other facilities (e.g., Advanced Separations of Plutonium Radiological Laboratory, ETF, OB/OD facilities) have the potential for adding to the hazardous waste generation; however, quantitative estimates are not available. Per the SPDP EIS, the LANL sub-alternative would add only small amounts (about 1.2 cubic meters) of hazardous waste as a result of implementation of that alternative, which would not notably contribute to the estimate for the Expanded Operations Alternative (NNSA 2024a). For conservatism and to account for uncertainties, NNSA has estimated that hazardous waste generation could be approximately 5-percent higher than the Modernized Operations Alternative. DOE does not have any additional proposed actions above the No-Action Alternative that would notably increase hazardous waste generation. Estimates of nonroutine hazardous waste for DD&D are 20 metric tons per year. As was true for radiological waste, the hazardous waste estimates are presented as annual averages with the acknowledgement that there could be temporary excursions or increases in any given year, but these higher projections have been accounted for in the total waste projected for the 15-year analytical period.

Table 5.11-14 LANL Generation of Hazardous Waste Under the Expanded Operations Alternative

Hazardous Waste Category	No-Action Alternative[a] (MT/yr)[b]	Expanded Operations Alternative Projection[c] (MT/yr)	Percent Change Over No-Action Alternative
Laboratory operations hazardous waste	2,961	3,264	10.2
Legacy cleanup hazardous waste	1	1	0
DD&D hazardous waste (nonroutine)	27	47	74.1
TOTALS	**2,961**	**3,312**	**11.9**

DD&D = decontamination, decommissioning, and demolition; MT/yr = metric tons per year
a From Table 5.11-4.
b Metric ton equals 1,000 kilograms. Metric tons multiplied by 1.1023 equals tons.
c From Table A.3.5-2.

The 3,312 metric tons per year of total hazardous waste equates to 11,565 cubic yards or about 312,268 cubic feet per year. (If it is assumed that the waste is heavier than 600 pounds per cubic yard, the amount of storage space required decreases.)

After material is declared a hazardous waste, the waste is characterized, labeled, and collected in appropriate storage areas. Many hazardous wastes are accumulated for up to 90 days at consolidated storage facilities. LANL sends hazardous waste to a variety of offsite commercial TSD facilities (*see* Chapter 4, Table 4.11-6). Approximately 330 shipments of hazardous waste would be made to a variety of commercial offsite facilities.

The 3,312 metric tons per year projected for LANL represents a small portion (less than 1 percent) of the hazardous waste quantities nationally but would comprise about 79 percent of the hazardous waste generated in New Mexico.

As discussed in Chapter 4, Section 4.11.4, NMSW is a nonhazardous solid waste that has unique handling, transportation, and/or disposal requirements to ensure protection of the environment and the public health, welfare, and safety. LANL generates NMSW in various facilities and processes. The largest quantities of NMSW generated at LANL are the filter cakes from treating the effluent of the TA-46 SWWS for cooling tower makeup water. Under the Expanded Operations Alternative, additional filter cake and other NMSW would be generated as a result of the operation of the FSI/HPC WTF and increases in cooling water needs for the LANSCE WTF due to proposed operations of DMMSC and LANSCE enhancements. These two projects are projected to generate approximately 2,874 metric tons of filter cake annually, which would represent an increase of 75 percent over the amount projected for the Modernized Operations Alternative and over six times the No-Action Alternative, which is the same as the five-year average presented in Chapter 4, Table 4.11-8.

Nonhazardous Solid Waste. Under the Expanded Operations Alternative, nonhazardous solid waste could be generated within LANL at the annual rate shown in Table 5.11-15. For direct comparison, the table also presents the estimated quantities of nonhazardous solid waste that would be generated at LANL under the No-Action Alternative. The increase in nonhazardous waste is attributed to the increase in workers at LANL and additional DD&D activities proposed under the Modernized Operations Alternative (no additional DD&D is proposed for the Expanded Operations Alternative).

Table 5.11-15 LANL Generation of Nonhazardous Solid Waste Under the Expanded Operations Alternative

Nonhazardous Solid Waste Category	No-Action Alternative (MT/yr)[a]	Expanded Operations Alternative[b] (MT/yr)	Percent Increase Over No-Action Alternative
Site-wide nonhazardous solid waste	6,995 – includes both routine (1,895 MT/yr) and nonroutine (5,100 MT/yr)	11,485 – includes both routine (2,085 MT/yr) and nonroutine (9,400 MT/yr))	64

MT/yr = metric tons per year

a Metric ton equals 1,000 kilograms. Metric tons multiplied by 1.1023 equals tons.

b From Table A.3.5-2.

Waste materials not diverted for reuse or recycling would be handled similar to the No-Action Alternative, as would construction and demolition debris.

5.11.3.3 Materials Management

The Expanded Operations Alternative would involve construction of new facilities (*see* Chapter 3, Section 3.4), many of which would expand operations. Although the use and presence of radioactive/hazardous materials at LANL would increase to some extent, the additional radioactive/hazardous materials likely would be the same or similar to materials already used within LANL; any new radioactive/hazardous materials would not be allowed on site without appropriate equipment, facilities, procedures, and training necessary to safely manage those materials.

Notable new facilities under the Expanded Operations Alternative with radioactive/hazardous materials inventories include:

- Formulation Additive Manufacturing Explosive,
- TA-40 POWER bomb-proof facility,
- HEMMF,
- Advanced Separations of Plutonium Radiological Laboratory,
- ETF,
- development and operation of a BSL-3 facility at TA-51,
- LEFFF,
- DMMSC, and
- microreactor.

By conducting operations in accordance with DOE orders and the applicable federal, state, and local laws and regulations, NNSA does not expect any significant impacts associated with radioactive/hazardous material management. Potential impacts on human health from operations are presented in Section 5.7. Potential impacts from accidents involving radioactive/hazardous material are presented in Section 5.14.

5.11.4 Summary of Waste Management Impacts for the Alternatives

Table 5.11-16 summarizes the potential waste management impacts for the No-Action Alternative, the Modernized Operations Alternative, and the Expanded Operations Alternative.

Table 5.11-16 Waste Management Impacts for the Alternatives

Resource Parameter	Baseline (existing environment)	No-Action Alternative	Modernized Operations Alternative	Expanded Operations Alternative
Total LLW generated (m^3/yr)	4,118	9,754	10,680	12,051
Total MLLW generated (m^3/yr)	507	280	296	323
Total TRU waste generated (m^3/yr)	363	652	655	670
Total hazardous waste generated (metric tons/yr)	2,350	2,961	3,109	3,264
Total nonhazardous solid waste generated (metric tons/yr)	3,896	6,995	11,385	11,485

LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed low-level radioactive waste; TRU = transuranic

5.12 Transportation

This section summarizes the potential impacts of shipping materials to and from LANL to various locations (such as waste disposal sites and other DOE or commercial sites) under both incident-free and accident conditions for each of the alternatives. Analysis to support this section is provided in Appendix F of this SWEIS.

Construction and DD&D activities under the alternatives would utilize the existing transportation infrastructure in the region and potentially could cause periodic light-to-moderate adverse impacts to local traffic flows from construction-worker commuting and the intermittent presence of additional construction vehicles. The potential impacts of future LANL-specific activities on local-area traffic flows and roadway infrastructure would be expected to remain approximately the same as current conditions (*see* Chapter 4, Section 4.12).

5.12.1 No-Action Alternative

5.12.1.1 Traffic and Onsite Transportation

Under the No-Action Alternative, expected annual workforce growth (construction and operations) would result in additional workers commuting to LANL on a regular basis, year-over-year. The largest annual increases would occur during the construction period (i.e., first seven years). The peak number of construction workers (1,300) likely would occur in about Year 4 (due to uncertainties in annual funding and logistics). Assuming a linear increase from the present baseline to Year 4 results in an annual increase of about 325 workers per year during that period. Annual increases after Year 4 would be smaller. Potential traffic impacts and congestion can be determined by comparing current traffic levels with projected future construction and operational employment. The addition of an estimated 1,574 total workers (construction and operations) over the 15-year period under this alternative would represent about a 10-percent increase in workers at LANL; the largest annual increases would be seen in the first four years (2.1 percent per year). The associated incremental annual increases in traffic due to this employment growth over the period likely would not change the LOS's on roads in the immediate vicinity of LANL, all of which presently operate between LOS "C" and LOS "D" levels (*see* Chapter 4, Section 4.12) during peak hours, which is above the LOS "E" designation used to denote a major deficiency condition in traffic-flow. Within the LANL site boundary, a maximum annual 2.1-percent increase in traffic likewise would be expected to pose minimal impacts on the site's existing road network. The analysis of increased teleworking associated with a hybrid work environment at LANL under the No-Action Alternative demonstrates a lower level of traffic volume increase year-over-year (less than 2.1-percent annualized).

A recent analysis of the LANL road network concluded that the current primary and secondary road network on site is essentially at relative capacity and would benefit from improvements to better facilitate traffic efficiency and flows. A gradual increase (i.e., less than or equal to 2.1 percent per year) in the Laboratory workforce under the No-Action Alternative would not be expected to significantly, adversely impact operation of the primary and secondary road networks at LANL. Undertakings such as LANL's proposed parking structure in TA-48 and the offsite parking and shuttle service would help accommodate increased levels of onsite traffic and parking. Additionally, under the No-Action Alternative, the Laboratory would deploy 26 acres of new or reconfigured roads and 18 additional acres of parking, both of which would improve onsite vehicular flows and address parking space shortages.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would potentially result in indirect impacts associated with the development of Rendija Canyon and TA-21 tracts from increased motor vehicle traffic (DOE 1999b). Estimates from the CT EIS indicate that access roads and new streets would be required to support the residential development, and an estimated 12,058 trips per day would be added to the transportation network. Additionally, the development of TA-21 would result in the addition of 3,471 trips per day, bringing the total additional trips to 15,529—a 15-percent increase over the estimated annual daily traffic in the ROI (*see* Appendix F, Section F.4.2). As reported in the CT EIS, the number of additional trips could degrade traffic flow and require improvements to regional transportation infrastructure (DOE 1999b).

5.12.1.2 Transportation of Radiological and Hazardous Materials to/from LANL

Under the No-Action Alternative, an estimated total of 210 SNM (including 30–80 pits shipped to Pantex and potentially other sites) plus "other-source" (i.e., sealed-sources, medical isotopes, americium-241, and tritium) material shipments would be made annually between 2024 and 2038 to and from LANL.[55] The transport of such materials would primarily be from/to various DOE/NNSA sites directly supporting nuclear weapons programs or global security; particularly, Pantex, NNSS, LLNL, SRS, and Y-12. Potential destinations associated with the transport of

[55] Depleted uranium is also included within this list of nuclear material shipments; however, it is not categorized as SNM.

sealed-sources, medical isotopes, americium-241, and tritium would include South Carolina; Texas; Massachusetts; Florida; Tennessee; California; Oregon; New York; and Georgia. Under the No-Action Alternative, NNSA estimates that there would be about 266,000 miles per year of SNM/other-source material shipments around the U.S.

In addition to the shipment of such radiological (non-waste) materials, about 891 LLW/MLLW (routine and nonroutine) offsite shipments (assumed to go to NNSS)[56] and 189 total TRU waste shipments to WIPP (and INL)[57] would occur annually. These reflect increases of 131 percent and 226 percent, respectively, over the baseline shipping averages presented in Chapter 4, Section 4.12.5.2 and are primarily driven by increases in radioactive waste from DD&D and site-wide environmental remediation activities. The associated total projected (one-way) distances traveled annually on public roads transporting these wastes to NNSS and WIPP under the No-Action Alternative would be 677,200 miles and 64,800 miles, respectively.

For annual hazardous waste offsite shipments, the analysis estimates that typical present-day baseline annual shipping numbers (about 196) would undergo very modest increases (i.e., about 4 percent) under the No-Action Alternative.

Impacts of Incident-Free Transportation

The annual collective dose to transportation crews from all offsite transportation activities under the No-Action Alternative would range from about 4.3 person-rem for TRU disposal at WIPP to 62 person-rem for transport of SNM/other-sources material nation-wide and would total approximately 77 person-rem annually from all potentially shipped materials under all possible material categories. The associated annual doses to the general populations along these routes would range from 1.4 to 5.4 person-rem, respectively, and would total approximately 10.4 person-rem annually from all potentially shipped materials under all possible material categories. Accordingly, incident-free transportation of all material sources would result in an annualized total of 0.046 additional LCF among all transportation workers (0.70 LCF from shipments over the entire 15-year period) and an annualized additional 0.0062 LCF in all affected public populations (0.094 LCF from shipments over the entire 15-year period). Table 5.12-1 in Section 5.12.4 summarizes the associated potential risks to both the public and transportation crews.

Annual doses to the public along the local routes from LANL to Pojoaque and from Pojoaque to Santa Fe from the shipment of all possible material categories would be a maximum of 0.24 and 0.21 person-rem, respectively. These annual doses would result in an approximately 1.4×10^{-4} and 1.3×10^{-4} additional LCF among the exposed local populations, respectively.

DOE regulations limit the maximum annual dose to a transportation worker to 100 millirem per year unless the individual is a trained radiation worker. Trained radiation workers have an administrative control dose level of 2 rem per year (DOE-STD-1098-2017; SNL 2000). The probability that a trained radiation worker would develop a fatal latent cancer from an annual dose at the maximum annual exposure level is 0.0012. Furthermore, a maximally exposed truck inspector would be expected to receive no greater than 19 millirem per hour of inspection-duty

[56] The assumption of NNSS for shipments of LLW/MLLW is an analytical construct and not an indication that these wastes would all go to Nevada. By making this simplifying assumption, the SWEIS can calculate a reasonable shipment mileage without modeling 15–20 separate origin/destination pairs. Historically, most LLW goes to NNSS.

[57] As described in Appendix F, Section F.3.1, there may be a small number of shipments of TRU-contaminated gloveboxes that would first be sent to INL for size-reduction/compaction prior to being classified as TRU waste and sent to the WIPP facility.

performed, which would likewise equate to a minimal (essentially 0) increase in LCF risk on an annual basis. Therefore, no individual transportation-related worker would be expected to develop a fatal latent cancer from exposure during these activities. These facets, as they relate to the identified occupational receptor groups above, uniformly apply under all three alternatives evaluated in this SWEIS.

Impacts of Accidents During Transportation

Under all three alternatives evaluated in this SWEIS, the maximum reasonably foreseeable offsite truck transportation accident with the greatest potential consequence would involve a truck carrying a maximum allowable capacity of plutonium-oxide powder between LANL and SRS. Resulting unmitigated public impacts related to radiation exposure (neglecting the probability of the accident occurring) are estimated to be less than 4.3 rem (less than 0.003 LCF) to an MEI and less than 6,300 person-rem (less than 4 LCFs) to nearby populations along any given route segment between LANL and SRS.

Under the No-Action Alternative, the total estimated annualized transportation accident risk (calculated via the summation of individual annual accident probabilities of occurrence times their associated unmitigated consequences) for all projected accidents involving radioactive shipments, regardless of type, was determined to be 5.6×10^{-4} LCF to the general population, as compared to the maximum assessed cumulative non-radiological accident risk (traffic accident fatalities) of 0.039 fatality per year from shipments of all candidate material categories to and from LANL. The associated annualized radiological transportation accident risks to the general populations along the LANL-to-Pojoaque and the Pojoaque-to-Santa Fe routes would be 8.0×10^{-6} and 7.2×10^{-6} additional LCFs, respectively. For comparison, the maximum expected annual traffic accident fatality risk along these local routes due to these shipments would be 9.2×10^{-4} and 8.1×10^{-4}, respectively.

Impacts of Construction, Operations, and Hazardous Material Transportation

This SWEIS also evaluates the impacts of transporting various non-radiological hazardous materials. These impacts are presented in terms of annual distance traveled and annual numbers of expected traffic fatalities. The transportation impacts under the No-Action Alternative would total 8.6×10^{-4} (i.e., essentially 0) traffic fatality. This total considers 203 shipments per year, which is 7 shipments per year more than the average number (about 196) of shipments annually performed during the baseline period. For all three alternatives evaluated in this SWEIS, hazardous waste shipments were assumed to travel an average of 250 miles considering that most such shipments have historically been sent to Henderson, Colorado (Veolia facility); Colorado Springs, Colorado (Liquid Environmental Solutions facility); and Rio Rancho, New Mexico (Waste Management-New Mexico landfill facility). No radiological or hazardous waste materials are expected to be shipped as part of the construction activities under any of the three alternatives. Likewise, any radiological and hazardous wastes associated with potential DD&D or environmental remediation activities have been included in assessed impacts from site operations under all three alternatives.

5.12.2 Modernized Operations Alternative

5.12.2.1 Traffic and Onsite Transportation

Under the Modernized Operations Alternative, the workforce increases for new construction and operations would be in addition to, but generally later than, those previously analyzed under the No-Action Alternative. The peak number of construction workers (1,060) would be unlikely to occur before Year 8 (projects being implemented under the No-Action Alternative have already begun planning and funding actions under the 2008 SWEIS). Considering that the workforce under the No-Action Alternative is projected to be 16,900 by 2029 (including an average of 650 construction workers), and the workforce under the Modernized Operations Alternative would be 17,680 by 2038, the average annual increases between 2029 and 2038 would be less than 1 percent per year. Therefore, as with the No-Action Alternative, the largest annual increases would occur in the first four years (2.1 percent per year). As a result, the impacts to traffic and local transportation would not be notably different than that presented for the No-Action Alternative (including the analysis of increased teleworking).

To improve traffic and parking under this alternative, the Laboratory would construct five parking structures (over 600,000 square feet), a 25-acre remote parking and bus transfer station in TA-72, 41 acres of new or reconfigured roads, and 11 acres of parking associated with the new facilities. Additionally, the replacement of the bridge across Los Alamos Canyon and the associated reconfiguration of the intersections north and south of the bridge should improve traffic flow, although during construction, traffic congestion would be expected in the area.

5.12.2.2 Transportation of Radiological and Hazardous Materials to/from LANL

Under the Modernized Operations Alternative, there would be no change in the number of SNM/other-source material shipments than that described for the No-Action Alternative.

In addition to the above radiological shipments, the analysis estimates that approximately 980 LLW/MLLW (routine and nonroutine) offsite shipments to NNSS or a commercial TSD facility and 190 total TRU waste (routine and nonroutine) shipments to WIPP would occur annually under the Modernized Operations Alternative. These are approximately 10 percent and 0.5 percent higher than the number of projected shipments under the No-Action Alternative, respectively. The associated total projected (one-way) distances traveled annually on public roads transporting these wastes to NNSS and WIPP under the Modernized Operations Alternative would be approximately 744,800 miles and 64,600 miles, respectively.

With respect to annual hazardous waste offsite shipments, the analysis estimates that the number of hazardous waste shipments would increase by about 5 percent above that projected for the No-Action Alternative. This would be directly related to the proposed increases in hazardous waste as reported in Section 5.11.2.

<u>Impacts of Incident-Free Transportation</u>

The annual collective dose to transportation crews from all offsite transportation activities under the Modernized Operations Alternative was estimated to range from about 4.4 person-rem for TRU disposal at WIPP to 62 person-rem for transport of SNM/other-source material nation-wide and would total approximately 79 person-rem annually from all potentially shipped materials under all possible material categories. The estimated annual doses to the general populations along these routes would range from about 1.4 to 5.4 person-rem, respectively, and would total approximately 10.9 person-rem annually from all potentially shipped materials under all possible material categories. Accordingly, incident-free transportation of all material sources would result in an annualized total of 0.047 additional LCF among all transportation workers (0.71 LCF from shipments over the entire 15-year period) and a 0.0065 annualized additional LCFs in all affected public populations (0.098 LCF from shipments over the entire 15-year period). Table 5.12-2 in

Section 5.12.4 summarizes potential risks to both the public and transportation crews associated with these shipments.

Annual doses to the public along the local routes from LANL to Pojoaque and from Pojoaque to Santa Fe from the shipment of all sources were estimated to be a maximum of 0.25 and 0.22 person-rem, respectively. These doses would result in an associated 1.5×10^{-4} and 1.3×10^{-4} additional LCFs among exposed local populations, respectively.

Impacts of Accidents During Transportation

Under the Modernized Operations Alternative, the estimated total annualized transportation accident risk to the general population is estimated to be 5.6×10^{-4} LCF, as compared to a maximum assessed annualized non-radiological accident risk of 0.041 traffic fatality per year from shipments of all candidate material categories to and from LANL. The maximum annualized radiological transportation accident risks to the general populations along the LANL-to-Pojoaque and the Pojoaque-to-Santa Fe routes would be 8.1×10^{-6} and 7.2×10^{-6} additional LCFs, respectively. For comparison, the maximum expected annual traffic accident fatality risk along these local routes due to these shipments would be 9.7×10^{-4} and 8.6×10^{-4}, respectively.

Impacts of Construction, Operations, and Hazardous Material Transportation

This SWEIS also evaluates the impacts of transporting various non-radiological hazardous materials. These impacts are presented in terms of annual distance traveled and annual numbers of expected traffic fatalities. The transportation impacts under this alternative would total 9.1×10^{-4} (i.e., essentially 0) traffic fatality.

5.12.3 Expanded Operations Alternative

5.12.3.1 Traffic and Onsite Transportation

Under the Expanded Operations Alternative, the workforce increases for new construction and operations would be in addition to, but generally later than, those previously analyzed under the No-Action Alternative. The workforce for the Expanded Operations Alternative would be about 915 more than the Modernized Operations Alternative over the same period. The peak number of construction workers (1,420) would be unlikely to occur before Year 8 (projects being implemented under the No-Action Alternative have already begun planning and funding actions) and would probably be closer to the end of the analytical period to coincide with the construction of DMMSC in TA-53. Considering that the workforce under the No-Action Alternative is projected to be 16,900 by 2029 (including an average of 650 construction workers), and the workforce under the Expanded Operations Alternative would be 18,595 by 2038, the average annual increases between 2029 and 2038 would be less than 1 percent per year. Therefore, as with the No-Action Alternative, the largest annual increases would occur in the first four years (2.1 percent per year). As a result, the impacts to traffic and local transportation would not be notably different than that presented for the No-Action Alternative (including the analysis of increased teleworking).

To improve traffic and parking under this alternative, the Laboratory would construct 20 acres of new or reconfigured roads and 6 acres of parking associated with new facilities, beyond that described for the Modernized Operations Alternative.

5.12.3.2 Transportation of Radiological and Hazardous Materials to/from LANL

Under the Expanded Operations Alternative, an estimated total of about 219 SNM/other-source material shipments would be made annually between 2024 and 2038 to and from LANL, which would reflect an increase of nine annual shipments over the No-Action Alternative (4 percent). The analysis estimates a total of approximately 280,000 miles per year of SNM/other-source material shipments nation-wide under this alternative.

In addition to the above radiological shipments, the analysis estimates that approximately 1,112 offsite shipments of LLW/MLLW to NNSS or a commercial TSD facility and 195 total TRU waste shipments to WIPP would occur annually under the Expanded Operations Alternative. These are approximately 25 percent and 3.2 percent higher than the projected number of shipments under the No-Action Alternative, respectively. The associated total projected (one-way) distances traveled annually on public roads transporting these wastes to NNSS or a commercial TSD facility and WIPP under the Expanded Operations Alternative would be approximately 845,100 miles and 66,300 miles, respectively.

The analysis estimates that the number of annual hazardous waste shipments would increase by about 10 percent above that projected for the No-Action Alternative. This would be directly related to the proposed increases in hazardous waste as reported in Section 5.11.3.

Impacts of Incident-Free Transportation

The annual dose to transportation crews from all offsite transportation activities under the Expanded Operations Alternative was estimated to range from about 4.5 person-rem for TRU disposal at WIPP to 62 person-rem for transport of SNM/other-source material nation-wide and would total approximately 81 person-rem annually from all potentially shipped materials under all possible material categories. The associated annual doses to the general populations along these routes would range from about 1.4 to 5.7 person-rem, respectively, and would total approximately 11.7 person-rem annually from all potentially shipped materials under all possible material categories. Accordingly, incident-free transportation of all material sources would result in an annualized total of 0.049 additional LCF among all transportation workers (0.73 LCF from shipments over the entire 15-year period) and 0.0070 annualized additional LCF in all affected public populations (0.11 LCF from shipments over the entire 15-year period). Table 5.12-2 in Section 5.12.4 summarizes potential associated risks to both the public and transportation crews associated with these shipments.

Annual doses to the public along the local routes from LANL to Pojoaque and from Pojoaque to Santa Fe from the shipment of all sources were estimated to be a maximum of 0.27 and 0.24 person-rem, respectively. These doses would result in an associated 1.6×10^{-4} and 1.4×10^{-4} additional LCFs among exposed local populations, respectively.

Impacts of Accidents During Transportation

Under the Expanded Operations Alternative, the estimated total annualized transportation accident risk to the general population would be 5.6×10^{-4} LCF, as compared to the maximum assessed annualized non-radiological accident risk of 0.046 traffic accident fatality per year from shipments of all candidate material categories to and from LANL. The maximum annualized radiological transportation accident risks to the general populations along the LANL-to-Pojoaque and the Pojoaque-to-Santa Fe routes would be 8.1×10^{-6} and 7.3×10^{-6} additional LCFs, respectively. For comparison, the maximum expected annual traffic accident fatality risk along these local routes due to these shipments would be 0.0011 and 9.6×10^{-4}, respectively.

Impacts of Construction, Operations, and Hazardous Material Transportation

This SWEIS also evaluates the impacts of transporting various non-radiological hazardous materials. These impacts are presented in terms of annual distance traveled and annual numbers of expected traffic fatalities. The transportation impacts under this alternative would be a total of 9.5×10^{-4} (i.e., essentially 0) traffic fatality.

5.12.4 Summary of Traffic and Transportation Impacts for the Alternatives

In summary, at LANL, radioactive materials (e.g., SNM, LLW, TRU) are transported both on site (between the TAs) and off site to multiple locations. Onsite transportation constitutes the majority of activities that are part of routine operations supporting various programs. The radioactive materials transported on site between TAs are primarily limited quantities moved over short distances and mostly on closed roads. The impacts of these activities are part of the impacts of normal operations at these areas and are reflected in the historical and average worker doses presented in Sections 4.7 and 5.7 of this SWEIS, respectively.

For evaluation purposes in this SWEIS, assessed offsite transportation locations were limited to those that would be involved in most shipments of radiological materials and wastes to and from LANL. Table 5.12-1 provides the overall estimated numbers of material and waste shipments, as well as total projected shipping miles, under the three alternatives during the 15-year analysis period.

Table 5.12-2 summarizes the total transportation impacts, as well as the transportation impacts on two local transportation routes nearby to LANL:

1. **LANL to Pojoaque, New Mexico** – the route segment that trucks from LANL use, and
2. **Pojoaque to Santa Fe, New Mexico** – the route segment that trucks traveling on I-25 (such as trucks traveling to WIPP) use.

The below conclusions can be drawn from the results presented in Table 5.12-2. The highest estimated total dose to the public under any of the alternatives would be 175 person-rem from all incident-free shipments over the 15-year Expanded Operations Alternative. The expected additional LCFs among the associated exposed populations would be about 0.11. The total dose to the public along the LANL-to-Pojoaque route under this option would be 4.0 person-rem, with much less than 1 additional LCF (0.0024 LCF) among the exposed population. The total dose to the public along the Pojoaque-to-Santa Fe route would be 3.6 person-rem, with much less than 1 additional LCF (0.0022 LCF) among the exposed population. The highest total dose to transportation crews (truck drivers) would be 1,209 person-rem from all incident-free shipments over the 15-year Expanded Operations Alternative period, with an associated 0.73 additional LCF among the exposed crews. However, because the probability of a trained radiation worker truck-crew member developing a fatal latent cancer from a maximum allowable annual exposure is 0.0012, an individual worker would thus not be expected to develop a lifetime latent fatal cancer even from a continual 15-year maximum allowable annual exposure associated with these activities (0.018 LCF total).

Table 5.12-1 Estimated Numbers of Total Cumulative Shipments and Miles Driven for Radiological Materials and Wastes over each Alternative's Proposed Full 15-Year Duration (Inbound + Outbound)

Alternative	Total Number of Shipments/(total miles driven)							
	Radioactive Materials							Nonrad
	LLW/ MLLW[a] (to NNSS or a commercial TSD Facility)	TRU Waste[a] (to WIPP and INL)	Sealed Sources, Tritium[b], Am-241, and Medical Isotopes	DU[b]	Plutonium and Pit-related Materials (Pu-Metal, Pu-238 heat sources, Targets)[c]	Pu Oxide[c]	HEU (including pit-related HEU)[c]	Hazardous[a] (to offsite TSD location)
No-Action (2024–2038)	13,365/ (10,157,400)	2,845/ (972,100)	2,323/ (3,278,100)[b]	255/ (125,200)	410/ (356,000)	76/ (120,800)	88/ (115,700)	3,045/ (761,250)
Modernized Operations (2024–2038)	14,700/ (11,172,000)	2,860/ (977,200)	2,323/ (3,278,100)[b]	255/ (125,200)	410/ (356,000)	76/ (120,800)	88/ (115,700)	3,210/ (802,500)
Expanded Operations (2024–2038)	16,680/ (12,676,800)	2,935/ (1,002,700)	2,323/ (3,278,100)[b]	255/ (125,200)	521/ (532,500)	94/ (149,500)	88/ (115,700)	3,360/ (840,000)

DU = depleted uranium; HEU = high-enriched uranium; INL = Idaho National Laboratory; LLNL = Lawrence Livermore National Laboratory; LLW = low-level radioactive waste; MLLW = mixed LLW; NNSS = Nevada National Security Site; Pu = plutonium; SNL = Sandia National Laboratories; SPDP = Surplus Plutonium Disposition Program; SRS = Savannah River Site; TRU = transuranic; TSD = treatment, storage, and disposal; WIPP = Waste Isolation Pilot Plant

a Outbound only. TRU waste shipments are also assumed to be transported to INL during the 15-year period.

b Tritium and DU do not pose any radiological risks to the public or crews during normal transit. The total number of shipments and miles-driven *excluding* tritium under this materials column would thus be 2,203 and 3,087,400, respectively, and were the values used in Table 5.12-2's radiological impact assessment below.

c HEU, Pu-238 heat-sources, and pit-materials. Pu-targets, Pu-metal, and Pu-oxide all fall under the category of "SNM" shipments. *See* Table 5.12-2 for impact results.

Notes: LLW would be transported in drums or Type A, B-25 boxes. Although LLW/MLLW may ultimately be shipped to other possible (and likely closer) locations for processing and disposition, all such shipments are conservatively assumed to be consistently transported to NNSS in the evaluation of assessed impacts. All TRU-waste shipments are assumed to be contact-handled based on the latest available TRU shipment projections for WIPP (DOE 2024b). Based on DOE (2003a), under any of the three alternatives, an estimated three shipments per year of pits (and/or direct pit-material) to or from Pantex would be associated with the generation of LANL's nominal production case of 30 pits per year. In addition, an average of 28 shipments per year of pits (and/or direct pit-material) is also estimated for transport (under the Expanded Operations Alternative only) between LANL and SRS for SPDP during the years of 2035–2038. Consistent with the LLNL SWEIS (NNSA 2023c), nine shipments per year of plutonium materials (under any of the three alternatives) are assumed to be shipped between LANL and LLNL (NNSA 2023c), which falls under the maximum rate of 16 shipments per year projected in that SWEIS's analysis. In addition, two shipments per year of target material (in support of Plutonium Isentropic Compression experiments) are assumed to be transported from SNL to LANL; however, it is possible that such shipments may ultimately instead be transported directly to INL from SNL (LANL 2023a). Approximately four shipments per year of HEU are assumed to be transported between LANL and Y-12 under any of the three alternatives (LANL 2024h).

Table 5.12-2 Estimated Impacts of Transporting Radioactive Materials and Wastes Over Each Alternative's Proposed Full Duration

Transport Segments	Offsite Destination or Origination	Radiological Material & (Estimated Number of Shipments)	Segment Distance	Incident-Free[a]				Accident[a]	
				Crew		Population		Annualized Radiological Risk (LCFs/yr)	Nonrad Risk (# of traffic-accident fatalities/yr)
				Total Dose (person-rem)	Total Risk (LCFs)	Total Dose (person-rem)	Total Risk (LCFs)		
No-Action – 15 years of shipping									
LANL to Pojoaque	NNSS	LLW/MLLW (13,365)	19	4.2	2.5×10^{-3}	1.4	8.4×10^{-4}	4.1×10^{-7}	5.5×10^{-4}
Pojoaque to Santa Fe	NNSS	LLW/MLLW (13,365)	17	3.7	2.2×10^{-3}	1.2	7.2×10^{-4}	3.6×10^{-7}	4.9×10^{-4}
Santa Fe to NNSS	NNSS[b]	LLW/MLLW (13,365)	725	160.5	0.096	52.2	0.031	1.6×10^{-5}	0.022
LANL to Pojoaque	WIPP & INL	TRU (2,845)	19	3.7	2.2×10^{-3}	1.1	6.6×10^{-4}	3.5×10^{-10}	1.6×10^{-4}
Pojoaque to Santa Fe	WIPP & INL	TRU (2,845)	17	3.3	2.0×10^{-3}	1.0	6.0×10^{-4}	3.2×10^{-10}	1.4×10^{-4}
Santa Fe to WIPP	WIPP & INL	TRU (2,845)	302	57.8	0.035	18.4	0.011	5.6×10^{-9}	2.4×10^{-3}
LANL to/from Pojoaque	Various	SNM/Other (574/2,203)	19	13	7.8×10^{-3}	1.1	6.6×10^{-4}	7.6×10^{-6}	2.1×10^{-4}[c]
Pojoaque to/from Santa Fe	Various	SNM/Other (574/2,203)	17	12	7.2×10^{-3}	1.0	6.0×10^{-4}	6.8×10^{-6}	1.8×10^{-4}[c]
Santa Fe to/from Various Locations	Various[b]	SNM/Other (574/2,203)	1,306	904	0.54	79	0.047	5.3×10^{-4}	0.014[c]
TOTALS	**--**	**--**	**--**	**1,162**	**0.70**	**156**	**0.094**	$\mathbf{5.6\times10^{-4}}$	**0.039**
Modernized Operations – 15 years of shipping									
LANL to Pojoaque	NNSS	LLW/MLLW (14,700)	19	4.6	2.8×10^{-3}	1.5	9.0×10^{-4}	4.5×10^{-7}	6.0×10^{-4}
Pojoaque to Santa Fe	NNSS	LLW/MLLW (14,700)	17	4.1	2.5×10^{-3}	1.3	7.8×10^{-4}	4.0×10^{-7}	5.4×10^{-4}
Santa Fe to NNSS	NNSS[b]	LLW/MLLW (14,700)	725	176.5	0.11	57.5	0.034	1.7×10^{-5}	0.023
LANL to Pojoaque	WIPP & INL	TRU (2,860)	19	3.7	2.2×10^{-3}	1.1	6.6×10^{-4}	3.5×10^{-10}	1.6×10^{-4}
Pojoaque to Santa Fe	WIPP & INL	TRU (2,860)	17	3.3	2.0×10^{-3}	1.0	6.0×10^{-4}	3.2×10^{-10}	1.4×10^{-4}
Santa Fe to WIPP	WIPP & INL	TRU (2,860)	302	58.3	0.035	18.5	0.011	5.6×10^{-9}	2.4×10^{-3}
LANL to/from Pojoaque	Various	SNM/Other (574/2,203)	19	13	7.8×10^{-3}	1.1	6.6×10^{-4}	7.6×10^{-6}	2.1×10^{-4}[c]
Pojoaque to/from Santa Fe	Various	SNM/Other (574/2,203)	17	12	7.2×10^{-3}	1.0	6.0×10^{-4}	6.8×10^{-6}	1.8×10^{-4}[c]
Santa Fe to/from Various Locations	Various[b]	SNM/Other (574/2,203)	1,306	904	0.54	79	0.047	5.3×10^{-4}	0.014[c]
TOTALS	**--**	**--**	**--**	**1,180**	**0.71**	**163**	**0.098**	$\mathbf{5.6\times10^{-4}}$	**0.041**

Transport Segments	Offsite Destination or Origination	Radiological Material & (Estimated Number of Shipments)	Segment Distance	Incident-Free[a]				Accident[a]	
				Crew		Population		Annualized Radiological Risk (LCFs/yr)	Nonrad Risk (# of traffic-accident fatalities/yr)
				Total Dose (person-rem)	Total Risk (LCFs)	Total Dose (person-rem)	Total Risk (LCFs)		
Expanded Operations – 15 years of shipping									
LANL to Pojoaque	NNSS	LLW/MLLW (16,680)	19	5.5	3.3×10^{-3}	1.7	1.0×10^{-3}	5.1×10^{-7}	7.0×10^{-4}
Pojoaque to Santa Fe	NNSS	LLW/MLLW (16,680)	17	4.7	2.8×10^{-3}	1.5	9.0×10^{-4}	4.6×10^{-7}	6.3×10^{-4}
Santa Fe to NNSS	NNSS[b]	LLW/MLLW (16,680)	725	200	0.12	65.2	0.039	1.9×10^{-5}	0.027
LANL to Pojoaque	WIPP & INL	TRU (2,935)	19	3.8	2.3×10^{-3}	1.2	7.2×10^{-4}	3.6×10^{-10}	1.6×10^{-4}
Pojoaque to Santa Fe	WIPP & INL	TRU (2,935)	17	3.4	2.0×10^{-3}	1.1	6.6×10^{-4}	3.2×10^{-10}	1.4×10^{-4}
Santa Fe to WIPP	WIPP & INL	TRU (2,935)	302	59.6	0.036	19	0.011	5.7×10^{-9}	2.4×10^{-3}
LANL to/from Pojoaque	Various	SNM/Other (703/2,203)	19	13	7.8×10^{-3}	1.1	6.6×10^{-4}	7.6×10^{-6}	2.1×10^{-4}[(c)]
Pojoaque to/from Santa Fe	Various	SNM/Other (703/2,203)	17	12	7.2×10^{-3}	1.0	6.0×10^{-4}	6.8×10^{-6}	1.9×10^{-4}[(c)]
Santa Fe to/from Various Locations	Various[b]	SNM/Other (703/2,203)	1,310	907	0.54	83	0.050	5.3×10^{-4}	0.015[c]
TOTALS	**--**	**--**	**--**	**1,209**	**0.73**	**175**	**0.11**	$\mathbf{5.6\times10^{-4}}$	**0.046**

DU = depleted uranium; HEU = high-enriched uranium; LLW = low-level radioactive waste; MLLW = mixed LLW; NNSS = Nevada National Security Site; Pu = plutonium; SNM = special nuclear material; TRU = transuranic waste; WIPP = Waste Isolation Pilot Plant; "Other" = sealed-sources, medical-sources, and americium-241

a Cumulative risks from shipments over the entire action period (15 years for all alternatives) are shown for incident-free transportation; annualized risks over the action periods are presented for accidents.

b All LLW/MLLW shipment impacts are assumed to be exclusively transported to NNSS; all SNM/Other material shipment impacts are evaluated by assuming such materials will be shipped to/from various locations across the U.S. for the various alternatives.

c Includes risks associated with two potential escort vehicles (per shipment) accompanying shipments of SNM (HEU, Pu-targets, Pu-238 heat-sources, Pit-materials, Pu-metal, and Pu-oxide).

