DOE/EIS-0552

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

January 2025

National Nuclear Security Administration

U.S. Department of Energy
National Nuclear Security Administration
Los Alamos National Laboratory

Volume 2

COVER SHEET

RESPONSIBLE FEDERAL AGENCY: U.S. Department of Energy (DOE)/National Nuclear Security Administration (NNSA)

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

For further information regarding this LANL SWEIS, please contact:	For general information on the NNSA National Environmental Policy Act (NEPA) process, contact:
Mr. Stephen Hoffman LANL SWEIS Document Manager 3747 W. Jemez Road Los Alamos, New Mexico 87544 email: LANLSWEIS@nnsa.doe.gov	Ms. Jessica Small NNSA Office of Environment, Safety and Health 24600 20th Street SE Albuquerque, New Mexico 87116 email: Jessica.Small@nnsa.doe.gov

This document is available for viewing and downloading on the NNSA NEPA Reading Room website (www.energy.gov/nnsa/nnsa-nepa-reading-room) and the DOE NEPA website (http://energy.gov/nepa/nepa-documents).

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*.

VOLUME 2 CONTENTS

APPENDIX A
Supplemental Supporting Information

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

1999 LANL SWEIS	Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico
2008 LANL SWEIS	Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico
2020 LANL SWEIS SA	Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory
Alts	alteration programs
ARIES	Advanced Recovery and Integrated Extraction System
BDD	Buckman Direct Diversion
BLM	U.S. Bureau of Land Management
BMP	best management practice
BRWTP	Buckman Regional Water Treatment Plant
BSL	Biosafety Level
BTF	Beryllium Technology Facility
CEQ	Council on Environmental Quality
CGP	Construction General Permit
CMR	Chemistry and Metallurgy Research
CMRR EIS	Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico
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
CMRR-NF	Chemistry and Metallurgy Research Replacement–Nuclear Facility
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
CWF	Consolidated Waste Facility
CX	categorical exclusion
DARHT	Dual Axis Radiographic Hydrodynamic Test
DARHT EIS	Final Environmental Impact Statement for the Dual-Axis Radiographic Hydrodynamic Test Facility
DCE	Distributed Center of Excellence
DD&D	decontamination, decommissioning, and demolition
DNFSB	Defense Nuclear Facilities Safety Board
DoD	U.S. Department of Defense
DOE-EM	DOE Office of Environmental Management
DP	Delta Prime
EA	environmental assessment
EJIWG	Federal Interagency Working Group on Environmental Justice
ELF	Explosives and Lasers Facility
EIS	environmental impact statement

EMCF	Energetic Materials Characterization Facility
EPA	Environmental Protection Agency
EPCU	Electric Power Capacity Upgrade
ETC	Environmental Test Complex
FONSI	Finding of No Significant Impact
FR	Federal Register
FSI	future supercomputing infrastructure
FSI WTF	FSI Water Treatment Facility
FY	fiscal year
HC	Hazard Category
HE	high explosives
HMX	high melting explosive
HPC	high-performance computing
LANL	Los Alamos National Laboratory
LANL SWEIS	Site-wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LEP	life extension program
LINAC	linear accelerator
LLW	low-level radioactive waste
µg/L	micrograms per liter
MAPR	Manhattan Project National Historical Park
MDA	material disposal area
MGY	million gallons per year
MLLW	mixed low-level radioactive waste
Mods	modification programs
MOX	mixed-oxide
MSGP	Multi-Sector General Permit
N3B	Newport News Nuclear BWXT Los Alamos, LLC
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NEEWC	National Energetic and Engineering Weapons Complex
NESHAP	National Emission Standards for Hazardous Air Pollutants
NM	New Mexico
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NPR	Nuclear Posture Review
NPS	National Park Service
NRC	U.S. Nuclear Regulatory Commission
OSRP	Offsite Source Recovery Program
pCi/L	picocuries per liter
PCBs	polychlorinated biphenyls
PETN	Pentaerythritol Tetranitrate
PFAS	per- and polyfluoroalkyl substances

PV	photovoltaic
R&D	research and development
RCRA	Resource Conservation and Recovery Act
RDX	Royal demolition explosives
RLUOB	Radiological Laboratory/Utility/Office Building
RLUOB EA	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
RLWTF	Radioactive Liquid Waste Treatment Facility
ROD	Record of Decision
ROW	right of way
SA	Supplement Analysis
SCC	Strategic Computing Complex
SEA	supplemental environmental assessment
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
SERF EA	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
SFNF	Santa Fe National Forest
SMA	site monitoring areas
SNM	special nuclear material
Solar Array EA	Final Environmental Assessment for the Proposed Construction and Operation of a Solar Photovoltaic Array at Los Alamos National Laboratory, Los Alamos, New Mexico
SSM PEIS	Programmatic Environmental Impact Statement for Stockpile Stewardship and Management
SPDP	Surplus Plutonium Disposition Program
SPDP EIS	Surplus Plutonium Disposition Program Final Environmental Impact Statement
SPP	Strategic Partnership Projects
SRS	Savannah River Site
STD	Standard (as in DOE-STD-1027)
SWMU	solid waste management unit
SWPPP	Stormwater pollution prevention plans
SWWS	Sanitary Wastewater System
TA	Technical Area
TCP	traditional cultural properties
TNT	trinitrotoluene
Trails Management EA	Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico
TRP	TA-55 Reinvestment Project
TRU	transuranic

TWF	TRU Waste Facility
UAS	unmanned aircraft system
UCN	ultracold neutron
U.S.C.	United States Code
USDOT	U.S. Department of Transportation
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Services
VOC	volatile organic compound
WETF	Weapons Engineering Tritium Facility
WIPP	Waste Isolation Pilot Plant
WTA	Western Technical Area
WTF	Water Treatment Facility

A SUPPLEMENTAL SUPPORTING INFORMATION

As identified in Chapter 1, Section 1.6, this SWEIS complies with the Council on Environmental Quality (CEQ) implementing regulations at 40 CFR Part 1502 that became effective May 2022 and which place a maximum page count for EISs at 300. Therefore, the material in Volume 1 was streamlined to include the elements required by CEQ and focus on current and future actions that Record of Decision (ROD). This appendix contains supplemental, supporting information that provides additional background related to the NEPA process, Laboratory missions, proposed project details, the affected environment, and potential environmental impacts. The section and subsection numbering of this appendix has been organized to assist the reader in relating the supplemental supporting information to the chapter and section in Volume 1 that the information supports. Therefore, some sections in this appendix are reserved (e.g., Section A.1.1) to keep the numbering consistent with Volume 1 and to allow for future expansion (e.g., in the Final SWEIS).

A.1 Introduction - Supplemental Information

This section provides information that supplements and supports the material presented in Chapter 1, Introduction. The primary information in this section is associated with documents prepared under the National Environmental Policy Act (NEPA) that are relevant to this *Draft Site-wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory* (DOE/EIS-0552) (LANL SWEIS or SWEIS).

A.1.1 Introduction

This section is reserved.

A.1.2 Background

This section is reserved.

A.1.3 Purpose and Need for Agency Action

This section is reserved.

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

This section provides information about the NEPA and other documents that are relevant to this LANL SWEIS and are listed in Table 1.4-1 in Chapter 1. The information is provided for programmatic NEPA documents relevant to LANL (A.1.4.1), site-specific EISs and associated supplement analyses (SAs) (A.1.4.2), waste-related EISs (A.1.4.3), site-specific environmental assessments (EAs) (A.1.4.4), and other documents related to the agency's purpose and need (A.1.4.5).

A.1.4.1 Programmatic NEPA Documents

In accordance with DOE's NEPA implementing procedures (10 CFR 1021.330(d)), DOE evaluates site-wide NEPA documents at least every five years by means of SA, as provided in 10 CFR 1021.314. Based on the SA, DOE determines whether the existing SWEIS remains adequate or whether to prepare a new SWEIS or supplement the existing EIS, as appropriate. The determination and supporting analysis are made publicly available.

The statutory requirements that were included in the *Fiscal Responsibility Act* (Public Law 118-5, June 3, 2023) state the following in Section 108:

> "*When an agency prepares a programmatic environmental document for which judicial review was available, the agency may rely on the analysis included in the programmatic environmental document in a subsequent environmental document for related actions as follows: (1) Within 5 years and without additional review of the analysis in the programmatic environmental document, unless there are substantial new circumstances or information about the significance of adverse effects that bear on the analysis. (2) After 5 years, so long as the agency reevaluates the analysis in the programmatic environmental document and any underlying assumption to ensure reliance on the analysis remains valid*."

This LANL SWEIS identifies several programmatic (or sitewide) EISs that are relevant to this SWEIS. Many of these programmatic EISs have been reevaluated or updated through SAs. Where applicable in the descriptions below, NNSA has indicated whether SAs have been prepared.

***Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (DOE/EIS-0236)** (SSM PEIS) (DOE 1996). During the mid-1990s, DOE prepared the SSM PEIS to evaluate alternatives for maintaining the safety and reliability of the U.S. nuclear weapons stockpile and preserving competencies in nuclear weapons in the post-Cold War era. During the Cold War, the United States could produce more than 1,000 pits per year. With regard to LANL activities, the SSM PEIS analyzed the potential impacts of a proposed action to provide enhanced experimental capability for stockpile stewardship. In particular, pit production, high-explosives (HE) fabrication, nonnuclear component fabrication, and plutonium research and development (R&D), among other things, were evaluated in the SSM PEIS. The No-Action Alternative proposed continuing to use existing capabilities at the Laboratory and elsewhere, as LANL maintained a limited capability to fabricate plutonium components using its plutonium R&D facility (including producing pits for nuclear explosives testing) and for performing surveillance to provide stockpile safety and reliability assessments. An SSM PEIS ROD published in the *Federal Register* (FR) on December 26, 1996 (61 FR 68014), documents DOE's decision to, among other things, transport and store an inventory of plutonium-242 from the Savannah River Site (SRS) to LANL. With regard to pit production, this ROD documented DOE's decision to reestablish the pit fabrication capability, at a small capacity, at LANL which involved reconfiguration of the Laboratory's Plutonium Facility at TA-55. The SSM PEIS is relevant for background information and was supplemented in 2008.

***Final Complex Transformation Supplemental Programmatic Environmental Impact Statement* (DOE/EIS-0236-S4)** (Complex Transformation SPEIS) (NNSA 2008a). In 2008, NNSA prepared the Complex Transformation SPEIS, a supplement to the 1996 SSM PEIS, to evaluate the potential environmental impacts of alternatives for transforming the nuclear weapons complex into a smaller, more efficient enterprise that could respond to changing national security challenges and ensure the long-term safety, security, and reliability of the nuclear weapons stockpile. A Complex Transformation SPEIS ROD, published in the *Federal Register* on December 19, 2008 (73 FR 77644), documents, among other things, the decision that manufacturing and R&D involving plutonium would remain at LANL at the authorized level of approximately 20 pits per year. This ROD also documents NNSA decision to construct and operate the Chemistry and Metallurgy Research Replacement–Nuclear Facility (CMRR-NF) at LANL as a replacement for portions of the Chemistry and Metallurgy Research (CMR) facility.

The Complex Transformation SPEIS is the current and best available information regarding potential impacts of its programmatic proposal. The SPEIS has been the subject of two SAs, one of which was related to evaluation of pit production at LANL and SRS (see below).

***Final Supplement Analysis of the Complex Transformation Supplemental Programmatic Impact Statement* (DOE/EIS-0236-S4-SA-02)** (Complex Transformation SPEIS SA) (NNSA 2019a). In December 2019, NNSA prepared an SA to evaluate NNSA's proposed action to adopt the Modified Distributed Center of Excellence (DCE) Alternative for plutonium operations. The Modified DCE Alternative enables NNSA to produce a minimum of 50 pits per year at a repurposed Mixed-Oxide Fuel Fabrication Facility at SRS and a minimum of 30 pits per year at LANL, with additional surge capacity at each site, if needed, to meet the requirements of producing pits at a rate of no fewer than 80 pits per year by 2030 for the nuclear weapons stockpile. The SA evaluated the potential complex-wide impacts of adopting the Modified DCE Alternative and of producing up to 80 pits per year at both SRS and LANL and considered new circumstances or information relevant to environmental concerns. For all resource areas, the analyses verified that the potential programmatic environmental impacts would not be different, or would not be significantly different, than impacts considered in existing NEPA analyses. Based on the results of the SA, NNSA determined that the Modified DCE Alternative does not constitute a substantial change from actions analyzed previously and that there were no significant new circumstances or information relevant to environmental concerns. As a result of the SA, NNSA published an amended ROD relative to programmatic decisions for pit production involving LANL. Specifically, this amended ROD stated:

> *"NNSA has decided at a programmatic level to implement aspects of a Modified DCE Alternative. LANL will implement actions to produce a minimum of 30 war reserve pits per year during 2026 for the national pit production mission and implement surge efforts to exceed 30 pits per year up to the analyzed limit as necessary. Pit production at these levels will take place without construction of CMRR-NF."*

Therefore, this amended ROD cancelled NNSA's prior commitment to build the CMRR-NF support facility (as analyzed in DOE/EIS-0350-SA-02; see description in Section A.1.4.2, below). The decision in this amended ROD is being implemented through a site-specific decision on the 2008 LANL SWEIS (*see* Chapter 1, Section 1.4.2). Since publication of the amended ROD, the 2026 pit production milestone has been delayed until 2028 (NNSA 2023a).

***Surplus Plutonium Disposition Final Supplemental Environmental Impact Statement* (DOE/EIS-0283-S2)** (NNSA 2015). In 2015, NNSA analyzed the environmental impacts of alternatives for the disposition of 13.1 metric tons of surplus plutonium for which a disposition path is not assigned, including 7.1 metric tons of surplus pit plutonium and 6 metric tons of surplus non-pit plutonium. In the ROD, published in the *Federal Register* on April 5, 2016 (81 FR 19588), DOE announced its decision to prepare and package the 6 metric tons of surplus non-pit plutonium using facilities at SRS to meet the Waste Isolation Pilot Plant (WIPP) waste acceptance criteria and ship the surplus non-pit plutonium transuranic (TRU) waste to the WIPP facility for disposal (the WIPP Disposal Alternative). NNSA prepared the *Supplement Analysis for Disposition of Additional Non-Pit Surplus Plutonium* (DOE/EIS-0283-SA-4) (NNSA 2020a). NNSA prepared this SA to consider whether the proposal to prepare and dispose of 7.1 metric tons of additional non-pit plutonium (rather than the pit plutonium described in the 2015 SPD SEIS) using the WIPP

Disposal Alternative represented significant new circumstances or information relevant to environmental concerns. NNSA concluded that the 2015 SPD SEIS addressed the impacts of the proposed preparation of an additional 7.1 metric tons of non-pit plutonium for disposal at the WIPP facility, and that no additional NEPA review was required. On August 28, 2020, NNSA published an amended ROD in the *Federal Register* (85 FR 53350) to announce its decision to dispose of an additional 7.1 metric tons of non-pit plutonium using the WIPP Disposal Alternative.

Surplus Plutonium Disposition Program Final Environmental Impact Statement **(DOE/EIS-0549)** (SPDP EIS) (NNSA 2024). On January 19, 2024, NNSA published a notice in the *Federal Register* (89 FR 3642) to announce the availability of the Final SPDP EIS. The Final SPDP EIS evaluates NNSA's proposed action to dispose of 34 metric tons of surplus plutonium. The SPDP EIS analyzes two alternatives in detail: the preferred alternative, consisting of four sub-alternatives, and the No-Action Alternative. Both alternatives use the dilute and dispose strategy and both address up to 7.1 metric tons of non-pit surplus plutonium that NNSA previously decided to dispose of (85 FR 53350; *see* NNSA 2020a) using the dilute and dispose strategy. NNSA's preferred alternative in the SPDP EIS is to use the dilute and dispose strategy for 34 metric tons of surplus plutonium made up of both pit and non-pit plutonium.

The base approach for the preferred alternative, which is reflected in the analysis in this LANL SWEIS, would include construction and modification activities at LANL to expand the existing pit disassembly and processing capability (i.e., DOE's Advanced Recovery and Integrated Extraction System (ARIES) Oxide Production Program) in the PF-4 building in TA-55. The construction and modification activities would include the addition of new or modified gloveboxes, material entry hoods, and other upgrades to increase throughput. These activities would occur largely inside the PF-4 building and would expand the current space used for pit disassembly and processing from 5,200 square feet to 6,800 square feet without impact to other programs.

The ROD was published on April 19, 2024 (89 FR 28763). NNSA's ROD 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) by approximately 10 years.

At the Laboratory, implementation of the pit disassembly and processing project would include construction and modification activities at LANL to expand the existing ARIES capabilities in PF-4. NNSA would construct a Logistical Support Center, a separate office building, a warehouse, a security portal, and a weather enclosure at the loading dock of PF-4.

In the interim, prior to implementation of pit disassembly and processing at LANL, the Laboratory may enhance the ARIES capabilities in PF-4. Chapter 3, Section 3.4.1 describes how this SWEIS evaluates the options for continued and future surplus plutonium disposition.

A.1.4.2 Site-Specific NEPA Documents

Continued Operation of Los Alamos Scientific Laboratory, Los Alamos, New Mexico **(DOE/EIS-0018)** (DOE 1979). The first Laboratory SWEIS described the ongoing site activities and discussed the actual and potential impacts, providing background and analysis including on overall cumulative impacts of the various missions and activities at the site. The SWEIS described the expansion of Laboratory and its nuclear programs in the post-World War II era, to include research programs in fission reactors, space technology, controlled thermonuclear reactions, and medical and biological applications. The Laboratory's diverse nonnuclear research areas included geothermal and solar energy resources and the use of superconductor technology for energy storage and transmission. The four major research areas covered national security, energy, biomedical and environmental, and physical research. This SWEIS is relevant for background information and was updated by issuance of the 1999 LANL SWEIS.

***Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EIS-0238)** (1999 LANL SWEIS) (DOE 1999a). The 1999 LANL SWEIS assessed four alternatives for the continued operation of the Laboratory: (1) No-Action, (2) Expanded Operations, (3) Reduced Operations, and (4) Greener. As analyzed in the 1999 SWEIS, the Expanded Operations Alternative was identified as the preferred alternative and would expand operations at the Laboratory, as the need arises, to increase the level of existing operations to the highest reasonably foreseeable levels, and to fully implement the mission elements assigned to the Laboratory. The preferred alternative presented in the Final 1999 LANL SWEIS included implementation of pit manufacturing at a level of 20 pits per year. This alternative also included the expansion of the low-level radioactive waste (LLW) disposal site at TA–54 and continued maintenance of existing and expanded capabilities, continued support/infrastructure activities, and implementation of several facility construction or modification projects at TA–53 (the long-pulse spallation source, the 5-megawatt target/blanket experimental area, the Dynamic Experiment Laboratory, and the Exotic Isotope Production Facility). A 1999 SWEIS ROD published in the *Federal Register* on September 20, 1999 (64 FR 50797), documents NNSA's decisions, which form the basis of the No-Action Alternative for the 2008 LANL SWEIS (*see* below).

Regarding pit production, the 1999 ROD announced that DOE would establish a pit production capability at LANL with a capacity of nominally 20 pits per year. The ROD also documented DOE's decision to continue to support both R&D and production activities involving tritium. These activities would include development of new reservoirs and reservoir fill operations, surveillance and performance testing on tritium components, tritium recovery and purification technologies, and production operations associated with neutron generator production for the stockpile. For HE processing and testing, the ROD documented an increase in the annual amount of explosives and mock explosives to about 82,700 pounds and 2,910 pounds, respectively. For accelerator operations, DOE decided to implement several facility construction or modification projects at TA–53: the Long-Pulse Spallation Source, the 5-Megawatt Target/Blanket Experimental Area, the Dynamic Experiment Laboratory, and the Isotope Production Facility. Lastly, DOE decided to continue onsite disposal of Laboratory generated LLW using the existing footprint at TA-54 Area G LLW disposal area and expand disposal capacity into Zones 4 and 6 at Area G. The 1999 SWEIS is relevant for background information and was updated by issuance of the 2008 LANL SWEIS. The 2008 SWEIS tiers from the 1999 SWEIS.

***Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EIS-0380)** (2008 LANL SWEIS) (NNSA 2008b). In May 2008, NNSA issued the 2008 LANL SWEIS, which analyzed NNSA's proposal to continue operating the Laboratory. NNSA assessed three alternatives for continued operation of LANL: (1) No-Action, (2) Reduced Operations, and (3) Expanded Operations. Expanded Operations was NNSA's preferred alternative. As mentioned above, the Expanded Operations Alternative selected in the 1999 ROD for the 1999 LANL SWEIS formed the basis of the No-Action Alternative in the 2008 SWEIS. In a ROD for the 2008 SWEIS, published in the *Federal*

Register on September 26, 2008 (73 FR 55833), DOE/NNSA announced its selection of the No-Action Alternative to continue operation of the Laboratory with the addition of two types of elements from the Expanded Operations Alternative: (1) changes in the level of operations for ongoing activities within existing facilities, and (2) new facility projects. The following bullets identify the specific activities include in the ROD and the status of the activities as of 2022.

- Changes in operational level in existing facilities:
  - Support for the Global Threat Reduction Initiative and Offsite Source Recovery Project (OSRP) (ongoing baseline activity);
  - Expansion of supercomputing capabilities at the Nicholas C. Metropolis Center (proposed expansion complete);
  - Research to improve beryllium detection and developing mitigation methods for beryllium dispersion to support industrial health and safety initiatives for beryllium workers (ongoing baseline activity); and
  - Retrieval and disposal of legacy TRU waste (ongoing baseline activity).

- New specific facility projects:
  - Plan, design, construct, and operate the Waste Management Facilities Transition projects required by the Compliance Order on Consent (2005 Consent Order; NMED 2005) (Transuranic Waste Facility completed; other ongoing activities included in the No-Action Alternative);
  - Repair and replace mission-critical cooling system components for buildings in TA-55 (completed); and
  - Complete final design of a new Radioactive Liquid Waste Treatment Facility and design of the Zero Liquid Discharge Facility (completed).

On July 10, 2009, DOE/NNSA issued a second ROD (74 FR 33232), in which DOE/NNSA documented its decision to maintain its selection of the No-Action Alternative from the 2008 LANL SWEIS but also decided to implement additional elements of the Expanded Operations Alternative specifying operational changes. The following projects were selected in the 2009 ROD:

- Complete environmental remediation and closure of the Pajarito Site at TA-18 (Pajarito Site closed and made part of the Manhattan Project National Historical Park);
- Complete environmental remediation and closure of the Delta Prime or DP4 Site at TA-21 (ongoing activity in the No-Action Alternative; parts of TA-21 have been transferred to Los Alamos County);
- Refurbish the Plutonium Facility Complex at TA-55 (ongoing activity in the No-Action Alternative);
- Construct and operate a new Radioactive Liquid Waste Treatment Facility at TA-50 and operate the Zero Liquid Discharge Facility at TA-52 (construction of the LLW Liquid Waste Treatment Facility is complete but requires modifications [*see* Section 2.6.5] the Transuranic Liquid Waste Facility is included in the No-Action Alternative); installation of the Solar Evaporation Tanks (formerly Zero Liquid Discharge Facility) is complete; waiting for permitting by the New Mexico Environment Department [NMED]);

- Continue expansion of supercomputing capabilities and operations at the Metropolis Center at TA-3 (ongoing baseline activity); and
- Construct and operate a new Science and Engineering Complex at TA-62 (cancelled).

Since 2008, NNSA has prepared six SAs on the 2008 LANL SWEIS. Information related to the SAs and any subsequently amended RODs are listed below:

In October 2009, NNSA prepared **DOE/EIS-0380-SA-01** (NNSA 2009), which evaluated the proposal to ship an estimated 15,000 cubic yards of low-specific activity and LLW from the North Ancho Canyon Aggregate Area to Energy*Solutions* in Clive, Utah, by truck and rail. The SA determined that the shipment for these proposed waste shipments was bounded by the 2008 LANL SWEIS transportation analysis. Neither additional NEPA evaluation nor an amendment to the existing ROD was required.

In April 2011, NNSA prepared **DOE/EIS-0380-SA-02** (NNSA 2011a), which evaluated within the OSRP, including recovery and management of high-activity beta/gamma sources from about 20 locations (domestic or foreign) annually as part of ongoing OSRP activities. Sources being transferred from foreign nations would be transported by commercial aircraft to a U.S. airport. From the receiving airport, or from other domestic locations, sources would be transported by commercial truck to a facility in Texas where they would be placed in storage pending reuse or disposal. The proposal also involved repatriation of sealed sources to another country. The SA demonstrated that implementation of the proposal would be expected to result in either environmental impacts that are within the range of the environmental impacts previously analyzed or that present no substantive change to those impacts. Based on the SA, NNSA published an amended ROD in the *Federal Register* on July 8, 2011 (76 FR 40352) that documented NNSA's decision to continue implementing the Global Threat Reduction Initiative OSRP program, including the recovery, storage, and disposition of high-activity beta/gamma sealed sources. This program includes the recovery of sealed sources from foreign countries, and NNSA decided that transport of high-activity sealed sources through the global commons via commercial cargo aircraft may be utilized as part of the ongoing Global Threat Reduction Initiative OSRP program.

In May 2016, DOE Office of Environmental Management (DOE-EM) prepared **DOE/EIS-0380-SA-03** (NNSA 2016a), which evaluated DOE's proposal to implement facility modifications to maintain safe handling and storage, and to conduct processing studies of 60 remediated TRU waste drums that contain remediated nitrate salts by implementing minor building modifications, installing a pressure-relief device with supplemental filtration, and executing tests to determine appropriate treatment methodologies. On the basis of the SA, DOE determined that the environmental impacts of the proposal were sufficiently considered and bounded by existing NEPA analyses and there was no need to prepare a supplemental EIS. An amended ROD was not required.

In December 2016, DOE-EM prepared **DOE/EIS-0380-SA-04** (NNSA 2016b), which evaluated DOE's proposal to treat, repackage, transport onsite, and store 89 TRU waste drums. These drums contained nitrate salts waste generated from 1979 through 1991 at the Laboratory. Of the 89 drums, 60 were improperly treated during a processing campaign from 2012 to 2014. As outlined in the earlier SA, these wastes were remediated nitrate salts drums. There were also 29 drums of unremediated nitrate salts included in the proposal. On the basis of this SA, DOE determined that the environmental impacts of the proposal were sufficiently considered and bounded by existing

NEPA analyses and there was no need to prepare a supplemental EIS. An amended ROD was not required.

In April 2018, NNSA prepared **DOE/EIS-0380-SA-05** (NNSA 2018a) to review changes in operations at the Laboratory since the publication of the 2008 LANL SWEIS (2008–2017) and evaluate the continued adequacy of the 2008 SWEIS for the future of LANL operations (2018–2022). The SA included a summary of major projects and programs including the TA-55 Reinvestment Project; modifications to the Radioactive Liquid Waste Treatment Facility; decontamination, decommissioning, and demolition (DD&D) of facilities across LANL (including TA-18 and TA-21); and various projects that had been initiated, implemented, and/or completed since issuance of the 2008 SWEIS pursuant to the 2016 Consent Order (NMED 2016a). The SA determined that the 2008 SWEIS provided a bounding NEPA analysis for a majority of projects planned over the next 5 years and no further NEPA evaluation was required.

In September 2020, NNSA prepared **DOE/EIS-0380-SA-06** (NNSA 2020b) to evaluate NNSA's proposal to implement elements of the Expanded Operations Alternative from the 2008 LANL 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 to produce up to 80 pits per year to meet Nuclear Posture Review (NPR) and national policy (*see* Chapter 1, Section 1.3.1.3). The SA determined that the potential environmental impacts of the proposal would not be different, or would not be significantly different, than impacts in existing NEPA analyses. On the basis of the SA, NNSA published an amended ROD in the *Federal Register* (85 FR 54544, September 2, 2020), documenting its 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. The No-Action Alternative in this SWEIS includes actions associated with producing 30 pits per year at LANL. Facility modifications associated with this decision are ongoing (*see* Chapter 3, Section 3.2.3).

Final Environmental Impact Statement for the Dual-Axis Radiographic Hydrodynamic Test Facility **(DOE/EIS-0228)** (DARHT EIS) (DOE 1995). DOE prepared the DARHT EIS to address the need to improve its radiographic hydrodynamic testing capability in order to ensure continued confidence in the safety and reliability of the U.S. nuclear weapons stockpile. Uncertainty in the behavior of the aging weapons in the enduring stockpile increases with the passage of time. Results of testing at the DARHT Facility assist in the assessment of the safety, performance, and reliability of the weapons primaries. The DARHT EIS also evaluated a vessel cleanout facility for use in connection with the DARHT testing activity. The operation of the DARHT Facility is included in the No-Action Alternative in this SWEIS and a description of the facility and its operations is included in Appendix D. The DARHT EIS presents the current and best available information regarding potential environmental impacts of operating the DARHT Facility.

Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico **(DOE/EIS-0350)** (CMRR EIS) (NNSA 2003a) and ***Final Supplemental Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico*** **(DOE/EIS-0350-S1)** (CMRR SEIS) (NNSA 2011b). The CMRR EIS examined the potential consolidation and relocation of the mission-critical CMR capabilities from a degraded building to a new modern building or buildings. The selected alternative, Modified CMRR-NF Alternative, included constructing and operating a new CMRR-

NF at TA-55 with design and construction modifications to address seismic safety, nuclear-safety-basis requirements, infrastructure enhancements, and sustainable design principles. This would have entailed replacement of the existing CMR Building and relocating certain CMR capabilities from the aging building to the new facility. The CMRR EIS also include an evaluation of potential impacts associated with disposition of the existing CMR Building. In 2004, NNSA issued a ROD (69 FR 6967, February 12, 2004), based on the CMRR EIS, to construct a two-building replacement facility in TA-55, with one building providing administrative space and support functions and the other building providing secure laboratory space for nuclear research and analytical support activities (a nuclear facility). The first building, the Radiological Laboratory/Utility/Office Building (RLUOB), has been completed. Enhanced safety requirements and updated seismic information caused NNSA to re-evaluate the design concept of the second building, the CMRR-NF. The *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) evaluated the construction and operation of a modified CMRR-NF design concept (NNSA 2011b). On February 13, 2012, NNSA deferred the construction of the CMRR-NF for at least 5 years. In August 2014, NNSA cancelled construction of the CMRR-NF. The CMRR SEIS did not change decisions related to disposition of the existing CMR Building. The CMRR EIS presents the current and best available information related to the disposition of the existing CMR Building.

***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). DOE prepared this EIS to analyze the environmental impacts of the future use of each of 10 tracts of land (approximately 4,800 acres) administered by DOE at LANL that were proposed for transfer to the Department of the Interior in trust for the Pueblo of San Ildefonso or conveyance to the County of Los Alamos in accordance with the provisions of Public Law 105-119. NNSA published the first ROD in the *Federal Register* on March 20, 2000 (65 FR 14952) to announce its decisions related to 10 tracts of land associated with the Laboratory. Since issuance of the 2008 LANL SWEIS, NNSA published an amended ROD in the *Federal Register* on January 23, 2012 (77 FR 3257) to announce its modified decisions on conveyance and transfer of certain land tracts at LANL based upon the conditions to transfer properties, as follows:

- NNSA decided to convey the remaining portions of the Airport Tract, about 55 acres, to Los Alamos County. With this decision, no acreage of the Airport Tract remains to be conveyed.
- NNSA decided to convey the remaining portions of the TA-21 Tract, totaling about 245 acres. This conveyance will occur on a partial-tract-by-partial-tract basis upon completion of environmental remediation activities. With this decision, the majority of the TA-21 Tract acreage will be conveyed.

Other transfers and conveyances that have occurred associated with Public Law 105-119 are identified in Chapter 4, Section 4.2.1.5. As identified in Chapter 3, Section 3.2.3, this SWEIS evaluates the potential impacts of conveyance of the remaining approximately 1,280 acres under the No-Action Alternative. The CT EIS presents the current and best available information for the potential impacts regarding continued transfer and conveyance of identified land tracts.

A.1.4.3 Waste-Related Environmental Impact Statements

***Waste Isolation Pilot Plant Final Environmental Impact Statement* (1980 WIPP EIS; DOE/EIS-0026)** (DOE 1980) analyzed the environmental impacts of initial construction and operation of the WIPP facility. The ROD (DOE 1981) documented DOE's decision to proceed with the phased construction and operation of the WIPP facility. The WIPP facility receives defense-related TRU waste for permanent disposal. The 1980 WIPP EIS is relevant for background information and was supplemented in 1990.

***Supplemental Environmental Impact Statement for the Waste Isolation Pilot Plant* (WIPP SEIS-I; DOE/EIS-0026-S)** (DOE 1990a) evaluated the environmental impacts associated with new information and changes since the issuance of the 1980 WIPP EIS and 1981 ROD. WIPP SEIS-I included an analysis of changes in the TRU waste inventory, consideration of the hazardous chemical constituents in the TRU waste, modification and refinement of the system for the transportation of TRU waste to the WIPP facility, modification of the Test Phase, and changes in the understanding of the hydrogeological characteristics of the WIPP site. The ROD for WIPP SEIS-I (DOE 1990b) documented DOE's decision to continue the phased development of the WIPP facility by instituting an experimental program to further examine WIPP's suitability as a TRU waste repository. The 1990 WIPP SEIS-1 is relevant for background information and was supplemented in 1997.

***Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (WIPP SEIS-II; DOE/EIS-0026-S2)** (DOE 1997a) analyzed the potential environmental impacts associated with disposing of TRU waste at the WIPP facility and polychlorinated biphenyl (PCB)-commingled TRU waste in the DOE inventory at the time. DOE's proposed action was to open the WIPP facility and dispose of up to 175,564 cubic meters of TRU waste generated from defense activities. The ROD (DOE 1998) documented DOE's decision to authorize the disposal of up to 175,564 cubic meters of TRU waste (except PCB-commingled TRU waste) at the WIPP facility. The WIPP SEIS and its 12 SAs are relevant for the current and best available information of potential impacts related to disposal of TRU waste. The SAs are available at https://www.energy.gov/nepa/eis-0026-s2-waste-isolation-pilot-plant-disposal-phase-carlsbad-new-mexico.

***Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste* (WM PEIS; DOE/EIS-0200-F)** (DOE 1997b) is a DOE complex-wide study examining the environmental impacts of managing more than 2 million cubic meters of radioactive waste from past, present, and future DOE activities. Waste analyzed in the WM PEIS results primarily from nuclear weapons production and related activities. DOE's goal in preparing the WM PEIS was to develop a nationwide strategy to treat, store, and dispose of LLW, mixed low-level radioactive waste (MLLW), high-level radioactive waste, TRU waste, and hazardous waste in a safe, responsible, and efficient manner that minimizes the impacts on workers and the public. The WM PEIS provides information on the impacts of using various alternatives and sites to consolidate or decentralize treatment, storage, and disposal activities for each waste type. DOE would conduct further NEPA reviews regarding the specific location of new facilities at selected sites, as appropriate. DOE has prepared four SAs of the WM PEIS, which are available at: https://www.energy.gov/nepa/eis-0200-waste-management-programmatic-environmental-impact-statement-managing-treatment.

A.1.4.4 Environmental Assessments

Environmental Assessments for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico **(Trails Management EA; DOE/EA-1431)** (NNSA 2003b). The Trails Management EA evaluated the potential impacts of implementing the Trails Management Program at LANL. The program addresses both public use of social trails within LANL and also social trail use by workers at LANL and by officially invited guests. The five goals of the Trails Management Program are (1) reduce the risk of damage and injury to property, human life, and health, and sensitive natural and cultural resources from social trail use at LANL; (2) facilitate the establishment of a safe, viable network of linked trails across the Pajarito Plateau that traverse land holdings of various private and government entities for recreational use and for alternate transportation purposes without posing a threat to DOE and NNSA mission support work at LANL or disrupting LANL operations; (3) maintain the security of LANL operations; (4) respect the wishes of local Pueblos to maintain access to traditional cultural properties by pueblo members while also preventing unauthorized public access to adjacent pueblo lands and other lands identified as both religious and culturally sensitive areas to Native American communities; and (5) adapt trail use at LANL to changing conditions and situations in a responsive manner. NNSA published a Finding of No Significant Impact (FONSI) after publication of the Final Trails Management EA (NNSA 2003c).

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)** (SERF EA) (NNSA 2010a). This EA considered two separate actions: the expansion of the Sanitary Effluent Reclamation Facility (SERF) and environmental restoration activities located within a portion of upper Sandia Canyon, designated as reach S-2. The SERF is a wastewater treatment facility located on the south rim of Sandia Canyon. NNSA proposed to expand SERF to improve wastewater treatment to meet permitted effluent limitations. NNSA issued FONSI with the Final SERF EA (NNSA 2010b). The actions associated with the SERF EA have been completed.

Final Environmental Assessment for Chromium Plume Control Interim Measure and Plume-Center Characterization, Los Alamos National Laboratory, Los Alamos, New Mexico **(DOE/EA-2005)** (DOE 2015). The Chromium Plume Interim Measure EA analyzed an interim measure to control a hexavalent chromium plume that exceeded the New Mexico groundwater standard of 50 parts per billion in TA-5. The EA presents a detailed evaluation of potential environmental impacts of the plume control interim measures and plume center characterization. The EA does not include analysis of the final remedy. DOE issued a mitigated FONSI in 2015. As of the year 2020, the proposed interim measure activities have been implemented along the southern portion of the plume, and the results have been positive. The actions have resulted in a new 50-parts per billion plume edge approximately 350 feet upgradient from where it was at the start of the project. DOE-EM has prepared an additional EA (*see* below) to address a final remedy for the hexavalent chromium plume.

Final Chromium Interim Measure and Final Remedy Environmental Assessment, Los Alamos National Laboratory, Los Alamos, New Mexico **(DOE/EA-2216)** (DOE 2024). The Chromium Plume Final Remedy EA evaluated a proposal for interim measures and a final remedy for the hexavalent chromium contamination in Sandia and Mortandad canyons. Under that proposed action, the EM Field Office at Los Alamos would use adaptive site management to select and implement options to remediate the hexavalent chromium contamination.

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)** (RLUOB EA) (NNSA 2018b). The NNSA proposed using the existing RLUOB to provide enduring analytical chemistry and materials characterization capabilities at the Laboratory to support plutonium operations. NNSA prepared the Final RLUOB EA to recategorize RLUOB from a radiological facility to a Hazard Category (HC)-3 nuclear facility, with an increased material-at-risk limit of 400 grams plutonium-equivalent (15 percent of the 2,610 grams of plutonium-equivalent allowed in a HC-3 nuclear facility). NNSA issued a FONSI for the EA (NNSA 2018c). The actions associated with the RLUOB EA are ongoing. As of publication of this Draft SWEIS, the RLUOB is still categorized as a radiological facility.

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)** (Solar Array EA) (NNSA 2019b). The NNSA prepared the Solar Array EA to evaluate the proposed construction and operation of a 10-megawatt, ground-mounted solar photovoltaic (PV) system and associated power transmission line within an existing power transmission line corridor. The proposed PV location (within TA-18 and TA-8) is on approximately 55-plus acres, of which approximately 50 acres are within a previously disturbed area that was used as a borrow pit at the Laboratory. The associated FONSI determined that there would be no significant impacts from proceeding with the proposal (NNSA 2019c). The actions associated with the Solar Array EA have not yet been completed. The No-Action Alternative in this SWEIS includes actions associated with the proposed PV project (*see* Chapter 3, Section 3.2).

Final Supplemental Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory **(DOE/EA-1329-S1)** (NNSA 2019d). Wildland fires threaten the Laboratory's operations and primary mission to promote and protect national security through the design, qualification, certification, and assessment of nuclear weapons. Strategies for addressing this threat were previously analyzed in the 2000 *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico* (NNSA 2000). As of its preparation in 2019, conditions had changed at LANL since the 2000 EA was issued, including longer fire seasons, changes in vegetation, and global climate change. To address the changing conditions, LANL proposed new strategies in its 2019 *Wildland Fire Mitigation and Forest Health Plan* (LANL 2019a). The 2019 Supplemental EA analyzed potential impacts of implementing the *Wildland Fire Mitigation and Forest Health Plan* with the objective of reducing wildland fire risk while also promoting healthy forests. In the proposal, 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 the associated FONSI, NNSA determined that there would be no significant impacts from proceeding with the proposal, along with implementation of the 2019 *Wildland Fire Mitigation and Forest Health Plan* that included standards for new unpaved roads, fire road stormwater plan, cultural site monitoring and treatment near fire roads, annual operating plan, pesticide discharge management plan update, invasive species nest management practices (BMPs), and fuels management and mastication research. The mitigation actions are ongoing and considered part of normal operations under the No-Action Alternative in this SWEIS (*see* Chapter 3, Section 3.2, and Chapter 5, Section 5.16).

***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 2020c). NNSA prepared this EA to analyze the proposal to construct and operate a fiber optic line and associated routing that would provide redundant voice, data, and Internet services. The proposed second fiber optic line would provide the same level of service to LANL and Los Alamos County. The entire project would require the installation of approximately 18.9 miles of new fiber optic line and supporting infrastructure on lands owned and managed by the U.S. Bureau of Land Management (BLM); DOE; U.S. Forest Service (USFS); Santa Fe County; and Los Alamos County White Rock community. In the associated FONSI, NNSA determined that with implementation of project-identified mitigations, which are an integral part of the proposal, there would be no significant impacts (NNSA 2020d). Mitigations include a traffic safety plan that ensures public transportation safety and minimization of traffic disruption; restricting construction vehicles to approved areas and roadway rights-of-way: erosion and sedimentation control; site restoration; wildlife protection measures; design, to the extent practicable, of the four fiber optic cable monopole structures for the White Rock Canyon crossing to match the line, color, texture, and pattern of the existing landscape; avoidance of cultural resources; compliance with Federal Aviation Administration regulations and recommendations; and good housekeeping requirements. The actions associated with the Second Fiber Optic Line EA have not yet been completed and are included as part of the No-Action Alternative of this SWEIS (*see* Chapter 3, Section 3.2).

***Los Alamos National Laboratory Electric Power Capacity Upgrade Project Draft Environmental Assessment* (DOE/EA-2199)** (NNSA 2023b). NNSA prepared this draft EA 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, three-phase, overhead 115-kV electric power transmission line that would originate at the Norton Substation and cross approximately 2.5 miles of land administered by the BLM, then cross approximately 8.6 miles of land administered by the Santa Fe National Forest (SFNF), and ultimately span White Rock Canyon onto DOE/NNSA-managed lands at LANL for approximately 3 miles. DOE/NNSA is seeking a special use permit from the U.S. Department of Agriculture Forest Service and a right-of-way (ROW) grant from the BLM for the construction and continued operation of the electrical line across their respective lands. DOE/NNSA prepared this EA in coordination with the SFNF as a cooperating agency and the BLM as a participating agency. The Final SWEIS will reflect any changes to the Final Electric Power Capacity Upgrade EA as a result of public and agency comments.

A.1.4.5 Other Documents

Fiscal Year 2024 Stockpile Stewardship and Management Plan – Report to Congress (NNSA 2023a) describes NNSA's plans to ensure the safety, reliability, and performance of the U.S. nuclear weapons stockpile mission to carry out national security responsibilities by maintaining a safe, secure, and effective nuclear deterrent; preventing, countering, and responding to the threats of nuclear proliferation and terrorism worldwide; and providing naval nuclear propulsion.

Nuclear Posture Review (DoD 2022) assesses previous nuclear policies and requirements and focuses on identifying the nuclear policies, strategy, and corresponding capabilities needed to protect the nation in the deteriorating threat environment that confronts the United States, its allies, and partners. The 2022 NPR provides guidance for the nuclear force posture and policy requirements needed now and in the future.

A.2 LANL Missions, Programs, and Facilities – Supplemental Information

This section provides information that supplements and supports the material presented in Chapter 2, LANL Missions, Programs, and Facilities.

A.2.1 Overarching DOE and NNSA Missions

This section is reserved.

A.2.2 Overview of Laboratory Programs and Capabilities

As reported in Section 2.2, the Laboratory is a large and complex site. From an operational perspective, the Laboratory defines it work through key missions and programs:

- Stockpile Stewardship/Weapons
- Global Security
- Science, Technology, and Engineering
- Mission-Enabling Operations and Miscellaneous Programs
- Environmental Management/Legacy Cleanup

This section of the appendix provides descriptions of these programs, the supporting infrastructure for each program, and notable changes within these programs that have occurred since the issuance of the 2008 LANL SWEIS. Notable changes are identified as those that could be relevant to changes in potential environmental impacts.

A.2.2.1 Stockpile Stewardship/Weapons Program

The Stockpile Stewardship and Weapons Program at LANL is focused on ensuring that the nation's nuclear deterrent remains safe, secure, and reliable. The Laboratory accomplishes this through implementation of, and support for, the NNSA Stockpile Stewardship mission. This mission is an ongoing national effort to develop and apply a science-based fundamental understanding of nuclear weapons performance, from creating enhanced warhead surveillance tools that detect the onset of problems, to advancing manufacturing capabilities that produce critical components. The Laboratory also partners with Combatant Commands and the Joint Staff, the Office of the Secretary of Defense, DoD agencies, and service components through the Nuclear Weapons Council to ensure that integrated NNSA and DoD priorities are met. Major capabilities supporting the Stockpile Stewardship and Weapons Program include:

- Weapons Design, Surveillance, and Certification (Section A.2.2.1.1);
- Weapons Engineering (Section A.2.2.1.2); and
- Weapons Component Production (Section A.2.2.1.3).

Section A.2.2.1.4 identifies the infrastructure and major facilities at LANL that support the Stockpile Stewardship and Weapons Program.

A.2.2.1.1 WEAPONS DESIGN, SURVEILLANCE, AND CERTIFICATION

For more than two decades, the science-based Stockpile Stewardship Program has allowed NNSA and DoD to certify the safety, reliability, and performance of the U.S. nuclear weapons stockpile to the President without the use of underground nuclear explosive testing (NNSA 2023a). LANL performs R&D, design, maintenance, and testing in support of the nuclear weapons stockpile. The Laboratory designs the nuclear explosive package for new modernization programs, or refurbish the warhead for life extension programs (LEPs), modification programs (Mods), and alteration programs (Alts), then certify the warhead for entry into the stockpile. For example, the Laboratory recently completed work associated with the design and certification of components to extend the life of the B61 warhead. The purpose of the B61-12 LEP was to refurbish, reuse, or replace all of the bomb's nuclear and nonnuclear components to extend the service life of the B61 by at least 20 years and to improve the bomb's safety, effectiveness, and security. The design maximized component reuse whenever possible and omits higher-risk technologies while reducing costs and schedule risks (NNSA 2022b).

> **Refurbishment Types**
>
> **LEPs** – Life extension activities addressing aging and performance issues within the stockpile because of use beyond the originally designed LEPs, Mods, and Alts
>
> **Mods** – Any alternation of a permanent nature made after production to an end item, component, or assemblage of material that results in a change to the miliary characteristics that affects weapon employment, fuzing, ballistics, or logistics
>
> **Alts** – Any change or changes that typically affect the assembly, testing, maintenance, or storage of weapons. An Alt may address identified defects and component obsolescence but does not change its operational capabilities.

Through routine surveillance of the systems and annual stockpile assessment, weapons issues that could lead to future performance degradation, such as aging effects, are discovered and addressed. Depending on the nature of these changes, parts may need to be replaced or refurbished to meet safety, reliability, and performance requirements. In this way, LEPs, Mods, and Alts extend the weapons' lifetimes and are carried out without conducting underground nuclear explosive tests. The Laboratory's design, surveillance, and certification capability includes site activities that enable the conceptualization and sustainment of the nuclear stockpile, including data for qualifying weapons design, confirming system performance requirements, and surveilling and certifying the stockpile. The capability also includes assets for conducting experiments related to weapons materials and properties. Surveillance activities are related to diagnostics and measurement of the current state of the stockpile and stockpile aging. Advanced surveillance techniques were instituted to help maintain existing stockpile weapons components for as long as possible without the need for nuclear testing. Surveillance has three primary goals: (1) detect stockpile defects, (2) assess and document stockpile conditions, and (3) uncover precursors of aging early enough to implement corrective action. These surveillance activities are conducted at various LANL facilities.

The weapons design, surveillance, and certification capability utilizes assets for environmental tests, high-energy density physics, radiography, radiation effects, subcritical experiments, material tests, and flight tests. Specific types of experiments and testing related to the weapons design, surveillance, and certification capabilities are discussed below.

Dynamic Experiments

A dynamic experiment is an experiment that provides information regarding basic physics of materials or characterizes physical changes or motion of materials under influence of HE detonations. Dynamic experiments are designed to improve knowledge of material properties, including equation of state (an equation that expresses the relationship between temperature, pressure, and volume of a substance) and strength, over broad ranges of relevant pressures, temperatures, and time scales, and may involve special nuclear material (SNM) (such as plutonium and uranium) or other weapons-relevant materials. None of these experiments reaches nuclear criticality or involves a self-sustaining nuclear reaction. These experiments provide data for validating models within multi-physics design codes and predicting nuclear weapon performance. Most dynamic experiments not involving SNM are executed at TA-15 and TA-36; some are conducted at TA-39 and TA-40. The Laboratory may perform future dynamic experiments in containment vessels using plutonium or uranium in containment vessels at the Dual Axis Radiographic Hydrodynamic Test (DARHT) or other LANL facilities. Dynamic experimentation at DARHT was evaluated in the DARHT EIS (DOE 1995).

Subcritical experiments, which are a subclass of dynamic experiments, are performed using SNM (for example, plutonium) in a manner that prevents the material from achieving a nuclear explosion. Subcritical experiments are designed to improve knowledge of the dynamic properties of new or aged nuclear weapons parts and materials and to assess the effects of new manufacturing techniques on weapon performance. Subcritical experiments can vary any or all factors that influence criticality. Because there is no nuclear explosion, subcritical experiments are consistent with the U.S. nuclear testing moratorium. LANL conducts most subcritical experiments at the Nevada National Security Site; however, as discussed earlier, facilities at DARHT provide a redundant capability for future subcritical experiments.

Hydrodynamic Testing

Hydrodynamic experiments, also a subclass of dynamic experiments, are high-explosives-driven experiments to assess the performance, response, and safety of nuclear weapons or subcomponents. They are typically coupled with HPC modeling and simulation to certify, without underground nuclear testing, the safety, reliability, and performance of the nuclear physics package of weapons. Such experiments may also be used to assess threat-relevant adversarial designs and defeat techniques. During a nuclear weapon function test, the behavior of solid materials is similar to liquids, hence the term “hydrodynamic.” These experiments do not use SNM but are conducted using test assemblies that are representative of nuclear weapons. Surrogate materials such as depleted uranium, tungsten, lead, and gold replace actual weapons materials in the test assemblies to ensure there is no potential for a nuclear explosion. Most hydrodynamic tests are conducted in TA-15 at the DARHT Facility (Figure A.2.2-1) as the primary location, with other tests conducted at TA-36. Component level or scaled hydrodynamic testing may also be conducted at TA-14 and TA-39.

Figure A.2.2-1 DARHT Facility at TA-15

Material Testing

Material testing includes capabilities that support the study of how materials in a nuclear weapon behave under conditions of temperature and pressure. When a refurbishment (or change) is proposed to a weapon component or subassembly, testing is conducted to determine whether the design changes will meet required specifications. Required test capabilities consist of material development, characterization, and mechanical testing of polymers and metals produced through additive or subtractive techniques, including radioactive materials. In addition, key environmental test capabilities help scientists understand what happens when a weapon component or subassembly design is subjected to thermal-mechanical environments. Environmental testing also includes the capability to perform new HE formulation experiments in test cells. As discussed below, two of the primary facilities used for material development and testing are the Sigma Complex and the Materials Science Laboratory, both located in TA-3. These facilities provide materials development, processing, and evaluation capabilities ranging from benchtop to industrial scales. Additionally, LANL has a number of other smaller facilities that support materials testing including the Lujan Center at TA-53 and at TAs-6, -9, -22, and -16. The LANSCE particle accelerator at TA-53 is also used for neutron scattering measurements, material response, and proton radiography supporting materials science and national security experiments.

The Sigma Complex supports a large, multidisciplinary technology base in materials fabrication science. This facility is used mainly for materials synthesis and processing, characterization, fabrication, joining, and coating of metallic and ceramic items. The Beryllium Technology Facility (BTF), which is part of the Sigma Complex, is a nonnuclear moderate hazard facility that is used to maintain and enhance the beryllium technology base that exists at LANL and to fabricate beryllium powder components. Research conducted at the BTF involves the energy- and weapons-related use of beryllium metal and beryllium oxide. As discussed in Chapter 3, Section 3.3 of this SWEIS, NNSA is proposing to construct the BTF replacement under the Modernized Operations Alternative. The Materials Science Laboratory is composed of several buildings containing 27 laboratories, 60 offices, 21 materials research areas, and various support areas. The principal capabilities and activities conducted at the Sigma Complex and the Materials Science Laboratory include:

- Materials processing to support formulation of a wide range of useful materials through the development of materials fabrication and chemical processing technologies;
- Mechanical testing in laboratories where materials are subjected to a broad range of mechanical loadings study their fundamental properties and characterize their performance;
- Development of advanced materials for high-strength and high-temperature applications;
- Characterization of materials utilizing x-ray, optical metallography, spectroscopy, and surface science chemistry to understand the properties and processing of these materials and to apply that understanding to materials development;
- Materials fabrication capabilities to support weapons R&D and production activities at the Laboratory; and
- Additive manufacturing across a range of technologies that include forming, joining, binding, stamping, and printing three-dimensional parts.

Explosives Research and Testing

Explosives research and testing activities are conducted primarily to study properties of the explosives themselves as opposed to explosive effects on other materials. Examples include tests to determine the effects of aging on explosives, safety and reliability of explosives from a quality assurance point of view, and development of new energetic materials. Explosives research and testing activities are performed at various facilities throughout the campus as well as any of the HE firing sites (*see* Section A.2.2.1.1 for more details regarding HE).

High-Explosives Pulsed-Power Experiments

HE pulsed-power experiments are conducted to develop and study new concepts of explosively driven electromagnetic power systems. These experiments are conducted primarily at TA-39.

High-Performance Computing

HPC is used for large multi-physics computer simulations and code development, which are conducted on some of the world's most capable supercomputers. The capabilities and infrastructure related to HPC include software, hardware, and facilities that provide sufficient power and cooling for modeling the performance and science of weapon systems. These capability systems also support critical national security mission areas for counterterrorism, climate modeling, and a variety of scientific challenges. The most accurate simulations can reduce design iterations and reduce or eliminate the need to conduct tests. Therefore, HPC has become essential for numerous scientific and engineering research areas at LANL. For stockpile stewardship, research focuses on gaining confidence that culminates in an annual assessment report. HPC operations are conducted and anticipated to continue in the Strategic Computing Complex (SCC) (also referred to as the Nicholas C. Metropolis Center) at TA-3 (Figure A.2.2-2).

Figure A.2.2-2 Strategic Computing Complex at TA-3

Simulation and computing capabilities and infrastructure at LANL support activities for computer modeling and the prediction of weapon performance and material properties not accessible through experimentation. HPC simulations offer a computational surrogate for nuclear testing. Major advances in hardware and software have made possible a clearer understanding of the issues involved with nuclear weapon performance by accurately simulating much of the extraordinary complexities of nuclear weapons systems. Full three-dimensional, high-fidelity simulations allow physicists to observe phenomena nanosecond by nanosecond, with a level of spatial resolution and physics realism previously unobtainable. The Laboratory anticipates installing new artificial intelligence systems in support of national defense at the SCC. LANL's most powerful computers are used primarily for Stockpile Stewardship Program efforts. As discussed in Chapter 4, Section 3.4 of this SWEIS, planning for future supercomputing infrastructure is underway as part of the Expanded Operations Alternative. Proposed plans include a new HPC in TA-6 with supporting facilities available to provide sufficient power and cooling needed to fulfill the Advanced Simulation and Computing Program and Stockpile Stewardship Program requirements anticipated in 2030, and possible new artificial intelligence program(s).

A.2.2.1.2 Weapons Engineering

Weapons engineering plays a key role in ensuring that the design of the nuclear explosives packages meets DoD requirements specified by the weapon's military characteristics. The confidence basis for the annual weapon certification process is built on a foundation of historical tests, along with the annual monitoring (i.e., surveillance) and design agency stockpile tests. This important test data allows the Laboratory to assess and communicate to the Secretary of Energy, Secretary of Defense, and the Nuclear Weapons Council the health of the stockpile.

Weapons engineering activities are key to the success of annual assessments, LEPs, Mods, Alts, and the development of new designs. Weapons engineering activities include design, development, systems integration, testing, production, and surveillance. Weapons engineering also includes activities and infrastructure related to the weapons lifecycle, including concept exploration, requirements satisfaction, design, and certification and qualification. Weapons engineering tests also require advanced material deposition and joining capabilities, such as welding or brazing. These joints are then applied to assemblies used in hydrodynamic and environmental tests to determine how materials are affected by the welding process.

Weapons engineering activities at the Laboratory include R&D related to weapons materials and components. Details related to weapons engineering activities are discussed below for the following weapons materials and components: (1) HE, (2) tritium/gas transfer system, (3) plutonium, and (4) uranium.

High Explosives

The Laboratory uses indoor and outdoor firing sites primarily for R&D, test operations, detonator development and testing related to the Stockpile Stewardship Program. Building types include preparation and assembly facilities, bunkers, analytical laboratories, testing facilities, HE storage magazines, and associated office areas. Most of the firing sites are in remote locations within canyons and specialize in experimental studies of the dynamic properties of materials under high-pressure and high-temperature conditions. The firing sites, which occupy approximately 22 square miles of land area, represent more than half of LANL's approximately 40 square miles. Engineering tests are primarily located at TA-11 and TA-16. These sites conduct experiments in controlled environments. The firing sites also support counterterrorism and counterproliferation (as part of global security) with expertise in dynamic material interactions, HE performance, radiation-generating devices, pulsed-power systems, radiography, state-of-the-art laser-based optical diagnostics, and advanced analysis techniques. The firing sites support nonproliferation static and dynamic focused experiments to develop detection methods, identify proliferation technology, and enable informed decisions on proliferation issues. In addition, focused experiment subject matter experts provide input and advice to intelligence analysts working in global security missions. More details regarding the types of experiments and testing related to HE is presented below.

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

- **Calibration, Development, and Maintenance Testing** – This testing involves experiments conducted primarily to prepare for more elaborate tests and includes tests to develop, evaluate, and calibrate diagnostic instrumentation or other systems. Calibration, development, and maintenance testing activities are concentrated at TA-15 and TA-36 but could involve any of the HE testing sites. Activities within this capability also include image processing capability maintenance.
- **Other Explosives Testing** – This capability includes activities such as advanced HE development and work to improve weapons evaluation techniques, as well as analytical benchtop testing and analysis.

Tritium/Gas Transfer System

Tritium activities at LANL support the Stockpile Stewardship Program as well as research on fusion energy. Modern nuclear weapons are equipped with gas transfer systems that use hydrogen isotopes, including tritium and deuterium. These systems and their components need ongoing maintenance, testing, development, gas replacement, and modifications to maintain safety and reliability. The principal capabilities and activities related to tritium/gas transfer systems at LANL include:

- High-pressure gas fills and processing operations for R&D;
- Function testing for highly specialized gas transfer systems used in nuclear weapons and experimental equipment;
- Separation and purification of tritium from gaseous mixtures using diffusion and membrane purification techniques;
- Tritium-handling capabilities to accommodate a wide variety of metallurgical and material research activities;
- Gas analysis using spectrometry and other techniques such as beta scintillation counting to measure the composition and quantities of gas samples;
- Calorimetry used for measuring the amount of tritium in a container; and
- Storage of tritium gas and tritium oxide.

Tritium operations are performed within TA-16 at the Weapons Engineering Tritium Facility (WETF) (Building 16-205). The WETF is a single-level facility located in TA-16 that began operations in 1989. The WETF is an HC-2 nuclear facility with approximately 7,890 square feet of floor area. Primary operations at WETF include repackaging, recycling, mixing, and analyzing tritium gas. These services include tritium gas purification, mixing tritium with other gases, analyzing gaseous tritium, and repackaging tritium and other gases to high pressures. High-pressure gas fills and processing operations for R&D and nuclear weapons systems are performed at the WETF. High-pressure gas containers (reservoirs) are filled with tritium or deuterium gas mixtures, or both, to specified pressures in excess of 10,000 pounds per square inch.

Plutonium

The capability and infrastructure for this strategic defense material includes assets for R&D, waste, and storage. R&D activities include stockpile surveillance, process development, certification, long-term aging, fabrication of small test objects, material characterization testing, and recovery of material from residues. Planning the future needs of the U.S. nuclear weapons stockpile and Nuclear Security Enterprise depends on plutonium R&D work by Laboratory scientists to maintain confidence in new manufacturing methods, changes in metallurgy, and the long-term stability of the plutonium residing inside weapons. Scientists and engineers who ensure the safety and reliability of the nation's stockpile have long been concerned that the damage accumulated over decades from plutonium self- irradiation could eventually compromise weapon performance. Stockpile stewardship activities at LANL include material characterization and analytical chemistry of components of U.S. stockpile weapons to ensure that current weapons function as designed and plutonium aging studies to determine when current weapons need to be remanufactured. The Laboratory also performs certification activities for pit components to ensure that they meet design intent, testing, and certification activities for LEP, Mod, and Alt nuclear material components.

Plutonium pit surveillance is an important activity at LANL. This activity provides for the disassembly of plutonium pits for examination using destructive and nondestructive techniques. The stockpile stewardship activities include pit surveillance to assess performance, reliability, and safety of the nation's nuclear stockpile. Pit surveillance data are used to identify defects that could affect safety, security, performance, or reliability; identify aging-related changes and trends; provide critical data for the annual reports and stockpile assessments; and inform options and designs for weapon LEP, Mod, and Alt programs. NNSA determines the number of pits to be destructively evaluated at LANL and the schedule for those evaluations. Most plutonium-related operations at LANL are conducted at TA-55 in the Plutonium Facility building 4 (PF-4) and the RLUOB.

Uranium

The capability and infrastructure for this strategic defense material includes assets for R&D, waste, and storage across the Laboratory. The majority of R&D with enriched uranium is centered on development of detectors for nonproliferation in support of the Nuclear Nonproliferation Treaty. Depleted uranium is used in many R&D activities as it is not only a component in nuclear weapons but can be used as a surrogate for enriched uranium. R&D activities include process development and material characterization. The Laboratory has robust R&D capabilities for uranium, which includes radiographic analysis, machining and inspection, metallographic analysis, microstructural characterization, chemical sampling, and mechanical testing. Other capabilities include performance of specialized heat treatments, chemical analysis, electron microscopy, and advanced microstructural analyses.

A.2.2.1.3 Weapons Component Production

The Laboratory produces plutonium pits and detonators for the nuclear weapons stockpile, as well as other components as part of its R&D mission.

Plutonium Pit Production

Congress and the President have directed NNSA to produce plutonium pits at specific quantities and within specific periods of time. To fulfill NNSA's obligation to produce plutonium pits, NNSA has decided that the Laboratory will produce a minimum of 30 pits per year, and implement surge efforts to exceed 30 pits per year to meet NPR and national policy. The Laboratory's pit production work is conducted primarily in PF-4 at TA-55. This capability includes plutonium pit reuse, the manufacture of plutonium pits and parts, and the fabrication of samples for R&D activities.[1] To achieve the required level of pit production, LANL continues to upgrade existing plutonium facilities; is upgrading/constructing new support facilities, administrative offices, and parking; and is hiring and training staff required for the mission (all of these activities are included in the No-

[1] 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/.

Action Alternative). Upgrades to PF-4 (Figure A.2.2-3) will consist of internal modifications and the installation of additional process equipment. The Laboratory has existing support facilities (e.g., warehouses, waste storage and staging, radiography capabilities, and maintenance support offices) within and outside the Perimeter Intrusion, Detection, and Assessment System (NNSA 2019a).

Operations in PF-4 at LANL began in 1978. Although PF-4 will reach its initial assumed 50-year design life in 2028, there are no known life-limiting mechanisms or issues that would preclude PF-4 from operating beyond its original design lifetime. As the ongoing and future upgrades to modernize and extend the life of PF-4 are completed, PF-4 will continue to effectively conduct mission-related operations safely and securely into the foreseeable future (NNSA 2019a). The Defense Nuclear Facilities Safety Board (DNFSB) has been engaged with NNSA on seismic safety of PF-4 since the Laboratory first identified elevated potential seismic hazards in 2009. In an August 2023 letter, DNFSB acknowledged that the Laboratory completed a probabilistic risk analysis and concluded that the seismic safety risk of PF-4 is acceptable. DOE/NNSA will update the site-specific probabilistic seismic hazard analysis in 2025. DNFSB found that NNSA's conclusion was technically defensible and that the accompanying peer review process was robust (DNFSB 2023).

The RLUOB conducts actinide chemistry and material characterization that supports missions performed in PF-4, including pit production. In February 2023, the RLUOB was approved to operate as an HC-3 nuclear facility with an administrative limit of 400 grams of plutonium-equivalent material. Laboratory space is outfitted with state-of-the-art analytical instruments, gloveboxes, open-front boxes, and fume hoods.

Figure A.2.2-3 PF-4 at TA-55

Detonator Production

Detonators are small devices (Figure A.2.2-4) used for detonating HE. In a nuclear weapon, the plutonium pit is surrounded by HE. The detonation of the HE is what causes the pit to implode (compress) and create nuclear yield. To ensure this compression happens evenly around the pit, multiple detonators must go off at exactly the same time. Detonator production has been essential to the Laboratory since its inception during World War II. After World War II, the Atomic Energy Commission moved detonator production from LANL to the Mound Plant in Miamisburg, Ohio. However, when the Mound Plant ceased operations in the early 1990s, detonator production was moved back to LANL. Currently, the Laboratory performs R&D and fabricates detonators. This capability includes activities such as detonator design; printed circuit manufacture; metal deposition and joining; plastic materials technology development; explosives loading, initiation, and diagnostics; laser production; and explosives systems design, development, and manufacturing safety. Detonators, cables, and firing systems for tests are built as part of this capability. The Laboratory's newest detonators use an electrical charge to vaporize material and create a shock wave to initiate an explosion. This separation of explosive and electrical components improves safety.

Figure A.2.2-4 Typical Detonator

These newest detonators are replacing the existing detonators through the B61-12 LEP (LANL 2022c).

Other Component Fabrication

The Laboratory performs component fabrication R&D and fabricates components as required to support the Stockpile Stewardship Program. Two of the primary component fabrication facilities are the Machine Shops Complex at TA-3 and the Target Fabrication Facility at TA-35. The primary capabilities and activities conducted at the Machine Shops Complex include:

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

The Target Fabrication Facility houses activities related to weapons production and laser fusion research. These activities are accomplished through high technology material science, effects testing, characterization, and technology development.

A.2.2.1.4 Infrastructure and Major Facilities Supporting the Stockpile Stewardship and Weapons Program

The Stockpile Stewardship and Weapons Program activities take place across the Laboratory in many technical areas, as described in Table A.2.2-1.

Table A.2.2-1 Stockpile Stewardship and Weapons Program Activities by Technical Area

Tech Area	Mission Activity Description
TA-3	TA-3 is referred to as the "Core Area" and is LANL's main technical area, housing approximately half of LANL's employees and total floor space. It is the entry point to LANL and is located on South Mesa. It houses most of the administrative and public access activities, as well as a mixture of Laboratory activities including work with special nuclear material and materials testing. TA-3 contains major facilities such as the Sigma Complex; the Machine Shops; the Materials Science Laboratory; and the SCC, which houses HPC capabilities. The analytical chemistry and material characterization in the Chemistry and Metallurgy Research Building, which is slated for DD&D, have started to be consolidated at TA-55. The HE mock material research and production capabilities are located in TA-3.
TA-6	The area currently hosts the Western Technical Area substation. TA-6 is central to future supercomputing infrastructure (under the Expanded Operations Alternative) necessary to continue supporting the HPC mission in 2030 and beyond. Additionally, the portion of TA- 6 within the Limited Area boundary is slated for the construction of several HE facilities supporting energetic R&D operations.
TA-8	TA-8 is a testing site where modern nondestructive dynamic testing techniques are maintained to ensure the quality of materials in items ranging from test weapons components to high-pressure dies and molds. The principal techniques used at this site include radiography (x-ray machines and a betatron), radioisotope techniques, ultrasonic and penetrant testing, and electromagnetic test methods.
TA-9	TA-9 is located on the western edge of LANL where fabrication feasibility and the physical properties of explosives are explored, and new organic compounds are investigated for possible use as explosives. Storage and stability problems are also studied.
TA-11	TA-11 is a remote technical area where facilities are used for testing explosives components and systems, including vibration analysis and drop-testing materials and components under a variety of extreme physical environments. These facilities are arranged so that testing may be controlled and observed remotely, allowing devices that contain explosives, radioactive materials, and nonhazardous materials to be safely tested and observed.
TA-14	Located in the northwestern part of LANL, TA-14 is one of 14 active firing areas. Most operations are remotely controlled and involve detonations, and certain types of HE machining. Tests are conducted on explosives charges to investigate fragmentation impact, explosives sensitivity, and thermal responses of new HE. This site is currently awaiting closure plan approval from the New Mexico Environment Department based on open detonation and open burning hazardous waste treatment activities conducted from 1980 to 2010. Dynamic experiments and hydrodynamic testing are conducted at TA-14.
TA-15	TA-15, located in the central portion of LANL, is used for HE research, development, and testing, mainly through hydrodynamic testing and dynamic experimentation. TA-15 is the location of two active firing sites and the Dual Axis Radiographic Hydrodynamic Test Facility, which has an intense high-resolution, dual-machine radiographic capability. TA- 15 is also used to investigate weapons functioning and systems behavior in nonnuclear testing.
TA-16	TA-16, located in the western part of LANL, is the site of the Weapons Engineering Tritium Facility. TA-16's HE research, development, and testing capabilities include HE processing; powder manufacturing; casting, machining, and pressing; inspection and radiography of HE components to guarantee integrity and ensure quality control; test device assembly; thermal testing; flight simulation testing; and chemical analysis. The Laboratory conducts controlled open burning waste treatment activities at TA-16.
TA-22	TA-22, located in the northwestern portion of LANL, houses the LANL Detonator Facility, where the Laboratory conducts R&D and fabrication of high-energy detonators and related devices.

Tech Area	Mission Activity Description
TA-35	The Target Fabrication Facility houses activities related to weapons production and laser fusion research. The facility conducts high-energy density physics tests and supports plutonium pit rebuild operations.
TA-36	TA-36 is in a fenced, remote area in the eastern portion of the site. It has four active firing sites that support explosives testing, including dynamic experiments and hydrodynamic testing. The sites are used for a wide variety of nonnuclear ordnance tests pertaining to warhead designs, armor and armor-defeating mechanisms, explosives vulnerability to projectile and shaped-charge attack, warhead lethality, and determining the effects of shock waves on explosives and propellants. The Laboratory also conducts controlled open detonation waste treatment activities at TA-36.
TA-37	TA-37 is used as an explosives storage area and is located at the eastern perimeter of TA- 16.
TA-39	TA-39 is located at the bottom of Ancho Canyon. The behavior of nonnuclear weapons is studied here, including dynamic experiments and hydrodynamic testing, primarily by photographic techniques. Also studied are the various phenomenological aspects of explosives, interactions of explosives, explosions involving other materials, shock wave physics, equation-of-state measurements, and pulsed-power systems design. The Laboratory also conducts controlled open detonation waste treatment activities at TA-39.
TA-40	TA-40, centrally located within LANL, is used for general testing of explosives or other materials and development of special detonators for initiating HE systems. Fundamental and applied research includes investigating phenomena associated with the physics of HE and research in rapid-shock-induced reactions. TA-40 is also used for investigating the physics and chemistry of detonators and shock wave propagation.
TA-48	LANL's Radiobioassay Program is located in TA-48 and uses radiobioassay (bioassay) of radionuclides as an in-vitro sampling method to detect and measure radionuclides inside a worker's body resulting from an event in which radionuclides are inadvertently inhaled, ingested, or absorbed through the body. Radionuclides that are monitored include isotopes of plutonium, americium, uranium, and tritium. Uranium and tritium, when inside the body, are cleared relatively quickly and workers are required to be monitored frequently (every two weeks), while plutonium and americium are slowly transported through the body gradually over many years and require less frequent monitoring (i.e., once or twice a year).
TA-51	Four warehouses (approximately 20,000 square feet each) have been constructed in TA-51 to support plutonium pit production.
TA-53	TA-53 is located in the northern portion of LANL and includes LANSCE, which houses one of the largest research linear accelerators in the world and supports both basic and applied research programs. Applied research provides experimental data for dynamic radiography, materials science, nuclear physics, and neutron radiography to support stockpile assessment and certification, part qualification, and the development and validation of advanced models. Basic research includes studies of subatomic and particle physics. LANSCE has also produced medical isotopes for the past 20 years and qualified electronics for aerospace applications.
TA-55	TA-55, located just southeast of TA-3, includes the Plutonium Facility Complex and the RLUOB. The manufacture of plutonium pits and parts, fabrication of samples for research and development activities, and pit surveillance takes place in PF-4, which is located at TA-55. Chemistry and metallurgy research, actinide chemistry, and materials characterization capabilities are housed in the RLUOB and PF-4. As discussed in Section 2.4, TA-55 also supports the global security mission (e.g., surplus plutonium disposition).
TA-68	TA-68, located in the southern portion of LANL, contains environmental study areas.

DD&D = decontamination, decommissioning, and demolition; HE = high explosives; HPC = high-performance computing; LANL = Los Alamos National Laboratory; LANSCE = Los Alamos Neutron Science Center; R&D = research and development; RLUOB = Radiological Laboratory Utility Office Building; SCC = Strategic Computing Complex; TA = technical area

A.2.2.1.5 Stockpile Stewardship/Weapons Program – Changes Since 2008 SWEIS

This section identifies notable changes that have occurred to the capabilities, facilities, and operations related to the Stockpile Stewardship/Weapon Program since publication of the 2008 LANL SWEIS.

A.2.2.1.5.1 Weapons Design, Surveillance and Certification

Sigma Complex

The Sigma Building, built in the 1950s, has undergone renovations and modifications since the 2008 LANL SWEIS was published. Upgrades to the facility include electrical upgrades, a roof replacement, and an entire building heating, ventilation, and air conditioning upgrade. In 2016, the Laboratory removed and disposed of legacy equipment in the Sigma Building and added foundry equipment and electron beam welders.

The Laboratory added a 4,000-square-foot addition to the main Sigma Building (TA-3-066) and plans to consolidate uranium machining operations that previously were performed in machine shops (Building TA-3-102) (NNSA 2017a).

In 2010, the Laboratory added an ion exchange building (Building TA-3-2519) to the Sigma Complex to reduce copper concentrations to meet new effluent discharge limits established in the National Pollutant Discharge Elimination System (NPDES) permit (LANL 2022a).

In 2017, the Laboratory demolished the Press Building (TA-3-0035). This building supported early R&D of nuclear weapons during the Cold War. The building was designed specifically to house the 5,000-ton hydraulic press used in the fabrication process. The previous footprint of the Press Building is now the Biological Research Laboratory (TA-3-2587), a 14,000-square foot Biosafety Level (BSL)-2 laboratory. (The addition of the Biological Research Laboratory is addressed in Section A.2.2.2.9.4.)

Machine Shops

A new modular inspection laboratory (known as the Mod Lab) was constructed in TA-3-0039 Room 27. The project began operations in 2021. The machine shop in Room 26 and the new inspection lab in Room 26A are referred to as the Plutonium Facility Mark Quality Manufacturing Center (LANL 2022a). As stated above, the Laboratory plans to relocate uranium machining operations from TA-3-0102 to the Sigma Building.

High-Performance Computing

Several supercomputers have been housed in the SCC in TA-3 since 2008, including Roadrunner, Trinity, and now Crossroads. The electrical and mechanical systems in the SCC were expanded to meet the new computers' requirements and to allow for future expansion. In 2021, the Laboratory completed the Exascale Class Computer Cooling Equipment Project, which expanded the water-cooling capability of the SCC by 4,800 tons (Figure A.2.2-5) (LANL 2022a; NNSA 2020e).

Figure A.2.2-5 Exascale Class Computer Cooling Equipment Project Cooling Towers

Crossroads is the current supercomputer utilized to serve the mission of national security science and runs some of the largest and most demanding simulations for stockpile stewardship. The Crossroads system has improved efficiency in three key areas: application performance, workflow, and application development. The second generation of Commodity Technology Systems became operational in 2021. Both systems required the additional cooling and power for up to 500 petaflops of computing. The power distribution within the SCC has been modified to maximize power to the computer floor.

Crystal Growing Laboratory

In 2020, the Laboratory completed the construction of the Crystal Growing Laboratory in the HE processing area of TA-16 in Building 0303 (LANL 2022a). This operation was relocated from TA-40 to TA-16.

Dual-Axis Radiographic Hydrodynamic Test Facility

In 2010, the Laboratory connected the DARHT Facility cooling tower outfall and septic system into the LANL sanitary sewer. This eliminated the discharge of cooling tower water to one of LANL's NPDES outfalls and removed the septic system for the DARHT complex (LANL 2012).

In 2017, the Laboratory upgraded the aboveground mineral oil storage tanks at the Radiographic Support Laboratory. This included decommissioning of two existing tanks (structures 15-435 and 15-436) and installation of a double-walled replacement tank (LANL 2019b). Additionally, a weather enclosure for the DARHT Facility was installed in 2020 (LANL 2022a). The weather enclosure was constructed to protect equipment from the elements, increase the number of experiments, and provide a safe year-round working environment for employees.

Dynamic Equation of State Facility

The Dynamic Equation of State Facility is a 15,000-square-foot facility that consolidated TA-39 powder and gas gun activities. The facility was completed in 2017 and relocated three gas gun facilities from TA-39 (Ancho Canyon) to TA-40 while closing the gas gun facilities and their supporting structures in TA-39. The facility replaced six facilities and reduced LANL's footprint by approximately 5,000 square feet (LANL 2019b).

A.2.2.1.5.2 Weapons Engineering

Decontamination, Decommissioning, and Demolition of Tritium Facilities

The Tritium Systems Test Facility (TA-21-0155) and Tritium Science and Fabrication Facility (TA-21-0209) in TA-21 underwent DD&D and was completed in 2010. The 2008 LANL SWEIS reported the plans for closure of TA-21 and consolidation of tritium operations at the WETF in TA-16. Operations at these facilities had ended by 2006 (LANL 2012).

Firing Site Upgrades

Since 2008, the Laboratory has implemented several safety upgrades at the various firing sites for the protection of human health and to minimize potential environmental impacts. Some examples of these upgrades include (LANL 2022a):

- The 2018 upgrades at the Eenie Firing Site in TA-36 included upgraded communications and power installations, relocated sirens and light equipment, and paving of the surrounding area of the firing point to maintain the facility for explosives operations.
- In 2017, the Laboratory installed a concrete pad and replaced the blast tube at the Lower Slobbovia Firing Site in TA-36.
- The Laboratory constructed a new steel building in TA-40 (Building 15) to enclose the existing firing point and to allow for year-round firing operations.
- The Laboratory implemented new fuel treatment prescriptions at all firing sites to minimize wildfire risks. For example, the prescriptions at Lower Slobbovia included a hardened 6-foot by 4-inch fire break surrounding the firing site.
- The Laboratory built a "drop tower" at the Meenie/Bravo firing site at TA-36 in the HE area. The site, which includes a bunker, was in need of repairs to accommodate the new tower structure and return to service (LANL 2021a) (Figure A.2.2-6). Drop tower operations were previously done at TA-11.
- In 2019, the Laboratory completed construction of a domestic and fire suppression water line from the DARHT Facility to the firing sites in TA-36. Lateral waterlines were installed from the main line to the existing facilities at the Eenie, Meenie, Minie, Moe, Abner, and Lower Slobbovia firing sites. Fire hydrants were installed within 300 feet of each firing site.

Figure A.2.2-6 Drop Tower at TA-36

High-Explosive Processing Operations

The 2008 LANL SWEIS described the high-explosive processing facilities, which include production and assembly buildings, analytical laboratories, explosives storage magazines, and a building to treat wastewater contaminated with explosives. The 2008 SWEIS reported that the activities analyzed under the No-Action Alternative would require an estimated 82,700 pounds of explosives and 2,910 pounds of mock explosives annually. The actual amount of these materials used annually was significantly less. Table A.2.2-2 provides the amounts of explosives and mock explosives that were used for high-explosive processing over the 5-year period 2016–2020. These values are not limits of capabilities but provide a sense of the level of activity and potential for environmental impacts when compared to the 2008 SWEIS. The averages over the 5-year period were about 10 percent and 43 percent of the projected volume of explosives and mock explosives, respectively.

Table A.2.2-2 Comparison of Explosives Used Annually for High-Explosive Processing (pounds)

Parameter	2008 SWEIS	2016	2017	2018	2019	2020	5-Year Average
Volume of explosives required	82,700	<10,000	<12,000	<8,000	<4,500	<8,000	<8,500
Volume of mock explosives required	2,910 pounds	<800	<1,000	<1,500	<1,500	<1,500	<1,260

Source: NNSA (2008a); LANL (2018, 2019b, 2020, 2021b, 2022a)

K-Site Control Building

The K-Site Control Building is used to monitor safety and mechanical testing operations at TA-11, Building 30. Construction of the new building was completed in 2017 (LANL 2019b).

High-Explosive Processing Building

The Laboratory completed construction of the Detonator Production Bonded Storage Facility in TA-22 (Building 22-0189) in 2020 (LANL 2022a).

A.2.2.1.5.3 Weapons Component Production

Chemistry and Metallurgy Research Building and Radiological Laboratory/Utilities Office Building

In 2003, DOE prepared the CMRR EIS to evaluate replacement of the CMR facility (NNSA 2003a). The CMRR EIS analyzed the potential impacts of the proposed relocation of analytical chemistry and materials characterization activities and associated R&D capabilities from the CMR Building to a newly constructed CMRR Facility. The NNSA decision was documented in the CMRR EIS ROD (69 FR 6967, February 12, 2004) and incorporated into the proposed action for the 2008 LANL SWEIS as part of the No-Action Alternative. The CMRR Facility was to consist of (1) a building housing administrative offices and support functions (now called the RLUOB); and (2) a nuclear facility housing HC-2 nuclear operations. The Laboratory completed construction of the RLUOB in TA-55 in 2012 and the facility began operations in 2014. In August 2015, DOE cancelled construction of the nuclear facility (NNSA 2017b). NNSA (2018a) considered the potential impacts of relocating CMR operations to TA-59-1, PF-4, and RLUOB, and the relocation is underway. The ongoing function of RLUOB is described in Appendix E, Section E.2.3.2 and more details about the facility are presented in Appendix E. NNSA plans to achieve overall facility cleanout and cessation of all operations by 2028. At that point, CMR would be transferred to DOE-EM for final closure.

The Radiological Sciences Institute was a facility proposed to replace aging research laboratories, including the CMR Building Wing 9 hot-cell capabilities (NNSA 2018a). The Radiological Sciences Institute was not included in the decisions in the 2008 LANL SWEIS and is not planned to be implemented (LANL 2022a). Some of the hot-cell capabilities are being replaced by the Light Manufacturing Laboratory, which is being constructed in TA-53 under the No-Action Alternative analyzed in this SWEIS (*see* Chapter 3, Section 3.2).

In 2003, modifications to Wing 9 in the CMR Building were started (in support of the Confinement Vessel Disposition Project) to provide for the disposition of large vessels previously used to contain experimental explosive shots involving various actinides. Containment vessels were relocated from TA-55 to CMR to be remediated for disposal. The 2008 LANL SWEIS evaluated the processing of these vessels. The vessel processing was completed in 2019 (LANL 2022a).

The Material Recycling and Recovery Program is still performing work in Wing 9 and some nuclear material is being stored in the hot cells (and other locations). Most Material Recycling and Recovery Program work is expected to be completed by 2024, except for projects to clean nuclear material out of spaces in Wings 5, 7, and 9. Limited future operations are expected in Wing 9 involving special projects, some of which may require revisions to safety basis documents.

TA-55 Reinvestment Project

The TA-55 Reinvestment Project (TRP) is intended to make seismic improvements and selectively replace and upgrade major facility and infrastructure systems at PF-4 and related structures at TA-55. Project Phases I and II are complete (as of 2020) and Phase III is ongoing, with construction projected to end around 2027 (NNSA 2022c). The TRP was analyzed in Appendix G of the 2008 LANL SWEIS and included in the 2008 and 2009 RODs. It was also included in the 2018 LANL SWEIS SA (NNSA 2018a). The goal of the project is part of a comprehensive, long-term strategy to extend the life of PF-4 at TA-55 so it can operate securely, safely, and effectively throughout its expected operating life. Construction for TRP Phase I began in 2009 and addressed building support systems: mechanical (heating, ventilation, and air conditioning and high-efficiency particulate air filtration), electrical (standby and emergency power), utility systems (process gases and liquids, piping), safety, facility monitoring and control, structural components, and architectural components (i.e., coatings). Phase II addressed the uninterruptible power supply, air dryers, confinement doors, criticality alarms, the vault water tank cooling system, seismic upgrades of glovebox stands, and exhaust stack sampling. Phase III includes replacement of the fire alarm system that supports PF-4. Additional facility system upgrades (e.g., replacement of fire suppression system, removal of the TA-55 office building from the fire water loop, upgrade of the PF-4 ventilation system) may take place in the future. In March 2022, NNSA responded to concerns from the DNFSB with a schedule and justification for the planned updates to the PF-4 ventilation system (NNSA 2022c).

Increased Pit Production

As described in Section A.2.2.1.3, NNSA has decided that the Laboratory will produce a minimum of 30 pits per year and implement surge efforts to exceed 30 pits per year to meet NPR and national policy (*see* Chapter 1, Section 1.3.1.3). This decision is consistent with analysis of the Expanded Operations Alternative in the 2008 LANL SWEIS and the 2020 LANL SWEIS SA (NNSA 2020b).

Federal law requires the Secretary of Energy to produce not less than 80 war reserve plutonium pits during 2030 (50 U.S.C. § 2538a). In 2018, Congress enacted as formal policy of the United States that LANL will produce a minimum of 30 pits per year for the national production mission and will implement surge efforts to exceed 30 pits per year to meet NPR and national policy (Public Law 115-232, Section 3120).

As identified in Section A.1.4.2, DOE issued an amended ROD (85 FR 54544, September 2, 2020), to implement elements of the Expanded Operations Alternative related to pit production from the 2008 LANL SWEIS. Elements of the decision that have yet to be implemented are part of the No-Action Alternative described in Chapter 3, Section 3.2. The specific elements included in the decision and the status of their implementation include:

- **Remove legacy equipment and install new equipment** – These activities are occurring inside of PF-4 and are anticipated to be completed in fiscal year (FY) 2028.
- **Hire and train approximately 400 additional staff** – Full staffing with trained personnel expected by FY 2026.
- **Upgrade existing support facilities and construct new support facilities** – These activities are ongoing. The facilities specific to increased pit production include infrastructure and support facilities at TA-48 and TA-50: office buildings, cafeterias, a training facility, and a west entry control facility into TA-55. Construction of these facilities is anticipated to be complete by mid-2028.
- **Repackage and dispose of MOX fuel rods** – The MOX Fuel Rods Size Reduction and Disposition Project is in pre-project planning. Per the discussion in Chapter 3, Section 3.2.3, the Laboratory will disposition these fuel rods in PF-4.
- **Implement Replacement Office Buildings Project** – No activity has currently been identified using this element of the 2020 amended ROD.
- **Implement elements of the Security-Driven Traffic Modifications Project** – This element of the project would include construction of a Pajarito Corridor Office Complex and upgrades to intersections along Pajarito Corridor and is anticipated to start in mid-FY 2025 and be completed in FY 2028.
- **Management and disposition of additional wastes generated** – This action would be ongoing for the duration of the pit production mission.
- **Transport additional materials, parts, and waste** – This action would be ongoing for the duration of the pit production mission.

In 2013, the Laboratory paused work on all fissile material operations in PF-4. The pause stemmed from self-reported procedural issues and resulted in management evaluation of work, identifying potential deficiencies in work processes and procedures and mechanisms for continuous improvement. In response to the DNFSB, DOE took actions to address the criticality safety concerns. Corrective actions include revising the Nuclear Criticality Safety Program. In addition, the Laboratory conducted a causal analysis of criticality safety infractions that occurred in 2013 and submitted a plan to DOE for reopening PF-4 for operations. The Laboratory incorporated corrective actions from prior assessments into the 2014 *Nuclear Criticality Safety Program Upgrades Project Management Plan* (LANL 2014a). Full operations, including pit manufacturing, resumed at PF-4 in August 2016. In NNSA's January 2023 annual report to the DNFSB (NNSA

2023c) regarding DOE nuclear criticality safety programs, LANL's "program health" and "operational implementation" were both assessed to be "good." In a letter in August 2023, DNFSB acknowledged that the Laboratory completed a probabilistic risk analysis and concluded that the seismic safety risk of PF-4 is acceptable until the site-specific probabilistic seismic hazard analysis is updated in 2025. DNFSB found that NNSA's conclusion was technically defensible and that the accompanying peer review process was robust (DNFSB 2023).

A.2.2.2 Global Security Program

The Laboratory executes global security work in a safe and secure manner to address defense nuclear nonproliferation, nuclear counterterrorism and counterproliferation, and incident response missions. NNSA prepares an annual report to Congress entitled, *Prevent, Counter, and Respond – NNSA's Plan to Reduce Global Nuclear Threats*, which highlights a five-year outlook at the most pressing national security challenges and how DOE/NNSA provides cross-cutting capabilities to address them (NNSA 2021a). The execution of global security work is organized around five broad objectives: (1) to support efforts to secure, account for, and interdict the illicit movement of nuclear weapons, weapons-useable nuclear materials, and radiological materials; (2) to support U.S. national and nuclear security objectives in reducing global nuclear security threats through the innovation of unilateral and multilateral technical capabilities to detect, identify, and characterize foreign programs designed to undermine U.S. strategic deterrence; (3) to support efforts to achieve permanent threat reduction by managing and minimizing excess weapons-useable nuclear materials and providing nuclear materials for peaceful uses; (4) to support efforts to prevent proliferation, ensure peaceful nuclear uses, and enable verifiable nuclear reductions in order to strengthen the nonproliferation and arms control regimes; and (5) to sustain and improve nuclear counterterrorism and counterproliferation science, technology, and expertise; execute unique emergency response missions; implement policy in support of incident response and nuclear forensics missions; and assist international partners/organizations. The following sections discuss LANL's global security programs in more detail.

A.2.2.2.1 Nuclear Nonproliferation

The Laboratory's current capability and infrastructure supports activities related to preventing or limiting the spread of materials, technology, and expertise for nuclear and radiological threats; developing technologies to detect nuclear proliferation worldwide; eliminating or securing inventories of surplus weapons-useable materials and infrastructure; and reducing the risk that hostile nations or terrorists could acquire nuclear weapons or weapons-useable material. The Laboratory applies its capabilities in computing, materials development, and sensor technologies as well as its nuclear weapons expertise to enable the nonproliferation mission. The Laboratory also supports the International Atomic Energy Agency's nuclear safeguards mission by developing new technologies and providing expert advice and training to the agency and to U.S. policy makers. Laboratory personnel not only work with international partners to strengthen safeguards implementation, but also take leaves of absence to serve as the Agency's staff members. The goal is to prevent proliferation and reduce the global risk posed by inadequately secured nuclear and radiological materials in support of the Nuclear Nonproliferation Treaty, the Comprehensive Test Ban Treaty and other bilateral and multilateral agreements. For example, the Laboratory utilizes its resources to determine whether a seismic event was an underground nuclear explosion or natural phenomenon. This capability supports compliance with the aforementioned treaties and agreements (*see* Chapter 1, Section 1.3.1.4).

A.2.2.2.2 Nuclear Counterterrorism, Counterproliferation, Forensics, and Space-Based Nuclear Detection

The Laboratory supports combatting the threat of nuclear terrorism and securing nuclear weapons, materials, related technology, and knowledge to prevent their malicious use. The Laboratory provides the methodologies and tools to deny, deter, and dissuade potential actors from acquiring the materials or technologies needed to execute such an event. The Laboratory also supports efforts for detecting (and if possible, countering) the development of any device or capability that may lead to an event. The Laboratory's work to counter nuclear weapons is focused on its capability to develop tools that could be used to prevent rogue use of a nuclear weapon against the United States or its allies. Effective nuclear forensics aids in the prevention of nuclear terrorism and enables the rapid attribution of a nuclear event. The Laboratory's actinide analytical chemistry activities support this effort through collection, analysis, and evaluation of radiological and nuclear material in both pre-detonation and post-detonation scenarios. The Laboratory's nuclear detection support develops instruments, sensors, and data integration platforms to detect and measure nuclear explosions in the subsurface, oceanic, atmospheric, and outer space using satellite and ground-based sensing systems.

Another element of nuclear counterterrorism and counter proliferation is the Laboratory's support of incident and emergency response, which includes capabilities and infrastructure related to responding to nuclear incidents, locating and disabling nuclear devices, and managing consequences of nuclear detonation. The Laboratory provides key technical capabilities and scientific expertise during radiological and nuclear incidents, in collaboration with the interagency preparedness and response community. LANL performs R&D of tools that can be used by incident responders to disable nuclear devices and provide for attribution of their source. The Laboratory also trains mission partners in the application of these tools. LANL partners with other national laboratories and sites to support emergency response capabilities. Laboratory experts have played important roles preparing for major national events that could attract terrorists bent on detonating a nuclear device. The Laboratory enhances NNSA's incident and emergency response programs by providing both pre- and post-event response and reach-back support for chemical, biological, radiological, nuclear, and/or explosive events. For example, Laboratory researchers develop computer models that track the transport and deposition of hazardous materials released into the atmosphere.

A.2.2.2.3 Offsite Source Recovery Program

The OSRP is a component of the Laboratory's nuclear nonproliferation mission and is tasked to recover and manage sealed radioactive sources from domestic and international locations for threat reduction purposes. For example, between 1997 and 2022, more than 45,000 U.S.-origin sources were removed from over 1,650 sites, including all 50 U.S. states and 28 foreign countries. The sealed radioactive sources are shipped and received at the TA-3-0030 warehouse, TA-55, or other approved DOE, LANL, or subcontracted facilities for interim staging or disposition. The OSRP recovers and manages unwanted radioactive sealed sources that:

- Present a risk to national security, public health, or safety;
- Present a potential loss of control by a U.S. Nuclear Regulatory Commission (NRC) or Agreement State[2] licensee;

[2] Congress authorized the NRC to enter into Agreements with states that allow the states to assume, and the NRC to discontinue, regulatory authority over source, byproduct, and small quantities of special nuclear material. The states, known as Agreement States, can then regulate byproduct, source, and small quantities of special nuclear materials

- Are excess and unwanted and are a DOE responsibility; or
- Are DOE owned.

A.2.2.2.4 Bioscience/Biosecurity

The Laboratory's biological threat reduction and response capabilities provide support through its rapid detection and characterization and predictive modeling capabilities for emerging and unknown threats. Capabilities include bio-surveillance tools and processes to characterize a variety of biothreats; development of new medical countermeasures that address key scientific barriers in the drug discovery and development process; and improved threat characterization, simulation, and intelligence analysis. LANL is able to work at biosafety level (BSL)-2—a key requirement for handling pathogens that could be potential terrorist threats as well as the ability to respond to a global pandemic, such as COVID-19. LANL utilizes expertise in HPC and artificial intelligence/machine learning to develop a suite of predictive analytics that will expedite the characterization of biological threats, predict the paths of diseases through the population, and help accelerate the development of technologies and treatments. Examples of capabilities and activities conducted at the Bioscience Facilities include (CDC 2020):

- Biothreat reduction and bioforensics analyses, including DNA sequencing and other analytical techniques to identify pathogen strain signatures for biodefense and national security purposes;
- Synthetic biology approaches for biomanufacturing of valuable products for bioenergy and the bioeconomy;
- Environmental microbiology research focused on microbial systems and their environment;
- Genomic studies using molecular and biochemical techniques to analyze the genes of humans, animals, and plants;
- Molecular synthesis work focused on creating new, isotopically labeled molecules for observation of specific chemical groups and for use as standards in the detection of chemical agents and biological toxins;
- Structural biology using experimental techniques such as nuclear magnetic resonance and time-resolved vibrational spectroscopies; and
- Pathogenesis research to gain a quantitative understanding of various aspects of pathogen life cycles, with a focus on understanding infections in humans, animals, and plants and the epidemiology and life cycle of pathogens in the environment and general biological work performed at BSL-1 and BSL-2, including select agent work at BSL-2 under the Center for Disease Control's "Biosafety in Microbiological and Biomedical Laboratories" guidelines.

A.2.2.2.5 Surplus Plutonium Disposition/ Advanced Recovery and Integrated Extraction System

The purpose of ARIES is to convert plutonium metal used in nuclear weapons into plutonium oxide powder. The processing line within PF-4 supports the Laboratory's—and the nation's—nuclear nonproliferation goals by helping to prevent the spread of weapon-grade nuclear material. ARIES dates to 1998, when the Surplus Disposition Program was mandated by U.S. policy born out of an

---

that are covered in the Agreement, using its own legislation, regulations, or other legally binding provisions. (Section 274b of the *Atomic Energy Act of 1954*, as amended).

agreement between the U.S. and Russia. In 2000, each country began working toward the conversion of 34 metric tons of weapons- grade plutonium sourced from Cold War weapons declared at that time to be no longer necessary for national defense. Initially, the U.S. hoped to convert weapon-grade plutonium into mixed-oxide fuel for commercial power reactors, but that plan was never implemented. Instead, NNSA is currently pursuing a "dilute and dispose" plan. Under this plan, LANL would receive surplus nuclear weapon pits from the Pantex Plant near Amarillo, Texas (and non-pit material from the SRS in Aiken, South Carolina).[3] The pits would be disassembled and placed into a furnace where heat and oxygen would turn the plutonium metal into plutonium oxide powder. This oxide powder would then be blended to ensure uniformity and placed in special stainless-steel cans to be transported to SRS. There, the oxide powder would be diluted with other materials and packaged for eventual transport to WIPP near Carlsbad, New Mexico, for safe disposal in an underground salt formation.

SURPLUS PLUTONIUM DISPOSITION PROGRAM EIS (SPDP EIS)

- The SPDP Final EIS, which evaluates NNSA's proposed action to dispose of 34 metric tons of surplus plutonium, was published on January 19, 2024 (NNSA 2024a). The ROD was published on April 19, 2024 (89 FR 28763).
- NNSA's ROD 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) by approximately 10 years.
- At the Laboratory, implementation of the pit disassembly and processing project would include construction and modification activities at LANL to expand the existing ARIES capabilities in PF-4. NNSA would construct: a Logistical Support Center, a separate office building, a warehouse, a security portal, and a weather enclosure at the loading dock of PF-4.

The process development work in the ARIES processing line also supports plutonium pit production, as described in the 2008 SWEIS, for actinide materials science and processing R&D. The disassembly process developed for ARIES supported development of similar equipment used in the first step in recovery of plutonium from pits arriving from Pantex. Equipment used in ARIES in PF- 4 can be used to support pit disassembly for the pit production mission.

A.2.2.2.6 Space Power Support

DOE and its predecessor agencies have supplied plutonium-238 (Pu-238) to provide power generation for U.S. space programs and national security missions for more than five decades. The National Aeronautics and Space Administration uses radioisotope power systems, which are fueled by Pu-238, as the source of electric power and heat for deep space missions. LANL maintains capability for Pu-238 processing and general-purpose heat source fuel clad production, among other mission support activities. This work is conducted at

RADIOISOTOPE POWER SYSTEM

A radioisotope power system converts heat generated by the natural decay of Pu-238—a radioactive isotope—into electrical power. Radioisotope power systems have powered more than two dozen U.S. space missions and are capable of producing heat and electricity under the harsh conditions in deep space for decades without any maintenance.

[3] The SPDP EIS defines surplus plutonium as, "… material sourced from both pit and non-pit plutonium. A pit is the central core of a nuclear weapon that principally contains plutonium or enriched uranium. The plutonium contained in the pit is termed 'pit plutonium.' Non-pit surplus plutonium may be in metal or oxide form or may be associated with other materials that were used in manufacturing and fabricating plutonium for use in nuclear weapons." Also, surplus plutonium has no identified programmatic use and does not fall into any of the national security reserves categories.

LANL's Plutonium Facility PF-4 and involves Pu-238 storage, chemical processing, analysis, fuel processing, and encapsulation of Pu- 238 into general-purpose heat source fuel clads used in radioisotope power systems.

A.2.2.2.7 Amerecium-241 Production

Amerecium-241 is used in a variety of industrial applications including oil and gas exploration, smoke detectors, and moisture gauges. Amerecium-241 is extracted from plutonium waste streams in PF-4. This provides a dual benefit: a needed radioisotope product for research and industry and a reduced volume of transuranic (TRU) waste for disposal.

A.2.2.2.8 Infrastructure and Major Facilities Supporting the Global Security Mission

The global security mission currently takes place in at least a dozen technical areas. In many cases, the mission work is executed by non-global security organizations or by global security organizations in facilities managed by other programs. A significant portion of the global security work is executed outside the state of New Mexico at the Nevada National Security Site, other DOE facilities, and LANL-operated, offsite secure facilities. Existing global security activities executed at LANL are described in Table A.2.2.-3.

Table A.2.2-3 Global Security Activities by Technical Area

Tech Area	Mission Activity Description
TA-00	TA-00 is one of the six facilities under the Bioscience Division. The bioscience facilities have BSL-1 and BSL-2 laboratories and include bioscience and biotechnology research at LANL, which covers structural, molecular, cell, and synthetic biology in microbial and cell culture systems.
TA-3	Mission activities include experimental sciences, work with SNM, materials synthesis, metallic and ceramic processing and fabrication, as well as theoretical and computational research. Global security facilities at TA-3 also include sensitive compartmented information facilities and special access program facilities, which are used for classified information/operations. All mission areas within global security execute work in this technical area. Major facilities used by global security include: • The Nonproliferation and International Security Center with mixed use radiological/electronic/optical laboratories focuses on detection research, intelligence, nuclear safeguards and emergency response. The Nonproliferation and International Security Center includes Security Category III SNM vaults as well as instrumentation development and training laboratories. • The Physics Building (SM-40) Complex is a laboratory and office complex located in TA-3. The buildings contain a mixture of offices, storage areas, small electronics shops, machine shops and light laboratory experimental areas.

Tech Area	Mission Activity Description
TA-3	• The TA-3-1405 building and National Security Sciences Building house administrative office and meeting space, including sensitive compartmented information facilities and special program access facilities. • The SCC in TA-3 also supports the global security mission. • The Bioscience Research Laboratory, as described in Appendix E, Section E.2.1.6 is located in TA-3. The Emerging Threat Laboratory synthesizes and characterizes acutely toxic, regulated materials and includes a BSL-2 suite that can be used to study these agents and emerging pathogens.
TA-9	Fabrication feasibility and the physical properties of explosives are explored at this site, and new organic compounds are investigated for possible use as explosives.
TA-14	Global Security performs experiments using the firing site capabilities at TA-14.
TA-15	TA-15 supports mission programs by enabling applied testing of energetics, related training, x-ray interaction and diagnostics, chemical effects, mechanical insult, and collateral effects testing and diagnostic development.
TA-16	TA-16 HE research, development, and testing capabilities include HE processing; powder manufacturing; casting, machining, and pressing; inspection and radiography of HE components to guarantee integrity and ensure quality control; test device assembly; and chemical analysis. Global security missions executed at TA-16, include nuclear counterterrorism and counterproliferation technology development, as well as support to nuclear emergency support team programs.
TA-33	Global security activities at this site include programs intended to protect, deter, and respond to weapons of mass destruction through tailored training and by using specialized applied electromagnetic solutions, rapid prototyping, designing and prototyping tools and trainers, along with novel safing technologies, radio frequency solutions, and cyber-physical applications. The anechoic chamber at TA-33 is a state-of-the-art user facility that enables LANL to test and validate innovative radio frequency concepts and systems in a pristine electromagnetic environment. Laboratories and testbeds include additive manufacturing, machining, pulsed power, laser interaction, power delivery and response, chemical compatibility, cryogenics, biological measurements, and radiological material detection and effects. Satellite ground stations are also located in TA-33.
TA-35	Global security activities include research in reactor safety and radiation detection and measurement for nuclear safeguards, border security, and waste management applications. TA-35 includes below-grade radiological laboratory space to provide a low background area for neutron measurements. Other buildings provide machining and electronics laboratories. TA-35 also houses light labs and a material balance area that support the Offsite Source Recovery Program.
TA-36	Global security performs experiments using the firing site capabilities in TA-36, including at Minnie and Meenie/Bravo. TA-36 contains an observation point, which allows observation of activities that occur in the Water Canyon and Canyon View Test sites at TA-68.
TA-39	This TA is used extensively for applied testing of energetic devices, chemical interactions, electrical transmission components, radiological detection and experimentation, unmanned aerial systems, and applied electromagnetics. TA-39 capabilities are also utilized in training counterterrorism and counter proliferation teams.

Tech Area	Mission Activity Description
TA-41	Global security activities at TA-41 include support to the nuclear debris collection and analysis, nuclear forensics, and treaty monitoring and verification missions. TA-41 has a very low cosmic radiation background due to its overburden (e.g., TA-41 has real estate in a tunnel). Research performed involves low-level gamma spectroscopy, evaluation of communications systems (transmit and receive), and other experimental systems that benefit from low cosmic radiation backgrounds.
TA-43	TA-43 is adjacent to the Los Alamos Medical Center at the northern border of LANL. The Bioscience Facilities (formerly called the Health Research Laboratory) are located within TA-43: The bioscience facilities have BSL-1 and BSL-2 laboratories and are the focal point of bioscience and biotechnology at LANL. Research performed at the bioscience facilities includes structural, molecular, cell, and synthetic biology in microbial and cell culture systems.
TA-46	TA-46 houses facilities for conducting research, development, and equipment calibration for imaging and other sensing techniques. Additionally, specific permissions for hazardous materials research have been approved to support instrument development and calibration.
TA-48	Global security activity at TA-48 includes the support of the nuclear forensics mission in chemistry laboratories. The Radiochemistry and Hot Cell Facility has three roles: research; production of medical radioisotopes; and support services to other LANL organizations, primarily through radiological and chemical analyses of samples.
TA-49	TA-49 contains two primary areas that are used as training and research facilities. The Emergency Response training facility, located in the center of TA-49, supports training for a variety of emergency response agencies and focuses on hazardous materials; chemical, biological, radiological, nuclear, and/or explosive events; and explosives response proficiency and training. This training supports local, state, and federal response agencies including DOE nuclear emergency support teams and counterproliferation activities. Kelly Field, on the eastern side of TA-49, supports outdoor tests on materials and equipment components that involve generating and receiving microwaves and outdoor training with radiological sources. It is also being developed as the new LANL Inter-Agency Unmanned Aerial System training facility. This facility will promote interagency training and related R&D for the use of remotely operated vehicle platforms to support emergency response activities, as well as other mission essential operations such as infrastructure, biological asset monitoring and management, archaeological site characterizations and preservation, and wildland fire preparedness.
TA-55	Global security work at the Plutonium Facility is necessary when security Category I or II SNM is involved or when processing of plutonium is required. The largest global security mission executed at TA-55 is the ARIES Program. The Laboratory's nuclear incident response programs also maintain capabilities at TA-55 to support threat device forensics and attribution. TA-55 also provides Pu-238 support to the space power program, houses a secure material balance area that supports the Offsite Source Recovery Program, and supports the nuclear emergency response mission.

Tech Area	Mission Activity Description
TA-57	The primary ongoing activity conducted at TA-57 is persistent monitoring of the night sky to find important changes in real time and conduct interrogating observations of those changes with a suite of optical telescopes. Those changes in the night sky can be as short as sub-second optical flashes from explosive astrophysical transients and/or satellite glints up to weeks long optical transients associated with the mergers of black holes and supernovae. This dark, high-altitude, site away from the light pollution of Los Alamos is a very valuable resource for developing, testing, and prototyping advanced instrumentation as well as next-generation autonomous sensor ecosystems.
TA-59	Activities in the emerging Plutonium Science Laboratory in TA-59, Building 1, will provide direct support to the Global Security Nonproliferation Stewardship Program. In particular, the Plutonium Science Laboratory will establish new infrastructure/equipment that will provide opportunities to cultivate and retain high quality workforce, with emphasis on developing plutonium science bench depth, that will benefit both the Stockpile Stewardship/Weapons and Global Security programs. Key technical areas will focus on aqueous plutonium chemistry and separations, plutonium molecular and materials science, as well plutonium-molten salt chemistry.
TA-66	TA-66 provides office, meeting, and training space to support nonproliferation and related missions. Building 1 has radiological laboratories with security Category III SNM that for training on nuclear measurement methods and nuclear safeguards.
TA-68	TA-68 provides a unique sensor calibration capability including isolated instrumented pads. The calibration and experimental sites along with semi-permanent structures allow for flexibility in test campaigns and sensor deployment. These facilities are known as Canyon View and Water Canyon test bed. Research conducted allows for the evaluation and capture of unique chemical signatures relevant to a number of global security missions.

A.2.2.2.9 Global Security Program – Changes Since 2008 SWEIS

This section identifies notable changes that have occurred to the capabilities, facilities, and operations related to the Global Security Program since publication of the 2008 LANL SWEIS.

A.2.2.2.9.1 Nuclear Nonproliferation

Sensitive Compartmented Information Facility

The Laboratory constructed a modular office building in TA-3 (TA-3-2618) that serves as a sensitive compartmented information facility for the Global Security Program. The new facility was officially named the Donald M. Kerr Office Building, in honor of the former Laboratory director, and was completed in 2020 (LANL 2021b). The approximately 8,000-square-foot building houses 19 employees performing intelligence work.

A.2.2.2.9.2 Nuclear Counterterrorism, Counterproliferation, Forensics, and Space-Based Nuclear Detection

The Water Canyon and Canyon View Test Site

The Laboratory constructed an outdoor test bed that is used for research, development, and equipment calibration for imaging techniques to detect materials of interest. The site consists of two 10-acre test beds. One of the test beds is used to detect hazardous materials while the other test bed is used as a calibration site.

TA-33 Utilization in Support of Global Security Mission

The Laboratory constructed an anechoic chamber (a room designed to stop reflections or echoes of either sound or electromagnetic waves) at TA-33, the largest enclosure of its kind at LANL, and began operations in 2018 in support of sensitive radiofrequency measurements and characterization efforts for a wide range of Global Security mission areas. The facility, approved for operations at the highest security levels, has greatly advanced the Laboratory's ability to support developmental phases of diagnostics design, antenna development/selection, and experimental validation to most efficiently baseline the Laboratory's ability to accurately collect and separate relevant radiofrequency spectra. Additional capability enhancements at TA-33 include operation of the Laboratory's largest open-air Class 4 laser in 2020. This 7.5-terawatt/300-megajoule pulsed laser is utilized for remote measurements associated with material degradation and characterization. TA-33 has also evolved to more effectively support Nuclear Emergency Support Team training and associated material detection evaluations through periodic use of radioactive materials and commercial/portable x-ray systems.

A.2.2.2.9.3 Offsite Source Recovery Program

Recovery of Foreign Sealed Sources

A notable change to the OSRP since 2008 is the inclusion of recovery and transportation of sealed sources from foreign countries to the U.S. through the global commons by commercial cargo aircraft and also the role of a commercial facility in managing these sealed sources. These elements of the program were evaluated in the *Supplement Analysis for the Transport and Storage of High-Activity Sealed Sources from Uruguay and Other Locations* (NNSA 2011a) (76 FR 40352, July 8, 2011).

A.2.2.2.9.4 Bioscience/Biosecurity

Bioscience Facilities

In the 2009 ROD for the 2008 LANL SWEIS, NNSA decided to construct and operate a new Science and Engineering Complex at TA-62 (74 FR 33232, July 10, 2009). The complex would have been a replacement facility for bioscience operations that are currently conducted at TA-43-0001. Subsequently, NNSA cancelled the project (NNSA 2010c).

In 2019, the Laboratory began construction on a new modular facility for the bioscience operations at the former location of the Press Building (TA-3-0035) in TA-3. This facility, referred to as the Biological Research Laboratory, meets the requirements to operate as a BSL-1 or BSL-2 facility. It was built on a previously disturbed site and provides approximately 14,000 square feet of space and houses BSL-2 laboratories and office space (NNSA 2018d). The Bioscience Research Laboratory began operations in 2022 and includes the following (LANL 2024a):

- **Virology laboratory** – research involving influenza strains;
- **Cellular laboratory** – activities involving human cell line studies;
- **Bacterial laboratories** – two laboratories with activities involving bacterial strains, growth, and DNA extraction;
- **Molecular biology laboratories** – three laboratories with activities involving DNA preparation, electrophoresis, and polymerase chain reaction techniques; and
- **Soils laboratories** – two laboratories with activities working with domestically collected soils.

The former Press Building and surrounding area underwent DD&D prior to construction (NNSA 2018d).

During 2004, the Laboratory constructed what was originally intended to be a BSL-3 facility (TA-3-1076) in TA-3. Building 1076 is a windowless, single-story, 3,200-square-foot, standalone biocontainment facility. Due to the need to consider new circumstances and information relevant to the actual construction of Building 1076 and its future operation, NNSA withdrew the NEPA coverage for the facility and it did not begin operations. In 2018, the Laboratory revised the proposed use of the facility to enable BSL-2 and chemical operations. In 2019, the building underwent significant upgrades to the heating, ventilation, and air conditioning control systems and other facility systems. One laboratory space is proposed to be used for select agents and one to be used for potential chemical and biological toxins. Building occupancy was transferred to the Bioscience Division, and they initiated programmatic startup plans. The facility was undergoing programmatic startup in 2022 and received full beneficial occupancy (LANL 2024a). This facility has been named the Emerging Threat Laboratory.

A.2.2.2.9.5 Surplus Plutonium Disposition/ARIES

During 2017, the Laboratory was directed to prepare a Critical Decision-0 package to initiate design for the dilute and dispose alternative (NNSA 2015). In 2021, the Laboratory achieved Critical Decision-0 for the dilute and dispose program, which would be implemented through the ARIES Program in PF-4 (LANL 2022a). As mentioned in Section A.1.4.1, NNSA announced a decision in the *Federal Register* (85 FR 53350, August 20, 2020) to dispose of an additional 7.1 metric tons of non-pit plutonium using the WIPP Disposal Alternative. The ROD stated that conversion of the non-pit plutonium would occur at either LANL or the SRS.

Future changes regarding the surplus plutonium mission at LANL are dependent on future decisions resulting from the *Surplus Plutonium Disposition Program EIS* (NNSA 2024) as described in Section A.1.4.1. For this Draft SWEIS, the activities associated with surplus plutonium disposition have been included in the Expanded Operations Alternative and are described in Section 3.4.

A.2.2.3 Science, Technology, and Engineering Program

A.2.2.3.1 Accelerator Science

Accelerator science supports many programs at the Laboratory, including stockpile stewardship and weapons; global security; and science, technology, and engineering. Accelerator science involves radiographic imaging, remote measurements of electromagnetic signatures, development of directed energy sources, isotope production, and development of new capabilities such as radiation therapy and irradiation/sterilization of materials. In addition, accelerator science is part of the basic science mission at LANL and supports fundamental research in key technologies.

The majority of LANL's accelerator activities are conducted at the LANSCE, which lies entirely within TA-53 and comprises more than 400 structures. The majority of LANSCE operations are associated with the 800-million-electron-volt linear accelerator, a proton storage ring, and three major experimental areas supporting the Stockpile Stewardship Program: the Manuel Lujan Neutron Scattering Center (the Lujan Center), the Weapons Neutron Research Facility, and the Proton Radiography Facility. The principal capabilities and activities conducted at LANSCE include:

- Accelerator beam delivery, maintenance, and development of diagnostic instruments;
- Experimental area support including facility and plant operating and engineering services; environment, safety, and health services and oversight; site and building physical security; visitor control; and facility specific training;
- Dynamic radiography research utilizing proton radiography;
- Materials science experiments using neutron scattering;
- Neutron radiography;
- Neutron science and nuclear physics research;
- Subatomic physics research;
- Testing of electronic components for their response to radiation;
- Production of medical radioisotopes; and
- High-power microwaves research and advanced accelerator development.

TA-53 includes other facilities and laboratories supporting accelerator R&D and integrated systems testing, for both current and future accelerator technologies and missions. One notable such facility is Building 365, which has an infrastructure capable of producing and accelerating high-energy particle beams.

A.2.2.3.2 Materials and Physical Sciences

The materials and physical sciences support many Laboratory programs, including stockpile stewardship and weapons, global security, and science, technology, and engineering. Activities include:

- R&D related to materials discovery, fabrication, integration, and performance;
- Generating new/improved technology in experimental physics;
- Diagnostics instrumentation, sensor, and tool development;
- Evaluating and predicting structure/property relationships;
- Practical applications of materials—from nano to macro;
- R&D of quantum materials, quantum sensors, quantum networking, and quantum computing, including experimental, computation, and theoretical work;
- Understanding and exploiting quantum phenomena;
- Materials characterization under extreme environments;
- Actinide chemistry and actinide material science;
- Fuel cells and electrolyzers;
- Advanced separation technologies;
- Acoustic separations and sensor technologies;
- Static and dynamic characterization of materials; and
- Ultrafast materials and optical science.

Operations related to materials and physical sciences are conducted in many LANL facilities, including the LANSCE, Center for Integrated Nanotechnologies, and National High Magnetic Field Laboratory-Pulsed Field Facility (LANL 2022g).

A.2.2.3.3 Isotope Program

Production of isotopes utilizes unique capabilities to produce radioisotopes that are in short supply. The Isotope Production Facility, a 100-megavolt proton bombardment station located at LANSCE, is a premier facility able to conduct high-current irradiations for large-scale production, as well as delicate, low-current experimental work. The Laboratory also maintains a robust hot-cell facility for isotope processing in TA-48, as well as a glovebox line within PF-4 in TA-55. The Laboratory produces the following isotopes for medical, industrial, and research applications:

- **Strontium-82** – used for cardiac imaging
- **Germanium-68** – used for diagnostic procedures
- **Actinium-225** – used for targeted alpha therapy
- **Sodium-22** – used as a source for positron emission tomography
- **Arsenic-73** – used for environmental research

The Laboratory also is engaged in the development of new isotopes for application in the fields of medicine, fundamental nuclear physics, national security, environmental science, and industrial applications (LANL 2022g).

A.2.2.3.4 Basic Science

Sponsored by a broad contingent of the scientific community—including the DOE Office of Science, academia, industry partners, and Laboratory-directed R&D—basic science ensures that LANL's research capabilities remain at the cutting edge and that Laboratory scientists and engineers are prepared to solve critical challenges across national missions. The Laboratory's basic science programs provide a focal point for basic and applied R&D programs in materials science, nanoscience, biology, biotechnology, environmental, climate, medical, isotopes, high-energy physics, nuclear physics, heavy-element chemistry, and advanced computing projects. The Laboratory's energy portfolio spans a broad spectrum from fuel-cell research to biofuels and fusion energy. Basic science capabilities are spread across the LANL campus with multiple technical divisions contributing.

MEDICAL USES

Isotopes produced at LANL are critical for medical diagnosis and disease treatment. One of the more common uses is as a tracer, in which a radioisotope is taken orally, injected, or inhaled into the body. The radioisotope then circulates through the body or is taken up only by certain tissues. Its distribution can be tracked according to the radiation it gives off. The emitted radiation can be captured by various imaging techniques, such as single-photon emission computed tomography or positron emission tomography.

Therapeutic applications of radioisotopes typically are intended to destroy the targeted cells. This approach forms the basis of radiotherapy, which is commonly used to treat cancer and other conditions involving abnormal tissue growth.

A.2.2.3.5 Strategic Partnership Projects

Strategic Partnership Projects (SPP) capabilities support federal and non-federal entities that are outside of DOE and NNSA and involve broader national security, energy security, and scientific development missions. LANL engages in partnerships with academia, industry, and government entities that support the Laboratory's mission and need to utilize the Laboratory's capabilities as a federally funded R&D center for national needs. The strategy for partnering includes entering into agreements with external partners and sponsors and obtaining long-term investments in the Laboratory's capabilities. The SPP program leverages the Laboratory's core competencies, infrastructure, and technical staff to deliver practical solutions. The two primary national security agencies with Laboratory SPP interagency agreements include the U.S. Department of Defense and the U.S. Department of Homeland Security (through the DOE Office of Intelligence and Counterintelligence). In turn, these activities have circled back to the NNSA for use as test diagnostics in support of stockpile stewardship as well as deployable units for defense nuclear nonproliferation missions.

A.2.2.3.6 Energy Security

The Laboratory is using its scientific capabilities to enhance national energy security. With energy use increasing across the nation and the world, the Laboratory applies its expertise to those areas in which energy security needs intersect with its scientific strengths and capabilities. Challenges are tackled through fundamental scientific discovery by harnessing experimental and high-performance computational modeling and simulation capabilities. LANL also partners with energy industry leaders to develop energy sources with limited environmental impacts and improve the nation's energy infrastructure security, reliability, and efficiency. LANL has three main areas of focus in energy security: (1) safe and sustainable nuclear energy, (2) materials and concepts for clean energy, and (3) mitigating impacts of global energy demand growth. Laboratory scientists and engineers have expertise and perform research in a range of energy areas (LANL 2022b):

- Fuel cells;
- Hydrogen storage and production;
- Carbon sequestration;
- Unconventional fossil fuels;
- Carbon dioxide separation and capture;
- Superconductivity;
- Biofuels;
- Energy storage;
- Geothermal energy;
- Nuclear reactor design and fuels development;
- Fusion energy theory and materials research; and
- Environmental impacts of energy systems, including climate change.

A.2.2.3.7 Climate Change

Climate research touches on two of the main major mission drivers at the Laboratory: (1) Global Security and (2) Science, Technology, and Engineering. Thus, climate research is core to LANL's mission. The Laboratory's approach to climate research relies on integrating observational data with analytic and computational models. The end goal is to provide practical, science-based decision support to managers and policy makers at local to national levels so that they have the right information to make the best decisions concerning climate policy and action. LANL addresses a variety of climate-related issues (LANL 2022d):

- Atmospheric measurements of greenhouse gases and pollutants;
- Improved models of climate through massively parallel simulation capabilities and other advances in computational and measurement technologies;
- Development and deployment of mobile/portable multi-sensor platforms for measurements of chemical, isotopic, and energy balance signatures;
- Field/modeling studies of climate impacts; and
- Impacts on surface water and groundwater systems and the linkages between water and energy production.

A.2.2.3.8 Infrastructure and Major Facilities Supporting Science, Technology, and Engineering

Science, technology, and engineering activities currently take place in many technical areas, as described in Table A.2.2-4.

Table A.2.2-4 Science, Technology, and Engineering Activities by Technical Area

Tech Area	Mission Activity Description
TA-00	The microbial research laboratory (under Biosciences) is located at TA-00.
TA-3	The Chemistry and Metallurgy Research building, the Bioscience Research Laboratory, and the Emerging Threat Laboratory are located in TA-3.
TA-33	TA-33 is remotely located at the southeastern boundary of LANL. The National Radioastronomy Observatory's Very Long Baseline Array telescope is located at TA-33. The Laboratory also operates its most powerful open-air laser in this TA.
TA-46	TA-46, located between Pajarito Road and the Pueblo de San Ildefonso, is one of LANL's basic research sites. Activities have focused on applied photochemistry operations and have included development of technologies for laser isotope separation and laser enhancement of chemical processes.
TA-48	The Radiochemistry and Hot Cell facilities at TA-48 support research and development in nuclear and radiochemistry. Their primary roles include research; production of medical radioisotopes; and support services to other LANL organizations, primarily through radiological and chemical analyses of samples. The TA-48 Complex contains five major research buildings: the Radiochemistry Laboratory (48-1), the Assembly Checkout Building (48-17), the Diagnostic Instrumentation and Development Building (48-28), the Clean Chemistry/Mass Spectrometry Building (48-45), and the Weapons Analytical Chemistry Facility (48-107).
TA-51	Greenhouse gas and climate studies are performed in TA-51. TA-51 is also used for research and experimental studies on the long-term impacts of radioactive materials on the environment. Various types of waste storage and coverings are studied at TA-51.
TA-53	As described in Table 2.3-1, the Los Alamos Neutron Science Center supports both basic and applied research programs related to science, technology, and engineering as well as the stockpile stewardship and weapons mission.
TA-66	TA-66 is located on the southeast side of Pajarito Road in the center of LANL. The Advanced Technology Assessment Center, the only facility in TA-66, provides office and technical space for technology transfer and other industrial partnership activities.

A.2.2.3.9 Science, Technology, and Engineering Program – Changes Since 2008 SWEIS

This section identifies notable changes that have occurred to the capabilities, facilities, and operations related to the Science, Technology, and Engineering Program since publication of the 2008 LANL SWEIS.

A.2.2.3.9.1 Accelerator Science

LANSCE Weapons Neutron Research National Security Nuclear Science Facility

The National Security Nuclear Science Facility is a 3,650-square-foot building that doubled the Weapons Neutron Research Facility's capacity for experimental testing. The National Security Nuclear Science Facility is a user facility and supports civilian and national security research. Construction was completed in 2012.

LANSCE Risk Mitigation Project

As part of the LANSCE Risk Mitigation Project, the Laboratory refurbished critical operating programmatic equipment at the LANSCE facility at TA-53. The project replaced aging components and infrastructure that comprised a substantial risk to the accelerator's performance and reliability. The project incorporated the following changes:

- Replaced the klystrons, which serve as amplifiers, with the same form, fit, function and capability as the existing equipment. LANL's supply of replacement klystrons had been exhausted and identical replacement parts were no longer available.
- Replaced obsolete and end-of-life radiofrequency power, phase/amplitude control systems that drive the drift-tube linear accelerator (LINAC) and coupled cavity LINAC systems, and the obsolete LINAC timing system. These systems were tailored to the new amplifier equipment.

A.2.2.3.9.2 Materials and Physical Sciences

Materials Science Laboratory

In TA-3, the Material Science Laboratory Infill Project began in 2012 and developed about 6,000 square feet of laboratory space in an unfinished area on the second floor of TA-3-1698. Four laboratory environments were developed and outfitted with appropriate enclosures and lab benches. The project was completed in 2014 (LANL 2016).

A.2.2.3.9.3 Isotope Program

TA-53 Radiological Facility

Construction began in 2020 for the new Light Manufacturing Laboratory, which will serve as a new TA-53 Radiological Facility to serve the Isotope Production Program. Construction was put on hold in 2021 (LANL 2024a). Details about the facility are provided in Chapter 3, Section 3.2 under the No-Action Alternative.

Isotope Production Facility

The Isotope Production Facility at TA-53 Building 984 generates radionuclides for medical diagnostic and therapeutic use. This facility has been a minor (unmonitored) source of airborne radionuclides since its operations started in 2004. To meet increased demand for radioisotopes, the facility expressed a desire to increase the number and type of targets irradiated each year, and also increase accelerator beam current delivered to the targets. These actions had the potential to increase the level of radioactive air emissions from the facility. To allow for this increased operational flexibility, the facility transitioned from a minor source to a major emissions source, meaning it became a fully monitored emissions source and meets associated inspection and maintenance criteria. In late 2020 and into 2021, the stack sample location was successfully tested to verify that it met required sampling criteria. Stack sampling equipment was installed in 2022 to measure emissions of particulate and vapor radionuclides. Sampling operations commenced in late December 2022. Measurements of gaseous radionuclide emissions had been ongoing for several years, and is being expanded to include full gamma spectroscopy capability. Effective January 1, 2023, the facility is being managed as a major source.

Even with the increased accelerator beam current and new targets, the Laboratory does not anticipate the actual level of emissions from the facility to significantly increase. Most emissions are gaseous radionuclides coming from general beam operations and are not dependent on the type or number of irradiated targets.

A.2.2.3.9.4 Energy Security

Fuels Research Laboratory

LANL modified an existing laboratory in Building 455 in TA-35 to serve as the Fuels Research Laboratory, which fabricates and characterizes fuel pellets. The former use of the building was the Polymer and Coating Laboratory.

This laboratory space primarily performs activities involving the synthesis and analysis of ceramics and ceramic composites of uranium-based materials, which are important to nuclear fuels program research at the LANL. The Fuels Research Laboratory also investigates thorium-based materials systems, irradiated metals, and other novel materials (NNSA 2010d).

A.2.2.4 Mission-Enabling Operations and Miscellaneous Programs

A.2.2.4.1 Utilities

Laboratory research demands 24-hour, highly reliable utilities and support services. Mission-Enabling Operations supports all Laboratory programmatic needs and is foundational to making sites habitable, including assets for communications, power, water, emergency services, offices, warehouses, roads, and parking. Other infrastructure assets include natural gas, wastewater collection and treatment, steam distribution, condensate return, and stormwater management. LANL is comparable to a small city, providing utility services to hundreds of buildings, roads, and basic support services for its population and some services for Los Alamos County (primarily electricity). LANL has its own electric, gas, water, communications, sewage collection systems, and fire stations. Mission support assets also include cafeterias, maintenance shops, analytical laboratories, and business functions. The enabling infrastructure supports the execution of all LANL missions. Chapter 4, Section 4.10 of this SWEIS provides details regarding the existing utility infrastructure and consumption at LANL.

Like many government agencies, cities, and counties, LANL is operating some facilities and infrastructure longer than expected. Support utilities and infrastructure are the foundation of all mission facilities. Some of this infrastructure is beyond its useful life and at or near capacity limitations, increasing maintenance costs and reliability risks. Aging infrastructure and the need for reliable, code-compliant systems create gaps that require ongoing investment. Existing infrastructure capacity must also be increased to meet the projected load demands of the future. As discussed in Chapter 3, Section 3.3 of this SWEIS, NNSA is proposing many infrastructure improvement projects, including upgrades to electrical, water supply and cooling, and electric vehicle charging systems.

A.2.2.4.2 Security

LANL is home to a broad spectrum of national security assets and is responsible for their protection, which requires enhanced security measures. To execute its safeguards and security mission, the Laboratory operates and maintains a number of site infrastructure facilities and systems. These include protective force training and operations facilities; physical protection elements (fences, gates, access control and intrusion detection systems, video surveillance systems, and barriers); and systems supporting security clearance and badging functions. This provides protection against a broad range of threats. Security threats include unauthorized access, cyber threats and electronic intrusion, theft or diversion of nuclear material, sabotage, espionage, loss or theft of classified matter and proprietary information, destruction of government-owned and Laboratory-managed property, and other hostile acts.

A primary aspect of the LANL protection strategy is a sophisticated, information technology access control and intrusion detection system. This system meets such stringent security requirements that the DOE's Office of Defense Nuclear Security has cited it as the standard for physical security systems protecting facilities. As it monitors and controls entry into buildings requiring enhanced security, this system is continually monitoring LANL for security threats and can alert and direct security protective forces to those threats. The Laboratory's sensitive information, materials, and facilities are thoroughly protected, intruders can be detected in real time, and intrusions and emergencies receive prompt response from the protective force, police, and investigative personnel. The Laboratory is provided with continuous forms of security 24 hours a day, seven days a week.

A.2.2.4.3 Occupational Health

Occupational medical services are provided to workers at the Laboratory. Occupational Medicine Building 1411, located at TA-3, houses about 60 medical personnel and supports approximately 2,500 LANL patients per month. Occupational medicine provides clinical services that are designed to protect and promote the physical and mental health and well-being of the Laboratory's workforce. This includes medical surveillance programs that utilize evidence-based care to provide for early detection of injury and/or illness that can potentially affect individuals whose work involves occupational and environmental hazards. In addition, occupational medicine conducts periodic qualification-based medical evaluations of worker's ability to perform assigned work activities safely. These evaluations are performed per applicable regulations and standards and promote health and safety for all required medical certifications. Also, occupational medicine maintains and provides records in support of the *Energy Employees Occupational Illness Compensation Program Act*. This act provides compensation and payment of medical expenses incurred by employees of DOE contractors and subcontractors, or their survivors, who develop an illness due to exposure to toxic substances at DOE facilities.

A.2.2.4.4 Waste Management

The Laboratory provides onsite waste characterization, packaging, treatment, storage, offsite disposal, and transportation of various sanitary, radioactive, hazardous, and otherwise regulated wastes generated by LANL activities. Wastes from Laboratory operations are regulated by federal and state regulations applicable to specific waste classifications. The Laboratory manages and disposes of LLW, TRU waste, MLLW, mixed TRU waste, hazardous waste, universal waste, *Toxic Substance Control Act* (15 U.S.C. § 2601 et seq.) waste, New Mexico Special Waste, "green is clean" derived waste, and biological waste. Wastes are disposed of at licensed offsite facilities.

Chapter 4, Section 4.11 of this SWEIS provides details about LANL's waste management facilities and operations.

A.2.2.4.5 Manhattan Project National Historical Park

The Manhattan Project National Historical Park (MAPR) is a U.S. National Historical Park jointly operated by the National Park Service (NPS) and DOE-LM. The MAPR was established in 2014 to preserve the historic resources of the Manhattan Project and to improve public understanding of the Manhattan Project's history and legacy (NPS 2022). The MAPR celebrates this legacy and incorporates the three most important sites of the Manhattan Project: Los Alamos, New Mexico; Oak Ridge, Tennessee; and Hanford, Washington. Today, the MAPR at Los Alamos encompasses 30 sites: 17 at LANL and 13 in downtown Los Alamos. Select MAPR sites on LANL property are open to the general public twice a year, corresponding with the opening of the Trinity Site in Alamogordo, New Mexico. DOE-LM is responsible for coordination among the DOE program offices responsible for implementation of the MAPR mission. DOE-LM also has long-term stewardship responsibilities for other select sites within the LANL footprint.

The MAPR was established and signed into law on December 19, 2014, through Section 3039 of the *Carl Levin and Howard P. "Buck" McKean National Defense Authorization Act for Fiscal Year 2015* (Public Law 113-291). The park is implemented through a Memorandum of Agreement between the Department of Interior and DOE for the Manhattan Project National Historical Park, signed on November 10, 2015. The Memorandum of Agreement establishes roles and responsibilities between the two federal agencies for historic properties located within the park (NNSA 2018a).

A.2.2.4.6 Wildland Fire Program and Forest Health Management

Most of LANL is largely undeveloped and forested with a mix of Ponderosa pine, piñon-juniper, and native grassland. The developed areas of the site are concentrated and isolated in a few mesa-top campuses that are incised by 13 steeply sloped and deeply eroded canyons. The Laboratory has managed the forests in its open areas since its inception, but several large wildland fires have broken through or come close to LANL's borders threatening or damaging the site's infrastructure and employees. Past large wildland fires include the La Mesa fire (1977), the Dome fire (1996), the Oso fire (1998), the Cerro Grande fire (2000), the Las Conchas fire (2011), and the Cerro Pelado fire (2022). At the time, the Cerro Grande fire in 2000 was New Mexico's most damaging on record.[8] It burned approximately 28 percent (7,650 acres) of LANL's footprint and destroyed 100 structures on the site (LANL 2002). After the Cerro Grande fire in 2000, the Laboratory took a number of proactive steps to minimize the threat of wildfires (LANL 2013):

- Thinning trees and removing ground fuels;
- Installing fire breaks and roads;
- Building an Emergency Operations Center at TA-69;
- Purchasing additional fire trucks, service vehicles and heavy equipment; and
- Enacting interagency agreements and training with the U.S. Forest Service (USFS), NPS, Los Alamos County, and the State of New Mexico.

Due to increased forest management activities after the Cerro Grande fire, the 2011 Las Conchas fire, which was then the largest fire in New Mexico state history, burned less than an acre at LANL with no infrastructure losses (LANL 2013). Most recently, the 2022 Cerro Pelado fire burned in the southern Jemez Mountains in Sandoval County, southwest of Los Alamos. Although the fire did not burn any LANL property, the Laboratory took emergency actions to be prepared.

In 2012, construction of an interagency fire center was completed at TA-49. The NPS is the primary building occupant, under an agreement with NNSA and the USFS. The facility supports interagency operations for wildfire response. It includes offices, a training and conference room, and storage for fire protection/suppression equipment and helicopter landing pads.

In 2019, NNSA published a supplemental environmental assessment (NNSA 2019d) that evaluated the current forest management activities and proposed a more aggressive and holistic forest management plan that considered the increased wildland fire risk due to longer fire seasons, changes in vegetation, and climate change. As a result, NNSA is planning to reduce wildland fire risk and achieve forest management objectives through forest thinning and the implementation of restoration treatment practices. Through this approach, NNSA expects to achieve a lower final tree density and encourage a mosaic of forested areas that include variable-sized openings, tree groups and clumps of various maturity, as well as open grasslands throughout LANL site (NNSA 2019d). Chapter 3, Section 3.4.2 of this SWEIS describes additional proposed actions that are intended to minimize the threat of wildland fires under the Expanded Operations Alternative.

A.2.2.4.7 Office and Warehouse Space

LANL includes about 2.4 million square feet of office and warehouse space. As discussed in Chapter 1, Section 1.3.2 of this SWEIS, many of these buildings are aging and have been used longer than expected due to limited capital to rebuild. Consequently, as discussed in that section, this SWEIS includes proposed actions to construct many new offices and warehouses.

In 2008, onsite LANL facilities comprised 8.6 million gross square feet of laboratory, production, administrative, storage, service, and miscellaneous space. About 2.4 million gross square feet of this space was designed to house personnel in an office environment. Additionally, DOE/NNSA and the Laboratory leased approximately 450,000 gross square feet of space within the towns of Los Alamos and White Rock. As of 2021, onsite facilities comprised about 8.2 million gross square feet of space, and the leased space in Los Alamos and White Rock declined to approximately 363,000 gross square feet.

In 2021, the Laboratory began a 10-year lease on a 28,000-square-foot building at the junction of north Guadalupe and west Alameda streets in Santa Fe. The new location offers space for Laboratory meetings, events, conferences, and teleworking. The Laboratory also leased two other Santa Fe office buildings totaling 77,856 square feet of space at the corner of Pacheco Street and St. Michael's Drive, which offer meeting rooms, permanent offices, and co-working space for roughly 500 employees in the Laboratory's administrative services sectors, including human resources, procurement, finance, and information technology.

In addition, the Laboratory announced in 2022, that it will lease approximately 20,000 square feet of light lab space at 81 Camino Entrada in Los Alamos. Light lab space is general-purpose space for conducting routine scientific tests such as algae growth or water-sample analysis. No nuclear or hazardous activity will take place in this space.

A.2.2.4.8 Roads and Parking

LANL manages and maintains approximately 83 miles of roads, as well as pathways and parking areas. Chapter 4, Section 4.12 of this SWEIS describes the transportation network on and around

LANL. As discussed in Chapter 3 of this SWEIS, NNSA is proposing many road and parking improvement projects within each of the alternatives.

Parking Structures at TA-3 and TA-50

The Laboratory constructed multi-level parking structures (each approximately 200,000 square feet) at TA-3 and TA-50 to provide additional and upgraded parking infrastructure. The TA-3 parking structure provides a net increase of approximately 380 spaces, and the TA-50 parking structure provides a net increase of approximately 370 spaces. The TA-50 facility provides additional parking for workers along the Pajarito Corridor (TAs -35, -48, -50, -55, and -63) (NNSA 2019a, 2019e). Additional parking structures are proposed under the No-Action Alterative and the Modernized Operations Alternative.

A.2.2.4.9 Emergency Services

This capability and infrastructure includes onsite and offsite emergency response to fires, medical emergencies, regional earthquakes, and other significant onsite incidents that may require a collaborative response by the Laboratory with the city, county, state, and federal agencies. Coordinated operations take place in the Emergency Operations Center located in TA-3. Appendix D of this SWEIS discusses emergency management, communications, and response teams and assets to meet DOE and state requirements.

A.2.2.4.10 Trails Management Program

There are 32 named trails on and around the LANL site with a combined length of about 50 miles. Twenty-five of these trails (approximately 36 miles) are commonly open for public use. NNSA and the Laboratory developed a Trails Management Program to address resource issues through improved and active stewardship. The Trails Management Program was evaluated in the LANL Trails Management Program EA as described in Section A.1.4.3 (NNSA 2003b). The Trails Management Program addresses both public use of trails within the LANL site and trails use by workers at the Laboratory. The Trails Management Program at LANL supports the Laboratory's mission by ensuring that trail use by employees, residents, and visitors remains compatible with LANL's stewardship of the important and protected cultural and biological resources on DOE lands on the Pajarito Plateau, and is protective of health, safety, and security with respect to LANL operations. The Trails Management Program is implemented through the *Trails Management Plan* (LANL 2015b), which includes policy guidance for all trails at LANL, sets requirements for trails management, and includes trail-specific management plans with recommendations for all managed trails.

A.2.2.4.11 Enduring Environmental Stewardship Program

The Enduring Environmental Stewardship Program facilitates planning, implementing, monitoring, updating, and communicating the execution of the Laboratory's long-term environmental stewardship strategy. The goals address enduring environmental stewardship planning and implementation, and include:

- **Advancing Communication and Engagement** – This goal addresses the enduring environmental stewardship communication strategy. It guides how the Laboratory uses transparent and effective communication to improve how they perform their environmental work and build stakeholder trust.

- **Supporting Mission and Compliance –** This goal recognizes the important balance between performing the mission and complying with environmental laws and regulations. It guides how the Laboratory continues to invest into strong and resilient regulatory compliance to support the mission and enduring environmental stewardship.
- **Controlling Emissions, Discharges, and Wastes –** This goal addresses the Laboratory's commitment and ongoing work to minimize emissions, discharges, and wastes generated from Laboratory activities. It focuses on how LANL complies with regulatory requirements and uses best management practices to guide activities related to pollution prevention, enduring waste management, monitoring, and environmental stewardship.
- **Managing Natural and Cultural Resources –** This goal addresses the importance of managing LANL's natural and cultural resources responsibly as part Laboratory activities. It highlights the plans/processes the Laboratory uses to be effective and respected long-term trustees of LANL resources.
- **Conserving Energy and Water –** This goal focuses on the important connection between enduring environmental stewardship and use of energy and water. It highlights the Laboratory's plans and goals for using energy and water in a responsible way that is sustainable long-term.
- **Ensuring Resilient Land Use –** This goal recognizes the long-term responsibility to manage the land effectively to support the Laboratory mission with minimal impacts on the environment. It focuses on continuing to improve the land use practices and ability to manage impacts of environmental changes that could affect the Laboratory mission.

The Enduring Environmental Stewardship Program develops and executes a portfolio of goal-aligned environmental stewardship projects and initiatives. These projects and initiatives support and further enable the Laboratory's mission and operations, can be used to mitigate actual and potential impacts, and enhance the enduring environmental stewardship capability.

A.2.2.4.12 Infrastructure and Major Facilities

The supporting infrastructure and miscellaneous operations take place in many technical areas, as described in Table A.2.2-5.

Table A.2.2-5 Miscellaneous Missions Activities by Technical Area

Tech Area	Mission Activity Description
TA-0 (offsite facilities)	TA-0 designation is assigned to structures leased by DOE and NNSA that are located outside LANL's boundaries. There are approximately 58 LANL facilities with this designation, with about 235,000 square feet of space. The University of California and the Community Reading Room; the Bradbury Science Museum; the White Rock Environment, Safety, and Health Training Center; and other various office suites are located in the Los Alamos townsite and White Rock.
TA-3	The Occupational Medicine Facility is located in TA-3. The Medical Facility includes a clinical laboratory. Institutional-level analytical support for environmental samples and bioassay samples is also provided. TA-3 is also the location for the TA-3 Substation, major switchgear equipment, and the Combustion Gas Turbine Generator.

Tech Area	Mission Activity Description
TA-6	The Western Technical Area Substation is located in TA-6 and provides power to the western portion of the LANL site.
TA-5	Largely uncleared, TA-5 is located between East Jemez Road and the Pueblo de San Ildefonso and contains physical support facilities, an electrical substation, test wells, several archaeological sites, and environmental monitoring and buffer areas.
TA-47	Office and warehouse space leased in Santa Fe.
TA-50	TA-50 is located near the center of LANL. The site supports LANL's waste management activities for several types of waste, including storing solid and liquid low-level, mixed low-level, TRU, and hazardous waste. Major facilities at TA-50 include the Radioactive Liquid Waste Treatment Facility, the Waste Characterization Reduction and Repackaging Facility (a size reduction facility), and the Actinide Research and Technology Instruction Center.
TA-53	The LANSCE Substation provides power to the TA-53 electrical loads. Waste treatment includes wastewater storage to allow for short-lived radioisotope decay followed by solar evaporation. Radioactive liquid waste is pumped from lift stations through double-walled piping to one of three 30,000-gallon horizontal fiberglass tanks located in a building at the east end of TA-53. After allowing for decay, the radioactive liquid waste is pumped to one of two aboveground concrete evaporation basins. Each of the basins can hold 125,000 gallons of liquid and has impermeable liners and leak detection instrumentation.
TA-54	TA-54, located on the eastern border of LANL, is one of the largest technical areas at LANL. Its primary function is management of solid radioactive and hazardous chemical wastes, including storage, treatment, decontamination, and disposal operations. The Radioactive Assay Nondestructive Testing Facility is located at TA-54. DOE-EM has ongoing environmental remediation activities in TA-54.
TA-57	TA-57 is located about 20 miles west of LANL on the southwest edge of the Valles Caldera in the Jemez Mountains. TA-57 lies within an area of land administered by the U.S. Forest Service. The primary purpose of TA-57 is observation of astronomical events. TA-57 houses the Milagro Gamma-Ray Observatory and a suite of optical telescopes.
TA-59	TA-59 is located on the south side of Pajarito Road, adjacent to TA-3. TA-59 facilities provide LANL support services in the areas of health physics, risk management, industrial hygiene and safety, policy and program analysis, air quality, water quality and hydrology, hazardous and solid waste analysis, and radiation protection.
TA-60	Various Laboratory waste streams (LLW, MLLW, chemical waste) are stored in TA-60. The TA also stores equipment for managing roads and grounds.
TA-61	TA-61, located in the northern portion of LANL, contains physical support and infrastructure facilities. It also hosts a 1-megawatt solar power plant and the Los Alamos County Eco Transfer Station that are operated by Los Alamos County.
TA-63	TA-63, located in the north-central portion of LANL, contains physical support and infrastructure facilities. The facilities at TA-63 serve as localized storage and physical support office space. The TRU Waste Facility is located at TA-63.
TA-64	TA-64 is located in the north-central portion of LANL and provides offices and storage space.

Tech Area	Mission Activity Description
TA-69	TA-69, located in the northwestern corner of LANL, serves as a forested buffer area. TA-69 includes the Emergency Operation Center.
TA-70	TA-70 is located on the southeastern boundary of LANL and borders the Santa Fe National Forest across the Rio Grande. It is a forested area and serves as a buffer zone. TA-70 is included in the Trails Management Program.
TA-71	TA-71 is located on the southeastern boundary of LANL and is adjacent to White Rock to the northeast. It is an undeveloped area that serves as a buffer zone for the High Explosives Test Area. TA-71 is included in the Trails Management Program.
TA-72	TA-72 is located along East Jemez Road on the northeastern boundary of LANL. The site contains LANL's small arms firing range, which is used by protective force personnel for required training and practice purposes.

A.2.2.4.13 Mission-Enabling Operations and Miscellaneous Programs – Changes Since 2008 SWEIS

This section identifies notable changes that have occurred to the capabilities, facilities, and operations related to Mission-Enabling Operations and miscellaneous programs since publication of the 2008 LANL SWEIS. The section also provides additional descriptions of several miscellaneous programs at the Laboratory related to environmental protection and stewardship.

A.2.2.4.13.1 Utilities

Photovoltaic Solar Array

Los Alamos County operates a 1-megawatt solar photovoltaic array, which was installed in 2012 on the old LANL landfill site. The solar array is on 15 acres of land. The system is connected to a 7-megawatt-hour battery storage system, which is connected to the Los Alamos Power Pool infrastructure (NNSA 2010e).

Sanitary Effluent Reclamation Facility

The construction and operation of the SERF, located on the south rim of Sandia Canyon in TA-3, was evaluated in the 2008 LANL SWEIS. In 2010, NNSA proposed to expand the size and operational capacity of the SERF to improve wastewater treatment to meet effluent limitations for PCBs imposed in NPDES Permit NM0028355. The permit required compliance with these limitations by July 31, 2012. The facility expansion was fully operational by the deadline and included the installation of associated storage tanks, pumps, piping, and equipment necessary to distribute the treated water for reuse at LANL facilities (LANL 2014b). Chapter 4, Section 4.4 of this SWEIS provides details related to the operation of the SERF.

TA-3 Substation Replacement

Between 2018 and 2022, the Laboratory constructed a new 115-kilovolt substation to replace the existing substation in TA-3 to provide back-up, redundant, and reliable feeder sources to LANL and Los Alamos County electrical distribution systems and provide additional capacities for future growth (NNSA 2016c). The substation replacement was completed in 2022 (LANL 2024a).

A.2.2.4.13.2 Security

Indoor Live Firing Range

The Laboratory constructed an indoor firing range in TA-16 on a 4-acre site. The facility is an approximately 15,000-square-foot building with a 50-meter, 20-position firing range, a 20-position-wide bullet trap, automated target turning systems, prefabricated shooting positions, and an integrated control booth. The facility includes a weapons and ammunition storage area, a classroom, range storage rooms, and restroom facilities (NNSA 2011c).

Tactical Training Facility

The TA-16 Tactical Training Facility was installed in 2013 and is a mock facility commonly referred to as a Military Operations in Urban Terrain Facility. The facility allows for interior and exterior feature reconfiguration to simulate both indoor and outdoor physical configurations of certain LANL facilities where tactical training is needed. In addition to modular configurable spaces, the facility also houses a supervisor viewing area, stairwells to accommodate "move and shoot" training based on local facilities of concern, a simulated central alarm station, a simulated technical area isolation zone monitored by the central alarm station that is inside the building, a briefing room, and a firearms storage area (vault type room). This building is a pre-manufactured steel building with a slab-on-grade foundation. It is sited on approximately 13.44 acres (LANL 2015a).