Notes: DU and tritium shipments were not included in the table's impact assessment rollup due to their innocuous external radiation exposure characteristics, and due to the fact that tritium-gas shipments would be transported in double-layered containers. Presented impact values throughout the table may be subject to slight deviations from calculated values due to rounding.

Regarding the SNM shipping case, the 2008 LANL SWEIS's analysis of "increased pit production" under the Expanded Operations Alternative projected that SNM associated with pit production would be shipped or received to/from Pantex, Y-12, NNSS, LLNL, and SRS; as discussed earlier, this SWEIS assumes that the same cadre of likely site origin/destination locations for SNM shipments would be expected. It should be noted that the transport of pits, pit fabrication materials, and other SNM (along with any wastes specifically associated with these materials [i.e., LLW, MLLW, TRU]) would comprise only a modest fraction of the total number of radiological shipments evaluated under this SWEIS's suite of alternatives (*see* Table 5.12-1). Accordingly, pit production-related shipments would represent just a modest fraction of the total impacts incurred by both the public and transport crews (*see* Table 5.12-2). In quantitative terms, for example, in the roughly 22,500 estimated total shipments (for SNM + TRU + LLW + MLLW + other sources combined) over the 15-year Expanded Operations Alternative period (i.e., about 1,500 annually on average), only about 40 (3 percent) of these shipments (per year), on average, would be related to pit production and/or direct pit-transfer activities under LANL's production case of 30 pits per year. As such, approximately 1 person-rem per year of collective dose to the public would be expected from the incident-free transportation of these associated shipments. For LANL's surge case of production of up to 80 pits per year, approximately 3 person-rem per year of collective transportation dose to the public would be expected (DOE 2003b, 2008a, 2012; LANL 2023a).

Table 5.12-2 summarizes the annual risk of traffic accident fatalities for each of the alternatives. In all cases (combinations of materials and route segments), under all alternatives, the annualized risk of a traffic accident fatality is greater than the annualized risk of an additional LCF due to potential radiological exposure from an accident. For example, the annualized LCF risk among exposed populations from an accident occurring during all waste and material shipments over the Expanded Operations Alternative period would be 5.6×10^{-4}, while the estimated annualized number of traffic accident fatalities associated with these shipments over the same period would be 0.046 (a factor of roughly 80 higher).

5.13 Environmental Justice

Chapter 4, Section 4.13 presents the existing environmental justice characteristics of the ROI of block groups within a 50-mile radius of LANL. The 50-mile radius population surrounding LANL is approximately 369,786 persons, of which 58 percent identify as minority persons (USCB 2022e). Of the current estimated population residing within a 50-mile radius of the LANL site for whom poverty status is determined, approximately 30 percent are considered low-income (USCB 2022g).

Regardless of alternatives considered in this SWEIS, DOE will continue to implement its environmental justice obligations to minority and low-income populations in accordance with EO 12898, EO 13985, EO 13990, and EO 14008, as well as in accordance with the DOE *Environmental Justice Strategy* (DOE 2017b). DOE will also continue to conduct its government-to-government obligations to federally recognized tribes and Pueblos in accordance with DOE's trust responsibilities to tribal nations; DOE Order 144.1, "Department of Energy American Indian Tribal Government Interactions and Policy"; EO 13175, "Consultation and Coordination with Indian Tribal Governments"; and the Accord Agreements with the Pueblo de San Ildefonso, Santa Clara Pueblo, Pueblo de Cochiti, and Jemez Pueblo (*see* Section 4.2.1.4).

Disproportionate and adverse health effects are measured in risks and rates that could result in LCFs and other fatal or nonfatal adverse impacts on human health. Adverse health effects may include bodily impairment, infirmity, illness, or death. Disproportionate and adverse human health effects occur when the risk or rate of exposure to an environmental hazard on a minority or low-income population is significant and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ 1997).

In addition to consideration of risks from radionuclides and chemicals in the environment to the general public, additional evaluation of special receptors was evaluated in this SWEIS for three receptors and ingestion exposure scenarios, including an offsite resident, recreational users of wildlands, and special pathways (*see* Section 5.7.5). Special pathways groups in this SWEIS analysis cover the full range of potential ingestion of radionuclides and chemicals and include those for offsite residents and recreational users of wildlands. Consideration of exposure pathways through ingestion is presented in Table 5.13-1.

Table 5.13-1 Consideration of Exposure Pathways through Ingestion

Exposure Pathway Component	Offsite Resident[a]	Recreational User[b]	Special Pathways[c]
Produce	*x*	*x*	*x*
Meat (free-range beef)	*x*	*x*	*x*
Milk	*x*	*x*	*x*
Fish (game)	*x*	*x*	*x*
Elk	*x*	*x*	*x*
Deer	*x*	*x*	*x*
Honey	*x*	*x*	*x*
Piñon nuts	*x*	*x*	*x*
Groundwater	*x*	*x*	*x*
Soil	*x*	*x*	*x*
Sediment	*x*	*x*	*x*
Surface water	-	*x*	*x*
Soil[d]	-	*x*	*x*
Sediment[d]	-	*x*	*x*
Fish (non-game)	-	-	*x*
Elk (heart, liver)	-	-	*x*
Indian Tea (Cota)	-	-	*x*

a A hypothetical person who is conservatively assumed to intake various foodstuffs, water, soil, and sediments with concentrations of contaminants at the 95 percent upper confidence limit for each contaminant.
b Assumed to visit the canyons on and near LANL 24 times per year, 8 hours per visit.
c Assumed to have traditional Native American or Hispanic lifestyles and diet.
d Soil and sediments from onsite locations.

A disproportionate and adverse environmental impact refers to an impact or risk of an impact on the natural or physical environment in a low-income or minority community that appreciably exceeds the environmental impact on the larger community (CEQ 1997). Such effects may include ecological, cultural, human health, economic, or social impacts in accordance with CEQ guidance as well as recent drivers identified in EO 14008 and EO 14096. In assessing cultural and aesthetic environmental impacts, DOE considered impacts that uniquely affect geographically dislocated or dispersed minority or low-income populations or American Indian Tribes or Pueblos (CEQ 1997).

5.13.1 No-Action Alternative

Table 5.13-2 shows the potential impacts to environmental justice populations for applicable resource sections in this SWEIS under the No-Action Alternative.

As reported in the CT EIS, conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in disproportionate and adverse impacts to environmental justice populations. Rendija Canyon has been identified as a location with traditional cultural properties; however, effects to these resources cannot be determined at this time. Legal counsel for the Pueblo de San Ildefonso had expressed the opinion during the preparation of the CT EIS that conveyance of the tract and subsequent use would result in environmental justice impacts to the Pueblo's population.

Restricting public use of roads and trails in Rendija Canyon would hinder public access to National Forest lands, which afford not only recreation opportunities for the general public but serve as traditional firewood gathering and collection areas for other forest products by local Hispanic and Native American populations. Therefore, restricted access to this area could have a potential disproportionate and adverse impact on these minority populations if gathering and collection is sufficiently performed by low-income or minority populations in these areas (DOE 1999b).

Impacts related to forest wood gathering would be mitigated by LANL's firewood donation program to the neighboring Pueblos for fuels that are thinned at the Laboratory under the Wildland Fire program. Fuels are sampled for contamination and constituents before release to communities. The donation program would continue with the implementation of the Laboratory's fuel mitigation program under the Wildland Fire Program and Forest Health Management (*see* Appendix A, Section A.2.2.4.13.5).

Ongoing environmental remediation under the Consent Order would continue to benefit environmental conditions as well as minority and low-income populations. As discussed in Appendix G.2, nine of the MDAs in the Consent Order have been closed, deferred, or in post-closure monitoring; seven of the MDAs are currently in process for remedy evaluation and closure and are anticipated for implementation after FY 2026; and 10 have been incorporated into the Aggregate Area program campaigns. These actions are conducted as part of DOE's Justice40 Initiative pilot program in accordance with EO 14008 (*see* Appendix A, Section A.4.13.1).

5.13.2 Modernized Operations Alternative

NNSA reviewed each of the projects proposed under the Modernized Operations Alternatives and impacts to environmental justice populations would be similar to the No-Action Alternative. Implementation of this alternative would pose no disproportionate and adverse impacts on communities with environmental justice concerns. Table 5.13-2 shows the potential impacts to environmental justice populations for applicable resource sections in the SWEIS under the Modernized Operations Alternative.

5.13.3 Expanded Operations Alternative

The Expanded Operations Alternative includes the actions in the Modernized Operations Alternative plus actions that would expand operations and missions to respond to future national security challenges and meet increasing requirements. This alternative would expand capabilities at LANL beyond those that currently exist. Implementation of this alternative would pose no disproportionate and adverse impacts on communities with environmental justice concerns. Table 5.13-2 shows the potential impacts to environmental justice populations under the Expanded Operations Alternative.

5.13.4 Summary of Environmental Justice Impacts for the Alternatives

Based on the analysis of impacts for the resource areas in this SWEIS, and as shown in Table 5.13-2, disproportionate and adverse environmental impacts on communities with environmental justice concerns from activities proposed under any of the alternatives would be unlikely.

Table 5.13-2 Summary of Impacts to Communities with Environmental Justice Concerns for the Alternatives

Resource/ SWEIS Section	No-Action Alternative	Modernized Operations	Expanded Operations
Land use/ 5.2.1	Land use designations would not change for all alternatives. Enduring land disturbance from permanent facilities is compatible with existing and planned land uses at LANL. Land use impacts during operations would be negligible. No disproportionate and adverse impacts on communities with environmental justice concerns are anticipated.		
Visual resources/ 5.2.2	Visual impacts would essentially be the same under all alternatives. After construction and DD&D actions are completed, long-term visual impacts are not anticipated. Additional temporary impacts would occur for the Los Alamos Canyon Bridge replacement and solar PV arrays along the western portion of LANL under the Modernized Operations Alternative. However, these projects would be away from the viewsheds of communities with environmental justice concerns. No disproportionate and adverse visual impacts on communities with environmental justice concerns are anticipated.		
Geology and soils/ 5.3	Soil sampling for contamination and constituents would continue under all alternatives in accordance with DOE Order 458.1, "Radiation Protection of the Public and the Environment." No disproportionate impacts to soils are anticipated for communities with environmental justice concerns.		
Water resources/ 5.4	No significant adverse impacts to water resources are anticipated from construction, DD&D, environmental remediation, and operations for all alternatives. Water quality monitoring for surface water, groundwater, drinking water, and outfalls would continue for all alternatives as required by the EPA and NMED Water Quality Bureau. No disproportionate and adverse impacts to water resources are anticipated for communities with environmental justice concerns.		
Air quality/ 5.5.1	For both the No-Action and Modernized Operations alternatives, radiological emissions would be small and would not be disproportionate to minority and low-income populations. Non-radiological air emissions from construction, commuting, DD&D, environmental remediation, and operations are anticipated to be within regulatory limits (with additional projected emissions with the Modernized Operations Alternative) but would not be disproportionate and adverse to communities with environmental justice concerns.	Under the Expanded Operations Alternative, radiological air emissions and non-radiological air emissions would increase with increased operations but are not anticipated to be disproportionate and adverse to communities with environmental justice concerns.	
Greenhouse gas and climate change/ 5.5.2	GHG emissions = 370,000 MT CO_2e in the highest emission year GHG cost (millions of USD annualized) = $145 GHG benefit (millions of USD annualized) = $6.12	GHG emissions = 387,000 MT CO_2e in the highest emission year GHG cost (millions of USD annualized) = $148 GHG benefit (millions of USD annualized) = $37	GHG emissions = 389,000 MT CO_2e in the highest emission year GHG cost (millions of USD annualized) = $149 GHG benefit (millions of USD annualized) = $37
Noise/ 5.5.3	Noise impacts for all alternatives would be attributed to construction, DD&D, environmental remediation, and operations as well as associated traffic. All noise from these activities would occur within their immediate vicinity on site and would not exceed permitted levels for human health for the general public and communities with environmental justice concerns.		

<table>
<tr><th>Resource/ SWEIS Section</th><th>No-Action Alternative</th><th>Modernized Operations</th><th>Expanded Operations</th></tr>
<tr><td>Ecological resources/
5.6</td><td colspan="3">Large game hunted by the Pueblo de San Ildefonso migrate between LANL and the Pueblo de San Ildefonso through several game corridors. A study in 2020 concluded that LANL operations and activities do not inhibit the migration of large game onto the Pueblo de San Ildefonso (Abeyta et.al. 2020). Ongoing sampling of large game and fish has shown that contamination to wildlife harvested by local communities is less than 0.01 millirem per year and is not disproportionate and adverse compared to the general population. Wild game and fish that would be potentially harvested locally will continue to be sampled annually in accordance with DOE Order 458.1, “Radiation Protection of the Public and the Environment.” No other potential disproportionate and adverse impacts to communities with environmental justice concerns are anticipated for ecological resources for all alternatives.</td></tr>
<tr><td>Human health and safety/
5.7</td><td colspan="3">Potential radiological impacts to human health are summarized below for all populations in the ROI. Exposures of special receptors, which could include communities with environmental justice concerns (i.e., offsite residents, recreational users, and special pathways) are slightly higher than the offsite MEI.
<table>
<tr><th rowspan="2">Receptor</th><th colspan="2">No Action Alternative and Modernized Operations Alternative</th><th colspan="2">Expanded Operations Alternative</th></tr>
<tr><th>Dose</th><th>Latent Cancer Fatality Risk[a]</th><th>Dose</th><th>Latent Cancer Fatality Risk[a]</th></tr>
<tr><td>Offsite MEI (mrem)</td><td>3.07–3.18</td><td>1.8×10^{-6}</td><td>3.66</td><td>2.2×10^{-6}</td></tr>
<tr><td>Population Within 50 Miles (person-rem)</td><td>6.11–6.18</td><td>3.7×10^{-3}</td><td>6.73</td><td>4.0×10^{-3}</td></tr>
<tr><td>Offsite Resident (mrem) [b]</td><td>4.1</td><td>2.5×10^{-6}</td><td>4.1</td><td>2.5×10^{-6}</td></tr>
<tr><td>Recreational User of Wildlands (mrem)[b]</td><td>6.0</td><td>3.6×10^{-6}</td><td>6.0</td><td>3.6×10^{-6}</td></tr>
<tr><td>Special Pathways – Subsistence Consumption of Fish and Wildlife (mrem) [b]</td><td>6.8</td><td>4.1×10^{-6}</td><td>6.8</td><td>4.1×10^{-6}</td></tr>
</table>
a Based on the dose-to-risk conversion factor of 0.0006 LCF per rem
b These values represent a 50-percent increase from the values presented in the 2008 SWEIS to provide additional conservatism.

Although there are differences in exposures for communities with environmental justice concerns, the differences do not constitute a disproportionate and adverse impact to these communities compared to the general population. DOE will continue to monitor potential exposures to these communities in accordance with DOE Order 458.1, “Radiation Protection of the Public and the Environment.”</td></tr>
<tr><td>Cultural and paleontological resources/
5.8</td><td colspan="3">DOE would continue to monitor activities under all alternatives that potentially could impact cultural resources and traditional cultural properties in accordance with the CRMP and Programmatic Agreement. Additionally, DOE/NNSA will continue to utilize the Programmatic Agreement and CRMP as guidance, additionally consulting with Native American Tribes and Pueblos, as appropriate, on projects that have potential to impact cultural resources and traditional cultural properties. These decisions determining when to consult shall be in accordance with the Programmatic Agreement and CRMP, and DOE Order 144.1, “Department of Energy American Indian Tribal Government Interactions and Policy.”</td></tr>
</table>

<table>
<tr><th>Resource/
SWEIS Section</th><th>No-Action Alternative</th><th>Modernized Operations</th><th>Expanded Operations</th></tr>
<tr><td>Socioeconomics/
5.9</td><td colspan="3">Increases of direct and indirect employment from construction and operation activities at LANL for all alternatives would increase regional population and housing needs. Such increases in employment throughout the ROI would result in increased economic growth including for communities with environmental justice concerns. LANL would also continue to partner with community organizations throughout the ROI to provide economic opportunities for small-business collaborations with the Laboratory. DOE and the Laboratory will continue to engage with communities on socioeconomic concerns and economic opportunities for small businesses to grow as the Laboratory continues with implementing its mission on behalf of DOE. It is not anticipated that disproportionate and adverse socioeconomic impacts would occur for any of the considered alternatives in this SWEIS.

As reported in Section 4.9.5 and Section 5.9, because of the smaller inventory of available housing in Los Alamos County versus other counties in the ROI, it stands to reason that housing prices in Los Alamos County could increase more than other counties. This increase could result in housing in the immediate area of LANL to be less available to low-income populations.</td></tr>
<tr><td>Infrastructure/
5.10</td><td colspan="3">For all alternatives, water and electricity consumption would increase to meet needs for construction, DD&D, environmental remediation, and operations. However, the Laboratory’s infrastructure would enable these activities to remain within existing capacities and would not disproportionately impact minority and low-income populations for these utilities. Consumption of natural gas and petroleum fuel are expected to decrease for each alternative due to upgrades for natural gas and petroleum fuel components to meet the site’s sustainability plan. Utility consumption and infrastructure are not expected to result in disproportionate and adverse impacts on communities with environmental justice concerns.</td></tr>
<tr><td>Waste management/
5.11</td><td colspan="3">Annual waste projections would increase under all alternatives for radioactive and hazardous waste generated at LANL. Although these waste streams would increase periodically per operational requirements at LANL, the process for preparing, packaging, and shipping radioactive and hazardous wastes to offsite disposal facilities would continue to be conducted in accordance with RCRA and other federal requirements. As such, potential additional radioactive and hazardous wastes generated at LANL are not anticipated to result in a disproportionate and adverse impact to communities with environmental justice concerns.</td></tr>
</table>

<table>
<tr><th>Resource/ SWEIS Section</th><th>No-Action Alternative</th><th>Modernized Operations</th><th>Expanded Operations</th></tr>
<tr><td>Transportation/ 5.12</td><td colspan="3">
Transportation impacts from SNM/high-activity and radioactive waste shipments are summarized for all three alternatives. It is assumed that the highest potential for exposure to minority and low-income populations in the ROI would occur on transportation segments between LANL to Pojoaque, then from Pojoaque to Santa Fe.
<table>
<tr><th rowspan="2">Transportation Segments</th><th colspan="2">No Action Alternative</th><th colspan="2">Modernized Operations Alternative[a]</th><th colspan="2">Expanded Operations Alternative[b]</th></tr>
<tr><th>Total Dose (person-rem)</th><th>Total Risk (LCF)[c]</th><th>Total Dose (person-rem)</th><th>Total Risk (LCF)[c]</th><th>Total Dose (person-rem)</th><th>Total Risk (LCF)[c]</th></tr>
<tr><td>LANL to Pojoaque</td><td>3.6</td><td>2.2×10^{-3}</td><td>3.7</td><td>2.2×10^{-3}</td><td>4.0</td><td>2.4×10^{-3}</td></tr>
<tr><td>Pojoaque to Santa Fe</td><td>3.2</td><td>1.9×10^{-3}</td><td>3.3</td><td>2.0×10^{-3}</td><td>3.6</td><td>2.2×10^{-3}</td></tr>
<tr><td>Santa Fe to/from Various Locations[d]</td><td>149.6</td><td>9.0×10^{-2}</td><td>155</td><td>9.3×10^{-2}</td><td>167</td><td>1.0×10^{-1}</td></tr>
</table>
a Modernized Operations assumes 10 percent higher LLW/MLLW waste shipments to NNSS and 0.6 percent higher TRU waste shipments to WIPP than the number of projected waste shipments than the No-Action Alternative.
b Expanded Operations assumes a 55 percent increase in SNM/high-activity material shipments; 25 percent higher LLW/MLLW waste shipments to NNSS; and 3.6 percent higher TRU waste shipments to WIPP than the number of projected waste shipments than the No-Action Alternative.
c Based on the dose-to-risk conversion factor of 0.0006 LCF per rem.
d All SNM/high-activity material shipment impacts assume such materials would be shipped to/from various locations across the U.S.

Nonradiological traffic fatalities are estimated to result in 0.039 to 0.046 fatalities per year for the range of alternative. This is in comparison to 466 traffic fatalities that occurred in New Mexico in 2022.

Based on the impacts of all three alternatives, potential impacts to communities with environmental justice concerns would not be disproportionate and adverse compared to the general population for transportation of SNM/high-activity material or radioactive waste.
</td></tr>
<tr><td>Accident analysis and intentional destructive acts/ 5.14</td><td colspan="3">For all alternatives, the potential risk to the population within 50 miles of the site would be dependent on the total population and their relative proximity to the site. Any impacts to minority or low-income populations are expected to be similar to those that would be experienced by the general population; therefore, accidents and intentional destructive acts would not result in disproportionate and adverse impacts on communities with environmental justice concerns.</td></tr>
</table>

5.14 Accident Analysis and Intentional Destructive Acts

5.14.1 Introduction

Many activities at the Laboratory require the use of radioactive materials, hazardous chemicals, explosives and biological hazards, all of which have the potential, under certain circumstances, to be involved in an accident. Activities using these materials onsite involve specialized facilities with appropriate safety equipment and procedures to reduce the possibility or the severity of accidents. Many of these specialized facilities are described in Appendix E.

An accident is a sequence of one or more unplanned events with potential outcomes that endanger the health and safety of workers and the public. An accident can involve a combined release of energy and hazardous materials (radiological or chemical) that might cause prompt or latent health effects. The sequence usually begins with an initiating event, such as human error, equipment failure, or earthquake, followed by a succession of other events that could be dependent or independent of the initial event, which dictate the accident's progression and the extent of materials released. Initiating events and a more detailed discussion of potential accident scenarios are presented in Appendix D, Section D.3 of this SWEIS.

If an accident were to occur involving the release of radioactive, chemical, or biological materials, workers, members of the public, and the environment would be at risk. Workers in the facility where the accident occurs would be particularly vulnerable to the effects of the accident because of their location. The offsite public and non-involved workers (assumed to be 100 meters from the accident) would also be at risk of exposure to the extent that meteorological conditions exist for the atmospheric dispersion of released hazardous materials. Using approved computer models, NNSA predicted the dispersion of released hazardous materials and their effects. However, prediction of latent potential health effects becomes increasingly difficult to quantify for facility workers as the distance between the accident location and the worker decreases. This is because the individual worker exposure cannot be precisely defined with respect to the presence of shielding and other protective features. The facility worker also may be injured or killed by physical effects of the accident itself.

This section presents the potential impacts on non-involved workers and the public (both an MEI and the population within 50 miles [80 kilometers] from the site) due to potential accidents associated with operations at the Laboratory. Additional details supporting the information presented here, as well as the methodologies used to perform the analyses, are provided in Appendix D, Section D.3. Section 5.14.2 presents the accident analyses that are applicable to continued operations at the Laboratory under the No-Action Alterative, which would also be applicable to any of the action alternatives. The subsections provides separate discussions of potential accidents involving radiological, chemical, and biological materials. Section 5.14.3 presents a discussion about potential accidents under the Modernized Operations Alternative and Section 5.14.4 presents potential accident consequences that could occur under the Expanded Operations Alternative.

Section 5.14.5 presents site-wide accident events (e.g., seismic events or wildland fires) that could impact multiple facilities and are applicable to any of the alternatives. Section 5.14.6 presents a discussion of the intentional destructive acts analysis.

5.14.2 No-Action Alternative

The No-Action Alternative would use existing capabilities to continue current, ongoing operations to support major DOE/NNSA programs and would proceed with projects or activities that have been approved, or in the process of being approved for implementation, as described in Chapter 3, Section 3.2 of this SWEIS. As described in Appendix D, NNSA reviewed the existing safety basis documents including DSAs, safety assessment documents (SADs), emergency planning hazards assessments, and others to identify accident scenarios that could occur at the Laboratory.

Each of the projects proposed under the No-Action Alternative was reviewed to determine whether the consequences from a radiological, chemical, biological, or HE accident potentially could result in greater consequences than the previous analysis of the existing buildings and facilities. As a result of the review, NNSA developed a list of accident scenarios that represent the potential risks associated with Laboratory operations under the No-Action Alternative.

Conveyance of the remaining approximately 1,280 acres identified in the CT EIS would not result in direct or indirect impacts associated with accidents involving radiological, hazardous, explosive, or biological materials.

5.14.2.1 Radiological Accidents

For potential accidents involving radiological materials, NNSA identified 13 design-basis accidents (DBAs) for evaluation under the No-Action Alternative. They generally represent the range of credible accident scenarios for the laboratory facilities that are categorized as HC-2 in accordance with DOE STD-1027 and also include accidents related to waste management and environmental remediation activities at TA-54 Area G and a representative radiological accident involving the accelerator facilities at LANSCE. Potential accident scenarios involving seismic or wildland fire initiators are presented in Section 5.14.5.

As explained in Appendix D, the DBAs were modeled using both conservative and average meteorology to determine the range of potential consequences and risks to the non-involved workers and the public.

The offsite population dose is based on a population of approximately 365,500 persons residing within 50 miles of the LANL site (LANL 2022q). The modeled population is distributed in each of the 16 compass sectors (e.g., north, north-northeast) and in varying distances from the site as described in Appendix D, Section D.3.1.3. For perspective, approximately 13,000 persons reside withing 6.2 miles of the LANL site and about 56,000 persons reside within 18.6 miles. The majority of the population (almost 310,000) resides between 18.6 and 50 miles from the site. The MEI was assumed to be located on the closest site boundary. The distance to the MEI is dependent on the accident location at the Laboratory and the prevailing wind direction.

The calculated radiation doses were converted to LCFs using the factor of 6×10^{-4} LCF per rem (or person-rem) for both members of the general public and workers (DOE 2003a).

Tables D.3-6 and D.3-7 in Appendix D provide the estimated accident frequency and potential consequences to receptors under conservative and average meteorological conditions, respectively. As discussed in Appendix D, the analysis used the frequency estimates from the safety basis documents for the selected DBAs to derive best-estimate accident frequencies by applying passive design features. Table 5.14-1 provides the estimated accident risk to the receptors based on the expected consequence and frequency of each event.

Table 5.14-1 Radiological Accident Fatality Annual Risk Under the No-Action Alternative

Accident Scenario	Conservative Meteorology			Average Meteorology		
	MEI[a] (LCF[b])	Offsite Population[c] (LCF)	Non-involved Worker[d] (LCF)	MEI (LCF)	Offsite Population (LCF)	Non-involved Worker (LCF)
DBA-1: TA-55, PF-4: Plutonium Facility glovebox fire	1.15×10^{-6}	1.13×10^{-4}	7.92×10^{-6}	1.64×10^{-7}	2.01×10^{-5}	1.51×10^{-6}
DBA-2: TA-55, PF-4: Plutonium Facility fire involving HS Pu	2.48×10^{-8}	1.21×10^{-6}	8.64×10^{-8}	1.74×10^{-9}	2.12×10^{-7}	3.20×10^{-8}
DBA-3: TA-54, Area G: Vehicle impact while transporting TRU waste containers with ensuing fuel pool fire	1.01×10^{-7}	2.25×10^{-6}	4.20×10^{-7}	2.06×10^{-8}	4.12×10^{-7}	4.54×10^{-8}
DBA-4: TA-54, Area G: Refueling vehicle impacts TRU Storage Array with ensuing fuel pool fire	8.28×10^{-7}	1.08×10^{-5}	1.44×10^{-6}	9.12×10^{-8}	1.95×10^{-6}	3.74×10^{-7}
DBA-5: TA-54, Area G: Large combustible fire in TRU Storage Array	1.02×10^{-7}	3.37×10^{-6}	2.64×10^{-7}	2.65×10^{-8}	6.00×10^{-7}	4.73×10^{-8}
DBA-6: TA-54, Area G: FTWC explosion causing sympathetic explosion of the other FTWCs resulting in a pressurized release of tritium	1.32×10^{-8}	2.70×10^{-6}	3.10×10^{-7} [i]	3.77×10^{-9}	2.72×10^{-7}	6.48×10^{-9}
DBA-7: TA-3, CMR: Explosion in CMR Wing 9	4.98×10^{-7}	1.63×10^{-4}	3.12×10^{-6}	1.51×10^{-7}	3.00×10^{-5}	9.96×10^{-7}
DBA-8: TA-54, RANT: Vehicle impacts waste containers inside RANT with ensuing pool fire	2.90×10^{-7}	1.41×10^{-5}	1.16×10^{-6}	8.22×10^{-8}	2.95×10^{-6}	6.54×10^{-7}
DBA-9: TA-16, WETF: Process Room fire	6.63×10^{-7} [e]	2.82×10^{-4}	1.95×10^{-7} [f]	3.55×10^{-7} [g]	3.09×10^{-5}	1.87×10^{-7}
DBA-10: TA-63, TWF: Vehicle impact in Shipping/Receiving Area with ensuing pool fire	1.11×10^{-8}	2.76×10^{-6}	8.42×10^{-7}	1.64×10^{-9}	4.76×10^{-7}	1.50×10^{-7}
DBA-11: TA-50, WCRRF: High impact seismic event and fire inside building	5.52×10^{-7}	1.12×10^{-4}	1.35×10^{-5}	8.46×10^{-8}	1.92×10^{-5}	1.35×10^{-5}
DBA-12: TA-50, TLW: External fire spreads into the TLW Treatment Facility	3.48×10^{-8}	4.62×10^{-6}	1.68×10^{-7}	4.79×10^{-9}	8.21×10^{-7}	6.12×10^{-8}
DBA-13: TA-53, LANSCE: Explosion due to deflagration from natural gas leak	7.80×10^{-8}	2.79×10^{-6}	1.74×10^{-7}	1.81×10^{-8}	5.42×10^{-7}	8.58×10^{-8}

CMR = Chemistry and Metallurgy Research Facility; DBA= design-basis accident; ER = Experimental Room in Lujan Center of LANSCE; GB = glovebox; HS Pu = heat source plutonium; LANSCE = Los Alamos Neutron Science Center; LCF = latent cancer fatality; m = meter; MEI = maximally exposed individual; PF = Plutonium Facility; Pu-239 = plutonium-239; RANT = Radioassay and Nondestructive Testing Facility; SAD = Safety Assessment Document; SSSR = sort, segregate, size reduction, and repackaging; TA = technical area; TLW = Transuranic Liquid Waste Treatment Facility; TRU = transuranic; TWF = Transuranic Waste Facility; WCRRF = Waste Characterization, Reduction, and Repackaging Facility; WETF = Weapons Engineering Tritium Facility

a See discussion in Appendix D, Section D.3.1.4 about distances from each facility to its MEI.

b Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003a). For an individual's acute dose ≥20 rem associated with an accident, the LCF is doubled (NCRP 1993).

c Based on Appendix D, Table D.3-4, *Population Distribution Estimates Within 80km from LANL* (LANL 2022q).

d At a distance of 100 m from the facility.

e For conservative meteorology, highest MEI dose is at 950 m, beyond site boundary of 425 m.

f For conservative meteorology, windspeed of 1 m/s and stability class F results in WETF plume from stack release passes overhead of the non-involved worker. Therefore, stability class D and 1 m/s were used based on having the highest non-involved worker dose of all stability classes having a probability of occurrence greater than 1 percent of the time (2016–2020 meteorology data).

g For average meteorology, highest MEI dose is at 470 m, beyond site boundary of 425 m.

h For conservative meteorology, highest MEI dose is at 630 m, beyond site boundary of 455 m.

i For conservative meteorology, utilized TA-54, Area G Attachment 1 (LANL 2022p) for determining non-involved worker dose.

As noted in Chapter 3, Section 3.2.3, the Laboratory is also considering an option that would allow continued use of elements of the CMR Facility beyond the planned DD&D date of 2031. If this option were implemented, the annual risk of continued operation of CMR would continue, as opposed to being reduced by the cessation of use of the building.

As illustrated in Table 5.14-1, the accident with the highest increased accident risk to the public would be a fire inside the WETF. Table D.3-6 indicates that the accident with the highest potential consequences to the offsite population during conservative meteorological conditions would be a process room fire in the WETF. For the MEI, the highest consequences would be from a vehicle impact and fire in TA-54. For non-involved workers, the highest consequences are postulated for a vehicle impact and fire at the TWF in TA-63.

5.14.2.2 Chemical Accidents

Chemicals are widely used at the Laboratory; however, with a few exceptions (e.g., PF-4, TWF, LANSCE, RLWTF, Transuranic Liquid Waste (TLW) Treatment Facility), Laboratory operations with chemicals are deemed consistent with OSHA's definition of "laboratory scale," as given in 29 CFR 1910.1450, i.e., *work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person*. Appendix D of this SWEIS examined safety basis documents to determine the potential for accidents involving hazardous chemicals used at the Laboratory. In the majority of facilities at LANL, chemical inventories do not present a risk to the non-involved workers or the public**.**

As identified in Appendix D, NNSA determined that the following five categories of chemicals had the potential to result in offsite consequences based on the review of the safety basis documents:

1. Beryllium/beryllium oxide,
2. Chlorine,
3. Sodium hydroxide,
4. Nitric and hydrochloric acids, and
5. Uranium (for chemical hazards) and other toxic metals.