Protective Force Running Track

A regulation four-lane, 400-meter running track was installed in TA-58 in 2009. The track provides the Laboratory's Protective Force with the capabilities to meet and maintain the demanding fitness standards required by federal regulations. It is sited on approximately 4.4 acres in an area previously used for outdoor fitness training (LANL 2012).

Training Facility Expansion

NNSA expanded and improved the Emergency Response Training Facility infrastructure at TA-49. Security and emergency personnel at LANL offer periodic bomb threat preparation and other training courses to local, state, and federal first responders. The facility has expanded to the east of the existing area and encompasses a footprint of approximately 12 acres. Construction work included the installation of new roads, utilities, and base course for props needed for different training scenarios. Examples include railcars, aircraft, and residential areas. Construction was completed in 2016 (LANL 2018).

Armory Cleaning Facility

The Laboratory Protection Force personnel operate an outdoor firing range at TA-72 to satisfy DOE/NNSA and LANL training requirements. The firing range required a new cleaning facility for firearms. The Armory Cleaning Facility is a prefabricated structure that began operations in 2017 (LANL 2018).

Shooting Range Upgrades

The Laboratory constructed a new dual-purpose firing range at TA-72 (Ranges 5A and 5B). Range 5A is approximately 80 feet wide and 600 feet long and includes a 10-foot-high by 80-foot-long earth berm to protect the firing line from ricochet. Range 5B is approximately 160 feet wide by 300 feet long and includes a 160-foot-long earth berm behind the target line and a knee wall to protect the target mechanisms. The upgrades included a new lighting system at both ranges. The range upgrades also included improvements to the stormwater drainage system around existing buildings and installation of a new system of underground drains associated with the shoot house for Range 2 to route water to the channel and prevent flooding and standing water (NNSA 2018a).

Security Supply Warehouse

A 2,400-square-foot warehouse was constructed in TA-72 south of the Range 2 shoot house in a developed area surrounded by other structures. This warehouse is used for storage of targets, supplies, and other consumables (NNSA 2018a).

A.2.2.4.13.3 Occupational Health

In Vivo Measurements Laboratory

The In Vivo Measurements Laboratory Program maintained equipment and facilities for the direct (*in vivo*) monitoring of personnel for intakes of radioactive materials in TA-43-0001. In 2018, the LANL discontinued all In Vivo Measurements Laboratory operations at the Health Research Laboratory. All radioactive sources and equipment have been removed from the facility (LANL 2022a).

A.2.2.4.13.4 Waste Management

Waste Management and Risk Mitigation Facility

The Waste Management and Risk Mitigation Facility is a steel-frame structure in TA-50 that provides emergency influent storage capacity and is designed to meet Performance Category 2 design requirements for seismic, wind, and snow loads. It was placed in service in 2010 and houses six storage tanks, each capable of holding 50,000 gallons of water, in a below-grade concrete vault. The floor of the vault is 26 feet below grade to allow for gravity drainage of low-level radioactive liquid waste into the tanks. The reinforced-concrete vault also serves as the facility structural foundation. The Waste Management and Risk Mitigation Facility is a radiological facility, limited to 0.52 americium-equivalent curies of radioactivity (LANL 2012).

Low-Level Radioactive Waste Treatment Facility

The Radioactive Liquid Waste Treatment Facility (RLWTF) upgrade was analyzed in the 2008 LANL SWEIS and included in the 2009 ROD (74 FR 33232, July 10, 2009). The 2008 SWEIS proposed action, Option 1, was selected and included construction of a new, single-liquid waste treatment building. However, in 2011, DOE incorporated aspects of Option 2, which included construction of two liquid waste treatment facilities at TA-50 to replace the existing RLWTF as opposed to one building for both transuranic and low-level liquid waste processing. The two facilities are referred to as the LLW RLWTF and the TRU Liquid Waste Facility (NNSA 2018a).

Construction of a replacement LLW RLWTF began in 2015 and was completed in 2018. However, the new facility will not be utilized until required modifications are implemented. A solar evaporator tank system was installed at TA-52 in 2012 but has not yet been placed into service. A soil moisture-monitoring system was installed beneath the solar evaporation tank system in 2019 as required by discharge permit, DP-1132. The solar evaporator tank system liners and leak detection system will require replacement and the pipeline connected to the RLWTF must be tested for water tightness before it can be placed into service (LANL 2024a).

Construction and operation of the TRU Liquid Waste Facility is included in the No-Action Alternative and described in Chapter 3, Section 3.2 of this SWEIS.

Transuranic Waste Facility

Appendix H.3 of the 2008 LANL SWEIS analyzed construction and operation of the Transuranic Waste Facility (Building 63-0144) to replace capabilities at Area G for the storing, processing, and shipping of newly generated transuranic waste. TA-63 was analyzed as one of the site options. Construction of the Transuranic Waste Facility at TA-63 was completed in 2017, and operations began in 2018 (Figure A.2.2-7) (NNSA 2018a). The TA-63 Transuranic Waste Facility permitted operating storage capacity is 105,875 gallons of waste including 55- and 85-gallon drums; 55-gallon pipe overpack containers and criticality controlled overpacks; standard waste boxes; oversize waste boxes; ten-drum overpacks; and standard large boxes. Additional details regarding the Transuranic Waste Facility are included in Appendix E of this SWEIS.

Figure A.2.2-7 Transuranic Waste Facility at LANL

Sanitary Wastewater System Compost Facility

In 2014, the NMED Solid Waste Bureau approved LANL's application to operate a facility to compost solid wastes produced by the Laboratory's sanitary wastewater system. The goal of this project is to eliminate the transport of sewage biosolids offsite for landfill disposal. The Sanitary Wastewater System Compost Facility uses an in-vessel composter. The in-vessel system controls temperature, moisture, and airflow. Full-scale operations at the TA-46 Sanitary Wastewater System Compost Facility began in late 2014. In 2018, the NMED approved a registration renewal.

The compost will be land-applied at LANL for beneficial use. This use includes 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 vector attraction reduction requirements as specified in the U.S. Environmental Protection Agency's (EPA's) Standards for the Use or Disposal of Sewage Sludge in 40 CFR Part 503. The final locations and rates for compost application are subject to site selection criteria, best management practices, and administrative controls. For example, compost will not be applied in canyon bottoms, wetlands, or in areas with shallow perched alluvial groundwater. Application rates will not exceed agronomic rates provided by the New Mexico State University Cooperative Extension Service. In 2021, the Sanitary Wastewater System Compost Facility produced 52 tons of composted biosolids. Finished compost has been continually stockpiled at the facility, although some land application of compost occurred at the sanitary wastewater system in 2018 (LANL 2022a).

Hazardous Waste Storage at TA-60

In 2018, the Laboratory established a 90-day storage area, in accordance with its hazardous waste permit, at TA-60-0017 to store waste generated across LANL. Waste accumulated at TA-60-0017 includes hazardous and mixed wastes; more specifically, hazardous chemicals 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).

A.2.2.4.13.5 Wildland Fire Program and Forest Health Management

Implementation of the *Wildland Fire Mitigation and Forest Health Plan*

In 2019, the Laboratory revised its *Wildland Fire Mitigation and Forest Health Plan* (LANL 2019a) with the objective of reducing wildland fire risk while also promoting healthy forests. As identified in Section A.1.4.3 of this SWEIS, NNSA prepared a supplemental environmental assessment to evaluate the potential impacts of implementing the revised plan (NNSA 2019d). The Laboratory is currently implementing the revised plan to manage wildland fire risks to LANL operations. The strategies and actions included in the plan are described as forest management treatments that mitigate potential wildland fire and promote forest health. The plan also defines strategies and actions to ensure the desired final forest conditions for LANL's open spaces. The plan differs from practices in place during the 2008 LANL SWEIS by more aggressively thinning trees to achieve a lower final tree density, and to encourage an overall mosaic of forested areas that includes groups of trees of various sizes and ages and grassy open spaces. The revised plan is applicable anywhere on LANL land, which is a change from the previous limit of 10,000 acres. The revised plan also includes an increased emphasis on soil stability by promoting more ground cover vegetation in open space.

Interagency Wildfire Center

The NPS constructed a single-story, multipurpose interagency fire center on land adjacent to New Mexico State Road 4 (NM-4) at the entrance to TA-49. The building contains about 6,400 square feet of offices, training and conference rooms, and about 200 square feet of storage for fire protection and suppression equipment. Construction was completed in 2013. NPS is the primary building occupant, under an agreement with NNSA and the USFS (NNSA 2012).

A.2.2.5 DOE-Environmental Management/Legacy Cleanup Mission

A.2.2.5.1 Infrastructure and Major Facilities

The supporting infrastructure for the environmental management and legacy cleanup mission involves many technical areas. Accountability for applicable personal (e.g., equipment, supplies) and real (land and facilities) property was transferred from NNSA to EM-LA: most notably, operational control of TA-21 and ownership of TA-54 (excluding the Radioactive Assay Nondestructive Testing Facility). DOE-EM performs legacy cleanup activities in every TA (except TA-47 [Santa Fe]); however, TA-21 (environmental remediation) and TA-54 (environmental remediation and waste management/ disposition) are the only site properties solely conducting DOE-EM legacy cleanup activities (*see* Table A.2.2-6).

Table A.2.2-6 DOE-EM Activities by Technical Area

Tech Area	Mission Activity Description
TA-21	TA-21, located along the northern of boundary LANL, is among the earliest laboratory processing sites, originally called the DP Site. It was divided into two sections: DP West, a former radioactive material processing area, and DP East, containing tritium facilities that provided space for energy, environment, and weapons defense research. Remaining cleanup activities focus on aboveground debris left over from previous cleanup operations, a radioactive materials processing facility (Building 257, the last remaining permanent building), several aboveground tanks, two large mobile warehouses, obsolete equipment, and unused fencing and utility poles. Belowground or at-grade material includes two large underground tanks (the General's Tanks) containing radioactive effluent from material processing, underground waste transfer lines between buildings, building slabs and roadways, and buried waste. In addition, two of the original five MDAs remain (MDAs A and T) and are planned to be dispositioned as part of the overall TA-21 cleanup effort; remediation of three MDAs has been completed.
TA-54	TA-54, located on the eastern border of LANL, is one of the largest TAs on the LANL site. Its primary function is management of solid radioactive and hazardous chemical wastes, including storage, treatment, decontamination, and disposal operations. The Radioactive Assay Nondestructive Testing Facility is located in TA-54. DOE-EM is conducting ongoing waste management/disposition and environmental remediation activities in TA-54.
All TAs (except TA-47 [Santa Fe])	The DOE-EM mission within all TAs except TA-47 is legacy cleanup, environmental remediation, and monitoring activities.

DOE = U.S. Department of Energy; DOE-EM = DOE Office of Environmental Management; DP = Delta Prime; LANL = Los Alamos National Laboratory; MDA = material disposal area; TA = technical area

Details related to DOE-EM's environmental cleanup mission are provided below and in Chapter 4, Sections 4.11 (waste management) and 4.14 (environmental remediation) of this SWEIS.

Appendix G to this SWEIS 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.

A.2.2.5.2 Current Capabilities

Since 1989, the *Resource Conservation and Recovery Act* (RCRA) has been the main regulatory driver to executing environmental cleanup (RCRA corrective actions) at LANL. In 1996, the EPA granted primacy to the State of New Mexico for corrective actions, under which characterization and remediation efforts are regulated by NMED for hazardous constituents under the *New Mexico Hazardous Waste Act* (NMSA 1978). New Mexico does not regulate radionuclides. DOE/NNSA are responsible for radionuclides under the Atomic Energy Act implemented through DOE Order 458.1, "Radiation Protection of the Public and the Environment," and DOE Order 435.1, "Radioactive Waste Management."

In March of 2005, the NMED, New Mexico Attorney General, University of California, and DOE signed a Compliance Order on Consent (Consent Order) pursuant to the *New Mexico Hazardous Waste Act*. The 2005 Consent Order identified over 2,100 corrective action sites to be addressed and was a comprehensive and enforceable Order which set a completion date for the last scheduled deliverable of December 2015 (NMED 2005).

The Las Conchas fire, which began burning in the SFNF in June 2011, destroyed over 150,000 acres and threatened LANL and the town of Los Alamos. The proximity of the fire to aboveground stored wastes in TA-54 prompted the New Mexico Governor to request the NNSA/Laboratory prioritize removing non-cemented aboveground wastes. NNSA/ Laboratory agreed to realign legacy cleanup priorities, entering into a non-binding Framework Agreement with New Mexico in 2012 that realigned environmental priorities from Consent Order activities to DOE/NNSA regulated waste management/disposition efforts. While negotiating the 2012 Framework Agreement, DOE/NNSA acknowledged that meeting milestones of the 2005 Consent Order was difficult, if not impossible, given past and anticipated funding shortfalls which resulted in DOE/NNSA and the State of New Mexico agreeing to discuss renegotiation of the 2005 Consent Order at a future date.

In June 2016, NMED and DOE entered into a new Consent Order (2016 Consent Order) (NMED 2016a) 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.

The Los Alamos Legacy Cleanup Contract between DOE-EM and its contractor, N3B, took effect in April 2018 encompassing legacy aboveground stored TRU waste disposition activities, ground and surface water monitoring and protection programs, groundwater contaminant plume investigation and evaluation including for hexavalent chromium and HE contamination, aggregate area investigations and remediation activities, and facility DD&D activities. Specific objectives include:

- Protect, characterize, remediate (as necessary), and monitor the regional aquifer.
- Clean up legacy contaminated media and legacy waste sites at LANL and surrounding private and government-owned lands, including groundwater and surface water, to levels appropriate for the intended land use and in accordance with regulatory requirements.
- DD&D inactive, process-contaminated, and non-contaminated facilities at TA-21 and TA-54 that impede the progress of the execution of environmental restoration activities.
- Retrieve, characterize, and prepare legacy MLLW and TRU waste for shipment off-site. The EM-LA Program manages the disposition of legacy waste generated between 1970 and 1998 and the newly generated waste, i.e., waste generated after fiscal year 1998, that is already within the EM operational control area at TA-54, Area G. NNSA is responsible for newly generated wastes that are outside of the EM operational control area at Area G.
- Transfer remediated sites to NNSA for long-term surveillance and monitoring as needed, to provide necessary safeguards and protection of workers, the public, and the environment. All required post-remediation monitoring and maintenance activities will be transitioned from EM to NNSA.

N3B annually conducts work across a broad front in many LANL technical areas. Consent Order activities have been completed in one campaign and are currently in progress for 11 additional campaigns of the 17 named in the Consent Order. Of the more than 2,100 contaminated sites identified in the 2005 Consent Order identified for resolution over sixty percent of them have received Certificates of Completion from NMED, ranging from small spill sites with only several cubic feet of contaminated soil to large landfills encompassing several acres.

DOE-EM is also responsible for DD&D of NNSA LANL excess, deactivated, high-risk facilities. DOE and NNSA work cooperatively with new contractors as they are awarded contracts for DD&D of these facilities (e.g., Ion Beam Facility).

A.2.2.5.3 Environmental Management/Legacy Cleanup Mission – Changes Since 2008 SWEIS

In addition to the transition of EM-funded legacy cleanup work from NNSA to DOE-EM to facilitate cleanup efforts at LANL, one notable change since publication of the 2008 SWEIS was the identification of supplemental environmental projects.

In 2014, the State of New Mexico's Hazardous Waste Bureau issued compliance orders for Laboratory violations of the New Mexico *Hazardous Waste Act*. One of the orders stemmed from the improper treatment of TRU waste shipped from LANL to WIPP. A settlement agreement (NMED 2016b) between DOE/NNSA and NMED was signed in 2016 and included five projects. Compliance with these projects became a component of the DOE-EM mission.

1. **Roads** – Improve transportation routes at LANL used for the transportation of TRU waste to WIPP.
2. **Triennial review** – Conduct an independent, external triennial review of environmental regulatory compliance and operations.
3. **Watershed enhancement** – Design and install engineering structures in and around LANL to slow stormwater flow and decrease sediment load to improve water quality in the area.
4. **Surface water sampling** – Increase sampling and improve monitoring capabilities for stormwater runoff in and around LANL with the results of sampling and monitoring shared with the public and the NMED.
5. **Potable water line replacement** – Replace aging potable water lines, and install metering equipment for LANL potable water systems. These improvements would reduce potable water losses, minimize reportable spills, and enhance water conservation.

As of the reporting in the *2022 LANL SWEIS Yearbook* (LANL 2024a), the status of each of these supplemental environmental projects are as follows:

1. **Roads** – The U.S. Army Corps of Engineers worked with a design engineering firm to manage the redesign of the State Route 4 and East Jemez Road intersection. The selected firm developed five options for the redesign of the intersection. The integrated project team consisted of the County of Los Alamos, the County of Santa Fe, the NM Department of Transportation, NPS, DOE/NNSA, and the Pueblo de San Ildefonso. After reviewing all five designs, a concept was selected and implemented. Construction of the intersection was completed in early 2024.

2. **Triennial review** – The first triennial review was conducted in 2018. The second triennial review report (Parsons 2021) documented the independent review that occurred in June and July 2021. The review identified findings (positive and negative) in the following six

focus areas; (1) NPDES individual stormwater permit, (2) NPDES Multi-Sector General Permit (MSGP) for stormwater discharges associated with industrial activity, (3) NPDES industrial and sanitary point source outfall permit, (4) New Mexico Administrative Code (NMAC) 20.6.2.1203, "Spill Regulations," (5) RCRA hazardous waste permit, and (6) New Mexico special wastes permit. There were no activities in 2022 (LANL 2024a).

3. **Watershed enhancement** – As part of the Watershed Enhancement Project, the Laboratory developed an institutional low-impact development master plan in 2017 to implement a number of projects to slow stormwater flow and decrease sediment loads to improve water quality and allow surface water management at the watershed scale (LANL 2017). There have been several watershed enhancement projects implemented at the Laboratory to date. Construction on the mid-Mortandad Slope Drain Project began in October 2018 and was completed in February 2020; it was certified to NMED in March 2020. Final certification of the entire Watershed Enhancement Project to NMED occurred in April 2020. This project is complete.
4. **Surface water sampling** – In 2018, LANL completed the stormwater sampling commitments and continued other surface water sampling activities in 2019 (e.g., aquatic life sampling on stream reaches in and around the Laboratory). In 2020, the Laboratory conducted targeted sampling for sediment, stormwater runoff, atmospheric deposits, and aquatic life in watersheds in and around the Laboratory and shared the results with the public and NMED. This project was completed in 2020.
5. **Potable water line replacement** – In 2019, LANL completed construction of Phases A and B waterlines, including installation of the meters, air-relief valves, and pressure-relief valves. The lines are completely operational and the project is complete.

A.3 Proposed Action and Alternative – Supplemental Information

A.3.1 Introduction and Development of the SWEIS Alternatives

This section is reserved.

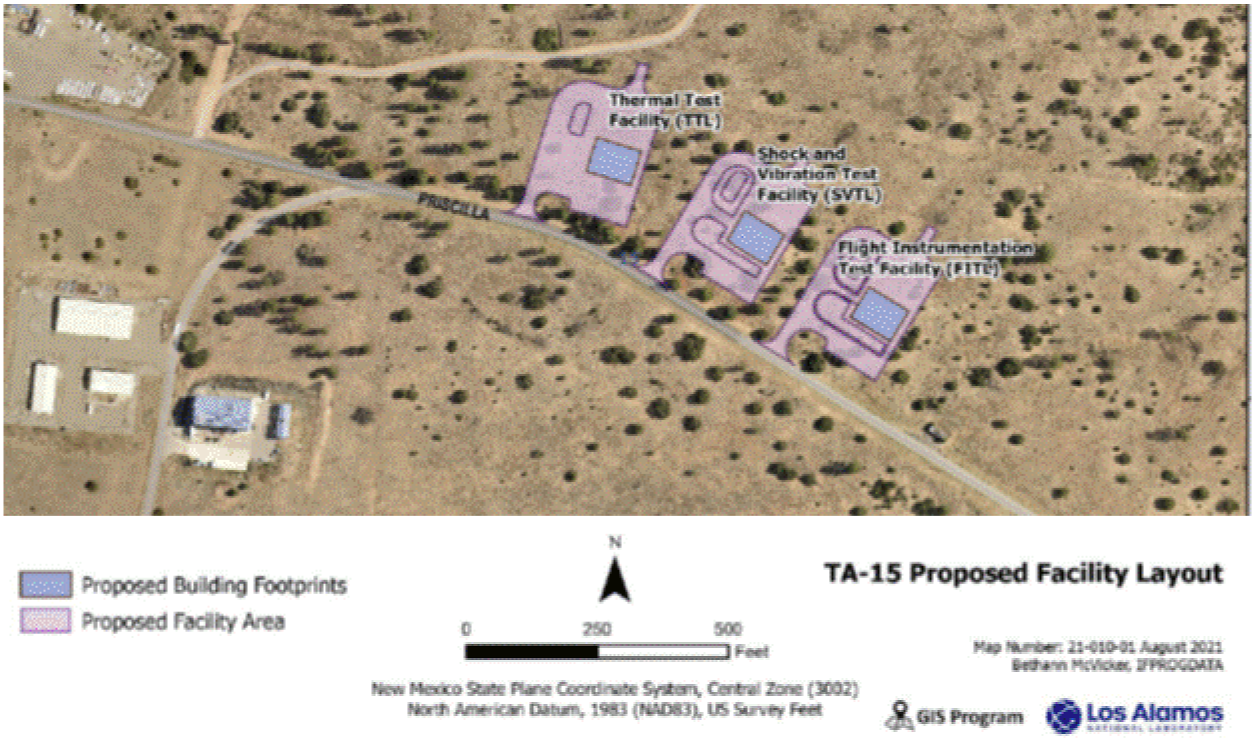
A.3.2 No-Action Alternative – Supplemental Information

Section A.3.2.1 provides supplemental information for projects identified in Chapter 3, Tables 3.2-1 and 3.2-2 that NNSA intends to implement under the No-Action Alternative. Section A.3.2 supplements information about changes in operations that will be implemented under the No-Action Alternative.

A.3.2.1 No-Action Alternative – Supplemental Project Description

Environmental Test Complex (ETC)

Normal environmental and mechanical testing of weapon components, subsystems, and full system weapon assemblies is currently conducted at the Laboratory in TA-11 and TA-16. The purpose of these tests is to observe, measure, and characterize responses of HE materials and assemblies to various normal environmental stresses resulting from such stimuli as vibration, acceleration, deceleration, shaking, spinning, and high/low temperature cycling. NNSA is consolidating existing environmental testing of assemblies containing HE components by constructing and operating a new ETC in TA-15 (Figure A.3.2-1). The ETC will comprise three separate HE-certified laboratories; the Flight Instrumentation and Test Laboratory, the Shock and Vibration Test Laboratory, and the Thermal Test Laboratory. Each building of the ETC will have a footprint of approximately 6,000 square feet, with each containing three to four reinforced-concrete test bays. Construction of the ETC began in 2023 and should be completed in 2027.



Source: LANL (2024c)

Figure A.3.2-1 The Environmental Test Complex at TA-15

Test bays for each building are designed to protect staff in adjacent test bays and the control room from accidental detonation of HE. One of the bays included in each building will serve as a location for preparation and application of instrumentation to experimental assemblies (LANL 2024c). The construction and operation of the ETC was bounded by the analysis in the 2008 SWEIS for safety and mechanical testing operations in the HE processing capabilities and activity levels.

Detonator Storage Facility and Detonator Production Magazines

This project will consist of a new 9,000-square-foot facility in TA-22 and include four munitions storage magazines (each approximately 1,000 square feet). The new facility and magazines are planned for construction at the previous location of TA-22 Buildings 66, 67, 68, and 69, all of which underwent DD&D in 2022. The facility will be climate controlled, served by a fire alarm and suppression system, and contain a vault type room (LANL 2024c). The Detonator Storage Facility was specifically analyzed in the Final Environmental Assessment for the Proposed Consolidation of Certain Dynamic Experimentation Activities at the Two-Mile Mesa Complex Los Alamos National Laboratory (NNSA 2003d) and was incorporated into the 2008 LANL SWEIS.

HE Transfer Facility

The 2,400-square-foot facility has been constructed at TA-8 to improve HE transportation safety, security, and efficiency. The new facility's sole purpose is to transfer HE packages to and from a commercial carrier and a LANL delivery vehicle upon receiving or shipping HE packages. A section of the security fence has been relocated to create a public access area. The fence was relocated to the east side of Anchor Ranch Road (Figure A.3.2-2). The project also reconfigured the intersection of Jumbino Road and TD Site Road and provided a new vehicle access point including two new security booths and associated access lanes (LANL 2024c). The activities for the HE transfer station were analyzed in the 2008 SWEIS under the capabilities and activity levels for the HE processing facilities that include support infrastructure for shipping, receiving, storage, packaging, and transportation.

Source: LANL (2024c)

Figure A.3.2-2 HE Transfer Facility

Armored Magazines

The Laboratory currently has many magazines on site that are used to store HE and munitions. Under the No-Action Alternative, the Laboratory plans to add additional magazines in various TA's such as TA-9, TA-15, TA-16, TA-33, TA-36, and TA-39 to support multiple missions and programs including Stockpile Stewardship/Weapons and Global Security. The magazines range in size from 160 square feet to 1,600 square feet and meet required specifications for HE and munitions storage. The smaller units can be shipped to LANL directly from the vendor. The larger units are typically a combination of smaller units, which are constructed at the vendor's facility and shipped to LANL for assembly at the select locations. The magazines have the capability to be connected to site power for lighting and a climate-controlled interior (LANL 2024c).

Radioactive TRU Liquid Waste Facility

NNSA is constructing this 15,000-square-foot facility in TA-50 to replace the existing RLWTF, which is more than 50 years old and is nearing the end of its functional and operational life. The existing RLWTF is experiencing a need for equipment improvements to maintain its capability to support critical missions and is no longer a feasible long-term facility. The replacement of the existing RLWTF has been designed and constructed as two separate projects to meet all applicable nuclear and safety requirements.

The LLW Facility has already been constructed; however, before the LLW Facility can begin operations there are numerous maintenance modifications (such as drains and overflows, replacing instrumentation, and modifying the evaporator and the micro-filter) that must be completed. Those modifications are ongoing and will continue through 2025. There will be no additional LLW Facility footprint associated with these modifications.

The TRU Liquid Waste Facility consists of an HC-3 facility to treat liquid TRU wastewaters generated mostly in TA-55 (e.g., PF-4, RLUOB). Construction has started on the 3,800-square-foot, reinforced-concrete structure. The facility will house processing equipment capable of treating up to 7,660 gallons of TRU liquid waste each year (LANL 2024c). The RLWTF upgrade was evaluated in the 2008 SWEIS and included in both the 2008 and 2009 SWEIS RODs.

Training and Development Center

The Laboratory plans to construct a training and development center in TA-52 to support training of operators that will be involved in plutonium operations in PF-4. The 130,000-square-foot facility will include classrooms, conference rooms, secure training areas, and areas outfitted with gloveboxes and PF-4 mock-ups for training purposes. Operations within the facility will not involve any hazardous or radiological materials.

Cold Test Facility

The TA-16 Cold Test Facility will consolidate the laboratory space of the design, engineering, and technology groups into a single, newly constructed, 14,000-square-foot facility, creating operational efficiencies and a more streamlined throughput flow of process equipment destined for use at TA-55. Currently, operations are housed in three separate facilities at TA-46 as well as a fourth location in TA-35. The new TA-16 Cold Test Facility is expected to include 12,500 square feet of laboratory, storage, and machining spaces (LANL 2024c).

The facility will support the Laboratory’s mission by providing a location for equipment modifications, final assembly, staging, acceptance testing, and customer training for process equipment built by outside vendors, in-house built equipment, and equipment needing to be repaired or upgraded. This process equipment is primarily for use in TA-55 PF-4 in support of the Laboratory's plutonium missions, including plutonium sustainment, pit production, and surplus plutonium disposition. Existing NEPA coverage is provided through the 2008 SWEIS, Appendix L (support structure activities).

Energetic Materials Characterization Facility (EMCF)

Energetic materials characterization is an essential capability that supports the Stockpile Stewardship/Weapons Program and is essential to inventing, developing, and certifying the nation’s current and future weapons stockpile. The Laboratory’s HE operations include analyzing and periodically qualifying HE parts going into or coming from stockpile systems; identifying, analyzing, and providing solutions to problems with existing HE operations resulting from stockpile returns or aging studies; producing energetic materials for the stockpile; and inventing and developing explosive formulations and explosive components for future systems or other novel applications (LANL 2024c).

The energetic material characterization capability at the Laboratory is currently performed in various facilities located in TA-9 and TA-22. The current facilities were built between 1949 and 1962 and have outlived their 50-year design life. Consequently, the Laboratory plans to construct and operate a new, consolidated EMCF that includes dedicated laboratory buildings, an administrative support building, HE magazines, a chemical storage building, and supporting utilities. The current planning for an approximately 75,000-square-foot EMCF concept consolidates the capabilities from the existing 18 separate facilities into a three- to four-building campus located in TA-6 along Two-Mile Mesa Road on an approximate 15-acre greenfield site with no significant existing infrastructure (LANL 2024c). NNSA is also considering a partial consolidation in which the capability would be met via five to seven smaller buildings as opposed to three larger facilities and the operations at some of the facilities at TA-9 would continue.

The 2008 SWEIS described and analyzed this action as an element of the Dynamic Experimentation Consolidation Project under the capabilities and activity levels for the HE testing facilities. The scope of the project included the construction and operation of 15 to 25 new structures (i.e., offices, laboratories, and shops) within the Two-Mile Mesa Complex to replace 59 structures currently used for dynamic experimentation operations. The analysis of potential impacts included the removal or demolition of vacated structures, upgrade or construction of new roads, parking, fencing, and utilities within the Two-Mile Mesa Complex. The project was included in the No-Action Alternative for HE testing in the 2008 SWEIS and covered in the 2008 ROD.

DARHT Vessel Repair Facility

The vessel repair facility (approximately 10,000 square feet) is being constructed in TA-15 to provide the capability to decontaminate, inspect, and repair test vessels after each use to bring them back to operational capability. These vessels are used in DARHT's operational mission to complete studies on assemblies with HE. Currently, all repair and inspection operations are being completed within one facility, the DARHT's Vessel Inspection Facility (Building 15-0285), which creates an inefficient operation. This new facility houses two bays with duplicate equipment, thereby allowing simultaneous vessel cleanout of hazardous material in one bay and repair of vessels in the other, with Building 15-0285 used to complete inspections (LANL 2024c).

DARHT Battery Project

This project will install a utility-scale back-up power supply for the DARHT Facility in TA-15. The Laboratory plans to install up to two 8 megawatt-hour (MWh) batteries approximately 100 yards from the main DARHT Facility (total of 16 MWh). This work will require excavating a site along the access road just before the turnoff for DARHT. In addition, a power distribution line connecting the battery to the DARHT Facility will be installed, either as an overhead power line or buried beneath the ground. The project does not include facility modifications to the DARHT Facility and will have a footprint of about 3,500 square feet (LANL 2024c). The project was evaluated and approved as a categorical exclusion (CX) in 2023 (NNSA 2023d).

Sigma Building Modification

The Sigma Building is a fabrication and materials science research facility that provides metallic and ceramic items, process development, and supports pit production. Installation of new equipment and systems within the Sigma Building are necessary to continue to support pit production. New equipment consists of in-kind replacements of removed legacy equipment and systems (e.g., lathes, mills, furnaces, inspection machines, electron beam welders, coating booths, other support equipment, and utility infrastructure). New equipment and systems are similar to those being replaced and do not result in changes in the processes currently conducted at the Sigma Complex. As part of the modification, a 4,000-square-foot machining annex and replacement of a legacy electrochemistry laboratory was completed in 2021. The Laboratory increased storage capacity in 2023 by adding a 4,400-square-foot warehouse in TA-3 near the Sigma Building to store nonradiological equipment and materials. These modifications were addressed in the 2008

SWEIS and the 2008 ROD. Specifically, the actions were included in the capabilities and activity levels for fabrication of metallic and ceramic items.

Training and Test Facilities

Global Security operations that involve HE are currently constrained due to limited availability of existing firing sites. NNSA intends to construct and operate a new training complex in TA-33 to support the Global Security Program. The scope of the planned training complex includes construction of two new multi-use buildings with space for offices, preparation, storage, test and evaluation, and training functions; extending a water line for potable and fire-protection water; and re-establishing HE operations at an existing firing point by conducting operations using an explosives confinement vessel or similar and scalable containment methods as appropriate (Figure A.3.2-3). The firing point would be upgraded with safety measures to reduce risks from HE operations and fragments in addition to the requirements of the explosives confinement vessel or alternate containment. Two earthen berms from historical operations—located on the north and east portions of the firing point—will be improved and maintained in accordance with DOE Standard (STD)-1212, "Explosives Safety." A third earthen berm will be constructed on the south side of the firing point to minimize the risk of potential fragment dispersal in the unlikely event that engineered containment integrity fails to contain fragments. To meet fire prevention requirements, the firing point will also have a fire hydrant connected to the water line extension (LANL 2024c).

Source: LANL (2024c)

Figure A.3.2-3 Example of an Explosives Confinement Vessel

The 2008 SWEIS analyzed potential environmental impacts from HE testing operations at various facilities throughout LANL. The Laboratory's HE testing facilities capabilities and activity levels evaluated in the 2008 SWEIS included experiments on munitions. NNSA determined that the construction and use of the training and test facilities would have impacts consistent with those presented in the 2008 SWEIS, would not involve extraordinary environmental circumstances, and could be implemented as an element of the No-Action Alternative.

Secure Laboratory and Offices with BSL-2 Capabilities

Global Security requires additional secure office space and additional capability for working with BSL-2 pathogens or toxins. As identified in Section 2.4.4, the Laboratory currently has labs that perform BSL-1 and -2 work in TA-3 and TA-43. This project includes construction of a 12,000-square-foot facility in TA-33 that will include office space, light laboratory space, and BSL-2 capabilities. The facility will include a sensitive compartmented information facility, which could be used for classified information/operations.

Light Manufacturing Laboratory

LANL has started construction on a new 10,000-square-foot Light Manufacturing Laboratory at TA-53 to support radiological operations of both LANL's Low Energy Nuclear Physics Program and LANL's Isotope Program. In the future, the facility could support other programs as warranted. Initially, for low energy nuclear physics, the facility will enable radioisotope separation and target development for LANSCE's Weapons Neutron Research facility. For the Isotope Program, the radiological support facility will be a fully integrated system of process equipment, hot cells, and analytic laboratories for the purpose of extracting alpha-emitting radioisotopes derived from thorium targets irradiated at the LANL Isotope Production Facility. In January 2021, NNSA prepared a CX for the proposed facility at TA-53 (NNSA 2021b). The laboratory will be regulated under DOE Order 420.2D, "Safety of Accelerator."

The alpha-emitting medical isotopes are used for targeted alpha therapy, a cancer treating therapy that has resulted in complete remission in patients with various end-stage (terminal) cancers. The current supply of alpha-emitting isotopes that can be used for targeted alpha therapy at any one time is approximately 5,000 patient doses. Currently, the DOE Isotope Program production of alpha-emitting isotopes for targeted alpha therapy has only occurred at the Oak Ridge National Laboratory using small-scale R&D methods. The DOE Isotope Program needs to be able to produce alpha-emitting isotopes using larger production methods to meet current and future demand. At LANL, medical isotopes are currently processed in the hot cells located at TA-48. However, the TA-48 hot-cell facility is a radiological laboratory that is limited to handling beta- and gamma-emitting radioisotopes and cannot be used to extract alpha-emitting isotopes. Locating the Light Manufacturing Laboratory near LANL's existing isotope production infrastructure at TA-53 takes advantage of the short half-life of the isotopes and limits onsite shipments across the LANL site (Figure A.3.2-4) (LANL 2024c).

Warehouses

NNSA plans to construct approximately 22 warehouses by 2029. Most warehouses utilize a standard design and will be single-story structures approximately 4,000 square feet in size. Some will be climate controlled. One of the warehouses will be approximately 30,000 square feet and support plutonium operations in TA-46. Four other warehouses (approximately 20,000 square feet each) have been constructed in TA-51 to support pit production. By planning area, the total number of additional warehouses includes:

- Core Area – 2 (8,000 square feet),
- Pajarito Corridor – 7 (118,000 square feet),
- National Energetic and Engineering Weapons Complex – 4 (27,000 square feet),
- LANSCE – 8 (32,000 square feet), and
- Balance of Site – 1 (4,000 square feet).

Source: LANL (2024c)

Figure A.3.2-4 Light Manufacturing Laboratory at TA-53 (conceptual design)

Of the projected layout of the proposed warehouses, approximately 42 percent of the footprint will be within areas that are not currently disturbed. One of the proposed warehouse projects in NEEWC (TA-36) is planned for empty drum storage (clean, unused drums). This project could involve as many as six 2,500-square-foot storage buildings. Two of the buildings will be used for the prototype of the Automated Drum Retrieval and Storage System and the others will be portable storage buildings used for empty drum storage. These new buildings could provide space for R&D on a new TRU Waste Facility (TWF) Drum Retrieval Robot Facility and Drum Storage Project. None of these storage buildings will involve radiological or hazardous materials or operations (LANL 2024c).

<u>Office Buildings</u>

Under the No-Action Alternative, NNSA plans to construct 10 standard office buildings and 13 general-purpose office buildings by 2029. The office buildings will be constructed in the Core Area, Pajarito Corridor, and NEEWC planning areas and range in size from single-story, 4,000-square-foot office buildings to three-story, 42,000-square-foot office buildings in the Pajarito Corridor to support the plutonium program. The general-purpose office building are expected to be modular and utilize a standard design that typically include two-story structures with a footprint of approximately 23,000 square feet. Another option being considered is the pre-designed office buildings, which are single story but scalable in size. By planning area, the number (and footprint) of projected office buildings includes:

- Core Area – 9 (207,000 square feet),
- Pajarito Corridor – 13 (385,000 square feet),
- NEEWC – 1 (20,000 square feet),
- LANSCE – 0, and
- Balance of Site – 0.

Of the projected layout of the proposed office buildings, approximately 15 percent of the footprint is expected to be within areas that are not currently disturbed (LANL 2024c).

Asphalt Batch Plant Replacement

LANL continuously has a need for asphalt products for roads and parking lots. The replacement plant was recently constructed and is a self-contained operation in TA-60 on Sigma Mesa that produces sufficient quality material for LANL projects, which includes ongoing road maintenance and repair as well as construction of new roads and parking areas under each of the alternatives evaluated in this SWEIS. The replacement asphalt batch plant includes a 35,000-gallon oil tank, a truck scale, and baghouse. Together, these facilities have a footprint of about 5,600 square feet and are located within an area that was previously developed. The expected life of the replacement plant is 25–30 years (LANL 2024c). NEPA coverage was provided through the 2008 SWEIS, Appendix L (support structure activities).

Fire Stations

NNSA plans to construct three new fire station facilities under the No-Action Alternative. Two of the stations will be at TA-61 (East Jemez Road Fire Station) and TA-63 (Pajarito Corridor Fire Station) to provide emergency response coverage in the highest density areas to meet National Fire Protection Association requirements. These two new multi-story stations (each between 15,000 and 20,000 square feet) serve to replace Fire Station 1 at TA-3. Fire Station 1 requires replacement to provide adequate emergency response to populated worker areas at LANL. The Pajarito Corridor Fire Station has been sited in TA-63 in an undeveloped area measuring approximately three acres immediately south of the TWF. The East Jemez Road Fire Station has been sited in TA-61 in an undeveloped area measuring approximately four acres between the Los Alamos County Landfill and the Elk Ridge community. The third fire station is also approximately 15,000 square feet and is being constructed in a developed area of TA-16 to replace Fire Station 5, which NNSA proposes to upgrade and reuse as part of the Modernized Operations Alternative (LANL 2024c).

Security Facilities

NNSA plans to construct six new security facilities under the No-Action Alternative. These facilities include security facilities in TA-46 to provide space for the LANL Protective Force subcontractor, four facilities constructed in TA-55 to support the plutonium infrastructure program to facilitate personnel and vehicle access control into and out of the TA-55 protected and material access areas, and vehicle access portals in TA-69 providing access into and out of S-Site at TA-16. Approximately 50 percent of the planned footprint of these facilities is within areas that are not currently disturbed.

Kelly Field Interagency Unmanned Aircraft System (UAS) Training Upgrade

Kelly Field, on the eastern side of TA-49, currently supports outdoor tests on materials and equipment components that involve generating and receiving microwaves and outdoor training with radiological sources. This project will create a new LANL Interagency UAS training space in an area that is currently undeveloped. This area is currently under construction and will promote interagency training for the use of remotely operated vehicle platforms to support emergency response activities, as well as other mission-essential operations such as infrastructure, biological asset monitoring and management, archaeological site characterizations and preservation, and wildland fire preparedness. The site will continue to be expanded over the next several years as training and agency needs are better defined. The completion of the training area will support a variety of LANL and local agency missions, including:

- Wildland fire,
- Los Alamos Fire Department,
- Los Alamos Police Department,
- LANL Emergency Management Division, and
- Other Laboratory groups requiring the use of UAS flights in support of their missions.

The project ss installing a Conex shipping container in an area that was previously disturbed. This structure could be used for temporary storage of UAS and robotic programmatic equipment and classrooms for training. Existing NEPA coverage is provided through the 2008 SWEIS, Appendix L (support structure activities) and as discussed in LANL (2007).

Steam Plant Upgrade

The TA-3 steam and condensate distribution system is the largest steam and condensate distribution system at LANL. The steam plant provides steam service to the Core Area from a centralized boiler plant located at TA-03-0022. The existing steam system is aged, inefficient, and expensive to maintain and operate. The upgrade and refurbishment of the steam system was evaluated and approved for implementation through a CX (NNSA 2018e) and will significantly reduce maintenance and operation costs. The overall footprint for the steam plant upgrade is approximately 80,000 square feet and is being implemented in the following three phases:

- **Phase 1** – Construction and installation of two new auxiliary boilers to replace existing boilers. This includes installation of a new high-pressure natural gas line to the existing combustion gas turbine generator. This phase is complete.
- **Phase 2** – Upgrade or replace steam distribution and condensate return lines throughout TA-3.
- **Phase 3** – Add a heat recovery steam generator and an organic Rankine cycle system to capture exhaust heat from the combustion gas turbine generator. Generally, the heat recovery steam generator will generate heating steam for the TA-3 area. When heat is not needed, the organic Rankine cycle system will convert unused heat energy into electric energy for use on site. The Laboratory plans to construct a steam turbine generator building to enclose a steam turbine and to support functions of the power generating facilities. Support functions and equipment could include a control room and separate electrical equipment rooms, a crane capable of handling the heaviest piece of disassembly for a steam turbine/generator, and miscellaneous hoists and trolleys. Additionally, a water treatment building may be constructed adjacent to the Steam Turbine Generator Building.

Electric Power Capacity Upgrade (EPCU) Project

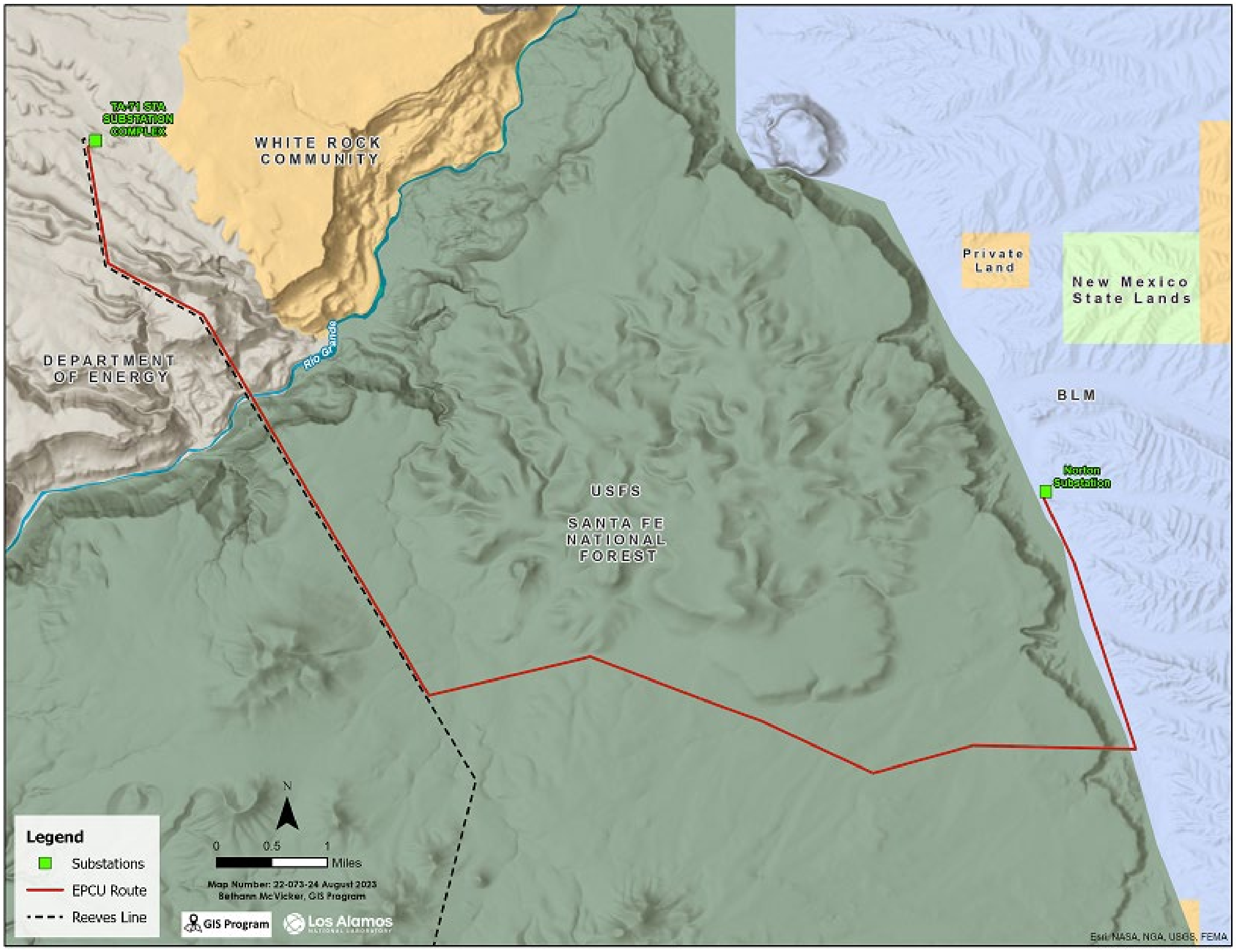
The Laboratory and Los Alamos County currently have two transmission lines that supply their power needs: the Norton Line and the Reeves Line. Dependence on only two transmission lines to supply these demands is inconsistent with utility industry practices for fully redundant power line service to large, critical load areas. Multiple power lines are necessary to provide a contingency supply capability in case of power line failure or a scheduled shutdown for maintenance. Los Alamos County and LANL have recognized the risk associated with reliance on only two transmission lines.

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 (Figure A.3.2-5). The project would construct an approximately 14 mile-long, three-phase, overhead, 115-kV electric power transmission line that would originate at the Norton Substation and cross approximately 2.5 miles of land administered by the BLM, then cross approximately 8.6 miles of land administered by the SFNF, and ultimately span White Rock Canyon onto DOE/NNSA-managed lands at LANL for approximately 3 miles. The entire transmission line would require a ROW of 50 feet from the centerline (100 feet total). A helicopter would be used for overhead stringing of the transmission lines across the Rio Grande. Within the ROW, NNSA would implement selective vegetation removal in areas where transmission structures are proposed to be sited and where equipment would be located for staging purposes. Descriptions and figures of the structures for transmission and distribution lines are included in the EPCU EA (NNSA 2023b). Disturbed areas would be reclaimed after construction. Based on the EA, the potential staging areas would be between 2 and 5 acres each, depending on the material and size of the equipment needed for the section of the line being constructed. NNSA estimates that the project would require four staging areas on SFNF land, one staging area on BLM land, and nine staging areas on the LANL site. The project would use previously disturbed land to the extent practicable. The total footprint of staging areas is conservatively estimated at 70 acres.

The EPCU project also would develop 1.44 miles of new temporary roads that would be used for access to the ROW for construction (about 7 acres). These temporary roads would be restored after the completion of construction. The project would also construct 1.69 miles of new permanent roads on BLM and SFNF land to provide access for line maintenance (about 8 acres). Most of these road segments would be built along the ROW of an existing two-track road. Overall, the project would result in the conversion of approximately 170 acres to utility ROW.

Implementation of the EPCU project would also include upgrading existing LANL electrical infrastructure within the LANL boundaries. Specifically, the project would include construction of approximately 4 miles of overhead transmission line (between the TA-5 Eastern Technical Area Substation and the TA-3 Substation), approximately 8 miles of overhead distribution line (including 3 miles to the SCC), and 3 miles of underground distribution line. Assuming a temporary disturbance width of about 20 feet, the underground distribution line would require the disturbance of about 7.2 acres on the LANL site, which would be restored after construction. The EPCU also would include upgrades to existing substations and switching stations to receive additional power from the new transmission line and distribute the power across the site. The upgrade of the TA-5 Eastern Technical Area Substation would include an expansion of the existing footprint by about 58,500 square feet.

Because the EPCU 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.



Source: NNSA (2023b)

Figure A.3.2-5 Electric Power Capacity Upgrade Transmission Line Routing

Offsite Parking and Shuttle Service

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. The initial effort to test and prove this concept provides commuter parking in an existing lot within ¼-mile of US 285 in Pojoaque and commuter bus service from that location to TA-55 and TA-60 (two trips to each location). The parking and shuttle service is provided by an outside contractor. The pilot is scheduled through 2024. A possible outcome after completion of the pilot project (depending on ridership) is that the Laboratory could propose expansion of the park-and ride service to other areas within the region. The Laboratory could lease existing properties within a 50-mile radius of LANL that are adjacent to main highways to provide additional shuttle service options and parking for an estimated 3,000 vehicles (LANL 2024c).

Second Fiber Optic Line

The Laboratory currently relies on a single fiber optic line for high-performance voice, data, and internet service, which is essential to support NNSA's mission for maintaining the nation's nuclear deterrent and collaborative scientific research. As identified in Chapter 1, Section 1.4 (and described in Appendix A, Section A.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). The underground fiber optic line is expected to originate and tie into existing fiber optic infrastructure at the Marty Sanchez Links de Santa Fe golf course (Figure A.3.2-6). From the golf course, the route will parallel Caja del Rio Road to Santa Fe County Road (CR) 62 and continue to follow CR 62 across BLM lands until reaching the SFNF. On SFNF lands, the route is planned primarily within the SFNF Forest Road 24 roadbed. The underground portion of the fiber optic cable will terminate at an underground concrete box (vault) adjacent to the 115 kV Reeves Line support structures. From the vault, the fiber optic line will transition to optical ground wire and connect to the top of the Reeves Line transmission line, replacing the existing Reeves Line shield wire. The fiber optic line will span White Rock Canyon to LANL lands. The canyon crossing will require two new in-line steel monopole structures on each side of the canyon for a total of four monopole structures. Once on LANL lands, the above ground line will span to the TA-71 Southern Technical Area substation, where the line will once again divert underground and parallel New Mexico State Road 4 (NM-4). The line will continue in the roadway corridor until reaching its termination at the existing underground fiber optic facilities at the intersection of Piedra Loop and Sherwood Boulevard in the community of White Rock. The entire route of the new fiber optic line will be within an existing utility corridor or easement.

Since issuance of the Final EA and FONSI (NNSA 2020c), the USFS has revised the *Santa Fe National Forest Land Management Plan* (USDA 2022). 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 will 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. Since these changes are currently unknown, this SWEIS also addresses this project as a reasonably foreseeable action in Chapter 6, Cumulative Impacts.

Institutional Laydown Areas

As a result of the construction and DD&D activities planned under the No-Action Alternative, the Laboratory requires the use of several institutional laydown and construction support areas. The laydown areas that could be implemented under the No-Action Alternative are planned to be centrally located on the site (Figure A.3.2-7). The potential siting of these laydown areas (1) provides consolidated laydown areas that could support multiple projects over multiple years; (2) minimizes the need for excess laydown areas in TAs and minimizes construction costs; (3) minimizes potential environmental impacts by collocating construction activities; and (4) provides separation between the necessary laydown areas and densely populated TAs to minimize impacts to ongoing operations and improve safety. There are up to nine laydown areas in six TAs that could be developed under the No-Action Alternative that have a combined footprint of about 29 acres (about 5 acres in Balance of Site, less than an acre in the Core Area Planning Area, and about 23 acres in the Pajarito Corridor Planning Area).

Some of the affected land is currently developed; the majority is undeveloped. Table A.3.2-1 below provides the estimated acreage of each of the potential institutional laydown areas shown in Figure A.3.2-7. As the Laboratory determines that individual laydown areas (including areas that are currently used for construction support) are no longer necessary, the areas would be remediated and returned to their original condition (LANL 2024c).

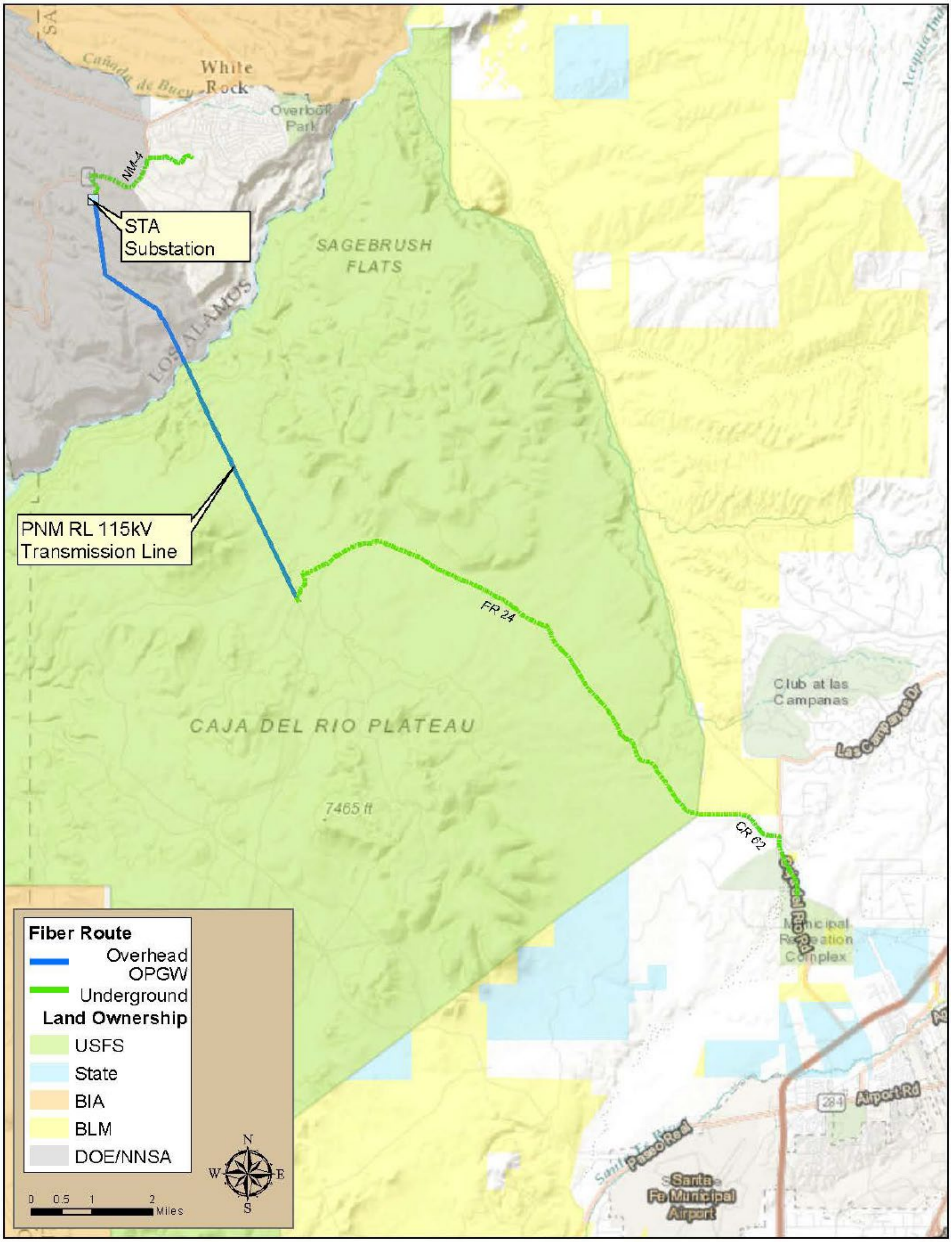


Figure A.3.2-6 Proposed Route of Second Fiber Optic Line

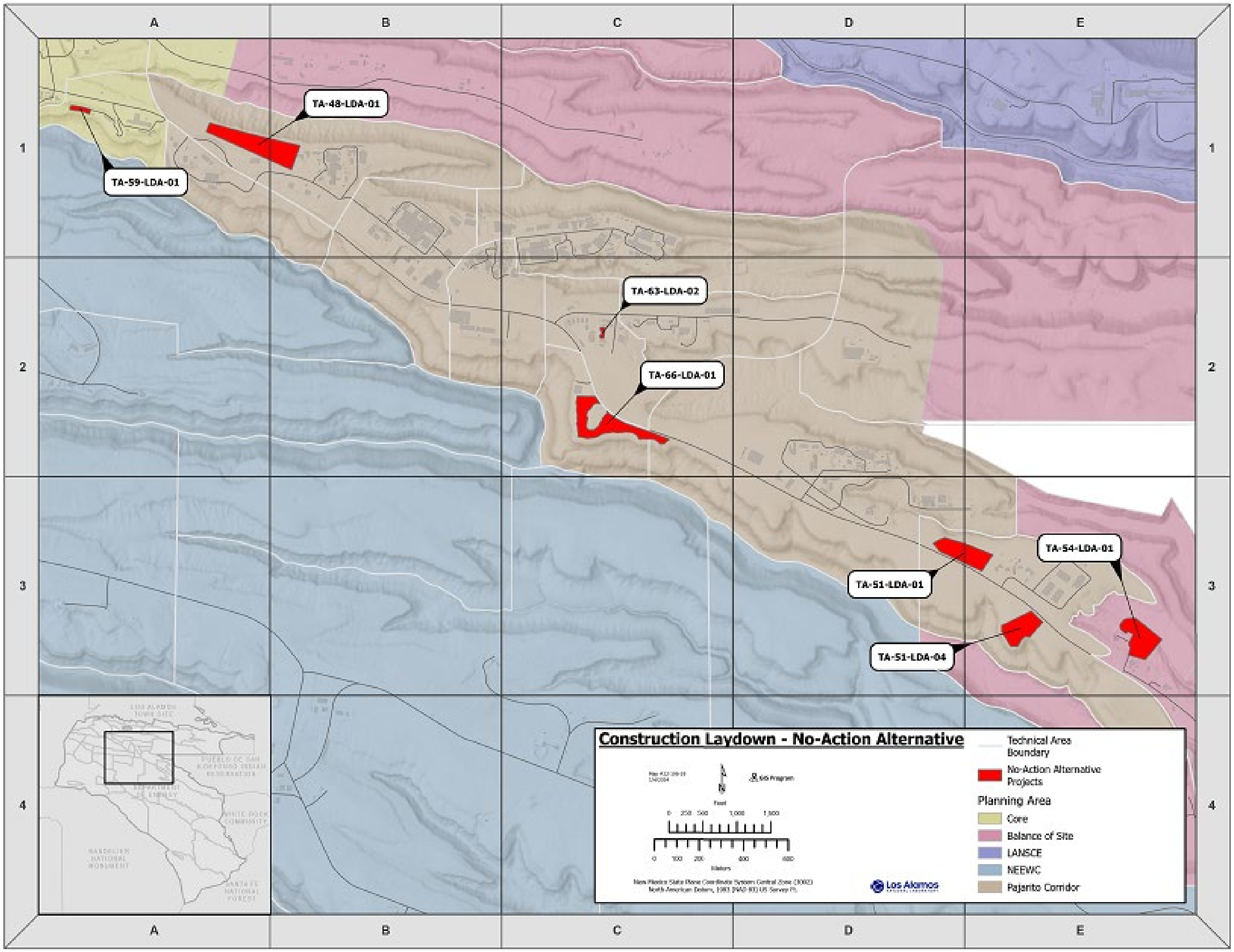


Figure A.3.2-7 No-Action Alternative – Institutional Laydown Areas

Table A.3.2-1 Institutional Laydown Areas – No-Action Alternative

Laydown and Construction Support Area	Currently Developed (acres)	Currently Undeveloped (acres)	Total Area
TA-48-LDA-01	2.93	4.99	7.92
TA-51-LDA-01	1.31	3.32	4.63
TA-51-LDA-04	0.75	3.24	3.99
TA-54-LDA-01	1.27	3.53	4.80
TA-59-LDA-01	0.42	0.05	0.47
TA-63-LDA-02	0.21	0	0.21
TA-66-LDA-01	0.80	5.93	6.73
TOTAL	**7.69**	**21.06**	**28.75**

Source: LANL (2024c)

10-Megawatt Solar Photovoltaic (PV) Array

As identified in Section A.1.4.3, NNSA prepared the *Environmental Assessment for the Proposed Construction and Operation of a Solar Photovoltaic Array at Los Alamos National Laboratory Los Alamos, New Mexico* (Solar Array EA) (NNSA 2019b) and associated FONSI in 2019 (NNSA 2019c). The Solar Array EA evaluated the construction and operation of a ground-mounted solar PV system (up to 10 megawatts) and associated power distribution line within an existing power line corridor. The PV location (primarily within TA-16 and partially within TA-8) was originally analyzed as approximately 55-plus acres, of which approximately 50 acres are within a previously disturbed area that was used as a borrow pit at the Laboratory. Since publication of the Solar Array EA, the Laboratory has reduced the planned footprint of the array to approximately 45 acres, about 5 acres of which remain in an area that is currently undeveloped in TA-8.

The Solar Array EA evaluated two feasible PV power line routes for a 13.8-kilovolt line from the PV site to the TA-6 Western Technical Area (WTA) substation. New power poles from the PV site to the WTA substation will be erected within an existing power line corridor adjacent to existing power poles. Either route will require some remedial work, such as brush clearing and filling of washouts prior to installation of the new power poles. Routing will be determined after technical, cost-effective, and security analyses are performed. The construction of the solar array will avoid any work in nearby floodplains.

Wood Yard

The Laboratory's Wildland Fire Group is developing a wood yard in TA-69 for processing wood materials removed during wildfire prevention activities and general maintenance of the LANL site. The wood yard will be located on approximately 3 acres of land with 1 acre on a partially developed portion of TA-69. A variety of equipment will be used at the wood yard to process wood materials, including masticators, chainsaws, skid steers, loaders, wood-processing machines, log trucks, backhoes, and pickup trucks. The operations of the wood yard include processing wood materials that are free of contamination for donation to public and governmental agencies, including nearby Pueblos, for use as mulch, fuel wood, latillas (small poles used for fencing, ceilings, art projects and rough furniture), vigas (rough-hewn roof timbers or rafters, especially in an adobe building), ceremonial purposes, handicrafts, and other similar processes. Some materials processed at the wood yard would be disposed of as waste at the Los Alamos County Eco Station after being sampled for contamination. Some of the wood materials processed at the wood yard are expected to be used as salvage timber. Commercial-sized timber (typically at least 9 inches in diameter) that is free from contamination may be salvaged during wood-processing activities. Trucks will remove logs from where they were cut either directly to offsite facilities owned or operated by contracted parties or temporarily to the proposed wood yard. Logs stored at the wood yard would then be donated or salvaged and removed by third parties.

Site-Wide Transportation Projects and Parking

The Laboratory plans to construct approximately 1.15 million square feet (approximately 26 acres) of roadway projects under the No-Action Alternative (LANL 2024c). In addition, there are plans for approximately 773,000 square feet (18 acres) of new parking lots, mostly associated with new facilities identified in Chapter 3, Table 3.2-1. These 18 acres of parking areas are in addition to the TA-48 parking structure identified in Table 3.2-1. Of these transportation and parking projects, approximately 34 percent are expected to be within areas that are currently undeveloped. Key site-wide transportation projects under the No-Action Alternative include the following:

- Construction of a TA-22 roundabout and bypass road – The TA-22 bypass road will connect Anchor Ranch Road to TD Site Road and West Jemez Road, providing direct access to the TA-16 main campus and a direct connection to West Jemez Road for vehicles that exit the Laboratory;
- Construction of pedestrian overpass bridges at TA-50 and TA-63 – The pedestrian bridges in TA-50 over Pajarito Road will be an elevated pedestrian walkway to allow for simultaneous pedestrian crossing and vehicle traffic at Pajarito Road. A second pedestrian bridge in TA-63 over Pajarito Road at the intersection of Puye Road will facilitate the same benefits as with TA-50. Figure A.3.2-8 provides an artist's rendering of the proposed overpass bridge design that could be used at both locations. These elevated walkways will increase the safety and traffic flow along Pajarito Road;

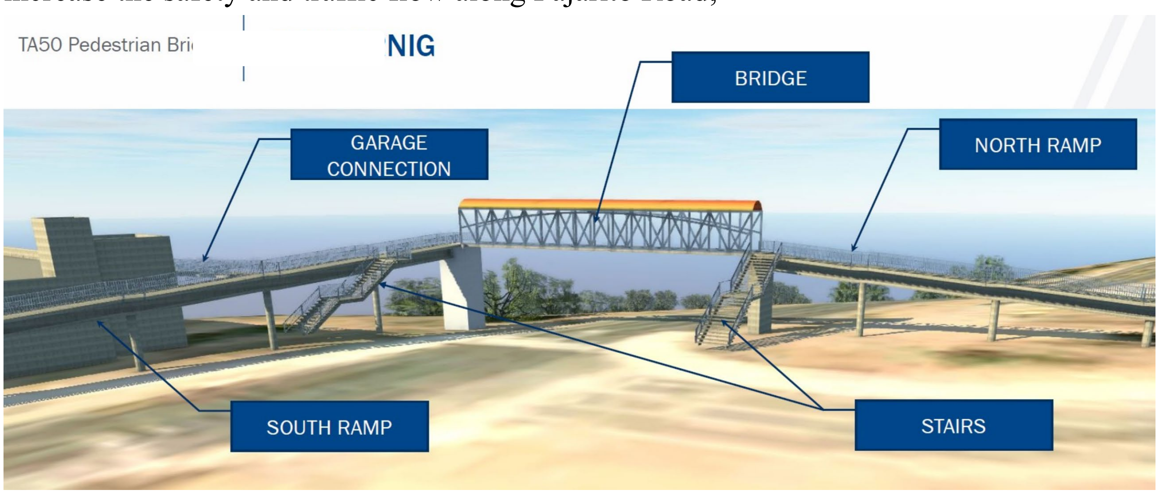


Figure A.3.2-8 Pedestrian Overpass at TA-50

- Construction of transit stations at TA-48 (Gamma Ray), TA-55 (Pecos), and TA-52 along Puye Road near one of the planned cafeterias – Each of the transit stations is expected to include a shuttle drop off area to accommodate four 45-foot buses at a time;

- Improvements to the TA-50 access road and a parking lot road;
- Improvements to the TA-3 frontage road;
- Improvements and realignment to TA-52/63 Puye Road;
- Construction of roads in TA-16;
- Construction of roads and reconfiguration of the intersection for the HE Transfer Facility; and
- Miscellaneous site-wide roadway construction and existing intersection improvement.

Ongoing Remediation Activities

Some groundwater and soils at LANL are contaminated from historical operations; the contamination is mostly confined to within the boundaries of the site. Chapter 4, Section 4.3.3 of this SWEIS describes the soil contamination at LANL, and Section 4.4.2 describes the groundwater contamination. DOE is actively remediating contaminated areas at LANL and those activities are expected to continue.

As identified in Section A.1.4, EM-LA has prepared the *Chromium Interim Measures and Final Remedy Environmental Assessment* (Chromium Final Remedy EA) (DOE 2024a) to evaluate alternatives for the final remedy for the hexavalent chromium plume in Mortandad Canyon.

A.3.2.2 No-Action Alternative – Additional Operations – Supplemental Information

The following section supplements information provided in Chapter 3, Section 3.2.3 under the No-Action Alternative for select projects.

Chromium Interim Measures and Final Remedy

The Chromium Final Remedy EA provides four options representing different remediation methods and technologies that provide maximum flexibility to adjust to potential or unanticipated events (DOE 2024a). These options and methods/technologies can selectively be implemented to improve the effectiveness of remediation, the cost of remediation, or minimize potential effects resulting from the cleanup activities. EM-LA considered the following options, or a combination of these options, to remediate hexavalent chromium contaminated groundwater below Sandia and Mortandad canyons:

- **Option 1** – Mass Removal via Expanded Treatment – would add extraction, injection, and monitoring wells and increase the rate of mass removal, treatment, and injection in the affected areas.
- **Option 2** – Mass Removal with Land Application – would be the same as Option 1 but add land application of treated groundwater as a disposition method.
- **Option 3** – Mass Removal via Treatment with Injection and/or Land Application and *In-situ* Treatment – would be the same as Option 2 but add in-situ treatments to supplement treatment of the contaminated groundwater.
- **Option 4** – Monitored Natural Attenuation – would rely on natural physical, chemical, or biological processes to reduce concentrations, toxicity, or mobility of hexavalent chromium and incorporate regular monitoring to verify that monitored natural attenuation is working.

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 (Public Law 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 of 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.

The remaining land tracts represent some portion of four of the original 10 tracts evaluated in the CT EIS. Table A.3.2-2 provides the original tract name, acreage, and planned land use after transfer. Figure A.3.2-9 below provides the locations of these remaining lands.

Table A.3.2-2 Status of Remaining Lands to by Conveyed under the No-Action Alternative

CT EIS Tract Name	Acreage Analyzed in CT EIS	Acreage Remaining for Transfer or Conveyance	Land Use Plan from CT EIS[a]
Rendija Canyon	910	890	Natural area (37 percent)/Residential development (63 percent) OR Cultural preservation (100 percent)
TA-21	260	220	Commercial and industrial development (55 acres)
TA-74	2,715	24	Cultural preservation OR Natural areas and utilities
White Rock "Y"	540	150	Cultural preservation OR Natural areas, transportation, and utilities

CT EIS = Conveyance and Transfer EIS
a The CT EIS analyzed potential future land uses for the transferred tracts. For some tracts, the CT EIS considered multiple scenarios with a combination of potential land uses.
Source: LANL (2024g)

A.3.2.3 No-Action Alternative – Proposed Project Locations

Figures A.3.2-10–A.3.2-14 provide planning area maps for locating the projects included in the No-Action Alternative at LANL.[4] The numbered bubbles on the maps correspond to the MAP ID numbers in Chapter 3, Tables 3.2-1 and 3.2-2.

[4] Figures A.3.2-10–A.3.2-14 can be used to find the approximate location of new facilities for the No-Action Alternative using the grid coordinates provided in Chapter 3, 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.

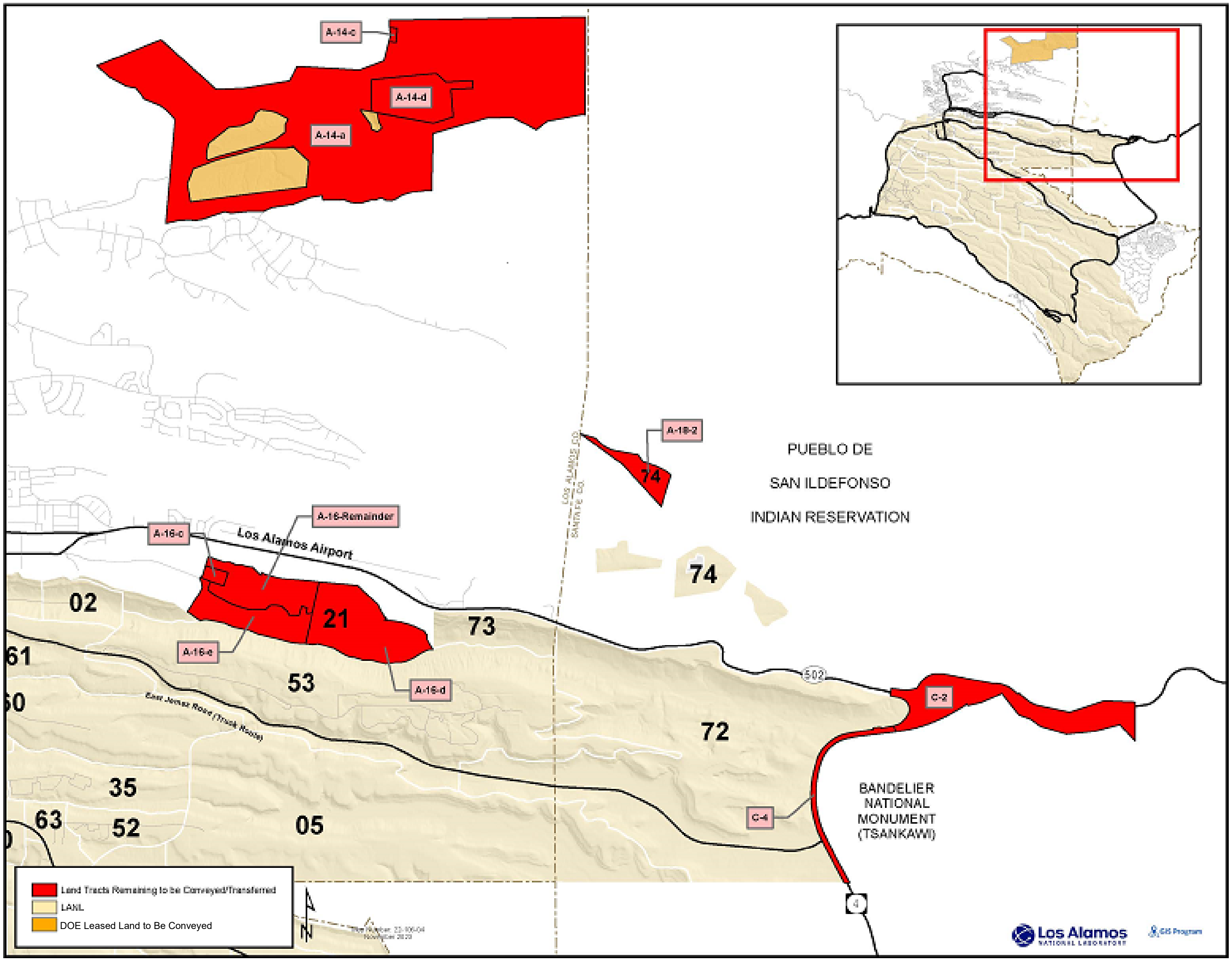


Figure A.3.2-9 Locations of Remaining Lands

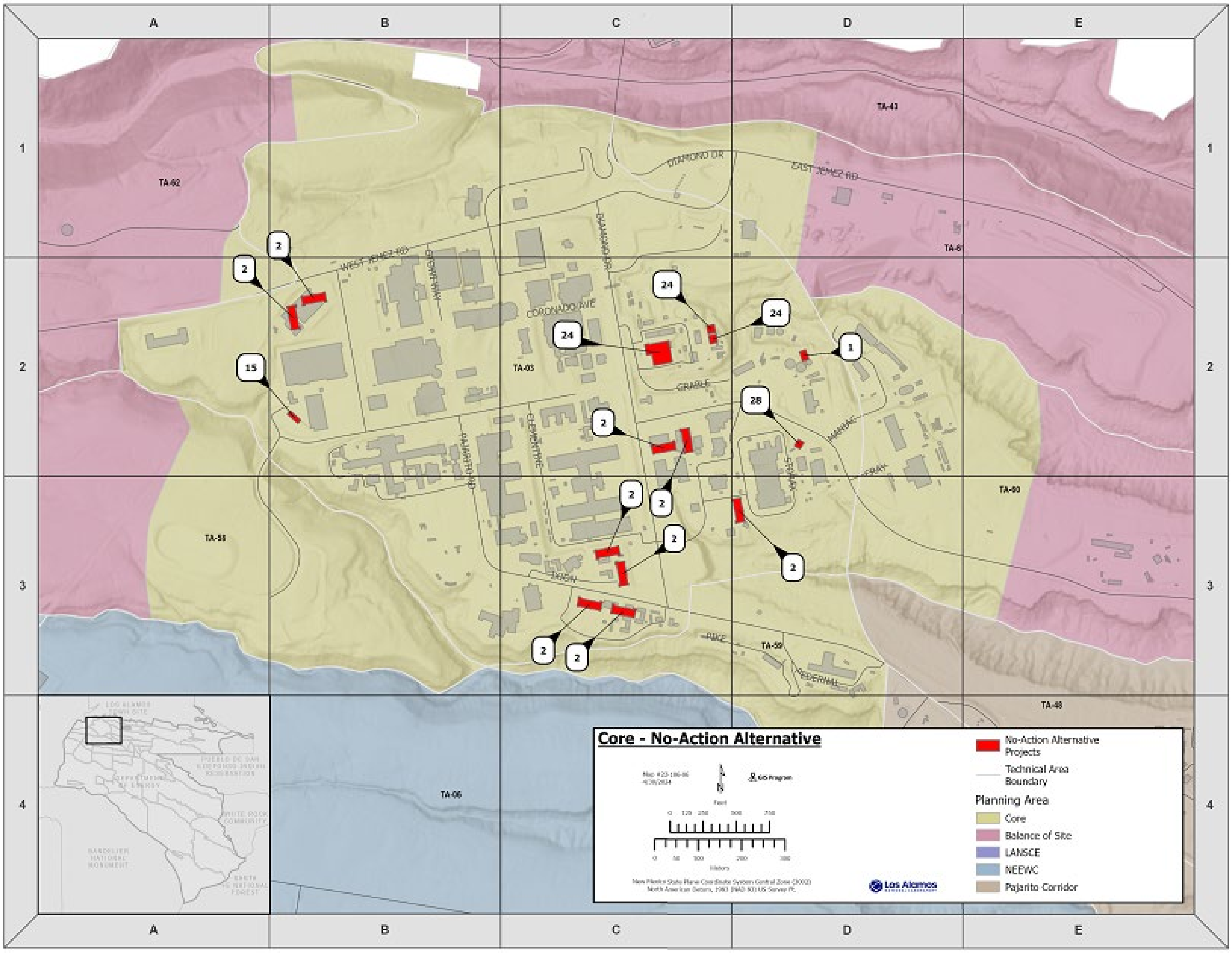


Figure A.3.2-10 No-Action Alternative – Core Area Planning Area

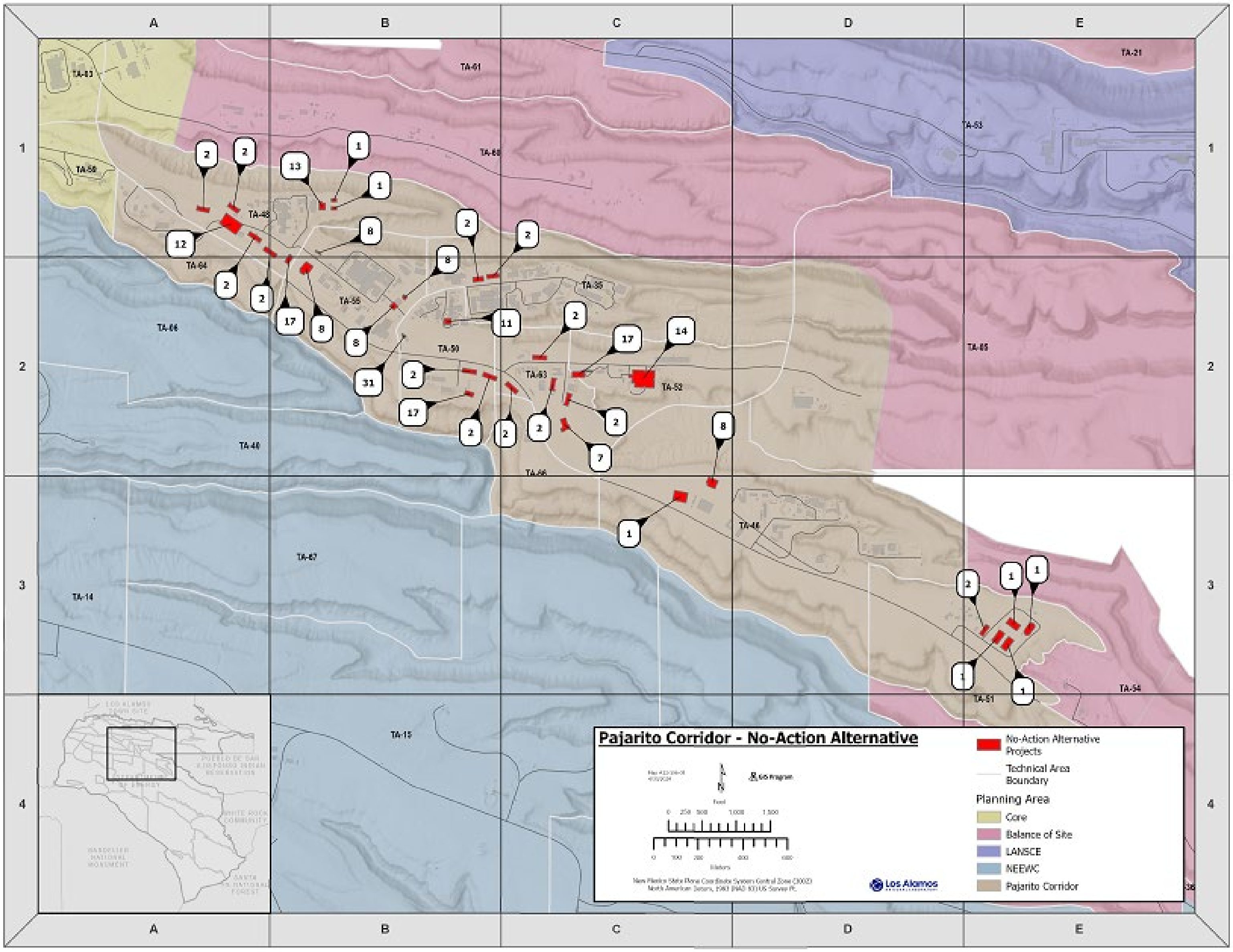


Figure A.3.2-11 No-Action Alternative – Pajarito Corridor Planning Area

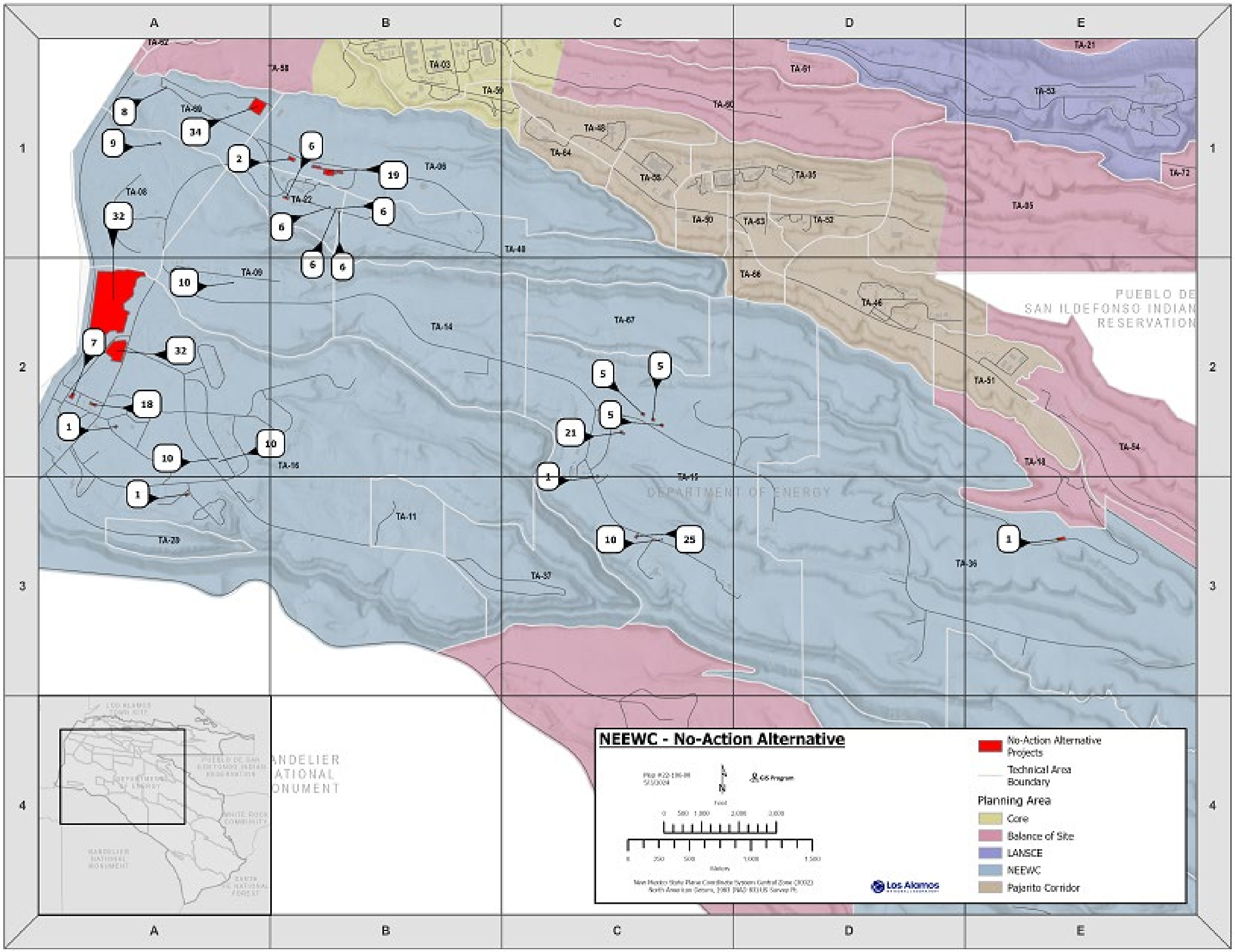


Figure A.3.2-12 No-Action Alternative – NEEWC Planning Area

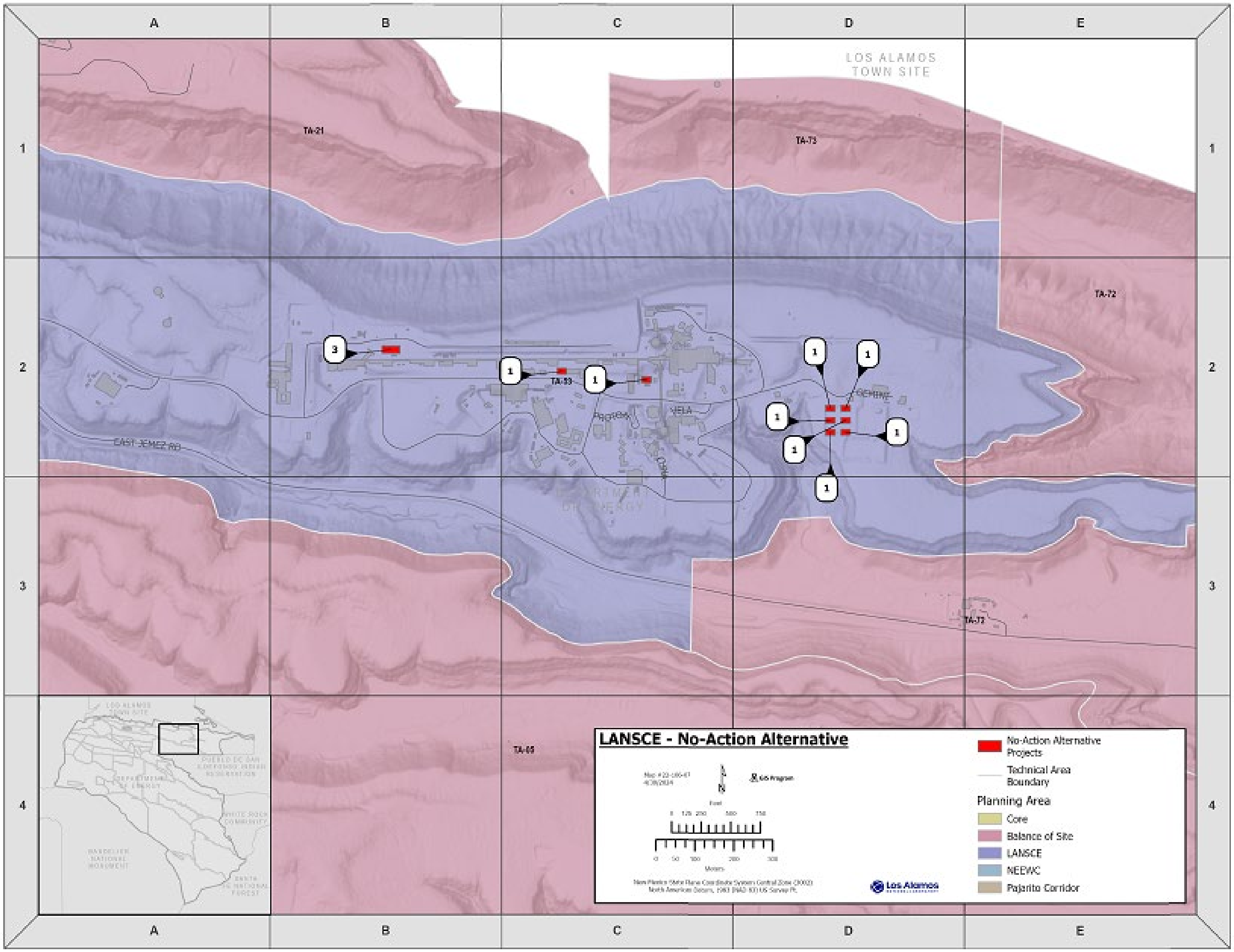


Figure A.3.2-13 No-Action Alternative – LANSCE Planning Area

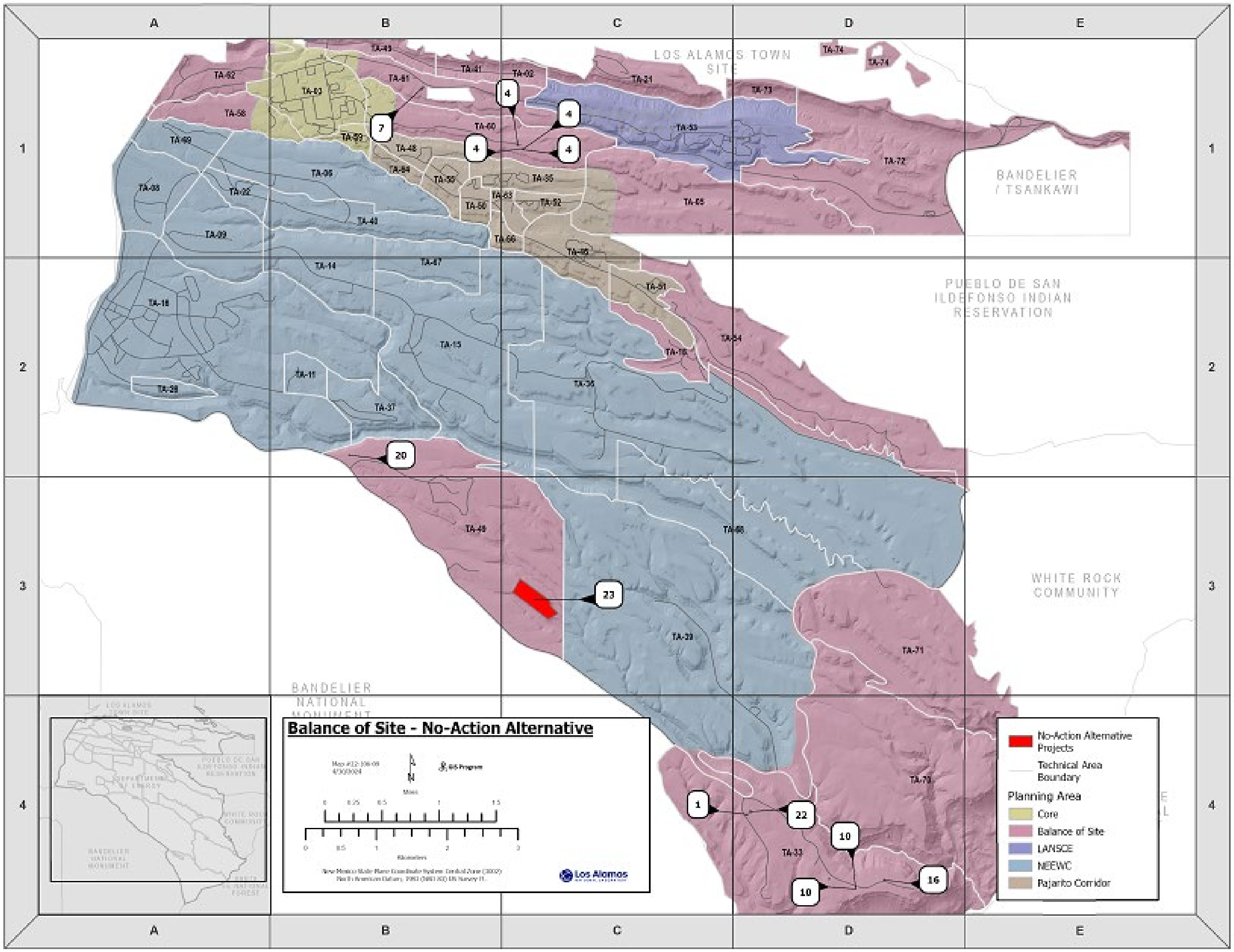


Figure A.3.2-14 No-Action Alternative – Balance of Site Planning Area

A.3.3 Modernized Operations Alternative Facility Descriptions – Supplemental Information

This section provides supplemental information for projects identified in Chapter 3, Tables 3.3-1 and 3.3-2 that NNSA intends to implement under the Modernized Operations Alternative. There are no notable changes in operations to discuss under this alternative.

A.3.3.1 Modernized Operations Alternative – Supplemental Project Description

DARHT Vessel Inspection Facility

This project would install an 8,000-square-foot facility in an area that is mostly undeveloped for use near the DARHT at TA-15 for the management of test vessels. The facility would be climate controlled with a fire alarm and suppression system and contain a 30-ton overhead crane (LANL 2024c). The new facility would consist of multiple bays for operational efficiency supporting a number of activities related to examination, inspection, and inventory management.

Explosives and Lasers Facility (ELF)

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 HE area. This facility would have a footprint of approximately 14,000 square feet and 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 (LANL 2024c).

Shock Physics Integrated Research Facility (SPIRe)

The SPIRe would be a gas gun facility for explosives and organic materials. A gas gun plays an integral role in the certification of the nation's nuclear weapons stockpile by providing a method to generate and measure data pertaining to the properties of materials at high-shock pressures, temperatures, and strain rates. These extreme laboratory conditions approximate those experienced in nuclear weapons. Data from the experiments are used to determine material equations-of-state and to validate computer models of material response for weapons applications. Experiment results are used for code refinement, providing better predictive capability, and ensuring confidence in the nuclear stockpile. The 17,000-square-foot 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 (LANL 2024c).

Detonator Production Facility Complex

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. A 17,500-square-foot office building would also be required; however, this office building has been included with other office construction as part of Mission-Enabling Operations. The Detonator Production Facility complex would have a total footprint of about 34,000 square feet and comprise the following buildings (LANL 2024c):

- **Detonator Production Facility and four replacement munitions storage magazines** – would replace existing capabilities that are housed in buildings in TA-22. The Detonator Production Facility and magazines would represent a footprint of about 6,000 square feet.
- **Receipt and Inspection Facility** – would support receipt and inspection of products used in detonator production; requirements include temperature and humidity control, refrigerated storage, forklift operations, rated for controlled storage, and segregated storage. Receipt inspection is currently handled elsewhere on site; this would not introduce new capabilities. This building would be constructed in TA-6 or TA-22 and have a footprint of about 4,000 square feet.
- **Production Agency Quality Building** – would support inspection development activities in addition to inert (non-HE) production in an environment designed to meet the increasingly stringent inspection requirements such as air quality (cleanroom-grade particle count), vibration, temperature, and humidity control. The Inert Metrology Lab (within the Production Agency Quality Building) would also include collaboration space for inspection resources, controlled/secure storage for tooling, fixtures, and product, secure telecommunications, and kitchen space. This building would have a footprint of about 4,000 square feet.
- **Packaging and Transportation Facility** – would support container kit assembly design, material storage, and packaging. The facility would replace existing space in TA-22, which is inadequate. The existing space is undersized and does not have a climate-controlled environment to successfully achieve the scheduled commitments of NNSA's packaging and transportation schedule. The storage facilities for container kit assembly components are at capacity and lack the necessary utilities (e.g., climate control, electricity, fire suppression) to properly store war reserve materials and indispensable life-of-program materials have resulted in non-conformance issues. This building would have a footprint of about 20,000 square feet.

Microwave Oven Thermo-Mechanical Experimentation (MOT-ME) Project

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, electromagnetic (microwave) HE heating, sub-shock mechanical testing (Taylor Gun), and non-HE machining of parts. The facility, which would be approximately 8,000 square feet, is planned for 2034. These capabilities are currently performed at TA-9 and TA-16 (LANL 2024c).

Radiological Laboratory (Rad Lab)

This 16,000-square-foot 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 R&D. 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 material from DOE-STD-1027 (LANL 2024c).

Beryllium Technology Facility Replacement

The existing BTF (TA-3-141) at TA-3 was originally built in the early 1960s and has reached its end of life. The 45,000-square-foot replacement facility would be constructed in a developed area in TA-35 and would provide process improvements and consolidate the beryllium operations at

LANL. Once replaced, the existing BTF is not expected to undergo DD&D by 2038 and would be considered an "enduring facility" (LANL 2024c).

Pentaerythritol Tetranitrate (PETN) Plant

This proposed facility would replace the capabilities for production of this explosive material currently performed in Building TA-9-46 and would largely support HE (i.e., PETN) production capabilities. 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 6,000-square-foot building would be constructed in an area that is currently undeveloped in TA-6 near the proposed location of the MOT-ME project (also proposed as part of the Modernized Operations Alternative).

HE Pilot Plant

This proposed building would replace the capabilities currently performed in TA-9, Building 45, including operations of 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 6,000-square-foot building would be constructed in TA-16 at the previous location of Building 306 (which underwent DD&D in 2022) and would support chemical analysis of explosives and associated materials using a wide variety of methods from classical wet chemistry to instrumental analysis.

National Gas Transfer Systems and Surety Laboratory (NGTS/S)

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 LEPs and new design development. The facility would include offices for 30-40 personnel, a storage area (i.e., vault type room), a 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. The two-story facility would be approximately 65,000 square feet in size with associated parking. Similar to the existing facility, this replacement facility would also be a radiological (below HC-3) facility (LANL 2024c).

Blast Tube Relocation

The current blast tube capability is 150 feet in length and 8-foot in diameter made from steel and located within one of the Laboratory’s large-scale firing sites. The Laboratory utilizes the blast tube to simulate environmental conditions that could be experienced by weapons. The blast tube is currently located at the Lower Slobbovia firing site and may be relocated to the Meenie Bravo firing site in TA-36. The blast tube would be disassembled, relocated, and could be extended an additional 60 feet to improve the capability’s effectiveness. Blast tube testing is performed in a controlled environment and has not resulted in radiological contamination. Both firing sites are well-suited for these activities and therefore would be a relatively easy transition of operations. This move would also relieve schedule pressure at the Lower Slobbovia firing site, which is typically one of the Laboratories most utilized facilities.

DARHT Modernization

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 proposes to modify one of the halls of the DARHT building to better support access to the A2 accelerator. The Laboratory would extend the A2 hall. The hall extension would improve A2 accelerator systems maintenance (e.g., injector, cells, vacuum systems); allow major components to be removed/installed in a safe indoor environment; make room for additional accelerator cells; and provide additional internal space. The current method for major component installation/removal requires a road mobile crane and blind critical lift through a roof hatch. This method not only potentially exposes the accelerator to adverse weather conditions but mobile crane operations are limited by wind and lighting conditions. The hall extension would be designed to allow direct visual observation of the lift using an indoor crane that would not be weather limited nor expose the accelerator to rain or snow. 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.

Heat Pipe and Robotics Facility

The Laboratory currently 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 several hundred times faster than conventional methods. Heat pipe operations and robotics are both multipurpose operations that can be applied to various missions. The Laboratory would construct a multipurpose facility to co-locate these operations from TA-46 to a developed area in TA-16. LANL continues to develop its robotics operations to support TA-55, LANSCE, Emergency Response, and others. Half of the 8,000-square-foot-facility would be used for heat pipe laboratory work and the other half would be used for robotics development and testing.

Sanitary Effluent Reclamation Facility Expansion

Under this proposal, NNSA would 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. 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 (MGY) to being able to treat 120 MGY (LANL 2024c). 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 (Figure A.3.3-1).

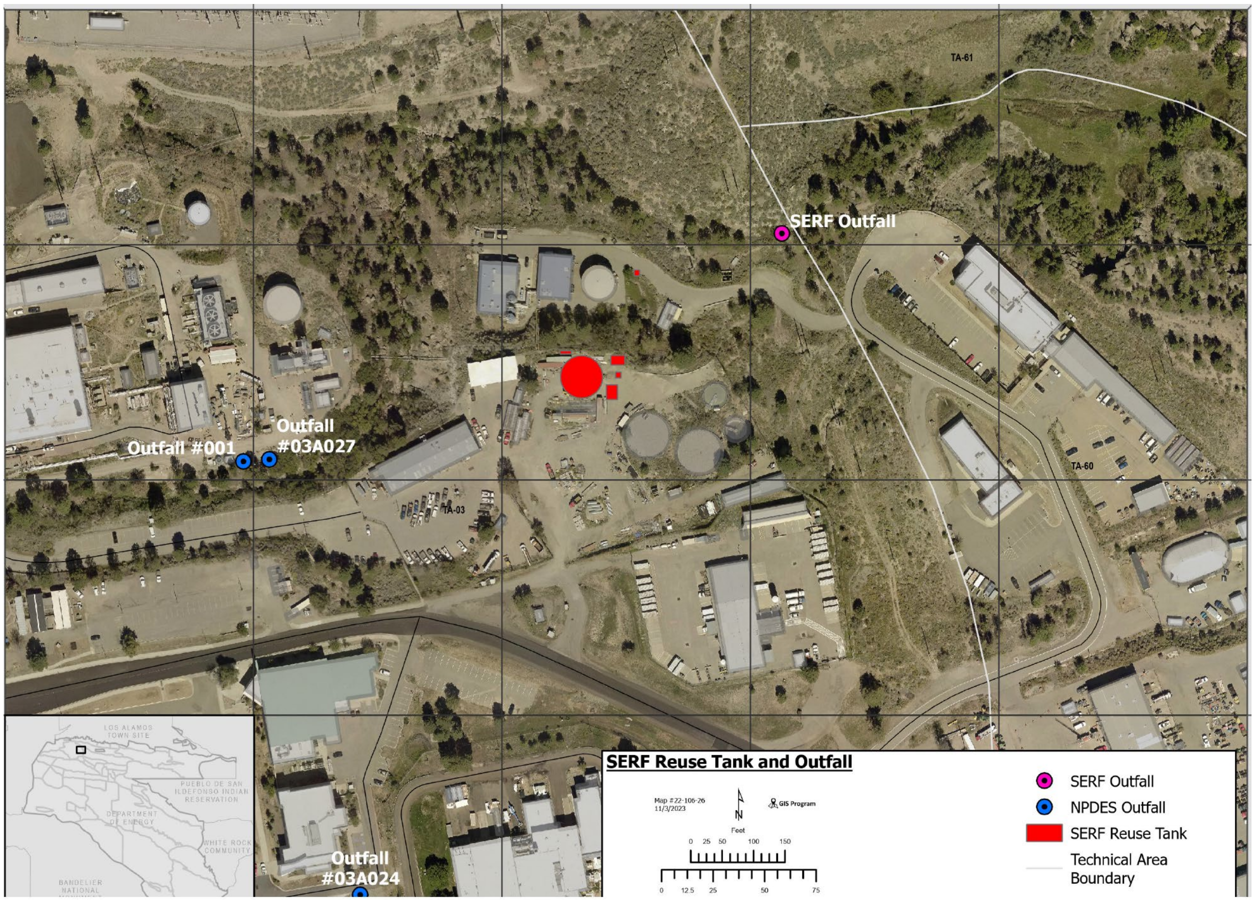


Figure A.3.3-1 SERF Outfall Associated with the Reuse Tank and SERF Expansion

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 or burned in an air curtain destructor (see below). 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. With a small unit that can utilize entire stumps and be sited near fuel mitigation activities, pre-processing and transportation costs would be further reduced. NNSA would also consider utilizing the biomass generator to process forest waste materials from other agencies in the area.

The biomass system converts biomass into black carbon (most of which would be trapped as biochar, a reusable byproduct) and because the system uses an air curtain incineration technology, it emits less smoke and carbon dioxide than would be created under typical burning conditions during a prescribed fire or wildfire. The biochar byproduct would be managed on site and could improve soil health and water retention.

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.

As discussed above, 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 are similar to those of the proposed biomass generator although the air curtain destructor does not generate electricity. The potential impacts associated with operations of the air curtain destructor were evaluated in *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory* and subsequent FONSI (DOE 2000a, 2001). Operation of the proposed biomass generator could either replace or supplement the operation of the air curtain destructor within existing permitted operating limits.

LANSCE Water Treatment Facility

This project would construct a new water treatment facility near LANSCE. The facility design would be based on the design of the existing SERF facility 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. The estimated 54,000 square feet of temporary disturbance would be returned to its original condition after construction. 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 an existing NPDES permitted outfall in TA-53.

The minimum design flow capacity of the water treatment facility would satisfy the current cooling water use requirements for the existing cooling needs and would have the ability to expand to address additional cooling towers, if warranted. The existing cooling towers currently discharge about 30 million gallons of water annually. After installation of the water treatment facility, the current LANSCE cooling water needs would result in a decreased discharge to about 12 million gallons; a savings of 18 million gallons of potable water annually. The Expanded Operations Alternative includes a proposal for additional cooling towers in TA-53 to support additional water-cooling needs associated with newly proposed projects. Water discharged from the water treatment facility would meet the same NPDES permit limits as currently met for Outfall #03A048.

Live Fire Shoot House

The Laboratory proposes to construct a live fire shoot house consisting of an approximately 10,000-square-foot pre-engineered steel building roof on a concrete slab 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 Protective Force individuals and teams would conduct live-fire dynamic entry training in a realistic environment. The facility would utilize frangible,[5] 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. The walls of the interior rooms, hallways, and sliding doors that separate the rooms would be covered with armor plate clad with plywood sheeting. Above the rooms and hallways, a catwalk would enable authorized personnel to control and observe students and Protective Force trainees as they move from room to room. The building would be equipped with a light-emitting diode lighting system to enable variable light levels from a fully lighted, low-light, and/or no light training environment.

Replacement of the Sanitary Wastewater System (SWWS) Treatment Plant

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. Under the Modernized Operations Alternative, the Laboratory would replace the SWWS treatment plant within a mostly undeveloped area in TA-46. In addition to the construction and operation of the new and upgraded SWWS treatment plant, the Laboratory would also upgrade several of the smaller sewer facilities within TA-46 and elsewhere across the site.

Steam Plant Renovation – Clean Energy Test Bed Facility

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. That upgrade has an additional footprint of 80,000 square feet and includes the Steam Turbine Generator Building and an accompanying water treatment building. 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,

[5] Frangible bullets are intended to disintegrate into tiny particles upon target impact to minimize their penetration of other objects.

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[6] (LANL 2024c).

Manhattan Project National Historical Park Infrastructure at TA-18

The Laboratory would install 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 facilities. The proposal would also include walkways, parking, and shade structures. The overall estimated footprint of facilities, walkways, and paving would be about 20,000 square feet. 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).

A.3.3.2 Modernized Operations Alternative – Proposed Project Locations

Figures A.3.3-2–A.3.3-6 provide planning area maps for locating the projects included in the Modernized Operations Alternative at LANL.[7] The numbered bubbles on the maps correspond to the MAP ID numbers in Chapter 3, Tables 3.3-1 and 3.3-2.

[6] DOE's National Energy Technology Laboratory manages these regional initiatives. Information about the Southwest region can be found at: https://netl.doe.gov/project-information?p=FE0031837

[7] Figures A.3.3-2–A.3.2-6 can be used to find the approximate location of new facilities for the Modernized Operations Alternative using the grid coordinates provided in Chapter 2, 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.

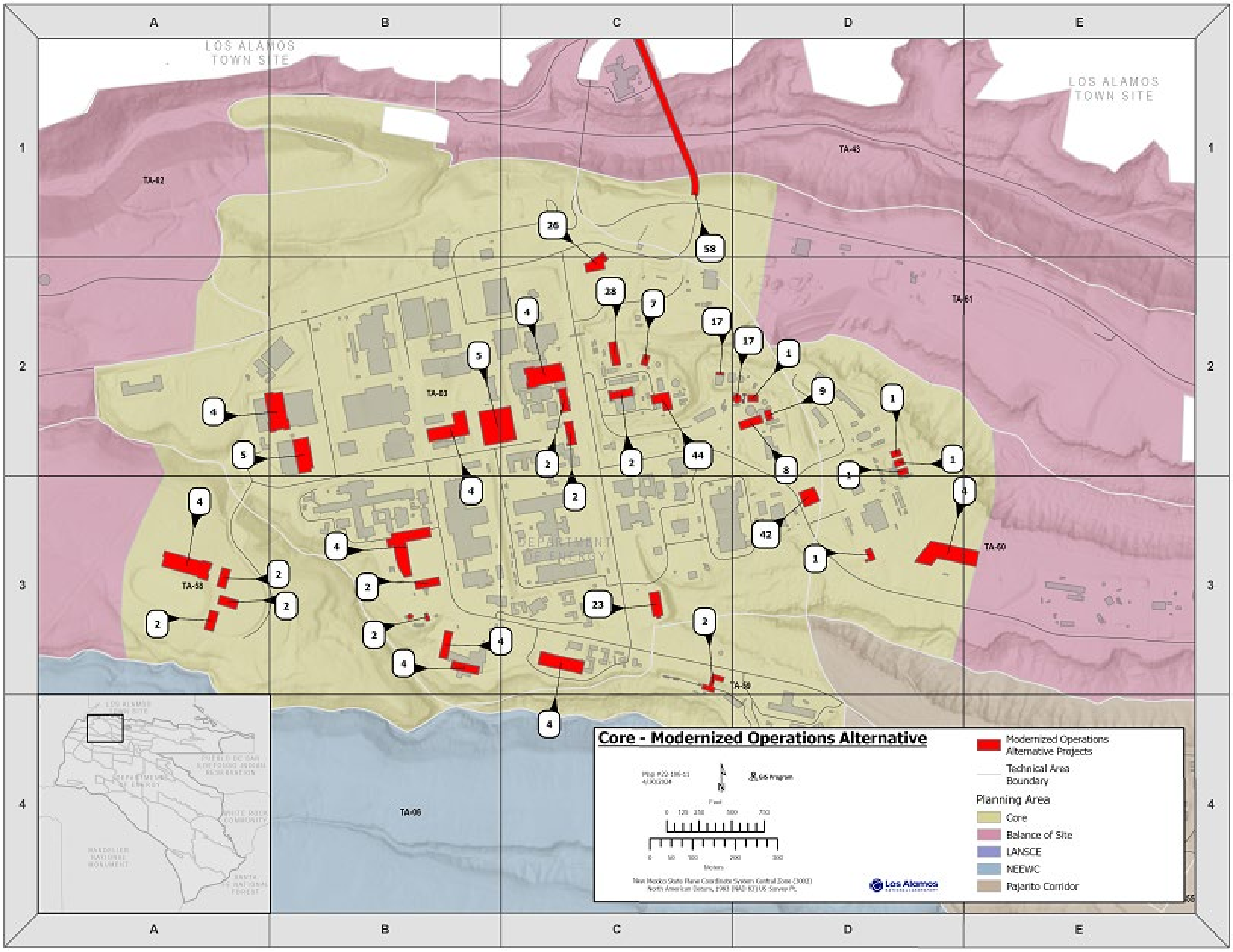


Figure A.3.3-2 Modernized Operations Alternative – Core Area Planning Area

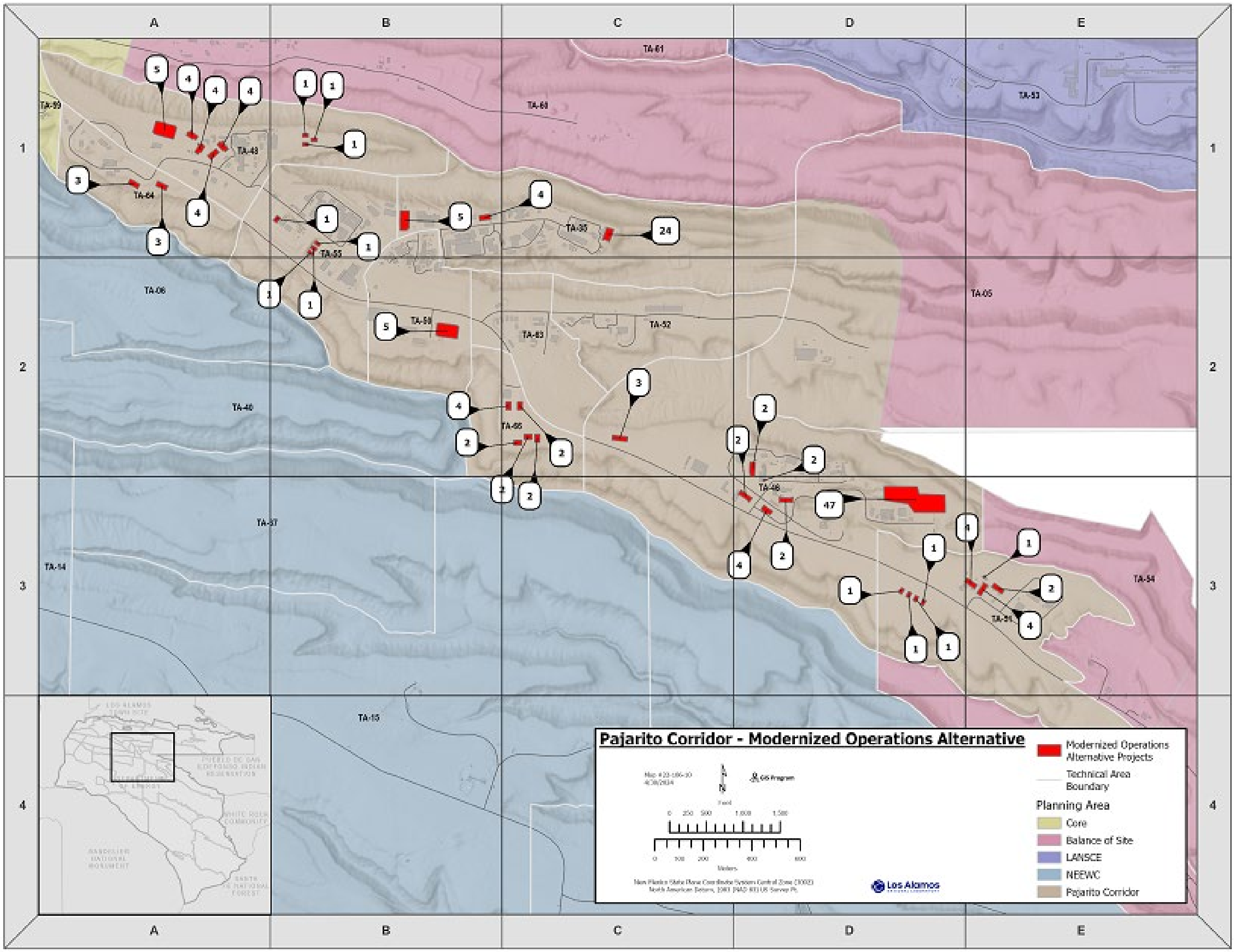


Figure A.3.3-3 Modernized Operations Alternative – Pajarito Corridor Planning Area

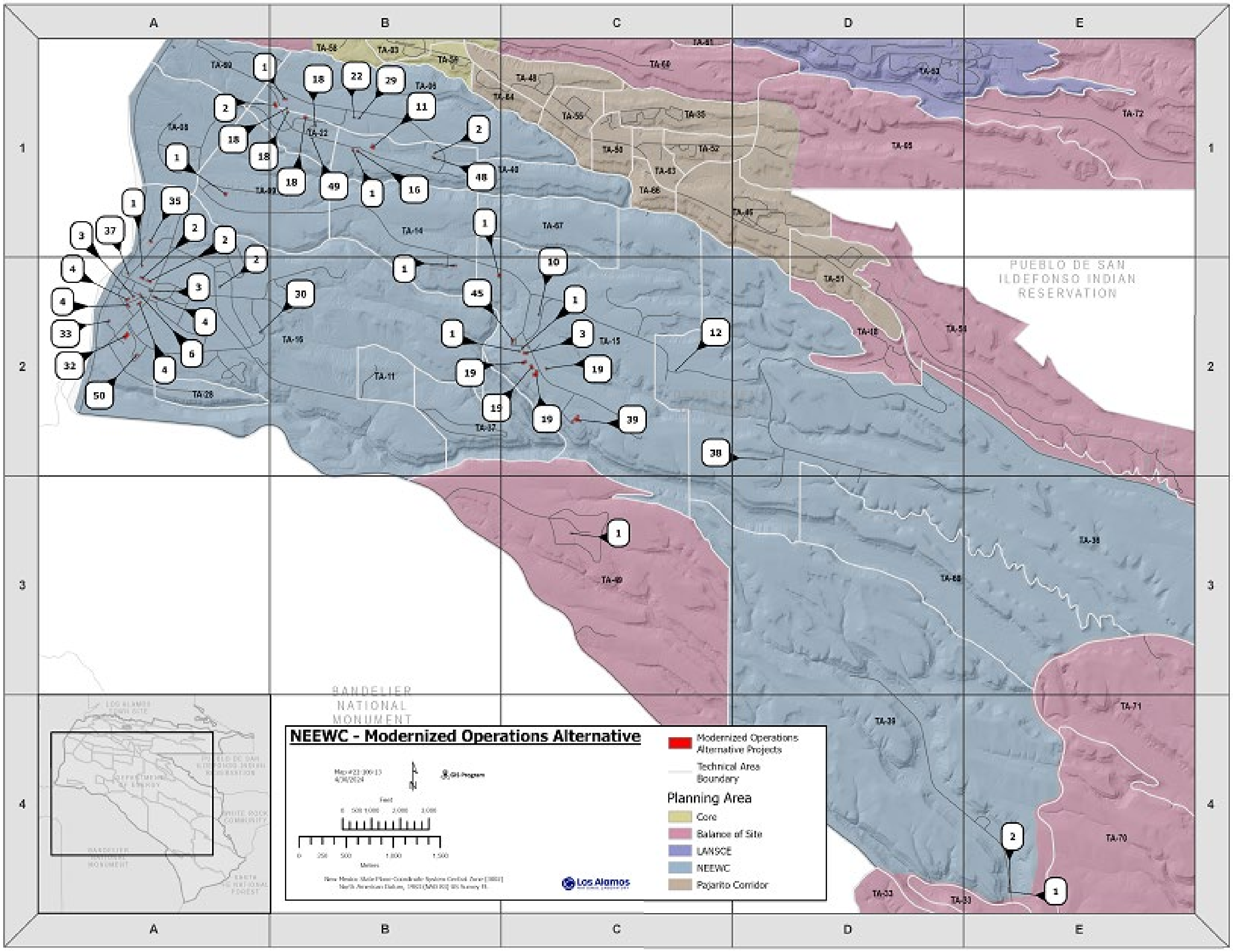


Figure A.3.3-4 Modernized Operations Alternative – NEEWC Planning Area

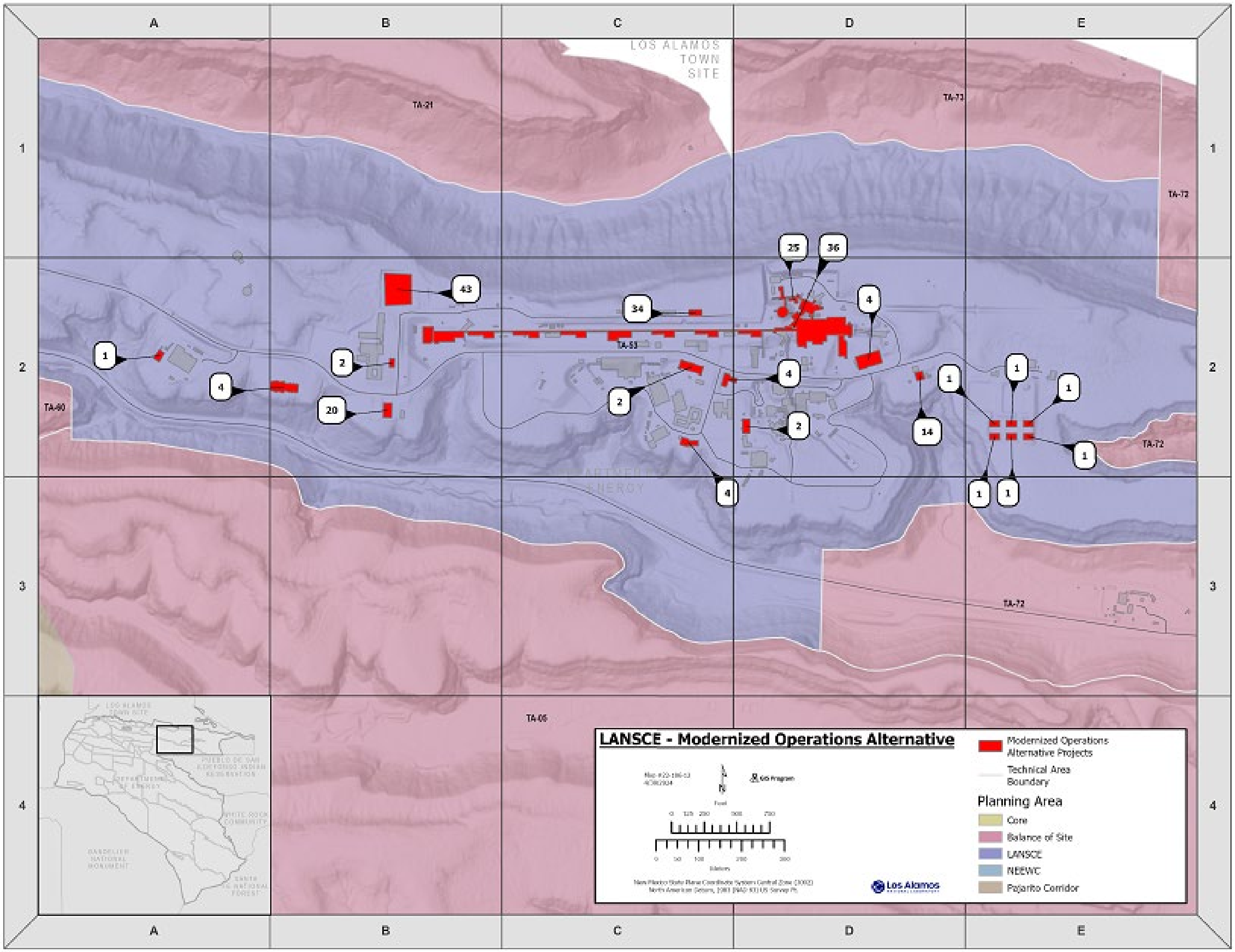


Figure A.3.3-5 Modernized Operations Alternative – LANSCE Planning Area

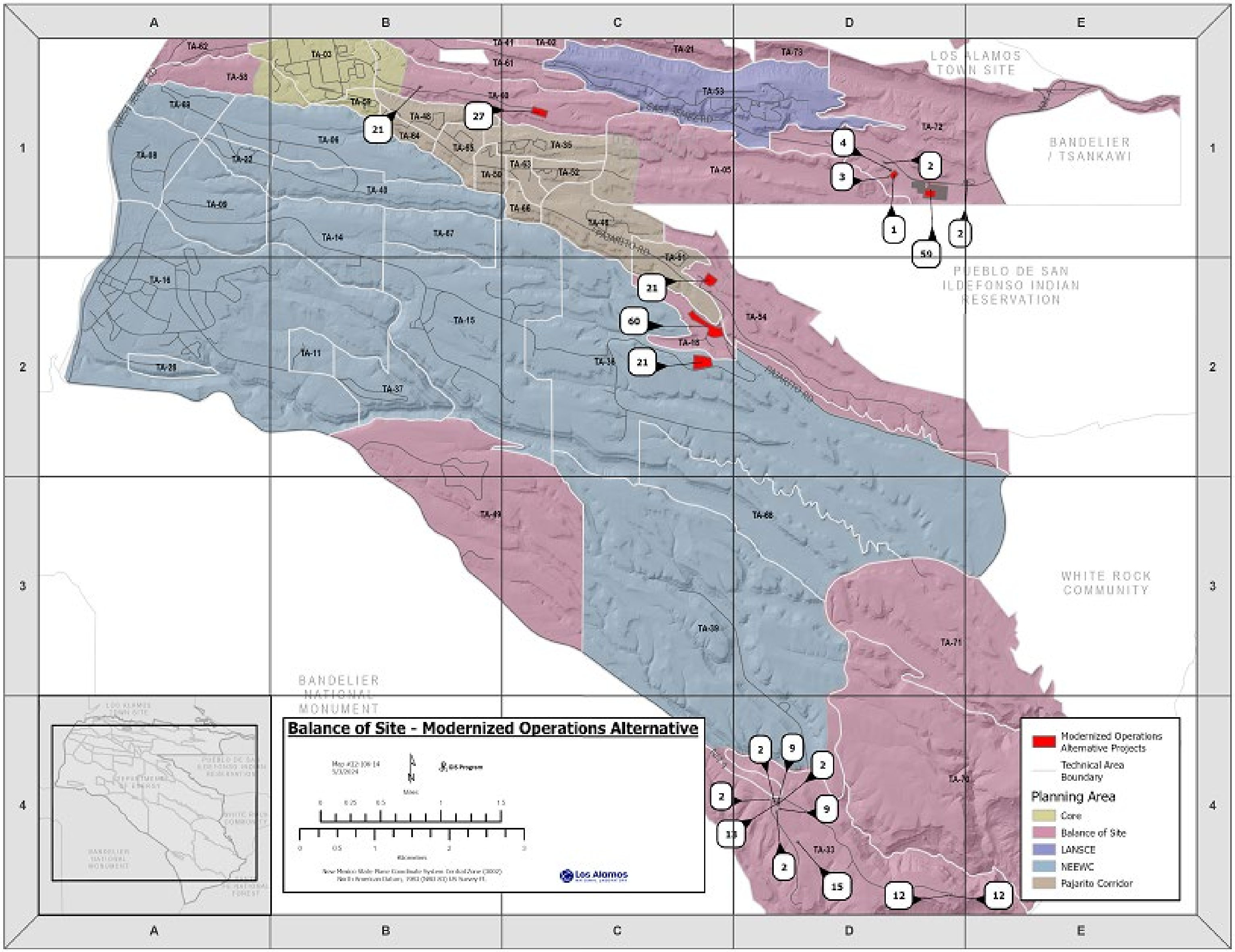


Figure A.3.3-6 Modernized Operations Alternative – Balance of Site Planning Area

A.3.4 Expanded Operations Alternative Facility Descriptions – Supplemental Information

Section A.3.4.1 provides supplemental information for projects identified in Chapter 3, Tables 3.4-1 and 3.4-2 that NNSA proposes to implement under the Expanded Operations Alternative. Section A.3.4.2 supplements information about changes in operations that are proposed under the Expanded Operations Alternative.

A.3.4.1 Expanded Operations Alternative – Supplemental Project Description

FSI Water Treatment Facility (FSI WTF) and Associated Water Lines

The FSI WTF would support the proposed FSI/HPC expansion at TA-6 (discussed in Section 3.4.1) and would provide treated reclaimed water to support the facility's needs. The Laboratory estimates that the FSI WTF could utilize approximately 3 million gallons of reclaimed water monthly during the peak season and approximately 30 million gallons of reclaimed water monthly during the non-peak season. (Note: Reclaimed water is dependent upon the amount of non-potable water that could be supplied from Los Alamos County.) This would allow the FSI WTF to provide treated water to the FSI/HPC cooling towers, which would not only decrease the use of potable water but would also increase the cycles of concentration for the cooling towers. The net effect would be for LANL to reduce its site-wide potable water intensity by up to approximately 2 percent. The non-potable 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. The new pipeline for the WTF blowdown would travel east then north and connect with an existing effluent force main to the existing SERF facility in TA-3. The water that would be returned to the FSI WTF from SERF would use existing water lines and tie into the proposed new source line from the non-potable fire hydrant. The proposed discharge pipeline to the new potential outfall in Two-Mile Canyon is also shown in Figure A.3.4-1.

- The overall development footprint for the FSI WTF and the proposed pipelines would be approximately 27.5 acres, however, almost of all of this development would be related to the pipelines and therefore would be temporary and restored after construction. Of this footprint, almost 8 acres are currently undeveloped. The permanent footprint of the water treatment facility would be about 5,000 square feet. Completion of this project would be required prior to startup of operations at the FSI/HPC mission expansion (LANL 2024c).
- The conceptual design of the FSI WTF includes both the pipelines to and from the SERF and the discharge pipeline to the new outfall. As the design matures, it is possible that the pipeline for sending water to (and returning water from) the SERF may not be implemented. In this case, the full discharge would go to the proposed outfall. The estimated discharge (or return to SERF if the line were built) would be about 12 MGY if the FSI WTF were operating at full capacity. The new outfall would be permitted for the maximum expected discharge.

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. As discussed in Section 3.3.1, the Modernized Operations Alternative includes a LANSCE modernization project that would replace several internal components to improve and modernize the accelerator's operations. Under the Expanded

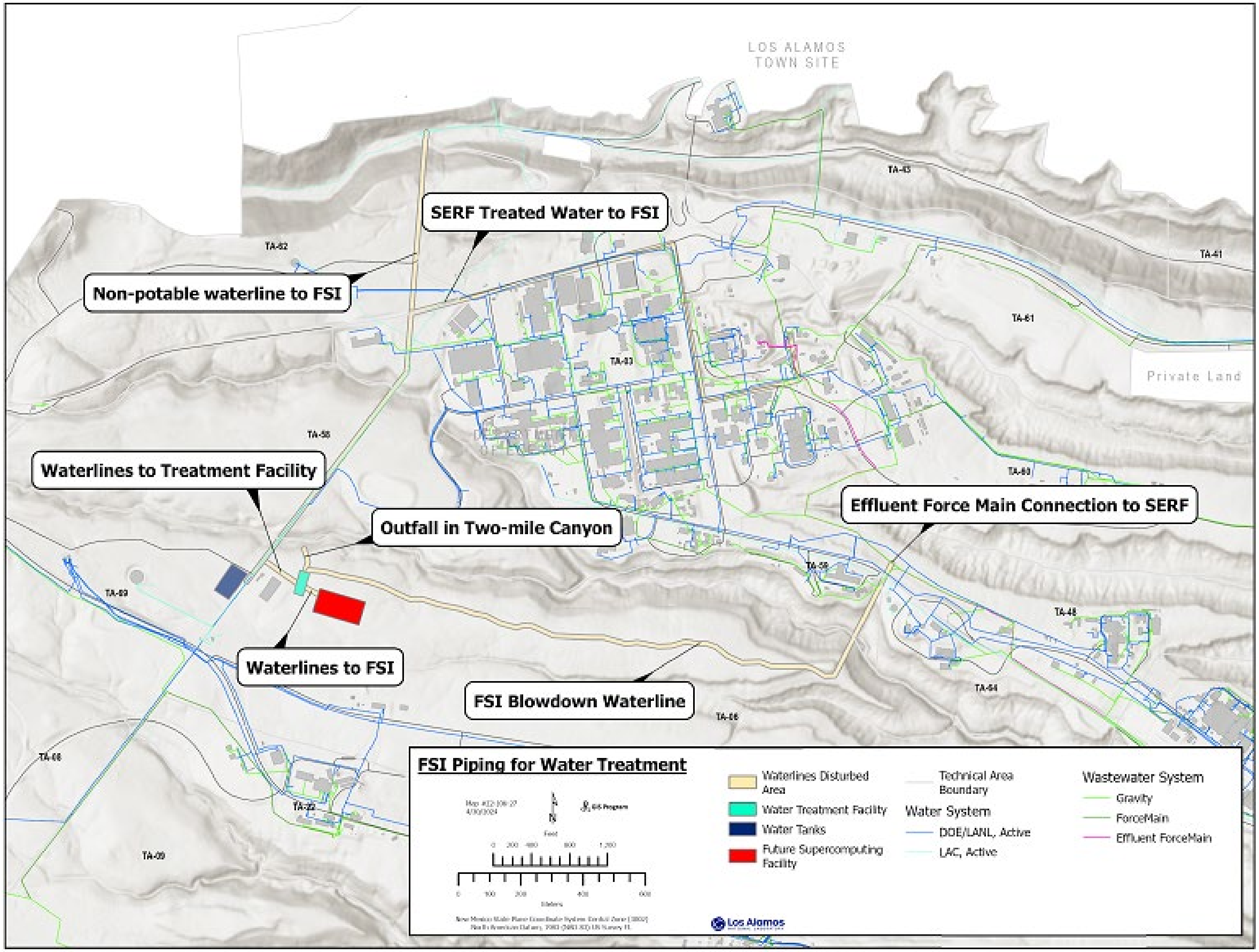


Figure A.3.4-1 Proposed FSI WTF Water Pipeline Routes

Operations Alternative, 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 six key enhancements include:

- **Enhanced energy proton radiography** – Proton radiography is used to diagnose and understand dynamic material behavior including the performance of HE. The current capability is limited by the existing accelerator beam energy of 800 MeV, which limits both the size of objects to be studied and the resolution that can be achieved. Both issues limit the data quality, and both can be addressed by raising the beam energy. The Laboratory proposes to boost the proton energy from 800 MeV to 3–5 giga electron-volts, which would dramatically improve both the depth penetration and the spatial resolution for proton radiography, thereby significantly improving data quality and enabling a variety of new measurements. Two technical approaches exist; both would use LANSCE to feed an additional accelerator to provide the necessary high-energy beams. This new accelerator would involve the addition of approximately 300 meters of new accelerator near the existing LANSCE LINAC. The project is proposed for 2035 and at this early stage of planning, the Laboratory has not determined whether this would continue to use LINAC technology or a ring-type accelerator.
- **Neutron target for nuclear physics** – High neutron fluence[8] environments, such as those measured via radiochemical diagnostics, can transmute stable isotopes to unstable ones. Many of the nuclear reaction rates on unstable isotopes have not yet been measured due to the technical challenge of working with existing neutron beams shining on radioactive samples, and a new approach is required to provide a fundamental understanding of the universe, as well as the materials in the stockpile.

The neutron target concept would solve this problem by shining a radioactive ion beam on a standing field of neutrons. Generating both the radioactive ion beam and neutron field require LANSCE beam power. A new spallation neutron source and ion storage ring would be added to LANSCE in an existing but unused experimental area (Area A) and as such, would not require construction of a new facility. Such a capability would deliver long-sought nuclear reaction data supporting NNSA missions.

- **Burst facility for acute radiation effects studies** – Acute and chronic radiation exposure can have profound effects on material properties and electronics reliability. The physical effects can include point defects, embrittlement and hardening, nucleation of voids and bubbles, and transmutation and activation. Despite the general interest in these effects, the scientific community's current technical means to address them are limited. Irradiation facilities are significantly oversubscribed across the DOE/NNSA complex, and the technical means to address acute radiation effects have contracted over the last two decades. An accelerator-driven, acute radiation effects facility could offer a powerful complement to LANSCE's existing capabilities, bringing new flexibility to experiment

[8] Fluence is defined as the number of particles (such as photons or neutrons) incident on a sphere divided by the cross-sectional area of the sphere or the total number of particles per unit area with which a material is irradiated.

design, while helping to mitigate the current oversubscription issues. The proposed Burst Facility would be constructed in 2035 and utilize a single large pulse of 4 giga electron-volts protons, which would allow for potentially significant technical and infrastructure overlap with energy-upgraded proton radiography. As a result, this facility could either utilize the same accelerator additions described above for Enhanced Energy Proton Radiography or a separate addition of 300 meters of accelerators could be required.

- **Compact x-ray sources for material science and dynamic radiography** – Neutrons and x-rays provide powerful and complementary means to study material properties in support of advanced manufacturing and aging. The ability to handle hazardous, radioactive, and classified components is required to meet the mission need. LANSCE's Lujan Center provides this capability for neutrons, while a capability gap remains for x-rays due to the logistical challenges associated with performing such experiments at existing national user facilities. The Laboratory proposes to add a compact x-ray source at LANSCE to leverage the existing expertise and infrastructure necessary to support materials characterization on hazardous, radioactive, and classified parts. This addition would dramatically improve the achievable range of experiments and throughput for NNSA-relevant measurements in a way that complements work done at other DOE light sources. The addition of the compact x-ray source would be planned for 2038 and could utilize existing infrastructure and buildings in TA-53.
- **Fusion prototype neutron source** – In potential future deployments, the first wall of a magnetically-confined fusion reactor burning deuterium-tritium fuel would experience significant neutron dose with the corresponding potential for radiation damage. Currently no capability exists to test candidate materials for their behavior in such an environment. DOE's Fusion Energy Sciences program is interested in addressing this capability gap. The Fusion Prototype Neutron Source concept would use a high-power spallation neutron source located in LANSCE's Area A to simulate this environment. Material damage data would then be used to evaluate candidate materials for their suitability as structural materials in a fusion reactor. The Laboratory would construct a new facility in 2032 in Area A to house a high-power spallation neutron source and replace or refurbished out-of-service hot cells in Area A for working with candidate materials post-irradiation.
- **Enhanced ultracold neutron (UCN) facility** – UCNs are used by customers, DOE's Office of Science, and the National Science Foundation to study the fundamental nature of matter.[9] All current UCN experiments at LANSCE are extremely statistics-limited, which constrains the physics the facility can study. Increasing neutron production at the facility would directly improve the facility's scientific reach. The Laboratory is developing concepts to both more effectively utilize the existing LANSCE beam that drives the UCN source, and to increase the amount of LANSCE beam power that can be used to drive the source. Both would enhance the neutron density in the UCN source, such that both would improve the physics reach in support of customers' physics. The neutron source itself may require more shielding to minimize exposure to personnel, however the supporting instrumentations would not require modification. The enhancement of the UCN capability is proposed for implementation in 2035.

[9] Information about UCN can be found at: https://lansce.lanl.gov/facilities/ultracold-neutrons/about.php

A.3.4.2 Expanded Operations Alternative – Additional Operations – Supplemental Information

The following section supplements information provided in Chapter 3, Section 3.4.2 under the Expanded Operations Alternative for select projects.

<u>Wildland Fire Risk Reduction Treatments</u>

In 2019, NNSA prepared the Wildfire Hazard Reduction Supplemental Environmental Assessment (SEA) (NNSA 2019d). 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. The Laboratory would modify the current Wildland Fire/Forest Health Plan to address additional wildfire risk reduction techniques that expand the activities beyond those currently evaluated in the Wildfire Hazard Reduction SEA (NNSA 2019d).

The goals of these forest management actions, including fuels reduction treatments, are 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. Generally, this restoration thinning would strategically reduce dense, continuous fuels and wildland fire risk by creating a mosaic of openings, groups, and clumps. The proposed prescriptions lean heavily on the ecological restoration of southwestern ponderosa pine principles (Allen et al. 2002). These principles focus on introducing stand diversity within existing evenly-spaced, second growth pine stands. The application of these principles would result in a forest structure more closely replicating the naturally occurring stand structure of western forests prior to widespread fire suppression, grazing, and logging (Covington and Moore 1994; Covington et al. 2000). By mimicking forest structures before the implementation of excessive fire suppression strategies, restoration thinning would improve the health and resiliency of the forest in the canyon.

The following bullets provide a high-level summary of the proposed prescription revisions:

- Use basal area[10] instead of trees per acre to quantify desired final tree density. Additionally, final density would be on average lower across treated areas, with more open areas (from 10 to 125 trees per acre to 60 to 80 square feet of basal area).
- Update utility corridor maintenance standards to align with industry standard in a changing climate, independent of whether the lines occur in threatened and/or endangered habitat.
- Revise general treatment recommendations based on the defensible space distance chart (*see* Table A.3.4-1).
- Allow for increased vegetation removal in Jemez Mountain salamander habitat and Mexican spotted owl planning areas and adjust the equipment that can be used in these areas.

[10] Basal area is the common term used to describe the average amount of an area (usually an acre) occupied by tree stems. It is defined as the total cross-sectional area of all stems in a stand measured at breast height and expressed as per unit of land area (typically square feet per acre). To standardize measurements, tree diameter is typically measured at 4.5 feet from the ground, or approximately breast height.

- Increase the ROW along fire roads and designate additional roads to be treated according to evacuation route standards.

Table A.3.4-1 Wildland Fire Treatments – Recommended Defensible Space Distances

Vegetation	Recommended Defensible Space Distance		
	Flat-to-Gently Sloping (0–20% grade)	Moderately Steep (21–40% grade)	Very Steep (+40% grade)
Grass – dry grass, cheatgrass and forbs and small shrubs	30 feet	100 feet	100 feet
Shrubs and woodland sagebrush, rubber rabbit brush, piñon, and juniper	100 feet	200 feet	200 feet
Trees – ponderosa pine, mixed conifer. If there is a substantial shrub understory, use those values stated above	100 feet	100 feet	200 feet

Forest structure naturally varies depending on the dominant species. For each of three broad timber types, diversity goals describe targets for size, species, and age composition. To achieve the diversity goals, tree removal would be necessary, but it would also require the identification of and preservation of trees that contribute to forest health and resiliency like long-lived "legacy" trees. Healthy trees of varying age and size classes that maintain species diversity and support healthy forest structure would be deemed leave trees or groups. The diversity goals for each of the three timber types are detailed below.

- **Piñon-juniper** – For pinion-juniper stands with a 40 to 60 square feet basal area or greater, thinning would aim to generate a mosaic of varied sized openings, groups, and clumps. Diversity goals would prioritize the preservation of oak motts and desirable piñon pine from all age classes. Additional priority would be given to legacy piñon pine stands or trees to be preserved. Legacy trees are identified by their large diameters of 16-inch diameter at root collar or greater and canopies that are extend above surrounding average canopies.
- **Ponderosa pine** – Diversity goals for ponderosa pine stands would be largely adapted from the 16 ecological restoration principals described in Allen et al. (2002) to restore stands to pre-settlement conditions. Diversity goals would be achieved by installing a mosaic of openings, groups, and clumps of varied sizes, ideally of different age classes. Oak motts, pinion-juniper, legacy or yellow bark ponderosa pine, and other desirable species such as Douglas fir would be preserved.
- **Mixed conifer** – The majority of the mixed conifer is in Mexican spotted owl and Jemez Mountains salamander habitat and would be largely left intact, removing only damaged and diseased high-risk trees, leaving most of the crown density intact. Encroaching or inhibiting trees would be removed from the understory leaving larger (healthy) white fir. In small areas surrounding cottonwood, some understory would be removed to promote the growth of less shade-tolerant species (existing cottonwood, willow, and oak) along the Los Alamos Canyon riparian area.

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 (2023b).

A.3.4.3 Expanded Operations Alternative – Proposed Project Locations

Figures A.3.4-2–A.3.4-6 provide planning area maps for locating the projects included in the Expanded Operations Alternative at LANL.[11] The numbered bubbles on the maps correspond to the MAP ID numbers in Chapter 3, Tables 3.4-1 and 3.4-2.

A.3.5 Analytical Parameters for the Alternatives

As identified in Chapter 3, Section 3.2.5, this SWEIS uses key parameters to facilitate the analysis of potential impacts associated with construction and operations of the Laboratory. The accumulated parameters are presented in Table A.3.5.1 (for construction) and Table A.3.5-2 (for operations) for all alternatives. Section 3.2.5 describes the process used to develop these parameters. Analysts utilized these parameters to conduct the impact analysis presented in Chapter 5 of this SWEIS.

[11] Figures A.3.4-2–A.3.4-6 can be used to find the approximate location of new facilities for the Expanded Operations Alternative using the grid coordinates provided in Chapter 2, 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.