The evaluation of these chemicals utilizes protective action criteria (PAC) to quantify the significance of an accident on both non-involved workers and the public, as recommended by DOE Order 151.1D and DOE-STD-3009 (Table 5.14-2). The three level of PACs are defined in Appendix D, Section D.3.6, and increase in severity from PAC-1 to PAC-3.

Table 5.14-2 Chemical Accident Impacts

Chemical	Frequency (per year)	PAC-1[a] (mg/m^3)	PAC-2[a] (mg/m^3)	PAC-3[a] (mg/m^3)	Concentration	
					Non-involved Worker at 100 meters	MEI at Site Boundary
Radioactive Liquid Waste Treatment Facility						
Sodium Hydroxide	$\leq 1\times10^{-4}$	0.5 (ERPG)	5 (ERPG)	50 (ERPG)	<PAC-3[b]	<PAC-2[b]

Chemical	Frequency (per year)	PAC-1[a] (mg/m^3)	PAC-2[a] (mg/m^3)	PAC-3[a] (mg/m^3)	Concentration	
					Non-involved Worker at 100 meters	MEI at Site Boundary
Nitric Acid (TRU acid waste stream)	(c)	0.16 ppm (AEGL)	24 ppm (AEGL)	92 ppm (AEGL)	<PAC-3	<PAC-2
Hydrochloric Acid	(c)	1.8 ppm (AEGL)	22 ppm (AEGL)	100 ppm (AEGL)	>PAC-3[d]	<PAC-2
Transuranic Liquid Waste Treatment Facility						
Nitric Acid (TRU acid waste stream)	$\leq 1\times10^{-4}$	0.16 ppm (AEGL)	24 ppm (AEGL)	92 ppm (AEGL)	<PAC-2	<PAC-1
Los Alamos Neutron Science Center						
Silver hydroxide (AgOH) [IPF]	$\leq 1\times10^{-4}$	0.035[e] (TEEL)	0.06[e] (TEEL)	11.6[e] (TEEL)	Note f	<PAC-1 4.2×10^{-3} mg/m^3
Mercury [Lujan Center]	$\leq 1\times10^{-4}$	0.1[e] (ERPG)	2.05[e] (ERPG)	4.10[e] (ERPG)	<PAC-1 (up to 350m)[g]	<PAC-2 1.2mg/m^3 (@ 2,400m)[g]
Tungsten oxide (WO_2) [1L Target]	$\leq 1\times10^{-4}$	11.7[e] (TEEL)	11.7[e] (TEEL)	11.7[e] (TEEL)	Note f	<PAC-1 2.34×10^{-1} mg/m^3
Plutonium Facility (PF-4 [h]						
Nitric Acid	$\leq 1\times10^{-2}$	0.16 ppm (AEGL)	24 ppm (AEGL)	92 ppm (AEGL)	<PAC-3	<PAC-2 22.9ppm
Beryllium	$\leq 1\times10^{-4}$	0.00015	0.025 (ERPG)	0.1 (ERPG)	<PAC-3	<PAC-2
Chlorine gas	$\leq 1\times10^{-2}$	0.5 ppm (AEGL)	2 ppm (AEGL)	20 ppm (AEGL)	<PAC-3	<PAC-2
Toxic metals[i]	$\leq 1\times10^{-2}$	0.6 (AEGL)	5 (AEGL)	30 (AEGL)	<PAC-3	<PAC-2
Transuranic Waste Facility						
Beryllium[j,k]	$\leq 1\times10^{-2}$	0.00015 (AEGL)	0.025 (ERPG)	0.1 (ERPG)	<PAC-3	≤PAC-1

AEGL = Acute Exposure Guideline Level; ERPG = Emergency Response Planning Guideline; IPF = Isotope Production Facility; LANSCE = Los Alamos Neutron Science Center; MEI = maximally exposed individual; mg/m3 = milligram per cubic meter; PAC = Protective Action Criteria; PF = Plutonium Facility; ppm = parts per million; RLWTF = Radioactive Liquid Waste Treatment Facility; SAD = Safety Assessment Document; TEEL = Temporary Emergency Exposure Limit; TLW = transuranic liquid waste; TRU = transuranic; ; TWF = Transuranic Waste Facility WNR = Weapons Neutron Research Facility

a PAC values from PAC Database Search at https://edms3.energy.gov/pac/Search except as noted for LANSCE.

b Spills of sodium hydroxide solutions of low vapor pressure solids would be expected to result in negligible release of the solute due to preferential evaporation of the water component.

c The DSA did not report a frequency of accident scenarios involving these chemicals.

d Although the RLWTF hydrochloric acid amount slightly exceeds the co-located worker threshold quantity (PAC-3), it is stored and used in small quantities in separate locations at RLWTF. It is unlikely that any single event would cause a simultaneous release of the entire inventory; therefore, the actual consequence to a non-involved worker would be lower.
e PAC values from LANSCE SAD (LANL 2020e).
f The LANSCE SAD (LANL 2020e) did not calculate impacts to the non-involved worker for these accident scenarios.
g During an accident involving the release of mercury, the thermally lofted plume would move over the non-involved worker and result in higher consequences at a location further from the release (calculated at 2,400 meters downwind).
h Assumes PF-4 passive design features (Nitric Acid Storage Tank Berm; Lathe Enclosure System, Confinement System, and gloveboxes; Chlorine Gas Delivery System) work as designed.
i Toxic metals represented by uranium.
j Assumes TWF passive design features (pipe overpack containers, site drainage, TRU waste containers, vehicle barriers, PC-2 building structures) work as designed.
k TRU waste drums contain <1% by weight of chemical constituents such as beryllium, cadmium, mercury, chromium, and PCBs (TWF only accepts newly generated waste meeting WIPP Waste Acceptance Criteria).

5.14.2.3 Biological Accidents

The Laboratory has, for decades, performed biological research requiring BSL-1 and BSL-2 safeguards. The facilities are designed for conducting safe and secure research and storage of infectious microorganisms and biologically derived toxins. Operation of these facilities under BSL-1 and BSL-2 requirements and safeguards are compliant with the guidelines specified in the *Biosafety in Microbiological and Biomedical Laboratories* (CDC 2020) for BSL-1 and BSL-2 containment laboratories and federal regulations governing select agents and toxins (biosecurity).

Activities related to BSL-1 and BSL-2 materials are normally categorically excluded from further NEPA review in accordance with 10 CFR Part 1021 under B3.12, "Microbiological and Biomedical Facilities." As such, accidents involving continued operations of BSL-1 and BSL-2 facilities would be unlikely to result in adverse consequences to non-involved workers or the offsite public.

5.14.3 Modernized Operations Alternative

Under the Modernized Operations Alternative, LANL would continue the same operations as the No-Action Alternative and, in some cases, replace or upgrade facilities and infrastructure to modernize the Laboratory. The projects proposed under the Modernized Operations Alternative were each reviewed to determine if any presented unique accident scenarios that could release radiological, chemical, or biological materials that would be notably different than the suite of accidents presented for the No-Action Alternative. There is the possibility that newer, more modern, replacement facilities could reduce the risks of operating the Laboratory. For the purposes of this SWEIS, NNSA concluded that the accident scenarios presented for the No-Action Alternative are also representative of the range of credible accidents that could occur under the Modernized Operations Alternative.

5.14.4 Expanded Operations Alternative

The Expanded Operations Alternative includes the actions in the Modernized Operations Alternative plus actions that would expand operations and missions to respond to future national security challenges and meet increasing requirements. This alternative would expand capabilities at LANL beyond those that currently exist. The new facilities and utility and infrastructure projects unique to this alternative are identified in Chapter 3, Tables 3.4-1 and 3.4-2, and described in

Section 3.4 of this SWEIS. In Appendix D, Section D.3.4, NNSA considered each of the additional projects proposed under the Expanded Operations Alternative to determine whether the consequences from a radiological, chemical, biological, or HE accident potentially could result in greater consequences than those identified under the No-Action or Modernized Operations alternatives.

5.14.4.1 Radiological Accidents

As identified in Appendix D, three of the projects proposed under the Expanded Operations Alternative would be less than HC-3 (radiological facilities). Laboratory safety management programs would adequately address the potential impact posed to human health and the environment from these projects. Potential impacts would be well represented by previous analyses involving radiological accidents and presented in Section 5.14.2.1. These three proposed projects include the LEFFF, the Advanced Separations Plutonium Radiological Laboratory, and the ETF at TA-55.

A factory manufactured, fully assembled, and pre-fueled microreactor up to 5 megawatts electric (MWe) is proposed for the Laboratory and initial siting options include TA-3 and TA-53. Microreactors are self-regulating and do not rely on engineered systems to ensure safe shutdown and removal of decay heat. While NNSA has not identified a particular design for a microreactor at LANL, there are existing analyses of potential impacts from hazardous and radioactive material release associated with a microreactor within the DOE Complex. Appendix D, Section D.3.4 presents information about a proposed microreactor at Idaho National Laboratory and compares potential dose consequences to an MEI and member of the public at the LANL site. As discussed in Section D.3.4, the consequences and risks of an operational accident involving the microreactor would be well represented by the consequences and risks of a criticality event at CMR. Therefore, a separate DBA was not developed for this proposed project.

Under some of the SPDP EIS sub-alternatives, the amount of surplus plutonium that would be processed at LANL would be higher than that currently approved (NNSA 2024a). However, potential accident impacts related to increasing the amount of surplus plutonium processed at LANL are dependent on the material at risk (MAR) in PF-4 and not on the amount processed under the SPDP. The MAR is administratively limited in PF-4 to reduce potential consequences to human health and the environment as documented in the DSAs (LANL 2021h, 2022n). Plutonium disposition activities would not increase the amount of plutonium available for an accident because the MAR limit would remain the same within the facility. As discussed in Section D.3.4, the consequences and risks of an accident involving SPDP activities within TA-55 would be well represented by the consequences and risks of other DBAs evaluated for PF-4. Therefore, a separate DBA was not developed for this proposed project.

TRU waste staging would potentially occur in up to four additional staging locations for TRU waste generated from PF-4, primarily associated with pit production operations or surplus plutonium disposition. The staging areas would be similar to, but larger, than the current TWF in TA-63; however, unlike TWF these staging areas would be used only for staging TRU waste drums as opposed to processing or preparing TRU waste for shipment to the WIPP facility. Each of the four locations could provide a staging area for up to approximately 1,675 TRU waste containers. Although the staging areas would be larger than the TWF, the accidents evaluated in the TWF DSA (LANL 2022n) are based on the number of waste containers impacted and involved in a fuel pool fire (MAR) and the volume of vehicle fuel available in accordance with DOE-STD-5506-

2021 fire analysis methodology. Since the postulated accident scenarios and accident analysis methodology for the TRU waste staging areas likely would be the same as those evaluated in TWF DSA (same number of waste containers impacted and involved in a fuel pool fire and the same volume of vehicle fuel available), the potential radiological accidents associated with the TRU waste staging areas would be represented by the TWF DBA-10. The additional staging areas would have a potential additive effect on the site-wide seismic and wildland fire scenarios, which are addressed in Section 5.14.5.

5.14.4.2 Chemical Accidents

Under the Expanded Operations Alternative, there are several proposed facilities that would use potentially hazardous chemicals but all facilities would follow LANL's chemical inventory management procedure to ensure that the facility chemical inventory is maintained within the established safety basis of the facility. None of the proposed facilities would be expected to have chemical inventories or the potential for chemical accidents that would not be bounded by the analysis for the No-Action Alternative.

5.14.4.3 Biological Accidents

As presented in Appendix D, Section D.3.8, under the Expanded Operations Alternative, the Laboratory has identified a need for BSL-3 facilities at LANL to work with bioagents (pathogens or toxins) that require a higher level of safety and security considerations than are currently available on site. The Laboratory proposes to acquire self-contained laboratory trailers that could be placed within available warehouse space and used for BSL-3 activities. The specific BSL-3 bioagents that may be used in the proposed laboratory have not been identified.

In 2002, NNSA prepared the *Environmental Assessment for the Proposed Construction and Operation of a Biosafety Level 3 Facility at Los Alamos National Laboratory* (LANL BSL-3 EA; NNSA 2002) to evaluate a proposal to construct and operate a BSL-3 facility at the Laboratory. A BSL-3 facility has not been constructed at LANL, however, the information from the LANL BSL-3 EA is applicable to evaluate potential accident scenario impacts from the new BSL-3 laboratory proposed under the Expanded Operations Alternative.

The LANL BSL-3 EA (NNSA 2002) discusses the potential for laboratory-acquired infection, a laboratory accident, the potential for transportation accidents, and the potential for terrorist actions. For the potential for a laboratory-acquired infection or accident, the LANL BSL-3 EA relied on information presented by the U.S. Army (Army 1989). Laboratory-acquired infections would be considered improbable; however, infections could be promptly treated with antibiotics, antiviral drugs or other appropriate medical strategies (NNSA 2002).

Operations personnel would be at the greatest risk of becoming ill from an accident involving a release into the facility, however researchers at a BSL-3 laboratory would wear powered air purifying respirator hoods with HEPA filters, so an exposure would be unlikely. As described in Appendix D, Section D.3.8, using the assumed scenario and organism from the Army study, a potential release from the containment laboratory, even under the worst-case meteorological conditions, would not represent a credible risk to the non-involved worker or offsite MEI or population.

5.14.5 Site-Wide Multiple Building Scenarios

This section provides an assessment of potential accident scenarios that could involve multiple buildings. Specifically, this SWEIS evaluates potential seismic events and wildland fire events that could theoretically engage multiple Laboratory buildings across the LANL site. The potential frequencies and consequences of these events were derived from existing LANL safety basis documents.

5.14.5.1 Seismic Events

The seismicity of the LANL site is described in Chapter 4, Section 4.3.2.3 in this SWEIS. Consistent with the 2008 SWEIS, this SWEIS evaluates the potential accident consequences of seismic events that could occur in the region and provides an assessment of the estimated consequence of these natural phenomena hazards for each of the facilities with radiological and hazardous materials. In addition, this section provides a conservative assessment of the potential offsite consequences if multiple facilities were affected by the same seismic event.

As identified in the 2008 SWEIS, two site-wide seismic events were used in the analysis to estimate the impacts of potential releases. The 2008 SWEIS referred to these events as Seismic 1 and Seismic 2 (nominally represented by performance categories [PCs] for seismic PC-2 and PC-3, respectively). In this SWEIS, the potential releases are evaluated for SDC-2 and SDC-3 seismic events (equivalent to seismic PC-2 and PC-3). SDC-3 seismic events have a lower probability of occurrence (return period of once every 2,500 to 10,000 years) than SDC-2 seismic events (return period of once every 1,000–2,500 years); however, the magnitude of the ground accelerations and potential effects of an SDC-3 event would be more severe. The safety basis documents determined that some LANL facilities with radiological or hazardous material could withstand an SDC-2 seismic event without damage, while other facilities or areas would sustain damage during an SDC-2 seismic event. The potential consequences from those facilities that would sustain damage in an SDC-2 seismic event are presented in Appendix D, Table D.3-11, and the resulting radiological accident risks (accounting for the event frequency) are presented in Table 5.14-3. The potential radiological consequences from those facilities that would survive an SDC-2 seismic event but sustain damage in an SDC-3 seismic event are presented in Appendix D, Table D.3-13, and the resulting accident risks (accounting for the event frequency) are presented in Table 5.14-4. As presented in these accident risk tables, the seismic event is also combined with an ensuing fire. For both seismic event scenarios, this SWEIS analysis assumes the same MAR, source term factors, and initial conditions as the supporting safety basis document DBAs to calculate the estimated consequences of the seismic events for each of the facilities. The tables are separated to indicate the potential impacts from the No-Action Alternative and the Expanded Operations Alternative, which also includes the four proposed TRU waste staging areas in TA-16, TA-54, TA-55, and TA-60.

In summary, the tables demonstrate, for example, that the total radiological accident risk to the offsite population as a result of multiple radiological facilities being involved in an SDC-2 seismic event would be about 1.38×10^{-5} and 2.51×10^{-5} additional LCFs per year for the No-Action and Expanded Operations alternatives, respectively. The Modernized Operations Alternative would be the same as the No-Action Alternative. The total radiological accident risk to the offsite population as a result of an SDC-3 seismic event (including the added risk from the facilities that would fail under an SDC-2 event), would be about 3.35×10^{-5} and 4.89×10^{-5} LCFs per year for the No-Action and Expanded Operations alternatives, respectively.

Table 5.14-3 Radiological Accident Fatality Annual Risk of SDC-2 Seismic Events

Accident Scenario	Average Meteorology		
	MEI[a] (LCF[b])	Offsite Population[c] (LCF[b])	Non-involved Worker[d] (LCF[b])
SDC-2 Seismic/Fire-1: TA-54, Area G: SDC-2 seismic event causes Area G building structures to collapse and top-tier waste containers to topple, releasing their contents that are burned in an ensuing fire along with confined burn of remain drums in an ensuing facility-wide fire.	1.73×10^{-7}	2.70×10^{-6}	5.08×10^{-7}
SDC-2 Seismic/Fire-2: TA-3, CMR: SDC-2 seismic event causes structural collapse of CMR and affects the entire CMR inventory of material (including holdup and material in transit and stored in the yard). All confinement systems are breached. A subsequent fire involves all uncontained material from the seismic impact.	5.86×10^{-8}	3.71×10^{-6}	2.74×10^{-6}
SDC-2 Seismic/Fire-3: TA-54, RANT: Earthquake causes the RANT building to collapse and/or the MLU crane to fall onto the building, fallen building/debris impacts TRU waste containers, and an ensuing fire burns their content.	8.22×10^{-8}	2.95×10^{-6}	6.54×10^{-7}
SDC-2 Seismic/Fire-4: TA-63, TWF: SDC-2 seismic event causes 3rd-tier TWF TRU waste drums to topple, releasing combustible contents that are burned in an ensuing fire along with confined burn of remain drums in the characterization and waste storage buildings.	8.88×10^{-9}	2.83×10^{-6}	2.60×10^{-7}
SDC-2 Seismic/Fire-5: TA-55, RLUOB: SDC-2 seismic event causes full collapse of RLUOB (PF-400) building with ensuing fire.	1.04×10^{-8}	1.44×10^{-6}	8.34×10^{-8}
SDC-2 Seismic/Fire-6: TA-50, RLWTF: SDC-2 seismic event causes full structural collapse of the RLWTF and a subsequent fire involves all facility radioactive material.	7.50×10^{-10}	8.76×10^{-8}	1.17×10^{-8}
SDC-2 Seismic/Fire-7: TA-53, LANSCE: SDC-2 seismic event causes structural collapse of LANSCE affecting IPF, Area C, Lujan Center, and/or WNR resulting in the release of radiological material with an ensuing fire.	1.81×10^{-9}	5.42×10^{-8}	8.58×10^{-9}
Annual Risk Totals for SDC-2 Seismic/Fire involved Facilities – No-Action Alternative	***3.36×10^{-7}***	***1.38×10^{-5}***	***4.27×10^{-6}***
SDC-2 Seismic/Fire-8: TWS, TA-16[e]: SDC-2 seismic event causes 3rd-tier TWS TRU waste drums to topple, releasing combustible contents that are burned in an ensuing fire along with confined burn of remain drums in the characterization and waste storage buildings.	2.94×10^{-8}	2.83×10^{-6}	2.60×10^{-7}
SDC-2 Seismic/Fire-9: TWS, TA-54[e]: SDC-2 seismic event causes 3rd-tier TWS TRU waste drums to topple, releasing combustible contents that are burned in an ensuing fire along with confined burn of remain drums in the characterization and waste storage buildings.	3.30×10^{-8}	2.83×10^{-6}	2.60×10^{-7}

Accident Scenario	Average Meteorology		
	MEI[a] (LCF[b])	Offsite Population[c] (LCF[b])	Non-involved Worker[d] (LCF[b])
SDC-2 Seismic/Fire-10: TWS, TA-55[e]: SDC-2 seismic event causes 3rd-tier TWS TRU waste drums to topple, releasing combustible contents that are burned in an ensuing fire along with confined burn of remain drums in the characterization and waste storage buildings.	1.02×10^{-8}	2.83×10^{-6}	2.60×10^{-7}
SDC-2 Seismic/Fire-11: TWS, TA-60[e]: SDC-2 seismic event causes 3rd-tier TWS TRU waste drums to topple, releasing combustible contents that are burned in an ensuing fire along with confined burn of remain drums in the characterization and waste storage buildings.	3.84×10^{-8}	2.83×10^{-6}	2.60×10^{-7}
Annual Risk Totals for SDC-2 Seismic/Fire involved Facilities – Expanded Operations Alternative	***4.47×10^{-7}***	***2.51×10^{-5}***	***5.31×10^{-6}***

CMR = Chemistry and Metallurgy Research Facility; ER = Experimental Room in Lujan Center; GB = glovebox; HS Pu = heat source plutonium; IPF = Isotope Production Facility; LANSCE = Los Alamos Neutron Science Center; LCF = latent cancer fatality; MEI = maximally exposed individual; PF = Plutonium Facility; Pu-239 = plutonium-239; RANT = Radioassay and Nondestructive Testing Facility; SDC = seismic design category; SSSR = sort, segregate, size reduction, and repackaging; TA = technical area; TLW = TRU Liquid Waste Treatment Facility; TRU = transuranic; TWF = Transuranic Waste Facility; TWS = TRU waste staging; WCRRF = Waste Characterization, Reduction, and Repackaging Facility; WETF = Weapons Engineering Tritium Facility

a See discussion in Appendix D, Section D.3.1.4 about distances from each facility to its MEI.

b Annual risk is based on postulated frequency multiplied by the calculated dose multiplied by an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003a).

c Based on Appendix D, Table D.3-4, *Population Distribution Estimates Within 80km from LAN*L (LANL 2022q).

d At a distance of 100 m from the facility.

e Under the Expanded Operations Alternative, four TRU waste staging areas are proposed (located in TAs-16, -54, -55, and -60). Due to similarity with TWF operations, the source terms and initial conditions of the TWF analysis were used; however, MEI distances were different for each location.

Table 5.14-4 Radiological Accident Fatality Annual Risk of SDC-3 Seismic Events

Accident Scenario	Average Meteorology		
	MEI[a] (LCF[b])	Offsite Population[c] (LCF[b])	Non-involved Worker[d] (LCF[b])
SDC-3 Seismic/Fire-1: TA-55, PF-4 (Outside): Seismic event causes external MAR to topple during MLU operations. HENC Canopy collapse or MLU crane crushes MAR on HENC pad and MLU crane fuel spills with ensuing pool fire involving containerized MAR causing container breach and release. Includes high-pressure release from sources on the HENC pad outside fire-rated safes and HENC trailer.	6.03×10^{-8}	7.02×10^{-6}	2.63×10^{-6}
SDC-3 Seismic/Fire-2: TA-55, PF-4 (Inside): SDC-3 Facility-wide seismic/fire affecting material in one room of the first floor of PF-4. Analyzed scenario is a single seismically induced fire.	3.7×10^{-8}	4.08×10^{-6}	2.74×10^{-6}
SDC-3 Seismic/Fire-3: TA-16, WETF: Seismic event exceeding SDC-2 damages WETF building and equipment releasing tritium from containers. An ensuing fire initiates in one of the rooms.	9.22×10^{-8}	7.34×10^{-6}	1.36×10^{-7}
SDC-3 Seismic/Fire-4: TA-63, TWF: SDC-3 seismic event causing multiple TWF buildings to collapse impacting drums and toppling of 3rd-tier drums, releasing their content with an ensuing site-wide fire burning.[e]	1.28×10^{-8}	3.85×10^{-6}	9.17×10^{-7}
SDC-3 Seismic/Fire-5: TA-50, WCRRF: Seismic event exceeding SDC-2 causes TRU waste containers to topple, structural debris falls on TRU waste containers, waste characterization glovebox, or glovebox enclosure releasing TRU waste which is burned in an ensuing fire which spreads to the yard areas impacting staged TRU waste containers.	8.46×10^{-10}	1.92×10^{-7}	1.35×10^{-7}
SDC-3 Seismic/Fire-6: TA-50, TLW: Seismic event exceeding SDC-2 causes structural collapse of the TLWTF, breach of tanks/ process equipment/ piping/ drums spilling all wastewater, sludge, and process solution. A subsequent fire involves all facility radioactive material.	4.96×10^{-10}	8.43×10^{-8}	8.34×10^{-9}
Annual Risk Totals for SDC-3 Seismic/Fire involved Facilities – No-Action Alternative	***2.04×10^{-7}***	***2.26×10^{-5}***	***6.57×10^{-6}***
Annual Risk Totals for SDC-3 Seismic/Fire involved Facilitues – Entire Site (SDC-2 plus SDC-3)[e] No-Action Alternative	***5.30×10^{-7}***	***3.35×10^{-5}***	***1.06×10^{-5}***
SDC-3 Seismic/Fire-7: TWS, TA-16[f]: SDC-3 seismic event causing multiple TWS buildings to collapse impacting drums and toppling of 3rd-tier drums, releasing their content with an ensuing site-wide fire burning.[e]	8.89×10^{-8}	3.85×10^{-6}	9.17×10^{-7}

Accident Scenario	Average Meteorology		
	MEI[a] (LCF[b])	Offsite Population[c] (LCF[b])	Non-involved Worker[d] (LCF[b])
SDC-3 Seismic/Fire-8: TWS, TA-54[f]: SDC-3 seismic event causing multiple TWS buildings to collapse impacting drums and toppling of 3rd-tier drums, releasing their content with an ensuing site-wide fire burning.[e]	1.02×10^{-7}	3.85×10^{-6}	9.17×10^{-7}
SDC-3 Seismic/Fire-9: TWS, TA-55[f]: SDC-3 seismic event causing multiple TWS buildings to collapse impacting drums and toppling of 3rd-tier drums, releasing their content with an ensuing site-wide fire burning.[e]	1.49×10^{-8}	3.85×10^{-6}	9.17×10^{-7}
SDC-3 Seismic/Fire-10: TWS, TA-60[f]: SDC-3 seismic event causing multiple TWS buildings to collapse impacting drums and toppling of 3rd-tier drums, releasing their content with an ensuing site-wide fire burning.[e]	1.19×10^{-7}	3.85×10^{-6}	9.17×10^{-7}
Annual Risk Totals for SDC-3 Seismic/Fire involving SDC-3 Seismic/Fire Involved Facilities Expanded Operations Alternative	***5.28×10^{-7}***	***3.80×10^{-5}***	***1.02×10^{-5}***
Annual Risk Totals for SDC-3 Seismic/Fire involving SDC-3 Seismic/Fire Involving Entire Site (SDC-2 plus SDC-3 Seismic/Fire Events)[e] – Expanded Operations Alternative	***8.55×10^{-7}***	***4.89×10^{-5}***	***1.42×10^{-5}***

HENC = High-Efficiency Neutron Counter; LCF = latent cancer fatality; MAR = material at risk; MEI = maximally exposed individual; MLU = Mobile Loading Unit; PF = Plutonium Facility; SDC = seismic design category; TA = technical area; TLWTF = Transuranic (TRU) Liquid Waste Treatment Facility; TWF = Transuranic Waste Facility; TWS = TRU waste staging; WCRRF = Waste Characterization, Reduction, and Repackaging Facility; WETF = Weapons Engineering Tritium Facility

a See discussion in Appendix D, Section D.3.1.4 about distances from each facility to its MEI.

b Annual risk is based on postulated frequency multiplied by the calculated dose multiplied by an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003a).

c Based on Table D.3-4, *Population Distribution Estimates Within 80km from LAN*L (LANL 2022q).

d At a distance of 100 m from the facility.

e The TWF and TWS SDC-3 seismic/fire event includes SDC-2 seismic/fire; therefore, the Annual Risk totals only include the TWF and TWS SDC-3 seismic/fire total.

f Under the Expanded Operations Alternative, four TRU waste staging areas are proposed (located in TAs-16, -54, -55, and -60). Due to similarity with TWF operations, the source terms and initial conditions of the TWF analysis were used; however, MEI distances were different for each location.

From a chemical perspective, the potential consequences of a site-wide seismic event would be conservatively represented by the combination of the consequences presented in Section 5.14.2.2, Table 5.14-2. In each individual instance, the DSAs estimate that offsite consequences would be below PAC-2. NNSA expects that considering the facilities are spread across the site and the MEI locations would be different for most involved facility locations, the likely consequences of chemical releases would approach PAC-2 levels but be below PAC-3 consequences.

5.14.5.2 Wildland Fire Events

Consistent with the 2008 SWEIS, this SWEIS evaluates the potential accident consequences of wildland fire events that could occur in the region and provides an assessment of the estimated consequence of these natural phenomena hazards for each of the facilities with radiological materials. In addition, this section provides a conservative assessment of the potential offsite consequences if multiple facilities were affected by the same wildland fire event.

Each of the Laboratory facilities with radiological materials subject to analysis, as delineated in Appendix D, Table D.3-2, were evaluated to determine the potential for a release of radiological materials from a wildland fire event based on their safety basis document (e.g., DSA). From this evaluation, the safety basis document accident scenarios for wildland fires or fires originating outside the facility with the highest consequences were selected for further analysis. Some facilities, because of their location in an industrial environment or the lack of potential fuels around the facility would not include a credible wildland fire accident scenario. The SWEIS used the MAR, source term factors, and initial conditions consistent with the safety basis documents. The potential consequences from a wildland fire at the listed facilities are presented in Appendix D, Table D.3-16, and the resulting accident risks (accounting for the event frequency) are presented in Table 5.14-5. Table 5.14-5 is separated to indicate the potential increased wildfire risk from the No-Action Alternative and the Expanded Operations Alternative, which also includes the four proposed TRU waste staging areas in TA-16, TA-54, TA-55, and TA-60.

In summary, Table 5.14-5 demonstrates, for example, that the total accident risk to the offsite population as a result of virtually all of the radiological facilities being involved in a single wildland fire event would be about 2.85×10^{-4} additional LCFs per year for the No-Action Alternative and 3.75×10^{-4} LCFs per year for the Expanded Operations Alternative, which takes into account the additional TRU waste staging areas. This result would be conservative since many of these facilities are several miles apart and separated by canyons and industrial areas that could inhibit the spread of the wildland fire.

Table 5.14-5 Radiological Accident Fatality Annual Risk From a Wildland Fire Event

Accident Scenario	Average Meteorology		
	MEI (LCF[a])	Offsite Population (LCF[a,b])	Non-involved Worker (LCF[a,c])
WLDFire-1: TA-55, PF-4: Plutonium Facility Wildland Fire.	0[d]	0[d]	0[d]
WLDFire-2: TA-54, Area G: External Fire propagates into Area G waste resulting in burning of waste and release of radiological material.	2.44×10^{-7}	9.79×10^{-6}	3.28×10^{-7}
WLDFire-3: TA-3, CMR: Wildland fire propagates to the CMR Yard and Loading Dock affecting all MAR within the yard including materials in transit resulting in the release of radioactive materials.	3.74×10^{-7}	3.98×10^{-5}	2.62×10^{-6}
WLDFire-4: TA-54, RANT: Wildland fire propagates to the RANT site and impinges upon the TRU waste containers, resulting in burning of waste.	1.34×10^{-6}	5.78×10^{-5}	4.34×10^{-6}
WLDFire-5: TA-16, WETF: WETF passive design features, such as fire-resistant structure, DOT Type B containers, etc. prevent exposure of MAR to wildland fire.	0[e]	0[e]	0[e]
WLDFire-6: TA-63, TWF: Wildland fire propagates to the TWF site and impinges upon the TRU waste containers in the characterization trailer, resulting in confined burning of waste.	6.96×10^{-8}	2.23×10^{-5}	1.02×10^{-6}
WLDFire-7: TA-50, WCRRF: Wildland fire ignites brush/grass in an open grass field near WCRRF and propagates to the transportainers, fire causes staged outside TRU waste containers lid seal failure and confined burning of waste.	5.23×10^{-7}	1.41×10^{-4}	5.63×10^{-6}
WLDFire-8: TA-55, RLUOB: Wildland fire burns the exterior of RLUOB (PF-400) structure and spreads to inside the building, outside waste containers are engulfed combustibles burn leading to full facility fire.	1.04×10^{-7}	1.44×10^{-5}	8.34×10^{-7}
WLDFire-9: TA-50, RLWTF: Wildland fire engulfs the RLWTF resulting in release of all facility material.	7.50×10^{-10}	8.76×10^{-8}	1.17×10^{-8}
WLDFire-10: TA-50, TLW: Wildland fire in the grassy field south of TLWTF spreads to the TLWTF resulting in release of all facility material.	4.96×10^{-10}	8.43×10^{-8}	8.34×10^{-9}
WLDFire-11: TA-53, LANSCE: Wildland fire engulfs LANSCE affecting IPF, Area C, Lujan Center, and/or WNR resulting in the release of radiological material.	1.81×10^{-9}	5.42×10^{-8}	8.58×10^{-9}
Annual Risk Totals for Sitewide Wildland fire Event – No-Action Alternative	$\mathbf{2.66\times10^{-6}}$	$\mathbf{2.85\times10^{-4}}$	$\mathbf{1.48\times10^{-5}}$
WLDFire-12: TWS, TA-16[f]: Wildland fire propagates to the TWF site and impinges upon the TRU waste containers in the characterization trailer, resulting in confined burning of waste.	2.28×10^{-7}	2.23×10^{-5}	1.02×10^{-6}
WLDFire-13: TWS, TA-54[f]: Wildland fire propagates to the TWF site and impinges upon the TRU waste containers in the characterization trailer, resulting in confined burning of waste.	2.58×10^{-7}	2.23×10^{-5}	1.02×10^{-6}

Accident Scenario	Average Meteorology		
	MEI (LCF[a])	Offsite Population (LCF[a,b])	Non-involved Worker (LCF[a,c])
WLDFire-14: TWS, TA-55[f]: Wildland fire propagates to the TWF site and impinges upon the TRU waste containers in the characterization trailer, resulting in confined burning of waste.	8.40×10^{-8}	2.23×10^{-5}	1.02×10^{-6}
WLDFire-15: TWS, TA-60[f]: Wildland fire propagates to the TWF site and impinges upon the TRU waste containers in the characterization trailer, resulting in confined burning of waste.	3.00×10^{-7}	2.23×10^{-5}	1.02×10^{-6}
Annual Risk Totals for Sitewide Wildland fire Event – Expanded Operations Alternative	3.53×10^{-6}	3.75×10^{-4}	1.89×10^{-5}

CMR = Chemistry and Metallurgy Research Facility; HS Pu = heat source plutonium; IPF = Isotope Production Facility; LANSCE = Los Alamos Neutron Science Center; LCF = latent cancer fatality; MAR = material at risk; MEI = maximally exposed individual; PF = Plutonium Facility; Pu-239 = plutonium-239; RANT = Radioassay and Nondestructive Testing Facility; RLUOB = Radiological Laboratory Utility Office Building [PF-400]; RLWTF = Radioactive Liquid Waste Treatment Facility; TA = technical area; TLWTF = Transuranic Liquid Waste Treatment Facility; TWF = Transuranic Waste Facility; WCRRF = Waste Characterization, Reduction, and Repackaging Facility; WETF = Weapons Engineering Tritium Facility; WNR = Weapons Neutron Research Facility

a Annual risk is based on postulated frequency multiplied by the calculated dose multiplied by an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003).

b Based on Appendix D, Table D.3-4, *Population Distribution Estimates Within 80km from LANL* (LANL 2022q).

c At a distance of 100 m from the facility.

d Due to the industrial setting and noncombustible construction of PF-4 and other passive design features such as waste containers, a wildland fire affecting MAR inside PF-4 is beyond extremely unlikely.

e WETF passive design features prevent exposure of MAR to postulated wildland fire.

f Under the Expanded Operations Alternative, four TRU Waste Staging areas are proposed (located in TAs-16, -54, -55, and -60). Due to similarity with TWF operations, the source terms and initial conditions of the TWF analysis were used; however, MEI distances were different for each location.

5.14.6 Intentional Destructive Acts

The 2008 SWEIS evaluated the potential impacts of terrorism (intentional destructive acts) and identified that the analysis was described in a classified appendix to the SWEIS. NNSA has updated the classified appendix to reflect any changes since 2008 and to reflect an evaluation of projects proposed under the No-Action and action alternatives. The impacts of some terrorist incidents would be similar to the accident impacts described in the SWEIS accident analyses, while some incidents may have more severe impacts. Appendix D, Section D.4 describes how NNSA assesses the vulnerability of its sites to terrorist threats and then designs its response systems.