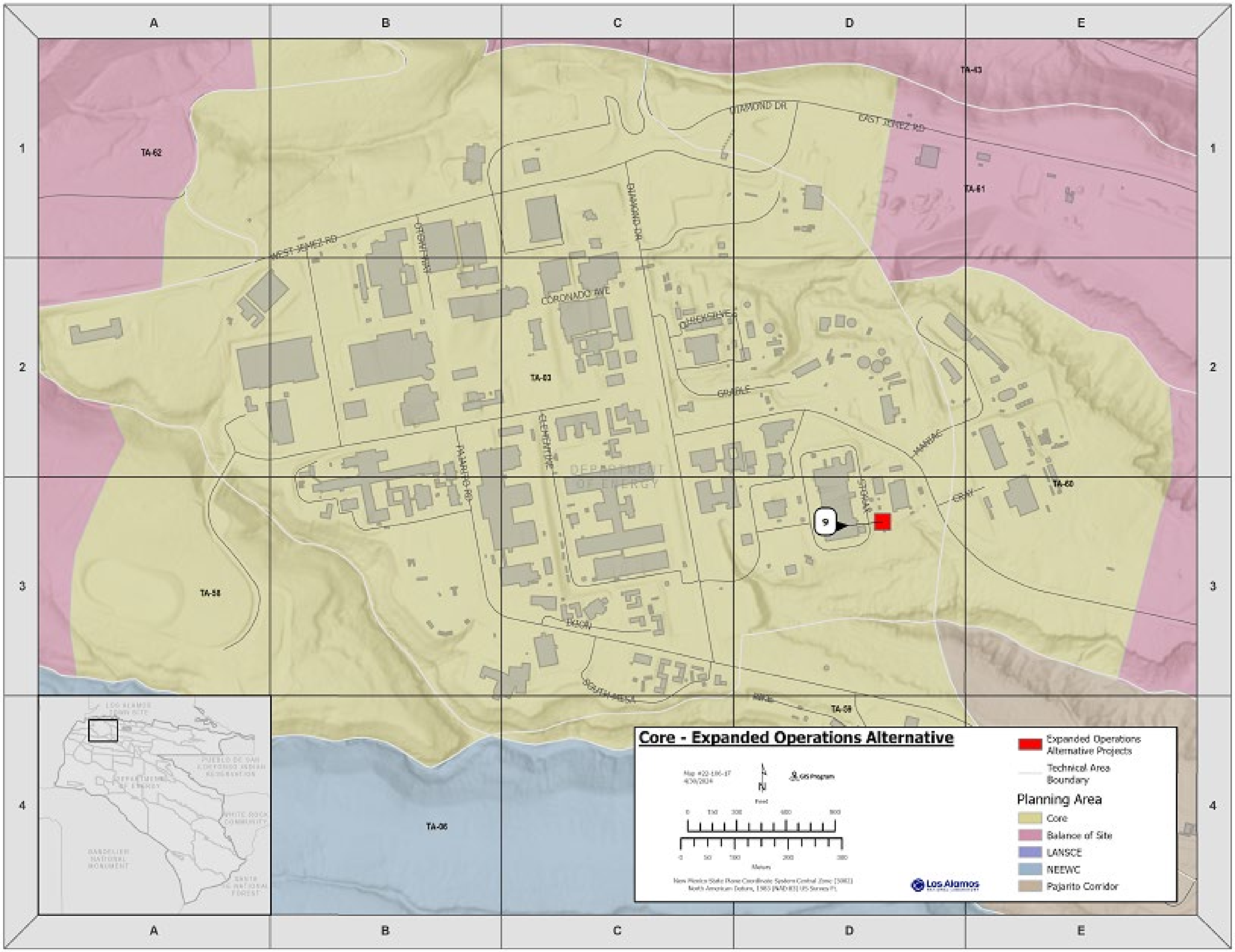


Figure A.3.4-2 Expanded Operations Alternative – Core Area Planning Area

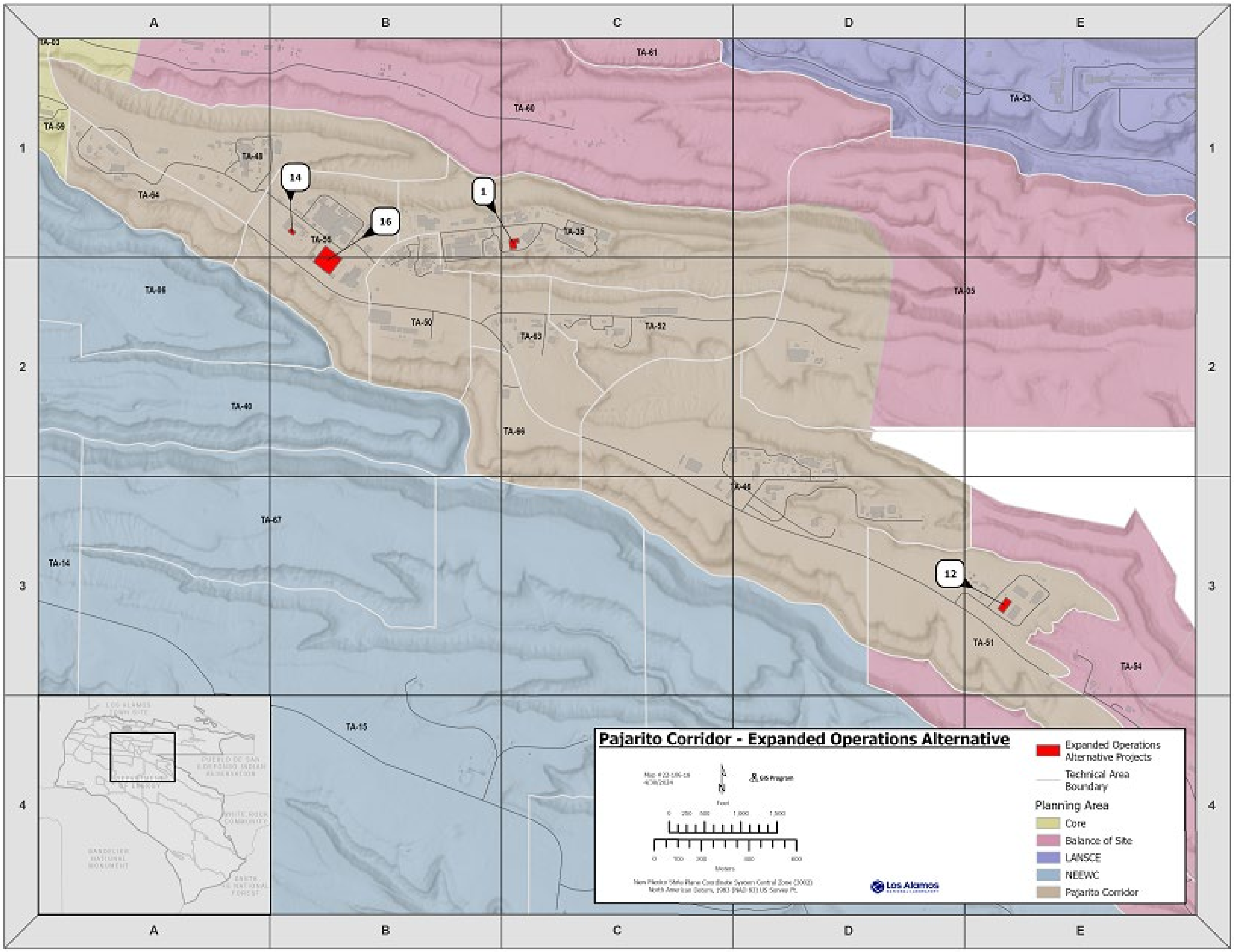


Figure A.3.4-3 Expanded Operations Alternative – Pajarito Corridor Planning Area

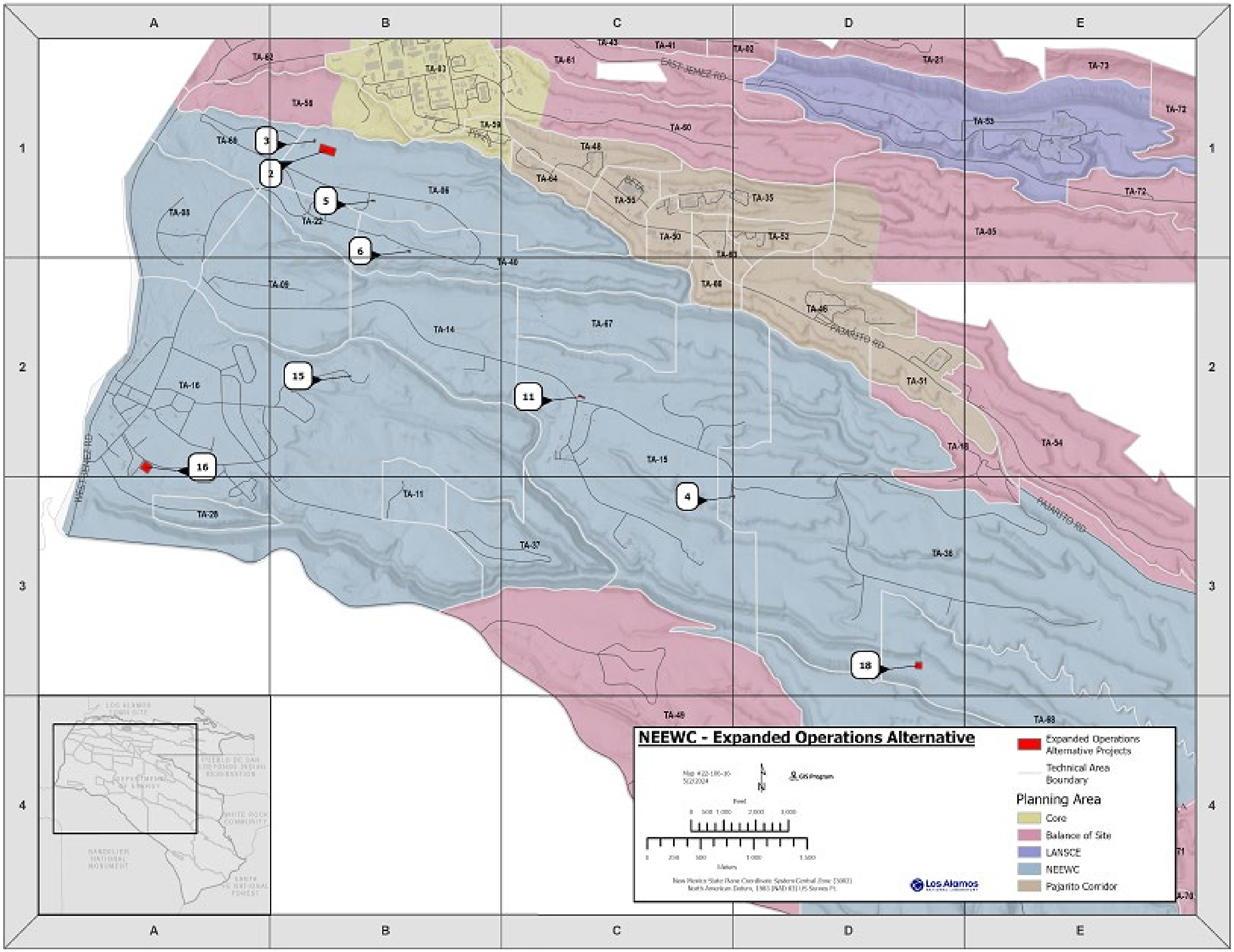


Figure A.3.4-4 Expanded Operations Alternative – NEEWC Planning Area

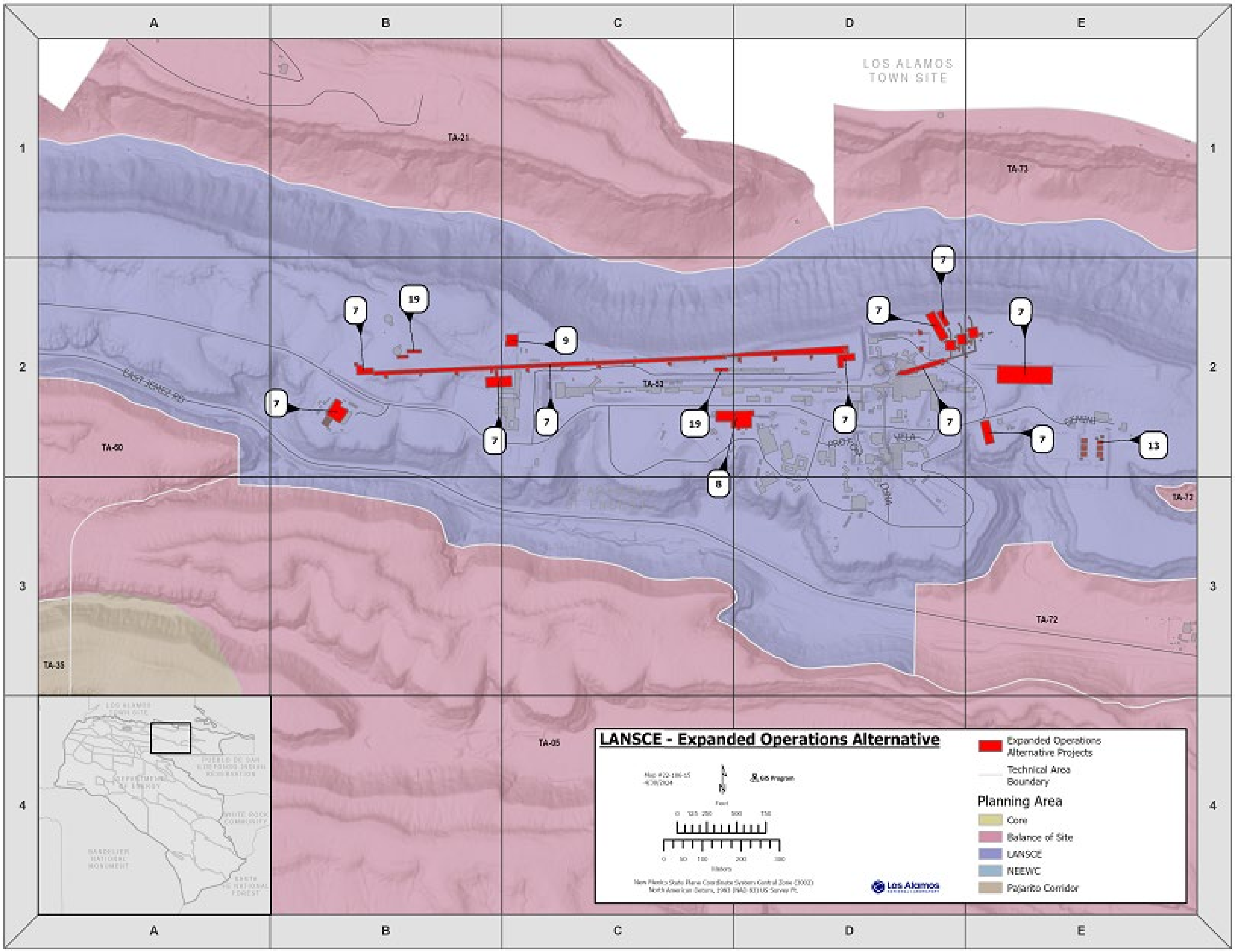


Figure A.3.4-5 Expanded Operations Alternative – LANSCE Planning Area

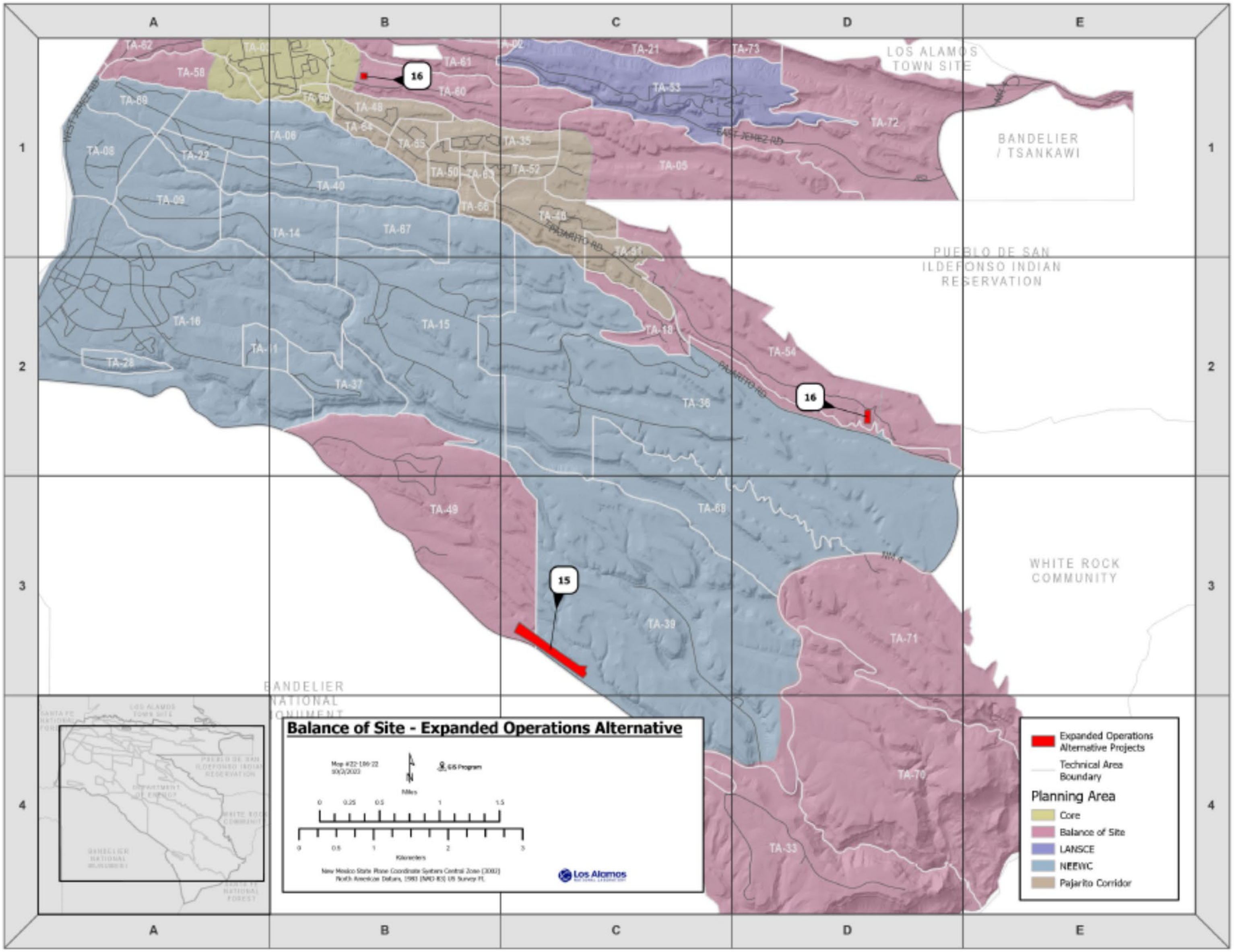


Figure A.3.4-6 Expanded Operations Alternative – Balance of Site Planning Area

Table A.3.5-1 Key Construction Parameters for the LANL SWEIS Alternatives

Resource	Baseline Data	No-Action Alternative (2023–2029)[a]	Modernized Operations Alternative (2024–2038)[b]	Expanded Operations Alternative (2024–2038)[c]
Land disturbance	LANL is approximately 25,536 acres in size; approximately 3,286 acres (13 percent) has been developed	• 250 acres total (34 acres for new facilities, 216 acres for utilities, infrastructure, and roads and parking) • Includes 84 acres of temporary construction areas • Includes disturbance of 62 acres that are currently undeveloped • average of 36 acres/year	• 1,007 acres total (79 acres for new facilities, 133 acres for utilities, infrastructure, roads and parking, and up to 795 acres of additional development for solar PV arrays[d]) • Includes disturbance of 731 acres that are currently undeveloped • average of 67 acres/year	• 1,142 acres total (100 acres for new facilities, 179 acres for utilities/ infrastructure/roads and parking, and up to 795 acres of additional development for solar PV arrays[d]) • Includes 68 acres of temporary construction areas • Includes disturbance of 806 acres that are currently undeveloped • average of 76 acres/year
Land restored by DD&D	Approximately 1,136,000 square feet of facilities (26 acres total, 1.8 acres/year) have undergone DD&D at LANL since completion of 2008 SWEIS (2008–2022)	37.4 acres total; average of 2.5 acres/year	27.9 acres total; average of 1.9 acres/year	27.9 acres total; average of 1.9 acres/year
Net land	Not applicable	• 129 acres developed (assumes DD&D land is reclaimed and temporary construction areas are restored) • Conversion of 62 acres to developed land	• 979 acres developed (assumes DD&D land is reclaimed) • Includes up to 795 acres of additional development for solar PV arrays[d] • Conversion of 731 acres to developed land	• 1,046 acres developed (assumes DD&D land is reclaimed and temporary construction areas are restored) • Includes up to 795 acres of additional development for solar PV arrays[d] • Conversion of 806 acres to developed land
Workforce for Construction and DD&D	Total LANL employment: 15,326 (2022)	650 construction workers/year; peak year: 1,300 construction workers	Average: 530 construction workers/year; peak year: 1,060 construction workers	Average: 710 construction workers/year; peak year: 1,420 construction workers

Resource	Baseline Data	No-Action Alternative (2023–2029)[a]	Modernized Operations Alternative (2024–2038)[b]	Expanded Operations Alternative (2024–2038)[c]
Fuel	525,130 gallons/year of petroleum and alternative fuels (annual average 2017–2021)	Fuel use for construction is included in the total site-wide fuel use during operations in Table A.3.5-2	Fuel use for construction is included in the total site-wide fuel use during operations in Table A.3.5-2	Fuel use for construction is included in the total site-wide fuel use during operations in Table A.3.5-2
Concrete	Not applicable	12,500 cubic yards/year (2023–2029)	13,400 cubic yards/year	18,200 cubic yards/year
Water use	266 million gallons/year (annual average 2017–2022)	Increase of 7 million gallons/year (2023–2029); 100,000 gallons/year (2030–2038)	Increase of 6.9 million gallons/year; increase of 13.8 million gallons during peak construction over the NAA	Increase of 8.2 million gallons/year; increase of 16.4 million gallons during peak construction over the NAA
Wastewater	303,400 gallons/day (based on average annual wastewater discharge 2017–2021)	Increase of 16,250 gallons/day; increase of 32,500 gallons/day during peak construction (based on 25 gallons/day per construction worker)	Increase of 13,250 gallons/day; increase of 26,500 gallons/day during peak construction (based on 25 gallons/day per construction worker) over the NAA	Increase of 17,750 gallons/day; increase of 35,500 gallons/day during peak construction (based on 25 gallons/day per construction worker) over the NAA

DD&D = Decontamination, Decommissioning, and Demolition; NAA = No-Action Alternative; PV = photovoltaic

a New facilities, roads, and parking for the No-Action Alternative are assumed to be completed by 2029. DD&D projects included in the No-Action Alternative are scheduled through 2038.

b Parameters presented for the Modernized Operations Alternative would be in addition to those presented for the No-Action Alternative.

c Parameters presented for the Expanded Operations Alternative include those presented for the Modernized Operations Alternative and would be in addition to the No-Action Alternative.

d There are nine options being considered for solar PV arrays that could develop up to795 acres. This SWEIS assumes that all options could be implemented.

Table A.3.5-2 Key Operational Parameters for the LANL SWEIS Alternatives

Resource	Baseline Data	No-Action Alternative (2023–2029)[a]	Modernized Operations Alternative (2024–2038)[b]	Expanded Operations Alternative (2024–2038)[c]
Land occupied by new projects after restoration of temporary construction areas	LANL is approximately 25,536 acres in size; approximately 3,286 acres (13 percent) has been developed	166 acres total	• 1,007 acres total • Includes up to 795 acres of additional development for solar PV arrays[d]	• 1,055 acres total • Includes up to 795 acres of additional development for solar PV arrays[d]
Land no longer occupied as a result of DD&D	Approximately 1,136,000 square feet of facilities (26 acres total, 1.8 acres/year) have undergone DD&D at LANL since completion of 2008 SWEIS (2008–2022)	37.4 acres total; average of 2.5 acres/year	27.9 acres total; average of 1.9 acres/year	27.9 acres total; average of 1.9 acres/year
Net change in land use	Not applicable	• 129 acres developed • 62 acres converted to developed land	• 979 acres developed • Includes up to 795 acres of additional development for solar PV arrays[d] • 731 acres converted to developed land	• 1,074 acres developed • Includes up to 795 acres of additional development for solar PV arrays[d] • 806 acres converted to developed land
Operational workforce	Total LANL employment: 15,326 (2022)	16,900 workers (increase of 1,574 workers over baseline)	17,680 workers (increase of 780 workers over NAA)	18,595 workers (increase of 1,695 workers over NAA)
Electricity	451 million kilowatt-hours/year (average consumption 2017–2022) 70.0 MW (annual peak demand)	• 621 million kilowatt-hours/year (average annual consumption) • 730 million kW-hr (peak year consumption) • 86.7 MW average annual peak demand • 111.4 MW highest annual peak demand	• 658 million kW-hr/year (average consumption) (including NAA) • 774 million kW-hr (peak year consumption) • 92 MW average annual peak demand • 132 MW highest annual peak demand	• 810 million kW-hr/year (average consumption) (including NAA) • 1,174 million kW-hr (peak year consumption) • 110 MW average annual peak demand • 171 MW highest annual peak demand

Resource	Baseline Data	No-Action Alternative (2023–2029)[a]	Modernized Operations Alternative (2024–2038)[b]	Expanded Operations Alternative (2024–2038)[c]
Natural gas usage	4,775 decatherms/day (based on 2021 usage after installation of CGTG)	4,155 decatherms/day (7-year annual average; 2023–2029)	3,913 decatherms/day (7-year annual average; 2025–2031) (including NAA)	3,913 decatherms/day (7-year annual average 2025–2031) (including NAA)
Fuel (oil, gasoline) usage	525,130 gallons/year of petroleum and alternative fuels (annual average 2017–2021)	Average – 426,000 gallons per year. Reduced to 350,000 gallons/year by 2038.	Average – 444,000 gallons per year. Reduced to 380,000 gallons/year by 2038 (including NAA)	Average – 483,000 gallons per year. Reduced to 447,000 gallons/year by 2038 (including NAA)
Water use	266 million gallons/year (annual average 2017–2022)	Increase to 290 million gallons/year	Increase to 300 million gallons/year (including NAA)	Increase to 495 million gallons/year (including NAA)
Wastewater	303,400 gallons/day (based on average annual wastewater discharge 2017–2021)	Increases to 371,400 gallons/day (68,000 over the 5-year average)	16,250 gallons/day over NAA	37,875 gallons/day over NAA
Radiological air emissions (Ci/year)	• Point source: 250 curies (187 Ci activation products, 63 curies tritium) • Non-point source: 66 curies Average annual emissions (2017–2022)	Total releases: 2,753 Ci/year • 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	150 Ci/year GMAP (in addition to NAA)	650 Ci/year in addition to the NAA • 650 Ci GMAP • 7.5×10^{-6} americium • 6.9×10^{-5} plutonium • 1.4×10^{-2} uranium
Radiation workers	2,819 (annual average 2017–2022); 4,444 in 2022	4,450 radiation workers	4,530 radiation workers (80 more than the NAA)	4,912 radiation workers (462 more than the NAA)
Average dose to radiation worker	92 mrem/year (average 2017–2022)	115 mrem/year	115 mrem/year	130 mrem/year
Waste Projections				
Hazardous waste	2,350 MT/year Annual average (2017–2022)	Routine operations • 2,962 MT/year Nonroutine operations • 27 MT/year	Routine operations • 149 MT/year Nonroutine operations • 20 MT/year	Routine operations • 303 MT/year Nonroutine operations • 20 MT/year

Resource	Baseline Data	No-Action Alternative (2023–2029)[a]	Modernized Operations Alternative (2024–2038)[b]	Expanded Operations Alternative (2024–2038)[c]
Nonhazardous solid waste	• Site-wide: 3,896 MT/year Annual average (2017–2022) (includes sanitary solid waste and C&D debris)	Routine operations (sanitary solid waste) • 1,895 MT/year Nonroutine operations (C&D debris) • 5,100 MT/year	Routine operations (sanitary solid waste) • 90 MT/year Nonroutine operations (C&D debris) • 4,300 MT/year	Routine operations (sanitary solid waste) • 190 MT/year Nonroutine operations (C&D debris) • 4,300 MT/year
New Mexico Special Waste	Annual Average 838 MT/year (2017-2022)	• 838 MT/year	• 2,478 MT/year	• 5,352 MT/year
LLW	• Triad: 3,054 m^3/year • N3B: 1,064 m3/year • Total: 4,118 m^3/year Annual average (2017–2022)	Routine operations • Triad: 3,879 m^3/year • N3B: 2,615 m^3/year • Total: 6,494 m^3/year Nonroutine operations • 3,260 m^3/year	Routine operations • Triad: 100 m^3/year • N3B: no additional waste • Total: 100 m^3/year Nonroutine operations • 826 m^3/year	Routine operations • Triad: 1,471 m^3/year • N3B: no additional waste • Total: 1,471 m^3/year Nonroutine operations • 826 m^3/year
MLLW	• Triad: 118 m^3/year • N3B: 389 m^3/year • Total: 507 m^3/year Annual average (2017–2022)	Routine operations • Triad: 122 m^3/year • N3B: 132 m^3/year • Total: 254 m^3/year Nonroutine operations • 26 m^3/year	Routine operations • Triad: 10 m^3/year • N3B: no additional waste • Total: 10 m^3/year Nonroutine operations • 6 m^3/year	Routine operations • Triad: 37 m^3/year • N3B: no additional waste • Total: 37 m^3/year Nonroutine operations • 6 m^3/year
TRU and mixed TRU wastes	• Triad: 267 m^3/year • N3B: 96 m^3/year • Total: 363 m^3/year Annual average (2017–2022)	Routine operations • Triad: 408 m^3/year • N3B: 233 m^3/year • Total: 641 m^3/year Nonroutine operations • 11 m^3/year	Routine operations • Triad: no additional waste • N3B: no additional waste • Total: no additional waste Nonroutine operations • 3.3 m^3/year	Routine operations • Triad: 15 m^3/year • N3B: no additional waste • Total: 15 m^3/year Nonroutine operations • 3.3 m^3/year
LLW shipments	325 annually of LLW Annual average (2017–2022)	Routine operations • Triad: 324 shipments/year • N3B: 176 shipments/year • Total: 500 shipments/year Nonroutine operations • 272 shipments/year	Routine operations • 9 shipments/year Nonroutine operations • 69 shipments/year	Routine operations • 123 shipments/year Nonroutine operations • 69 shipments/year

Resource	Baseline Data	No-Action Alternative (2023–2029)[a]	Modernized Operations Alternative (2024–2038)[b]	Expanded Operations Alternative (2024–2038)[c]
MLLW shipments	61 annually of MLLW Annual average (2017–2022)	Routine operations • Triad: 82 shipments/year • N3B: 19 shipments/year • Total: 101 shipments/year Nonroutine operations • 18 shipments/year	Routine operations • 7 shipments/year Nonroutine operations • 4 shipments/year	Routine operations • 25 shipments/year Nonroutine operations • 4 shipments/year
TRU waste shipments to WIPP	66 annually Annual average (2017–2022)	Routine operations • Triad: 120shipments/year • N3B: 65 shipments/peak year • Total: 185 shipments/year Nonroutine operations • 4 shipments/year	Routine operations • 0 shipment/year Nonroutine operations • 1 shipment/year	Routine operations • 5 shipments/year Nonroutine operations • 1 shipment/year

C&D = construction and demolition; CGTG = combustion gas turbine generator; ci = curies; DD&D = decontamination, decommissioning, and demolition; GMAP = gaseous mixed activation products; kW-hr = kilowatt-hour; LLW = low-level radioactive waste; m^3 = cubic meters; MFP = mixed fission products; MLLW = mixed low-level radioactive waste; MT = metric tons; MW = megawatt; NAA = No-Action Alternative; P/VAP = particulate/vapor activation products; PV = photovoltaic; TRU = transuranic

a New facilities, roads, and parking for the No-Action Alternative are assumed to be completed by 2029. DD&D projects included in the No-Action Alternative are scheduled through 2038.

b Parameters presented for the Modernized Operations Alternative would be in addition to those presented for the No-Action Alternative.

c Parameters presented for the Expanded Operations Alternative include those presented for the Modernized Operations Alternative and would be in addition to the No-Action Alternative.

d There are nine site options being considered for solar PV arrays that could develop up to795 acres. This SWEIS assumes that all options could be implemented.

A.4 Existing Environment – Supplemental Information

A.4.1 Introduction

This section is reserved.

A.4.2 Land Resources

This section is reserved.

A.4.3 Geology and Soils

This section provides supplemental supporting information related to Section 4.3.3.

Soil Monitoring Results

The regional statistical reference level for a chemical or radionuclide in soil is calculated using results from all the soil samples collected at regional background locations during the previous 10 years. The regional statistical reference level is the level below which precisely 99 percent of the results from regional background soil samples fall. Levels of constituents in soil and sediment are also compared with ecological screening levels for soil.

General observations from the 2021 institutional soil monitoring program are summarized as follows:

- The majority of radionuclides were below regional statistical reference levels, and all were below ecological screening levels.
- Uranium isotope concentrations varied among locations with onsite results having higher concentrations from both naturally occurring background and potential human-made sources.
- Most inorganic elements were detected and were below the regional statistical reference levels.
- Lead concentrations exceeded the regional statistical reference levels and the no-effect ecological screening levels at six locations and are similar to previous results.
- The majority of inorganic elements were not changing over time, and several elements had higher concentrations in soil samples collected from locations containing naturally occurring background constituents contained in the soil.
- The most toxic dioxin compound (tetrachlorodibenzodioxin-2,3,7,8) was only detected in one soil sample collected at TA-63 near the TWF, which exceeded the no-effect ecological screening level.
- Minor chemical constituents of PCBs were detected in the majority of soil samples, and all were below ecological screening levels.
- The majority of semi-VOCs were not detected.
- No VOCs were detected in soil samples.
- HEs were only detected in two samples on the LANL site; the Minie firing site on Three-Mile Mesa and the TA-16 burn grounds.
- The majority of PFAS chemicals were not detected in soil samples..

A.4.4 Water Resources

A.4.4.1 Surface Water

These subsections provide supporting information related to surface water within the ROI for LANL.

A.4.4.1.1 Stormwater Runoff

This section provides supplemental supporting information related to Section 4.4.1.3.

Multi-Sector General Permit

In effect since December 2000, the NPDES MSGP regulates stormwater runoff from the industrial activities and sites at LANL.

The MSGP for "Storm Water Discharges Associated with Industrial Activities" regulates stormwater discharges from specific industrial activities and their associated facilities. Industrial activities conducted at LANL covered under the MSGP include (LANL 2024b);

- metal and ceramic fabrication,
- wood product fabrication,
- hazardous waste treatment and storage,
- vehicle and equipment maintenance,
- recycling activities,
- electricity generation,
- warehousing activities, and
- asphalt manufacturing.

The MSGP has undergone several renewals since initial issue that have added requirements, such as an increased frequency of stormwater monitoring, increased stringency in monitoring benchmark values, a defined corrective action process for identified issues, and new documentation requirements. Active MSGP tracking numbers for LANL facilities are identified in Table A.4.4-1.

Table A.4.4-1 MSGP Tracking Numbers by Operator and Covered Industrial Activity

Permit Tracking No.	Industrial Activities Covered	Responsible Operator	Operator Role	Date Permit Coverage Began
NMR050011	Technical Area 54 Maintenance Facility West	N3B	EM Legacy Cleanup	June 2021
NMR050012	Technical Area 54 Areas G and L	N3B	EM Legacy Cleanup	June 2021
NMR050013	Metal fabrication, vehicle and equipment maintenance, recycling activities, electricity generation, warehousing activities, and asphalt manufacturing	Triad	NNSA Management and Operations and Management	June 2021

Source: LANL (2024b)

The EPA issues a permit tracking number to an operator to authorize stormwater discharge for a specific facility or group of sites at a facility that conducts industrial activities regulated under the General Permit. Because MSGP coverage, implementation, and compliance are now operator and facility specific, annual activities are reported separately for each operator.

The Laboratory's MSGP requires the implementation of stormwater control measures and BMPs, development of stormwater pollution prevention plans (SWPPPs), and monitoring of stormwater discharges from eight active permitted sites. Compliance with the requirements is achieved by (LANL 2024b):

- developing and implementing facility-specific SWPPPs;
- implementing corrective actions that are identified during inspections;
- monitoring stormwater runoff at facility samplers for benchmark parameters, impaired water constituents, and effluent limitations; and
- visually inspecting stormwater runoff to assess color; odor; floating, settled, or suspended solids; foam; oil sheen; and other indicators of stormwater pollution.

Stormwater monitoring, as required by the MSGP, occurs annually January 1–December 31. Under the current permit, the benchmark values for some pollutants are the same as New Mexico water quality standards. As such, some pollutant limits are significantly more stringent now than under previous permits, and exceedances of permit limits occur more frequently. Some of these permit limit exceedances could be caused by natural background conditions. Any exceedance triggers corrective action, which includes evaluation of potential sources and either follow-up action or documentation to explain why no action is required.

Individual Permit

The NPDES Individual Permit for "Storm Water Discharges (Individual Permit)" authorizes discharges of stormwater from certain stormwater management units (SWMUs) and areas of concern (hereinafter site monitoring areas [SMAs]) at the Laboratory.

Since the issuance of the 2008 LANL SWEIS, LANL received a new Individual Storm Water Permit (NPDES Permit No. NM0030759) (LANL 2022a). The Individual Permit lists 397 permitted SMAs that are managed to prevent the transport of constituents to surface waters via stormwater runoff. The permit establishes target action levels that are equivalent to NMED water quality criteria. These target action levels are used as benchmarks to determine the effectiveness of control measures implemented under the permit. If one or more confirmation monitoring result exceeds a target action level, LANL must take corrective action. More than 70 corrective action controls (e.g., earthen berms, run-on diversion, and drop inlets) have been installed at Individual Permit SMAs, including controls to address the September 2013 flood event, which led to significant increases in runoff from the surrounding landscape adjacent to LANL. Confirmation sampling results consistently show aluminum, copper, zinc, and PCBs very close to background concentrations (NNSA 2018a).

Construction General Permit

At the time of the 2008 LANL SWEIS, the Construction General Permit (CGP) program required all LANL construction activities and projects that disturb 1 acre or more of land to be permitted. These permits required development and implementation of a site-specific SWPPP and the use of BMPs to reduce or eliminate the potential for offsite erosion and sediment and/or constituent transport off site.

The CGP has undergone two renewals since initial issue that have added new requirements for construction sites 1 acre or more in size to protect stormwater quality, an increased frequency of site inspections, reduced timeframes for completion of required maintenance activities, and more restrictive BMPs and corrective actions. Per the CGP requirements, these sites are required to manage runoff velocities to pre-development conditions. The Laboratory installed site features, such as stormwater detention ponds, to manage the increased volumes, control runoff velocity, and mitigate downstream impacts. Compliance with approved SWPPPs during construction has prevented impacts to surface water from associated erosion (NNSA 2018a).

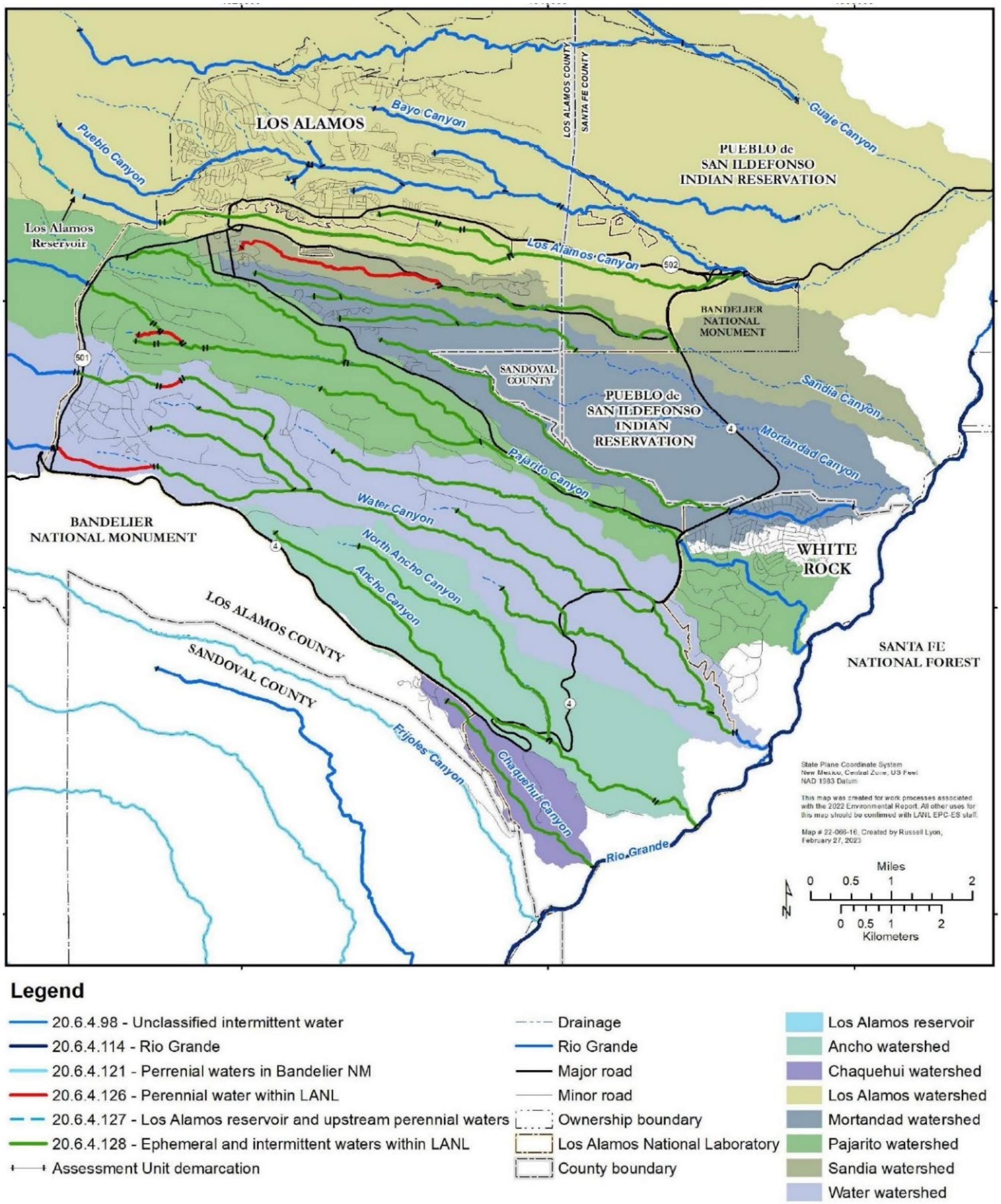
Compliance with the CGP includes developing and implementing a SWPPP before soil disturbance may begin and conducting site inspections once soil disturbance has commenced. A stormwater pollution prevention plan should describe (LANL 2024b):

- project activities and potential pollutants,
- site conditions,
- BMPs (sediment and erosion control measures), and
- permanent control measures required to minimize the discharge of pollutants from the site.

A.4.4.1.2 Watercourse Protection

This section provides details associated with engineering controls installed for watercourse protection to supplement the information provided in Section 4.4.1.4. Figure A.4.4-1 shows the locations of watercourse protection controls.

- Los Alamos SMA 2 detention basins were built in the bottom of Los Alamos Canyon between 2010 and 2015. Prior to construction of the basins, two remediation projects involving removal of PCB-contaminated soils were completed on the hillslope. In total, three detention basins were designed as a series with connecting spillways to contain contaminated sediment and minimize transport downstream. A pipeline was built in 2015 to divert stormwater runoff past the hillslope site, minimizing the amount of water traveling over the area. The detention basins have been effective in containing contaminated sediment and minimizing transport downstream.
- DP Canyon grade-control structure was completed in 2010 to mitigate contaminated sediment transport in Los Alamos and Pueblo canyons. The grade-control structure was designed to increase sediment deposition and stabilize the ground surface upstream of the structure, which decreases erosion of stream banks below the structure. Data from gauging stations has shown that the structure has significantly reduced the sediment load transported downstream.
- Los Alamos weir and three associated detention basins were built near the eastern LANL boundary in Los Alamos Canyon in 2001, following the 2000 Cerro Grande fire, to help prevent contaminated sediment from being transported farther downstream. The sediment detention basins are upstream of the Los Alamos weir to reduce stream flow, allowing more sediment to settle out of stormwater runoff. Sediment is excavated from the basins once a sufficient amount has accumulated. Since their construction, the Los Alamos weir and the detention basins have reduced the rate of streamflow and the amount of sediment transported downstream.



Source: LANL (2024b)

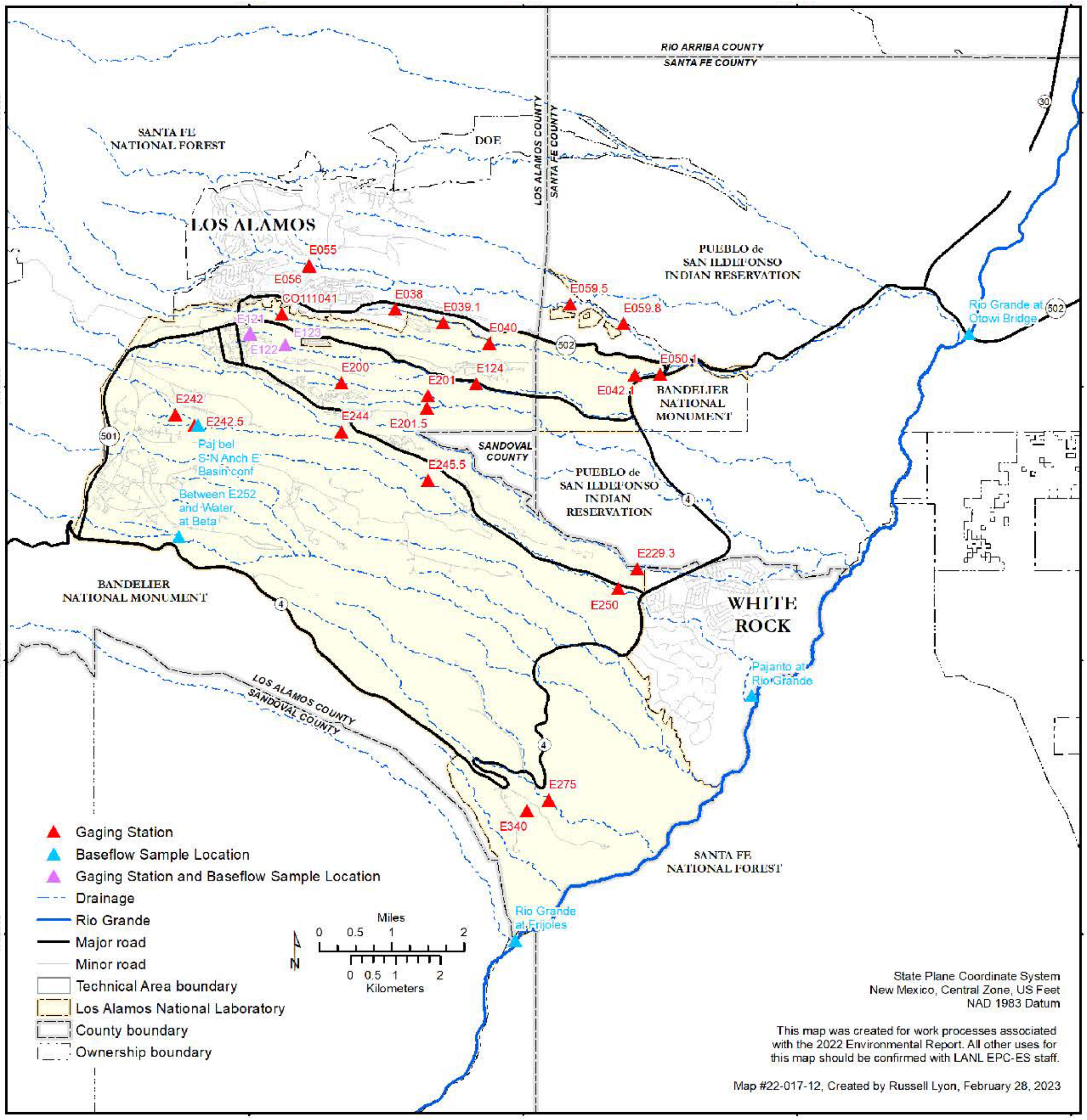
Figure A.4.4-1 Watershed Control Measures at the Laboratory in the Pueblo, Los Alamos, Sandia, and Mortandad Canyons

- The Lower Pueblo Canyon grade-control structure was completed in 2010 to mitigate the transport of contaminated sediments. The grade-control structure was designed to promote sediment deposition upstream of the structure, which controls the grade of the channel and provides stability to a headcut (an abrupt vertical drop in a stream channel associated with erosion and channel incision) that formed in the stream channel after a large storm event in 2008. In addition to stabilizing the area, the structure also promotes expansion of the wetland area above it. Along with the other controls upstream, stream flow in Pueblo Canyon has been effectively slowed by the Lower Pueblo Canyon grade-control structure, and sediment transport has been reduced.
- The Middle Pueblo Canyon grade-control structure (also referred to as the Pueblo Canyon drop structure) was completed in 2015. A large flood event in September 2013 caused significant erosion that widened an existing headcut that had initially formed following the 2000 Cerro Grande fire. The three-tiered structure was designed to arrest headcutting, stabilize banks, and prevent the migration of sediment-containing chemicals or radionuclides from historic Laboratory activities. The structure has been effective in stabilizing the banks and channel and has contributed to decreasing the rate of stream flow within the canyon.
- The Sandia Wetland grade-control structure was completed in 2013. The purpose of this structure was to stop a large headcut and maintain favorable wetland conditions that help minimize movement of contaminated sediment downstream.
- The Mortandad sediment traps are located within the stream channel of Mortandad Canyon downstream of its confluence with Ten-Site Canyon. These “traps” are sediment detention basins. Two traps were constructed in 1976, and the third was built in 1980. Since then, the Mortandad sediment traps have been re-excavated when sediment filled the basins, usually due to large storms or increased runoff and erosion following wildfires. Major improvements were made in 2014 after a large flood in September 2013 caused significant damage to the traps. The traps were excavated and the material was moved upstream to help stabilize new berms, which serve to reduce the rate of runoff and sediment transport during storm events. The Ten-Site Canyon sediment trap was constructed during the 2014 improvements; it is located just upstream of the confluence of the Mortandad and Ten-Site canyons (LANL 2022h).

A.4.4.1.3 Watershed and Sediment Monitoring

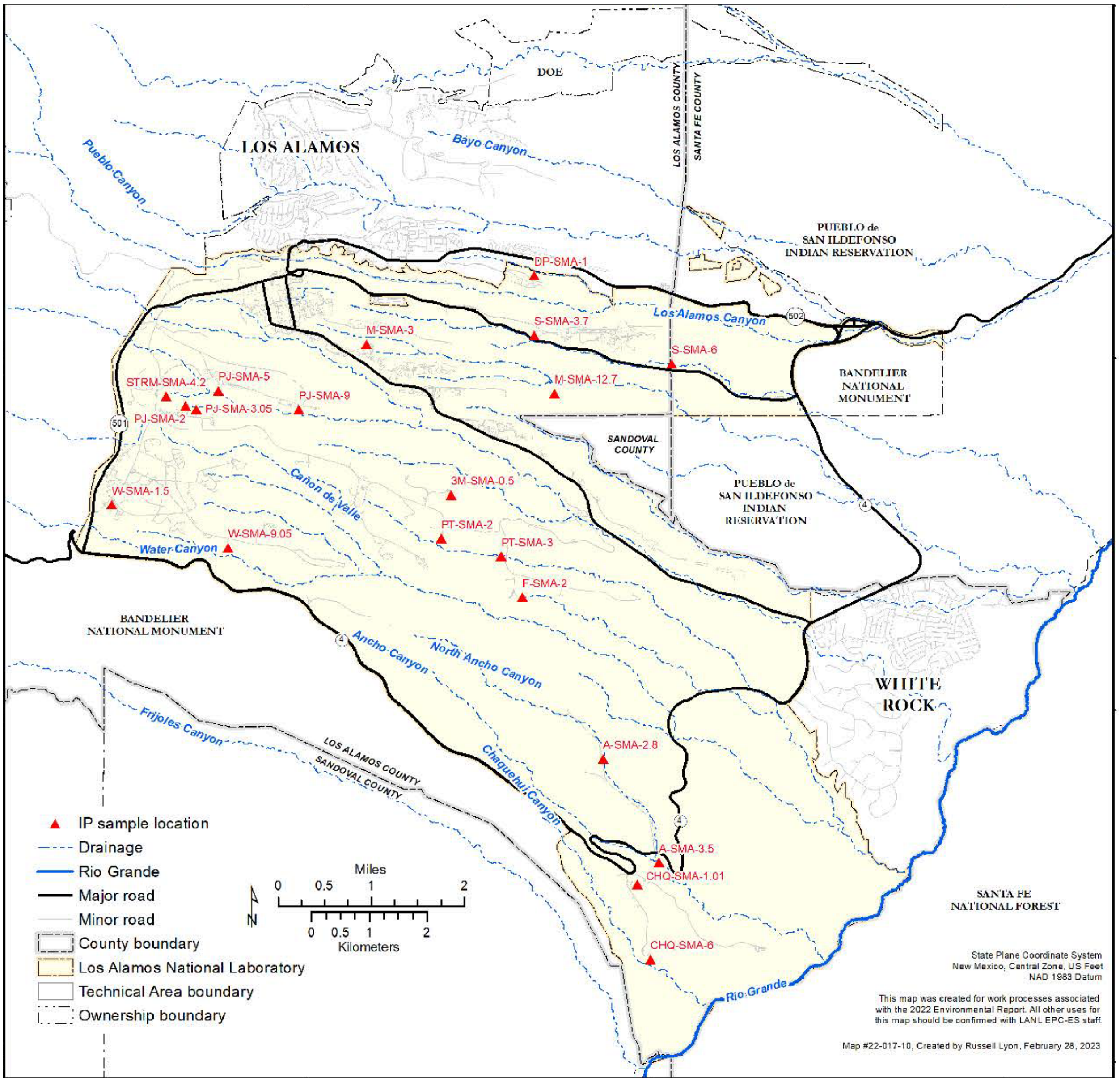
To support Section 4.4.1.5, the following subsections provide information related to surface water monitoring and recent sampling efforts and constituents identified to occur from either background sources or Laboratory operations.

The Laboratory maintains 38 stream gauging stations on and near LANL, 36 of which are equipped with automated samplers that activate at the start of stormwater runoff events. Stormwater samples are also collected at eight additional stream channel locations that do not have active gauging stations. To meet monitoring requirements under the Individual Permit, the Laboratory installed samplers in 239 SMAs to sample stormwater runoff directly from 397 SMAs. Water discharged from springs is a type of base flow (the portion of stream flow that is not runoff). LANL collects grab samples of surface water below springs that discharge groundwater at locations. During 2022, stormwater runoff was collected from all watersheds where stormwater was present. Sample locations are shown on Figures A.4.4-2 and A.4.4-3. In 2022, the Laboratory collected stormwater from 25 locations, base flow samples from 8 locations, and 21 samples from 20 Individual Permit SMAs (LANL 2024b). Stormwater or base flow exceedances are summarized in Table A.4.4-2.



Source: LANL (2024b)

Figure A.4.4-2 Stormwater Sampling Locations for Stream Channel and Base Flow, 2022



Source: LANL (2024b)

Figure A.4.4-3 Stormwater Sampling Locations for Individual Permit Site Monitoring Areas, 2022

Table A.4.4-2 Stormwater or Base Flow Exceedances of New Mexico Water Quality Standards, 2022[a,b]

Chemical or Radioactive Constituent	Irrigation and Irrigation Storage	Livestock Watering	Wildlife Habitat	Acute Aquatic Life	Chronic Aquatic Life	Human Health–Organism Only
Total Aluminum	–	–	–	27 (93%)	12 (41%)	–
Dissolved Copper	0	0	–	13 (45%)	8 (28%)	–
Total Iron	–	–	–	–	12 (41%)	–
Dissolved Lead	0	0	–	0	8 (28%)	–
Total Mercury	–	0	4 (14%)	–	–	–
Total Selenium	–	–	13 (45%)	5 (17%)	3 (10%)	–
Dissolved Silver	–	–	–	1 (3%)	–	–
Dissolved Zinc	0	0	–	3 (10%)	3 (10%)	0
Gross alpha	–	20 (67%)	–	–	–	–
Total PCB	–	–	19 (79%)	2 (8%)	6 (25%)	23 (96%)
Dioxin	–	–	–	–	–	18 (67%)
Benzo(a)anthracene	–	–	–	–	–	1 (13%)
Benzo(a)pyrene	–	–	–	–	–	1 (13%)
Benzo(b)fluoranthene	–	–	–	–	–	1 (13%)
Benzo(k)fluoranthene	–	–	–	–	–	1 (13%)
Dibenzo(a,h)anthracene	–	–	–	–	–	2 (25%)
Indeno(1,2,3-cd)pyrene	–	–	–	–	–	2 (25%)

PCB = polychlorinated biphenyls

a A dash indicates there is no standard for a given chemical or radionuclide in this category.

b The percentage in parentheses represents the percent of locations that have an exceedance for that analyte.

c The dioxin criteria apply to the sum of the dioxin toxicity equivalents expressed as tetrachlorodibenzo-p-dioxin (2,3,7,8-).

Source: LANL (2024b)

LANL collects sediment samples at a depth between 0 and 6 inches, depending on the thickness of the uppermost sediment layer, from stream channels and floodplains where new sediment is deposited annually. For streams with flowing water, sediment samples are collected near the edge of the main channel adjacent to, but not in, the water. In 2022, there were minimal exceedances of screening levels for sediment samples collected. Out of 97 sediment samples collected, only 10 had exceedances, which included chromium, manganese, PCB-126, and PCB-170 (Table A.4.4-3). All radionuclide concentrations in sediment samples collected in 2022 were below screening action levels and the DOE biota concentration guides, so there were no exceedances to report (LANL 2024b).

Table A.4.4-3 2022 Exceedances for Sediment Sampling Results[a,b]

Canyon	Stream Reach	Location ID	Chemical	Result (mg/kg)	Residential Soil Cancer Screening Level (mg/kg)	Residential Soil Noncancer Screening Level (mg/kg)	Industrial Soil Cancer Screening Level (mg/kg)	Industrial Soil Noncancer Screening Level (mg/kg)	Construction Worker Soil Cancer Screening Level (mg/kg)	Construction Worker Soil Noncancer Screening Level (mg/kg)
Ancho	ANCHO @ RG	AN-61358	Manganese	520	–	10548	–	160183	–	464
Chaquehui	CHQ @ RG	CH-61334	Manganese	513	–	10548	–	160183	–	464
Cañon de Valle	CDV-2E	CV-61551	PCB-170	0.401	0.374589	0.397719	1.76580	5.73889	13.1184	1.71780
Pajarito	PA-4	PA-61576	Manganese	948	–	10548	–	160183	–	464
		PA-61577	Manganese	802	–	10548	–	160183	–	464
Potrillo	PO-4	PO-61509	Manganese	484	–	10548	–	160183	–	464
Sandia	S-2	SA-61654	Chromium	300	97	45183	505	313931	468	134
			Manganese	1040	–	10548	–	160183	–	464
			PCB-126	0.000461	0.000375	0.000398	0.001719	0.005739	0.013118	0.001718
		SA-61655	Manganese	1180	–	10548	–	160183	–	464
	S-6W	SA-61661	Manganese	701	–	10548	–	160183	–	464
Water	WA-4	WA-61565	Manganese	476	–	10548	–	160183	–	464

mg/kg = milligram per kilogram; PA = planning area; RG = Rio Grande

a A dash indicates that there is no screening level for a given chemical.

b Gray highlighting indicates a particular soil screening level exceeded by a given chemical.

Source: LANL (2024b)

Stormwater and base flow results from 2022 fall within the ranges observed between 2011 and 2021.

Sediment data are compared with soil screening levels to determine if the following conceptual model is still accurate. The process of sediment transport by stormwater runoff observed in LANL canyons generally results in the same or lower levels of LANL-released substances in new sediment deposits than previously existed in a given reach. Through the monitoring program, the Laboratory is able to track the movement and concentration of contaminants over time and take appropriate action to mitigate or slow transport where needed. The comparison of 2022 and historic data with soil screening levels verify this conceptual model and support the idea that the risk assessments presented in the canyons' investigation reports represent an upper bound of potential human health risks in the canyons. Although some chemical concentrations in stormwater, base flow, and sediment were above screening levels in 2022, these transient events do not significantly affect human or biota health (LANL 2024b).

Some chemicals and radionuclides detected during surface water (stormwater and base flow) sampling at LANL may come from both naturally occurring sources and human-derived sources. Others are known to have been released during historical Laboratory operations. The following section provides details of the recent sampling of constituents related to background sources and laboratory operations.

Constituents Related to Background Sources

Some chemicals and radionuclides detected during surface water (stormwater and base flow) sampling at LANL may come from both naturally occurring sources and human-derived sources. This includes aluminum, arsenic, copper, iron, lead, manganese, selenium, zinc, gross alpha, and radium-226/228, as described below (LANL 2024b).

- **Aluminum –** Stormwater samples collected on the Pajarito Plateau within LANL boundaries in 2022 commonly contained aluminum concentrations above NMED water quality standards. However, most or all of this aluminum is likely naturally occurring. Aluminum is a natural component of soil and Bandelier Tuff and is not known to be derived from LANL operations in any significant quantity. The NMED Surface Water Quality Bureau has stated that "the large number of exceedances" for aluminum in surface water on the Pajarito Plateau "may reflect natural sources associated with the geology of the region" (LANL 2022f). In 2022, total aluminum concentrations in stormwater exceeded the acute aquatic life standard at 27 sampling locations (93 percent of locations) and the chronic aquatic life standard at 12 sampling locations (41 percent of locations). There were five exceedances of the target action level for dissolved aluminum concentrations in 15 Individual Permit-related runoff samples collected in 2022 that were analyzed for aluminum. Sixteen of the 42 assessment units, or stream reaches, on LANL or former LANL lands are listed as impaired for aluminum. In 2022, no sediment samples exceeded soil screening levels for aluminum. Stormwater and sediment results in 2022 for aluminum were similar to those measured in recent years.
- **Arsenic –** Arsenic has both natural and human-derived sources. Coal-fired power plants emit gaseous arsenic. While the Four Corners Generating Station coal-fired power plant (near Fruitland, New Mexico, about 135 miles from LANL) has contributed to arsenic contamination, LANL also historically operated coal-fired power plants (LANL 2022f). Arsenic is also found naturally in the local volcanic rocks. In 2022, none of the filtered

gauging station stormwater or base flow results exceeded the surface water quality standards for arsenic. The 13 Individual Permit-related samples from 2022 that were analyzed for arsenic did not exceed the target action level. None of the 42 assessment units, or stream reaches, on LANL or former LANL lands is listed as impaired for arsenic. In 2021, one sediment sample from Pajarito Canyon exceeded soil screening levels for arsenic. Stormwater and sediment results in 2022 for arsenic were similar to those measured in recent years.

- **Copper –** Copper is naturally occurring and is also associated with explosives firing sites, forest fires, and developed areas, such as buildings and parking lots. Copper sources in developed landscapes include brake pad abrasion and building materials, such as flashing, plumbing pipes, and electrical components. In 2022, copper concentrations in filtered stormwater and base flow samples were detected above the acute aquatic life standard at 13 sampling locations (45 percent of locations) and above the chronic aquatic life standard at eight sampling locations (28 percent of locations). Historically, every watershed across LANL has recorded elevated copper concentrations in stormwater at some time, including all of the LANL's upstream boundary gauging stations. Fifteen of the 42 assessment units, or stream reaches, on LANL or former LANL lands are listed as impaired for copper. In 2022, 16 out of 21 Individual Permit-related runoff samples that were analyzed for copper exceeded the target action level. Concentrations measured in 2022 were similar to those measured in previous years. In 2022, no sediment samples exceeded soil screening levels for copper.
- **Iron –** Iron is naturally occurring, and it is also associated with explosives firing sites. The water quality standard for total iron became effective in 2022. Iron concentrations in stormwater and base flow in 2022 were detected above the chronic aquatic life standard at 12 sampling locations (41 percent of locations). None of the 42 assessment units on Laboratory or former Laboratory lands are listed as impaired for iron. Concentrations measured in 2022 were similar to those measured in previous years. In 2022, no sediment samples exceeded soil screening levels for iron.
- **Lead –** Lead is associated with developed areas, such as buildings and parking lots. The major lead sources in developed landscapes are lead-based paints, building sidings, and the operation of automobiles. Lead concentrations in filtered stormwater and base flow in 2022 were detected above the chronic aquatic life standard at eight sampling locations (28 percent of locations). None of the 42 assessment units, or stream reaches, on LANL or former LANL lands is listed as impaired for lead. In 2022, 1 out of 14 Individual Permit-related runoff samples that were analyzed for lead exceeded the target action level. In 2022, no sediment samples exceeded soil screening levels for lead. Stormwater and sediment results in 2022 for lead were similar to those measured in recent years.
- **Manganese –** Manganese is naturally occurring on the Pajarito Plateau. Laboratory operations have not generated or released significant quantities of manganese. Dissolved manganese concentrations were elevated following the Cerro Grande fire in 2000 and then decreased quickly in subsequent years. No manganese exceedances occurred in stormwater and base flow in 2022, and no target action level exists for manganese for Storm Water Individual Permit samples. None of the 42 assessment units, or stream reaches, on LANL or former LANL lands is listed as impaired for manganese. In 2022, manganese concentrations in sediment exceeded the construction worker noncancer soil screening

level in nine samples. Stormwater and sediment results in 2022 for manganese were similar to those measured in recent years.

- **Selenium –** Selenium is naturally occurring on the Pajarito Plateau. Laboratory operations have not generated or released significant quantities of selenium. Total selenium concentrations were elevated following the Cerro Grande fire in 2000 and then decreased quickly in subsequent years. In 2022, total selenium concentrations in stormwater and base flow were detected above the wildlife habitat standard at 13 sampling locations (45 percent of locations), above the acute aquatic life standard at five sampling locations (17 percent of locations), and above the chronic aquatic life standard at three sampling location (10 percent of locations). Three of the 42 assessment units, or stream reaches, on LANL or former LANL lands are listed as impaired for selenium. In 2022, three out of 13 Individual Permit-related runoff samples that were analyzed for selenium exceeded the target action level. In 2022, no sediment samples exceeded soil screening levels for selenium. Stormwater and sediment results in 2022 for selenium were similar to those measured in recent years.
- **Zinc –** While naturally occurring, zinc can also be associated with developed areas. Zinc sources include automobile tires, galvanized materials, motor oil, and hydraulic fluid. In 2022, filtered zinc concentrations in stormwater and base flow samples were detected above the acute aquatic life standard at three sampling locations (10 percent of locations) and above the chronic aquatic life standard at three sampling locations (10 percent). None of the 42 assessment units, or stream reaches, on LANL or former LANL lands is listed as impaired for zinc. In 2022, three of 13 Storm Water Individual Permit compliance samples that were analyzed for zinc exceeded the target action level. In 2022, no sediment samples exceeded soil screening levels for zinc. Stormwater and sediment results in 2022 for zinc were similar to those measured in recent years.
- **Gross Alpha –** The gross alpha activity is the sum of the radioactivity from alpha particle emissions from radioactive materials. Alpha particles are released by many naturally occurring radionuclides, such as isotopes of radium, thorium, and uranium, and their decay products. In 2022, 20 sampling locations (67 percent of locations) had gross alpha activities above the livestock watering standard. In 2011, 2012, and 2013, the highest gross alpha activities in stormwater were measured in samples containing ash and sediment from the 2011 Las Conchas fire. Gross alpha activities were also particularly high in runoff samples from the large September 2013 flood event. For sampling under the Individual Permit in 2022, gross alpha activity was above the target action level in 12 out of 18 samples collected that were analyzed for gross alpha. Twenty-seven of the 42 assessment units, or stream reaches, on LANL or former LANL lands are listed as impaired for gross alpha radioactivity. However, the analytical results from 2022 support earlier conclusions that the majority of the alpha radioactivity in stormwater on the Pajarito Plateau is from the decay of naturally occurring isotopes in sediment.
- **Radium-226/228 –** The 13 Storm Water Individual Permit compliance samples from 2022 that were analyzed for radium-226 and radium-228 did not exceed the target action level. One of the 42 assessment units, or stream reaches, on LANL or former LANL lands is listed as impaired for radium. The analytical results from 2022 support earlier conclusions that the majority of the radium-226 and radium-228 found in stormwater on the Pajarito Plateau is from the decay of naturally occurring isotopes in sediment and soil.

<u>**Constituents Related to Los Alamos National Laboratory Operations**</u>

Several constituents were measured in stormwater and sediment that were known to be released during historical Laboratory operations. This includes, chromium, dioxins and furans, mercury, PCBs, polycyclic aromatic hydrocarbons, and silver in surface water and base flow samples, as described below (LANL 2024b).

- **Chromium –** Chromium is associated with potassium dichromate that was used as a corrosion inhibitor in the cooling system at the TA-3 power plant and was discharged through Outfall 001 from 1956 to 1972. Filtered stormwater and base flow results did not exceed surface water quality standards in 2022 for total chromium or hexavalent chromium. There were no exceedances of the target action levels for filtered chromium concentrations in the 13 Individual Permit-related runoff samples in 2022 that were analyzed for chromium. None of the 42 assessment units, or stream reaches, on LANL or former LANL lands is listed as impaired for chromium. In 2022, one sediment samples exceeded both the residential cancer and the construction worker noncancer soil screening levels for chromium. These samples were from Sandia Canyon, where chromium was known to have been released. Stormwater and sediment results in 2022 for chromium were similar to those measured in recent years. Groundwater monitoring and remediation activities for hexavalent chromium in the Sandia and Mortandad canyons are currently in progress (*see* Chapter 4, Section 4.4.2.2).
- **Dioxins and furans –** Dioxins and furans are associated with the incineration of medical, industrial, municipal, and private wastes; municipal wastewater treatment sludge; coal-fired boilers; and diesel fuel emissions. Forest fires are also a major, natural source of dioxins. In 2022, dioxin concentrations in stormwater and base flow samples exceeded the human health–organism-only standard at 18 sampling locations (67 percent of locations). None of the 42 assessment units, or stream reaches, on LANL or former LANL lands is listed as impaired for dioxins or furans. Dioxin exceedances were in watersheds of the Sandia and Mortandad canyons. In 2022, no sediment samples exceeded soil screening levels for dioxins or furans. Dioxin concentrations for stormwater and sediment have been of similar range since 2011.
- **Mercury –** Natural sources of mercury include forest fires and fossil fuels such as coal and petroleum. Human activities such as mining and fossil fuel combustion have led to widespread global mercury pollution. While the Four Corners Generating Station coal-fired power plant (near Fruitland, New Mexico, about 135 miles from LANL) has contributed to mercury contamination in the surrounding areas, LANL has historically operated coal-fired power plants (LANL 2022f). In 2022, total mercury concentrations in stormwater and base flow were detected above the wildlife habitat standard at four sampling locations (14 percent of locations). In 2022, there were two exceedances of the target action levels for total mercury concentrations in the 13 Individual Permit-related runoff samples in 2022 that were analyzed for mercury. Six of the 42 assessment units, or stream reaches, on LANL or former LANL lands are listed as impaired for mercury. In 2022, no sediment samples exceeded soil screening levels for mercury. Stormwater and sediment results in 2022 for mercury were similar to those measured in recent years.
- **Polychlorinated biphenyls –** PCBs are stable, persistent organic compounds that break down slowly in the environment. PCBs are associated with materials used historically by LANL including transformers; oils, solvents, and paints used in industrial activities; and a

former asphalt batch plant in Sandia Canyon. In 2022, 23 sampling locations (96 percent of locations) had PCB concentrations above the human health–organism-only standard, two sampling locations (8 percent of locations) had concentrations above the acute aquatic life standard, six sampling locations (25 percent of locations) had concentrations above the chronic aquatic life standard, and 19 sampling locations (79 percent of locations) had concentrations above the wildlife standard. For sampling under the Individual Permit in 2022, PCB concentrations were above the target action level in four out of six samples collected that were analyzed for PCBs. Thirty-one of the 42 assessment units on Laboratory or former Laboratory lands are listed as impaired for PCBs. In 2022, a sediment sample from Cañon de Valle exceeded the residential soil cancer and residential soil noncancer screening levels for PCB-170. A sediment sample from Sandia Canyon exceeded the residential soil cancer and residential soil noncancer screening level for PCB-126. Total PCB concentrations in stormwater in Sandia Canyon tended to be higher in 2022 and 2021 than in recent years, although still within range of what has been observed. LANL will continue to monitor Sandia Canyon to detect any upward trends.

- P**olycyclic aromatic hydrocarbons –** Asphalt is prepared using petroleum products that contain polycyclic aromatic hydrocarbons, and operations at the former asphalt batch plant in Sandia Canyon released effluent from operations to the stream. In 2022, one sampling locations (13 percent of locations) exceeded the human health–organism-only standard for 4 of the 19 polycyclic aromatic hydrocarbons with water quality standards (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and benzo(k)fluoranthene). Two locations (25 percent of locations) exceeded the human health–organism-only standard for dibenzo(a,h)anthracene and indeno(1,2,3-cd)pyrene. There were no Individual Permit-related exceedances in 2022. None of the 42 assessment units, or stream reaches, on LANL or former LANL lands is listed as impaired for polycyclic aromatic hydrocarbons. In 2022 no sediment samples exceeded screening levels for polycyclic aromatic hydrocarbons. Historically, polycyclic aromatic hydrocarbons in stormwater and sediment exceeded applicable standards in 2016 and 2021.
- **Silver –** Silver is associated with historical LANL activities in Pajarito Canyon and Cañon de Valle. Of 14 compliance samples in 2022, no Storm Water Individual Permit-related exceedances occurred of silver. Of the 42 assessment units on Laboratory or former Laboratory lands, one unit is listed as impaired for silver. In 2022, no sediment results exceeded soil screening levels for silver.
- **Thallium –** Gaseous emissions from cement factories and coal-fired power plants have led to thallium pollution. While the Four Corners Generating Station coal-fired power plant (near Fruitland, New Mexico, about 135 miles from LANL) has contributed to thallium contamination in the surrounding areas, LANL has historically operated coal-fired power plants (LANL 2022f). In 2022, none of the filtered gauging station stormwater or base flow results exceeded the surface water quality standards for thallium. There were no Individual Permit-related exceedances for thallium in 2022. None of the 42 assessment units, or stream reaches, on LANL or former LANL lands is listed as impaired for thallium. In 2022, no sediment samples exceeded soil screening levels for thallium. Stormwater and sediment results in 2022 for thallium were similar to those measured in recent years.

A.4.4.2 Groundwater

A.4.4.2.1 Groundwater Monitoring Program

This section provides supplemental information related to the groundwater monitoring program described in Section 4.4.2.2.

LANL collects samples from 11 Los Alamos County water supply wells (Figure A.4.4-4). Samples are also collected from wells located on Pueblo de San Ildefonso lands and from the Buckman well field operated by the City of Santa Fe. Groundwater monitoring locations on the Pueblo de San Ildefonso mostly represent the regional aquifer. However, Vine Tree Spring and Los Alamos Spring discharge from perched-intermediate groundwater, and wells LLAO-1b and LLAO-4 monitor alluvial groundwater (LANL 2024b).

Some wells and springs are part of six area-specific monitoring groups defined to address monitoring objectives unique to the area: TA-54, TA-21, MDA AB, MDA C, the Chromium Investigation area, and the TA-16 260 outfall (Figure A.4.4-5). Wells and springs not included within one of these six area-specific monitoring groups are assigned to the General Surveillance monitoring group (Figure A.4.4-6). Numerous springs along the Rio Grande are also monitored (LANL 2024b).

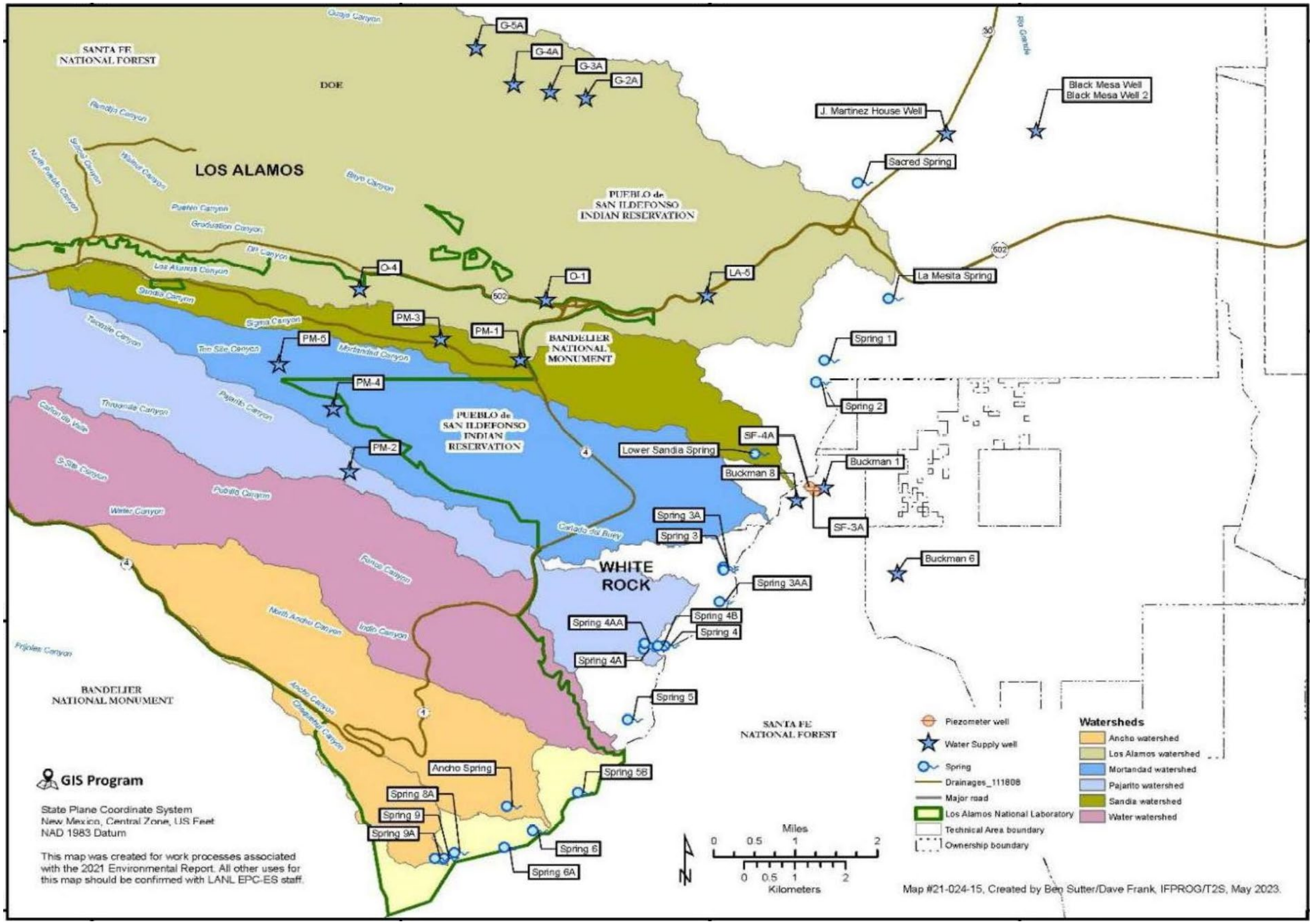
LANL has been monitoring groundwater for many years. Two areas are showing groundwater contaminants of sufficient concentration and extent to warrant an action such as interim measures, further characterization, and potential remediation under the Consent Order: (1) Royal Demolition Explosives (RDX) contamination in the vicinity of TA-16 and (2) hexavalent chromium contamination beneath Sandia and Mortandad canyons (LANL 2024b). Further characterization work and studies to evaluate groundwater risks and potential remediation strategies are ongoing in both of these areas; see the following discussions under the Chromium Investigation Monitoring Group and TA-16 260 Monitoring Group paragraphs.

<u>**Groundwater Sampling Results by Monitoring Group**</u>

The following sections discuss groundwater sampling results for the Los Alamos County and City of Santa Fe water supply wells, seven area-specific monitoring groups, the General Surveillance monitoring group, and springs along the Rio Grande. The discussions are grouped according to the groundwater zone, proceeding from deepest (the regional aquifer) to shallowest (the alluvial groundwater). The discussion addresses radionuclides, inorganic compounds, inorganic elements (primarily metals), and organic compounds for each groundwater zone.

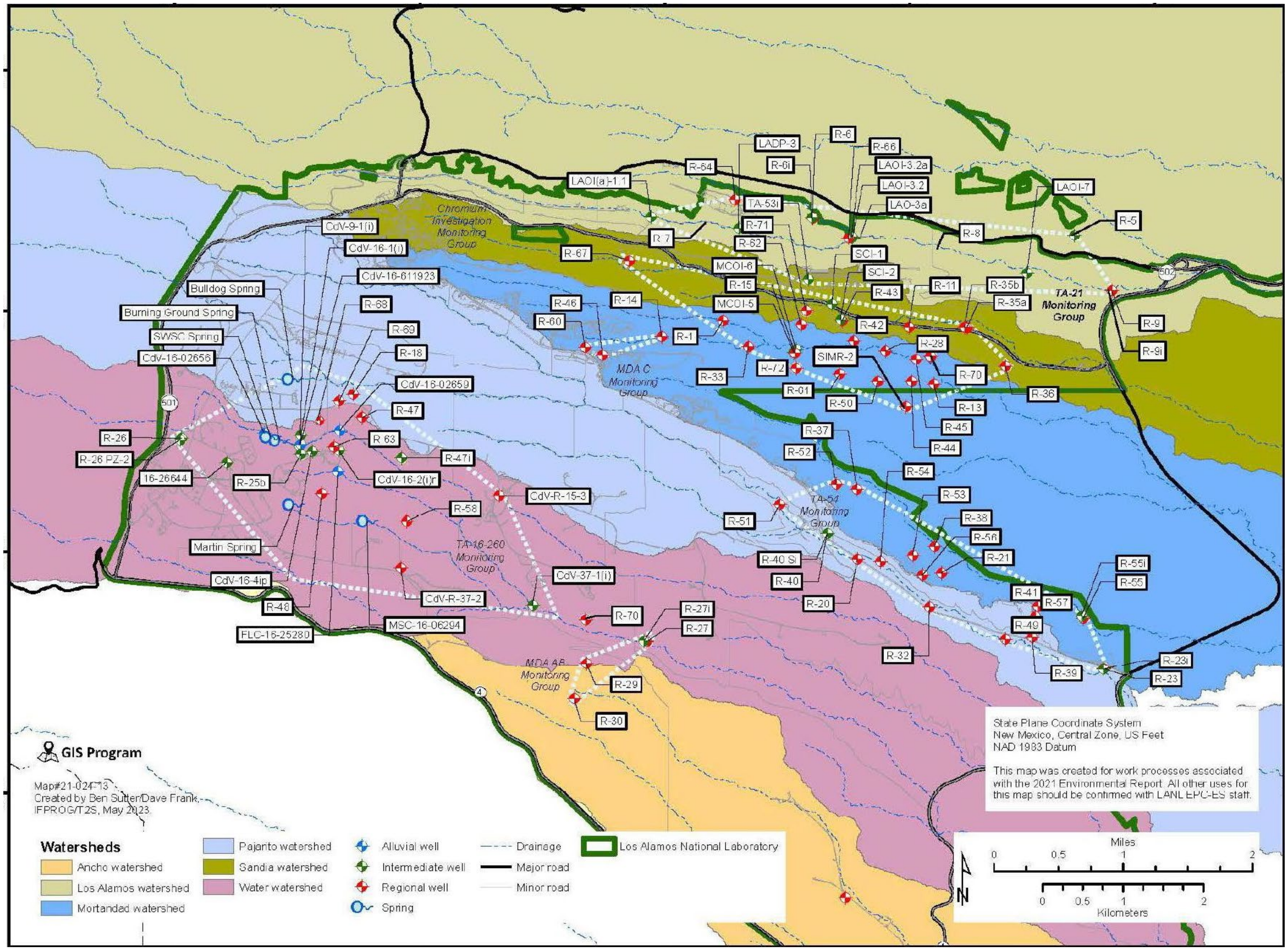
<u>**Water Supply Well Monitoring**</u>

Los Alamos County. In 2022, the Laboratory collected samples from 11 Los Alamos County water supply wells that produce water for the community and LANL (Figure A.4.4-4). These samples are in addition to Los Alamos County's regular monitoring and specifically address potential Laboratory contaminants. All drinking water produced by the Los Alamos County water supply system meets federal and state drinking water standards as reported in the county's annual drinking water quality report. No water supply wells showed detections of Laboratory-related constituents above applicable drinking water standards in 2022, consistent with results from previous years (LANL 2024b; Los Alamos County 2022).



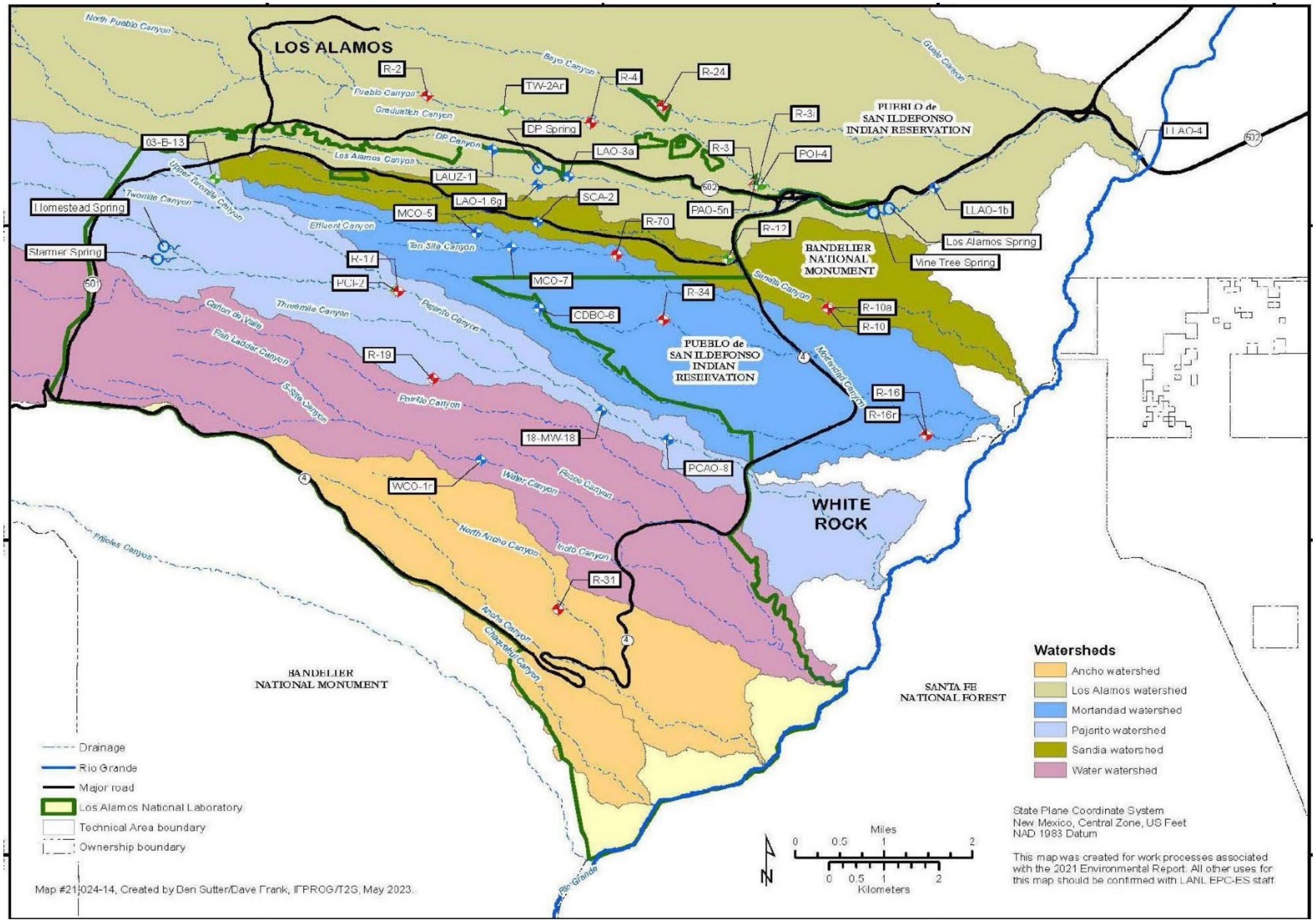
Source: LANL (2024b)

Figure A.4.4-4 Water Supply Wells, Piezometers, and Springs Used for Monitoring the Regional Aquifer



Source: LANL (2024b)

Figure A.4.4-5 Groundwater Monitoring Wells and Springs Assigned to Area-Specific Monitoring Groups



Source: LANL (2024b)

Figure A.4.4-6 Groundwater Monitoring Wells and Springs Assigned to the General Surveillance Monitoring Group

City of Santa Fe. In 2022, LANL sampled three water supply wells (Buckman-1, Buckman-6, Buckman-8) in the City of Santa Fe's Buckman well field (*see* Figure A.4.4-4). Samples were also collected from two piezometers (wells typically used to measure water levels; SF-3A and SF-4A) in the well field. These samples are in addition to the City of Santa Fe's regular monitoring and specifically address potential Laboratory contaminants. No Laboratory-related constituents were present above standards for these locations, consistent with results from previous years (LANL 2024b; City of Santa Fe 2022).

Groundwater Monitoring by Area-Specific Group

TA-21 Monitoring Group. TA-21 is located on a mesa bordered by Los Alamos Canyon on the north and DP Canyon on the south. It contains two historical operational areas, DP West and DP East, that generated liquid and solid radioactive wastes. The operations at DP West included plutonium processing; at DP East, weapons initiators production and tritium research. From 1952 to 1986, a liquid waste treatment plant discharged effluent containing radionuclides from the plutonium processing facility into DP Canyon (Figure A.4.4-5).

Samples from several wells that monitor perched-intermediate groundwater in the TA-21 monitoring group have tritium that likely originated from the former liquid waste treatment plant, the Omega West Reactor, or both. Tritium concentrations in perched-intermediate wells R-6i, LAOI-3.2, LAOI-3.2a, and LAOI-7 in 2021 are generally consistent with concentrations measured in recent years and show long-term declines over time consistent with the relatively short half-life of tritium (12.3 years). The highest tritium concentration among these wells in 2022 was 804 picocuries per liter (pCi/L) in R-6i, down from 1,070 pCi/L in 2021. For comparison, the EPA maximum contaminant level for tritium in drinking water is 20,000 pCi/L.

Chromium Investigation Monitoring Group. In the Chromium Interim Measure and Final Remedy EA, DOE evaluated alternatives for groundwater remediation in Sandia and Mortandad canyons with the primary goal of chromium mass removal or remediation to achieve compliance with groundwater quality standards (DOE 2024). DOE evaluated corrective measures for a final remedy that achieves permanence, cost effectiveness, and cleanup requirements. DOE's Proposed Action for a final remedy is a combination of treatment options whereby EM-LA would use adaptive site management to select, implement, and manage removal of hexavalent chromium from source areas and the groundwater. The Proposed Action would increase groundwater extraction and injection rates from 150,000,000 gallons per year (gpy) to a maximum rate of 550,000,000 gpy. The Proposed Action provides four options for implementing adaptive site management to remediate hexavalent chromium contaminated groundwater below Sandia and Mortandad canyons.

- **Option 1: Mass Removal via Expanded Treatment** – Under this option, EM-LA would construct a semi-permanent treatment facility within Mortandad Canyon and add up to 45 new extraction, injection, and monitoring wells with associated piping infrastructure and up to 30 new deep vadose zone piezometers. This option would target both source area contamination in Sandia Canyon and groundwater contamination in Mortandad Canyon.
- **Option 2: Mass Removal with Land Application** – This option would use land application of treated groundwater as a disposition method. Land application would only occur in permitted areas per a NPDES discharge permit that regulates land application rates.

- **Option 3: Mass Removal via *In-situ* Treatment** –This option would use *in-situ* treatment to address hexavalent chromium contaminated groundwater. *In-situ* treatment involves injecting reducing agents in untreated water and relying on chemical processes (e.g., sodium dithionite amendments) to immobilize and detoxify contaminants within soil or groundwater without removing them from the ground.
- **Option 4: Monitored Natural Attenuation** – Monitored natural attenuation relies on natural physical, chemical, or biological processes to reduce concentrations, toxicity, or mobility of chromium and incorporates regular monitoring to verify that natural attenuation is working. In the case of chromium, attenuation occurs via the reduction of mobile hexavalent chromium to insoluble trivalent chromium.

The Chromium Investigation Monitoring Group is located in Sandia and Mortandad canyons. Chromium is present in the regional aquifer below these canyons at levels above the NMED groundwater standard of 50 micrograms per liter (µg/L) in an area that is estimated to be approximately one mile in length and about a one-half mile wide. From 1956 to 1972, potassium dichromate was used as a corrosion inhibitor in the cooling system at LANL's power plant and was present in the effluent discharged through an outfall to Sandia Canyon. These past discharges of potassium dichromate are the source of the hexavalent chromium observed in groundwater beneath Sandia and Mortandad canyons. The conceptual model indicates that chromium originated from releases into Sandia Canyon and then migrated below ground along geologic perching horizons to locations in the regional aquifer beneath Sandia and Mortandad canyons. Hexavalent chromium is found within approximately the upper 100 feet of the water table of the regional aquifer. The 2022 chromium concentrations exceeded the New Mexico groundwater standard of 50 µg/L in five regional aquifer wells within the monitoring group: R-43 screen 1, R-45 screen 2, R-61 S1, R-62, and R-70 screen 2. The Laboratory also evaluated the performance of the interim measures being conducted to mitigate the hexavalent chromium plume migration while alternatives for a final remedy for the plume are evaluated. The Laboratory's *Interim Measures Work Plan for Chromium Plume Control* (LANL 2015c) presents an approach to use extraction wells and injection wells to control plume migration. The Laboratory's objective for the interim measures operations is to establish and maintain the portion of the plume containing 50 µg/L or more of chromium completely within the LANL boundary. To accomplish this, the Laboratory is extracting contaminated groundwater from five extraction wells, piping the extracted water to an aboveground ion exchange treatment system, and, following treatment, injecting the treated water back into the regional aquifer through five injection wells located in the downgradient portion of the plume. Interim measure operations along the northeastern portion of the plume began in late 2019 (LANL 2022h). Two wells located along the northwestern upgradient portion of the hexavalent chromium plume, R-62, and R-43 (two screens), continued to show a steady increase in the concentration of chromium in 2022. The Laboratory will install new monitoring wells in this area to further characterize the extent of chromium and perchlorate contamination and will use data from these wells to evaluate whether mitigation actions are necessary in this area (LANL 2024b).

A small area with perchlorate contamination is also present in perched groundwater beneath Mortandad Canyon. The primary source of perchlorate is effluent discharges from the RLWTF from 1963 to March 2002. Perchlorate is present above the NMED tap water screening level of 13.8 parts per billion in two perched-intermediate wells, MCOI-5 and MCOI-6. The Laboratory continues to monitor perchlorate and will incorporate remedial actions for perchlorate as part of the chromium project, if necessary. Other constituents detected in the Chromium Investigation Monitoring Group include 1,4-dioxane and tritium in perched-intermediate wells MCOI-5 and MCOI-6. Concentrations of 1,4-dioxane are not present above the screening level of 4.59 µg/L in the regional aquifer. Between 2016 and 2022, samples taken from perched-intermediate wells MCOI-5 and MCOI-6 showed tritium concentrations ranging from 3,000 to 5,000 pCi/L, well below the EPA maximum contaminant level for tritium in drinking water of 20,000 pCi/L.

Material Disposal Area C Monitoring Group. Material Disposal Area (MDA) C is located in TA-50, at the head of Ten-Site Canyon. It is an inactive landfill where solid LLW and chemical wastes were disposed of between 1948 and 1974. Vapor-phase volatile organic compounds (VOCs) and tritium are present in the upper 500 feet of the unsaturated soil and rock beneath MDA C. The primary volatile organic compound is trichloroethene. The MDA C Monitoring Group includes nearby regional aquifer monitoring wells. Monitoring data indicate no contamination is present in the groundwater in the regional aquifer immediately downgradient of MDA C, consistent with results from previous years. No perched-intermediate groundwater is present beneath MDA C (LANL 2024b).

TA-54 Monitoring Group. TA-54 is located in the east-central portion of LANL on Mesita del Buey. TA-54 includes four MDAs designated Areas G, H, J, and L; a waste characterization, storage, and transfer facility (TA-54 West); active radioactive waste storage operations at Area G; hazardous and mixed-waste storage operations at Area L; and administrative and support areas.

At TA-54, groundwater monitoring is conducted to support both (1) monitoring of SMAs (particularly Areas G, H, and L) under the 2016 Consent Order and (2) the Laboratory's Hazardous Waste Facility Permit. The TA-54 Monitoring Group includes perched-intermediate and regional wells (*see* Figure A.4.4-5).

Monitoring data show that vapor-phase VOCs are present in the upper portion of the unsaturated zone beneath Areas G and L. The primary vapor-phase VOCs at TA-54 are 1,1,1-trichloroethane; trichloroethene; and Freon-113. Tritium is also present.

There have been periodic detections of a variety of substances, including several VOCs from the groundwater monitoring network around TA-54. In 2021, the chemical 1,4-dioxane was detected above the EPA maximum contaminant level of 4.59 µg/L at Well R-37 screen 1, with a concentration 6.22 microgram per liter, which is the third detection of 1,4-dioxane above the screening level at this well. Well R-37 screen 1 was not sampled in 2022 due to changing sampling frequency in the Interim Facility-Wide Groundwater Monitoring Plan. However, LANL will continue to monitor this trend (LANL 2024b). The sporadic and limited spatial nature of the VOC detections and the minimal amount of tritium data suggest that TA-54 may not be the source of the detected compounds (LANL 2022f).

TA-16 260 Monitoring Group. Water Canyon and Cañon de Valle (a tributary of Water Canyon) cross the southwestern portion of LANL where the Laboratory develops and tests explosives. In the past, LANL released wastewater into both canyons from several HE processing facilities in TA-16 and TA-9. The TA-16 260 Monitoring Group was established for the upper Water Canyon/Cañon de Valle watershed to monitor substances released from Consolidated Unit 16-021(c)-99, which includes the TA-16 260 outfall and associated SMAs. The TA-16 260 outfall discharged high-explosives-bearing water from a HE machining facility to Cañon de Valle from 1951 through 1996. These discharges served as a primary source of HE and inorganic element contamination in the area. Current evidence indicates that over time the effluent from the TA-16

260 outfall, sometimes mixed with naturally occurring surface water and alluvial groundwater in Cañon de Valle, infiltrated from Cañon de Valle, and percolated through unsaturated rock layers to perched-intermediate groundwater zones and ultimately into the regional aquifer. Surface soil cleanup during the periods 2000–2001 and 2009–2010 removed and properly disposed of approximately 1,500 cubic yards of high-explosive-contaminated soil from the outfall area. Residual RDX remains in the subsurface groundwater. The Laboratory conducts monitoring and maintenance to evaluate the effectiveness of the corrective measure and provide information for the conceptual site model for RDX movement through surface water, springs, and groundwater. Other corrective actions have consisted of maintaining an impermeable cap and installation of impermeable grout underneath the former settling pond; installing a carbon filter for the treatment of spring water at Burning Ground Spring in Cañon de Valle; modifying the existing carbon filter at Martin Spring in Martin Spring Canyon; and installing a pilot permeable reactive barrier for treatment of high explosives and barium in the Cañon de Valle. The carbon filters and permeable reactive barrier were damaged by flooding in 2011 and were removed in 2016 with NMED approval (N3B 2019).

Springs, surface water, alluvial groundwater, and perched-intermediate groundwater in the area contain explosive compounds, including RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine); high melting explosive (HMX) (octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine); and trinitrotoluene (TNT) (2-methyl-1,3,5-trinitrobenzene). RDX has been detected in the regional aquifer in wells R-18, R-63, R-68, and R-69 screens 1 and 2 (Figure A.4.4-5). RDX in perched-intermediate groundwater wells exhibits more variability than regional aquifer wells, with concentrations ranging from not detected to approximately 180 µg/L. In addition, barium, boron, iron, manganese, nitrosodiethylamine[N-], and nitrosodimethylamine[N] have been detected above their respective screening levels in springs, alluvial groundwater, and perched-intermediate groundwater (LANL 2024b).

RDX is the primary groundwater contaminant in this area and the only contaminant that exceeds its groundwater standard (9.66 µg/L) in the regional aquifer. Two regional aquifer wells, R-68 and R-69 screens 1 and 2, have had RDX concentrations of 2 to 3 times the tap water screening level of 9.66 µg/L since 2016. RDX concentrations in regional monitoring wells R-63 and R-18 were below the groundwater standard but are exhibiting stable to increasing trends.

The springs in the TA-16 260 Monitoring Group discharge from perched-intermediate groundwater zones. Of the springs sampled, the concentrations of RDX are highest in Martin Spring (25–75 µg/L) since 2016. RDX concentrations at Burning Ground Spring (10–20 µg/L) have been relatively steady over the past 5 years, with the exception of samples collected in July 2015 and March 2019, which had concentrations of approximately 40 µg/L. Sanitation Wastewater Systems Consolidation Spring (10–20 µg/L), near the former location of the TA-16 260 outfall, does not have consistent flow and was last sampled during 2016.

RDX concentrations in alluvial monitoring wells show significant variability because of seasonal influences (periods of heavier rain), but remain relatively low. RDX concentrations in each of the perched-intermediate wells show some variability (LANL 2024b).

Other substances, including tetrachloroethene, trichloroethene, boron, and barium, are present in all groundwater zones but are well below applicable standards in the regional aquifer. An investigation report on the extent and implications of RDX contamination in perched-intermediate and regional groundwater was submitted to the NMED in August 2019 (N3B 2019). The

Laboratory submitted a report on the fate, transport modeling, and risk assessment for RDX in groundwater to the NMED in May 2020 (N3B 2020), which concluded that there is no current risk to human health over the next 50 years. Risks to human health beyond 50 years was evaluated in a revision of this report (N3B 2020; LANL 2022f). The revision to the risk assessment concluded that there is no risk to human health over the next 200 years and was submitted to NMED in September 2022 (LANL 2024b).

Material Disposal Area AB Monitoring Group. The MDA AB Monitoring Group is located in TA-49. Also known as the Frijoles Mesa Site, TA-49 is located on a mesa near the western end of Ancho Canyon. Part of the area drains into Water Canyon. The canyons in the Ancho Canyon watershed are mainly dry with no known persistent alluvial groundwater zones and no known perched-intermediate groundwater (LANL 2024b).

The site of MDA AB was used to test nuclear weapons components from 1959 to 1961. The testing involved isotopes of uranium and plutonium; lead and beryllium; explosives such as TNT, RDX, and HMX; and barium nitrate. Some of this material remains in shafts in the mesa top.

In 2022 and the last several years, no constituents were found in MDA AB Monitoring Group wells at concentrations above standards or screening levels (LANL 2022f, 2022h, 2024b).

White Rock Canyon Monitoring Group. The springs that flow along and near the Rio Grande in White Rock Canyon discharge predominantly regional aquifer groundwater. A few springs appear to represent discharge of perched-intermediate groundwater. Some other springs may discharge a mixture of regional aquifer groundwater, perched-intermediate groundwater, and percolation of recent precipitation. The White Rock Canyon springs serve as important monitoring points for evaluating the Laboratory's potential to impact the Rio Grande (*see* Figure A.4.4-4).

In 2020, iron was detected above the applicable groundwater standard (1000 µg/L) on the Rio Grande at Otowi Bridge at a concentration of 2,930 µg/L (LANL 2022h). In 2021, iron was detected on the Rio Grande at Otowi Bridge and Frijoles at concentrations of 4,890 and 1,290 µg/L, respectively. Aluminum exceeded the NMED tap water screening level (5,000 µg/L) in 2021 with a detected concentration of 7,150 µg/L on the Rio Grande at Otowi Bridge. Six constituents (iron, aluminum, manganese, arsenic, benzo(a)anthracene, and dibenz(a,h)anthracene) on the Rio Grande (Frijoles and Otowi) and two springs (2 and 4) were detected above applicable groundwater standards or screening levels for this monitoring group in 2022 (LANL 2024b). Prior samples from 2015 to 2019 had detected no concentrations above applicable groundwater standards or screening levels. Since the location of the Otowi Bridge is upriver of LANL on the Rio Grande, before any contributions from LANL groundwater flows, concentrations of iron and aluminum at this location would not be attributable to prior or current LANL operations.

The Buckman Direct Diversion (BDD) structure is located on the east riverbank of the Rio Grande 3 miles below the Otowi Bridge. The BDD structure diverts and pumps water from the Rio Grande 11 miles and 1,100 vertical feet uphill to the Buckman Regional Water Treatment Plant (BRWTP). The BDD then makes bulk wholesale deliveries to the City and County of Santa Fe by pumping treated drinking water to their independent public water systems. The BDD includes the BRWTP, the diversion structure on the Rio Grande, a sand removal facility, three raw water booster stations, two treated water pump stations, 12 million gallons of water storage capacity, and 31 miles of raw and finished water pipelines. The BDD is able to deliver up to 15 million gallons per day of treated drinking water, pumped from the Rio Grande to the City and County of Santa Fe water system customers. Water diverted from the Rio Grande via the BDD and groundwater pumped from the Buckman well field, together, provide water for Santa Fe (BDDD 2022).

General Surveillance Monitoring in Specific Watersheds

Los Alamos and Pueblo Canyon. Alluvial Well LAO-3a in Los Alamos Canyon (*see* Figure A.4.4-6) continues to show strontium-90 concentrations above the EPA's 8 pCi/L maximum contaminant level, with concentrations ranging from approximately 10 to 18 pCi/L in the last several years. Alluvial Well LAUZ-1 had not been sampled since 2011, but was sampled in 2018, 2019, and 2021. In 2011, the concentration of strontium-90 was 64.5 pCi/L. The concentration of strontium-90 in Well LAUZ-1 was 15.6 pCi/L in 2018, 18.6 pCi/L in 2019, 17.1 pCi/L in 2021, and 6.01 picocuries per liter in 2022. The source of the strontium-90 is SWMU 21-011(k), which was an outfall from industrial waste treatment at TA-21. Strontium-90 is persistent at this location and in several downgradient alluvial wells near the confluence of DP Canyon with Los Alamos Canyon. However, it has not been migrating to alluvial locations farther down Los Alamos Canyon (LANL 2024b).

Alluvial Well PAO-5N and intermediate wells POI-4 and R-3i in Pueblo Canyon have results above the NMED tap water screening level of 70 nanograms per liter for per- and polyfluoroalkyl substances (PFAS). In 2021, results were 107.61, 89.7, and 75.8 nanograms per liter, respectively. In 2020, concentrations were slightly higher, at 179.4, 107.6, and 84.7 nanograms per liter, respectively. Alluvial Well LAUZ-1 in Los Alamos Canyon showed a result of 520 nanograms per liter in 2021. LAUZ-1 was not sampled in 2020. In 2022, alluvial wells PAO-5n and LAUZ-1 and intermediate wells POI-4 and R-3i in Pueblo Canyon showed results above the NMED tap water screening level of 70 nanograms per liter for PFAS; the results were 195.9, 339.6, 136.7, and 86.4 nanograms per liter, respectively. As a new emerging contaminant, this was the third sampling event for PFAS. LANL will continue to monitor for PFAS at these locations (LANL 2024b).

Lower Los Alamos Canyon. Vine Tree Spring on Pueblo de San Ildefonso land represents discharge of perched-intermediate groundwater (*see* Figure A.4.4-6). Sampling at Vine Tree Spring began as a replacement for nearby Basalt Spring, which had been sampled since the 1950s until it dried up around 2010. The perchlorate concentration in Vine Tree Spring for 2022 is consistent with prior years' data. The perchlorate contamination may be associated with historical Laboratory operations. For context, the perchlorate values are below the risk-based screening level of 13.8 µg/L. The screening level for perchlorate is determined according to a hierarchical data-screening process required under the 2016 Consent Order (NMED 2016a).

Sandia Canyon. The General Surveillance Monitoring Group wells located in Sandia Canyon that are not part of the Chromium Investigation Monitoring Group include regional aquifer wells R-10 and R-10a and perched-intermediate well R-12. Wells R-10 and R-10a are on Pueblo de San Ildefonso land. No constituents were measured near or above standards or screening levels in these wells during 2022, which is consistent with prior years' data (LANL 2022f, 2022h, 2024b).

Mortandad Canyon. Several regional aquifer wells in Mortandad Canyon are part of the General Surveillance Monitoring Group. No constituents in the regional aquifer during 2022 were above their respective screening values for these wells.

The TA-50 RLWTF is regulated by Discharge Permit DP-1132 and requires quarterly and annual samples to be collected from seven alluvial, perched-intermediate, and regional aquifer wells to monitor impacts from the facility, including discharges from NPDES Industrial and Sanitary Point

Source Permit Outfall 051 in Mortandad Canyon. Historically, perchlorate has been detected in alluvial monitoring wells MCO-4B, MCO-6, and MCO-7. Since the 2002 RLWTF upgrades, the perchlorate concentrations from these wells are low relative to past perchlorate concentrations in Mortandad Canyon alluvial groundwater. However, in 2021, MCO-6 had elevated concentrations of perchlorate and exceeded the New Mexico tap water screening level for perchlorate[12] (LANL 2024b).

Due to insufficient water, MCO-4B has not been sampled since 2017. Similarly, MCO-6 was sampled in 2018 but was not sampled during 2019 and 2020 due to insufficient water. MCO-6 was sampled in 2021 yielding quarterly results of 83.8, 96.8, 97.9, and 102 µg/L of perchlorate (LANL 2022f, LANL 2022h). Prior to 2017, concentrations of perchlorate were below the screening level, except for sampling in 2013 when perchlorate in MCO-6 was detected at 14.8 µg/L and in MCO-4B at 14 µg/L. The NMED tap water screening level for perchlorate is 13.8 µg/L. In 2022, MCO-4B, MCO-6, and MCO-7 were not sampled (LANL 2024b).

Cañada del Buey. Alluvial Well CDBO-6 in Cañada del Buey was dry in 2022 and, thus, not sampled, consistent with the previous several years. CDBO-6 has not been sampled since 2011.

Pajarito Canyon. Pajarito Canyon has a watershed that begins in the Sierra de los Valles west of LANL. Two-mile and Three-mile canyons at LANL are tributaries of Pajarito Canyon. Saturated alluvium is present in portions of Pajarito Canyon, including a reach in lower Pajarito Canyon, but does not extend beyond the Laboratory's eastern boundary. In the past, the Laboratory released small amounts of wastewater into tributaries of Pajarito Canyon from several HE processing sites in TA-9. A nuclear materials experimental facility occupied the floor of Pajarito Canyon in TA-18. Waste management areas in TA-54 occupy the mesa north of the lower part of the canyon.

SWMU 03-010(a) is the outfall area from a former vacuum repair shop behind the warehouse in TA-3. The outfall area is located on a small tributary to Two-Mile Canyon. A small zone of shallow perched-intermediate groundwater is present and is apparently recharged by runoff from adjacent parking lots and building roofs. This perched groundwater is sampled at a depth of approximately 21 feet by Well 03-B-13. In 2022, Well 03-B-13 contained aluminum at 3,970 micrograms per liter, up from 1,130 micrograms per liter in 2021, and iron at 2,170 micrograms per liter, up from 727 micrograms per liter in 2021. The New Mexico groundwater standard for aluminum is 5,000 µg/L and for iron is 1,000 µg/L. The contaminant 1,4-dioxane was detected at 3.2 µg/L in Well 03-B-13, below the New Mexico groundwater standard of 4.59 µg/L (LANL 2024b).

Several other alluvial and perched-intermediate groundwater and regional aquifer wells in Pajarito Canyon are part of the General Surveillance Monitoring Group. At Alluvial Well 18-MW-18, chloride was measured at 346 milligrams per liter, above the New Mexico groundwater standard of 250 milligrams per liter (LANL 2024 b).

Water Canyon. The 2022 and 2021 sampling of Alluvial Well WCO-1r were cancelled due to insufficient water during the time of sampling. During the previous sampling event (2019), iron was detected at 1,560 µg/L, which is above the New Mexico groundwater standard of 1,000 µg/L (LANL 2024b).

Groundwater Discharge Permit Monitoring. In samples collected in support of groundwater discharge permits (from Wells MCA-RLW-1, MCA-RLW-2, MCOI-6, SCA-3, SCI-1, R-1, R-14 screen 1, R-46, and R-60), no permit-related constituents were above applicable standards or

[12] MCO-6 was not sampled in 2022.

screening levels in 2022 and 2021. Several analytes related to historical operations were detected in perched/intermediate aquifer Well MCOI-6; these various analytes measured above applicable standards or screening levels as presented in the Chromium Investigation Monitoring Group (LANL 2024b).

A.4.5 Air Quality and Noise

Additional information related to air quality and the affected environment are presented in Appendix H.

A.4.6 Ecological Resources

As identified in Chapter 4, Section 4.6.1.1, LANL's updated land cover map identifies 20 vegetation cover types and 6 non-vegetation land cover classes. Seventeen vegetation cover types and five non-vegetation cover types occur on the LANL site. Table A.4.6-1 provides a list of land cover types and a distribution (in acres) across the site.

Table A.4.6-1 Summary of Land Cover Types on LANL

Class Name	Description	LANL Site[a] (acres)
Asphalt road	Paved roads.	542
Blue grama grassland	Grasslands dominated by blue grama with scattered chamisa, big sagebrush, and snakeweed. Scattered piñon, juniper, or ponderosa pine may be present. Minimum mapped elevation: 6,227 feet above sea level; maximum mapped elevation of 9,083 feet.	675
Dense juniper Woodland	Woodlands dominated by one-seed juniper, with at least 30-percent total woodland tree canopy cover. Minimum mapped elevation: 5,365 feet above sea level; maximum mapped elevation: 7,498 feet.	7,160
Dense oak shrubland	Shrublands dominated by oak species, typically Gambel oak or wavyleaf oak, with at least 30-percent total canopy cover. Minimum mapped elevation: 6,598 feet above sea level; maximum mapped elevation: 9,967 feet.	344
Developed	Areas developed for human use (e.g., buildings, houses)	1,560
Forested riparian	Forested riparian areas identified by the presence of diagnostic tree species such as boxelder, narrow-leaf cottonwood, and Rio Grande cottonwood. Minimum mapped elevation: 5,366 feet above sea level; maximum mapped elevation: 7,034 feet.	92
Las Conchas recovering grassland	Las Conchas recovering grasslands areas experienced very high tree mortality during the Las Conchas wildfire in 2011, and current vegetation growth is not dominated by any tree or shrub species. Minimum mapped elevation: 6,665 feet above sea level; maximum mapped elevation: 10,504 feet.	15

Class Name	Description	LANL Site[a] (acres)
Mixed-conifer	Forest or woodland stands of moderately open to dense tree canopy with mixture of ponderosa pine, Douglas fir, white fir, and limber pine. Minimum mapped elevation: 6,125 feet above sea level; maximum mapped elevation: 9,877 feet.	2,585
Mixed-species shrubland	Mixed-species shrublands at higher elevations that support ponderosa pine or higher. Could be dominated by Fendler's buckbrush or other low-growing shrubs. Minimum mapped elevation: 6,195 feet above sea level; maximum mapped elevation: 10,411 feet.	381
New Mexico Locust shrubland	Dominated by New Mexico locust, often co-occurring with Gambel oak and/or regenerating quaking aspen. Minimum mapped elevation: 6,222 feet above sea level; maximum mapped elevation: 9,930 feet.	36
Non-forested wetland/riparian	Contains diagnostic facultative or obligate wetland species, or shrub or herbaceous species distinctly different from adjacent upland areas such as coyote willow, sedges and rushes, cattails, reed canary grass, and skunkbush sumac. Minimum mapped elevation: 5,367 feet above sea level; maximum mapped elevation: 7,645 feet.	427
Ponderosa pine forest	Moderately dense to dense ponderosa pine canopy. Occasional occurrences of Douglas fir or juniper species and sparse herbaceous layer. Minimum mapped elevation: 6,286 feet above sea level; maximum mapped elevation: 7,779 feet.	115
Ponderosa pine regeneration	Predominantly ponderosa pine seedling or saplings, either planted or naturally regenerating. Minimum mapped elevation: 6,394 feet above sea level; maximum mapped elevation: 8,682 feet.	638
Ponderosa pine woodland	Moderately dense tree canopy dominated by ponderosa pines. Juniper may be present. Minimum mapped elevation: 6,220 feet above sea level; maximum mapped elevation: 8,518 feet.	3,733
Semievergreen shrubland	Lower elevation communities dominated by low-growing shrubs such as fourwing saltbush, sand sage, fringed sage, winterfat, big sagebrush, or chamisa, but not oak species. Minimum mapped elevation: 5,372 feet above sea level; maximum mapped elevation: 7,703 feet.	440
Sparse juniper woodland	Dominated by one-seeded juniper, typically less than 10 feet tall and less than 30% canopy cover with sparse herbaceous layer. Occasional pinyon pine and ponderosa pine present. Minimum mapped elevation: 5,373 feet above sea level; maximum mapped elevation: 7,489 feet.	3,721

Class Name	Description	LANL Site[a] (acres)
Sparse oak shrubland	Dominated by shrub forms of oaks. Oaks occur in sparse to moderate densities. Minimum mapped elevation: 6,286 feet above sea level; maximum mapped elevation: 9,553 feet.	1,213
Sparsely vegetated – bare rock	Primarily rock substrate and less than 20 percent total vegetation cover. Minimum mapped elevation: 5,380 feet above sea level; maximum mapped elevation: 10,277 feet.	748
Sparsely vegetated – bare soil	Primarily soil substrate and less than 20% total vegetation cover. Minimum mapped elevation: 5,366 feet above sea level; maximum mapped elevation: 10,326 feet.	367
Submontane grassland	Moderate-to-dense herbaceous layer dominated by grass species other than blue grama. Does not contain dense sod-forming bunchgrasses. Minimum mapped elevation: 6,592 feet above sea level; maximum mapped elevation: 10,277 feet.	805
Water	Open water, ponds, and streams.	66
ALL CLASSES COMBINED		**25,536**

a LANL site refers to the land inside the LANL property boundaries.
Source: LANL (2022k); Hansen et al. (2018)

As identified in Chapter 4, Section 4.6.4.4, 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.

Table A.4.6-2 Species Classified as Sensitive at LANL

Common Name	Scientific Name	NM State Status	SWAP Category	NHNM[a]	Other
Mammals					
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	NA	Susceptible	S3	NA
Spotted bat	*Euderma maculatum*	Threatened	Susceptible	S3	NA
Gunnison's prairie dog	*Cynomys gunnisoni*	NA	Immediate priority	S2	NA
Birds					
Bald eagle	*Haliaeetus leucocephalus*	Threatened	Limited Habitat	S1	NA
Peregrine falcon	*Falco peregrinus*	Threatened	Limited Habitat	S3	NA

Common Name	Scientific Name	NM State Status	SWAP Category	NHNM[a]	Other
Northern American goshawk	*Accipiter gentilisatricapillus*	NA	NA	S2, S3	NA
Flammulated owl	*Psiloscops flammeolus*	NA	Immediate priority	S3	PIFWL
Lewis's woodpecker	*Melanerpes lewis*	NA	Immediate priority	S3	PIFWL
Gray vireo	*Vireo vicinior*	Threatened	Immediate priority	S3	PIFWL
Pinyon jay	*Gymnorhinus cyanocephalus*	NA	Immediate priority	S2, S3	Petitioned and under status review[b]
Juniper titmouse	*Baeolophus ridgwayi*	NA	Immediate priority	NA	NA
Evening grosbeak	*Coccothraustes vespertinus*	NA	Susceptible	NA	PIFWL
Cassin's finch	*Haemorhous cassinii*	NA	Susceptible	S3	PIFWL
Black-chinned sparrow	*Spizella atrogularis*	NA	Immediate priority	S3	PIFWL
Virginia's warbler	*Leiothlypis virginiae*	NA	Immediate priority	S3	PIFWL
Grace's warbler	*Setophaga graciae*	NA	Immediate priority	S3	PIFWL
Black-throated gray warbler	*Setophaga nigrescens*	NA	Immediate priority	S3	NA
Amphibians and Reptiles					
Smooth green snake	*Opheodrys vernalis*	NA	NA	S3	NA
Plants					
Mountain wood lily	*Lilium philidelphicum*	Endangered	NA	S3	NA
Springer's blazingstar	*Mentzelia springeri*	NA	NA	S3	NA
Yellow lady's slipper	*Cypripedium parviflorum*	Endangered	NA	S2	NA
Giant helleborine orchid	*Epipcactis gigantea*	NA	NA	S2	NA
Sapello canyon larkspur	*Delphinium sapellonis*	NA	NA	S3	NA

Common Name	Scientific Name	NM State Status	SWAP Category	NHNM[a]	Other
Invertebrates					
Monarch butterfly	*Danaus plexippus*	NA	NA	NA	Candidate[c]

ESA = Endangered Species Act; NA = not applicable; NHNM = Natural Heritage New Mexico; NM = New Mexico; PIFWL = Partners in Flight watch list; SWAP = State Wildlife Action Plan; USFWS = U.S. Fish and Wildlife Service

a Natural Heritage New Mexico state rankings of critically imperiled (S1), imperiled (S2), vulnerable (S3).

b Under status review by USFWS based on a petition for federal listing under the ESA.

c Candidate species warranted for federal listing under ESA but is precluded at this time due to higher-priority listings (December 2020).

Source: Berryhill et al. (2020, Table 1); NMDGF (2019)

A.4.7 Human Health and Safety

This section is reserved.

A.4.8 Cultural and Paleontological Resources

The following subsections include additional supporting information utilized by NNSA in identifying and describing cultural and paleontological resources at LANL and that supplement information provided in Section 4.8 of this SWEIS.

A.4.8.1 Cultural Chronology

Occupation and use of the Pajarito Plateau began as early as 11,500 years ago as foraging groups used the area for gathering and hunting large game animals. Since that time, a succession of peoples has populated the area as reflected in the archaeological resources, historic buildings and structures, and traditional cultural properties still present today at LANL. Table A.4.8-1 depicts the chronological sequence associated with the cultural history for the central portion of the Pajarito Plateau where LANL is situated; a detailed description of each period is provided in *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico* (Cultural Resources Management Plan; CRMP) (LANL 2019c).

A.4.8.2 Cultural Resource Management and 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 2022i) and the CRMP (LANL 2019c). These two documents contain procedures and processes that enable the NNSA to maintain compliance with federal laws, regulations, and guidelines that address cultural resources, such as the National Historic Preservation Act (NHPA) (54 U.S.C. § 300101 et seq.), Native American Graves Protection and Repatriation Act (25 U.S.C. § 3001 et seq.), and Archaeological Resources Protection Act (16 U.S.C. § 470aa–470mm), as well as DOE policies and directives related to cultural resources.

Table A.4.8-1 Cultural History Chronology for the Pajarito Plateau and Los Alamos National Laboratory

Culture Period	Culture Sub-Period	Dates
Paleoindian	Clovis	9500–8000 BC
	Folsom	9000–8000 BC
	Late Paleoindian	8000–5500 BC
Archaic	Jay	5500–4800 BC
	Bajada	4800–3200 BC
	San Jose	3200–1800 BC
	Armijo	1800–800 BC
	En Medio	800 BC–AD 400
	Trujillo	400–600
Ancestral Pueblo	Early Developmental	600–900
	Late Developmental	900–1150
	Coalition	1150–1325
	Classic	1325–1600
Historic American Indian, Hispanic, and Euro-American	Early Historic Pajarito Plateau	1600–1890
	Homestead	1890–1942
Federal Scientific Laboratory	Manhattan Project	1942–1946
	Early Cold War	1946–1956
	Cold War	1956–1990

Source: LANL (2019c)

The NPS maintains the *National Register of Historic Places* (National Register), a listing of prehistoric, historic, and ethnographic buildings, structures, sites, districts, and objects considered significant at a national, state, or local level. Listed resources can have significance in the areas of history, archaeology, architecture, engineering, or culture. Cultural resources listed, or eligible for listing, on the National Register have been documented and evaluated according to uniform standards, found in 36 CFR 60.4, and have been found to meet criteria of significance and integrity. Generally, resources evaluated for eligibility are at least 50 years old. There are exceptions to this standard, particularly resources associated with the Cold War era. Cultural resources that meet the criteria for listing on the National Register, regardless of age, are called historic properties. Resources that have undetermined eligibility are treated as historic properties until a determination otherwise is made.

For projects and undertakings occurring at LANL, the processes 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. The processes for each of these steps include consultation with the New Mexico State Historic Preservation Officer, Native American communities and tribes with an interest in resources of the LANL region, and other consulting parties with a demonstrated interest in cultural resources located at LANL such as Hispanic groups or organizations that focus on archaeological resources. Any necessary field investigations, assessments, consultations, and mitigation activities are completed prior to project implementation.

The CRMP outlines the responsibilities and requirements for long-term management of the cultural heritage at LANL. In addition to analyzing potential effects from proposed actions, NNSA and Laboratory personnel conduct condition assessments, monitoring, and inspections of known resources to identify any changes in their integrity; monitoring of areas of common public use to ensure no inadvertent effects occur to known resources; identification surveys of locations on LANL that are known to have high concentrations of resources; preservation and maintenance repairs to historic properties; consultations with tribes regarding resources for which they have concerns; and outreach and interpretation of resources to NNSA and LANL personnel and the public.

As part of its efforts to manage cultural resources at LANL, NNSA conducts consultation with 24 Native American communities with traditional ties to the region that includes LANL (LANL 2022n):

- Hopi Tribe
- Jicarilla Apache Nation
- Mescalero Apache Tribe
- Navajo Nation
- Ohkay Owingeh (Pueblo of San Juan)
- Pueblo of Acoma
- Pueblo de Cochiti
- Pueblo of Isleta
- Pueblo of Jemez
- Pueblo of Laguna
- Pueblo of Nambe
- Pueblo of Picuris
- Pueblo of Pojoaque
- Pueblo of Sandia
- Pueblo of San Felipe
- Pueblo de San Ildefonso
- Pueblo of Santa Ana
- Pueblo of Santa Clara
- Pueblo of Santo Domingo
- Pueblo of Taos
- Pueblo of Tesuque
- Pueblo of Zia
- Pueblo of Zuni
- Ute Mountain Ute Tribe

A.4.8.3 Archaeological Resources

While evidence suggests that human activity occurred at LANL from the Paleoindian Period through the present day, nearly 79 percent of the more than 1,900 archaeological sites identified at LANL (including villages, shrines, structures, springs, trails, agricultural features, and rock art) were constructed and used by Ancestral Pueblo people during the 13th, 14th, and 15th centuries (LANL 2022f, 2023). Other common types of archaeological resources at LANL include Archaic Period lithic scatters from the production and use of stone tools, and late 19th to early 20th century homestead, ranching, and logging sites.

There are more than 1,300 known Ancestral Pueblo archaeological sites at LANL, among the highest densities of such sites in the North American Southwest. While all are considered important by the modern Pueblo descendants of the people who made these sites, a small percentage of sites—because of integrity of location and the nature of the resource—best serve to tell the story of the Ancestral Pueblo use of the Pajarito Plateau during the period 1250–1700. NNSA recognizes a number of Ancestral Pueblo archaeological sites that are especially significant to the state of New Mexico and the nation due to their integrity and site type (LANL 2019c).

Included are complex plaza pueblos, cavate complexes, and petroglyph panels dating from the Archaic Period through the Ancestral Pueblo Classic Period, and four sites relating to the Homestead Period (NNSA 2008b; LANL 2019c).

A.4.8.4 Manhattan Project Resources

The Manhattan Project was the nationwide effort by the United States to develop an atomic weapon during World War II, and it took place at many sites across the country. Congress established the Manhattan Project National Historical Park in 2014, with the goal of preserving World War II sites associated with the Manhattan Project and the creation of the atomic bomb (LANL 2022f, 2019c). DOE and the NPS jointly manage the park, with the goals of historic preservation, interpretation, and enhanced public access (LANL 2022h).

The park preserves sites in Hanford, Washington; Oak Ridge, Tennessee; and Los Alamos, New Mexico. Nine buildings associated with the design and assembly of The Gadget (the atomic bomb tested at the Trinity Site in southern New Mexico in July 1945), the Little Boy weapon (the atomic bomb detonated over Hiroshima, Japan, in August 1945), and the Fat Man weapon (the atomic bomb detonated over Nagasaki, Japan, in August 1945) are part of the Manhattan Project National Historic Park at LANL. Eight additional buildings and structures at LANL, identified in the legislation establishing the park, are considered eligible for future inclusion in the park (LANL 2022f). The park unit at LANL is located in eight separate TAs and features historic buildings and stories connected with the scientific and engineering aspects of design, assembly, and testing of the atomic weapon. NNSA has developed a five-year plan that addresses all Manhattan Project-related buildings at LANL to preserve the buildings that are essential to telling the story of the Project and to facilitate public tours by providing an authentic experience (LANL 2022f, 2022j).

A.4.8.5 Traditional Cultural Properties

Traditional cultural properties are usually identified through consultation with the communities who have a history of use within a particular area. Traditional cultural properties were first considered at LANL in the specific context of the 1993 then-proposed Bason Land Exchange in Rendija Canyon (LANL 2019c). Consultations by project staff with the Pueblo de San Ildefonso resulted in the identification of traditional cultural properties.

The next traditional cultural property consultations occurred 1996–1997, during the preparation of an ethnographic study in conjunction with the 1999 LANL SWEIS (DOE 1999a). This undertaking resulted in contact with 16 tribes and members of nearby Hispanic communities. The ethnographic study divided its classification of potential traditional cultural properties into five basic categories: ceremonial and archaeological sites, natural features, ethnobotanical gathering sites, artisan material gathering sites, and traditional subsistence features. Native American communities represented by the Pueblo of Acoma, Pueblo de Cochiti, Pueblo of Laguna, Pueblo of Picuris, Pueblo of Pojoaque, Pueblo of Sandia, Pueblo de San Ildefonso, Pueblo of Santa Clara, Pueblo of Zia, and Pueblo of Zuni indicated the use of traditional cultural properties from one or more of these categories on LANL land and/or cultural affiliation to LANL land (LANL 2019c). In addition to physical cultural places, concerns were expressed that “spiritual,” “unseen,” “un-documentable,” or “beingness” aspects can be present at LANL that are an important part of American Indian culture (NNSA 2008b).

In 2000, NNSA contacted 24 Native American communities and tribes as part of developing *A Comprehensive Plan for the Consideration of Traditional Cultural Properties and Sacred Sites at*

Los Alamos National Laboratory (LANL 2000). The purposes of the plan are "to provide a framework for identifying TCPs [traditional cultural properties] and sacred sites that tribal and other ethnic communities are willing to have documented within LANL so that their presence may be considered in future management decisions" (LANL 2000) and to identify whether the Native American communities have potential or known traditional cultural properties on LANL land. During development of the plan the Pueblo of Acoma, Pueblo de Cochiti, Pueblo of Jemez, Pueblo de San Ildefonso, Pueblo of Santa Clara, and the Hopi Tribe responded affirmatively, as did the Mescalero Apache Tribe.

Four Pueblo governments in the vicinity of LANL have signed individual Accord Agreements with NNSA (Pueblo of Santa Clara, Pueblo de San Ildefonso, Pueblo de Cochiti, and Pueblo of 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. In furtherance of these Accord Agreements, and specifically to address concerns and issues raised by tribes during development of the 2008 SWEIS, DOE developed a mitigation action plan, which is updated as needed to address specific concerns and issues raised by tribal communities (DOE 2008a; NNSA 2008b). 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, including those related to the Pueblos. NNSA continues to conduct consultations with the Accord Pueblos regarding the identification and preservation of traditional cultural properties, human, remains, and sacred objects at LANL.

A.4.9 Socioeconomics

This section is reserved.

A.4.10 Infrastructure

This section is reserved.

A.4.11 Waste Management

This section is reserved.

A.4.12 Transportation

This section is reserved.

A.4.13 Environmental Justice

This section provides supplemental supporting information related to Section 4.13.

A.4.13.1 Justice40 Initiative

Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," and the White House guidance memorandum, *Interim Implementation Guidance for the Justice40 Initiative* (White House 2021) established the Justice40 Initiative. The guidance memorandum provided direction to federal agencies on the Justice40Initiative and identified 21 pilot programs.

As detailed in the guidance memorandum, Justice40 Initiative-covered programs make covered investments in the following seven categories: climate change, clean energy and energy efficiency, clean transit, affordable and sustainable housing, training and workforce development, remediation and reduction of legacy pollution, and the development of critical clean water and wastewater infrastructure. Existing and new programs, including those created by the Bipartisan Infrastructure Law, that make covered investments in any of these categories are considered Justice40 covered programs.

Specifically relevant to this LANL SWEIS, the Justice40 Initiative at LANL focuses on efforts related to soil and groundwater remediation. EM-LA continues engagement and efforts to support the Justice40 Initiative, which directs certain federal investments to achieve a goal that 40 percent of the overall benefits flow to disadvantaged communities. EM-LA has conducted Justice40 Initiative engagements with stakeholders, Pueblos in northern New Mexico, local community organizations, and the public.

EM-LA is also engaged with the Community Engagement Grants, under which DOE has provided grants to the Santa Fe Indian School and the four Accord Pueblos as part of the Los Alamos Pueblos Project.

Since the launch of the Justice40 Initiative in EO 14008 and the subsequent guidance memorandum, the Federal Government has been applying the interim guidance and reviewing programs for inclusion in the Justice40 Initiative. DOE-EM's programs include the following:

- Community Engagement Cooperative Agreements
- Non-Superfund Soil and Groundwater Remediation at the following locations:
  - Moab Uranium Mill Tailings Remedial Action Project
  - Nevada National Security Site
  - Sandia National Laboratories
  - Idaho National Laboratory
  - Hanford Site
  - Savannah River Site
  - Los Alamos National Laboratory
- Community Engagement Grants

A.4.13.2 Federal Interagency Working Group on Environmental Justice and NEPA Committee

In 1994, EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," established the Federal Interagency Working Group on Environmental Justice (EJIWG) In 2011, a *Memorandum of Understanding on Environmental Justice and Executive Order 12898* identified NEPA as one of four areas of focus. The EJIWG established the NEPA Committee in 2012. The goal of the EJIWG NEPA Committee is to improve the effective, efficient, and consistent consideration of environmental justice issues in the NEPA process through the sharing of best practices, lessons learned, research, analysis, training, consultation, and other experiences of federal agencies' NEPA practitioners. To advance this goal, the EJIWG NEPA Committee produced *Promising Practices for EJ Methodologies in NEPA Reviews* (Promising Practices) (EJIWG 2016). In this 2016 report, federal agencies identified opportunities in the NEPA environmental review process for agencies to learn from communities about impacts on, and ways to provide protections for, minority populations, low-income populations, Indian tribes, and indigenous communities. Promising Practices compiles methodologies taken from current agency practices. It does not establish new requirements for NEPA analysis and is not intended to be legally binding or create rights and benefits for any person.

The EJIWG's *Community Guide to Environmental Justice and NEPA Methods* provides information for communities who want to assure that their environmental justice issues are adequately considered when there is a federal agency action that may involve environmental impacts on minority, low-income populations, and/or Indian tribes and indigenous communities. The guide lays out a framework for how federal agencies generally consider environmental justice in the NEPA process (EJIWG 2019). The guide provides guidance for the identification of minority and low-income populations. Promising Practices identifies three ways to identify the presence of minority populations:

- **The No-Threshold Analysis** – This analysis is a process that aims to identify all minority populations regardless of population size. Agencies select an appropriate geographic unit for review (such as a Census Block or a Block Group). Then agencies determine the total number of minority individuals and the percent minority population for each unit of analysis within the affected environment. Following that, agencies list and map the minority population(s) present in each geographic unit. The environmental analysis following this analysis can look at effects on all minority populations, even if they are small percentages of the overall population.
- **The Fifty-Percent Analysis** – This analysis identifies areas where there is a majority-minority population, where more than half of residents or potentially affected persons are defined as minorities. This analysis is used in combination with the Meaningfully Greater Analysis.
- **The Meaningfully Greater Analysis** – This analysis identifies instances where more people in the affected area are minorities than in the general population or in other areas used as reference areas. Agencies may either establish a percentage threshold (such as 10 percent or 20 percent) to discern that there is a "meaningfully greater" minority population in the affected area or determine that any percentage is sufficient to qualify.

The guide also provides guidance for the identification of low-income populations. Promising Practices identifies two ways to determine low-income populations:

- **The Alternative Criteria Analysis** – Using this analysis, the agency first chooses the official poverty level threshold that it will use. Then the agency selects a geographic area to analyze for low-income populations. The agency finds the total number of low-income individuals (or households) for each portion of the affected area and determines the percentage low-income units.
- **The Low-Income Threshold Criteria Analysis** – This approach is similar to the Alternative Criteria Analysis but includes an additional step. The Low-Income Threshold Criteria Analysis identifies and reports the number and percentage of low-income persons or households in each geographic unit. Then the agency takes an additional step of finding a reference community (such as a county or a state) with which to compare the affected community. The percentage of low-income residents in the two (reference community and affected community) areas are compared to see if there is a meaningful difference.

A.4.14 Environmental Remediation

Information regarding environmental remediation is provided in Appendix G.

A.5 Statutory Requirements and Environmental Standards

Activities at the Laboratory must be performed in a manner that ensures the protection of public health, safety, and the environment through compliance with all applicable federal, state, and local laws, regulations, and other requirements. This section identifies the statutory requirements and environmental standards that are applicable to the activities included in the alternatives addressed in this SWEIS. These requirements and standards originate from several sources. Federal and state statutes define broad environmental and safety programs and provide authorization to agencies to carry out the mandated programs. More specific requirements are established through regulations at both the federal and state level. Federal agencies, such as DOE/NNSA, receive additional direction in complying with executive policy through Executive Orders. In addition, DOE/NNSA has established regulations and management directives (DOE Orders) that are applicable to DOE/NNSA activities, facilities, and contractors. Regulations often include requirements for permits and consultations, which provide an in-depth, facility-specific review of the activities proposed. Laws, regulations, Executive Orders, and DOE Orders are discussed in Section A.5.1. Other regulatory activities and environmental permits are discussed in Sections A.5.2 and A.5.3, respectively.

A.5.1 Laws, Regulations, Executive Orders, and DOE Orders

Multiple federal agencies regulate specific aspects of activities that would be conducted at LANL. The EPA regulates air emissions, hazardous waste management, water quality, and emergency management. In many cases, the EPA delegated all or part of its environmental protection authorities to states, including Mew Mexico, but retains oversight authority. For example, air emissions are regulated by NMED.

DOE/NNSA imposes its own standards on many aspects of activities that would be conducted at the Laboratory through regulations, orders, and contract requirements related to facility design and operations, radioactive waste management, and health and safety, including radiation protection. U.S. Department of Transportation regulates commercial transportation of hazardous and radioactive materials.

Table A.5-1 provides a listing, of environmental laws, regulations, and other requirements, including, but not limited to, those mentioned below, that are potentially applicable to continued operations of the Laboratory.

Table A.5-1 Major Federal and State Environmental Laws, Regulations, and Executive Orders

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
General			
Atomic Energy Act of 1954, as amended	42 U.S.C. § 2011 et seq.	DOE	NNSA shall follow its own standards and procedures to ensure the safe operation of its facilities. The Act assigns responsibility to DOE for providing nuclear weapons to support U.S. national security strategy.
NEPA	42 U.S.C. § 4321 et seq.	CEQ	Establishes requirements for environmental impact statements. Statutory requirements for preparation of EISs apply to all major federal actions significantly affecting the environment. NNSA shall comply with NEPA implementing procedures in accordance with 10 CFR Part 1021. NNSA's NEPA compliance program is established in Policy NAP-451.1.
Regulations for Implementing the Procedural Provisions of NEPA	40 CFR Parts 1500–1508	CEQ	These regulations seek to integrate the NEPA process into the early planning phase of a project to insure appropriate consideration of NEPA policies and to eliminate delays, emphasize cooperative consultation among agencies before the environmental document is prepared, identify at an early stage the significant environmental issues deserving of study, provide a mechanism for putting appropriate time limits on the environmental documentation process, and provide for public participation in the NEPA process.
NEPA Implementing Procedures	10 CFR Part 1021	DOE	DOE established its NEPA implementing procedures to meet the requirements of Section 102(2)(c) of NEPA, CEQ implementing regulations, and EO 11514, Protection and Enhancement of Environmental Quality (35 FR 4247). DOE's implementing procedures formalize DOE's policy to follow the letter and spirit of NEPA, comply fully with the CEQ regulations, and apply the NEPA review process early in the planning stages for DOE proposals. This SWEIS is being prepared under 10 CFR §1021.330, programmatic (including site-wide) NEPA documents, requiring preparation of site-wide environmental documentation for certain of its large, multiple-facility sites.
EO 11514, "Protection and Enhancement of Environmental Quality"	3 CFR Parts 1966–1970 Comp., p. 902	CEQ	Requires federal agencies to demonstrate leadership in achieving the environmental quality goals of NEPA; provides for DOE consultation with appropriate federal, state, and local agencies in carrying out their activities as they affect the environment.

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations"	NA	EPA	Requires each federal agency to identify and address any disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations.
EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks"	NA	EPA	Requires each federal agency to identify and assess any environmental health risks and safety risks that may disproportionately affect children and ensure that its policies, programs, activities, and standards address these disproportionate risks.
EO 14008, "Tackling the Climate Crisis at Home and Abroad"	NA	Office of the President	Directs federal agencies to review regulations to ensure they are consistent with national objectives to improve public health and the environment; ensure access to clean air and water; limit exposure to dangerous chemicals and pesticides; hold polluters accountable, including those who disproportionately harm communities of color and low-income communities; reduce greenhouse gas emissions; bolster resilience to the impacts of climate change; restore and expand our national treasures and monuments; and prioritize both environmental justice and employment. In 2023 CEQ issued guidance on considering greenhouse gas emissions and climate change (88 FR 1196) consistent with this EO.
EO 14057, "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability"	NA	Office of the President	Announces policy to achieve a carbon pollution-free electricity sector by 2035 and net-zero emissions economy-wide by no later than 2050.
EO 14096, "Revitalizing Our Nation's commitment to Environmental Justice for All"	NA	Office of the President	Builds on the initiatives of EO 12898, strengthening the role of scientific, data-based research and analysis, along with the integration of environmental considerations within administrative functions.

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
Ecology			
Fish and Wildlife Coordination Act	16 U.S.C. § 661 et seq.	USFWS	Requires consultation on the possible effects on wildlife if there is construction, modification, or control of bodies of water in excess of 10 acres in surface area.
Bald and Golden Eagle Protection Act	16 U.S.C. § 668 et seq.	USFWS	Consultations should be conducted to determine if any protected birds are found to inhabit the area. If so, DOE must obtain a permit prior to moving any nests due to mission requirements.
Migratory Bird Treaty Act	16 U.S.C. § 703 et seq.	USFWS	Requires consultation to determine if there are any impacts on migratory bird populations due to mission requirements. If so, DOE will develop mitigation measures to avoid adverse effects.
Endangered Species Act of 1973	16 U.S.C. § 1531 et seq.	USFWS	Requires consultation to identify endangered or threatened species and their habitats, assess DOE impacts thereon, obtain necessary biological opinions, and, if necessary, develop mitigation measures to reduce or eliminate adverse effects of construction or operation.
EO 13112, "Invasive Species, as amended by EO 13751"	NA	Department of Interior, National Invasive Species Council	EO 13112 establishes the National Invasive Species Council. It requires federal agencies to act to prevent the introduction of invasive species and provide for their control; to implement restoration with native species; and to minimize actions that could spread invasive species. EO 13751 amended EO 13112 and included an updated definition of invasive species, which is "a non-native organism whose introduction causes or is likely to cause economic or environmental harm, or harm to human, animal, or plant health."
EO 13186, "Responsibilities of Federal Agencies to Protect Migratory Birds"	NA	USFWS	Requires federal agencies to avoid or minimize the adverse impact of their actions on migratory birds and to assure that environmental analyses under NEPA evaluate the effects of proposed federal actions on such species. A Memorandum of Understanding between DOE and USFWS implements the Order targeting the conservation and management of migratory birds and their habitats.
Air Quality and Noise			
Clean Air Act of 1970, as amended	42 U.S.C. § 7401 et seq.	EPA	Protects and enhances the nation's air quality. Requires federal agencies to comply with air quality regulations. NMED is the state agency charged with coordinating efforts to attain and maintain ambient air quality standards. The NMED Air Quality

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
			Bureau has authority over air quality in all areas of New Mexico except in Bernalillo County and on Tribal lands.
National Ambient Air Quality Standards	40 CFR Part 50	EPA	The *Clean Air Act* requires EPA to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The *Clean Air Act* establishes two types of NAAQS. Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.
National Emission Standards for Hazardous Air Pollutants (NESHAP)	40 CFR Part 61	EPA	Emissions of hazardous air pollutants, including radionuclides and asbestos that could be released during operation, demolition, or renovation of DOE facilities, are regulated under the NESHAP program.
EO 14008, "Tackling the Climate Crisis at Home and Abroad"	NA	Office of the President	Requires federal agencies use the appropriate tools and methodologies in quantifying the greenhouse gas emissions of their actions.
Noise Control Act of 1972	42 U.S.C. § 4901 et seq. as amended by the *Quiet Communities Act* of 1978	EPA	Protects the health and safety of the public from excessive noise levels. Requires federal agencies to comply with federal, state, and local noise abatement requirements.
Water			
Clean Water Act	33 U.S.C. § 1251 et seq.	EPA	Requires EPA- or state-issued permits and compliance with provisions of permits regarding discharge of effluents to surface waters.
Safe Drinking Water Act of 1944, as amended	42 U.S.C. § 300f	EPA	This Act sets national standards for contaminant levels in public drinking water systems, regulates the use of underground injection wells, and prescribes standards for groundwater aquifers that are a sole source of drinking water. The Act applies to federal facilities that own or operate a public water system. A public water system is

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
			defined as a system for the provision of piped water for human consumption that has at least 15 service connections or regularly serves at least 25 individuals. The Laboratory provides drinking water to its employees and is required to monitor drinking water quality for organic and inorganic compounds, radionuclides, metals, turbidity, and total coliform bacteria.
NPDES Stormwater Permit	33 U.S.C. § 1342	NMED	The NPDES Stormwater Program requires operators of construction sites, industrial facilities, and municipal separate storm sewer systems to obtain authorization to discharge stormwater under an appropriate NPDES permit for construction, industrial, or municipal operations. Federal facilities have been defined by regulation to be a municipal separate storm sewer system.
Dredged or Fill Material (Section 404 of the *Clean Water Act*)/*Rivers and Harbors Appropriations Act of 1899*	33 U.S.C. § 1344 33 U.S.C. § 401 et seq.	USACE	Requires permits to authorize the discharge of dredged or fill material into navigable waters or wetlands and to authorize certain structures or work in or affecting navigable waters.
Floodplain Management	Executive Order 11988 10 CFR Part 1022	DOE	Addresses concerns over the potential loss of the natural and beneficial functions of the nation's floodplains as well as the increased cost to federal, state and local governments from flooding disasters that are worsened by unwise development of the floodplain.
Protection of Wetlands	Executive Order 11990 10 CFR Part 1022	DOE	This Order (implemented by DOE in 10 CFR Part 1022) requires federal agencies to avoid any short- or long-term adverse impacts on wetlands wherever there is a practicable alternative. Each agency must also provide opportunities for early public review of any plans or proposals for new construction in wetlands.
Cultural and Paleontological			
National Historic Preservation Act of 1966	54 U.S.C. § 300101 et seq. 36 CFR Part 800	ACHP	Protects historic properties. Section 106 of this Act requires consultation with the State Historic Preservation Officer and other consulting parties prior to any federal funding, permit, or action that could affect National Register of Historic Properties-eligible historic properties. Additional provisions of the Act provide direction to

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
			federal agencies on the protection and management of cultural resources located on federally managed lands.
Carl Levin and Howard P. "Buck" McKean National Defense Authorization Act for FY 2015	P.L. 113-291	NPS	Established the Manhattan Project National Historical Park, which is implemented through a Memorandum of Agreement Between the United States Department of Interior and the United States Department of Energy for the Manhattan Project National Historical Park, signed on November 10, 2015. The Memorandum of Agreement establishes roles and responsibilities between the two federal agencies for historic properties located within the park. The park includes significant historic properties at Los Alamos, New Mexico; Hanford, Washington; and Oak Ridge, Tennessee.
National Register of Historic Places	54 U.S.C. § 302101 et seq. 36 CFR Part 60	NPS	Sets forth the procedural requirements for listing properties in the National Register of Historic Places.
American Indian Religious Freedom Act of 1978	42 U.S.C. § 1996	Office of the President	Reaffirms American Indian religious freedom under the First Amendment and sets U.S. policy to protect and preserve the inherent and constitutional right of American Indians to believe, express, and exercise their traditional religions. The Act requires that federal actions avoid interfering with access to sacred locations and traditional resources that are integral to the practice of religions.
Native American Graves Protection and Repatriation Act of 1990	25 U.S.C. § 3001 et seq. 43 CFR Part 10	NPS	Protects American Indian burial remains, funerary objects, sacred objects, and objects of cultural patrimony found on federal or Tribal land.
Archaeological Resources Protection Act of 1979	16 U.S.C. §§ 470aa–mm 32 CFR Part 229	Federal agencies	Makes it a federal offense to excavate, remove, damage, alter, or otherwise deface archaeological resources on federal lands without authorization. Permits allowing for professional archaeological excavations can be granted by the land-managing agency.
Indian Sacred Sites	Executive Order 13007	Office of the President	Directs federal agencies, to the extent practicable, as permitted by law, and not clearly inconsistent with essential agency functions, to: (1) accommodate access to and ceremonial use of American Indian sacred sites by their religious practitioners,

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
			and (2) avoid adversely affecting the physical integrity of such sacred sites. Where appropriate, agencies are to maintain the confidentiality of sacred sites.
Protection and Enhancement of the Cultural Environment	Executive Order 11593	Office of the President	Directs federal agencies to administer cultural properties under their control in a spirit of stewardship and to direct their policies, plans, and programs such that cultural resources are preserved and maintained.
Antiquities Act of 1906	16 U.S.C. §§ 431–433	Federal agencies	Establishes a penalty for the unlawful appropriation, excavation, or injury to any "historic or prehistoric ruin or monument, or any object of antiquity" that is situated on federal lands or federally controlled lands. Paleontological resources that have significant research potential are protected under this law.
Worker Health and Safety			
Occupational Safety and Health Act of 1970	29 U.S.C. § 651 et seq.	OSHA	Ensures worker and workplace safety, including a workplace free from recognized hazards, such as exposure to toxic chemicals, excessive noise levels, and mechanical dangers.
Occupational Safety and Health Standards	29 CFR Part 1910 29 CFR Part 1926	OSHA	Protect workers from hazards encountered in the workplace (Part 1910) and at the construction site (Part 1926).
Worker Safety and Health Program	10 CFR Part 851	DOE	Defines controls and monitoring of hazardous materials to ensure that workers are not being exposed to health hazards, such as toxic chemicals, excessive noise, and ergonomic stressors.
Chronic Beryllium Disease Prevention Program	10 CFR Part 850	DOE	Established to reduce the number of workers currently exposed to beryllium in the course of their work at DOE facilities managed by DOE or its contractors, minimize the levels of, and potential for, exposure to beryllium, and establish medical surveillance requirements to ensure early detection of the disease.
Chemical Accident Prevention Provisions	40 CFR Part 68	EPA	Provides the list of regulated substances and thresholds, and the requirements for owners or operators of stationary sources concerning the prevention of accidental releases.
Occupational Radiation Protection	10 CFR Part 835	DOE	Defines radiation protection standards, limits, and program requirements for protecting workers from ionizing radiation resulting from DOE activities.

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
Traffic and Transportation			
Hazardous Materials Transportation Act	49 U.S.C. § 5101 et seq.	USDOT	Provides the USDOT with authority to protect against the risks associated with transportation of hazardous materials, including radioactive materials, in commerce.
Packaging and Transportation of Radioactive Material	10 CFR Part 71	NRC	Regulations include detailed packaging design requirements and package certification testing requirements. Complete documentation of design and safety analysis and the results of required certification tests are submitted to NRC to certify the package for use.
Hazardous Materials Regulations	49 CFR Parts 171–185, 385, 397	USDOT	Establish USDOT requirements for classification, packaging, hazard communication, incident reporting, handling, and transportation of hazardous materials; hazardous materials safety permits; and driving and parking rules.
Hazardous Waste and Materials Management			
Toxic Substances Control Act (TSCA)	15 U.S.C. § 2601 et seq.	EPA	Addresses the production, import, use, and disposal of specific chemicals, including polychlorinated biphenyl (PCBs). 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: (1) dielectric fluids, (2) solvents, (3) oils, (4) waste oils, (5) heat-transfer fluids, (6) hydraulic fluids, (7) slurries, (8) soil, and (9) materials contaminated by spills.
Emergency Planning and Community Right-To-Know Act of 1986	42 U.S.C. § 11001 et seq.	EPA	Requires the development of emergency response plans and reporting requirements for chemical spills and other emergency releases, and imposes right-to-know reporting requirements covering storage and use of chemicals that are reported in toxic chemical release forms.
Federal Facility Compliance Act of 1992	42 U.S.C. § 6961	NMED	The Act requires federal facilities that generate or store mixed radioactive and hazardous wastes to submit a Site Treatment Plan that includes a schedule for developing capacities and technologies to treat all mixed waste.
RCRA/Hazardous and Solid Waste Amendments of 1984	42 U.S.C. § 6901 et seq./ P.L. 98-616	EPA/NMED	RCRA regulates wastes from generation to disposal. Hazardous wastes include all solid wastes that are (1) listed as hazardous by the EPA (listed wastes); (2) ignitable, corrosive, reactive, or toxic (characteristic wastes); or (3) batteries, pesticides, lamp bulbs, or contain mercury. Mixed radioactive waste (also called mixed waste) is listed as hazardous, and characteristic hazardous waste is commingled with

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
			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.
Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level, and Transuranic Radioactive Wastes	40 CFR Part 191	DOE	Indicates the standard for radiation doses received by members of the public as a result of the management (except for transportation) and storage of used nuclear fuel, high-level radioactive wastes, and TRU waste.
Low-Level Radioactive Waste Policy Act of 1980	42 U.S.C. § 2021 et seq.	DOE	Specifies that the Federal Government is responsible for the disposal of certain LLW, including LLW owned or generated by DOE.
Licensing Requirements for Land Disposal of Radioactive Waste	10 CFR Part 61	NRC	These regulations establish the procedures, criteria, terms, and conditions upon which NRC issues licenses for land disposal of LLW containing byproduct, source, and special nuclear material. These regulations do not apply to high-level radioactive waste or DOE-managed LLW, but do apply to LLW managed in commercial facilities, regardless of the generator. The regulations also apply to LLW such as MLLW that is also regulated under other statutory authorities.
Radioactive Waste Management	DOE Order 435.1	DOE	The objective of DOE Order 435.1 is to ensure that all DOE/NNSA radioactive waste is managed in a manner that is protective of worker and public health and safety and the environment. The Order is implemented through DOE Manual 435.1, "Radioactive Waste Management Manual," which addresses the management of DOE high-level waste, transuranic waste, low-level waste, and the radioactive component of mixed waste. The purpose of the manual is to catalog those procedural requirements and existing practices that ensure that DOE elements and contractors continue to manage DOE's radioactive waste to the requirements in the Order.