As reported in Section D.4.2 of this SWEIS, substantive details of intentional destructive act scenarios and security countermeasures are not released to the public because disclosure of this information could be exploited by terrorists to plan attacks. Depending on the malevolent, terrorist, or intentionally destructive acts, impacts may be similar to or could exceed accident impact analyses prepared for this SWEIS. The classified appendix considers the underlying facility threat assumptions with regard to malevolent, terrorist, or intentionally destructive acts. Based on these threat assumptions, the classified appendix evaluates the potential human health impacts using appropriate analytical models, similar to the methodology used in LANL DSAs and this SWEIS to analyze accident impacts. These data provide NNSA with information upon which to base, in part, decisions regarding activities related to ongoing or future operations at the Laboratory.

5.15 Hybrid Work Environment

As discussed in Chapter 3, Section 3.2.5, this SWEIS includes a sensitivity analysis to evaluate the effects of increasing teleworking at LANL for workforce added as a result of the projects proposed under each alternative. The analysis assumes that approximately 10–20 percent of the increased Laboratory workforce would telework a maximum of 2.5 days per week without detriment to NNSA mission requirements.

Although consolidation of personnel could help accelerate DD&D and construction activities, the number of facilities and offices would not change; potential decreases in office space could be countered by pandemic-type distancing requirements that may be required/accommodated for in the future or by evolving mission needs. There would be no net change in safety, health, and waste generation because facility and Laboratory personnel would continue to operate facilities and conduct the same types and amounts of operations, production, experiments, and tests. As a result, the increasing telework potentially could impact air quality, transportation, and infrastructure.

Air Quality. Reduced worker commuting and reduced travel would decrease air emissions. However, some of this decrease likely would be offset by workers using their home heating and air conditioning systems. In Appendix F, NNSA estimates that onsite traffic could be reduced by up to 10 percent on any given day, which could reduce emissions from commuting vehicles by a up to one percent. Because LANL operations do not violate any air quality standard or contribute substantially to an existing or projected air quality violation, a reduction of one percent in emissions would be inconsequential. Effects on air quality from construction would be the same with or without the implementation of this initiative. The reduced employee commuting and business travel is expected to have a positive impact on reduction of GHGs and would therefore reduce the SC-GHG.

Transportation. Reduced worker commuting would improve the LOS of area roads. Appendix F, Section F.4.2 provides an estimate for the reduction of regional traffic for each of the alternatives. Increased teleworking would offset the projected increases in traffic that are expected under the alternatives. Reduced onsite worker population would also reduce onsite vehicle circulation and improve the availability of onsite parking.

Socioeconomics. The reduction of commuters to the LANL site could have a small impact to businesses along the common commuter routes and surrounding the Laboratory in the town of Los Alamos because the workers that did not commute for those days would not be available to shop locally or use local restaurants during their meal break. As mentioned above, the increased teleworking would offset potential traffic increases that would be associated with each of the three alternatives analyzed in this SWEIS. Therefore, the impact would not be a decrease from the current baseline but would be anticipated to remain steady instead of increasing with projected workforce increases. Additionally, with a greater percentage of the workforce working from home, the economic input from the local shopping and restaurant use during the workday would be further distributed across the ROI as opposed to being focused only around the LANL site.

Infrastructure. Reduced onsite worker population would reduce domestic water use by up to 3.9 million gallons annually. Because annual domestic water usage is expected to be approximately 290–495 million gallons annually, the reduction would amount to approximately 0.9–1.3 percent of the Laboratory usage, depending on the alternative. The reduced electricity use at the Laboratory from a reduction of staff would be offset by an increased use at home offices.

5.16 Design Features, Best Management Practices, and Mitigation Measures

5.16.1 Introduction – Design Features and Best Management Practices

As specified in the CEQ's NEPA regulations (40 CFR 1508.20), mitigation includes:

- avoiding the impact altogether by not taking a certain action or parts of an action;
- minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and
- compensating for the impact by replacing or providing substitute resources or environments.

Each of the alternatives has the potential to affect one or more resource areas. If mitigation measures above and beyond those required by regulations are needed to reduce impacts, DOE/NNSA is required to describe mitigation commitments in the ROD and prepare a mitigation action plan (10 CFR 1021.331). The Laboratory currently operates under the *Mitigation Action Plan for Los Alamos National Laboratory Operations* (LANL MAP) (DOE 2020). The LANL MAP provides a comprehensive list of all current mitigations that have been identified in the 2008 LANL SWEIS and other LANL NEPA documents. The LANL MAP explains how, before implementing any of the alternatives, certain measures must be planned and implemented to mitigate adverse environmental impacts. In some resource areas (e.g., nonradiological air quality) and some projects with separate NEPA documents (e.g., EPCU EA, Chromium Final Remedy EA) potential adverse impacts were identified that would require additional mitigation measures beyond those required by regulation or achieved through design features or BMPs; therefore, DOE/NNSA would revise the current LANL MAP to include such mitigation measures prior to implementation of the selected alternative or projects. Potential mitigation measures are identified in Section 5.16.15.

For any new projects, the Laboratory would implement a combination of design features and BMPs to avoid or reduce potential environmental impacts that could result from implementing the alternative. Facility designs could include features such as HEPA filtration and seismically qualified confinement structures that could minimize potential impacts to worker and public safety. BMPs are policies, practices, and measures that reduce the environmental impacts of proposed activities, functions, or processes.

Table 5.16-1 provides examples of design features and potential BMPs that could be utilized for new projects at the Laboratory. The first column of Table 5.16-1 lists a series of potential design features and BMPs, and the remaining columns identify those environmental resource areas that could benefit from the potential design features and BMPs. Sections 5.16.2–5.16.14 discuss these features and BMPs as applicable to the environmental resources evaluated in this SWEIS. In general, activities associated with each of the alternatives would follow standard practices, such as BMPs for minimizing impacts on environmental resources as required by regulation, permit, or guidelines. For all of the alternatives, NNSA would implement stewardship practices that are protective of the air, water, land, and other natural and cultural resources affected by DOE/NNSA operations in accordance with an environmental management system established pursuant to DOE Order 436.1, "Departmental Sustainability."

Table 5.16-1 Design Features and Potential BMPs

Design Feature or BMP	Land Use & Visual Resources	Geology and Soils	Water Resources	Air Quality & Noise	Ecological Resources	Human Health and	Cultural Resources	Socioeconomics	Infrastructure	Waste Management	Transportation	Environmental Justice
Potential Design Features or BMPs Related to Construction/DD&D/Environmental Remediation												
Erosion and sediment control plans		*x*	*x*		*x*		*x*					
Sequencing or scheduling of work		*x*		*x*	*x*		*x*	*x*	*x*		*x*	
Spill prevention control and countermeasures		*x*	*x*		*x*	*x*	*x*					
Use of low-sulfur, more-refined fuels				*x*	*x*	*x*					*x*	
Dust suppression measures	*x*	*x*		*x*	*x*	*x*						
HEPA filters, ventilation systems				*x*	*x*	*x*						
Silencers/mufflers, hearing protection programs				*x*		*x*						
Preconstruction characterization/surveys of site		*x*	*x*		*x*	*x*	*x*					
Personal protective equipment				*x*		*x*						
Potential Design Features or BMPs Related to Operations												
Water conservation practices			*x*						*x*			
Spill prevention control and countermeasures		*x*	*x*		*x*	*x*	*x*					
Personal protective equipment				*x*		*x*						
Confinement and shielding systems				*x*		*x*						
Ventilation and filter systems			*x*	*x*	*x*	*x*						
Emergency preparedness and response plans						*x*					*x*	*x*
Radiological Protection and ALARA Program						*x*					*x*	
High-efficiency electric equipment/off-peak use									*x*			
Pollution prevention and waste minimization						*x*			*x*	*x*	*x*	
Public outreach and training						*x*						*x*
Scheduling, carpooling							*x*		*x*		*x*	

ALARA = as low as reasonably achievable; BMP = best management practice; HEPA = high-efficiency particulate air

In addition to operational procedures and permits, the Laboratory implements processes (i.e., [1] Integrated Review Tool and [2] Permits and Requirements Identification) to plan and initiate new operations and projects that could affect land use and natural and cultural/historical resources. Land use and resources management subject matter experts use the Integrated Review Tool to review actions and identify requirements that must be addressed before or as part of execution. The majority of the requirements are addressed through the implementation of several key institutional plans, policies, and regulatory documents (LANL 2021c).

5.16.2 Land Use and Visual Resources

Several measures could be considered for minimizing impacts on land use and visual resources, including the following:

- Follow the objectives of the LANL CMP (LANL 2021c, 2022b) and permitting requirements.
- Utilize an environmental monitor for construction activities to ensure protection of vegetation and adherence to ground disturbance limits.
- Use the Integrated Review Tool and Permits and Requirements Identification process to plan and evaluate potential impacts of proposed projects.
- Where possible, limit land disturbed to previously disturbed areas or areas already designated for industrial use.
- Use existing infrastructure and rights-of-way to the extent practicable.
- Site access roads and temporary work areas to avoid and/or minimize impacts to existing operations and structures.
- Restore and landscape open areas upon completion of construction-related activities.

The generation of dust during construction and operations activities could be reduced by limiting speed and/or travel routes utilized by equipment. Water, dust palliative, or gravel may be applied to access roads or exposed surfaces to reduce dust.

As part of the alternatives, the EPCU EA identifies BMPs related to land use, trail management, and visual resources. The BMPs from Appendix C of NNSA (2023b) are incorporated by reference. Additional visual BMPs include:

- Site facilities, laydown areas, and staging areas as far as possible from sensitive viewing locations;
- Site facilities away from prominent landscape features;
- Site facilities in previously developed or disturbed landscapes;
- Site facilities in existing clearings;
- Site and design facilities to repeat the form, line, color, and texture of the existing landscape;
- Incorporate visual barriers to obstruct undesirable views;
- Confine construction activities, laydown areas, and staging areas away from public view;
- Maintain good-housekeeping rules for construction trash and debris;
- Minimize or screen use of night lighting; and
- Bury underground utilities along transportation routes to allow roads to double as ROWs.

5.16.3 Geology and Soils

Facility construction or modification will disturb soil. At all areas on the LANL site where construction or facility modifications would occur, adherence to BMPs for soil erosion and sediment control during land-disturbing activities would minimize soil erosion and loss. In general, limiting the time soils are exposed, limiting the area disturbed during any phase of a construction project, and applying protective coverings to denuded areas during construction (e.g., mulching and/or geotextiles) until such time as disturbed areas could be revegetated or otherwise covered by facilities would reduce the potential for soil loss. Soil loss would be further reduced by using appropriate sedimentation and erosion control measures as weather conditions dictate. The construction contractor would cover stockpiles of soil removed during construction with a geotextile or temporary vegetative covering and/or enclose the soil with a silt fence to prevent loss by erosion.

Contaminated soils and possibly other media could be encountered during excavation and other site activities. Prior to commencing any new ground disturbance, DOE/NNSA would survey potentially affected areas to determine the extent and nature of any contaminated media and required remediation in accordance with the procedures established under the Laboratory's soils or wastes program. Any contaminated soils and media would be managed in accordance with existing waste management practices.

As part of the alternatives, the EPCU EA identifies BMPs related to geology and soils. The BMPs from Appendix C of NNSA (2023b) are incorporated by reference. The Chromium Final Remedy EA (DOE 2024a) also identifies potential BMPs to minimize soil erosion, which could include installation of ground cover, straw wattles, or silt fencing and managing dust suppression by soil watering. Stabilization controls would also limit erosion around excavations, such as piping associated with new extraction wells, injection wells, and the treatment plant.

5.16.4 Water Resources

Potential impacts to water resources would be minimized by remaining in compliance with existing LANL NPDES and NMED permits. These permits and related regulations require the Laboratory to prepare and implement plans to control or eliminate discharge of pollutants, including hazardous and toxic substances, sediment, and contaminated stormwater. These plans include a best management plan, an SPCC plan, and an SWPPP. These plans, particularly the SPCC plan, also protect surface waters from spills of hazardous materials in instances where hazardous materials are being handled. In addition, base flow, stormwater, sediment, and groundwater are monitored, as specified by the Consent Order and applicable permits, to assess contaminant levels, and to determine whether existing controls and remedial actions are effective.

During construction, these plans would address the presence of heavy equipment and staged fuel storage containers, as applicable, and would require actions, such as putting temporary storage containers within secondary containment and identifying the types and locations of equipment available to respond to (i.e., contain and cleanup) spills or leaks of potential pollutants. These efforts to protect surface water from spills and leaks also act to protect groundwater from pollutants infiltrating from the surface.

No mitigation would be required to reduce potential impacts from water use, but existing site-wide efforts to identify and implement water conservation opportunities would be pursued in the new operations.

5.16.5 Air Quality and Noise

Construction, modification, or DD&D of facilities under all alternatives would result in some emissions of criteria and hazardous air pollutants, of which particulate matter would be a primary concern. Construction equipment criteria pollutant emissions would be minimized by using specific fuels (e.g., low-sulfur diesel fuel, alternative ethanol-containing fuel) and by maintaining equipment to ensure that emissions control systems and other components are functioning at peak efficiency. Soils exposed in excavations and slope cuts during new facility construction would be subject to wind or rain erosion if left exposed. In addition, fugitive dust emissions would result from land disturbed by heavy equipment and motor vehicles. The Laboratory would control particulate emissions during construction by using water to control dust from exposed areas, revegetating exposed areas after construction, and limiting construction activities under dry or windy conditions.

As discussed in Section 5.5.1, NNSA has identified potential mitigation measures to ensure that the concentrations of PM_{10} do not exceed *de minimis* standards during grading of previously undeveloped lands. These measures are discussed in Section 5.16.15.

Facility operations would result in air emissions of various criteria and non-criteria air pollutants, including radionuclides and organic and inorganic constituents. These emissions would be controlled using best available control technologies to ensure that emissions are compliant with applicable standards. As examples, impacts would be minimized by use of biosafety cabinets, glovebox confinement, and air filtration systems (e.g., HEPA filters) to remove particulates (e.g., radioactive, microorganism) before discharging process exhaust air to the atmosphere.

DD&D of excess facilities would have the potential to release radiological, hazardous, and nonhazardous pollutants. Prior to DD&D of a facility with potentially hazardous constituents (e.g., radionuclides, asbestos, chemicals), the Laboratory would prepare a DD&D plan for DOE/NNSA approval of the adequacy of actions to protect the environment as well as health and safety of workers and the public.

Construction and operations workers could be exposed to noise levels higher than acceptable limits, particularly for confined areas, as specified in OSHA noise regulations. DOE/NNSA has implemented hearing protection programs that meet or exceed OSHA standards to minimize noise impacts on workers. These include the use of standard silencing packages on construction equipment, sequencing and scheduling work shifts, administrative controls, engineering controls, and personal hearing protection.

5.16.6 Ecological Resources

Potential impacts to ecological resources during construction activities would be minimized by using previously disturbed land when possible. The alternatives include projects that would be in Mexican spotted owl habitat and either buffer or core habitat for the Jemez Mountains salamander and would follow the LANL HMP to evaluate and minimize potential impacts to threatened and endangered species (LANL 2022l). The Laboratory would also follow guidance in the *Sensitive Species Management Practices Source Document* (Berryhill et al. 2020) and *Migratory Bird Best Management Source Document* (Stanek et al. 2020b) to reduce impacts to these species.

As part of the alternatives, the EPCU EA identifies BMPs related to wildlife and vegetation. The BMPs from Appendix C of NNSA (2023b) are incorporated by reference. Similarly, the Chromium Final Remedy EA also identifies BMPs related to threatened, endangered, sensitive species, pollinators, migratory birds, and nonnative invasive plants in Table C-2 of Appendix C of DOE (2024a).

Implementation of soil erosion and sediment control and SWPPPs would prevent runoff and dust from impacting offsite areas. Following construction, the cleared and graded areas not covered with facilities, parking lots, or roads would be landscaped except for areas required to remain clear for security or fire prevention purposes.

During operations, SWPPPs and wastewater treatment would minimize potential impacts to offsite resources from stormwater runoff and effluent discharges. The Radiological Protection and ALARA Program designed to protect human health would also minimize or eliminate potential radiological impacts to ecological resources.

5.16.7 Human Health and Safety

Construction activities would generally occur in nonradiological areas and doses to workers would be essentially zero. Although contaminated soils are not expected, NNSA would prevent potential exposure from excavation activities by assessing or sampling the soil for radioactive contamination before excavation begins (*see* Section 5.16.3).

Safety features would be incorporated into the design of new facilities to minimize impacts to workers and the public. These include, but are not limited to, confinement (e.g., gloveboxes), shielding, ventilation, and air filtration systems. BMPs to ensure radiation protection would include formal analysis by workers, supervisors, and radiation protection personnel of methods to reduce exposure of workers to the lowest practicable level. For all activities involving radiation work, DOE/NNSA employs ALARA measures, such as minimizing time spent in high-radiation areas, maximizing distances from sources of radiation, using shielding, and/or reducing the radiation source. The radiological limit for an individual worker is 5,000 millirem per year (10 CFR Part 835). However, DOE's goal is to maintain radiological exposure to ALARA levels. At LANL, the Laboratory has established an administrative control level of 2 rem per year for external exposures (LANL 2020e).

LANL adheres to programs used to ensure minimization of human health and safety impacts to the maximum extent practicable. The Radiological Protection and ALARA Program ensures that radiological exposures and doses to all personnel are maintained to ALARA levels by providing job-specific instructions in job hazard analyses to the facility workers regarding the use of personal protective equipment. The Emergency Preparedness Program minimizes accident consequences by ensuring that appropriate organizations (e.g., fire department, operations, medical, and security) are available to respond to emergency situations and take appropriate actions to recover from anticipated events while reducing the spread of contamination and protecting facility personnel and the public.

Occupational safety risks to workers would be minimized by adherence to federal and state laws; OSHA regulations; DOE requirements, including regulations and orders; and LANL-specific plans and procedures for performing work. DOE regulations addressing worker health and safety include 10 CFR Part 851, "Worker Safety and Health Program," and 10 CFR Part 850, "Chronic Beryllium Disease Prevention Program." Workers are protected from specific hazards by training, monitoring, use of personal protective equipment, and administrative controls (i.e., job hazard analyses).

5.16.8 Cultural and Paleontological Resources

Potential impacts to cultural and paleontological resources would be minimized by conducting pre-construction surveys to identify resources and developing appropriate mitigation measures to resolve any adverse effects, all in accordance with the Programmatic Agreement and LANL CRMP. BMPs would be used during construction to control drainage and erosion patterns, thereby limiting the potential for erosion impacts to cultural and paleontological resources. Use of SPCC would limit the potential for contamination of resources located on or near construction project areas. The Laboratory would sequence and schedule construction work in consultation with tribes to address the potential for such work to impact traditional tribal activities in the vicinity. In the unlikely event of a discovery of cultural or paleontological resources, such discovery would be evaluated, as necessary, in accordance with LANL procedures and the LANL CRMP (LANL 2019c). Use of SWPPPs would minimize potential impacts to offsite resources from stormwater runoff and erosion.

5.16.9 Socioeconomics

Impacts related to population changes, availability of housing, and community services during the continued operations of the Laboratory are expected to be minor. Payroll and materials expenditures would have a generally positive impact on the local economies. During construction, LANL could sequence or schedule work to evenly distribute the number of personnel on site. This measure could reduce potential impacts on population, housing, and community services.

5.16.10 Infrastructure

In general, construction activities associated with the alternatives would occur in areas with existing utility infrastructure. The consumption of energy, fuel, and water resources would be within the capabilities of the existing infrastructure. Impacts on the regional electrical grid would be minimized by incorporating high-efficiency motors, pumps, lights, and other energy-saving equipment into the design of new facilities, and by scheduling some operations during off-peak times. Impacts on water use would be minimized by using water-conserving processes and equipment. Impacts on fuel use would be reduced by using fuel-efficient processes, equipment, and vehicles (e.g., hybrids or electric vehicles). Pursuant to DOE Order 436.1, DOE has established goals for energy efficiency and water conservation improvements at DOE sites, including reductions in energy and potable water consumption, use of advanced electric metering systems, use of sustainable building materials and practices, and use of innovative renewable and clean energy sources (LANL 2021g).

5.16.11 Waste Management

LANL would manage wastes generated during the continued operation of the Laboratory in a manner consistent with existing practices. That is, each waste type would be managed through facilities and processes that have the appropriate operational permits and are in compliance with applicable waste management regulations.

Section 5.11 of this SWEIS identifies the amounts of LLW, MLLW, TRU, hazardous, and special wastes that would be generated during operations, DD&D, and environmental remediation. These projected volumes are higher than the amounts the Laboratory currently generates. Impacts from the increased waste are expected to be manageable. DOE/NNSA would implement waste minimization efforts that potentially could make waste management simpler and even conserve resources. Waste minimization would be pursued during operations as part of the goals and objectives of the LANL Site Sustainability Plan (LANL 2024f).

5.16.12 Transportation

Measures that could be used to minimize transportation impacts include transporting materials and wastes during periods of light traffic volume, providing vehicle escorts, avoiding high-population areas, avoiding high-accident areas, and training drivers and emergency response personnel. The Department of Homeland Security is responsible for coordinating the response to accidents involving radioactive materials and waste, with DOE maintaining many of the resources that would be used if such an event were to occur. In addition, to reduce the possibility of an accident, DOE issued DOE Manual 460.2-1A, which establishes a set of standard transportation practices for the DOE, including the NNSA, to use in planning and executing offsite shipments of radioactive materials and wastes. BMPs related to minimizing commuter traffic fatalities include encouraging carpooling and promoting safe driving practices among the workforce.

5.16.13 Environmental Justice

Measures that could be used to mitigate and/or minimize environmental justice concerns include conducting early and diligent efforts to meaningfully engage potentially affected communities with environmental justice concerns about Laboratory actions and activities. Include other interested individuals, communities, and organizations in these discussions, as appropriate. NNSA will avoid, minimize, or rectify impacts to environmental resources to minimize impacts to the general and populations with environmental justice concerns.

5.16.14 Facility Accidents

Appendix D, Section D.3 discusses mitigation measures related to accidents. Many of the mitigations include passive design features that are assumed to mitigate potential consequences of accident scenarios.

5.16.15 Mitigation Measures Incorporated in the SWEIS Alternatives

Several specific mitigation measures are included in the SWEIS alternatives. Unless otherwise noted below, the analyses in this chapter assume the implementation of the following measures:

- The single biggest proposal affecting land use is the utility-scale PV solar installations proposed under the Modernized Operations Alternative, which have the potential to affect up to 795 acres on LANL. Though this represents only a small portion of the total LANL site, approximately 3 percent, it is the largest single-driver of land use changes during the 15-year analytical period. To mitigate the effects from this project, several mitigation measures would be considered:
  - utilizing previously disturbed or degraded lands, or areas identified for D&DD, i.e., brownfields to the extent practicable;
  - siting installations on lands otherwise classified as “unbuildable”;
  - designing installations to integrate green spaces between and within the solar PV installations, such as pollinator-friendly gardens or wildlife habitats;
  - consulting with stormwater and biological resource subject matter experts during the design phase to ensure the implementation of BMPs for stormwater stabilization, pollinators, and avian wildlife into the construction of the solar PV array installations;

- conducting pre-construction surveys for pinyon jays and other special-status species in respective suitable habitat locations; and
- preventing soil erosion through appropriate vegetative cover and erosion control measures.

- Exceedances of air quality standards would be expected for particulate matter if more than 2 million square feet (about 46 acres) of soil were left graded and bare for more than three consecutive months. Reasonable precautions to minimize particulate matter might include using water to control dust from building construction and demolition, road grading, or land clearing. Cleared or graded land would be seeded and/or vegetated in a timely manner to reduce fugitive dust. The Laboratory would implement the following actions to reduce potential effects:
  - Use SWPPPs for construction and demolition activities that disturb 1 acre or more of land.
  - Ensure that all persons responsible for any operation, process, handling, transportation, or storage facility that could result in fugitive dust (particulate matter) take reasonable precautions to prevent such dust from becoming airborne.
  - Inspect construction sites routinely to ensure adherence to project-specific requirements.

- DOE will continue environmental remediation actions necessary to comply with the Consent Order, regardless of decisions it makes on other actions analyzed in this SWEIS. Removal of contamination from MDAs and other potential release sites would be conducted in a manner that protects the environment and public and worker health and safety. Removal of waste from some large MDAs may require use of temporary enclosures to limit possible releases of contaminated material to the environment to levels within applicable standards and ALARA.
- Under all alternatives, impacts on sensitive wildlife species (e.g. noise, vegetation removal, mowing, etc.) during MDA remediation, DD&D, wildland fire treatments, and construction activities would be mitigated by planning activities outside of the breeding season for sensitive species, if any sensitive species' habitat is identified in the area and if the habitat is occupied or the status is uncertain. If appropriate, other protective measures could be employed, such as biological resource evaluations by subject matter experts or hand digging.
- To ensure compliance with the Migratory Bird Treaty Act, all newly constructed buildings, upgrades to buildings, and power line installations will be wildlife/avian safe by using bird friendly glass and standard bird guarding equipment as identified in the *Migratory Bird Best Management Practices Source Document for Los Alamos National Laboratory* (Stanek et al. 2020).
- Under all alternatives, radiological air emissions would be monitored and tracked to maintain the annual dose to the public under the administrative limit. Specifically, the venting of FTWCs in TA-54, Area G would be closely monitored to ensure that the amount of tritium released would not challenge this administrative limit.
- Under all alternatives, actions would be taken to mitigate the risks of a wildland fire on Laboratory facilities. This includes implementing the current treatments for forest thinning, life safety actions, open space forest health, and the implementation of new treatment

practices identified in the *Wildfire Mitigation and Forest Health Plan* (LANL 2019a). Under the Expanded Operations Alternative, NNSA has proposed additional or modified treatment standards designed to more aggressively address increasing wildland fire threat due to changing climate and a history of fire suppression that has led to overgrown forests.

- DOE/NNSA would comply with the Section 106 Programmatic Agreement (LANL 2022j) to identify significant cultural resources within the area of potential effect, utilizing archival research, field survey, and tribal consultation as well as other appropriate methods as described in the CRMP (LANL 2019c); determine what resources would be affected by the project; and work with project designers and engineers to alter the project design to avoid or reduce the impacts to the extent practicable. For any impacts that cannot be avoided or minimized, DOE would implement standard mitigation measures contained in the Programmatic Agreement and CRMP or develop and implement project-specific mitigation measures. Mitigation measures could include, but are not limited to, the following:
  - fencing of resources;
  - monitoring resources at risk for inadvertent impacts;
  - monitoring ground-disturbing activities in areas where there is a potential for subsurface cultural deposits;
  - conducting archaeological investigations or excavations;
  - recording the history and architecture of historic buildings or structures;
  - providing opportunities for interested tribal representatives to visit resources; or
  - conducting ethnographic studies.
- DOE/NNSA would implement the mitigation measures and BMPs identified in the EPCU EA related to geology and soils, vegetation, wildlife, cultural resources, recreational resources, visual resources, and other resources (NNSA 2023b).

5.17 Unavoidable Adverse Impacts

Ongoing activities at LANL under any of the three alternatives analyzed in this SWEIS could result in unavoidable adverse impacts on the human environment. In general, these impacts would be minimal and would come from incremental impacts attributed to ongoing LANL operations. This SWEIS has identified potential adverse impacts that could occur under the No-Action Alternative and the action alternatives and measures that could be taken to minimize or avoid these impacts. The residual adverse impacts of actions remaining after design features, BMPs, and mitigation measures are credited, if any, are considered to be unavoidable. In accordance with NEPA requirements (40 CFR 1502.16), this section discusses any adverse environmental effects that cannot be avoided should the proposal be implemented.

Development of new facilities, utilities, and infrastructure at the Laboratory under any of the three alternatives would develop land that is currently undisturbed. However, because activities under each alternative represent a continuation of existing land uses, they would be compatible with existing and approved future land uses at and surrounding the site.

Ongoing activities at LANL will continue to result in unavoidable radiation and chemical exposure to workers and the public. Generation of radioactive isotopes under any of the three alternatives is unavoidable. Radioactive waste generated during operations, environmental remediation, and DD&D would be collected, treated, stored, and eventually removed for suitable recycling or disposal in accordance with applicable DOE and EPA regulations.

Operations at LANL under any of the three alternatives would have unavoidable adverse impacts from air emissions. Air emissions include various chemical or radiological constituents in the routine emissions typical of nuclear facility operations. DD&D of excess buildings could result in the one-time generation of radioactive and nonradioactive waste material that could affect storage requirements. This could produce unavoidable impacts on the amount of available and anticipated storage space and the requirements of disposal facilities at LANL.

Temporary construction impacts associated with the construction of new facilities at LANL also would be unavoidable. These impacts would include generation of fugitive dust and noise, as well as increased construction vehicle traffic.

5.18 Relationship Between Short-Term Uses and Enhancement of Long-Term Productivity

Ongoing operations at the Laboratory under any of the three alternatives would require short-term commitments of resources and permanent commitments of certain resources (such as energy). Environmental resources have already been committed to continuing operations at LANL. Additional commitments would serve to maintain existing environmental conditions with little or no impact on the long-term productivity of the environment.

Short-term commitments of resources would include space and materials required to construct new buildings; new operations support facilities; transportation; and disposal resources and materials for continued Laboratory operations. Workers, the public, and the environment could be exposed to increased amounts of hazardous and radioactive materials over the 15-year period of this SWEIS analysis due to process emissions, DD&D and environmental remediation activities, and handling of radioactive and hazardous waste.

Regardless of changes in the levels of activities at Laboratory facilities, additional air emissions could introduce small amounts of radiological and nonradiological constituents to the air in the region around LANL. These emissions would result in additional exposure but would not be expected to impact compliance with air quality or radiation exposure standards at LANL. There would be no significant residual environmental effects on long-term environmental viability.

Management and disposal of additional sanitary solid waste and nonrecyclable radiological waste would require the use of energy and space at LANL treatment and storage facilities or at offsite disposal facilities. Regardless of location, the land required to meet solid waste needs at LANL would require a long-term commitment of terrestrial resources. Activities being considered at LANL, such as modernization or expansion of facilities, capabilities, or infrastructure, would result in further disturbance, use, and commitment of previously undisturbed land. Ultimately, after closure of facilities at LANL, NNSA plans to DD&D the buildings and equipment and restore them to brownfield sites that could be made available for future reuse.

5.19 Irreversible and Irretrievable Resource Commitments

Operations at the Laboratory under the three alternatives require the consumption of a number of resources. Table 5.10-4 shows the projected usage of water, electricity, natural gas, and petroleum-based fuel across the SWEIS alternatives. (These resources are also discussed by alternative in Sections 5.10.1, 5.10.2, and 5.10.3.) There also are many materials requirements for construction and maintenance of facilities, and operations require the consumption of the entire range of expected products and materials, such as chemicals. Commitments of capital, energy, labor, and materials are generally irreversible.

Energy expended would be in the form of fuel for equipment and vehicles, electricity for facility operations, and human labor. Changes in Laboratory operations could generate nonrecyclable waste streams such as radiological and nonradiological solid waste and some wastewater. Certain materials and equipment used during operations, however, could be recycled when buildings undergo DD&D. Disposal of hazardous and radioactive wastes also would cause irreversible and irretrievable commitments of land, mineral, and energy resources.

CHAPTER 6
CUMULATIVE IMPACTS

6.0 CUMULATIVE IMPACTS

6.1 Introduction

This chapter discusses the potential cumulative impacts resulting from the action alternatives and the No-Action Alternative. CEQ NEPA regulations at 40 CFR Part 1508.1(i)(3) define cumulative impacts as:

> *"… effects [or impacts] on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time."*

Thus, the cumulative impacts of an action can be viewed as the total effects on a resource (e.g., land, air, water, soil), ecosystem, or human community of that action and all other activities affecting that resource no matter what entity (federal, non-federal, or private) is taking the actions (EPA 1999). It is possible that a potential impact that may be small by itself could result in a moderate or large cumulative impact when considered in combination with the impacts of other actions on a particular affected resource. For example, if a resource is regionally declining or imperiled, even a small, individual impact could be substantial if it contributes to or accelerates the overall resource decline.

Cumulative impacts can also result from spatial (geographic) and/or temporal (time) crowding of environmental perturbations (i.e., concurrent human activities and the resulting impacts on the environment are additive if there is insufficient time for the environment to recover). The geographic area over which past, present, and reasonably foreseeable future actions could contribute to cumulative impacts is dependent on the type of resource considered.

6.2 Methodology and Assumptions

The following approach was used to estimate cumulative impacts for this LANL SWEIS:

- In general, potential cumulative impacts are determined by considering the baseline affected environment, the SWEIS alternatives, and other regional current and reasonably foreseeable future actions. The existing environment, which is described in Chapter 4, includes the impacts of past actions and ongoing LANL operations through 2022 and serves as the baseline for the cumulative impacts analysis.
- Regional current and reasonably foreseeable future actions include projects and activities that could result in impacts to resources, ecosystems, or human communities within the defined ROI as defined in Chapter 4, Section 4.1. These current and reasonably foreseeable future actions are described in Section 6.3.
- Cumulative impacts are assessed by combining the effects of the SWEIS alternatives with the impacts of other present and reasonably foreseeable future actions in the ROI. Many of these actions occur at different times and locations, and the potential impacts may not be truly additive. For example, actions affecting air quality occur at different times and locations across the ROI; therefore, it is unlikely that the impacts would be completely additive. In order to envelope any uncertainties in the projected activities and their effects, the analysis combines the effects irrespective of the time and location of the impact. This

approach produces a conservative estimation of cumulative impacts for the activities considered.

- This cumulative impact analysis is conducted for all resource areas identified with impacts analyses in Chapter 5. Some cumulative impacts analysis are quantitative, while others are limited to a qualitative discussion.

6.3 Current and Reasonably Foreseeable Future Actions

In addition to the actions associated with the alternatives evaluated in this SWEIS, other regional actions that may contribute to cumulative impacts include offsite projects conducted by federal, state, and local governments or the private sector that are within the ROIs of this SWEIS. Information on current and reasonably foreseeable future regional actions was obtained by reviewing publicly available information for the region, site-specific actions, and relevant NEPA documents. Table 6.3-1 summarizes the current and reasonably foreseeable future actions. In some cases (e.g., Los Alamos County housing and utility development projects), the projects are combined and discussed as a group.

Table 6.3-1 is grouped into DOE/NNSA actions and non-DOE/NNSA actions, which could include actions by other federal or state agencies (e.g., NPS, SFNF) or other entities (e.g., Los Alamos County).

Table 6.3-1 Projects and Other Actions Considered in the Cumulative Impacts Analysis

Project Name	Summary of Project	Status/ Schedule	Source
DOE/NNSA Actions			
Second Fiber Optic Line for LANL	As discussed in Chapter 3, Section 3.2.1.4, NNSA prepared an EA to evaluate a proposal to construct and operate a second fiber optic line and routing that would provide redundant voice, data, and internet services (NNSA 2020b, 2020c). Since issuance of the Final EA and FONSI, the USFS has revised the Santa Fe National Forest Land Management Plan (USDA 2022a). Revision of this Plan could result in revisions to the route or construction method for the fiber optic line. If no changes are necessary, this project would be implemented under the No-Action Alternative in this LANL SWEIS. In the event that revisions to the route or construction method are required, additional NEPA evaluations would be completed.	Potential	NNSA (2020b, 2020c) USDA (2022a)
Continued operation of Sandia National Laboratories, Albuquerque, New Mexico	Sandia National Laboratories/New Mexico (SNL/NM) have been operating in Albuquerque, New Mexico since 1948. SNL/NM is located about 60 miles south of Los Alamos on Kirtland Air Force Base. SNL/NM's primary mission is to function as a nuclear weapons research, development, and engineering laboratory. The ROIs for LANL and SNL overlap for several resource areas.	Ongoing	NNSA (1999) SNL (2023)

Project Name	Summary of Project	Status/ Schedule	Source
Non-DOE/NNSA Actions			
Santa Fe National Forest (SFNF) Land Management Plan (Forest Plan)	The SFNF revised its Forest Management Plan and prepared an EIS (USDA 2022c) to evaluate the potential impacts of its implementation. The Forest Plan provides strategic, program-level guidance for managing the SFNF's resources and uses over the next 10–15 years. The forest plan is strategic in nature and does not specifically authorize any projects or activities. Site-specific decisions are made following project-specific proposals and analyses that comply with the plan. The key differences between the 2022 Forest Plan and the 1987 plan that it replaced include: • Five additional wilderness areas totaling 23,845 acres; an increase of about 22,000 acres. • Proposed Caja del Rio Cultural Interpretive/ Biological Management Area (over 35,000 acres). • Four new cultural interpretive management areas (total of almost 7,000 acres)	Ongoing	USDA (2022a)

Bandelier National Monument	Bandelier National Monument prepared a Strategic Action Plan in 2022. The plan identifies goals and priorities for the Monument through 2027. Specific actions identified in the plan include:
	• Harden trails and resources in high visitation areas (2025)
	• Tsankawi ranger station rehab/redesign (2026–2027)
	• Prescribed forest thinning for Cerro Grande and Tsankawi (2026)
	• New construction (2026–2027)
	  o Paint Brush employee housing
	  o Re-establish Falls Trail
	  o Visitor Center bridge
		2022–2027	NPS (2022)

Project Name	Summary of Project	Status/ Schedule	Source
Valles Caldera National Preserve	The Valles Caldera National Preserve was established in 2014 and developed a foundation document to provide guidance for the preserve's planning and management decisions (NPS 2018). The NPS is currently preparing a general management plan/development concept plan to establish long-term direction for resource protection and visitor experiences at the park, as well as high-level concepts to guide future development and facility investments. The plan builds on a management zoning effort undertaken in 2021, which initiated the process of exploring a variety of desired future resource conditions and visitor experiences to be achieved and maintained in different areas of Valles Caldera. NPS plans to issue the general management plan and associated NEPA documents in 2024.	Ongoing	NPS (2018) NPS (2023)
Camp May Water Pipeline Project	Project to install a water pipeline, four pump stations, and a new water tank adjacent to the existing Pajarito 4 Tank on West Road to support the Pajarito Ski Hill. The majority of the pipeline and three pump stations would be located on USFS land. A short segment of the pipeline is on Los Alamos County land. The new tank, fourth pump, and a short segment of the pipeline would be on DOE land. The USFS prepared an EA in 2021 (USDA 2021b).	Planned	USDA (2021b)
East Jemez Road Intersection Upgrade	Realignment of the intersection at NM-4 and East Jemez Road and change the intersection to a four-way, adding more lanes, and increasing merge lane lengths. The Bandelier National Monument Tsankawi Unit parking area was completed near the NM-4 and East Jemez Road intersection. This project is associated with Supplemental Environmental Projects, as described in Appendix A, Section A.2.2.5.3.	Completed in 2024	NMED (2016b) LANL (2023a) NMDOT (2023)
NM-30 Improvements	Project for physical, operational, and safety improvements to reduce congestion and delays on NM-30 between NM 502 and US-84/285 intersection in Espanola, New Mexico.	Proposed	NMDOT (2023)
Los Alamos County – Public Utility Development	Los Alamos County has several utility projects currently under construction or development that would be within the ROI for this SWEIS and could have cumulative impacts. Examples of these projects include: • Bayo Booster Station – construct a new 833,000-gallon non-potable water storage tank to expand from the current 182,000 gallons to 1,015,000 gallons. The expanded non-potable water system would capture flows normally discharged to the environment and	Ongoing and planned	LAC (2024) NNSA (2024b) USDA (2022a) NNSA (2024c)

Project Name	Summary of Project	Status/ Schedule	Source
	increase the amount of non-potable water that can be conveyed for irrigation. • White Rock Wastewater Treatment Plant – replace the wastewater treatment plant in White Rock with a new water resource recovery plant. • DP Road Infrastructure Phase II – Roadway and Utility Infrastructure – install a new low-pressure sewer collection system to provide sewer service to the existing customers on DP Road and to serve new development that will occur on the vacant parcels. DOE had previously conveyed these parcels to the county. • Reservoir Road Project – Restore and address sedimentation from post wildfire flooding impacts in Los Alamos Canyon. This restoration project includes: the upper watershed area above the reservoir, the reservoir, and the area where Los Alamos Canyon Creek, water pipeline and access road run parallel to each other down the valley. The project is located on USFS and DOE/NNSA lands. Los Alamos County retains an easement for the road surface between the reservoir and West Road. NNSA prepared a FONSI (NNSA 2024b) based on a USFS EA (USDA 2022b) for NNSA's portion of the project. • Construction of a new water supply line within the right-of-way for NM-4 from White Rock to NM-502. Part of this line will pass through DOE property. The trench that will be constructed for the water line will also be used for a separate project proposed by the Pueblo de San Ildefonso to install a fiber optic conduit and cable. The trench that will include the water supply line and the fiber optic conduit and cable will be partially constructed in a floodplain; therefore, NNSA has prepared a floodplain assessment to evaluate the potential impacts from the projects (NNSA 2024c). • Foxtail Flats solar power and battery storage – the County has entered into agreements to build 170 MW of solar power and 80 MW of battery storage. The facilities would be located in the Four Corners region, northwest of Farmington, New Mexico (134 miles northwest of LANL). Construction of the facilities will occur 2024–2026 and power will be available to the LAPP by 2026.		

Project Name	Summary of Project	Status/ Schedule	Source
Los Alamos County – Housing Development	Los Alamos County has several housing projects currently under construction or development that would be within the ROI for this SWEIS and could have cumulative impacts. Examples of these projects include: • Arbolada Subdivision – development and construction of 85 homes on North Mesa in Los Alamos. The site is approximately 1.5 miles northeast of the LANL site boundary. • Bluffs Senior Apartments – construction of multi-family, affordable, senior apartments on DP Road in Los Alamos. The 64-unit complex is located on land DOE conveyed to the county. • Canada Bonita Apartments – 160 apartment units are being developed and constructed on Canyon Road, approximately 0.75 mile north of the LANL site boundary. • Mirador Mixed-Use Development – 57 units of multi-family housing is being developed and constructed in White Rock on land DOE conveyed to the county. • Ponderosa Estates Subdivision – 49 residential housing lots are being developed about 2 miles north of the LANL site. • The Hill Apartments – 144 multi-family rental units are being developed and constructed along Trintiy Drive in Los Alamos.	Ongoing and planned	LAC (2024)

6.4 Cumulative Impacts by Resource Area

6.4.1 Introduction

Chapter 5 of this SWEIS presents the potential environmental impacts associated with the No-Action Alternative and the two action alternatives. This section combines Chapter 5 impact information with the potential impacts from current and reasonably foreseeable future regional actions identified in Table 6.3-1. The potential cumulative impacts (Sections 6.4.2–6.4.14) are presented in the same order as the resource analyses in Chapter 5.

6.4.2 Land Resources

6.4.2.1 Land Use

Key metrics in the analysis of land use include: (1) the footprint of new facilities and infrastructure; (2) the amount of land disturbance and the conversion of currently undeveloped land; and (3) a qualitative analysis of consistency with current land use plans, classifications, and policies.

No-Action Alternative and Action Alternatives. As identified in Section 5.2.1, the alternatives represent a continuation of existing land uses at LANL. Under the alternatives, DOE would develop a new facility footprint. The addition to the developed footprint for the No-Action

Alternative would be 166 acres, 62 of which are currently undeveloped. The addition to the developed footprint for the Modernized Operations Alternative would be 1,007 acres above the No-Action Alternative (mostly associated with 795 acres of potential development from solar PV arrays), 723 of which are undeveloped. The addition to the developed footprint for the Expanded Operations Alternative would be 1,074 acres above the No-Action Alternative, 767 of which are undeveloped.

LANL is predominately open space, and none of the alternatives would change the current or future land use designation. Because activities under each alternative represent a continuation of existing land uses, they would be compatible with existing and approved future land uses at and surrounding the site. The enduring land disturbance from permanent facilities is compatible with existing and planned land uses at LANL. There would be no conflicts with established land uses on and off site, no land acquisition, and no conflicts with land use control plans. The increase in square footage and amount of land disturbance is not negligible but is consistent with past and current uses.

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would not have cumulative land use impacts.

If revisions to the SFNF Forest Plan result in revisions to the proposed route for the second fiber optic line to support LANL, NNSA would work cooperatively with the SFNF to manage any potential land use impacts to ensure that they are consistent with the Forest Plan and not contribute to cumulative land use impacts.

Non-DOE/NNSA Actions. The ongoing and proposed actions at the Valles Caldera National Preserve, SFNF, and Bandelier National Monument would continue to preserve and protect the existing land uses of those areas.

The restoration of Reservoir Road is ongoing to repair the road from flood damage, which occurred in March 2019. During active restoration activities, access to the road is restricted for safety reasons. Other than these temporary restrictions, the project does not have any effects on the surrounding land uses.

The Los Alamos County water line and Pueblo de San Ildefonso fiber optic line would be within an existing road right-of-way and would not impact land use or visual resources.

Utility development by Los Alamos County would not change the land uses of the developed parcels or existing rights-of-way but would improve the ability of the developed land or rights-of-way to satisfy its planned use. Housing development within Los Alamos County would change land uses in the area from previously undeveloped or underdeveloped to residential to increase the amount of available housing in the immediate area of the LANL site. For example, the county sponsored a North Mesa Housing Study (LAC 2020) to determine the feasibility of developing housing on the North Mesa site, a 30-acre, undeveloped site adjacent to Los Alamos Middle School. The draft housing study evaluated a range of concepts from single family homes to large, multi-family apartments. The concept recommended in the draft study (after considering input from public participants) includes a combination of single-family cottages and apartments, resulting in the potential for 210–360 new residential units. Actual development of this property would not be expected for several years.

Several of the development projects are on lands DOE previously conveyed to the county (DOE 1999b). Potential impacts of that development, and those associated with future conveyance or transfer of 1,280 acres of remaining tracts under the No-Action Alternative, were included in the CT EIS.

6.4.2.2 Visual Resources

The key metric in the cumulative impact analysis of visual resources is compatibility with the existing viewshed.

No-Action Alternative and Action Alternatives. As discussed in Chapter 5, Section 5.2.3, there would be short-term impacts to visual resources during construction activities. Each alternative identifies specific projects that would be most likely to result in short-term visual impacts. Aside from the Balance of Site Planning Area, the remaining four planning areas would retain their existing VRM classes in the long-term under each alternative. For the Balance of Site Planning Area, because it is currently less developed and has a VRM rating of Class I, it would likely change to a VRM rating of Class II because of proposed new development near the boundaries of the LANL site (e.g., pumped hydropower in TA-39 and solar PV arrays). Under the No-Action Alternative, there would be additional transmission lines added as part of the EPCU project. These transmissions lines would be routed through the SFNF and span the Rio Grande and add to visual resource impacts off the LANL site.

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would not have cumulative impacts to visual resources.

If revisions to the SFNF Forest Plan result in revisions to the proposed route for the second fiber optic line to support LANL, NNSA would work with the SFNF to further evaluate potential impacts to visual resources, however, as stated in the current EA, the fiber optic line would not be noticeable after construction and revegetation are completed (NNSA 2020b).

Non-DOE/NNSA Actions. The potential visual resources impacts from the Camp May pump stations and water tanks would be minimized through low visual impact design, which would include green or brown coloring to blend in with the surrounding landscape (USDA 2021b).

The ongoing and proposed actions at the Valles Caldera National Preserve, SFNF, and Bandelier National Monument would continue to preserve and protect the existing visual resources of those areas.

Road improvements in the region, including the restoration of Reservoir Road, would cause temporary visual impacts from construction equipment and additional traffic, however, these impacts should abate at the end of construction.

Utility development by Los Alamos County would also cause temporary visual impacts from construction equipment and additional traffic, however, these impacts should be limited to the construction period. Housing development within Los Alamos County would change the current viewshed of the surrounding land parcels since the current land is either undeveloped or underdeveloped. For example, the potential development in the North Mesa area is currently undeveloped, however, the 30 acres are between a middle school and sports fields and are on one of the four mesas that comprise the Los Alamos Townsite. The land slopes to the east, affording extensive views across the Rio Grande Valley to the peaks of the Pecos Wilderness (LAC 2020).

6.4.3 Geology and Soils

Key metrics in this analysis are: (1) amount of soil disturbance; and (2) potential for causing erosion, soil loss, landslides, or impacts to prime farmland.

No-Action Alternative and Action Alternatives. As discussed in Chapter 5, Section 5.3, the No-Action Alternative would disturb 62 acres of previously undisturbed land on the LANL site. The Modernized and Expanded Operations alternatives would disturb 731 and 806 acres of previous undisturbed land, respectively. These new disturbances represent 0.2 percent, 2.8 percent, and 3.1 percent of the total LANL site, respectively, for the alternatives. No soils on the LANL site are classified as prime farmland. Erosion controls and BMPs would be used to minimize soil erosion during construction and operations, and significant impacts would not be expected. Soil disturbances, with the exception of the EPCU and second fiber optic line under the No-Action Alternative, would occur within site boundaries and would not impact offsite soils.

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would not have cumulative impacts to geology and soils.

Non-DOE/NNSA Actions. The ongoing and proposed actions at the Valles Caldera National Preserve, SFNF, and Bandelier National Monument would continue to preserve and protect soils on their managed lands. The Camp May water pipeline project would be constructed on soils with a moderate to severe erosion potential; however, these soils are generally located on flat ground adjacent to existing roads. Within the previously disturbed areas adjacent to the existing roads, approximately 20 acres of temporary disturbance would be required to install the water pipeline and utility conduits. The project would use erosion and sediment control measures during construction and revegetation of disturbed terrain after construction.

For the Reservoir Road Project, the road is being restored to a functional and stable condition by using sediment removed from the reservoir[58] as a resource to re-build the road base. Natural materials such as ponderosa logs and boulders are being used to construct log and rock vanes (barbs) to protect the road from future floodwaters (NNSA 2024b).

The Los Alamos County water line and Pueblo de San Ildefonso fiber optic line would be within an existing road right-of-way and would be unlikely to affect geology and soils. The proposal would excavate a trench, install the 12-inch and 16-inch pipe, partially backfill and compact the soil, place the PVC fiber optic conduit above and to the side of the new pipeline, and complete the backfill and compaction. In some areas, the construction may include horizontal drilling to minimize disturbance from trenching (NNSA 2024c).

Utility and housing development within Los Alamos County would follow standard BMPs for soil conservation and erosion control. The county's natural resource management goals and strategies include elements such as (1) monitoring conditions regarding soil erosion, vegetative cover, water quality, and air quality, (2) finalizing development of stormwater standards for construction projects in the county, and (3) ensuring proper re-seeding and habitat restoration is included as part of construction projects.

6.4.4 Water Resources

Key metrics in this analysis include: (1) increases in impervious areas and stormwater effects; (2) analysis of effluents and the potential for surface/groundwater contamination; and (3) potential

[58] As part of the Reservoir Road Project, work on the reservoir includes dredging to remove sediments. These sediments would be used in other locations to raise the elevation of the road base.

floodplain impacts. The availability of water for consumption (water use) is addressed in Section 6.4.10 as part of infrastructure.

No-Action Alternative and Action Alternatives. As discussed in Chapter 5, Section 5.4, the No-Action Alternative would create 62 acres of additional impervious surfaces on the LANL site. By complying with NPDES and Wastewater Discharge Permit limits and requirements, and the use of BMPs, potential impacts to surface water and groundwater quality would be minimized. Groundwater monitoring would continue to ensure that remediation of contamination already present continues to be effective. Implementation of the final remedy for the hexavalent chromium plume would continue to improve groundwater quality in the Sandia and Mortandad Canyons. There are no projects that would affect floodplains.

As discussed in Section 5.4, projects under the Modernized Operations Alternative would result in the development of 90 acres of undeveloped land that is converted to facility and infrastructure use and therefore introduce new impervious surfaces and potential for permanent alteration of the existing hydrology. There may be a new permitted outfall in TA-3, however, water discharged from the outfall would meet the same NPDES permit limits and no significant impacts to receiving surface water would be expected. A proposed water treatment facility at TA-53 would allow the cooling towers at LANSCE to more efficiently reuse water, thus reducing the amount water discharged to the permitted outfall. Potential groundwater impacts would be the same as the No-Action Alternative.

As discussed in Section 5.4, projects under the Expanded Operations Alterative would add 31 acres of impervious surfaces in addition to the Modernized Operation Alternative. A new proposed water treatment facility to support the FSI HPC and associated water lines would be installed in TA-6. The water lines would cross streams and floodplains within Two-Mile Canyon. The project would be subject to the CGP, SWPPP, and *Clean Water Act* Section 404/401 requirements. The project would also include a new permitted outfall to Two-Mile Canyon, which could discharge as much as 24 million gallons per year to the canyon. Because the new outfall would be evaluated as part of the NPDES permitting process, no adverse impacts to the receiving surface water would be expected.

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would not have cumulative impacts to water resources. As noted in Sections 5.4.1.1, 5.4.1.2, and 5.4.1.3, no impacts to downstream receiving surface waters would be expected from continued LANL operations.

Non-DOE/NNSA Actions. The ongoing and proposed actions at the Valles Caldera National Preserve, SFNF, and Bandelier National Monument would continue to preserve and protect water resources on their managed lands.

The Camp May water pipeline project would provide enhanced fire suppression capability around the project area, as well as providing potable water to Camp May Park through the proposed pipeline. This potable water would allow users of Camp May Park to access drinking water without hauling in water. The project would provide additional water for the Pajarito Ski Hill to use for their snowmaking system. No adverse impacts to water resources are expected (USDA 2021b).

The Reservoir Road Project includes implementing a restoration design to mitigate continuing erosion and channel instability in the Los Alamos Canyon Creek. The design includes activities in the upper watershed (to create a stable channel and floodplain), reservoir (dredging to improve water storage capacity), below the reservoir (clear the channel and remove debris), and on DOE/NNSA property (clear excess sediment and protect the road embankment). All these activities are being performed in accordance with the USFS EA and the identified mitigation measures to minimize potential impacts to these water resources (USFS 2022b).

The Los Alamos County water line and Pueblo de San Ildefonso fiber optic line would be within an existing road right-of-way and cross a 100-year floodplain. NNSA has prepared a Floodplain Assessment (NNSA 2024c) and a Floodplain Statement of Finding in accordance with 10 CFR Part 1022, which determined that no long-term impacts to the floodplain are anticipated as a result of this project. Flow paths within the floodplain would not be modified from pre-project conditions to post project conditions (NNSA 2024d).

Utility and housing development within Los Alamos County would follow standard BMPs for water conservation and stormwater controls. The construction of the Bayo Booster Station would increase the ability to reuse non-potable water and avoid discharging the water to the environment. The replacement of the White Rock Wastewater Treatment Plant would improve the county's ability to manage expected wastewater increases that result from increased population and housing development.

6.4.5 Air Quality and Noise

This section addresses potential cumulative impacts to air quality (Section 6.4.5.1), GHG emissions (6.4.5.2), and from noise (Section 6.4.5.3) from the alternatives and current and reasonably foreseeable future actions within the ROI.

6.4.5.1 Air Quality

Key metrics presented in the air quality analysis for air emissions include: (1) quantities of projected air emissions and comparisons to air quality standards and (2) quantities of projected radiological emissions (potential human health impacts from radiological emissions are presented in Section 6.4.7).

No-Action Alternative and Action Alternatives. As discussed in Chapter 5, Section 5.5.1, the alternatives would result in radiological and nonradiological air emissions. For nonradiological air emissions, Table 6.4-1 compares the construction and operations emissions to *de minimis* threshold values. Table 5.5-5 in Chapter 5 provides the individual emissions for each nonradiological pollutant under the Expanded Operations Alternative. These values represent the implementation of all projects proposed under the alternatives and conservatively assumes that they are all constructed and operating over the same five-year period. As identified in Section 5.5.1, the Laboratory would implement mitigation measures to control potential PM_{10} emissions.

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would be unlikely to result in cumulative impacts to air quality. While both LANL and SNL identify potential air radiological and nonradiological air emissions, any potential cumulative impacts from these releases would be very unlikely for two primary reasons: (1) potential concentrations of releases (whether radiological or nonradiological) decrease with distance from the source and releases from either location would have diminished to near zero by the time it traveled 60 miles toward the other facility, and (2) potential releases would travel in the direction of the wind at the time of release and winds blowing from one laboratory toward the other laboratory at the same time would be highly unlikely.

Table 6.4-1 Potential Air Quality Impacts for the Alternatives

Resource Parameter	No-Action	Modernized Operations	Expanded Operations
de minimis threshold exceeded	Yes, for PM_{10} only. Measures would be required to reduce below threshold.	Yes, for PM_{10} only. Measures would be required to reduce below threshold.	Yes, for PM_{10} only. Measures would be required to reduce below threshold.
Radiological emissions	Tritium[a] = 1,850 curies GMAP = 800 curies MFP = 100 curies P/VAP = 3 curies Am-241 = 1.3×10^{-5} curies PuEq = 8.9×10^{-4} curies U-235 = 0.15 curies	Tritium[a] = 1,850 curies GMAP = 950 curies MFP = 100 curies P/VAP = 3 curies Am-241 = 1.3×10^{-5} curies PuEq = 8.9×10^{-4} curies U-235 = 0.15 curies	Tritium[a] = 1,850 curies GMAP = 1,454 curies MFP = 100 curies P/VAP = 3 curies Am-241 = 2.05×10^{-5} curies PuEq = 9.6×10^{-4} curies U-235 = 0.164 curies

Am-241 = americium-241; GMAP = gaseous mixed activation products; MFP = mixed fission products; P/VAP = Particulate and vapor activation products; PuEq = plutonium equivalent; U-235 = uranium-235

a Tritium could also have a one-time release of up to 30,000 curies associated with flanged tritium waste container venting (*see* Sections 3.2.3 and 5.7.1.1).

Non-DOE/NNSA Actions. The Camp May Water Pipeline Project would result in a temporary increase in emissions from construction activities and a long-term increase in emissions from increased electricity use from the pumping and snowmaking systems. However, the increases would be negligible and would not meaningfully impact the level of emissions from the broader Los Alamos area (USDA 2021b).

For the SFNF, the Forest Management Plan indicates that since air quality in the project area is considered very good, relatively small amounts of emissions from some activities would be negligible to the broader airshed. The Plan did not analyze smaller emissions from sources like vehicle emissions, mechanical treatment of vegetation, or roadwork and mining. The predominate air emissions evaluated in the Forest Management Plan are associated with natural or prescribed fire, which would result in high concentrations of PM_{10} emissions (USDA 2022a). The potential air quality impacts at Bandelier National Monument and Calles Vadera would be similar to that of the SFNF in the event that natural or prescribed fires occurred.

Highway improvements in the region, including the Reservoir Road Project, would cause temporary, localized emissions of criteria pollutants. Similar to actions proposed on the LANL site, these highway improvement projects would implement BMPs for dust control and would be unlikely to exceed *de minimis* standards.

Utility and housing development by Los Alamos County would be expected to follow these recommendations as they are developed. Regardless, these developments would result in short-term increases of criteria pollutants during construction that would be cumulative with those identified for continued operation of the Laboratory.

6.4.5.2 Greenhouse Gas Emissions

Key metrics presented in the analysis for GHG emissions include quantities of projected GHG emissions and their social cost along with the social benefits of implementing solar PV arrays.

No-Action Alternative and Action Alternatives. As discussed in Chapter 5, Sections 5.5.2, the alternatives would result in GHG emissions. Table 6.4-2 provides estimated GHG emissions and the expected social costs and benefits of GHGs (*see* Section 5.5.2 for an explanation).

For all alternatives evaluated, the Laboratory would take reasonable precautions to reduce GHG emissions integrating DOE O 436.1A and EO 14057 through advances in their net-zero emissions plan. Practices implemented during construction could also include use of construction equipment and vehicles with low-emission engines, scheduling to reduce vehicle trips, proper equipment maintenance, offering and promoting alternative transportation options for construction workers, and implementing policies to minimize engine idling for construction equipment.

Table 6.4-2 Potential GHG Impacts for the Alternatives

Resource Parameter	No-Action	Modernized Operations	Expanded Operations
GHG emissions	An increase of GHG emissions of roughly 10,500 metric tons of CO_2e annually during the peak of construction would be a negligible (~3 percent) increase from 2022 site-wide emissions.	An increase of roughly 17,000 metric tons of CO_2e annually during the peak of construction would be a minor adverse (~5 percent) increase from the No-Action Alternative.	An increase by roughly 18,100 metric tons annually during the peak of construction would be a minor adverse (~5 percent) increase from the No-Action Alternative.
SC-GHG	The 2024 present value of the social cost of GHG would be about $1,930,000,000 in 2020 dollars at a 1.5-percent discount rate, an annualized value of $145,000,000 site-wide with roughly $3,000,000 expected from construction and operations of new facilities and transport of waste and materials over the 15-year period. Present value social benefits from operating solar PV arrays were estimated at $6,120,000.	The annualized value of the GHG emissions would be roughly $6,600,000 from construction and operation of new facilities over the 15-year period. Annualized social benefits from implementation of half of the proposed solar PV arrays (about 89 MW) was estimated at $37,000,000.	The annualized value of GHG emissions would be about $7,400,000 from construction and operations of new facilities over the 15-year period. Annualized social benefits from implementation of half of the proposed solar PV arrays (about 89 MW) was estimated at $37,000,000.

CO2e = carbon dioxide equivalent; GHG = greenhouse gas; PV = photovoltaic; SC-GHG = social cost of greenhouse gas emissions

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would be unlikely to result in cumulative impacts to GHG emissions when both are working to integrate DOE O 436.1A and EO 14057.

Non-DOE/NNSA Actions. Los Alamos County Council established the Los Alamos Resiliency, Energy and Sustainability Task Force (Task Force) in 2020 to serve as an advisory body council for the purpose of recommending ways for the county, including government, businesses, and residents, to achieve net-zero GHG emissions and advance other sustainable practices in the face of climate change. In February 2022, the Task Force released a report to the Los Alamos County Council that contains six focus areas: general recommendations; natural gas reduction; electricity, transportation, and mobility; waste, consumption, and natural resources; and community planning. General recommendations focus primarily on GHG emissions reductions (LARES 2022). As a result of the Task Force report, Los Alamos County is developing a Climate Action Plan to implement many of the recommendations.

6.4.5.3 Noise

No-Action Alternative and Action Alternatives. As discussed in Chapter 5, Section 5.5.3, noise from construction and operations at the Laboratory would be expected to be similar to existing noise and, for the most part, contained within the LANL property boundary. Intermittent, offsite noise impacts from fire station sirens and alarms may also be expected in the SFNF outside TA-16. Continued environmental remediation would cause noise from heavy equipment and truck traffic, however, it would be expected to be similar to existing noise and would fluctuate depending on where the remediation activities are occurring across the site. There would also be increased traffic noise associated with the higher levels of employment. Construction activities associated with the EPCU would contribute to offsite noise within the SFNF but would be temporary and intermittent during construction.

Two construction projects under the Modernized Operations Alternative would be within 800 feet of the LANL property boundary and human activities: Los Alamos Canyon Bridge replacement and associated building DD&D and the Option B solar PV array. The noise would be temporary and intermittent and would not be loud enough to interfere with communication at the hospital or in homes when the windows are closed. Therefore, these effects would be minor.

Under the Expanded Operations Alternative, the Laboratory would construct and operate the pumped hydropower demonstration at TA-39 and TA-49. This project would be north of the Bandelier National Monument, about 1.5 miles to the northwest of the Juniper Family Campground. Noise from construction of the facility would not be expected to be heard at that distance.

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would not result in cumulative noise impacts.

Non-DOE/NNSA Actions. The majority of the non-DOE/NNSA actions identified in Table 6.3-1 would include construction activities, which would be intermittent and temporary and unlikely to contribute to significant changes to the noise environment of the region. The development of housing in undeveloped or underdeveloped areas of Los Alamos County would increase the noise of the region in the immediate locality of the new housing, although noise associated with residential areas is typically not a significant impact unless it is immediately adjacent to natural, scenic areas.

The Reservoir Road Project would involve activity, equipment, and vehicles that may temporarily (days to weeks) generate noise, thereby diminishing the enjoyment of recreation near the activity. The noise would diminish recreation enjoyment during weekday work hours (USDA 2022b).

6.4.6 Ecological Resources

Key metrics presented in this analysis include: (1) identify disturbances to land/vegetation and discuss impact on habitats, fish and wildlife, and special status species; and (2) identify and discuss wetland impacts.

No-Action Alternative and Action Alternatives. As discussed in Chapter 5, Section 5.6, the primary impact to ecological resources under all three alternatives would be clearing of previously undisturbed vegetation for the construction of facilities and infrastructure. Vegetation clearing would reduce usable habitat for a variety of wildlife species that inhabit the LANL site. Because many of the projects are relatively small and distributed throughout the LANL site, impacts from individual projects may not be readily observable but may occur cumulatively from loss of habitat and fragmentation of remaining habitat. Additional impacts would occur through wildlife avoidance of areas surrounding new facilities and infrastructure constructed in previously undisturbed areas. The extent of the avoidance factor would depend on the type of activity occurring at each project site. Projects with more outdoor human activity or noise (e.g., equipment operation or detonations) would have greater impacts. Impacts to federally listed species would depend on the location of each project in relation to identified core habitat and buffer habitat for each species and whether the project would disturb previously undisturbed habitat. Projects occurring in undisturbed core or buffer habitat for any federally listed species would be evaluated in accordance with the LANL HMP (LANL 2022l) and Section 7 consultation with the USFWS if required.

As identified in Sections 5.6.2, 5.6.3, and 5.6.4, the implementation of the Expanded Operations Alternative would disturb up to 806 acres of previously undisturbed vegetation and wildlife habitat (62 acres under the No-Action, 731 acres under the Modernized Operations, and an additional 75.2 acres under the Expanded Operations alternatives). The largest single project would be the solar PV arrays (641 acres previously undisturbed). Numerous projects would disturb vegetation in areas mapped as core and buffer habitat for the Mexican spotted owl and Jemez Mountains salamander and would require consultation with the USFWS prior to implementation.

Proposed operational changes under the Expanded Operations Alternative include implementing revised wildfire risk reduction standards and removing feral cattle on DOE/NNSA land in White Rock Canyon. Implementing the revised wildfire risk reduction treatments would modify habitat on the LANL site, potentially changing available habitat for wildlife which could have adverse and beneficial impacts on different species. The wildfire risk reduction treatment also could have long-term beneficial impacts on wildlife habitat by reducing the frequency of severe fire and conserving the mature ponderosa pine woodland, juniper woodland, and mixed forest vegetation. The removal of feral cattle in White Rock Canyon would have beneficial impacts by allowing natural recovery of overgrazed riparian vegetation.

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would not have cumulative impacts to ecological resources. Impacts to ecological resources are typically associated with impacts to habitat, which would not occur significant distances from the LANL site boundary.

If revisions to the SFNF Forest Plan result in revisions to the proposed route for the second fiber optic line to support LANL, NNSA would work with the SFNF to further evaluate potential impacts to ecological resources; however, as stated in the current EA, the fiber optic line would result in minimal impacts to these resources (NNSA 2020b).

Non-DOE/NNSA Actions. The ongoing and proposed actions at the Valles Caldera National Preserve, SFNF, and Bandelier National Monument would continue to preserve and protect ecological resources on their managed lands.

A Biological Evaluation and Biological Assessment were prepared specifically as part of the EA for the Camp May water line project (USDA 2021b). For bird species, the EA determined that the project may affect, but is not likely to adversely affect the Mexican spotted owl. For amphibian species, the EA determined that the project may affect, and is likely to adversely affect the Jemez

Mountains salamander. Through consultation with the USFWS for the Jemez Mountains salamander and the fact that the project would disturb approximately 12.1 acres of land within salamander critical habitat (which corresponds to approximately 0.01 percent of the entire designated critical habitat), the USFWS found that the project was not likely to jeopardize the continued existence of the Jemez Mountains salamander nor adversely modify or destroy its critical habitat (USDA 2021b).

The Reservoir Road Project would involve work in an aquatic and riparian environment. The NNSA FONSI identified that the proposed channel design structures would be constructed using natural materials and work to create natural channel features such as pools and riffles that provide habitat to aquatic organisms. Revegetation associated with the project would use native riparian plants such as coyote willow, bluestem willow, and narrow-leaf cottonwood and would be done by machine and possibly by hand planting off DOE property. All of these activities are being performed in accordance with the USFS EA and the identified mitigation measures to minimize potential impacts to these ecological resources (USDA 2022b).

Utility and housing development within Los Alamos County would follow standard BMPs for protection of threatened and endangered species during construction. As identified in the CT EIS (DOE 1999b), as a result of development in areas around the LANL site, species would not be protected by the LANL HMP and highly mobile wildlife would be forced to relocate to adjacent undeveloped areas. However, successful relocation may not occur due to increased competition for limited resources. For less-mobile species, direct mortality could occur during the actual construction or from habitat alteration.

Since two-thirds of federally listed threatened and endangered species have at least some habitat on private land, and some species have most of their remaining habitat on private land, the USFWS has developed an array of tools and incentives to protect the interests of private landowners while encouraging management activities that benefit listed and other at-risk species.

Under Section 10 of the ESA, non-federal entities can get an exemption for incidental take of listed species during their development activities. If there was the possibility for an incidental take during development, Los Alamos County or the developer must develop a habitat conservation plan that meets specific requirements as identified in the ESA, apply for an incidental take permit, and once issued, implement the project as specified in their permit. This habitat conservation plan would minimize future cumulative impacts to threatened and endangered species from utility and housing development in the county.

6.4.7 Human Health and Safety

The key metrics presented in this analysis are radiological doses and the potential radiological risks to the public.

No-Action Alternative and Action Alternatives. Although construction and DD&D activities would have the potential to adversely impact workers, they would not cause offsite health effects. Similarly, there would be no offsite health effects from normal operations involving nonradiological materials. Consequently, the analysis in this section focuses on potential cumulative radiological impacts offsite.

Members of the public would be subject to radiological exposures from: (1) Laboratory operations and environmental remediation; (2) other radiological facility operations in northern New Mexico that could impact populations within 50 miles of LANL; and (3) background radiation (*see* Chapter

4, Table 4.7-1). As identified in Table 6.3-1, SNL/NM is about 60 miles from LANL and the next subsection discusses any potential contribution to radiological exposure from SNL/NM operations.

Table 6.4-3 summarizes the potential impacts to human health and safety for the alternatives.

Table 6.4-3 Potential Impacts to Human Health and Safety for the Alternatives

Resource Parameter	Baseline (existing environment)	No-Action	Modernized Operations	Expanded Operations
MEI risk (LCF)	3.0×10^{-7}	1.8×10^{-6}	1.9×10^{-6}	2.2×10^{-6}
Population risk (LCF)	6.0×10^{-5}	3.7×10^{-3}	3.7×10^{-3}	4.0×10^{-3}
Collective annual dose to radiological workers (person-rem)	224	512	521	632
Total annual radiological worker risk (LCFs)	0.13	0.31	0.31	0.38
Lost days due to injury/illness per year	407	483	498	527
Number of occupational fatalities per year	1.1	1.3	1.3	1.4

LCF = latent cancer fatality

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would be unlikely to have cumulative impacts to human health. This conclusion is supported by the following: (1) the collective dose to a population within 50 miles in every direction from LANL is projected to be 6.73 person-rem annually for the Expanded Operations Alternative (*see* Chapter 5, Table 5.7-8); (2) the estimated collective dose from operations of SNL/NM to a population within 50 miles in every direction from SNL/NM was reported to be 0.0266 person-rem in 2022 (SNL 2023); (3) potential radiological doses to individuals decrease rapidly as a function of distance from the source; and (4) the majority of individuals that would receive cumulative doses from both national laboratories would be the subset of the collective populations that reside north of SNL/NM and south of LANL (e.g., between Santa Fe and Albuquerque). Even under the extremely conservative assumption that the population around LANL (365,453 persons) also received the full collective dose from the population within 50 miles of SNL/NM (1,075,207 persons), the additional contribution above the projected LANL population dose would be 0.3 percent. Therefore, no cumulative health impacts would be expected.

Non-DOE/NNSA Actions. There would be no cumulative radiological health effects from any of the non-DOE/NNSA actions.