Law or Regulation	Citation	Responsible Agency	DOE/NNSA Responsibilities
Byproduct Material	10 CFR Part 962	DOE	Applies only to radioactive waste substances which are owned or produced by DOE at facilities owned or operated by or for DOE under the Atomic Energy Act of 1954. This part does not apply to substances which are not owned or produced by DOE.
WIPP Land Withdrawal Act, as amended	P.L. 102-79	DOE	Withdrew land from the public domain for the purpose of creating and operating the WIPP facility in New Mexico as the national disposal site for defense TRU waste. The Act also defined the characteristics and amount of waste that will be disposed of at the facility. Amendments to the Act exempt waste to be disposed of at WIPP from the RCRA land disposal restrictions.

ACHP = Advisory Council on Historic Preservation; CFR = Code of Federal Regulations; et seq. = and what follows; EO = Executive Order; FR = Federal Register; LLW = low-level radioactive waste; MLLW = mixed LLW; NA = not applicable; NESHAP = National Emission Standards for Hazardous Air Pollutants; NMED = New Mexico Environment Department; NPDES = National Ambient Air Quality Standards; NPS = National Park Service; NRC = U.S. Nuclear Regulatory Commission; OSHA = Occupational Safety and Health Administration; PCBs = polychlorinated biphenyls; P.L. = Public Law; USACE = U. S. Army Corps of Engineers; U.S.C. = United States Code; USDOT = U.S. Department of Transportation; USFWS = U.S. Fish and Wildlife Service

A.5.2 Regulatory Activities

Activities associated with implementation of the alternatives would be conducted in accordance with a variety of applicable laws and regulations. Below is a brief discussion of the major laws and regulations that would apply to continuation of operations at LANL.

With respect to design requirements, the major DOE design criteria are found in DOE Order 6430.1A (1989), "General Design Criteria," and its successive Orders 420.1C, Change 3 (2019), "Facility Safety," and 430.1C, "Real Property Asset Management," which delineate applicable regulatory and industrial codes and standards for both conventional facilities designed to industrial standards and "special facilities," defined as nonreactor nuclear facilities and explosive facilities. Nuclear facilities would also comply with all the requirements of 10 CFR Part 830, "Nuclear Safety Management." 10 CFR Part 830 provides both quality assurance and safety requirements for the design and operations of the facilities, as documented in the required facility safety analysis. Prior to operation, the facilities would undergo cold and hot startup testing and an operational readiness review in accordance with the requirements of DOE Order 425.1D, Change 2 (2019), "Verification of Readiness to Start Up or Restart Nuclear Facilities." Prior to startup, NNSA would prepare a safety evaluation report to evaluate the proposed safety basis and controls for the new facilities and would obtain approval of the NNSA Administrator or designee prior to startup.

Nuclear facilities would need to comply with 10 CFR Part 820, "Procedural Rules for DOE Nuclear Facilities," and other applicable regulations and standards related to worker and public health and safety and environmental protection, including radiation protection standards (10 CFR Part 835, "Occupational Radiation Protection," and 10 CFR Part 851, "Worker Safety and Health Program"). Occupational Safety and Health Administration regulations governing industrial safety aspects of chemical risks to workers would apply. Also, radiological exposure levels to members of the public would apply, as regulated under DOE O 458.1, "Radiation Protection of the Public and the Environment" (DOE Order 458.1 2020), 40 CFR Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities," for radionuclide emissions to air. The protection of the environment from chemical risks is regulated by EPA and NMED.

Federal or state regulations implementing the *Clean Water Act* and the *Clean Air Act* would also be applicable. In addition, DOE requirements affecting site interfaces and infrastructure would also be applicable. These regulations are implemented through permits, mainly through NMED. Prior to any new facility operations, an evaluation would be required to determine whether emissions and activities require modification of existing permits and the acquisition of additional air and water permits.

At the Laboratory, radioactive wastes are managed in accordance with DOE Order 435.1 and Manual 435.1-1. TRU waste would be generated routinely as a result of operations, environmental remediation, and DD&D of radiologically contaminated facilities, but would be regularly shipped offsite to WIPP for disposal. Before any TRU waste could be sent to WIPP for disposal, DOE/NNSA would prepare or modify waste certification plans, quality assurance plans, and TRU waste authorized methods for payload control, as applicable. Methods of compliance with each requirement and associated criteria to be implemented at the Laboratory shall be described or specifically referenced and shall include procedural and administrative controls consistent with the Carlsbad Field Office *Quality Assurance Program Document* (DOE 2017). DOE/NNSA would be required to submit these program documents to the Carlsbad Field Office for review and approval prior to their implementation (DOE 2017). DOE/NNSA would then certify that each container of TRU waste intended for transport to WIPP meets the most current waste acceptance criteria (DOE 2016).

Operations, environmental remediation, and DD&D at Laboratory would produce solid LLW. Offsite disposal of LLW at the Nevada Nuclear Security Site (or a commercial facility such as Waste Control Specialists or Energy*Solutions*) would be contingent on waste meeting the disposal facility's waste acceptance criteria and adherence to the associated performance assessment. The performance assessment sets limits based on the type and amount of radionuclides and still meet the worker and public health and safety performance standards and other applicable regulatory criteria for the disposal facility.

A.5.3 Permits and Compliance Orders

The various missions at the Laboratory require a variety of permits or are performed in accordance with compliance orders. Many of the activities associated with continued operations of the Laboratory would be conducted within existing structures in developed areas of the LANL Site, would use existing infrastructure, and would operate under existing permits. The need for new permits or modifications to existing permits would depend on new construction, DD&D of existing structures, and operation scenarios. Prior to project implementation, required environmental permits would be obtained in accordance with federal, state, and local requirements. As identified in Chapter 1, Section 1.3, 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 (NMED 2016a). As identified in Chapter 4, Section 4.14.2, the 2016 Consent Order establishes an annual process by which DOE and NMED jointly determine cleanup activities. Table A.5-2 is a summary of active permits and compliance orders as of 2022 at the Laboratory.

Table A.5-2 Active Permits and Compliance Orders at the Laboratory, 2022

Permit Name	Activity	Issuing and Revision Dates	Expiration Date	Lead Agency
LANL Hazardous Waste Facility Permit	A permit regulating management of hazardous wastes at the Laboratory, including storage and treatment. This permit also has standards for closure of indoor and outdoor areas used for hazardous waste storage or treatment.	Renewed November 2010	December 2020 (Administratively continued until new permit is effective)	NMED
Administrative Compliance Order No. HWB-14-20 Settlement Agreement and Stipulated Final Order (Supplemental Environmental Projects) (NMED 2016b)	Settlement of Administrative Compliance Order No. HWB-14-20 issued on December 6, 2014, for violations of the Hazardous Waste Act and the Laboratory's Hazardous Waste Facility Permit associated with the WIPP drum breach. As part of the settlement, DOE is funding a series of supplemental environmental projects, including road improvements on transport routes to WIPP.	Settlement Agreement and Stipulated Final Order finalized on January 22, 2016	None	NMED
Compliance Order on Consent (NMED 2016a)	An order giving requirements for the investigation, corrective actions, and monitoring of Solid Waste Management Units and Areas of Concern.	Issued March 1, 2005 Revised October 29, 2012 Replaced by 2016 Compliance Order on Consent on June 24, 2016 2016 Compliance Order on Consent modified February 2017	None Transferred to N3B on April 30, 2018	NMED

Permit Name	Activity	Issuing and Revision Dates	Expiration Date	Lead Agency
Federal Facilities Compliance Order [for Mixed Wastes]	An order requiring the Laboratory to submit an annual update to its Site Treatment Plan for treating all mixed hazardous and radiological wastes (mixed waste).	Issued October 4, 1995 Amended May 20, 1997	None	NMED
Clean Air Act, Title V Operating Permit	A permit regulating air emissions from Laboratory operations (i.e., emissions from the power plant, asphalt batch plant, permanent generators, etc.). These emissions are subject to operating, monitoring, and recordkeeping requirements.	Issued August 7, 2009 Reissued October 17, 2018	February 27, 2020 [Administratively continued until new permit is effective]	NMED
Authorization to Discharge [from Outfalls] under the NPDES	A permit authorizing the Laboratory to discharge industrial and sanitary liquid effluents through outfalls under specific conditions, including water quality requirements and monitoring requirements. LANL Industrial Wastewater Permit - Final NPDES Permit No. NM0028355 EPA.	Issued August 12, 2014 Effective October 1, 2014 Modified May 1, 2015 Reissued March 30, 2022 Effective May 1, 2022	April 30, 2027	EPA
NPDES General Permit for Discharges of Storm Water from Construction Sites	A general permit (not LANL-specific) authorizing the discharge of pollutants during construction activities under specific conditions. Conditions include water quality requirements, inspection requirements, erosion and sediment controls, notices of intent to discharge, preparation of stormwater pollution prevention plans, and other conditions.	Effective February 16, 2022	February 16, 2027	EPA

Permit Name	Activity	Issuing and Revision Dates	Expiration Date	Lead Agency
NPDES Multi-Sector General Permit for Storm Water Discharges Associated with Industrial Activity	A general permit (not LANL-specific) authorizing facilities with some industrial activities to discharge stormwater and some non-storm-water runoff. The permit provides specific conditions for the authorization, including pollutant limits to meet water quality standards, inspection requirements, compliance with biological and cultural resource protection laws, and other conditions.	The 2021 Multi-Sector General Permit was issued on February 19, 2021 (86 FR 10269) and became effective on March 1, 2021	February 28, 2026	EPA
[Individual Permit] Authorization to Discharge [from Solid Waste Management Units and Areas of Concern] under the NPDES	A permit authorizing the Laboratory to discharge stormwater from 405 Solid Waste Management Units and Areas of Concern under specific conditions. Conditions include requirements for monitoring and for corrective actions where necessary to minimize pollutants in the stormwater discharges. LANL - Storm Water Individual Permit - NPDES Permit No. NM0030759	Issued August 1, 2022	July 31, 2027	EPA

Permit Name	Activity	Issuing and Revision Dates	Expiration Date	Lead Agency
Clean Water Act, Section 404/401 Permits	U.S. Army Corps of Engineers authorizes certain work within water courses at the Laboratory under *Clean Water Act* Section 404 permits. The projects below were authorized to operate under a Section 404 nationwide permit with Section 401 certification. The following projects had an ongoing annual monitoring requirement: • Water Canyon Storm Drain Reconstruction Project • Mortandad Wetland Enhancement • Technical Area 72 Firing Site Storm Water Control	Effective January 4, 2021 (Four new nationwide permits, 12 nationwide permits reissued, 40 2017 nationwide permits remain effective.) Annual monitoring and reporting required through 2023 Annual monitoring and reporting required through 2022 Annual monitoring and reporting required through 2023	January 3, 2026 (all current nationwide Section 404 permits)	USACE and NMED (all permits and verifications)
Groundwater Discharge Permit DP-857	A permit authorizing discharges to groundwater from the Laboratory's sanitary wastewater system plant and the Sanitary Effluent Reclamation Facility.	Issued December 16, 2016	December 16, 2021 (Administratively continued)	NMED

Permit Name	Activity	Issuing and Revision Dates	Expiration Date	Lead Agency
Groundwater Discharge Permit DP-1589	A permit authorizing discharges to groundwater from the Laboratory's septic tank/disposal systems.	Issued May 17, 2023	May 16, 2028	NMED
Groundwater Discharge Permit DP-1793	A permit authorizing discharges to groundwater from the Laboratory's land application of treated groundwater.	Issued July 27, 2015	December 16, 2021 Permit reapplication was submitted to NMED on June 17, 2021; issuance of the renewed permit is pending	NMED
Groundwater Discharge Permit DP-1835	A permit authorizing discharges to groundwater from the Laboratory's injection of treated groundwater into six Class V underground injection control wells.	Issued August 31, 2016	July 22, 2021 A permit reapplication was submitted to NMED on January 20, 2021; issuance of the renewed permit is pending	NMED

Permit Name	Activity	Issuing and Revision Dates	Expiration Date	Lead Agency
Groundwater Discharge Permit DP-1132	A permit authorizing discharges to groundwater from the Laboratory's Radioactive Liquid Waste Treatment Facility to three discharge locations: NPDES Outfall 051, mechanical evaporator system, or solar evaporative tank system.	May 5, 2022	May 4, 2027	NMED
NPDES Pesticide General Permit	A general permit authorizing the discharge of pesticides that have potential to enter waters of the United States.	Issued October 31, 2021	October 31, 2026	EPA

EPA = U.S. Environmental Protection Agency; NMED = New Mexico Environment Department; USACE = U.S. Army Corps of Engineers

A.6 Cumulative Impacts – Supplemental Information

This section is reserved.

A.7 References

61 FR 68014. "Record of Decision Programmatic Environmental Impact Statement for Stockpile Stewardship and Management." *Federal Register*. Department of Energy. December 26, 1996. Available online: https://www.govinfo.gov/content/pkg/FR-1996-12-26/pdf/96-32759.pdf

64 FR 50797. "Record of Decision: Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory in the State of New Mexico." *Federal Register*. Department of Energy. September 20, 1999. Available online: https://www.govinfo.gov/content/pkg/FR-1999-09-20/pdf/99-24456.pdf

65 FR 14952. "Record of Decision: Conveyance and Transfer of Certain Land Tracts Administered by the Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico." *Federal Register*. Department of Energy. March 20, 2000. Available online: https://www.govinfo.gov/content/pkg/FR-2000-03-20/pdf/00-6504.pdf

69 FR 6967. "Record of Decision: Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project, Los Alamos National Laboratory, Los Alamos, NM." *Federal Register*. National Nuclear Security Administration, Department of Energy. February 12, 2004. Available online: https://www.govinfo.gov/content/pkg/FR-2004-02-12/pdf/04-3096.pdf

73 FR 55833. "Record of Decision: Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, NM." Federal Register. Department of Energy, National Nuclear Security Administration. September 26, 2008. Available online: https://www.govinfo.gov/content/pkg/FR-2008-09-26/pdf/E8-22619.pdf

74 FR 33232. "Record of Decision : Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, NM." *Federal Register*. National Nuclear Security Administration, U.S. Department of Energy. July 10, 2009. Available online: https://www.govinfo.gov/content/pkg/FR-2009-07-10/pdf/E9-16343.pdf

73 FR 77644. "Record of Decision for the Complex Transformation Supplemental Programmatic Environmental Impact Statement—Operations Involving Plutonium, Uranium, and the Assembly and Disassembly of Nuclear Weapons." *Federal Register*. National Nuclear Security Administration, Department of Energy. December 19, 2008. Available online: https://www.govinfo.gov/content/pkg/FR-2008-12-19/pdf/E8-30193.pdf

74 FR 33232. "Record of Decision: Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, NM." *Federal Register*. National Nuclear Security Administration, Department of Energy. July 10,

2009. Available online: https://www.govinfo.gov/content/pkg/FR-2009-07-10/pdf/E9-16343.pdf

76 FR 40352. "National Nuclear Security Administration; Amended Record of Decision: Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, NM." *Federal Register*. National Nuclear Security Administration, U.S. Department of Energy. July 8, 2011. Available online: https://www.govinfo.gov/content/pkg/FR-2011-07-08/pdf/2011-17161.pdf

77 FR 3257. "Transfer of Land Tracts Located at Los Alamos National Laboratory, New Mexico." *Federal Register*. National Nuclear Security Administration, Department of Energy. Available online: https://www.govinfo.gov/content/pkg/FR-2012-01-23/pdf/2012-1208.pdf

81 FR 19588. "Surplus Plutonium Disposition." Federal Register. National Nuclear Security Administration, Department of Energy. April 5, 2016. Available online: https://www.govinfo.gov/content/pkg/FR-2016-04-05/pdf/2016-07738.pdf

85 FR 53350. "Surplus Plutonium Disposition." *Federal Register*. National Nuclear Security Administration, Department of Energy. August 29, 2020. Available online: https://www.govinfo.gov/content/pkg/FR-2020-08-28/pdf/2020-19023.pdf

85 FR 54544. "Amended Record of Decision for the Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, NM." *Federal Register*. National Nuclear Security Administration, Department of Energy. September 2, 2020. Available online: https://www.govinfo.gov/content/pkg/FR-2020-09-02/pdf/2020-19349.pdf

89 FR 3642. "Notice of Availability of Final Environmental Impact Statement for the Surplus Plutonium Disposition Program." *Federal Register*. National Nuclear Security Administration, Department of Energy. January 19, 2024. Available online: https://www.govinfo.gov/content/pkg/FR-2024-01-19/pdf/2024-00890.pdf

89 FR 28763. "Record of Decision for the Final Environmental Impact Statement for the Surplus Plutonium Disposition Program." *Federal Register*. National Nuclear Security Administration, Department of Energy. April 19, 2024. Available online: https://www.govinfo.gov/content/pkg/FR-2024-04-19/pdf/2024-08390.pdf

15 U.S.C. § 2601 et seq. "Toxic Substance Control Act." Available online: http://uscode.house.gov/view.xhtml?path=/prelim@title15/chapter53&edition=prelim

42 U.S.C. § 2391. "Assistance to Government Entities." Available online: https://uscode.house.gov/view.xhtml?req=granuleid:USC-1999-title42-section2391&num=0&edition=1999

50 U.S.C. § 2538a. "Plutonium Pit Production Capacity." Available online: https://uscode.house.gov/view.xhtml?req=granuleid:USC-prelim-title50-section2538a&num=0&edition=prelim

Berryhill, J.T.; J.E. Stanek; E.J. Abeyta; and C.D. Hathcock. 2020. *Sensitive Species Best Management Practices Source Document*. Revision 1. LA-UR-20-24514. Los Alamos National Laboratory. July 9. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-20-24514

BDD (Buckman Direct Diversion) 2022. "How the BDD Works." Available online: https://bddproject.org/about-the-bdd/how-the-bdd-works/

CDC (Centers for Disease Control). 2020. *Biosafety in Microbiological and Biomedical Laboratories*. 6th Edition. June. Available online: https://www.cdc.gov/labs/pdf/SF__19_308133-A_BMBL6_00-BOOK-WEB-final-3.pdf

City of Santa Fe 2022. *City of Santa Fe 2021 Water Quality Table Regulated Compliance Monitoring*. January Available online: https://santafenm.gov/Water_Quality_Report_2021_Final.pdf

DNFSB (Defense Nuclear Facility Safety Board). 2023. Letter from The Honorable Joyce L. Connery, Chair, Defense Nuclear Facility Safety Board to The Honorable Jennifer M. Granholm, Secretary of Energy. August 15. Available online: https://www.dnfsb.gov/sites/default/files/document/29006/LANL%20PF-4%20Interim%20Seismic%20Risk%20Closeout%20%5b2023-100-023%5d.pdf

DoD (U.S. Department of Defense) 2022. *Nuclear Posture Review*. Office of the Secretary of Defense. October 2022. Available online: https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.PDF

DOE (U.S. Department of Energy) 1979. *Los Alamos Scientific Laboratory, Los Alamos, New Mexico.* DOE/EIS-0018. December. Available online: https://www.energy.gov/sites/default/files/2014/12/f19/EIS-0018_FEIS.pdf

DOE (U.S. Department of Energy) 1980. *Environmental Impact Statement Waste Isolation Pilot Plant*. DOE/EIS-0026. October. Available online: https://www.energy.gov/nepa/downloads/eis-0026-final-environmental-impact-statement

DOE (U.S. Department of Energy) 1981. "Waste Isolation Pilot Plant Record of Decision." Volume 46 of the *Federal Register*, page 9162. Available online: https://www.energy.gov/sites/prod/files/2016/12/f34/EIS-0026-ROD-1981.pdf

DOE (U.S. Department of Energy) 1990a. *Final Supplement Environmental Impact Statement Waste Isolation Pilot Plant*. DOE/EIS-0026-FS. Office of Environmental Restoration and Waste Management. January. Available online: https://www.energy.gov/nepa/downloads/eis-0026-s1-final-supplemental-environmental-impact-statement

DOE (U.S. Department of Energy) 1990b. "Record of Decision; Waste Isolation Pilot Plant." Volume 55 of the *Federal Register*, page 25689. Available online: https://www.energy.gov/sites/prod/files/2016/12/f34/EIS-0026-S1-ROD-1990.pdf

DOE (U.S. Department of Energy) 1995. *Dual Axis Radiographic Hydrodynamic Test Facility Final Environmental Impact Statement*. DOE/EIS-0228. Available online: https://www.energy.gov/nepa/articles/doeeis-0228-final-environmental-impact-statement-august-1995

DOE (U.S. Department of Energy) 1996. *Programmatic Environmental Impact Statement for Stockpile Stewardship and Management*. DOE/EIS-0236. ID 1065. July 10, 1996. Available online: https://www.energy.gov/nepa/listings/eis-0236-documents-available-download?page=1

DOE (U.S. Department of Energy) 1997a. *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement*. DOE/EIS-0026-S2. Carlsbad Area Office, Carlsbad, New Mexico. September. Available online: https://www.energy.gov/nepa/downloads/eis-0026-s2-final-supplemental-environmental-impact-statement

DOE (U.S. Department of Energy) 1997b. *Waste Management Programmatic Environmental Impact Statement for Managing Treatment, Storage, and Disposal of Radioactive and Hazardous Waste*. DOE/EIS-0200-F, Office of Environmental Management, Washington, D.C. May. Available online: https://www.energy.gov/nepa/articles/doeeis-0200-final-programmatic-environmental-impact-statement-june-1997

DOE (U.S. Department of Energy) 1998. "Record of Decision for the Department of Energy's Waste Isolation Pilot Plant Disposal Phase." Volume 63 of the *Federal Register*, page 3624. Available online: https://www.energy.gov/sites/prod/files/2014/03/f10/EIS-0026-ROD-1998.pdf

DOE (U.S. Department of Energy) 1999a. *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EIS-0238. January 1999. Available online: https://www.energy.gov/nepa/articles/eis-0238-site-wide-environmental-impact-statement

DOE (U.S. Department of Energy) 1999b. *Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico*. DOE/EIS-0293. October 1, 1999. Available online: https://www.energy.gov/nepa/articles/doeeis-0293-final-environmental-impact-statement-october-1999

DOE (U.S. Department of Energy) 2008. *2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory (DOE/EIS 0380) Mitigation Action Plan*. December. Available online: https://www.energy.gov/sites/default/files/nepapub/nepa_documents/RedDont/EIS-0380-MAP-2008.pdf

DOE (U.S. Department of Energy) 2015. *Final Environmental Assessment for Chromium Plume Control Interim Measure and Plume-Center Characterization, Los Alamos National*

Laboratory, Los Alamos, New Mexico. DOE/EA-2005. December. Available online: https://www.energy.gov/sites/default/files/2015/12/f27/EA-2005-FEA-2015.pdf

DOE (U.S. Department of Energy) 2016. *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Plant.* DOE/WIPP-02-3122. Revision 8.0. Carlsbad, NM. July 5, 2016. Available online: https://www.wipp.energy.gov/library/wac/WAC.pdf

DOE (U.S. Department of Energy) 2017. *Quality Assurance Program Document*. DOE/CBFO-94-1012, Rev. 14. Carlsbad Field Office, Carlsbad, NM. Available online at: https://wipp.energy.gov/Library/qapd/QAPD_Rev_14_Final_SOF.pdf

DOE (U.S. Department of Energy) 2020. *Mitigation Action Plan for Los Alamos National Laboratory Operations*. September. Available online: https://www.energy.gov/nepa/articles/mitigation-action-plan-lanl-operations-september-2020

DOE (U.S. Department of Energy) 2024. *Final Chromium Interim Measure and Final Remedy Environmental Assessment, Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EA-2216. July. Available online: https://www.energy.gov/nepa/doeea-2216-chromium-interim-measure-and-final-remedy-los-alamos-new-mexico

EJIWG (Federal Interagency Working Group on Environmental Justice) 2016. *Promising Practices for EJ Methodologies in NEPA Reviews*. March. Available online: https://www.epa.gov/sites/default/files/2016-08/documents/nepa_promising_practices_document_2016.pdf

EJIWG (Federal Interagency Working Group on Environmental Justice) 2019. *Community Guide to Environmental Justice and NEPA Methods Product.* March. Available online: https://www.energy.gov/lm/articles/community-guide-ej-and-nepa-methods-2019

Hansen, L.A.; A.N. Skurikhin; and B.J. Sutter. 2018. *An Updated Land Cover Map and Descriptions of Vegetative Communities for Los Alamos National Laboratory and Surrounding Areas*. Revision 1. LA-UR-18-23397. Los Alamos National Laboratory. January 7. https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-18-23397

LANL (Los Alamos National Laboratory) 2000. *A Comprehensive Plan for the Consideration of Traditional Cultural Properties and Sacred Sites at Los Alamos National Laboratory, New Mexico*. LA-UR-00-2400. Review Draft. April 1. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-00-2400

LANL (Los Alamos National Laboratory) 2007. *Site wide operations in support of the mission of Los Alamos National Laboratory*. LA-UR-07-2983. April. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-07-2983

LANL (Los Alamos National Laboratory) 2012. *SWEIS Yearbook 2010 Comparison of 2010 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-12-01648. April.

Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-12-01648

LANL (Los Alamos National Laboratory) 2013. "Fact Sheet: Material Disposal Areas and the Threat of Wildfire." Available online: https://www.energy.gov/sites/prod/files/2015/07/f25/DOE_Response_2013-02.pdf

LANL (Los Alamos National Laboratory) 2014a. *Nuclear Criticality Safety Program Upgrades Project Management Plan*. NCS-Plan-14-001. June 30.

LANL (Los Alamos National Laboratory) 2014b. *SWEIS Yearbook 2012 Comparison of 2012 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-13-29469. January 16. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-13-29469

LANL (Los Alamos National Laboratory) 2015a. *SWEIS Yearbook 2013 Comparison of 2013 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-15-22755. May 26 Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-15-22755

LANL (Los Alamos National Laboratory) 2015b. *Trails Management Plan 2015*. LA-UR-15-20807. November 3. Available online https://cdn.lanl.gov/files/document-15_ef2ad.pdf

LANL (Los Alamos National Laboratory) 2015c. *Interim Measures Work Plan for Chromium Plume Control*.

LANL (Los Alamos National Laboratory) 2016. *SWEIS Yearbook 2014 Comparison of 2014 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-16-24711. July. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-16-24711

LANL (Los Alamos National Laboratory) 2017. *Low Impact Development Standards*. LA-UR-17-27537. September 18. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-17-27537

LANL (Los Alamos National Laboratory) 2018. *SWEIS Yearbook 2015–2016 Comparison of 2015 and 2016 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. Revision 1. LA-UR-18-20988. March. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-18-20988

LANL (Los Alamos National Laboratory) 2019a. *Wildland Fire Mitigation and Forest Health Plan*. October 2019. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-18-30013

LANL (Los Alamos National Laboratory) 2019b. *SWEIS Yearbook 2017 Comparison of 2017 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-19-20119. February 20. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-19-20119

LANL (Los Alamos National Laboratory) 2019c. *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico*. LA-UR-19-21590. February 25. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-19-21590

LANL (Los Alamos National Laboratory) 2020. *SWEIS Yearbook 2018 Comparison of 2018 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-19-32158. February. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-19-32158

LANL (Los Alamos National Laboratory) 2021a. *Tower Power: A New Drop Test Capability Helps Ensure High Explosives Safety*. December. Available online: https://discover.lanl.gov/publications/national-security-science/2021-winter/drop-test/

LANL (Los Alamos National Laboratory) 2021b. *SWEIS Yearbook 2019 Comparison of 2019 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-20-30217. January. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-20-30217

LANL (Los Alamos National Laboratory) 2022a. *SWEIS Yearbook 2020: Comparison of 2020 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-22-20010. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-20010

LANL (Los Alamos National Laboratory) 2022b. *Energy Security Solutions*. Available online: https://www.lanl.gov/about/mission/energy-security

LANL (Los Alamos National Laboratory) 2022c. "Devils in the Details." Available online: https://www.lanl.gov/media/publications/national-security-science/2019-winter/devils-in-the-details

LANL (Los Alamos National Laboratory) 2022d. *Climate Signatures Fingerprints of a Dynamic Planet*. Available online: https://www.osti.gov/biblio/1184613/

LANL (Los Alamos National Laboratory) 2022e. "Materials Physics and Applications." Available online: https://www.lanl.gov/engage/organizations/physical-sciences/materials-physics-applications

LANL (Los Alamos National Laboratory) 2022f. *Los Alamos National Laboratory 2021 Annual Site Environmental Report*. LA-UR-22-29103. September 28. Revision 2. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-29103

LANL (Los Alamos National Laboratory) 2022g. "Isotope Program." Available online: https://www.lanl.gov/science-engineering/science-programs/office-of-science-programs/isotopes

LANL (Los Alamos National Laboratory) 2022h. A*SER Annual Site Environmental Report 2020*. Revision 4. LA-UR-21-28555. December 7. Available online: https://cdn.lanl.gov/files/tr_66d2f.pdf

LANL (Los Alamos National Laboratory) 2022i. *Amendment to 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 (AGREEMENT)*. LA-UR-22-27894. August 1. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-27894

LANL (Los Alamos National Laboratory) 2022j. *Historic Buildings Report: Five-Year Preservation Planning for Manhattan Project National Historical Park Sites*. LA-UR-22-21519. March 4. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-21519

LANL (Los Alamos National Laboratory). 2022k. *Threatened and Endangered Species Habitat Management Plan for Los Alamos National Laboratory*. Revision 2. LA-UR-22-20556. April 14. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-20556

LANL (Los Alamos National Laboratory) 2023. *SWEIS Yearbook 2021: Comparison of 2021 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-22-32473. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-32473

LANL (Los Alamos National Laboratory) 2024a. *SWEIS Yearbook 2022: Comparison of 2022 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-24-22037. May. Rev. 1. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-24-22037

LANL (Los Alamos National Laboratory) 2024b. *Los Alamos National Laboratory 2024 Annual Site Environmental Report*. LA-UR-23-29640. Revision 2. February 5. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-23-29640

LANL (Los Alamos National Laboratory) 2024c. *Project Information for the LANL Site-Wide Environmental Impact Statement*. LA-UR-24-26126. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-24-26126

Los Alamos County 2022. Los Alamos Department of Public Utilities 2021 Annual Drinking Water Quality Report. Department of Public Utilities. January 1. https://www.losalamosnm.us/files/sharedassets/public/v/1/departments/utilities/

N3B (Newport News Nuclear BWXT Los Alamos) 2019. *Investigation Report for Royal Demolition Explosive in Deep Groundwater*. August. Available online: https://ext.em-la.doe.gov/eprr/repo-file.aspx?oid=0902e3a6800bc3cc&n=EMID-700561-01_RDX_Deep_GW_IR_082919.pdf

N3B (Newport News Nuclear BWXT Los Alamos) 2020. *Fate and Transport Modeling and Risk Assessment Report for RDX Contamination in Deep Groundwater*. EM2020-0135. May. Available online: https://ext.em-la.doe.gov/eprr/repo-file.aspx?oid=0902e3a6800d5115&n=EMID-700925-01_EMLA-2020-1452-02-001_RDX_Deep_GW_Risk_Rpt_052820.pdf

NMDGF (New Mexico Department of Game and Fish) 2019. *State Wildlife Action Plan for New Mexico*. November 22. Available online: https://wildlife.dgf.nm.gov/download/new-mexico-state-wildlife-action-plan-swap-final-2019/?wpdmdl=43338&refresh=67633c3e656c41734556734

NMED (State of New Mexico Environment Department) 2005. Compliance Order on Consent, Proceeding Under the New Mexico Hazardous Waste Act §74-4-10 and the New Mexico Solid Waste Act §74-9-36(D). March 1.

NMED (State of New Mexico Environment Department) 2016a. "Compliance Order on Consent." June. Available online: https://www.energy.gov/sites/prod/files/2020/01/f70/2016%20Consent%20Order_February%202017.pdf.

NMED (State of New Mexico Environment Department) 2016b. "Settlement Agreement and Stipulated Final Order." Environmental Health Division. January. Available online: https://www.env.nm.gov/wp-content/uploads/sites/12/2019/10/LANLSASFOFINAL1_22_16.pdf

NMSA (New Mexico Statutes Annotated) 1978. "New Mexico Hazardous Waste Act of 1978." Available online: https://www.env.nm.gov/hazardous-waste/hazardous-waste-regulation-and-authorization/

NNSA (National Nuclear Security Administration) 2000. *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico.* DOE-EA-1329. August. Available online: https://www.energy.gov/sites/default/files/nepapub/nepa_documents/RedDont/EA-1329-FEA-2000.pdf

NNSA (National Nuclear Security Administration) 2003a. *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National laboratory, Los Alamos, New Mexico*. DOE/EIS-0350. November. Available online: https://www.energy.gov/nepa/articles/eis-0350-final-environmental-impact-statement

NNSA (National Nuclear Security Administration) 2003b. *Environmental Assessment for the Proposed Los Alamos National Laboratory Trails Management Program, Los Alamos, New Mexico.* DOE/EA-1431. September. Available online: https://www.energy.gov/nepa/ea-1431-trails-lanl

NNSA (National Nuclear Security Administration) 2003c. *Department of Energy National Nuclear Security Administration Finding of No Significant Impact for the Los Alamos National Laboratory Proposed Trails Management Program, Los Alamos, New Mexico*. September. Available online: https://www.energy.gov/sites/default/files/nepapub/nepa_documents/RedDont/EA-1431-FONSI-2003.pdf

NNSA (National Nuclear Security Administration) 2003d. *Final Environmental Assessment for the Proposed Consolidation of Certain Dynamic Experimentation Activities at the Two-Mile Mesa Complex Los Alamos National Laboratory.* Available online: https://www.energy.gov/sites/default/files/nepapub/nepa_documents/RedDont/EA-1447-FEA-2003.pdf

NNSA (National Nuclear Security Administration) 2008a. *Final Complex Transformation Supplemental Programmatic Environmental Impact Statement*. DOE/EIS-0236-S4. ID 1062. October 24, 2008. Available online: https://www.energy.gov/nepa/downloads/eis-0236-s4-final-supplemental-programmatic-environmental-impact-statement

NNSA (National Nuclear Security Administration) 2008b. *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EIS-0380. May. Available online: https://www.energy.gov/nepa/downloads/eis-0380-final-site-wide-environmental-impact-statement

NNSA (National Nuclear Security Administration) 2009. *Supplement Analysis: Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory; Proposed Transport of Low Level Radioactive Waste by Truck and Rail from Los Alamos National Laboratory (LANL) for Disposal at EnergySolutions at Clive, Utah*. DOE/EIS-0380-SA-01. October 2009. Available online: https://www.energy.gov/nepa/downloads/eis-0380-sa-01-supplement-analysis

NNSA (National Nuclear Security Administration) 2010a. *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. August 2. Available online: https://www.energy.gov/nepa/listings/ea-1736-documents-available-download

NNSA (National Nuclear Security Administration) 2010b. *Finding of No Significant Impact for the Proposed Expansion of the Sanitary Effluent Reclamation Facility and Environmental Restoration of Reach S-2 of Sandia Canyon at Los Alamos National Laboratory.* August . Available online: https://www.energy.gov/sites/default/files/nepapub/nepa_documents/RedDont/EA-1736-FONSI-2010.pdf

NNSA (National Nuclear Security Administration) 2010c. Letter from Thomas P. D'Agostino, Administrator, National Nuclear Security Administration, to Dr. Michael Anastasio, Director, Los Alamos National Laboratory. March 24.

NNSA (National Nuclear Security Administration) 2010d. *Fuels Research Lab at TA-35-455*. Categorical Exclusion. LASO-10-001. June. Available online: https://www.energy.gov/sites/default/files/CX-002689.pdf

NNSA (National Nuclear Security Administration) 2010e. *Photovoltaic Array Reuse of Los Alamos County Landfill Location*. Categorical Exclusion. LASO-10-001. March. Available online: https://www.energy.gov/sites/default/files/CX-001045.pdf

NNSA (National Nuclear Security Administration) 2011a. *Supplement Analysis: Transport and Storage of High-Activity Sealed Sources from Uruguay and Other Locations.* DOE/EIS-0380-SA-02. April. Available online: https://www.energy.gov/nepa/downloads/eis-0380-sa-02-supplement-analysis

NNSA (National Nuclear Security Administration) 2011b. *Final Supplemental Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EIS-0350-S1. August. Available online: https://www.energy.gov/nepa/articles/eis-0350-s1-final-supplemental-environmental-impact-statement

NNSA (National Nuclear Security Administration) 2011c. *Construction of Protective Force Indoor Live Fire Range at TA-16.* Categorical Exclusion. LAN-11-0002. February. Available online: https://www.energy.gov/sites/default/files/CX-005361.pdf

NNSA (National Nuclear Security Administration) 2012. *Construction of Interagency Fire Center at TA-49*. Categorical Exclusion. January. Available online: https://www.energy.gov/sites/default/files/CX-007678.pdf

NNSA (National Nuclear Security Administration) 2015. *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement*. DOE/EIS-0283-S2. April. Available online: https://www.energy.gov/nepa/downloads/eis-0283-s2-final-supplemental-environmental-impact-statement

NNSA (National Nuclear Security Administration) 2016a. *Supplement Analysis for a Proposal to Implement Safe Handling and Storage and to Conduct Processing Studies of 60 Transuranic Remediated Nitrate Salts Drums*. DOE/EIS-0380-SA-03. May 2016. Available online: https://www.energy.gov/nepa/downloads/eis-0380-sa-03-supplement-analysis

NNSA (National Nuclear Security Administration) 2016b. *Supplement Analysis for Treatment, Repackaging, and Storage of Nitrate Salt Waste Drums At Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EIS-380-SA-04. December 2016. Available online: https://www.energy.gov/nepa/downloads/eis-0380-sa-04-supplement-analysis

NNSA (National Nuclear Security Administration) 2016c. *TA-3 Substation Replacement Project*. Categorical Exclusion. 09P-0059 V2. February. Available online: https://www.energy.gov/sites/default/files/CX-015048.pdf

NNSA (National Nuclear Security Administration) 2017a. *Uranium Machining Consolidation at Technical Area 4 from Building 102 into Building 66*. Categorical Exclusion. December. Available online: https://www.energy.gov/sites/default/files/2018/01/f47/CX-017443.pdf

NNSA (National Nuclear Security Administration) 2017b. *CMRR Project – REI2 Subproject Los Alamos National Laboratory Project Execution Plan*. CMRR-PLAN-00019, R2. September 2017. Available online: https://www.energy.gov/sites/default/files/2019/02/f60/CMRR-REI2_1.pdf

NNSA (National Nuclear Security Administration) 2018a. *Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory*. DOE/EIS-0380-SA-05. April 2018. Available online: https://www.energy.gov/nepa/downloads/eis-0380-sa-05-supplement-analysis

NNSA (National Nuclear Security Administration) 2018b. *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. July 2018. Available online: https://www.energy.gov/nepa/ea-2052-proposed-changes-analytical-chemistry-and-materials-characterization-radiological

NNSA (National Nuclear Security Administration) 2018c. *Finding of No Significant Impact for the 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.* July. Available online: https://www.energy.gov/sites/default/files/2018/08/f54/Final%20RLUOB%20EA%20FONSI_073018_508.pdf

NNSA (National Nuclear Security Administration) 2018d. *TA-3 Modular Laboratory Building*. Categorical Exclusion. LAN 17-13. January 2018. Available online: https://www.energy.gov/sites/default/files/2018/02/f49/CX-017541.pdf

NNSA (National Nuclear Security Administration) 2018e. Categorical Exclusion – CX 120002 – Steam Plant Acquisition. March. Online at: https://www.energy.gov/sites/default/files/2018/05/f51/CX-120002.pdf

NNSA (National Nuclear Security Administration) 2019a. *Final Supplement Analysis of the Complex Transformation Supplemental Programmatic Environmental Impact Statement*. DOE/EIS-0236-S4-SA-02. December. Available online: https://www.energy.gov/nepa/downloads/doeeis-0236-s4-sa-02-final-supplement-analysis

NNSA (National Nuclear Security Administration) 2019b. *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. June. Available online: https://www.energy.gov/nepa/downloads/ea-2101-final-environmental-assessment

NNSA (National Nuclear Security Administration) 2019c. *Finding of No Significant Impact Final Environmental Assessment for the Proposed Construction and Operation of a Solar Photovoltaic Array at Los Alamos National Laboratory, Los Alamos, New Mexico.* June. Available online: https://www.energy.gov/sites/default/files/2019/06/f63/fonsi-ea-2101-Construction-Operation%20Solar%20Photovoltaic%20Array-2019-06.pdf

NNSA (National Nuclear Security Administration) 2019d. *Final Supplemental Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory*. DOE/EA-1329-S1. July 24. Available online: https://www.energy.gov/nepa/doeea-1329-s1-wildfire-hazard-reduction-and-forest-health-improvement-program-los-alamos

NNSA (National Nuclear Security Administration) 2019e. *Construction and Operation of a TA-03 Parking Structure*. Categorical exclusion. Accession No. 24627. October 1. Available online: CX-270456.pdf (energy.gov)

NNSA (National Nuclear Security Administration) 2020a. *Supplement Analysis for Disposition of Additional Non-Pit Surplus Plutonium*. DOE/EIS-0283-SA-04. August. Available online: https://www.energy.gov/nepa/downloads/doeeis-0283-sa-04-supplement-analysis-disposition-additional-non-pit-surplus

NNSA (National Nuclear Security Administration) 2020b. *Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory*. DOE/EIS-0380-SA-06. September 1. Available online: https://www.energy.gov/nepa/downloads/doeeis-0380-sa-06-final-supplement-analysis

NNSA (National Nuclear Security Administration) 2020c. *Final Environmental Assessment: Construction and Operation of a Second Fiber Optic Line to Los Alamos National Laboratory, Los Alamos, New Mexico.* DOE/EA-2122. April 30. Available online: https://www.energy.gov/nepa/downloads/doeea-2122-final-environmental-assessment

NNSA (National Nuclear Security Administration) 2020d. *Finding of No Significant Impact Final Environmental Assessment: Construction and Operation of a Second Fiber Optic Line to Los Alamos National Laboratory, Los Alamos, New Mexico.* May. Available online: https://www.energy.gov/sites/default/files/2020/04/f74/fonsi-ea-2122-second-fiber-optic-circuit-route-LANL-2020-04-29.pdf

NNSA (National Nuclear Security Administration) 2020e. "New System Lays the Groundwork of Future Exa-scale Class Systems at Los Alamos." Available online: https://www.energy.gov/nnsa/articles/nnsa-completes-exascale-class-cooling-equipment-project

NNSA (National Nuclear Security Administration) 2021a. *Prevent, Counter, and Respond—NNSA's Plan to Reduce Global Nuclear Threats FY2022 – FY2026—Report to Congress*. December. Available online: https://www.energy.gov/sites/default/files/2021-12/FY2022%20NNSA%20Prevent%2C%20Counter%2C%20and%20Respond%E2%80%94A%20Strategic%20Plan%20to%20Reduce%20Global%20Nuclear%20Threats.pdf

NNSA (National Nuclear Security Administration) 2021b. *Light Manufacturing Facility, Categorical Exclusion, CX-270609*. Available online: https://www.energy.gov/sites/default/files/2021/01/f82/CX-270609_0.pdf

NNSA (National Nuclear Security Administration) 2022c. "Los Alamos National Laboratory Technical Area 55 Plutonium Facility 4 Ventilation System Report to the Defense Nuclear Facilities Safety Board." Letter from Jill Hruby, NNSA Administrator to The Honorable Joyce L. Connery, Chair, Defense Nuclear Facility Safety Board. March 15. Available online: https://ehss.energy.gov/deprep/2022/TB22M15A.PDF

NNSA (National Nuclear Security Administration) 2023a. *Fiscal Year 2024 Stockpile Stewardship and Management Plan – Report to Congress*. November. Available online: https://www.energy.gov/sites/default/files/2023-11/FY24SSMP_FINAL_NOVEMBER_2023_0.pdf

NNSA (National Nuclear Security Administration) 2023b. *Los Alamos National Laboratory Electric Power Capacity Upgrade Project Draft Environmental Assessment*. DOE/EA-2199. LA-UR-23-32753. Available online: https://www.energy.gov/sites/default/files/2023-11/draft-ea-2199-epcu-project-2023-11_0.pdf

NNSA (National Nuclear Security Administration) 2023c. "2022 Annual Metrics Report to the Defense Nuclear Facilities Safety Board January 2023 Criticality Safety Programs." Letter from NNSA to The Honorable Joyce L. Connery, Chair, Defense Nuclear Facility Safety Board. January. Available online: https://ehss.energy.gov/deprep/2023/TB23J31A.PDF

NNSA (National Nuclear Security Administration) 2024. *Surplus Plutonium Disposition Program Final Environmental Impact Statement.* DOE/EIS-0549. January. Available online: https://www.energy.gov/nepa/articles/doeeis-0549-final-environmental-impact-statement

NPS (National Park Service) 2019. "Cultural Landscape Inventory." TA-18, Los Alamos National Laboratory, New Mexico, Manhattan National Historical Park. Cultural Landscape Research Group. University of Oregon.

NPS (National Park Service) 2022. *Manhattan Project National Historical Park, Los Alamos, New Mexico*. Available online: https://www.lanl.gov/about/history-innovation/mapr

Parsons 2021. *FINAL Supplemental Environmental Project: Second Independent External Triennial Review for Los Alamos National Laboratory*. September. https://permalink.lanl.gov/object/tr?what=info:lanl-repo/eprr/ESHID-603659

White House 2021. "Interim Implementation Guidance for the Justice40 Initiative." Memorandum for the Heads of Departments and Agencies. Executive Office of the President. M-21-28. July. Available online: https://www.whitehouse.gov/wp-content/uploads/2021/07/M-21-28.pdf

APPENDIX B
SCOPING PROCESS AND SUMMARY

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ARIES	Advanced Recovery and Integrated Extraction System
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMP	Campus Master Plan
CMR	Chemistry and Metallurgy Research
DD&D	Decontamination, decommissioning, and demolition
DMMSC	Dynamic Mesoscale Materials Science Capability
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DSA	Documented safety analyses
EA	environmental assessment
EG	Evaluation guideline
EIS	Environmental impact statement
EPA	Environmental Protection Agency
FONSI	Finding of No Significant Impacts
GAO	General Accounting Office
LANL	Los Alamos National Laboratory
LTS	Long Term Stewardship
MaRIE	Matter and Radiation Interactions in Extreme
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NOI	Notice of Intent
NPR	Nuclear Posture Review
PFAS	per- and polyfluoroalkyl substances
PSHA	probabilistic seismic hazard analysis
RDX	Royal Demolition Explosives
ROI	Region of influence
SA	Supplement Analysis
SPDP	Surplus Plutonium Disposition Program
SRS	Savannah River Site
TRU	transuranic (waste)
USACE	U.S. Army Corps of Engineers
WIPP	Waste Isolation Pilot Plant

B SCOPING PROCESS AND SUMMARY

B.1 The Scoping Process

Regulations established by the Council on Environmental Quality at Title 40 of the *Code of Federal Regulations* Section 1501.9 (40 CFR 1501.9) and the U.S. Department of Energy (DOE) at 10 CFR 1021.311 require that an initial process be conducted to engage the public and obtain input on the scope of issues to be addressed in an environmental impact statement (EIS) and to identify significant issues related to the proposed action. This scoping process is the first of several opportunities for public involvement in the EIS process (Figure B-1).

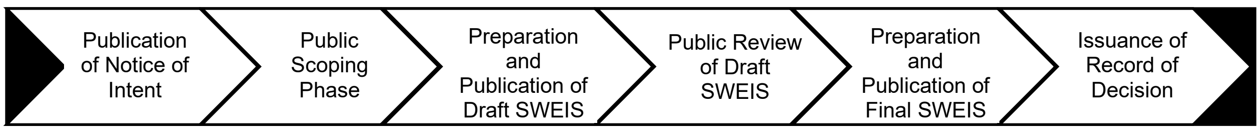


Figure B-1 The EIS Process Showing Opportunities for Public Involvement During Development of the SWEIS

On August 22, 2022, the National Nuclear Security Administration (NNSA) initiated public involvement on the *Site-wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory* (DOE/EIS-0552) (LANL SWEIS or SWEIS) with publication of a Notice of Intent (NOI) in the *Federal Register* (87 FR 51083). The NOI started a public scoping period that initially ran until October 3, 2022, and was extended until October 18, 2022, in response to public comments.

Congressional and intergovernmental notifications were sent to inform key stakeholders of the public scoping period. NNSA sent notifications to the GovDelivery mailing list. The notice of the extension to the scoping period was also sent to the same stakeholders.

Considering the ongoing public health concerns, NNSA hosted two virtual scoping meetings on September 13 and 14, 2022. These meetings were convened at different times to help accommodate participation by members of the public located across multiple time zones. NNSA used the Cisco WebEx™ platform to host the virtual scoping meetings. People were able to participate in these meetings either by internet connection (providing audio and visual access) or by phone (providing only audio access).

As shown in Table B-1, total participation in the virtual scoping meetings included 116 people during the first meeting and 66 people during the second meeting.

Table B-1 Participation in the LANL SWEIS Public Scoping Meetings

Date	Participation
September 13, 2022	By Internet: 88 By Phone: 28 Total: 116
September 14, 2022	By Internet: 48 By Phone: 18 Total: 66

The scoping meetings began with a presentation by NNSA providing background information about LANL, the purpose and need for the proposed action, the alternatives to be evaluated, the proposed scope of the SWEIS, and the anticipated SWEIS production schedule. The presentation, which was the same for both meetings, was followed by a formal comment period.

Elected officials were given an opportunity to speak first, followed by other meeting participants (in the order by which they signed up), each of whom was given a maximum of 3 minutes to speak. After everyone had an opportunity to provide a comment, participants who had already spoken were given the opportunity to provide additional comments. Eleven people spoke at the first scoping meeting (four spoke more than once) and twelve people spoke at the second meeting (two spoke more than once).

Details regarding the dates and times for the virtual scoping meetings, how to connect to the meeting by internet or phone, and how to provide comments during the virtual meetings were posted on the NNSA NEPA Reading Room website (https://www.energy.gov/nnsa/nnsa-nepa-reading-room). These details also were disseminated via existing LANL communication channels (e.g., GovDelivery emails), and via published advertisements in local New Mexico newspapers, as outlined in Table B-2.

Table B-2 Public Scoping Advertisements

Newspaper	Circulation Frequency	Dates of Publication
Los Alamos Daily Post	Weekly	September 1 and 8, 2022
Albuquerque Journal North	Daily	September 4 and 11, 2022
Santa Fe New Mexican	Daily	September 4 and 11, 2022
Rio Grande Sun	Weekly	September 1 and 8, 2022

NNSA provided multiple mechanisms for accepting scoping comments, including by mail, email, and verbally during either of the scoping meetings. Individuals who had questions about the NNSA NEPA process were directed to contact the project NEPA Compliance Officer, either by mail or by email.

In total, NNSA received 74 pieces of correspondence, or comment documents, during scoping. A comment document is defined as a single submittal of comments received by mail or email. In addition, the transcripts of verbal comments made during the public scoping meetings are each counted as a comment document. Email and mail correspondence included comments related to two campaigns, one of which contained identical or near identical form letters. Accounting for the transcripts, campaign submittals, duplicate submittals, and non-comment submittals, the 74 pieces of correspondence contained 853 individual comments, which were grouped into 10 categories, representing 48 unique topic areas (Table B-3).

Table B-3 Summary of Scoping Comments by Category

Category	Topic Areas	Comment Count
SWEIS Alternatives	5	88
National Security Policies and NNSA Missions	2	28
Pit Production	5	37
NEPA Process	5	131
LANL Cleanup	4	47
Waste Isolation Pilot Plant	4	34
SWEIS Resource Analysis	18	397
General Support	1	1
General Opposition	1	32
Miscellaneous	1	1
Out of Scope	2	57
TOTAL	**48**	**853**

B.2 Scoping Comment Summaries

Table B-4 provides a summary of the scoping comments received during the public scoping process, by issue category and topic area, the number of comments addressed by each summary comment, and corresponding information on how the comments were considered in the SWEIS.

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: as represented in Table B-4, comments on similar or related topics were grouped under comment issue categories and corresponding topic areas so that all comments on a particular topic could be considered individually and collectively.

Table B-4 Comments and Responses by Category

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
1-a SWEIS Alternatives – General/Other Alternatives	Some commenters do not support any of the three proposed alternatives. Others urge NNSA to expand the number of other potential alternatives and to further explain what construction is involved in each alternative.	9	*The alternatives evaluated in this SWEIS are consistent with those identified in the NOI; however, they have now been fully defined in Chapter 3 of this SWEIS, Proposed Action and Alternatives. They provide an adequate range of alternatives to support NNSA future decisions. Section 3.6 describes other alternatives that were considered in developing this Draft SWEIS but eliminated from detailed analysis because they did not allow the Laboratory to fulfill the NNSA mission requirements.*
1-b SWEIS Alternatives - Do not include pit production in No-Action	Commenters indicate that expanded pit production at LANL needs to be analyzed and not be included in the No-Action Alternative. They state that the analysis must evaluate the need for expanded pit production; planned expenditures in facility upgrades to support expanded pit production; impacts to other sites, such as the Savannah River Site (SRS) and Waste Isolation Pilot Plant (WIPP); and the environmental, cultural, health, and socioeconomic impacts of expanded pit production on tribes and local communities. In the commenters' opinion, the 2008 Complex Transformation Programmatic EIS, the 2008 LANL SWEIS, and 2020 LANL Supplement Analysis (SA) were inadequate.	41	*The evaluation of expanded pit production at LANL, including the need for pits, was evaluated in the Complex Transformation Supplemental Programmatic EIS (CT SPEIS), the 2008 LANL SWEIS, and the 2020 LANL SWEIS SA. The need for a new programmatic EIS to evaluate pit production was already evaluated in the CT SPEIS SA in 2019.* *As described in Section 3.2, the No-Action Alternative reflects implementation of decisions NNSA made based on the 2008 LANL SWEIS and subsequent SAs (see Section 1.5 and Section A.1.5) and implementation of decisions made on actions evaluated in other relevant NEPA documents completed since 2008 (see Section 1.5). The discussion on pit production is addressed in Section 3.2. Impacts of the actions included in the No-Action Alternative, including the implementation of increased pit production, are presented in Chapter 5 of this SWEIS.*
1-c SWEIS Alternatives - Include additional cleanup alternatives	Commenters state that major remediation efforts need to be considered with respect to helping with a thorough cleanup.	3	*The evaluation of cleanup alternatives was completed in the 2008 SWEIS. Compliance with the 2016 Consent Order is included in the No-Action Alternative. As described in Section 4.14 of this SWEIS, DOE and NMED agreed to use a structure called the "campaign approach," where corrective action activities required by the 2016 Consent Order are organized into campaigns, generally based on a risk-based approach to grouping,*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
			prioritizing, and accomplishing corrective action activities. A campaign may consist of one or more projects, requiring one or more tasks and deliverables. Appendix G of this SWEIS provides updated information on the current remediation planning basis and the associated environmental impacts.
1-d SWEIS Alternatives - Include reduced operations alternative	Commenters recommend inclusion of a “reduced operations” alternative to reduce operations such as plutonium pit production and related operations that produce toxic and radioactive waste. This could include a reduction in LANL’s nuclear weapons role or a complete reevaluation of LANL’s scope. This could be consistent with the reduced operations alternatives in the 1999 and 2008 SWEISs.	13	*Chapter 3, Section 3.6, explains that a reduced operations alternative would not allow NNSA to meet the purpose and need discussed in Chapter 1, Section 1.3, of this LANL SWEIS.*
1-e SWEIS Alternatives - Campus Master Plan	Commenters indicate that the Campus Master Plan (CMP) and the budget allocation confirm that pit production is the priority at LANL. The SWEIS should include analysis of the projects in the CMP.	4	*As identified in Section 3.1, the projects included in CMP are categorized as elements of the No-Action Alternative, Modernized Operations Alternative, and Expanded Operations Alternative. Projects related to pit production are included in the No-Action Alternative.*
	Commenters request that DOE explain why the CMP was not released to the public and provide full disclosure and analysis of the CMP.	3	*The CMP forms the basis for the projects identified in each alternative and a version has been made publicly available.*
	A commenter states that the Matter and Radiation Interactions in Extreme (MaRIE) project should be included in the NEPA analysis.	1	*A description of MaRIE is included as part of the Expanded Operations Alternative in Section 3.4. Impacts of MaRIE are included in Chapter 5 for that alternative. The project is now referred to as the Dynamic Mesoscale Materials Science Capability (DMMSC).*
	Commenters indicate that the CMP states that most of the land within Rendija Canyon was deemed eligible for conveyance. Why is the land transfer planned for Los Alamos County and not the less-affluent pueblos?	2	*The transfer or conveyance of lands within Rendija Canyon are addressed in the Final Environmental Impact Statement for the Conveyance and Transfer of Certain Land Tracts Administered by the U.S. Department of Energy and Located at Los Alamos National Laboratory, Los Alamos and Santa Fe Counties, New Mexico (DOE/EIS-0293). This SWEIS provides an update to the*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
			status of transfer and conveyances and includes conveyance or transfer of the remaining lands as part of the No-Action Alternative. Descriptions of the actions are included in Section 3.2 and impacts are described in Chapter 5 under each resource area for the No-Action Alternative.
	Commenters state that the SWEIS must include analysis of the planned demolition of the approximately 550,000-square-foot Chemistry and Metallurgy Research (CMR) building.	12	*The potential decontamination, decommissioning, and demolition (DD&D) of the CMR facility could occur within the next 15 years and is included as a DD&D project under the No-Action Alterative, as discussed in Section 3.2 of this SWEIS. The potential impacts are included in Chapter 5 of this SWEIS.*
2-a National Security Policies and NNSA Missions - Proliferation/nonproliferation and Comprehensive Test Ban Treaty	NNSA should justify the need for expansion of pit production.	12	*The purpose and need for continued operation of the Laboratory, including pit production, is discussed in Section 1.3 of this SWEIS.*
	Commenters question DOE's ability to rely on the 2016 Consent Order since the New Mexico Environmental Department sued DOE.	6	*Implementation of the 2016 Consent Order and the coordination between DOE and NMED is discussed in Section 2.7 and Section 4.14 of this SWEIS. The planning basis for remediation is also described in Appendix G.*
	Commenters question how nuclear weapons activities at LANL promote international nonproliferation and why there is a need to develop new weapons for future applications.	3	*Nonproliferation is discussed as part of the purpose and need in Section 1.3 of this SWEIS.*
	Commenters indicate that NNSA and the Labs are increasing production of new plutonium pits that may deviate from tested legacy designs and may have to resume testing.	2	*NNSA's commitment to the Comprehensive Test Ban Treaty is discussed in Section 1.3.1 of this SWEIS.*
	Commenters indicate that elimination of nuclear weapons and facilities must be one of the considered alternatives in the LANL SWEIS.	3	*The purpose and need for continued operation of the Laboratory is discussed in Section 1.3 of this SWEIS. Section 3.6 describes other alternatives that were considered in developing this Draft SWEIS but were*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
			eliminated from detailed analysis because they did not allow LANL to fulfill the NNSA mission requirements.
2-b National Security Policies and NNSA Missions - Overall NNSA mission	Commenters note that LANL's mission must pivot from the design and production of weapons of mass destruction to a dual mission of both dismantling the U.S. and global nuclear stockpile and to developing and implementing technologies to clean up contamination that has occurred from activities of the nuclear industry since the 1940s.	2	*The purpose and need for continued operation of the Laboratory, including pit production and legacy cleanup, is discussed in Section 1.3 of this SWEIS.* *Section 3.6 describes other alternatives (e.g., shifting funding from nuclear weapons work to environmental cleanup) that were considered in developing this Draft SWEIS but were eliminated from detailed analysis because they would not allow LANL to fulfill the NNSA mission requirements.*
3-a Pit Production – No pit production	Commenters provide several reasons why pit production should be eliminated or delayed until: (1) the release of an unclassified Nuclear Posture Review (NPR), (2) the release of a final CMP, (3) the SWEIS is finalized, (4) DOE publishes a plan for the storage of transuranic (TRU) waste, (5) the Ground-Based Strategic Deterrent is funded, (6) 2038 or later for nuclear weapon warhead if the Sentinel missile is funded, and (7) all legacy wastes are remediated to pre-1943 conditions.	4	*The unclassified NPR was released in October 2022 and is discussed as part of the purpose and need for continued operation of the Laboratory in Section 1.3 of this SWEIS. The CMP has also been publicly released. The publicly available version can be found at the following link: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/eprr/ESHID-603721* *As described in Section 3.2, the No-Action Alternative reflects implementation of decisions NNSA made based on the 2008 LANL SWEIS and subsequent SAs (see Section 1.5 and Section A.1.5) and implementation of decisions made on actions evaluated in other relevant NEPA documents completed since 2008 (see Section 1.5). The discussion of projects related to pit production is included in Section 3.2. Implementation of expanded pit production is ongoing.* *Implementation of DOE EM's mission for environmental remediation is addressed in Section 2.7 and Section 4.14 of this SWEIS.* *Impacts of the actions included in the No-Action Alternative, including pit production and site remediation, are presented in Chapter 5 of this SWEIS.*
3-b Pit Production – Pit aging studies	Commenters request that the Plutonium Pit Aging Study be completed by NNSA before pit production starts.	5	*The need for pits was evaluated in the CT SPEIS, the SRS Pit Production EIS, and the 2020 LANL SWEIS SA. These documents address the Plutonium Pit Aging Study.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
3-c Pit Production - Reuse old pits	A commenter states that plutonium pits manufactured at LANL should be derived from older surplus pits.	1	*Reuse of old pits is an element of pit production and was evaluated in the CT SPEIS, the SRS Pit Production EIS, and the 2020 LANL SWEIS SA.*
3-d Pit Production - New warhead designs	Commenters state that new pits will be used to "modernize" the nuclear arsenal and the priority for pit production is for the timely completion of the W87-1 warhead for use on the Sentinel Intercontinental Ballistic Missile.	2	*Comments related to the specific warhead designs were discussed in the CT SPEIS, the SRS Pit Production EIS, and the 2020 LANL SWEIS SA.*
3-e Pit Production – Expanded Production/Surge Production	Commenters want more information on how expanded pit production can safely operate at the PF-4. They would like the SWEIS to analyze PF-4's capacity to sustain surge production at 80 pits per year if planned simultaneous pit production at the SRS is further delayed or canceled.	23	*The potential impacts of expanded pit production (with surge capacity to 80 pits per year) at LANL were evaluated in the 2008 SWEIS and the 2020 LANL SWEIS SA. As described in Section 3.2 of this SWEIS, the No-Action Alternative reflects implementation of decisions NNSA made based on the 2008 LANL SWEIS and subsequent SAs (see Section 1.5 and Section A.1.5) and implementation of decisions made on actions evaluated in other relevant NEPA documents completed since 2008 (see Section 1.5). The discussion of projects related to pit production is addressed in Section 3.2. Impacts of the actions included in the No-Action Alternative, including pit production, are presented in Chapter 5 of this SWEIS.*
	Commenters request a discussion of Advanced Recovery and Integrated Extraction System (ARIES), including a discussion of the relationship between ARIES and processing to yield pure plutonium for pits. The commenter is concerned about TRU generation by ARIES, how TRU will be managed, capacity in PF-4 for ARIES and purification of pits.	2	*This SWEIS evaluates all activities that would occur in PF-4 and TA-55, including pit production and ARIES. Potential impacts of TRU waste generation at LANL includes TRU from PF-4 associated with these activities. These impacts are presented in Section 5.11 of this SWEIS.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
4-a NEPA Process - Extend scoping comment period	Commenters request that the scoping period be extended. Commenters state that the scoping comment period is inadequate and/or should be extended for various reasons including the need for more time to make meaningful comments on a complex and technical proposal.	24	*As discussed in Section 1.6, the scoping comment period was extended for 15 days upon request.*
4-b NEPA Process - Scoping meetings	Commenters object that the scoping meeting format did not allow the use of chat, Q&A, or camera, or allow seeing the names of meeting attendees.	4	*NNSA provided multiple opportunities for participating in scoping meetings on the SWEIS and facilitated the meetings to permit maximum participation with minimum distractions. See Section 1.6 and Section B.1 of this appendix.*
	A commenter requests additional information be added to the scoping meeting presentation: (1) a slide on tiering and (2) impacts not considered.	1	*The same scoping presentation was provided to both virtual meetings. No changes were made between the first and second meeting.*
	Commenters state that Jay Coghlan should be given a chance to give his presentation.	2	*Mr. Coghlan was given several opportunities to speak at both meetings. Everyone was given an initial 3-minute period to provide their comments. Since time was available after everyone spoke, several individuals took the opportunity to speak multiple times. No one was limited during either meeting.*
	Commenters indicate that comments made during the scoping process should be analyzed and considered within the scope of the SWEIS. In addition, comments made during the scoping period should be included in their entirety, not just summarized.	5	*All scoping comments made during the scoping period (and those received after the close of the comment period) were considered in the preparation of this Draft SWEIS. While summarized in this appendix, the complete unaltered comments have been included in the Administrative Record, consistent with NNSA practice.*
	Commenters request in-person, interactive scoping meetings in affected communities with adequate time for questions, answers, and testimony. Meetings should also be on social media or televised.	5	*The scoping meetings were held virtually because, when planning the meetings, the incidence of COVID-19 in northern New Mexico was high. The scoping meetings held for the Draft SWEIS were consistent with NNSA and DOE guidelines and recent practice.*
4-c NEPA Process - Prepare a programmatic EIS	Commenters state that a programmatic EIS on expanded plutonium pit production	57	*NNSA prepared the 2019 CT SPEIS SA to determine whether the existing CT SPEIS should be supplemented.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	needs to be prepared. They feel that the 2008 Complex Transformation Programmatic EIS, 2008 LANL SWEIS, and 2020 LANL SA were inadequate and not compliant with NEPA.		*That SA considered relevant new information and changed circumstances since publication of the CT SPEIS related to pit production at LANL and SRS. Similarly, NNSA prepared the site-specific 2020 LANL SWEIS SA to evaluate the implementation of 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 to meet NPR and national policy. The 2020 LANL SWEIS SA evaluated the potential impacts of implementing elements of the Expanded Operations Alternative for pit production and considered new circumstances or information relevant to environmental concerns through a comprehensive review of existing NEPA analyses to determine if additional NEPA analysis was required per DOE's NEPA regulations in 10 CFR 1021.314. For all resource areas, the analyses verified that the potential environmental impacts would not be different, or would not be significantly different, than impacts in existing NEPA analyses.*
4-d NEPA Process - Analytical period (15 years)	Commenters state that the 15-year analytical period is too long. DOE estimates actual cleanup to extend beyond 2036. There is no analysis for additional health risks and environmental consequences past 20+ years.	19	*The 15-year analytical period in the SWEIS analyzes construction, operations, remediation, and DD&D through 2038. The adequacy of the SWEIS will be evaluated every five years in accordance with DOE NEPA implementing procedures [10 CFR 1021.330(d)] through a supplement analysis. Any projects that arise before the next SWEIS is prepared and that are not covered by the analysis in this SWEIS would receive a separate NEPA evaluation.*
4-e NEPA Process - Availability of information / Stakeholder involvement	Commenters state that information is not being provided to the public. They have not seen several publicized reports dealing with the safety of the planned facilities, the training of their operators, the transportation of radioactive materials through the state, the protections against air and water	10	*For the 15-year analytical period, the potential health and safety impacts from continued operations of the Laboratory and from the potential projects included in the alternatives are presented in Chapter 5 of this SWEIS. Where possible, (i.e., when not copyright protected or otherwise unavailable for a specific reason), the SWEIS*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	contamination, the length of time radioactive material will be in Los Alamos, or the mitigation plans in case of any sort of accident, and the Site Sustainability Plan.		*reference list includes hyperlinked web addresses for all references cited in the SWEIS.*
	A commenter asks if the SWEIS could be translated into Tewa, Caras, Spanish, and any other language of impacted communities and states; if not, it needs to be remedied.	1	*NNSA has not received requests specifically from these potentially impacted groups for translation. NNSA has historically made interpreters available at public hearings, when requested. NNSA would address any specific request individually.*
	A commenter states that DOE should consider employing enhanced public engagement practices in the SWEIS process particularly with tribes, pueblos, local governments, and utilities by providing early "previews" of proposed federal, state, and local actions.	1	*NNSA is committed to effective communications with the surrounding communities and pueblos and complies with DOE Order 144.1,* DOE American Indian Tribal Government Interactions and Policy. *The formal scoping meetings and hearing on the Draft SWEIS are required by DOE/NNSA NEPA regulations. NNSA has periodic communications and consultations with the pueblos and discusses a variety of topics including ongoing NEPA actions. NNSA is available upon request to provide additional information regarding foreseeable projects.*
	Commenters request that transcript and references be made publicly available.	2	*The transcripts of the scoping meeting are included in the SWEIS Administrative Record and have been summarized in this appendix, consistent with NNSA practice. Where possible, (i.e., when not copyright protected or otherwise unavailable for a specific reason), the SWEIS reference list includes hyperlinked web addresses for all references cited in the SWEIS.*
5-a LANL Cleanup - Not satisfied with "cap and cover"	Commenters are opposed to cap and cover. Cleanup must be defined. Analysis must include threat to groundwater. Comprehensive cleanup, including waste exhumation and proper treatment, must be analyzed as a more than reasonable alternative. Commenters also state that tribal authorities must certify the appropriateness of the cleanup of lands and adjoining canyons and that the U.S. Environmental Protection	23	*The evaluation of cleanup alternatives was completed in the 2008 SWEIS. Compliance with the 2016 Consent Order is included in the No-Action Alternative. As described in Section 4.14 of this SWEIS, DOE and NMED agreed to use a structure called the "campaign approach," where 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. A campaign may consist of one or more projects, requiring one or more tasks and deliverables.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	Agency (EPA) and NMED must certify that all contamination originating from the Laboratory is absent from the surface and groundwaters to include but not be limited to the Rio Grande and the aquifers used by Albuquerque and neighbors counties for drinking water.		*Under the 2016 Consent Order, if changes to the organization and sequence of campaigns potentially affect the priorities of any municipality, county or pueblo that shares a common border with LANL, as well as the Four Accord Pueblos (Cochiti Pueblo, Pueblo de San Ildefonso, Santa Clara Pueblo, and Jemez Pueblo), NMED is required to confer with appropriate representatives of such municipalities, counties and pueblos and allow them to comment on the new proposed organization and sequence of campaigns.* *The potential impacts of the continuing remediation actions are included in Chapter 5 as part of the No-Action Alternative. Appendix G of this SWEIS provides updated information on the current remediation planning basis and the associated environmental impacts.*
5-b LANL Cleanup - Pace of cleanup	Commenters are concerned about the slow pace of cleanup. The slow pace of cleanup prompted the NMED to terminate a 2016 Consent Order.	3	*The Consent Order has not been terminated. NMED filed a lawsuit against DOE regarding the 2016 Consent Order on February 24, 2021; that litigation is pending. However, DOE and NMED continue to work closely to implement the 2016 Consent Order, including identification of annual milestones and targets. In addition to these milestones and targets, DOE completes numerous other deliverables under the 2016 Consent Order. For example, since the 2016 Consent Order became effective in June 2016, DOE has completed 79 milestones (agreed to between NMED and DOE) and submitted 395 deliverables to NMED.*
5-c LANL Cleanup - Proof of harm	Commenters are concerned that people who live around Los Alamos are required to show proof of harm.	2	*Implementation of the DOE Office of Environmental Management's mission for environmental remediation of legacy waste is addressed in Sections 2.7 and 4.14 of this SWEIS.* *Impacts of the actions included in the No-Action Alternative, including site remediation, are presented in Chapter 5 of this SWEIS. Appendix G of this SWEIS provides updated information on the current remediation planning basis and the associated environmental impacts.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
5-d LANL Cleanup – Consent Order	Commenters state that the new SWEIS must address: • actions by NMED to sue DOE regarding the 2016 Consent Order; • impacts to the environment as a result of a withdrawn Consent Order; • compliance with the revised 2016 Consent Order regarding cleanup issues; and • hexavalent chromium contamination of the regional aquifer.	17	*The Consent Order has not been terminated. NMED filed a lawsuit against DOE regarding the 2016 Consent Order on February 24, 2021; that litigation is pending. However, DOE and NMED continue to work closely to implement the 2016 Consent Order, including identification of annual milestones and targets. In addition to these milestones and targets, DOE completes numerous other deliverables under the 2016 Consent Order. For example, since the 2016 Consent Order became effective in June 2016, DOE has completed 79 milestones (agreed to between NMED and DOE) and submitted 395 deliverables to NMED. Details regarding DOE's implementation of the 2016 Consent Order are provided in Sections 2.7 and 4.14 of this SWEIS. As identified in Section 1.5 of this SWEIS, DOE has prepared an environmental assessment on the final remedy for the hexavalent chromium plume. The analyses in the Chromium Final Remedy EA have been incorporated into this SWEIS. For example, this is discussed in the water resources sections of this SWEIS (Sections 4.4 and 5.4).*
	NMED urges DOE and NNSA to focus on expanded remedial activities under the Expanded Operations Alternative, including activities directly related to compliance with the New Mexico Water Quality Act, the 2016 Consent Order, and any successor Order. In February 2021, NMED filed a complaint against DOE in district court to terminate the 2016 Consent Order and initiate court-supervised negotiations to establish enforceable terms that accelerate cleanup of legacy contamination. NNSA's evaluation of environmental impacts as part of the SWEIS must account for DOE's past cleanup commitments and obligations and meaningfully consider expanded remedial activities and definite timelines, such as	1	*DOE and NMED continue to work closely to implement the 2016 Consent Order. Implementation of the DOE Office of Environmental Management's mission for environmental remediation of legacy waste is addressed in Section 4.14 of this SWEIS. Impacts of the actions included in the No-Action Alternative, including site remediation, are presented in Chapter 5 of this SWEIS. Appendix G of this SWEIS provides updated information on the current remediation planning basis and the associated environmental impacts.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	those that may be encompassed by a new compliance order on consent as the litigation on the 2016 Consent Order is resolved.		
	A commenter asks if all the current and planned remedial actions meet the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and other pertinent laws and regulations. For what period of time will LANL be remediated?	1	*The Laboratory remediation is not governed by CERCLA. The federal and state requirements associated with remediation at the Laboratory are presented in Chapter 5 of this SWEIS. Section 4.14 of this SWEIS provides information on the remediation.*
6-a Waste Isolation Pilot Plant - WIPP volume limit is oversubscribed	Commenters state that the WIPP volume is oversubscribed. Continued generation of plutonium-contaminated radioactive wastes that could be disposed of at WIPP must be addressed in the SWEIS.	5	*WIPP is discussed in Section 4.11 and waste management impacts are discussed in Section 5.11. The potential cumulative impacts of TRU waste disposal at WIPP are discussed in Chapter 6 of this SWEIS.*
	Commenters state that prior to the production of pits, the SWEIS must include a plan for waste disposal that does not involve WIPP.	2	*The WIPP facility is the Nation's only repository for TRU waste. The NEPA evaluation for expanded pit production was included in the 2008 LANL SWEIS and the 2020 LANL SWEIS SA. These documents evaluated the foreseeable availability of the WIPP facility. Pit production at LANL is an element of the No-Action Alternative, and the disposal of resultant TRU waste is addressed in Section 5.11.*
	Commenters state that the 2008 SWEIS and 2020 SA relied on the claim that WIPP would be available as a disposal site for all of LANL's radioactive TRU wastes, including the increased waste streams from expanded pit production. The commenter states that this assumption is not consistent with existing facts, such as those reported by the National Academy of Sciences. In addition, commenters stated that LANL's poor waste management practices led to the closure of WIPP for nearly 3 years.	16	*The availability of the WIPP facility is addressed in Section 5.11 and in Chapter 6, Cumulative Impacts. The subject National Academy report was considered during the preparation of this SWEIS, however, it did not affect the impacts presented in Chapters 5 or 6.* *As identified in Section 1.5 of this SWEIS, DOE prepared two supplement analyses to address safe handling and storage of TRU waste drums containing nitrate salts.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
6-b Waste Isolation Pilot Plant - WIPP permit is expiring	Commenters state that the WIPP permit is expiring in 2024 and question what will happen after 2024 in the event WIPP loses its license.	3	*The availability of the WIPP facility is addressed in Section 5.11 and in Chapter 6, Cumulative Impacts.*
6-c Waste Isolation Pilot Plant - Need new EIS on WIPP/PEIS to include WIPP	Commenters feel that NNSA has not adequately analyzed the implications of increased plutonium pit production in the context of disposal of TRU waste at WIPP. There is a need for a Programmatic EIS on future TRU waste disposal that includes discussion of WIPP.	3	*The potential impacts of expanded pit production at LANL and the potential impacts on the WIPP facility were evaluated in the 2008 SWEIS and the 2020 LANL SWEIS SA. As described in Section 3.2, the No-Action Alternative of this SWEIS includes expanded pit production. Impacts to TRU waste management and the WIPP facility from the No-Action Alternative, including pit production, are presented in Section 5.11 of this SWEIS.*
6-d Waste Isolation Pilot Plant - Effects of surplus plutonium disposition	Commenters request that the SWEIS address the issue of processing more than 40 metric tons of excess plutonium for eventual disposal at WIPP.	4	*The impacts on the WIPP facility from the Surplus Plutonium Disposition Program (SPDP) are presented in the SPDP Final EIS, which was issued in January 2024. Potential implementation of SPDP at LANL is included in the Expanded Operations Alternative (see Section 3.4). Additionally, Chapter 6 of this SWEIS addresses the cumulative impacts from TRU waste disposal across the DOE/NNSA Complex at the WIPP facility, including TRU wastes generated by the SPDP action.*
	A commenter requests that the SWEIS address concerns outlined in the General Accounting Office's report "Surplus Plutonium Disposition – NNSA's Long Term Plutonium Oxide Production Plans are Uncertain."	1	*The impacts associated with the SPDP are presented in the SPDP Final EIS, which was issued in January 2024. Potential implementation of SPDP at LANL is included in the Expanded Operations Alternative (see Section 3.4). Additionally, Chapter 6 of this SWEIS addresses the cumulative impacts from TRU waste disposal across the DOE/NNSA Complex at the WIPP facility. As it relates to the evaluation of cumulative impacts, DOE/NNSA considered the subject report during the preparation of this SWEIS.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
7-a SWEIS Resource Analyses - Land Use and Visual	Commenters request that the SWEIS include impacts on visual aesthetics and land use. Analysis should include impacts on surrounding communities including staffing and physical footprints on county-maintained open areas, trails, and other amenities. Impacts to land use should include a review of the Los Alamos County Master Plan, land use for housing, mitigation measures for land use, bridge designs that may impact housing negatively, and cleanup of lands required by law to be conveyed to the county and additional cleanup throughout the region to make more land available.	2	*The discussions of existing land use and visual resources are addressed in Section 4.2, and potential impacts are discussed in Section 5.2 of this SWEIS. Sections 4.2 and 5.2 also address the current status and plans for conveyance of lands around LANL. The Los Alamos County Master Plan has been considered in the analyses. Potential staffing is addressed in the sections related to socioeconomics (Sections 4.9 and 5.9). Section 5.9 also addresses potential impacts to housing. Any identified mitigations are addressed in Section 5.16.* *As of the preparation of this SWEIS, the specific designs for the replacement bridge have not been developed.*
7-b SWEIS Resource Analyses - Geology and Soils/Seismic	A commenter requested that the SWEIS include discussion on the physiography, topography, geology, soil characteristics, and contamination to soil resources.	1	*The discussion of the affected environment for geology and soils is addressed in Section 4.3 of this SWEIS.*
	Commenters state that the site is not an appropriate location for pit production because of seismic activity. Commenters have concern regarding seismic impacts and construction on the Pajarito Plateau.	4	*The potential impacts of expanded pit production at LANL, including impacts from a seismic event, were evaluated in the 2008 SWEIS and the 2020 LANL SWEIS SA. Expanded pit production is addressed as part of the No-Action Alternative in this SWEIS. The potential for seismic events is discussed in Section 4.3.2.3. The potential impacts from a seismic event are addressed in Appendix D and Section 5.14.*
	Commenters request that the SWEIS include impacts from seismic activity including: • updated seismic data and hazard analysis; • discussion on design criteria for proposed construction and how it will meet required safety analyses for design integrity and seismic risk mitigation; • impacts of fracking on seismic activity; and	18	*The discussion of the affected environment for geology and soils is addressed in Section 4.3 of this SWEIS. The section includes discussion and consideration of the latest seismic data. The potential impacts at PF-4 from a seismic event are addressed in Appendix D and Section 5.14.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	• discussion on how PF-4 has been brought up to current seismic standards.		
7-c SWEIS Resource Analyses - Water Resources	Commenters request that the SWEIS discuss environmental effects of the contaminated runoff from LANL properties to the Rio Grande, increasing contamination to the regional aquifer, and the permanent threat to groundwater. This should also include an evaluation of per- and polyfluoroalkyl substances (PFAS), hexavalent chromium, and RDX.	55	*The discussion of the affected environment for stormwater runoff is provided in Section 4.4.1.3. The potential impacts from stormwater runoff for the various alternative is provided in Section 5.4. The requested contaminants (PFAS, hexavalent chromium, and RDX) are included in the analysis.*
	Commenters request that the SWEIS address the historic water shortage in the Central and Southern Rio Grande Basins and include a discussion on whether current operations are causing a drawdown of the groundwater table.	7	*The effects of LANL water use and the potential drawdown of the groundwater table are presented in the sections on domestic water for infrastructure (Sections 4.10.3 and 5.10).*
	Commenters request that the SWEIS discuss impacts on surface- and groundwater, floodplains and wetlands, and water use and quality. It should also address Clean Water Act permitting and compliance requirements and analyze the need for best management practices to ensure protection of surface waters.	4	*Information related to surface and groundwater, floodplains, and water quality is included in Section 4.4 (affected environment) and Section 5.4 (potential impacts).* *Information related to wetlands is included as part of ecological resources in Section 4.6 (affected environment) and Section 5.6 (potential impacts).* *Information related to water use is included as part of infrastructure in Section 4.10 (affected environment) and Section 5.10 (potential impacts).*
7-d SWEIS Resource Analyses - Air Quality and Noise	Commenters request that the SWEIS consider impacts to air and noise and address: • increased vehicle commuter traffic, industrial discharges, construction dust, and plant activities involving plutonium pit production; • greenhouse gases; • mitigation measures;	3	*These topics are addressed in Section 4.5 (affected environment) and Section 5.5 (potential impacts).*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	• monitoring plan; • noise studies and analysis of noise detected by humans, and animals; and • noise reduction plan for construction and operations during the night-time hours.		
	Commenters request that the SWEIS analyze plans to vent up to 100,000 curies of gaseous radioactive tritium.	16	*The potential release of tritium from flanged tritium waste containers is addressed in Section 5.5 (air quality), Section 5.7 (human health), Section 5.14 (accidents), and Appendix D of this SWEIS.*
	A commenter requests that the use of the airfield on the Plateau be minimized or curtailed entirely.	1	*The airport is operated and maintained by Los Alamos County and is categorized as a private use facility. DOE transferred the airport to Los Alamos County on October 30, 2008. Potential air quality impacts associated with operations of the airport are included as part of the SWEIS baseline environment (Section 4.5); however, NNSA does not have the authority to change the airport's level of operation.*
	Commenter request that the SWEIS develop an accessible and transparent method for the county to access current air quality readings from the Lab's stations, current Lab construction activities by location, or other Lab initiatives, and conduct an analysis of the Lab's commitment to carbon-free energy. In addition, facility stack monitoring for all plutonium programs at the Lab must be analyzed given LANL's instances of noncompliance with the National Emission Standards for Hazardous Air Pollutants under the Clean Air Act.	2	*This SWEIS (Sections 4.5, 5.5, and Appendix H) addresses historical and potential air emissions associated with Laboratory operations. Radiological and non-radiological emissions are reported annually. The ability for Los Alamos County to access the air quality readings and monitoring results is outside the scope of this SWEIS.*
7-e SWEIS Resource Analyses – Ecological Resources	A commenter requests that the SWEIS review plans, programs, and services regarding ecological resources during construction and operation activities. In addition, funding must be allocated for enhanced studies, monitoring, and remediation.	1	*The potential impacts to ecological resources from construction and operations of the Laboratory are addressed in Section 5.6 of this SWEIS. Future funding is outside the scope of the SWEIS.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	The EPA and others provided recommendations for the preparation of the SWEIS including: • Clean Water Act Section 404 consultation be conducted to confirm the presence or absence of wetlands and other waters in the project area; • Preparation of a mitigation plan to ensure that the SWEIS has sufficient information to demonstrate whether potential adverse impacts have been adequately characterized and addressed; • Consultation with the U.S. Army Corps of Engineers (USACE) to determine the extent of jurisdictional wetlands present at the project site; • Include practicable alternatives for any discharges of dredged or fill material, measures taken to avoid and minimize impacts to aquatic habitats, and a provide compensatory mitigation for all unavoidable impacts; • Consider downstream impacts of facility discharges in ephemeral streams which flow into the Rio Grande; • Provide short-term and long-term direct, indirect, and cumulative impacts on Waters of the U.S. regarding human health/welfare, life stages of aquatic life and other wildlife dependent on aquatic ecosystems, aquatic ecosystem diversity, productivity, and stability, and/or discharge impacts on recreational, aesthetic, and economic values; and • Provide compensatory mitigation within the project watershed for all unavoidable	5	*Information related to wetlands is included as part of ecological resources in Section 4.6 (affected environment) and Section 5.6 (potential impacts).* *Preparation of a mitigation action plan (new or revised) will occur after preparation of the Final SWEIS and will include any mitigations determined to be necessary to minimize potential impacts.* *Permitting and consultation with the USACE is addressed in Section A.5 under statutory requirements and in the associated sections in Chapter 4 (affected environment and Chapter 5 (potential impacts). NPDES permits are also discussed in Section A.5.* *Potential downstream impacts of Laboratory operations, including facility discharges, are addressed in Section 5.4.* *The analysis of impacts in Chapter 5 includes short-term and long-term direct and indirect impacts. Cumulative impacts are addressed in Chapter 6 of this SWEIS.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	impacts that should fully offset all lost Waters of the U.S. functions and values		
	Commenters request that the SWEIS consider the impact of wildfires to ecological resources including: • how wildfires impact indigenous people living near the Lab; • implementation of wildfire mitigation; and • how the environment will benefit/or not benefit from new fire-fighting protocols.	5	*The Wildland Fire and Forest Health Program is an element of the Mission-Enabling Operations and Miscellaneous Programs. The mission is described in Section 2.6. Future projects associated with this mission are described in Chapter 3, and the potential impacts of these ongoing and future projects on ecological resources are addressed in Section 5.6. Expansion of the wildland fire program to include additional treatment methods and areas are addressed as part of the Expanded Operations Alternative (see Section 3.4). Potential impacts to ecological resources related to this expansion are addressed in Section 5.6. Potential impacts to cultural resources related to this expansion are addressed in Section 5.8.*
	Commenters state that the SWEIS should consider impacts to ecological resources including feral cattle that continue to pose a threat, and impacts to the Jemez Mountains salamander and spotted owl as federally designated endangered species.	2	*Impacts related to feral cattle and protected species are addressed as part of ecological resources in Section 4.6 (affected environment) and Section 5.6 (potential impacts). Future management of feral cattle is analyzed as an operational element of the Expanded Operations Alternative (Section 3.4) for all affected resource areas.*
7-f SWEIS Resource Analyses - Cultural	Commenters believe that land taken from the Pueblos of Santa Clara, San Ildefonso, and Rendija Canyon must be repatriated immediately.	3	*Lands that could be transferred from NNSA/DOE are addressed in the 1999 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). See Section 1.5 of this SWEIS. The status of lands conveyed or transferred is presented in Section 4.2 of this SWEIS. Conveyance or transfer of the 1,280 acres remaining from those tracts identified in the CT EIS are addressed as part of the No-Action Alternative in this SWEIS. Any repatriation of lands is outside the scope of this SWEIS.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	A commenter asks that DOE not stand in the way of the upgrade of the Bandelier Monument becoming a National Park.	1	*This SWEIS discusses Bandelier National Monument in the land resources (4.2), water resources (4.4), air quality and noise (4.5), ecological resources (4.6), cultural resources (4.8), and traffic (4.12) sections. Whether the Monument is proposed to become a National Park is beyond the scope of this SWEIS.*
	Commenters state that the Draft SWEIS should provide for identification and investigation of any Native American sites, in consultation with local tribes. Impacts to cultural resources need to be analyzed and lessened in consultation with the pueblo. Local tribal authorities should be involved in all planning to address the sacred sites. Impact of LANL operations and impact of "remediation" of waste must be especially analyzed regarding impact to pueblos and their residents. The SWEIS must address the environmental, cultural, health, and social-economic impacts of communities. The lack of access to cultural sites needs to be considered.	9	*Potential impacts to cultural resources that are identified as affiliated with tribes and pueblos are the subject of consultation under Section 106 of the National Historic Preservation Act (NHPA) and DOE Order 144.1. The affected environment for cultural resources is presented in Section 4.8. Potential impacts to cultural resources from continued operation of the Laboratory are discussed in Section 5.8 of this SWEIS.* *The potential health and safety impacts from continued operation of the Laboratory (including environmental remediation) to the local populations (including tribes and pueblos) are presented in Section 5.7 of this SWEIS.*
	Commenters state that NNSA must consider the health and wellbeing of local pueblos including the Pueblo of San Felipe and Tewa cultural ancestral sites. DOE NNSA must ensure that pueblos are able to continue traditional practices and be safe from activities at LANL, some sites are no longer accessible because of contamination. The SWEIS needs to include community assurances for any future contamination incidents and state how current legacy impacts will be fully funded and resourced in order to collaborate meaningfully, with impacted communities.	4	*Implementation of the DOE Office of Environmental Management's mission for environmental remediation of legacy waste is addressed in Section 4.14 of this SWEIS.* *Impacts of the actions included in the No-Action Alternative, including site remediation, are presented in Chapter 5 of this SWEIS. As set forth in Executive Order 13175 (Consultation and Coordination With Indian Tribal Governments) and DOE policy, prior to taking action with potential impact upon federally recognized tribes (including pueblos), DOE is to communicate, coordinate, cooperate, and collaborate with such tribes to determine the impact on traditional and cultural ways of life, natural resources, treaty and other federally reserved rights, consistent with a government-to-government relationship.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
7-g SWEIS Resource Analyses - Infrastructure	Commenters state that the SWEIS must include analysis of construction of a bridge over the Rio Grande and other large infrastructure projects planned to support the pit mission.	3	*NNSA is not proposing a bridge over the Rio Grande in any of the evaluated alternatives. There are several infrastructure projects included in the alternatives, including replacement of the Omega Bridge over Los Alamos Canyon. These projects are described in Chapter 3 and the potential impacts of these projects are presented in Chapter 5 of this SWEIS.*
	Commenters request that impacts from the use of utilities, including water and electricity consumption, fuel use, sewer discharges, revised requirements for infrastructure, and resource conservation be considered.	2	*The potential impacts associated with the requested topics are provided in Section 5.10 of this SWEIS.*
	A commenter states that the remoteness of LANL is putting a burden on Santa Fe resources including infrastructure and water.	1	*The potential impacts to infrastructure within the region of influence (ROI) are provided in Section 5.10 of this SWEIS. The socioeconomic ROI includes Santa Fe County; therefore, impacts in Section 5.9 for employment, housing, government finances, and services are provided for that county. Water use is a more localized resource and its ROI evaluated in Section 5.10 covers the LANL site and surrounding area.*
7-h SWEIS Resource Analyses - Socioeconomics	A commenter states that the remoteness of LANL is putting a burden on Santa Fe resources including housing, schooling, and protection.	1	*The potential socioeconomic impacts to Santa Fe housing, schools, and police and fire protection are provided in Section 5.9 of this SWEIS.*
	Commenters request that the SWEIS address the socioeconomic impacts of LANL activities including offsite leasing for office space, employment, local economy, housing opportunities, retail, community services, and impacts of a dramatically expanded workforce.	8	*The potential impacts to the requested topics are provided in Section 5.9 of this SWEIS.*
	Commenters state that NNSA should demonstrate how the buildout of the campus, cleanup of the site, and shift to production could improve the economic	2	*The potential impacts to the requested topics are provided in Section 5.9 of this SWEIS. In accordance with 40 CFR 1508.1(g)(4), impacts may be both beneficial and detrimental.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	condition of New Mexicans, especially within a 50-mile radius of the Lab. The analysis should include housing costs, workforce, income, and community services.		
	A commenter asks about the impact increased pit production will have on tourism.	1	*Pit production has been an approved activity at LANL for over two decades. The potential impacts from pit production at LANL have been evaluated in numerous NEPA documents and are presented in this SWEIS as an element of the No-Action Alternative in Chapter 5. Section 5.9 of this SWEIS presents the socioeconomic impacts from implementation of the alternatives.*
	A commenter notes that DOE funding for dangerous activities at the Lab is more than New Mexico's state funding. The commenter requests that the SWEIS discuss these social and economic inequities to the downstream indigenous pueblo tribal communities.	1	*Potential socioeconomic impacts of continued operation of the Laboratory are addressed in Section 5.9 of this SWEIS. State funding is outside of the scope of the SWEIS.*
	A commenter states that the ROI has minimal level of first responders and almost none with training in radioactive accidents.	1	*Section 4.9.7 of this SWEIS provides the current level of services within the ROI, including services of first responders. Section 5.9 presents the potential impacts to these services from the analyzed alternatives for continuing operation of the Laboratory.*
7-i SWEIS Resource Analyses - Environmental Justice	Commenters encourage a comprehensive and transparent implementation of the DOE Justice40 Initiative and Executive Order 14008.	5	*The Justice40 Initiative is discussed in Appendix A, Section A.4.13 of this SWEIS. NNSA/DOE complies with Executive Orders, including EO 14008 (Tackling the Climate Crisis at Home and Abroad), which is discussed in the air quality section (Section 4.5) and several other locations in the document.*
	Commenters state that the SWEIS must address environmental justice impacts including activities that have a disproportionately high and adverse effect on minority and/or low-income populations.	10	*Section 5.13 of this SWEIS discusses potential impacts that could have a disproportionately high and adverse effect on minority and/or low-income populations.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	Commenters request that the SWEIS consider the health disparities of indigenous communities including the legacy of nuclear testing on indigenous communities.	2	*Section 4.7 of this SWEIS includes the baseline health information about the ROI. Appendix D, Human Health, Safety, Accidents, and Emergency Management, discusses special pathways analysis for potential impacts to indigenous populations.*
	Commenters state that federal regulation and laws governing the hiring of minorities, disabled people, and women must be adhered to. Any feasible efforts should be taken to raise the standard of living through job hiring preferences or admission to training programs to benefit the indigent residents of Rio Arriba, Santa Fe, Sandoval, or Los Alamos counties.	4	*The potential socioeconomic and environmental justice impacts to the regions of influence are presented in Sections 5.9 and 5.13, respectively. Hiring practices at the Laboratory are outside the scope of the SWEIS.*
	EPA recommends that NNSA comply with NEPA pursuant to Executive Order 13175 and provide discussions on Tribal impacts.	1	*NNSA/DOE complies with Executive Orders, including EO 13175 (Consultation and Coordination with Indian Tribal Governments), which is discussed in the Chapter 5 section on laws, regulations, and permits. EO 13175 is also discussed later in the chapter when discussing tribal consultations that occurred in accordance with DOE Order 144.1.*
	Commenters request that the SWEIS address and consider environmental justice issues stemming from increased pit production.	12	*The potential impacts of expanded pit production at LANL, including potential environmental justice impacts, were evaluated in the 2008 SWEIS and the 2020 LANL SWEIS SA. As described in Section 3.2, the No-Action Alternative of this SWEIS includes expanded pit production. Potential impacts to communities with environmental justice concerns are considered for all alternatives in the SWEIS in accordance with DOE's Environmental Justice Strategy and Executive Orders 12898, 14008, and 13985, and DOE Order 144.1. This includes pit production. Impacts are presented in Section 5.13 of this SWEIS.*
	Commenters request that the SWEIS include a discussion of environmental racism.	3	*Section 5.13 of this SWEIS discusses potential impacts that could have a disproportionately high and adverse effect on minority and/or low-income populations in the region of influence.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	Commenters request that the environmental justice analysis include a discussion of young college students entering the workforce of pit production.	3	*The potential socioeconomic and environmental justice impacts of pit production were analyzed in the 2020 SA and are presented in Sections 5.9 and 5.13, respectively. Hiring practices at the Laboratory are outside the scope of this SWEIS.*
	A commenter requests that the SWEIS address human health and environmental costs of storing nuclear waste in New Mexico and the environmental justice implications for a state that disproportionately carries the burden for the Nation's nuclear weapons arsenal.	1	*The presence of communities with environmental justice concerns and potential impacts to those communities are addressed in Section 4.13 and Section 5.13, respectively. Impacts to human health are presented in Section 5.7. The cumulative impacts to human health from activities in New Mexico are presented in Chapter 6. This includes continued operations of Sandia National Laboratories in Albuquerque.*
7-j SWEIS Resource Analyses - Waste Management	Commenters state that the SWEIS must discuss hazardous materials and waste, analyze the impacts of streams of waste, and plan and fund waste management prior to any activity. It should demonstrate that LANL has the capability of handling additional waste.	8	*Information related to the management of hazardous materials and waste is presented in Section 4.11 (affected environment) and Section 5.11 (potential impacts).*
	Commenters state that the SWEIS must address LANL's waste management practices that led to a ruptured drum that closed WIPP for nearly 3 years.	8	*The incident referred to in the comment is part of the affected environment for waste management, as described in Section 4.11 of this SWEIS. Corrective actions have been implemented and are inherently incorporated in the potential waste management impacts presented in Section 5.11.*
	Commenters ask if TRU waste from pit production and non-pit production activities would be comingled and how such waste streams will be stored, handled, and transported.	4	*Information related to the management of TRU waste is presented in Section 4.11 (affected environment) and Section 5.11 (potential impacts). As mentioned in Section 4.11.5 (waste management), shipment of TRU to WIPP may include comingled waste from operations, environmental remediation, and DD&D.*
	A commenter states that the SWEIS should analyze the environmental impacts of open explosives testing and open burning and	1	*Activities that include explosives testing, detonation, or burning (open or contained) are evaluated in this SWEIS for potential environmental impacts. Any open burn/open detonation of HE waste would take place under controlled*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	detonation of wastes, including those that are hazardous and/or radioactive.		*conditions as specified by LANL's Resource Conservation and Recovery Act permit. Laboratory activities do not include open burn/open detonation of radioactive wastes. A proposal to include new equipment for HE waste treatment is described in Section 3.4 under the Expanded Operations Alternative and evaluated in Chapter 5.*
	Commenters request that the SWEIS address the handling of tritium waste container stored primarily at Area G. A commenter asks if Area G will be closed with hazardous material remaining on site. Analysis must include mitigation measures for the venting of tritium waste containers.	2	*The potential release of tritium from flanged tritium waste containers is addressed in Sections 5.5, 5.7, and 5.14 of this SWEIS. As noted in Section 4.14.3, DD&D at TA-54 will occur before the final remedy at Area G can commence.*
7-k SWEIS Resource Analyses - Human Health and Safety	Commenters state that the SWEIS should address LANL's nuclear safety record, including a 3-year suspension of plutonium operations at LANL.	27	*Potential health and safety impacts from normal operations of the Laboratory are addressed in Section 5.7. Potential impacts from facility accidents are addressed in Section 5.14.*
	Commenters request that the SWEIS consider the health and safety of indigenous and land-based peoples and communities living downwind.	3	*Section 4.7 of this SWEIS includes the baseline health information about the ROI. Section 5.7 (human health) discusses special pathways analysis for potential impacts to indigenous populations.*
	Commenters request that the SWEIS address the long-term healthcare costs associated with increased plutonium and other hazardous materials contamination. LANL funding must be used to address existing public health and safety concerns and mitigation measure that will prevent further impacts.	2	*Potential health and safety impacts from normal operations of the Laboratory are addressed in Section 5.7. Potential impacts from facility accidents are addressed in Section 5.14. Section 5.7 of this SWEIS addresses the incidence of cancer in the ROI, including Los Alamos County.*
	Commenters request that the SWEIS consider if "reference man" is an adequate measurement of safe levels of radiation and consider indigenous pregnant women, girls, and infants.	2	*DOE/NNSA does not use "reference man" but estimates potential health impacts to a hypothetical maximally exposed individual. A discussion of this analysis and the potential risks to various groups (e.g., men/women, children/adults) is included in Section D.2.1.3 of Appendix D, Human Health, Safety, Accidents, and Emergency Management, of this SWEIS.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	Commenters indicate that the SWEIS must analyze potential radiation doses to workers and members of the public.	6	*Potential health and safety impacts (radiological and nonradiological) from normal operations of the Laboratory are addressed in Section 5.7. Potential impacts from facility accidents are addressed in Section 5.14.*
	A commenter asks what the current surveillance and monitoring is to ensure the safety of the environment and human health.	1	*Radiological air monitoring is described in Section 4.5.3.1. Watershed and sediment monitoring is described in Section 4.4.1.5. Monitoring programs related to the health and safety of workers and the public are described in Section 4.7.*
7-1 SWEIS Resource Analyses - Accidents/Intentional Destructive Acts	Commenters state that the new SWEIS should certify that all facility safety bases are complete and up to date.	9	*This SWEIS presents information from safety basis documents in Appendix D, Human Health, Safety, Accidents, and Emergency Management. The regulations at 10 CFR Part 830 govern the conduct of DOE contractors, DOE personnel, and other persons conducting activities that affect, or may affect, the safety of DOE nuclear facilities.*
	A commenter asks about the risks of preparation and storage of TRU waste at LANL and the potential to generate explosive gases; whether this could affect WIPP.	1	*Potential health and safety impacts from normal operations of the Laboratory, including the management of TRU waste, are addressed in Section 5.7. Potential impacts from facility accidents, including those associated with onsite management of TRU waste, are addressed in Section 5.14. The February 2014 incident at the WIPP facility is an element of the existing environment for waste management, which is addressed in this SWEIS in Section 4.11. Corrective actions have been implemented and are incorporated in the potential waste management impacts presented in Section 5.11.*
	Commenters request that the SWEIS include discussions of intentional destructive acts, accidents, terrorism. Analysis should include protocols to inform local officials of any accidents.	12	*Accidents and intentional destructive acts are described in Appendix D, Human Health, Safety, Accidents, and Emergency Management, in accordance with DOE guidance. Communications protocols are in place; however, that topic is outside the scope of this SWEIS. Appendix D discusses emergency management and the SWEIS includes a classified appendix to address consequences of intentional destructive acts.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
7-m SWEIS Resource Analyses - Transportation	Commenters request that that SWEIS consider transportation issues, including the need for safe transportation; availability and suitability of emergency evacuation routes; increased traffic circulation; and the transportation of radioactive, toxic, and hazardous materials.	10	*Transportation topics (e.g., traffic, parking, transportation of radiological and hazardous materials) are addressed in Section 4.12 (affected environment), Section 5.12 (potential impacts), and a supporting appendix (Appendix F).*
	Commenters are concerned about how to mitigate safety issues associated with increased traffic to and from LANL near local Pueblos.	2	*Local area traffic is addressed in Section 4.12 (affected environment) and Section 5.12 (potential impacts).*
7-n SWEIS Resource Analyses - Contamination	Commenters state that environmental harm from contamination will last a long time and goes beyond the LANL boundaries. A discussion of contamination impacts and cleanup needs to be included in the SWEIS.	7	*The impacts evaluation in this SWEIS includes short- and long-term impacts. Remediation activities to implement the Consent Order are an element of the No-Action Alternative, and the impacts of these remediation activities are presented in Chapter 5.*
	A commenter states that the SWEIS should consider sites at LANL where petroleum storage tank releases have been confirmed.	1	*Impacts associated with remediation activities to implement the Consent Order are included in Chapter 5 of this SWEIS.*
7-o SWEIS Resource Analyses - Climate change and resiliency	Commenters state that there is a growing threat of wildfires caused by climate change and post-fire flooding. Planning for such emergencies should be a high priority. The effects of this accelerated change for human health and the environment require analysis in a new or supplemental SWEIS. DOE must also analyze the fire risks and climate-change risks to health and the environment. The demonstrated and systematic failure to implement wildfire mitigation and protection measures that DOE had previously relied upon to support its conclusion in the 2008 SWEIS that it could adequately manage the risks of wildfires must be discussed.	36	*The Wildland Fire and Forest Health Program is an element of the Mission-Enabling Operations and Miscellaneous Programs. The mission is described in Section 2.6. Ongoing and future projects associated with this mission are described in Chapter 3 and the potential impacts of these ongoing and future projects are addressed in Chapter 5.* *Climate change and greenhouse gases are addressed in Section 4.5 (affected environment) and Section 5.5 (potential impacts). These sections also discuss implementation of Executive Order 14008 (Tackling the Climate Crisis at Home and Abroad).*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
7-p SWEIS Resource Analyses - Cumulative Impacts	Commenters request that the SWEIS include analysis of short-term and long-term direct, indirect, and cumulative impacts for resources.	10	*In accordance with 40 CFR 1508.1(g) and the DOE NEPA implementing procedures, this SWEIS includes the evaluation of direct, indirect, and cumulative effects or impacts. Direct and indirect impacts are presented in Chapter 5. Cumulative impacts are presented in Chapter 6.*
	Commenters request that the SWEIS consider the impacts of the proposed 12.5-mile-long, 115-kilovolt power line through the Caja Del Rio.	13	*NNSA and the U.S. Forest Service have prepared a draft environmental assessment of the electrical power capacity upgrade project, which evaluates the specific environmental impacts associated with this project. Because the project is undergoing a separate NEPA review but has not yet been implemented, this SWEIS includes it as an element of the No-Action Alternative in Section 3.2. The potential impacts of this project are included in Chapter 5 under the No-Action Alternative.*
7-q SWEIS Resource Analyses - General	A commenter states that the SWEIS needs to be clear about roles and responsibilities for NNSA versus the Environmental Management side of LANL on remediation activities and how remediation and natural resource damage assessment and restoration will be factored into all alternatives assessed in the SWEIS.	1	*The mission of the DOE Office of Environmental Management is identified in Section 2.7 and detailed in Section 4.14. Potential environmental impacts of continuing operation of the Laboratory are provided in Chapter 5 of this SWEIS and are not segregated by mission, but include all activities proposed for each alternative (see Chapter 3), including remediation. Natural Resource Damage Assessments are prepared for sites involved in the Comprehensive Environmental Response, Compensation and Liability Act and does not apply to the LANL site.*
	A commenter states that unavoidable adverse impacts must be addressed.	1	*In accordance with 40 CFR 1502.16 and the DOE NEPA implementing procedures, Section 5.17 of this SWEIS includes a description of unavoidable adverse impacts.*
	A commenter states that mitigation commitments should be discussed.	1	*In accordance with 40 CFR 1502.14 and the DOE NEPA implementing procedures, Section 5.16 of this SWEIS includes a discussion of mitigation measures. NNSA implements mitigations through a Mitigation Action Plan for the Laboratory.*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	A commenter requests that the SWEIS include an analysis with a 100-mile radius of LANL.	1	*As identified in Section 4.1, this SWEIS evaluates the environmental impacts of the alternatives within defined 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, socioeconomics is evaluated within the five-county region where about 86 percent of LANL employees reside (95 percent of those personnel that reside in New Mexico). Human health risks to the public from exposure to airborne contaminant emissions are assessed for an area within a 50-mile radius of the center of the LANL site. This is consistent with other DOE/NNSA and federal EISs. The potential for health impacts beyond 50 miles is extremely low. Computer modeling of atmospheric dispersion (as presented in Appendix D, Figure D.3-1 of this SWEIS) demonstrates that potential offsite concentrations of contaminants drops off rapidly as a function of distance and the contribution to overall population dose beyond 50 miles is effectively zero.*
7-r SWEIS Resources Analyses – Defense Nuclear Facilities Safety Board (DNFSB)	Commenters identify that DOE's calculated potential doses to workers and the public in its 2020 SA are orders of magnitude lower than those calculated by the independent Defense Nuclear Facilities Safety Board (DNFSB). This mismatch between the NNSA's and the board's potential dose calculations should be reconciled in the new SWEIS.	14	*The derivation of potential accident consequences are addressed in Appendix D, Human Health, Safety, Accidents, and Emergency Management, of this SWEIS. See Section B.3 for additional details related to this comment.*
	Commenters request that NNSA's analysis of all of the alternatives should specifically address how the safety basis and seismic recommendations of the DNFSB will be incorporated.	2	*The DNFSB recommendations related to safety basis and seismic recommendations are addressed in Appendix D, Human Health, Safety, Accidents, and Emergency Management, of this SWEIS. As reported in Section 2.3.3 of this SWEIS, the DNFSB has been engaged with the NNSA on seismic safety of PF-4 since the Laboratory first identified elevated potential seismic hazards in 2009. In a letter in August 2023, DNFSB acknowledged that the Laboratory completed a probabilistic risk analysis and*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
			concluded that the seismic safety risk of PF-4 is acceptable until the site-specific probabilistic seismic hazard analysis is updated in 2025. DNFSB found that NNSA's conclusion was technically defensible and that the accompanying peer review process was robust.
	A commenter requests that NNSA consult DNFSB because of the board's special expertise and provide any resulting statements from that consultation to the public.	1	*NNSA works closely with the DNFSB on any issues related to nuclear safety. However, NNSA does not need to consult with DNFSB regarding NEPA matters. This request is outside the scope of the SWEIS.*
	Commenters note that LANL's history of nuclear safety incidents need analysis and resolution before expanding plutonium pit production. They further commented that a recent DNFSB report noted that approximately one third of Lab criticality evaluations reviewed were noncompliant with analysis and documentation requirements defined in DOE-STD-3007.10. The impacts of and rigorous avoidance of criticality accidents must be analyzed in the SWEIS.	3	*Potential criticality accidents are addressed in Appendix D, Human Health, Safety, Accidents, and Emergency Management, of this SWEIS.*
	A commenter requests that the SWEIS include an update to the probabilistic seismic hazard analysis (PSHA), even though the DNFSB reports that LANL has it scheduled for 2025.	1	*The need for an updated PSHA is addressed Section 4.3 of this SWEIS. As reported in Section 2.3.3 of this SWEIS, the DNFSB has been engaged with the NNSA on seismic safety of PF-4 since the Laboratory first identified elevated potential seismic hazards in 2009. In a letter in August 2023, DNFSB acknowledged that the Laboratory completed a probabilistic risk analysis and concluded that the seismic safety risk of PF-4 is acceptable until the site-specific probabilistic seismic hazard analysis is updated in 2025. DNFSB found that NNSA's conclusion was technically defensible and that the accompanying peer review process was robust.*
	A commenter notes that in March 2022, NNSA stated that it is no longer pursuing a safety class active confinement system at	1	*Potential accident impacts at PF-4 are addressed in Appendix D, Human Health, Safety, Accidents, and Emergency Management, of this SWEIS. They are based*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	PF-4 in spite of recommendations from the DNFSB. The SWEIS must analyze the potential impacts of the Lab not installing active confinement at PF-4.		*on the documented safety analyses prepared for the facility, which evaluate the need for safety class equipment. The analyses reflect potential accidents that could be credible (more than one chance in a million years) and takes credit for safety class equipment and passive design features.*
	Commenters are concerned that DOE/NNSA controls DNFSB access to nuclear facilities. While the issue has reportedly been resolved in writing between the DNFSB and DOE, the commenters feel it should be restated in the SWEIS as public record.	2	*DOE/NNSA's commitment to work effectively with the DNFSB is already in the public record and is outside the scope of the SWEIS.*
8-a General Support or Opposition - Opposition to LANL activities including pit production for a variety of reasons, including health and environmental risks and accidents	Commenters express general opposition to LANL activities, opposition to proceeding with the LANL SWEIS, nuclear weapons, or opposition to NNSA and the changes in direction of this program over time.	32	*NNSA acknowledges receipt of these comments.*
8-b General Support or Opposition - Support for LANL activities for a variety of reasons	A commenter expressed general support for the staff and how much care they are taking with regard to safety and concern for the public.	1	*NNSA acknowledges receipt of this comment.*
9 Miscellaneous	The U.S. Geological Survey had no comment at this time.	1	*NNSA acknowledges receipt of this comment.*
10-a Out of Scope - Not related to the SWEIS	Several commenters provide observations related to LANL without any substantive comment related to the SWEIS.	30	*NNSA acknowledges receipt of these comments.*
	A commenter requests that the SWEIS discuss the $8 billion in costs for the CMP.	1	*The estimated cost figures in the CMP are not relevant to the analysis of potential impacts for the various alternatives and are considered outside the scope of the SWEIS. No projects listed in the CMP would be implemented until after an appropriate NEPA review (i.e., categorical exclusion, environmental assessment and FONSI, or inclusion in a record of decision).*

Category/Topic Area	Summary	No. of Comments	SWEIS Reference or NNSA Response
	A commenter indicates a need for a paid tribal and local representation as part of any current emergency operations monitoring and response operations at LANL.	1	*Payment of tribal and local representation at LANL is outside the scope of the SWEIS.*
	A commenter indicates that the SWEIS should address how the People's Republic of China is recruiting scientists from LANL to advance its own military.	1	*This comment is outside the scope of the SWEIS as it does not affect the proposed action, environmental conditions, or potential impacts at the Laboratory.*
	Commenters note that NNSA has been on the GAO's High Risk List for project management since 1991 and claims that the lack of an integrated Master Schedule for expanded plutonium pit production is illustrative of why NNSA remains on the list.	7	*This comment has no bearing on the evaluation of potential impacts of continued operation of the Laboratory and is considered outside the scope of the SWEIS.*
	A commenter states that they have requested documents under the Freedom of Information Act that have not been provided.	1	*This comment has no bearing on the evaluation of potential impacts of continued operation of the Laboratory and is considered outside the scope of the SWEIS.*
	A commenter suggests following up on State and Tribal Government Working Group Long Term Stewardship (LTS) to discuss stewardship of hazardous waste still on site.	1	*NNSA is committed to improving communications with the surrounding communities and pueblos; however, this comment is not relevant to the SWEIS.*
10-b Out of Scope - Focused on another site (e.g., LLNL, SRS)	A number of comments were received that are outside the scope of the LANL SWEIS because the comments focus on another DOE site including SRS, Rocky Flats, and the Idaho National Laboratory.	15	*NNSA acknowledges receipt of these comments.*

B.3 Additional Background for Selected Comments

This section provides additional background information related to specific comment summaries (and associated specific comment) that may not be addressed in this LANL SWEIS.

Summary Comment 7-r:

Commenters identify that DOE's calculated potential doses to workers and the public in its 2020 SA are orders of magnitude lower than those calculated by the independent Defense Nuclear Facilities Safety Board (DNFSB). This mismatch between the NNSA's and the board's potential dose calculations should be reconciled in the new SWEIS.

Specific Comment from Nuclear Watch New Mexico:

Calculations for worker and public doses in its DOE's 2020 SA are orders of magnitude lower than those calculated by the DNFSB (some of which are lethal doses). NNSA accepted an exigent condition where there is no viable control strategy to meet the evaluation guideline (EG) to the public. NNSA accepted bounding mitigated consequences to the public that ranged from 490 to 3,175 rem during a post-seismic/fire. NNSA deemed the risk acceptable based on conservatisms in the analysis, low likelihood that the accident occurs, the limited number of shipping containers, and the seismic power shutoff system (which has acknowledged deficiency and cannot prevent all fire ignition sources). Work associated with this activity will primarily be performed in four GBs [gloveboxes], only one of which meets seismic requirements. New LANL seismic analyses must be completed to make the SWEIS credible. [Comment cites the DNFSB conclusion that the approved PF-4 safety basis (August 2018 version) does not appropriately analyze the hazards at PF-4 and that the current safety control strategy does not adequately protect the public from the post-seismic fire scenario.]

Background Information:

The TA-55 safety basis document (as discussed in Appendix D of this SWEIS) addresses PF-4 and is updated approximately annually to address needed changes. The safety basis document thoroughly analyzed two scenarios involving a seismic event and an ensuing fire. One for inside PF-4 and one outside. Note that due to seismic upgrades inside the facility and its equipment, the frequency of this event is extremely unlikely. For a seismic fire event inside the facility, the analysis concluded that the unmitigated consequences to a person at the site boundary (maximally exposed offsite individual) would exceed the EG and would require specific controls. Those controls were implemented through technical safety requirements imposed on the facility. The mitigated dose (after crediting the controls) to the maximally exposed offsite individual is below the EG. Other required controls would further reduce the dose or prevent the fire from propagating to the entire facility as the scenario suggests. For the seismic fire event outside the facility, the analysis calculated unmitigated consequences to the maximally exposed offsite individual at the site boundary would exceed the EG and would also require needed controls. Those controls, many of which are passive design features, were implemented through technical safety requirements imposed on the facility. The mitigated dose (after crediting the controls) to the maximally exposed offsite individual is below the EG. Note that with the passive design features, the frequency of a seismic fire event outside the facility is also extremely unlikely.

In regard to the DNFSB recommendations and accompanying DNFSB/TECH-46 report (September 2020), DOE provided a response to the recommendations in March 2021. In the response, DOE addressed the DNFSB's question concerning whether the hazards associated with the current transuranic (TRU) waste container population at LANL are consistently and adequately analyzed and controlled. DOE's response stated that there are four facilities at LANL that generate, handle and/or store, and ship TRU waste. These are TA-55 (which houses PF-4), CMR, TWF, and Area G. Each of these facilities has up-to-date safety-basis documents, compliant with 10 CFR Part 830, that identify and analyze hazards within the facilities, including chemical incompatibility.

The TA-55 and CMR safety basis documents analyzed a high-pressure release from a TRU waste drum caused by incompatible chemical composition (collocated polysaccharides and high molarity nitric acid). These safety basis documents also analyzed low-energy chemical incompatibility events. Based on the analyses, appropriate controls have been established and implemented. After careful evaluation, no other chemical incompatibility hazards within TRU waste drums that can lead to a rapid over-pressurization were identified, other than the one analyzed in the TA-55 and CMR safety-basis documents. Waste management at LANL has established processes (chemical compatibility evaluation) to ensure that new or modified operations do not introduce potential combinations that could lead to a chemical reaction. Visual inspection of waste to be placed in containers is conducted by waste management and a representative of the disposal site prior to waste being placed in a container.

One additional item related to the specific scoping comment is the difference in purpose between a safety basis document and the results of an accident analysis presented in a NEPA document. The preparation of documented safety analyses (DSAs) uses source terms and other assumptions for bounding DSA frequency and consequence estimates. A central focus of the DSA process under 10 CFR Part 830 is to demonstrate that safety controls would be sufficient to protect workers and the public from accidents that could occur as infrequently as once every 1,000,000 years. The DSA process assists in determining what aspects of facility operation require engineered or administrative controls to reduce the probability and consequences of accidents. In contrast, the purpose of the NEPA analysis is to quantify the risk and provide estimates of the probabilities or consequences of postulated accidents.

Consistent with the DSA purpose, source terms and other assumptions used for bounding safety analysis frequency and consequence estimates are very conservative; that is, they overestimate the expected impacts. In reality, the actual risk of facility operations is expected to be much lower than portrayed in DSAs when the necessary controls, brought to light by the DSA process, are applied. In general, a NEPA analysis will make many assumptions since the proposed facility or proposed facility modifications have not been designed at the time of the NEPA analysis. These assumptions are based on experience with similar facilities and operations and expert engineering judgment. As a result, this leads to differences between a NEPA document and a DSA in assumptions and estimated doses to the noninvolved worker, the maximally exposed individual, and the public. Therefore, the doses presented in this SWEIS may not match those presented in the DSAs. The NNSA has compared the doses presented in this SWEIS against the DSAs and determined that they are more realistic, while still conservative, estimates of doses that could result under accident conditions.

For the SWEIS or other NEPA documents, consistent, conservative, but not overly bounding, assumptions should be used so that fair comparisons could be made of accident risks between alternatives. However, in all cases, sufficient safety controls (10 CFR Part 830) would be in place so that significant accidental releases are eliminated, reduced in frequency, mitigated to reduce the consequences by implementing a combination of preventive or mitigative measures. If safety controls are fully credited, then the consequences of an accident would likely be much less than those reported in this SWEIS.

APPENDIX C
Methodologies Used in this SWEIS

CONTENTS

ACRONYMS AND ABBREVIATIONS

ACAM	Air Conformity Applicability Model
BEA	U.S. Bureau of Economic Analysis
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DD&D	decontamination, decommissioning, and demolition
DOE	U.S. Department of Energy
EO	Executive Order
GHG	greenhouse gas
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LLW	low-level radioactive waste
LOS	level of service
MEI	maximally exposed individual
MLLW	mixed low-level radioactive waste
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NNSA	National Nuclear Security Administration
PM_{10}	particulate matter with a diameter 10 micrometers and smaller in diameter
RIMS II	Regional Input-Output Modeling System
ROI	Region of Influence
SWEIS	*Site-wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory LANL*
TRU	transuranic (waste)
VRM	Visual Resource Management
WIPP	Waste Isolation Pilot Plant

C METHODOLOGIES USED IN THIS SWEIS

C.1 Introduction

This SWEIS was prepared in accordance with the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the *National Environmental Policy Act* (NEPA) (40 CFR Parts 1500–1508) and the Department of Energy (DOE) Procedures for Implementing NEPA (10 CFR Part 1021). In accordance with 40 CFR 1502.1, this SWEIS is intended to "provide a full and fair discussion of significant effects" and "to inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse effects or enhance the quality of the human environment." This SWEIS includes a discussion of direct effects and their significance and indirect effects and their significance in Chapter 5 (40 CFR 1501.3(d)); and cumulative impacts in Chapter 6 (40 CFR 1508.1(g)(3)). Effects can be adverse or beneficial.

This appendix describes the methodologies used to assess the potential direct and indirect impacts of the alternatives in this SWEIS. The analysis in this LANL SWEIS considers ongoing activities and proposed activities that could occur over approximately the next 15 years (2024–2038). This SWEIS evaluates the environmental impacts of the alternatives within a defined Regions of Influence (ROIs), as described for each resource below. The ROIs encompass geographic areas within which any notable impact would be expected to occur. The level of detail in the description of each resource methodology varies with the likelihood of a potential impact to the resource.

Resource methodologies are presented in the same order as the resource areas in Chapters 4 and 5. For each resource area, NNSA developed key metrics to provide a comparative basis of evaluation appropriate for that resource. The No-Action Alternative is compared against the 2022 existing environment baseline,[1] and the Modernized Operations Alternative and Expanded Operations Alternative are compared against the No-Action Alternative.

As discussed in Chapter 3, both the No-Action Alternative and the two action alternatives encompass a multitude of discrete projects/actions that could give rise to environmental impacts. 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 defined by the No-Action Alternative, the Modernized Operations Alternative, and Expanded Operations Alternative (*see* Chapter3, Section 3.5). The accumulated parameters (e.g., total land disturbed, water consumption, waste generation) are shown in Table 3.5-1 (for construction) and Table 3.5-2 (for operations) for the No-Action Alternative, the Modernized Operations Alternative, and Expanded Operations Alternative. In developing the analytical parameters for the SWEIS analysis, NNSA is able to account for projects/actions both individually and in totality, and the analysis in this SWEIS addresses each of these aspects.

The methodology for addressing accidents and intentional destructive acts is presented in Appendix D. The methodology for evaluating potential effects from transportation of radioactive materials is presented in Appendix F. The methodology for evaluating potential effects to air quality and greenhouse gas (GHG) emissions is presented in Appendix H. The methodology for

---

[1] The latest referenceable baseline information is available for most resource areas in the 2022 SWEIS Yearbook and 2022 Annual Site Environmental Report.

assessing cumulative impacts is presented in Chapter 6. For any new projects, NNSA would implement a combination of design features, best management practices, and mitigation measures to avoid or reduce potential environmental impacts that could result from implementing any of the alternatives (*see* Chapter 5, Section 5.16).

C.2 Land Use and Visual Resources

C.2.1 Land Use

Description of Affected Resources and Region of Influence. Land use is the term used to describe the designation and use of land. It represents the economic and cultural activities (e.g., agricultural, residential, commercial, industrial, recreational, and conservation) that are practiced at a given place. The analysis of impacts to land use considers land use plans and policies, zoning regulations, and existing land use as appropriate for the site analyzed. This analysis identifies temporary and permanent changes of land uses associated with any of the alternatives.

The affected project area or ROI for land use is the LANL site and leased and nearby offsite areas. The land use designations of nearby locations were determined through review of land ownership maps and agency planning documents where available and land uses as observed through publicly available aerial and street imagery. The ROI includes the limits of operational/physical disturbance, as well as the construction-related impact area, which includes additional areas of temporary disturbance (e.g., laydown areas) required for construction activities.

Description of Impact Assessment. Land use changes could potentially affect previously disturbed land and undisturbed land. Key metrics in this analysis are: (1) total area of land disturbance; (2) number and footprint of new facilities; and (3) a qualitative analysis of consistency with current and use plans, classifications, and policies. Activities under the No-Action Alternative and action alternatives were reviewed to identify actions that would change or cause adverse effects to use, designation, development density, ownership, or local planning and zoning. The land use analysis also considers potential impacts resulting from the conversion of, or the incompatibility of, land use changes with special-status lands, such as national parks/monuments or prime farmland, and other protected lands, such as federal- and state-controlled lands (e.g., public land administered by the Bureau of Land Management [BLM] or other government agency). Land use data gathered for this analysis were also used in analyzing impacts on the visual environment, the results of which are described in greater detail immediately below in Section C.2.2.

C.2.2 Visual Resources

Description of Affected Resources and Region of Influence. Visual resources are natural and manmade features that give a particular landscape its character and aesthetic quality. The features that form the overall impression a viewer receives of an area include landform, vegetation, water, color, adjacent scenery, rarity, and manmade modifications. The visual ROI is the location of the facilities and views of the facilities from on site and public viewpoints off site. Special consideration is given to actions within visually sensitive locations and viewpoints from visually sensitive locations.

Description of Impact Assessment. The key metric in this analysis is visual compatibility (i.e., whether actions would be consistent with existing landscapes, obscure views, increase the visibility of structures or otherwise detract from the scenic perspectives of existing and planned residential developments adjacent to the sites, or cause glare). This SWEIS uses the following criteria in the visual resources analysis: scenic quality, visual sensitivity, distance, and visibility zones from key public viewpoints. The analysis is comparative in nature and consists of a qualitative examination of potential changes in visual resources, scenic values (attractiveness), and modification activities that could alter the visibility of structures at each of the sites or obscure views of the surrounding landscape, and changes in land cover that could make structures more visible.

To rate the scenic quality of the LANL site and surrounding areas, DOE/NNSA used BLM's Visual Resource Management (VRM) Classification System (BLM 1986). Although this classification system is designed for undeveloped and open land managed by BLM, this is one of the only systems of its kind available for the analysis of VRM and planning activities.

The VRM Classification System provides a systematic approach for evaluating the potential changes to visual resources that may result from the projects/actions and is typically used by DOE/NNSA in its NEPA evaluations. The major concepts of the BLM's VRM methodologies that this SWEIS followed are as listed:

- Establish an understanding of the existing visual character and qualities of the landscape and environment of the project area;
- Determine areas from which the projects/actions would be visible;
- Estimate the visual expectations and response of the viewers to visual changes resulting; from projects/actions; and
- Identify the visual contrast resulting from changes to the existing landscape character, and
- Assess qualities in the project area as a result of projects/actions.

C.3 Geology and Soils

Description of Affected Resources and Region of Influence. The ROI for geology and soils consists of the LANL site and nearby offsite areas. This SWEIS presents collated and summarized information on the regional structural geology, stratigraphy, and soils. In addition, this SWEIS evaluates the seismicity of the region surrounding the site to provide a perspective on the probability of earthquakes in the area and their likely severity. This information is also used in the SWEIS evaluation of accidents from natural phenomena.

Description of Impact Assessment. Key metrics in this analysis include: (1) the amount 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 and flooding). This SWEIS evaluates the projects/actions based on the amount of disturbance that may affect the geology and/or soils of the ROI. These impacts could include potential erosion impacts and impacts to geologic economic resources. Impacts, if any, are evaluated and a determination made as to severity. In addition, the analysis identifies and discusses seismic requirements for new facilities.

C.4 Water Resources

C.4.1 Surface Water

Description of Affected Resources and Region of Influence. The affected environment discussion includes a description of local surface water resources at or near the LANL site, flow characteristics and relationships, existing water quality, and the location of floodplains. The water quality of potentially affected receiving waters was determined by reviewing current monitoring data for contaminants of concern. Monitoring reports for discharges permitted under the National Pollutant Discharge Elimination System were examined for compliance with permit limits and requirements.

Description of Impact Assessment. The impacts analysis evaluates the following: (1) possible changes in quantity or quality of stormwater runoff during construction activities; (2) the type, rate, and characteristics of any wastewater generated during operations; and (3) the type and quantity of water needed to support construction and operations. Changes in stormwater volumes and directions have the potential to adversely impact existing discharge points or receiving waters. Spills or leaks of contaminants from heavy equipment during construction could affect stormwater runoff. The analysis evaluates wastewater from operations in terms of treatment and capacity of existing facilities. Lastly, the impacts analysis evaluates the potential for projects/actions to be within the 100- or 500-year floodplains.

C.4.2 Groundwater

Description of Affected Resources and Region of Influence. Groundwater is described in terms of the regional groundwater system in which LANL is located; more specifically, in terms of the local aquifers. The SWEIS presents the local groundwater system of aquifers and confining units in terms of general water quality, depths from the ground surface, and rates and direction of groundwater movement. The discussion of groundwater quality from past LANL activities and the associated ongoing remedial activities includes mapped locations of groundwater contaminant plumes.

Description of Impact Assessment. Key metrics presented 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 floodplain impacts. Potential impacts to wetlands are discussed in Section C.6 (Ecological Resources). Potential impacts associated with water use are discussed in Section C.10 (Infrastructure).

The SWEIS evaluates potential impacts to groundwater resources that could result from a potential release of contaminants during construction and discharge of wastewaters during operations that could reach groundwater. The evaluation also considers whether the alternatives could affect or be affected by existing groundwater contaminant plumes and cleanup activities.

C.5 Air Quality and Noise

C.5.1 Air Quality

Description of Affected Resources and Region of Influence. The ROI for air quality is the LANL site and nearby offsite areas within the Air Quality Control Region where air quality impacts could occur. The air quality impact analysis evaluates the criteria pollutants, hazardous/toxic air pollutants, and GHG from the alternatives. Criteria pollutants are defined in 40 CFR Part 50. The National Ambient Air Quality Standards set standards for primary and secondary sources. Title III of the 1990 *Clean Air Act* amendments, known as the National Emission Standards for Hazardous Air Pollutants (NESHAP), regulates hazardous air pollutants, such as carcinogens, mutagens, and reproductive toxins. Title V of the *Clean Air Act* requires major sources of air pollutants and certain other sources to obtain and operate in compliance with an operating permit. The *Clean Air Act* requires sources with these "Title V permits" to certify compliance with the applicable requirements of their permits at least annually. DOE/NNSA activities at LANL comply with Title V requirements.

Description of Impact Assessment. Key metrics presented in the air quality analysis include: (1) quantities of air emissions and comparisons to air quality standards; (2) quantities of GHG emissions and comparison to state-wide emissions; and (3) quantities of radiological emissions (Note: Potential human health impacts from radiological emissions are discussed in Section C.7 [Human Health]). The SWEIS analysis used the Air Conformity Applicability Model (ACAM) to determine whether emissions from new sources would exceed the general conformity rule's *de minimis* threshold values for assessing effects to air quality. The detailed analysis is described in Appendix H of this SWEIS.

The SWEIS estimated construction and operational emissions from the LANL site. For purposes of analysis, the SWEIS assessed peak annual emissions. Therefore, regardless of the ultimate implementation schedule of any phase of development, annual emissions should be less than those specified. Small changes in facilities site and ultimate design and moderate changes in quantity and types of equipment used would not substantially change the emission estimates and would not change the determination under the general conformity rule or the effects.

Construction and demolition emissions were estimated for fugitive dust, on- and off-road diesel equipment and vehicles, worker trips, and off-gases from new pavements. There would be temporary increases in air quality impacts from construction equipment, trucks, and construction employee vehicles. Exhaust emissions from these sources would result in releases of criteria pollutants such as sulfur dioxide, nitrogen oxide, PM_{10}, total suspended particulates, volatile organic compounds, and carbon monoxide. All three alternatives would disturb land during construction. Fugitive dust generated during the clearing, grading, and other earth-moving operations is dependent on a number of factors, including silt and moisture content of the soil, wind speed, and area disturbed. There would be no radiological emissions during construction activities. Several facilities have used or stored radiological materials and are known to contain residual contamination. Consequently, there is a potential for short-term radiological air emissions for decontamination, decommissioning, and demolition (DD&D) actions.

Operational emissions were estimated for heating and cooling of buildings and vehicles. The impacts of nonradiological emissions from operations were evaluated based on results of the ACAM analysis. Estimates of GHG emissions from stationary (e.g., backup diesel generators) and mobile sources (e.g., vehicles) were based on U.S. Environmental Protection Agency (EPA) emission factors and number of employees for the alternatives. With regard to operations, as discussed in Chapter 4, Section 4.5, LANL operations release radioactivity to the environment through stacks and from diffuse sources. The SWEIS estimated the radiological emissions for all three alternatives and, in some cases, emissions limits were used for the analysis. The potential human health impacts from radiological emissions are discussed in Section C.7 (Human Health).

As described in Appendix H, this SWEIS also evaluates the potential social costs (and potential benefits) from GHG emissions (and reductions of GHG emissions related to implementation of renewable energy projects).

C.5.2 Noise

Description of Affected Resources and Region of Influence. Information on noise was obtained from current LANL documentation (e.g., site annual reports, recent environmental documents).

Resources potentially affected by noise include workers, members of the public, wildlife, and sensitive receptors in the vicinity of the project site. The ROI for noise is the LANL site and nearby offsite areas where notable noise impacts could occur.

Description of Impact Assessment. Key metrics presented in the noise analysis include: (1) identification of construction and operational noise sources; (2) identification of new projects within approximately 400–800 feet of site boundaries, that may cause offsite noise impacts; (3) qualitative analysis of potential noise levels off site to determine whether there would be a violation of any federal, state, or local noise regulation; and (4) traffic noise analysis.

In the noise assessment, DOE/NNSA included a description of the noise sources and noise levels anticipated for construction and operations. A review of both existing and proposed facility noise was conducted. With regard to noise from traffic, the analysis estimated the increase in traffic on area roads to determine whether there would be perceptible noise effect. Noise is measured on a logarithmic scale. Therefore, two-line sources of traffic of equal level added together would result in an increase of 3 decibels. If the sound of traffic traveling on one southbound lane produced 60 decibels of noise, a second line of similar traffic moving in the northbound direction would produce total noise (for both directions of traffic) at about 63 decibels.

C.6 Ecological Resources

Description of Affected Resources and Region of Influence. The affected biological resources include vegetation, fish and wildlife, protected and sensitive species, and wetlands at the LANL site. The ROI for biological resources is defined by the boundaries of the site. The description of the affected environment includes information on vegetation, fish and wildlife, protected and sensitive species, and wetlands.

Description of Impact Assessment. Key metrics presented in the analysis include: (1) level of disturbances to land/vegetation and discuss impact on habitats, fish and wildlife, and protected and special-status species; (2) wetland impacts; and (3) tritium levels and potential impacts on vegetation and commodities. In general, the analysis of impacts was qualitative rather than quantitative. The impact assessment was based on the degree to which various habitats or species could be affected relative to the existing affected environment. Where appropriate, impacts were evaluated against federal and state protection regulations and standards.

C.6.1 Vegetation

Potential impacts on vegetation were evaluated by comparing data on site vegetation to land requirements for construction and operational activities for the alternatives. Changes to the existing vegetation, cleared areas, or disturbed sites proposed to be redeveloped for construction were determined. Potential impacts on vegetation and commodities from increased tritium emissions were evaluated to determine the potential level of contamination that could occur.

C.6.2 Fish and Wildlife

Potential impacts on fish and wildlife were based primarily on the amount of habitat changed or lost due to the activities involving clearing of vegetation and construction and operation of facilities. The construction and operational activities proposed in previously disturbed sites and those in undeveloped areas were evaluated for assessment of habitat changes, loss of habitats, and whether any sensitive or unique habitats would be impacted. The assessment also considered availability of suitable habitat adjacent to the proposed construction and operational activities as well as human disturbance, including construction and operational noise, to determine potential impacts on fish and wildlife.

C.6.3 Protected and Sensitive Species

Potential impacts on protected and sensitive species were generally based on the same approach taken for fish and wildlife. The primary concerns for assessing potential impacts were co-location of protected and sensitive species and the presence of designated critical habitat with the area of construction and operational activities. The occurrence or potential occurrence of protected and sensitive species in the proposed sites was secondarily considered in the evaluation of potential impacts.

C.6.4 Wetlands

Potential impacts on wetlands were generally based on the same approach taken for vegetation. The assessment of direct impacts considered the amount of wetlands that would be impacted by the construction and operational activities. Indirect impacts such as runoff sedimentation were based on the proximity of wetlands to the construction and operational activities.

C.7 Human Health

Description of Affected Resources and Region of Influence. Potential impacts on public and worker health and safety include radiological and nonradiological exposure pathways and occupational injuries, illnesses, and fatalities resulting from construction activities and normal (accident-free) operations for the alternatives. Exposure pathways include inhalation, immersion, ingestion, and exposure to external sources. Occupational ROIs include involved and non-involved workers. The ROI for human health and safety is the LANL site and offsite areas within a 50-mile radius of those sites due to potential release of materials to the environment. As presented in Appendix D, Figure D.3-1 of this SWEIS demonstrates that potential offsite concentrations of contaminants drops off rapidly as a function of distance and the contribution to overall population dose beyond 50 miles is effectively zero.

Because operations at LANL have the potential to release radionuclides to the environment that result in exposure to the worker and the public, DOE/NNSA conducts environmental surveillance and monitoring activities at LANL and surrounding areas. These activities provide data that are used to evaluate potential radiation exposures that may contribute doses to the public. Each year, environmental data from LANL are collected and analyzed. The results of these environmental monitoring activities are summarized in the annual site environmental reports. The environmental monitoring conducted at LANL consists of two major activities: effluent monitoring and environmental surveillance.

Effluent monitoring involves the collection and analysis of samples or measurements of liquid (waterborne) and gaseous (airborne) effluents prior to release into the environment. These analytical data provide the basis for the evaluation and official reporting of contaminants, assessment of radiation and chemical exposures to the workers and the public, and demonstration of compliance with applicable standards and permit requirements.

Environmental surveillance data provide a direct measurement of contaminants in air, water, groundwater, soil, food, biota, and other media subsequent to effluent release into the environment. These data verify LANL's compliance status and, combined with data from effluent monitoring, allow the determination of chemical and radiation dose and exposure assessment of DOE/NNSA operations and effects, if any, on the local environment. The effluent and environmental surveillance data presented in the environmental reports were used as the primary source of data for the analysis of radiation exposure to the public for the No-Action Alternative.

Description of Impact Assessment. Key metrics presented in the human health analysis are: (1) radiological doses and potential latent cancer fatalities (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. A summary of the methodology used to assess the human health impacts during normal operations is presented below. Additional details are documented in Appendix D.

Radiological impacts were assessed for workers involved in LANL operations (both involved workers and non-involved workers) and for the public (maximally exposed individual [MEI] and population within the 50-mile radius of the site). Similarly, health impacts to the MEI and population are based on doses calculated by the radiological air analyses.

Radiological doses were calculated for the MEI and the entire population residing within 50 miles of the LANL site. The analysis calculated doses from normal operations using the EPA-mandated air dispersion dose model, CAP88-PC Version 4.1.1.[2] The CAP88 dose model 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.

Meteorological data used in the calculations were in the form of joint frequency distributions of wind direction, wind speed class, and atmospheric stability category. For occupants of residences within the ROI, the dose calculations assumed that the occupant remained at home (unprotected outside the house) during the entire year and obtained food according to the rural pattern defined in the NESHAP background documents. For workers, radiological doses were estimated by DOE/NNSA based on historical dose information.

Occupational injury, illness, and fatality estimates were evaluated using occupational incidence rates of major industry groups based on U.S. Department of Labor, Bureau of Labor Statistics injury, illness, and fatality information for similar activities (BLS 2021). These rates were compared to person-hour estimates for the alternatives. Occupational injury, illness, and fatality categories used in this analysis are in accordance with Occupational Safety and Health Administration definitions. Incident rates were developed for facility construction and operations.

Facility operations were evaluated to determine if any chemical-related or biological-related health impacts would be associated with normal (accident-free) operations. Facility design features that minimize the worker exposures during facility operations act as defense-in-depth controls. In addition to these controls, worker protection is augmented by programs such as the Integrated Safety Management System, an environmental management system, an operational health and safety management system, a worker safety and health program, work planning and control documents, chemical hygiene, industrial hygiene personnel monitoring, and emergency preparedness.

The methodology for analyzing facility accidents is described in Appendix D, Section D.3.

[2] https://www.epa.gov/radiation/forms/cap88-pc-version-411-downloads-and-supporting-documents

C.8 Cultural Resources

Description of Affected Resources and Region of Influence. Cultural resources are divided into three general categories for this SWEIS: archaeological resources, historic resources, and Native American resources, including traditional cultural properties. The analysis of impacts to cultural resources is organized by these three categories of resources and is focused on those resources that have been determined eligible for listing on the *National Register of Historic Places*.

Section 106 of the *National Historic Preservation Act* and its implementing regulations (36 CFR Part 800) state that an undertaking has an effect on a significant historic property (i.e., eligible to the National Register) when that undertaking may alter those characteristics of the property that qualify it for listing on the *National Register of Historic Places*. An undertaking is considered to have an adverse effect when it diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, or association. Adverse effects include, but are not limited to:

- physical destruction, damage, or alteration of all or part of the property;
- removal of a property from its historic location;
- change to the character of the property's use or of physical features in its setting when that character contributes to the property's historic significance;
- introduction of visual, audible, or atmospheric elements that are out of character with the property, or changes that alter its setting;
- neglect of a property resulting in its deterioration or destruction; or
- transfer, lease, or sale of a property out of Federal ownership without adequate provisions to protect the property's historic integrity (36 CFR 800.5(a)(2)).

Paleontological resources are the fossil remains of past life forms. Fossils are the remains of once living organisms such as plants, animals, fungi, and bacteria that have been replaced by minerals. Fossils also include imprints or traces of organisms preserved in rock, such as impressions, burrows, and trackways. Paleontological resources are considered a fragile and nonrenewable scientific record of the history of life on earth and so represent an important component of America's natural heritage.

The ROI for cultural resources includes the area within which cultural and paleontological resources could be affected by construction and operations activities and includes those resources located within the boundaries of the LANL site.

Description of Impact Assessment. Key metrics presented in the cultural analysis include: (1) identification of land disturbances and (2) qualitative analysis of the potential to impact cultural and paleontological resources.

The analysis of potential impacts to paleontological resources from construction and operations activities focused on impacts resulting from ground-disturbing activities. The analysis considered the previous ground-disturbance that has occurred from LANL development activities. Potential impacts to surrounding Pueblos and traditional cultural properties were also evaluated.

C.9 Socioeconomics

Description of Affected Resources and Region of Influence. The analysis of socioeconomics considers the attributes of human social and economic interactions from the alternatives and the impacts on the ROI, which is defined as the five-county area in which about 95 percent of LANL employees (that have residences in New Mexico) reside: Los Alamos, Santa Fe, Rio Arriba, Bernalillo, and Sandoval counties. The potential for socioeconomic impacts is greatest in local jurisdictions. The SWEIS socioeconomic analysis reviewed the local demographics, regional and local economy, local housing, and community services.

Description of Impact Assessment. 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. Estimates of the potential impacts on economic output, employment, and earnings under each alternative were derived using multipliers provided from the Regional Input-Output Modeling System (RIMS II) developed by the U.S. Bureau of Economic Analysis (BEA) for a select region (BEA 2023). Multipliers were developed for an aggregation of the five-county ROI. The BEA develops RIMS II multipliers using input-output tables that show the distribution of inputs purchased and outputs sold for each industry. A national input-output table, representing approximately 500 different industries, is adjusted using BEA regional economic accounts to accurately reflect the structure of a given area.

The impacts analysis examined potential impacts with respect to employment, population, and local economic conditions. 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. The analysis considered vacant housing units in the ROI to determine whether an influx of workers/families into the ROI would impact housing availability. The analysis also analyzed potential effects on fire protection, police protection services, and medical services, and estimated the effects on schools. Generally, effects that result in greater employment or income, or that otherwise improve the quality of life for the local population, are considered beneficial socioeconomic impacts.

C.10 Infrastructure

Description of Affected Resources and Region of Influence. Potentially affected site infrastructure resources include electrical distribution systems, natural gas, fuel, domestic water, and sanitary sewer systems. The affected environment is considered to be the land area and resources within the LANL site boundary.

Description of Impact Assessment. Key metrics presented in the infrastructure analysis are: (1) quantities of water, sanitary sewer (wastewater), electricity, and fuel (petroleum and natural gas) associated with construction, DD&D, modernization/upgrade/utility projects, and operations and (2) analysis of the current infrastructure to meet demands. The SWEIS assessment of potential impacts to site infrastructure focused on the ability of the site to support the alternatives. Based on estimated requirements for the alternatives, the Campus Master Plan, and other DOE/NNSA planning documents, infrastructure requirements were projected over the planning periods for the alternatives. The analyses identifies significant demands and potential impacts to the existing infrastructure from implementation of the alternatives. The analysis considered DOE/NNSA site sustainability goals to reduce infrastructure demands and impacts.

C.11 Waste Management

Description of Affected Resources and Region of Influence. Affected resources in this discussion are the LANL site processes and facilities currently in place to manage (treat, store, and dispose) waste. The ROI consists of the LANL site and any offsite facilities where LANL waste is sent for management. The LANL waste streams considered in this case include the following:

- radioactive waste:

  - low-level radioactive waste (LLW)
  - mixed low-level radioactive waste (MLLW)
  - transuranic (TRU) waste, including mixed TRU waste;
- hazardous waste, including explosives waste;
- New Mexico special waste;
- biohazardous/medical waste;
- municipal solid waste; and
- construction and demolition waste.

The emphases for the affected resources are those waste types and quantities that are currently generated within LANL and that would be generated under the three alternatives. The description of affected resources consists of a brief discussion of each waste type that includes typical characteristics of the waste involved, the amount generated per year, and the manner in which it is managed. Waste management actions or processes are described in terms of throughput and capacity to the extent possible. They are also evaluated with respect to the identification of any regulatory or permit issues (e.g., throughput limitations, violations, adverse findings) that might indicate adverse environmental impacts could be associated with additional waste generation.

Description of Impact Assessment. 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.

Potential impacts associated with waste management are evaluated based on the waste types and estimated volumes that would be generated by the three alternatives. Waste types were evaluated to determine if they are consistent with existing LANL waste streams and appropriate for management in the same procedures and processes as used for similar waste streams. Projections for waste volumes from the three alternatives were each compared to the routine waste generation within LANL to determine if procedures, processes, or infrastructure capacity could possibly be overwhelmed by the additional waste loads. The regulatory or permit status of existing waste management activities was also evaluated to determine if additional waste volumes could impact regulatory compliance.

LANL employs several types of waste treatment processes within the LANL site and, for some waste types, uses recovery and reuse methods, but rarely disposes of waste on site. In many cases, LANL's waste treatment is intended to make the waste suitable for offsite disposal or to reduce its volume to make offsite treatment or disposal more efficient. Accordingly, a key element of evaluating the impact of managing LANL waste is considering how offsite treatment and disposal facilities might be affected. Two DOE facilities, the Waste Isolation Pilot Plant (WIPP) facility near Carlsbad, New Mexico, and the Nevada Nuclear Security Site, are identified as disposal sites for LANL TRU and LLW/MLLW, respectively. The analysis focused on how increased waste quantities associated with the three alternatives could impact disposal capacities and ongoing waste receipt operations. Long-term impacts associated with potential impacts to WIPP's capacity and planned life span are addressed in the cumulative impacts analysis in Chapter 6.

C.12 Traffic and Transportation

Description of Affected Resources and Region of Influence. The ROI for transportation is the LANL site, adjacent areas, and the corridors between LANL and other sites where radiological and hazardous material transportation could occur. For the existing environment, the SWEIS described the transportation infrastructure (road network, mass transit, and ride sharing) utilized by workers for commuting. The level of service (LOS) on area roads was presented to describe operational conditions as they relate to traffic streams and perceptions by motorists and passengers. The existing circulation and transportation network within the LANL site was described, as well as parking conditions. The description of the existing environment also includes a discussion of the transport of radiological materials/wastes and nonradiological hazardous materials/waste shipments between LANL and other sites.

Description of Impact Assessment. Key metrics presented in the traffic and transportation analysis include: (1) traffic changes on area roads and (2) impacts to the public and transport crews from shipments of radiological and hazardous materials. Nonradiological/nonhazardous transportation impacts utilized workforce estimates to evaluate the impact of commuting workers on the LOS of area roads. Within the LANL site, the analysis focused on the impact of workforce changes on circulation and parking.

Because the SWEIS alternatives involve offsite transport of radiological materials/wastes and nonradiological hazardous materials/waste shipments between LANL and other sites, the analysis addressed the impacts of transporting these types of materials/wastes. For this analysis, NNSA determined the types and quantities of materials/wastes that would be transported, as well as the origins and destinations for the shipments. Impacts were calculated for anticipated incident-free (or routine) transportation as well as for postulated transportation accidents. The detailed analysis is presented in Appendix F.

For transportation accidents, the analysis presents both radiological and nonradiological impacts. Radiological impacts from accident conditions consider foreseeable scenarios that could damage transportation packages, leading to releases of radioactive materials to the environment and are expressed in terms of LCFs to potentially exposed nearby populations and to a hypothetical maximally exposed public receptor. The radiological risks from the routine transportation of materials and wastes are likewise estimated in terms of the number of LCFs, both among shipping crews and exposed populations. Nonradiological impacts are expressed in terms of traffic fatalities and were determined by multiplying the number of miles to be driven, based on the number of shipments, by the route-specific fatality rate. Appendix F presents more details regarding the methodology for offsite transport of radiological materials/wastes and nonradiological hazardous materials/waste shipments.