6.4.8 Cultural and Paleontological Resources

As identified in Chapter 5, Section 5.8, the potential direct and indirect impacts analyzed for cultural resources include physical destruction or damage from ground disturbance, erosion, or changes to buildings or structures. Other impact analyses include changes to the historic setting of resources for which setting is important, and reduced access by practitioners to traditional resources.

No-Action Alternative and Action Alternatives. Under the No-Action Alternative, potential impacts to cultural resources would be avoided or reduced by locating projects in areas previously disturbed and with modern developments already present; rerouting construction to avoid resources; marking or fencing cultural resources that are at risk; and monitoring construction activities to ensure erosion is controlled and inadvertent impacts do not happen. Beneficial impacts would occur for some properties included in the MAPR by moving operations that work with explosives and other high-risk materials away from these properties.

Under the Modernized and Expanded Operations alternatives, as many as 33 known cultural resources could be physically impacted or damaged by the proposed projects. Of these resources, 19 are considered significant and would likely require mitigation prior to construction. In addition, several projects could impact the settings of traditional cultural properties. Consultation with tribes would be needed on specific projects to determine the potential for physical impacts, setting impacts, and access impacts to traditional cultural properties. Beneficial impacts to cultural resources and their settings could occur from burial of site utility lines, more aggressive wildland fire risk reduction treatments, and feral/invasive livestock management.

Prior to moving forward with a new project, once specific project plans have been developed, DOE/NNSA would comply with the Section 106 Programmatic Agreement (LANL 2022j) to identify significant cultural resources that would be impacted by the project and work with project developers to alter project design to avoid or reduce the impacts. These efforts would include consultation with interested parties, especially tribes. For any impacts that could not be avoided or minimized, DOE would implement steps in the Programmatic Agreement and CRMP (LANL 2019c) to develop and implement appropriate mitigation measures.

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would not have cumulative impacts to cultural resources. Both national laboratories have cultural resource management plans to minimize potential impacts at their facilities.

If revisions to the SFNF Forest Plan result in revisions to the proposed route for the second fiber optic line to support LANL, NNSA would work with the SFNF to further evaluate potential impacts to cultural resources; however, as stated in the current EA, the fiber optic line would result in minimal impacts to these resources (NNSA 2020b).

Non-DOE/NNSA Actions. The ongoing and proposed actions at the Valles Caldera National Preserve, SFNF, and Bandelier National Monument would continue to preserve and protect cultural resources on their managed lands. As identified in Table 6.3-1, the Forest Plan includes an additional 35,000 acres to be set aside as the Casas del Rio Cultural Interpretative/ Biological Management Area and another 7,000 acres identified as new cultural interpretive management areas. As identified in the Forest Management Plan, these actions would improve: (1) access to the forest by recognized tribes and rural historic communities, (2) confidentiality and privacy for traditional resources and lifeways, (3) communications with the SFNF about the needs of the tribal communities, and (4) preservation and protection of cultural resources (USDA 2022a).

As part of the EA prepared for the Camp May water line project, archaeologists completed a Class III pedestrian survey of the entire area of potential effect and identified four archaeological sites and two isolated finds. One of the finds was recommended eligible for listing on the National Register. Therefore, all proposed ground disturbance will occur on the northern side of West Road. The cultural site location will be avoided during project implementation. The EA included a finding that no historic properties would be affected by the project (USDA 2021b).

Regarding the Reservoir Road Project, the EA prepared by the USFS identified the potential for impacts to cultural resources (USDA 2022b). Generally, actions within an active river channel occur in a zone where intact cultural resources are not present. Riparian restoration work to be implemented under these types of projects may enhance traditional plant and animal resources valued by Native American tribes. These restoration measures would reduce the potential for future erosion and direct disturbance of cultural sites, potentially maintain historic settings, and protect water resources for traditional uses.

The Los Alamos County water line and Pueblo de San Ildefonso fiber optic line would be within an existing road right-of-way and would be unlikely to impact cultural resources.

Additional utility and housing development in Los Alamos County has the potential to disturb cultural resources in the area. However, Los Alamos County manages the rich cultural history of the region through implementation of the county's Historic Preservation Plan, that provides for the preservation and restoration of historic buildings and their surroundings and the protection of archaeological sites (LAC 2005).

The implementation of DOE/NNSA cultural resource management procedures to protect and preserve important cultural resources for the actions under each of the LANL alternatives, combined with implementation of the same types of management procedures for the other current and reasonably foreseeable actions in the ROI, would ensure that the alternatives would result in only incremental impacts to cultural resources. The geological environment of LANL that precludes the presence of paleontological resources extends throughout the ROI and thus no cumulative impacts are expected to those resources.

6.4.9 Socioeconomics

The socioeconomic analysis presented in Chapter 5, Section 5.9 identifies the potential impacts from changes in employment and economic activity due to new construction, utility/infrastructure projects, operations, environmental remediation, and DD&D of excess facilities. About 90 percent of the LANL workforce resides in New Mexico. As defined in Chapter 4, the ROI is a five-county area surrounding LANL where about 86 percent of LANL employees and their families reside. Key metrics presented in the socioeconomics analysis are: (1) employment and population changes; (2) changes in economic activity; and (3) impacts to housing and community services.

No-Action Alternative and Action Alternatives. Under the various alternatives evaluated in this SWEIS, the ROI would benefit from generally positive socioeconomic impacts. Table 6.4-4 summarizes the impacts of the three alternatives.

Table 6.4-4 Potential Socioeconomic Impacts for the Alternatives

Resource/Metric	Existing Environment (2022 Baseline)	No-Action Alternative (by end of 2029)	No-Action Increase over 2021 Baseline (%)	Modernized Operations Alternative (by end of 2038)	Modernized Operations increase over the No-Action Alternative (%)	Expanded Operations Alternative (by end of 2038)	Expanded Operations increase over the No-Action Alternative (%)
Net increase in direct LANL jobs	15,326[a]	16,856	10.0	17,636	4.6	18,551	10.1
Net increase in indirect jobs	9,413	10,113	7.4	10,557	2.8	11,052	9.3
Total ROI labor force	504,330	521,555	3.4	545,289	4.6	545,289	4.6
Annual earnings from direct jobs at LANL (millions of dollars)	$2,084	$2,247	7.8	$2,317	3.1	$2,429	8.1
Annual earnings from indirect jobs (millions of dollars)	$1,280	$1,364	6.6	$1,394	2.2	$1,469	7.7
Anticipated value added to ROI economy (millions of dollars)	$3,223	$3,470	7.7	$3,573	3.0	$3,744	7.9
Additional school children added to ROI	4,988	758	15.2	1,120	1.5	1,599	2.1
Total housing units occupied by LANL workforce[b]	15,326	16,856	10.0	17,636	4.6	18,551	10.1

a Direct LANL employment is based on 2022 employment.
b Assuming one LANL worker per household.

Other DOE/NNSA Actions. Due to the fact that the national laboratories at LANL and SNL/NM are within 60 miles of each other, they can both draw from the same pool of potential employees and both contribute to the socioeconomic conditions of the surrounding ROI. The LANL five-county ROI includes Bernalillo County, which contains SNL/NM. According to SNL (2023), there were 12,580 employees at SNL/NM in 2022. Most of the SNL/NM employees reside in Bernalillo County, while only about 6 percent of the LANL workforce reside in Bernalillo County. Impacts to employment and economic activity include direct, indirect, and induced economic impacts that could potentially result from project activities. As project-related direct expenditures are made in the ROI, these dollars begin to circulate in the economy. As funds are expended to pay employees and to buy goods and services, the recipients then make purchases, causing successive rounds of local spending, until the original expenditures eventually exit the ROI. Overall, both national laboratories have been located in their respective communities for over 70 years, provide generally positive socioeconomic benefits to the ROI, and do not have projected changes that would significantly stress the housing or public services of the ROI.

Non-DOE/NNSA Actions. The ongoing and proposed actions at the Valles Caldera National Preserve, SFNF, and Bandelier National Monument would bring visitors to the region and provide recreation opportunities that support the economies within the ROI. None of these actions would result in a significant change to the employment statistics within the region.

The utility and housing development in Los Alamos County is being implemented in direct response to the housing and infrastructure needs in the county. The Los Alamos Housing Program, a component of the Economic Development Division of Los Alamos County, is responsible for developing and implementing programs and projects to maintain and increase housing opportunities for all segments of the Los Alamos Community. This includes contracting with service providers who oversee operations of affordable housing homeownership, rental, and rehabilitation programs. The Housing Division works to ensure compliance with state and federal regulations and updates to county Housing Programs' policies and procedures on an ongoing basis. The county also works with the Planning Division to produce short-term rental policy and feasibility studies with the Los Alamos Public Schools for housing on school-owned land on North Mesa. The North Mesa Housing Study (LAC 2020) (as discussed in Section 6.4.2) identified specific housing needs and potential options for additional development to provide up to 360 additional housing units. The Los Alamos townsite and White Rock are considering the development of high-density, mixed-use housing units in the town center areas that would include a transit center to the LANL site. The plans include up to 363 housing units in White Rock and 2,591 units in Los Alamos (LAC 2019, 2021a, 2021b).

6.4.10 Infrastructure

Key metrics presented in the cumulative infrastructure analysis are: (1) consumed quantities of water, sanitary wastewater, electricity, and fuel (petroleum and natural gas); and (2) discussion of the current infrastructure to meet demands.

No-Action Alternative and Action Alternatives. Table 6.4-5 summarizes the potential impacts to infrastructure under the alternatives analyzed in this SWEIS as compared to the LANL baseline and existing capacity.

All infrastructure demands for the alternatives are expected to be within the existing or projected capacity (i.e., assuming the implementation of the EPCU project under the No-Action Alternative).

As a result of commitments in the Site Sustainability Plan (LANL 2024g), future projections for natural gas and petroleum use are reduced from the current levels of baseline consumption.

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM, continued operations of the two national laboratories would be unlikely to have cumulative infrastructure impacts. Both facilities have been a part of the utility and infrastructure demand in their respective ROIs for over 70 years and both have programs in place to conserve and minimize the use of resources, consistent with their Site Sustainability Plans (LANL 2024g; SNL 2022).

Table 6.4-5 Potential Impacts to Infrastructure for the Alternatives

Resource Parameter	Existing Capacity	Baseline (existing environment)[a]	No-Action Demand[b,c]	Modernized Operations[d]	Expanded Operations[d]
Domestic water (MGY)	542	266	290	300	495
Sanitary wastewater (gal/d)	602,800	312,600	371,400	387,650	409,275
Electricity – power consumption (MkW-hr/yr)	651[f]	451 average	621 average; 730 peak	658 average; 774 peak	810 average; 1,174 peak
Electricity – average annual peak demand (MW)	116.0[f]	70.0 average	86.7 average; 111.4 peak[e]	92 average; 132 peak[e]	110 average; 171 peak[e]
Natural gas (dec/d)	22,110	4,755	4,155	3,913	3,913
Petroleum fuel (gal/yr)	NA	525,130	426,000	440,000	483,000

DD&D = decontamination, decommissioning, and demolition; dec/d = decatherms per day; gal/d = gallons per day; gal/yr = gallons per year; MGY = million gallons per year; MkW-hr/yr = million kilowatt-hours per year; MW = megawatt; NA = not applicable

a Average value from 2017 to 2021.

b No-Action Alternative implemented between 2023 and 2029.

c DD&D projects included in the No-Action Alternative are scheduled through 2038.

d Modernized and expanded operations implemented from 2024 to 2038.

e Monthly peak.

f The EPCU project under the No-Action Alternative would increase import capacity from 116 MW to 200 MW and capacity for electrical consumption from 651 to 1,440 million kWh per year (based on 7,200 hrs/year and 200 MW import capacity).

Non-DOE/NNSA Actions. The ongoing and proposed actions at the Valles Caldera National Preserve, SFNF, and Bandelier National Monument would conserve utilities and energy within their managed lands. None of these actions would result in a significant change to the availability of fuel resources, water, or electricity.

The Camp May water line project would not make a notable contribution to utilities and energy use and would not contribute to infrastructure cumulative impacts (USDA 2021b).

As described in Section 6.4.5, Los Alamos County is considering recommendations for overall management of natural resources including water consumption. Examples of higher priority recommendations in the report related to water and wastewater include: (1) develop and adopt a comprehensive water conservation and watershed stewardship plan to maintain and enhance the quality and quantity of the county's water supply; and (2) develop and implement a plan to capture stormwater runoff and reduce contamination through green infrastructure approaches. Implementation of these recommendations would reduce potential impacts to this infrastructure resource.

Water rights for Los Alamos County total 5,541 acre-feet per year and are made up of a combined right of groundwater and surface water. Between the late 1960s and 2015, total water consumption in Los Alamos County had ranged between 4,000 and 5,000 acre-feet per year with maximum annual consumption above 5,000 acre-feet on two occasions (LAC 2015). As outlined in Table 6.4-6, current water usage for Los Alamos County is about 4,200 acre-feet annually, of which LANL consumes about 24 percent. The Expanded Operations Alternative would increase LANL's water consumption by 706 acre-feet by 2038.

Table 6.4-6 Water Rights and Projected Water Use for Los Alamos County, New Mexico

Location	Water Rights	Current Use	Projected Water Use
Los Alamos County (acre-feet/year)	3,879	3,387	3,590[a]
LANL (acre-feet/year)	1,662	813[b]	1,519[c]
TOTALS (acre-feet/yr)	**5,541**	**4,200**	**5,109**

a Estimate based on population of 20,000.
b Existing baseline of 264 million gallons per year equals 813 acre-feet per year for water consumption; 1 acre-foot equals 325,581 gallons.
c Projected water consumption under the Expanded Operations Alternative from Table 5.10.3.
Source: LAC (2015)

Assuming a population of 20,000 residents[59] in Los Alamos County plus LANL water usage, projected water consumption would be approximately 5,109 acre-feet, which would remain about 8 percent below the water rights of 5,541 acre-feet. Ongoing water conservation efforts are in place both in Los Alamos County and at LANL and include water reuse projects, leak-detection and repair, water meter replacements, and public outreach. Sustainable water use practices will be paramount in the coming years due to potential impacts from climate change and increasing social demand.

DOE/NNSA, LANL, and Los Alamos County commit their generation, transmission, and distribution resources to a pool in a long-term contract among the parties called the LAPP. The LAPP supplies Los Alamos County and LANL with electricity through hydroelectric, coal, and natural gas power generators from across the western U.S. Historically, LANL has used approximately 80 percent of the energy from the LAPP. As shown in Table 6.4-7, LAPP's electrical consumption is projected to increase over the next 15 years due mostly to LANL's

[59] Per the Bureau of Census, Los Alamos County had a population of 19,187 persons in July 2022 (https://www.census.gov/quickfacts/fact/table/losalamoscountynewmexico/PST045222).

proposed energy requirements under expanded operations. The LAPP would need to increase the contracted amounts of imported electricity from its providers. Los Alamos County and LANL are increasingly seeking opportunities to add renewable energy to their supply portfolio through the coordination of Los Alamos County Department of Public Utilities and the Los Alamos County Council, such as adopting goals and federal mandates on LANL to increase renewable energy use. As such, future imported electricity demand would be partially offset by increasing renewable energy projects within Los Alamos County and LANL. As noted in Section 5.10, NNSA's proposed solar PV arrays for the No-Action Alternative (10 MW) and Modernized Operations Alternative (about 159 MW) would assist in offsetting this increase.

Table 6.4-7 Baseline and Projected Average Annual Electrical Energy Consumption (MkW-hr/yr) for the LAPP

Category	LANL Total	County Total	LAPP Total
2008 SWEIS projection	651	150	801
Baseline electrical consumption[a]	451	120	571
Projected electrical consumption	810[b]	132[c]	942

LAPP = Los Alamos Power Pool; MkW-hr/yr = mega kilowatt-hours per year

a Average annual electrical energy consumption from 2017–2022.

b Projected electrical consumption for the Expanded Operations Alternative from Section 5.10.2.

c Projected electrical consumption based on 10 percent increase to baseline.

Source: LANL (2018b, 2019b, 2020d, 2021b, 2022a, 2023a, 2024e)

In 2026, Los Alamos County expects to begin receiving energy into the LAPP from the Foxtail Flats solar and battery storage project near Farmington, New Mexico. According to LAC (2024), the project will produce 170 MW per hour, which is more than enough to supply the daytime load for the LAPP. The county plans to sell 50 MW per hour under a separate power purchase agreement. Therefore, this project will add 120 MW per hour to the LAPP. The battery storage system will also be located near the solar project and will help supply the night load to LAPP and be used to store excess generated solar power above the required load and help the county manage cost-efficient use of the various power generations.

6.4.11 Waste Management

This cumulative impact analysis evaluates the disposal of a range of radioactive wastes, specifically LLW, MLLW, and TRU waste, that could be generated at LANL from each alternative and compares that range to disposal capacities at other DOE and commercial sites. The assessment also addresses the cumulative impacts of hazardous waste and solid nonhazardous waste generation and evaluates the potential cumulative impacts on commercial disposal facilities for those waste types.

Table 6.4-8 summarizes the potential waste management impacts identified for the alternatives evaluated in this SWEIS.

Other DOE/NNSA Actions. The cumulative impacts analysis for radiological waste disposal includes contributions from both LANL and SNL/NM since the laboratories dispose of their radiological waste at the same locations. The individual contributions by SNL/NM to specific waste volumes are addressed in the following subsections.

Non-DOE/NNSA Actions. None of these actions would generate radioactive waste. The nonhazardous solid waste generated by these ongoing and future actions is addressed in Section 6.4.11.4.

Table 6.4-8 Waste Management Impacts for the Alternatives

Resource Parameter	Baseline (2017–2022)	No-Action	Modernized Operations	Expanded Operations
Total LLW generated (m^3/yr)	4,118	9,754	10,680	12,051
Total MLLW generated (m^3/yr)	507	280	296	323
Total TRU waste generated (m^3/yr)	363	652	655	670
Total hazardous waste generated (metric tons/yr)	2,350	2,989	3,157	3,312
Total nonhazardous solid waste generated (metric tons/yr)	3,896	6,995	11,385	11,485

LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed low-level radioactive waste; TRU = transuranic

6.4.11.1 Low-Level Radioactive Waste

As discussed in Section 5.11.1.1 and summarized in Table 6.4-9, approximately 37 percent of LLW generated at LANL in 2022 was shipped to the NNSS for disposal; 28 percent to WCS; 22 percent to the Energy*Solutions* facility in Utah; and the remaining 13 percent was sent to TSD facilities in Washington and Florida. From 2015 through 2022, the NNSS disposed of an average of 838,000 cubic feet (NNSS 2016, 2017, 2018, 2019, 2020, 2021, 2022), or 23,700 cubic meters, of LLW per year in its land-based disposal cells. Currently, LANL LLW accounts for approximately 16 percent of the LLW disposed of at NNSS annually. If 37 percent of LANL's

Table 6.4-9 Cumulative LLW Disposal Impacts for the Alternatives

LLW Disposal Location	Baseline (2017–2022) (m^3/yr)	Percent of Total LLW Disposed per year	Range of Alternatives (m^3/yr)	Percent of Total LLW Disposed per year
NNSS	1,521	6.4	3,610–4,497	15–19
WCS	1,151	N/A	2,732–3,403	N/A
Energy *Solutions*[a]	905	<1	2,146–2,652	1.6–2.0
Other LLW disposal sites[a]	535	N/A	1,269–1,580	N/A
TOTALS	**4,118**	**NA**	**9,754–12,051**	**NA**

N/A = not available; NA = not applicable

a Other disposal sites include Perma-Fix Environmental Services in Oak Ridge, TN; and Perma-Fix in Richland, WA. Compared to percentages of shipments to NNSS, WCS, and Energy*Solutions*, relatively small volumes would be sent to these other facilities for disposal (totaling about 13 percent).

future LLW generated under each of the alternatives were sent to NNSS, it would account for between 15 and 19 percent of the LLW disposed of at NNSS annually.

As stated in Section 5.11.1.1, between 2020 and 2022, Energy*Solutions* received an average of 4,750,000 cubic feet (134,000 cubic meters) of LLW per year (NRC 2023). If 22 percent of LANL's future LLW generated under each of the alternatives were sent to Energy*Solutions*, it would account for between 1.6 and 2 percent of the LLW disposed of at Energy*Solutions* annually.

The amount of LLW generated at SNL/NM over the past five years was about 57 cubic meters annually, which would add less than 1 percent to the projected LANL estimated volumes SNL 2023).

6.4.11.2 Mixed Low-Level Radioactive Waste

As discussed in Chapter 5, Section 5.11.1.1, LANL manages its MLLW through a combination of onsite treatment followed by disposal as LLW, or shipment to commercial facilities for treatment and/or disposal. Table 6.4-8 demonstrates that the projected annual average volumes of MLLW for all three alternatives would be less than the average MLLW volumes generated during the five-year baseline period (2017–2022). As a result, these various permitted, commercial treatment and disposal facilities that managed the previous waste streams should be able to accommodate the lower volumes forecast for the next 15 years.

The amount of MLLW generated at SNL/NM over the past five years was about 59 cubic meters annually, which would add about 19 percent to the projected LANL estimated volume for the Expanded Operations Alternative (SNL 2023). Even with this addition, the projected annual volumes of MLLW would be less than the five-year baseline presented in Section 4.11.

6.4.11.3 Transuranic Waste

The WIPP facility is the only permanent disposal option for TRU waste generated by atomic energy defense activities as required by the WIPP LWA, which specifies a TRU waste disposal volume capacity of 6.2 million cubic feet (175,564 cubic meters). The ATWIR serves as a current estimate of the TRU waste inventory for potential disposal at the WIPP facility (DOE 2024b). The ATWIR estimates are also used in performance assessment compliance calculation submittals to EPA for technical analyses, strategic planning, and NEPA analyses. The TRU Waste Inventory Profile Reports (Appendices A and B of the ATWIR) reflect the information reported by the TRU waste generator/storage sites. The TRU waste inventory estimates in the ATWIR have inherent uncertainties and therefore the inventory estimates change annually. The TRU waste inventory estimates typically change due to factors such as updates or revisions to site treatment plans, waste minimization activities, packaging adjustments, and technical and planning changes.

As of the data collection cutoff date for the 2023 ATWIR (December 31, 2022), approximately 72,600 cubic meters of TRU waste had been emplaced at WIPP (DOE 2024b). Based on the analysis presented in Section 5.11 of this SWEIS, the maximum amount of TRU waste estimated to potentially be generated over the life of the LANL planning period analyzed in this SWEIS (15 years) would range from 8,580 to 8,850 cubic meters. This estimate includes up to 408 cubic meters per year of routine TRU waste from Laboratory operations; about 233 cubic meters per year from environmental remediation activities; and about 14 cubic meters per year of nonroutine TRU waste from DD&D of radiologically contaminated buildings (*see* Chapter 5, Section 5.11). The 8,580–8,850 cubic meters of TRU waste would represent about 5 percent of the LWA TRU waste disposal volume capacity of 175,564 cubic meters. It would also represent 8.6 percent of the available WIPP capacity, based on the 2023 ATWIR.

In addition to the emplaced volume, the 2023 ATWIR presents an estimate of the WIPP-bound TRU waste streams that appear to be eligible to be received at the WIPP facility. However, the WIPP-bound waste streams listed in the 2023 ATWIR would need to comply with the WIPP Waste Acceptance Criteria, the WIPP Hazardous Waste Facility Permit Waste Analysis Plan, and pass a certification audit before the waste could be shipped and disposed of at the WIPP facility. The ATWIR category of WIPP-bound is further subdivided into stored, projected, and anticipated. Anticipated is a subcategory that represents the sum of stored plus projected volume estimates (DOE 2024b). The estimated value in the 2023 ATWIR for "anticipated" TRU waste is about 42,800 cubic meters. The grand total presented in the 2023 ATWIR through 2033 includes the emplaced volume plus the WIPP-bound volume, or 115,000 cubic meters (about 65.5 percent of the LWA disposal volume capacity). The 2023 ATWIR also identifies a volume estimate for WIPP-bound TRU waste streams that could be generated after 2033. In fact, one site projection extends out to 2083 (DOE 2024b). This projected WIPP-bound TRU waste volume estimate that could be generated after 2033 is reported to be approximately 37,300 cubic meters.

The maximum TRU waste volume estimates in this SWEIS that have been projected for the SWEIS alternatives represent TRU waste volume estimates and not the volume of the overpack disposal container(s). Some of the waste estimates may have already been accounted for in the 2023 ATWIR. The ATWIR projects 10,980 cubic meters of LANL TRU waste by 2033 and an additional 9,341 cubic meters from 2033 to 2083. In addition, other proposed actions since publication of the current ATWIR could change the TRU waste inventory for potential disposal at WIPP. These actions will be incorporated, as appropriate, into future ATWIR TRU waste inventory estimates.

TRU waste volume estimates such as those provided in NEPA documents cannot be used to determine compliance with the WIPP LWA total TRU waste disposal volume capacity limit. The TRU waste estimates in the ATWIR change annually. Determining compliance to the WIPP LWA disposal capacity limit is determined by proven and audited procedures and process implemented for the WIPP facility by the Carlsbad Field Office. The Carlsbad Field Office monitors and tracks the actual defense related TRU waste volume emplaced at the WIPP facility to ensure compliance with the WIPP LWA and will take action as appropriate in a timely and appropriate manner to ensure needs of the DOE complex are met.

6.4.11.4 Nonradiological Waste

Hazardous Waste. As discussed in Chapter 5, Section 5.11.1.2, hazardous waste would be generated within LANL at the annual rate shown in Table 6.4-8. Consistent with statements in Section 5.11, the projected hazardous waste would include PCBs, asbestos-contaminated materials, and waste from explosives operations.

The Laboratory utilizes a variety of commercial facilities in order to accommodate the varied and often unique nature of the hazardous waste generated from its operations. The quantities of hazardous waste associated with the No-Action Alternative are not large on a national level, but do represent a large percentage of that generated within New Mexico. Based on EPA's biennial reports for hazardous waste, there were 39.6 million metric tons of hazardous waste generated nationally in 2021, with 4,204 tons generated in New Mexico in that year (EPA 2023b). Between 2019 and 2022, the Laboratory annually sent 125–239 shipments of hazardous waste to at least 10 different facilities (all but two were outside of New Mexico) (LANL 2024a). Considering that the forecast amounts of hazardous waste generated at LANL under the three the alternatives would increase from 27 to 40 percent over the next 15 years, the nationwide capacity for hazardous waste treatment at permitted commercial facilities should be able to easily accommodate the increase.

Nonhazardous Solid Waste. The Laboratory sends sanitary solid waste to the Los Alamos County Eco Station for transfer to municipal landfills. Los Alamos County operates this transfer station and is responsible to NMED for obtaining all related permits for these activities. In 2022, LANL sent approximately 1,750 tons to the Los Alamos County Eco Station (LANL 2024e). Construction and demolition debris is regulated as a separate category of solid waste and consists of soils, broken up concrete, scrap metals, and various building material waste or rubble. LANL segregates and tracks construction and demolition waste and has implemented actions to reuse or recycle these materials where feasible rather than send them for landfill disposal. Soils are reused on site or arrangements are made for the landfill to use it as cover; broken up concrete is used at the landfill for roads, pads, or cover; and scrap metals are sent for recycling. The primary driver for the forecasted increase in solid waste in Table 6.4-9 is construction and demolition debris from DD&D of excess facilities under the No-Action and Modernized Operations alternatives.

As of September 2022, there were five permitted landfills within the five-county ROI and 27 permitted landfills within New Mexico.

6.4.12 Transportation

Key metrics presented in this analysis include (1) traffic changes on area roads and (2) impacts to the public and transport crews from shipments of radiological and hazardous materials.

6.4.12.1 Local Transportation

No-Action Alternative and Action Alternatives and non-DOE/NNSA Actions. Cumulative traffic impacts were determined by comparing current traffic levels with projected traffic increases associated with the alternatives and general area-wide regional growth. Chapter 4, Section 4.9.2, identifies that population growth in the ROI is expected to increase by about 0.7 percent annually. This annual growth would include the utility and housing development included in Table 6.3-1. Chapter 5, Section 5.12, identifies that the highest annual increase in traffic would be expected during Year 4 under the No-Action Alternative. This increase would also be included in both the Modernized Operation and Expanded Operations alternatives. As shown in Table 6.4-10, local traffic on area roads in the vicinity of LANL would increase by a total of approximately 17.5 percent (1.1 percent annually) during the Expanded Operations Alternative 15-year period. Traffic congestion is a non-linear function, meaning that a small increase in peak traffic volume can cause a proportionally larger delay. For example, a 5-percent increase in traffic volumes on a congested road (for example, from 1,900 to 2,000 vehicles per hour) may cause a 10–30-percent decrease in average vehicle speeds (e.g., decreasing traffic speeds from 45 to 35 mph). As a result, even relatively small annual changes in traffic volume or capacity on congested roads can provide relatively large increases in traffic delay. Consequently, increasing traffic by an average of 1.1 percent per year would eventually exacerbate traffic levels on LANL area roads, particularly during peak commuting hours. However, traffic increases over the entirety of the Expanded Operations Alternative period would not be expected to degrade the LOS on such roads, all of which presently operate at between LOS C and LOS D at intersections. In general, traffic would need to increase by at least 20 percent to cause a LOS change (Traffic 2021).[60] As noted in Chapter 5, Section 5.15, increased teleworking would offset the projected increases in traffic that are expected under the Proposed Action.

Table 6.4-10 Cumulative Impacts to Area Roads for the Expanded Operations Alternative

Road	2021 Baseline Average Daily Traffic (ADT) Volume (vehicles/day)[a]	2038 Potential Increase in ADT Volume Due to Expanded Operations Alternative[a] (vehicles/day)	2038 Potential Increase in ADT Volume Due to General Area-Wide Growth[b] (vehicles/day)	2038 Expanded Operations Alternative Cumulative ADT Volume (vehicles/day)	Potential Cumulative Percentage Increase in ADT Volume
NM-4 at Los Alamos County Line to NM-501	918	60	101	1,079	**17.5% total (1.1% annually over the 15-year Expanded Operations Alternative period)**
NM-4 at Bandelier Park Entrance	1,988	130	219	2,337	
NM-4 Junction of Pajarito Road – White Rock	8,829	576	971	10,376	
NM-4 at Jemez Road	9,483	618	1,043	11,144	
NM-501 at Junction of NM-4 and Diamond Drive	9,622	628	1,058	11,308	
NM-501 at Junction of Diamond Drive	20,899	1,363	2,299	24,561	
NM-501 at NM-502	13,875	905	1,526	16,306	
NM-502 at Oppenheimer Street	12,817	836	1,410	15,063	
NM-502 at Los Alamos-Santa Fe County Line	13,024	849	1,433	15,306	
Pajarito Road between NM-4 and Diamond Drive (2021 data)	8,780	573	966	10,319	
TOTALS	**100,235**	**6,538**	**11,026**	**117,799**	

a Values from Appendix F, Table F-8.
b Based on 0.7 percent annual growth in traffic on each road (11-percent total growth over 15 years).
Source: NMDOT (2021)

[60] The distinctions between LOS ratings are subjective, and many factors can affect how a given traffic change will affect the LOS on a given road, including road design, number of lanes, number of intersections, speed limit, and signalization. Consequently, the ability to make definitive conclusions about an LOS change on a given road is limited.

6.4.12.2 Radiological Transportation

As stated in Section 5.12 of this SWEIS, all alternatives would involve offsite and onsite shipment of radiological materials and wastes during operations. Radiological materials and wastes to be transported include, but are not limited to:

- LLW and MLLW shipments to NNSS, Energy*Solutions* in Utah, WCS in Texas, and other permitted, commercial TSD facilities;
- TRU waste shipments to WIPP;
- SNM to and from other national laboratories, Pantex, SRS, and NNSS; and
- Sealed sources and isotopes to and from various locations across the nation and abroad.

The assessment of cumulative impacts includes other nationwide facilities, and their present and reasonably foreseeable future actions involving radioactive material transport, and focuses on radiological impacts from offsite transportation throughout the nation that would result in potential radiation exposure to the general population. This is in addition to those impacts evaluated for the alternatives for LANL in this SWEIS. Cumulative radiological impacts from transportation are measured using the collective dose to the general population and workers because dose can be directly related to LCFs using a dose-conversion factor.

Table 6.4-11 compares the potential impacts on transport workers and the general population from future transportation activities considered in this SWEIS with the cumulative impacts estimates from past, present, and reasonably foreseeable future DOE actions; past, present, and reasonably foreseeable future non-DOE actions; and general radioactive material transport.

Table 6.4-11 Cumulative Radiological Transportation Impacts

Action	Crew Dose (person-rem)	Latent Cancer Fatalities	Population Dose (person-rem)	Latent Cancer Fatalities
Past, Present, and Reasonably Foreseeable Future DOE Actions as identified in the Surplus Plutonium Disposition (SPD) SEIS (NNSA 2015)				
Historical (SNF to SRS) – (1953–1993)	49	0.03	25	0.02
Past, present, and reasonably foreseeable DOE actions[a]	30,900	18.5	36,700	22.5
Additional Reasonably Foreseeable Future DOE Actions since Publication of the SPD SEIS (NNSA 2015)				
Permanent disposal or interim storage of SNF[b]	5,600–5,900	3.4–3.5	1,100–1,200	0.66–0.72
Greater-than-Class-C waste EIS[c]	180	0.1	68	0.04
WIPP Supplement Analysis[d]	492	0.3	383	0.23
Production of tritium in a commercial light-water reactor[e]	25–60	0.02–0.04	2.7–12	0.0–0.01
SPD SEIS proposed action[f]	230–650	0.4	150–580	0.3
SRS Pit Production EIS[g]	580.5–901	0.4–0.48	334–455	0.17–0.23

Action		Crew Dose (person-rem)	Latent Cancer Fatalities	Population Dose (person-rem)	Latent Cancer Fatalities
Versatile Test Reactor EIS preferred alternative[h]		1,878	1.13	1,764	1.06
Total DOE Actions		**38,680–41,052**	**23–24.6**	**39,500–41,200**	**24–25**
Past, Present, and Reasonably Foreseeable Future Non-DOE Actions					
Enrichment facility in Lea County[i]		1,500	0.90	450	0.27
Eagle Rock enrichment facility[j]		3,350	2.01	60,000	36
GE Global laser enrichment[k]		242	0.15	419	0.25
American Centrifuge plant[l]		285	0.17	390	0.23
General radioactive material transport (1943–2073)[a]		384,000	230	338,000	203
Total Non-DOE Actions		**389,000**	**233**	**399,000**	239
SUBTOTALS		**427,680–430,000**	**256–258**	**438,500–440,200**	**263–264**
LANL SWEIS	No-Action Alternative[m] (over 15 years)	1,162	0.70	156	0.094
	Modernized Operations Alternative[m] (over 15 years)	1,180	0.71	163	0.098
	Expanded Operations Alternative[m] (over 15 years)	1,209	0.73	175	0.11
TOTAL IMPACTS (up to 2073)		**428,842–431,209**	**256.7–258.7**	**438,656–440,375**	**263.1–264.1**

a Does not include the doses from shipping Greater-than-Class-C waste.
b Source: DOE (2008b), Table 8-14; assumed the Yucca Mountain, Nevada, surrogate for repository or interim storage.
c Source: DOE (2016a), Table 4.3.9-1, pp. 4-68 and 4-69; DOE (2018), p. 3-20.
d Source: DOE (2009), Table 2.
e Source: DOE (2016b), Table F-12; calculated from LCFs.
f Source: NNSA (2015).
g Source: NNSA (2020e), Table 5-7.
h Source: DOE (2022e). INL VTR Alternative (preferred alternative).
i Source: NRC (2005). The values presented are for 30 years of operation.
j Source: NRC (2011), Table 4-12.
k Source: NRC (2012), Table 4-14.
l Source: NRC (2006).
m Impact indicators are from Chapter 5, Table 5.12-2 of this SWEIS.

6.4.13 Environmental Justice

The analysis in this section identifies and addresses any disproportionate high and adverse human health or environmental effects on communities with environmental justice concerns, based on other resource impacts.