C.13 Environmental Justice

Description of Affected Resources and Region of Influence. The potential for disproportionately high and adverse human health or environmental impacts from the alternatives on minority and low-income population was examined in accordance with Executive Order (EO) 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." 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 in the United States and its territories and possessions, the District of Columbia, the Commonwealth of

Puerto Rico, and the Commonwealth of the Mariana Islands. In January 2021, EO 14008, "Tackling the Climate Crisis at Home and Abroad," was issued. The order formalized the commitment to make environmental justice a part of the mission of federal agencies 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." In April 2023, EO 14096 ,"Revitalizing Our Nation's Commitment to Environmental Justice for All" was issued. The order 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 EOs, including EO 12898, EO 13985,[3] EO 13990,[4] and EO 14008.

Minority populations refer 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. The potentially affected area for this SWEIS includes parts of eight counties in New Mexico that comprise an area within a 50-mile radius of the LANL site.

Description of Impact Assessment. The environmental justice analysis identifies and addresses any disproportionate and adverse human health or environmental effects on minority or low-income populations. Environmental justice concerns the environmental impacts that alternatives may have on minority and low-income populations, and whether such impacts are disproportionate to those on the population as a whole in the potentially affected area. The SWEIS used population data from the U.S. Census Bureau and state population projections for New Mexico to calculate the population within a 50-mile radius of the center of the LANL site. The 50-mile radius population surrounding the LANL site is 369,786 persons. The population is based on the 2020 Census.

The threshold for identifying minority and low-income communities surrounding LANL is consistent with CEQ guidance (CEQ 1997) for identifying minority populations using either the 50-percent threshold or a "meaningfully greater" percentage of minority or low-income individuals in the general population. For this SWEIS, NNSA defined "meaningfully greater" as 20 percentage points above the population percentage in the general population. Once minority and low-income communities were identified, the impacts analysis focused on whether there would be any high and adverse environmental or human health effects.

Meaningfully greater low-income populations are identified using the same methodology described above for identifying meaningfully greater minority populations. The low-income population in New Mexico is 39 percent, and the low-income population percentage of the counties surrounding the LANL site is 40 percent. Comparatively, a meaningfully greater low-income population percentage using these statistics would be 20 percentage points greater than the low-income population for counties surrounding the LANL site (or 60 percent). Therefore, the county threshold was used to identify areas that have meaningfully greater low-income populations within a 50-mile radius of the LANL site.

---

[3] 86 FR 7009 (2021). In 2021 the President issued EO 13985, Advancing Racial Equity and Support for Underserved Communities Through the Federal Government, to address equity issues in programs, policies, actions, and decisions conducted by the federal government.

[4] 86 FR 7037 (2021).

C.14 References

BEA (Bureau of Economic Analysis) 2023. "Regional Input-Output Modeling System (RIMS II)." Generated October 2023. Multipliers for Bernalillo, Los Alamos, Rio Arriba, Sandoval, and Santa Fe Counties, New Mexico. Available online: https://www.bea.gov/sites/default/files/methodologies/RIMSII_User_Guide.pdf

BLM (Bureau of Land Management) 1986. *Manual 8431 – Visual Resource Contrast Rating*. Available online: https://blmwyomingvisual.anl.gov/docs/BLM_VCR_8431.pdf

BLS (Bureau of Labor Statistics) 2021. "Injuries, Illnesses, and Fatalities, 2021." Available online: https://www.bls.gov/iif/state-data.htm#NM

CEQ (Council of Environmental Quality) 1997. *Environmental Justice Guidance under the National Environmental Policy Act*. Washington D.C. December. Available online: https://www.energy.gov/node/256081

APPENDIX D
Human Health, Safety, Accidents, Intentional Destructive Acts, and Emergency Management

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ACGIH	American Conference of Governmental Industrial Hygienists
ACM	asbestos-contaminated materials
AEGL	Acute Exposure Guideline Levels
ALARA	as low as reasonably achievable
ALOHA	Areal Locations of Hazardous Atmospheres
ARF	airborne release fraction
BIO	bases for interim operation
BLS	Bureau of Labor Statistics
BMBL	Biosafety in Microbiological and Biomedical Laboratories
CDC	Centers for Disease Control and Prevention
CMR	Chemistry and Metallurgy Research
CSED	Criticality Safety Evaluation Document
DARHT	Dual-Axis Radiographic Hydrodynamic Test Facility
DART	days away with restricted time
DBA	design-basis accident
DBE	design-basis events
DMMSC	Dynamic Mesoscale Materials Science Capability
DR	damage ratio
DSA	Documented Safety Analysis
EOS	Emergency Operations System
EPA	U.S. Environmental Protection Agency
EPHA	emergency planning hazards assessment
EPZ	emergency planning zone
ERO	Emergency Response Organization
ERPG	Emergency Response Planning Guideline
ES&H	environment, safety, and health
ESSP	Explosive Safety Site Plan
FGE	fissile gram equivalent
FTWC	Flanged Tritium Waste Containers
HALEU	high-assay low-enriched uranium
HAZMAT	hazardous materials
HE	high explosive
HENC	high-efficiency neutron counter
HEPA	high-efficiency particulate air
HID	human infectious doses
HMR	hazardous materials regulations
HS Pu	heat source plutonium
ICRP	International Commission on Radiological Protection
INL	Idaho National Laboratory
IWL	industrial waste line
JCO	justifications for continued operation
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
LCF	latent cancer fatality
LEFFF	Low-Enriched Uranium Fuel Fabrication Facility

LINAC	linear accelerator
LPF	leak path factor
MAR	material at risk
MDA	material disposal area
MEI	maximally exposed individual
NES	nuclear environmental sites
NESHAP	National Emission Standards for Hazardous Air Pollutants
NIH	National Institutes of Health
NIOSH	National Institute for Occupational Safety and Health
NM	New Mexico
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
PAC	protective action criteria
PEL	permissible exposure limits
RANT	radioassay and nondestructive testing
RF	respirable fraction
RLUOB	Radiological Laboratory Utility Office Building
RLWTF	Radioactive Liquid Waste Treatment Facility
SAD	safety assessment documents
SARA	Superfund Amendments and Reauthorization Act
SPDP	Surplus Plutonium Disposition Program
ST	source term
SWEIS	site-wide environmental impact statement
TEDE	total effective-dose equivalents
TEEL	Temporary Emergency Exposure Limit
TLW	TRU liquid waste
TNT	trinitrotoluene
TRC	total recordable case
TRISO	tri-structural isotopic
TRU	transuranic
TSD	Transportation Safety Document
TWA	time-weighted averages
TWF	Transuranic Waste Facility
WCRRF	Waste Characterization, Reduction, and Repackaging Facility
WETF	Weapons Engineering Tritium Facility
WIPP	Waste Isolation Pilot Plant

D HUMAN HEALTH, SAFETY, ACCIDENTS, INTENTIONAL DESTRUCTIVE ACTS, AND EMERGENCY MANAGEMENT

The purpose of this appendix is two-fold: (1) to discuss the environment, safety, and health (ES&H) programs at Los Alamos National Laboratory (LANL); and (2) support the sections in Chapters 4 and 5 of this site-wide environmental impact statement (SWEIS) related to health and safety (Sections 4.7 and 5.7) and accident analyses and intentional destructive acts (Section 5.14).

Section D.1 discusses the ES&H programs at LANL, regulatory requirements for ES&H, and the responsibilities to address ES&H requirements. Section D.2 discusses occupational exposures/impacts from radiation, chemicals, and other industrial hazards arising from the normal operations of facilities. Section D.2 also discusses environmental monitoring programs and the impact of releases of radioactive and hazardous materials from normal plant operations. The potential impacts to workers and members of the general public from hypothetical accidents are discussed in Section D.3 (Note: Transportation accidents are discussed in Appendix E). Section D.4 discusses intentional destructive acts and Section D.5 discusses emergency management.

D.1 ES&H Programs and Regulatory Requirements

The Laboratory's ES&H policies commit the organization to perform work in a manner that ensures the protection of employee health and safety, the environment, and the public. These policies provide that these ES&H protections are ensured by the systematic and consistent use of the LANL Integrated Safety Management System, Environmental Management System, and Occupational Health and Safety Management System to drive safe work practices at all levels. These policies also state commitments to continuous improvement (i.e., feedback solicitation and iterative refinement).

The Laboratory's policies commit LANL to comply with all ES&H requirements, including laws, regulations, and other related requirements such as DOE Orders. 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 ES&H laws, regulations, and requirements and with directives promulgated by the National Nuclear Security Administration (NNSA) and DOE regarding occupational safety and health. DOE Order 458.1 directs DOE facilities to keep radiological doses to the public and the environment as low as reasonably achievable and to monitor for routine and nonroutine releases of radioactive materials. DOE Order 458.1 requires DOE sites to do the following:

- Ensure the radiological dose to the public from their site activities does not exceed 100 millirem in any given year.
- Comply with the order's dose limits for wildlife and plants.
- Notify the public about any radiation doses resulting from operations.
- Use radiological limits authorized by thine DOE to evaluate property that has potential to contain residual radioactivity (for example, surplus equipment, waste shipped for disposal off site, or land parcels transferred to new owners) before releasing it to ensure that the dose does not exceed 25 millirem per year above background for real estate or 1 millirem per year above background for moveable items (LANL 2024a).

D.2 Radiation, Chemicals, and Other Industrial Hazards Arising from Normal Operations

D.2.1 Radiation and Impacts to Human Health

Humans are constantly exposed to naturally occurring radiation through sources such as from cosmic radiation and from the Earth's rocks and soils. This type of radiation is referred to as *background radiation* and it is always around us. Background radiation remains relatively constant over time and is present in the environment today just as it was hundreds of years ago. In addition, humans are also exposed to manmade sources of radiation, including medical and dental x-rays, household smoke detectors, materials released from coal burning power plants, and nuclear facilities. The following sections describe some important principles concerning the nature, types, sources, and effects of radiation and radioactivity.

D.2.1.1 What Is Radiation?

Some atoms have large amounts of energy and are inherently unstable. They may reach a stable, less energetic state through the emission of subatomic particles or electromagnetic radiation, a process referred to as radioactivity. *Ionizing radiation* has enough energy to free electrons from atoms, creating ions that can cause biological damage. Although it is potentially harmful to human health, ionizing radiation is used in a variety of ways, many of which are familiar to us in our everyday lives. An x-ray machine is one source of ionizing radiation. Likewise, most home smoke detectors use a small source of ionizing radiation to detect smoke particles in the room's air. The two most common mechanisms in which ionizing radiation is generated are the electrical acceleration of atomic particles such as electrons (as in x-ray machines) and the emission of energy from nuclear reactions in atoms.

Some elements, such as uranium, radium, plutonium, and thorium, share a common characteristic: they are unstable or radioactive. Such radioactive isotopes are called *radionuclides* or *radioisotopes*. As these elements attempt to change into more stable forms, they emit invisible rays of energy or particles at rates which decrease with time. This emission is known as radioactive decay. The time it takes a material to lose half of its original radioactivity is referred to as its half-life. Each radioactive isotope has a characteristic half-life. The half-life may vary from a millionth of a second to millions of years, depending upon the radionuclide. Eventually, the radioactivity will essentially disappear.

As a radioactive element emits radioactivity, it often changes into an entirely different element that may or may not be radioactive. Eventually, however, a stable element is formed. This transformation may require several steps, known as a decay chain. Radium, for example, is a naturally occurring radioactive element with a half-life of 1,622 years. It emits an alpha particle and becomes radon, a radioactive gas with a half-life of only 3.8 days. Radon decays to polonium and, through a series of steps, to bismuth, and ultimately to lead.

Non-ionizing radiation bounces off or passes through matter without displacing electrons. Examples include visible light and radio waves. In this SWEIS, the term radiation is used to describe ionizing radiation.

D.2.1.2 What Are Some Sources of Radiation?

Several different sources of radiation have been identified. Most sources are naturally occurring, or background sources, which can be categorized as cosmic, terrestrial, or internal radiation sources. Manmade radiation sources include consumer products, medical sources, and other miscellaneous sources. Table D.2-1 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.

Table D.2-1 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 (2024a, 2024b)

Cosmic radiation is ionizing radiation resulting from energetically charged particles from space that continuously hit the Earth's atmosphere. These particles and the secondary particles and photons they create are referred to as cosmic radiation. Because the atmosphere provides some shielding against cosmic radiation, the intensity of this radiation increases with altitude above sea level. For example, a person in Los Alamos, at an altitude of 7,320 feet above sea level, is exposed to more cosmic radiation than a person at sea level. The average annual dose from cosmic radiation to a person in the vicinity of Los Alamos is about 66 millirem.

Terrestrial radiation is emitted from the radioactive materials in the Earth's rocks, soils, and minerals. Radon, radon progeny, potassium, isotopes of thorium, and isotopes of uranium are the elements responsible for most terrestrial radiation. The average annual dose from terrestrial radiation to a person in the vicinity of Los Alamos is about 100 millirem. This dose varies geographically across the country, and the average annual dose from terrestrial radiation to a person in the United States is about 21 millirem (NCRP 2009).

Internal radiation arises from the human body metabolizing natural radioactive material that has entered the body by inhalation, ingestion, or through an open wound. Natural radionuclides in the body include isotopes of uranium, thorium, radium, radon, bismuth, polonium, potassium, rubidium, and carbon. The major contributors to the annual dose equivalent for internal radioactivity are the short-lived decay products of radon which contribute about 200 millirem per year. The average dose to a person in the vicinity of Los Alamos from other internal radionuclides is about 30 millirem per year, most of which results from potassium-40 and polonium-210 (LANL 2024a).

Consumer products also contain sources of ionizing radiation. In some products, like smoke detectors and airport x-ray machines, the radiation source is essential to the operation of the product. In other products, such as televisions and tobacco products, the radiation occurs incidentally to the product function. The average annual dose to a person in the vicinity of Los Alamos from consumer products is about 13 millirem (LANL 2024a).

Medical source radiation is an important diagnostic tool and is the main source of exposure to the public from manmade radiation. Exposure is deliberate and directly beneficial to the patient exposed. In general, medical exposures from diagnostic or therapeutic x-rays result from beams directed to specific areas of the body. Thus, all body organs generally are not irradiated uniformly. Nuclear medicine examinations and treatments involve the internal administration of radioactive compounds or radiopharmaceuticals by injection, inhalation, consumption, or insertion. Even then, radionuclides are not distributed uniformly throughout the body. Radiation and radioactive materials also are used in the preparation of medical instruments, including the sterilization of heat-sensitive products such as plastic heart valves. Diagnostic x-rays and nuclear medical procedures result in an average annual exposure of 300 millirem. It is recognized that the averaging of medical doses over the entire population does not account for the potentially significant variations in annual dose among individuals, where greater doses are received by older or less healthy members of the population.

A few additional sources of radiation contribute minor doses to individuals in the United States. The doses from nuclear fuel cycle facilities, such as uranium mines, mills, and fuel processing plants, nuclear power plants, and transportation routes have been established to be less than 1 millirem per year. Radioactive fallout from atmospheric atomic bomb tests, emissions of radioactive material from DOE facilities, emissions from certain mineral extraction facilities, and transportation of radioactive materials contributes less than 1 millirem per year to the average individual dose. Air travel contributes approximately 1 millirem per year to the average dose.

D.2.1.3 How Does Radiation Affect the Human Body?

Ionizing radiation affects the body through two basic mechanisms. The ionization of atoms can generate chemical changes in body fluids and cellular material. Also, in some cases the amount of energy transferred can be sufficient to actually knock an atom out of its chemical bonds, again resulting in chemical changes. These chemical changes can lead to alteration or disruption of the normal function of the affected area. At low levels of exposure, such as the levels experienced in an occupational or environmental setting, these chemical changes are small and innocuous. The body has a wide variety of mechanisms that repair the damage induced. However, occasionally, these changes can cause irreparable damage that could ultimately lead to initiation of a cancer, or change to genetic material that could be passed to the next generation. The probability for the occurrence of health effects of this nature depends upon the type and amount of radiation received, and the sensitivity of the part of the body receiving the dose.

At much higher levels of acute whole-body exposure, at least 10–20 times higher than the legal limits for occupational exposures (the limit for annual occupational exposures is 5 rem), damage is much more immediate, direct, and observable. Health effects range from reversible changes in the blood to vomiting, loss of hair, temporary or permanent sterility, and other changes leading ultimately to death at acute exposures (above about 100 times the regulatory limits). In these cases, the severity of the health effect is dependent upon the amount and type of radiation received. Exposures to radiation at these levels are quite rare.

For low levels of radiation exposure, the probabilities for induction of various cancers or genetic effects have been extensively studied by both national and international expert groups. The problem is that the potential for health effects at low levels is extremely difficult to determine without extremely large, well-characterized populations. For example, to get a statistically valid estimate of the number of cancers caused by an external dose equivalent of 1 rem, 10 million people would be required for the test group, with another 10 million for the control group. The risk factors for radiation-induced cancer at low levels of exposure are small, and it is extremely important to account for the many non-radiation-related mechanisms for cancer induction, such as smoking, diet, lifestyle, chemical exposure, and genetic predisposition. These multiple factors also make it difficult to establish cause-and-effect relationships that could attribute high or low cancer rates to specific initiators.

The most significant ill-health effects that result from environmental and occupational radiation exposure are cancer fatalities. These ill-health effects are referred to as "latent" cancer fatalities (LCFs) because the cancer may take many years to develop and for death to occur. Furthermore, when death does occur, these ill-health effects may not actually have been the cause of death.

Health impacts from radiation exposure, whether from sources external or internal to the body, generally are identified as somatic (affecting the individual exposed) or genetic (affecting descendants of the exposed individual). Radiation is more likely to produce somatic effects rather than genetic effects. The somatic risks of most importance are the induction of cancers.

For a uniform irradiation of the body, the incidence of cancer varies among organs and tissues. The thyroid and skin demonstrate a greater sensitivity than other organs; however, such cancers also produce relatively low mortality rates because they are relatively amenable to medical treatment.

NNSA cannot measure the actual dose that every member of the public receives from its operations. To conservatively estimate dose to the public, it is necessary to characterize a hypothetical individual who is expected to receive a bounding dose (i.e., "maximally exposed individual" [MEI]). The MEI must be conservatively represented with respect to all sources of dose (e.g., inhalation, direct exposure, and "special pathways" such as ingestion from food and water). Typically, inhalation is the greatest source of dose from normal operations; consequently, the standard methodology in DOE NEPA documents is to analyze impacts to the MEI from inhalation. This SWEIS also includes an analysis of a secondary analysis of dose from special pathways (see Section 5.7).

With regard to portions of the population being "more susceptible" to health effects from radiation dose, research shows that fatal cancer risks (expressed as LCFs) are different between: (1) males and females; (2) children and adults; and (3) workers and the general population. The differences are minor and not statistically significant. For example: (1) the fatal cancer risk for males is 0.00048 LCF/rem, while female risk is 0.00066 LCF/rem; and (2) the fatal cancer risk for adults is 0.00041 LCF/rem, while the general population risk is 0.00055 LCF/rem. Rather than developing dose estimates for each of these different populations, the MEI is "representative" of the general population that would receive a dose. The methodology for estimating dose is inherently conservative because it is based on a linear non-threshold approach that overestimates impacts for low doses (ICRP 2006, ICRP 2007).

Genetic effects and cancer are the primary health concerns from radiation exposure. Cancer would be about five times more likely than a genetic effect (such as chromosome changes, stillbirths, congenital abnormalities, and infant and childhood mortality) (ICRP 2006, ICRP 2007). Consequently, this SWEIS presents LCFs as the primary impact.

D.2.1.4 How Is Radiation Exposure Regulated?

The release of radioactive materials and the potential level of radiation doses to workers and the public are regulated by DOE for its contractor facilities. Under conditions of the *Atomic Energy Act* (as amended by the *Price-Anderson Amendments Act* of 1988), DOE is authorized to establish federal rules controlling radiological activities at the DOE sites. The act also authorizes DOE to impose civil and criminal penalties for violations of these requirements. Some NNSA activities are also regulated through a DOE Directives System that is contractually enforced.

Occupational radiation protection is regulated by 10 CFR Part 835, Occupational Radiation Protection. DOE has set occupational dose limits for an individual worker at 5,000 millirem per year. NNSA sites have set administrative exposure guidelines at a fraction of this exposure limit to help enforce the goal of managing and controlling worker exposure to radiation and radioactive material as low as reasonably achievable (ALARA). 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 2020a).

Environmental radiation protection is currently regulated contractually through DOE Order 458.1. This order is applicable to all DOE/NNSA contractor entities managing radioactive materials. This order sets annual dose standards to members of the public, as a consequence of routine DOE operations, of 100 millirem through all exposure pathways. The order requires that no member of the public receive an annual dose greater than 10 millirem from the airborne pathway and 4 millirem from ingestion of drinking water. In addition, the dose requirements in the Radionuclide National Emission Standards for Hazardous Air Pollutants (NESHAP) limit exposure of an individual member of the public to airborne releases of radionuclides to a maximum of 10 millirem per year.

Limits of exposure to members of the public and radiation workers are derived from International Commission on Radiological Protection (ICRP) recommendations. The U.S. Environmental Protection Agency (EPA) uses the National Council on Radiation Protection and Measurements and the ICRP recommendations and sets specific annual exposure limits in *Radiation Protection Guidance to Federal Agencies* documents.

Each regulatory organization then establishes its own set of radiation standards. The various exposure limits set by DOE and the EPA for radiation workers and members of the public are shown in Table D.2-2.

D.2.1.5 Sources at LANL That May Lead to Radiation Exposure

Releases of radionuclides to the environment from LANL operations are another source of radiation exposure to workers and individuals in the vicinity of LANL. This section describes the primary types of radioactive sources at LANL and describes how DOE/NNSA monitors, measures, and regulates radiation and radioactive materials.

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

Guidance Criteria (organization)	Public Dose Limit at the Site Boundary	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

ALARA = as low as reasonably achievable; NA = not applicable

a Although this is a limit (or level) that is enforced by DOE, worker doses must be managed in accordance with 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 rem per year has been established for external exposures (LANL 2023c).

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

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.

Airborne emissions contribute to the potential for radiation dose at, and around, LANL with operations involving radioactive materials. NESHAP regulations specify that any source that potentially can contribute greater than 0.1 millirem per year total effective-dose equivalents (TEDE) to an offsite individual is to be considered a "major source" and emissions from that source must be continuously sampled.

In addition to major sources, there are a number of minor sources that have the potential to emit radionuclides to the atmosphere. Minor sources are composed of any ventilation systems or components such as vents, laboratory hoods, room exhausts, and exhaust stacks that do not meet the criteria for a major source but are located in or vent from a radiologically controlled area. Emissions from LANL facility ventilation systems are estimated from radiation control data collected on airborne radioactivity concentrations in the work areas. Other emissions from unmonitored processes and laboratory exhausts are categorized as minor emission sources. Additionally, as explained in Section D.3, accidents can release radionuclides that can result in radiation exposure.

In addition, there are also areas of potential fugitive and diffuse sources at LANL, such as contaminated soils and structures. Diffuse and fugitive sources include any source that is spatially distributed, diffuse in nature, or not emitted with forced air from a stack, vent, or other confined conduit. Radionuclides are transported entirely by diffusion or thermally driven air currents. Typical examples include emissions from building breathing; resuspension of contaminated soils, debris, or other materials; unventilated tanks; ponds, lakes, and streams; wastewater treatment systems; outdoor storage and processing areas; and leaks in piping, valves, or other process equipment.

Liquid discharges are another source of radiation release and exposure. Three types of liquid discharge sources at LANL include treatment facilities, other point- and area-source discharges, and in-stream locations. A radiological monitoring plan is in place at LANL required to address compliance with DOE Orders and National Pollutant Discharge Elimination System (NPDES) Permits. Radiological monitoring of storm water is also usually required by the applicable NPDES permits.

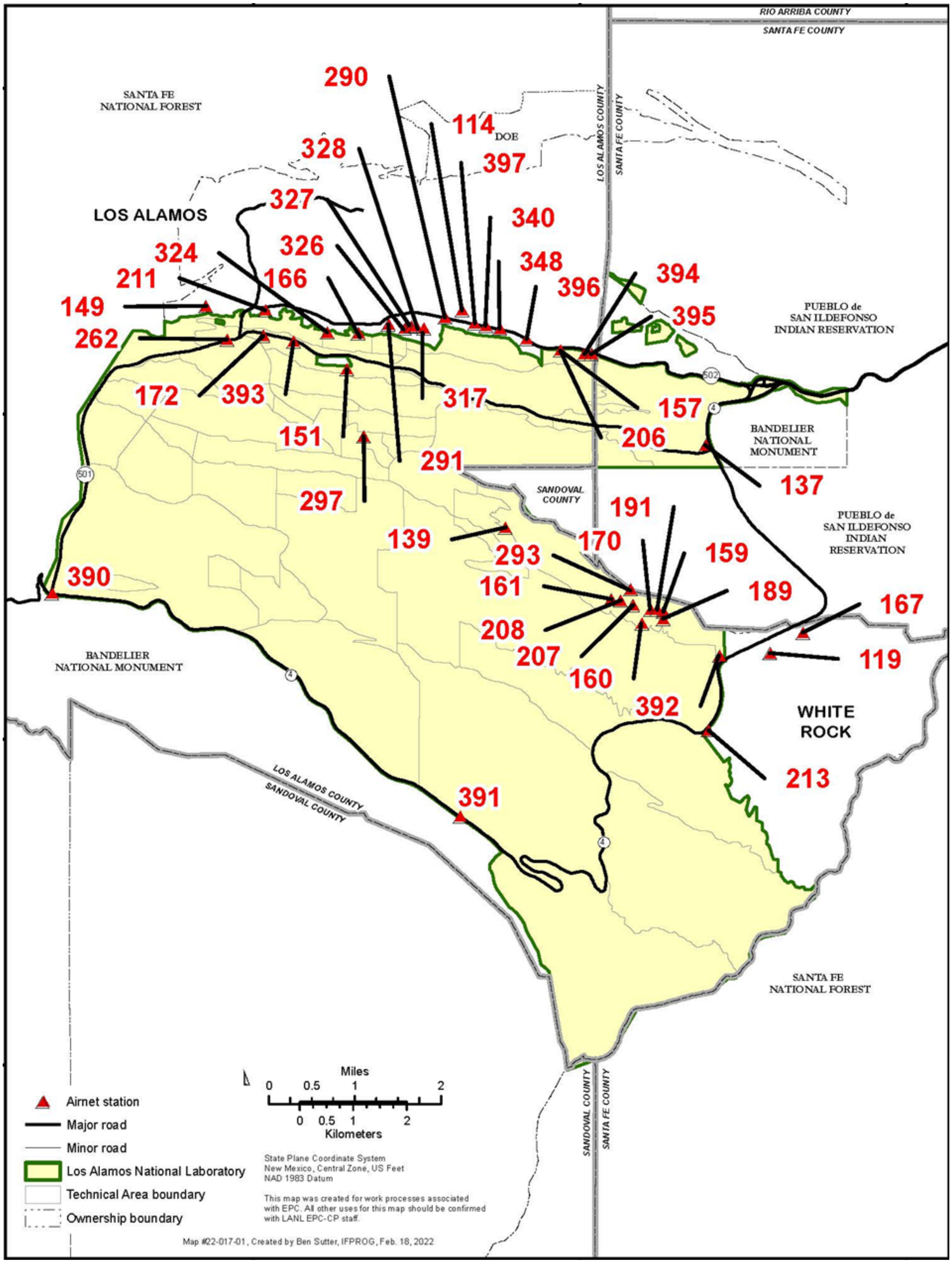
In accordance with 40 CFR Part 61, Subpart H, LANL performs air effluent monitoring of atmospheric discharge points to evaluate its compliance with local, state, and federal laws and regulations and to ensure that human health and the environment are protected. That monitoring is used to determine the actual radionuclide releases from individual facilities during routine and nonroutine operations and to confirm the operation of facility emission-control systems. Subpart H requires continuous monitoring of facility radiological air effluents if the potential offsite (fence-line) dose equivalent is greater than 0.1 millirem/year, as calculated using the EPA -mandated air dispersion dose model, CAP88-PC, without credit for emission-control devices. The results of monitoring air discharge points provide the actual emission source information for modeling, which is used to ensure that the NESHAPs standard of 10 millirem per year total site effective-dose equivalent from the airborne pathway is not exceeded.

Many different radioisotopes are present at LANL including tritium, plutonium and other transuranic isotopes, and others. Radioisotope handling procedures and work enclosures are determined for each project or activity, depending on the isotopes, the quantities being used, and the types of operations being performed. Work enclosures include glove boxes, exhaust hoods, and laboratory bench tops. Exhaust paths to the atmosphere include high-efficiency particulate air (HEPA) filtered ventilation systems, roof vents and stacks without abatement devices, resuspension of deposited depleted uranium in the soil from previous open-air explosives testing, and releases to ambient air from a variety of diffuse sources.

LANL groups radionuclide emission sources into two categories: major sources or minor sources. Major sources are defined as those that have the potential to emit radionuclides that could result in an annual potential effective dose of 0.1 millirem or more to a member of the public at an offsite location; the radionuclide NESHAPs regulation requires continuous monitoring of the stack effluent when the annual potential effective dose exceeds 0.1 millirem to an offsite member of the public. Minor sources are defined as sources that do not have the potential to cause an annual effective dose of 0.1 millirem to an offsite member of the public. At LANL, all major sources of emissions are point sources, i.e., stack emission points; however, minor sources include both point sources and diffuse sources.

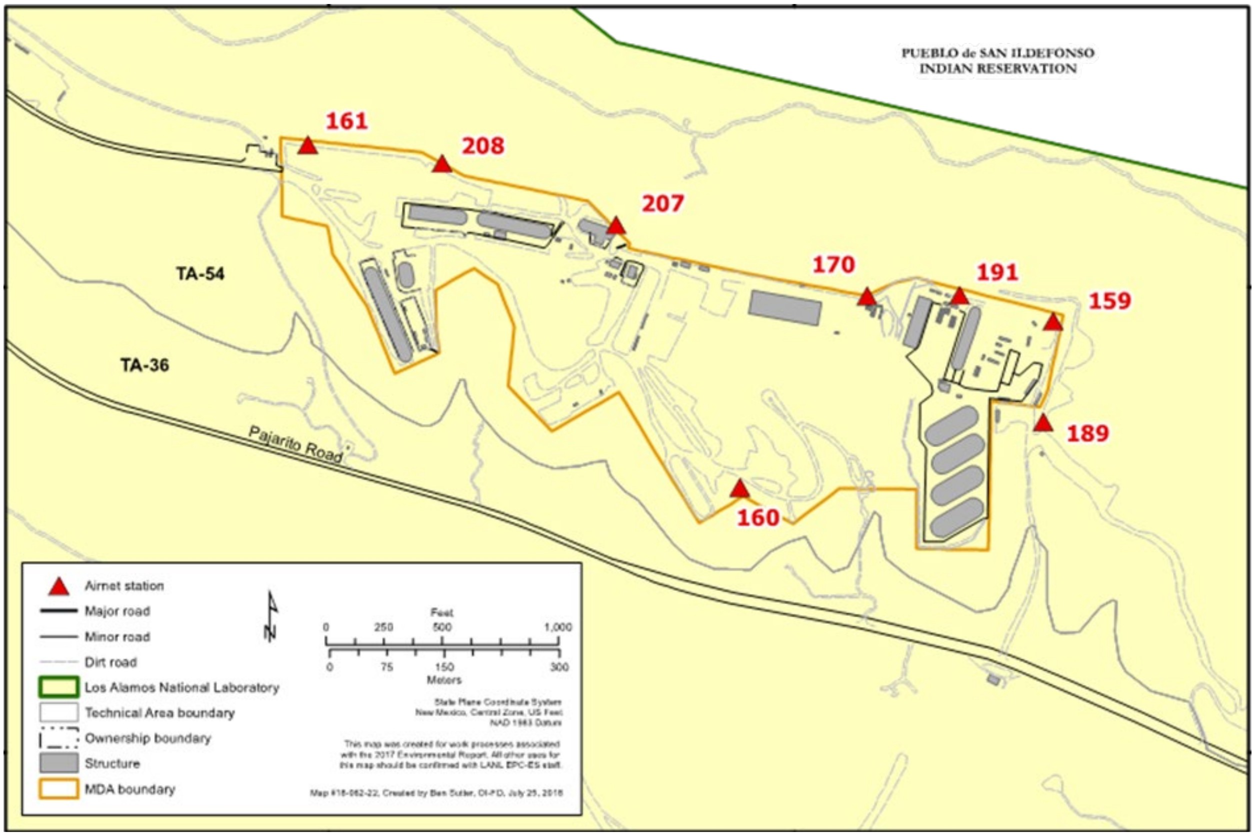
A primary objective of air quality surveillance is to measure levels of airborne radiological materials in order to calculate radiological doses to humans, plants, and animals. Results are compared with DOE and EPA standards. Radioactivity levels in the air are compared with the limits for members of the public provided in DOE Order 458.1 and in NESHAP regulations (40 CFR Part 61).

During 2020, the Laboratory operated approximately 41 environmental air-monitoring stations to monitor radionuclides in the air (Figures D.2-1 and D.2-2). Station locations are categorized as regional (away from the Laboratory), perimeter, onsite, or waste site. The waste site locations



Source: LANL (2024b)

Figure D.2-1 Environmental Air-Monitoring Stations at and near LANL



Source: LANL (2024b)

Figure D.2-2 Environmental Air-Monitoring Stations at TA-54, Area G

monitor radionuclides near the Laboratory's low-level radioactive waste disposal area and radioactive waste storage area, Area G, at TA-54. These stations operate continuously by pulling ambient air through a filter to capture airborne particulate matter. The filters are changed out every two weeks and sent to an offsite analytical laboratory for analysis. All concentrations of airborne radioactive material measured in ambient air samples were below the applicable concentration levels for environmental compliance (LANL 2024a).

Radioactive materials are used in some Laboratory operations. The buildings that house those operations may vent radioactive materials to the environment through an exhaust stack or other release point. The Laboratory's stack monitoring team monitors emission points that could cause a public dose greater than 0.1 millirem during a one-year period. Each of these stacks is sampled in accordance with the NESHAP regulations (LANL 2024a). The EPA has enforcement authority for LANL compliance with radiological air emission regulations.

Many of the monitored stacks at LANL have effluent controls, such as HEPA filters, to collect materials before they are emitted to the atmosphere. Air samples for particulate emissions are extracted downstream of HEPA filters and prior to the discharge point to the atmosphere. Particles are collected on high-efficiency cellulose membrane filters. The sample filters are removed and analyzed for radioactive particulate activity on a weekly or bi-weekly frequency depending on the facility. In all cases, continuous passive filter aerosol collection systems are used. At some facilities, continuous air monitors also sample the stack air exhaust for radionuclide activity. Continuous air monitors have an alarm capability in the event of an unplanned release of radionuclide activity. Continuous air monitors are used for facility personnel safety; they are not used for NESHAPs compliance demonstration (LANL 2024a).

Table D.2-3 provides detailed emissions data for Laboratory buildings with sampled stacks. Emission-control systems in Laboratory facilities for particulates such as plutonium and uranium continue to work as designed, and particulate emissions remain very low (i.e., in the micro-curie range). Emissions of short-lived gases and vapors were lower in 2020 than in 2019. During 2020, the radioactive emissions from all Laboratory sources amounted to approximately one percent of the regulatory limit (LANL 2024a).

Table D.2-3 Airborne Radioactive Emissions from LANL Buildings, 2020 (curies)

TA and Building Number(s)	Tritium	Americium-241	Plutonium	Uranium	Thorium	Particulate Matter plus Vapor Activation Products	Gaseous Mixed Activation Products
TA-03-029	NA	5.9×10^{-6}	1.9×10^{-5}	4.0×10^{-6}	6.1×10^{-7}	1.7×10^{-5}	
TA-16-205/450	36.1	-	-				
TA-48-001	-	-	-	4.8×10^{-9}	1.6×10^{-9}	1.3×10^{-2}	
TA-50-001	-	-	-	7.9×10^{-8}	2.5×10^{-8}		
TA-50-069	-	1.6×10^{-10}	6.8×10^{-10}		3.8×10^{-10}		
TA-53-003	12.4	-				3.1×10^{-1}	36
TA-53-007	2.9	-				6.4×10^{-1}	119
TA-54-231/375/412	-	-		3.3×10^{-9}	1.4×10^{-8}		
TA-55-004	-	-	1.9×10^{-8}	4.9×10^{-8}	2.4×10^{-8}		
TOTALS	**52.4**	**5.9×10^{-6}**	**1.9×10^{-5}**	**4.1×10^{-6}**	**6.7×10^{-7}**	**9.6×10^{-1}**	**155**

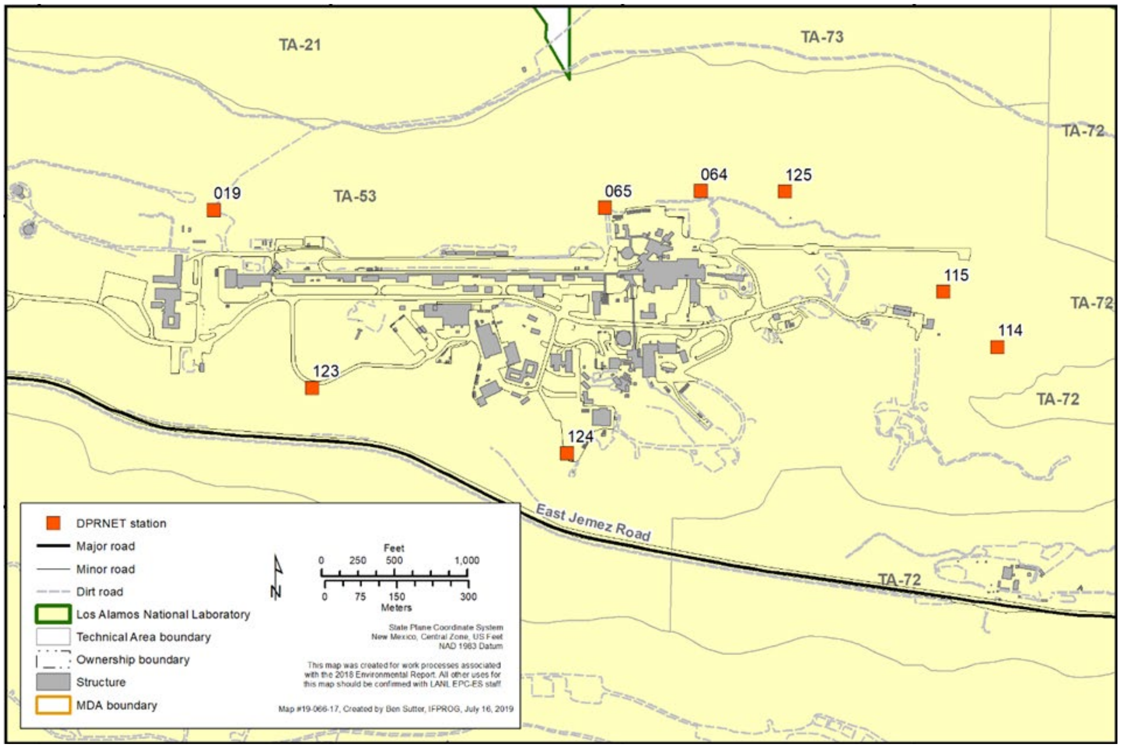
Source: LANL (2024a)

Gamma and neutron radiation levels are monitored by the Direct-Penetrating Radiation Network and supplemented by the Neighborhood Environmental Watch Network. The objectives are to monitor gamma and neutron radiation in the environment as required by DOE Order 458.1.

Dosimeters are devices that measure exposure to ionizing radiation. LANL deployed dosimeters at a total of 83 locations to monitor direct-penetrating radiation in the environment during 2020. Thermoluminescent dosimeters (which monitor gamma and neutron radiation) are deployed at every environmental air-monitoring station (Figures D.2-1 and D.2-2). Additional thermoluminescent dosimeters are deployed at TA-53 and TA-54, which are potential Laboratory sources of direct-penetrating radiation (Figures D.2-3 and D.2-4). All together, these locations make up the Direct-Penetrating Radiation Network (LANL 2024a).

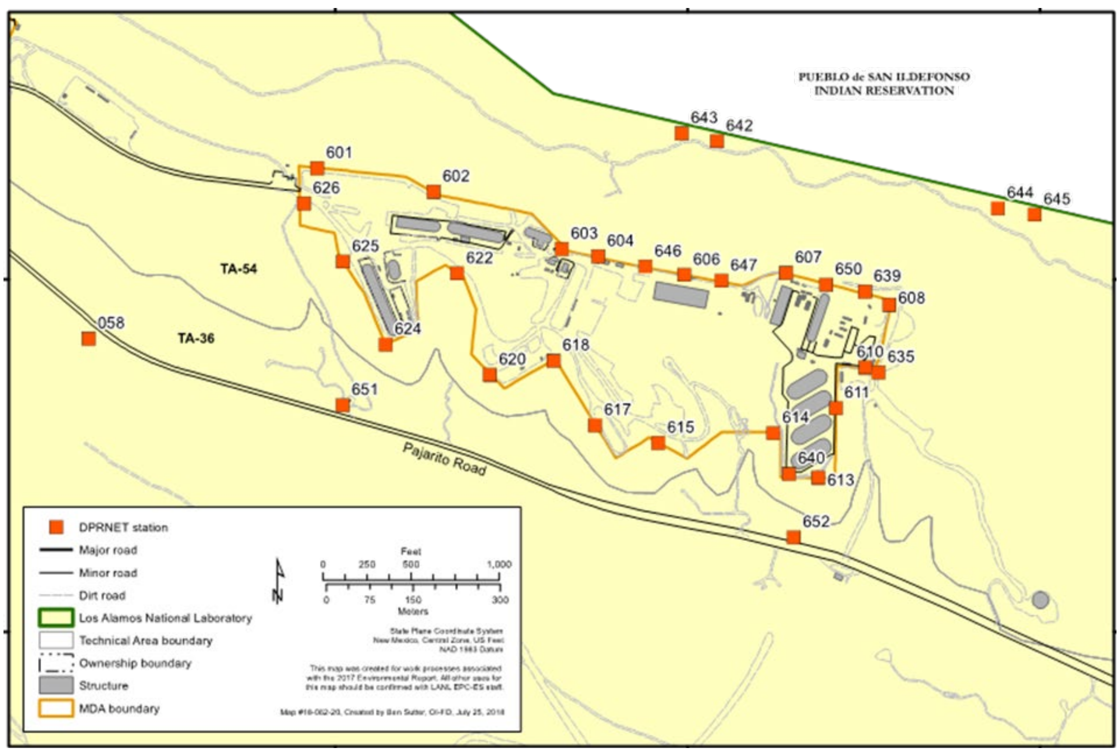
Gamma radiation occurs naturally, typically 100 to 200 millirem per year, so it is difficult to distinguish the much smaller levels of radiation contributed by the Laboratory. Radiation from the Laboratory is identified by higher radiation levels near the source and reduced radiation levels at greater distances (LANL 2024a).

Neutron doses are measured near known or suspected sources of neutrons, including TA-53 and TA-54. At 52 locations, the accuracy of the neutron measurements is enhanced by the addition of Lucite blocks that reflect neutrons into the dosimeter. The neutron background is measured at locations far from Laboratory sources (LANL 2024b).



Source: LANL (2024b)

Figure D.2-3 Locations of Thermoluminescent Dosimeters at TA-53 that are part of the Direct-Penetrating Radiation Monitoring Network



Source: LANL (2024b)

Figure D.2-4 Locations of Thermoluminescent Dosimeters at Area G that are Part of the Direct-Penetrating Radiation Monitoring Network

Table D.2-4 summarizes the gamma radiation data for 2020. At regional locations, the gamma radiation is natural and, as expected, has not changed compared to previous years. At the perimeter stations, the gamma radiation is generally higher than at the regional stations because of increased cosmic radiation at higher altitudes and increased uranium and thorium in the soil. At these stations, the radiation is mostly natural and, as expected, 2020 data are similar to data from previous years. Onsite, the slight decrease likely is not statistically significant. At the Los Alamos Neutron Science Center (LANSCE) accelerator facility, there is measurable radiation from the accelerator, which varies from year to year. At the Area G waste site, there is a downward trend as waste is sent to the Waste Isolation Pilot Plant (WIPP) facility in Carlsbad, New Mexico (LANL 2024a).

Table D.2-4 Gamma Radiation for 2020 – Group Summaries

Station Grouping	Number of Stations	Group Mean ± 1 Standard Deviation (millirem)	
		Previous Years	2020
Regional	11	118 ± 15	121 ± 14
Perimeter	28	127 ± 10	131 ± 10
Onsite	3	130 ± 10	137 ± 15
Los Alamos Neutron Science Center	8	143 ± 23	134 ± 14
Area G Waste Site	33	205 ± 117	148 ± 42

Source: LANL (2024a)

Table D.2-5 summarizes the neutron radiation data. At regional stations, the radiation is natural and there is no change. Similar to the gamma radiation data, for waste site locations near Area G, there is a decreasing trend as waste is sent off site. Generally, the data are similar to previous years and show that emissions of direct-penetrating radiation from Laboratory facilities were far below the DOE limits (LANL 2024a).

Table D.2-5 Neutron Radiation for 2020 – Group Summaries

Station Grouping	Number of Stations	Group Mean ± 1 Standard Deviation (millirem)	
		Previous Years	2020
Regional	7	2.6 ± 1.5	3.0 ± 1.5
Perimeter	3	4.6 ± 3.7	2.5 ± 0.9
Onsite	10	2.4 ± 0.5	1.4 ± 1.9
Los Alamos Neutron Science Center	8	3.6 ± 1.1	5.3 ± 1.2
Area G Waste Site	33	148 ± 185	32 ± 32

Source: LANL (2024a)

D.2.1.6 Methodology for Estimating Radiological Impacts for Normal Operations

The public health consequences of radionuclides released to the atmosphere from normal operations at NNSA sites are characterized and calculated in the applicable annual site environmental report. Radiation doses are calculated for the ME) and the entire population residing within 50 miles of the center of the site. In this SWEIS, dose calculations from normal operations were made based on the CAP-88 package of computer codes, version 4.1.1 (EPA 2023), which was developed under EPA sponsorship to demonstrate compliance with 40 CFR Part 61 (found in 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. Meteorological data used in the calculations were in the form of joint frequency distributions of wind direction, wind speed class, and atmospheric stability category. The results for the SWEIS alternatives are discussed in Section D.2.1.8.

D.2.1.7 Baseline Risk Estimates and Health Effects for Potential Radiation Exposures to the Public

Because fatal cancer is the most probable serious effect of environmental and occupational radiation exposures, this SWEIS presents estimates of latent cancer fatalities (LCFs). The Interagency Steering Committee on Radiation Standards (Lawrence 2002) recommended a risk estimator of 6×10^{-4} excess (above those naturally occurring) fatal cancers per person-rem of dose in order to assess health effects to the public and to workers. The probability of an individual worker or member of the public contracting a fatal cancer is 6×10^{-4} per rem. Radiation exposure can also cause nonfatal cancers and genetic disorders. The probability of incidence of these is one third that of a cancer fatality (Lawrence 2002). In this SWEIS, only estimates of potential excess fatal cancers are presented.

The radiation exposure risk estimators are denoted as excess because they result in fatal cancers above the naturally occurring annual rate, which is 146 per 100,000 population nationally (USCSWG 2022).[1] Based on this national cancer mortality rate, approximately 500 fatal cancers would be expected to occur annually in the population of approximately 343,000 people living within 50 miles of LANL.

As required by DOE Order 458.1, NNSA calculates doses from the Laboratory to the following members of the public:

- the total human population within 50 miles of the Laboratory, and
- the hypothetical MEI.

To identify the location of and the total dose to the hypothetical MEI, the following are considered:

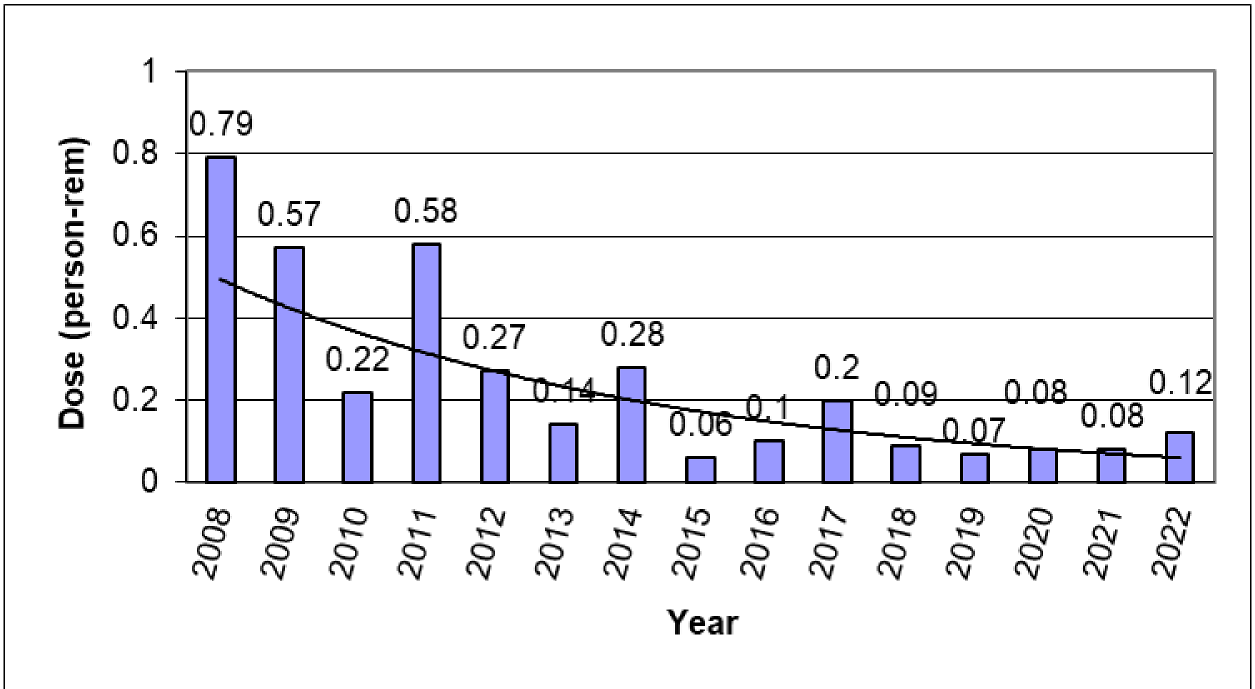
- the air-pathway dose,
- the onsite dose at publicly accessible locations,
- other locations with measurable doses, and
- the offsite dose (LANL 2024a).

Collective Dose to the Population within 50 Miles. The collective population dose from Laboratory operations is the sum of the doses for each member of the public within a 50-mile radius of the Laboratory. Outside of Los Alamos County, the doses are too small to measure directly, so the collective dose is calculated by modeling the transport of radioactive air emissions using CAP88. The dose from the other pathways are consistent with zero (LANL 2024).

The 2022 collective population dose to people living within 50 miles of the Laboratory is 0.12 person-rem. This dose is less than 0.001 millirem per person and is much less than the background

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

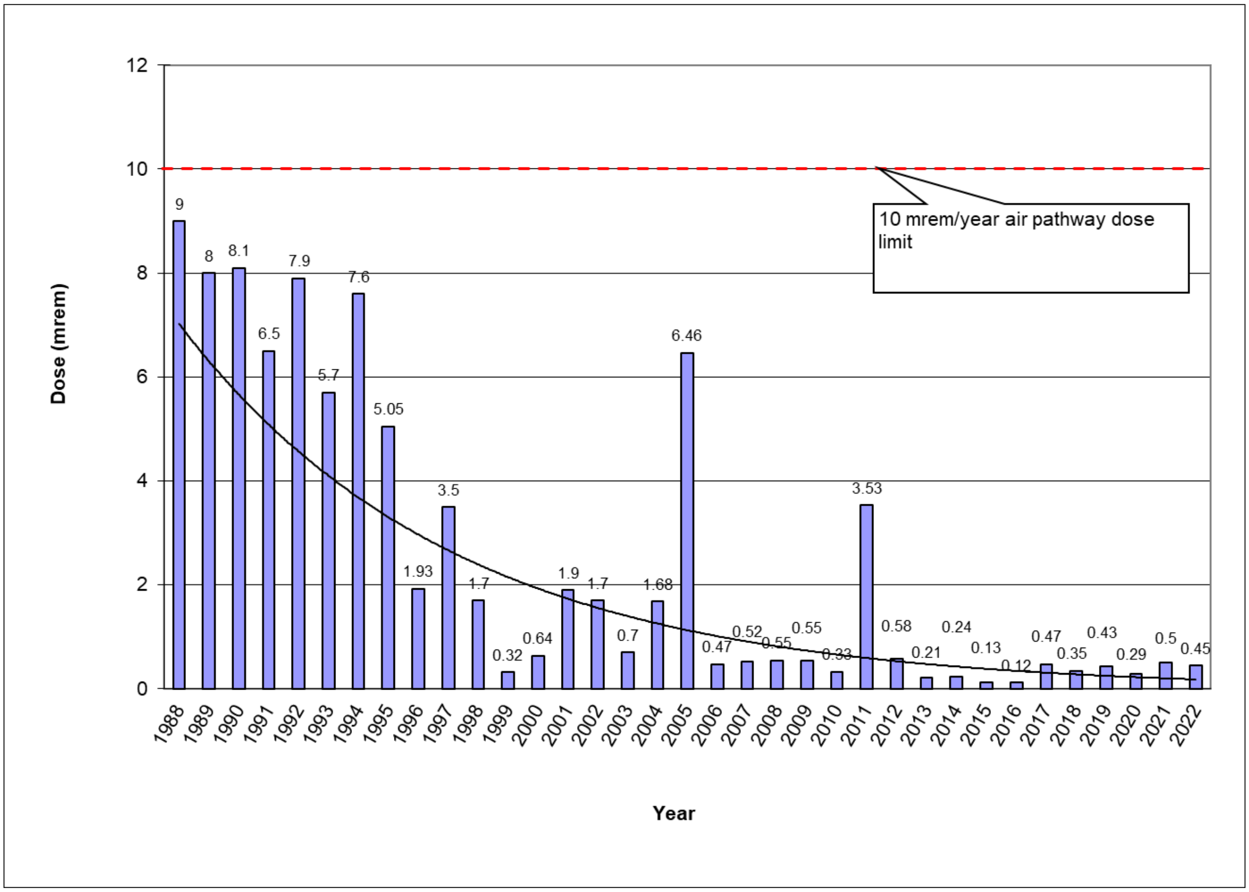
doses shown in Table D.2-1. Collective population doses for recent years are shown in Figure D.2-5. The trend-line for the past 10 years shows a general decrease, which is the result of improved engineering controls at the LANSCE and the tritium facilities.



Source: LANL (2024b)

Figure D.2-5 Annual Collective Dose to the Population Within 50 Miles of LANL

Dose to the MEI. The MEI is a hypothetical member of the public who receives the greatest possible dose from Laboratory operations from the combination of all evaluated radionuclide source emissions, as determined by modeling. The MEI represents the hypothetical member of the public at a fixed public location who, over an entire year, would receive the maximum effective-dose equivalent (summed over all pathways) from site-wide releases of radionuclides to air during normal operations. In 2022, the offsite location of the hypothetical MEI was at 95 Entrada Drive, close to environmental air-monitoring station 396 (See Figure D.2-1). For LANL to comply with the NESHAPs regulations, the MEI cannot receive an effective-dose equivalent greater than 10 millirem/year per site. A site-wide MEI is defined as a *hypothetical* member of the public at a single residence, school, business, church, or other such facility who receives the greatest LANL induced dose. As discussed in Section D.3, for accident analyses, individual facilities have different MEIs at fence-line locations. The total offsite dose for the MEI during 2022 was 0.45 millirem. Figure D.2-6 depicts the annual MEI doses for LANL over the past 35 years. The general downward trend is the result of improved engineering controls and ongoing remediation. Doses are far below all regulations and standards (LANL 2024b).



Note: 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.
Source: LANL (2024b)

Figure D.2-6 Annual MEI Dose for LANL

Table D.2-6 presents the annual doses to the public from LANL emissions of radioactive materials to the air from 2017 to 2022. Doses are presented for a MEI[2] and the population within a 50-mile radius of LANL. These doses fall within radiological exposure limits presented in Table D.2-2 and are much lower than the background radiation dose presented in Table D.2-1.

[2] The MEI is a hypothetical member of the public who receives the greatest possible dose from Laboratory operations. In 2021, the offsite location of the hypothetical maximally exposed individual was at 132 DP Road, close to environmental air-monitoring station 326, as shown on Figure 4.7-1. In 2022, the location was at 95 Entrada Drive, close to environmental air-monitoring station 396.

Table D.2-6 Annual Radiation Doses to Public from LANL Operations, 2017–2026

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 (2024b)

Based on the information presented in Table D.2-6, 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 2.5×10^{-7} (or about 1 chance in 4 million). The projected number of LCFs to the population within a 50-mile radius of LANL would be about 7.2×10^{-5} (or about 1 chance in about 14,000). 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).[3] 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.

D.2.1.8 Risk Estimates and Health Effects for Potential Radiation Exposures to the Public for the SWEIS Alternatives

No-Action Alternative. Under normal operations, public radiation doses would occur from airborne releases from continued operations. In addition, under the No-Action Alternative, the

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

following projects have the potential to increase the radioactive air emissions, the number or radiation workers, and the dose to workers at LANL: (1) Increased pit production; (2) Light Manufacturing Laboratory operations; (3) Radioactive Liquid Waste Treatment Facility (RLWTF) operations; (4) Chemistry and Metallurgy Research Facility (CMR) Hot Cell Operations in support of Isotope Production; (5) decontamination, decommissioning, and demolition(DD&D of radiologically contaminated buildings; and (6) EM activities.

> **RADIATION DOSE MEASUREMENT**
>
> In this SWEIS, radiation doses are measured in units of either "person-rem" or "rem."
>
> 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. For example, an individual who receives a dose of 1.5 rem would have a 0.0009 chance of developing a latent cancer fatality (LCF).
>
> 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 doses. Statistically, approximately 1,667 person-rem would result in one LCF.

NNSA has estimated that there would be 2,750 Ci (consisting of mostly tritium and mixed fission and activation products) released to the air under the No-Action Alternative. These potential annual airborne radioactive emissions would result in radiological doses to the public. Table D.2-7 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs at LANL. As shown in Table D.2-7, 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 D.2-7 Annual Radiological Impacts to the Public from Potential Operational Radiological Emissions under the No-Action Alternative at LANL

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 MEI at LANL is located 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.

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 (2023a)

In addition to the reoccurring radiological releases from the projects discussed above, this SWEIS analyzes the venting of four Flanged Tritium Waste Containers (FTWC) 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 this is not a recurring operation, the potential dose from the FTWC venting project is presented as a one-time event in the SWEIS. 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.[4]

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, 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) Radiography/Assembly Complex (RACR); (2) Radiological Laboratory (Rad Lab); (3) Replacement office/lab and light lab facilities; (4) Consolidated Waste Facility; (5) National Gas Transfer Systems/Surety; (6) LANSCE Modernization; and (7) DD&D of radiologically contaminated buildings.

NNSA has estimated that the Modernized Operations Alternative would add 150 curies of radioactive air emissions (consisting of mostly activation products) above and in addition to the No-Action Alternative estimate of 2,750 curies. Table D.2-8 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs at LANL. As shown in Table D.2-8, 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 would be 3.7×10^{-3}. As shown in Table D.2-8, the MEI and public dose would be slightly higher for the Modernized Operations Alternative compared to the No-Action Alternative. However, the increases are minimal.

Table D.2-8 Annual Radiological Impacts to the Public from Operations under the Modernized Operations Alternative at LANL

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 MEI at LANL is located 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.

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 (2023a)

[4] 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 sitewide releases) would remain less than 10 millirem/year.

Expanded Operations Alternative. Under normal operations, public radiation doses would occur from airborne releases from continued operations. In addition, under the Expanded Operations Alternative, 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) Low-Enriched Uranium Fuel Fabrication Facility (LEFFF); (2) Dynamic Mesoscale Materials Science Capability (DMMSC); (3) LANSCE Enhancements; (4) Microreactor; (5) Surplus Plutonium Disposition Program (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 an additional 650 curies would be released annually as compared to the No-Action Alternative. As part of the 650 curies, the total releases for the Expanded Operations Alternative would include: 0.014 Ci of uranium. 6.9×10^{-5} Ci of plutonium, and 7.5×10^{-6} Ci of americium. Table D.2-9 lists incremental radiation doses estimated for the public (offsite MEI and collective population dose) and corresponding incremental LCFs at LANL. 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 Table D.2-9, the MEI and public dose would be slightly higher for the Expanded Operations Alternative compared to the No-Action Alternative. However, the increases are minimal.

Table D.2-9 Annual Radiological Impacts to the Public from Operations under the Expanded Operations Alternative at LANL

Receptor/Dose/Risk	No-Action Alternative	Expanded Operations Alternative
Offsite MEI[a]		
Dose (millirem)	3.07	3.668
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 MEI at LANL is located 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.

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 (2023a)

D.2.1.9 Baseline Risk Estimates and Health Effects for Potential Radiation Exposures to Workers

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. Table D.2-10 presents the annual average individual and collective worker doses from LANL operations from 2017 to 2022. These doses fall within the regulatory limits presented in Table D.2-2.

Table D.2-10 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 2020a).

Source: DOE (2023), LANL (2019, 2022s)

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 2020, 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. No worker exceeded DOE's 5-rem-per-year dose limit (LANL 2024b).

In 2021, TA-55 Plutonium Facility operations account for the majority (approximately 85 percent) of the collective total effective dose at LANL. Occupational dose was accrued from weapons stewardship and manufacturing-related work, Pu-238 work, repackaging materials, and providing radiological control technicians and other infrastructure support for radiological work and facility maintenance at TA-55. In 2021, the highest 25 individual worker doses at LANL were accrued at TA-55. A primary contributor to dose in 2020 was work with Pu-238—producing general-purpose heat sources for use individually and combined in radioisotope thermoelectric generators. Doses at TA-55 were slightly higher for 2021 compared to 2020, reflecting the resumption of mission-essential work following the COVID-19 pandemic. In addition to TA-55 operations, a significant portion of the LANL worker dose was associated with programmatic and maintenance work at the TA-53 LANSCE. Lastly, a significant portion of LANL worker dose was associated with performing retrieval, repackaging, and shipping of radioactive solid waste within LANL facilities and at waste facilities TA-50 and TA-54 (LANL 2023b).

D.2.1.10 Risk Estimates and Health Effects for Potential Radiation Exposures to Workers for the SWEIS Alternatives

No-Action Alternative. 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 an average of 2,819 to 4,450 under the No-

Action Alternative. The average worker dose is estimated to increase from an average of 92 mrem/year to 115 mrem/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 which 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.

The estimates of annual radiological doses to workers for the No-Action Alternative are provided in Table D.2-11. 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 2020a). The total annual collective dose to all LANL radiological workers would be 512 person-rem, which would result in 0.31 LCFs annually.

Table D.2-11 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

a. Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem.

Modernized Operations Alternative. 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 mrem/year.

A total of 156 facilities, with a total footprint of 1,216,000 square feet, would be scheduled to undergo DD&D under the Modernized Operations Alternative. Twenty-nine facilities are radiologically contaminated (about 390,000 square feet, 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 ALARA objectives would be implemented.

The estimates of annual radiological doses to workers for the Modernized Operations Alternative are provided in Table D.2-12. 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.

Table D.2-12 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.

Expanded Operations Alternative. NNSA has estimated that the number of radiation workers would increase from 4,450 (No-Action Alternative) to 4,862 under the Expanded Operations Alternative. The projects associated with the Expanded Operations Alternative would increase the average worker dose to 130 mrem/year. Other than those identified for the Modernized Operations Alternative, there are no additional DD&D activities proposed for the Expanded Operations Alternative. The estimates of annual radiological doses to workers for the Expanded Operations Alternative are provided in Table D.2-13. The total annual collective dose to all LANL radiological workers would be 632 person-rem under the Expanded Operations Alternative. Statistically, a total annual dose of 632 person-rem would result in 0.38 LCFs annually to the LANL radiological workforce.

Table D.2-13 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 fatality
a Based on the dose-to-risk conversion factor of 0.0006 LCF per rem or person-rem.

D.2.2 Hazardous Chemicals, Other Industrial Hazards, and Impacts to Human Health

D.2.2.1 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, LANL 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:

- working with cadmium-containing alloys;
- work that generates or involves contact with soot and tar;
- use of mineral oil products that may contain polyaromatic hydrocarbons;
- involving 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 chemical 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.

D.2.2.2 How Do Chemicals Affect the Body?

Industrial pollutants may be released either intentionally or accidentally to the environment in quantities that could result in health effects to those who come in contact with them. Chemicals that are airborne, or released from stacks and vents, can migrate in the prevailing wind direction for many miles. The public may then be exposed by inhaling chemical vapors or particles of dust contaminated by the pollutants. Additionally, the pollutants may be deposited on the surface soil and biota (plants and animals) and subsequent human exposure could occur. Chemicals may also be released from industries as liquid or solid waste (effluent) and can migrate or be transported from the point of release to a location where exposure could occur.

Exposure is defined as the contact of a person with a chemical or physical agent. For exposure to occur, a chemical source or contaminated media such as soil, water, or air must exist. This source may serve as a point of exposure, or contaminants may be transported away from the source to a point where exposure could occur. In addition, an individual (receptor) must come into either direct or indirect contact with the contaminant. Contact with a chemical can occur through ingestion, inhalation, dermal contact, or external exposure. The exposure may occur over a short (acute or sub-chronic) or long (chronic) period of time. These methods of contact are typically referred to as exposure routes. The process of assessing all of the methods by which an individual might be exposed to a chemical is referred to as an exposure assessment.

Once an individual is exposed to a hazardous chemical, the body's metabolic processes typically alter the chemical structure of the compound in its efforts to expel the chemical from the system. For example, when compounds are inhaled into the lungs they may be absorbed depending on their size (for particulates) or solubility (for gases and vapors) through the lining of the lungs directly into the blood stream. After absorption, chemicals are distributed in the body and may be metabolized, usually by the liver, into metabolites that may be more toxic than the parent compound. The compound may reach its target tissue, organ, or portion of the body where it will exert an effect, before it is excreted via the kidneys, liver, or lungs. The relative toxicity of a compound is affected by the physical and chemical characteristics of the contaminant, the physical and chemical processes ongoing in the human body and the overall health of an individual. For example, infants, the elderly, and pregnant women are considered more susceptible to certain chemicals.

D.2.2.3 How Does DOE/NNSA Regulate Chemical Exposures?

Environmental Protection Standards. DOE Order 450.1 requires implementation of sound stewardship practices that are protective of the air, water, land, and other natural and cultural resources impacted by the DOE operations and by which DOE cost-effectively meets or exceeds compliance with applicable environmental; public health; and resource protection laws, regulations, executive orders, and DOE requirements. Applicable Federal and State environmental acts/agreements include:

- *Resource Conservation and Recovery Act* (RCRA)
- *Comprehensive Environmental Response, Compensation, and Liability Act* as amended by the *Superfund Amendments and Reauthorization Act* (SARA)
- *Federal Facility Compliance Agreement*
- *Endangered Species Act*
- *Safe Drinking Water Act*
- *Clean Water Act* (CWA)(which resulted in the establishment of the NPDES and pretreatment regulations for Publicly-Owned Treatment Works [POTW])
- *Clean Air Act* (Title III, Hazardous Air pollutants Rad-NESHAP, Asbestos NESHAP)
- *Toxic Substances Control Act* (TSCA)
- *Federal Insecticide, Fungicide, and Rodenticide Act*

Many of these acts/agreements include environmental standards that must be met to ensure the protection of the public and the environment. Most of the acts/agreements require completed permit applications in order to treat, store, dispose of, or release contaminants to the environment. The applicable environmental standards and reporting requirements are set forth in the issued permits and must be met to ensure compliance.

The *Emergency Planning and Community Right-To-Know Act*, also referred to as SARA Title III, requires reporting of emergency planning information, hazardous chemical inventories, and environmental releases to federal, state, and local authorities. The annual Toxics Release Inventory report addresses releases of toxic chemicals into the environment, waste management activities, and pollution prevention activities associated with those chemicals.

Regulated Occupational Exposure Limits. Occupational limits for hazardous chemicals are regulated by the Occupational Safety and Health Administration (OSHA). The permissible exposure limits (PELs) represent the legal concentration levels set by OSHA that are safe for 8-hour exposures without causing noncancer health effects. Other agencies, including the National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) provide guidelines. The NIOSH guidelines are Recommended Exposure Limits, and the ACGIH guides are threshold limit values. Occupational limits are further defined as time-weighted averages (TWAs), or concentrations for a conventional 8-hour workday and a 40-hour workweek, to which it is believed nearly all workers may be exposed, day after day, without adverse effects. Often ceiling limits, or airborne concentrations that should not be exceeded during any part of the workday, are also specified. In addition to the TWA and ceiling limit, short-term exposure limits may be set. Short-term exposure limits are 15-minute TWA exposures that should not be exceeded at any time during a workday, even if the 8-hour TWA is within limits. OSHA also uses action levels to trigger certain provisions of a standard (e.g., appropriate workplace precautions, training, and medical surveillance) for workers whose exposures could approach the PEL.

D.2.2.4 Other Industrial Hazards

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. 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.

LANL's occupational health and safety performance is measured by injury and illness rates (Total Recordable Case [TRC] and Days Away with Restricted Time [DART]) pursuant to DOE Orders that use OSHA criteria. As shown on Table D.2-14, the number of TRCs at LANL has varied between 89 and 227 over the past five years; this means there is an average of approximately 139 work-related injuries or illnesses annually that result in either death, days away from work, or days of restricted work activity or job transfer. DART represents severe injuries annually. As shown in Table D.2-14, the number of DART cases at LANL has varied between 20 and 101 over the past five years; this means there is an average of approximately 53 work-related severe injuries or illnesses annually that result in days away from work or days of job restriction or transfer.

Table D.2-14 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	151
Number of DART Cases[b]	20	26	67	106	101	59	64

DART = Days Away, Restricted Time; TRCs = Total Recordable Cases

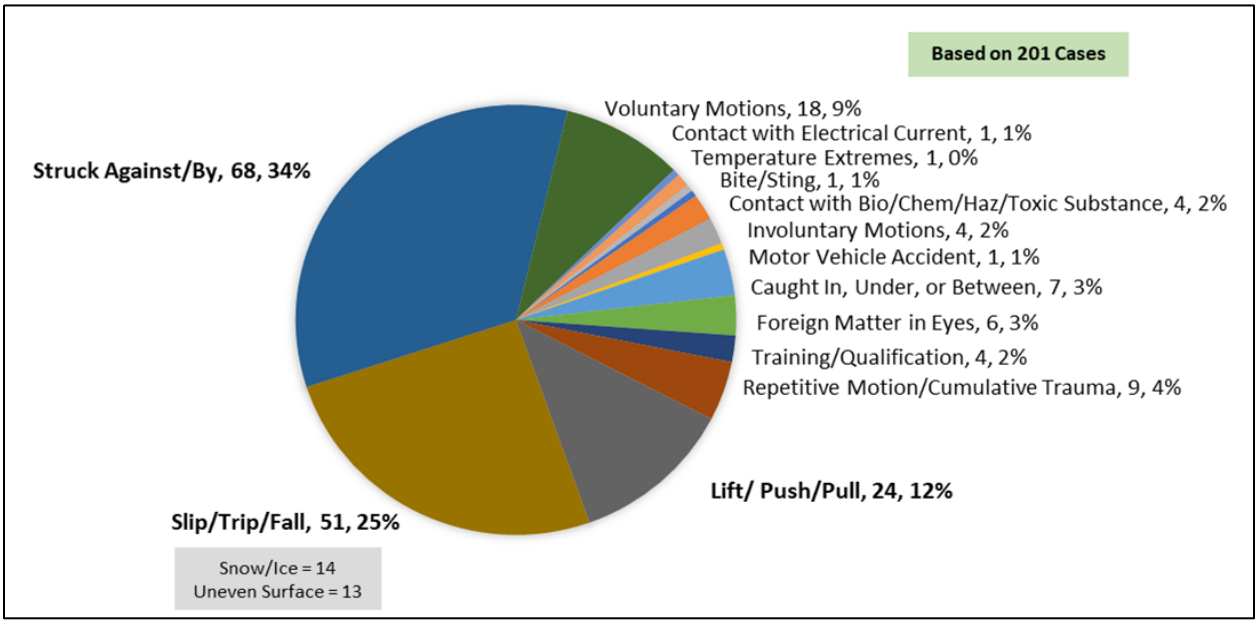
a Number of TRCs: The total number of work-related injuries or illnesses that resulted in either death, days away from work, days of restricted work activity, or days of job transfer.

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 (2019, 2020e, 2021g, 2022s, 2023b, 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 D.2-7 depicts the types of occupational injuries at LANL for the TRCs in 2021. In 2021 work-related injuries included foreign matter in eye, exposure to hazardous chemicals, burns, trips and falls that resulted in wrist/leg/foot fractures, concussions, serious cuts from machining operations, and electric shocks. No work-related fatalities occurred at LANL between 2017 and 2021 (LANL 2019, 2020e, 2021g, 2022s, 2023b, 2024a).



Source: LANL (2024a)

Figure D.2-7 LANL Recordable Injury Data for 2022

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.

D.2.2.5 Impacts for the Alternatives

No-Action Alternative. 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 D.2-15 lists the potential estimates of injuries/illnesses and fatalities estimated in an average year for the No-Action Alternative. As shown in the table, in an average year, approximately 483 days of lost work from illness/injury and 1.28 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 D.2-15 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)

Non-Ionizing Radiation. Technologies used at LANL that generate non-ionizing radiation[5] include lasers, microwave-generating and radiofrequency devices, technologies that generate ultraviolet radiation, video displays and instrumentation, welding, and security-related devices. Devices that generate non-ionizing radiation are regulated by the U.S. Food and Drug Administration, while 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 eye

[5] 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.

injury to anyone who looks directly into the beam or its mirror reflection, or skin burns. Worker exposures could occur because of equipment failure, improper use of equipment, or non-adherence to procedures.

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 2024a). As shown in Table D.2-16, emissions of hazardous air pollutants and volatile organic compounds were significantly below Title V Operating Permit limits.

Table D.2-16 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	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 2024b). 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 2024b).

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, 4 percent of the total footprint) and 27 facilities have some level of asbestos contamination (about 334,000 square feet, 21 percent of the total footprint). 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 asbestos-containing materials (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 Section 5.2, the square footage associated with new facilities with expanded or new laboratory or research functions could increase for 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 5.16.

Biological Hazards. The hazards associated with working with biological materials (agents) range from personal exposure to accidental environmental releases.[6] Biological operations at LANL are categorized into the following two risk groups based on their relative risk to human health:

- Risk Group 1 (RG1) – Agents not associated with disease in healthy adult humans.
- Risk Group 2 (RG2) – Agents associated with human disease that is rarely serious and for which preventive or therapeutic interventions are often available.

LANL only operates Biosafety Level 1 (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).

Modernized Operations Alternative. Table D.2-17 lists the potential estimates of injuries/illnesses and fatalities estimated in an average year for 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 D.2-17 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. 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 has concluded that there is 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

[6] Potential impacts associated with accidental releases of biological materials are presented in Section 5.16.

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 D.3.

Non-Ionizing Radiation and Biological Hazards. Potential human health impacts associated with working with non-ionizing radiation and biological materials (agents) would be the same as presented for the No-Action Alternative.

Expanded Operations Alternative. Table D.2-18 lists the potential estimates of injuries/illnesses and fatalities estimated in an average year for 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.

None of the actions proposed under the Expanded 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 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 5.16.

Table D.2-18 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 (NIH) 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 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 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 D.3.

D.3 Accident Analysis

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. The buildings and facilities at LANL contain radiological, chemical, biological, and explosive materials. An accident can involve a combined release of energy and hazardous materials (radiological, chemical, or biological) 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.

If an accident were to occur involving the release of radioactive, chemical, or biological materials, or accidental high explosive (HE) explosions, 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 close proximity to the incident. The offsite public and non-involved workers would also be at risk of exposure or effect to the extent that meteorological conditions exist for the atmospheric dispersion of released materials.

The DOE *Recommendations for Analyzing Accidents under the National Environmental Policy Act* (DOE 2002a), provides guidance for preparing accident analyses in DOE environmental impact statements and environmental assessments. It states that documents prepared under NEPA should inform the decisionmakers and the public about chances that reasonably foreseeable accidents associated with proposed actions and alternatives could occur, and about their adverse consequences. The term "reasonably foreseeable" extends to events that may have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason (40 CFR 1502.21). "Credible" means having reasonable grounds for believability and the "rule of reason" means that the analysis is based on scientifically sound judgment.

D.3.1 Approach to the Analysis of Potential Accidents

For this LANL SWEIS, the approach to the accident analysis was to examine the accidents that were evaluated in the 2008 LANL SWEIS (NNSA 2008), the building or area-specific Documented Safety Analyses (DSAs) or other safety basis documents, the building or area-specific

Emergency Planning Hazards Assessments (EPHAs), and other documents that analyze LANL accidents/hazards that have been prepared for current facilities and that determine potential impacts to the following (DOE 2002a):

- Involved workers, non-involved workers, and the general public,
- MEI in each category and collective impact to each population,
- The environment including biota and environmental media, such as land and water.

A simple, commonly used equation to calculate the radiological (ST) used in the accident analysis is:

$$ST = MAR \times DR \times ARF \times RF \times LPF \qquad \textbf{Equation D-1}$$

where:

ST = The amount and form of radioactive or chemical material released to the environment under accident conditions,
MAR = The amount and form of radioactive or chemical material at risk (MAR) of being released to the environment under accident conditions,
DR = The damage ratio (DR) reflecting the fraction of MAR that is damaged in the accident and available for release to the environment,
ARF = The airborne release fraction (ARF) reflecting the fraction of damaged MAR that becomes airborne as a result of the accident,
RF = The respirable fraction (RF) reflecting the fraction of airborne radioactive material that is small enough to be inhaled by a human, and
LPF = The leak path factor (LPF) reflecting the fraction of respirable radioactive material that has a pathway out of the facility for dispersal in the environment.

However, there are certain accidents that require more detailed and complex modeling than is provided with Equation D-1, e.g., the evaporative source term following a chemical spill. In those cases, there are computer programs that are used to calculate the source term. Phenomenological models and atmospheric dispersion models to address chemicals and their human health effects are addressed in DOE-HDBK-1224-2018. Section D.3.1.3 describes the computer programs that were used to calculate the source terms for this SWEIS. The equations used by these computer programs to calculate release may be found in the program's documentation.

Next, the meteorological model is used to transport source term from the release point to the receptor location. There are numerous documents that describe the various meteorological models; for example, NRC's Regulatory Guide 1.145 (NRC 1983) describes several variations of the Gaussian transport and dispersion model. Both the HotSpot[7] and MELCOR Accident Consequence Code System, Version 2 (MACCS2)[8] computer codes use the Gaussian plume model

[7] The HotSpot Health Physics Code is used for safety analysis of DOE facilities handling nuclear material. HotSpot V 2.07.1 includes a module that can be used to calculate dose distribution for up to 20 radial centerline distances in each of 16 wind direction sectors using historical meteorological data input by the user. https://narac.llnl.gov/tools/hotspot-epicode
[8] The MACCS2 code is based on the straight-line Gaussian plume model developed originally for the NRC. MACCS2 evaluates doses and health risks from the accidental atmospheric releases of radionuclides. The principal phenomena considered in MACCS2 are atmospheric transport and deposition under time-variant meteorology, short-term and long-term mitigative actions and exposure pathways, deterministic and stochastic health effects, and economic costs. https://maccs.sandia.gov/maccs.aspx

to transport and disperse a release of radiological material to the atmosphere. Although the Gaussian model is relatively straight forward, there are several parameter assumptions that the analyst must make which can have a significant effect on the magnitude of the calculated dispersion. These parameters include wind speed, atmospheric stability class, distance to the MEI, release elevation, plume buoyancy, surface roughness factors, building wake, deposition velocity, plume meander, wind direction, and off-centerline distance.

Accident frequencies in this SWEIS are generally grouped into the following four bins:

- "anticipated" (with estimated annual frequencies of greater than or equal to 1 in 100 [$\geq 1\times10^{-2}$]);
- "unlikely" (with estimated annual frequencies between 1 in 100 and 1 in 10,000 [$\leq 1\times10^{-2}$ to 1×10^{-4}]);
- "extremely unlikely" (with estimated annual frequencies between 1 in 10,000 and 1 in 1 million [$\leq 1\times10^{-4}$ to 1×10^{-6}]); and
- "beyond extremely unlikely" (estimated annual frequencies less than 1 in 1 million [$\leq 1\times10^{-6}$]). These accidents are not considered reasonably foreseeable and were not considered further in this analysis.

Accidents that are reasonably foreseeable fall within the four bins described above. Generally, frequencies lower than 10^{-7} are not considered in NEPA documents (DOE 2002a). As defined above, the accident frequencies are based on the frequency of the entire event sequence, not just the initiating event. For example, an accident may be initiated by an event, such as human error (e.g., 0.1 per year), but in order for a hazardous material release to occur, that event must be followed by another event, such as the failure of a valve to close (e.g., 0.01 per year), thus this hypothetical accident scenario has a frequency (e.g., 0.1×0.01 =) of 10^{-3} per year. This approach for determining the accident frequency is equivalent to that recommended by DOE-STD-3009 "Preparation of Nonreactor Nuclear Facility Documented Safety Analysis" (DOE 2014) and ensures that this LANL NEPA document is consistent with the LANL safety basis documents. Frequencies for the accidents analyzed in this SWEIS were derived from the safety basis documents with the application of passive design features to establish realistic yet conservative estimates.

D.3.1.1 Accident Scenarios Analyzed

As stated above, an accident can involve a combined release of energy and hazardous materials (radiological, chemical, or biological) that might cause prompt or latent health effects. Therefore, this SWEIS postulated and analyzed the following five types of facility accident scenarios:

1. Radioactive Material Release (Section D.3.5)
2. Toxic Chemical Release (Section D.3.6)
3. High Explosives (Section D.3.7)
4. Biological Hazard Release (Section D.3.8)
5. Site-Wide Multiple-Building Scenarios (Section D.3.10)

Site-wide multiple-building scenarios are accidents that could potentially involve more than a single LANL facility, such as an earthquake or a wildfire.

In addition to the five types of facility accident scenarios listed above, this SWEIS discusses the potential for accidents that could occur during the onsite transport of material between LANL facilities (Section D.3.9).

Whenever possible, the accident scenarios presented in this SWEIS are based on scenarios that have been previously analyzed at LANL. Documents consulted for these previous analyses include the 2008 LANL SWEIS and the facility or area-specific DSAs, safety assessment documents (SADs), bases for interim operation (BIOs), justifications for continued operation (JCOs), and EPHAs, as well as calculations prepared by LANL in support of these documents. Each of the documents consulted is identified in the following text and listed in the reference section at the end of this appendix (i.e., Section D.6).

Additionally, Section 3.2 of this SWEIS provides information about the projects anticipated under the No-Action Alternative and Sections 3.3 and 3.4 provide information about projects proposed under the Modernized and Expanded Operations alternatives, respectively. Each project, regardless of the alternative, was reviewed to determine whether updates to the information in the DSA or other safety basis document analyses was necessary.

D.3.1.2 Facilities Included in the Analysis

Accident analyses have been performed at LANL for decades and safety-related documents have been prepared for all of the notable LANL facilities that handle radiological, chemical, biological, or explosive materials. As shown in Table D.3-1, the safety-related documents include DSAs, SADs, BIOs, JCOs, and EPHAs. The selection of accidents for inclusion in this SWEIS was built upon these existing accident analyses.

All of the documents in Table D.3-1, as well as other documents, were reviewed to select the facilities and accident scenarios to be included in this SWEIS. Most of the DSAs and SADs identify a complete spectrum of accidents, meaning that low-consequence/high-probability accidents, as well as high-consequence/low-probability accidents, and accidents in-between, are considered and analyzed. For example, the Plutonium Facility (PF-4) DSA (LANL 2021a) identified over 300 potential hazard events, but only analyzed those with the most severe consequences (e.g., the PF-4 DSA analyzed 21 design-basis events [DBEs], plus two beyond-DBEs). The accidents selected for inclusion in this SWEIS were selected from the analyzed DBEs for each of the notable LANL facilities.

Based on the reviews of the existing safety basis documents at the Laboratory, NNSA identified all of the hazard category (HC)-2 and HC-3 facilities (per DOE-STD-1027-1992) for further evaluation of potential accidents involving the release of radiological materials (*see* Table D.3-2). Table D.3-3 presents the facilities evaluated for the potential release of hazardous chemicals.

DOE guidance recognizes this as an acceptable approach to NEPA accident analyses and refers to it as “bounding.” Specifically, the DSAs, SADs, BIOs, JCOs, and/or EPHAs provide the initiating events, the accident frequencies, the MAR, and the source term for each of the accident scenarios analyzed in this SWEIS. The applicable initiating event, accident frequency, MAR, and source term used in the analysis are provided in Sections D.3.5, D.3.6, D.3.7, and D.3.8 for the radiological, chemical, explosive, and biological hazard analyses, respectively. Section D.3.9 discusses accidents associated with onsite transportation of radiological or hazardous material. Section D.3.10 describes the analysis of accident scenarios that could involve multiple buildings in the site-wide seismic and wildfire analyses.

Table D.3-1 LANL Facility/Area Safety Documents Reviewed

Document Type and Description
Documented Safety Analysis
• (Plutonium Facility [PF]-4), TA-55 Documented Safety Analysis (LANL 2021a) • TA-55 Documented Safety Analysis, Addendum 1-R3 (LANL 2022r) • TA-55 Plutonium Facility 400 (PF-400) Documented Safety Analysis, Radiological Laboratory Utility Office Building (RLUOB) (LANL 2020b) • Technical Area 54, Area G Basis for Interim Operation (LANL 2022a); Addendum to Area G BIO (LANL 2022b); and Justifications for Continued Operations (LANL 2022c through LANL 2022g) • Chemistry and Metallurgy Research Facility Documented Safety Analysis (LANL 2021b) • Radioassay and Nondestructive Testing (RANT) Facility Documented Safety Analysis (LANL 2022h) • Weapons Engineering Tritium Facility (WETF) Documented Safety Analysis (LANL 2020a) • Transuranic Waste Facility (TWF) Documented Safety Analysis (LANL 2022i) • Waste Characterization, Reduction, and Repackaging Facility (WCRRF) Documented Safety Analysis (LANL 2024c) • Transportation Safety Document (TSD) (LANL 2016a) • TA-50 Radioactive Liquid Waste Treatment Facility Documented Safety Analysis (LANL 2022j) • Preliminary Documented Safety Analysis for the TA-50-0269 TRU Liquid Waste Treatment Facility Design (LANL 2021c) • Documented Safety Analysis for the Nuclear Environmental Sites (NES) at LANL (N3B 2023a) • Documented Safety Analysis for Building 21-0257 and the Industrial Waste Lines (N3B 2023b)
Safety Assessment Document
• Safety Assessment Document Dual-Axis Radiographic Hydrodynamic Test Facility (LANL2020c)[a] • Los Alamos Neutron Science Center Safety Assessment Document (LANL 2020d)
Emergency Planning Hazard Assessment
• TA-03 Chemistry and Metallurgy Research Facility (LANL 2022k) • TA-16, Weapons Engineering Tritium Facility (WETF) (LANL 2022l) • TA-54, Area G Site (LANL 2022m) • TA-50, Low-Level Waste Treatment Facility, and TA-50, Radiological Liquid Waste Treatment Facility (LANL 2021d) • TA-53, 1L Target Facility, (Meson Physics Facility) (LANL 2021e)

BIO = Basis for Interim Operations; CMR = Chemistry and Metallurgy Research Facility; DARHT = Dual-Axis Radiographic Hydrodynamic Test Facility; DSA = Documented Safety Analysis; EPHA = Emergency Planning Hazard Assessment; LANL = Los Alamos National Laboratory; LANSCE = Los Alamos Neutron Science Center; PF-400 = Radiological Laboratory Utility Office Building (RLUOB); RANT = Radioassay and Nondestructive Testing Facility; RLWTF = Radioactive Liquid Waste Treatment Facility; SAD = Safety Assessment Document; SBD = Safety Basis Document; TA = Technical Area; TLWTF = TRU Liquid Waste Treatment Facility; TSD = Transportation Safety Document; TWF = Transuranic Waste Facility; WCRRF = Waste Characterization, Reduction, and Repackaging Facility; WETF = Weapons Engineering Tritium Facility

a The DARHT EIS (DOE 1995) evaluated the potential for dynamic experiments at DARHT using plutonium. Any future dynamic experiments at DARHT would be performed in accordance with DOE O 420.2D, Safety of Accelerators, and would not exceed established safety thresholds for MEI exposure.

Table D.3-2 LANL Facilities with Radiological Materials Subject to Analysis

Technical Area	Building/Facility Description (hazard category)	Radionuclides Subject to Analysis	Source
TA-3	Chemistry and Metallurgy Research Facility (CMR) (HC-2)[a]	Actinides, tritium, and irradiated items	DSA, EPHA
TA-16	Weapons Engineering Tritium Facility (WETF) (HC-2)[a]	Tritium and other radionuclides	DSA, EPHA
TA-50	Radioactive Liquid Waste Treatment Facility (RLWTF) (HC-3)[b]	Various including americium, plutonium, uranium, and tritium converted to Am-241 equivalent[c]	DSA, EPHA
TA-50	TRU Liquid Waste (TLW) Treatment Facility (HC-3)[d]	Various including americium, plutonium, uranium, and tritium converted to Am-241 equivalent[e]	Preliminary DSA
TA-50	Waste Characterization Reduction and Repackaging Facility (WCRRF) (HC-3)[d]	Various including plutonium, uranium, and tritium. Also, sealed sources of a variety of radionuclides	DSA
TA-53	Los Alamos Neutron Science Center (LANSCE) – Linear Accelerator (LINAC) and Beam Delivery; Isotope Production Facility; Lujan Center, Weapons Neutron Research Facility	Radioisotope samples/ targets expressed in Pu-239 equivalent	SAD[f]
TA-54	Area G dome structures, trenches, and pit (HC-2)[a]	Various including plutonium, uranium, and tritium. Also, sealed sources of a variety of radionuclides	BIO, BIO Addendum, JCOs, EPHA
TA-54	Radioactive Assay Nondestructive Testing (RANT) Facility (HC-2)[a]	Various including plutonium, uranium, and tritium. Also, sealed sources of a variety of radionuclides	DSA
TA-55	Plutonium Facility (PF-4) (HC-2)[a]	Plutonium, uranium, and a variety of other radionuclides typically converted to Pu-239 equivalent. Also, sealed sources of a variety of radionuclides	DSA
TA-55	Radiological Laboratory Utility Office Building (RLUOB) (HC-3)[b,g]	Various including plutonium, uranium, and tritium converted to Pu-239 equivalent	DSA
TA-63	Transuranic Waste Facility (TWF) (HC-2)[a]	Various including plutonium, uranium, and tritium. Also, sealed sources of a variety of radionuclides	DSA

Technical Area	Building/Facility Description (hazard category)	Radionuclides Subject to Analysis	Source
TA-21, TA-35, TA-49, TA-54	Nuclear Environmental Sites (MDA A General's Tanks [HC-2] MDA-T [HC-2], MDA W [HC-3] MDA AB [HC-2], and MDA H [HC-3])	Various including americium, plutonium, uranium, and tritium	DSA
TA-21	Building 21-0257 and industrial waste lines (HC-2)	Various including americium, plutonium, uranium, and tritium in liquid and solid form	DSA
Site-wide	Site-wide Transportation	Various including plutonium, uranium, and tritium	TSD

Am = Americium; BIO = Basis for Interim Operations; CMR = Chemistry and Metallurgy Research Facility; DSA = Documented Safety Analysis; EPHA = Emergency Planning Hazard Assessment; JCO = Justification for Continued Operations; LANL = Los Alamos National Laboratory; LANSCE = Los Alamos Neutron Science Center; LINAC = Linear Accelerator; PDSA = Preliminary Documented Safety Analysis; PF = Plutonium Facility; Pu = Plutonium; RANT = Radioassay and Nondestructive Testing Facility; RLUOB = Radiological Laboratory Utility Office Building; RLWTF = Radioactive Liquid Waste Treatment Facility; SAD = Safety Assessment Document; TA = Technical Area; TLWTF = TRU (transuranic) Liquid Waste Treatment Facility; TSD = Transportation Safety Document; TWF = Transuranic Waste Facility; WCRRF = Waste Characterization, Reduction, and Repacking Facility; WETF = Weapons Engineering Tritium Facility;

a These facilities are categorized as HC-2 facilities in accordance with DOE-STD-1027-1992.

b These facilities are categorized as HC-3 facilities in accordance with NNSA SD G 1027 Admin Change 1 (NNSA 2011), which is supplemental guidance to DOE-STD-1027-92.

c Americium-241 is the highest average constituent of the low-level influent to RLWTF (25nCi/L versus Pu-238 at 23nCi/L and Pu-239 at 11nCi/L). The normal operations influence Am-241 conversion is utilized for accident analysis for operational convenience.

d This facility is categorized as an HC-3 facility in accordance with DOE-STD-1027-1992.

e Am-241 was chosen for conversion of other radionuclides in the influent to TLW Treatment Facility to be consistent with the DSA for the existing RLWTF, which uses Am-241 for the same purpose. Am-241 has similar dispersion characteristics to the plutonium and uranium isotopes, which along with Am-241 are the predominant radionuclides in the liquid waste streams.

f The LINAC (including the experimental facilities) is operated in accordance with DOE Order 420.2D, Safety of Accelerators, and determined to present a low risk to onsite and offsite impacts (LANL 2020d).

g In 2018, DOE prepared an EA to recategorize RLUOB from a radiological facility to a HC-3 nuclear facility, with an increased MAR limit of 400 grams PuE (15 percent of the 2,610 grams of PuE allowed in a HC-3 nuclear facility), which would allow certain laboratory capabilities previously planned for PF-4 to be installed in RLUOB. As a result, fewer modifications to PF-4 would be required, while additional modifications would be made to RLUOB (NNSA 2018). In April 2023, RLUOB was added as a HC-3 nuclear facility based on NNSA authorization to commence operations (LANL 2023).

Table D.3-3 LANL Site Facilities with Chemicals Subject to Analysis

Technical Area	Building/Facility Description	Chemicals Subject to Analysis	Source
TA-50	Radioactive Liquid Waste Treatment Facility	Sodium hydroxide	DSA, EPHA
		Argon	
		Nitric acid	
		Potassium chloride	
		Hydrochloric acid	
TA-50	TRU Liquid Waste Treatment Facility	Nitric acid	Preliminary DSA
TA-53	Los Alamos Neutron Science Center – Linear Accelerator and Beam Delivery; Isotope Production Facility; Lujan Center, Weapons Neutron Research Facility	Silver (bounding IPF)	SAD, EPHA
		Mercury (Lujan Center)	
		Tungsten (Bounding 1L Target)	
		Lead (bounding WNR)	
TA-55	Plutonium Facility	Nitric acid	DSA
		Beryllium	
		Chlorine gas	
		Toxic metals	
TA-63	Transuranic Waste Facility	Beryllium	DSA

CMR = Chemistry and Metallurgy Research Facility; DARHT = Dual-Axis Radiographic Hydrodynamic Test Facility; DSA = Documented Safety Analysis; EPHA = Emergency Planning Hazard Assessment; ER = Experimental Room in Lujan Center; IPF = Isotope Production Facility; LANL = Los Alamos National Laboratory; PDSA = Preliminary Documented Safety Analysis; RANT = Radioassay and Nondestructive Testing Facility; RLUOB = Radiological Laboratory Utility Office Building; SAD = Safety Assessment Document; TA = Technical Area; WCRRF = Waste Characterization, Reduction, and Repacking Facility; WETF = Weapons Engineering Tritium Facility; WNR = Weapons Neutron Research Facility;

Note: The chemicals in the following facilities were screened out of further analysis or determined to have insignificant consequences at 100m from a postulated release due to having a limited quantity, common use, or physical form not representing an airborne hazard (standard industrial hazards): TA-54, Area G; CMR; RANT; WETF; WCRRF; NES; Building 21-0257 and IWL; Site-wide Transportation; RLUOB; and DARHT.

High Explosives. There are over 160 facilities on LANL that use or store HE within the facility. Explosives safety is managed in accordance with DOE Technical Standard DOE-STD-1212-2019 (DOE 2019c). Section 12 of the standard provides level-of-protection criteria for handling HE within the facilities and at outdoor firing sites. The level of protection is based on the hazard class for a specific activity as opposed to the facility. Based on these definitions, the hazard class of activities within a facility or area that handle HE could change multiple times within a single day. There are five hazard classes for HE activities:

Class 0 Explosives operations that involve the intentional initiation of explosives materials or articles (e.g., explosives testing, firing activities associated with training, and destruction of explosives by detonation).

Class I Explosives operations that involve activities with a high accident potential where: (1) energies approach the upper safety limits, (2) loss of control of interfacing energy is likely to exceed safety limits, and (3) research and development where safety implications have not been fully characterized. Examples include screening, blending, pressing, extrusion, drilling of holes, dry machining, machining explosives and metal in combination, some environmental testing, new explosives development and processes, explosives disposal by burning and some destructive testing.

Class II Explosives operations that involve activities with moderate accident potential due to the explosives type, condition of the explosives, or nature of the operations. These activities involve energies that do or may interface with the explosives are normally well within the safety boundaries for the explosives involved, but where the loss of control of these energies could approach the safety limits. Examples include weighing, some wet machining, assembly and disassembly, some environmental testing, and some packaging operations.

Class III Explosives operations that involve activities with low accident potential. Examples include activities during storage and operations incidental to storage or removal from storage.

Class IV Explosives operations that involve activities with insensitive HE or insensitive HE subassemblies where the probability of accidental initiation or transition from burning to detonation is negligible. Examples include processing and storage activities with insensitive HE and insensitive HE subassemblies.

In accordance with DOE-STD-1212-2019 (DOE 2019c), each facility that handles HE prepares an Explosive Safety Site Plan (ESSP). The ESSP establishes HE mass limits and limits on the number of personnel that can be in the facility to manage the risks of an accident. With regard to potentially comingling radioactive materials and HE, the Technical Standard states, "Explosives and hazardous radioactive materials (e.g., plutonium, enriched uranium) shall not be included in the same test or operation if the test or operation is not contained." The Laboratory does perform some HE tests with depleted uranium.

D.3.1.3 Analytical Tools

The DOE maintains a list of "toolbox" computer codes (i.e., analytical tools) in this central registry that have been evaluated against DOE safety software quality assurance requirements of DOE O 414.1D (DOE 2020a) and the safety software guidance in DOE Guide 414.1-4. All analytical results presented in this section were determined by computer codes that are listed in the DOE toolbox, either specifically for this SWEIS or in a referenced document used in this SWEIS.

Radioactive Material Release. Two computer codes from DOE's toolbox were considered appropriate for calculating impacts from an accident involving the release of radioactive materials: HotSpot Version 2.07.1 and MACCS2 Version 1.13.1. Both codes are similar in that they calculate doses to individuals based on the straight-line Gaussian plume dispersion and transport model. As such, both codes have been used in past LANL radioactive materials release accident analyses (e.g., the 2008 SWEIS, DSAs, BIOs, EPHAs) and either would be appropriate for performing analyses required for this SWEIS. HotSpot was chosen to perform analyses for this SWEIS, primarily due to its ease of use. MACCS2 on the other hand, was developed to support probabilistic risk assessment, and contains many features which are not necessary for a SWEIS analysis (e.g., food ingestion, sheltering, relocation, evacuations, economic cost).

Due to their similarity, the equations used to calculate the MEI and population doses were used to calculate the population dose using the HotSpot results. For example, the inhalation dose is calculated via:

$$D_{MEI} = \sum_{m=1}^{m} \left(ST_m \times \frac{X}{Q_{MEI}} \times BR \times DCF_m\right) \quad \textbf{Equation D-2}$$

$$D_{Pop} = \sum_{m=1}^{m}(ST_m \times BR \times DCF_m) \times \sum_{k,n=1}^{k,n} \left(f_n \times \frac{\chi}{Q_{k,n}} \times P_{k,n}\right) \quad \textbf{Equation D-3}$$

Where:

D_{MEI} = *Calculated MEI dose (rem),*
D_{Pop} = *Calculated population dose (person-rem),*
m = *Number of radionuclides released,*
ST_m = $MAR \times ARF \times RF \times DR \times LPF$ (Source term of radionuclide m released (e.g., Ci)),
MAR = Material at risk (e.g., Ci),
ARF = Airborne release fraction,
RF = Respirable fraction,
DR = Damage ratio,
LPF = Leak path factor,
DCF_m = Radionuclide m inhalation dose conversion factor (rem/Ci),
BR = Breathing rate (m^3/second),
X/Q_{MEI} = Atmospheric dispersion at the MEI location (seconds/m^3),
k = Offsite population distribution from LANL in direction *n* at (0.5, 1, 2, 3, 4, 5, 10, 20, 30, 40, 50, 60, and 80 km),
$X/Q_{k,n}$ = Atmospheric dispersion at the distance *k* in direction *n* (seconds/m^3),
n = Offsite direction wind is blowing towards corresponding wind rose sector numbers 1–16,
f_n = Frequency of wind blowing towards direction *n*, and
$P_{k,n}$ = Offsite population at distance k and direction *n* (number of people).

For the MEI dose, Equation D-2 shows that the radionuclide source term (ST_m) is multiplied by the dispersion factor to the MEI location (X/Q_{MEI}), which gives the concentration at the MEI location. That concentration is multiplied by the MEI's breathing rate, which gives the amount taken into the MEI's body. Finally, the amount taken into the MEI's body is multiplied by the dose conversion factor (DCF_m), which results in the dose to the MEI. This is repeated for each radionuclide and summed over all radionuclides to give the estimated MEI dose. Mathematically, the above MEI dose equation is the same as Regulatory Guide 1.195, Equation 7 (NRC 2003).

The population dose Equation (D-3) takes the individual dose at each downwind distance and multiplies it by the number of individuals at the distance. Because the wind direction at the time of the accident is unknown, for each distance, the population equation multiplies the population in each direction at that distance ($P_{k,n}$) by the probability that the wind is blowing in that direction (f_n) and then sums the products over all directions. The estimated 2020 population distribution across the 16 directional sectors around LANL at distances from 0 to 80 km (0 to 50 miles) is shown in Table D.3-4. Sector numbers are used in the table presentation of consequences later in this appendix.

Table D.3-4 Population Distribution Estimates Within 80km from LANL

Direction (sector #)	Distance from the LANL Site (kilometers)												
	0.5	**1**	**2**	**3**	**4**	**5**	**10**	**20**	**30**	**40**	**50**	**60**	**80**
N (1)	4	14	97	253	301	563	1,480	16	103	1,077	0	945	641
NNW (2)	4	18	112	190	411	310	1,424	7	22	291	0	0	528
NW (3)	9	4	63	160	238	292	1,129	2	27	56	821	0	1,153
WNW (4)	4	21	37	71	126	156	309	0	35	41	0	0	3,305
W (5)	8	8	24	28	27	33	19	16	135	651	0	152	291
WSW (6)	0	0	0	0	0	0	0	16	80	788	0	5,287	0
SW (7)	0	0	0	0	0	0	0	5	0	0	0	4,485	0
SSW (8)	0	0	0	0	0	0	0	7	1,998	2,706	6,419	5,193	113,396
S (9)	0	0	0	0	0	0	0	10	35	310	0	0	6,855
SSE (10)	0	0	0	0	0	0	0	55	436	7,314	3,574	0	0
SE (11)	0	0	0	0	0	0	0	1	1,415	94,874	10,599	234	6
ESE (12)	0	0	0	0	0	0	0	16	932	11,234	0	862	2,430
E (13)	8	8	24	28	27	33	19	2,056	5,371	549	631	1	598
ENE (14)	4	21	37	70	126	156	308	2,793	5,820	4,636	208	1,211	1,752
NE (15)	9	4	63	160	238	292	1,129	1,314	17,067	2,878	1,604	1,597	3,527
NNE (16)	4	18	112	190	411	310	1,424	15	2,739	479	3,483	0	58
TOTALS	**54**	**116**	**569**	**1,150**	**1,905**	**2,145**	**7,240**	**6,329**	**36,215**	**127,884**	**27,339**	**19,967**	**134,540**

LANL = Los Alamos National Laboratory; E = east; ENE = east-northeast; ESE = east-southeast; N = north; NE = northeast; NNE = north-northeast NNW = north-northwest; NW = northwest; S = south; SE = southeast; SSE = south-southeast; SSW = south-southwest; SW = southwest; W = west; WSW = west-southwest
Source: LANL (2022n, 2022p)

The LANL Population Distribution within 80 km from LANL (LANL 2022n) provides the 0–50 mile (0–80 km) population in each of the 16 compass sectors surrounding the LANL site. All population doses presented in this SWEIS were based on that population distribution. The populations within this 50-mile radius are expected to continue to increase by about 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 these population increases would result in a corresponding approximate 12.6 percent increase in the total population dose by 2038; however, the majority of the population is well away from the lab and their contribution to the total dose is much smaller. It is noted that the exact increase in the population dose would ultimately depend upon where the increased population is located.

The meteorological data came from the Meteorological Tower located in TA-6. The wind speed and stability class data files for 2016 through 2020 (LANL 2022o) were used in the radiological dose calculations for this SWEIS as discussed below in Section D.3.1.4.

Toxic Chemical Release. Two computer codes from the DOE Central Registry's toolbox have been used to calculate the potential impact from a toxic chemical release accident: Areal Locations of Hazardous Atmospheres (ALOHA)[9] and EPIcode.[10] The Laboratory has used both codes in past analyses for DSAs, BIOs, and SADs. For example, EPIcode was used for the LANSCE, Lujan Center SAD, while ALOHA was used for the PF-4 DSA.

Biological Hazard Release. Bioscience research activities at LANL are currently conducted in biosafety levels (BSLs) 1 and 2 facilities and are categorized as low hazard and nonnuclear. BSL-1 and 2 laboratories that include limited work with potentially infectious microorganisms are regulated by the Centers for Disease Control and Prevention, NIH, LANL's Institutional Biosafety Committee, and the Institutional Biosafety Officer. While a BSL-3 laboratory is proposed under the Expanded Operations Alternative, no BSL-4 work is currently performed or proposed to be performed at LANL.

Site-Wide Multiple-Building Scenarios. Consequences for the site-wide seismic and wildland fire events were analyzed using the same tool discussed above for radioactive material release (i.e., HotSpot).

D.3.1.4 Meteorological Assumptions

There are several meteorological assumptions that are necessary to perform the accident analyses, including wind speed, wind direction, atmospheric stability class, distance to the MEI, release elevation, plume buoyancy, terrain factors (surface roughness), dry deposition velocity, building wake, and off-centerline distance.

Wind Speed and Atmospheric Stability Class. DOE O 151.1D, *Comprehensive Emergency Management System* (DOE 2019a), states that accident impacts should be calculated under conservative and average dispersion conditions. Based on this guidance and five years of LANL site meteorological data (i.e., 2016 through 2020) (LANL 2022o), it was found that for ground level releases the conservative case corresponded to F stability class and a wind speed of 1 meter/second (m/sec) (2.2 miles per hour). The 2016-2020 average meteorological data corresponded to D stability class and 2.54 m/sec wind speed (5.7 miles per hour); however, the average dispersion conditions vary widely over the wind directions with wind stability ranging from B to E stability class and wind speeds ranging from 1.72 to 3.40 m/sec (3.8 to 7.6 miles per hour). Therefore, the average wind speeds and stability classes used for accident calculations were based on the averages for each wind direction. Conservative meteorology is based on five years of site meteorological data (i.e., 2016 through 2020) (Appendix D, LANL 2022o). 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 in 2016 through 2020 reflect that wind speed less than 1 meter/second and Stability Class F occurs less than 2.5 percent of the time.

---

[9] https://www.epa.gov/cameo/aloha-software
[10] https://www.energy.gov/ehss/epicode

Distance to the MEI. The LANL site covers approximately 40 square miles (25,536 acres) and has buildings located at various locations on the site. The MEI is a hypothetical individual who is assumed to remain at a location closest to the point on the site boundary fence line of the analyzed facility. Each building on the LANL site potentially has its own MEI distance. The subsequent sections of this appendix present the MEI distance for each building analyzed.

Elevated Releases. The standard atmospheric dispersion models assume that the plume spread has a Gaussian distribution in both the horizontal and vertical planes. The maximum downwind concentration occurs at the horizontal and vertical centerlines. For ground level releases the concentration continually decreases with distance from the release point, as demonstrated by the dashed lines in Figure D.3-1. In the case of an elevated or buoyant release, the maximum concentration would occur at the release elevation and an individual standing on the ground would be exposed to a lesser concentration. For an elevated release the maximum ground level concentration occurs at "some" downwind distance from the release point. The exact distance at which the maximum concentration occurs is a function of the release height and the stability class. The solid lines in Figure D.3-1 demonstrate this for an assumed 100-foot release.

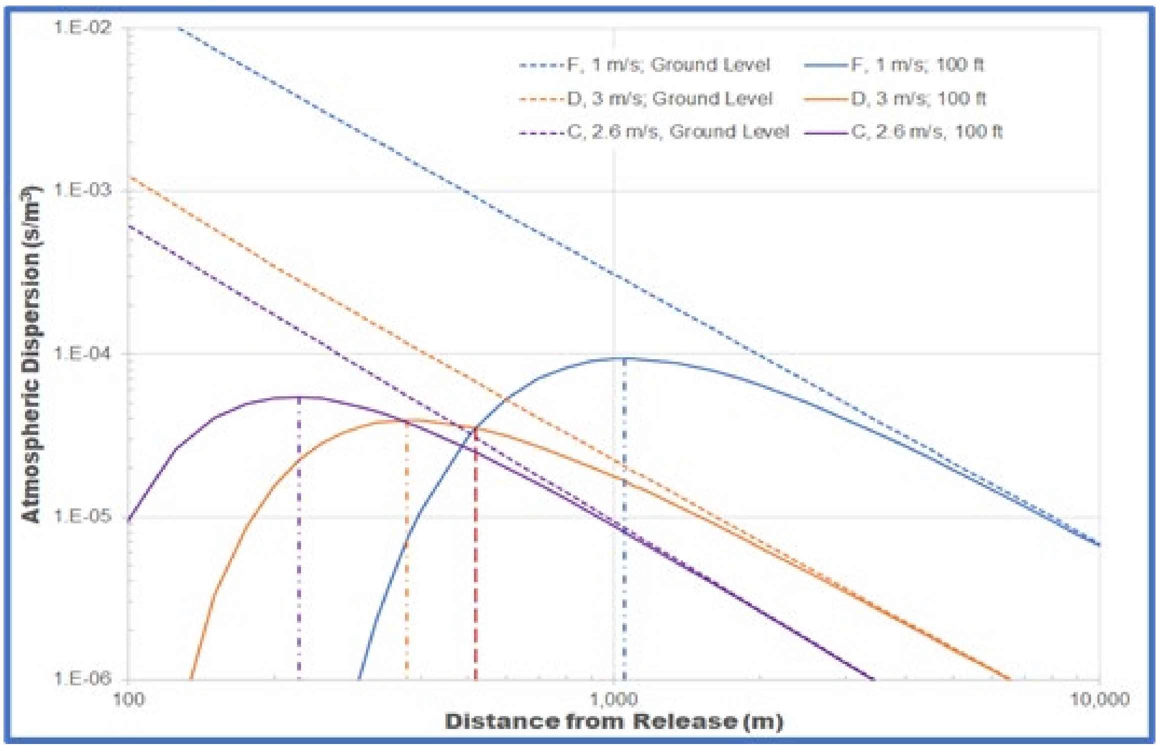


Figure D.3-1 Offsite Concentration from a 100 ft Elevated Release

For a 100-foot elevated release (either from a stack or due to buoyancy or exit velocity), Figure D.3-1 shows that the maximum downwind concentration occurs at 400 and 1,050 meters for stability classes D and F, respectively. The MEI exposures would be determined at these distances or the site boundary, whichever produces a larger exposure. For example, if the site boundary is at 800 meters, then for stability class D the MEI exposures would be determined at 800 meters, but the class F exposures would be determined at 1,050 meters. This approach is consistent with DOE guidance, which states that the MEI "is evaluated where the offsite ground level consequence is maximized," which for elevated or buoyant releases, "could be beyond the DOE site boundary" (DOE 2014).

Figure D.3-1 also shows that for elevated releases, the exposure of the non-involved worker, assumed to be located at 100-meters, is negligible. This is due to the fact that the contamination plume would pass well over the head of the worker at this location.

The final effect shown in Figure D.3-1 of an elevated release is the fact that at distances close to the release point, the average meteorology (i.e., Class D, 3 m/sec) results in concentrations and exposures that are greater than those under the conservative meteorology (i.e., class F, 1 m/sec). In Figure D.3-1 this effect can be seen out to a distance of about 519 meters. Additionally, at even closer distances other, more unstable, meteorological conditions may result in still greater concentrations and exposures. For example, as shown in Figure D.3-1, out to a distance of about 375 meters the combination of stability class C and 2.6 m/sec wind speed results in greater concentrations than either the average or conservative meteorological conditions.

Wind Direction and Horizontal Off-Centerline Distance. For the MEI and the non-involved worker, it was assumed that the wind was always blowing directly towards the individual (i.e., both individuals are located on the centerline). As described in Sections D.3.1.3 and D.3.1.4 for the population impacts, each sector's population was weighted by the annual frequency the wind blows towards the sector.

Terrain Factors and Building Wake. To determine atmospheric dispersion the Pasquill-Gifford horizontal and vertical diffusion coefficients (commonly referred to as σ_y and σ_z, respectively) are necessary. To account for different terrain types, there are two sets of diffusion coefficients; the first or standard set is for a flat rural terrain and the second is for an urban or city terrain. Urban or city diffusion coefficients account for the increased plume dispersion from crowded structures and the heat retention characteristics of urban surfaces, such as asphalt and concrete. A city terrain factor results in lower concentrations than the standard or rural coefficients, due to the increased dispersion from large urban structures and materials.

For accidents involving transuranic (TRU) radionuclides, DOE-STD-5506-2021 (DOE 2021) specifies use of the standard or rural diffusion coefficients, unless there is specific justification for using the urban or city coefficients. LANL is located in a more rural area and has fewer buildings spread over a larger area; however, with the ponderosa pines and canyons, the diffusion coefficients are more like an urban than rural terrain. Since standard or rural diffusion coefficients are more conservative, the standard or rural diffusion coefficients were used for all LANL analyses.

The building wake effect is the enhanced dispersion of the plume due to mechanical mixing of the air as it flows over and around structures. Wakes can be generated by the building releasing the material, as well as by structures in the flow path of the release. Because the terrain type selection (discussed above) already accounts for structures in the flow path of the release, this discussion is focused on wakes generated by the building releasing the material. Credit for enhanced dispersion caused by the building wake has not been taken in any of the SWEIS accident analyses.

D.3.1.5 Involved Worker Impacts

For all accidents, there is a potential for injury or death to involved workers in the vicinity of the accident. Estimation of potential health effects becomes increasingly difficult to quantify as the distance between the accident location and the worker decreases because the exposure cannot be adequately established with respect to the presence of shielding and other protective features. The worker also may be acutely injured or killed by physical effects of the accident.

No major consequences for the involved worker are expected from leaks, spills, and smaller fires. These accidents are such that involved workers would be able to evacuate immediately or would be unaffected by the events. Explosions could result in immediate injuries from flying debris, as well as the uptake of radioactive particulates through inhalation. If a criticality occurred, workers in the immediate vicinity could receive high to fatal radiation exposures from the initial burst. The dose would strongly depend on the magnitude of the criticality (number of fissions), the distances of the exposed workers from the criticality, and the amount of shielding provided by structures and equipment between workers and the accident. While an earthquake with subsequent fire could also have substantial consequences, ranging from workers being killed by debris from collapsing structures to high radiation exposure and uptake of radionuclides, the probability of such an event occurring at LANL is less than once in 2,500 years (or 10,000 years depending on the facility) (*see* Section D.3.10). Accelerator operations pose potential hazards to involved workers due to exposure to prompt radiation, air activation products, and toxic gases generated during operations. However, LANL has many controls, including passive structural shielding, venting requirements, and exclusion areas that mitigate and control these hazards.

For most accidents, immediate emergency response actions would likely reduce the consequences for workers near the accident. Established emergency management programs would be activated in the event of an accident (*see* Section D.5). Following initiation of accident/site emergency alarms, workers would evacuate the area in accordance with site emergency operating procedures and would not be vulnerable to additional radiological or chemical risk of injury. First responder organizations develop plans and protocols that address radiation protection during a radiological incident and that ensure appropriate training is provided to responders and decisionmakers. The radiological impacts to first responders are controlled during the accident by incident commanders using the EPA's emergency worker protective action guides (EPA 2017). Generally, the protective action guide is 5 rem, but may be exceeded to prevent further destruction and/or loss of life. Each first responder makes an informed decision as to how much radiation risk he or she is willing to accept to complete a particular critical infrastructure/key resources or lifesaving mission. Therefore, the first responder's potential radiological exposures are administratively controlled, even during an accident.

D.3.2 No-Action Alternative Projects Accident Impacts

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 Section 3.2 of this SWEIS. For this section, each of the projects was reviewed to determine whether the consequences from a radiological, chemical, biological, or HE accident resulting from the project could potentially result in greater consequences than the previous analysis of the existing buildings and facilities. Many of the No-Action Alternative projects involve infrastructure improvement and similar projects, which by their nature would not result in any potential for a radiological, chemical, biological, or HE accident. However, there are several No-Action Alternative projects for which that conclusion is not intuitively obvious, those projects have been discussed below in further detail.

Increased Plutonium Pit Production. As needed, a minimum of 30 plutonium pits per year would be produced for the national pit production mission and surge efforts would be implemented to produce up to 80 pits per year to meet the previous and current Nuclear Posture Reviews and national policy. The potential consequences of an accident in PF-4 are dependent on the amount of MAR in the facility as stipulated in the DSA for TA-55 (LANL 2021a). The potential accident impacts associated with pit production at the Laboratory were analyzed in the 2008 LANL SWEIS and in the 2020 LANL SWEIS Supplement Analysis, as discussed in Section 1.5.2 of this SWEIS. The analysis presented in Section D.3.5 for radiological accidents includes a design-basis accident (DBA) to identify potential consequences of pit production of 30 to 80 pits per year.

TRU Liquid Waste Treatment Facility. The TRU Liquid Waste Treatment Facility would replace the existing Radioactive Liquid Waste Treatment Facility (RLWTF) for handling liquid wastes containing TRU waste. Although the radiological consequences associated with postulated accidents in RLWTF and the replacement facility TLW Treatment Facility (which are both HC-3 facilities) are low due to the low radiological concentration of the source material, small amount of facility MAR, and its limited dispersibility, a DBA was selected for analysis in this SWEIS for completeness and presented in Section D.3.5. Chemical accidents associated with the TLW Treatment Facility are addressed by the analyses presented in Section D.3.6.

Environmental Test Complex, Detonator Storage Facility and magazines, HE Transfer Facility, Energetic Materials Characterization Facility, and Training and Test Facilities. These projects were all analyzed in the 2008 SWEIS, were included in the 2008 SWEIS ROD, and are bounded by the analyses in Section D.3.7 for accidents involving HE.

Offices with BSL-2 Capabilities. BSL-1 and -2 work is currently performed in TA-3 and TA-43. The potential consequences of accidents involving BSL-2 risks are presented in Section D.3.8.

Light Manufacturing Laboratory. The facility would support radiological operations by enabling radioisotope separation and target development and extracting alpha-emitting medical isotopes for cancer treating therapy. This laboratory would have potential hazards below HC-3. DOE-STD-1027 describes accidents at HC-3 facilities as having "only local significant consequences." Thus, the proposed facility would be bounded by the analyses performed for HC-3 facilities and is not analyzed further in this SWEIS. The safety management programs address the potential impact posed to human health and the environment from the initial project and are bounded by the analyses presented in Section D.3.5 for radiological accidents.

Nuclear Environmental Sites. The NES are below-ground waste disposal units (also referred to as MDAs) containing waste and isolation systems that protect the waste from potential impacts. DOE-EM has planned activities for these MDAs, which include continued site maintenance and limited sampling and/or characterization activities. Site maintenance involves controlling vegetation, erosion, and sediment. Drilling/sampling or characterization determines the nature and extent of contamination but does not intrude into the waste inventory. In general, samples of tuff, soil, sediment, biota, and water are analyzed to provide characterization. Subsurface sampling may include shallow boring/drilling into the ground to collect cores. NES DSA (LANL 2023a) assessed hazards associated with waste sample removal and determined the small samples would be adequately addressed by safety management programs. For drilling between waste disposal units, the DSA postulated two bounding accidents associated with inadvertently boring into the waste. The bounding MEI consequences from a drill core spill/impact or a postulated fire involving a drill core container were orders of magnitude less than other accident scenarios presented in Section D.3.5 for radiological accidents.

Building 21-0257 and IWLs. Building 21-0257 with its IWLs treated liquid waste from processing facilities (now dismantled) in TA-21 until the mission terminated in 2003. Tanks and equipment were drained and flushed; however, the heels and residual material remain in some tanks, equipment, and piping based on recent characterization. Building 21-0257 and the IWLs are "cold and dark" and isolated from utilities and each other (IWLs' valves were closed and locked, one line cut and capped). IWL piping is covered with a soil overburden that is generally 3 feet or more. DOE-EM's planned activities for these facilities include continued surveillance and maintenance, removal of debris, and limited waste sampling and characterization. There would be no facility operations associated with the building. Prior to the initiation of DD&D activities, DOE would prepare a detailed DD&D plan that would contain a detailed description of the project-specific DD&D activities to be performed, an evaluation of the potential accident scenarios and impacts, and actions required to protect workers, the public, and the environment. DD&D planning would implement ALARA objectives, establish technical safety requirements, and follow radiological protection guidelines to ensure that radiation doses to workers and the public are kept to ALARA levels. The accident scenarios involving Building 21-0257 are represented by the accident scenarios presented in Section D.3.5 for radiological accidents.

D.3.3 Modernized Operations Alternative Projects Impacts

The Modernized Operations Alternative continues existing programs and activities by modernizing facilities, as necessary. This alternative includes the scope of the No-Action Alternative with additional modernization activities including replacement facilities, upgrades to existing facilities, and additional DD&D projects. This alternative would not expand capabilities and operations beyond those that currently exist. The new facilities, modernization/upgrade of existing facilities, upgrades of utility and infrastructure, and additional DD&D projects are described in Section 3.3 and summarized in Tables 3.3-1, 3.3-2, and 3.3-3 of this SWEIS. For this section, NNSA considered each of these projects to determine whether the consequences from a radiological, chemical, biological, or HE accident resulting from the project could potentially result in greater consequences than the previous analysis of existing buildings and facilities. Many of the Modernized Operations Alternative projects involve infrastructure improvement and similar projects, which by their nature would not result in any potential for a radiological, chemical, biological, or HE accident. Accident impacts of the replacement and upgraded facilities are bounded by the accidents analyzed in this SWEIS since the amount of material available for an accident would remain the same and there are no significant differences in the operations of the replacement facilities. However, there are several projects for which that conclusion is not intuitively obvious, those projects have been discussed below in further detail.

Beryllium Technology Facility, Explosive and Lasers Facility, Shock Physics Integrated Research Facility, Detonator Production Facility, Microwave Oven Thermo-Mechanical Experimentation (MOT-ME), Pentaerythritol Tetranitrate (PETN) Plant, and HE Pilot Plant. A review of these projects determined they are replacement facilities for existing capabilities, would not involve radiological materials, and are bound by previous analyses. Potential chemical releases are addressed in Section D.3.6. Several of the facilities use HE and are addressed by the discussion and analysis in Section D.3.7.

Radiograph/Assembly Complex (RACR), Rad Lab, and National Gas Transfer System and Surety Laboratory (NGTS/S). The RACR, Rad Lab, and NGTS/S facilities would be radiological facilities (below HC-3 per DOE-STD-1027-1992) and would replace existing facilities and capabilities at the Laboratory. DOE-STD-1027 describes accidents at HC-3 facilities as having "only local significant consequences." Thus, the proposed facilities would be bounded by the analyses performed for HC-3 facilities and are not analyzed further in this SWEIS. Safety management programs adequately address the potential impacts posed to human health and the environment and these potential impacts are bounded by the analyses presented in Section D.3.5 for radiological accidents.

Weapons Engineering Tritium Facility (WETF) Modernization. New systems and equipment associated with the WETF modernization would consist of in-kind replacements of removed legacy systems/equipment. WETF's current processes and capabilities would not change with the upgrade and MAR limits would remain in place; therefore, this project would be represented by radiological accidents presented in Section D.3.5.

LANSCE Modernization Project. The LANSCE Modernization Project would replace existing equipment with modern equipment with similar operating characteristics. The improved availability may increase radioactive air emissions because of the increased operational availability of the beam; however, potential accident impacts would not change since the amount of material available for an accident would be unchanged. Section D.3.5 presents potential impacts of a postulated radiological accident at LANSCE.

D.3.4 Expanded Operations Alternative Projects Impacts

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 are described in Section 3.4 and summarized in Tables 3.4-1 and 3.4-2 of this SWEIS. For this section, NNSA considered each of these projects to determine whether the consequences from a radiological, chemical, biological, or HE accident resulting from the project could potentially result in greater consequences than the previous analysis of existing buildings and facilities. Some of the Expanded Operations Alternative projects involve new infrastructure or expansion of existing capabilities that would not result in any increased potential for a radiological, chemical, biological, or HE accident. A specific evaluation of the other Expanded Operations projects is presented below:

Low-Enriched Uranium Fuel Fabrication Facility. The LEFFF would fabricate high-assay low-enriched uranium fuels (HALEU) and would increase the quantity of enriched uranium-based material systems above the current ceramic fuel capacities at LANL. Initially, the project would operate under a facility limit of 896 grams of uranium-235 and thus not present a criticality or radiological impact beyond a radiological facility (below HC-3). Thus, the proposed facility would be bounded by the analyses performed for HC-3 facilities and is not analyzed further in this SWEIS. Safety management programs would adequately address the potential impact posed to human health and the environment from the initial project and would be bounded by previous analyses involving radiological accidents presented in Section D.3.5.

Future expansion of fuel fabrication at LEFFF could increase the facility limit to about 4.0 kilograms of uranium-235 (wet processing) and 30 kilograms (dry processing) in order to produce approximately 200 kilograms of 19.75 percent enriched uranium-235 fuel per year. The expanded fuel fabrication capability would present the potential for an inadvertent criticality impact; however, the radiological impact would still be below the HC-3 threshold for uranium-235 (6,710 kilograms per DOE-STD-1027). As discussed in Section D.3.5.4 below, the CMR DSA (LANL 2021b) evaluated an inadvertent criticality event in CMR Wing 9 (TA-3). The consequences of the event are based on 1×10^{19} fissions from a solution criticality, which would bound criticality accidents involving other material forms (e.g., powders, metals, etc.).

Formulation Additive Manufacturing Explosive (FAME), TA-60 Performance Oriented Weapons Explosives Research Bomb Proof Facility (POWER), HE Modernized Manufacturing Facility, Open Burn/Open Detonation (OB/OD) Facility. These proposed facilities and operations would operate in accordance with established HE limits and controls and involve accident risks associated with HE and potential HE accident consequences, which are described in Section D.3.7.

Environmental Test Facility. This facility would be contained within the Perimeter Intrusion, Detection, and Assessment System at TA-55 and would only operate with sealed components. It would be categorized as a radiological facility (below HC-3); therefore, the safety management programs would adequately address the potential impact posed to human health and the environment from the initial project and would be bounded by previous analyses involving radiological accidents presented in Section D.3.5.

Dynamic Mesoscale Materials Science Capability. The DMMSC would be a new x-ray-free electron laser facility focused on the control of performance and production of materials at the mesoscale. The project would be a radiological, beryllium, and nanoparticle accelerator facility. The project would increase radioactive air emissions under normal operations; however, accident impacts would be bounded by previous analysis for the LANSCE facility; therefore, potential accident risks of DMMSC would be represented by radiological consequences presented in Section D.3.5.

LANSCE Enhancements. In addition to the Modernized Operation Alternative projects, six key enhancements (enhanced energy proton radiography, neutron target for nuclear physics, burst facility for acute radiation effects studies, compact x-ray sources for material science and dynamic radiography, fusion prototype neutron source, and enhanced ultracold neutron facility) would be implemented over the next 15 years. These projects have the potential to increase radioactive air emissions under normal operations; however, like DMMSC, would be bounded by previous analysis for the LANSCE facility. Radiological accident risks and consequences are presented in Section D.3.5.

Microreactor. A factory manufactured, fully assembled, and pre-fueled microreactor up to 5 megawatts electric (MWe) would arrive at LANL and would be connected to the electric grid. Microreactors are safe because they are self-regulating and do not rely on engineered systems to ensure safe shutdown and removal of decay heat. The microreactor likely would be powered by up to 400 kilograms of HALEU tri-structural isotopic (TRISO) fuel. For the typical microreactor, the entire reactor system would be swapped-out when fuel is depleted.

While NNSA has not identified a particular design for a microreactor at LANL, there are existing analyses of hazardous and radioactive material release impacts associated with a microreactor within the DOE Complex. The U.S. Department of Defense and DOE issued a Record of Decision for the Pele Project Final EIS (DOE/EIS-0546, [DOD 2022]) on April 15, 2023 (87FR22521). The Pele microreactor would be located at the Idaho National Laboratory (INL).

The Pele Project EIS evaluated three bounding radioactive material release accident scenarios (inadvertent criticality, onsite transportation, and operational accident). Results of the mobile microreactor probabilistic risk analysis and other safety analyses indicate that all operational accidents would be controlled and not result in fuel melting. The mobile microreactor accident consequences at INL are based on conservative assumptions that do not consider decay of short-lived isotopes, mitigation to limit releases, or emergency actions; therefore, the potential impacts are likely overstated. The evaluation of the inadvertent criticality accident at INL assumed 1×10^{19} fissions occurring in a uranium solution with an MEI consequence of 98 millirem. The distance to the assumed MEI location at INL was 610 meters. The CMR DSA (LANL 2021b) evaluated an inadvertent criticality event in CMR Wing 9 (667 meters from the LANL site boundary) also based on 1×10^{19} fissions from a uranium solution with a MEI dose estimated to be 600 millirem.

The onsite transportation accident evaluates a vehicle impacting the mobile microreactor (assumed to have operated for some time but having cooled for seven days) with an ensuing fuel pool fire while the microreactor is being transported onsite at INL. The evaluation of the onsite transportation accident estimates the INL MEI consequence to be 13 millirem (distance to the site boundary was 610 meters).

The mobile microreactor operational accident assumes large or multiple breaches of the prototype mobile microreactor pressure boundary occur in conjunction with failure of the reactivity control system. Failure of the reactivity control system could result in a fuel temperature increase. If fuel temperatures were to rise, TRISO fuel damage may result, and fission products could be released from the particles into the cooling medium of the microreactor. If the pressure boundary of the primary coolant were breached, a release of fission products would occur. Most of the fission products are expected to be contained within the fuel particles. The operational accident was assumed to occur after the microreactor has run for an extended time and assumed to occur approximately 9 kilometers from the INL site boundary. The operational accident evaluation estimated the MEI dose at the INL location to be 3.7×10^{-4} rem (or 0.37 millirem).

For comparison to potential siting locations on the LANL site, the operational accident would result in a release of the fission products similar to the criticality event but with less energy and thus less potential dose to the MEI. The Pele Project criticality accident MEI distance was analyzed at 610 meters and the LANL CMR criticality MEI distance is 667 meters illustrating that CMR criticality bounds a potential operational accident of a microreactor (98 mrem versus 600 mrem).

Based on the potential accident impacts associated with this project, the previous analyses and radiological consequences presented in Section D.3.5 would bound this project. If and when NNSA developed a specific proposal for a microreactor at LANL, the Laboratory would complete a DSA in accordance with 10 CFR Part 830.

Surplus Plutonium Disposition Program. NNSA published a final SPDP EIS in January 2024 (NNSA 2024). The EIS evaluates dilution and disposal of 34 metric tons of surplus plutonium made up of both pit and non-pit plutonium. 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. However, potential accident impacts related to increasing the amount of surplus plutonium processed at LANL are dependent on the amount of MAR in the facility and not on the amount processed under the SPDP. The SPDP EIS states that the DSAs are the basis for the doses presented. However, NNSA uses more realistic assumptions, such as the application of controls, to estimate doses in the SPDP EIS. The MAR is administratively limited in the facilities to reduce potential consequences to human health and the environment as documented in the DSAs [LANL 2021a and LANL 2022i]. Disposition activities would not increase the amount of plutonium available for an accident because the MAR limit would remain the same within PF-4. The risks postulated in the accident scenarios are expected to remain the same as those analyzed in the DSAs.

The SPDP EIS also states that the disposition activities do not require the use or storage of large amounts of hazardous chemicals; therefore, the impacts from postulated chemical releases are limited to the immediate accident vicinity and present negligible risks to the non-involved worker, MEI, and the population. The occupational risks associated with postulated chemical releases are managed under the required industrial hygiene program.

The potential accident impacts associated with SPDP are bounded by the previous radiological accident analyses in Section D.3.5.

BSL-3 Facility at TA-51. As identified in Section 3.5.1, the Laboratory proposes to acquire self-contained laboratory trailers that could be placed within the available warehouse space in TA-51 and used for BSL-3 activities. The specific biological agents have not yet been identified. The potential consequences of an accident involving a BSL-3 facility is addressed in Section D.3.8.

Advanced Separations of Plutonium Radiological Laboratory. This facility would be a radiological facility (less than HC-3); therefore, the safety management programs adequately address the impact posed to human health and the environment and potential radiological consequences would be bounded by accidents presented in Section D.3.5.

Transuranic (TRU) Waste Staging. TRU Waste Staging would occur in up to four additional staging locations for TRU waste generated from the LANL Plutonium Facility (PF-4), primarily associated with pit production operations. The staging areas would be similar, but larger, than the current Transuranic Waste Facility (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 potentially consist of 60,000 square feet of 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 2022i) are based on the number of waste containers impacted and involved in a fuel pool fire (MAR) and the amount of vehicle fuel available in accordance with DOE-STD-5506-2021 (DOE 2021) fire analysis methodology. Additionally, the TA-55 DSA (2021a) evaluated outside waste container staging on the high-efficiency neutron counter (HENC) and waste pads using the same DOE-STD-5506-2021 methodology as was analyzed in the TWF DSA. Since the postulated accident scenarios and accident analysis methodology for the TRU Waste Staging areas would likely be the same as those evaluated in TWF and TA-55 DSAs (same number of waste containers impacted and involved in a fuel pool fire and the same amount of vehicle fuel available), the potential radiological accidents associated with the TRU waste staging areas would be bounded by the accidents presented in Section D.3.5. The addition of TRU waste staging areas at multiple locations across the LANL site would introduce an additional risk under a potential seismic or wildfire event. These additional risks are discussed in Section D.3.10.

Light Manufacturing Laboratory. The Light Manufacturing Laboratory would be constructed and operated under the No-Action Alternative as an accelerator facility under DOE O 420.2D. Under the Expanded Operations Alternative, the Laboratory proposes to use chemicals as part of the radioisotope separation process and therefore the facility would be designated as an HC-3 nuclear facility under DOE-STD-1027-2018 (DOE 2019b). Based on this designation, the activities and potential accidents in the HC-3 nuclear facility would be bounded by the radiological accidents presented in Section D.3.5.

D.3.5 Accident Scenarios Involving Radioactive Material

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 Laboratory uses radioactive materials in a wide variety of operations including scientific and weapons R&D and production, diagnostic research, research on the properties of materials, isotope separation, surveillance and aging studies, machining and inspection, chemical processing, analytical chemistry, metallurgy, weapon component processing, and as calibration and irradiation sources. Radioactive materials are collected as waste products in forms varying from contaminated laboratory equipment and metal filings to contaminated trash and liquids. Radioactive materials are transported onsite. As part of the ongoing DOE-EM activities, radioactive materials are handled during characterization and remediation actions at solid waste management units and areas of concern. Therefore, there is a potential for releases of radioactive materials due to human error, failure or malfunctioning of equipment, accidents during the treatment, handling, or transportation of radioactive wastes, and severe natural events like earthquakes or wildland fires.

Accident scenarios involving radioactive materials were evaluated for each alternative (No-Action, Modernized Operations, and Expanded Operations) and are presented below.

D.3.5.1 No-Action Alternative Radiological Accident Scenarios

As indicated in Section D.3.1.2, the Laboratory facilities presented in Table D.3-2 have sufficient radioactive material to warrant analysis. The No-Action Alternative would use these existing facilities and their capabilities to continue current, ongoing operations and would proceed with projects that have been approved, or in the process of being approved for implementation. The DSAs and other safety basis documents for these facilities/activities provide information regarding the types of radioactive material contained in each facility. The central focus of the DSAs and other safety basis documents is to provide reasonable assurance that the facility can be operated safely with respect to workers, the public, and the environment by demonstrating that sufficient safety controls have been put in place. Consistent with their purpose, source terms and other assumptions used to develop accident frequency and consequences estimates in the safety basis documents are conservative (usually very conservative). NNSA expects that the actual risk of the facility operations would be much lower than portrayed in the safety basis documents. For this SWEIS, these safety basis documents are the basis for the frequencies and consequences presented. However, NNSA applies more realistic assumptions, such as the application of controls, to estimate doses. Additionally, many of the dose estimates provided in the DSAs were determined using a different dispersion model. As reported in Section 3.1.3, the analysis in this SWEIS used the HotSpot code. Considering these factors, the doses presented in the SWEIS may not be identical to those presented in the safety basis documents, however, they are considered to be realistically conservative estimates of doses that could result under accident conditions. Based upon the information from the LANL safety documents, this SWEIS selected the following DBAs, associated with LANL facilities and their operations, for further analysis (Table D.3-5). The results of the DBA analyses are presented in Section D.3.5.5 below.

Table D.3-5 Radiological Accident Scenarios

Accident Identifier	TA and Building Number	Accident Scenario Description
DBA-1	TA-55, PF-4	Plutonium Facility glovebox fire involving Pu-239 equivalent aqueous solutions in up to two gloveboxes
DBA-2	TA-55, PF-4	Plutonium Facility fire (in or out of gloveboxes) involving heat-source-Pu
DBA-3	TA-54, Area G	Vehicle impact while transporting TRU waste containers to TA-54, Area G with ensuing fuel pool fire involving waste containers in transport and potentially at the sort, segregate, size reduction, and repackaging area
DBA-4	TA-54, Area G	Refueling vehicle impacts storage array in TA-54, Area G with ensuing fuel pool fire involving stored TRU waste containers
DBA-5	TA-54, Area G	Large combustible fire in TA-54, Area G storage array involving nonmetal and metal TRU waste containers
DBA-6	TA-54, Area G	FTWC explosion during venting, handling of the portable AL-M1, or fire during operations or from a seismic or wildland fire that causes a sympathetic explosion of the other FTWCs resulting in a pressurized release of tritium.
DBA-7	TA-3, CMR	Explosion in CMR, Wing 9 damaging equipment and building structure
DBA-8	TA-54, RANT	Vehicle impacts waste containers inside the RANT Facility building with ensuing pool fire
DBA-9	TA-16, WETF	WETF Process Room fire spreads to Room 124
DBA-10	TA-63, TWF	Vehicle impact in shipping/receiving area of the TWF with ensuing pool fire
DBA-11	TA-50, WCRRF	High-impact seismic event with subsequent fire inside WCRRF building involving TRU waste within glovebox and staged waste containers
DBA-12	TA-50, TLW	External fire spreads into the TRU Liquid Waste Treatment Facility breaching tanks/equipment/ drums
DBA-13	TA-53, LANSCE	LANSCE, Lujan Center – Experimental Room-2 explosion due to deflagration from natural gas leak causing release from a sample container

CMR = Chemistry and Metallurgy Research Facility; FTWC = Flanged Tritium Waste Containers; HS Pu = heat source plutonium; LANSCE = Los Alamos Neutron Science Center; PF = Plutonium Facility; Pu-239 = plutonium -239; RANT = Radioassay and Nondestructive Testing Facility; SSSR = sort, segregate, size reduction, and repackaging; TA = technical area; TLW = TRU Liquid Waste Treatment Facility; TRU = transuranic; WETF = Weapons Engineering Tritium Facility; TWF = Transuranic Waste Facility; WCRRF = Waste Characterization, Reduction, and Repacking Facility

Rationale for selecting these SWEIS DBAs is as follows:

TA-55 Plutonium Facility

Of the 22 DBAs in the TA-55 DSA (LANL 2021a), two were selected to represent and bound all other postulated accidents except for seismic. The TA-55 DSA evaluated the potential impacts of an aircraft crash into PF-4. The potential MEI consequences of the aircraft crash event (0.84 rem) are bounded by the DBA-1 and DBA-2 scenarios selected for evaluation in this SWEIS. The potential site-wide consequences of seismic and wildland fire events involving TA-55 are addressed in Section D.3.10.

An Addendum to the TA-55 DSA (LANL 2022r) analyzed the processing of 18 kilograms (kg) of heat source plutonium (HS Pu) from the INL. NNSA reviewed the addendum to determine whether an additional DBA was warranted for this short-duration activity (estimated to start in 2024 and last for about 3 years). The evaluation of the addendum concluded that the probability of a fire event with loss of confinement integrity while the INL HS Pu was being processed was significantly below the frequency threshold in *Recommendations for Analyzing Accidents under NEPA* (DOE 2002) for evaluation of "reasonably foreseeable" accidents. The frequency threshold in DOE (2002) is 1×10^{-7} per year, or once in 10 million years. SWEIS DBA-2 and the seismic/fire analysis adequately represent the expected accident risk associated with the INL HS Pu shipments.

Based on the expected duration of the project, the time in which INL HS Pu would be in a vulnerable configuration within PF-4, the established frequencies associated with loss of building containment integrity and initiation of a fire, the overall probability of the analyzed accident scenarios are less than the recommended 1×10^{-7} threshold and not further analyzed in this SWEIS.

Although the frequencies of analyzed events associated with processing the INL HS Pu were beyond extremely unlikely, NNSA acknowledges DNFSB's August 11, 2022 letter, which reported the results from the DSA Addendum that the mitigated offsite consequences of a potential seismic event could range from 490 to 3,175 rem, depending on the assumptions used (DNFSB 2022). In addition to the conservative values presented in the DSA Addendum and the DNFSB letter, the Addendum also presents a mean/best estimate consequence that ranges from less than 1 rem (0.95 for a mitigated scenario) to about 8.5 rem to the MEI (for an unmitigated scenario). The mean/best estimate consequences are below the potential consequences of DBA-2, which is evaluated further in this SWEIS.

DBA-1 is relevant to pit production and plutonium disposition (including ARIES) in PF-4. The frequency of this postulated accident is unlikely (3×10^{-4} per year). DBA-1 is a bounding generic glovebox fire involving up to two gloveboxes. A single glovebox can contain up to 30 kg of plutonium-239 equivalent (Pu-EQ). All material forms were analyzed in the DSA, though the evaluation concluded a fire involving aqueous solution (assumed to be salt) resulted in the highest public dose; therefore, this SWEIS DBA assumed 60 kg Pu-EQ aqueous solution. The SWEIS analysis used the DSA source term factors and other initial conditions. It also assumed the passive feature associated with PF-4 confinement system was functioning as designed during the postulated accident.

Potential impacts related to the increased pit production are dependent on the amount of MAR in the facility and not on the number of pits produced. The MAR is administratively limited in TA-55 to reduce potential consequences to human health and the environment as documented in the DSA (LANL 2021a). Production of either 30 or 80 pits per year would not increase the amount of plutonium available for an accident because the MAR limit would remain the same within the facility (NNSA 2020). The accident consequences and risks of increased pit production in PF-4 are included in the current DSA for TA-55.

DBA-2 is representative of postulated accidents associated with production of Radioisotope Thermoelectric Generators and HS Pu processing in PF-4. The frequency of this postulated accident is extremely unlikely (1×10^{-6} per year). This DBA analyzes a fire starting outside or inside a glovebox in the Plutonium Facility HS Pu processing/storage room and involving the entire room (several gloveboxes). This SWEIS DBA used the same MAR, solubility types, source terms, and other assumed initial conditions as the DSA. DBA-2 assumed the passive feature associated with PF-4 confinement system functions as designed during the postulated accident.

TA-54, Area G

Of the 24 DBAs presented in TA-54, Area G, BIO (LANL 2022a), three were selected to represent postulated accidents associated with Area G operations. The TA-54, Area G, BIO stated the frequency of an aircraft crash was less than 1×10^{-6} per year due to dimensions of storage area, separation distance between storage areas, helicopter standoff distance, and low MAR in the process area. Thus, it did not select aircraft crash as a DBA. DBA-3, -4, and -5 bound others that were postulated in the BIO for this area except for seismic and wildland fire. Their frequencies are extremely unlikely (1×10^{-5} per year). The potential site-wide consequences of seismic and wildland fire events involving Area G are addressed in Section D.3.10. Additionally, DBA-6 was selected to bound postulated accidents related to venting and handling four FTWCs analyzed in Attachment 1 of the TA-54, Area G, BIO and an Evaluation of the Safety of the Situation for the FTWCs (LANL 2018).

DBA-3 bounds representative vehicle accidents in TA-54, Area G. The SWEIS DBA analyzed a vehicle transporting TRU waste containers in Area G impacting staged TRU waste containers and potentially the waste in the sort, segregate, size reduction, and repackaging area. An ensuing fuel pool fire from the leaked fuel ignites the transported and staged waste containers and the spilled unconfined waste. The frequency of this postulated accident is extremely unlikely (1×10^{-5} per year). This SWEIS DBA utilized the BIO MAR (936 Pu-EQ Ci), source term factors, and initial conditions. Additionally, passive features, such as metal waste containers, vehicle barriers, and thermal separation distances between defined storage areas, are assumed to function as designed during the postulated event. The spill and fire components of the analysis are combined to derive the consequences.

DBA-4 evaluates a refueling vehicle impacting stored TRU waste containers in a defined storage area at TA-54, Area G, with an ensuing fuel pool fire from the leaking fuel engulfing the stored waste containers and spilled unconfined waste. The frequency of this postulated accident is extremely unlikely (1×10^{-5} per year). This SWEIS DBA utilized the BIO MAR (10,000 Pu-EQ Ci), source term factors, and initial conditions. Additionally, passive features, such as metal waste containers, vehicle barriers, and thermal separation distances between defined storage areas are assumed to function as designed during the postulated event. The spill and fire components of the analysis are combined to derive the consequences.

DBA-5 represents and bounds a large combustible fire within a TA-54, Area G, storage array involving both nonmetal and metal TRU waste containers. The postulated fire is assumed to start small within an array of non-compliant, nonmetal TRU waste containers and propagate to additional metal containers in the array. The frequency of this DBA is extremely unlikely (1×10^{-5} per year). This SWEIS DBA utilized the BIO MAR (10,000 Pu-EQ Ci [storage array] plus 200 Pu-EQ Ci [nonmetal waste containers]), source term factors, and initial conditions. Additionally, passive features, such as metal waste containers, fire-rated sealed source safes, and thermal separation distances between defined storage areas, are assumed to function as designed during the postulated event.

DBA-6 is representative of and bounds postulated accidents associated with venting and handling the four FTWCs in TA-54, Area G. The frequency of this DBA is extremely unlikely (1×10^{-5} per year). This DBA analyzes an FTWC explosion (deflagration to detonation) during venting, handling of the portable AL-M1, or fire during operations or from a seismic or wildland fire that causes a sympathetic explosion of the other FTWCs resulting in a pressurized release of tritium. The entire inventory of tritium (122,269 Ci) from the four FTWCs and a co-located container, in the form of tritiated water, is postulated in the release. This SWEIS DBA used the BIO attachment MAR, source terms, and other assumed initial conditions. Venting of the FTWCs involves reducing headspace gas pressures and accumulated quantities of flammable gases within a FTWC prior to handling using a vent rig secured to the FTWC. Once vented, the vent rig would be removed and a FTWC long term pressure monitoring manifold installed and remain attached to the FTWC until it is remediated at WETF. A portable AL-M1 will act as a filter during venting to contain the exhausted tritiated water vapor. Handling includes activities required to remove the vented FTWCs, with attached pressure monitoring manifolds, from the tritium shed in TA-54 and place them onto a transport vehicle for shipment to WETF. Each FTWC would be moved and shipped individually. The LANL TSD (LANL 2016a) and WETF DSA (LANL 2020a) address the FTWCs while in transit onsite and during processing at WETF.

TA-3, Chemical and Metallurgy Research Facility

The CMR DSA (LANL 2021b) analyzed 20 DBAs. The DBA-7 was selected for this SWEIS because it has the highest unmitigated dose and frequency, except seismic, and reflects that the majority of operations in CMR are limited to Wing 9. It bounds scenarios for single and multiple process explosions in other wings. The potential site-wide consequences of seismic and wildland fire events involving CMR are addressed in Section D.3.10.

DBA-7 is an explosion within the operating wing of CMR (Wing 9) that damages equipment and collapses the wing building structure. Its frequency is unlikely (1×10^{-4} per year). This SWEIS DBA utilized the DSA MAR (5.8 kg Pu-EQ plus 0.2 kg Pu-EQ holdup), source term factors, and initial conditions. Passive features are assumed to function as designed during the postulated event; however, they were not credited in the dose calculations.

TA-54, Radioassay and Nondestructive Testing Facility

Of the seven accidents evaluated in the RANT DSA (LANL 2022h), the DSA DBA selected for this SWEIS bounds all other postulated accidents including seismic and wildfire; however, the potential site-wide consequences of seismic and wildland fire events involving RANT are addressed in Section D.3.10. This DBA represents a fire inside the building and has the highest unmitigated dose of accidents evaluated in the DSA. Since publication of the 2008 SWEIS, RANT's MAR has been significantly reduced, which has been reflected in the DSA and the potential consequences of accident scenarios.

DBA-8 postulates a vehicle colliding with TRU waste containers inside the RANT Facility (building TA-0038). Spilled fuel ignites and engulfs waste containers inside the facility. Its frequency is unlikely (1×10^{-4} per year). This SWEIS DBA utilized the DSA MAR, source term factors, and initial conditions; however, no passive features are assumed to function as designed during the postulated event. The spill and fire components of the analysis are combined to derive the consequences.

TA-16, Weapons Engineering Tritium Facility

Of the 14 accidents evaluated in the WETF DSA (LANL 2020a), the DSA DBA selected for this SWEIS represents and bounds all other postulated accidents including seismic and wildfire with the highest dose and frequency. However, the potential site-wide consequences of seismic and wildland fire events involving WETF are addressed in Section D.3.10.

DBA-9 evaluates an incipient fire starting and then propagating into Room 124 of WETF involving the tritium within equipment and/or gloveboxes. The frequency is extremely unlikely (6.5×10^{-5} per year). This SWEIS DBA utilizes the DSA MAR (240g tritium oxide), source term factors, and initial conditions. Realistic conditions are assumed to be present such as passive features (i.e., containers, building structure, fire walls, tritium systems containment).

TA-63, Transuranic Waste Facility

There were four DBAs analyzed in the TWF DSA (LANL 2022i). The DBA selected for this SWEIS represents and bounds the other postulated accidents (except seismic) and has the highest dose. The potential site-wide consequences of seismic and wildland fire events involving TWF are addressed in Section D.3.10.

DBA-10 involves a low-speed, moderate energy impact of a large vehicle into another vehicle holding or remaining nearby TRU waste containers in the TWF shipping/receiving area causing a fuel leak and the ensuing fuel pool fire that impacts all co-located waste containers. SWEIS DBA-10 has an extremely unlikely frequency (1×10^{-6} per year) and uses the DSA MAR (1,240 Pu-EQ Ci), source term factors, and initial conditions. It presumes the availability of passive design features such as vehicle barrier systems, TRU waste containers, pipe overpack containers, and TWF site drainage. The spill and fire components of the analysis are combined to derive the consequences.

TA-50, Waste Characterization, Reduction, and Repackaging Facility

The WCRRF DSA (LANL 2024c) semi-quantitatively analyzed a full spectrum of potential accident scenarios; however, only one bounding scenario was quantitatively analyzed (high-impact seismic event with subsequent fire involving the TRU waste within a glovebox and staged waste containers). This bounding accident was selected for WCRRF's SWEIS DBA. The potential site-wide consequences of seismic and wildland fire events involving WCRRF are also addressed in Section D.3.10.

DBA-11 postulates a seismic event involving the WCRRF building TA-50-69 with a subsequent fire impacting the entire facility inventory of 45 Pu-EQ Ci. The MAR is conservatively assumed to be 50 percent combustible waste and 50 percent of the combustible waste is assumed to burn unconfined. DBA-11 has an unlikely frequency (1×10^{-3} per year). This SWEIS DBA utilizes the DSA MAR (45 Pu-EQ Ci), source term factors, and initial conditions. Realistic conditions are assumed to be present, such as passive features (i.e., waste containers, building structure and waste characterization glovebox confinement); however, they are not credited in the dose calculations.

TA-50, TRU Liquid Waste Treatment Facility

The TLW Treatment Facility Preliminary DSA (LANL 2021c) evaluated eight DBAs. DBA-12 was selected for this SWEIS because it bounds and is representative of other postulated events with the highest dose and frequency. However, the potential site-wide consequences of seismic and wildland fire events involving TLW Treatment Facility are addressed in Section D.3.10.

DBA-12 analyzes a fire ignited outside of the TLW Treatment Facility propagating into the building causing a building-wide fire that breaches tanks, equipment, and drums of wastewater and sludge, which then spills and vaporizes their content. This DBA is extremely unlikely given the unfavorable configuration of a fire relative to the spilled wastewater and sludge; however, for conservatism, the PDSA and this SWEIS assigned an unlikely frequency (1×10^{-4} per year). The PDSA MAR (55 Am-241-Equivalent Curies), source term factors, and initial conditions are utilized in this SWEIS DBA. The principle radioactive elements associated with the RLWTF and TLW Treatment Facility include plutonium, americium, uranium, and tritium. For analytical convenience and because Am-241 is the primary average constituent, the MAR is converted to Am-241 equivalent. The DSA discusses passive design features that are available in the facility; however, these features, which would reduce the expected consequences, are not credited in the dose calculations.

TA-53, Los Alamos Neutron Science Center

Of the eight radiological accident scenarios evaluated in the LANSCE – LINAC and Beam Delivery SAD (LANL 2020d), DBA-13 was selected because it bounds other postulated accidents. The selected scenario has the highest unmitigated radiological dose. However, the potential site-wide consequences of seismic and wildland fire events involving LANSCE are addressed in Section D.3.10.

Per the SAD prepared for DARHT (LANL 2020c), the inventory of radionuclides at DARHT does not present a hazard to the public. Therefore, the accidents selected for LANSCE, which is also closer to the site boundary, are representative of accidents involving accelerators at the Laboratory.

DBA-13 evaluates a natural gas explosion in the LANSCE, Lujan Center, Experimental Room (ER)-1 or -2 causing the release from the sample container. As identified in the SAD (LANL 2020d), the estimated frequency of this postulated explosion is unlikely (1×10^{-4} per year). The SAD MAR (0.4 kg Pu-EQ), source term factors, and initial conditions are used in this SWEIS DBA. The SWEIS DBA assumed the entire volume of ER-2 is filled with natural gas to derive the trinitrotoluene (TNT) explosion equivalent used in the analysis. Realistic conditions, such as passive design features, are present; however, they are not credited in the dose calculations.

The potential differences in the estimated MEI and population doses from the 2008 SWEIS (as compared to results presented in this SWEIS) can be attributed to several factors. Some facilities have reduced administrative limits on the MAR and other reductions can be attributed to more realistic but still conservative accident analysis parameters used in this SWEIS, such as presuming availability of passive design features, and updated dose conversion factors.

D.3.5.2 Modernized Operations Alternative Radiological Accident Scenarios

As discussed in Section D.3.3 above, the Modernized Operations Alternative continues existing programs and activities by modernizing facilities, as necessary. This alternative would not expand capabilities and operations beyond those that currently exist. Radiological accident impacts of the replacement and upgraded facilities are bounded by the accidents analyzed in this SWEIS since the amount of radioactive material available for an accident would be unchanged. New systems/equipment and facilities would consist of in-kind replacements of removed legacy systems/equipment and facilities (i.e., DARHT, WETF, and LANSCE). Their current processes and capabilities would not change with the Modernized Operations Alternative. The new RACR, Rad Lab, and NGTS/S facilities would be less than HC-3 radiological facilities, would replace the existing capabilities at LANL currently being performed in older buildings, and would not pose any additional radiological hazard to the public as defined by DOE-STD-1027-1992. Therefore, the accidents presented in Section D.3.5.1 are also representative of potential accidents that could occur under the Modernized Operations Alternative.

D.3.5.3 Expanded Operations Alternative Radiological Accident Scenarios

Section D.3.4 discusses the projects proposed under the Expanded Operations Alternative. This 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 beyond the capabilities at LANL that currently exist. There are no potential accident impacts associated with the projects under the Expanded Operations Alternative that would be larger than the accident risks presented for the No-Action Alternative. A review of potential radiological accident scenarios associated with the Expanded Operations Alternative and their potential impacts are further discussed below:

- The LEFFF would initially be a radiological facility (less than HC-3) and therefore, not present a public radiological hazard as defined by DOE-STD-1027-1992. Expanded operations at LEFFF would present an inadvertent criticality accident potential; however, as discussed in Section D.3.5.4, the consequences of an inadvertent criticality are bounded by the DBAs selected in Section D.3.5.1 above (low consequence to the MEI and public) and as analyzed in this SWEIS. Other than inadvertent criticality, the radiological impact associated with the expansion of fuel fabrication at LEFFF would still not present a public radiological hazard.
- The DMMSC project would be a new accelerator facility. The accident impacts associated with this project would be well represented by those previously analyzed at LANSCE since the amount of radioactive material available for an accident would remain the same; therefore, the DBAs selected in Section D.3.5.1 bound potential accidents associated with this project.
- LANSCE enhancements expand on the modernization initiatives of the Modernized Operation Alternative; however, these enhancements (described in Chapter 3, Section 3.4.1.3) would not be expected to introduce unique radiological accident scenarios beyond those already evaluated by previous LANSCE analyses. Therefore, the DBAs selected in Section D.3.5.1 bound potential accidents associated with this project.
- The proposed microreactor (up to 5 megawatts electric [MWe]) would arrive at LANL completely assembled and fueled. It would be powered by up to 400 kilograms of HALEU TRISO fuel. A specific design or location for the LANL microreactor has not been identified at this time, however, the Pele microreactor, planned for installation at the INL, would use the same fuel and have similar operating characteristics. The potential accident consequences of inadvertent criticality, onsite transportation, and operational accidents are addressed in Section 3.4.
- Under some of the SPDP EIS sub-alternatives (NNSA 2024), the amount of surplus plutonium that would be dispositioned at LANL facilities would be higher than that currently approved. However, potential radioactive material accident scenarios and their associated consequences are dependent on the MAR limits in these facilities and not on the total amount dispositioned under the SPDP EIS. MAR is administratively limited in the facilities to reduce potential consequences to human health and the environment as documented in the DSAs [LANL 2021a and LANL 2022i]. These MAR limits are initial conditions of the analyses. SPDP activities would not increase the amount of plutonium

available for an accident because the MAR limit would remain the same within the facility. Therefore, DBAs selected in Section D.3.5.1 above and analyzed in this SWEIS bound potential accidents postulated for these disposition activities under the Expanded Operations Alternative.

- TRU waste staging could occur in up to four additional staging locations for TRU waste generated from PF-4, primarily associated with pit production operations. 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 containers as opposed to processing or preparing TRU waste for shipment to the WIPP facility. Future TRU waste staging locations are currently proposed for TA-16, -54, -55, and -60. Each of the four locations could potentially consist of 60,000 square feet of 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 2022i) are based on the number of waste containers impacted and involved in a fuel pool fire (MAR) and the amount of vehicle fuel available in accordance with DOE-STD-5506-2021 (DOE 2021) fire analysis methodology. Additionally, the TA-55 DSA (2021a) evaluated outside waste container staging on the HENC and waste pads using the same DOE-STD-5506 methodology as was used in the TWF DSA. Since the postulated accident scenarios and accident analysis methodology for the TRU waste staging areas would likely be the same as those evaluated in TWF and TA-55 DSAs (same number of waste containers impacted and involved in a fuel pool fire and the same amount of vehicle fuel available), DBA-10 selected in Section D.3.5.1 and analyzed in this SWEIS represents potential accidents associated with this project. Additionally, Section D.3.10, evaluates the contribution of these four additional TRU waste staging areas to the overall seismic and wildfire impacts. Each of the four staging areas' contribution is conservatively assumed to be the same as the TWF seismic and wildfire scenarios with the exception of MEI doses due to different site boundary distances for the four waste staging locations.

D.3.5.4 Inadvertent Criticality, Mixed Fission Product Release

Because of the quantity of fissionable material present within some LANL radiological facilities, the potential for inadvertent nuclear criticality is credible. Detailed evaluations of criticality hazards and controls are an integral part of all operations, processes, and activities at these facilities. The implementation of the LANL Nuclear Criticality Safety Program (LANL 2021f) requires that a specific Criticality Safety Evaluation Document (CSED) be prepared for a process or activity whenever fissionable materials are present. The CSED delineates the necessary controls for all normal and credible abnormal conditions (credible contingencies).

Although inadvertent criticality was not selected for analysis as a DBA in this SWEIS due to the low consequence to the MEI and public, the discussion from the safety basis documents (i.e., DSAs, BIOs, PDSAs, and SADs) is presented here for public awareness. It should be noted that facility and co-located workers are protected from inadvertent criticality by the LANL Nuclear Criticality Safety Program and engineered safety features. These important features (preventive and mitigative) include the following:

- administrative controls identified and implemented on the amount of fissionable material in any operation involving fissionable materials,
- operators trained to adhere to strict limits and conduct of process operations,

- criticality safety evaluations conducted before initiating any operation or activity involving significant quantities of fissionable material, and
- criticality accident alarm system designed, implemented, and tested in accordance with ANSI/ANS standards.

In CMR Wing 9 (TA-3), the LANL Criticality Safety Program controls criticality parameters in conjunction with the nature of operations to ensure the likelihood of an inadvertent criticality is trivial, based on the cumulative probability. However, a generic inadvertent criticality event was analyzed in the CMR DSA (LANL 2021b). The consequences of the event are based on 1×10^{19} fissions from a solution criticality, which bounds other material forms. The MEI doses from internal uptake, cloud shine, and prompt radiation were estimated to be 600 millirem for uranium solution criticality and 2.4 rem for plutonium solution criticality.

The WETF DSA (LANL2020a) affirms that fissile material in quantities that may pose a criticality hazard are not used, handled, or stored in WETF; therefore, the facility does not have the potential for a criticality accident.

The RLWTF DSA (LANL 2022j) states that based on the nature of the process, current LANL Waste Acceptance Criteria (LANL 2022q), and materials present, the potential for criticality does not exist.

The TLW Treatment Facility PDSA (LANL 2021c) indicates that the total fissile material content of the facility must be controlled to less than the single parameter limit (i.e., 450 Pu-239 Fissile Gram Equivalent [FGE]) as an initial condition; therefore, an inadvertent criticality is not credible as long as this limit is maintained.

The WCRRF DSA (LANL 2024c) establishes a facility fissile material limit of ≤400 Pu-239 FGE to ensure the total quantity of fissile material is always below the single parameter limit thus ensuring a criticality event is not credible.

The TA-53 SAD (LANL 2020d) specifies that experiments presenting a concern for a criticality event are reviewed by the Nuclear Criticality Safety Division and that no experiments are allowed that have the potential for criticality. The Criticality Safety Evaluation for Experiment Area C (LANSCE Proton Beam Experiment) involving a low-enriched uranium (19.9 weight percent) assembly concluded that a criticality event was not credible, given the controls presently employed. Radioactive material experiments at pRad involve quantities of plutonium that do not reach the criticality threshold defined in DOE Order 420.2D.

The TA-54, Area G, BIO (LANL 2022a) indicates that compliance with the LANL Waste Acceptance Criteria, in conjunction with the Criticality Safety Program, reduces the frequency of an inadvertent criticality to beyond extremely unlikely. However, criticality events were evaluated. The risk was determined to be low to the public and therefore, the BIO did not select criticality as a DBA for detailed analysis.

The RANT Facility DSA (LANL 2022h) specifies that a review of RANT operations, in accordance with the LANL Criticality Safety Program, confirmed that the unmitigated frequency of an inadvertent criticality at RANT is beyond extremely unlikely based on compliance with WIPP (DOE 2018) and LANL Waste Acceptance Criteria FGE material limits and the stacking limits.

Due to the quantity of fissionable material present in PF-4, the potential for inadvertent criticality is credible. CSEDs delineate the necessary controls for all normal and abnormal conditions to ensure criticality is prevented. Though not representing a significant public risk, a number of criticality scenarios across the range of facility operations were evaluated in the TA-55 DSA (LANL 2021a). A general criticality event was selected as a DBA associated with solution operations that bounds criticality events with other systems, operations, storage/handling, and other material forms. Assuming 1×10^{19} fissions (prompt or oscillating) from the solution criticality, the MEI dose was calculated to be 1.23 rem total effective dose (cloud shine dominates the dose).

As specified in the RLUOB DSA (LANL 2020b), the fissile material limit for the TA-55 facility is ≤ 400 Pu-239 FGE; therefore, an inadvertent criticality is not credible.

The TWF DSA (LANL2022i) states that the quantity of fissile material at the facility is based on the WIPP waste acceptance criteria fissile material limits for allowed containers. While the total fissionable material inventory of the TWF exceeds the threshold fissionable material limit, the concentration of this material is very low, at most 200 FGE per 55-drum or pipe overpack containers. Processes at TWF have a near-zero probability for inadvertent criticality and therefore, a DBA for criticality was not specified in the DSA. However, criticality scenarios were evaluated. Estimated MEI unmitigated doses for all criticality scenarios were determined to be <5 rem with unmitigated frequencies of beyond extremely unlikely.

The NES DSA (LANL 2023a) states that criticality is not credible in the MDA A General's tanks under the current configuration and during sampling operations. Additionally, the Building 21-0257 and IWLs DSA (LANL 2023b) indicates that due to the limited waste characterization activities, criticality is not credible.

The LANL site-wide TSD (LANL 2016a) indicates that the packaging and transport systems provide equivalent level of safety to the requirements of 10 CFR 71.55). If packaging is not compliant with DOE regulations for criticality safety, then fissile materials in TSD transfers are packaged in accordance with the approved Criticality Safety Program and provide an equivalent level of safety to the Hazardous Materials Regulations, 49 CFR Parts 171-180. Therefore, a criticality event involving onsite transportation would not be credible.

D.3.5.5 Consequences of Potential Radioactive Material Release Accidents

The preceding sections describe the accidents analyzed in this SWEIS, including the calculated source terms and the MEI distances for each accident identified for the No-Action, Modernized Operations, and Expanded Operations alternatives.

The LANL safety basis documents use the ICRP Publications 71 and 72 dose conversion factors (ICRP 1995a, 1995b) for public dose calculations, ICRP-68 (ICRP 1994b) dose conversion factors for co-located worker dose, and ICRP-66 (ICRP 1994a) for breathing rate used in the dose calculations. Hence, for this SWEIS, NNSA used the dose coefficients and breathing rate from these ICRP publications for calculating the accident scenario consequences, which would provide consistency with the safety basis documents for those facilities. Tables D.3-6 and D.3-7 present the radiological accident frequency and calculated consequences under conservative and average meteorological conditions, respectively. The tables also present the assumed distance to the MEI based on the specific facility and the sector (wind direction from the facility) that would realize the projected consequences. The sector numbers correspond to the sector numbers provided in Table D.3-5.

Consistent with DOE NEPA accident analysis recommendations (DOE 2002a), the consequences presented in Tables D.3-6 and D.3-7 represent the range or "spectrum" of reasonably foreseeable accidents, including low-probability/high-consequence accidents and high-probability/low-consequence accidents. Also, because "risk" is a combination of the accident's probability (or frequency) and consequence, the accidents with the highest doses in Tables D.3-6 and D.3-7 do not dominate LANL's radiological accident risk, as the following discussion describes.

The LCFs identified in Tables D.3-6 and D.3-7 are "conditional" risks, based on the assumption that the accident has occurred with the assumed meteorological conditions. Table D.3-8 shows the total fatality risk for each analyzed accident, and the meteorological conditions (as described in Section D.3.1.4). As shown in Table D.3-8, the maximum offsite population risk (with conservative meteorology) would be associated with a fire inside WETF. This accident scenario has an estimated frequency of about once in 15,385 years. To put this risk in perspective, in 2020, the total annual death rate from all causes in New Mexico was 824 per 100,000 people (CDC 2024). Within the 50-mile radius of LANL, this would equate to over 3,000 deaths in 2020.

Table D.3-8 shows that a potential CMR explosion in Wing 9 would contribute about 90 percent to the total offsite population risk when compared to all of the accident risks listed. Of note, when compared to the accident risks presented in the 2008 SWEIS, there were two accidents with risks that ranged from 0.4 to 0.76 LCFs per year. Therefore, the estimated risks in this SWEIS reflect a notable reduction.

Table D.3-6 Radiological Accident Frequency and Consequences Under the No-Action Alternative – Conservative Meteorology

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (person -rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
DBA-1: TA-55, PF-4: Plutonium Facility glovebox fire	3×10^{-4} (unlikely)	6.4	3.84×10^{-3}	6.29×10^{2}	3.77×10^{-1}	22	2.64×10^{-2}	MEI at 1,013 m, Sectors 1, 2, and 16
DBA-2: TA-55, PF-4: Plutonium Facility fire involving HS Pu	1×10^{-6} (extremely unlikely)	21	2.48×10^{-2}(f)	2.01×10^{3}	1.21	72	8.64×10^{-2}	MEI at 1,013 m, Sectors 1, 2, and 16
DBA-3: TA-54, Area G: Vehicle impact while transporting TRU waste containers with ensuing fuel pool fire	1×10^{-5} (extremely unlikely)	17	1.01×10^{-2}	3.75×10^{2}	2.25×10^{-1}	35	4.20×10^{-2}	MEI at 240 m, Sectors 1 and 2
DBA-4: TA-54, Area G: Refueling vehicle impacts TRU storage array with ensuing fuel pool fire	1×10^{-5} (extremely unlikely)	69	8.28×10^{-2}(f)	1.80×10^{3}	1.08	120	1.44×10^{-1}	MEI at 240 m, Sectors 1 and 2
DBA-5: TA-54, Area G: Large combustible fire in TRU storage array	1×10^{-5} (extremely unlikely)	17	1.02×10^{-2}	5.61×10^{2}	3.37×10^{-1}	22	2.64×10^{-2}	MEI at 240 m, Sectors 1 and 2
DBA-6: TA-54, Area G: FTWC explosion causing sympathetic explosion of the other FTWCs resulting in a pressurized release of tritium	1×10^{-5} (extremely unlikely)	2.2[g]	1.32×10^{-3}	4.51×10^{2}	2.70×10^{-1}	25.9[h]	3.10×10^{-2}	MEI at 630 m, Site boundary at 455 m, Sectors 2 and 3
DBA-7: TA-3, CMR: Explosion in CMR Wing 9	1×10^{-4} (unlikely)	8.3	4.98×10^{-3}	2.71×10^{3}	1.63	26	3.12×10^{-2}	MEI at 667 m, Sectors 1 and 2
DBA-8: TA-54, RANT: Vehicle impacts waste containers inside RANT with ensuing pool fire	1×10^{-4} (unlikely)	4.8	2.90×10^{-3}	2.35×10^{2}	1.41×10^{-1}	19	1.16×10^{-2}	MEI at 448 m, Sectors 2 and 3
DBA-9: TA-16, WETF: Process Room fire	6.5×10^{-5} (extremely unlikely)	17	1.02×10^{-2}	7.24×10^{3}	4.34	5[f]	3.0×10^{-3}(i)	MEI at 950 m, Site boundary at 425 m,[j] Sectors 12, 13 and 14

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
DBA-10: TA-63, TWF: Vehicle impact in shipping/receiving area with ensuing pool fire	1×10^{-6} (extremely unlikely)	18.5	1.11×10^{-2}	4.59×10^{3}	2.76	701	8.42×10^{-1}	MEI at 1,465 m, Sectors 15 and 16
DBA-11: TA-50, WCRRF: High impact seismic event and fire inside building	1×10^{-3} (unlikely)	0.92	5.52×10^{-4}	1.87×10^{2}	1.12×10^{-1}	22.5	1.35×10^{-2}	MEI at 1,187 m, Sectors 1 and 2
DBA-12: TA-50, TLW: External fire spreads into the TLW Treatment Facility	1×10^{-4} (unlikely)	0.58	3.48×10^{-4}	7.71×10^{1}	4.62×10^{-2}	2.8	1.68×10^{-3}	MEI at 1,280 m, Sector 1
DBA-13: TA-53, LANSCE: Explosion due to deflagration from natural gas leak	1×10^{-4} (unlikely)	1.3	7.80×10^{-4}	4.66×10^{1}	2.79×10^{-2}	2.9	1.74×10^{-3}	MEI at 350 m[k]

CMR = Chemistry and Metallurgy Research Facility; DBA= design-basis accident; ER = Experimental Room in Lujan Center; GB = glovebox; HS Pu = heat source plutonium; 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; 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 Repacking Facility; WETF = Weapons Engineering Tritium Facility

a See discussion in Section D.3.1.4 about distances from each facility to its MEI.

b The MEI and the non-involved worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person and the fatalities would be multiplied by the number of persons exposed.

c Based on Table D.3-4, *Population Distribution Estimates Within 80km from LAN*L (LANL 2022n).

d At an assumed distance of 100 meters from the facility.

e Frequencies were derived from the safety basis documents with the application of passive design features to establish realistic yet conservative estimates.

f 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).

g Highest MEI dose is at 630 m, beyond site boundary of 455 m.

h Utilized TA-54, Area G Attachment 1 (LANL 2022s) for determining non-involved worker dose.

i 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 was used based on it 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).

j Highest MEI dose is at 950 m, beyond site boundary of 425 m.

k Sectors not specified; however, presumed the wind direction blowing to MEI in Sector 1 or 2 based on general discussion in the SAD and TA-53 figures.

Table D.3-7 Radiological Accident Frequency and Consequences Under the No-Action Alternative – Average Meteorology

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person -rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
DBA-1: TA-55, PF-4: Plutonium Facility glovebox fire	3×10^{-4} (unlikely)	0.9	5.46×10^{-4}	1.12×10^{2}	6.71×10^{-2}	8.4	5.02×10^{-3}	MEI at 1,013 m, Sectors 1, 2, and 16
DBA-2: TA-55, PF-4: Plutonium Facility fire involving HS Pu	1×10^{-6} (extremely unlikely)	2.9	1.74×10^{-3}	3.54×10^{2}	2.12×10^{-1}	27	3.20×10^{-2}	MEI at 1,013 m, Sectors 1, 2, and 16
DBA-3: TA-54, Area G: Vehicle impact while transporting TRU waste containers with ensuing fuel pool fire	1×10^{-5} (extremely unlikely)	3.4	2.06×10^{-3}	6.87×10^{1}	4.12×10^{-2}	7.6	4.54×10^{-3}	MEI at 240 m, Sectors 1 and 2
DBA-4: TA-54, Area G: Refueling vehicle impacts TRU Storage Array with ensuing fuel pool fire	1×10^{-5} (extremely unlikely)	15	9.12×10^{-3}	3.25×10^{2}	1.95×10^{-1}	31	3.74×10^{-2}	MEI at 240 m, Sectors 1 and 2
DBA-5: TA-54, Area G: Large combustible fire in TRU Storage Array	1×10^{-5} (extremely unlikely)	4.4	2.65×10^{-3}	1.00×10^{2}	6.00×10^{-2}	7.9	4.73×10^{-3}	MEI at 240 m, Sectors 1 and 2
DBA-6: TA-54, Area G: FTWC explosion causing sympathetic explosion of the other FTWCs resulting in a pressurized release of tritium	1×10^{-5} (extremely unlikely)	0.63	3.77×10^{-4}	4.53×10^{1}	2.72×10^{-2}	1.08	6.48×10^{-4}	MEI at 455 m, Sectors 2 and 3
DBA-7: TA-3, CMR: Explosion in CMR Wing 9	1×10^{-4} (unlikely)	2.5	1.51×10^{-3}	5.00×10^{2}	3.00×10^{-1}	17	9.96×10^{-3}	MEI at 667 m, Sectors 1 and 2
DBA-8: TA-54, RANT: Vehicle impacts waste containers inside RANT with ensuing pool fire	1×10^{-4} (unlikely)	1.4	8.22×10^{-4}	4.92×10^{1}	2.95×10^{-2}	11	6.54×10^{-3}	MEI at 448 m, Sectors 2 and 3

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person -rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
DBA-9: TA-16, WETF: Process Room fire	6.5×10^{-5} (extremely unlikely)	9.1[g]	5.46×10^{-3}	7.91×10^{2}	4.75×10^{-1}	4.8	2.88×10^{-3}	MEI at 470 m, Site boundary at 425 m,[g] Sectors 12, 13 and 14
DBA-10: TA-63, TWF: Vehicle impact in Shipping/Receiving Area with ensuing pool fire	1×10^{-6} (extremely unlikely)	2.74	1.64×10^{-3}	7.93×10^{2}	4.76×10^{-1}	125	1.50×10^{-1}	MEI at 1,465 m, Sectors 15 and 16
DBA-11: TA-50, WCRRF: High impact seismic event and fire inside building	1×10^{-3} (unlikely)	0.14	8.46×10^{-5}	3.20×10^{1}	1.92×10^{-2}	22.5	1.35×10^{-2}	MEI at 1,187 m, Sectors 1 and 2
DBA-12: TA-50, TLW: External fire spreads into the TLW Treatment Facility	1×10^{-4} (unlikely)	0.08	4.79×10^{-5}	1.37×10^{1}	8.21×10^{-3}	1.0	6.12×10^{-4}	MEI at 1,280 m, Sector 1
DBA-13: TA-53, LANSCE: Explosion due to deflagration from natural gas leak	1×10^{-4} (unlikely)	0.3	1.81×10^{-4}	9.03	5.42×10^{-3}	1.4	8.58×10^{-4}	MEI at 350 m[h]

CMR = Chemistry and Metallurgy Research Facility; DBA= design-basis accident; ER = Experimental Room in Lujan Center; GB = glovebox; HS Pu = heat source plutonium; 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; 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 Repacking Facility; WETF = Weapons Engineering Tritium Facility

a See discussion in Section D.3.1.4 about distances from each facility to its MEI.

b The MEI and the non-involved worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person and the fatalities would be multiplied by the number of persons exposed.

c Based on Table D-21, *Population Distribution Estimates Within 80km from LAN*L (LANL 2022n).

d At a distance of 100 meters from the facility.

e Frequencies were derived from the safety basis documents with the application of passive design features to establish realistic yet conservative estimates.

f Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003). For an individual's acute dose ≥20 rem associated with an accident, the LCF is doubled (NCRP 1993).

g Highest MEI dose is at 470 m, beyond site boundary of 425 m.

h Sectors not specified; however, presumed the wind direction blowing to MEI in Sector 1 or 2 based on general discussion in the SAD and TA-53 figures.

Table D.3-8 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; ER = Experimental Room in Lujan Center; GB = glovebox; HS Pu = heat source plutonium; 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; SSSR = sort, segregate, size reduction, and repackaging; 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 See discussion in 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 2003). For an individual's acute dose ≥20 rem associated with an accident, the LCF is doubled (NCRP 1993).

c Based on Table D.3-4, *Population Distribution Estimates Within 80km from LAN*L (LANL 2022n).

d At a distance of 100 meters from the facility.

e For conservative meteorology, highest MEI dose is at 950m, beyond site boundary of 425m.

f For conservative meteorology, windspeed of 1 m/s and stability class F results in WETF plume from stack release passing overhead of the non-involved worker. Therefore, stability class D and 1 m/s was used based on it having the highest CW 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 470m, beyond site boundary of 425m.

h For conservative meteorology, highest MEI dose is at 630m, beyond site boundary of 454.68m.

i For conservative meteorology, utilized TA-54, Area G Attachment 1 (LANL 2022a) for determining non-involved worker dose.

D.3.6 Accident Scenarios Involving Toxic Chemicals

Chemicals are widely used at the Laboratory, however, with a few exceptions (e.g., PF-4, TWF, LANSCE, RLWTF, 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*. Chemical inventories consisting of laboratory chemicals, cleaners, and oils have been examined to determine the chemical hazard category. In the majority of facilities at LANL, chemical inventories do not present a risk to the non-involved workers or the public**.**

From the 2008 SWEIS analysis, the chemicals of concern at LANL facilities were selenium hexafluoride, sulfur oxide, chlorine gas, and helium (NNSA 2008). These chemicals were selected from a database of chemicals used on site based on their quantities, chemical properties, and human health effects. Emergency Response Planning Guideline (ERPG) values for planning levels 2 and 3 are the concentrations that, if an accident occurred, could result in serious health effects or life-threatening implications for exposed individuals. The cause of a chemical release could be mechanical failure, corrosion, mechanical impact, or natural phenomena (e.g., fire, seismic). Waste cylinders from TA-54-216 have been removed, eliminating two of the most hazardous chemicals that were included in the 2008 evaluation.

Nonetheless, for this SWEIS, based on an independent review of the DSAs, SBDs, and EPHAs, NNSA determined that the following five categories of chemicals warranted further examination:

- Beryllium/Beryllium Oxide,
- Chlorine,
- Sodium Hydroxide,
- Nitric and Hydrochloric Acids, and
- 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. The three level of PACs are:

PAC-1 The airborne concentration (expressed as ppm [parts per million] or mg/m^3 [milligrams per cubic meter]) of a substance above which it is predicted that the general population, including susceptible individuals, could experience notable discomfort, irritation, or certain asymptomatic, non-sensory effects. However, these effects are not disabling and are transient and reversible upon cessation of exposure.

PAC-2 The airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape.

PAC-3 The airborne concentration (expressed as ppm or mg/m^3) of a substance above which it is predicted that the general population, including susceptible individuals, could experience life-threatening adverse health effects or death.

For chemical hazards, PAC values are based on the following hierarchy of exposure limit values:

- If available use 60-minute Acute Exposure Guideline Levels (AEGL) values published by the EPA;
- If AEGLs are not available, use ERPG values produced by the American Industrial Hygiene Association (AIHA);
- If neither AEGLs or ERPGs are available, use Temporary Emergency Exposure Limit (TEEL) values developed by DOE's Subcommittee on Consequence Assessment and Protective Actions (DOE-HDBK-1046-2016).

The PACs for the chemicals discussed in this section are shown in Table D.3-9. AEGL and ERPG values are developed in units of either parts per million (ppm) or milligrams per cubic meter (mg/m^3). The PACs are listed in the units provided in the PAC dataset (i.e., Revision 29A) (DOE 2021).

Table D.3-9 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]
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 $4.2\times10^{-3} mg/m^3$
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 $1.2 mg/m^3$ (@ 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-2 2.34×10^{-1} mg/m^3
Plutonium Facility (PF-4)						
Nitric Acid[h]	$\leq 1\times10^{-2}$	0.16 ppm (AEGL)	24 ppm (AEGL)	92 ppm (AEGL)	<PAC-3	<PAC-2 22.9ppm
Beryllium[h]	$\leq 1\times10^{-4}$	0.00015	0.025 (ERPG)	0.1 (ERPG)	<PAC-3	<PAC-2
Chlorine gas[h]	$\leq 1\times10^{-2}$	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 = 60-minute Acute Exposure Guideline Level; ERPG = Emergency Response Planning Guideline; IPF = Isotope Production Facility; LANSCE = Los Alamos Neutron Science Center; MEI = maximally exposed individual; mg/m^3 = milligram per cubic meter; PAC = Protective Action Criteria; PCBs = Polychlorinated biphenyls; 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; WAC = waste acceptance criteria; WIPP = Waste Isolation Pilot Plant; 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 2020d).

f The LANSCE SAD (LANL 2020d) 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 (the TWF only accepts newly generated waste meeting WIPP WAC).

D.3.7 Accident Scenarios Involving High Explosives

The 2008 SWEIS reported that, for accidents involving HE, there was no potential for associated radionuclide or toxic chemical release consequences to public. Section D.3.1.2 describes the controls used to manage the level of protection and potential risk of accidents involving HE. HE detonation scenario impacts are short range and affect involved workers only. Involved worker impacts are discussed in Section D.3.1.5.

D.3.8 Accident Scenarios Involving Biological Hazard

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* (BMBL) (CDC-NIH 2020) for BSL-1 and -2 containment laboratories and federal regulations governing select agents and toxins (biosecurity). The BMBL is an advisory document developed by the U.S. Department of Health and Human Services, NIH, and Centers for Disease Control and Prevention. Biosafety practices are intended to reduce or eliminate exposure of individuals and the environment to potential biological hazards and select agents. Biosecurity practices are also intended to prevent the loss, theft, release, or misuse of biological hazards and research-related information by limiting access to facilities and this information.

Activities related to BSL-1 and BSL-2 materials are normally categorically (CX) excluded from further NEPA review in accordance with 10 CFR Part 1021 under B3.12, Microbiological and Biomedical Facilities. The specific CX states, "Siting, construction, modification, operation, and decommissioning of microbiological and biomedical diagnostic, treatment and research facilities (excluding BSL-3 and BSL-4), in accordance with applicable requirements and best practices including, but not limited to, laboratories, treatment areas, offices, and storage areas, within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible)." As such, operations of BSL-1 and BSL-2 facilities would be unlikely to result in adverse consequences to non-involved workers or the offsite public and are not addressed further in this SWEIS.

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.

According to CDC standards, the primary hazards to personnel working with BSL-3 agents relate to accidental injections, ingestion, and exposure through airborne pathways. In BSL-3 labs, more emphasis is placed on primary and secondary barriers to protect personnel in contiguous areas, the community, and the environment from exposure to potentially infectious aerosols. There are currently over 200 BSL-3 laboratory facilities in the United States at various non-DOE sites. BSL-3 laboratory facilities are specifically designed and engineered for work with bioagents with the potential for aerosol transmission that may cause serious or potentially lethal disease by inhalation if left untreated (such as the bacteria responsible for causing tuberculosis in humans). Examples of common BSL-3 facilities include hospital surgical suites, clinical, diagnostic, and teaching laboratories associated with medical or veterinary schools and pharmaceutical production laboratories.

Section 4.2.2 of 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-EA relied on information presented by the U.S. Army in its *Final Programmatic Environmental Impact Statement Biological Defense Research Defense Program* (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).

A potential laboratory accident and release scenario was also postulated in Army (1989) and referenced in NNSA (2002). The organism selected for the scenario was *Coxiella burnetii*, the *rickettsial* agent causing Q fever, a disease of varying degrees of incapacitation. *Coxiella burnetii* grows to high concentrations in chick embryos. It is a hardy organism that withstands laboratory manipulation with little or no loss in viability. It is highly stable in aerosol and undergoes a biological decay rate of about one percent per minute over a wide range of humidity. *Coxiella burnetii* is extremely infectious in a small particle aerosol.

This accident scenario involves an immunized laboratory worker processing *Coxiella burnetii*. In this scenario, the laboratory worker fails to use rubber O-rings to seal the centrifuge tubes, and all six bottles leak, allowing some of the slurry into the rotor, with some of the slurry also escaping into the centrifuge compartment that houses the rotor. The leakage of six bottles is highly improbable.

As reported in the Army's Programmatic EIS, approximately 5×10^4 Human Infectious Doses $(HID)_{50}$ (i.e., the dose causing infection 50 percent of the time for humans) could escape from the building exhaust stack. This is a conservative assumption, as the facility would likely have HEPA filters on the exhaust system. The quantity of HID, by simple Gaussian plume dispersion models, would dissipate to less than 1 HID_{50} per liter of air at less than 2 meters from the stack, less than 0.1 HID_{50} per liter of air at 16 meters, and less than 0.01 HID_{50} per liter of air at 38 meters. Thus, this level of escape of *Coxiella burnetii* 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.

The operator would be at the greatest risk of becoming ill. In opening the equipment, the infectious aerosol would be released initially and momentarily into a confined area. The researchers at a BSL-3 laboratory would wear powered air purifying respirator hoods with HEPA filters, so an exposure would be unlikely.

For transportation accidents, the LANL BSL-3 EA concluded that the addition of milliliter quantity samples shipped to and from the BSL-3 facility through the U.S. Postal Service or by commercial or private courier would not be expected to change the overall incidence of risk of transportation accidents. Samples could consist of cells in media contained within DOT-certified packages. The consequences of such accidents would be anticipated to be minor, based on the historical data.

A discussion of the potential impacts associated with a terrorist or intentional destructive act involving biological materials is included in Section D.4.

D.3.9 Accident Scenarios Involving Onsite Transport of Material

Onsite transfers at LANL are defined as the movement of materials between facilities. The TSD (LANL 2016a) covers the nuclear onsite transportation activities not performed in accordance with the requirements of Hazardous Materials Regulations (HMR), 49 CFR Parts 171-180. Implementation of the LANL TSD establishes an equivalent level of safety to the HMR. Transportation accident scenarios for radioactive waste transfer operations to and from RANT and TA-54, Area G are bounded by the accident evaluations in the TA-54, Area G BIO (LANL 2022a). Compliance with the HMR requirements and the additional communications and controls of the TSD and the TA-54, Area G BIO address potential hazards associated with chemical, explosive, biological, industrial, and radiological materials to ensure safe transport of hazardous materials. The TSD analyzed the deviations from the HMR for hazard communications and the onsite transfer of greater than or equal to the HC-3 quantity of radioactive materials per DOE-STD-1027-1992 in DOT non-compliant packaging. The LANL TSD also established controls necessary to perform the packaging and transportation activities with an acceptable level of safety equivalent to the HMR. All applicable requirements of the HMR must be implemented for onsite transfers of radioactive material, except where deviations from the HMR have been identified, analyzed, and communications and controls derived to mitigate the associated risk. For example, at the TWF, the transfer vehicle is stationary and within the TWF boundary; however, the shipment remains under the requirements of the TSD until the transfer vehicle is decoupled from the shipping trailer. Onsite transfers between TA-54, Area G and RANT are addressed by the HMR, TSD, and TA-54, Area G BIO.

The results of these hazard evaluations are summarized in Table D.3-10.

Table D.3-10 Onsite Transportation Hazards Evaluation Results

Type of Hazard	Risk
Chemical	SIH or Low
Biological	Low (see Section D.3.8)
Explosives	Low (see Section D.3.7)
Industrial	SIH
<HC-3 Radiological	Low
≥HC-3 Radiological	See discussion above

SIH = standard industrial hazard; HC = hazard category
Source: TSD (LANL 2017), DSAs, BIOs, and SADs

Standard industrial hazards, such as use of chemicals with no known or suspected toxic properties, use of materials that are commonly available and used by the public, and use of small-scale quantities of chemicals which can be handled by one person when in use, such as in laboratories do not have the potential for unmitigated release of hazards with impacts to the public and do not present an appreciable risk of health effects to non-involved workers. Low-hazard-classification transportation activities are addressed by adherence to the HMR, TSD, and the TA-54, Area G BIO transportation requirements.

Therefore, the accident scenarios associated with the onsite transportation of hazardous material are bound by the DBAs presented in Sections D.3.5 through D.3.8, above. Additionally, adherence with the requirements of the HMR, TSD, and other applicable DOT regulations ensures onsite transportation activities are performed to an acceptable level of safety to the HMR.

D.3.10 Site-Wide Multiple-Building Scenarios

This section provides an assessment of potential accident scenarios that could involve multiple buildings. Specifically, this appendix 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.

D.3.10.1 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 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. In this SWEIS, 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 10,000 years) than SDC-2 seismic events (approximate return period of once every 2,500 years); however, the magnitude of the ground accelerations and potential effects of a SDC-3 event would be more severe. The safety basis documents (DSAs, PDSA, BIOs, or SADs) 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 frequencies of SDC-2 and -3 seismic events and a subsequent fire were derived from these safety basis documents with the exception of RANT, RLUOB, and LANSCE as denoted in Table D.3-11. The potential radiological consequences from those facilities that would sustain damage in an SDC-2 seismic event are presented in Table D.3-11 and the resulting accident risks (accounting for the event frequency) are presented in Table D.3-12. 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 Table D.3-13 and the resulting accident risks (accounting for the event frequency) are presented in Table D.3-14. As described in these tables, the seismic event is also combined with an ensuing fire. For both seismic event scenarios, this SWEIS analysis assumed the same MAR, source term factors, and initial conditions as the supporting safety basis document DBAs to calculate the estimated radiological consequences of the seismic events for each of the facilities. The sum of the doses and estimated LCFs from each of these facilities are provided at the end of Tables D.3-11 and D.3-13. The radiological fatality annual risk for each of these facilities is provided in Tables D.3-12 and D.3-14. These results are presented for the average meteorological conditions.

In summary, Table D.3-12 demonstrates that the total 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} additional LCF per year for the No-Action Alternative and 2.51×10^{-5} additional LCF per year for the Expanded Operations Alternative. Table D.3-14 presents the total 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), which would be about 3.35×10^{-5} LCF per year for the No-Action Alternative and 4.89×10^{-5} LCF per year for the Expanded Operations Alternative.

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 D.3.6, Table D.3-9. 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.

The potential health effects presented for these two postulated seismic events should be also considered within the context of the accompanying nonradiological human health impacts that would also be expected. These seismic events would cause widespread failures of both nonnuclear LANL structures and structures outside of LANL. A much larger number of fatalities and injuries from structure collapse would be expected for these seismic events than those that result from radiological or chemical exposure.

Table D.3-11 Radiological Accident Frequency and Consequences of SDC-2 Seismic Events – Average Meteorology

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
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.	1×10^{-4}	2.89	1.73×10^{-3}	4.49×10^{1}	2.70×10^{-2}	8.46	5.08×10^{-3}	MEI at 240 m, Sectors 1&2
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.	1×10^{-5}	9.76	5.86×10^{-3}	6.19×10^{2}	3.71×10^{-1}	2.28×10^{2}	2.74×10^{-1}	MEI at 667 m, Sectors 1&2
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.	1×10^{-4}	1.37	8.22×10^{-4}	4.92×10^{1}	2.95×10^{-2}	10.9	6.54×10^{-3}	MEI at 448 m, Sectors 2 & 3

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
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.	1×10^{-5}	1.48	8.88×10^{-4}	4.72×10^{2}	2.83×10^{-1}	21.6	2.60×10^{-2}	MEI at 1,465 m, Sectors 15 & 16
SDC-2 Seismic/Fire-5: TA-55, RLUOB: SDC-2 seismic event causes full collapse of RLUOB (PF-400) building with ensuing fire.	1×10^{-4}	1.74×10^{-1}	1.04×10^{-4}	2.41×10^{1}	1.44×10^{-2}	1.39	8.34×10^{-4}	MEI at 1,081 m, Sectors 1 & 2
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.	1×10^{-5}	1.25×10^{-1}	7.50×10^{-5}	1.46×10^{1}	8.76×10^{-3}	1.95	1.17×10^{-3}	MEI >1,000 m[g]
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.	1×10^{-5}	3.02×10^{-1}	1.81×10^{-4}	9.03	5.42×10^{-3}	1.43	8.58×10^{-4}	MEI at 350 m[h]
Dose and LCF Totals – No-Action Alternative		***16.1***	***9.66×10^{-3}***	***1.23×10^{3}***	***7.39×10^{-1}***	***2.74×10^{2}***	***3.14×10^{-1}***	

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
SDC-2 Seismic/Fire-8: TWS, TA-16[i]: 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.	1×10^{-5}	4.9	2.94×10^{-3}	4.72×10^{2}	2.83×10^{-1}	21.6	2.60×10^{-2}	MEI at 530 m, Sector 5
SDC-2 Seismic/Fire-9: TWS, TA-54[i]: 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.	1×10^{-5}	5.5	3.30×10^{-3}	4.72×10^{2}	2.83×10^{-1}	21.6	2.60×10^{-2}	MEI at 480 m, Sector 1
SDC-2 Seismic/Fire-10: TWS, TA-55[i]: 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.	1×10^{-5}	1.7	1.02×10^{-3}	4.72×10^{2}	2.83×10^{-1}	21.6	2.60×10^{-2}	MEI at 1,170 m, Sector 1
SDC-2 Seismic/Fire-11: TWS, TA-60[i]: SDC-2 seismic event causes 3rd-tier TWS TRU waste drums to	1×10^{-5}	6.4	3.84×10^{-3}	4.72×10^{2}	2.83×10^{-1}	21.6	2.60×10^{-2}	MEI at 440 m, Sector 3

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
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.								
Dose and LCF Totals for SDC-2 Seismic/Fire involved Facilities – Expanded Operations Alternative		***34.6***	***4.15×10^{-2}***	***3.12×10^{3}***	***1.87***	***3.60×10^{2}***	***4.32×10^{-1}***	

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 The MEI and the non-involved worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person and would be multiplied by the number of persons exposed.
c Based on Table D.3-4, Population Distribution Estimates Within 80km from LANL (LANL 2022n).
d At a distance of 100 meters from the facility.
e Frequencies were derived from the safety basis documents with the application of passive design features to establish realistic yet conservative estimates.
f Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003). For an individual's acute dose ≥20 rem associated with an accident, the LCF is doubled (NCRP 1993).
g Sectors not specified; however, presumed the wind direction blowing to MEI in Sector 1,2, or 16 based on general discussion in the DSA in relation to TA-55.
h Sectors not specified; however, presumed the wind direction blowing to MEI in Sector 1 or 2 based on general discussion in the SAD and TA-53 figures.
i 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 and shown in this table.

Table D.3-12 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 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 2003).

c Based on Table D.3-4, *Population Distribution Estimates Within 80km from LAN*L (LANL 2022n).

d At a distance of 100 meters 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 D.3-13 Radiological Accident Frequency and Consequences of SDC-3 Seismic Events – Average Meteorology

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
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.	4.5×10^{-5}	2.23	1.34×10^{-3}	2.60×10^{2}	1.56×10^{-1}	48.7	5.84×10^{-2}	MEI at 1,013 m, Sectors 1, 2, & 16
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. Bounding scenario is a single seismically induced fire in Hs Pu processing/storage room.	7.2×10^{-6}	8.57	5.14×10^{-3}	9.45×10^{2}	5.67×10^{-1}	3.16×10^{2}	3.80×10^{-1}	MEI at 1,013 m, Sectors 1, 2, & 16
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.	3.6×10^{-5}	4.27	2.56×10^{-3}	3.40×10^{2}	2.04×10^{-1}	6.3	3.78×10^{-3}	MEI at 425 m, Sectors 12, 13 & 14

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
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 contents with an ensuing site-wide fire burning.[g]	3.5×10^{-6}	6.09	3.65×10^{-3}	1.83×10^{3}	1.1	2.19×10^{2}	2.62×10^{-1}	MEI at 1,465 m, Sectors 15 & 16
SDC-3 Seismic/Fire-5: TA-50, WCRRF: SDC-3 seismic event 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.	1×10^{-5}	1.41×10^{-1}	8.46×10^{-5}	3.20×10^{1}	1.92×10^{-2}	22.5	1.35×10^{-2}	MEI at 1,187 m, Sectors 1 & 2
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.	1×10^{-5}	8.26×10^{-2}	4.96×10^{-5}	1.40×10^{1}	8.43×10^{-3}	1.39	8.34×10^{-4}	MEI at 1,280 m, Sector 1
Dose and LCF Totals for SDC-3 Seismic/Fire Involved Facilities – No-Action Alternative		***21.38***	$\boldsymbol{2.57\times10^{-2}}$	$\boldsymbol{3.42\times10^{3}}$	***2.05***	$\boldsymbol{6.14\times10^{2}}$	$\boldsymbol{7.37\times10^{-1}}$	

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
Dose and LCF Totals for SDC-3 Seismic/Fire Involving Entire Site (SDC-2 plus SDC-3 Seismic/Fire Events)[f] – No-Action Alternative		***36***	***4.32×10⁻²***	***4.18×10³***	***2.51***	***8.66×10²***	***1.04***	
SDC-3 Seismic/Fire-7: TWS, TA-16[h]: SDC-3 seismic event causing multiple TWS buildings to collapse impacting drums and toppling of 3rd-tier drums, releasing their contents with an ensuing site-wide fire burning.[g]	3.5×10^{-6}	21.2	2.54×10^{-2}	1.83×10^{3}	1.1	2.19×10^{2}	2.62×10^{-1}	MEI at 530 m, Sector 5
SDC-3 Seismic/Fire-8: TWS, TA-54[h]: SDC-3 seismic event causing multiple TWS buildings to collapse impacting drums and toppling of 3rd-tier drums, releasing their contents with an ensuing site-wide fire burning.[g]	3.5×10^{-6}	24.1	2.90×10^{-2}	1.83×10^{3}	1.1	2.19×10^{2}	2.62×10^{-1}	MEI at 480 m, Sector 1
SDC-3 Seismic/Fire-9: TWS, TA-55[h]: SDC-3 seismic event causing multiple TWS buildings to collapse impacting drums and toppling of 3rd-tier drums, releasing their contents with an ensuing site-wide fire burning.[g]	3.5×10^{-6}	7.1	4.26×10^{-3}	1.83×10^{3}	1.1	2.19×10^{2}	2.62×10^{-1}	MEI at 1,170 m, Sector 1
SDC-3 Seismic/Fire-10: TWS, TA-60[h]: SDC-3 seismic event causing multiple TWS buildings to collapse impacting drums and toppling of 3rd-	3.5×10^{-6}	28.3	3.40×10^{-2}	1.83×10^{3}	1.1	2.19×10^{2}	2.62×10^{-1}	MEI at 440 m, Sector 3

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		MEI Distance and Sector
		Dose (rem)	Latent Cancer Fatality[f]	Dose (Person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	
tier drums, releasing their contents with an ensuing site-wide fire burning.[g]								
Dose and LCF Totals for SDC-3 Seismic/Fire Involved Facilities – Expanded Operations Alternative		***102.08***	***1.23×10^{-1}***	***1.07×10^{4}***	***6.44***	***1.49×10^{3}***	***1.79***	
Dose and LCF Totals for SDC-3 Seismic/Fire Involving Entire Site (SDC-2 plus SDC-3 Seismic/Fire Events)[f] – Expanded Operations Alternative		***116.7***	***1.40×10^{-1}***	***1.15×10^{4}***	***6.90***	***1.74×10^{3}***	***2.09***	

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 Section D.3.1.4 about distances from each facility to its MEI.

b The MEI and the non-involved worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person would be multiplied by the number of persons exposed.

c Based on Table D.3-4, Population Distribution Estimates Within 80km from LANL (LANL 2022n).

d At a distance of 100 meters from the facility.

e Frequencies were derived from the safety basis documents with the application of passive design features to establish realistic yet conservative estimates.

f Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003). For an individual's acute dose ≥20 rem associated with an accident, the LCF is doubled (NCRP 1993).

g The TWF and TWS SDC-3 seismic/fire event includes SDC-2 seismic/fire; therefore, the dose and LCF totals only include the TWF and TWS SDC-3 seismic/fire total.

h 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 and shown in this table.

Table D.3-14 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])**
SD-C 3Seismic/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. Bounding scenario is a single seismically induced fire in Hs Pu processing/storage room.	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; MA = 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 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 2003).

c Based on Table D.3-4, *Population Distribution Estimates Within 80km from LAN*L (LANL 2022n).

d At a distance of 100 meters 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.

D.3.10.2 Wildland Fires

History has shown that wildland fires are the most frequent natural hazard threatening Los Alamos County. Wildland fires are uncontrolled fires in forested or other vegetated landscapes. They are most often caused by lightning or by people, and they create a significant threat to life and property. The area most at risk is the wildland and urban interface, and nationally, this area increases as communities expand into previously uninhabited forested areas. Interestingly, in Los Alamos County, the opposite has been true until the recent development spurt of the past few years. The community saw very limited growth during the previous 30 years. The forest grew into the town and Laboratory perimeter. Wildland fires often result from other natural hazards, leaving burned areas vulnerable to additional hazards. For example, the wildland fire vulnerability resulting from lightning is further increased as a result of the dry and drought-like conditions. These conditions weaken trees, increasing their vulnerability to Pine Beetle Kill, which in turn provides greater quantities of fuel that lightning can then ignite. Pine Beetle Kill is the result of a beetle that bores into the bark of pine trees, spreading a blue stain like fungus that kills the tree very rapidly. The post-fire environment is then more susceptible to erosion, debris-flows, and flooding.

Within the past 70 years, there have been at least eight major wildland fires within Los Alamos County and the immediate vicinity. These are noted in Table D.3-15. Chapter 4, Section 4.5.1.3 discusses the history of wildland fires in the region.

Table D.3-15 Wildland Fire in the Vicinity of LANL During the Past 70 Years

Fire Name	Date	Acreage Burned
Water Canyon Fire	1953	6,000 acres
Burnt Mountain Fire	1954	1,000+ acres
La Mesa Fire	1977	15,444 acres
Dome Fire	1996	16,683 acres
Oso Complex Fire	1998	5,820 acres
Cerro Grande Fire	2000	47,658 acres
Las Conchas Fire	2011	~156,293 acres
Cerro Pelado Fire	2022	45,000 acres

In order to reduce potential risks of wildland fire, the Laboratory currently operates under the *Wildfire Mitigation and Forest Health Plan* (LANL 2019a), which includes wildland fire risk reduction and forest health objectives that are accomplished through treatments for forest thinning, life safety actions, open space forest health, and the implementation of specific treatment practices. As an element of the Expanded Operations Alternative, the Laboratory is proposing additional wildland fire treatments to further reduce wildland fire risks. These operational changes are described in Chapter 3, Section 3.4.2.

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.

For this SWEIS, each of the LANL facilities with radiological materials subject to analysis, as delineated in Table D.3-2, were evaluated to determine the potential for a wildland fire event for the facility based on their safety basis document (DSA, PDSA, BIO, or SAD). From this evaluation, the safety basis document DBAs for wildland fires or fires originating outside the facility with the highest consequences were selected for further analysis in this SWEIS. 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 frequency of wildland fire for each facility is derived from its safety basis document. The SWEIS used the DBA 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 Table D.3-16 and the resulting accident risks (accounting for the event frequency) are presented in Table D.3-17.

In summary, Table D.3-17 demonstrates 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 LCF per year for the No-Action Alternative and 3.75×10^{-4} additional LCF per year for the Expanded Operations Alternative. This result would be extremely conservative since many of these facilities are several miles apart and separated by canyons and industrial areas.

The potential health effects presented for a wildland fire event large enough to involve all of these LANL facilities should also be considered within the context of the accompanying nonradiological human health impacts that would also be expected. A wildland fire event of this magnitude would cause widespread destruction of both nonnuclear LANL structures and structures outside of LANL. A much larger number of fatalities and injuries would be expected for the fire and the resultant evacuation than those that result from radiological exposure.

Table D.3-16 Radiological Accident Frequency and Consequences from a Wildfire Event – Average Meteorology

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		
		Dose (rem)	Latent Cancer Fatality[f]	Dose (person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	MEI Distance and Sector
WLDFire-1: TA-55, PF-4: Plutonium Facility Wildland Fire.	1×10^{-6}[g]	0	0	0	0	0	0	MEI at 1,013 m, Sectors 1, 2, & 16
WLDFire-2: TA-54, Area G: External Fire propagates into Area G waste resulting in burning of waste and release of radiological material.	1×10^{-2}	4.06×10^{-2}	2.44×10^{-5}	1.46	8.79×10^{-4}	5.47×10^{-2}	3.28×10^{-5}	MEI at 240 m, Sectors 1 & 2
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.	1×10^{-3}	6.23×10^{-1}	3.74×10^{-4}	6.63×10^{1}	3.98×10^{-2}	4.37	2.62×10^{-3}	MEI at 667 m, Sectors 1 & 2
WLDFire-4: TA-54, RANT: Wildland fire propagates to the RANT site and impinges upon the TRU waste containers, resulting in burning of waste.	1×10^{-2}	2.23×10^{-1}	1.34×10^{-4}	9.63	5.78×10^{-3}	7.24×10^{-1}	4.34×10^{-4}	MEI at 448 m, Sectors 2 & 3
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.	1×10^{-6}[h]	0	0	0	0	0	0	MEI at 425 m, Sectors 12, 13 & 14

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		
		Dose (rem)	Latent Cancer Fatality[f]	Dose (person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	MEI Distance and Sector
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.	1×10^{-3}	1.16×10^{-1}	6.96×10^{-5}	3.72×10^{1}	2.23×10^{-2}	1.7	1.02×10^{-3}	MEI at 1,465 m, Sectors 15 & 16
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.	1×10^{-2}	8.71×10^{-2}	5.23×10^{-5}	2.35×10^{1}	1.41×10^{-2}	9.39×10^{-1}	5.63×10^{-4}	MEI at 1,187 m, Sectors 1 & 2
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.	1×10^{-3}	1.74×10^{-1}	1.04×10^{-4}	2.41×10^{1}	1.44×10^{-2}	1.39	8.34×10^{-4}	MEI at 1,081 m, Sectors 1&2
WLDFire-9: TA-50, RLWTF: Wildland fire engulfs the RLWTF resulting in release of all facility material.	1×10^{-5}	1.25×10^{-1}	7.50×10^{-5}	1.46×10^{1}	8.76×10^{-3}	1.95	1.17×10^{-3}	MEI >1,000 m[i]
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.	1×10^{-5}	8.26×10^{-2}	4.96×10^{-5}	1.40×10^{1}	8.43×10^{-3}	1.39	8.34×10^{-4}	MEI at 1,280 m, Sector 1

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		
		Dose (rem)	Latent Cancer Fatality[f]	Dose (person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	MEI Distance and Sector
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.	1×10^{-5}	3.02×10^{-1}	1.81×10^{-4}	9.03	5.42×10^{-3}	1.43	8.58×10^{-4}	MEI at 350 m[j]
Dose and LCF Totals for Site-Wide Wildfire Event – No-Action Alternative		***1.77***	***1.06×10^{-3}***	***2.00×10^{2}***	***1.20×10^{-1}***	***1.39×10^{1}***	***8.37×10^{-3}***	
WLDFire-12: TWS, TA-16[k]: Wildland fire propagates to the TWF site and impinges upon the TRU waste containers in the characterization trailer, resulting in confined burning of waste.	1×10^{-3}	3.80×10^{-1}	2.28×10^{-4}	3.72×10^{1}	2.23×10^{-2}	1.7	1.02×10^{-3}	MEI at 530 m, Sector 5
WLDFire-13: TWS, TA-54[k]: Wildland fire propagates to the TWF site and impinges upon the TRU waste containers in the characterization trailer, resulting in confined burning of waste.	1×10^{-3}	4.30×10^{-1}	2.58×10^{-4}	3.72×10^{1}	2.23×10^{-2}	1.7	1.02×10^{-3}	MEI at 480 m, Sector 1
WLDFire-14: TWS, TA-55[k]: Wildland fire propagates to the TWF site and impinges upon the TRU waste containers in the characterization trailer, resulting in confined burning of waste.	1×10^{-3}	1.40×10^{-1}	8.40×10^{-5}	3.72×10^{1}	2.23×10^{-2}	1.7	1.02×10^{-3}	MEI at 1,170 m, Sector 1

Accident Scenario	Frequency[e] (per year)	Maximally Exposed Individual[a,b]		Offsite Population[c]		Non-involved Worker[b,d]		
		Dose (rem)	Latent Cancer Fatality[f]	Dose (person-rem)	Latent Cancer Fatality[f]	Dose (rem)	Latent Cancer Fatality[f]	MEI Distance and Sector
WLDFire-15: TWS, TA-60[k]: Wildland fire propagates to the TWF site and impinges upon the TRU waste containers in the characterization trailer, resulting in confined burning of waste.	1×10^{-3}	5.00×10^{-1}	3.00×10^{-4}	3.72×10^{1}	2.23×10^{-2}	1.7	1.02×10^{-3}	MEI at 440 m, Sector 3
Dose and LCF Totals for Site-Wide Wildfire Event – Expanded Operations Alternative		***3.22***	***1.93×10^{-3}***	***3.49×10^{2}***	***2.09×10^{-1}***	***2.07×10^{1}***	***1.25×10^{-2}***	

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; m = meter; 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 (TRU) Liquid Waste (TLW) Treatment Facility; TWF = Transuranic Waste Facility; WCRRF = Waste Characterization, Reduction, and Repackaging Facility; WETF = Weapons Engineering Tritium Facility; WNR = Weapons Neutron Research Facility

a See discussion in Appendix D. Section D.3.1.4 about distances from each facility to its MEI.

b The MEI and the non-involved worker scenarios each assume that one person was exposed. If more than one person was exposed in either of these scenarios, then that scenario's dose would be per person and the doses would be multiplied by the number of persons exposed.

c Based on Table D.3-4, *Population Distribution Estimates Within 80km from LAN*L (LANL 2022n).

d At a distance of 100 meters from the facility.

e Frequencies were derived from the safety basis documents with the application of passive design features to establish realistic yet conservative estimates.

f Based on an LCF risk estimate of 0.0006 LCF per rem or person-rem (DOE 2003). For an individual's acute dose ≥20 rem associated with an accident, the LCF is doubled (NCRP 1993).

g 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.

h WETF passive design features prevent exposure of MAR to postulated wildland fire.

i Sectors not specified; however, presumed the wind direction blowing to MEI in Sector 1,2, or 16 based on general discussion in the DSA in relation to TA-55.

i Sectors not specified; however, presumed the wind direction blowing to MEI in Sector 1 or 2 based on general discussion in the SAD and TA-53 figures.

k 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 and shown in this table.

Table D.3-17 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 Site-Wide Wildfire Event – No-Action Alternative	***2.66×10^{-6}***	***2.85×10^{-4}***	***1.48×10^{-5}***

Accident Scenario	Average Meteorology		
	MEI (LCF[a])	Offsite Population (LCF[a,b])	Non-involved Worker (LCF[a,c])
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}
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 Site-Wide Wildfire 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 Table D.3-4, *Population Distribution Estimates Within 80km from LAN*L (LANL 2022n).

c At a distance of 100 meters 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.

D.4 Intentional Destructive Acts

D.4.1 Introduction

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. This section describes how NNSA assesses the vulnerability of its sites to terrorist threats and then designs its response systems.

Assessment of Vulnerability to Terrorist Threats

In accordance with DOE Order 470.3C, "Design Basis Threat Policy," and DOE Order 470.4B, "Safeguards and Security Program," NNSA conducts vulnerability assessments and risk analyses of the facilities and sites under its management to evaluate the possible threats and the protection elements, technologies, and administrative controls used to protect against these threats. DOE Order 470.4B establishes the roles and responsibilities for the conduct of DOE's Safeguards and Security Program. DOE Order 470.3C establishes requirements designed to prevent unauthorized access, theft, diversion, or sabotage (including unauthorized detonation or destruction) of all nuclear weapons, nuclear weapons components, and SNM under DOE's control. Among other provisions, the order: (a) specifies those national security assets that require protection; (b) outlines threat considerations for safeguards and security programs to provide a basis for planning, design, and construction of new facilities or modifications to existing facilities; and (c) provides an adversary threat basis for evaluating the performance of safeguards and security systems. NNSA also protects against espionage, sabotage, and theft of radiological, chemical, or biological materials; classified matter; nonnuclear weapon components; and critical technologies.

NNSA's safeguards and security programs and systems employ state-of-the-art technologies to:

- Deny access to nuclear weapons, nuclear test devices, and completed nuclear assemblies;
- Prevent theft, sabotage, or an unauthorized nuclear yield (criticality) of SNM and credible rollup quantities of SNM;
- Protect the public and employees from unacceptable impacts resulting from an adversary's use of radiological, chemical, or biological materials; and
- Protect classified matter and designated critical facilities and activities from sabotage, espionage, and theft.

NNSA's vulnerability assessments employ a rigorous methodology. Typically, a vulnerability assessment involves analyses of modeling, simulation, and performance testing results by subject matter experts to determine the effectiveness of a safeguard and security system against an adversary's objectives. Vulnerability assessments generally include the following activities.

Characterize the Threat. Threat characterization provides a detailed description of a physical threat by a malevolent adversary to a site's physical protection systems. Usually the description includes information about potential adversary types, motivations, objectives, actions, physical capabilities, and site-specific tactical considerations. Much of the information required to develop a threat characterization is described in DOE Order 470.3C and the Adversary Capabilities List. DOE also issues additional site-specific threat clarification and guidance.

Determine the Target. Target determination involves identifying, describing, and prioritizing potential targets among NNSA's security interests that meet the criteria outlined in DOE Order 470.3C. Target determination results are used to help characterize potential threats and target facilities, as well as protective force and neutralization requirements.

Define the Scope. The scope of a vulnerability assessment is determined by agreement among DOE Headquarters and Field staff and contractor personnel. In addition to defining the threat and applicable targets to be assessed, the scope establishes the key assumptions and interpretations that will guide the analyses, as well as the objectives, methods, schedule, personnel responsibilities, and format for documenting the results of the assessment.

Characterize the Facility or Site. This activity requires defining and documenting aspects of the facility or site, particularly existing security programs (personnel security, information security, physical security, material control and accountability, etc.), to assist in identifying strengths and weaknesses. Results are used as inputs to the pathway analyses used to develop representative case scenarios for evaluating the security system.

Characterize the Protective Force. To assess a facility or site's vulnerability, analysts must accurately characterize the associated protective force's capabilities against a defined threat and objective, particularly the force's ability to detect, assess, respond to, interrupt, and neutralize an adversary. Specific data used for this activity include SNM categorization; configuration, flow, and movement of SNM within or from a facility or site; defined threats; detection and assessment times; and adversary delay and task time. The protective force's equipment, weapons, number, and locations also are considered in the characterization. The characterization information is validated and verified via observation, alarm response assessments, limited scope performance tests, force-on-force exercises, joint conflict and tactical simulations, and tabletop analyses.

Analyze Adversary Pathways. This activity identifies and analyzes base case adversary pathways based on the results of threat, target, facility, and protective force characterization, as well as ancillary analyses such as explosives analysis. Analysts use modeling tools and conduct insider analysis as part of this activity.

Develop Base Case Scenarios. Base case scenarios are developed for use in performance testing and to determine the effectiveness of the security system in place against a potential adversary's capabilities and objectives. As part of this activity, data from the base case adversary pathways analyses are used to identify applicable threats, threat strategies, and objectives, and combined with protective force strategies and capabilities to develop scenarios that include specific adversary resources, capabilities, and projected task times to successfully complete their objectives. Specialists also work with the vulnerability assessment team to develop realistic scenarios that provide a structured, intellectually honest analysis of the strengths and weaknesses of the terrorist adversary.

Determine the Probability of Neutralization. The probability of neutralization is a numeric value representing the probability that the protective force can prevent an adversary from achieving their objectives. The calculated number is derived from more than one source, one of which must be based on Joint Tactical Simulation analysis, or force-on-force exercises.

Determine System Effectiveness. System effectiveness is determined by applying an equation that reflects the capabilities of a multi-layered protection system. Analysis data derived from the various vulnerability assessment activities are used to calculate this equation, which reflects the security system's effectiveness against each of the scenarios developed for the vulnerability assessment. If system effectiveness is unacceptable for a scenario, the root cause of the weakness must be analyzed and security upgrades must be identified. The scenarios are reanalyzed with the upgrades, and the successful upgrades are documented in the vulnerability analysis report.

Implement. The culmination of the vulnerability assessment is development of a report documenting the analyses and results and a plan for implementing any necessary upgrades to achieve the required security system effectiveness. NNSA verifies the results of the vulnerability assessment report and the conclusions of the implementation plan. NNSA also provides management oversight of the actual implementation of security system upgrades.

D.4.2 Intentional Destructive Acts Analysis

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 bounding accident impact analyses prepared for this SWEIS. A separate classified appendix to this SWEIS (Appendix M) has been prepared that considers the underlying facility threat assumptions with regard to malevolent, terrorist, or intentionally destructive acts. Based on these threat assumptions, the classified appendix evaluates the potential human health impacts using appropriate analytical models, similar to the methodology used in 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.

D.5 Emergency Management

D.5.1 Introduction

DOE Order 151.1D, *Comprehensive Emergency Management System*, requires that each NNSA/DOE site establish and maintain a documented Emergency Management Program that implements the requirements of applicable federal, state, and local laws, regulations, and ordinances for fundamental worker safety programs (e.g., fire, safety, and security). The Laboratory has prepared the *Los Alamos National Laboratory Emergency Management Plan* (Emergency Plan; LANL 2023) to comply with this requirement and to document LANL's comprehensive Emergency Management Program.

The LANL Emergency Plan includes both the NNSA Los Alamos Field Office (NA-LA) and the DOE-EM Los Alamos Field Office (EM-LA) as well as the LANL Management and Operating Contractor (Triad) and the DOE-EM Los Alamos Legacy Cleanup Contractor (LLCC; N3B). The LANL Emergency Management Program is based on program elements, and requirements for an Emergency Management Core Program and an Emergency Management Hazardous Materials (HAZMAT) Program, as well as requirements for Defense Nuclear Facilities, as applicable. The plan also provides a framework for integration with existing county, state, tribal, and federal emergency systems and integrates with their emergency management and planning processes. In addition, the plan serves as the integrated site-wide wildland fire management plan as required by DOE O 420.1C, *Facility Safety*. The plan incorporates Emergency Management Program responsibilities from the New Mexico Environment Department (NMED) NM0890010515, *Los Alamos National Laboratory Hazardous Waste Facility Permit*, including Attachment D, the Resource Conservation and Recovery Act Hazardous Waste Facility Contingency Plan.

The Emergency Plan identifies lines of authority and the responsibilities of emergency response personnel, establishes the LANL site-level Emergency Response Organization (ERO), documents the Emergency Public Information program, and lists LANL personnel and equipment resources available to handle emergencies. The plan also outlines an organized process for handling emergency incidents or potential incidents that could threaten human health or the environment and operational emergencies with adequate emergency response and recovery capabilities through comprehensive preparedness activities.

The primary capabilities identified within the Emergency Plan include the following:

- Provide maximum protection for onsite and offsite personnel who could be affected by an emergency at LANL.
- Ensure protection of national security, the environment, critical infrastructure, facilities, and equipment.
- Minimize the impact of an emergency on facility and site operations and security.
- Provide clear, timely, and technically accurate site-related emergency information to employees; the public and public officials; federal, state, and county agencies/organizations; DOE Headquarters (HQ); and the media.
- When requested and in accordance with mutual aid and cooperative agreements with offsite agencies (e.g., Memoranda of Understanding [MOUs], Memoranda of Agreement, Mutual Aid Agreements, Agreements in Principle), provide emergency assistance to the State of New Mexico (NM) and NM counties and communities in planning and responding to an emergency occurring outside the boundaries of LANL.
- Facilitate all-hazards emergency planning with offsite authorities.
- Provide full compliance with the National Incident Management System per U.S. Department of Homeland Security Presidential Directive (HSPD)-5, *Management of Domestic Incidents*.

The site-level ERO is depicted in Figure D.5-1. The LANL ERO provides management, direction, and support of emergency response activities with specific roles and responsibilities during an emergency.

The LANL Emergency Plan includes specific responsibilities and authorities for members of the ERO. The various organizations include, but are not limited to, the LANL Incident Response Commander, Los Alamos Fire Department, HAZMAT teams, hazardous device teams, Protective Force, Los Alamos Police Department, and Facility-Level Emergency Coordinators.

The LANL Emergency Plan covers the management of actual or potential operational emergencies or significant emergency incidents onsite at LANL or at LANL outlying locations. An emergency is defined as any incident, whether natural or manmade, that could endanger or adversely affect people, property, or the environment, and that requires responsive action beyond normal operations.

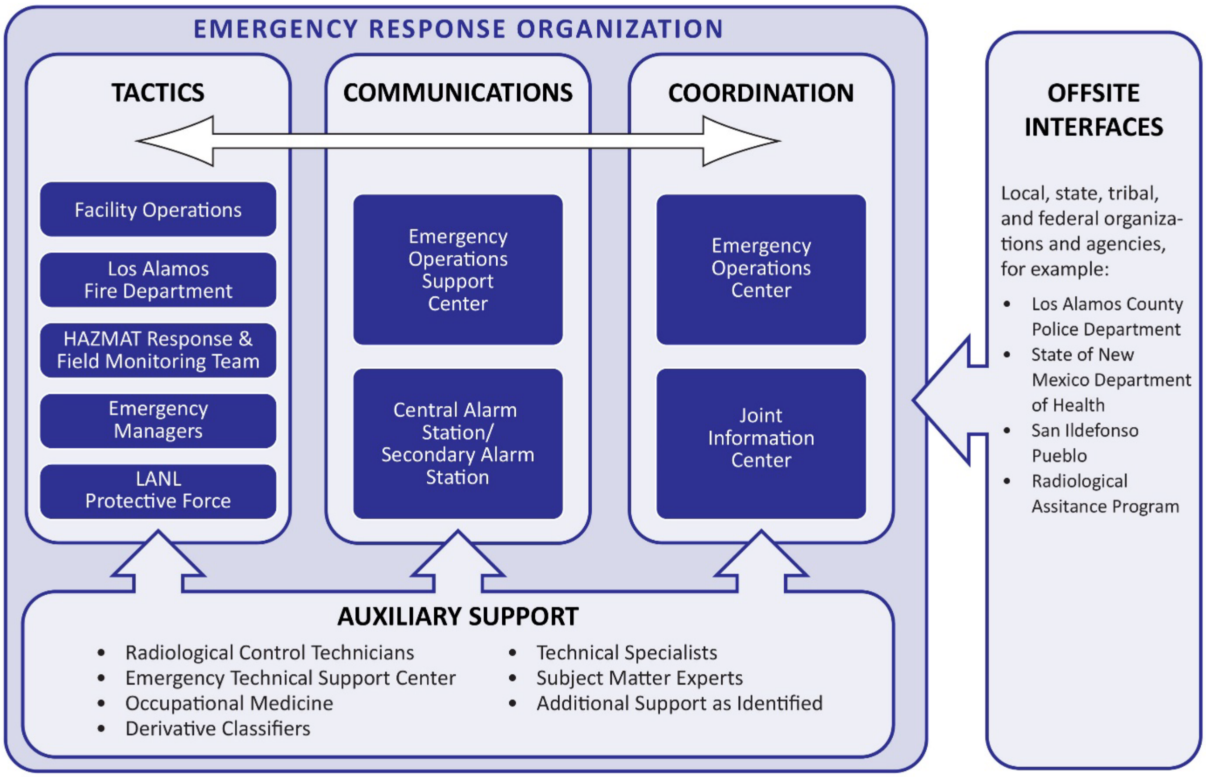


Figure D.5-1 LANL Emergency Response Organization

D.5.2 All-Hazards Technical Planning Basis

The LANL all-hazards survey and EPHAs form the all-hazards, scientific and technical basis for emergency planning, preparedness, and response activities.

Hazard surveys are performed for zones rather than individual facilities and document the identification and qualitative assessment of hazards applicable to operations and the associated emergency conditions that may require a response. A hazard survey identifies types of emergency conditions (e.g., fires, workplace accidents, natural phenomenon); describes potential health, safety, or environmental impacts; and summarizes the applicable planning and preparedness requirements. Natural hazards (e.g., earthquakes, tornadoes) and technological hazards (e.g., system and structure failures) as well as human-caused incidents (e.g., terrorist attack, cyber incident) are addressed in hazard surveys. These surveys also identify large scale storage inventories of fuel oil and gases, consequences with respect to HAZMAT overpressure or radiant heat dose exposures from explosions or fires involving flammable inventories, hazards associated with explosives, and simple asphyxiants and cryogenic materials.

The LANL EPHAs provide the technical basis and graded approach for elements of the Emergency Management HAZMAT Program. The EPHAs are quantitative analyses identifying hazards and potential consequences of unplanned release of or loss of control over HAZMAT (either radiological or nonradiological [i.e., chemical and/or biological]) identified in hazard surveys. Facilities that handle or store HAZMAT above defined threshold levels whose inadvertent release could result in PAC or Protective Action Guidelines being exceeded, are required to conduct an EPHA.

The EPHAs quantitatively analyze all significant types of bounding accident and severe event scenarios identified in the LANL facility/activity DSAs and evaluate the consequences. In addition, the EPHAs consider a malevolent act as the initiator for a release using an appropriate MAR, which is used to estimate the worst-case source term. For Defense Nuclear Facilities, EPHAs include potential incidents ranging from low-consequence/high-probability incidents to high-consequence/low-probability incidents to ensure a comprehensive picture of the types of incidents and the range of associated consequences that could occur at a facility is captured.

Each EPHA performed also includes a determination of the size of geographic area surrounding the facility to which emergency planning will be applied, known as Emergency Planning Zone (EPZ), and contributes to the determination of the consolidated site EPZ. Within the EPZ, special planning and preparedness activities are required to reduce the potential health and safety impacts from an incident involving HAZMAT.

Due to the number, distribution, and types of HAZMAT facilities at LANL, there is also a composite EPZ determined for the entire LANL site. The LANL EPZ is the geographic area within which the results from the EPHAs indicate a need for specific and detailed emergency planning and preparedness to protect workers and the public from the consequences of HAZMAT releases. The composite EPZ is based upon both radiological and chemical information contained in the technical analysis of facility EPHAs along with population, geographic, and jurisdictional boundaries. The EPZ for LANL includes all or portions of Los Alamos County, the Pueblo de San Ildefonso, Bandelier National Monument, and U.S. Forest Service (USFS) lands.

D.5.3 Training and Drills

The Laboratory provides a combination of formal classroom or self-paced instruction, on-the-job training, workshops, drills, and/or a qualification system for all of the site-level ERO members. The purpose of this training is to provide skilled emergency management and response personnel to safely, efficiently, and effectively respond to an emergency incident.

The LANL ERO Training Program has been established to provide training to support site-level ERO needs and to provide ERO personnel with basic knowledge of Emergency Management topics, fundamentals, and responsibilities while meeting regulatory requirements. The program also provides general instruction for all LANL personnel on the proper response to emergencies and provides controllers and evaluators with effective training that will enable them to adequately control and evaluate drills and exercises. In addition, emergency management training is provided to technical specialists and offsite response personnel to handle specialized emergency situations.

Drills are supervised, hands-on training used to develop and maintain personnel skills, expertise, proficiency, and response capabilities. Emergency drills are of sufficient scope and frequency to ensure adequate response capabilities in all applicable areas and the drill scenarios align with hazards/threats (i.e., accidents or emergencies) identified in the all-hazards planning basis including those analyzed in the hazard survey or specific EPHA for the respective facility/activity. Drills are also designed to address specific activities within the LANL mission set (e.g., notification, categorization and classification, emergency communication, fire and medical response, HAZMAT detection and monitoring, security/law enforcement incidents, personnel accountability and evacuation, decontamination, public information, radiological control).

Applicable offsite first responders (e.g., primary first response agencies such as Los Alamos Fire Department and Los Alamos Police Department) are formally invited to participate in a relevant drill or exercise at least annually.

D.5.4 Emergency Operations System

The management of and response to emergency incidents focuses on minimizing the risk of personnel injury and minimizing the exposure of employees, the environment, and the public to radioactive or hazardous substances/wastes to a level that is as low as reasonably achievable. During significant or escalating incidents, the Emergency Operations System (EOS) supports the Incident Commander and field responders by relieving the burden of site-level and external communication and securing additional resources needed for the response according to plans and procedures.

The EOS has overall responsibility for supporting and coordinating the emergency response, obtains and maintains situational awareness and disseminates a common operating picture among response components and external partners, and ensures the centralized collection, validation, analysis, and coordination of information related to an emergency.

Initial protective actions, including shelter in place, evacuation, lockdown, or remain indoors, may be issued by any worker in the immediate area of the incident; by operations centers or access control personnel according to facility procedures; or by emergency responders. Workers may be initially alerted to take protective actions based on fire alarms, radiological alarms, criticality alarms, or an active threat. Some facilities at the Laboratory use public address systems to provide specific actions to be taken and information regarding an emergency to the workers at the facility.

The LANL Emergency Plan includes specific actions to be taken in the event of operational emergencies and general emergencies (LANL 2023c).

The Emergency Operations Center is activated at the appropriate level for any declared operational emergency impacting the site or may activate for other significant incidents and planned events when emergency management and leadership decides support operations would be advantageous. The Center may be activated at three different staffing levels based on the incident (e.g., severity, type, location, consequences) and support needed. Table D.5-2 provides the staffing for the Emergency Operations Center for various activation levels.

Action planning during the activation of the Emergency Operations Center is crucial to effective and efficient operations and is linked with the application of command, control, and leadership principles. The action plan identifies a common set of objectives and priorities to guide all Center-related response and support activities to a successful conclusion. The planning evolves through a cycle from the initial phases of situational awareness through development of a more formal and comprehensive action plan with approvals based on formal planning phases, which occur during each operational period; all with a consistent set of objectives and priorities.

Table D.5-2 LANL Emergency Operations Center Activation Levels

Activation	Description	Staff
Level 3: Normal Operations	Activities that are normal for the EOC when no incident or specific risk or hazard has been identified.	No activated EOC staff required.
Level 2: Partial Activation	Specific EOC team members/ organizations are activated to monitor a credible threat, risk, or hazard and/or to support the response to a new and potentially evolving incident.	Minimum staff is not required; EOC maintains the flexibility to staff as needed, commensurate with the required incident response.
Level 1: Full Activation	Entire EOC is activated in accordance with minimum staffing protocols, including personnel from assisting agencies, to support the response to an actual incident, major incident, or credible threat. Minimum staffing requirements must be met.	Full staffing of all EOC positions for all operational emergencies. requiring classification or as requested.

D.6 References

CDC (Centers for Disease Control and Prevention) 2024. "Underlying Cause of Death, 1999-2020," https://wonder.cdc.gov/ucd-icd10.html. (accessed April 2024).

CDC-NIH (Centers for Disease Control and Prevention-National Institutes of Health) 2020 *Biosafety in Microbiological and Biomedical Laboratories*. 6th edition. June. Available online: https://www.cdc.gov/labs/bmbl/

DNFSB (Defense Nuclear Facilities Safety Board) 2022. "Receipt and Repackaging of Large Amounts of Heat Source Plutonium at the Los Alamos National Laboratory Plutonium Facility." Letter from J.L. Connery, DNFSB, to J.M. Granholm, Secretary of the Department of Energy. August. Available online: https://www.dnfsb.gov/documents/letters/receipt-and-repackaging-large-amounts-heat-source-plutonium-lanl-pf-4

DoD (U. S. Department of Defense) 2022. *Construction and Demonstration of a Prototype Mobile Microreactor.* DOE/EIS-0546. February. Available online: https://www.energy.gov/nepa/articles/doeeis-0546-final-environmental-impact-statement-february-2022

DOE (U.S. Department of Energy) 1995. *Final Environmental Impact Statement for the Dual-Axis Radiographic Hydrodynamic Test Facility*. DOE/EIS-0228. Available online: https://www.energy.gov/nepa/articles/doeeis-0228-final-environmental-impact-statement-august-1995

DOE (U.S. Department of Energy) 2002. *Recommendations for Analyzing Accidents under the National Environmental Policy Act*. Office of NEPA Policy and Compliance. July. Available online: https://www.energy.gov/sites/default/files/nepapub/nepa_documents/RedDont/G-DOE-AccidentAnalysis.pdf

DOE (U.S. Department of Energy) 2003. *Estimating Radiation Risk from Total Effective Dose Equivalent (TEDE)*. ISCORS Technical Report No. 1. DOE/EH-412/0015/0802, Rev. 1. ID 1970. Office of Environmental Policy and Guidance. January. Available online: https://www.osti.gov/servlets/purl/1374991 (accessed October 2023).

DOE (U.S. Department of Energy) 2018. *Transuranic Waste Acceptance Criteria for the Waste Isolation Pilot Project*. DOE/WIPP-02-3122. Revision 9. October. Available online: https://wipp.energy.gov/library/wac/DOE-WIPP-02-3122_Rev_9_FINAL.pdf

DOE (Department of Energy) 2023. *Occupational Radiation Exposure Report for Calendar Year 2021*. January 26. Available at: https://www.energy.gov/sites/default/files/2023-02/2021%20ORER%20final.pdf

DOE Guide 414.1-4. *Safety Software Guide for Use with 10 CFR 830 Subpart A, Quality Assurance Requirements, and DOE O 414.1C, Quality Assurance*. November 3, 2010. Available online at: https://www.directives.doe.gov/directives-documents/400-series/0414.1-EGuide-4/@@images/file

DOE Order 151.1D. *Comprehensive Emergency Management System*. Change 1, October 4, 2019. Available online at: https://www.directives.doe.gov/directives-documents/100-series/0151.1-BOrder-d-chg1-minchg/@@images/file

DOE Order 414.1D. *Quality Assurance*. Change 2. September 15, 2020. Available online at: https://www.directives.doe.gov/directives-documents/400-series/0414.1-BOrder-d-chg2-ltdchg/@@images/file

DOE Order 420.2D. *Safety of Accelerators*. September 9, 2022. Available online at: https://www.directives.doe.gov/directives-documents/400-series/0420.2-BOrder-d/@@images/file

DOE Handbook 1046-2016. *Temporary Emergency Exposure Limits for Chemicals: Methods and Practices.* December 2016. Available online at: https://www.standards.doe.gov/standards-documents/1000/1046-Bhdbk-2016-reaff-2022

DOE Handbook 1224-2018. *Hazard and Accident Analysis Handbook.* August 2018. Available online at: https://www.standards.doe.gov/standards-documents/1200/1224-BHdbk-2018/@@images/file

DOE Standard 1027-2018. *Hazard Categorization of DOE Nuclear Facilities.* Change 1. January 2019. Available online at: https://www.standards.doe.gov/standards-documents/1000/1027-astd-2018-cn1/@@images/file

DOE Standard 1212-2019. *Explosives Safety*. November. Available online: https://www.standards.doe.gov/standards-documents/1200/1212-astd-2019/@@images/file

DOE Standard 3009-2014. *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*. November 2014. Available online at: https://www.standards.doe.gov/standards-documents/3000/3009-astd-2014/@@images/file

DOE Standard 5506-2021. *Preparation of Safety Basis Documents for Transuranic (TRU) Waste Facilities*. August 2021. Available online at: https://www.standards.doe.gov/standards-documents/5000/5506-astd-2021/@@images/file

ICRP (International Commission on Radiological Protection) 1994a. *Human Respiratory Tract Model for Radiological Protection*. ICRP Publication 66. Ottawa, Ontario Canada. Available online: https://www.icrp.org/publication.asp?id=ICRP%20Publication%2066

ICRP (International Commission on Radiological Protection) 1994b. *Dose Coefficients for Intakes of Radionuclides by Workers*. ICRP Publication 68. Ottawa, Ontario Canada. Available online: https://www.icrp.org/publication.asp?id=ICRP%20Publication%2068

ICRP (International Commission on Radiological Protection) 1995a. *Age-dependent Doses to Members of the Public from Intake of Radionuclides – Part 4 Inhalation Dose Coefficients*. ICRP Publication 71. Washington DC. Available online: https://www.icrp.org/publication.asp?id=ICRP%20Publication%2071

ICRP (International Commission on Radiological Protection) 1995b. *Age-dependent Doses to the Members of the Public from Intake of Radionuclides - Part 5 Compilation of Ingestion and Inhalation Coefficients*. ICRP Publication 72. Ottawa, Ontario Canada. Available online: https://www.icrp.org/publication.asp?id=ICRP%20Publication%2072

ICRP (International Commission on Radiological Protection) 2006. *Assessing Dose of the Representative Person for the Purpose of Radiation Protection of the Public*. ICRP Publication 101. Ottawa, Ontario Canada. Available online: https://www.icrp.org/publication.asp?id=ICRP%20Publication%20101a

ICRP (International Commission on Radiological Protection) 2007. *The 2007 Recommendations of the International Commission on Radiological Protection*. ICRP Publication 103. Ottawa, Ontario Canada. Available online at: https://www.icrp.org/publication.asp?id=ICRP%20Publication%20103

LANL (Los Alamos National Laboratory) 2016. *Transportation Safety Document (TSD)*. P&T-SA-002, R14. November.

LANL (Los Alamos National Laboratory) 2018. *Evaluation of the Safety of the Situation, PISA: MLLW Flanged Tritium Waste Containers Stored at Area G*. ESS-AREAG-114-R1.1. February.

LANL (Las Alamos National Laboratory) 2019. *SWEIS Yearbook 2017 Comparison of 2017 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-19-20119. February 20. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-19-20119

LANL (Los Alamos National Laboratory) 2020a. *Weapons Engineering Tritium Facility (WETF) Documented Safety Analysis*. DSA- WETF-001-R1. May.

LANL (Los Alamos National Laboratory) 2020b. *TA-55 Plutonium Facility 400 (PF-400) Documented Safety Analysis*. DSA-PF400-001-R2. September. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2020c. *Safety Assessment Document Dual-Axis Radiographic Hydrodynamic Test Facility*. SAD-DARHT-003-R1. August.

LANL (Los Alamos National Laboratory) 2020d. *Safety Assessment Document*. SAD-TA53-003-R0.2. Los Alamos Neutron Science Center. March.

LANL (Los Alamos National Laboratory) 2020e. *SWEIS Yearbook 2018 Comparison of 2018 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-19-32158. February. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-19-32158

LANL (Los Alamos National Laboratory) 2021a. *Plutonium Facility (PF)-4, TA-55 Documented Safety Analysis*. TA-55-DSA-2021-R0. December. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2021b. *Chemistry and Metallurgy Research Facility Documented Safety Analysis*. CMR-DSA-001-R11. June.

LANL (Los Alamos National Laboratory) 2021c. *Preliminary Documented Safety Analysis for the TA-50-0269 TRU Liquid Waste Treatment Facility Design*. 15-002-TRPT-007. Revision 3. April. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2021d. *TA-50, Low-Level Waste Treatment Facility, and TA-50, Radiological Liquid Waste Treatment Facility*. EMD-EPHA-401, R0. June. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2021e. *TA-53, 1L Target Facility, Meson Physics Facility*. EMD-EPHA-407. R0. July. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2021f. L*ANL Nuclear Criticality Safety Program.* SD130. Revision 8. March 19.

LANL (Los Alamos National Laboratory) 2021g. *SWEIS Yearbook 2019 Comparison of 2019 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-20-30217. January. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-20-30217

LANL (Los Alamos National Laboratory) 2022a. *Technical Area 54, Area G Basis for Interim Operation, ABD-WFW-001*. Rev. 10.1. July.

LANL (Los Alamos National Laboratory) 2022b. *Addendum to Area G BIO for CMP Retrieval, Storage, and Shearing Size Reduction*. N3B-ADD-001. Rev. 2. December.

LANL (Los Alamos National Laboratory) 2022c. *Justifications for Continued Operations – N3B-JCO-AREAG-21-001*. R2. June.

LANL (Los Alamos National Laboratory) 2022d. *Justifications for Continued Operations – N3B-JCO-AREAG-21-002*. R1. June.

LANL (Los Alamos National Laboratory) 2022e. *Justifications for Continued Operations – N3B-JCO-AREAG-21-003*. R2. June.

LANL (Los Alamos National Laboratory) 2022f. *Justifications for Continued Operations – N3B-JCO-AREAG-21-004*. R4. June.

LANL (Los Alamos National Laboratory) 2022g. *Justifications for Continued Operations – N3B-JCO-AREAG-21-005*. R1. November.

LANL (Los Alamos National Laboratory) 2022h. *Radioassay and Nondestructive Testing (RANT) Facility Documented Safety Analysis*. DSA-RANT-001-R5. October.

LANL (Los Alamos National Laboratory) 2022i. *Transuranic Waste Facility (TWF) Documented Safety Analysis*. DSA-TWF-001-R6.1. May.

LANL (Los Alamos National Laboratory) 2022j. *TA-50 Radioactive Liquid Waste Treatment Facility Documented Safety Analysis*. DSA-RLWTF-001-R6. June.

LANL (Los Alamos National Laboratory) 2022k. *TA-03 Chemistry and Metallurgy Research Facility*. EMD-EPHA-405. R0. October. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2022l. *TA-16, Weapons Engineering Tritium Facility (WETF)*. EMD-EPHA-406. R0. April. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2022m. *TA-54, Area G Site*. EMD-EPHA-403. R1. October. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2022n. *Population Distribution Within 80km of LANL*. December 16.

LANL (Los Alamos National Laboratory) 2022o. 2016 through 2020 TA-6 Meteorological Tower Corrected Windspeed and Stability Class Excel Worksheet Data Files – based on SBD-CALC-146, R0, Updated MACCS2 Five-Year TA-06 Meteorological Tower Input Data: 2016-2020, May 20, 2021.

LANL (Los Alamos National Laboratory) 2022p. *Performing an Environmental Census for Human Dose Assessment Purposes*. EPC-ES-TP-012. R2. October 17. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2022q. *LANL Waste Acceptance Criteria*. P409-1. R2, Admin Chg 2. January 7.

LANL (Los Alamos National Laboratory) 2022r. *Higher MAR Limits for Receipt of Large HS Pu Shipments.* TA55-DSA-2020-R1. Addendum 1-R3. April 29. UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION

LANL (Los Alamos National Laboratory) 2022s. *Los Alamos National Laboratory 2021 Annual Site Environmental Report*. LA-UR-22-29103. Revision 2. September 28. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-29103

LANL (Los Alamos National Laboratory) 2022a. *SWEIS Yearbook 2020 Comparison of 2020 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-22-20010. January. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-20010

LANL (Los Alamos National Laboratory) 2023a. *Dose Calculations for SWEIS Air Emissions*. September 21. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2023b. *SWEIS Yearbook 2021 Comparison of 2021 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-22-32473. Rev. 2. February 22. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-32473

LANL (Los Alamos National Laboratory) 2023c. *LANL Emergency Management Plan*. EM-PLAN-100. Revision 0. November. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2024a. *SWEIS Yearbook 2022: Comparison of 2022 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-24-22037. Rev. 1. May. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-24-22037

LANL (Los Alamos National Laboratory) 2024b. *Los Alamos National Laboratory 2024 Annual Site Environmental Report*. LA-UR-23-29640. Revision 2. February. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-23-29640

LANL (Los Alamos National Laboratory) 2024c. *Waste Characterization, Reduction, and Repacking Facility (WCRRF) Documented Safety Analysis*. DSA-WCRRF-001-R2. January 10.

N3B (Newport News Nuclear BWXT-Los Alamos, LLC) 2023a. Documented Safety Analysis for the Nuclear Environmental Sites (NES) at Los Alamos National Laboratory. NES-ABD-0101, Revision 13.0. August. UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION

N3B (Newport News Nuclear BWXT-Los Alamos, LLC) 2023b. Documented Safety Analysis for Building 21-0257 and the Industrial Waste Lines. N3B-DSA-ER-0001, Revision 0. December. UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION

NCRP (National Council on Radiation Protection and Measurements) 1993. *Risk Estimates for Radiation Protection.* NCRP Report No. 115, Bethesda, Maryland. December. Available online: https://ncrponline.org/shop/reports/report-no-115-risk-estimates-for-radiation-protection-1993/

NCRP (National Council on Radiation Protection and Measurements) 2009. *Ionizing Radiation Exposure of the Population of the United States*. NCRP Report No. 160. March. Available online: https://pubs.rsna.org/doi/abs/10.1148/radiol.2532090494?journalCode=radiology

NNSA (National Nuclear Security Administration) 2008. *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. DOE/EIS-0380. May. Available online at: https://energy.gov/node/300205

NNSA (National Nuclear Security Administration) 2018. *Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. DOE/EIS-0380-SA-05. April. Available online at: https://www.energy.gov/sites/default/files/2018/05/f51/EIS-0380-SA-05_2018_0.pdf

NNSA (National Nuclear Security Administration) 2020. *Final Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. DOE/EIS-0380-SA-06. August. Available online at: https://www.energy.gov/nepa/articles/doeeis-0380-sa-06-final-supplement-analysis

NNSA (National Nuclear Security Administration) 2024. *Final Environmental Impact Statement for the Surplus Plutonium Disposition Program*. DOE/EIS-0549. January. Available online: https://www.energy.gov/nepa/articles/doeeis-0549-final-environmental-impact-statement

NRC (U. S. Nuclear Regulatory Commission) 2003. *Methods and Assumptions for Evaluating Radiological Consequences of Design Basis Accidents at Light-Water Nuclear Power Reactors*. Regulatory Guide 1.195. May. Available online at: https://www.nrc.gov/docs/ML0314/ML031490640.pdf

APPENDIX E
LANL Facility Information

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AC	actinide chemistry
AI	artificial intelligence
AM	additive manufacturing
ARIES	Advanced Recovery and Integrated Extraction System
BSL	Biosafety Level
BTF	Beryllium Technology Facility
Ci	curie
CINT	Center of Integrated Nanotechnologies
CMP	Campus Master Plan
CMR	Chemistry and Metallurgy Research
CMRR EIS	*Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico*
CMRR-NF	Chemistry and Metallurgy Research Replacement–Nuclear Facility
CY	calendar year
DARHT	Dual Axis Radiographic Hydrodynamic Test
DD&D	decontamination, decommissioning, and demolition
DNA	deoxyribonucleic acid
DOE-EM	DOE Office of Environmental Management
EIS	environmental impact statement
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
FR	Federal Register
HC	Hazard Category
HE	high explosives
HENC	High Efficiency Neutron Counter
HEPA	high-efficiency particulate absorbing
HPC	high-performance computing
HVAC	heating, ventilation, and air conditioning
IPF	Isotope Production Facility
LANL	Los Alamos National Laboratory
LANL SWEIS	*Site-wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*
LANSCE	Los Alamos Neutron Science Center
LEFFF	Low-Enriched Uranium Fuel Fabrication Facility
LINAC	linear accelerator
LLW	low-level radioactive waste
LUN	LANL Ultracold Neutrons
MAR	material-at-risk
MeV	mega electron-volt
MGY	million gallons per year
MLLW	mixed LLW
MSL	Materials Science Laboratory
MTRU	mixed TRU
MW	megawatt

N3B	Newport News Nuclear BWXT Los Alamos, LLC
NEEWC	National Energetic and Engineering Weapons Complex
NEPA	National Environmental Policy Act
NHMFL	National High Magnetic Field Laboratory
NM	New Mexico
NISC	Nonproliferation and International Security Center
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
OSRP	Offsite Source Recovery Program
PCBs	polychlorinated biphenyls
PF-4	Plutonium Facility 4
pRad	proton radiography
PV	photovoltaic
R&D	research and development
RANT	Radioassay and Nondestructive Testing Facility
RCRA	*Resource Conservation and Recovery Act*
RGD	radiation-generating device
RLUOB	Radiological Laboratory/Utility/Office Building
RLWTF	Radioactive Liquid Waste Treatment Facility
RMUS	Radioactive Materials User Survey
RNA	ribonucleic acid
ROD	Record of Decision
RTG	Radioisotope thermoelectric generator
SCC	Strategic Computing Complex
SERF	Sanitary Effluent Reclamation Facility
SNM	special nuclear material
SWWS	Sanitary Wastewater System
TA	Technical Area
TCP	Traditional cultural properties
TRU	transuranic
TWF	Transuranic Waste Facility
WCRRF	Waste Characterization, Reduction, and Repackaging Facility
WETF	Weapons Engineering Tritium Facility
WIPP	Waste Isolation Pilot Plant
WNR	Weapons Neutron Research

E LANL Facility Information

E.1 Introduction

This appendix characterizes the Los Alamos National Laboratory (LANL or the Laboratory) facilities and existing activities to facilitate the analysis of alternatives in this site-wide environmental impact statement (SWEIS). The purposes of this appendix are as follows:

- Present specific information on the major facilities including size, capabilities, and activities conducted in these facilities, associated hazards of those activities, and wastes generated;
- Describe any significant changes to these major facilities that have occurred since the 2008 LANL SWEIS;
- Describe other select facilities at LANL used to support the LANL mission or the basic science function; and
- Present the facilities that have reached the end of their lifecycle and are proposed for Decontamination, Decommissioning, and Demolition (DD&D) over the next 15 years.

E.2 Major Facilities

The previous LANL SWEIS' (DOE 1999 and NNSA 2008) were organized to identify "Key Facilities" to facilitate an evaluation of potential environmental impacts of operating the Laboratory. The Key Facilities were identified as:

- critical to meeting mission assignments,
- housed operations that have the potential to cause significant environmental impact,
- were of interest or concern to the public (based on comments in the SWEIS public hearings),
- would be subject to change because of U.S. Department of Energy (DOE) programmatic decisions, or
- represent the great majority of environmental risks associated with LANL operations.

For the purpose of this SWEIS, many of the major facilities were previously included as Key Facilities.

Descriptions of the major facilities, with information on operations, activities, and wastes generated are described in the sections below. Hazards are indicated as radiological, chemical, or other. Radiological hazards include low-level ionizing radiation and radiological emissions. Chemical hazards can be toxic, flammable, corrosive, poisonous, and/or carcinogenic. Other hazards include radiation-generating devices (RGDs), explosives, non-ionizing radiation, biological, storage and handling of compressed gas cylinders, and electrical hazards.

As identified in Chapter 3, Section 3.1, LANL published the 2021 Campus Master Plan (CMP) in 2021. 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 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 divides LANL into the following five planning areas:

- Core Area,
- Pajarito Corridor,
- National Energetic and Engineering Weapons Complex (NEEWC),
- LANSCE, and
- Balance of Site.

This SWEIS is organized by mission (as described in Chapter 2) and by planning area. The following subsections describe facilities within each of the five planning areas.

E.2.1 Core Area Planning Area

The Core Area Planning Area, primarily Technical Area (TA)-03, is the administration Complex that contains the Director's office, administrative offices, and support facilities. Laboratories for several divisions are in the main TA. TA-3 contains major facilities such as the Chemistry and Metallurgy Research (CMR) Building, the Sigma Complex, the machine shops, and the Materials Science Laboratory (MSL). Other buildings house central computing facilities, chemistry and materials science laboratories, Earth and space science laboratories, physics laboratories, technical shops, cryogenics laboratories, the main cafeteria, and the Study Center. TA-3 contains about 50 percent of LANL's employees. This section describes the major facilities within the Core Area Planning Area. Figure E-1 shows the major facilities within the Core Area.

E.2.1.1 CMR Building

Facility Description

The CMR building (TA-03-0029) was built in 1952 as a research facility for analytical chemistry, plutonium, and uranium metallurgy. This facility is approximately 563,601 square feet. In 1959, Wing 9 (54,000 square feet) was added to the CMR building to provide remote-handling operations that needed to be performed in hot cells[1]. Wing 9 also contains other support laboratories. In 2003, modifications to Wing 9 in the CMR Building were started (in support of the Confinement Vessel Disposition Project) to provide for the disposition of large vessels previously used to contain experimental explosive shots involving various actinides. Containment vessels were relocated from TA-55 to CMR to be remediated for disposal (LANL 2022).

During 1998, a number of studies were initiated to investigate seismic issues at TA-3. The studies found that TA-3 contained small faults with vertical displacements of 1 to 10 feet in the Bandelier tuff. The studies also determined that the CMR Facility, has extended beyond its design life and does not meet current seismic standards and safety requirements given the site conditions. Based on these findings, decisions were made to pursue minimal future upgrades, construct replacement facilities, and implement an overall exit strategy (LANL 2021B).

In 2003, DOE prepared the *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project* (CMRR EIS) to evaluate replacement of the CMR Building (NNSA 2003). The CMRR EIS analyzed the potential impacts of the proposed relocation of analytical chemistry and materials characterization activities and associated research and development (R&D) capabilities from the CMR Building to a newly constructed CMRR

[1] A hot cell is an enclosed area that allows for the remote handling of highly radioactive materials to minimize personnel exposure.

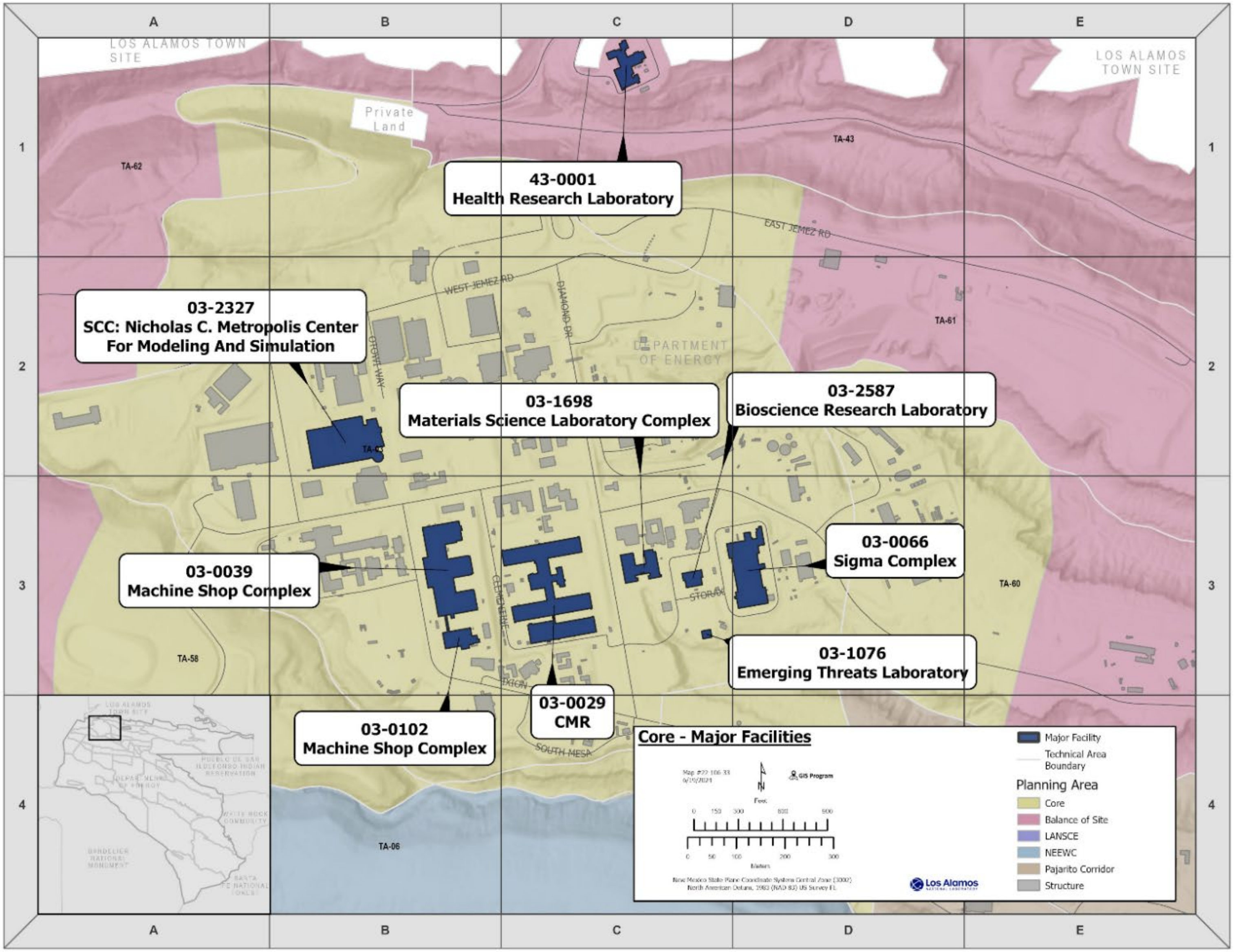


Figure E-1 Major Facilities in the Core Area Planning Area

Facility. The NNSA decision was documented in the CMRR EIS Record of Decision (ROD) (69 FR 6967; February 12, 2004) and incorporated into the proposed action for the 2008 LANL SWEIS as part of the No-Action Alternative. The CMRR Facility was to consist of: (1) a building housing administrative offices and support functions; and (2) a nuclear facility housing Hazard Category 2 (HC-2) nuclear operations. The Laboratory completed construction of the Radiological Laboratory Utility Office Building (RLUOB) in TA-55 in 2012 and the facility began operations in 2014. In August 2015, DOE cancelled construction of the replacement nuclear facility for CMR. The relocation of CMR operations to TA-59-0001, PF-4, and RLUOB is underway. The ongoing functions of RLUOB are presented in Section E.2.3.2.

Limited future operations are expected to continue in Wing 9 involving special projects, some of which may require revisions to safety basis documents. In addition to continuing the use of the hot cell capability at CMR, one other project could occur in Wing 9 through 2030:

- Material disposition project (would last approximately 24 months) involves the cleanout of nuclear material stored in CMR.

Capabilities and Activities

The CMR Facility was constructed to serve as a production, research and support center for actinide CMR and analysis, uranium processing and fabrication of weapons components. Current plans are to move these capabilities out of CMR by 2030. Once the CMR Facility is cold and dark,[2] DOE-EM would take over the facility for final closure and demolition.

Table E-1 lists the capabilities that will remain at the CMR Facility prior to the cleanout and cessation of operations. Although the large vessel processing from legacy dynamic experiments has been completed, that area could be used for size reduction activities.

Table E-1 Existing CMR Capabilities and Activity Levels

Capability	Activities
Analytical Chemistry	Support actinide research and processing activities by processing samples. From 2017 to 2022, CMR processed up to 3,150 samples per year.
Uranium Processing	Recover, process, and store LANL's highly enriched uranium inventory.
Actinide R&D	• Perform TRU waste characterization. • Analyze gas generation such as could occur in TRU waste during transportation to WIPP. Demonstrate actinide decontamination technology for soils and materials. • Develop actinide precipitation method to reduce mixed wastes in LANL effluents.
Large Vessel Handling	Process large vessels. From 2017 to 2022, CMR processed up to two large vessels per year.

CMR = Chemistry and Metallurgy Research; LANL = Los Alamos National Laboratory; TRU = transuranic; WIPP = Waste Isolation Pilot Plant

[2] Cold and dark refers to an abandoned facility where all systems have been shut down and permanently isolated.

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

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

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

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

Large Vessel Handling. Large (6 to 8 feet in diameter) experimental vessels would be cleaned and materials recovered for reuse or disposal. Large vessel handling operations would begin with unloading and opening the vessel. The vessels would then be emptied and the contents sorted and packaged.

Depending on the condition and quality of the special nuclear material (SNM) recovered from the vessels, the material could be processed for reuse or prepared for disposal as TRU waste. Other vessel contents would be disposed of as either low-level radioactive waste (LLW) or TRU waste. The empty vessel would be cleaned for disposal as LLW.

Hazards and Wastes

Based on criteria in DOE-STD-1027-92, the CMR Facility is listed as HC-2 nuclear facility. Radioactive materials are stored, handled, and processed in the CMR Facility. The risks from the wastes and hazards would be reduced as the facility undergoes physical and programmatic changes to bring it offline (LANL 2021B).

The CMR Facility generates chemical, LLW, mixed LLW (MLLW), TRU waste, and mixed TRU (MTRU) waste. The contributions to the various waste streams from the CMR Building are included in the 6-year averages in Section 4.11.2. From calendar year (CY) 2017 to CY 2022, the CMR Building has generated the following waste types (Table E-2):

Table E-2 CMR Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	155	170.6	152.9	238.8	1,259	1,129
LLW (m^3/yr)	13.7	54.8	10.8	248.5	67	84.7
MLLW (m^3/yr)	0	1.2	0	0.26	3	17.2
TRU (m^3/yr)	2.7	2.5	3.1	2.7	4	3.3
MTRU (m^3/yr)	21.6	31.8	19.4	0.42	0.2	5.4

CMR = Chemistry and Metallurgy Research; CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW; MTRU = mixed TRU; TRU = transuranic (waste)
Source: LANL (2019, 2020, 2021a, 2022, 2023a, 2024a)

Krypton-85, Xenon-131, Xenon-133 are radionuclides that might be emitted at the CMR Facility, but are not considered to be significant to offsite dose from this stack. From CY 2017 to CY 2022, the CMR Building has generated the following radioactive air emissions (Table E-3, in curies per year, Ci/yr):

Table E-3 CMR Radioactive Air Emissions Data, CY 2017–2022

Type	2017	2018	2019	2020	2021	2022
Total Actinides[a] (Ci/yr)	2.86E-06	3.88E-06	1.95E-05	2.89E-05	3.18E-05	8.27E-06

Ci/yr = curies per year; CMR = Chemistry and Metallurgy Research; CY = calendar year
a Includes plutonium-239; radioactive progeny (daughter products) are not included.
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

As presented in the 2008 SWEIS, the CMR Facility previously discharged wastewater to an NPDES-permitted outfall. Since that time, the outfall for CMR has been eliminated so that the facility no longer requires a permitted outfall and does not discharge liquid effluents to the environment.

E.2.1.2 Sigma Complex

Facility Description

The Sigma Complex consists of three principal buildings, the Sigma Building (TA-03-0066), the Beryllium Technology Facility (BTF; TA-03-0141), and the Thorium Storage Building (TA-03-0159) as well as several support and storage facilities. The Sigma Building contains four levels and approximately 200,000 square feet (60,960 square meters) of space.

The BTF, originally referred to as the Rolling Mill Building, is a nonnuclear moderate hazard facility that is used to maintain and enhance the beryllium technology base that exists at LANL and to fabricate beryllium powder components. The building was built in the early 1960s and encompasses over 20,000 square feet that houses powder metallurgy activities, filament welding, ceramics R&D, rapid-solidification research, and work with beryllium and uranium/graphite fuels. Research conducted at the BTF involves the energy- and weapons-related use of beryllium metal and beryllium oxide. As discussed in Chapter 3, Section 3.3.1 of this SWEIS, NNSA is proposing to construct a replacement BTF replacement in TA-35 to provide process improvements and to consolidate beryllium operations at the Laboratory.

The Thorium Storage Building, originally referred to as the Forming Building, is used for storing thorium in both ingot and oxide forms. To ensure material accountability and to limit radiation exposure, the building is surrounded by fencing and has its own controlled access.

A 4,000-square-foot addition was added to the Sigma Building (TA-03-0066) and plans to consolidate uranium machining operations that previously were performed in machine shops are underway (Building TA-03-102). In 2022, a new process cooling water system was installed in the Sigma Building to replace the original system from the 1950s.

In 2017, the Laboratory demolished the Press Building (TA-03-0035). This building supported early R&D of nuclear weapons during the Cold War. The building was designed specifically to house the 5,000-ton hydraulic press used in the fabrication process. The previous footprint of the Press Building is now the Bioscience Research Laboratory (TA-03-2587), a 14,000-square-foot Biosafety Level (BSL)-2 laboratory.

In 2023, the Sigma Baghouse, located on the east side of the building, was demolished. Construction of the new Graphite Storage building began in April 2024. This 4,000-square-foot building will provide needed storage space for equipment for cutting graphite prior to machining at Sigma, and a secure room with limited access to classified parts, materials and information.

Capabilities and Activities

Table E-4 lists the capabilities that are conducted at the Sigma Complex. Since the 2008 LANL SWEIS, additive manufacturing has become important in weapon design because it offers several advantages over traditional manufacturing methods, such as: milling and lathing. Additive Manufacturing has been added as a capability for the Sigma Complex.

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

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

Fabrication of Metallic and Ceramic Items. Materials fabrication includes work with metallic and ceramic materials and combinations thereof. Items are fabricated out of uranium, both depleted and enriched in uranium-235. Stainless steel, lithium, various ceramics, and beryllium items are also fabricated. Items are fabricated on a limited production basis as well as one-of-a-kind and prototype pieces. One specific set of applications for this technology is the fabrication of nonnuclear weapons components.

Table E-4 Existing Sigma Capabilities and Activity Levels

Capability	Activities
Research and Development on Materials Fabrication, Coating Joining and Processing	• Fabricate items from metals, ceramics, salts, beryllium, enriched and depleted uranium, and other uranium isotope mixtures.
Characterization of Materials	• Perform R&D on properties of ceramics, oxides, silicides, composites, and high-temperature materials. • Develop a library of aged non-SNM from stockpiled weapons and develop techniques to test and predict changes. • Store and characterize non-SNM component samples, including uranium.
Fabrication of Metallic and Ceramic Items	• Fabricate stainless steel and beryllium components for up to 80 pits per year. • Fabricate reservoirs for tritium. • Fabricate components for secondary stages per year (of depleted uranium, depleted uranium alloy, enriched uranium deuterium, and lithium). • Fabricate beryllium targets. • Fabricate targets and other components for accelerator production of medical isotopes research. • Fabricate test storage containers for nuclear materials stabilization. • Fabrication of Specialty Components. • Fabrication Utilizing Unique Materials. • Dimensional Inspection of Fabricated Components.
Additive Manufacturing	• Additive manufacturing across a range of technologies that includes forming, joining, binding, stamping, and printing three-dimensional parts.

R&D = research and development; SNM = special nuclear material

Additive Manufacturing. Additive manufacturing (AM) plays a critical role in weapon design and prototype development. This is due to the many advantages that AM offers over traditional manufacturing methods. The use for AM is rapid prototyping. Rapid prototyping is a process in which engineers can quickly create prototypes of new products without the need for expensive tooling or molds. This helps to speed up the product development cycle and get new products to market faster. At LANL, AM is important in weapon design because it offers several advantages over traditional manufacturing methods, such as: milling, lathing, stamping and joining. AM creates complex shapes that would be impossible to create using traditional methods. AM can also fabricate parts with very tight tolerances, which is critical in weapon design where even small discrepancies can have a major impact on performance.

<u>Hazards and Wastes</u>

The Sigma Complex is categorized as a radiological facility and includes operations involving plutonium and uranium in quantities that do not meet or exceed HC-3 threshold criteria. Operations of the Sigma Complex present a potential risk of worker exposure to radiological materials and beryllium.

The Sigma Complex generates LLW, MLLW, and chemical waste. The contributions to the various waste streams are included in the 6-year averages reported in Section 4.11.2. From calendar year 2017 to calendar year 2022, the Sigma Complex has generated the following waste types (Table E-5):

Table E-5 Sigma Complex Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	24,584.2	2,256.2	70,136.2	25,498.1	26,398	37,840
LLW (m^3/yr)	290.5	372.7	405.2	564.2	635	350.3
MLLW (m^3/yr)	0	20.0	29.7	24.9	31	55.8

CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

Radiological air emissions from Sigma are below levels that require direct monitoring. Minor sources like the Sigma Building are tracked administratively with the annual Radioactive Materials Usage Survey (RMUS) in addition to being monitored using the ambient air sampling network located at public locations around the Laboratory.

Table E-6 shows the NPDES Discharge Data for CY 2017-2022 for the Sigma Complex.

Table E-6 Sigma Complex NPDES Discharge Data, CY 2017–2022

Year	Outfall Number	Discharge Amount (MGY)
2017	03A022	0.48
2018	03A022	0.57
2019	03A022	1.6
2020	03A022	3.1
2021	03A022	0.74
2022	03A022	1.1

CY = calendar year; MGY = million gallons per year; NPDES = National Pollutant Discharge Elimination System
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

E.2.1.3 Materials Science Laboratory Complex

Facility Description

The MSL Complex is composed of several buildings containing laboratories, offices, materials research areas, and various support areas to primarily support the Stockpile Stewardship/Weapons Program. The main laboratory (TA-03-1698) is a two-story, approximately 55,000-square-foot building. The first floor contains a high bay and laboratories in the east wing, laboratories in the west wing and offices and conference rooms in the center. The building is designed to accommodate scientists and researchers, including participants from academia, government, and industry with a focus on materials science research.

The MSL Infill Project began in 2012 and developed about 6,000 square feet of laboratory space in an unfinished area on the second floor of TA-03-1698. Four laboratory spaces were developed and outfitted with appropriate enclosures and lab benches. The project was completed in 2014 (LANL 2016). In 2014, a new capability was added to the MSL for applied energy research.

Capabilities and Activities

The MSL Complex supports five major types of experimentation. Table E-7 lists the capabilities that are conducted at the MSL Complex.

Table E-7 Existing Materials Science Laboratory Capabilities and Activity Levels

Capability	Activities
Materials Processing	• Support development and improvement of technologies for materials formulation. • Support development of chemical processing technologies, including recycling and reprocessing techniques to solve environmental problems.
Mechanical Behavior in Extreme Environments	• Study fundamental properties of materials and characterize their performance, including research on the aging of weapons. • Develop and improve techniques for these and other types of studies.
Advanced Materials Development	• Synthesize and characterize single crystals and nanophase and amorphous materials. • Perform ceramics research, including solid-state, inorganic chemical studies involving materials synthesis. A substantial amount of effort in this area would be dedicated to producing new high-temperature superconducting materials. • Provide facilities for synthesis and mechanical characterization of materials systems for bulk conductor applications. • Develop and improve techniques for development of advanced materials. • Electroplating, surface finishing, and corrosion studies of different materials. • Development of multifunctional coatings/films via electrochemistry (e.g., electro plating/electroforming).
Materials Characterization and Modeling	• Perform materials characterization activities to support materials development. • Predict structure/property relationships of materials. • Characterization of thermophysical properties. • Measurement of the mechanical properties of metals and ceramics. • Computational materials modeling.
Applied Energy Research	Perform materials, including nanomaterials, development for catalysis, sensing photovoltaics, energy production, hydrogen storage, and functional polymer membranes.

Materials Processing. Materials processing is a capability that supports the formulation of a wide range of useful materials through the development of materials fabrication and chemical processing technologies. The following synthesis and processing techniques represent some of the capabilities available for this area of research:

- wet chemistry,
- thermomechanical processing,

- microwave processing,
- heavy-equipment materials processing,
- single-crystal growth,
- amorphous alloys, and
- powder processing.

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

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

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

Advanced Materials Development. The various laboratories are configured for development of advanced materials for high-strength and high-temperature applications. A substantial amount of effort in this area is dedicated to producing new high-temperature superconducting materials. Capabilities involve research in synthesis and characterization using ceramics, superconductors, and new materials. MSL also provides facilities for synthesis and mechanical characterization of materials systems for bulk conductor applications.

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

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

Fuel Fabrication. As discussed in Chapter 3, Section 3.4.1 of this SWEIS, NNSA is proposing to repurpose rooms in TA-35 to operate a Low-Enriched Uranium Fuel Fabrication Facility (LEFFF). The LEFFF would fabricate high-assay low-enriched uranium fuels at the scale of hundreds of kilograms per year.

Hazards and Wastes

The MSL is categorized as a radiological facility and includes operations involving radiological materials in quantities that do not meet or exceed HC-3 threshold criteria. There are many safety controls throughout the building including a wet-pipe sprinkler system; automatic fire alarms; chemical fume hoods; gloveboxes; high-efficiency particulate absorbing (HEPA)-filtered heating, ventilation, and air conditioning (HVAC); and safety showers.

The MSL generates chemical wastes. The contributions to the various waste streams are included in the 6-year averages reported in Section 4.11.2. From CY 2017 to CY 2022, the MSL has generated the following waste types (Table E-8):

Table E-8 Materials Science Laboratory Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	529.3	2.2	314.2	55.8	314	4,129.3
LLW (m^3/yr)	0	0	0	0	0	6.34
MLLW (m^3/yr)	0	0	0	0	0.1	0

CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

Radiological air emissions from this major facility are below levels that require direct monitoring. Minor sources like the MSL are tracked administratively with the annual RMUS in addition to being monitored using the ambient air sampling network located at public locations around the Laboratory.

There are no outfalls associated with this major facility.

E.2.1.4 Machine Shops Complex

Facility Description

The Machine Shops Complex consists of two buildings, the Nonhazardous Materials Workshop (Building 3-0039), also known as the Main Shops, and the Radiological Hazardous Materials Workshop (Building 3-0102). It contains approximately 181,500 square feet of floor space, including a 13,500-square-foot administrative office area and was constructed in 1953. The Radiological Hazardous Materials Workshop (also known as the Tech Shops Addition or the Uranium Shop), was constructed in 1957 and contains approximately 12,500 square feet of floor space. The buildings are connected by a corridor.

Building 3-0039 contains a variety of lathes, mills, and other metal-forming and joining equipment and also houses the old beryllium shop which is ventilated through a HEPA air filtration system. Beryllium operations in Main Shops ceased in 2001 when the material and equipment were moved to the Sigma Complex. Building 3-102 similarly contains a variety of metal fabricating machines.

A new modular inspection laboratory (known as the Mod Lab) was constructed in TA-03-0039 Room 27. The project began operations in 2021. The machine shop in Room 26 and the new inspection lab in Room 26A are referred to as the Plutonium Facility Mark Quality Manufacturing Center (LANL 2022).

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

Capabilities and Activities

Table E-9 lists the capabilities that are conducted at the machine shops. These primary capabilities and activities have not changed since 2008.

Table E-9 Existing Machine Shops Capabilities and Activity Levels

Capability	Activities
Fabrication of Specialty Components	• Provide fabrication support and explosives research studies. • Support hydrodynamic tests. Between 2017 and 2022, up to 10 hydrodynamic tests were supported per year. • Manufacture joint test stages. Between 2017 and 2022, up to 10 joint test assemblies were manufactured per year. • Conduct production work in the new Mark Quality Manufacturing Center. • Provide general laboratory fabrication support as requested.
Fabrication Utilizing Unique Materials	• Fabricate items using unique and unusual materials such as depleted uranium and lithium.
Dimensional Inspection of Fabricated Components	• Perform dimensional inspection of finished components. • Perform other types of measurements and inspections.
Additive Manufacturing	• Additive manufacturing across a range of technologies that includes forming, joining, binding, stamping, and printing three-dimensional parts (*see* Section E.2.1.1).

Fabrication of Specialty Components. The primary purpose of the machine shops is for the fabrication of specialty components. Specialty components are unique, unusual, or one-of-a-kind parts, fixtures, tools, or other equipment. These include components or equipment used in the destructive testing, replacement parts for the Stockpile Stewardship Program, and glove boxes for a variety of applications.

Fabrication Utilizing Unique Materials. Parts and components are fabricated using unique or exotic materials at the machine shops. The list of unusual or unique materials routinely used includes depleted uranium, beryllium, and lithium and its compounds.

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

Hazards and Wastes

The Machine Shops Complex is categorized as a radiological facility and includes operations involving radiological materials in quantities that do not meet or exceed HC-3 threshold criteria. Other potentially hazardous operations in the Machine Shops Complex include the use of RGDs, such as x-ray-generating equipment. Safety controls, such as enclosing x-ray tubes in steel cabinets and using interlocks and shielding devices for x-ray systems, are in place to minimize the potential of personnel exposure to x-rays.

The Machine Shops Complex generates LLW and chemical wastes. The contributions to the various waste streams are included in the 6-year averages reported in Sections 4.11.2 and 4.11.3, respectively. From calendar year 2017 to calendar year 2022, the Machine Shops Complex has generated the following waste types (Table E-10):

Table E-10 Machine Shops Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	3,145.9	11,612.1	2,269.6	3,620.7	50,395	42,430
LLW (m^3/yr)	0	46.2	0	0	80	16.49
MLLW (m^3/yr)	0	0	0	0	0	0.20

CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

The main stack at TA-03-0102 was shut down in 2011. Radiological air emissions from the Machine Shops Complex are below levels that require direct monitoring. Minor sources like TA-03-0102 are tracked administratively with the annual RMUS in addition to being monitored using the ambient air sampling network located at public locations around the Laboratory.

There are no outfalls associated with this major facility.

E.2.1.5 The Strategic Computing Complex

Facility Description

The Nicholas C. Metropolis Center or Strategic Computing Complex (SCC) is an approximately 303,000-square-foot facility. The SCC features a single vault type building located in the heart of the laboratory's core and houses a 43,500-square-foot computer room for advanced high-performance supercomputing. The SCC also has over three hundred office spaces for high-performance computing and weapons designer staff. The facility has a large auditorium, several conference rooms, classrooms, break areas, visualization theaters, and collaboration laboratories. All aspects of the SCC facility design were specifically aimed at providing the Laboratory with the most current technologies to support secure, high-performance computing (HPC).

The SCC hosts two interconnected capabilities: HPC and visualization technologies. The facility houses some of the world's fastest supercomputers and is adjacent to the Nonproliferation and International Security Center, which was built to increase the efficiency and effectiveness of support to the NNSA Office of Nonproliferation and International Security by consolidating personnel at a central LANL location. The SCC plays a critical role in stockpile stewardship, including use in Lifetime Extension Programs and Alterations. Operating the supercomputers and the computer cooling systems requires 40 MW of power – more than the Los Alamos township (LANL 2016).

Several supercomputers have been housed in the SCC in TA-3 since 2008, including, Roadrunner, Trinity, Fire, Ice, Cyclone, and now Crossroads, Rocinante, Tycho and Venado. Rocinante and Tycho are part of the 2nd generation of Commodity Technology Systems, known as CTS-2. The electrical and mechanical systems in the SCC continue to be expanded to meet the new computers' requirements and to allow for future expansion. In 2021, the Laboratory completed the Exascale Class Computer Cooling Equipment Project, which expanded the water-cooling capability of the SCC by 4,800 tons (LANL 2022, NNSA 2020).

The newest supercomputers in the SCC are Advanced Technology System (ATS)-3, referred to as Crossroads, Venado, and Rocinante and Tycho (CTS-2). Crossroads is the current supercomputer utilized to serve the mission of national security science and runs some of the largest and most demanding simulations for stockpile stewardship. The Crossroads system has improved efficiency in three key areas: application performance, workflow, and application development. Crossroads became fully operational in 2024. The second generation of Commodity Technology Systems became operational in 2023. Venado became operational in 2024 and serves giant-scale artificial intelligence (AI) applications. Collectively, these systems required the additional cooling and power for up to 10 exaflops of computing. The power distribution within the SCC has been modified to maximize power to the computer floor. In 2025, the Laboratory anticipates installing new AI systems in support of national defense. In 2027, the Laboratory expects to install the newest supercomputer (ATS-5) in the existing building as identified in Chapter 3, Section 3.2.3.

HPC operations are anticipated to continue in the SCC with an emerging AI program likely maximizing the capabilities of the SCC. As described in Section 3.4, planning for future supercomputing infrastructure is underway. Plans include one or more new HPC and supporting facilities with multiple locations available to provide sufficient power and cooling needed to fulfill the Advanced Simulation and Computing Program, emerging AI program, and Stockpile Stewardship Program requirements anticipated in 2030 until 2050.

Capabilities and Activities

Table E-11 lists the capabilities that are conducted at the SCC.

Table E-11 Existing SCC Capabilities and Activity Levels

Capability	Activities
Computer Simulations	• Perform complex three-dimensional computer simulations to estimate nuclear yield and aging effects to demonstrate nuclear stockpile safety. • Apply computing capability to solve other large-scale, complex problems.
Artificial Intelligence	• Training AI models. • Petascale and above data management activities to support AI processing. • User systems to present AI models to scientists.

AI = artificial intelligence; SCC = Strategic Computing Complex

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

Artificial Intelligence. Developing, training and using models for AI applications for national defense. There is significant overlap with HPC and computer simulations and co-location of the solutions enables an integrated approach. Significant data systems and management will be necessary to effectively train and use the AI models.

Hazards and Wastes

The SCC is a general industry facility. As such, the only hazardous materials present are industrial cleaning agents, equipment lubricating oils, and maintenance solvents and chemicals used for maintaining the cooling system, such as biocide, corrosion inhibitor, and chlorine. The SCC consists of offices and computing facilities only. No radioactive, hazardous, or mixed wastes are generated during normal operations.

The SCC is permitted to discharge cooling tower blowdown to either Outfall 03A027 or Outfall 001. Since 2016, there has not been discharge to Outfall 03A027. Table E-12 shows discharge information for CY 2017 to CY 2022.

Table E-12 SCC NPDES Discharge Data, CY 2017–2022

Year	Outfall 001 Discharge Amount (MGY)
2017	14.7
2018	19.5
2019	10.2
2020	10.3
2021	12.17
2022	13.8

CY = calendar year; MGY = million gallons per year; SCC = Strategic Computing Complex;
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

E.2.1.6 Bioscience Facilities

Facility Description

Spread across TAs-3, -16, -35, -43, -46, -59, and the Bioscience Facilities have BSL-1 and BSL-2 laboratories and are the focal point of bioscience and biotechnology at LANL. The major Bioscience facilities include the Health Research Laboratory (TA-43-0001), the Bioscience Research Laboratory (TA-03-2587), the Emerging Threats Laboratory (TA-03-1076), the Research Park (TA-03-4200), and the offsite leased Entrada Facility (TA-00-0799) and the Bioscience Lab Office, Operations and Management (TA-00-0846).

The Bioscience Facilities focus on the study of intact organs and cells, cellular components (ribonucleic acid [RNA], deoxyribonucleic acid [DNA], and proteins), instrument analysis (sequencing, flow cytometry, and mass spectroscopy), human animal and plant cellular systems (repair, growth, and response to stressors), and chemical-biological threats to systems. Activities other than theoretical, computations, or paper studies are subject to review and approval by internal organizations. External organizations such as the Centers for Disease Control and Prevention and the National Institutes of Health also review and approve projects for which they provide funding.

Work with biohazardous agents is reviewed and approved by the LANL Institutional Biosafety Committee, which includes members that are both internal and external to LANL organizations.

During 2004, the Laboratory constructed what was originally intended to be a BSL-3 facility (TA-03-1076) in TA-3. Building 1076 is a windowless, single-story, 3,200-square-foot, standalone biocontainment facility. NNSA withdrew the NEPA coverage for the facility and it did not begin operations. In 2018, the Laboratory revised the proposed use of the facility to enable BSL-2 and chemical operations. In 2019, the building underwent significant upgrades to the heating, ventilation, and air conditioning control systems and other facility systems. One laboratory space is proposed to be used for selecting agents and one to be used for potential chemical and biological toxins. Building occupancy was transferred to the Bioscience Division, and they initiated programmatic startup plans. The newly named Emerging Threats Laboratory was undergoing programmatic startup in 2022 and expected to begin operations in 2024 (LANL 2023a).

Capabilities and Activities

Table E-13 lists the capabilities that are conducted at the Bioscience Facilities.

Table E-13 Existing Bioscience Facilities Capabilities and Activity Levels

Capability	Activities
Biologically Inspired Materials and Chemistry	• Determine formation and structure of biomaterials for bioenergy. • Synthesize biomaterials. • Characterize biomaterials.
Cell Biology	• Study stress-induced effects and responses on cells. • Study host-pathogen interactions. • Determine effects of chemical and biological exposure.
Computational Biology	• Collect, organize, and manage information on biological systems. • Develop computational theory to analyze and model biological systems.
Environmental Microbiology	• Study microbial diversity in the environment; collect and analyze environmental samples. • Study biomechanical and genetic processes in microbial and plant systems. • Develop biological systems for bioenergy and biomanufacturing applications.
Genomic and Proteomic Science	• Analyze genes of living organisms such as humans, animals, microbes, viruses, plants, and fungi. • Develop and implement high-throughput tools Perform genomic and proteomic analysis. • Study pathogenic and nonpathogenic systems.
Measurement Science and Diagnostics	• Develop and use flow cytometry, sequencing, and mass spectrometry tools to study cells, molecules, and molecular systems. • Perform genomic, proteomic, and metabolomic studies.
Molecular Synthesis	• Synthesize molecules and materials. • Perform spectroscopic characterization of molecules and materials. • Develop new molecules that incorporate stable isotopes. • Develop chem-bio sensors and assay procedures. • Synthesize polymers and develop applications for them.

Capability	Activities
Structural Biology	• Research three-dimensional structure and dynamics of macromolecules and complexes Use various spectroscopy techniques.
Pathogenesis	• Perform genome-scale, focused, and computationally enhanced experimental studies on pathogenic organisms.

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

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

Studies in cell biology are directed at understanding cellular responses to environmental insults, particularly effects resulting from ionizing radiations and reactive oxygen species. Focal areas of study include cell cycle regulation, apoptosis (programmed cell death), reproductive inactivation, senescence, DNA repair, genomic instability, cell immortalization, and tumorigenesis. In addition, a cancer risk assessment initiative has been initiated that involves identifying cancer susceptibility gene candidates and the development of biomarkers to assess cancer risk in individuals before and after exposure to carcinogens. A new area of interest for this group is the identification of cell-derived mediators of genetic change.

As with genomics, standard molecular and biochemical methods including hybridization, sequence analysis, and electrophoretic and chromatographic separations are used in this research.

Sealed radioactive sources are used to irradiate test material and cause damage. Radioactive tracers (beta-emitters with half-lives less than 85 days, such as phosphorus-32 and sulfur-35) are used to study damage and repair mechanisms at the molecular level. These studies have numerous internal and external collaborations that provide flexibility in direction and scope.

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

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

The environmental biology programs focus on microbial ecology in stressed environments to understand and predict how components of an ecosystem respond to human-induced changes in the environment. Unique DNA/protein signatures of microorganisms are studied to understand how these respond to changes.

Genomic and Proteomic Science. This capability emphasizes development and implementation of high-throughput tools and technologies for understanding biology at the systems level in living organisms from mammalian cells, microbes (including viruses), plants, fungi, and other species. Researchers perform genomics, transcriptomics, proteomics, metabolomics and bioinformatics and are involved in development of high-throughput technologies for high-affinity, high-specificity ligand generation, and expression arrays. This capability focuses on pathogen and environmental microbial sequencing and comparative genomics and on affinity tag production for detection and sensing applications in support of biothreat reduction and environmental bioscience work.

Measurement Science and Diagnostics. These activities encompass a broad set of technologies including sequencing, flow cytometry, mass spectrometry, imaging microscopy and spectroscopy for understanding molecular dynamics and structure for biomedical and environmental applications. These technologies provide the platforms and data that can lead to new strategies for detection and sensing technologies.

Molecular Synthesis. Work in this area includes synthesis, materials preparation, and spectroscopic characterization of a variety of compounds. Current work is focused on creating new molecules using natural and enriched stable isotopes for biomolecular structure analysis, observation of specific chemical groups, and use as standards in detection of chemical agents and biological toxins. Additional work in this area includes creating chemical and biological microsensors for detection and sensing.

Structural Biology. This research focuses on determination and analysis of three-dimensional structures and dynamics of macromolecules and the complexes that they form. Experimental and computational techniques include nuclear magnetic resonance, time-resolved vibrational spectroscopies, and analysis of cryo-EM data.

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

All these capabilities also include the ability to undertake classified laboratory and information processing and analysis projects.

Hazards and Wastes

Hazards associated with operations of the Bioscience Facilities include electrical hazards (high voltage), hazardous and toxic materials, and risk group 1 and 2 (RG-1 and RG-2) biological materials. RG-1 materials include live agents or materials commonly used in research, university, college, and hospital settings; RG-1 materials are not infectious to humans. RG-1 materials used in the facility include recombinant DNA work. RG-2 materials include agents associated with human disease that are rarely serious and for which preventative or therapeutic interventions are often available. RG-2 materials used in Building 132N include infectious agents; tissues, including blood; or other items such as sewage, which may contain biologically hazardous agents and toxins produced by living organisms. Controls for these hazards are specified in work control documents and facility safety plans.

From 2017 to 2022, the Bioscience Facilities generated the following waste types (Table E-14).

Radiological air emissions from the Health Research Laboratory are below levels that require direct monitoring. Minor sources like the Health Research Laboratory are tracked administratively with the annual RMUS in addition to being monitored using the ambient air sampling network located at public locations around the Laboratory.

There are no outfalls associated with this major facility.

Table E-14 Bioscience Facilities Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	1,879.3	2,615.1	2,264.8	4,501.3	6,581	3,113.7
LLW (m^3/yr)	0	0	0	2.6	0	0
MLLW (m^3/yr)	0	0	0	0	0	0.51

CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW

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

E.2.2 National Energetic and Engineering Weapons Campus (NEEWC) Planning Area

The NEEWC is the HE, engineering, and environmental testing planning area for the weapons programs at the Laboratory. It is 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. Figure E-2 shows the major facilities within the NEEWC Planning Area.

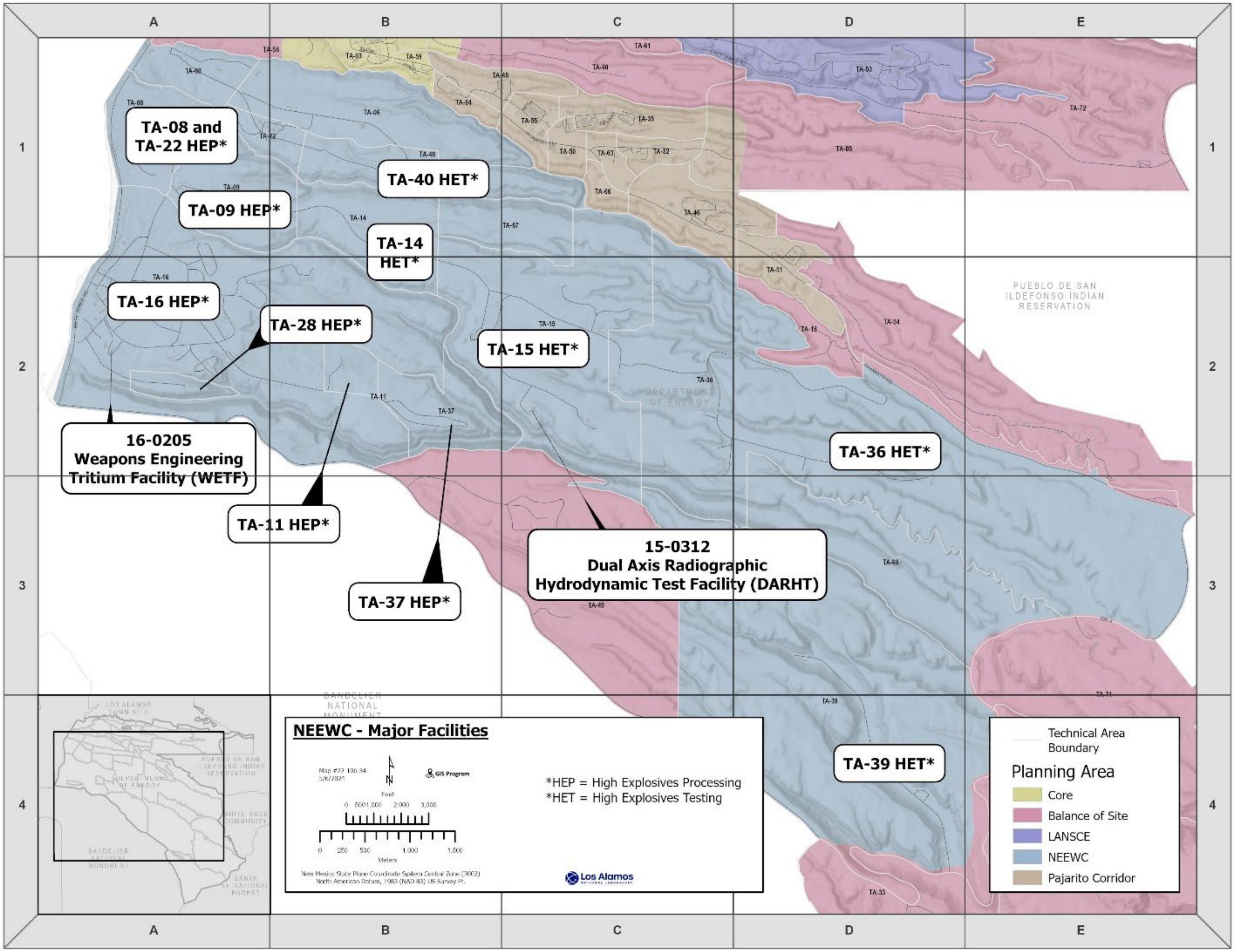


Figure E-2 Major Facilities in the NEEWC Planning Area

E.2.2.1 High Explosives Processing Facilities

Facility Description

High Explosives Processing Facilities are located in six TAs: -8, -9, -11, -16, -22, and -37. These facilities include production and assembly buildings, analytical laboratories, explosives storage magazines, and a building to treat wastewater contaminated with explosives. Activities within the High Explosives Processing Facilities consist primarily of the manufacture and assembly of detonators for nuclear weapons HE components for Stockpile Stewardship Program tests and experiments and work conducted under the global security/threat reduction missions. Environmental, performance, and safety tests are performed at TAs-9, -11, and -16. TA-8 houses nondestructive testing, including radiography and ultrasonic activities (LANL 2023a). These facilities have a collective footprint of approximately 25,000 square feet.

Capabilities and Activities

Table E-15 lists the capabilities that are conducted at the High Explosives Processing Facilities.

Table E-15 Existing High Explosives Processing Capabilities and Activity Levels

Capability	Activities
Volume of Explosives Required[a]	High explosives processing activities would use approximately explosives mock explosives annually. Between 2017 and 2022, up to 12,000 pounds (5,454 kilograms) of high explosives and up to 1,000 pounds (454 kilograms) of mock explosives materials were used annually. Mock and some high explosives material are recycled when possible.
High Explosives Synthesis and Production	• Perform high explosives synthesis and production R&D. • Produce new materials for research, stockpile, security interest, and other applications. • Formulate, process test, and evaluate explosives.
High Explosives Development and Characterization	• Evaluate stockpile returns and materials of specific interest. • Develop and characterize high explosives for stockpile, military, and security interest improvements. • Improve predictive capabilities. • Research high explosives waste treatment methods.
High Explosives and Plastics Fabrication	• Perform stockpile surveillance and process development. • Supply parts to the Pantex Plant for surveillance and stockpile rebuilds and joint test assemblies. • Fabricate materials for specific military, security interest, hydrodynamic, and environmental testing.
Test Device Assembly	• Assemble test devices. • Perform radiographic examination of assembled devices to support stockpile related hydrodynamic tests, joint test assemblies, environmental and safety tests, and R&D activities. • Support major hydrodynamic test device assemblies per year. From 2017 to 2022, up to 363 device assemblies were conducted annually.
Safety and Mechanical Testing	• Conduct safety and environmental testing related to stockpile assurance and new materials development. • Conduct safety and mechanical tests per year

Capability	Activities
Research, Development, and Fabrication of High-Power Detonators	• Continue to support stockpile stewardship and management activities. • Manufacture major product lines. From 2017 to 2022, up to two major product lines were manufactured annually. • Support DOE-wide packaging and transport of electro-explosive devices.

R&D = research and development
a The total amount of explosives and mock explosives used across all activities is an indicator of overall activity levels.

High Explosives Synthesis and Production. Activities under this capability include explosive manufacturing capacity such as synthesizing new explosives and manufacturing pilot-plant quantities of raw explosives and plastic-bonded explosives. These operations allow the LANL contractor to develop and maintain expertise in explosive materials and processes that is essential for long-term maintenance of stockpile weapons and materials. Most of the high explosive synthesis and small-scale production activities are conducted at TA-9. War Reserve detonator testing and production is conducted at TA-22, as discussed below under Research, Development, and Fabrication of High-Power Detonators.

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

A thorough understanding of the chemical and physical properties of these materials is necessary to effectively model weapons behavior.

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

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

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

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

Hazards and Wastes

Hazardous materials in the High Explosives Processing Facilities are used in HE synthesis and formulation, HE properties characterization, assembly of explosives experiments, hand processing of explosives, combustion and detonation calorimetry, shock-loading experiments, detonation experiments, and various support shop operations. Hazard sources associated with operations include intentional detonation of HE; high-voltage power; toxic, reactive, flammable, and corrosive materials; and ionizing and non-ionizing radiation. Hazardous chemicals include explosives, organic solvents, inorganic and organic acids and bases, inorganic salts, oxidizers, liquid fuels, thermites, reactive metals, compressed gases, and industrial products (e.g., adhesives, fillers, and cleaning materials). Hazardous chemicals may be irritating, toxic, corrosive, reactive, flammable, carcinogenic, and/or mutagenic. Health hazards include chemical burns to the skin, eye injuries, and exposures from inhalation. Other hazards include ingestion, or absorption of chemicals through the skin, and reproductive hazards. The physical hazards include flammability, reactivity, and corrosivity. The High Explosives Processing Facilities generate LLW, MLLW, and chemical wastes. The contributions to the various waste streams are included in the 6-year averages reported in Sections 4.11.2 and 4.11.3, respectively. From 2017 to 2022, the High Explosives Processing Facilities generated the following waste types (Table E-16):

Table E-16 High Explosives Processing Facilities Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	57,463.94	77,739	41,771.2	67,829.9	186,899	267,995.8
LLW (m^3/yr)	5.4	0	7.8	0	65	5.42
MLLW (m^3/yr)	0	0	0	0	17	4.9

CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW

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

There are several stacks and diffuse sources that are below levels that require direct monitoring for radiological air emissions at the High Explosives Processing Facilities. Minor stacks are tracked administratively with the annual RMUS. All non-point sources are measured using ambient air measurements at public receptor locations to evaluate compliance from diffuse emissions.