No-Action Alternative and Action Alternatives. As documented in Chapter 5, Section 5.13, based on the analysis of impacts for the resource areas in this SWEIS, disproportionate high and adverse impacts are unlikely under any of the alternatives. To the extent that any impacts could be adverse, DOE/NNSA expects the impacts to affect all populations in the area equally. Section 5.7 evaluates special exposure and diet pathways to assess the potential impacts to Native American, Hispanic, and other residents whose traditional living habits and diets could cause larger exposures to environmental contaminants than those experienced by the hypothetical offsite resident. The results of this evaluation identify increases in potential doses from these lifestyles; however, the relative health risks would be very small (an increased LCF risk of about 1 in 245,000 for the special pathways receptor per year).

Other DOE/NNSA Actions. Due to the relative distance between LANL and SNL/NM and that neither site disproportionately impacts communities with environmental justice concerns, there would be no cumulative adverse impacts to these communities.

Non-DOE/NNSA Actions. The ongoing and proposed actions at the Valles Caldera National Preserve, SFNF, and Bandelier National Monument would not have disproportional adverse impacts to communities with environmental justice concerns.

The utility and housing development in Los Alamos County is being implemented in direct response to housing and infrastructure needs in the county. Los Alamos County is working to increase the availability of affordable housing, rentals, and rehabilitation programs. These developments aim to assist lower-income families in the community.

6.4.14 Accidents and Intentional Destructive Acts

As identified in Chapter 5, Section 5.14, there are three potential accidents that have the highest potential risks to the offsite population within a 50-mile radius of the LANL site. The accident with the highest increased accident risk to the public would be a lightning strike and fire inside WCRRF, which has a potential increased risk of 1.26×10^{-3} LCF to the offsite population. The other two scenarios are the site-wide seismic or wildfire event that conservatively involves all LANL radiological facilities that postulate a credible wildfire event. For the site-wide seismic event, risks could be as high as 4.96×10^{-5} LCF and the site-wide wildfire event could result in an increased risk of as high as 1.04×10^{-3} LCF. Regarding non-NNSA offsite impacts from earthquakes or wildfire in the Los Alamos region, the magnitude of these site-wide events would cause deaths, injuries, property damage, and economic losses. Such impacts would be independent of impacts from NNSA operations at the Laboratory.

Section 5.14 presents the analysis for intentional destructive acts associated with the continued operation of LANL. Other than SNL/NM in Albuquerque, other reasonably foreseeable actions from Table 6.3-1 are unlikely to substantively contribute to additional cumulative impacts from intentional destructive acts.

CHAPTER 7
REFERENCES

7.0 REFERENCES

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CHAPTER 8
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CHAPTER 9
GLOSSARY

9.0 GLOSSARY

absorbed dose—For ionizing radiation, the energy imparted to matter by ionizing radiation per unit mass of the irradiated material (such as biological tissue). The units of absorbed dose are the rad and the gray. (*See* rad and gray.)

accident sequence—With regard to nuclear facilities, an initiating event followed by system failures or operator errors, which can result in significant core damage, confinement system failure, and/or radionuclide releases.

actinide—Any member of the group of elements with atomic numbers from 89 (actinium) to 103 (lawrencium) including uranium and plutonium. All members of this group are radioactive.

activation products—Nuclei, usually radioactive, formed by the bombardment and absorption in material with neutrons, protons, or other nuclear particles.

administrative control level—A dose level that is established well below the regulatory limit to administratively control and help reduce individual and collective radiation doses. Facility management should establish an annual facility administrative control level that should, to the extent feasible, be more restrictive than the more general administrative control level.

air pollutant—Generally, an airborne substance that could, in high enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated, or for which maximum guideline levels have been established because of potential harmful effects on human health and welfare.

air quality control region—Geographic subdivisions of the U.S., designed to deal with pollution on a regional or local level. Some regions span more than one state. alluvium—Sediment deposited by flowing water, as in a riverbed, flood plain, or delta. alpha activity—The emission of alpha particles by radioactive materials.

alpha particle—A positively charged particle ejected spontaneously from the nuclei of some radioactive elements. It is identical to a helium nucleus and has a mass number of 4 and an electrostatic charge of +2. It has low penetrating power and a short range (a few centimeters in air). (*See* alpha radiation.)

alpha radiation—A strongly ionizing, but weakly penetrating, form of radiation consisting of positively charged alpha particles emitted spontaneously from the nuclei of certain elements during radioactive decay. Alpha radiation is the least penetrating of the three common types of ionizing radiation (alpha, beta, and gamma). Even the most energetic alpha particle generally fails to penetrate the dead layers of cells covering the skin and can be easily stopped by a sheet of paper. Alpha radiation is most hazardous when an alpha-emitting source resides inside an organism. (*See* alpha particle.)

ambient—Surrounding.

ambient air—The surrounding atmosphere as it exists around people, plants, and structures.

ambient air quality standards—The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

analytical chemistry—The branch of chemistry that deals with the separation, identification, and determination of the components of a sample.

aquatic—Living or growing in, on, or near water.

aquifer—An underground geological formation, group of formations, or part of a formation that is capable of yielding a significant amount of water to wells or springs.

archaeological sites (resources)—Any location where humans have altered the terrain or discarded artifacts during either precontact or historic times.

Area of Concern (AOC)—Any area that may have had a release of a hazardous waste or hazardous constituent, which is not a Solid Waste Management Unit.

artifact—An object produced or shaped by human workmanship of archaeological or historical interest.

as low as is reasonably achievable (ALARA)—An approach to radiation protection to manage and control worker and public exposures (both individual and collective) and releases of radioactive material to the environment to as far below applicable limits as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit but a process for minimizing doses to as far below limits as is practicable.

atmospheric dispersion—The process of air pollutants being dispersed in the atmosphere. This occurs by the wind that carries the pollutants away from their source, by turbulent air motion that results from solar heating of Earth's surface, and air movement over rough terrain and surfaces.

Atomic Energy Act—A law originally enacted in 1946 and replaced in 1954 that placed nuclear production and control of nuclear materials within a civilian agency, originally the Atomic Energy Commission. The functions of the Atomic Energy Commission were replaced by the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy.

Atomic Energy Commission—A five-member commission, established by the Atomic Energy Act of 1946, to supervise nuclear weapons design, development, manufacturing, maintenance, modification, and dismantlement. In 1974, the Atomic Energy Commission was abolished, and all functions were transferred to the Nuclear Regulatory Commission and the Administrator of the Energy Research and Development Administration. The Energy Research and Development Administration was later terminated, and functions vested by law in the Administrator were transferred to the Secretary of Energy.

atomic number—The number of positively charged protons in the nucleus of an atom or the number of electrons on an electrically neutral atom.

attainment area—An area that the U.S. Environmental Protection Agency has designated as being in compliance with one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants but not for others. (*See* National Ambient Air Quality Standards, nonattainment area, and particulate matter.)

attractiveness level—A categorization of nuclear material types and compositions that reflects the relative ease of processing and handling required to convert that material to a nuclear explosive device.

backfill—The replacement of excavated earth or other material into an open trench, cavity, or other opening in the earth.

background radiation—Radiation from (1) cosmic sources, (2) naturally occurring radioactive materials, including radon (except as a decay product of source or special nuclear material), and (3) global fallout as it exists in the environment (such as from the testing of nuclear explosive devices).

barrier—Any material or structure that prevents or substantially delays movement of pollutants or materials containing radionuclides toward the accessible environment.

basalt—The most common volcanic rock, dark gray to black in color, high in iron and magnesium and low in silica. It is typically found in lava flows.

baseline—The existing environmental conditions against which impacts of the Proposed Action and its alternatives can be compared. The environmental baseline is the site environmental conditions as they exist or are estimated to exist in the absence of the Proposed Action.

basin—Geologically, a circular or elliptical downwarp or depression in the earth's surface that collects sediment. Younger sedimentary beds occur in the center of basins. Topographically, a depression into which water from the surrounding area drains.

bedrock—The solid rock that lies beneath soil and other loose surface materials.

BEIR VII—Biological Effects of Ionizing Radiation; referring to the seventh in a series of committee reports from the National Research Council.

benthic—Plants and animals dwelling at the bottom of oceans, lakes, rivers, and other surface waters.

beryllium—An extremely light-weight element with the atomic number 4. It is metallic and is used in reactors as a neutron reflector.

best management practices (BMPs)—Structural, nonstructural, and managerial techniques, other than effluent limitations, to prevent or reduce pollution of surface water. They are the most effective and practical means to control pollutants that are compatible with the productive use of the resource to which they are applied. BMPs are used in both urban and rural areas. BMPs can include schedules of activities; prohibitions of practices; maintenance procedures; treatment requirements; operating procedures; and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

beta particle—A particle emitted in the radioactive decay of many radionuclides. A beta particle is identical to an electron. It has a short range in air and a small ability to penetrate other materials.

biomimetic—Imitating, copying, or learning from nature.

biota (biotic)—The plant and animal life of a region (pertaining to biota).

block—U.S. Bureau of the Census term describing small areas bounded on all sides by visible features or political boundaries; used in tabulation of census data.

borrow—Excavated material that has been taken from one area to be used as raw material or fill at another location.

bound—To use simplifying assumptions and analytical methods in analyzing potential impacts or risks such that the result provides an overestimate or upper limit that "bounds" the potential impacts or risks.

bounded—Producing the greatest consequences of any assessment of impacts associated with normal or abnormal operations.

Breccia—Rock composed of sharp-angled fragments embedded in a fine-grained matrix.

cancer—The name given to a group of diseases characterized by uncontrolled cellular growth, with cells having invasive characteristics such that the disease can transfer from one organ to another.

canister—A general term for a container, usually cylindrical, used in handling, storage, transportation, or disposal of waste.

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

capable fault—A fault that has exhibited one or more of the following characteristics: (1) movement at or near the ground surface at least once within the past 35,000 years, or movement of a recurring nature within the past 500,000 years; (2) macro-seismicity instrumentally determined with records of sufficient precision to demonstrate a direct relationship with the fault; (3) a structural relationship to a capable fault according to characteristic (1) or (2) above, such that movement on one could be reasonably expected to be accompanied by movement on the other.

carbon dioxide—A colorless, odorless gas that is a normal component of ambient air; it results from fossil fuel combustion, and is an expiration product.

carbon dioxide equivalent—Is the unit of measurement for the impacts of different greenhouse gases on global warming in terms of the amount of carbon dioxide calculated on the basis of the global warming potential index.

carbon monoxide—A colorless, odorless, poisonous gas produced by incomplete fossil fuel combustion.

carcinogen—An agent that may cause cancer. Ionizing radiation is a physical carcinogen; there are also chemical and biological carcinogens, and biological carcinogens may be external (such as viruses) or internal (such as genetic defects).

cask—A heavily shielded container used to store or ship radioactive materials.

categories of special nuclear material (Categories I, II, III, and IV)—A designation determined by the quantity and type of special nuclear material or a designation of a special nuclear material location based on the type and form of the material and the amount of nuclear material present. A designation of the significance of special nuclear material based upon the material type, form of the material, and amount of material present in an item, grouping of items, or in a location

cation—A positively charged ion.

cavate—Consists of a room carved into a cliff face within the Bandelier Tuff geological formation. The category includes isolated cavates, multi-roomed contiguous cavates, and groups of adjacent cavates that together form a cluster or complex.

cell—See hot cell.

chain reaction—A reaction that initiates its own repetition. In nuclear fission, a chain reaction occurs when a neutron induces a nucleus to fission and the fissioning nucleus releases one or more neutrons which induce other nuclei to fission.

chemical wastes—Defined as hazardous waste (designated under RCRA regulations); toxic waste (asbestos and polychlorinated biphenyls, designated under the Toxic Substances Control Act); and special waste (designated under the New Mexico Solid Waste Regulations and including industrial waste, infectious waste, and petroleum contaminated soils). In the past, LANL tracking efforts for chemical waste included construction and demolition debris and all other non-radioactive waste that managed through the Solid Chemical and Radioactive Waste Facilities. For waste projections in this SWEIS, construction and demolition debris are presented as a separate category.

classified information—(1) Information that has been determined pursuant to Executive Order 12958, any successor order, or the Atomic Energy Act of 1954 (42 U.S.C. § 2011) to require protection against unauthorized disclosure; (2) certain information requiring protection against unauthorized disclosure in the interest of national defense and security or foreign relations of the U.S. pursuant to federal statute or Executive Order.

clay—The name for a family of finely crystalline sheet silicate minerals that commonly form as a product of rock weathering. Also, any particle smaller than or equal to about 0.002 millimeters (0.00008 inches) in diameter.

Clean Air Act—This Act mandates and provides for enforcement of regulations to control air pollution from various sources.

Clean Water Act of 1972, 1987—This Act regulates the discharge of pollutants from a point source into navigable waters of the U.S. in compliance with a National Pollutant Discharge Elimination System permit, and regulates discharges to or dredging of wetlands.

Code of Federal Regulations **(CFR)**—All federal regulations in effect are published in codified form in the CFR. References to the CFR usually take the form of XX CFR Part YY, where XX refers to Title (major division) and YY refers to Part (section).

collective dose—The sum of the individual doses received in a given period of time by a specified population from exposure to a specified source of radiation. Collective dose is expressed in units of person-rem.

colluvium (colluvial)—A loose deposit of rock debris accumulated at the base of a cliff or slope.

committed dose equivalent—The dose equivalent to organs or tissues that will be received by an individual during the 50-year period following the intake of radioactive material. It does not include contributions from radiation sources external to the body. Committed dose equivalent is expressed in units of rem.

committed effective dose equivalent—The dose value obtained by—(1) multiplying the committed dose equivalents for the organs or tissues that are irradiated and the weighting factors applicable to those organs or tissues, and (2) summing all the resulting products. Committed effective dose equivalent is expressed in units of rem. (*See* committed dose equivalent and weighting factor.)

community (biotic)—All plants and animals occupying a specific area under relatively similar conditions.

community (environmental justice definition)—A group of people or a site within a spatial scope exposed to risks that potentially threaten health, ecology, or land values; or are exposed to industry that stimulates unwanted noise, smell, industrial traffic, particulate matter, or other nonaesthetic impacts.

Compliance Order on Consent (Consent Order)—Originally, an enforcement document signed by the New Mexico Environment Department (NMED), DOE, and the Regents of the University of California on March 1, 2005, which prescribed the requirements for corrective action at LANL. In June 2016, NMED and DOE entered into a new Consent Order (2016 Consent Order) that superseded the 2005 Consent Order. Changes from the 2005 Consent Order included removal of many of the detailed technical requirements and, instead, focused on the cleanup process itself. In addition, the fixed corrective action schedules contained in the 2005 Consent Order were replaced with an annual work prioritization and planning process with enforceable milestones to be met on a yearly basis. Requirements for investigation and cleanup as well as enforceable deadlines for achieving desired remediation end-states and for submitting documents such as investigation work plans, investigation reports, periodic monitoring reports, and corrective measures evaluation reports were broken down into a "campaign approach" to identify specific cleanup projects, facilitate project coordination, and promote focused attention on cleanup activities and attainable results.

conformity—Conformity is defined in the Clean Air Act as the action's compliance with an implementation plan's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards, and achieving expeditious attainment of such standards; and that such activities will not: (1) cause or contribute to any new violation of any standard in any area; (2) increase the frequency or severity of any existing violation of any standard in any area; or (3) delay timely attainment of any standard or any required interim emission reduction, or other milestones in any area.

contact-handled waste—Radioactive waste or waste packages whose external dose rate is low enough to permit contact handling by humans during normal waste management activities, (such as waste with a surface dose rate not greater than 200 millirem per hour). (*See* remote-handled waste.)

container—With regard to radioactive wastes, the metal envelope in the waste package that provides the primary containment function of the waste package.

contamination—The deposition of undesirable radioactive material on the surfaces of structures, areas, objects, or personnel.

coolant—A substance, either gas or liquid, circulated through a nuclear reactor or processing plant to remove heat.

criteria pollutants—An air pollutant that is regulated by National Ambient Air Quality The U.S. Environmental Protection Agency must describe the characteristics and potential health and welfare effects that form the basis for setting, or revising, the standard for each regulated pollutant.

Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than or equal to 10 micrometers (0.0004 inch) in diameter, and less than or equal to 2.5 micrometers (0.0001 inch) in diameter. New pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available. (*See* National Ambient Air Quality Standards.)

critical habitat—Habitat essential to the conservation of an endangered or threatened species that has been designated as critical by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR Part 424). The lists of Critical Habitats can be found in 50 CFR 17.95 (fish and wildlife), and 50 CFR 17.96 (plants). (*See* endangered species and threatened species.)

critical mass—The smallest mass of fissionable material that will support a self-sustaining nuclear chain reaction.

criticality—The condition in which a system is capable of sustaining a nuclear chain reaction.

cultural resources—Archaeological materials (artifacts) and sites that date to the pre-contact, historic, and ethnohistoric periods and that are currently located on the ground surface or buried beneath it; standing structures and/or their component parts that are over 50 years of age and are important because they represent a major historical theme or era, including the Manhattan Project and the Cold War era and structures that have an important technological, architectural, or local significance; cultural and natural places, select natural resources, and sacred objects that have importance for American Indians; American folklife traditions and arts; “historic properties” as defined in the National Historic Preservation Act; “archaeological resource” as defined in the Archaeological Resources Protection Act; and “cultural items” as defined in the Native American Graves Protection and Repatriation Act.

cumulative impacts (effects)—In accordance with 40 CFR 1508.1(i)(3), these are effects that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance from the proposed action or alternatives.

Curie (Ci)—A unit of radioactivity equal to 37 billion disintegrations per second; also a quantity of any radionuclide or mixture of radionuclides having 1 curie of radioactivity.

deactivation—The placement of a facility in a radiologically and industrially safe shutdown condition that is suitable for a long-term surveillance and maintenance phase prior to final decontamination and decommissioning.

decay (radioactive)—The decrease in the amount of any radioactive material with the passage of time due to spontaneous nuclear disintegration (the emission from atomic nuclei of charged particles, photons, or both).

decibel (dB)—A unit for expressing the relative intensity of sounds on a logarithmic scale where 0 is below human perception and 130 is above the threshold of pain to humans. For traffic and industrial noise measurements, the A-weighted decibel, a frequency-weighted noise unit, is widely used. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.

decibel, A-weighted (dBA)—A unit of frequency-weighted sound pressure level, measured by the use of a metering characteristic and the "A" weighting specified by the American National Standards Institution (ANSI S1.4-1983 [R1594]) that accounts for the frequency response of the human ear.

decommissioning—Retirement of a facility, including any necessary decontamination and dismantlement.

decontamination—The actions taken to reduce or remove substances that pose a substantial present or potential hazard to human health or the environment, such as radioactive or chemical contamination, from facilities, equipment, or soils by washing, heating, chemical or electrochemical action, mechanical cleaning, or other techniques.

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

degrees C (degrees Celsius)—A unit for measuring temperature using the centigrade scale in which the freezing point of water is 0 degrees and the boiling point is 100 degrees.

degrees F (degrees Fahrenheit)—A unit for measuring temperature using the Fahrenheit scale in which the freezing point of water is 32 degrees and the boiling point is 212 degrees.

depleted uranium—Uranium whose content of the fissile isotope uranium-235 is less than the 0.7 percent (by weight) found in natural uranium, so that it contains more uranium-238 than natural uranium. (*See* enriched uranium, highly enriched uranium, natural uranium, low enriched uranium, and uranium.)

deposition—In geology, the laying down of potential rock-forming materials; sedimentation. In atmospheric transport, the settling on ground and building surfaces of atmospheric aerosols and particles ("dry deposition") or their removal from the air to the ground by precipitation ("wet deposition" or "rainout").

design basis—For nuclear facilities, information that identifies the specific functions to be performed by a structure, system, or component, and the specific values (or ranges of values) chosen for controlling parameters for reference bounds for design. These values may be: (1) restraints derived from generally accepted state-of-the-art practices for achieving functional goals; (2) requirements derived from analysis (based on calculation and/or experiments) of the effects of a postulated accident for which a structure, system, or component must meet its functional goals; or (3) requirements derived from federal safety objectives, principles, goals, or requirements.

dewatering—The removal of water. Saturated soils are "dewatered" to make construction of building foundations easier.

discharge—In surface water hydrology, the amount of water issuing from a spring or in a stream that passes a specific point in a given period of time.

disposition—The ultimate "fate" or end use of a surplus U.S. Department of Energy facility following the transfer of the facility to the Office of the Assistant Secretary for Environmental Management.

diversion—The unauthorized removal of nuclear material from its approved use or authorized location.

DOE Orders—Requirements internal to the U.S. Department of Energy (DOE) that establish DOE policy and procedures, including those for compliance with applicable laws.

dose (radiological)—A generic term meaning absorbed dose, dose equivalent, effective dose equivalent, committed dose equivalent, committed effective dose equivalent, or committed equivalent dose, as defined elsewhere in this glossary. It is a measure of the energy imparted to matter by ionizing radiation. The unit of dose is the rem or rad.

dose equivalent—A measure of radiological dose that correlates with biological effect on a common scale for all types of ionizing radiation. Defined as a quantity equal to the absorbed dose in tissue multiplied by a quality factor (the biological effectiveness of a given type of radiation) and all other necessary modifying factors at the location of interest. The units of dose equivalent are rem.

dose rate—The radiation dose delivered per unit of time (such as rem per year).

dosimeter—A small device (instrument) carried by a radiation worker that measures cumulative radiation dose (such as a film badge or ionization chamber).

drinking water standards—The level of constituents or characteristics in a drinking water supply specified in regulations under the Safe Drinking Water Act as the maximum permissible.

ecology—A branch of science dealing with the interrelationships of living organisms with one another and with their nonliving environment.

ecosystem—A community of organisms and their physical environment interacting as an ecological unit.

effective dose equivalent—The dose value obtained by multiplying the dose equivalents received by specified tissues or organs of the body by the appropriate weighting factors applicable to the tissues or organs irradiated, and then summing all of the resulting products. It includes the dose from radiation sources internal and external to the body. The effective dose equivalent is expressed in units of rem. (*See* committed dose equivalent and committed effective dose equivalent.)

effluent—A waste stream flowing into the atmosphere, surface water, groundwater, or soil. Most frequently the term applies to wastes discharged to surface waters.

electron—An elementary particle with a mass of 9.107×10^{-28} gram (or 1/1,837 of a proton) and a negative charge. Electrons surround the positively charged nucleus and determine the chemical properties of the atom.

emission—A material discharged into the atmosphere from a source operation or activity.

emission standards—Legally enforceable limits on the quantities and/or kinds of air contaminants that can be emitted into the atmosphere.

endangered species—Plants or animals that are in danger of extinction through all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR Part 424). The lists of endangered species can be found in 50 CFR 17.11 for wildlife and 50 CFR 17.12 for plants. (*See* threatened species.)

enriched uranium—Uranium whose content of the fissile isotope uranium-235 is greater than the 0.7 percent (by weight) found in natural uranium. (*See* depleted uranium, uranium, natural uranium, low-enriched uranium, and highly enriched uranium.)

Environment, Safety, and Health Program—In the context of the U.S. Department of Energy (DOE), encompasses those requirements, activities, and functions in the conduct of all DOE/NNSA and DOE/NNSA-controlled operations that are concerned with impacts to the biosphere; compliance with environmental laws, regulations, and standards controlling air, water, and soil pollution; limiting the risks to the well-being of both operating personnel and the general public; and protecting property against accidental loss and damage. Typical activities and functions related to this program include, but are not limited to, environmental protection, occupational safety, fire protection, industrial hygiene, health physics, occupational medicine, process and facility safety, nuclear safety, emergency preparedness, quality assurance, and radioactive and hazardous waste management.

environmental impact statement (EIS)—The detailed written statement required by the National Environmental Policy Act (NEPA) section 102(2)(C) for a proposed major federal action significantly affecting the quality of the human environment. A DOE EIS is prepared in accordance with applicable requirements of the Council on Environmental Quality National Environmental Policy Act regulations in 40 CFR Parts 1500 to 1508 and DOE NEPA regulations in 10 CFR Part 1021. The statement includes, among other information, discussions of the environmental impacts of the Proposed Action and all reasonable alternatives, adverse environmental effects that cannot be avoided should the proposal be implemented, the relationship between short-term uses of the human environment and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources.

environmental justice—The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of federal, state, local, and tribal programs and policies. Executive Order 12898 directs federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations. (*See* minority population and low-income population.)

ephemeral stream—A stream that flows only after a period of heavy precipitation.

epidemiology—Study of the occurrence, causes, and distribution of disease or other health-related states and events in human populations, often as related to age, sex, occupation, ethnicity, and economic status, to identify and alleviate health problems and promote better health. **excavation**—A cavity in the earth's surface formed by cutting, digging, or scooping by excavating, such as with the use of heavy construction equipment.

excavation—A cavity in the earth's surface formed by cutting, digging, or scooping by hand or with the use of heavy construction equipment for the purpose of removing soil, rock, minerals, or artifacts. With regard to archaeological excavation, the careful exposure, documentation, and collection of buried material remains related to past human activities.

exposure limit—The level of exposure to a hazardous chemical (set by law or a standard) at which or below which adverse human health effects are not expected to occur.

fault—A fracture or a zone of fractures within a rock formation along which vertical, horizontal, or transverse slippage has occurred.

fissile materials—An isotope that readily fissions after absorbing a neutron of any energy, either fast or slow. Fissile materials are uranium-235, uranium-233, plutonium-239, and plutonium-241. Uranium-235 is the only naturally occurring fissile isotope. Although sometimes used as a synonym for fissionable material, this term has acquired a more restricted meaning, namely, any material fissionable by thermal (slow) neutrons. The three primary fissile materials are uranium-233, uranium-235, and plutonium-239.

fission—The splitting of the nucleus of a heavy atom into two lighter nuclei. It is accompanied by the release of neutrons, gamma rays, and kinetic energy of fission products.

fission products—Nuclei (fission fragments) formed by the fission of heavy elements, plus the nuclides formed by the fission fragments' radioactive decay.

floodplain—The lowlands and relatively flat areas that include, at a minimum, that area with at least a 1.0 percent chance of being inundated by a flood in any given year.

The *base floodplain* is defined as the area that has a 1.0 percent or greater chance of being flooded in any given year. Such a flood is known as a 100-year flood.

The *critical action floodplain* is defined as the area that has at least a 0.2 percent chance of being flooded in any given year. Such a flood is known as a 500-year flood. Any activity for which even a slight chance of flooding would be too great (such as storage of highly volatile, toxic, or water-reactive materials) should not occur in the critical action floodplain.

The *probable maximum flood* is the hypothetical flood considered to be the most severe reasonably possible flood, based on the comprehensive hydrometeorological application of maximum precipitation and other hydrological factors favorable for maximum flood runoff (such as sequential storms and snowmelts). It is usually several times larger than the maximum recorded flood.

flux—Rate of flow through a unit area; in reactor operation, the apparent flow of neutrons in a defined energy range. (*See* neutron flux.)

formation—In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

fugitive emissions—(1) Emissions that do not pass through a stack, vent, chimney, or similar opening where they could be captured by a control device, or (2) any air pollutant emitted to the atmosphere other than from a stack. Sources of fugitive emissions include pumps; valves; flanges; seals; area sources such as ponds, lagoons, landfills, piles of stored material (such as coal); and road construction areas or other areas where earthwork is occurring.

gamma radiation—High-energy, short wavelength, electromagnetic radiation emitted from the nucleus of an atom during radioactive decay. Gamma radiation frequently accompanies alpha and beta emissions and always accompanies fission. Gamma rays are very penetrating and are best stopped or shielded by dense materials, such as lead or depleted uranium. Gamma rays are similar to, but are usually more energetic than, x-rays.

genetic effects—Inheritable changes (chiefly mutations) produced by exposure to ionizing radiation or other chemical or physical agents of the parts of cells that control biological reproduction and inheritance.

genomics—The study of genes and their function.

geology—The science that deals with Earth—the materials, processes, environments, and history of the planet, including rocks and their formation and structure.

glovebox—Large enclosure that separates workers from equipment used to process hazardous material, while allowing the workers to be in physical contact with the equipment; normally constructed of stainless steel, with large acrylic/lead glass windows. Workers have access to equipment through the use of heavy-duty, lead-impregnated rubber gloves, the cuffs of which are sealed in portholes in the glovebox windows.

grading—Any stripping, cutting, filling, stockpiling, or combination thereof that modifies the land surface.

groundwater—Water below the ground surface in a zone of saturation.

habitat—The environment occupied by individuals of a particular species, population, or community.

half-life—The time in which one-half of the atoms of a particular radioactive isotope disintegrate to another nuclear form. Half-lives vary from millionths of a second to billions of years.

Hazard Category 1—DOE nuclear facility with the potential for significant offsite consequences. An example would be a nuclear reactor, 20 megawatt or greater in size.

Hazard Category 2—DOE nuclear facility with the potential for significant onsite consequences beyond localized consequences. An example would be a facility with sufficient hazardous material and energy that an unmitigated release would require an emergency plan for onsite evacuation. Examples include nuclear R&D and nuclear material processing.

Hazard Category 3—DOE nuclear facility with the potential for only local consequences. Examples include lab operations, low-level waste handling facilities, or research machines with inventories of nuclear materials above HC-3 threshold quantities (per DOE-STD-1027), but less than HC-2 threshold quantities.

hazardous air pollutants—Air pollutants not covered by ambient air quality standards but which may present a threat of adverse human health effects or adverse environmental effects. Those specifically listed in 40 CFR 61.01 are asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. More broadly, hazardous air pollutants are any of the 189 pollutants listed in or pursuant to the Clean Air Act, 42 U.S.C. § 7412(b). Very generally, hazardous air pollutants are any air pollutants that may realistically be expected to pose a threat to human health or welfare.

hazardous chemical—Under 29 CFR Part 1910 Subpart Z, hazardous chemicals are defined as "any chemical which is a physical hazard or a health hazard." Physical hazards include combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics, and reactives. A health hazard is any chemical for which there is good evidence that acute or chronic health effects occur in exposed employees. Hazardous chemicals include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, agents that act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.

hazardous material—A material, including a hazardous substance, as defined by 49 CFR 171.8, that poses a risk to health, safety, and property when transported or handled.

hazardous waste—A category of waste regulated under the Resource Conservation and Recovery Act (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 CFR 261.20-24 (ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 CFR 261.31-33.

hazards classification—The process of identifying the potential threat to human health of a chemical substance.

high-efficiency particulate air (HEPA) filter—An air filter capable of removing at least 99.97 percent of particles 0.3 micrometers (about 0.00001 inches) in diameter. High-efficiency particulate air filters include a pleated fibrous medium (typically fiberglass) capable of capturing very small particles.

high-level radioactive waste—High level waste is the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation.

highly enriched uranium—Uranium whose content of the fissile isotope uranium-235 has been increased through enrichment to 20 percent or more (by weight). (*See* uranium, natural uranium, enriched uranium, highly enriched uranium, and depleted uranium.)

historic artifact scatter/trash scatter—A concentration of items, including Euro-American artifacts, produced and deposited after AD 1600 (but most typically in the Los Alamos area deposited after about AD 1890) and at least 50 years old.

historic resources—Archaeological sites, architectural structures, and objects produced after the advent of written history, dating to the time of the first European-American contact in an area.

historic structure—A building or other structure constructed after AD 1593 (but most typically in the Los Alamos area constructed after about AD 1900).

Holocene—An epoch of the Quaternary period that began at the end of the Pleistocene, or the "Ice Age," about 10,000 years ago and continuing to the present. It is named from the Greek words "holos" (entire) and "ceno" (new).

hot cell—A shielded facility that requires the use of remote manipulators for handling radioactive materials.

hydrology—The science dealing with the properties, distribution, and circulation of natural water systems.

hydrophobic soils—Non-permeable soil areas created as a result of very high temperatures often associated with wildland fires.

Idaho National Laboratory (INL)—Formerly the Idaho National Engineering and Environmental Laboratory and the Argonne National Laboratory-West, INL is a U.S. Department of Energy (DOE) laboratory complex located in southeast Idaho about 25 miles west of Idaho Falls, that is managed and operated by a private consortium under contract to DOE.

incident-free risk—The radiological or chemical impacts resulting from emissions during normal operations and packages aboard vehicles in normal transport. This includes the radiation or hazardous chemical exposure of specific population groups and workers.

injection wells—A well that takes water from the surface into the ground, either through gravity or by mechanical means.

ion—An atom that has too many or too few electrons, causing it to be electrically charged.

ion exchange resin—An organic polymer that functions as an acid or base. These resins are used to remove ionic material from a solution. Cation exchange resins are used to remove positively charged particles (cations), and anion exchange resins are used to remove negatively charged particles (anions).

ionizing radiation—Alpha particles, beta particles, gamma rays, high-speed electrons, high-speed protons, and other particles or electromagnetic radiation that can displace electrons from atoms or molecules, thereby producing ions.

irradiated—Exposure to ionizing radiation. The condition of reactor fuel elements and other materials in which atoms bombarded with nuclear particles have undergone nuclear changes.

isolates—A population of bacteria or other cells that has been isolated.

isotope—Any of two or more variations of an element in which the nuclei have the same number of protons (and thus the same atomic number), but different numbers of neutrons so that their atomic masses differ. Isotopes of a single element possess almost identical chemical properties, but often different physical properties (for example, carbon-12 and -13 are stable; carbon-14 is radioactive).

joule—A metric unit of energy, work, or heat, equivalent to one watt-second, 0.737 foot-pound, or 0.239 calories.

landscape character—The arrangement of a particular landscape as formed by the variety and intensity of the landscape features (land, water, vegetation, and structures) and the four basic elements (form, line, color, and texture). These factors give an area a distinctive quality that distinguishes it from its immediate surroundings.

latent cancer fatalities (LCFs)—Deaths from cancer occurring some time after, and postulated to be due to, exposure to ionizing radiation or other carcinogens.

lithic scatter—Cluster of chipped-stone tools, groundstone tools, and/or pieces of chipped stone produced during the manufacturing of chipped-stone tools.

loam—Soil material that is composed of 7 percent to 27 percent clay particles, 28 percent to 50 percent silt particles, and less than 52 percent sand particles.

long-lived radionuclides—Radioactive isotopes with half-lives greater than 30 years.

long-term impact—In general, an impact that endures beyond the timeframe of the action or activity that causes the impact.

low-income population—In terms of the U.S. Census Bureau annual statistical poverty levels, may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient, where either group experiences common conditions of environmental exposure or effect. (*See* environmental justice and minority population.)

low-level radioactive waste—Waste that contains radioactivity but is not classified as high-level waste, transuranic waste, spent nuclear fuel, or byproduct material as defined by the *Atomic Energy Act of 1954*, as amended, found at 42 U.S.C. § 2014(e). Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level radioactive waste, provided the concentration of transuranic waste is less than 100 nanocuries per gram.

material access area—A type of security area that is authorized to contain a security Category I quantity of special nuclear material and which has specifically defined physical barriers, is located within a Protected Area, and is subject to specific access controls.

material characterization—The measurement of basic material properties, and the change in those properties as a function of temperature, pressure, or other factors.

material control and accountability—The part of safeguards that detects or deters theft or diversion of nuclear materials and provides assurance that all nuclear materials are accounted for appropriately.

material disposal area (MDA)—An area used any time between the beginning of Los Alamos National Laboratory operations in the early 1940s and the present for disposing of chemically, radioactively, or chemically and radioactively contaminated materials, pre-dating waste regulations or in compliance with current waste regulations.

maximally exposed individual (MEI)—A hypothetical individual whose location and habits result in the highest total radiological or chemical exposure (and thus dose) from a particular source for all exposure routes (inhalation, ingestion, direct exposure).

maximally exposed individual (transportation analysis)—A hypothetical individual receiving radiation doses from transporting radioactive materials on the road. For the incident-free transport operation, the maximally exposed individual would be an individual stuck in traffic next to the shipment for 30 minutes. For accident conditions, the maximally exposed individual is assumed to be an individual located approximately 33 meters (100 feet) directly downwind from the accident.

maximum contaminant level (MCL)— The designation for U.S. Environmental Protection Agency standards for drinking water quality under the Safe Drinking Water Act. The MCL for a given substance is the maximum permissible concentration of that substance in water delivered by a public water system. The primary MCLs (40 CFR Part 141) are intended to protect public health and are federally enforceable. They are based on health factors, but are also required by law to reflect the technological and economic feasibility of removing the contaminant from the water supply. Secondary MCLs (40 CFR Part 143) are set by the U.S. Environmental Protection Agency to protect the public welfare. The secondary drinking water regulations control substances in drinking water that primarily affect aesthetic qualities (such as taste, odor, and color) relating to the public acceptance of water. These regulations are not federally enforceable, but are intended as guidelines for the states.