The 2008 SWEIS identified three NPDES-permitted outfalls for the High Explosives Processing facilities. There is currently only one permitted outfall (05A055) as a result of the outfall minimization program. Over the past 6 years, there have been no wastewater discharges to that outfall.

E.2.2.2 High Explosives Testing Facilities

Facility Description

The High Explosives Testing Facilities are located in multiple technical areas throughout the NEEWC Planning Area. These facilities, which include approximately 16 firing sites, occupy approximately 22 of LANL's 40 square mile land area. The facilities that make up the explosives testing operations are used primarily for research, development, test operations, and detonator development and testing related to the Stockpile Management Program supporting the weapons program. Varying building functions within the facilities consist of preparation and assembly of test devices, bunkers, analytical laboratories, testing facilities, HE storage magazines, waste treatment, and offices. The firing sites are located in remote locations and canyons and specialize in experimental studies of the dynamic properties of materials under high-temperature and high-pressure conditions.

Since 2008, the Laboratory has implemented several safety upgrades at the various firing sites for the protection of human health and to minimize potential environmental impacts. Some examples of these upgrades include (LANL 2022):

- The 2018 upgrades at the Eenie Firing Site in TA-36 included upgraded communications and power installations, relocated sirens and light equipment, and paving of the surrounding area of the firing point to maintain the facility for explosives operations.
- In 2017, the Laboratory installed a concrete pad and replaced the blast tube at the Lower Slobbovia Firing Site in TA-36.
- The Laboratory constructed a new steel building in TA-40 (Building 15) to enclose the existing firing point and to allow for year-round firing operations.
- The Laboratory implemented new fuel treatment prescriptions at all firing sites to minimize wildfire risks. For example, the prescriptions at Lower Slobbovia included a hardened 6-foot by 4-inch fire break surrounding the firing site.
- The Laboratory built a "drop tower" at the Meenie/Bravo firing site at TA-36 in the high-explosives area. The site, which includes a bunker, was in need of repairs to accommodate the new tower structure and return to service (LANL 2021b).
- In 2019, the Laboratory completed construction of a domestic and fire suppression water line from the DARHT Facility to the firing sites in TA-36. Lateral waterlines were installed from the main line to the existing facilities at the Eenie, Meenie, Minie, Moe, Abner, and Lower Slobbovia firing sites. Fire hydrants were installed within 300 feet of each firing site.

In 2017, LANL completed construction of the Dynamic Equation of State Facility, a 15,000-square-foot facility that consolidated TA-39 powder and gas gun activities. The facility relocated three gas gun facilities from TA-39 (Ancho Canyon) to TA-40 while closing the gas gun facilities and their supporting structures in TA-39. The facility replaced six facilities and reduced LANL's footprint by approximately 5,000 square feet (LANL 2019).

Capabilities and Activities

Table E-17 lists the capabilities that are conducted at the High Explosives Testing Facilities.

Table E-17 Existing High Explosives Testing Facilities Capabilities and Activity Levels

Capability	Activities
Volume of Materials Required[a]	• Conduct experiments. From CY 2017 to CY 2022, up to 650 experiments were conducted per year. • Use depleted uranium in experiments annually. From CY 2017 to CY 2022, up to 1,657 pounds of depleted uranium were depleted annually.
Hydrodynamic Tests	• Develop containment technology. • Conduct baseline and code development tests of weapons configuration. • Conduct major hydrodynamic tests.
Dynamic Experiments	Conduct dynamic experiments to study properties and enhance understanding of the basic physics and equation of state and motion for nuclear weapons materials, including some SNM experiments.
Explosives Research and Testing	Conduct tests to characterize explosive materials, as well as synthesis and formulation activities.
Munitions Experiments	• Support the U.S. Department of Defense with R&D of conventional munitions. Conduct experiments to study external stimuli effects on munitions.

CY = calendar year; R&D = research and development; SNM = special nuclear material

a This is not a capability. The total volume of materials required across all activities is an indicator of overall activity levels for this major facility.

Hydrodynamic Tests. Hydrodynamic tests are dynamic integrated systems tests of mockup nuclear packages during which high explosives are detonated and resulting motions and reactions of materials and components are observed and measured. Explosively generated pressures and temperatures cause some materials to behave hydraulically (like a fluid). Surrogate materials such as depleted uranium replace actual weapons materials in the mockup nuclear weapons package to ensure there is no potential for a nuclear explosion. Most hydrodynamic tests are conducted in TA-15 at the DARHT Facility as the primary location, with other tests conducted at TA-36 are conducted at TA-36.[3]

Dynamic Experiments. These are experiments designed to provide improved knowledge of plutonium material properties, including equation of state and strength, over broad ranges of relevant pressures, temperatures, and time scales. These experiments range from essentially static experiments, such as diamond anvil cell and quasi-static load frame, to increasingly dynamic experiments, such as gas-gun-driven, pulsed-power-driven, SNM-mated-to-high-explosives-driven, and laser-driven experiments. None of these experiments reaches nuclear criticality or involves self-sustaining nuclear reactions.

Most dynamic experiments are conducted at TA-36; some are conducted at TA-39 and TA-40. DOE could perform dynamic experiments using plutonium in the future at DARHT and other

[3] In 1995, DOE prepared the DARHT EIS to address the need to improve its radiographic hydrodynamic testing capability in order to ensure continued confidence in the safety and reliability of the U.S. nuclear weapons stockpile. The 2008 SWEIS included the DARHT facility within the High Explosives Testing Facilities capabilities and activity levels. A more detailed description of DARHT is included in Section E.2.2.3 below.

facilities. Dynamic experiments involving plutonium would be conducted inside containment vessels and would be performed in accordance with the DARHT Safety Assessment Document.

Explosives Research and Testing. Explosives research and testing activities would be conducted primarily to study properties of the explosives themselves as opposed to explosive effects on other materials. Examples include tests to determine effects of aging on explosives, safety and reliability of explosives from a quality assurance point of view, and development of new energetic materials. Explosives research and testing activities are performed at various facilities throughout the campus as well as any of the High Explosives Testing sites.

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

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

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

Other Explosives Testing. This capability includes activities such as advanced high explosives development and work to improve weapons evaluation techniques, as well as analytical bench top testing and analysis.

Hazards and Wastes

Hazardous materials in the High Explosives Testing Facilities are used in HE synthesis and formulation, HE properties characterization, assembly of explosives experiments, hand processing of explosives, combustion and detonation calorimetry, shock-loading experiments, detonation experiments, and various support shop operations. Hazard sources associated with operations include intentional detonation of high-explosives; high-voltage power; toxic, reactive, flammable, and corrosive materials; and ionizing and non-ionizing radiation. Hazardous chemicals include explosives, organic solvents, inorganic and organic acids and bases, inorganic salts, oxidizers, liquid fuels, thermites, reactive metals, compressed gases, and industrial products (e.g., adhesives, fillers, and cleaning materials). Hazardous chemicals may be irritating, toxic, corrosive, reactive, flammable, carcinogenic, and/or mutagenic. Health hazards include chemical burns to the skin, eye injuries, and exposures from inhalation. Other hazards include ingestion, or absorption of chemicals through the skin, and reproductive hazards. The physical hazards include flammability, reactivity, and corrosivity.

All non-point sources are measured using ambient air measurements at public receptor locations to evaluate compliance from diffuse emissions.

There are no outfalls associated with this major facility.

The High Explosives Testing Facilities generate LLW, MLLW, and chemical wastes. The contributions to the various waste streams are included in the 6-year averages reported in Sections 4.11.2 and 4.11.3, respectively. From 2017 to 2022, the High Explosives Testing Facilities generated the following waste types (Table E-18):

Table E-18 High Explosives Testing Facilities Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	496,598.9	25,468.6	193,216.3	213,103.3	179,425	148,267
LLW (m^3/yr)	490.9	102.1	63.9	115.3	446	293.5
MLLW (m^3/yr)	2.49	0	0	0	0	0

CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW

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

E.2.2.3 Dual Axis Radiographic Hydrodynamic Test (DARHT)

<u>Facility Description</u>

The DARHT Facility (TA-15-0312) is located on approximately 20 acres in TA-15 and is a fundamental component of the High Explosives Testing Facilities at LANL. DARHT is primarily used to conduct hydrodynamic experiments for the Stockpile Stewardship/Weapons Program, which are high-explosives-driven experiments to assess the performance and safety of nuclear weapons. They are coupled with HPC modeling and simulation to certify, without underground nuclear testing, the safety, reliability, and performance of the nuclear physics package of weapons. During a nuclear weapon function test, the behavior of solid materials is similar to liquids, hence the term "hydrodynamic." DARHT may conduct dynamic and hydrodynamic experiments that involve surrogate or SNM that can be static experiments or increasing levels of dynamic-driven devices such as high explosives or lasers. All experiments using SNM and high explosives would be in double-contained vessels and further isolated inside of a metal building. These experiments would not be able to achieve criticality. Surrogate materials such as depleted uranium, tungsten, lead, and gold can be used to replace actual weapons materials in the test assemblies to ensure there is no potential for a nuclear explosion.

DARHT houses two linear-induction accelerators at right angles to one another. A linear-induction accelerator uses magnetic cores to enable better coupling of electrostatic fields, thus accelerating electrons or other particles to extremely high energies. As high-energy electrons hit the target, the electrons are deflected, converting the beam's kinetic energy to powerful x-rays. Such radiographs help scientists ensure that weapons in the stockpile are safe, effective, and will perform as designed (LANL 2022).

A new vessel cleanout facility was constructed in 2021 across from Building 15-534. The new facility houses two repair bays with duplicate equipment, thereby allowing two vessels to be repaired in parallel. Inspections will continue to be conducted at Building 15-285. This support facility doubles the number of vessels that can be rehabilitated (NNSA 2018a, LANL 2021B).

<u>Capabilities and Activities</u>

DARHT is used to study the implosion of mock nuclear weapons primaries. This information assists NNSA with its stockpile stewardship and management mission to ensure the continued safety and reliability of nuclear weapons in the enduring stockpile, and to further a basic scientific understanding of the behavior of nuclear weapons.

- Conduct dynamic experiments with metals, composites, or other materials to obtain more information about their physical and chemical properties.
- Help other nations evaluate the condition, safety, and reliability of their existing nuclear weapons under current international agreements and any future agreements.
- Assess the condition, safety, performance, and reliability of other nuclear weapons, such as those designed by a non-friendly nation or a terrorist and obtained by the United States.
- Assist the Department of Defense with evaluations of conventional weapons and other military equipment.
- Study explosives-driven materials and high-velocity impact phenomena for non-weapons applications and other uses of interest to industry.
- Pursue other applications of radiography or accelerator technology and other equipment developed for high-resolution radiography (LANL 2020).

In 2000, DARHT's first single-axis hydrodynamic test was conducted, and nine years later achieved its first dual-axis, multi-frame hydrotest in 2009.

Open-air detonations occurred from 2000 to 2002, detonations using foam mitigation were conducted from 2003 to 2006, and detonations within closed steel containment vessels have been conducted since 2007. These closed steel containment vessels are reused so they require decontamination, repair, and inspection after each shot to allow reuse. NNSA could perform dynamic experiments using plutonium in the future at DARHT. Dynamic experiments involving plutonium would be conducted inside containment vessels.

Table E-19 lists the capabilities that are conducted at the DARHT Facility.

Table E-19 Existing DARHT Capabilities and Activity Levels

Capability	Activities
Hydrodynamic Tests	• Develop containment technology. • Conduct baseline and code development tests of weapons configuration. • Conduct hydrodynamic tests per year. From CY 2017 to CY 2022, up to 10 hydrodynamic tests per year have been conducted at DARHT.
Dynamic Experiments	Conduct dynamic experiments to study properties and enhance understanding of the basic physics and equation of state and motion for nuclear weapons materials, including some SNM experiments. Static experiments are conducted annually to support mission needs.
Enhanced Radiography	Conduct radiographic hydrodynamic tests and dynamic experiments.

CY = calendar year; DARHT = Dual Axis Radiographic Hydrodynamic Test

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

Dynamic Experiments. These are experiments designed to provide improved knowledge of plutonium material properties, including equation of state and strength, over broad ranges of relevant pressures, temperatures, and time scales. These experiments range from essentially static experiments, such as diamond anvil cell and quasi-static load frame, to increasingly dynamic experiments, such as gas-gun-driven, pulsed-power-driven, SNM-mated-to-high-explosives-driven, and laser-driven experiments. None of these experiments reaches nuclear criticality or involves self-sustaining nuclear reactions.

Enhanced Radiography. Obtain high-resolution, multi-time, multi-view information needed to assess safety, performance, and reliability of weapons; evaluate aging weapons; obtain information about plutonium through dynamic experiments; and for other uses.

Hazards and Wastes

Potential hazards present at DARHT include standard industrial hazards, chemical hazards, radioactive source hazards, and magnetic field hazards. Several special fluids, gases, and materials are used in the accelerator or on the firing point in larger quantities than usual laboratory or industrial applications. These materials include sulfur hexafluoride (SF_6), insulating oil, ethylene glycol, deionized water, compressed gases, and beryllium.

Insignificant amounts of nonradioactive hazardous materials are produced from DARHT operations. Debris from firing operations may be present in the soil around the firing site. Materials for the construction of the accelerator and beam stop were chosen to minimize hazards from induced radiation. Only sealed radioactive sources are allowed inside the DARHT. The activity associated with sealed sources is small and inconsequential when compared to the radionuclide inventory of the beam stops. Magnetic field hazards up to 2 kilogausses can extend into spaces accessible by a human hand near the accelerator. Stray fields can range from 10 to 100 gauss. Magnetic fields are pulsed, with duration of less than 1 minute and repetitive rates greater than 1 minute (LANL 2020). Table E-20 shows the waste data for CY 2017 to CY 2022 for DARHT.

Radiological air emissions from DARHT are below levels that require direct monitoring. Minor sources like DARHT are tracked administratively with the annual RMUS in addition to being monitored using the ambient air sampling network located at public locations around the Laboratory.

Table E-20 DARHT Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	48,661.3	17,158.5	39,856.6	17,904	35,775.1	5,861.3
LLW (m^3/yr)	0	0	0	36.1	50.7	0.41

DARHT = Dual Axis Radiographic Hydrodynamic Test; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year

Note: SWEIS Yearbooks for CY 2017 to CY 2022 included DARHT Waste Data within the High Explosives Testing Facility as part of that Key Facility total.

In 2010, the Laboratory connected the DARHT cooling tower outfall and septic system into the LANL sanitary sewer. This eliminated the discharge of cooling tower water to one of LANL's NPDES outfalls and removed the septic system for the DARHT complex. There are no permitted outfalls for DARHT.

E.2.2.4 Weapons Engineering Tritium Facility (WETF)

Facility Description

The WETF is in TA-16 (Building 16-0205), also referred to as S-site, and is the principal building in the WETF. It contains approximately 11,000 square feet. It was first placed into service in 1989, with the first tritium operations in 1992. The mission of WETF is to perform R&D and to process tritium to meet the requirements of the present and future Stockpile Stewardship Program, while providing protection for LANL workers, the public, and the environment. The tritium-processing activities performed by WETF support the nuclear weapons program and other programs at LANL.

Capabilities and Activities

Typical WETF tritium-processing activities include repackaging tritium into smaller quantities, removing helium-3 decay products and other impurities from gaseous tritium, mixing tritium with other gases, analyzing tritium mixtures, loading tritium onto getter or storage materials, repackaging tritium and other gases to user specifications, loading targets, performing various user-defined experiments with tritium, unloading (depressurizing) containers of tritium, and functionally testing weapons components that contain tritium.

The Tritium Gas Handling Systems are the primary systems used to supply tritium to the processing activities at WETF. The Tritium Gas Handling Systems are a collection of piping, valves, pumps, instrumentation, and other equipment designed to provide the flexibility to perform a wide variety of tritium operations to meet programmatic requirements. The systems provide primary containment for the tritium and are normally enclosed in gloveboxes, which are monitored inside for oxygen, tritium content, and ambient pressure. Under normal operating conditions, very small amounts of tritium that may leak from equipment inside a glovebox are contained by the glovebox and purged through the Tritium Waste Treatment System for tritium removal. The Tritium Waste Treatment System removes tritium from the gaseous effluents of various sources before the effluents are released to the environment through the facility stack.

Table E-21 lists the capabilities that are conducted at the WETF Facility.

Table E-21 Existing WETF Capabilities and Activity Levels

Capability	Activities
High-Pressure Gas Fills and Processing	Handle and process tritium gas. Between CY 2017 and CY 2022, up to two hydride transport vessel fills for an approximate 15 grams was completed per year.
Gas-Boost System Testing and Development	Conduct gas-boost system R&D and testing and gas processing operations. From CY 2017 to CY 2022, up to four gas-boost system tests (all below 100 grams) and 14 associated gas analyses and processing were performed per year.
Diffusion and Membrane Purification	• Conduct research on gaseous tritium movement and penetration through materials. • Use this capability for effluent treatment.
Metallurgical and Material Research	Conduct metallurgical and materials research and applications studies and tritium effects and properties R&D. Small amounts of tritium would be used for these studies.
Gas Analysis	Measure the composition and quantities of gases (in support of tritium operations).
Calorimetry	Perform calorimetry measurements in support of tritium operations.
Solid Material and Container Storage	Store tritium inventory in process systems and samples, inventory for use, and waste. From CY 2017 to CY 2022, up to 240 grams of tritium was stored.
Hydrogen Isotopic Separation	Perform R&D of tritium gas purification and processing.

CY = calendar year; R&D = research and development; WETF = Weapons Engineering Tritium Facility

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

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

Diffusion and Membrane Purification. The WETF performs separation and purification activities to separate and purify tritium from gaseous mixtures using diffusion and membrane purification techniques. Research on gaseous tritium penetration of, and through, materials is also conducted at the WETF. These activities are also used to treat effluent as part of the waste management activities of the Lab.

Metallurgical and Material Research. Tritium-handling capabilities at the WETF accommodate a wide variety of metallurgical and material research activities, such as studying methods to remove hydrogen isotopes (including tritium) from flowing streams of nitrogen and other inert gases. In application, this capability may be used to clean up exhaust air streams and the air in tritium containment areas without generating tritiated water, a more hazardous form of tritium. Metallurgical and materials research, including metal getter research and application studies, and tritium effects and properties R&D are conducted at the WETF.

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

Calorimetry. This nondestructive method is used for measuring the amount of tritium in containers. This method is based on the measurement of heat flow from a container. The radioactive decay of tritium gives off heat at a rate that is directly proportional to the amount of tritium contained in gas containers. No tritium leaves the container in the performance of calorimetry measurements.

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

Tritium gas may also be safely stored in metal hydride form contained in containers. The metal hydride that forms when tritium reacts with the metallic powder in the container is a very stable compound. Tritium can be released from this compound by heating the container to several hundred degrees Celsius (°C). Accountable quantities of tritium are stored in these ways in designated areas that have been approved for such storage. Tritium oxide (tritiated water) can also be stored in solid form when it is adsorbed (gathered on a surface in a condensed layer) on molecular sieves. Molecular sieves are made with materials that adsorb tritiated water in the fine pores on their surface, thus forming a solid material that can be stored in containers. Tritiated water adsorbed on molecular sieves is physically stable. Tritiated water is released from the molecular sieve when the temperature is raised above the boiling point for water.

Hydrogen Isotopic Separation. R&D on tritium gas purification is conducted in the WETF using methods such as hydrogen isotopic separation.

Hazards and Wastes

Based on criteria in DOE-STD-1027-92, WETF is listed as a HC-2 nuclear facility. The only significant radiological hazards at WETF involve tritium. The HC-2 threshold value listed in DOE-STD-1027-92 for tritium is 3.0×10^5 curies, or about 30 grams. WETF is limited to a total inventory of 240 grams of tritium classified as material-at-risk (MAR). Controlling the amount of the MAR inventory is the primary means of limiting the hazard and its associated risk to workers and the public. Processes, experiments, and storage configurations involving radioactive MAR typically use two containment barriers to reduce the potential for an inadvertent tritium release. LANL workers and the public are sufficiently protected from MAR hazards by physical barriers and administrative procedures. Although TA-16 includes several buildings that store high explosives, WETF is located outside the high-explosives buffer zone; accidents in the buffer zone will not impact WETF (LANL 2020a).

The WETF generates the following waste streams: LLW, MLLW, and chemical wastes. The contributions to the various waste streams are included in the 6-year averages reported in Section 4.11. Typically, the radioactive and mixed-waste streams at WETF contain only tritium as the radioactive component. Chemical wastes are generated throughout WETF through routine cleaning and maintenance activities. Typically, chemical wastes at WETF consists of small amounts of standard industrial solvents, such as acetone, ethanol, or methanol that has been absorbed on rags, Kimwipes, and Q-tips. From CY 2017 to CY 2022, WETF generated the following waste types (Table E-22):

Table E-22 WETF Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	591.6	104.6	7.7	3,769.3	1,087	753.0
LLW (m^3/yr)	26.5	14.4	32.8	25.9	32	42.3
MLLW (m^3/yr)	0	0	0	0	0	2.5

CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW; WETF = Weapons Engineering Tritium Facility
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

From CY 2017 to CY 2022, WETF Building generated the following radioactive air emissions (Table E-23):

Table E-23 WETF Radioactive Air Emissions Data, CY 2017–2022

Type	2017	2018	2019	2020	2021	2022
TA-16/WETF, Elemental tritium (Ci/yr)	8.2	6.5	10.5	6.12	18.8	7.25
TA-16/WETF, Tritium in water vapor (Ci/yr)	73.8	17.4	28.1	30	25.8	33.70

CY = calendar year; Ci/yr = curies per year; WETF = Weapons Engineering Tritium Facility
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

There are no outfalls associated with this major facility.

E.2.3 Pajarito Corridor Planning Area

The Pajarito Corridor Planning Area is the physical center of nuclear research and production at the Laboratory. Weapons production, testing, verification activities, and science functions are located in the Pajarito Corridor. At TA-55, the Plutonium Facility (PF-4) necessitates the presence of protective force personnel for security and mission support. Other functions in support of science R&D activities are located in the Pajarito Corridor, including radiological hot cells, high-energy laboratories, and fabrication. Large-scale 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. Figure E-3 shows the major facilities within the Pajarito Corridor Planning Area.

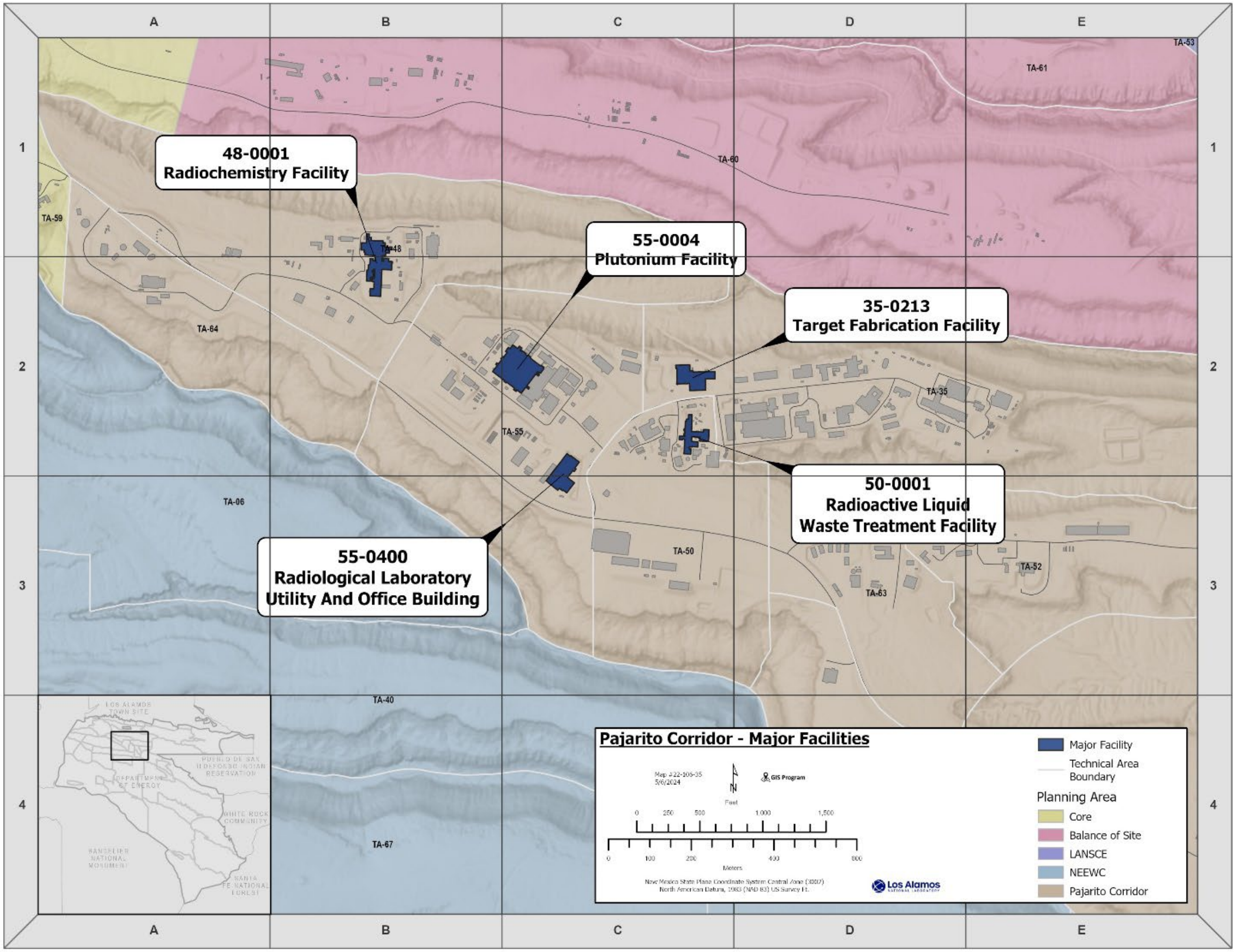


Figure E-3 Major Facilities in the Pajarito Corridor Planning Area

E.2.3.1 Plutonium Facility Complex and Plutonium Facility 4 (PF-4)

Facility Description

The Plutonium Facility Complex is located on 93 acres in TA-55 and consists of six primary buildings and a number of support, storage, security, and training structures located throughout the TA. Collectively, the buildings in the complex total approximately 236,192 square feet. The Plutonium Facility Complex has the capability to process and perform research on actinide materials, although plutonium is the principal actinide used in the facility. In 2008, NNSA designated LANL as the center of excellence for plutonium R&D and manufacturing, primarily based on the fact that LANL has the existing facilities, infrastructure, and trained personnel necessary for this mission (NNSA 2018a).

The Plutonium Facility (PF-4), a two-story laboratory of approximately 151,000 square feet, is the major facility in the complex. It was built in the 1970s to support actinide chemistry R&D. Its location in TA-55 places it approximately 1,000 meters from the site boundary. Current missions at PF-4 include nuclear weapon pit manufacturing and pit reuse, pit surveillance, plutonium disposition, and manufacturing radioisotope power sources for space and defense applications. As such, PF-4 supports the Stockpile Stewardship/Weapons Program and global security mission. It is categorized as a HC-2 nuclear facility.

Operations at PF-4 at LANL began in 1978. Although PF-4 will reach its initial assumed 50-year design life in 2028, there are no known life-limiting mechanisms/issues that would preclude PF-4 from operating beyond its original design lifetime. As a result of previous and ongoing upgrades to modernize and extend the life of PF-4, NNSA is confident that PF-4 can continue to safely and securely conduct plutonium operations into the foreseeable future (NNSA 2019). The TA-55 Reinvestment Project is intended to make seismic improvements and selectively replace and upgrade major facility and infrastructure systems at PF-4 and related structures at TA-55 (*see* Appendix A, Section A.2.3.3 for a discussion of the TA-55 Reinvestment Project).

To fulfill NNSA's obligation to produce plutonium pits, LANL continues to upgrade existing plutonium facilities; upgrade and construct new support facilities, administrative offices, and parking; and hire and train staff required for the mission. Upgrades to PF-4 directly supporting the production of plutonium pits consist of internal modifications to PF-4 and the installation of additional process equipment. The Laboratory has existing support facilities (e.g., warehouses, waste storage and staging, radiography capabilities, and maintenance support offices) within and outside the Perimeter Intrusion, Detection, and Assessment System at TA-55 (NNSA 2019).

Capabilities and Activities

Table E-24 lists the capabilities that are conducted at the Plutonium Facility Complex.

Table E-24 Existing Facility Complex Capabilities and Activity Levels

Capability	Activities
Plutonium Stabilization	Recover, process, and store existing plutonium inventory.
Manufacturing Plutonium Components	• Produce a minimum of 30 war reserve plutonium pits per year and to implement surge efforts to exceed 30 pits per year up to 80 pits per year to meet the Nuclear Posture Review and national policy. • Fabricate parts and samples for R&D activities, including parts for dynamic and subcritical experiments.
Surveillance and Disassembly of Weapons Components	Disassemble, survey, and examine up to 65 plutonium pits per year.
Actinide Materials Science and Processing R&D	• Perform plutonium (and other actinide) materials research, including metallurgical and other characterization of samples and measurements of mechanical and physical properties. • Operate the 40-millimeter Impact Test Facility and other test apparatus. • Develop expanded disassembly capacity and disassemble up to 200 pits per year. • Process neutron sources (including plutonium and beryllium and americium-241). • Process neutron sources other than sealed sources. • Process up to 400 kilograms per year of actinides at Technical Area 55. • Process pits through the Special Recovery Line (tritium separation). • Perform or alloy decontamination up to 48 uranium components per month. • Conduct research in support of DOE actinide cleanup activities and on actinide processing and waste activities at DOE sites. • Fabricate and study nuclear fuels used in terrestrial and space reactors. • Fabricate and study prototype fuel for lead test assemblies. • Develop safeguards instrumentation for plutonium assay. • Analyze samples.
Fabrication of Ceramic-Based Reactor Fuels	• Make prototype mixed oxide fuel. • Build test reactor fuel assemblies. • Continue R&D on other fuels.
Plutonium-238 Research, Development, and Applications	• Process, evaluate, and test plutonium-238 in production of materials and parts to support space and terrestrial uses. • Recover, recycle and blend plutonium-238.

Capability	Activities
Storage, Shipping, and Receiving	• Provide interim storage of the LANL SNM inventory, mainly plutonium. • Store working inventory in the vault in Technical Area 55, Building 4; ship and receive SNM as needed to support LANL activities. • Provide temporary storage of Security Category I and II materials removed in support of Technical Area 18 closure, pending shipment to the Nevada National Security Site and other DOE Complex locations. • Store sealed sources collected under DOE's Offsite Source Recovery Program. • Store mixed oxide fuel rods and fuel rods containing archive and scrap metals from mixed oxide fuel lead test assembly fabrication.
Repackage and dispose of mixed oxide fuel fabrication facility fuel rod[a]	• Cut mixed oxide fuel rods and fuel rods containing archive and scrap materials from mixed oxide fuel lead assembly fabrication into smaller pieces, repackage, and continue to store materials. Prepare and transport waste or materials to appropriate locations.
Management and disposition of additional wastes generated[a]	*See* Section E.2.6.1 for details.
Transport additional materials, parts, and waste.[a]	• Waste transport reception and acceptance, including visual inspection of vehicles and containers, cross-checking of container labels and shipping manifests, and radiation surveys of vehicle and containers. • Support DOE-wide packaging and transport of electro-explosive devices. • Radioactive, hazardous, and commercial materials would be transported onsite and to and from various offsite locations. Transport of special nuclear material (such as plutonium, highly enriched uranium [mainly uranium-235], and uranium-233); WIPP in New Mexico for the transport of transuranic wastes; the Nevada National Security Site and a commercial disposal site for low-level radioactive wastes; and multiple locations for disposal of hazardous and nonhazardous waste materials.

R&D = research and development; WIPP = Waste Isolation Pilot Plant
a Source: DOE (2020)

Plutonium Stabilization. This capability employs a variety of plutonium and other actinide recovery operations to improve the storage condition of legacy plutonium in the LANL inventory. Cleaning metallic plutonium, converting metal to oxide, reprocessing scrap material, and high-firing oxides are among the routine Plutonium Complex chemical processing capabilities. The goal of this activity is to improve the storage condition of legacy plutonium in the LANL inventory. Some of the existing containers show signs of corrosion. The stability of some of the materials can be improved through reprocessing, cleaning, high-firing (oxidizing at relatively high temperatures) oxides, and storage in improved containers. After these stabilization steps, the materials will be repackaged under inert atmosphere (an atmosphere free of materials that may initiate chemical reactions) in pressure-closure cans that are then placed in outer cans that are welded closed. These will be stored until needed to support program requirements.

Manufacturing Plutonium Components. This capability involves the production of plutonium pits and fabrication of parts and samples for R&D activities. This capability includes fabrication of parts for dynamic and subcritical experiments. The goal of this activity is to take purified plutonium metal and use it to manufacture pits or other items for R&D or to manufacture components for the nuclear weapons stockpile. This capability includes the fabrication of samples and parts for research applications, including dynamic experiments, subcritical experiments (at the Nevada National Security Site), fundamental research on plutonium at the LANSCE. The plutonium items produced may be encapsulated or coated with stainless steel, beryllium, or other materials. At every step, the pieces are inspected and samples are taken for analysis. Those finished components that meet the specifications may be stored in the Plutonium Facility vault pending shipment or research use.[4] Those that do not meet specifications are reprocessed into plutonium metal.

Surveillance and Disassembly of Weapons Components. This capability provides for the disassembly of plutonium pits for examination. Destructive and nondestructive techniques are used for examination. The goal of this activity is to conduct a series of nondestructive and destructive evaluation on pits removed from the stockpile and/or from storage, as well as for materials being considered in process development activities. These evaluations determine the effects of aging and other stresses on pits, as well as the compatibility of materials used or being considered for use in weapons. They are a part of the stockpile reliability and safety analysis and documentation programs that DOE has conducted for the nuclear weapons stockpile since pit production was initiated. Beginning with the intact pit, a series of tests are made to determine the changes in the materials from which the pit was constructed. Tests include leak testing, weighing, dimensional inspection and measurements, dye penetration tests, and radiography. Some of the pits evaluated at LANL are returned to storage after these nondestructive analyses (to be analyzed again at a later date). Other pits are taken apart (disassembled) for further tests, which include metallography, microtensile testing, and chemical analysis. The scrap remaining after these destructive tests is reprocessed. Any pit fabricated at LANL or sent to LANL could be evaluated or disassembled through these processes.

Actinide Materials Science and Processing R&D. Research would be conducted on plutonium (and other actinide) materials, including metallurgical and other characterization of samples and measurements of mechanical and physical properties. Research is conducted to develop new techniques useful for such research or for enhanced surveillance. In addition, research is performed to support development and assessment of technology for manufacturing and fabrication of components, including activities in areas such as welding bonding, fire resistance, and casting, machining, and other forming technologies.

Neutron sources (plutonium and beryllium, and americium-241 and beryllium) can be processed at TA-55. Included in this capability is the technology to process neutron sources other than sealed sources, process items through the special recovery line, and perform plutonium decontamination of oralloy components.

Research in support of DOE's actinide cleanup activities and on actinide processing and waste activities at DOE sites is conducted. In addition, LANL staff fabricate and study nuclear fuels used

---

[4] 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/

in terrestrial and space reactors; develop safeguards instrumentation for plutonium assay; and analyze samples.

In general, these include metallurgical and other characterization of materials and measurements of physical materials properties. Activities to develop new measurements for enhanced surveillance also are conducted at the facility. In addition, measurements at TA-55 study the properties of plutonium materials and samples at high strain rates using a 40-millimeter projectile launcher Impact Test Facility and other apparatus, and other bench-scale capabilities to measure mechanical and physical properties. These operations are usually conducted in glove boxes and involve relatively small amounts of plutonium, as compared with other activities at TA-55.

In addition, research at TA-55 supports development and assessment of technologies for manufacturing and fabrication of components, a capability discussed previously in this section. These activities include research on welding and bonding processes and research associated with casting, machining, and other forming technology. In addition, measurements associated with fire-resistance of weapons components are conducted at TA-55.

Actinide processing (also called recovery and reprocessing) includes methods by which plutonium and other actinides including uranium can be extracted, concentrated, and converted into forms easier to store and to use in other activities. The discussion below focuses on plutonium because this accounts for most of the processing activity at TA-55, but the discussion also applies to the many other actinides used in research at LANL.

The form, recoverability, and concentration of remaining plutonium determines whether the material will be discarded as waste or treated with further reprocessing steps. Aspects of this reprocessing capability are described below.

Actinide recovery processing typically involves dissolving materials in nitric or hydrochloric acid using the physical and chemical characteristics of the actinide (e.g., using solvent extraction or ion-exchange processes) to preferentially extract it as a high-purity solution. The oxides and oxalates can be converted to metal using a variety of chemical processing techniques, including high-temperature oxidation and electrochemical techniques. Waste solutions from these processes are pretreated (redistilled to reclaim acid and precipitate nitrate sludges, if appropriate) before being discharged as radioactive liquid waste to TA-50.

Plutonium-239/beryllium sources can be reprocessed at TA-55, but the capability could be used to reprocess americium-241/beryllium sources as well.

In addition, this actinide reprocessing capability includes research into new recovery and decontamination techniques, research regarding the fundamental properties of actinides, analytical and nondestructive measurement of actinides (including development of new techniques), and research regarding nuclear fuels.

Fabrication of Ceramic-Based Reactor Fuels. Development and demonstration of ceramic fuel fabrication technologies is conducted. R&D continues on other fuels. Development and demonstration of ceramic fuel fabrication technologies is conducted. R&D on other fuels is performed.

Plutonium-238 Research, Development, and Applications. Radioisotope thermoelectric generators (RTGs) and milliwatt generators using plutonium-238 as an energy source are developed and fabricated under this capability. Oak Ridge National Laboratory or Idaho National Laboratory routinely transport plutonium-238 to LANL, although other locations may transport as well. As part of the research, development, and testing, plutonium-238 is processed, recovered, recycled, and blended. Materials and parts are fabricated and units tested in support of space and terrestrial uses. RTGs and units called milliwatt generators have been produced, tested, and reprocessed at the Plutonium Facility for many years, and RTG R&D (including design), fabrication, and testing activities continue. After the RTGs are produced, they are extensively tested for integrity, resistance to mechanical shocks, and heat generation rate.

Aqueous reprocessing of plutonium-238 material uses the same processing techniques as used for other actinides as discussed above.

Storage, Shipping, and Receiving. The Plutonium Facility provides storage, shipping, and receiving activities for the majority of the LANL SNM inventory, mainly plutonium. In addition, sealed sources collected under DOE's OSRP are stored at TA-55 or sent to other LANL locations for storage pending final disposition. By broadening the types and quantities of radioactive sealed sources (Co-60, Ir-192, Cf-252, Ra-226) that LANL can manage and store prior to their disposal, NNSA can retrieve and store more of these sources. When appropriate, mixed oxide fuel materials stored at TA-55 would be transported to other DOE sites.

Hazards and Wastes

Based on criteria in DOE-STD-1027-92, PF-4 is listed as a HC-2 nuclear facility. There are three main physical areas where nuclear material is handled – the first floor (including laboratories), basement, and outside PF-4. All PF-4 activities involving actual analytical chemistry/materials characterization evaluation of nuclear material occur within the first-floor laboratory spaces (Section E.2.3.2 describes RLUOB analytical chemistry/materials characterization capabilities). Facility support activities involving shipping/receiving, waste staging, and maintenance occur on both the first floor and basement levels. Radioactive material at PF-4 includes weapons grade plutonium, heat source plutonium, tritium, highly enriched uranium, and smaller quantities of other transuranic isotopes. Weapons grade and heat source plutonium in PF-4 exist in solid forms (metal or powder), molten metal, or in solution (NNSA 2019).

Other hazard event scenarios include fires (glovebox fires, room (laboratory) fires, and facility fires), a loss of confinement events/spill of radiological material, explosions/overpressures/depressurization, direct exposure to ionizing radiation sources, natural phenomena (seismic and lightning), and external events (wildland fire, vehicle crash with fuel pool fire, aircraft crash, natural gas fire/deflagration) (LANL 2021b). These accidents are evaluated in the Documented Safety Analysis for TA-55 and summarized in Appendix D of this SWEIS.

PF-4 generates LLW, MLLW, TRU, Mixed TRU, and chemical wastes. The contributions to the various waste streams are included in the 6-year averages reported in Section 4.11. NNSA's pit production mission in PF-4 will increase the annual production rate to at least 30 pits per year (see Section 3.2.3). With that anticipated increase in production, the volume of wastes generated will increase as well. Chapter 5, Section 5.11 evaluates the increased waste generation associated with pit production of 30 to 80 pits per year. From CY 2017 to CY 2022, the Plutonium Facility Complex generated an average of the following waste types (Table E-25):

Table E-25 Plutonium Facility Complex Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	17,644.7	7,847.9	21,935.5	15,106	31,012	106,735.3
LLW (m^3/yr)	307.2	309.9	260.9	187.2	322	318.5
MLLW (m^3/yr)	72.4	20	2.9	18.6	58	14.2
TRU (m^3/yr)	30.2	26.5	20.6	20.6	61	107.4
MTRU (m^3/yr)	69.4	64.3	71.8	71.8	212	483.6

CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW; MTRU = mixed TRU; TRU = transuranic (waste)
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

From CY 2017 to CY 2022, the Plutonium Facility Complex generated the following radioactive air emissions (Table E-26):

Table E-26 Plutonium Facility Complex Radioactive Air Emissions Data, CY 2017–2022

Type	2017	2018	2019	2020	2021	2022
Plutonium isotopes (Ci/yr)	2.96E-10	2.08E-09	1.42E-08	8.50E-07	5.06E-09	1.09E-07
Tritium in Water Vapor (Ci/yr)	1.39E+00	1.16E+00	4.54E-01	8.67E-01	2.03E-01	1.31E+01
Tritium as a Gas (Ci/yr)	2.79E-01	3.12E-01	2.06E-01	1.52E-01	1.15E-01	6.35E-02

CY = calendar year; Ci/yr = curies per year
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

The facilities in the Plutonium Facility Complex discharge cooling tower blowdown to NPDES-permitted Outfall 03A181. Table E-27 shows discharge amounts for CY 2017 to CY 2022.

Table E-27 Plutonium Facility Complex NPDES Discharge Data, CY 2017–2022

Year	Outfall Number	Discharge Amount (MGY)
2017	03A181	3
2018	03A181	3.1
2019	03A181	3
2020	03A181	3.2
2021	03A181	3
2022	03A181	4.2

CY = calendar year; MGY = million gallons per year; NPDES = National Pollutant Discharge Elimination System
Source: LANL (2019, 2020, 2021, 2022, 2023a, and 2024a)

E.2.3.2 Radiological Laboratory Utility Office Building (RLUOB)

Facility Description

The RLUOB (TA-55-0400) provides approximately 204,000 square feet of laboratory space, office space, a training center, an operations center, and a facility incident command center at TA-55. Construction of this facility was completed in 2011 and radiological operations began in August 2014. The RLUOB was planned and constructed from 2004 to 2011. NNSA evaluated its site location in the 2003 CMRR EIS (NNSA 2003). The RLUOB supports actinide chemistry and material characterization supporting radiological operations performed in PF-4. The RLUOB is a MAR-limited HC-3 nuclear facility that supports PF-4 missions, features special instrumentation and equipment for supporting national security science through the understanding of plutonium. Laboratory space is outfitted with analytical instruments, gloveboxes, open-front boxes, fume hoods, gloveports, enclosure coating and double-door transfer systems.

In 2018, DOE prepared an EA to recategorize RLUOB from a radiological facility to a HC-3 nuclear facility, with an increased MAR limit of 400 grams PuE, which would allow certain laboratory capabilities previously planned for the Chemistry and Metallurgy Research Building Replacement Nuclear Facility (CMRR-NF) to be installed in RLUOB. As a result, fewer modifications to PF-4 would be required, while additional modifications would be made to RLUOB (NNSA 2018b). In 2023, RLUOB was added as a HC-3 nuclear facility based on NNSA authorization to commence operations.

RLUOB is equipped with state-of-the-art systems to monitor and control (via the operations center) all instrumented facility systems via real-time digital sensors, including laboratory HVAC temperature and humidity. Three diesel generators outside of the Central Utility Building can supply electric power in the event of emergencies.

Capabilities and Activities

Capabilities at RLUOB support:

- Actinide Chemistry and Material Characterizations Operations, and
- Beryllium Analysis of Samples.

Actinide Chemistry and Material Characterizations operations. AC and MC operations are moving from the CMR building, which is unable to be functional at its full extent to meet future AC and MC operational requirements. The 2018 EA recategorization of RLUOB from a Radiological Facility to a HC-3 nuclear facility allows certain laboratory capabilities previously planned for PF-4 to be performed in RLUOB instead. Some of these capabilities include plutonium assay, x-ray analysis, plasma spectroscopy, MC synthesis, waste management and nondestructive assay measurements, and some MC activities, such as transmission electron microscopy and scanning electron microscopy (NNSA 2018b). Fewer modifications to PF-4 would be required, with less generation of radioactive waste and fewer radiological exposures to workers performing the modifications.

Beryllium Analysis of Samples. Analysis of plutonium samples that contain beryllium, and smears that may contain beryllium. Operations involving refining, machining, or manufacturing beryllium or beryllium-containing products that have the potential to expose workers to finely divided, respirable beryllium are not performed in RLUOB.

Hazards and Wastes

The RLUOB structure and equipment anchorages in radiological spaces meet the requirements for Seismic Performance Category 2, as provided in DOE Standard-(STD) 1020-2002, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities," while the remainder of the facility meets the requirements of Seismic Performance Category 1.

RLUOB generates chemical and low-level wastes during operations (NNSA 2018b). From 2017 to 2022, the RLUOB generated the following waste types (Table E-28):

Table E-28 RLUOB Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	1,620.7	18.6	3,154.7	487.2	23,668.9	24,472.2
LLW (m^3/yr)	0	0	0	5.09	5.26	10.19
MLLW (m^3/yr)	0	0	0	0	0	2.58

CY = calendar year; kg/yr = kilograms per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW; RLUOB = Radiological Laboratory Utility Office Building

Note: RLUOB is monitored for radiological emissions; however, its emissions are combined and reported with PF-4 emissions.

E.2.3.3 Target Fabrication Facility

Facility Description

The Target Fabrication Facility, located in TA-35, comprises two buildings, 35-213 and 35-458. The main building encompasses approximately 84,900 square feet of floor space housing activities related to weapons production and laser fusion research.

Capabilities and Activities

Table E-29 lists the capabilities that are conducted at the Target Fabrication Facility.

Table E-29 Existing Target Fabrication Facility Capabilities and Activity Levels

Capability	Activities
Precision Machining and Target Fabrication	• Provide targets and specialized components for laser and physics tests. • Perform high-energy-density physics tests. • Analyze tritium reservoirs. • Perform magnetron sputtering with beryllium.
Polymer Synthesis	• Produce polymers for targets and specialized components for laser and physics tests. • Perform high-energy-density physics.
Chemical and Physical Vapor Deposition	• Coat targets and specialized components for laser and physics tests per year.
	• Support high-energy-density physics. • Support plutonium pit rebuild operations.

Precision Machining and Target Fabrication. Considered the primary measurement of activity for this major facility, precision machining operations produce sophisticated devices consisting of very accurate part shapes and often optical-quality surface finishes. A variety of processes are used to produce the final parts, which include conventional machining, ultraprecision machining, lapping, electron discharge machining, and magnetron sputtering. Dimensional inspections are performed during part production using a variety of mechanically and optically based inspection techniques. A variety of mechanically and optically based inspection techniques are employed to make these inspections. Electronic and beam balances are used to gather weight information that also is often required. Tritium reservoirs are analyzed at the Target Fabrication Facility.

Polymer Synthesis. Polymer synthesis science formulates new polymers, studies their structure and properties, and fabricates them into various devices and components. Capabilities exist at the Target Fabrication Facility for developing and producing polymer foams by organic synthesis, liquid crystalline polymers, polymer host dye laser rods, microfoams and composite foams, high-energy-density polymers, electrically conducting polymers, chemical sensors, resins and membranes for actinide and metal separations, thermosetting polymers, and organic coatings.

The materials and devices are typically prepared using solvents at temperatures ranging from 70 °F to 302 °F (20 °C to 150 °C) or by melt processing at temperatures from room temperature up to 572 °F (300 °C). A wide variety of analytical techniques are used to determine the structure and behavior of polymers, including spectroscopy, microscopy, x-ray scattering, thermal analysis, chromatography, rheology, and mechanical testing.

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

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

Hazards and Wastes

The Target Fabrication Facility is categorized as a radiological facility and includes operations involving radiological materials (e.g., typically tritium) in quantities that do not meet or exceed HC-3 threshold criteria. Small quantities of process chemicals are used in operations and maintenance. Some of these chemicals are flammable, carcinogenic, corrosive, toxic, or reactive. Chemical wastes are the primary waste generated at the Target Fabrication Facility. The contributions to the various waste streams are included in the 6-year averages reported in Sections 4.11.2 and 4.11.3, respectively. Radioactive liquid waste and chemical waste are transported to the TA-50 Radioactive Liquid Waste Treatment Facility by direct pipeline.

From CY 2017 to CY 2022, the Target Fabrication Facility generated of the following waste types (Table E-30):

Table E-30 Target Fabrication Facility Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	4,392.1	612.1	12,233.8	7,483.8	1,961	4,178
MLLW (m^3/yr)	0	0	0	0	50	0

CY = calendar year; kg/yr = kilogram per year; m^3/yr = cubic meters per year; MLLW = mixed low-level radioactive waste

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

Radiological air emissions from the Target Fabrication Facility are below levels that require direct monitoring. Minor sources like the Target Fabrication Facility are tracked administratively with the annual RMUS in addition to being monitored using the ambient air sampling network located at public locations around the Laboratory. There are no outfalls associated with this major facility.

E.2.3.4 Radiochemistry Facility

Facility Description

The Radiochemistry Facility includes all of TA-48 (approximately 116 Acres). The facilities at TA-48 support R&D in nuclear and radiochemistry. Its primary roles include research; production of medical radioisotopes; and support services to other LANL organizations, primarily through radiological and chemical analyses of samples. The TA-48 Complex contains five major research buildings: the Radiochemistry Laboratory (TA-48-0001), the Assembly Checkout building (TA-48-0017), the Diagnostic Instrumentation and Development Building (TA-48-0028), the Clean Chemistry/Mass Spectrometry Building (TA-48-0045), and the Weapons Analytical Chemistry Facility (TA-48-0107). TA-48 also includes a Machine and Fabrication Shop (TA-48-0008) that is part of the Complex. The main buildings are located in an 8.6-acre area enclosed behind a security fence. Collectively, the facilities total approximately 105,000 square feet.

Capabilities and Activities

Measurements of radioactive substances are taken in hot cells equipped for remote handling of radioactive materials. The Radiochemistry Facility is classified as a radiological facility and includes operations involving radiological materials in quantities that do not meet or exceed HC-3 threshold criteria. Table E-31 lists the capabilities that are conducted at the Radiochemistry Facility.

Table E-31 Existing Radiochemistry Facility Capabilities and Activity Levels

Capability	Activities
Radionuclide Transport Studies	• Conduct actinide transport, sorption, and bacterial interaction studies per year. • Develop models for evaluation of groundwater. • Assess performance of risk of release for radionuclide sources at proposed waste disposal sites.
Environmental Remediation Support	• Conduct background contamination characterization pilot studies. • Conduct performance assessments, soil remediation R&D, and field support. • Support environmental remediation activities.
Ultra-Low-Level Measurements	Perform chemical isotope separation and mass spectrometry at current levels.
Radiochemical Separations	Conduct radiochemical operations involving quantities of alpha-, beta-, and gamma-emitting radionuclides at current levels for non-weapons and weapons work.
Isotope Production	Conduct target preparation, irradiation, and processing to recover medical and industrial application isotopes to support offsite shipments per year. From CY 2017 to CY 2020, up to 200 offsite shipments per year were completed.
Actinide and TRU Chemistry	Perform radiochemical operations involving alpha-emitting radionuclides.
Data Analysis	Re-examine archive data and measure nuclear process parameters of interest to weapons radiochemists.

Capability	Activities
Inorganic Chemistry	Conduct synthesis, catalysis, and actinide chemistry activities: • Chemical synthesis of organo-metallic complexes; • Thermodynamic structural and reactivity analysis, organic product analysis, and reactivity and mechanistic studies; • Synthesis of new ligands for radiopharmaceuticals; • Environmental technology development activities; • Ligand design and synthesis for selective extraction of metals; • Soil washing; • Membrane separator development; and • Ultrafiltration.
Structural Analysis	• Perform synthesis and structural analysis of actinide complexes at current levels. • Conduct x-ray diffraction analysis of powders and single crystals.
Sample Counting	Measure the quantity of radioactivity in samples using alpha-, beta-, and gamma-ray counting systems.

CY = calendar year; R&D = research and development; TRU = transuranic

Radionuclide Transport. Chemical and geochemical investigations address concerns about hydrologic flow and transport of radionuclides. Areas of study include the sorption (binding) of actinides, fission products, and activation products in minerals and rocks and the solubility and speciation of actinides in various chemical environments such as those associated with waste disposal.

Environmental Remediation and Risk Mitigation. Characterization and remediation of soils contaminated with radionuclides and toxic metals, data analysis, and integrated site-wide assessment are the two functions provided by this capability. Activities also include background contamination characterization pilot studies as well as soil remediation R&D to provide support for necessary work in the field.

Ultra-Low-Level Measurements. Isotopic tracers and high-sensitivity measurement technologies have been developed to support the U.S. nuclear weapons program. Isotopic tracers can include both radioactive and nonradioactive isotopes, although this capability emphasizes nonradioactive tracers. Specialty applications include developing analytical techniques for a variety of problems in nuclear, environmental, and biological sciences. Typical analyses include determining the origin of radioactive contamination in an environmental sample (for example, whether the contamination results from a nearby nuclear facility or from radioactive fallout from global weapons testing). This capability can also be used to trace the migration of radioactive contamination through the environment.

Mass spectrometers detect and analyze samples as small as one-thousandth of one-billionth of a gram (atto-Curie levels). Chemical separation procedures to isolate the element to be measured are conducted in a chemistry laboratory specially designed to keep the sample from being contaminated by natural or human-made sources. This technique can determine both the source and the amount of radioactive contamination.

Nuclear and Radiochemistry Separations. Activities under this capability include developing radiation detectors, conducting radiochemical separations, and performing nuclear chemistry. Development, calibration, and use of radiation detectors include the use of off-the-shelf systems for routine measurement of radioactivity and development of new radiation detection systems for a number of special applications. LANL personnel conduct both routine and special separations of radioactive materials from other radioactive species and stable impurities. These experiments have provided support to Hanford waste tank treatment activities and production of medical isotopes. Separations are based on traditional approaches that use commercially available ion-exchange media and chemical reagents. LANL staff have also developed new separations techniques based on experimental chemical systems, using radioactive tracers to synthesize the chemicals and to characterize their performance.

In addition, nuclear chemistry-related activities use exotic laser-based atom traps to probe the interactions of energy and atoms in energy regimes that are not easily accessed by other techniques. This work requires conducting extensive laser spectroscopy, handling of radioactive materials, and interpreting the resulting data. Other nuclear chemistry-related activities include irradiating targets at the LANSCE or at offsite reactors to produce specific radioactive isotopes. These isotopes are then separated from impurities, and their neutron-capture cross sections are measured at the Radiochemistry Laboratory.

Isotope Production. Activities under this capability include the production, chemical separation, and distribution of isotopes to medical and industrial users. Activities also include preparing the target packages to be irradiated using the LANSCE accelerator, processing in the Radiochemistry Laboratory hot cell to recover the desired isotopes and packaging the isotopes for offsite shipment.

Actinide and Transuranic Chemistry. Activities in the Alpha wing of the Radiochemistry Laboratory are essentially the same as the radiochemical separations carried out in the rest of the building, but with different materials. The materials handled are actinides and transuranics that require the special safe handling environment provided in this wing.

Data Analysis. Data analysis is the evaluation of experimental data to interpret results of experiments, measurements, and other activities. Data analysis is the process of taking information learned from all of the measurements made on a material and putting it into the context of the experimental design. This capability includes evaluation of archived data in support of weapons programs. This process is a paper exercise that turns data into useful information that will help answer experimenters' questions.

Inorganic Chemistry. Inorganic chemistry work includes two main categories of activities: (1) synthesis, catalysis, and actinide chemistry; and (2) development of environmental technology. The former category includes chemical synthesis of new organometallic complexes, structural and reactivity analysis, organic product analysis, reactivity and mechanistic studies, and synthesis of new ligands for radiopharmaceuticals. Development of environmental technology includes designing and synthesizing ligands for selective extraction of metals, soil washing, development of membrane separators, photochemical processing, and ultrafiltration.

Other work involves oxidation-reduction studies on uranium and other metals for both environmental restoration and advanced processing.

Structural Analysis. Structural analysis includes the synthesis, structural analysis, and x-ray diffraction analysis of actinide complexes in both single-crystal and powder form. This capability supports programs in basic energy sciences, materials characterization, stockpile stewardship, and environmental management.

Sample Counting. Sample counting, the measurement of the quantity of radioactivity present in a sample, is accomplished with a variety of radiation detectors, each customized to the type of radiation being counted and the expected levels of radioactivity. All samples counted in the counting facility are sealed items placed inside appropriate detectors for specified periods of time. Data are automatically processed through the computer system and results are presented to the users. Other activities in the counting room include system calibration, quality checks on system performance, and corrective action when problems occur.

Hydrotest Sample Analysis. This capability involves the measurement of beryllium contamination from hydrotesting simulated nuclear weapons. This work includes analysis, ligand binding, materials characterization, field sampling, fundamental beryllium chemistry, and beryllium mitigation.

Hazards and Wastes

Radiological material used in the facility to support programmatic operations includes sealed radioactive sources and small quantities of isotopes for medical and industrial application. Small quantities of chemicals are used for sampling and analytical operations and maintenance. Some of these chemicals are flammable, carcinogenic, corrosive, toxic, or reactive. The Radiochemistry and Hot Cell Facility has no permitted outfalls and generates LLW, MLLW, and chemical wastes. The contributions to the various waste streams are included in the 6-year averages reported in Sections 4.11.2 and 4.11.3, respectively Table E-32 shows the waste generated by the Radiochemistry Facility from CY 2017 to CY 2022.

From CY 2017 to CY 2022, the Radiochemistry Facility generated the following radioactive air emissions (Table E-33):

Table E-32 Radiochemistry Facility Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	1,547.3	2,718.9	832.6	1,487.1	12,889	16,834.4
LLW (m^3/yr)	39.4	57.6	80.3	75.4	65	131
MLLW (m^3/yr)	3.5	6.2	8.4	6.3	10	3.4

CY = calendar year; kg/yr = kilogram per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW

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

Table E-33 Radiochemistry Radioactive Air Emissions Data, CY 2017–2022

Type	2017	2018	2019	2020	2021	2022
Mixed Fission Products (Ci/yr)	Not measured[a]	Not measured[a]	Not measured[a]	Not measured[a]	Not measured[a]	Not measured[a]
Plutonium-239 (Ci/yr)	No emissions	No emissions	No emissions	No emissions	No emissions	1.35E-07
Uranium isotopes (Ci/yr)	6.65E-09	6.22E-09	No emissions[b]	4.82E-09	4.82E-09	No emissions[b]
Arsenic-72 (Ci/yr)	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]
Arsenic-73 (Ci/yr)	No emissions[b]	6.08E-06	1.25E-06	No emissions[b]	No emissions[b]	No emissions[b]

Type	2017	2018	2019	2020	2021	2022
Arsenic-74 (Ci/yr)	No emissions[b]	3.97E-07	No emissions[b]	No emissions[b]	No emissions[b]	2.21E-08
Beryllium-7 (Ci/yr)	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]
Bromine isotopes[c] (Ci/yr)	4.96E-04	1.63E-04	6.01E-06	No emissions[b]	No emissions[b]	1.29E-05
Germanium-68[d] (Ci/yr)	8.88E-03	3.26E-03	1.31E-04	2.14E-04	2.14E-04	9.75E-05
Rubidium-86 (Ci/yr)	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]
Selenium-75 (Ci/yr)	2.89E-05	4.23E-05	8.69E-05	1.91E-04	1.91E-04	5.36E-06
Other Activation Products[e] (Ci/yr)	3.59E-04	5.65E-05	5.16E-04	6.42E-03	6.42E-03	3.79E-08

Ci/yr = curies per year; CY = calendar year

a The emission category of "mixed fission products" is no longer used for EPA compliance reporting; individual nuclides are called out instead. However, for this table, the measured value includes emissions of cesium-137, iodine-131, and stronium-90/yttrium-90.

b Although stack sampling systems were in place to measure these emissions, any emissions were sufficiently small to be below the detection capabilities of the sampling systems.

c Bromine isotopes that were measured are bromine-76 and bromine-77.

d Germanium-68 was assumed to be in equilibrium with gallium-68.

e The measured value in this table includes activation products not included in specific line items.

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

E.2.3.5 Radioactive Liquid Waste Treatment Facility (RLWTF)

Facility Description

The RLWTF provides waste treatment services for organizations throughout the Laboratory, including concentrating radioactive components and removing them from liquid waste. Pipelines throughout the Laboratory connect facilities to the RLWTF. 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):
  - Construction of a replacement low-level radioactive liquid waste treatment facility was completed in 2018; however, the new facility has not been in use because of needed post-project modifications.
- Transuranic Liquid Waste Facility (TA-50-0269):
  - Design of the replacement TRU Liquid Waste Facility was completed in 2022. Construction of the new TRU Liquid Waste Facility began in 2022 and is in process. Construction and operation of the new TRU Liquid Waste Facility are part of the No-Action Alternative.

Capabilities and Activities

Table E-34 lists the capabilities that are conducted at the RLWTF.

Table E-34 Existing RLWTF Capabilities and Activity Levels

Capability	No-Action Alternative Activities
Waste Transport, Receipt, and Acceptance	• Collect radioactive liquid waste from generators and transport to the RLWTF at Technical Area 50 for treatment. • Support, certify, and audit generator characterization programs. • Maintain the waste acceptance criteria for the RLWTF. • Send secondary waste reverse osmosis concentrate to an offsite commercial facility for solidification/year. From CY 2017 to CY 2022, up to 768,000 liters of radioactive liquid waste bottoms were shipped to an offsite commercial facility.
Radioactive Liquid Waste Treatment	• Treat liquid LLW. • Dewater, characterize, and package LLW sludge. Between CY 2017 and CY 2022, up to 24 cubic meters of LLW sludge were packaged per year. • Discharge treated liquids through an NPDES Outfall 05l, Mechanical Evaporator System, or Solar Evaporator Tank.

CY – calendar year; LLW = low-level radioactive waste; NPDES = National Pollutant Discharge Elimination System; RLWTF = Radioactive Liquid Waste Treatment Facility

Waste Transport, Receipt, and Acceptance. Most radioactive liquid waste is conveyed directly to the Radioactive Liquid Waste Treatment Facility through an underground pipeline system. Pipelines for liquid radioactive waste exist in 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 Radioactive Liquid Waste Treatment Facility. Generators of small quantities of radioactive liquid waste collect their waste in drums, which are then trucked to TA-50.

Radioactive Liquid Waste Treatment. Liquid TRU waste and LLW are treated in sequential steps to remove and reduce the radioactive components of the liquid waste stream. Neutralization, precipitation, filtration, ion-exchange, and reverse osmosis are among the treatment steps that can be used, depending on individual waste stream characteristics.

Hazards and Wastes

From CY 2017 to CY 2022, the RLWTF generated of the following waste types (Table E-35):

Table E-35 RLWTF Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	974.9	27,602.7	3,932.2	1,990.5	3,949	509.4
LLW (m^3/yr)	649.4	1,129.4	799.3	406	653	588.7
MLLW (m^3/yr)	0	0	0	0	0	0.4

CY = calendar year; kg/yr = kilogram per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW; RLWTF = Radioactive Liquid Waste Treatment Facility
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

From CY 2017 to CY 2022, the RLWTF generated the following radioactive air emissions (Table E-36):

Table E-36 RLWTF Radioactive Air Emissions Data, CY 2017–2022

Type	2017	2018	2019	2020	2021	2022
Americium-241(Ci/yr)	No emissions[a]	No emissions[a]	No emissions[a]	No emissions[a]	No emissions[a]	No emissions[a]
Plutonium-238 (Ci/yr)	No emissions[a]	1.46E-08	2.02E-08	No emissions[a]	No emissions[a]	No emissions[a]
Plutonium-239 (Ci/yr)	1.68E-08	1.64E-08	5.07E-09	No emissions[a]	No emissions[a]	No emissions[a]
Thorium-228 (Ci/yr)	No emissions[a]	No emissions[a]	No emissions[a]	2.45E-08	No emissions[a]	No emissions[a]
Thorium-230 (Ci/yr)	No emissions[a]	No emissions[a]	2.53E-08	No emissions[a]	4.14E-08	No emissions[a]
Thorium-232 (Ci/yr)	No emissions[a]	No emissions[a]	No emissions[a]	No emissions[a]	No emissions[a]	No emissions[a]
Uranium isotopes (Ci/yr)	1.77E-07	1.42E-07	No emissions[a]	7.92E-08	No emissions[a]	No emissions[a]

Ci/yr = curies per year; CY = calendar year; RLWTF = Radioactive Liquid Waste Treatment Facility

a Although stack sampling systems were in place to measure these emissions, any emissions were sufficiently small to be below the detection capabilities of the sampling systems.

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

The RLWTF discharges treated effluent to Outfall 051. Table E-37 shows the discharge amount from CY 2017 to CY 2022.

Table E-37 RLWTF NPDES Discharge Data, CY 2017–2022

Year	Outfall Number	Discharge Amount (MGY)
2017	051	0
2018	051	0
2019	051	0.021
2020	051	0.03
2021	051	0.24
2022	051	0.22

CY = calendar year; MGY = million gallons per year; NPDES = National Pollutant Discharge Elimination System; RLWTF = Radioactive Liquid Waste Treatment Facility

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

E.2.3.6 Solid Radioactive and Chemical Waste Facilities

Facility Description

The Solid Radioactive and Chemical Waste Facilities are located at TAs-50, -54, -55, -60, and -63. Activities and are related to the management (e.g., packaging, characterization, receipt, transport, and storage) of radioactive and chemical wastes generated at LANL by Triad (Figure E-4). While these facilities are being described under the Pajarito Corridor Planning Area, some of these Solid

Radioactive and Chemical Waste Facilities are located in the Balance of Site Planning Area but are included here for completeness.

In 2015, EM split from the NNSA Los Alamos Field Office to give it a dedicated manager and the attention to complete its mission. N3B assumed operational and management control for waste activities at several facilities in TA-54. The description of Area G in TA-54 is presented in Section E.2.5 under Balance of Site. For further explanation on EM's environmental remediation mission, see Appendix G of the SWEIS.

The facilities that make up the Solid Radioactive and Chemical Waste Facilities include:

TA-50, Waste Characterization, Reduction, and Repackaging Facility (WCRRF). The WCRRF, building 69, houses LANL's transuranic waste size reduction, visual examination, headspace gas sampling/analysis, and repackaging operations. Physical containment of the transuranic waste is provided by the building, the transuranic waste containers, gloveboxes, and the facility's administrative controls. The building and the gloveboxes are maintained at a negative pressure with respect to the outside, and the building. Since 2021, WCRRF downgraded its safety basis and changed from a HC-2 nuclear facility to a HC-3 nuclear facility. The WCRRF will support the size reduction and disposition of equipment from PF-4 and other areas across LANL.

TA-54, Radioassay and Nondestructive Testing (RANT) Facility. The RANT Facility, building 38, is a HC-2 nuclear facility managed by Triad that is used to load TRU waste containers into TRUPACT shipping casks for disposition to WIPP.

TA-55, RCRA-permitted High Efficiency Neutron Counter (HENC) Pad. Waste drums from the PF-4 are characterized, counted and loaded up for transportation to the WIPP. The HENC pad area is currently authorized to handle TRU and MTRU waste in approved containers, including the current loading and unloading area identified for proposed TRU and MTRU waste loading. Mobile loading operations occur at TA-55 for direct shipment to WIPP.

TA-60, RCRA-permitted Hazardous Waste Storage Area. In 2018, LANL created a new Treatment Storage Facility at TA-60 building 17. This area was stood up to replace the Treatment Storage Facility at Area L at TA-54. N3B assumed operational control and management of several facilities at TA-54. This change in management initiated a need for a temporary central accumulation waste storage area for Triad. In 2024, the Class 2 Permit Modification to the LANL Hazardous Waste Permit to add TA-60 Building 17 as a temporary storage facility that allows for the additional storage of enduring mission hazardous and mixed wastes up to 1 year was approved (LANL 2023b).

TA-63, Transuranic (TRU) Waste Facility (TWF). In 2017, the construction was completed on the new TWF (TA-63, Building 0144). The TWF can store up to 1,240 drums for no longer than one year. This HC-2 nuclear facility manages TRU and mixed TRU waste.

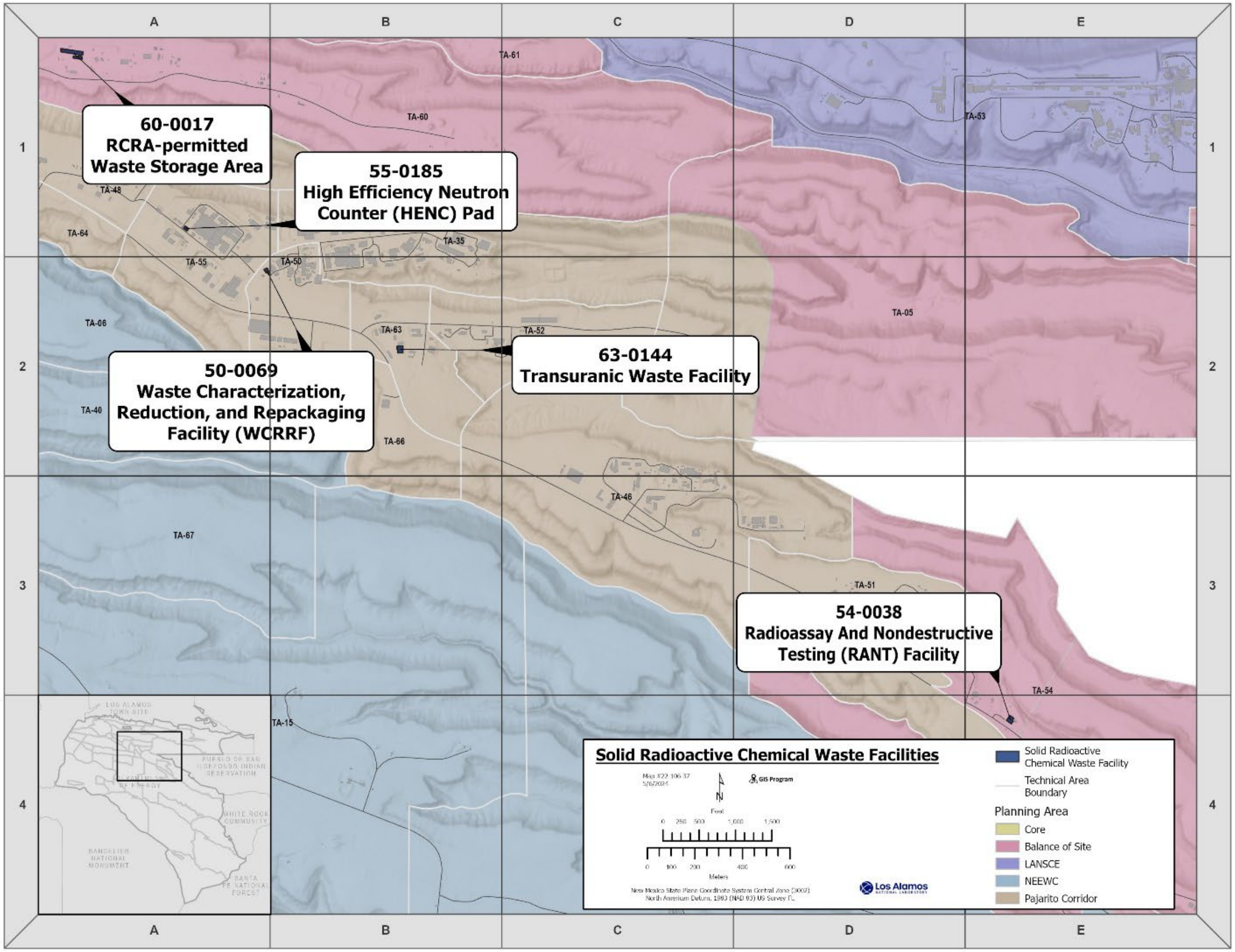


Figure E-4 Solid Radioactive Chemical Waste Facilities

Capabilities and Activities

Table E-38 lists the capabilities that are conducted at the Solid Radioactive and Chemical Waste Facilities.

Table E-38 Existing Solid Radioactive and Chemical Waste Facilities Capabilities and Activity Levels

Capability	Activities
Waste Characterization, Packaging, and Labeling	• Characterize newly generated TRU waste: o Characterize LLW, MLLW, and chemical waste, including waste from DD&D activities; and o Characterize additional LLW, MLLW, and chemical waste, including waste from DD&D activities. • Perform coring and visual inspection of a percentage of TRU waste packages. • Overpack and bulk small waste, as required. • Support, certify, and audit generator characterization programs. • Maintain waste acceptance criteria for LANL waste management facilities. • Maintain waste acceptance criteria for offsite treatment, storage, and disposal facilities. • Maintain WIPP waste acceptance criteria compliance and liaison with WIPP operations.
Waste Transport, Receipt, and Acceptance	• Ship newly generated TRU waste to WIPP. • Ship LLW to offsite disposal facilities. • Ship MLLW for offsite treatment and disposal in accordance with EPA land disposal restrictions. • Ship chemical wastes for offsite treatment and disposal in accordance with EPA land disposal restrictions. • Ship LLW, MLLW, and chemical waste from DD&D activities. • Ship additional LLW, MLLW, and chemical waste from DD&D activities.
Waste Storage	• Stage chemical and mixed wastes before shipment for offsite treatment, storage, and disposal. • Store TRU waste until it is shipped to WIPP. • Store MLLW pending shipment to a treatment facility. • Store LLW uranium chips until sufficient quantities are accumulated for stabilization campaigns. • Store TRU waste generated by DD&D activities. • Manage and store sealed sources for the OSRP at increased types and quantities.
Waste Treatment	• Compact LLW. • Process TRU waste through size reduction at the WCRRF. • Demonstrate treatment (e.g., electrochemical) of liquid MLLW. • Stabilize uranium chips. • Process newly generated TRU waste through new TRU Waste Facility. • Dispose additional LLW generated by DD&D activities.

DD&D = decontamination, decommissioning, and demolition; EPA = U.S. Environmental Protection Agency; LANL = Los Alamos National Laboratory; LLW = low-level radioactive waste; MLLW = mixed LLW; OSRP = Offsite Source Recovery Program; TRU = transuranic; WCRRF = Waste Characterization, Reduction, and Repacking Facility; WIPP = Waste Isolation Pilot Plant

Waste Characterization, Packaging, and Labeling. LANL supports, certifies, and audits generator characterization programs and maintains the waste acceptance criteria for LANL waste management facilities. LANL also manages compliance with the waste acceptance criteria for offsite treatment, storage, and disposal facilities. Deteriorating drums are overpacked, and small waste items are bulked (packaged together) to facilitate their management. Capabilities include coring and visual inspection of a percentage of TRU waste packages, maintaining compliance with the current version of the WIPP waste acceptance criteria, and coordinating with WIPP operations for disposal of LANL TRU waste.

Waste Transport, Receipt, and Acceptance. Hazardous and mixed wastes are collected from LANL generators, transported to the consolidated remote storage sites at TA-60, and TA-54, and TA-63 and shipped offsite for treatment and disposal in accordance with U.S. Environmental Protection Agency (EPA) land disposal restrictions. Newly generated TRU wastes are prepared for disposal and shipped to WIPP.

Waste Treatment. This capability involves a variety of activities to prepare different waste types for storage and disposal: size reduction, and special treatment of wastes on an as-needed basis. LLW generated onsite is compacted to reduce its volume prior to disposal.

Larger pieces of equipment from PF-4 will be reduced in size at the WCRRF to make them suitable to be packaged for shipment to WIPP. This will begin once WCRRF restarts as a HC-3 nuclear facility.

Waste Storage. LANL stores chemical and mixed wastes prior to shipment to offsite treatment, storage, and disposal facilities; TRU waste until it is shipped to WIPP; MLLW until it is transported to a treatment facility; sealed sources from OSRP until a disposition path is available. By broadening the types and quantities of radioactive sealed sources (CO-60, Ir-192, Cf-252, Ra-226) that LANL can manage and store prior to their disposal, NNSA can retrieve and store more of these sources, which, if not adequately secured, could be used in a radiation dispersion device (a ‘dirty bomb’).

<u>Hazards and Wastes</u>

From CY 2017 to CY 2022, the Solid Radioactive and Chemical Waste Facilities generated the following radioactive air emissions (Table E-39):

Table E-39 Solid Radioactive and Chemical Waste Facilities Radioactive Air Emissions Data, CY 2017–2022

Type	2017	2018	2019	2020	2021	2022
Tritium (Ci/yr)	Not measured[a]	Not measured[a]	Not measured[a]	Not measured[a]	Not measured[a]	Not measured[a]
Americium-241 (Ci/yr)	No emissions[b]	No emissions[b]	No emissions[b]	1.59E-10	1.59E-10	No emissions[b]
Plutonium-238 (Ci/yr)	1.78E-10	2.87E-11	No emissions[b]	6.47E-10	6.47E-10	No emissions[b]
Plutonium-239 (Ci/yr)	3.85E-11	No emissions[b]	No emissions[b]	2.83E-11	2.83E-11	6.36E-11
Uranium-234 (Ci/yr)	No emissions[b]	5.48E-09	1.03E-08	3.32E-09	3.32E-09	No emissions[b]
Uranium-235 (Ci/yr)	No emissions[b]	No emissions	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]
Uranium-238 (Ci/yr)	1.27E-08	2.40E-09	No emissions[b]	No emissions[b]	No emissions[b]	No emissions[b]
Other Radionuclides (Ci/yr)	2.76E-10	1.87E-09	5.97E-09	1.45E-08	1.00E+00	2.06E-08

Ci/yr = curies per year; CY = calendar year

a Data shown are measured emissions from Waste Characterization, Reduction, and Repackaging Facility and the Actinide Research and Technology Instruction Center Facility at TA-50; and TA-54-0412, Dome 231, and Dome 375 at TA-54. All non-point sources at TA-50 and TA-54 are measured using ambient monitoring.

b This radionuclide was not considered to be a significant source of emissions or offsite dose from this facility.

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

There are no outfalls associated with this major facility.

E.2.4 LANSCE Planning Area

The LANSCE Planning Area at TA-53 comprises the Los Alamos Neutron Science Center, 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. 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. Figure E-5 shows the major facilities within the LANSCE Planning Area.

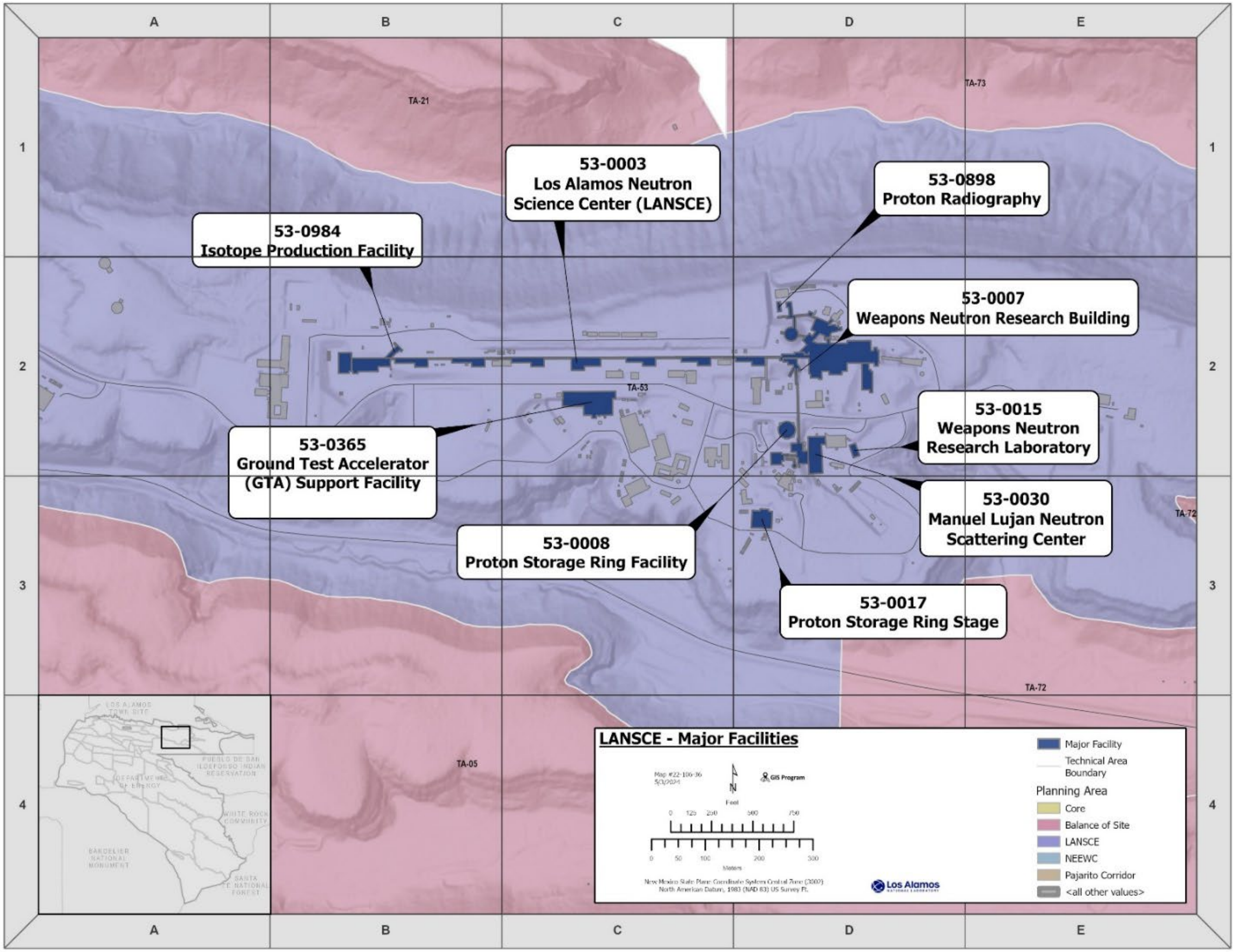


Figure E-5 LANSCE Planning Area

E.2.4.1 Los Alamos Neutron Science Center (LANSCE)

Facility Description

The LANSCE accelerator complex is a unique NNSA asset that provides physics and engineering support to LANL, Lawrence Livermore National Laboratory, and Sandia National Laboratories. LANSCE provides the capability to measure cross sections of materials to characterize and qualify high explosives and other materials, and to support stockpile certification. The LANSCE accelerator complex primarily supports the Stockpile Stewardship/Weapons Program and also plays an integral role in the science, technology, and engineering missions of the Laboratory.

The majority of LANSCE operations are centered around the 800-million-electron-volt LINAC. The LINAC at LANSCE is one of the nation's most powerful linear accelerators; it spans a half mile in length and features 338,803 square feet of floor space. The intense pulsed protons are used for proton radiography and to produce the wide energy spectrum of spallation neutrons needed to interrogate various materials—materials that improve safety and security, advance nuclear technology, and have commercial applications. The LINAC supports five state-of-the-art experimental facilities: the Manuel Lujan Neutron Scattering Center (the Lujan Center), the Weapons Neutron Research Facility (WNR), the Proton Radiography Facility (pRad), Isotope Production Facility (IPF), and LANSCE Ultracold Neutrons. These five facilities are detailed below:

- The Lujan Center provides exceptional research opportunities to scientists in national security, academia, and industry. Applications for neutron scattering include materials science, engineering, condensed matter physics, chemistry, biology, and geology. The center leverages moderated pulsed neutrons for NNSA's Defense Programs.
- The WNR enables basic, applied, industrial, and defense-related research through the high flux of neutrons provided by the LANSCE proton beam and a unique instrument suite. Science thrust areas include fission processes, neutron-capture cross sections, neutron radiography, and semiconductor irradiations. WNR delivers key nuclear data in support of NNSA's Defense Programs.
- Proton radiography was invented at LANL. Proton radiography (pRad) employs a high-energy proton beam to image the properties and behavior of materials driven by high explosives. The efficacy and versatility of pRad stems from the ability to produce multiple proton pulses in an accelerator coupled with multiple optical viewing systems that can result in 20–40 frame movies.
- The IPF uses a 100-mega electron-volt (MeV) proton beam extracted from the main LANSCE accelerator to produce isotopes for application in the fields of medicine, fundamental nuclear physics, national security, environmental science, and industrial applications. IPF supplies a variety of radioisotopes to medical researchers and other scientists all over the world and is a leader in developing and producing new and unique isotopes for international R&D.
- The LANSCE Ultracold Neutrons facility produces high-energy spallation neutrons and uses solid deuterium to cool neutrons by one million billion-fold. The resulting ultracold neutrons have unique properties that allow them to be studied precisely: They move at speeds of only a few meters per second and are completely confined by magnetic fields and material bottles for many hundreds of seconds at a time.

Another experimental facility was constructed in TA-53-0365 to demonstrate the practicality of using continuous-wave accelerator beam technology to produce tritium, as an alternative to the historical use of nuclear reactors. The building consists of two major parts: an underground, shielded beam tunnel (16,200 square feet) and a four-story, steel-frame building (53,800 square feet). The heating, ventilation, and air conditioning system allows short-lived radioisotopes to decay in the beam tunnel prior to release via the 82-foot-high exhaust stack. The facility has been used periodically for its original intent and other uses, including partnerships with researchers from outside the federal government. As part of the LANSCE Modification Project under the Modernized Operations Alternative, the facility would be modified to contain a 3 MeV Radio Frequency Quadruple accelerator coupled to a 10 MeV output energy Drift Tube LINAC accelerator and is currently named the Ground Test Accelerator.

Capabilities and Activities

Table E-40 lists the capabilities that are conducted at the LANSCE Facility.

Table E-40 Existing LANSCE Capabilities and Activity Levels

Capability	Activities
Accelerator Beam Delivery, Maintenance, and Development	• Operate 800-MeV LINAC beam and deliver beam to Areas A, B, C, WNR Facility, the Lujan Center, Dynamic Test Facility, and IPF. Between CY 2017 and CY 2022, the beam was available seven months per year (up to 4,103 hours, depending on the experimental area). • Reconfigure beam delivery and support equipment to support new facilities, upgrades, and experiments.
Experimental Area Support	• Provide support to ensure availability of the beam lines, beam line components, handling and transport systems, and shielding, as well as radio frequency power sources. • Perform remote handling and packaging of radioactive material, as needed.
Neutron Research and Technology[a]	Conduct experiments using neutrons from the Lujan Center and WNR. Between 2017 and 2022, up to 162 experiments were conducted.
Materials Test Station	Irradiate materials and fuels in a fast-neutron spectrum and in a prototype temperature and coolant environment.

Subatomic Physics Research	• Conduct physics experiments at the Lujan Center and WNR.
	• Conduct pRad experiments, including using small-to-moderate quantities of high explosives, including:
	  o Dynamic experiments in containment vessels with high explosives and depleted uranium; and
	  o Dynamic experiments in powder launcher with gun powder.
	• Contain experiments using small-to-moderate quantities of high explosives similar to those discussed under Neutron Research and Technology.[a]
	Conduct research using ultracold neutrons.

Medical, Industrial, and Research Isotope Production	Irradiate targets per year for medical isotope production at the IPF. From CY 2017 to CY 2022, up to 41 targets were irradiated per year.

Capability	Activities
High-Power Microwaves and Advanced Accelerators	Conduct R&D in high-power microwaves and advanced accelerators in areas including microwave research for industrial and environmental applications.
Radioactive Liquid Waste Treatment (Solar Evaporation at Technical Area 53)	Treat radioactive liquid waste.

CY = calendar year; IPF = Isotope Production Facility; LINAC = linear accelerator; MeV = mega electron-volt; R&D = research and development; WNR = Weapons Neutron Research

a High explosives quantities used under the Neutron Research and Technology capability include up to 10 pounds of high explosives and/or depleted uranium, small quantities of actinides and sources, and up to 50 grams of plutonium.

Accelerator Beam Delivery, Maintenance, and Development. This capability is responsible for development, configuration, and maintenance of components and support systems needed to deliver proton ion beams and for delivery of those beams.

Generation and delivery of the proton ion beams require considerable development and maintenance capabilities for all components of the linear accelerator, including the ion sources and injectors, the mechanical systems in the accelerator (including cooling water), all systems for the proton storage ring and its associated transfer lines, and beam diagnostics in the accelerator and transfer lines. Beam development activities include beam dynamics studies and design and implementation of new capabilities. This activity requires the coordination of many disciplines, including accelerator physics, high-voltage and pulsed-power engineering, mechanical engineering, materials science, radiation shielding design, digital and analog electronics, high-vacuum technology, mechanical and electronics design, mechanical alignment, hydrogen furnace brazing, machining, and mechanical fabrication.

Experimental Area Support. This support capability focuses on the maintenance, improvement, and operational readiness of beam lines and experimental areas at LANSCE. Support also includes the design, operation, and maintenance of remote-handling systems for highly activated components; the handling and transportation (usually for disposal) of highly activated components; and the specification, engineering, design, and installation of radiation shielding.

Neutron Research and Technology. Fundamental research is conducted on the interaction of neutrons with various materials, molecules, and nuclei to advance condensed matter science (including material science and engineering and aspects of bioscience), nuclear physics, and the study of dynamic phenomena in materials. Applied neutron research is conducted to provide scientific and engineering support to weapons stockpile stewardship and nonproliferation surveillance. Efforts include resonance neutron spectroscopy and neutron radiography. Research is also performed to develop instrumentation and diagnostic devices by scientists from universities, other Federal laboratories, and industry.

Neutrons from the Lujan Center and WNR are used to conduct experiments at LANL. In addition, LANL continues to support contained weapons-related experiments using small-to-moderate quantities of high explosives and would provide support for static stockpile surveillance technology R&D.

Material Test Station. Safely irradiate materials and fuels in a fast-neutron spectrum and in a prototypic temperature and coolant environment. A fast-neutron irradiation environment would be produced by interaction of the proton beam with a tungsten target. The neutrons would be used to irradiate small samples of materials and fuels to conduct proof of performance experiments to prove the practicality of transmuting plutonium and high-level radioactive wastes into other elements or isotopes.

Subatomic Physics Research. Proton radiography experiments include contained experiments using small-to-moderate quantities of high explosives.

Research built on subatomic physics techniques and knowledge is also developing the technology for, and use of, neutron and proton radiography for stockpile stewardship applications. This research includes development and demonstration of advanced detectors.

Medical Isotope Production. Radioisotopes used by the medical community for diagnostic procedures, therapeutic treatment, clinical trials, and biomedical research are produced at LANSCE.

High-Power Microwaves and Advanced Accelerators. R&D is conducted for advanced accelerator concepts, high-powered microwaves, room-temperature and superconducting linear accelerator structures, as well as in microwave chemistry for industrial and environmental applications.

High-power microwave research and experiments have occurred in a number of technology areas, including: (1) high-power microwave, radio frequency, and electromagnetic pulse sources that typically use multi-kilo-ampere, relativistic electron beams; (2) future linear accelerator power sources and directed energy; (3) explosively driven high-power microwave and radio frequency systems for defense applications; (4) intense beam physics and modeling for application to high-power microwave source development; (5) high-power, free-electron lasers based on high-brightness electron accelerators; (6) high-brightness accelerator as a driver for an extreme ultraviolet source for lithography; (7) high-performance ground penetrating radar for environmental remediation; (8) application of high-power microwaves to industrial processing, such as chemical catalysis and environmental remediation; (9) microwave and electromagnetic pulse vulnerability and effects testing of weapons systems; (10) novel high-power microwave sources based on shock compression of solid materials; (11) advanced pulsed-power modulator development; (12) development of room-temperature and superconducting radio frequency linear accelerator structures; and (13) development of advanced electron accelerators.

Radioactive Liquid Waste Treatment Plant. Wastes from LANSCE activities and certain wastes from TA-16 are treated in facilities at TA-53. Treatment includes wastewater storage to allow for short-lived radioisotope decay followed by solar evaporation.

<u>Hazards and Wastes</u>

Radiation hazards at LANSCE include both prompt radiation and penetrating radiation. Prompt radiation sources include radiation associated with normal beam operation, radiation from activated materials (including activated air), and prompt radiation due to transient beam spills. Penetrating radiation represents a hazard to personnel at LANSCE. When produced directly by the accelerator beam, it is a hazard only when the beam is on. It also is generated as a result of induced activity in materials during beam operation. Certain accelerator components (e.g., klystrons) generate penetrating radiation (x-rays) when powered. Penetrating radiation is also produced by radioactive materials (i.e., sources) used onsite. The following categories of penetrating radiation are present at the LANSCE User Facility:

- Radiation generated directly by the accelerator beam (beam radiation).
- Radiation generated from induced activity in materials during beam operation (i.e., as a result of beam interaction with beamline components, targets, shielding, air, etc.).
- Radiation generated secondary to accelerator component operation (incidental radiation).

Other hazards at LANSCE are standard industrial hazards including high-voltage electrical equipment.

LANSCE generates LLW, MLLW, TRU, and chemical wastes. The contributions to the various waste streams are included in the 6-year averages reported in Sections 4.11.2 and 4.11.3, respectively. From CY 2017 to CY 2022, LANSCE generated of the following waste types (Table E-41):

Table E-41 LANSCE Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical (kg/yr)	25,677	99,028	15,037	19,074	35,773	12,698
LLW (m^3/yr)	379.0	484	26.6	206.9	221	358
MLLW (m^3/yr)	2.7	11	18.5	0.07	17	10.7

CY = calendar year; kg/yr = kilogram per year; LANSCE = Los Alamos Neutron Science Center; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW

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

From CY 2017 to CY 2022, LANSCE generated the following radioactive air emissions (Table E-42):

Table E-42 LANSCE Radioactive Air Emissions Data, CY 2017–2022

Type	2017	2018	2019	2020	2021	2022
Argon-41 (Ci/yr)	1.13E+02	4.81E+01	1.57E+01	2.22E+00	1.48E+01	5.16E+01
Particulate and Vapor Activation Products (Ci/yr)	2.08E-03	2.89E-03	2.57E-03	9.50E-01	8.56E-01	1.29E−01
Carbon-10 (Ci/yr)	2.75E-01	4.18E-01	3.21E-01	3.01E-01	5.92E-01	1.01E−01
Carbon-11 (Ci/yr)	1.32E+02	2.19E+02	1.18E+02	9.90E+01	1.21E+02	8.37E+01
Nitrogen-13 (Ci/yr)	2.41E+01	3.39E+01	4.17E+01	1.93E+01	3.23E+01	1.43E+01
Oxygen-15 (Ci/yr)	2.28E+01	4.87E+01	1.04E+02	4.12E+01	6.06E+01	2.21E+01
Tritium as Water (Ci/yr)	2.21E+01	2.34E+01	8.77E+00	1.53E+01	1.28E+01	8.59E+00

Ci/yr = curies per year; CY = calendar year

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

LANSCE facilities in TA-53 discharge to two NPDES-permitted outfalls. Discharges from CY 2017 to CY 2022 are shown in Table E-43.

Table E-43 LANSCE NPDES Discharge Data, CY 2017–2022

Year	Outfall 03A048 Discharge Amount (MGY)	Outfall 03A113 Discharge Amount (MGY)
2017	27.7	0.53
2018	26.8	0.44
2019	25.8	0.2
2020	24.3	0.2
2021	31.9	0.29
2022	26.2	0.3

CY = calendar year; LANSCE = Los Alamos Neutron Science Center; MGY = million gallons per year
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

E.2.5 Balance of Site Planning Area

The Balance of Site Planning Area, which includes the remaining TAs not specifically addressed in the four primary planning areas (Core, Pajarito, NEEWC, and LANSCE) and leased space. It also ensures that the entire site footprint is addressed in the planning process. Twenty-one TAs and leased space are addressed in this planning area. The general criteria used to distinguish Balance of Site TAs from TAs within specific planning areas include:

- The anticipated scale, complexity, and significance of the associated near-, mid-, and long-term infrastructure investment;
- The size, remote location, and single mission;
- A capability primarily focused on site-wide industrial support or buffer/reserve area; and
- Other unique context relative to site-wide capabilities and operations including leased space.

E.2.5.1 Material Disposal Area G

Facility Description

TA-54 is the legacy waste management area at LANL. For purposes of this SWEIS, TA-54 is included in the Balance of Site Planning Area. As described in Section E.2.3.6, DOE-EM owns TA-54 (with the exception of the RANT facility) and the area is operated by N3B.

Area G, within TA-54, has served as the Laboratory's principal radioactive solid waste storage and disposal site since the Laboratory's routine operations began there in 1957, and is the only active radioactive waste disposal facility at the Laboratory today. Area G includes all operating RCRA-permitted surface units and all other operational buildings or structures at TA-54, including MDA G. Area G includes some disposed radioactive waste that is not included within MDA G. Included at MDA G are historical disposal of LLW, certain infectious waste that contained radioactive materials, asbestos-containing material, PCBs, and temporary storage of transuranic waste.

Planning for the closure of MDA G has been underway since 1992. The 2005 Compliance Order on Consent began the formal process for closure of legacy waste sites with the New Mexico Environment Department Hazardous Waste Bureau, including MDA G. Specific to MDA G, the 2005 agreement was superseded by the 2016 Consent Order to develop and implement corrective measures for the solid waste management units at MDA G. In addition to the corrective measures for MDA G, a performance assessment and composite analysis is underway for Area G, to comply with DOE Order 435.1, "Radioactive Waste Management." Under this order, the performance assessment and composite analysis models the long-term performance of the Area G disposal facility so that the risk posed by the disposed waste to human health and safety and the environment can be determined. A closure plan for Area G will be developed to capture the recommendations of the corrective measures evaluation for MDA G and the results of the performance assessment and composite analysis for Area G.

Capabilities and Activities

The current capacity to dispose of LLW at Area G is very limited; waste is accepted for disposal only under special circumstances and with prior authorization (LANL 2024b). Area G is now dedicated to storing, characterizing and remediating LANL's legacy TRU and LLW before being shipped off site for permanent disposal (DOE 2023). TRU waste containers are stored in domes equipped with fire detection and air monitoring systems. The containers are routinely monitored and inspected. TRU waste from LANL's legacy defense-related activities is disposed at the WIPP facility. Prior to shipment, the containers and their contents are independently, non-destructively analyzed and certified under a state- and EPA-approved program to confirm that containers meet the WIPP Waste Acceptance Criteria (DOE 2023). Table E-44 details MDA G capabilities and activity levels.

Waste Characterization, Packaging, and Labeling. LANL supports, certifies, and audits generator characterization programs and maintains the waste acceptance criteria for LANL waste management facilities. LANL also manages compliance with the waste acceptance criteria for offsite treatment, storage, and disposal facilities. Deteriorating drums are overpacked, and small waste items are bulked (packaged together) to facilitate their management. Capabilities include coring and visual inspection of a percentage of transuranic waste packages, ventilating packages of transuranic waste retrieved from below grade, maintaining compliance with the current version of the WIPP waste acceptance criteria, and coordinating with WIPP operations for disposal of LANL TRU waste.

Waste Storage. LANL stores chemical and mixed wastes prior to shipment to offsite treatment, storage, and disposal facilities; legacy TRU waste until it is shipped to WIPP and MLLW until it is transported to a treatment facility.

Waste Retrieval. This capability involves the retrieval and management of waste stored in pits, shafts, and trenches in TA-54 Area G so that the waste can be processed for eventual disposition.

Waste Disposal. Solid LLW was disposed of in cells, pits, and shafts in TA-54 Area G. LLW is now disposed at approved disposal facilities. The Consent Order requires investigation and remediation of environmental contamination at LANL, including certain subsurface units in MDA G in Area G.

Table E-44 Existing MDA G Capabilities and Activity Levels

Capability	Activities
Waste Characterization, Packaging, and Labeling	• Characterize legacy TRU waste. • Characterize LLW, MLLW, and chemical waste, including waste from DD&D and remediation activities. • Overpack and bulk small waste, as required. • Support, certify, and audit generator characterization programs. • Maintain waste acceptance criteria for LANL waste management facilities. • Maintain waste acceptance criteria for off-site treatment, storage, and disposal facilities. • Maintain WIPP waste acceptance criteria compliance and liaison with WIPP operations. • Ship legacy TRU waste to WIPP. • Ship LLW to off-site disposal facilities. • Ship MLLW for off-site treatment and disposal in accordance with EPA land disposal restrictions. • Ship chemical wastes for off-site treatment and disposal in accordance with EPA land disposal restrictions. • Collect chemical and mixed wastes from LANL generators and transport to Consolidated Remote Storage Sites and TA-54.
Waste Storage	• Stage chemical and mixed wastes before shipment for off-site treatment, storage, and disposal. • Store TRU waste until it is shipped to WIPP. • Store LLW pending shipment to a treatment and/or disposal facility. • Store MLLW pending shipment to a treatment facility. • Manage and store sealed sources for the OSRP.
Waste Retrieval	Retrieve remaining legacy TRU waste.
Waste Disposal	• With prior approval from DOE, dispose of LLW in approved disposal areas in Area G. • Dispose additional LLW generated by DD&D and remediation activities at approved disposal facility.
Waste Transport, Receipt, and Acceptance	Send evaporator bottoms to an off-site commercial facility for solidification and disposal.
Waste Characterization, Packaging, and Labeling	• Characterize legacy TRU waste. • Characterize LLW, MLLW, and chemical waste, including waste from DD&D and remediation activities. • Overpack and bulk small waste, as required. • Support, certify, and audit generator characterization programs. • Maintain waste acceptance criteria for LANL waste management facilities. • Maintain waste acceptance criteria for off-site treatment, storage, and disposal facilities. • Maintain WIPP waste acceptance criteria compliance and liaison with WIPP operations. • Ship legacy TRU waste to WIPP.

Capability	Activities
	• Ship LLW to off-site disposal facilities. • Ship MLLW for off-site treatment and disposal in accordance with EPA land disposal restrictions. • Ship chemical wastes for off-site treatment and disposal in accordance with EPA land disposal restrictions. • Collect chemical and mixed wastes from LANL generators and transport to Consolidated Remote Storage Sites and TA-54.

DD&D = decontamination, decommissioning, and demolition; EPA = U.S. Environmental Protection Agency; LANL = Los Alamos National Laboratory; LLW = low-level radioactive waste; MLLW = mixed LLW; OSRP = Offsite Source Recovery Program; TRU = transuranic; WIPP = Waste Isolation Pilot Plant

Waste Transport, Receipt, and Acceptance. Hazardous and mixed wastes are collected from LANL generators, transported to the consolidated remote storage sites and TA-54, and shipped offsite for treatment and disposal in accordance with EPA land disposal restrictions. Legacy and newly generated TRU wastes are prepared for disposal and shipped to WIPP. Receipt of offsite waste is not routine and must be approved by NNSA. Once received, the wastes are managed along with similar wastes generated at LANL. These wastes are generated by LANL activities at other locations and by other DOE facilities that do not have the capability to manage the wastes.

Hazards and Wastes

Environmental monitoring at Area G includes direct-penetrating radiation, air quality, groundwater, soil, vegetation, and small mammal sampling (LANL 2024b).

Non-point sources of radioactive air emissions are present at Area G. MDA G is also a known source of diffuse emissions of tritium vapor and direct radiation from above-ground storage of radioactive waste (LANL 2023c). Resuspension of soil contaminated with low levels of plutonium/americium has also created a diffuse source. Point sources at Area G include operations involving characterization, processing, or repackaging of waste containers. Two new monitored point sources came on-line in 2010, at Building 412 and Dome 231. These two sources are waste processing facilities, where drums are repackaged, inspected, and otherwise prepared for offsite disposal (LANL 2023c). The Dome 231 processing facility was expanded in 2012 to increase throughput capacity of the dome. In March 2014, a new building (Dome 375) began radiological operations to process larger waste containers. Non-monitored (minor) sources of emissions at TA-54 include drum characterization work at Building 33 and Dome 224 as well as air sample management work outside of Area G in Building 1001 (LANL 2023c).

E.3 Other Support Facilities

This section describes facilities that do not meet the criteria as a "major facilities," but still provide an important support role to the LANL mission or operate as a facility for basic science research. The 2008 SWEIS referred to these facilities as "Non-Key Facilities."

From CY 2017 to CY 2022, the other support facilities generated an average of the following waste types (Table E-45):

Table E-45 Other Support Facilities Waste Data, CY 2017–2022

Waste Type	2017	2018	2019	2020	2021	2022
Hazardous/Chemical kg/yr	3,429,957	1,325,948	1,965,972	1,116,441	847,762	966,964
LLW m^3/yr	2,720.4	909.1	141.9	243.7	45	849.8
MLLW m^3/yr	0.2	2.7	2.8	3.3	2	41.6
TRU m^3/yr	0	5	5.8	1	0	0

CY = calendar year; kg/yr = kilogram per year; LLW = low-level radioactive waste; m^3/yr = cubic meters per year; MLLW = mixed LLW; TRU = transuranic
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

From CY 2017 to CY 2022, there were no reported radioactive air emissions from these facilities.

Wastewater discharges from the other support facilities from CY 2017 to CY2021 are shown in Table E-46.

Table E-46 Other Support Facilities NPDES Discharge Data, CY 2017–2022

Year	001[a]	13S	03A160	03A199	Total
2017	61.6	0	0.23	18.9	80.7
2018	59.9	0	0.06	13.3	73.3
2019	72.1	0	0	12.7	84.8
2020	78.0	0	0	12.8	90.8
2021	65.2	0	0	12.2	77.4
2022	86	0	0	12.7	98.7

CY = calendar year; NPDES = National Pollutant Discharge Elimination System
a Outfall 001 data includes discharges from the Strategic Computing Complex.
Source: LANL (2019, 2020, 2021a, 2022, 2023a, and 2024a)

Other support facilities, as described in the 1999 and 2008 SWEIS, include the balance and majority of LANL buildings. Most of these support facilities house operations that do not have the potential to cause significant environmental impacts. The primary support facilities that may have some potential environment impact are discussed in this section, including:

- Live Firing Range,
- Emergency Operations Center,
- Interagency Fire Center,
- Sanitary Wastewater System,
- Center for Integrated Technologies,
- National High Magnetic Field Laboratory,
- Nonproliferation and International Security Center, and
- Sanitary Effluent Reclamation Facility.

E.3.1 Live Firing Range

E.3.1.1 Facility Description

LANL operates a live firing range at TA-72, which is used by security force personnel to satisfy DOE and LANL training requirements. The live firing range is used for training with machine guns, handguns, rifles, grenade launchers, and other small arms. Qualification courses for these weapons are designed to verify the shooter's skills in manipulation and marksmanship under daylight and nighttime conditions. A variety of targets are used for training purposes.

A live fire shoot house is also located at TA-72, and consists of ballistic resistant, modular steel panels that can be moved to allow for different sizes and shapes of the shooting area. Certain shooting exercises require a long and narrow shooting area while other exercises can be performed in smaller areas. The shoot house is used for covert and dynamic tactical entry training for security personnel. Bullet traps are placed behind each target to prevent impact of the bullets onto the modular panel walls, thereby preserving the integrity of the structure.

The surface danger zone (the total of the impact area and ricochet area extending the maximum range needed for the weapon in use) is within the fenced area, which is posted with permanent signs warning persons of the danger of the live firing range and prohibiting trespassing. Secondary danger areas are located outside the surface danger zone and extend 100 meters on all sides. The small arms live fire range extends for 100 meters, and the grenade launcher range extends for 400 meters.

Spent ammunition impacts the berms at the back of the firing range. Personnel follow all safety requirements outlined in a Live Fire Range Safety Assessment. The spent ammunition is collected and disposed of properly.

E.3.1.2 Capabilities and Activities

The live firing range and all associated structures meet DOE's Range Design Criteria. A variety of ammunition is used for training, including:

- practice rounds and live rounds,
- tracer ammunition, and
- paintball rounds.

E.3.2 Emergency Operations Center (EOC)

E.3.2.1 Facility Description

The EOC (TA-69-0033) is an approximately 18,000-square-foot, state-of-the-art facility. It provides a central location for interagency and interjurisdictional coordination and executive decision-making in support of an incident response. The EOC generates a small amount of chemical waste from preventative maintenance on equipment.

E.3.2.2 Capabilities and Activities

The EOC carries out the coordination function through:

- information collection and evaluation,
- internal and external communications,
- establishing objectives and priorities (objective-based planning),
- managing resources and tasks, and
- supporting the Incident Commander.

E.3.3 Interagency Fire Center

E.3.3.1 Facility Description

The Interagency Fire Center is a single-story multipurpose facility at TA-49. The facility is located at the junction of the entrance road to TA-49 and State Road 4 and is used for wildfire response and storage for interagency wildfire response equipment and supplies. Personnel from LANL, Los Alamos County, the National Park Service, and the U.S. Forest Service staff the facility. The facility consists of three helicopter pads (helipads), two at-grade dip tanks (one 1500 gallon and one 3500-gallon tanks), a building, office trailer, and other associated infrastructure.

E.3.3.2 Capabilities and Activities

During the fire season, helicopter crews and maintenance staff use the facility and are ready to assist during an emergency wildfire. The building houses two fire engines, fire equipment, and office space for emergency management.

Except during emergency situations or for safety reasons, the flight path to and from the helibase is from the south or east to the extent possible to avoid sensitive habitat located in the northern and western canyon areas. In addition, administrative controls prevent recreational use of the canyons surrounding the site.

E.3.4 Sanitary Wastewater System (SWWS) Facility

E.3.4.1 Facility Description

The Laboratory's sanitary wastewater is collected by the SWWS and treated at the TA-46 SWWS treatment plant (TA-46-0333, -0334, -0335, -0336, -0337, -0338, and -0375.). It treats sanitary wastewater, process water, cooling water, storm water, and wastewater discharged to the sanitary sewer and/or collected in storage tanks from technical areas at the Laboratory. Once the wastewater reaches the SWWS plant, the sewage goes through physical, chemical, and biological processes which clean the wastewater and remove the solids.

For the SWWS to function properly, there are prohibited wastewater parameters that include:

- Cooling tower wastewater in excess of 1000 gallons per day;
- Liquids containing PCBs. PCBs were used as an insulating fluid in electrical equipment. Past PCB spills have contaminated some areas, so collected rainwater and some industrial spill water may have PCB contamination;
- Wastewater at temperatures >140 °F for flows > 100 gpd;
- Wastewater at temperatures >180 °F;
- Non-aqueous waste (i.e., oil/grease, paper towels, gloves, clothing);
- Medical wastewater;
- Radioactive wastewater;
- Toxic waste (as defined by Microtox methodology-e.g., wastewater that could kill the SWWS treatment plant microbes); and
- Line disinfection discharge greater than 1000 gallons (typically used for cleaning industrial system pipes).

E.3.4.2 Capabilities and Activities

The Laboratory must maintain a healthy microbial population in the SWWS plant to effectively treat the Laboratory's sanitary wastewater. Industrial discharges of large volumes of clean water do not contain organic matter (nutrients) needed by the plant's waste treatment microbes. Minimizing the volume of industrial wastewater helps maintain the proper balance of nutrients flowing into the plant.

E.3.5 Center for Integrated Nanotechnologies (CINT)

E.3.5.1 Facility Description

The CINT (TA-3-1420) was constructed as a new R&D facility dedicated to nanotechnologies. Jointly operated by LANL and Sandia National Laboratories, the CINT is a DOE, Office of Science National User Facility.

The CINT Facility is categorized as a radiological facility and includes operations involving radiological materials in quantities that do not meet or exceed HC-3 threshold criteria.

E.3.5.2 Capabilities and Activities

The following activities are conducted within the laboratories:

- Chemical and physical synthesis of nanoscale and nanostructured materials,
- Biologically inspired approaches to material design,
- Optical, electron, and force microscopies and microscopectroscopies for imaging and characterization,
- Ultrafast science,
- Photonics and plasmonics,
- Metamaterials, and
- Nanomechanical testing.

E.3.6 National High Magnetic Field Laboratory (NHMFL)

E.3.6.1 Facility Description

The NHMFL (TA-35-0125) is a unique user facility with its one-of-a-kind magnets and experts in pulsed magnet science. It is used by LANL, other governmental, industrial, and academic personnel. The great majority of experimental research conducted at the NHMFL is in the fields of materials science and condensed matter physics.

The NHMFL is classified as a radiological facility and includes operations involving radiological materials in quantities that do not meet or exceed HC-3 threshold criteria. Engineering controls, such as radiation air sampling and alarms, redundant interlocks protecting energized electrical equipment, HEPA filtration, and oxygen monitors, are used to limit access to high magnetic field areas and protect personnel from ultra-high magnetic fields. Pulsed magnetic fields are generated using high-voltage stored energy systems (non-PCB capacitor banks enclosed within cages). Experimental areas and control rooms for data acquisition are also included within the facility.

The NHMFL has cooling towers that can discharge blowdown to NPDES-permitted Outfall 03A160 or the SWWS Treatment Facility.

The NHMFL is a large electricity user.

E.3.6.2 Capabilities and Activities

- Current magnets have maximum magnetic field intensities ranging from 20 to 300 Tesla for several microsecond to several millisecond intervals.
- There are both superconducting magnets and pulsed-power capacitor-driven magnets.
- Very small samples are studied, and include plutonium (Pu) 239, Pu-242, depleted uranium 238, thorium compounds, cerium, high-temperature superconductors, other metals and semi-conductors, and other materials.
- Magnets are contained within enclosure rooms or surrounded by fragment barriers. The 300 T magnet is contained within an airtight enclosure room in a large high bay.

E.3.7 Nonproliferation and International Security Center (NISC)

E.3.7.1 Facility Description

The NISC (TA-03-2322) is a 169,374-square-foot, five-story, mixed-use facility with radiological, electronic, and optical laboratories. The center also houses offices for the Nonproliferation and International Security Division at LANL in support of the Global Security program. The building includes Category III SNM vaults as well as instrumentation development and training laboratories. The building also features a full machine shop with high-bay assembly area.

The NISC Facility is categorized as a radiological facility and includes operations involving radiological materials in quantities that do not meet or exceed HC-3 threshold criteria. The NISC uses small quantities of hazardous materials including solvents and other flammable materials which may generate wastes that are regulated under RCRA. These wastes are temporarily stored for up to 90 days in a RCRA-compliant storage area pending offsite disposal.

E.3.7.2 Capabilities and Activities

Laboratory work that primarily consists of light hazard computer and electronics laboratory activities; and radiological activity that includes the training and calibration operations that would occur in the basement area. The latter operation involves the movement and handling of a variety of sealed radioactive sources, most of which require no special handling due to their low intrinsic hazard, and the use of instruments to detect and monitor the radiation given off by the various sources (DOE 1999).

E.3.8 Sanitary Effluent Reclamation Facility (SERF)

E.3.8.1 Facility Description

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.

In 2010, NNSA proposed to expand SERF to improve wastewater treatment to meet permitted effluent limitations (NNSA 2010). The SERF expansion was completed in 2012. 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.

E.3.8.2 Capabilities and Activities

The SERF treatment system uses chemical precipitation, gravity settling of precipitates, microfiltration, and reverse osmosis technologies to lower the silica concentrations in the wastewater. The SERF treatment technologies provide makeup water with lower total dissolved solids (primarily lower silica), to the cooling towers at the SCC allowing an expected 4 to 6 cycles of concentration for more efficient reuse of the treated effluent in cooling towers that would otherwise require the use of potable water.

E.4 DD&D

DD&D are 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. 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.

As identified in Table 3.2-3, approximately 1.6 million square feet of facilities will undergo DD&D under the No-Action Alternative. Section E.4.1 provides the list of facilities planned for DD&D under the No-Action Alternative. Section E.4.2 provides the list of facilities proposed for DD&D under the Modernized Operations Alternative.

E.4.1 No-Action Alternative

Tables E-47–E-51 list the DD&D facilities under the No-Action Alternative for the five planning areas, respectively.

Table E-47 DD&D Facilities under the No-Action Alternative – Core Planning Area

TA	Building Number	Name	Gross Square Feet
3	16	Ion Beam Facility	56,259
3	22	Steam Plant	65,557
3	28	Office Building	17,176
3	29	Chemistry And Metallurgy Research Facility	563,601
3	30	Receiving And Distribution Center	114,643
3	40	Physics Building	164,423
3	41	Fire Station #1	12,045
3	142	Warehouse	32,726
3	200	Office Building	37,713
3	206	Equipment Building	478
3	332	Office Building	3,276
3	390	Transportable	2,874
3	391	Transportable	3,313
3	422	Office Building	17,665
3	456	Transportable	4,690
3	463	Transportable	3,525
3	468	Transportable	3,314
3	470	Transportable	3,349
3	474	Transportable	3,141
3	481	Transportable	3,327

TA	Building Number	Name	Gross Square Feet
3	495	Transportable	1,712
3	496	Transportable	1,711
3	512	Transportable	1,686
3	513	Transportable	1,684
3	514	Transportable	1,685
3	524	Office Building	6,227
3	782	Trailer	663
3	1353	Transportable	3,388
3	1382	Pump House	200
3	1522	Trailer	710
3	1616	Transportable	3,454
3	1663	Wellness Center	12,002
3	1701	Trailer	720
3	1762	Trailer	980
3	1790	Trailer	1,959
3	1888	Transportable	3,382
3	1898	Trailer	720
3	1911	Transportable	1,680
3	1912	Transportable	1,700
3	2003	Transportable	1,700
3	2004	Transportable	1,671
3	2005	Transportable	1,707
3	2006	Transportable	1,691
3	2007	Transportable	1,701
3	2008	Transportable	1,691
3	2009	Transportable	1,699
3	2010	Transportable	1,701
3	2206	Storage Bldg	3,003
		Core Area Total	1,175,922

Table E-48 DD&D Facilities under the No-Action Alternative – NEEWC Planning Area

TA	Building Number	Name	Gross Square Feet
8	32	Magazine	224
9	20	Office Building	189
9	21	Lab & Office Building	25,476
9	22	Magazine	9
9	23	Magazine	9
9	24	Magazine	9
9	25	Magazine	10
9	26	Magazine	9
9	27	Magazine	9
9	30	Gas Storage	242
9	31	Solvent Storage	330
9	32	Lab Office Building	2,549
9	33	Laboratory Building	949
9	34	Process Laboratory	1,771
9	37	Process Laboratory	1,591
9	214	Shop Building	2,468
11	24	Shop/Assembly Building	3,685
11	36	HE Magazine	82
14	5	Bunker	358
15	183	Lab & Office Building	20,039
16	16	Office Building	6,323
16	305	Plastics Building	5,402
16	328	Transportable	1,698
16	329	Transportable	2,232
16	380	HE "Powder" Inspection	3,983
16	900	Transportable	1,707
16	901	Transportable	1,698
16	946	Transportable	2,247
22	52	Shops Building	7,265
22	66	Storage Building	480
22	67	Storage Building	480
22	68	Storage Building	480
22	69	Storage Building	480
22	9501	Modular Complex (4 Plex)	2,632
22	9502	Modular Complex (4 Plex)	2,632
36	5	Preparation Building	624
36	6	Control Building	658

TA	Building Number	Name	Gross Square Feet
36	53	Storage Building	297
40	12	He Chemistry Research Building	1,392
69	26	Guard Station #431	31
		NEEWC Total	102,749

Table E-49 DD&D Facilities under the No-Action Alternative – Pajarito Corridor Planning Area

TA	Building Number	Name	Gross Square Feet
35	2	Laboratory & Office	84,300
35	27	Nuclear Safeguard Lab	43,148
35	34	Laboratory Building	4,747
35	67	Support Building	5,037
35	68	Office Building	6,120
35	186	Transportable	2,903
35	218	Guard Station	273
35	238	Trailer	592
35	239	Trailer	588
35	254	Transportable	1,449
35	347	Garage	314
35	441	Shed	384
46	24	Laboratory & Office Building	23,742
46	75	Warehouse	4,218
46	158	Laser Induced Chemistry L	5,934
46	165	Transportable	1,683
46	178	Transportable	1,451
46	179	Transportable	1,451
46	187	Transportable	1,446
46	188	Transportable	1,446
46	217	Transportable	1,701
46	218	Transportable	1,711
46	577	Transportable (5-Plex)	3,550
46	578	Transportable (6-Plex)	4,260
48	8	Isotope Separator Building	4,097
48	29	Transportable	5,064
48	34	Transportable	3,382
48	154	Doublewide Trailer	1,454
48	208	Transportable	2,512
48	214	Transportable	1,431
48	234	Transportable	4,260

TA	Building Number	Name	Gross Square Feet
48	235	Transportable	2,130
48	242	Transportable	4,230
48	9000	Trailer (6-Plex)	4,251
50	84	Transportable	1,618
50	9001	Construction Trailer (5-Plex)	3,535
50	9002	Construction Trailer (16-Plex)	11,280
50	9006	Trailer, 24'×60' 2×wide	768
50	9007	Trailer, 12'×60' 1×wide	1,536
50	9500	Trailer	710
51	25	Transportable	1,708
51	26	Transportable	1,701
51	27	Transportable	1,690
51	80	Transportable	1,678
51	81	Transportable	1,690
51	82	Transportable	1,707
51	103	Doublewide Trailer	1,465
52	42	Transportable	1,449
52	44	Transportable	3,356
52	45	Transportable	3,389
52	114	Transportable	1,678
52	115	Transportable	1,694
52	116	Transportable	1,682
52	117	Transportable	1,682
55	48	Guard Tower Station #407	36
55	125	Guard Tower Station #406	36
55	249	Storage Building	593
55	433	Transportable	568
55	434	Transportable	2,149
59	3	Office Building	17,727
59	53	Transportable	1,671
59	96	Transportable	1,717
59	97	Transportable	1,720
59	116	Transportable	1,703
59	117	Transportable	1,700
59	122	Shed	553
63	3	Craft Shop	4,240
		Pajarito Corridor Total	315,688

Table E-50 DD&D Facilities under the No-Action Alternative – LANSCE Planning Area

TA	Building Number	Name	Gross Square Feet
53	385	Guard Station #457	204
53	387	Trailer	744
53	400	Transportable	1,452
53	404	Transportable	1,449
53	406	Transportable	1,450
53	407	Transportable	1,450
53	408	Transportable	1,451
53	526	Transportable	1,680
53	882	Transportable	3,427
53	885	Transportable	1,457
53	886	Transportable	1,454
		LANSCE Total	16,218

Table E-51 DD&D Facilities under the No-Action Alternative – Balance of Site

TA	Building Number	Name	Gross Square Feet
21	257	Rad Liquid Waste Disposal	4,227
33	16	Storage Building	1,039
33	26	Storage Building	173
33	91	Hose House	241
33	168	Transportable	1,440
33	280	Transportable	1,994
33	360	Guard Shack	94
43	12	Warehouse	1,440
54	1005	Trailer	674
54	1014	Trailer	1,436
57	49	Trailer	312
60	4	Trailer	1,890
60	6	Trailer	671
60	7	Permanent Shed	576
60	8	Trailer	720
60	9	Trailer	720
60	14	Corrugated Shed	120
60	233	Trailer	159
60	311	Trailer	722
60	324	Shed	163
		Balance of Site Total	18,811

E.4.2 Modernized Operations Alternative

As shown in Chapter 3, Table 3.3-3, there are over 1.2 million square feet of facilities proposed for DD&D under the Modernized Operations Alternative. Tables E-52–E-56 list the facilities by planning area that are proposed for DD&D under the Modernized Operations Alternative. There are no additional facilities proposed for DD&D under the Expanded Operations Alternative.

Table E-52 DD&D Facilities under the Modernized Operations Alternative – Core Planning Area

TA	Building Number	Name	Gross Square Feet
3	24	Water Treatment House	2,244
3	32	Superconductivity Tech Ce	15,121
3	34	Cryogenics Building "B"	32,310
3	37	Lab Maintenance/Shop/Stock	5,424
3	38	Administration & Shops	115,191
3	65	Source Storage Building	1,145
3	123	Theoretical Office Building	34,167
3	130	Calibration Building	2,463
3	132	Central Computing Facility	114,779
3	154	Hot Waste Pump House	400
3	164	Shop Storage Building	4,193
3	215	Physics Analytical Center	28,460
3	216	Weapons Test Support Facility	44,840
3	218	Magnetic Energy & Storage	6,949
3	223	Utilities Control Center	9,704
3	228	Service Support Building	667
3	253	Electron Prototype Laboratory	6,552
3	271	Sample Management Facility	14,333
3	316	Relativis Electric Beam	5,150
3	322	Laboratory Building	1,202
3	336	Re-Use Tank	6,800
3	410	Office Facility	15,169
3	494	Geochem Analytical Facility	5,988
3	502	Space Science Lab	23,807
3	503	Guard Station #321	349
3	508	Computational Physics Off	11,722
3	510	Photo Lab Building	9,042
3	564	Equipment Shelter	80
3	586	Mechanical Building	336
3	1228	Storage Shed	294
3	1229	Storage Shed	294
3	1610	Guard Station #333	288

TA	Building Number	Name	Gross Square Feet
3	1651	Doublewide Trailer	1,942
3	1690	Cnls Tech Research Building	7,662
3	1819	Cms/Stc Laboratories	5,184
3	2002	X-Ray Machine Lab	1,624
3	2011	Advanced Computer Lab	8,506
		Core Area Total	544,381

Table E-53 DD&D Facilities under the Modernized Operations Alternative – NEEWC Planning Area

TA	Building Number	Name	Gross Square Feet
9	204	Refrigerator Shelter	39
9	208	Day Magazine	50
15	9	Firing Bunker	297
15	27	Control Building	560
15	41	Storage Building	328
15	44	Control Building	531
15	45	Control Building	555
15	184	Pulsed High-Energy Radiographic Machine Detection Chamber	10,144
15	185	Pulsed High-Energy Radiographic Machine Power Control/Supply	12,977
15	186	Pulsed High-Energy Radiographic Machine Detection Chamber	2,338
15	189	Pulsed High-Energy Radiographic Machine Power Control/Supply	452
15	198	Phermex Tunnel	830
15	199	Pulsed High-Energy Radiographic Machine Tunnel	2,027
15	200	Pulsed High-Energy Radiographic Machine Tunnel	702
15	201	Pulsed High-Energy Radiographic Machine Tunnel	870
15	233	Carpenter Shop	1,617
15	241	Ready Magazine	142
15	242	Make Up Building	455
15	243	Main Magazine	516
15	263	Laboratory Building	1,287
15	285	Vessel Repair Facility	3,921
15	290	Signal Chamber	100
15	310	Pulsed High-Energy Radiographic Machine Multidiagnostic Operations Buildings	3,194
15	446	Firing Access Control Facility	3,103
15	484	Hydrodynamic Test Operation	7,460

TA	Building Number	Name	Gross Square Feet
16	54	Historic Grinding Building	3,789
16	88	Casting Rest House	2,043
16	302	Process Building	17,858
16	360	HE Equipment Assembly Facility	4,249
22	5	Packaging And Transportation	6,151
22	34	Laboratory Building	4,809
36	1	Laboratory & Office	10,216
36	9	Magazine	67
36	10	Magazine	416
36	19	Instrument Chamber	110
36	46	Storage Building	952
36	47	Storage Building	362
36	48	Laboratory	399
36	55	Control Building	732
36	78	Prep Building	1,527
36	83	Pro-Moe Magazine	1,040
36	104	Shop	600
36	107	Control Bunker	1,055
36	136	Backflow Preventer Shed	72
36	237	Security Building	194
36	238	Security Check Point	48
36	239	Security Check Point	48
36	240	Guard Station	48
36	241	Security Check Point	48
39	9	Hose House	59
39	56	Gun Building	276
39	62	Laboratory	1,536
39	64	Equipment Shelter	262
39	69	Gun Building	2,613
39	89	Gas Gun Support Building	1,800
40	9	Gun Building	4,520
		NEEWC Total	122,394

Table E-54 DD&D Facilities under the Modernized Operations Alternative – Pajarito Corridor Planning Area

TA	Building Number	Name	Gross Square Feet
35	25	Machine Shop	1,760
35	29	Zebra Building	6,163
35	85	Bio Tech Laboratory	26,119

TA	Building Number	Name	Gross Square Feet
35	86	Lab/Office	23,272
35	87	Lab Office Building	42,514
35	186	Transportable	2,903
35	188	High Voltage Development	1,646
35	189	Optics Evaluation	13,048
35	207	Experimental Support	4,899
35	424	Motor Control Center Shed	160
35	425	Chemical Treatment Shed	100
35	455	Polymer Laboratory	4,493
46	16	Test Building #1	8,297
46	17	Utility Building	720
46	18	Utility Tunnel	583
46	25	Engineering Lab	4,581
46	37	Propell.Pump House-1	429
46	42	Lab/Office Building	14,506
46	58	Laboratory & Shop Building	932
46	77	Prototype Fabrication Building	1,403
46	161	Accelerator Vault Facility	2,101
46	208	Fel Lab Building	521
46	334	Entrance Works Building	693
46	335	Blower Building	4,349
46	339	Reuse Pump Building	1,118
46	431	Soda Ash Chemical Feed Pl	112
46	477	Garage Building	1,532
50	1	Radioactive Liquid Waste Treatment Facility	42,285
50	2	Pumping Station	2,943
50	37	Actinide Research and Technology Instructional Complex	22,495
50	54	Machine Shop	7,171
50	69	Size Reduction Facility	3,749
50	188	Emergency Generator Building	238
50	211	Electrical Substation	125
50	248	Tank Farm Building	2,008
50	250	Influent Tank/Pump House	23,912
51	11	Environmental Research Lab	1,909
51	12	Environmental Science	3,267
51	23	Library & Maintenance	2,433
52	1	Lab/Office	31,864
52	11	Destruction Facility	2,064
52	33	Weapons Support Office	14,297

TA	Building Number	Name	Gross Square Feet
52	118	Passageway	182
		Pajarito Corridor Total	329,896

Table E-55 DD&D Facilities under the Modernized Operations Alternative – LANSCE Planning Area

TA	Building Number	Name	Gross Square Feet
53	2	Equipment Test Lab	25,611
53	27	Crafts Maintenance Shop	1,684
53	31	Npb Technical Support Building	47,168
53	315	Mrs Counting House	1,830
53	541	Detector Building	510
53	676	Guard Station #458	208
53	733	Relay Building	395
53	898	pRad Support Transportable	1,690
		LANSCE Total	79,096

Table E-56 DD&D Facilities under the Modernized Operations Alternative – Balance of Site Planning Area

TA	Building Number	Name	Gross Square Feet
33	19	Laboratory & Office	3,995
33	20	Laboratory	4,203
33	39	Machine Shop	5,513
33	113	Machine Shop	4,000
33	114	Laboratory & Office	12,693
33	129	Test Cell	202
43	1	Health Research Laboratory	103,369
43	10	Sewage Lift Station	148
49	115	Day Room	3,260
54	1001	Radiation Exposure Building	2,311
54	1002	Lift Building	68
54	1003	Control Building	197
		Balance of Site Total	139,959

E.5 References

85 FR 54544. "Amended Record of Decision for the Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory, Los Alamos, NM." *Federal Register*. National Nuclear Security Administration, Department of Energy. September 2, 2020. Available online: https://www.govinfo.gov/content/pkg/FR-2020-09-02/pdf/2020-19349.pdf

DOE (U.S. Department of Energy) 1999. *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EIS-0238. January. Available online: https://www.energy.gov/nepa/articles/eis-0238-site-wide-environmental-impact-statement.

DOE (U.S. Department of Energy) 2023. "Los Alamos National Laboratory TA-54 Area G Fact Sheet." September 2023. Available online: https://www.energy.gov/sites/default/files/2023-09/TA-54%20Area%20G%20Fact%20Sheet.pdf

LANL (Los Alamos National Laboratory) 2016. *SWEIS Yearbook 2014 Comparison of 2014 Data to Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-16-24711. September 16. Available at: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-16-24711.

LANL (Los Alamos National Laboratory) 2019. *SWEIS Yearbook 2017 Comparison of 2017 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-19-20119. February 20. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-19-20119

LANL (Los Alamos National Laboratory) 2020. *SWEIS Yearbook 2018 Comparison of 2018 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-19-32158. February. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-19-32158

LANL (Los Alamos National Laboratory) 2021a. *SWEIS Yearbook 2019 Comparison of 2019 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-20-30217. January. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-20-30217

LANL (Los Alamos National Laboratory) 2021b. *Plutonium Facility (PF)-4, TA-55 Documented Safety Analysis*. TA-55-DSA-2021-R0. December 2021. OFFICIAL USE ONLY.

LANL (Los Alamos National Laboratory) 2022. *SWEIS Yearbook 2020 Comparison of 2020 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-22-20010. January. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-20010

LANL (Los Alamos National Laboratory) 2023a. *SWEIS Yearbook 2021 Comparison of 2021 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-22-32473. Rev. 2. February 22. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-32473

LANL (Los Alamos National Laboratory) 2023b. "Approval and Response to Comments Class 2 Permit Modification for the Addition of the New Hazardous Waste Management Unit at Technical Area 60 Los Alamos National Laboratory," issued by the New Mexico Environment Department to Los Alamos National Laboratory, EPA No. NM0890010515, November 14, 2023.

LANL (Los Alamos National Laboratory) 2023c. *2022 LANL Radionuclide Air Emissions Report*. Los Alamos National Laboratory. LA-UR-23-25741. July. https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-23-25741

LANL (Los Alamos National Laboratory) 2024a. *SWEIS Yearbook 2022 Comparison of 2022 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-24-22037. May. Rev. 1. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-24-22037

LANL (Los Alamos National Laboratory) 2024b. *Los Alamos National Laboratory 2022 Annual Site Environmental Report*. LA-UR-23-29640. Revision 2. February 5. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-23-29640

NNSA (National Nuclear Security Administration) 2003. *Final Environmental Impact Statement for the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National laboratory, Los Alamos, New Mexico*. DOE/EIS-0350. November. Available online: https://www.energy.gov/nepa/articles/eis-0350-final-environmental-impact-statement.

NNSA (National Nuclear Security Administration) 2008. *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EIS-0380. May. Available online: https://www.energy.gov/nepa/downloads/eis-0380-final-site-wide-environmental-impact-statement

NNSA (National Nuclear Security Administration) 2010. *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. August 2. Available online: https://www.energy.gov/nepa/listings/ea-1736-documents-available-download

NNSA (National Nuclear Security Administration) 2018a. *Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory*. DOE/EIS-0380-SA-05. April 2018. Available online: https://www.energy.gov/nepa/downloads/eis-0380-sa-05-supplement-analysis

NNSA (National Nuclear Security Administration) 2018b. *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. July 2018. Available online: https://www.energy.gov/nepa/ea-2052-proposed-changes-analytical-chemistry-and-materials-characterization-radiological.

NNSA (National Nuclear Security Administration) 2019. *Final Supplement Analysis of the Complex Transformation Supplemental Programmatic Environmental Impact Statement*. DOE/EIS-0236-S4-SA-02. December. Available online: https://www.energy.gov/nepa/downloads/doeeis-0236-s4-sa-02-final-supplement-analysis

NNSA (National Nuclear Security Administration) 2020. *Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory*. DOE/EIS-0380-SA-06. September 1. Available online: https://www.energy.gov/nepa/downloads/doeeis-0380-sa-06-final-supplement-analysis

APPENDIX F
Transportation

CONTENTS

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ADT	average daily traffic
ARIES	Advanced Recovery and Integrated Extraction System
CFR	*Code of Federal Regulations*
DHS	U.S. Department of Homeland Security
DOE	U.S. Department of Energy
HEU	high-enriched uranium
INL	Idaho National Laboratory
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LLNL	Lawrence Livermore National Laboratory
LLW	low-level radioactive waste
LOS	level of service
MEI	maximally exposed individual
MLLW	mixed low-level radioactive waste
NEPA	National Environmental Policy Act
NMDOT	New Mexico Department of Transportation
NNSA	National Nuclear Security Administration
NNSS	National Nuclear Security Site
NRC	U.S. Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
Pu	plutonium
RADTRAN	Radioactive Material Transportation Risk Assessment
SNL	Sandia National Laboratories
SNM	special nuclear material
SRS	Savannah River Site
SWEIS	site-wide environmental impact statement
TRAGIS	Transportation Routing Analysis Geographic Information System
TRU	transuranic (waste)
TRUPACT-II	TRU Package Transporter-II
TSD	treatment, storage, and disposal
USDOT	U.S. Department of Transportation
WIPP	Waste Isolation Pilot Plant

F TRANSPORTATION

F.1 Overview

Transportation of any commodity involves a risk to both transportation crew members and members of the public. This risk results directly from transportation-related accidents and indirectly from increased levels of pollution from vehicle emissions, regardless of the cargo. The transport of certain materials, such as radiological materials (waste or other materials), can pose an additional risk due to the unique nature of the material itself. To permit a complete appraisal of the environmental impacts among the three alternatives, this site-wide environmental impact statement (SWEIS) assesses the potential human health risks associated with the transportation of radiological materials to and from the Los Alamos National Laboratory (LANL) on public roadways.

This appendix provides an overview of the approach used to assess the human health risks that could result from transportation of radiological materials and wastes between LANL and several potential origins or destinations across the U.S. Department of Energy/National Nuclear Security Administration (DOE/NNSA) complex within the United States. The topics in this appendix include discussions of the overall scope of the subject transportation impact evaluation (Section F.2), packaging and determination of potential shipping routes (Sections F.2.2 and F.3/F.5.3, respectively), the specific analytical methods employed for the impact evaluation (e.g., computer models, scaling) (Section F.3), as well as other key supporting assumptions that were utilized in the analysis (Section F.3). In addition, to aid in the understanding and interpretation of the evaluation results, Section F.5 describes specific areas of uncertainty with an emphasis on how those uncertainties may affect comparisons among the distinct alternatives.

Title 49 *Code of Federal Regulations* (CFR) Parts 171–178 establish maximum permissible package dose rates, maximum permissible dose rates to vehicle crew members, exclusive-use shipment criteria, packaging certification conditions, and other features of radiological materials transportation. NNSA uses the Radioactive Material Transportation Risk Assessment (RADTRAN) model in the assessment of human health risks that may result from the transport of radiological material and waste cargo traveling along highway routes within rural, suburban, and urban population zones. Potential impact results are presented in this appendix in terms of cumulative risks for incident-free transportation conditions (over the 15-year duration of the SWEIS analysis) as well as annualized risks for postulated transportation accident conditions. Assessed impacts (both radiological and nonradiological) for either type of condition (incident-free or accident risks) relied upon calculated total shipment miles to estimate overall risks to various receptors (e.g., public, crews, inspectors) between a given origin and destination. Calculated transportation impact risks in this SWEIS were derived from normalized RADTRAN-generated "risks-per-shipment" (per material form) provided in the 2008 LANL SWEIS (DOE 2008a), with associated presumed travel routes continuing to occur along interstate highways/freeways to the greatest extent practicable. The aforementioned normalized 2008 SWEIS risk values were then applied to this SWEIS's assumptions for projected numbers of shipments (per material form) associated with each of the three alternatives being evaluated.

F.2 Assessment Scope

This section describes the scope of the transportation human health risk evaluation, including transportation activities, applicable packaging and transportation regulations, transportation modes, and emergency response. The applied assessment methodology and derived radiological impacts that follow are addressed further below in Sections F.3 and F.4, respectively.

F.2.1 Transportation-related Activities

The transportation risk evaluation focuses upon the potential human health risks related to transportation for each alternative for this SWEIS. This includes incident-free risks to persons in the vicinity of a shipment during transport or at stops, as well as accident risks. The impacts of increased transportation levels on local traffic flows or infrastructure are also addressed in this appendix (Section F.4.2).

F.2.2 Packaging and Transportation Regulations

The packaging and transportation of radiological materials and wastes are highly regulated. The U.S. Department of Transportation (USDOT) and the U.S. Nuclear Regulatory Commission (NRC) have primary responsibility for federal regulations governing commercial radiological materials and waste transportation. In addition, the DOE works with USDOT and NRC in developing requirements and standards for radiological materials and waste transportation. DOE, including NNSA, has broad authority under the *Atomic Energy Act of 1954*, as amended, to regulate all aspects of activities involving radiological materials and waste that are undertaken by DOE or on its behalf, including the transportation of radiological materials and waste. While DOE can regulate under the *Atomic Energy Act*, the vast majority of shipments are performed by approved commercial carriers operating under USDOT and NRC rules.

The regulatory standards for packaging and transporting radiological materials and waste cargo are designed to achieve the following four primary objectives:

- Protect persons and property from radiation emitted from packages during transportation by specific limitations on allowable radiation levels.
- Contain radiological material and waste in the package (achieved by packaging design requirements based on performance-oriented packaging integrity tests and environmental criteria).
- Prevent nuclear criticality (an unplanned nuclear chain reaction that could occur as a result of concentrating too much fissile material in one place).
- Provide physical protection against theft and sabotage during transit.

The CFR details regulations pertaining to the ground transportation of radiological materials and waste cargo published by USDOT at 49 CFR Parts 106, 107, and 171–178; and NRC at 10 CFR Parts 20, 61, 71, and 73. International Air Transport Association regulations for shipment via aircraft can be found in Association-published criteria regarding hazardous cargo protocols. For the U.S. Postal Service, Publication 52, "Hazardous, Restricted, or Perishable Mail," specifies the quantities of radiological material and waste prohibited in surface mail. Interested readers are encouraged to visit the cited resources for the most current regulations, review USDOT's *Radioactive Material Regulations Review* (USDOT 2008) for a comprehensive discussion on radiological material and waste cargo regulations, or review USDOT's Radioactive Materials Branch website at https://www.phmsa.dot.gov/research-and-development/hazmat/radioactive-materials.

F.2.2.1 Packaging Regulation Specifics

Packaging represents the primary barrier between the radiological material and waste cargo being transported and radiation exposure to the public, workers, and the environment. Transportation packaging for radiological materials and waste must be designed, constructed, and maintained to contain and shield its contents during normal transport conditions. For radiological material, such as special nuclear material (SNM), and waste, packaging must contain and shield the contents in the event of severe accident conditions. The type of packaging used is determined by the total radiological hazard presented by the material or waste within the packaging. Four basic types of packaging are used: Excepted, Industrial, Type A, and Type B. Specific requirements for these packages are detailed in 49 CFR Part 173, Subpart I, Class 7, "Radioactive Materials". All packages are designed to protect and retain their contents under normal operations. Packages typically shipped from or received by the Laboratory are Excepted, Type A, or Type B.

Excepted packaging is limited to transporting materials and waste that present a limited hazard to the public and the environment, because of their extremely low levels of radioactivity and very low external radiation dose (e.g., depleted uranium).

Type A packaging, typically a 55-gallon drum or metal boxes, are commonly used to transport radiological materials or waste with higher concentrations or amounts of radioactivity than that transported in Excepted packages. Type A packaging is designed to protect and retain its contents under normal transport conditions. Furthermore, it must maintain sufficient shielding to limit radiation exposure to handling personnel.

Type B packaging is used to transport material or waste with the highest radioactivity levels and is designed to protect and retain its contents under transportation accident conditions. In addition, it must maintain sufficient shielding to limit radiation exposure to handling personnel. There are numerous designs of Type B packages that DOE/NNSA uses for transporting radiological materials or waste. Packages are selected based on the purpose and contents for which they will be used. For non-WIPP TRU shipments (e.g., if TRU is shipped to Idaho National Laboratory [INL]), DOE may elect to use other NRC/DOT Type B packaging and shipping casks for both materials and waste.

DOE typically uses the TRU Package Transporter-II (TRUPACT-II) for TRU waste shipments. The TRUPACT-II is a large cask that can contain multiple smaller packages. It includes armor, impact limiters, and thermal insulation. Other similarly robust transporters, such as the HalfPACT or TRUPACT-III, may also be used. For SNM transport, 9975 and 9977 containers are examples of Type B packages that are regularly used by DOE/NNSA (49 CFR Part 173, Subpart I; SIMCO 2023).

In some cases, DOE may use remote-handled packaging and shipping casks for higher-dose shipments with specialized shielding such as the RH-72B TRU cask for remote-handled TRU waste. The RH-72B is leak-tight and constructed with inner and outer steel containment vessel approximately 12-feet long and about 3.5 feet in diameter. The cylinder fits into circular impact limiters, similar to shock absorbers, designed to protect the cask and its contents in the event of an accident including fire damage. Inside, a cylindrical canister holds direct-loaded remote-handled TRU waste or up to three 55-gallon drums of remote-handled TRU waste.

Compliance with packaging requirements is demonstrated by using a combination of simple calculation methods, computer simulation techniques, scale-modeling, or full-scale testing of transportation packages or casks.

F.2.2.2 Transportation Regulation Specifics

USDOT regulates the transportation of hazardous materials in interstate commerce by land, air, and water. USDOT specifically regulates the carriers of radiological materials and waste cargo and the conditions of transport, such as routing, handling and storage, and vehicle and driver requirements. USDOT also regulates the labeling, classification, and marking of radiological material and waste packaging.

NRC regulates the packaging and transportation of radiological material and waste for its licensees, including commercial shippers of radiological materials and waste. In addition, under an agreement with USDOT, NRC sets the standards for packages containing fissile materials and Type B packaging.

DOE, through its management directives, Orders, and contractual agreements, ensures the protection of public health and safety by imposing on its transportation activities standards that meet those of USDOT and NRC. USDOT recognizes in 49 CFR 173.7(d) that packaging made by or under the direction of DOE may be used for transporting Class-7 materials (radioactive materials and radioactive waste) when the packages are evaluated, approved, and certified by DOE against packaging standards equivalent to those specified in 10 CFR Part 71.

USDOT also has requirements that help reduce transportation impacts. Some requirements affect drivers, packaging, labeling, marking, and placarding. Other requirements specify the maximum dose rate of radiological materials and/or waste shipments to limit doses during incident-free transportation. The dose rate requirements for shipments are stated in 49 CFR 173.441.

In general, numbers of shipping containers per shipment are estimated on the basis of the dimensions and weight of the shipping containers, the Transport Index (which is the dose rate at 3.3 feet [1 meter] from the container), and the transport vehicle dimensions and weight limits. The various materials assumed to be shipped under this SWEIS's impact evaluation are all assumed to be transported in a single stack aboard a legal-weight transport vehicle.

F.2.3 Transportation Modes

Radiological Materials Transportation. For radiological material (nonwaste) transportation scenarios evaluated in this SWEIS, all such shipments are assumed to be performed by NNSA's Office of Secure Transportation, which consists of safeguard-truck-transport. Of note, shipments involving transport of SNM such as plutonium oxide or metal always exclusively use safeguard-truck-transports, regardless of circumstance (NNSA 2023a).

Radiological and Hazardous Waste Transportation. For radiological waste and hazardous waste transportation scenarios evaluated in this SWEIS, all shipments are conservatively assumed to use commercial tractor-trailer vehicles. TRU waste shipments to the Waste Isolation Pilot Plant (WIPP) are typically transported via trucks with specially designed trailers to handle the heavy weight and large load dimensions of the shipments.

Of note, as discussed below in Section F.3.1, this SWEIS's transportation analysis conservatively assumes all radiological shipments (materials and wastes) are to be transported exclusively by truck (i.e., no rail or air); as such, ground shipment scenarios bound all potential radiological risks to both the general public and transport crews.

F.2.4 Emergency Response

The U.S. Department of Homeland Security (DHS) is responsible for establishing policies for, and coordinating civil emergency management, planning, and interaction with, federal executive agencies that have emergency response functions in the event of a transportation incident. In the event a transportation incident involving radiological material or waste occurs, guidelines for response actions have been outlined in the National Response Framework (FEMA 2019).

The Federal Emergency Management Agency, an organization within DHS, coordinates federal and state participation in developing emergency response plans and is responsible for the development and the maintenance of the *Nuclear/Radiological Incident Annex* to the National Response Framework. The National Response Framework and its annex describe the policies, situations, concepts of operations, and responsibilities of the federal departments and agencies governing the immediate response and short-term recovery activities for incidents involving release of radioactivity to address the consequences of the event (FEMA 2019).

DHS has the authority to activate nuclear incident response teams, which include DOE Radiological Assistance Program Teams that can be dispatched from regional DOE Offices in response to a radiological incident. These teams provide first-responder radiological assistance to protect the health and safety of the general public, responders, and the environment and to assist in the detection, identification and analysis, and response to events involving radiological/nuclear material or waste. Deployed teams provide traditional field monitoring and assessment support, as well as a search capability.

DOE uses DOE Order 151.1D, "Comprehensive Emergency Management System," as a basis to establish a comprehensive emergency management program that provides detailed, hazard-specific planning and preparedness measures to minimize the health impacts of accidents involving loss of control over radiological material and chemicals/biologicals. DOE provides technical assistance to other federal agencies and to state and local governments. Contractors are responsible for maintaining emergency plans and response procedures for all facilities, operations, and activities under their jurisdiction and for implementing those plans and procedures during emergencies. Contractor and state and local government plans are fully coordinated and integrated. In addition, DOE established the Transportation Emergency Preparedness Program[1] to ensure that its operating contractors and state, tribal, and local emergency responders are prepared to respond promptly, efficiently, and effectively to accidents involving DOE shipments of radiological material. This program is a component of the overall emergency management system established by DOE Order 151.1D.

In the event of a release of radiological cargo from a shipment along a route, local emergency response personnel would be first to arrive at the accident scene. NNSA expects that response actions would be taken in context of the *Nuclear/Radiological Incident Annex*. Based on an initial assessment at the scene, their training, and available equipment, first responders would involve state and federal resources as necessary. First responders and/or state and federal responders would initiate actions in accordance with the USDOT *Emergency Response Guidebook*[2] to isolate the

[1] http://teppinfo.com/
[2] https://www.phmsa.dot.gov/hazmat/erg/emergency-response-guidebook-erg

incident and perform any actions necessary to protect human health and the environment (such as evacuations or other means to reduce or prevent impacts to the public). Cleanup actions are the responsibility of the carrier. DOE would partner with the carrier, shipper, and applicable state and local jurisdictions to ensure cleanup actions meet regulatory requirements.