Megawatt (mW)—A unit of power equal to 1 million watts. Megawatt thermal is commonly used to define heat produced, while megawatt-electric defines electricity produced.

MeV (million electron volts)—A unit used to quantify energy. In this SWEIS, it describes a particle's kinetic energy, which is an indicator of particle speed.

micron—One-millionth of 1 meter.

migration—The natural movement of a material through the air, soil, or groundwater; also, seasonal movement of animals from one area to another.

Migratory Bird Treaty Act—This Act, found at 16 U.S.C. § 703(a), states that it is "unlawful at any time, by any means and in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, kill...any migratory bird, any part, nest, or egg of any such bird" other than permitted activities.

millirem—One-thousandth of 1 rem.

minority population—Minority populations exist where either: (a) the minority population of the affected area exceeds 50 percent, or (b) the minority population percentage of the affected area is meaningfully greater than in the general population or other appropriate unit of geographic analysis (such as a governing body's jurisdiction, a neighborhood, census tract, or other similar unit). "Minority" refers to individuals who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. "Minority populations" include either a single minority group or the total of all minority persons in the affected area. They may consist of groups of individuals living in geographic proximity to one another or a geographically dispersed/transient set of individuals, where either group experiences common conditions of environmental exposure or effect. (*See* environmental justice and low-income population.)

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

mitigate—Mitigation includes: (1) avoiding an impact altogether by not taking a certain action or parts of an action; (2) minimizing impacts by limiting the degree or magnitude of an action and its implementation; (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment; (4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of an action; or (5) compensating for an impact by replacing or providing substitute resources or environments.

mixed waste—Waste that contains both nonradioactive hazardous waste and radioactive waste, as defined in this glossary.

National Ambient Air Quality Standards—Standards defining the highest allowable levels of certain pollutants in the ambient air (the outdoor air to which the public has access). Because the U.S. Environmental Protection Agency must establish the criteria for setting these standards, the regulated pollutants are called *criteria* pollutants. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter (less than or equal to 10 micrometers [0.0004 inches] in diameter and less than or equal to 2.5 micrometers [0.0001 inches] in diameter). Primary standards are established to protect public health; secondary standards are established to protect public welfare (such as visibility, crops, animals, buildings). (*See* criteria pollutant.)

National Emission Standards for Hazardous Air Pollutants—Emissions standards set by the U.S. Environmental Protection Agency for air pollutants which are not covered by National Ambient Air Quality Standards and which may, at sufficiently high levels, cause increased fatalities, irreversible health effects, or incapacitating illness. These standards are given in 40 CFR Parts 61 and 63. National Emission Standards for Hazardous Air Pollutants are given for many specific categories of sources (such as equipment leaks, industrial process cooling towers, dry cleaning facilities, petroleum refineries). (*See* hazardous air pollutants.)

National Environmental Policy Act (NEPA) of 1969—This Act, found at 42 U.S.C. § 4321 et seq., is the basic national charter for protection of the environment. It establishes policy, sets goals, and provides the means for carrying out policy. 42 U.S.C. § 4332 contains "action-forcing" provisions to ensure that federal agencies follow the letter and spirit of the Act. For major federal actions significantly affecting the quality of the human environment, 42 U.S.C. § 4332(C) requires federal agencies to prepare a detailed statement that includes the environmental impacts of the Proposed Action and other specified information.

National Historic Preservation Act—This Act provides that cultural resources with significant national, state, or local historic value be placed on the National Register of Historic Places. It does not require any permits; however, if a federal action might affect a historic property, it mandates consultation with the proper agencies and interested parties to determine the affect and develop measures to avoid, minimize, or mitigate adverse effects (54 U.S.C. § 300101 et seq. and 36 CFR 800.1 et seq.).

National Pollutant Discharge Elimination System (NPDES)—A provision of the Clean Water Act which prohibits discharge of pollutants into waters of the U.S. unless a special permit is issued by the U.S. Environmental Protection Agency, a state, or, where delegated, a tribal government on an Indian reservation. The National Pollutant Discharge Elimination System permit lists either permissible discharges, the level of cleanup technology required for wastewater, or both.

National Register of Historic Places—The official list of the Nation's cultural resources that are worthy of preservation. The National Park Service maintains the list under direction of the Secretary of the Interior. Buildings, structures, objects, sites, and districts are included in the National Register for their importance in American history, architecture, archaeology, culture, or engineering. The listed properties are not just of nationwide importance; most are significant primarily at the state or local level. Procedures for listing properties on the National Register are found in 36 CFR Part 60.

natural phenomena accidents—Accidents that are initiated by phenomena such as earthquakes, tornadoes, floods, etc.

natural uranium—Uranium with the naturally occurring distribution of uranium isotopes (approximately 0.7-weight percent uranium-235, and the remainder essentially uranium-238). (*See* uranium, depleted uranium, enriched uranium, highly enriched uranium, and low-enriched uranium.)

neptunium-237—A manmade element, with the atomic number 93. Pure neptunium is a silvery metal. The neptunium-237 isotope has a half-life of 2.14 million years. When neptunium-237 is bombarded by neutrons, it is transformed to neptunium-238, which in turn undergoes radioactive decay to become plutonium-238. When neptunium-237 undergoes radioactive decay, it emits alpha particles and gamma rays.

neutron—An uncharged elementary particle with a mass slightly greater than that of the proton. Neutrons are found in the nucleus of every atom heavier than hydrogen-1.

neutron flux—The product of neutron number density and velocity (energy), giving an apparent number of neutrons flowing through a unit area per unit time.

nitrogen—A natural element with the atomic number 7. It is diatomic in nature and is a colorless and odorless gas that constitutes about four-fifths of the volume of the atmosphere.

nitrogen oxides—Refers to the oxides of nitrogen, primarily nitrogen oxide and nitrogen dioxide. These are produced in the combustion of fossil fuels and can constitute an air pollution problem. Nitrogen dioxide emissions contribute to acid deposition and formation of atmospheric ozone.

noise—Undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (hearing, sleep), damage hearing, or diminish the quality of the environment.

noise pollution—Any sound that is undesirable because it interferes with speech and hearing, or is intense enough to damage hearing, or is otherwise annoying or undesirable.

nonattainment area—An area that the U.S. Environmental Protection Agency has designated as not meeting (not being in attainment of) one or more of the National Ambient Air Quality Standards for sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and particulate matter. An area may be in attainment for some pollutants, but not for others. (*See* attainment area, National Ambient Air Quality Standards, and particulate matter.)

non-nuclear aboveground experimentation—Aboveground experimentation or testing in support of nuclear weapons programs that does not involve detonation of a nuclear explosive.

nonproliferation—Preventing the spread of nuclear weapons, nuclear weapon materials, and nuclear weapon technology.

normal operations—All normal (incident-free) conditions and those abnormal conditions that frequency estimation techniques indicate occur with a frequency greater than 0.1 events per year.

Notice of Availability (NOA)—Public announcement that an EIS has been prepared and published by and agency (either in draft or final form). It describes the Proposed Action, possible alternatives, and the process for submitting comments (for a Draft EIS), including whether, when, and where any hearings will be held (for a Draft EIS). The NOA is usually published in the *Federal Register* and local media. The comment period on the Draft EIS officially begins with publication of the EPA NOA for the Draft EIS.

Notice of Intent (NOI)—Public announcement that an environmental impact statement will be prepared and considered. It describes the Proposed Action, possible alternatives, and scoping process, including whether, when, and where any scoping meetings will be held. The NOI is usually published in the *Federal Register* and local media. The scoping process includes holding at least one public meeting and requesting written comments on issues and environmental concerns that an environmental impact statement should address.

nuclear criticality—See criticality.

nuclear explosive—Any assembly containing fissionable and/or fusionable materials and main-charge high-explosive parts or propellants capable of producing a nuclear detonation.

nuclear facility—A facility that is subject to requirements intended to control potential nuclear hazards. Defined in U.S. Department of Energy directives as any nuclear reactor or any other facility whose operations involve radioactive materials in such form and quantity that a significant nuclear hazard potentially exists to the employees or the general public.

nuclear material—Composite term applied to—(1) special nuclear material; (2) source material such as uranium or thorium or ores containing uranium or thorium; and (3) byproduct material, which is any radioactive material that is made radioactive by exposure to the radiation incident to the process of producing or using special nuclear material.

nuclear reactor—A device that sustains a controlled nuclear fission chain reaction that releases energy in the form of heat.

Nuclear Regulatory Commission (NRC)—The federal agency that regulates the civilian nuclear power industry in the U.S.

nuclear weapon—The general name given to any weapon in which the explosion results from the energy released by reactions involving atomic nuclei, either fission, fusion, or both.

nuclear weapons complex—The sites supporting the research, development, design, manufacture, testing, assessment, certification, and maintenance of the Nation's nuclear weapons and the subsequent dismantlement of retired weapons.

nuclide—A species of atom characterized by the constitution of its nucleus and hence by the number of protons, the number of neutrons, and the energy content.

Oak Ridge National Laboratory (ORNL)—A U.S. Department of Energy (DOE) laboratory complex located in eastern Tennessee about 25 miles west of Knoxville, that is managed and operated by a private consortium under contract to DOE.

Occupational Safety and Health Administration (OSHA)—The federal agency that oversees and regulates workplace health and safety; created by the Occupational Safety and Health Act of 1970.

offsite—The term denotes a location, facility, or activity occurring outside the site boundary.

One- to three-room structure/fieldhouse—The remains of a small, surface structure constructed of adobe, jacal (thatch), or masonry. The site typically consists of square- to rectangular-shaped rock alignments, with individual units being no more than 3 meters in length. The majority of these sites is identical to what many researchers term seasonally used fieldhouses and farmsteads. Also included in the one- to three-room structure type are examples of unusually large rectangular structures, along with several rather small structures, which are unusual because of the presence of upright stones or because of location, such as at the eastern tips of mesas. Some of these unusual structures may represent shrines or have been used for purposes not directly related to agriculture.

onsite—The term denotes a location or activity occurring within the boundary of a DOE/NNSA complex site.

oralloy—Introduced in early Los Alamos documents to mean enriched uranium (Oak Ridge alloy); now uncommon except to signify highly enriched uranium.

outfall—The discharge point of a drain, sewer, or pipe as it empties into the environment.

ozone—The triatomic form of oxygen; in the stratosphere, ozone protects Earth from the sun's ultraviolet rays, but in lower levels of the atmosphere, ozone is considered an air pollutant.

package—For radioactive materials, the packaging, together with its radioactive contents, as presented for transport (the packaging plus the radioactive contents equals the package).

packaging—With regard to hazardous or radionuclide materials, the assembly of components necessary to ensure compliance with federal regulations. It may consist of one or more receptacles, absorbent materials, spacing structures, thermal insulation, radiation shielding, and devices for cooling or absorbing mechanical shocks. The vehicle tie-down system and auxiliary equipment may be designated as part of the packaging.

page—The CEQ NEPA implementing regulations at 40 CFR 1502.7 require that "[t]he text of final environmental impact statements … shall not exceed 300 pages." Per 40 CFR 1508.1(bb), "Page means 500 words and does not include citations, explanatory maps, diagrams, graphs, tables, and other means of graphically displaying quantitative or geospatial information."

paleontological resources—The physical remains, impressions, or traces of plants or animals from a former geologic age; may be sources of information on ancient environments and the evolutionary development of plants and animals.

particulate matter (PM)—Any finely divided solid or liquid material, other than uncombined (pure) water. A subscript denotes the upper limit of the diameter of particles included. Thus, PM_{10} includes only those particles equal to or less than 10 micrometers (0.0004 inches) in diameter; $PM_{2.5}$ includes only those particles equal to or less than 2.5 micrometers (0.0001 inches) in diameter.

perennial stream—A stream that flows throughout the year.

permeability—In geology, the ability of rock or soil to transmit a fluid.

person-rem—A unit of collective radiation dose applied to populations or groups of individuals; that is, a unit for expressing the dose when summed across all persons in a specified population or group. (*See* collective dose.)

Perimeter Intrusion Detection and Assessment System (PIDAS)—A mutually supporting combination of barriers, clear zones, lighting, and electronic intrusion detection, assessment, and access control systems constituting the perimeter of the Protected Area and designed to detect, impede, control, or deny access to the Protected Area.

pit—The central core of a primary assembly in a nuclear weapon typically composed of plutonium-239 and/or highly enriched uranium and other materials.

plaza pueblo—Contains one pueblo roomblock that partially encloses (on three sides) or completely encloses a plaza and/or contains two or more pueblo roomblocks located close together (less than 200 meters apart). Plaza pueblos typically are much larger (in both room numbers and site size) than single pueblo roomblock sites, often representing structures originally two or three stories in height.

Pleistocene—The geologic time period of the earliest epoch of the Quaternary period, spanning between about 1.6 million years ago and the beginning of the Holocene epoch at 10,000 years ago. It is characterized by the succession of northern glaciations and also called the "Ice Age."

plume—The elongated volume of contaminated water or air originating at a pollutant source such as an outlet pipe or a smokestack. A plume eventually diffuses into a larger volume of less contaminated material as it is transported away from the source.

plutonium—A heavy, radioactive, metallic element with the atomic number 94. It is produced artificially by neutron bombardment of uranium. Plutonium has 15 isotopes with atomic masses ranging from 232 to 246 and half-lives from 20 minutes to 76 million years.

plutonium-238—An isotope with a half-life of 87.74 years used as the heat source for radioisotope power systems. When plutonium-238 undergoes radioactive decay, it emits alpha particles and gamma rays. Plutonium-238 may fission if exposed to neutrons. The likelihood of plutonium-238 undergoing fission is dependent upon many factors including the number and energy of neutrons, temperature, plutonium-238 purity and shape, and the presence and proximity of other elements.

plutonium-239—An isotope with a half-life of 24,110 years that is the primary radionuclide in weapons-grade plutonium. When plutonium-239 decays, it emits alpha particles. Plutonium-239 may fission if exposed to neutrons. The likelihood of plutonium-239 undergoing fission is dependent upon many factors including the number and energy of neutrons, temperature, plutonium-239 purity and shape, and the presence and proximity of other elements.

population dose—See collective dose.

pounds per square inch—A measure of pressure; atmospheric pressure is about 14.7 pounds per square inch.

precontact resources—The physical remains of human activities that predate written records; they generally consist of artifacts that may alone or collectively yield otherwise inaccessible information about the past.

Prevention of Significant Deterioration—Regulations established to prevent significant deterioration of air quality in areas that already meet National Ambient Air Quality Standards. Specific details of Prevention of Significant Deterioration are found in 40 CFR 51.166. Among other provisions, cumulative increases in sulfur dioxide, nitrogen dioxide, and PM_{10} levels after specified baseline dates must not exceed specified maximum allowable amounts. These allowable increases, also known as increments, are especially stringent in areas designated as Class I areas (such as national parks, wilderness areas) where the preservation of clean air is particularly important. All areas not designated as Class I are currently designated as Class II. Maximum increments in pollutant levels are also given in 40 CFR 51.166 for Class III areas, if any such areas should be so designated by EPA. Class III increments are less stringent than those for Class I or Class II areas. (*See* National Ambient Air Quality Standards.)

prime farmland—Land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oil-seed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, without intolerable soil erosion, as determined by the Secretary of Agriculture (Farmland Protection Act of 1981, 7 CFR Part 7, paragraph 658).

probabilistic risk assessment—A comprehensive, logical, and structured methodology that accounts for population dynamics and human activity patterns at various levels of sophistication, considering time-space distributions and sensitive subpopulations. The probabilistic method results in a more complete characterization of the exposure information available, which is defined by probability distribution functions. This approach offers the possibility of an associated quantitative measure of the uncertainty around the value of interest.

process—Any method or technique designed to change the physical or chemical character of the product.

programs—DOE and NNSA are organized into Program Offices, each of which has primary responsibilities within the set of DOE and NNSA missions. Funding and direction for activities at DOE/NNSA 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.

projects—This term is used to describe activities with a clear beginning and end that are undertaken to meet a specific goal or need. Projects can vary in scale from very small (such as a project to undertake one experiment or a series of small experiments) to major (such as a project to construct and start up a new nuclear facility). Projects are usually relatively short-term efforts, and they can cross multiple programs and missions, although they are usually "sponsored" by a primary Program Office. In this SWEIS, this term is usually used more narrowly to describe construction activities, including facility modifications (such as a project to build a new office building or to establish and demonstrate a new capability). Construction projects considered reasonably foreseeable at LANL over about the next 15 years are discussed and analyzed in this SWEIS (*see* Chapter 3).

Protected Area—A type of security area defined by physical barriers (walls or fences), to which access is controlled, used for protection of security Category II special nuclear materials and classified matter and/or to provide a concentric security zone surrounding a Material Access Area (security Category I nuclear materials) or a Vital Area.

proton—An elementary nuclear particle with a positive charge equal in magnitude to the negative charge of the electron; it is a constituent of all atomic nuclei, and the atomic number of an element indicates the number of protons in the nucleus of each atom of that element.

pueblo roomblock— The remains of a contiguous, multiroom habitation structure (four or more rooms with no enclosed plaza) constructed of adobe, jacal, or masonry. Often appearing as somewhat amorphous mounds, they contain evidence of stone rubble (rubble mounds).

Quaternary—The third and last of the three periods of the Cenozoic Era, which began 2.58 million years ago. The Quaternary Period is divided into two epochs: the Holocene (earlier) and Pleistocene (later). A thin layer of sediments deposited during the Quaternary covers much of Earth's land surface. The Quaternary Period is famous for the many cycles of glacial growth and retreat, the extinction of many species of large mammals and birds, and the spread of humans.

rad—See radiation absorbed dose.

radiation (ionizing)—See ionizing radiation.

radiation absorbed dose (rad)—The basic unit of absorbed dose equal to the absorption of 0.01 joules per kilogram (100 ergs per gram) of absorbing material.

radioactive waste—In general, waste that is managed for its radioactive content. Waste material that contains source, special nuclear, or byproduct material is subject to regulation as radioactive waste under the Atomic Energy Act. Also, waste material that contains accelerator-produced radioactive material or a high concentration of naturally occurring radioactive material may be considered radioactive waste.

radioactivity—

Radioactivity—

Defined as a *process*: The spontaneous transformation of unstable atomic nuclei, usually accompanied by the emission of ionizing radiation.

Defined as a *property*: The property of unstable nuclei in certain atoms to spontaneously emit ionizing radiation during nuclear transformations.

radioisotope or radionuclide—An unstable isotope that undergoes spontaneous transformation, emitting radiation. (*See* isotope.)

radioisotope power system—Any one of a number of technologies used in spacecraft and in national security technologies that produces heat or electricity from the radioactive decay of suitable radioactive substances such as plutonium-238. They are typically used in applications such as to enable the operation of instruments and sensors where energy sources such as solar power are undesirable or impractical due to the remoteness or extreme conditions of the operating environment.

radioisotope thermoelectric generator (RTG)—An electrical generator that derives its electric power from heat produced by the decay of radioactive strontium-90, plutonium-238, or other suitable isotopes. The heat generated is directly converted into electricity, in a passive process, by an array of thermocouples.

radon—A gaseous, radioactive element with the atomic number 86, resulting from the radioactive decay of radium. Radon occurs naturally in the environment and can collect in unventilated enclosed areas, such as basements. Large concentrations of radon can cause lung cancer in humans.

RADTRAN—A computer code combining user-determined meteorological, demographic, transportation, packaging, and material factors with health physics data to calculate the expected radiological consequences and accident risk of transporting radioactive material.

reactor facility—Unless it is modified by words such as containment, vessel, or core, the term "reactor facility" includes the housing, equipment, and associated areas devoted to the operation and maintenance of one or more reactor cores. Any apparatus that is designed or used to sustain nuclear chain reactions in a controlled manner, including critical and pulsed assemblies and research, test, and power reactors, is defined as a reactor. All assemblies designed to perform subcritical experiments that could potentially reach criticality are also considered reactors.

Record of Decision (ROD)—A document prepared in accordance with the requirements of 40 CFR 1505.2 and 10 CFR 1021.315 that provides a concise public record of the U.S. Department of Energy's (DOE) decision on a Proposed Action for which an environmental impact statement was prepared. A ROD identifies the alternatives considered in reaching the decision; the environmentally preferable alternative; factors balanced by DOE in making the decision; and whether all practicable means to avoid or minimize environmental harm have been adopted, and, if not, the reason why they were not.

reference dose—The chronic-exposure dose (milligram or kilogram per day) for a given hazardous chemical at which or below which adverse human noncancer health effects are not expected to occur.

region of influence (ROI)—A site-specific geographic area in which the principal direct and indirect effects of actions are likely to occur.

rem (roentgen equivalent man)—A unit of dose equivalent. The dose equivalent in rem equals the absorbed dose in rad in tissue multiplied by the appropriate quality factor and possibly othermodifying factors. Derived from "roentgen equivalent man," referring to the dosage of ionizing radiation that will cause the same biological effect as one roentgen of x-ray or gamma-ray exposure. (*See* absorbed dose and dose equivalent.)

remediation—The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

remote-handled waste—In general, refers to radioactive waste that must be handled at a distance to protect workers from unnecessary exposure (waste with a dose rate of 200 millirem per hour or more at the surface of the waste package). (*See* contact-handled waste.)

resin—See ion exchange resin.

Resource Conservation and Recovery Act (RCRA), as amended—A law that gives the U.S. Environmental Protection Agency the authority to control hazardous waste from "cradle to grave" (from the point of generation to the point of ultimate disposal), including its minimization, generation, transportation, treatment, storage, and disposal. The Resource Conservation and Recovery Act also sets forth a framework for the management of nonhazardous solid wastes. (*See* hazardous waste.)

riparian—Of, on, or relating to the banks of a natural course of water.

risk—The probability of a detrimental effect of exposure to a hazard. Risk is often expressed quantitatively as the probability of an adverse event occurring multiplied by the consequence of that event (in other words, the product of these two factors). However, separate presentation of probability and consequence is often more informative.

risk assessment (chemical or radiological)—The qualitative and quantitative evaluation performed in an effort to define the risk posed to human health and/or the environment by the presence or potential presence and/or use of specific chemical or radiological materials.

rock shelter—An overhang, indentation, or alcove formed naturally in a rock face or large boulder, or alternatively, a partly enclosed area created by rock falls leaning against a rock face or large boulder, and which exhibits evidence of human use. Rock shelters generally are not of great depth, in contrast to caves.

roentgen—A unit of exposure to ionizing x- or gamma radiation equal to or producing one electrostatic unit of charge per cubic centimeter of air.

runoff—The portion of rainfall, melted snow, or irrigation water that flows across the ground surface, and eventually enters streams.

Safe Drinking Water Act—This Act protects the quality of public water supplies, water supply and distribution systems, and all sources of drinking water.

safeguards—An integrated system of physical protection, material accounting, and material control measures designed to deter, prevent, detect, and respond to unauthorized access, possession, use, or sabotage of nuclear materials.

Safety Analysis Report—A report that systematically identifies potential hazards within a nuclear facility, describes and analyzes the adequacy of measures to eliminate or control identified hazards, and analyzes potential accidents and their associated risks. Safety analysis reports are used to ensure that a nuclear facility can be constructed, operated, maintained, shut down, and decommissioned safely and in compliance with applicable laws and regulations. Safety analysis reports are required for U.S. Department of Energy nuclear facilities and as a part of applications for U.S. Nuclear Regulatory Commission licenses. The U.S. Nuclear Regulatory Commission regulations or DOE Orders and technical standards that apply to the facility type provide specific requirements for the content of safety analysis reports. (*See* nuclear facility.)

sand—Loose grains of rock or mineral sediment formed by weathering that range in size from 0.0625 to 2.0 millimeters (0.0025 to 0.08 inches) in diameter, and often consists of quartz particles.

sandstone—A sedimentary rock composed mostly of sand-size particles cemented usually by calcite, silica, or iron oxide.

sanitary waste—Wastes generated by normal housekeeping activities, liquid or solid (includes sludge), that are not hazardous or radioactive.

Savannah River Site (SRS)—A U.S. Department of Energy (DOE) industrial complex located in southwestern South Carolina about 20 miles southeast of Augusta, Georgia, that is managed and operated by a private consortium under contract to DOE.

scope—In a document prepared pursuant to the National Environmental Policy Act of 1969, the range of actions, alternatives, and impacts to be considered.

scoping—An early and open process, including public notice and involvement, for determining the scope of issues to be addressed in an environmental impact statement (EIS) and for identifying the significant issues related to a Proposed Action. The scoping period begins after publication in the *Federal Register* of a Notice of Intent to prepare an EIS. The public scoping process is that portion of the process where the public is invited to participate. The U.S. Department of Energy's scoping procedures are found in 10 CFR 1021.311.

security—An integrated system of activities, systems, programs, facilities, and policies for the protection of Restricted Data and other classified information or matter, nuclear materials, nuclear weapons and nuclear weapons components, and/or U.S. Department of Energy or contractor facilities, property, and equipment.

sediment—Soil, sand, and minerals washed from land into water that deposit on the bottom of a water body.

seismic—Pertaining to any earth vibration, especially an earthquake.

seismicity—The frequency and distribution of earthquakes.

select agent—A select agent is defined as an agent, virus, bacteria, fungi, rickettsiae or toxin listed in Appendix A of *Federal Register* 29327 (42 CFR Part 72) titled, *Additional Requirements for Facilities Transferring or Receiving Select Agents*. Select Agents also includes (a) genetically modified micro-organisms or (b) genetic elements that contain nucleic acid sequences associated with pathogenicity from organisms listed in Appendix A, (c) genetically modified micro-organisms listed in Appendix A, and (d) genetically modified micro-organisms or genetic elements that contain nucleic acid sequences coding for any of the toxins in Appendix A, or their toxic subunits.

severe accident—An accident with a frequency rate of less than 10-6 per year that would have more severe consequences than a design-basis accident, in terms of damage to the facility, offsite consequences, or both. Also called a beyond-design-basis accident.

sewage—The total organic waste and wastewater generated by an industrial establishment or a community.

shielding—With regard to radiation, any material of obstruction (bulkheads, walls, or other construction) that absorbs radiation to protect personnel or equipment.

short-lived nuclides—Radioactive isotopes with half-lives no greater than about 30 years (such as cesium-137 and strontium-90).

short-term impact—In general, an impact that occurs during or for a short time after the action or activity that causes the impact.

silt—A sedimentary material consisting of fine mineral particles, intermediate in size between sand and clay. In general, soils categorized as silt show greater rates of erosion than soils categorized as sand.

soils—All unconsolidated materials above bedrock. Natural earthy materials on the earth's surface, in places modified or even made by human activity, containing living matter, and supporting or capable of supporting plants out of doors.

solid waste management unit (SWMU)—Any discernible unit at which solid waste has been placed at any time, and from which the New Mexico Environment Department determines there may be a risk of a release of hazardous waste or hazardous waste constituents, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at the Facility (LANL) at which solid wastes have been routinely and systematically released; they do not include one-time spills. See 61 FR 19431 (May 1, 1996).

source material—Depleted uranium, normal uranium, thorium, or any other nuclear material determined, pursuant to Section 61 of the Atomic Energy Act of 1954, as amended, to be source material, or ores containing one or more of the foregoing materials in such concentration as may be determined by regulation.

source term—The amount of a specific pollutant (chemicals, radionuclides) emitted or discharged to a particular environmental medium (air, water, earth) from a source or group of sources. It is usually expressed as a rate (amount per unit time).

spallation—A nuclear reaction in which the energy of the incident particle is so high that more than two or three particles are ejected from the target nucleus, and both its mass number and atomic number are changed.

special nuclear material(s)—A category of material subject to regulation under the Atomic Energy Act, consisting primarily of fissile materials. It is defined to mean plutonium, uranium-233, uranium enriched in the isotopes of uranium-233 or -235, and any other material that the Nuclear Regulatory Commission determines to be special nuclear material, but it does not include source material.

spectral characteristics—The natural property of a structure as it relates to the multidimensional temporal accelerations.

staging—The process of using several layers to achieve a combined effect greater than that of one layer.

stockpile—The inventory of active nuclear weapons for the strategic defense of the U.S.

stockpile stewardship program—A program that ensures the operational readiness (safety and reliability) of the U.S. nuclear weapons stockpile by the appropriate balance of surveillance, experiments, and simulations.

straw wattles—Tubes of rice straw used for erosion control, sediment control and stormwater runoff control.

sulfur oxides—Common air pollutants (primarily sulfur dioxide), a heavy, pungent, colorless gas (formed in the combustion of fossil fuels, considered a major air pollutant) and sulfur trioxide. Sulfur dioxide is involved in the formation of acid rain. It can also irritate the upper respiratory tract and cause lung damage.

supernatant—The liquid that stands over a precipitated material.

surface water—All bodies of water on the surface of Earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

target—A tube, rod, or other form containing material that, on being irradiated in a nuclear reactor or an accelerator, would produce a desired end product.

technical area (TA)—Geographically distinct administrative units established for the control of LANL operations. There are currently 50 active TAs; 47 in the 40 square miles of the LANL site, one at Fenton Hill, west of the main site, one comprising leased properties in town, and one compromising leased properties in Santa Fe.

tectonic—Of or relating to motion in Earth's crust and occurring on geologic faults.

Tertiary—The first geologic time period of the Cenozoic era (after the Mesozoic era and before the Quaternary period), spanning between about 66 million and 1.6 million years ago. During this period, mammals became the dominant life form on Earth.

threatened species—Any plants or animals that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and which have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set out in the Endangered Species Act and its implementing regulations (50 CFR Part 424). (*See* endangered species.)

threshold limit values—The recommended highest concentrations of contaminants to which workers may be exposed according to the American Conference of Governmental Industrial Hygienists.

total effective dose equivalent—The sum of the effective dose equivalent from external exposures and the committed effective dose equivalent from internal exposures.

Toxic Substances Control Act of 1976 (TSCA)—This Act authorizes the U.S. Environmental Protection Agency (EPA) to secure information on all new and existing chemical substances and to control any substances determined to cause an unreasonable risk to public health or the environment. This law requires that the health and environmental effects of all new chemicals be reviewed by the EPA before they are manufactured for commercial purposes.

transmutation—The transformation of one isotope into another isotope by changing its nuclear structure. It can occur naturally through radioactive decay, or the fission and neutron capture processes can be hastened by using nuclear reactors or particle accelerators. By converting long-lived hazards into materials that are, or soon will be, sable and harmless, the nuclear cycle is effectively complete.

transuranic—Refers to any element whose atomic number is higher than that of uranium (atomic number 92), including neptunium, plutonium, americium, and curium. All transuranic elements are produced artificially and are radioactive.

transuranic waste—Radioactive waste containing more than 100 nanocuries of alpha-emitting transuranic isotopes per gram of waste, with half-lives greater than 20 years, except for: (1) high-level radioactive waste; (2) waste that the Secretary of Energy has determined, with the concurrence of the Administrator of the Environmental Protection Agency, does not need the degree of isolation required by the 40 CFR Part 191 disposal regulations; of (3) waste that the U.S. Nuclear Regulatory Commission has approved for disposal on a case-by-case basis in accordance with 10 CFR Part 61 (DOE 435.1).

tuff—A fine-grained rock composed of ash or other material formed by volcanic explosion or aerial expulsion from a volcanic vent.

Type B packaging—A regulatory category of packaging for transportation of radioactive material. The U.S. Department of Transportation and U.S. Nuclear Regulatory Commission require Type B packaging for shipping highly radioactive material. Type B packages must be designed and demonstrated to retain their containment and shielding integrity under severe accident conditions, as well as under the normal conditions of transport. The current U.S. Nuclear Regulatory Commission testing criteria for Type B package designs (10 CFR Part 71) are intended to simulate severe accident conditions, including impact, puncture, fire, and immersion in water. The most widely recognized Type B packages are the massive casks used for transporting spent nuclear fuel. Large-capacity cranes and mechanical lifting equipment are usually needed to handle Type B packages.

Type B shipping cask—A U.S. Nuclear Regulatory Commission-certified cask with a protective covering that contains and shields radioactive materials, dissipates heat, prevents damage to the contents, and prevents criticality during normal shipment and accident conditions. It is used for transport of highly radioactive materials and is tested under severe, hypothetical accident conditions that demonstrate resistance to impact, puncture, fire, and submersion in water.

uranium—A radioactive, metallic element with the atomic number 92; one of the heaviest naturally occurring elements. Uranium has 14 known isotopes, of which uranium-238 is the most abundant in nature. Uranium-235 is commonly used as a fuel for nuclear fission. (*See* natural uranium, enriched uranium, highly enriched uranium, and depleted uranium.)

Vadose zone—The portion of Earth between the land surface and the water table.

vault (special nuclear material)—A penetration-resistant, windowless enclosure having an intrusion alarm system activated by opening the door and which also has—walls, floor, and ceiling substantially constructed of materials that afford forced-penetration resistance at least equivalent to that of 20-centimeter- (8-inch-) thick reinforced concrete; and a built-in combination-locked steel door, which for existing structures is at least 2.54-centimeters (1-inch) thick exclusive of bolt work and locking devices, and which for new structures meets standards set forth in federal specifications and standards.

viewshed—The extent of an area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

volatile organic compounds—A broad range of organic compounds, often halogenated, that vaporize at ambient or relatively low temperatures, such as benzene, chloroform, and methyl alcohol. With regard to air pollution, any organic compound that participates in atmospheric photochemical reaction, except for those designated by the U.S. Environmental Protection Agency Administrator as having negligible photochemical reactivity.

waste acceptance criteria—The requirements specifying the characteristics of waste and waste packaging acceptable to a disposal facility, and the documents and processes the generator needs to certify that the waste meets applicable requirements.

waste classification—Wastes are classified according to DOE Order 435.1, Radioactive Waste Management, and include high-level, transuranic, and low-level wastes.

Waste Isolation Pilot Plant (WIPP)—A U.S. Department of Energy facility designed and authorized to permanently dispose of defense-related transuranic waste in a mined underground facility in deep geologic salt beds. It is located in southeastern New Mexico, 26 miles east of the city of Carlsbad.

waste management—The planning, coordination, and direction of those functions related to generation, handling, treatment, storage, transportation, and disposal of waste, as well as associated surveillance and maintenance activities.

waste minimization and pollution prevention—An action that economically avoids or reduces the generation of waste and pollution by source reduction, reducing the toxicity of hazardous waste and pollution, improving energy use, or recycling. These actions will be consistent with the general goal of minimizing present and future threats to human health, safety, and the environment.

water table—The boundary between the unsaturated zone and the deeper, saturated zone. The upper surface of an unconfined aquifer.

watt—A unit of power equal to 1 joule per second. (*See* joule.)

wetland—Wetlands are "... those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 CFR 328.3).

whole-body dose—In regard to radiation, dose resulting from the uniform exposure of all organs and tissues in a human body. (*See* effective dose equivalent.)

wind rose—A circular diagram showing, for a specific location, the percentage of the time the wind is from each compass direction. A wind rose for use in assessing consequences of airborne releases also shows the frequency of different wind speeds for each compass direction.

yield—The force in tons of TNT of a nuclear or thermonuclear explosion.

CHAPTER 10
LIST OF PREPARERS

10.0 LIST OF PREPARERS

U.S. Department of Energy/National Nuclear Security Administration

Name	Education/Expertise	Contribution
Stephen Hoffman	M.A., Public Administration B.S., Mathematics Over 40 years of experience	NNSA Los Alamos NEPA Document Manager
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To support preparation of the LANL SWEIS, the Laboratory M&O Contractor, Triad, established a dedicated team of environmental professionals that were referred to as "the SWEIS Office." This team prepared supporting references, identified details related to project proposals, and supported technical reviews of the SWEIS for accuracy and completeness.

DOE-EM Los Alamos also received assistance during the preparation and review of the LANL SWEIS from their support contractor, N3B. The following individuals made a notable contribution to the SWEIS.

Name	Education/Expertise	Contribution
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The SWEIS was prepared under a contract with Tetra Tech, Inc. and its subcontractors, Rivers Consulting, Inc. and SC&A, as listed in the following table.

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Dave Wertz	M.S., Geophysics B.S. Environmental Science Over 17 years of experience	Water Resources; Infrastructure