To mitigate the possibility of an accident, DOE issued DOE Order 460.2B, "Departmental Materials Transportation Management." As specified in this Order, carriers are expected to exercise due caution and care in dispatching shipments. According to the Order, the carrier determines the acceptability of weather and road conditions, whether a shipment should be held before departure, and when actions should be taken while enroute. The Order emphasizes that shipments should not be dispatched if severe weather or bad road conditions make travel hazardous. Conditions at the point of origin and along the entire route would be considered.

F.3 Impact Assessment Methodology

F.3.1 General Routing Assumptions

Under the alternatives evaluated in this SWEIS, all radiological shipments (materials and wastes) are conservatively assumed to be transported exclusively by truck (i.e., no rail or air). This assumption results in the highest *estimated* worker and population doses. This does not preclude potential air or water transport, as needed, since these modes of transportation have been used in the past and could continue in the future. No matter what distance is to be traveled for ground shipments, shipments would be expected to use the most direct route(s) that minimize radiological risks. Shipments leaving the immediate Los Alamos area for out-of-state destinations (e.g., South Carolina, Nevada, Texas, Tennessee, California) would be transported over federal highways for the vast majority of their routes. To most accurately predict anticipated shipment mileages (and potential health impacts) associated with the transportation of radiological materials (including SNM) to/from LANL, the analysis includes a wide variety of candidate origination and destination locations across the United States associated with the Laboratory's SNM-based (i.e., plutonium and high-enriched uranium [HEU]) shipments. These locations include a specific, unclassified estimate of pit production-related shipments that would occur between LANL and Pantex each year and likewise a specific estimate of plutonium shipments that would occur between LANL and Lawrence Livermore National Laboratory (LLNL) and/or the National Nuclear Security Site (NNSS) each year. With regard to transport of radiological wastes, LLW/MLLW is assumed to be exclusively shipped to NNSS, whereas the transport of TRU waste is assumed to be exclusively shipped to the WIPP. (Note: There may be a small number of shipments of TRU-contaminated gloveboxes that would first be sent to INL beforehand for size-reduction/compaction prior to being classified as TRU waste and sent to WIPP.) *See* Sections F.3.8 and F.5.2, and Tables F.3-1, F.3-2, and F.4-1 below for additional information.

F.3.2 Population Projections

Directly feeding into the above-discussed 2008 LANL SWEIS's (DOE 2008a) original determination of per-shipment impacts, the Transportation Routing Analysis Geographic Information System (TRAGIS) computer program (Johnson and Michelhaugh 2003) was employed to choose transportation routes in accordance with USDOT regulations. TRAGIS data used in the evaluation were originally based on calendar year 2000 U.S. Census Bureau population estimates along the various shipping routes and were accordingly scaled upward in the 2008 SWEIS to reflect population projections over future years (e.g., circa-2020) of its Proposed Action periods. This future-year scaling was deemed appropriately representative for direct use within this appendix's transportation risk evaluations given that these evaluations commence in year-2024.

F.3.3 Receptors Evaluated

Estimates of potential radiological impacts to various receptor groups (e.g., public, truck crews, inspectors) were performed in this SWEIS's transportation risk analysis. Specific cohorts within each of these receptor groups include (SNL 2000):

- Members of the public residing or temporarily situated near/along transportation routes (within 0.5 miles [800 meters] of each side of a traversed roadway),
- Nearby people in adjacent vehicles along shipping routes,
- Nearby people at rest-areas and stops (e.g., gasoline stations) along shipping routes,
- Truck transport-crews (two per shipment),
- Truck/cargo inspectors,
- A public maximally exposed individual (MEI) located 330 feet (100 meters) directly downwind from a transportation accident location,
- Public population within 50 miles of an accident location, and
- A first responder at a distance ≤10 meters of an accident location.

F.3.4 2008 LANL SWEIS Per-Shipment Scaling Approach

As mentioned above, this transportation analysis directly employs the use of public and crew *risk-per-shipment* values from the 2008 LANL SWEIS (LANL 2008a) for the various radiological material forms (e.g., SNM, sealed sources, LLW, TRU waste) that would be shipped over the next 15 years. Specifically, the per-shipment values extracted from the 2008 SWEIS were directly applied to the number of estimated shipments (and thus miles to be ultimately traversed) per material form to and from LANL to attain radiological health risk estimates (in terms of latent cancer fatalities [LCFs]) for both the public and truck crews. The associated results from this assessment are summarized in Table F.3-2 below, which provides total (i.e., cumulative) LCF estimates that could result from this SWEIS's 15-year analytical period (under all alternatives) to the public and crews for incident-free transport, as well as projected public LCF consequences from a hypothetical maximum reasonably foreseeable transportation accident.

F.3.5 Incident-Free Impact Analysis

For incident-free transportation, potential human health impacts from the radiation fields surrounding radiological packages were estimated for transportation workers and populations along routes, people sharing the routes, and people at rest-areas and stops along the routes. The RADTRAN 5 computer program (*see* below) (SNL 2000) was originally used in the development of estimated per-shipment impacts for transportation workers and populations (DOE 2008a), as well as the impact to an MEI (for example, a person stuck in traffic, a gas station attendee, or an inspector), who may be a worker or a member of the public. In general, material containers to be shipped offsite or to LANL are expected to present low levels of radiation exposure to the public and truck crews. The radiological dose rates would be below the limiting provisions specified per 49 CFR 173.441 regarding transport-indexes and exclusive-use shipments. For incident-free transportation, the potential radiological exposure of truck crews and the public would be directly related to the external dose rates associated with such material packages.

All incident-free radiological health impacts are expressed as additional LCFs. LCFs associated with radiological exposure were estimated by multiplying occupational (worker) and public doses by 6.0×10^{-4} LCFs per rem (for individuals) or person-rem (for collective populations) of exposure (DOE 2003a).

F.3.6 Accident Impact Analysis

Human health impacts can likewise (and potentially more severely) result from a transportation-related accident. The impact of a specific radiological accident is expressed in terms of probabilistic risk, which is defined as the accident's probability (accident frequency) multiplied by the accident's consequences. The analysis of accident risks accounts for a spectrum of accidents ranging from high-probability accidents of low severity (a fender bender) to hypothetical high-severity accidents that have a corresponding low probability of occurrence. Only as a result of a severe fire or a powerful collision, which are of extremely low probability, could a transportation package of the type used to transport radiological material be damaged to the extent that radioactivity could be released to the environment with potentially significant consequences. In concert with calculating the individual radiological risks that could result from all reasonably conceivable accidents during transportation of radiological materials under the alternatives assessed in this SWEIS, DOE/NNSA placed particular emphasis upon the consequences of maximum reasonably foreseeable accidents with conditional probabilities greater than 1×10^{-7} (i.e., 1 in 10 million) per year (DOE 2002a). Such consequences were determined for atmospheric conditions that would likely prevail during accidents (NNSA 2023a).

Potential accident damage to a transport container/cask is categorized according to the magnitude of the mechanical forces (impact) and thermal forces (fire) to which it may be subjected during an accident. Because all accidents can be described in these terms, severity is independent of the specific accident sequence. In other words, any sequence of events that results in an accident in which a container/cask is subjected to forces within a certain range of values is assigned to the accident severity category associated with that range. Accident severity assignment schemes are designed to take into account all potential foreseeable transportation accidents, including accidents with low probability but high consequences, and those with high probability but low consequences (as discussed above).

In essence, accident consequence assessments typically only consider the potential impacts of severe transportation accidents. In terms of risk, the severity of an accident must be viewed in terms of potential radiological consequences, which are directly proportional to the fraction of the radiological material within a container/cask that is released to the environment during the accident. Although accident severity categories span the entire range of *mechanical and thermal* accident loads, they are conventionally grouped into "assessment-bins" that can be characterized by a single set of release fractions and are, therefore, collectively evaluated within an accident consequence assessment. Accident "severity-fractions" thus account for the sum of all conditional probabilities that exist within a particular accident bin.

This SWEIS's transportation accident risk assessment emphasizes the importance of distinguishing between the airborne release fraction and respirable fraction of a released-material in a scenario resulting from a transportation accident event. Radiological consequences are typically calculated by assigning radionuclide release fractions on the basis of the type of waste, the type of shipping container, and the accident severity category. The airborne release fraction is defined as the fraction of the radioactivity in the container that could be released to the atmosphere in a given severity of accident. Airborne release fractions vary according to the waste type and the physical or chemical properties of the radioisotopes. Most solid radionuclides are nonvolatile and are, therefore, relatively non-dispersible. It is noteworthy to emphasize that such is likely the case for the vast majority of material types/streams evaluated in this SWEIS, with the possible exception of tritium gas and liquid-based medical isotopes. Release fractions, on the other hand, quantitatively represent a percentage of airborne radiological material that is estimated to be completely uptaken into the human body via clearance through the lungs.

Potential public impacts from the *unmitigated maximum foreseeable accident event for this SWEIS* (involving the transport of plutonium oxide powder to or from LANL) were evaluated in the *Surplus Plutonium Disposition Supplemental Environmental Impact Statement* and estimated to be less than 4.3 rem (<0.003 LCF) to an MEI and less than 6,300 person-rem (<4 LCFs) to nearby populations (DOE 2015). This accident also represents the maximum reasonably foreseeable accident event for this SWEIS. The atmospheric environments assumed in the near-and far-field modeling for this event invoked both stable (Class F with a windspeed of 1 meter per second [2.2 miles per hour]) and neutral (Class D with a windspeed of 4 meters per second [8.8 miles per hour]) conditions. This approach provided suitable estimates of the potential dose to the MEI as well as nearby populations within a zone, respectively. The MEI was modeled under worst-case weather conditions (stable atmosphere, with minimum diffusion and dilution), while the population was modeled under average (i.e., neutral) weather conditions.

Projected radiological health impacts to potential receptors for this accident evaluation are expressed as additional transportation accident risks (in terms of LCFs) and were derived by multiplying occupational (worker) and public doses by a dose conversion factor of 6.0×10^{-4} LCF per person-rem of exposure (DOE 2003a).

For those accidents where a material or waste container (or cask shielding) was undamaged and no radiological material or waste was released, it was assumed that it would take 12 hours to recover from the accident and resume shipments. During this period, no individual would remain close to a container/cask. A first responder is conservatively assumed to stay at a location 2 to 10 meters (6.6 to 33 feet) from a/the container(s) for 1 hour (DOE 2002b). As mentioned earlier, estimated impacts to public populations from radiological transportation accidents include populations within 50 miles of an accident site as potential receptors and accordingly consider all of the following exposure pathways:

- External exposure to the passing radioactive cloud (plume),
- External exposure to contaminated ground,
- Internal exposure from inhalation of airborne contaminants, and
- Internal exposure from the ingestion of contaminated food.

Although remedial activities after such an event (e.g., evacuation or ground cleanup) would reduce the overall consequences to the public, as a conservative measure, these activities were generally not assumed to occur.

In general, LANL has carefully examined onsite transfers of radiological materials and has established engineered and administrative controls to minimize the impact and frequency of related potential accidents. LANL site documents describe the envelopes within which onsite shipping operations must occur in order to meet safety objectives. Such references/resources may include onsite hazardous materials packaging and transportation safety guides that address operational requirements for smaller quantity transfers, while onsite nuclear material transportation safety guides, or the like, would prescribe the requirements for larger quantity transfers.

For determining nonradiological traffic accident fatalities from offsite commercial truck transportation, separate accident rates and accident fatality risks were used for rural, suburban, and urban population zones. Accident and fatality rate reference information were available from information provided in *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*, ANL/ESD/TM-150 (Saricks and Tompkins 1999), with "mean" accident and fatality statistics broken down by "interstate," "primary," and "total" categorizations. Such values could then be assigned to assessed rural, suburban, and urban population zones, respectively. Accident "rates" are generically defined as the number of accident involvements (or fatalities) in a given year per unit of travel in that same year. Therefore, the rate is a fractional value, with "accident involvement" depicting the numerator of the fraction and "vehicular activity" (i.e., total travel distance in truck-miles) as the denominator.

F.3.7 Intentional Destructive Acts

With regard to the topic of intentional destructive acts (also referred to as sabotage and terrorism), DOE/NNSA estimates that the potential consequences from such an assault on a shipment of radiological materials from/to LANL would be expected to be bounded by the unmitigated consequences of the maximally reasonably foreseeable accident (i.e., "severe accident") discussed in Section F.3.6 above (i.e., <4 LCFs to the general public). This is due to the notion that a severe accident entails, by definition, the most extreme (yet plausible) mechanical (impact) and thermal (fire) forces (including from a truck-fuel-based explosion) being placed upon a subject container due to a roadway accident event. In addition to this evaluation, NNSA has prepared a classified appendix, which is discussed in Appendix D, Section D.4.2. This classified appendix provides a detailed analysis of other potential intentional destructive acts involving shipments of radiological materials to/from the Laboratory. The impacts of these potential events could be larger or smaller than the impacts presented in this section.

F.3.8 Material and Waste Routing – Specific Locational Assumptions

For analysis purposes, this SWEIS identifies primary transportation locations (origination and/or destination) that would represent the expected majority of shipments made during the 15-year analytical period. In practice, the Laboratory would occasionally transport SNM and radiological wastes to other additional locations beyond those primarily assessed, however, the selection of these primary locations would likely bound any such additional shipments. The primary locations are identified as follows and further detailed below in Table F.3-1: NNSS for LLW/MLLW; WIPP for TRU wastes; Y-12 and LLNL for HEU SNM; Savannah River Site (SRS), Pantex, LLNL, INL, Oak Ridge National Laboratory (ORNL), Sandia National Laboratories (SNL), and NNSS for plutonium-based SNM; SRS for tritium; various locations around the United States for sealed sources; and various other locations around the United States for the shipping of medical isotopes. Of note, depleted uranium shipments are also anticipated to various locations across the United States; however, due its subdued radiological characteristics, no incident-free doses to the public or truck crews associated with these shipments would be expected. The same assumption applies for the (double-contained) tritium shipments discussed above to the SRS.

Table F.3-1 Candidate Locations for Transport of Radiological Materials and Wastes from/to LANL

Location or Logistical Scenario	Radiological Material/Form							
	Route Distance to/from LANL (mi)	LLW/ MLLW	TRU Waste	Sealed Sources, Tritium, Am-241, Medical Isotopes	DU	Plutonium and Pit-related Materials [a]	Pu Oxide	HEU[b]
NNSS, NV	760	X			X	X		
WIPP, NM	340		X					
SRS, SC	1,590			X (Tritium)	X	X	X	
Pantex, TX	340					X		
LLNL & Berkeley, CA	1,150			X (Am-241: Berkeley)	X (LLNL)	X (LLNL)	X (LLNL)	X (LLNL)
SNL, NM	100				X	X (targets)		
INL, ID	820		X[c]			X (Pu-238)		
Y-12, ORNL, & Oak Ridge, TN	1,400			X (Am-241: Oak Ridge)	X (Y-12)	X (Pu-238 from ORNL)		X (Y-12)
Houston, TX to LANL	910			X (sealed sources)				
Portland, OR	1,360			X (medical isotopes)				
Los Angeles, CA	880			X (medical isotopes)				
Knoxville, TN	1,430			X (medical isotopes)				
New York, NY	2,040			X (medical isotopes)				
Atlanta, GA	1,420			X (medical isotopes)				
Burlington, MA	2,250			X (Am-241)				
Gainesville, FL	1,650			X (Am-241)				

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; ORNL = Oak Ridge National Laboratory; SNL = Sandia National Laboratories; SNM = special nuclear material; SRS = Savannah River Site; TRU = transuranic; WIPP = Waste Isolation Pilot Plant

a Plutonium and other pit-related materials (Pu metal, Pu-238 heat sources, targets) are all categorized as part of SNM shipments.

b HEU shipments, among other things, include HEU related to pit production. HEU is also considered as part of SNM shipments.

c Associated with assumed small number of potential shipments of contaminated equipment that would be size-reduced (prior to being sent to WIPP for permanent disposal).

Source: NNSA (2023b); DOE (2003b, 2008a, 2013, 2015, 2020); LANL (2024)

Impacts from the periodic transportation of other incidental radiological materials (outside of the above-listed categories) to other possible locations (DOE or commercial) would be expected to still be represented by the overall estimate of health impacts from radiological transportation in this SWEIS.

Table F.3-2 provides the overall estimated numbers of waste and material shipments to/from each destination/origination-location under each alternative over the 15-year analytical period. The analysis also assumes the transportation of a discrete number of plutonium pits that would be shipped to and from LANL and Pantex (included within the "Plutonium and Pit-Related Materials" category) and also includes projected shipments of other plutonium materials between LANL and the other nuclear weapons laboratories (e.g., LLNL and SNL). Based on DOE (2003b), LANL's nominal production case of 30 pits per year would result in an estimated three shipments per year of pits (and/or direct pit-material) to or from Pantex. Under the surge case where LANL could produce up to 80 pits per year, there could be as many as 10 shipments per year to and from Pantex. NNSA (2023b) estimates up to 16 annual shipments of SNM (i.e., plutonium [Pu] target material, HEU, and other Pu metal or oxide) between LANL and LLNL. These shipments are included in the estimated SNM shipment numbers in this SWEIS.

The total estimated number of radiological shipments (materials and wastes) over the 15-year period for each alternative conservatively assumes that annual shipments would be constant and occur every year. This conservative assumption does not account for the actuality that many of the projects may not be implemented in the first years after a Record of Decision (or at all) or that there may be periods when the expected number of shipments do not occur (e.g., increased pit production may not occur at a level of 30 pits per year until 2026; shipments of plutonium oxide to SRS associated with the Surplus Plutonium Disposition Program may be delayed for years and then begin with a slower ramp up to full operations). By employing this conservative approach, NNSA has not underestimated potential impacts associated with transportation of radiological materials.

Table F.3-2 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)							
	Radiological Materials							Nonrad
	LLW/ MLLW[a] (to NNSS)	TRU Waste[a] (to WIPP)	Sealed Sources, Tritium[b], Am-241, and Medical Isotopes	DU[b]	Plutonium and Pit-related Materials [c]	Pu Oxide[c,d]	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; LLW = low-level radioactive waste; MLLW = mixed LLW; NNSS = Nevada National Security Site TRU = transuranic; TSD = treatment, storage, and disposal; WIPP = Waste Isolation Pilot Plant; Pu-ICE = plutonium isentropic compression (*see* "Notes" below)

a Outbound only. A total of 10 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; as such, they were not assessed for radiological impacts within this appendix's transportation analysis. 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 F.4-1'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 F.4-1 for impact results.

d Total shipments of Pu oxide include potential recycled material from disposition of mixed-oxide fuel rods (*see* Chapter 3, Section 3.2.3).

NOTES: LLW would be transported in drums or Type A, B-25 boxes; if the LLW is remote-handled, it would likely be exclusively transported in 55-gallon drums. 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 2023); total TRU waste shipment projections include 10 shipments associated with contaminated equipment shipped to INL (for size-reduction) prior to being shipped to WIPP; this accounts for <0.5% of all TRU-related shipments. *See* Section F.5.2.

Based on DOE (2003b), under the No-Action Alternative, an estimated 3 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, the following shipping assumptions were employed within the SWEIS transportation analysis:

- 28 shipments per year of pits (and/or direct pit-material) would be transported between LANL and SRS (Expanded Operations Alternative only – SPDP-related CY 2025–2038). Limited ARIES enhancement would reduce this value to less than 14 shipments per year.
- 9 shipments per year of SNM would be transported to/from LLNL (maximum estimated was 16 per year [NNSA 2023b]).
- 2 shipments per year of target material (i.e., Pu-ICE experiments) would be transported from SNL to LANL (direct transport from SNL to INL is an alternative option that would not impact LANL operations).
- 4 shipments per year of HEU would be transported between LANL and Y-12.

Source: LANL (2024)

F.3.9 Radiological and Nonradiological Transportation Impacts

Table F.3-3 summarizes the total transportation impacts, as well as the localized transportation impacts on two nearby LANL transportation routes: LANL to Pojoaque, New Mexico, the route segment that trucks from LANL use, and Pojoaque to Santa Fe, New Mexico, the route segment that all trucks using Interstate-25 (such as trucks traveling to WIPP) use. As discussed above, for consistency and conservatism within the SWEIS's transportation analysis, all LLW/MLLW was assumed to be shipped exclusively to NNSS. Furthermore, all TRU waste was assumed to be transported to WIPP, while SNM shipments were assessed to travel between LANL and numerous locations across the United States, including Pantex, SRS, LLNL, Y-12, ORNL, INL, NNSS, and SNL. In the 2008 LANL SWEIS, NNSA analyzed increased pit production under its Expanded Operations Alternative and identified that SNM associated with pit production would be specifically 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.

Table F.3-3 Estimated Impacts of Transporting Radiological 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	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	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	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[b]	904	0.54	79	0.047	5.3×10^{-4}	0.014[c]
TOTALS	--	--	--	**1,162**	**0.70**	**156**	**0.094**	**5.6×10^{-4}**	**0.039**

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)		
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	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	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	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[b]	904	0.54	79	0.047	5.3×10^{-4}	0.014[c]
TOTALS	--	--	--	**1,180**	**0.71**	**163**	**0.098**	$\mathbf{5.6 \times 10^{-4}}$	**0.041**
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	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	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	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[b]	907	0.54	83	0.050	5.3×10^{-4}	0.015[c]
TOTALS	--	--	--	**1,209**	**0.73**	**175**	**0.11**	$\mathbf{5.6 \times 10^{-4}}$	**0.046**

DU = depleted uranium; HEU = high-enriched uranium; LLW = low-level radioactive waste; MLLW = mixed LLW; NNSS = Nevada National Security Site; 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 action period (15 years) are shown for incident-free transportation; annualized risks over the action period are presented for accidents.

b All LLW/MLLW shipment impacts are conservatively and consistently evaluated by assuming such materials are 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 United States during the assessed alternative periods. A weighted-average shipping distance was determined from Santa Fe for each of these locations and was applied to the radiological impacts assessment for each alternative.

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. Total number of TRU waste shipments includes 10 shipments associated with contaminated equipment shipped to INL for size-reduction prior to being shipped to WIPP; this accounts for <0.5% of all TRU-related shipments. *See* Section F.5.2 for additional information. Presented impact values throughout the table may be subject to slight deviations from calculated values due to rounding.

To provide perspective, pit production-related shipments represent only a modest fraction of the total impacts incurred by both the public and transport-crews (*see* Table F.3-3) when all material and waste shipping streams are considered and aggregated. 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 nominal production case of 30 pits per year. Correspondingly, a contribution of approximately 1 person-rem per year (of the 175 person-rem/year presented for the collective population dose of the Expanded Operations Alternative in Table F.3-3) would be expected from the incident-free transportation of these pit-related 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 2024). The maximum total dose to the public under any of the three alternatives would be 175 person-rem under the Expanded Operations Alternative, which would result in about 0.11 LCFs over the 15-year period to the population across the nationwide transportation routes.

Similarly, comparing the numbers of shipments of TRU waste to the total number of shipments of radiological materials provides a perspective of the relative contribution of TRU waste shipments to WIPP. For the Expanded Operations Alternative, Table F.3-3 indicates that there would be about 2,935 shipments over 15 years. This would be approximately 13 percent of the total radiological shipments during the period.

The additional LCFs that could be expected among the associated exposed populations for all radiological shipments would be about 0.11 over 15 years. 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 over 15 years. 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. With regard to a potential annual bounding dose to a hypothetical MEI from incident-free transportation at any point along a route, a dose of 1.8×10^{-4} rem/year is estimated, with an associated increased risk of an LCF to that individual of 1.1×10^{-7}/year (DOE 2008a).

The maximum 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 LCFs among the collective worker population. As discussed prior, however, because the potential for 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). A maximally exposed inspector would be expected to receive 19 millirem per hour of inspection duty performed, and would likewise be limited to the subject 2 rem/year administrative annual dose limit (DOE 2017; SNL 2000).

Table F.3-3 also presents the annual risk of traffic accident fatalities for each of the alternatives. In all cases, under all alternatives, the annualized risk of a traffic accident direct 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 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).

F.3.10 Onsite Traffic and Parking-Capacity Impacts

With regard to onsite traffic and parking-capacity considerations at LANL, the analysis resulted in the conclusions summarized in Tables F.3-4–F.3-9. Discussion of these conclusions follows the tables.

Table F.3-4 Impacts to Area Roads During Operations under the No-Action Alternative (vehicles per day)

Road	Average Daily Traffic Volume[a]	Percentage of LANL Site Traffic Using Road	Average Daily Traffic Volume Due to Current LANL Site Traffic[b]	Potential Maximum Increase in Average Daily Traffic Volume toward/at end of the Analytical Period[b]	Potential Maximum Percentage Increase in Average Daily Traffic Volume During the Analytical Period
NM-4 at Los Alamos County Line to NM-501	918	0.92	282	29	~10% total increase over 15 years, **with a projected maximum annual increase of 2.1% occurring during Years 1-4**
NM-4 at Bandelier Park Entrance	1,988	1.98	607	62	
NM-4 Junction of Pajarito Road – White Rock	8,829	8.81	2,700	277	
NM-4 at Jemez Road	9,483	9.46	2,900	298	
NM-501 at Junction of NM-4 and Diamond Drive	9,622	9.60	2,943	302	
NM-501 at Junction of Diamond Drive	20,899	20.85	6,391	656	
NM-501 at NM-502	13,875	13.84	4,242	436	
NM-502 at Oppenheimer Street	12,817	12.79	3,920	403	
NM-502 at Los Alamos-Santa Fe County Line	13,024	12.99	3,982	409	
Pajarito Road between NM-4 and Diamond Drive (2021 data)	8,780	8.76	2,685	276	
TOTALS	**100,235**	**100%**	**30,652**	**3,148**	**NA**

a Source: NMDOT (2016, 2021)

b Assumes that: (1) future traffic would be distributed across area roads in the same percentages as existing traffic, (2) each additional worker would commute to the LANL site alone daily and would follow the same route to and from LANL, and (3) conservatively assumes all LANL employees commute round-trip daily (no remote working) resulting in a total ADT count of 30,652 (15,326 workers × 2 trips) currently and 33,800 (16,900 workers × 2 trips) toward/at the end of the 15-year No-Action Alternative period, respectively. Increases are presented in comparison to existing ADT volumes on roads.

Table F.3-5 Impacts to Area Roads During Operations under the No-Action Alternative (vehicles per day; assuming increased telework)

Road	Average Daily Traffic Volume[a]	Percentage of LANL Site Traffic Using Road	Estimated Maximum Average Daily Traffic Volume[b]	Potential Overall Maximum Decrease in Average Daily Traffic Volume with Maximum Telework[b]	Potential Maximum Percentage Decrease in Average Daily Traffic Volume with a Maximum Telework
NM-4 at Los Alamos County Line to NM-501	918	0.92	311	-31	-10% total
NM-4 at Bandelier Park Entrance	1,988	1.98	669	-67	
NM-4 Junction of Pajarito Road – White Rock	8,829	8.81	2,977	-298	
NM-4 at Jemez Road	9,483	9.46	3,198	-320	
NM-501 at Junction of NM-4 and Diamond Drive	9,622	9.60	3,245	-324	
NM-501 at Junction of Diamond Drive	20,899	20.85	7,047	-705	
NM-501 at NM-502	13,875	13.84	4,678	-468	
NM-502 at Oppenheimer Street	12,817	12.79	4,323	-432	
NM-502 at Los Alamos-Santa Fe County Line	13,024	12.99	4,391	-439	
Pajarito Road between NM-4 and Diamond Drive (2021 data)	8,780	8.76	2,961	-296	
TOTALS	**100,235**	**100%**	**33,800**	**-3,380**	**NA**

a Source: NMDOT (2016, 2021)

b Assumes that future traffic would be distributed across area roads in the same percentages as existing traffic. Conservatively assumes that a full 20 percent of the LANL workforce (all worker types) during the No-Action Alternative period telecommutes 2.5 days each week even though construction workers do not qualify for teleworking.

Table F.3-6 Impacts to Area Roads During Operations under the Modernized Operations Alternative (vehicles per day)

Road	Average Daily Traffic Volume[a]	Percentage of LANL Site Traffic Using Road	Average Daily Traffic Volume Due to Current LANL Site Traffic[b]	Potential Maximum Increase in Average Daily Traffic Volume toward/at end of the Analytical Period[b]	Potential Maximum Percentage Increase in Average Daily Traffic Volume During the Analytical Period
NM-4 at Los Alamos County Line to NM-501	918	0.92	282	43	~15% total increase over 15 years, **with a projected maximum annual increase of 2.1% occurring during Years 1-4**
NM-4 at Bandelier Park Entrance	1,988	1.98	607	93	
NM-4 Junction of Pajarito Road – White Rock	8,829	8.81	2,700	415	
NM-4 at Jemez Road	9,483	9.46	2,900	445	
NM-501 at Junction of NM-4 and Diamond Drive	9,622	9.60	2,943	452	
NM-501 at Junction of Diamond Drive	20,899	20.85	6,391	982	
NM-501 at NM-502	13,875	13.84	4,242	652	
NM-502 at Oppenheimer Street	12,817	12.79	3,920	602	
NM-502 at Los Alamos-Santa Fe County Line	13,024	12.99	3,982	612	
Pajarito Road between NM-4 and Diamond Drive (2021 data)	8,780	8.76	2,685	412	
TOTALS	**100,235**	**100%**	**30,652**	**4,708**	**NA**

a Source: NMDOT (2016, 2021)

b Assumes that: (1) future traffic would be distributed across area roads in the same percentages as existing traffic, (2) each additional worker would commute to the LANL site alone daily and would follow the same route to and from LANL, and (3) conservatively assumes all LANL employees commute round-trip daily (no remote working) resulting in a total ADT count of 30,652 (15,326 workers × 2 trips) currently and 35,360 (17,680 workers × 2 trips) toward/at the end of the 15-year Modernized Operations Alternative period, respectively. Increases are presented in comparison to existing ADT volumes on roads.

Table F.3-7 Impacts to Area Roads During Operations under the Modernized Operations Alternative (vehicles per day; assuming increased telework)

Road	Average Daily Traffic Volume[a]	Percentage of LANL Site Traffic Using Road	Estimated Maximum Average Daily Traffic Volume[b]	Potential Overall Maximum Decrease in Average Daily Traffic Volume with Maximum Telework[b]	Potential Maximum Percentage Decrease in Average Daily Traffic Volume with Maximum Telework
NM-4 at Los Alamos County Line to NM-501	918	0.92	325	-33	-10% total
NM-4 at Bandelier Park Entrance	1,988	1.98	700	-70	
NM-4 Junction of Pajarito Road – White Rock	8,829	8.81	3,115	-312	
NM-4 at Jemez Road	9,483	9.46	3,345	-335	
NM-501 at Junction of NM-4 and Diamond Drive	9,622	9.60	3,395	-340	
NM-501 at Junction of Diamond Drive	20,899	20.85	7,373	-737	
NM-501 at NM-502	13,875	13.84	4,894	-489	
NM-502 at Oppenheimer Street	12,817	12.79	4,522	-452	
NM-502 at Los Alamos-Santa Fe County Line	13,024	12.99	4,594	-459	
Pajarito Road between NM-4 and Diamond Drive (2021 data)	8,780	8.76	3,097	-310	
TOTALS	**100,235**	**100%**	**35,360**	**-3,536**	**NA**

a Source: NMDOT (2016, 2021)

b Assumes that future traffic would be distributed across area roads in the same percentages as existing traffic. Conservatively assumes that a full 20 percent of the LANL workforce (all worker types) during the Modernized Operations Alternative period telecommutes 2.5 days each week even though construction workers do not qualify for telework.

Table F.3-8 Impacts to Area Roads During Operations under the Expanded Operations Alternative (vehicles per day)

Road	Average Daily Traffic Volume[a]	Percentage of LANL Site Traffic Using Road	Average Daily Traffic Volume Due to Current LANL Site Traffic[b]	Potential Maximum Increase in Average Daily Traffic Volume toward/at end of Analytical Period[b]	Potential Maximum Percentage Increase in Average Daily Traffic Volume During the Analytical Period
NM-4 at Los Alamos County Line to NM-501	918	0.92	282	60	~21% total increase over 15 years, **with a projected maximum annual increase of 2.1% occurring during Years 1-4**
NM-4 at Bandelier Park Entrance	1,988	1.98	607	130	
NM-4 Junction of Pajarito Road – White Rock	8,829	8.81	2,700	576	
NM-4 at Jemez Road	9,483	9.46	2,900	618	
NM-501 at Junction of NM-4 and Diamond Drive	9,622	9.60	2,943	628	
NM-501 at Junction of Diamond Drive	20,899	20.85	6,391	1,363	
NM-501 at NM-502	13,875	13.84	4,242	905	
NM-502 at Oppenheimer Street	12,817	12.79	3,920	836	
NM-502 at Los Alamos-Santa Fe County Line	13,024	12.99	3,982	849	
Pajarito Road between NM-4 and Diamond Drive (2021 data)	8,780	8.76	2,685	573	
TOTALS	**100,235**	**100%**	**30,652**	**6,538**	**NA**

a Source: NMDOT (2016, 2021)

b Assumes that: (1) future traffic would be distributed across area roads in the same percentages as existing traffic, (2) each additional worker would commute to the LANL site alone daily and would follow the same route to and from LANL, and (3) conservatively assumes all LANL employees commute round-trip daily (no remote working) resulting in a total ADT count of 30,652 (15,326 workers × 2 trips) currently and 37,190 (18,595 workers × 2 trips) toward/at the end of the 15-year Expanded Operations Alternative period, respectively. Increases are presented in comparison to existing ADT volumes on roads.

Table F.3-9 Impacts to Area Roads During Operations under the Expanded Operations Alternative (vehicles per day; assuming increased telework)

Road	Average Daily Traffic Volume[a]	Percentage of LANL Site Traffic Using Road	Estimated Maximum Average Daily Traffic Volume[b]	Potential Overall Maximum Decrease in Average Daily Traffic Volume with Maximum Telework[b]	Potential Maximum Percentage Decrease in Average Daily Traffic Volume with Maximum Telework
NM-4 at Los Alamos County Line to NM-501	918	0.92	342	-34	-10% total
NM-4 at Bandelier Park Entrance	1,988	1.98	737	-74	
NM-4 Junction of Pajarito Road – White Rock	8,829	8.81	3,276	-328	
NM-4 at Jemez Road	9,483	9.46	3,518	-352	
NM-501 at Junction of NM-4 and Diamond Drive	9,622	9.60	3,571	-357	
NM-501 at Junction of Diamond Drive	20,899	20.85	7,754	-776	
NM-501 at NM-502	13,875	13.84	5,147	-515	
NM-502 at Oppenheimer Street	12,817	12.79	4,756	-476	
NM-502 at Los Alamos-Santa Fe County Line	13,024	12.99	4,831	-483	
Pajarito Road between NM-4 and Diamond Drive (2021 data)	8,780	8.76	3,258	-326	
TOTALS	**100,235**	**100%**	**37,190**	**-3,719**	**NA**

b Assumes that future traffic would be distributed across area roads in the same percentages as existing traffic. Conservatively assumes that a full 20 percent of the LANL workforce (all worker types) during the Expanded Operations Alternative period telecommutes 2.5 days each week even though construction workers do not qualify for telework.

a Source: NMDOT (2016, 2021)

No-Action Alternative

The baseline affected environment (current conditions) for traffic within the region of influence is presented in Chapter 4, Section 4.12. Table F.3-4 displays how projected employment increases under the No-Action Alternative could potentially impact area roads. As shown in the table, compared to current conditions, potential maximum increases in average daily traffic (ADT) volumes along area roads would be expected to mirror the site's employee growth (operations and construction) estimate of approximately 10 percent over the entire No-Action Alternative period (with a 2.1 percent maximum annual growth occurring during Years 1 through 4). While these increases would add to the already existing periodic congestion common to these roads, they would not be expected to change the current level of service (LOS) designations of these roads. The presented estimates conservatively assume that all additional workers would: (1) exclusively commute to work alone in personal vehicles and would follow the same route to and from the site, and (2) not be telecommuting/remote-working in any capacity at any time.

Of note, if the analysis were to assume that only 90 percent (as opposed to all) of additional workers would commute to work alone and that 20 percent of the workers (operations workers only) would work from home on any given day (which is consistent with current workforce commuting statistics), the potential maximum increase in ADT volumes on area roads seen toward/at the end of the No-Action Alternative period (compared to current conditions) would lie closer to 9 percent, as opposed to about 10 percent. No remote-work assumptions to these regards are obviously applicable for construction workers.

Under a potential hybrid work environment, as discussed in Chapter 3, Section 3.2.5, the analysis assumes approximately 10 to 20 percent of the LANL operations workforce would telework a maximum of 2.5 days per week. Over the course of each week/year during the No-Action Alternative period, this increased teleworking would mitigate potential increases in ADT volumes along area roads, as shown in Table F.3-5.

Modernized Operations Alternative

Table F.3-6 displays how the above-discussed employment increases over the 15-year Modernized Operations Alternative period could potentially impact area roads. As shown in the subject table, compared to current conditions, potential maximum increases in ADT volumes along area roads toward/at the end of the Modernized Operations Alternative period would be expected to mirror the site's employee growth estimate of approximately 15 percent toward/at the end of the period (≤2.1% maximum annual growth during Years 1 through 4). While these increases would add to the already existing periodic congestion common to these roads, they would not be expected to change the current LOS designations of these roads. The presented estimates in the table conservatively assume that all additional workers would: (1) exclusively commute to work alone in personal vehicles and would follow the same route to and from the site, and (2) not be telecommuting/remote-working in any capacity at any time.

Of note, if the analysis were to assume that only 90 percent (as opposed to all) of the additional workers would commute to work alone and that 20 percent of the workers (operations workers only) would work from home on any given day (which is consistent with current workforce commuting statistics), the potential maximum increase in ADT volumes on area roads seen during the Modernized Operations Alternative period (compared to current conditions) would lie closer to 13 percent, as opposed to about 15 percent. No remote-work assumptions to these regards are obviously applicable for construction workers.

Under a potential hybrid work environment, approximately 10 to 20 percent of the LANL workforce would telework a maximum of 2.5 days per week. Over the course of each week/year during the Modernized Operations Alternative period, this increased teleworking would mitigate potential increases in ADT volumes along area roads, as shown in Table F.3-7.

Expanded Operations Alternative

As shown in Table F.3-8, compared to current conditions, potential maximum increases in ADT volumes along area roads toward/at the end of the Expanded Operations Alternative period would be expected to mirror the site's employee growth estimate of approximately 21 percent toward/at the end of the period (≤2.1% maximum annual growth during Years 1 through 4).

While these increases would add to the already existing periodic congestion common to these roads, they would not be expected to change the current LOS designations of these roads. The presented estimates conservatively assume that all additional workers would: (1) exclusively commute to work alone in personal vehicles and would follow the same route to and from the site, and (2) not be telecommuting/remote-working in any capacity at any time.

Of note, if the analysis were to assume that only 90 percent (as opposed to all) of the additional workers would commute to work alone and that 20 percent of the workers (operations workers only) would work from home on any given day (which is consistent with current workforce commuting statistics), the potential maximum increase in ADT volumes on area roads seen during the Expanded Operations Alternative period (compared to current conditions) would lie closer to 19 percent, as opposed to about 21 percent. No remote-work assumptions to these regards are obviously applicable for construction workers.

Under a hybrid work environment, approximately 10 to 20 percent of the LANL workforce would telework a maximum of 2.5 days per week. Over the course of each week/year during the Expanded Operations Alternative period, increased teleworking would mitigate potential increases in ADT volumes along area roads, as shown in Table F.3-9.

As depicted in Table F.3-10, local traffic flows around LANL would be expected to moderately increase above current levels under the No-Action Alternative because employment levels would see a modest increase over current levels under this alternative. For the Modernized Operations Alternative, a further modest increase in traffic around LANL would be expected due to additional projected increases in employment under this alternative. For the Expanded Operations Alternative, traffic around LANL would again be expected to undergo a further additional modest increase over that seen for the Modernized Operations Alternative due to the further projected associated increase in site employment under this alternative. Under all alternatives, there would be periods with higher levels of construction that would result in increased traffic congestion, although these periods would be expected to be limited and would vary across the site. The one location that could result in the highest potential localized traffic impacts would be during the replacement of the Los Alamos Canyon Bridge, although that project would not be expected for more than a decade and NNSA would work with the town of Los Alamos and the New Mexico Department of Transportation (NMDOT) to identify potential mitigations for potential traffic issues.

Table F.3-10 Comparison of Changes in LANL Workforce Traffic Flows at Area Roads Among All Alternatives (vehicles per day)

Road	Present Baseline Average Daily Traffic Volume[a]	Projected No-Action Alternative Average Daily Traffic Volume[b]	Projected Modernized Operations Alternative Average Daily Traffic Volume[b]	Projected Expanded Operations Alternative Average Daily Traffic Volume[b]
NM-4 at Los Alamos County Line to NM-501	282	311	325	342
NM-4 at Bandelier Park Entrance	607	669	700	737
NM-4 Junction of Pajarito Road – White Rock	2,700	2,977	3,115	3,276
NM-4 at Jemez Road	2,900	3,198	3,345	3,518
NM-501 at Junction of NM-4 and Diamond Drive	2,943	3,245	3,395	3,571
NM-501 at Junction of Diamond Drive	6,391	7,047	7,373	7,754
NM-501 at NM-502	4,242	4,678	4,894	5,147
NM-502 at Oppenheimer Street	3,920	4,323	4,522	4,756
NM-502 at Los Alamos-Santa Fe County Line	3,982	4,391	4,594	4,831
Pajarito Road between NM-4 and Diamond Drive (2021 data)	2,685	2,961	3,097	3,258
TOTALS	**30,652**	**33,800**	**35,360**	**37,190**

a Source: NMDOT (2016, 2021)

b Assumes that: (1) future traffic would be distributed across area roads in the same percentages as existing traffic, (2) each additional worker would commute to the LANL site alone daily and would follow the same route to and from LANL, and (3) conservatively assumes all LANL employees commute round-trip daily (no remote working).

F.4 Uncertainties and Conservatisms in Estimated Impacts

The sequence of analysis usually performed to generate estimates of radiological risk for transportation endeavors typically includes the following items: (1) determination of material inventories and characteristics, (2) estimations of shipment requirements, (3) determinations of route characteristics, (4) calculations of radiation doses to exposed individuals (including estimation of environmental transport and uptake of radionuclides), and (5) estimations of associated health effects (LCFs). Uncertainties, however, are inherently associated with each of these steps. Uncertainties exist in the way that the physical systems being analyzed are essentially represented/depicted by the computational models used for characterizing them; either by the data required to exercise such models (due to measurement errors, sampling errors, natural variability, or unknowns caused simply by the future nature of the actions being analyzed), or within the calculations themselves (e.g., algorithm approximations used within the computer codes; rounding errors).

In principle, one can estimate the uncertainty associated with each input or computational source and predict the resultant uncertainty in each set of calculations. Thus, one can propagate the uncertainties from one set of calculations to the next and estimate the uncertainty in the final, or absolute, result; however, conducting such a full-scale quantitative uncertainty-analysis is often impractical and sometimes impossible, especially for actions to be initiated at an unspecified time in the future. Instead, transportation risk analysis was designed to ensure through uniform, judicious, and conservative selection of scenarios, models, and input parameters, that relative comparisons of risk among candidate alternatives are meaningful. Within a specific transportation risk assessment, this design is accomplished by uniformly applying common input parameters and assumptions to all evaluated alternatives. Therefore, although considerable uncertainty is inherent in the absolute magnitude of the transportation risk for each alternative, much less uncertainty is associated with the relative differences between the alternatives in a given measure of risk (DOE 2002b).

As such, the following sections briefly discuss typical areas of uncertainty that are addressed within each of the assessment steps listed above. Special emphasis is placed on identifying whether the uncertainties affect relative or absolute measures of risk. Moreover, the reality and conservatism of the assumptions are addressed, and where practical, the parameters that most significantly affect the overall risk assessment results are identified.

F.4.1 Uncertainties in Material Inventories and Characterization

Material inventories and their physical/radiological characteristics are important input parameters to a transportation risk assessment. The potential numbers of shipments under each considered alternative are primarily based on the projected dimensions of package contents, radiation-field strength/intensity, and assumptions concerning shipment capacities. Physical and radiological characteristics are important in determining the amount and nature of material released during accidents and the subsequent doses to exposed individuals through multiple environmental exposure pathways.

Uncertainties in material inventories and characterization are directly reflected in transportation risk results. If an inventory is overestimated (or underestimated), the resulting transportation risk estimates are also overestimated (or underestimated) by roughly the same factor. However, the same inventory estimates (on a per-unit basis) are used to analyze shipping impacts under each of the alternatives; therefore, for comparative purposes, the observed differences in transportation risks among alternatives are believed to represent unbiased, reasonably accurate estimates based on the most current assessment information available. DOE/NNSA has used historical shipment inventories for nuclear materials and radiological waste to provide a realistic estimate of inventories and their characterization. Considering that the analysis uses unit risk factors from the 2008 SWEIS, the inventories remain consistent with materials that would be shipped during continued operations of the Laboratory.

F.4.2 Uncertainties in Containers, Shipment Capacities, and Number of Shipments

The extent of transportation required under each alternative is based in part on assumptions concerning the packaging characteristics and shipment capacities for transport vehicles. Representative shipment capacities have been defined for assessment purposes based on probable future shipment capacities. In reality, the actual shipment capacities may differ from the predicted capacities such that the projected number of shipments and, consequently, the total transportation risk, would change. While the predicted transportation risks would increase or decrease accordingly, the relative differences in risks among the alternatives would remain about the same (USDOT 2008).

DOE/NNSA has used a best-estimate projection of potential shipment numbers for each alternative to provide a realistic expectation of potential impacts as opposed to a bounding projection that would grossly overestimate potential results.

DOE/NNSA is considering the option of initially shipping future operational TRU waste quantities to INL (for size-reduction / compaction) prior to being sent to WIPP for disposal. This effort would ultimately reduce the number of waste packages (and thus associated volumes) of LANL TRU wastes emplaced at WIPP and would thus accordingly serve to increase the remaining overall available capacity for future TRU waste disposal at the site under the established WIPP Land Withdrawal Act volume limit. This transportation action would only occur if DOE was confident that the particular waste would be accepted at WIPP; there would not be any net increase of TRU waste at INL.

The tradeoff for these size-reduction efforts, however, would be an increase in the total number of shipment-miles associated with TRU waste transportation. While there could be a net reduction in the number of *compacted* TRU waste shipments (INL to WIPP) as compared to the number of *non-compacted* shipments (LANL to WIPP), such undertakings would ultimately be determined on a case-by-case basis and would consider such factors as radionuclide content and mass of each package relative to transportation limits. The TRUPACT II or III TRAMPAC will ensure compliance of the payload with parameters of the packaging. These would include container and physical properties, nuclear properties, chemical properties, gas generation properties, and payload assembly criteria. Compaction reduces the number of trips required to transport waste to WIPP. The supercompactor at INL has compacted more than 275,000 55-gallon drums of TRU waste debris during its years of operation. Using compaction, the Advanced Mixed Waste Treatment Project at INL has saved more than 6,000 truck shipments that would have been required to send the waste to the WIPP for permanent disposal. Furthermore, supercompaction has led to more efficient and effective use of available disposal space at WIPP.

Under a bounding scenario whereby all operational-based TRU waste shipments are first sent to INL for size-reduction, and the presumption that the number of post-compaction shipments from INL to WIPP would be equal to the number of pre-compaction shipments from LANL to INL, an estimated 4,700,000 number of additional shipping miles (LANL-INL-WIPP vs. LANL-WIPP) would be expected under the Expanded Operations Alternative (i.e., the maximum case). This would ultimately result in a substantial increase of about 470 percent in the estimated dose-contributions (to both the general public and crews) from TRU waste transport under the SWEIS alternatives, while more modest increases of about 53 percent and 23 percent would be seen in the total collective doses to public and crews, respectively, when taking into account the transportation of *all* radiological material/waste shipping categories (i.e., LLW, MLLW, SNM, and other sources, in addition to TRU waste). Considering that the current estimate for impacts to the exposed public along the nationwide routes for the Expanded Operations Alternative is 0.11 LCF over the 15-year period, implementation of the approach to ship operational TRU waste to INL potentially would increase the population impacts to about 0.17 LCF for the same period (still a small impact statistically).

F.4.3 Uncertainties in Route Determinations

TRAGIS-analyzed routes were initially determined between most likely origin and destination locations (DOE 2008a) from which per-shipment dose/risk factors (per shipment material type) were evaluated for this SWEIS's projected numbers of shipments under each of the alternatives. The routes were determined to be consistent with current guidelines, regulations, and practices, but nevertheless may not end up being the actual routes used for a number of future shipments. As such, notable differences in shipping-miles and nearby populations along route-lines could potentially occur. Because materials could be transported over an extended period starting at some time in the future, highway infrastructure and core demographics along routes could likewise change from what was originally anticipated. Although these effects have not been accounted for in this analysis via any type of sensitivity-study, it is not anticipated that such changes would significantly affect relative comparisons of risk among the alternatives considered in this SWEIS.

F.4.4 Uncertainties in the Calculation of Radiation Doses

The models originally used to calculate radiation doses from transportation activities introduce an uncertainty in the risk assessment process. Estimating the accuracy or absolute uncertainty of the risk assessment results is generally difficult. The accuracy of the calculated results is closely related to the limitations of the computational models and to the uncertainties in each of the input parameters that the model requires. The single greatest limitation facing users of RADTRAN, or any computer code of this type, is the limitation of data for certain input parameters. Populations along the transportation routes, shipment surface dose rates, and individuals residing near anticipated routes are the most uncertain data in shipping dose calculations. In preparing these data, the analysis uses assumptions that potentially affected populations are uniformly distributed and are proportional to traffic density, with an assumed occupancy of two persons per car; that the shipment surface dose rate is the maximum allowable dose rate per USDOT standards; and, that the potential exists for an individual to be residing at the edge of a highway. It is clear that not all assumptions are accurate nor would be realized during the continuity of an entire 15-year period. For example, off-link populations are predominantly heterogeneous, and on-link traffic densities typically vary widely within a geographic zone (i.e., urban, suburban, or rural). Finally, added to this complexity are the assumptions regarding the expected distances between the public and the shipment at a traffic stop, rest stop, or during stalled traffic, and the afforded degree of shielding that may be available (but not credited) at such times.

Uncertainties associated with the computational models are reduced by using state-of-the-art computer codes that have undergone extensive review. Because many uncertainties are recognized but difficult to quantify, assumptions are made at each step of the risk assessment process that are intended to ultimately produce conservative results (i.e., overestimations of calculated dose and radiological risk). Because conservative parameters and bounding assumptions were applied consistently to each alternative in this transportation analysis whenever possible, such model bias is not expected to affect the meaningfulness of relative comparisons of risk; however, it should be expected that final results may not represent risks in an absolute sense.

F.4.5 Uncertainties in Traffic Fatality Rates

Future accident and fatality rate data may change as a result of vehicle and highway improvements. Recent national accident and fatality statistics for large trucks and buses continue to indicate lower trends for accident and fatality rates over recent years.

F.5 High Explosives Transportation

With regard to the potential transportation of any materials that may contain varying amounts of high explosives, associated DOE/NNSA protocols and guidance to prevent or mitigate potential impacts to shipment crews and/or the public are provided in DOE Order 460.2A, DOE Order 460.1C, DOE Order 452.2A, and DOE Manual 440.1-1A. Therein DOE/NNSA specifies that before transporting explosive substances or articles fabricated by DOE (or alternatively under the direction or supervision of DOE) that the originating DOE organization must test the materials and obtain explosive hazard classification(s) from the NNSA's Office of Technical Services, and also that DOE must likewise provide two copies of the approval and supporting documentation for registration with the USDOT. In addition, the following high explosives-related key criteria are furthermore mandated (NNSA 2023a):

- Only qualified explosives handlers shall load and unload explosives aboard transport vehicles.
- Explosives shipped on common carriers shall be packaged, labeled, and shipped in accordance with USDOT regulations.
- Explosives containing items transported by special agents in DOE-approved secure transporters are specifically governed by said DOE Orders 452.2A and 460.1C.
- Section 161.K of the Atomic Energy Act of 1954 as amended and Title 18 USC, Chapter 40, Section 845 govern security and emergency vehicles carrying explosives in support of approved contingency plans.
- The cargo on partly or completely loaded vehicles (including flatbed types) shall be blocked, braced, chocked, tied down, or otherwise secured to prevent shifting during transit.
- No explosives shall be loaded or unloaded from a transportation vehicle while the motor is running unless the motor is required to provide power to vehicle accessories used in loading and unloading operations, and is moreover equipped with an exhaust spark arrestor.
- USDOT regulations govern commercial transport vehicle shipments on public highways. Shipments from a DOE installation that meet the USDOT definition of "in commerce" must fully comply with the applicable portions of USDOT regulations, and with state and municipal regulations.
- A qualified inspector shall inspect and approve for compliance with an approved checklist any transport vehicle that may be loaded with explosives and is designated for movement over public highways. After loading, the cargo shall be inspected and approved, which includes verification of proper labeling/placarding.

- Before transport vehicles loaded with explosive materials leave a DOE facility, drivers shall be informed of the nature of their cargo and appropriate measures to take if the vehicle or load becomes involved in a fire.
- Drivers of explosive-laden vehicles shall meet the pertinent requirements of 49 CFR Parts 390–397. Moreover, such drivers shall be provided special training that emphasizes caution, road courtesy, and defensive driving. Drivers shall also have proper training in general safety precautions for explosives handling.
- Explosive-laden vehicles shall avoid congested areas whenever possible and shall stop at all railroad crossings.
- No personnel shall ride in the cargo area. Loose items (e.g., handling-gear) in the cargo compartments are prohibited.
- No smoking is allowed in or within 25 feet of any vehicle containing explosives. Matches, lighters, or other fire-, flame-, or spark-producing devices shall not be in the vehicle or carried by personnel in the vehicle.
- The vehicle shall be subjected to regular maintenance checks.
- Other than when opened for inspection, containers of explosives shall not be opened or repaired on any transportation vehicle.
- Except for emergency situations, fueling or maintenance of vehicles containing explosives is forbidden.

F.6 References

10 CFR Part 20, U.S. Nuclear Regulatory Commission, "Standards for Protection Against Radiation."

10 CFR Part 61, U.S. Nuclear Regulatory Commission, "Licensing Requirements for Land Disposal of Radioactive Waste."

10 CFR Part 71, U.S. Nuclear Regulatory Commission, "Packaging and Transportation of Radioactive Material."

10 CFR 71.4, U.S. Nuclear Regulatory Commission, "Packaging and Transportation of Radioactive Material: Definitions."

10 CFR Part 835, *Occupational Radiation Protection*, U.S. Department of Energy, Washington, DC, latest issue.

29 CFR 1910.1096, Occupational Safety and Health Standards, *Ionizing Radiation,* Occupational Safety and Health Administration, U.S. Department of Labor, Washington, DC, latest issue.

49 CFR Part 106, U.S. Department of Transportation, "Rulemaking Procedures."

49 CFR Part 107, U.S. Department of Transportation, "Hazardous Materials Program Procedures."

49 CFR Part 171, U.S. Department of Transportation, "General Information, Regulations, and Definitions."

49 CFR Part 172, U.S. Department of Transportation, "Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements."

49 CFR Part 173, U.S. Department of Transportation, "Shippers – General Requirements for Shipments and Packagings."

49 CFR Part 173, Subpart I. U.S. Department of Transportation, "Shippers – General Requirements for Shipments and Packagings," Class 7 (Radioactive) Materials.

49 CFR 173.403, U.S. Department of Transportation, "Shippers – General Requirements for Shipments and Packagings: Definitions."

49 CFR 173.411, U.S. Department of Transportation, "Shippers – General Requirements for Shipments and Packagings: Industrial Packages."

49 CFR 173.427, U.S. Department of Transportation, "Shippers – General Requirements for Shipments and Packagings: Transport Requirements for Low Specific Activity (LSA) Class 7 (Radioactive) Materials and Surface Contaminated Objects (SCO)."

49 CFR 173.435, U.S. Department of Transportation, "Shippers – General Requirements for Shipments and Packagings: Table of A1 and A2 Values for Radionuclides."

49 CFR 173.441, U.S. Department of Transportation, "Shippers – General Requirements for Shipments and Packagings: Radiation Level Limitations and Exclusive Use Provisions."

49 CFR 173.7(d), U.S. Department of Transportation, "Shippers – General Requirements for Shipments and Packagings: Government Operations and Materials."

49 CFR Part 177, U.S. Department of Transportation, "Carriage by Public Highway."

49 CFR Part 178, U.S. Department of Transportation, "Specifications for Packagings."

DOE (U.S. Department of Energy) 1997. *Final Waste Management Programmatic Environmental Impact Statement for Managing, Treatment, and Disposal of Radioactive and Hazardous Waste*. Washington, DC. DOE/EIS-0200. May. Available online: https://www.energy.gov/sites/prod/files/EIS-0200-FEIS-Summary-1997.pdf

DOE (U.S. Department of Energy) 2002a. *Recommendations for Analyzing Accidents under the National Environmental Policy Act*, Washington, DC, July. Available online: https://www.energy.gov/node/258439

DOE (U.S. Department of Energy) 2002b. *A Resource Handbook on DOE Transportation Risk Assessment*. DOE/EM/NTP/HB-01. Office of Environmental Management, National Transportation Program, Albuquerque, New Mexico, July. Available online: https://www.energy.gov/nepa/articles/resource-handbook-doe-transportation-risk-assessment-doe-2002

DOE (U.S. Department of Energy) 2003a. "Recommended Radiation Risk Factors Updated." National Environmental Policy Act Lessons Learned, Office of NEPA Policy and *Compliance, Quarterly Report*. Issue No. 34. March 3. Available online: https://www.energy.gov/nepa/articles/lessons-learned-quarterly-report-march-2003

DOE (U.S. Department of Energy) 2003b. *Draft Supplemental Programmatic Environmental Impact Statement on Stockpile, Stewardship, and Management for a Modern Pit Facility*, Washington, DC. DOE/EIS-236-S2. May. Available online: https://www.energy.gov/sites/prod/files/EIS-0236-S2-DEIS-Summary-2003.pdf

DOE (U.S. Department of Energy) 2008. *2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory (DOE/EIS 0380) Mitigation Action Plan*. December. Available online: https://www.energy.gov/sites/default/files/nepapub/nepa_documents/RedDont/EIS-0380-MAP-2008.pdf

DOE (U.S. Department of Energy) 2012. *NEPA Source Document for Pit Disassembly and Conversion (PDC) Project*. Revision 1. SRB-25.02-12-0001. June 18. Available online: https://www.energy.gov/nnsa/national-nuclear-security-administrationsites/default/files/nnsa/10-12-multiplefiles/118_DOE%202012%20NEPA%20source%20document.pdf

DOE (U.S. Department of Energy) 2013. *Final Sitewide Environmental Impact Statement for the Continued Operation of the DOE/NNSA Nevada National Security Site and Offsite Locations in the State of Nevada*. DOE/EIS-0426. February. Available online: https://www.energy.gov/nepa/eis-0426-site-wide-environmental-impact-statement-continued-operation-department-energy

DOE (U.S. Department of Energy) 2015. *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement*. DOE/EIS-0283-S2. April. Available online: https://www.energy.gov/sites/prod/files/2015/04/f22/EIS-0283-S2_SPD_Summary.pdf

DOE (U.S. Department of Energy) 2017. *DOE Standard, Radiological Control*, DOE-STD-1098-2017. January 31. Available online: https://www.standards.doe.gov/standards-documents/1000/1098-AStd-2017

DOE (U.S. Department of Energy) 2020. *Supplement Analysis for the 2008 Site-Wide Environmental Impact Statement for Continued Operations of Los Alamos National Laboratory*. DOE/EIS-0380-SA-06. September. Available online: https://www.energy.gov/nepa/articles/doeeis-0380-sa-06-final-supplement-analysis

DOE Order 151.1D. "Comprehensive Emergency Management System." Change 1 (MinChg) Approved October 4, 2019. Available online: https://www.directives.doe.gov/directives-documents/100-series/0151.1-BOrder-d-chg1-minchg/@@images/file

DOE Order 452.2F. "Nuclear Explosive Safety." Approved July 27, 2020. Available online: https://www.directives.doe.gov/directives-documents/400-series/0452.2-BOrder-f/@@images/file

DOE Order 460.1D, Chg 1 (LtdChg). *Hazardous Materials Packaging and Transportation Safety*, June 10, 2022. Available online: https://www.directives.doe.gov/directives-documents/400-series/0460.1-BOrder-d-chg1-ltdchg/@@images/file

DOE Order 460.2B, *Departmental Materials Transportation Management*, June 10, 2022. Available online: https://www.directives.doe.gov/directives-documents/400-series/0460.2-BOrder-b/@@images/file

FEMA (Federal Emergency Management Agency) 2019. *National Response Framework*, 4th edition, U.S. Department of Homeland Security, October 28. Available online: https://www.fema.gov/sites/default/files/2020-04/NRF_FINALApproved_2011028.pdf

Johnson, P.E. and R.D. Michelhaugh 2003. *Transportation Routing Analysis Geographic Information System (TRAGIS) – User's Manual*, ORNL/NTRC-006, Rev. 0, U.S. Department of Energy, Oak Ridge National Laboratory, Oak Ridge, Tennessee, June. Available online: https://info.ornl.gov/sites/publications/Files/Pub57293.pdf

LANL (Los Alamos National Laboratory) 2024. *Material Shipments Project Information for the LANL Site-Wide Environmental Impact Statement*. LA-UR-24-25542. June 5. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-24-25542

NMDOT (New Mexico Department of Transportation) 2016. "TIMS Road Segments by Posted Route/Point with AADT Info - NM Routes." Santa Fe, New Mexico. June. Available online: https://www.dot.nm.gov/planning-research-multimodal-and-safety/planning-division/data-management-bureau/traffic-monitoring-program/

NMDOT (New Mexico Department of Transportation) 2021. *Average Weekday Traffic Volumes in the Vicinity of NM-502 and NM-4 for CY 2021*. Available online: https://www.dot.nm.gov/planning-research-multimodal-and-safety/planning-division/data-management-bureau/traffic-monitoring-program/

NNSA (National Nuclear Security Administration) 2008a. *Final Sitewide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*, *Los Alamos, New Mexico*. DOE/EIS-0380. May. Available Online: https://www.energy.gov/nepa/doeeis-0380-site-wide-environmental-impact-statement-continued-operation-los-alamos-national

NNSA (National Nuclear Security Administration) 2023a. "Office of Secure Transportation." Available online: https://www.energy.gov/nnsa/office-secure-transportation

NNSA (National Nuclear Security Administration) 2023b. *Final Site-Wide Environmental Impact Statement for Continued Operation of the Lawrence Livermore National Laboratory*. DOE/EIS-0547. November. Available online: https://www.energy.gov/nepa/articles/doeeis-0547-final-environmental-impact-statement

Saricks, C. and M.M. Tompkins 1999. *State-Level Accident Rates for Surface Freight Transportation: A Reexamination*. ANL/ESD/TM-150. Center for Transportation Research, Argonne National Laboratory, U.S. Department of Energy, Argonne, Illinois, April. Available online: https://publications.anl.gov/anlpubs/1999/05/32608.pdf

SIMCO (Salado Isolation Mining Contractors) 2023. *Packaging*, U.S. Department of Energy Waste Isolation Pilot Plant, Carlsbad, NM. Available online: https://wipp.energy.gov/packaging.asp

SNL (Sandia National Laboratories) 2000. RADTRAN 5 *Technical Manual*. SAND2000-1256. May. Available online: https://www.nrc.gov/docs/ML1601/ML16013A013.pdf

USDOT (U.S. Department of Transportation) 2008. *Radioactive Material Regulations Review*. RAMREG-12-2008. December. Available online: https://www.phmsa.dot.gov/sites/phmsa.dot.gov/files/docs/training/hazmat/56526/ramreview2008.pdf

APPENDIX G
Environmental Remediation

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

AOC	Area of Concern
CFR	Code of Federal Regulations
CME	Corrective Measures Evaluation
CMI	Corrective Measures Implementation
CoC	Certificate of Completion
DD&D	decontamination, decommissioning, and demolition
DOE	U.S. Department of Energy
EO	Executive Order
EPA	U.S. Environmental Protection Agency
ER	environmental remediation
ET	evapotranspiration
IFGMP	Interim Facility-Wide Groundwater Monitoring Plan
IR	Investigation Report
IWP	Investigation Work Plan
LANL	Los Alamos National Laboratory
LCF	latent cancer fatality
LLW	low-level radioactive waste
MDA	material disposal area
MLLW	mixed low-level radioactive waste
NEPA	National Environmental Policy Act
NFA	no further action
NMED	New Mexico Environment Department
NNSA	National Nuclear Security Administration
NNSS	Nevada National Security Site
PRS	Potential Release Site
RCRA	Resource Conservation and Recovery Act
RDX	Royal Demolition Explosives
RFI	RCRA Facility Investigation
SIR	Supplemental Investigation Report
SSL	soil screening level
SWEIS	*Site-wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*
SWMU	Site Waste Management Unit
TRU	transuranic (waste)
WIPP	Waste Isolation Pilot Plant

G ENVIRONMENTAL REMEDIATION

G.1 Introduction

To facilitate remediation and cleanup efforts at LANL the Secretary of Energy directed NNSA and DOE-EM to transition the management of EM-funded legacy cleanup work from NNSA to DOE-EM in September 2014. This appendix addresses possible environmental impacts associated with investigations, corrective measures, and remediation being conducted at LANL in accordance with the *Atomic Energy Act of 1954*, as amended, and the *Resource Conservation and Recovery Act* (RCRA) and related legislation, particularly the Hazardous and Solid Waste Amendments. RCRA-related investigations and corrective actions will be conducted in accordance with a Compliance Order on Consent (Consent Order) entered into by DOE and the State of New Mexico in June 2016 (modified February 2017 and again in August 2024) (NMED 2016).

Commonly Used Terms

SWMU – A solid waste management unit (SWMU) means any discernible unit at which solid waste has been placed at any time, and from which NMED determines there may be a risk of a release of hazardous waste or hazardous constituents, irrespective of whether the unit was intended for the management of solid or hazardous waste.

AOC – Area of concern (AOC) means any area having a known or suspected release of hazardous waste or hazardous constituents that is not from a solid waste management unit. An AOC may include buildings, and structures at which releases of hazardous waste or constituents were not remediated, including one-time and accidental events.

PRS – A potential release site (PRS) means a site suspected of releasing or having the potential to release contaminants (radioactive, chemical, or both). PRS is a legacy term that includes SWMU and AOC that are cited and defined in the 2016 Consent Order.

MDA – Material Disposal Area (MDA) means 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. All MDAs are SWMUs and have SWMU designations.

Aggregate area – an area within a single watershed or canyon made up of one or more SWMUs and AOCs and the media affected or potentially affected by SWMUs or AOCs releases and for which investigation or remediation, in part or in entirety, is conducted for the area as a whole to address area-wide contamination, ecological risk assessment, and other factors.

The Consent Order was revised from its 2005 issuance to implement four primary enhancements:

1. Adoption of a Campaign Approach (Consent Order – Section VIII) to help group cleanup projects according to key criteria (long-term reliability and effectiveness, reduction of toxicity, mobility or volume, short-term effectiveness, implementability, and cost).
2. All descriptive language regarding areas for investigation has been removed, enhancing the focus on cleanup.
3. Annual Planning Process (Consent Order – Section VIII.C) allows for revisions during the year to accommodate upward or downward adjustments in funding.
4. Data Quality Objectives (Consent Order – Section XIII) allows for focus on overall goals that facilitate cleanup while reducing risk.

The analyses performed for this Site-Wide Environmental Impact Statement (SWEIS) updates the analyses presented in Appendix I of the 2008 SWEIS to consider levels of operations and projects re-scheduled and proposed for 2024 through about 2039 (NNSA 2008). Some of the operations and projects identified in the 2008 SWEIS associated with the 2005 Consent Order have been completed and have not been re-evaluated in this appendix. Table G-1 provides a summary of the MDAs. A current status of the MDAs in provided later in the appendix (Table G-4). However, much of the prior analyses remain applicable to the re-scheduled and proposed projects that may be taken through FY 2038; and if necessary, beyond.

Table G-1 Material Disposal Area Summary

MDA	Size (acres)	TA	Disposal Operation Period
A	1.8	21	1945–1977
B	6.03	21	1944–1948
C	11.80	50	1948–974
D	0.03	33	1948–1952
E	1.40	33	1949–1955, 1950–1963
F	1.40	06	1946–1952
G	65.00	54	1957–Present
H	0.30	54	1960–1986
J	2.65	54	1961–2002
K	1.00	33	1954–1990
L	2.58	54	1950–1985
M	3.00	09	1949–1965
N	0.28	15	1962–1965
P	1.40	16	1950–1984
Q	0.20	08	1946
R	2.25	16	1945–1951
S	0.002	11	1965–Present
T	2.21	21	1945–1983
U	0.2	21	1948–1968
V	0.88	21	1945–1961
W	0.001	35	1957–1964
X	0.05	35	1959
Y	0.20	39	1960s–1989
Z	0.40	15	1965–1981
AA	1.40	36	1960s–1989
AB	0.45	49	1959–1961

MDA = material disposal area; TA = technical area

G.2 Consent Order

The Consent Order fulfills the requirements for: (1) corrective actions for releases of hazardous waste or hazardous waste constituents, (2) corrective actions of releases of groundwater contaminants, toxic pollutants, and explosive compounds; (3) groundwater monitoring, groundwater characterization, and groundwater corrective action activities; and (4) additional groundwater information required in permit applications (NMED 2016).

On August 30, 2024, NMED and DOE signed this Settlement Agreement in full settlement of the litigation filed by NMED in 2021. The modified Consent Order settlement agreement offers necessary revisions regarding public participation, an improved and faster dispute resolution process, and broadened enforcement of deadlines conforming to a new five-year plan for some of the cleanup sites.

https://www.env.nm.gov/hazardous-waste/wp-content/uploads/sites/10/2024/09/NzcxOWIxNWEzOWE1OTZiMjcxNTcwNTY1YV8xNjc5MzE.pdf

In June 2016, the New Mexico Environment Department (NMED) and DOE entered into a new Consent Order that supersedes the March 2005 Consent Order. Changes from the 2005 Consent Order included removal of many of the detailed technical requirements so that the focus was more on the process. 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 established on a yearly basis. The 2016 Consent Order also provides for increased communication and collaboration between NMED and DOE during planning and execution of work. In 2016, the Consent Order replaced the determination for no further action (NFA) with a Certificate of Completion (CoC). A CoC is intended to document completion of any required corrective action activities and assign necessary controls. From the start of the Consent Order through the end of 2023, NMED issued 387 Certificates of Completion, 293 CoCs without controls, and 94 CoCs with controls. The total number of corrective action sites remaining in the investigation process at LANL was 1,018 as of December 2023. Figure G-1 provides a simplified graphical presentation of the Consent Order process.

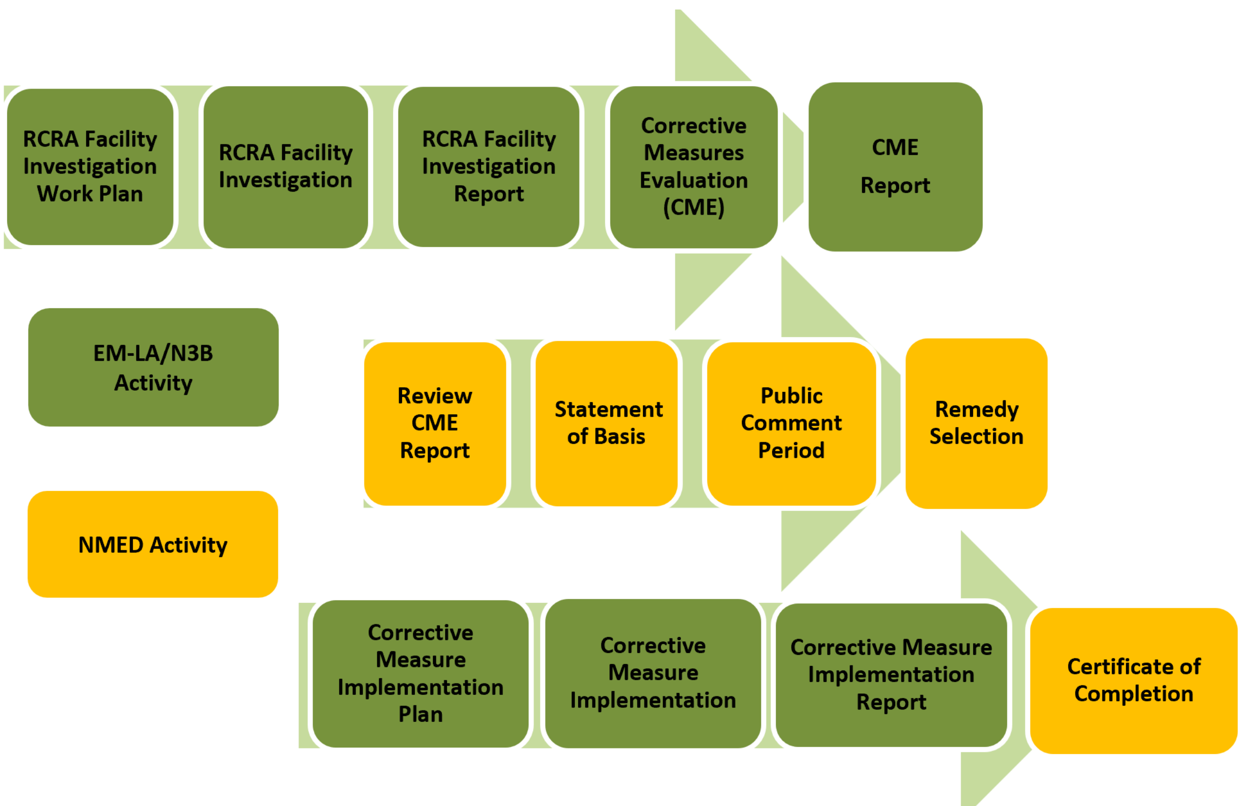


Figure G-1 Simplified Consent Order Process

The Consent Order requires investigations to fully characterize the nature, extent, fate, and transport of contaminants that have been released to air, soil, sediment, surface water, and groundwater. For example, the investigations of the canyon watersheds must address canyon alluvial sediments, surface water monitoring and sampling, and groundwater monitoring and sampling, focusing on the fate and transport of contaminants from the point of origin to each canyon watershed drainage system, and, if necessary, to the regional aquifer and the Rio Grande.

In order to clean up and remediate solid waste management units (SWMUs) and/or areas of concern (AOCs), RCRA facility investigations (RFIs) must first be conducted to investigate releases or potential releases of site-related contaminants from SWMUs and AOCs or releases of legacy contaminants. DOE then documents the results of investigations within investigation reports (IRs) that are submitted to NMED for review and approval. The IRs must identify potential corrective action activities for the SWMU/AOC(s) in question, and whether performance of a Corrective Measure Evaluation (CME) is recommended. Based on the relevant RFI report, NMED will notify DOE whether a CME report is required.

CME reports must identify, develop, and evaluate potential corrective measures alternatives for removal, containment, and/or treatment of site-related contamination. CME Reports focus on remedies based on consideration of site conditions and the extent, nature, and complexity of releases and contamination. DOE uses a graded approach in identifying corrective measures alternatives. Any corrective measure alternative proposed in the CME report must meet the threshold criteria, which are evaluation standards derived from the U.S. Environmental Protection Agency's (EPA) RCRA Corrective Action Plan, Directive 9902.3-2A (EPA 1994).

RCRA Facility Investigation (RFI) is the investigation(s) conducted to investigate releases or potential releases of site-related contaminants from SWMUs and AOCs to support the purposes of the Consent Order.

IR – Investigation Report (IR) is the report submitted by DOE to NMED capturing the results of the RFI within which DOE identifies potential contaminants of concern, defines nature and extent of those contaminant, and conducts human health and ecological risk assessments. Based on the IR, NMED will notify DOE whether a CME Report is required.

CME – Corrective Measures Evaluation is a study or report identifying, developing, and evaluating potential corrective measures alternatives for removal, containment, and/or treatment of site-related contamination and recommending a preferred alternative for remediation of such contamination.

CMI – Corrective Measures Implementation is the design, construction, operation, maintenance, and monitoring of the remedy selected following preparation of a CME and Statement of Basis.

Statement of Basis – a document prepared by NMED based on a CME that describes the basis for NMED's selection of a remedy.

DOE will then submit the CME report to NMED for its review in order for NMED to issue a Statement of Basis; which will describe the basis for NMED's selection of a remedy. After NMED issues the Statement of Basis, there is a public comment period that will last for at least 60 days. NMED will also provide an opportunity for a public hearing on the remedy. Within 90 days after the end of the public comment period, or other appropriate time, NMED will select a final remedy and issue a response to public comments.

After NMED has selected the remedy, DOE will develop a corrective measures implementation (CMI) Plan and submit it to NMED for approval. The CMI Plan is a plan for the design, construction, operation, maintenance, and monitoring of the remedy selected by NMED. After NMED approves the CMI Plan, DOE will execute the plan and implement the remedy. Once the remedy is completed in accordance with the CMI Plan, EM-LA will submit a CMI Report to NMED for approval. The CMI Report documents implementation and completion of the remedy in accordance with the CMI Plan. NMED's approval of CMI Reports provide validation for whether corrective action activities are complete at particular sites, including validation of recommended controls.

G.2.1 Campaigns

Investigations and corrective action activities required by the 2016 Consent Order are organized under campaigns (Table G-2). These campaigns are developed using a risk-based approach to grouping, prioritizing, and accomplishing corrective action activities at SWMUs (including MDAs) and AOCs. A campaign may consist of one or more projects. As of 2023, nine of the MDAs identified in Table G-1 are either closed, deferred, or in post-closure monitoring and were excluded from analyses in this SWEIS. Seven of the MDAs (A, T, C, AB, H, G, and L) identified in Table G-1 are in process of remedy evaluation and closure (Table G-2). The remaining 10 MDAs have been incorporated into Consent Order campaigns (Table G-2).

Table G-2 Consent Order Campaigns and Status

Campaign		2024 Status	# SWMUs / AOCs
A	Chromium Interim Measures and Characterization Campaign	In Process	0
B	Historical Properties Completion Campaign	In Process	62
C	Royal Demolition Explosives (RDX) Characterization Campaign	In Process	2
D	Supplemental Investigation Reports Campaign	In Process	142
E	TA-21 D&D and Cleanup Campaign	In Process	38
F	RDX Remedy Campaign	Not Started	2
G	Known Cleanup Sites (above SSLs) Campaign	Completed	0
H	MDAs A & T Remedy Campaign	In Process	9
I	Chromium Final Remedy Campaign	Not Started	0
J	Southern External Boundary Campaign	In Process	76
K	MDA C Remedy Campaign	In Process	1
L	Sandia Canyon Watershed Campaign	Not Started	64
M	Pajarito Watershed Campaign	In Process	169
N	Upper Water Watershed Campaign	Not Started	258
O	MDA AB Remedy Campaign	Not Started	5
P	MDA H Remedy Campaign	In Process	1
Q	MDAs G & L Remedy Campaign	In Process	12

D&D = deactivation and decommissioning; MDA = material disposal area; RDX = Royal Demolition Explosives; SSL = soil screening levels

As of December 2023, remediation implementation of the seven MDAs in the process of remedy evaluation and closure are not scheduled, but would likely be implemented after FY 2026 upon completion of Consent Order regulatory processes.

G.2.2 Cleanup Objectives and Cleanup Levels

DOE will continue to implement corrective actions to address potential contamination associated with potential releases from SWMUs and AOCs. Corrective actions to cleanup SWMUs/AOCs will be predicated on measured exceedances of contaminant screening levels determined during the RFI. Cleanup corrective actions designed to prevent unacceptable risks to human health and ecological receptors will be defined in a CME report that DOE submits to NMED. These corrective actions will be developed based on both screening levels for contamination concentrations that pose unacceptable risk thresholds, and cleanup levels for contamination concentrations that indicate when cleanup concentrations are met. DOE will define both screening and cleanup levels in accordance with Sections XIII and XIV of the 2016 Consent Order.

G.2.3 Facility Investigations

RFIs will be conducted to investigate releases or potential released of site-related contaminants from SWMUs and AOCs, and will focus on the overall goal to clean up the environment and reduce risks to human health and ecological receptors. RFIs will focus on collecting the data necessary and sufficient to support decisions on corrective action activities. Each RFI will be executed pursuant to an Investigation Work Plan approved by NMED in accordance with Section XXIII of the Consent Order.

The objectives of the work plans are to characterize the nature and extent of contamination, if any, and to determine the need for corrective action. Investigations may include (but are not necessarily limited to) geodetic and geophysical surveys, radiological surveys, surface and near-surface soil sampling, sampling soil and tuff from boreholes, and confirmation sampling of soil or tuff after conducting a remedial action. A phased approach will be used that will be tailored to each SWMU and/or AOC; including site reconnaissance, screening, characterization, excavation, confirmation sampling, and evaluation of survey screening and sample data. Results from the Investigation Work Plan will be documented in an IR that will identify corrective action activities for the SWMUs and AOCs in question. IRs are subject to NMED review and approval.

Any investigation-derived waste generated during the site investigation process will be managed in accordance with all applicable EPA and NMED regulations, DOE orders, and LANL implementation requirements. Investigation-derived waste may include drill cuttings, contaminated personal protective equipment, sampling supplies, plastic, and decontamination fluids. Some field investigations may also displace environmental media such as groundwater, surface water, surface and subsurface soils, rocks, bedrock, and gravel.

G.2.4 Newly Discovered Releases

DOE will notify NMED upon any discovery of a potential SWMU or AOC and develop and implement a preliminary screening plan for such newly discovered potential SWMUs or AOCs. If results of the preliminary screening indicate hazardous constituents above residential screening levels, then the newly discovered SWMU or AOC will be added to Appendix A (SWMU/AOC List) of the 2016 Consent Order and incorporated into the appropriate Consent Order Campaign.

In 2010, two previously unknown sites were identified and reported. In 2012, one SWMU was split into two new SWMUs to facilitate completion of a corrective action associated with land development. In 2013, two low-level radioactive waste (LLW) disposal pits at Area G were identified as two new SWMUs. In 2016, an additional 4 SWMUs and 1 AOC were split into 10 new SWMUs and 2 new AOCs to facilitate completion of a corrective action associated with land development. One of these new SWMUs was split again in 2017 to create one additional new SWMU.

G.2.5 Deferred Sites

Deferral of investigations and corrective action activities may occur at SWMUs/AOCs where the site is determined inaccessible or where or investigation is not feasible until decontamination and decommissioning of associated operational facilities is complete. Deferred sites include the SWMU/AOCs located within or near active Laboratory facility operations. Deferral is proposed and approved by NMED in Investigation Work Plans and Reports and documented in Appendix A (SWMU/AOC List) of the 2016 Consent Order.

In Appendix A of the 2016 Consent Order, 134 sites are deferred for investigation and corrective action. These areas include sites within Testing Hazard Zones of active firing sites, which are deferred until the firing site used to delineate the relevant Testing Hazard Zone is closed or declared inactive and DOE determines that it is not reasonably likely to be reactivated. Corrective actions for the deferred sites will be implemented under LANL's Hazardous Waste Facility Permit if not completed before the end date of the Consent Order.

G.2.6 Groundwater Monitoring

DOE will continue to monitor groundwater at and around LANL, including base flow, alluvial groundwater, intermediate-perched groundwater, and regional aquifer groundwater, in accordance with NMED-approved annual updates to the Interim Facility-Wide Groundwater Monitoring Plan (IFGMP). Monitoring results will be reported in periodic monitoring reports submitted to NMED. DOE will prepare a revised IFGMP annually (October 1 through September 30) that includes monitoring locations, frequencies, analytical suites, and related activities, as well as a schedule for performing monitoring activities and submitting period monitoring reports. As appropriate, the revised IFGMP will specify collection of monitoring data that is necessary and sufficient to support corrective action activities. Per NMED guidelines, analytical methods will be capable of detecting contaminants at or below screening levels or, with approval of NMED, other reporting levels, as appropriate. As DOE completes corrective action activities at SWMUs or AOCs, DOE may propose changes to monitoring groups to reflect near-term groundwater monitoring activities. Upon completion of corrective action activities at a SWMU or AOC or for contaminated groundwater and the requisite monitoring period, DOE may include long-term groundwater monitoring requirements in a permit modification request. DOE will then remove groundwater monitoring requirements for that SWMU/AOC from the next revision of the IFGMP (NMED 2016).

The Consent Order requires the construction of new wells, the abandonment of some existing wells, and environmental groundwater sampling. Newly constructed wells include alluvial wells, intermediate wells, and regional aquifer wells. Requirements for specific LANL TAs are often prescribed in terms of individual SWMUs/AOCs. The investigations for each SWMU/AOC must typically include a survey of disposal units, drilling explorations, soil and rock sampling, sediment sampling, vapor monitoring and sampling, intermediate and regional aquifer groundwater well installation, and groundwater monitoring (NMED 2016).

Exploratory and monitoring well borings must be drilled using the most effective, proven, and practicable method for recovery of undisturbed samples and potential contaminants. Methods to be used must be approved by NMED. Monitoring wells are typically constructed by advancing a boring with a drilling rig, installing a well casing and screen, and backfilling the annulus between the casing and the wall of the borehole (NFEC 1998). Based on drilling conditions, the borings may be advanced using one of the following methods: hollow-stem auger, air rotary, mud rotary, percussion hammer, sonic, dual-wall air rotary, direct-push technology, cryogenic, and cable tool. Drilling techniques will be selected and used that minimize collateral disturbance and investigation-derived waste. NMED prefers hollow-stem auger or direct-push technology drilling methods if vapor-phase or volatile organic compound contamination is known or suspected. Air rotary drilling is preferred for borings intersecting the regional aquifer. The type of drilling fluid used must be approved by NMED (NMED 2016).

Drilling Techniques

- **Hollow-stem auger** – A hollow-tem auger may be used to install monitoring wells in unconsolidated or poorly consolidated materials, but is inappropriate for solid rock. No drilling fluids are required (NFEC 1998).
- **Air rotary** – Rotary drilling uses circulating fluids to remove drill cuttings and maintain an open hole as drilling progresses. In the air rotary method, air is forced down the drill pipe and back up the borehole to remove drill cuttings. Air rotary is often discouraged for environmental investigations because of the difficulty of yielding representative samples (NFEC 1998).
- **Mud rotary** – Mud rotary drilling, like water rotating drilling, requires the introduction of fluids through the drill pipe to maintain an open hole, to provide drill bit lubrication, and to remove drill cuttings. Mud rotary drilling is often used instead of water drilling when the subsurface properties make it difficult to maintain an open borehole (NFEC 1998).
- **Dual-wall air rotary** – The dual-wall reverse-circulation rotary method employs a double-walled drill pipe. Air (or water) is forced down the outer casing and circulated up through the inner pipe. Cuttings are forced to the surface through the pipe (NFEC 1998).
- **Percussion hammer** – This drilling technique uses compressed air to hammer a series of short, rapid blows to the drill rods or bits and also simultaneously applies a rotating motion. Drill cuttings are flushed to the surface by compressed air (NFEC 1998).
- **Sonic** – Resonant sonic drilling uses a combination of mechanically generated vibrations and limited rotary power to penetrate soil. The drill head, attached to the drill pipe, uses two counter-rotating, out-of-balance rollers, causing the drill pipe to vibrate in resonance. The vibration and weight of the drill pipe, along with the downward thrust of the drill head, permit penetration of the geologic formation without adding drilling mud or lubricating fluid. The technique is adaptable to any slant angle and virtually any geologic formation and typically produces no cuttings or secondary waste streams (NFEC 1998).
- **Direct-push technology** – Direct-push technologies use hydraulically powered machines that drive small-diameter tools directly into the surface. This technology generates little to no investigation-derived wastes and can be mounted on relatively small vehicles, allowing for use at sites that are difficult to access and minimizing collateral disturbance to surrounding soil and vegetation (NFEC 1998).
- **Cryogenic –** Cryogenic drilling replaces ambient air with cold nitrogen liquid or gas—as cold as 320° F (degrees Fahrenheit) (-196° C [degrees Celsius])—as the circulating medium. The nitrogen stream freezes moisture in the ground surrounding the borehole, thus stabilizing it (DOE 1998).
- **Cable tool** – The cable tool drilling method uses a heavy string of drilling tools that are repeatedly lifted and dropped within a borehole. The drill bit breaks and crushes consolidated rock into small fragments and loosens unconsolidated material. The reciprocating action of the tools mixes the crushed and loosened rock particles with water to form a slurry. A sand pump or bailer removes the slurry (NFEC 1998).

G.2.7 Interim Measures

Interim measures refer to actions that can be implemented to reduce or prevent migration of site-related contaminants, which have or may present an unacceptable risk to human health or environmental receptors. These interim measures may be employed while long-term corrective action activities are evaluated and implemented. DOE and NMED may identify the need for interim measures during the development and/or review of Investigation Work Plans and IRs, during the execution of RFIs, or during the review of new information related to potential releases of contaminants from SWMUs and/or AOCs.

If interim measures are determined necessary by NMED, DOE will prepare an Interim Measures Work Plan for NMED's review and approval in accordance with Section XXIII of the 2016 Consent Order. During the implementation of any approved interim measures, DOE may determine whether any emergency interim measures are necessary to address immediate threats to human health or the environment. In the event emergency interim measures are determined necessary, DOE will notify NMED, but these emergency interim measures will not require a new Interim Measures Work Plan. Following the completion of interim measures, DOE will submit to NMED an Interim Measures Report that will summarize the results of all field screening, monitoring, sampling, analysis, and other data generated during interim measures implementation.

G.3 Maintenance of Nuclear Environmental Sites

Some of the SWMUs/AOCs addressed in this appendix are nuclear environmental sites, which are inactive waste handling or disposal areas that contain sufficient radioactive material to be classified as HC-2 or -3 according to DOE Standard thresholds (DOE 1997). Nuclear and radiological facilities are identified by hazard category in accordance with the potential consequences in the event of an accident. DOE performs routine inspections and maintenance at these sites to maintain compliance with 10 CFR Part 830. Maintenance activities are those efforts necessary for satisfactory containment of hazardous materials and protection of workers, the public, and the environment. DOE has a documented safety analysis for surveillance and maintenance of the sites (N3B 2023).

Nuclear Facility Hazard Categories (HC)

HC-1 – Hazard analysis shows the potential for significant offsite consequences.

HC-2 – Hazard analysis shows the potential for significant onsite consequences.

HC-3 – Hazard analysis shows the potential for only significant localized consequences.

(Source: 10 CFR Part 830)

Table G-3 identifies the nuclear environmental sites managed by DOE-EM. These sites were identified in LANL (2018).

Table G-3 Nuclear Environmental Sites with Nuclear Hazard Classifications

TA	MDA	SWMU/AOC	Hazard Classification
21	A (General's Tanks)	SWMU 21-014	2
21	Building 21-257		2
21	T	Consolidated Unit 21-016(a)-99	2
35	W	AOC 35-001	3
49	AB	SWMUs 49-001(a), 49-001(b), 49-001(c), & 49-001(d)	2
54	H	SWMU 54-004	3
54	G (as an element of TA-54 Waste Storage and Disposal Facility, Area G)	Consolidated Unit 54-013(b)-99	2

AOC = area of concern; MDA = material disposal area; SWMU = solid waste management unit

Maintenance Activities

- **General Maintenance** – Activities may include mowing, debris clearing, foliage removal, and fence repair. Tasks such as mowing, clearing brush, removing debris, and removing small trees are performed to maintain site surface characteristics and to limit combustible materials.
  - Equipment used may include miscellaneous hand tools and cutters, chain saws, tractors with fixed or adjustable cutting attachments, weed-line or blade trimmers, push mowers, tractors with fixed or adjustable (hydraulic) mower decks, and trucks and transport vehicles, including cherry picker hydraulic lifts.
- **Boundary Marking** – The disposal units that comprising the nuclear facilities may require demarcation. Activities may include general surveying, placement of posts, and placement of temporary barriers such as orange construction fencing.
  - Equipment used may include pin flags, flagging tape, and/or wooden or metal stakes to mark locations and may pound stakes 1 foot (0.3 meter) or deeper into the subsurface. General surveying may require the installation of permanent benchmarks using hand- or battery-operated rock drills to make small holes in bedrock and cementing the benchmarks in the drilled holes.
- **Baseline Radiological Survey** – activities may include establishing surface radiological conditions at a specific point in time, and performing radiological surveys in areas of changed conditions.
  - Equipment used may include a wide array of devices that are generally small, handheld, and self-contained. Survey instruments may be mounted on all-terrain vehicles.
  - To conduct a survey, personnel may require access to radioactive storage areas; waste lagoons; areas downwind of stack release points or exhaust vents; areas near storm, septic, sanitary, or drainage systems; and areas where runoff may collect. These areas may be within or outside of nuclear environmental site boundaries.
- **Erosion Control Studies and Maintenance** – Erosion control measures may include installation and maintenance of check dams, straw wattles, and/or surface basecourse or earthen berms.
- **New Fencing** – New fence construction can include digging holes, placing concrete, setting posts, and using a "come along" or other light equipment to stretch fencing.
  - Equipment used may include trucks and transport vehicles with mounted hydraulic lifts and pole drivers to install posts and lift materials; vehicle-mounted, power, or manual augers to excavate post holes; hand tools to support post and fence placement; cutting torches to cut fencing or signage materials; radiological and industrial-hygiene survey equipment; oxy-acetylene or arc welding units; or electric or pneumatic cutting drills and saws.

G.4 Remediation Options

Determining remediation options for a campaign (*see* Section G.2.1) relies on the collaborative CMI Plan development (*see* Section G.2) with NMED. Previous CMI plans have identified three broad-scope options that have aligned with the Consent Order evaluation process. Historically, CMI plans may combine aspects of these broad-scope options. To predict the impacts associated with potential CMI actions for the seven MDAs that are in process of remedy evaluation and closure, as well as the remaining 10 MDAs that have been incorporated into Consent Order campaigns, the three broad-scope options considered for purposes of NEPA include:

- **No Action Option** – Environmental investigations and remediation efforts would be carried out at a minimum-compliance accordance with the Consent Order. This effort is currently limited to the investigations and maintenance activities described in the 2008 SWEIS (NNSA 2008, Appendix I.3.2.2 and I.3.2.3) until NMED issues a project-specific Statement of Basis. Under this option, no additional extensive corrective measures would be conducted for MDAs. Some removal activities, which have been incorporated into Consent Order campaigns (*see* Table G-2), are included in this option.

- **Capping Option** – Environmental investigations and remediation efforts would be carried out in accordance with the Consent Order. For this appendix under this option, it was assumed that "in-progress" or "not started" LANL MDAs (Table G-4) would be stabilized in place, and several other SWMUs/AOCs would be remediated annually. Stabilizing MDAs in place means placing final covers over them and conducting certain other environmental restoration activities such as remediating the volatile organic compound plumes existing in soil at some MDAs, as described in the 2008 SWEIS (NNSA 2008, Appendix I.3.3.2.1). Currently no capping activities are planned. Potential impacts of individual capping options will be evaluated beyond the estimates provided in Table G-5 in project-specific NEPA analysis to be conducted in conjunction with the CME report(s).
- **Removal Option** – Environmental investigations and remediation efforts would be carried out in accordance with the Consent Order. For this appendix it was assumed under this ption that "in-progress" or "not started" LANL MDA waste and contamination (Table G-4) would be removed. Transuranic waste stored at MDA G would be removed and shipped to WIPP along with other transuranic-contaminated material. Remediation of additional SWMUs/AOCs would occur by various methods, as described in the 2008 SWEIS (NNSA 2008, Appendix I.3.3.2.4). Currently no removal activities for major SWMUs/AOCs are planned. Estimates of potential impacts of individual removal options are provided in Table G-5, but further analyses of impacts will be described in project-specific NEPA analysis to be conducted in conjunction with the associated CME report(s).

Tables G-5 and G-6 provide additional information relative to future actions that could emerge from negotiations with NMED during the Consent Order process related to capping and/or waste removal. Currently, only the No Action Option is included as part of DOE/NNSA's planning basis for this SWEIS. Table G-7 provides a sense of the types of impacts, by resource area, that could be realized upon implementation of capping and removal options site-wide. DOE plans to evaluate whether additional NEPA review is required for each corrective measure prior to implementation.

Capping Operational Elements

- **Design, Planning, and Permitting** – Includes planning for site operations, including equipment and personnel coordination. Includes health and safety plans, site security plans, erosion control plans, and others. Includes permits and authorizations.
- **Demolishing/Relocating Existing Operations, Structures, or Materials** – Includes moving, demolishing, or relocating existing structures or operations.
- **Rerouting/Modifying Utilities, Pipelines, or Similar** – Includes rerouting or modifying water, electrical, telephone, or other underground or overhead lines as needed to preclude damage. Includes removal or rerouting of liquid waste or chemical piping to preclude damage.
- **Mobilization** – Includes mobilization and initial site placement of equipment such as cranes, backhoes, dump trucks, water trucks, and graders. Includes installation of a site management trailer. Includes site storage of equipment and initial mobilization of the workforce.
- **Site Preparation** – Includes explorations needed to determine the specific locations of disposed wastes, and other site-specific studies and tests such as removal of areas of surface contamination. Includes clearing of vegetation. Includes the demolition or removal of asphalt or other hard covers over disposal units. Includes removal and disposal of existing security fencing.
- **Perform Special Activities** – Includes activities unique to a specific MDA. For MDA A, it includes stabilizing the buried General's Tanks.
- **Install Moisture Monitoring System** – Before cover installation, includes the possible placement of moisture detection probes at selected locations, as well as ancillary equipment.
- **Regrading/Evapotranspiration Cover Installation/Revegetation** – Includes placement of the cover, including spreading and fine-grading of topsoil, compaction using heavy construction equipment, watering for dust abatement, and watering of planted areas for vegetation germination at approved levels.
- **Install New Fencing/Gate** – Includes security fencing with a gate large enough for vehicle passage, as well as appropriate signage.
- **Demobilization** – Includes demobilization of equipment such as backhoes, dump trucks, water trucks, and graders. Includes removal of the management trailer.
- **Health and Safety** – Includes development of a site health and safety plan; performing surface sampling confirming nonhazardous site conditions; monitoring site activities; and conforming to standard construction health and safety policies, laws, and procedures.
- **Project Management** – Includes an onsite project manager or foreman, who reports daily site progress, as well as site office support. Includes, as needed, specialists such as an evapotranspiration specialist for confirmation of material placement.

Table G-4 Status of MDA Remediation as of 2023

MDA	TA	SWMU/AOC	Brief Description	Current Status
A	21	SWMU 21-014	1.25-acre site containing 2, 50,000-gal. underground tanks (General's Tanks) and 3 pits	In Process IWP submitted to NMED in June 2023.
B	21	SWMU 21-015	6-acre site used primarily for solid waste disposal; small section used for chemical waste disposal, contained 2 underground trenches	Completed Remediation of MDA B occurred in 2010-2011. NMED issued a CoC without controls in May 2015. DOE transferred land to Los Alamos County in 2018.
C	50	SWMU 50-009	7 pits and 108 shafts within 11.8-acre site	In Process CME report, Rev 1 submitted to NMED in 2021. Pore-gas monitoring is ongoing. Soil vapor extraction system to continue running in fall of 2023.
D	33	SWMUs 33-003(a–b)	Two underground concrete chambers used to test explosive devices	In Process Phase I Consent Order Investigation occurred from 2020 to 2021 as part of South Ancho Canyon Aggregate Area Investigation. IR written and submitted to NMED with recommendation for Corrective Actions CoC without controls. IR pending NMED approval.
E	33	SWMUs 33-001(a–e)	One underground chamber plus 6 waste disposal pits, spent projectiles, uranium, beryllium	In Process Additional sampling inside the fence included in Chaquehui Phase III IWP, currently in draft form.
F	06	SWMU 06-007(a)	Two pits and 3 disposal shafts. Classified trash was interred here during the late 1940s	In Process Phase I Consent Order sampling is included as part of Two-mile Canyon Aggregate Area.
G	54	SWMUs 54-013(b) 54-014(b-d) 54-015(k) 54-017 54-018 54-019 54-020 54-023 54-024	35 disposal pits, 294 disposal shafts, and 4 transuranic waste trenches within a 63-acre site	In Process Performance Assessment and Composite Analysis performed annually.

MDA	TA	SWMU/AOC	Brief Description	Current Status
H	54	SWMU 54-004	9 vertical shafts within a 0.3-acre site	In Process CME report submitted to NMED in September 2023.
J	54	SWMU 54-005	6 disposal pits and 4 disposal shafts within a 5.5-acre site	Completed Closure completed in June 2002 and a Closure Certificate Report submitted to NMED in October 2002. Ongoing post-closure monitoring.
K	33	SWMUs 33-002(a–e)	Septic tank, sump, 3 seepage pits, roof drain, and outfall associated with main site, contaminants include tritium from TA-33 processing facility	In Process Additional sampling required in Chaquehui Phase III IWP, currently in draft form. Three additional vapor-monitoring wells proposed to be installed during implementation.
L	54	SWMU 54-006	1 chemical waste disposal pit, 34 disposal shafts and 3 chemical waste disposal impoundments within a 2.5-acre site	In Process Pore-gas monitoring is ongoing.
M	09	SWMU 09-013	2 former surface trash disposal areas	In Process Phase I Consent Order sampling is included in the Starmer/Upper Pajarito Canyons Aggregate Area IWP for 2023.
N	15	SWMU 09-013	Inactive landfill. Construction and office debris reported to be buried in shallow trenches <1 acre in size	In Process The 2019 SIR for Potrillo and Fence Canyons Aggregate Area, Rev. 1 recommended a CoC without controls; CoC pending.
P	16	SWMU 16-018	HE burn ground residues, concrete, construction debris, metal, asbestos-containing material, LLW, and mixed waste disposed at the site	Completed The MDA P landfill was closed as a RCRA unit in 1999 and NMED approved the closure in 2005.
Q	08	SWMUs 08-006(a–b)	0.2 acre landfill. Naval guns and other metallic trash was buried here during the late 1940s	In Process Phase I Consent Order sampling will be included as part of the Starmer/Upper Pajarito Canyon Aggregate Area investigation for 2023.
R	16	SWMU 16-019	World War II era HE burn ground and associated HE residues and trash on surface	In Process Phase I Consent Order sampling is as part of Cañon de Valle Aggregate Area investigation expected to be conducted in 2024–2025.
S	11	SWMU 11-009	Active experimental test plot	Not Started Site investigation is deferred (not expected to occur within the next 15 years) until adjacent firing sites are closed.

MDA	TA	SWMU/AOC	Brief Description	Current Status
T	21	SMWUs 21-016(a-c)	2.2-acre site consisting of 4 inactive liquid waste absorption beds, a waste storage area, and a series of 62 disposal shafts to dispose of wastes mixed with cement	In Process A moisture monitoring pilot study was conducted in 2021. IWP submitted to NMED in June 2023.
U	21	SWMUs 21-017(a–c)	1.3-acre site containing 2 absorption beds and associated sump	Completed In September 2005, NMED issued a CoC with controls.
V	21	SWMUs 21-018(a–b)	0.88-acre site containing 3 liquid absorption beds designed to dispose the outflow from a radioactive laundry facility	Completed In June 2019, NMED issued a CoC without controls.
W	35	AOC 35-001	Two 4-in diameter, 125 ft long stainless steel tubes suspended vertically inside 8-in diameter carbon-steel-cased wells; each tube is backfilled under pressure with nitrogen and is sealed, it contains 150 l of liquid sodium reactor coolant contaminated with plutomiun-239 and associated fission products	Completed EPA and NMED approved the NFA proposal in 2005.
X	35	SWMU 35-002	Site of the Los Alamos Power Reactor Experiment No. 2 (LAPRE II) reactor, which was buried in place after it was decommissioned in 1959; the site was remediated in 1991 as an ER interim action	Completed NMED issued a CoC without controls in 2011.
Y	39	SWMU 39-001(b)	Firing site debris, chemical containers, concrete, and office waste buried in 3 shallow trenches	Completed NMED issued a CoC without controls in 2010.
Z	15	SWMU 15-007(b)	Inactive landfill. Approximately 2000 yd of construction debris and other debris from firing site activities, including depleted uranium	In Process Phase I Consent Order sampling is included as part of Cañon de Valle Aggregate Area investigation expected to be conducted in 2024–2025.
AA	36	SWMU 36-001	Firing site debris (burned and unburned) place in trenches approximately 13 ft deep, and covered 2–3 ft of soil	In Process Phase II Consent Order sampling is included in the Potrillo and Fence Canyons Aggregate Area investigation, expected to be conducted in 2023–2024.
AB	49	SWMUs 49-001(a–g)	Multiple shafts and chambers at depths between 60 ft and 80 ft (18 m and 24 m), used for hydro nuclear safety experiments from late 1959 to 1961, total volume of contaminated tuff estimated at about 1,000,000 ft^3 (30,000 m^3), radiological inventory estimated as 0.2 Ci uranium-235 and 2450 Ci plutonium-239, solid lead used as shielding for experiments contained in the experiment chambers as well as beryllium	In Process SWMUs 49-001 (a, b, c, d, f) recommended for evaluation in a RCRA Gap Analysis. SWMUs 49-001(e, g) recommended for CoC with controls.

AOC = area of concern; CME = Corrective Measures Evaluation; CoC = Certificate of Completion; EPA = U.S. Environmental Protection Agency; IR = Investigation Report; IWP = Investigation Work Plan; MDA = material disposal area; NMED = New Mexico Environment Department; RCRA = Resource Conservation and Recovery Act; SIR = Supplemental Investigation Report; SWMU = solid waste management unit; TA = technical area

Table G-5 Cover Materials for Selected Material Disposal Areas

MDA	Cover Area		Minimum RCRA Cover Volume (cubic yards)			RCRA Cover Shipments		Minimum ET Cover Volume (cubic yards)			ET Cover Shipments	
	Acres	Square Feet	Rock/soil/clay layer[a]	Sand layer	Total	One-Way Shipments 2024–2036[b]	Estimated Shipments per day[c]	Minimum Operational Cover[d]	Durable Rock ad-mixture[e]	Total	One-Way Shipments 2024–2036[b]	Estimated Shipments per day[c]
A[f]	2.7	117,612	17,424	4,356	21,780	1,361	0.5	19,602	2,058	21,660	1,354	0.5
C	11.8	514,008	76,149	19,037	95,186	5,949	2.0	76,149	12,692	88,841	5,553	1.9
G	51	2,221,560	575,960	82,280	658,240	41,140	13.7	370,260	77,755	448,015	28,001	9.3
H	0.6	26,136	3,872	986	4,858	304	0.1	4,356	457	4,813	301	0.1
L	0.9	39,204	10,164	1,452	11,616	726	0.2	6,534	686	7,220	451	0.2
T	2.1	91,476	13,552	3,388	16,940	1,059	0.4	15,246	1,600	16,846	1,053	0.4
AB	1.3	55,500	8,222	2,056	10,278	642	0.2	9,250	971	10,221	639	0.2

ER = environmental remediation; ET = evapotranspiration; MDA = material disposal area; RCRA = Resource Conservation and Recovery Act

a Includes existing operational cover, compacted layer and vegetation layer.

b 16 cubic yards of material per shipment based upon allowable U.S. Department of Transportation weight limits.

c Assuming 250 working days per year over 12 years.

d Some MDAs may have an existing cover suitable for ET cover implementation, so the addition of the entire amount may not be necessary.

e Rock ad-mixture mixed into the existing cover.

f Does not include the General's Tanks.

Table G-6 Volumes and Shipments of Material for Removal of Material Disposal Areas A, C, G, H, L, T, and AB

MDA	Total Excavated Volume (yd^3)	Waste Type(s)	Stockpile Material Returned (yd^3)	Additional Fill Needed (yd^3)[a]	One-Way Shipments 2024–2036[b]	Estimated Shipments per day[c]
A[d]	24,081	LLW, MLLW	13,244	15,653	2,784	1
C	412,000	LLW, MLLW	226,600	267,800	47,638	16
G	1,654,535	MLLW, TRU	751,720	1,233,722	201,198	67
H	71,644	LLW, MLLW	40,000	45,973	8,247	3
L	80,801	LLW, MLLW	45,532	51,429	9,274	3
T	30,877	LLW, MLLW	16,982	20,070	3,570	1
AB	222,000	LLW, MLLW	122,100	144,300	25,669	9

LLW = low-level radioactive waste; MDA = material disposal area; MLLW = mixed LLW; TRU = transuranic (waste); yd^3 = cubic yard

a Assuming 20% additional fill beyond the volume excavated.

b 16 cubic yards of material per shipment based upon allowable U.S. Department of Transportation weight limits.

c Assuming 250 working days per year over 12 years.

d Does not include the General's Tanks.

Table G-7 Impact Assessment for the Remediation Options

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
Land Use	Continuing LANL's environmental remediation activities would reduce the amount 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. Consent Order investigation programs such as well installation and monitoring will not change the designated land use in the TAs where the investigations take place. Wells or other monitoring equipment should not require significant dedication of land once installed. However, there may be temporary commitments of land to construct the investigation systems. For example, installation of a well may require temporary clearing of several hundred square feet of vegetation. But this resource commitment would be short lived. Following well installation, the affected land would be allowed to return to its original condition. See Section 5.2.1 for land use impacts.	Implementing the Capping Option at the MDAs would present restrictions on the future use of the land associated with the MDAs. At present, most MDAs are open areas that are fenced and excluded from any use other than safely maintaining inventories of waste. Capping the MDAs is expected to cover about 110 acres of land, which would be retained as exclusion areas for radioactive waste. Additional acreage may be temporarily committed to support implementing the Capping Option. In the future, the MDAs would continue to be surveyed and maintained to protect public health and safety and the environment. Capping the MDAs within TA-54 would result in no significant change to current restrictions on accessing the land comprising the MDAs. Overall, those portions of TA-54 currently used as waste management areas would still be used for that purpose. The Capping Option would involve the temporary commitment of land to support capping activities. The largest temporary commitment of land would be for temporary storage of bulk capping materials. Implementing the Capping Option for other SWMUs/AOCs may directly affect several acres of land on an annual basis. In general, land use and continued operation of facilities adjacent to SWMUs/AOCs are largely independent of remediation and cleanup actions.	Implementing the Removal Option at the MDAs would present fewer restrictions on land reuse than under the Capping Option. Removing the MDAs could free the land occupied by the MDAs for other purposes. Any buffer area surrounding the MDAs could also be used for other purposes. But implementation of the Removal Option may not cause major changes in the designated uses of the TAs containing MDAs. Operating or inactive contaminated facilities would remain near MDAs C, G, and L. Assuming complete removal at MDAs A and T, there may be residual stabilized contamination after other, nearby structures are removed. After removal of MDA AB, other nearby SWMUs/ AOCs in TA-49 may remain. A similar situation exists at the other, smaller MDAs. While future use of the remediated sites is not yet known, it is likely that the land would be reused to support existing and future LANL missions. The Removal Option would involve the temporary commitment of land to support removal operations (e.g., removal or surface contamination; remediation of subsurface volatile organic compound plumes; inhalation of subsurface barriers; installation of groundwater pump-and-treat systems). Following removal, the land would be remediated as needed and be made available for other uses. Removal would take place over a several years at different times within different

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
			TAs, smaller areas than those estimated above would be affected annually. Implementing the Removal Option for other SWMUs/AOCs is expected to have the same impact on land use as the No Action Option.
Land Use Visual Resources	Continuing LANL's environmental remediation activities should generally improve visual resources, as older structures and signage warning of possible hazards are removed for lack of need, and areas are revegetated. There could be some temporary, short-term reductions in the visual environment. For example, installing a well may require temporary clearing of several hundred square feet of land. But visual impacts would be short lived. Cleared or disturbed areas would be allowed to return to their original condition. Site monitoring and sample collection systems would be unobtrusive. Small quantities of dust could be generated, which could slightly reduce visual quality. Dust generation would be localized, temporary, and could be controlled. See Section 5.2.2 for impacts to visual resources.	Implementing the Capping Option at the MDAs would create short-term negative visual impacts. Capping would require stripping or disturbing the existing vegetative cover over the MDAs, placing cover materials in compacted lifts, and revegetating the site. Not all land would be affected at the same time, and many of the MDAs are not readily visible by the public. Once the MDAs are capped and revegetated, those visible from higher elevations to the west would have the same grassy appearance as they had before capping began. Support areas would be remediated as needed. Implementing the Capping Option for other SWMUs/AOCs would depend on their location and the nature and extent of the contamination. Individual affected areas would be generally small, and many would be in locations not routinely accessed by the public. Once remediation is complete, the affected areas would return to a similar, more natural condition.	Implementing the Removal Option at the MDAs would also create short-term negative visual impacts, as many of the larger MDAs may be exhumed under enclosures similar to those used for transuranic waste recovery at TA-54. These enclosures would be visible from greater distances than would the MDAs under the Capping Option, but their presence would be temporary. After waste removal is completed, the enclosures would be removed and the backfilled excavations revegetated. As under the Capping Option, implementation of the Removal Option for MDAs and SWMUs/AOCs would present short-term negative visual impacts. MDAs not exhumed under enclosures would visually impair the natural viewshed while removal is in progress. However, after removal is complete, the excavations would be backfilled and revegetated, allowing for a rehabilitated viewshed. Direct impacts would be associated with removal activities while indirect impacts would be associated with support activities (e.g. waste management and staging areas; waste inspection, treatment, packaging, and storage areas; equipment decontamination areas; parking areas for worker vehicles; and areas for bulk storage of materials such as exhumed soil). The Removal Option would probably create smaller visual impacts due to suspended dust

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
			than the Capping Option. Waste removal at the larger MDAs may occur within enclosures, and air exhausted from these structures would be filtered. Implementing the Removal Option for other SWMUs/AOCs is expected to have the same impact on visual resources as the Capping Option.
Geology and Soils	Continuing LANL's environmental remediation activities could impact geology and soils but would be dependent on the specific planning basis for the MDA and/or SWMU/AOC being considered. For those MDAs and/or SWMUs/AOCs 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. See Section 5.3 for impacts to geology and soils.	Implementing the Capping Option at the MDAs would require surface soils be re-contoured and provided with run-on and runoff control measures consistent with their design. In addition, soils adjacent to or beneath the stored waste may be affected by construction of vertical or sub-waste horizontal containment walls. The final designs of the covers would follow completion of the corrective measure studies being performed for the Consent Order. The corrective measure studies would include conceptual models of each MDA that would consider long-term geologic processes such as cliff retreat. Contamination within the subsurface of the MDAs and in the immediate vicinities would be fixed in place, except for the contamination existing as a gas or vapor. Capping would not by itself address any contamination existing as vapor within soil, such as volatile organic compounds or tritium as a gas or vapor. However, soil vapor volatile organic compounds can be removed and treated using unobtrusive equipment that would be compatible with the installed evapotranspiration covers (NNSA 2008, I.3).	Implementing the Removal Option at the MDAs would eliminate the risk of erosion or other geological risks at remediation sites. For partial removal of MDAs, there would be residual, but reduced, concerns of erosion-induced contamination because high-concentration pockets of contamination would be removed. The Removal Option would reduce existing soil contamination in the vicinity of the MDAs and SWMUs/AOCs. Contamination existing as a soil or gas would also be largely eliminated. In 2024, DOE estimated that materials needed (crushed tuff, rock, gravel, topsoil, etc.) to remediate the excavated areas created during the implementation of the Removal Option for the 7 MDAs "In Process" of Remedy Evaluation and Closure (Table G-4), including backfilling material and cover, would be approximately 3 million cubic yards of material (Table G-6). These materials would be obtained from either onsite borrow areas or within the immediate vicinity. Implementing the Removal Option for other SWMUs/AOCs is expected to have the same impact on local geology and soils as the No Action Option.

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
		In 2024, DOE estimated that materials needed (crushed tuff, rock, gravel, topsoil, etc.) to construct covers for the 7 MDAs "In Process" of Remedy Evaluation and Closure (Table G-4) would require approximately 600,000 to 820,000 cubic yards of material (Table G-5). These materials would be obtained from either onsite borrow areas or within the immediate vicinity. Implementing the Capping Option at other SWMUs/AOCs would require orders of magnitude less material than at the MDAs, as it is not anticipated to be a significant aspect of the remediation of other SWMUs/AOCs under the Consent Order.	
Water Resources – Surface Water	Continuing LANL's environmental remediation activities via investigations will provide additional information about the identity and extent of contaminants in groundwater and surface waters and information needed to predict impacts on water resources. The investigations may cause short-term risks to surface water quality because of generation of purge water as part of well sampling. However, this purge water would be retained and managed as required in the Consent Order, indicating that impacts on surface water of the investigation programs would be minimal. See Section 5.4 for water resources impacts.	Implementing the Capping Option at the MDAs would pose negative short-term risks to surface waters, as industrial equipment would disturb land, disrupting existing covers and presenting opportunities for runoff and erosion to transport soil and small levels of contamination to canyons. In addition, capping the MDAs would require the import of large quantities of tuff and surface amendment, some of which could be eroded into canyons. These risks would be reduced and mitigated using best management practices consistent with documented stormwater pollution prevention plans. Despite possible short-term detriments, the Capping Option would be expected to improve surface water quality compared to the No Action Option. The design and installation of the final covers for MDAs would minimize surface water run-on and runoff and erosion	Implementing the Removal Option at the MDAs would pose similar, if not smaller negative short-term risks to surface water, as contamination in most LANL MDAs would be removed. Assuming that the contamination is removed to screening levels, surface water could remain at slight risk. Complete removal would eliminate the great bulk of the contamination at the MDAs. The contamination at the MDAs would be subsequently treated and disposed of offsite. Partial removal of waste from MDAs would result in smaller risks to surface water resources than either the No Action or the Capping Option. After waste is partially removed from the MDAs, residual contamination would be stabilized and capped and impacts would be similar to those described in the Capping Option. Implementing the Removal Option for other SWMUs/AOCs is expected to have the same

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
		and would similarly protect surface water resources. Implementing the Capping Option at other SWMUs/AOCs would also be expected to improve surface water quality compared to the No Action Option.	impact on surface water quality as the No Action Option.
Water Resources – Groundwater	Continuing LANL's environmental remediation activities would require continued groundwater monitoring to ensure that remediation efforts are effective and that contaminant fate and transport is fully understood. Further characterization and remediation of RDX contamination in the vicinity of TA-16, and 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 2024) to evaluate the final remedy for the hexavalent chromium plume in Mortandad Canyon. Groundwater quality in the Sandia and Mortandad canyons would continue to improve as an effective groundwater treatment plan would be further developed and implemented. See Section 5.4 for water resources impacts.	Implementing the Capping Option at the MDAs would reduce risks to groundwater quality. The long-term effectiveness of a final cover in reducing infiltration into the disposed waste at the MDAs will depend on its design and construction, considering the natural processes that will affect its performance. Implementing the Capping Option at other SWMUs/AOCs would also be expected to improve groundwater quality or reduce risks to it from LANL SWMUs/AOCs compared to the No Action Option. Implementing the Capping Option at other SWMUs/AOCs would also be expected to improve surface water quality compared to the No Action Option.	Implementing the Removal Option at the MDAs would reduce risks to groundwater further than under the Capping Option, although there is potential risk relating to any remaining contamination not removed that could meet screening levels. In addition, the filled, compacted excavation may still experience greater short-term infiltration rates than in undisturbed areas, which could drive migration of contaminants deeper - beyond the reach of excavation efforts. Partial removal of waste from MDAs would result in slightly greater risk to groundwater resources than either the No Action or Capping Options. Residual contamination in the MDAs would be stabilized and capped. Implementing the Removal Option for other SWMUs/AOCs is expected to have the same impact on groundwater quality as the No Action Option.
Air Quality	Continuing LANL's environmental remediation activities may have small impacts on air quality. Pollutants and greenhouse gases	Implementing the Capping Option at the MDAs may create short-term negative impacts on air quality. The Capping Option would require the use of additional heavy equipment that would	Implementing the Removal Option at the MDAs may create greater short-term negative impacts on air quality than under the Capping Option, as the Removal Option would require

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
	would be emitted from operation of waste management facilities supporting environmental remediation, as well as from vehicles and construction equipment. Site investigations under the Consent Order should have few, if any, impacts on LANL air quality. See Section 5.5.1 and 5.5.2 for air quality and greenhouse gas impacts, respectively.	result in additional air emissions. In addition, dust (and particulate matter) would be dispersed into the air from grading, earthmoving, and compaction. This could occur at the MDAs being capped and at locations where sources of capping materials would be excavated. Release of dust into the air would be controlled using standard techniques. Localized emissions of criteria pollutants, greenhouse gases, particulates, and dust would be further reduced if some material was obtained from other sources. Small levels of radionuclides may be discharged into the air from capping the MDAs because of small quantities of radionuclides and other contaminants in soil. Construction activities that abrade and loosen the soil would help to promote release. But these levels would be small and temporary. Capping would be accompanied, as needed, by installation of soil vapor extraction systems to address phases of volatile organic compounds at some MDAs. Implementing the Capping Option at other SWMUs/AOCs would also be expected to improve groundwater quality or reduce risks to it from LANL SWMUs/AOCs compared to the No Action Option.	use of additional vehicles and construction equipment compared with the Capping Option. Therefore, air emissions from these sources would be increased compared with the Capping Option.. Dust and particulate matter would be generated as part of MDA exhumation, backfilling, and final restoration. This could occur at the SWMUs/AOCs being remediated and at locations where sources of backfilling materials would be excavated. Release of dust into the air would be controlled using standard techniques. Excavating, sorting, characterizing, and classifying the waste removed from the larger MDAs may be performed within enclosures. Enclosures may not be needed for many MDAs, particularly the small ones, or for remediating other SWMUs/AOCs. Enclosures may be used for removal of the larger MDAs because of the types and quantities of the wastes to be exhumed and the proximity of the MDAs to occupied areas. However, implementation of the Removal Option (in full or partial) would greatly reduce, if not eliminate, the potential for long-term release of volatile organic compounds from the MDAs. Implementing the Removal Option for other SWMUs/AOCs is expected to have the same impact on air quality as the No Action Option.
Noise	Continuing LANL's environmental remediation activities would contribute background noise from heavy equipment and truck traffic. However, these impacts are expected	Implementing the Capping Option at the MDAs would have greater noise impacts compared with the No Action Option. The Capping Option would require more heavy equipment for clean fill delivery and construction of	Implementing the Removal Option at the MDAs could have greater noise impacts compared with the Capping Option and potentially significantly greater noise impacts compared to the No Action Option for

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
	to be similar to existing noise levels and would fluctuate depending on where the remediation activities are occurring across the site. Site investigations under the Consent Order would cause very small, temporary noise impacts. See Section 5.5.3 for noise impacts.	ET/RCRA covers. These activities would increase onsite traffic. Both factors would increase background noise near the work areas. Implementing the Capping Option at other SWMUs/AOCs would also be expected to increase noise impacts at LANL SWMUs/AOCs compared to the No Action Option, though capping activities are not anticipated to be a significant aspect of the remediation of other SWMUs/AOCs under the Consent Order.	remediation activities associated with the MDAs. The Removal Option would require more heavy equipment and there would be increased vehicle traffic. Both factors would increase background noise near the work areas. Implementing the Removal Option for other SWMUs/AOCs is expected to have the same noise impacts as the No Action Option.
Ecological Resources	Continuing LANL's environmental remediation activities would bring on some negative impacts to the natural landscape, such as clearing of vegetation associated with creating site access and well-drilling. Well-drilling equipment typically would be mounted on trucks that must be positioned at the drilling locations. Following disturbances to natural settings, vegetation could return if site restoration techniques are effectively employed. See Section 5.6 for ecological resources impacts.	Implementing the Capping Option at the MDAs would disturb terrestrial habitats, as the MDAs would be cleared of vegetation and then capped. At most MDAs, this activity would have minimal direct impact because the MDAs are generally grassy areas enclosed by fencing. However, siting and operation of 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. Proper maintenance of equipment and restrictions preventing workers from entering adjacent undisturbed areas would be implemented, as appropriate, to lessen impacts on ecological resources. Once the MDAs are capped and revegetated, they would provide habitat similar to that existing before remedial actions were implemented: they would be fenced, grassy areas. Implementing the Capping Option would have minimal impact, if any, on wetlands or aquatic resources. None of the MDAs contain such resources, as well as few, if any, of the other	Implementing the Removal Option at the MDAs would likely have a greater negative impact on terrestrial habitats and ecological resources than those described for the Capping Option. Although little habitat exists within the MDAs themselves, siting and operation of temporary remediation support facilities could disrupt some nearby habitat over the short term, and noise and human presence could disturb wildlife. This would probably occur whether removals are complete or partial. Yet once remediation actions are complete, the sites would be re-contoured and revegetated. Because wastes would have been removed from the MDAs, there would be few restrictions on the types of plants that could be reintroduced. This would permit the establishment of more natural conditions that would, in turn, provide additional habitat for area wildlife. Although remedial actions would create a disruptive environment for local wildlife in the short term, long-term impacts would be beneficial. With the removal of wastes and contamination from the MDAs and

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
		SWMUs/AOCs. Best management practices would be implemented to prevent erosion and any subsequent sedimentation of downstream wetlands or ephemeral streams. Although some of the MDAs fall within the core and buffer zones of the Mexican spotted owl, direct impacts on this species are not expected from remediation activities, including capping. This sensitive species would not likely be present at remediation sites because of the disturbed nature of the sites. Additionally, remediation activities would not result in critical habitat loss. Caps over MDAs would be designed to prevent or reduce intrusion by roots or burrowing animals. The capped sites would be maintained in grassy states; shrubs and trees would be prevented from becoming established. Penetration of the waste by burrowing animals would be prevented by the design of barriers within final MDA covers. Implementing the Capping Option for other SWMUs/AOCs would depend on their location, as many SWMUs/AOCs overlap with protected species' core and buffer habitat, as well as protected waters and wetlands. Individual affected areas would be generally small, and given that capping activities are not anticipated to be a significant aspect of the remediation of other SWMUs/AOCs under the Consent Order, it is expected that implementation of the Capping Option would not generate significant negative impacts to ecological resources beyond the No Action Option. If remediation activities in these areas is required, individual affected areas would	SWMUs/AOCs, deep-root penetration and burrowing animals would not reintroduce contamination to the environment. Thus, this option would result in long-term benefits because of reductions in contaminants. Implementing the Removal Option for other SWMUs/AOCs would depend on their location, as many SWMUs/AOCs overlap with protected species' core and buffer habitat, as well as protected waters and wetlands. If remediation activities in these areas is required, individual affected areas would be generally small and analyzed under site-specific permits with the U.S. Fish & Wildlife Service and/or the U.S. Army Corps of Engineers. Therefore, it is expected that implementation of the Removal Option would not generate significant negative impacts to ecological resources beyond the No Action Option.

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
		analyzed under site-specific permits with the U.S. Fish & Wildlife Service and/or the U.S. Army Corps of Engineers.	
Human Health and Safety – Public Health	Continuing LANL's environmental remediation activities could result in impacts to the public from the release of radiological and nonradiological air emissions. The contribution of these impacts has been included in the worker impacts presented in Section 5.7.1 for the No-Action Alternative.	Implementing the Capping Option at the MDAs would reduce future risks to public health. The improved covers would reduce infiltration of water into the waste, which would reduce the potential for release of radionuclides and hazardous constituents into the environment. The improved covers would also reduce the potential for dispersion of contaminated materials currently existing as hotspots in soil, and as brought to the surface from burrowing animals. The Capping Option would generally result in increased thicknesses of rock, tuff, and soil over the MDAs. This would reduce the risk to future potential inadvertent intruders. A larger thickness of cover implies less chance of contaminated material being contacted from future inadvertent intrusion into disposal units; if the contaminated material is contacted, less would be brought to the surface for dispersal and possible human exposure. Implementing the Capping Option at other SWMUs/AOCs is expected to have a similar impact on public health as the No Action Option, as capping activities are not anticipated to be a significant aspect of the remediation of other SWMUs/AOCs under the Consent Order. If any implementation of the Capping Option is exercised for other SWMUs/AOCs, it is unlikely to generate significant negative impacts to public health beyond the No Action Option.	Implementing the Removal Option at the MDAs would reduce long-term risks to members of the public from either contaminants released slowly over time or inappropriate uses of the sites assuming temporary future accidental breakdowns in institutional control. The bulk of the contamination within and near the MDAs would be removed, and remaining contamination would be stabilized in place. Contamination at other SWMUs/AOCs would also be removed or stabilized in place. The Removal Option would require the use of heavy equipment, resulting in emission of pollutants to the air, including criteria and hazardous pollutants. At some MDAs, these activities would be of longer duration than typical LANL construction activities and could involve extensive movement of materials. The overall emissions from heavy equipment under the Removal Option would be more than 20 times those under the Capping Option. These emissions could be reduced by management controls such as scheduling so that public impacts would be minimized. Implementing the Removal Option at other SWMUs/AOCs is expected to have a slightly greater impact on public health as the No Action Option. However, any implementation of the Removal Option is exercised for other SWMUs/AOCs, it is unlikely to generate significant negative impacts to public health

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
			beyond the No Action Option. Potential increased health impacts resulting from transportation of the removed waste to offsite disposal locations are addressed separately.
Human Health and Safety – Worker Health	Continuing LANL's environmental remediation activities could result in impacts to workers associated with industrial accidents (e.g., slips, falls) and from potential exposure to hazardous chemicals or radiological materials. The contribution of these impacts has been included in the worker impacts presented in Section 5.7.1 for the No Action Alternative. On average, remediation workers have demonstrated a lower annual worker dose than other Laboratory radiation workers.	Implementing the Capping Option at the MDAs would somewhat increase risk of radiological doses received by site workers compared to the No Action Option. Worker doses from implementing the site investigations program under the Consent Order should be very small. Compared to the No Action Option, additional worker doses could result from capping the MDAs and annually remediating several SWMUs/AOCs. In addition, small radiation doses to workers may result from actions associated with grouting the General's Tanks in MDA A or optionally stabilizing in place the transuranic waste currently stored in shafts 200-232 in Area G. Operation of the TA-61 borrow pit to support MDA capping would not cause radiation exposures to borrow pit workers. Risks to workers from possible exposure to hazardous or toxic chemicals would continue to be minimized through training, administrative controls, monitoring, and proper use of equipment. Increased activities associated with the Capping Option at the MDAs would increase the number of personnel and also the projected number of nonradiological impacts to workers. Implementing the Capping Option for other SWMUs/AOCs is expected to have the same impact on worker health as the No Action Option, as capping activities are not anticipated to be a significant aspect of the remediation of	Implementing the Removal Option at the MDAs would result in risks of larger radiation doses to site workers than the Capping Option. Worker doses were estimated in the 2008 SWEIS, Appendix I, and assume a higher risk to workers during complete removal of waste from MDAs. Partial removal of waste from MDAs would result in smaller doses and risks to workers (compared to full removal). Doses and risks could be reduced in practice using standard radiation protection techniques. As a result of the additional workforce required for the Removal Option, the total collective dose from radiological operations would increase substantially. Compared with the Capping Option, the Removal Option could result in increased risks to site workers from exposure to hazardous or toxic chemicals. These risks would be minimized through training, administrative controls, monitoring, and proper use of equipment. Implementing the Removal Option for other SWMUs/AOCs is expected to have the same impact on worker health as the No Action Option.

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
		other SWMUs/AOCs under the Consent Order. If any implementation of the Capping Option is exercised for other SWMUs/AOCs, it is unlikely to generate significant negative impacts to worker health beyond the No Action Option.	
Cultural and Paleontological Resources Impacts	Continuing LANL's environmental remediation activities has the potential to affect, but would endeavor to avoid impacts to cultural resources. Remediation activities conducted within previously disturbed sites would be unlikely to have adverse impacts to resources. The potential for erosional changes from clearing, capping, removal, or contamination recovery could impact cultural resources on site or nearby. Installation of monitoring wells or other site investigation equipment under the Consent Order would be coordinated with LANL personnel responsible for preservation of cultural resources to avoid potential impacts. Usually there is sufficient flexibility in the selection of sites for investigation equipment so that impacts on cultural resources can be avoided. See Sections 4.8 and 5.8 for a discussion cultural resources programs and potential impacts.	Implementing the Capping Option at the MDAs would not likely impact cultural resources sites. This would also be the case for actions involving grouting the General's Tanks in MDA A or actions performed to provide additional stabilization to any transuranic waste left in place in TA-54, if this option is implemented. Indirect impacts on cultural resources of remedial actions are possible because of increased erosion resulting from capping operations or SWMU/AOC remediation and from workers or equipment occupying the work area. Implementing the Capping Option for other SWMUs/AOCs would depend on their location, as many SWMUs/AOCs overlap with cultural resources sites. In most cases, there would be few or no risks to cultural resources. At sites where there may be potential impacts, consultations with the necessary regulatory authorities would be required to minimize or mitigate those potential impacts. Given that capping activities are not anticipated to be a significant aspect of the remediation of other SWMUs/AOCs under the Consent Order, it is expected that implementation of the Capping Option would not generate significant negative	Implementing the Removal Option at the MDAs would be similar to those addressed under the Capping Option. Direct impacts on cultural resources would be unlikely. The potential for indirect impacts also would be similar to that under the Capping Option. As with that option, LANL personnel responsible for preservation of cultural resources would be notified so that any resource sites located near the affected areas would be protected. These conclusions would apply whether complete or partial removal occurred at the MDAs. Implementing the Removal Option for other SWMUs/AOCs would depend on their location, as many SWMUs/AOCs overlap with cultural resources sites. In most cases, there would be few or no risks to cultural resources. At sites where there may be potential impacts, consultations with the necessary regulatory authorities would be required to minimize or mitigate those potential impacts. Therefore, it is expected that implementation of the Removal Option would not generate significant negative impacts to cultural resources beyond the No Action Option.

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
		impacts to cultural resources beyond the No Action Option.	
Socioeconomics	Continuing LANL's environmental remediation activities would not significantly affect existing employment practices, with contractor labor providing much of the support for site investigation and remediation. As of December 31, 2023, EM/N3B and its contractors consist of 554 personnel. These personnel are included in the total workforce for the No Action Alternative. See Section 5.9 for socioeconomic impacts.	Implementing the Capping Option at the MDAs would create a higher density of remediation activities than the No Action Option. Including operations at the TA-61 borrow pit, carrying out the Capping Option is projected to require an average of 70 to 110 additional workers per year. Implementing the Capping Option for other SWMUs/AOCs is expected to have the same impact on socioeconomics as the No Action Option, as capping activities are not anticipated to be a significant aspect of the remediation of other SWMUs/AOCs under the Consent Order.	Implementing the Removal Option at the MDAs would be a complex and cost-intensive excavation effort that would provide both positive and negative local economic impacts. As indicated in Table G-6, implementing the Removal Option would remove extensive volumes of material from MDAs and loading/transporting about 100 trucks per day. This effort would increase the current remediation workforce planning basis by a substantial margin. If considered for implementation, DOE would evaluate the workforce requirements and impacts separately. Implementing the Removal Option for other SWMUs/AOCs is expected to have the same impact on local socioeconomics as the No Action Option.
Infrastructure	Continuing LANL's environmental remediation activities would not significantly affect existing electricity or natural gas consumption associated with continued remediation. Water consumption from remediation activities (mostly associated with dust suppression), has been included in the site-wide estimates for the No Action Alternative. Infrastructure impacts are further detailed in Section 5.10 of the SWEIS.	Implementing the Capping Option at the MDAs would create a higher density of remediation activities than the No Action Option. Including operations at the TA-61 borrow pit, carrying out the Capping Option is projected to require a marginal increase in electricity and/or natural gas consumption compared to the No Action Option. Under the Capping Option, the projected annual decrease in fuel consumption described in Section 5.10.1.2 would not be realized, and annual consumption of petroleum would remain around 525,130 gallons per year. Additional water would be required, mainly for soil compaction at the MDAs and dust suppression at the MDAs and borrow pit	Implementing the Removal Option at the MDAs would create a higher density of remediation activities than the No Action and Capping Options. Including operations at the TA-61 borrow pit, carrying out the Removal Option is projected to generate significant additional volumes of waste, and it may be necessary to develop additional capacity to sort, characterize, treat, and package all the waste to be removed (NNSA 2008, Sections I.3.3.2.8 and I.5.9.3). Use of this additional capacity would increase utility infrastructure demands at LANL. Operation of heavy equipment for exhuming MDAs and performing other actions under the Removal Option is projected to

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
		excavations. Implementing the Capping Option could require the continued need of 7 million gallons of water per year beyond 2029 (*see* Section 5.10.1.3). Implementing the Capping Option for other SWMUs/AOCs is expected to have a similar, if slightly greater impact on infrastructure as the No Action Option, as capping activities are not anticipated to be a significant aspect of the remediation of other SWMUs/AOCs under the Consent Order. However, if any implementation of the Capping Option is exercised for other SWMUs/AOCs, additional fuel and water would be required, but that impact it is unlikely to generate significant negative impacts to infrastructure beyond the No Action Option.	require use of over 7 million gallons of petroleum fuel (diesel and gasoline) per year through FY 2038. Water use through FY 2038 would be comparable to that under the Capping Option, or approximately 7 million gallons per year. Implementing the Removal Option for other SWMUs/AOCs is expected to have a similar, if slightly greater impact on infrastructure as the No Action Option. However, if any implementation of the Removal Option is exercised for other SWMUs/AOCs, additional fuel and water would be required, but that impact it is unlikely to generate significant negative impacts to infrastructure beyond the No Action Option.
Waste Management	Continuing LANL's environmental remediation activities would include the DD&D of certain sites and facilities that have been transferred to DOE-EM and that require remediation under the Consent Order. The contribution of legacy cleanup to the historical estimates of radioactive waste generation (LLW, MLLW, and TRU) is included in Section 4.11.2. Under the No Action Alternative DOE provides projections of radioactive legacy waste generation from remediation activities in Section 5.11.1.1: LLW – 2,615 cubic meters/year MLLW – 132 cubic meters/year TRU – 233 cubic meters/year	Implementing the Capping Option at the MDAs would create a higher density of remediation activities than the No Action Option. Implementing the Capping Option is projected to require a marginal increase in construction-derived universal waste compared to the No Action Option. However, under the Capping Option, additional clean fill would be required to support remediation activities. Implementing the Capping Option could require an additional 600,000 to 820,000 cubic yards of clean fill material to cover the 7 MDAs "In Process" of Remedy Evaluation and Closure (Table G-4). Additional materials and associated shipment estimates for the Capping Option are provided in Table G-5.	Implementing the Removal Option at the MDAs would create a higher density of remediation activities than the No Action and Capping Options. Implementing the Removal Option is projected to generate significant additional volumes of waste requiring offsite transportation and disposal, as detailed in Table G-6. The material would include physically or chemically hazardous materials, and some would present external exposure or inhalation hazards. This may require development of additional waste management capacity as discussed in the 2008 SWEIS (NNSA 2008, Section I.3.3.2.8). Compared with the Capping Option (which would not generate hazardous waste), the Removal Option would generate significant quantities of LLW, MLLW, and TRU waste.

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
	The contribution of legacy cleanup to the historical estimates of hazardous waste generation is included in Section 4.11.3. DOE provides projections of hazardous legacy waste generation from remediation activities in Section 5.11.1.12 of 1 metric ton per year. Wastes associated with DD&D of excess and aging facilities are provided in Sections 5.11.1 and 5.11.2 and are independent of which contractor or DOE office is responsible for the DD&D.	Implementing the Capping Option for other SWMUs/AOCs is expected to have the same impact on waste management as the No Action Option.	DOE's current estimates are approximately 2.5 million cubic yards of waste could require management if all 7 MDAs "In Process" of Remedy Evaluation and Closure were to be remediated through the Removal Option (Table G-4). Additional materials and associated shipment estimates under the Removal Option are provided in Table G-6. Implementing the Removal Option for other SWMUs/AOCs is expected to have similar impacts on waste management as the No Action Option.
Transportation	Continuing LANL's environmental remediation activities include transportation of waste offsite for treatment and disposal. The contribution of legacy cleanup waste shipments under the No Action Option are included in the total projected shipments from LANL in Section 5.12.1.2. The average annual number of shipments associated with remediation activities are estimated as: LLW – 176 shipments/year MLLW – 19 shipments/year TRU – 65 shipments/year These waste shipments are included in the overall transportation analysis in Appendix F and summarized in Section 5.12.1, which includes both radiological health impacts and potential impacts to local traffic.	Implementing the Capping Option at the MDAs would create a higher density of remediation activities than the No Action Option. Implementing the Capping Option would not significantly change the number of shipments of radiological waste (LLW, MLLW, or TRU) beyond the No Action Option. Implementing the Capping Option for all 7 MDAs "In Process" of Remedy Evaluation and Closure (Table G-4) would increase traffic on site and in the region by between 12 (full implementation of ET covers) and 17 (full implementation of RCRA covers) shipments of clean fill per day (*see* Table G-5). Implementing the Capping Option for other SWMUs/AOCs is expected to have a similar, if slightly greater impact on transportation as the No Action Option, as capping activities are not anticipated to be a significant aspect of the remediation of other SWMUs/AOCs under the Consent Order. However, if any	Implementing the Removal Option at the MDAs would create a higher density of remediation activities than the No Action and Capping Options. Implementing the Removal Option would significantly change the number of shipments of radiological waste (LLW, MLLW, or TRU) beyond both the Capping and No Action Options. Implementing the Removal Option for all 7 MDAs "In Process" of Remedy Evaluation and Closure (Table G-4) would increase onsite traffic by up to 100 shipments of LLW, MLLW, and TRU waste per day (*see* Table G-6). TRU waste shipments would be derived solely from remediation of MDA G (up to 67 shipments per day) and bound for WIPP. The remaining 33 removal-derived LLW/MLLW shipments per day would be bound for NNSS. It should be noted that the volume of TRU waste that could be generated under the Removal Option has not been included in the

Resource	No Action Option Impacts	Capping Option Impacts	Removal Option Impacts
		implementation of the Capping Option is exercised for other SWMUs/AOCs, minor additional shipments of nonradiological material would be required, but that impact it is unlikely to generate significant negative impacts to transportation beyond the No Action Option.	planning basis for WIPP and would likely cause an exceedance to the WIPP Land Withdrawal Act volume limit. Implementing the Removal Option for other SWMUs/AOCs is expected to have a similar, if slightly greater impact on transportation as the No Action Option. However, if any implementation of the Removal Option is exercised for other SWMUs/AOCs, minor additional shipments of both radiological and nonradiological materials would be required, but that impact it is unlikely to generate significant negative impacts to transportation beyond the No Action Option.

AOC = area of concern; DD&D = decontamination, decommissioning, and demolition; DOE-EM = DOE Office of Environmental Management; ET = evapotranspiration; FY = fiscal year; LANL = Los Alamos National Laboratory; LLW = low-level radioactive waste; MDA = material disposal area; MLLW = mixed LLW; RDX = Royal Demolition Explosives; SWMU = solid waste management unit; TA = technical area; TRU = transuranic (waste)

G.5 References

DOE (U.S. Department of Energy) 1997. *DOE Standard, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.* DOE-STD-1027-92. Change Notice No. 1. Washington, DC, September. Available online: https://www.standards.doe.gov/standards-documents/1000/1027-AStd-1992-cn1/@@images/file

DOE (U.S. Department of Energy) 1998. *Innovative Technology Summary Report – Cryogenic Drilling, Subsurface Contaminants Focus Area*. DOE/EM-0382. Office of Environmental Management. October. Available online: https://www.frtr.gov/pdf/CryogenicDrilling_2.pdf

DOE (U.S. Department of Energy) 2024. *Final Chromium Interim Measure and Final Remedy Environmental Assessment, Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EA-2216. July. Available online: https://www.energy.gov/nepa/doeea-2216-chromium-interim-measure-and-final-remedy-los-alamos-new-mexico

EPA (U.S. Environmental Protection Agency) 1994. *RCRA Corrective Action Plan*. Office of Waste Programs Enforcement Office of Solid Waste Directive 9902.3-2A. May. Available online: https://www.epa.gov/sites/default/files/2013-10/documents/rcracactionpln-rpt.pdf

EPA (U.S. Environmental Protection Agency) 2004. *Resource Conservation and Recovery Act (RCRA) Corrective Action Plan, Office of Solid Waste and Emergency Response (OSWER) Directive 9902.3-2A*. EC-G-2002-100. May. Available online: https://www.epa.gov/sites/default/files/2013-10/documents/rcracactionpln-rpt.pdf

LANL (Los Alamos National Laboratory) 2018. *List of Los Alamos National Laboratory Nuclear Facilities*. LIST-SBD-503-R1.1. December.

N3B (Newport News Nuclear BWXT-Los Alamos, LLC) 2023. Documented Safety Analysis for the Nuclear Environmental Sites (NES) at Los Alamos National Laboratory. NES-ABD-0101, Revision 13.0. August. UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION

NFEC (Naval Facilities Engineering Command and the U.S. Environmental Protection Agency) 1998. "Field Sampling and Analysis Technologies Matrix and Reference Guide." Available online: https://www.frtr.gov/site/toc.html

NMED (New Mexico Environment Department) 2016. "Compliance Order on Consent." June. Available online: https://www.energy.gov/sites/prod/files/2020/01/f70/2016%20Consent%20Order_February%202017.pdf

NNSA (National Nuclear Security Administration) 2008. *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EIS-0380. May. Available online: https://www.energy.gov/nepa/downloads/eis-0380-final-site-wide-environmental-impact-statement

APPENDIX H
Air Quality and Greenhouse Gas Emissions

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ACAM	Air Conformity Applicability Model
°C	degree Celsius
CEQ	Council on Environmental Quality
DD&D	decontamination, decommissioning, and demolition
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
EO	Executive Order
EV	Electric vehicle
°F	degree Fahrenheit
FTWC	Flanged Tritium Waste Containers
GHG	greenhouse gas
GMAP	gaseous mixed activation products
GWP	global warming potential
HAP	hazardous air pollutants
HE	high explosive
IPCC	Intergovernmental Panel on Climate Change
LANL	Los Alamos National Laboratory
LANSCE	Los Alamos Neutron Science Center
MFP	mixed fission products
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Protection Act
NMED	New Mexico Environmental Department
NNSA	National Nuclear Security Administration
OB/OD	open burn/open detonation
PV	photovoltaic
RLUOB	Radiological Laboratory Utility and Office Building
SWEIS	Site-Wide Environmental Impact Statement
USGCRP	U.S. Global Change Research Program
VOC	volatile organic compound
U.S.C.	United States Code
WETF	Weapons Engineering Tritium Facility
ZEV	zero-emissions vehicle

H AIR QUALITY AND GREENHOUSE GAS EMISSIONS

This appendix is organized in two parts: (H.1) Air Quality for General Conformity and (H.2) Greenhouse Gas (GHG) Emissions. Content from this appendix is summarized in Chapter 4, Section 4.5. and Chapter 5, Section 5.5. of this SWEIS. Ongoing and proposed activities that could occur over approximately 15 years (2024–2038) were evaluated from the Modernized Operations Alternative and Expanded Operations Alternative for comparison against the No-Action Alternative.

H.1 Air Quality for General Conformity

This section describes air quality standards for General Conformity, the methods used to analyze alternatives, and the analyses for both nonradiological and radiological emissions.

H.1.1 Standards

The U.S. Environmental Protection Agency (EPA) Region 6 and New Mexico Environmental Department (NMED) regulate air quality in New Mexico. The EPA established primary and secondary National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) in compliance with the *Clean Air Act* (42 U.S.C. § 7401 et seq.), as amended. Short-term NAAQS (1-, 8-, and 24-hour periods) have been established for pollutants contributing to acute health effects, while long-term NAAQS (annual averages) have been established for pollutants contributing to chronic health effects. NAAQS define criteria for six pollutants: particulate matter (measured as both particulate matter less than 10 microns in diameter [PM_{10}] and particulate matter less than 2.5 microns in diameter [$PM_{2.5}$]), sulfur dioxide, carbon monoxide, nitrogen dioxide (presented as nitrogen oxides), ozone, and lead. NMED has established state-level standards for sulfur compounds, carbon monoxide, nitrogen dioxide and adopted the NAAQS for the remaining pollutants (20.2.3 NMAC). Table H-1 lists the criteria pollutant standards.

Air pollutants known to cause serious health effects are considered hazardous air pollutants (HAPs). HAP emissions are regulated by specific source categories under the National Emissions Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61)—New Mexico excludes some subparts of 40 CFR Part 61 (20.2.78.10 NMAC). The EPA has identified 188 HAPs regulated by source categories; source categories include such industries as aerospace, manufacturing, and waste operations (EPA 2022).

The Laboratory also regulates volatile organic compounds (VOCs), which include commonly used chemicals at the Laboratory, such as ethanol, methanol, trichloroethylene, and isopropanol. VOCs are any compounds of carbon that participate in atmospheric photochemical reactions.

Federal regulations designate regions in violation of the NAAQS as nonattainment areas and regions with levels less than the NAAQS as attainment areas. The EPA's General Conformity Rule ensures that federal actions do not cause new violations of the *Clean Air Act* in nonattainment areas. The region of influence for air quality is LANL and nearby offsite areas within the Upper Rio Grande Valley Intrastate Air Quality Control Region where air quality impacts could occur. Because this area is in attainment for all six NAAQS criteria pollutants (40 CFR 81.332), the General Conformity Rule does not apply.

Table H-1 Criteria Pollutant Standards

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon monoxide		Primary	8-hour	8.7 ppm[a]	Maximum allowable
			1-hour	13.1 ppm[a]	
Lead		Primary and Secondary	Rolling 3-month average	0.15 µg/m³	Not to be exceeded
Nitrogen dioxide		Primary	24-hour	0.10 ppm[a]	Maximum allowable 24-hour average
		Primary and Secondary	Annual	0.05 ppm[a]	Maximum allowable annual arithmetic average
Ozone		Primary and Secondary	8-hour	0.070 ppm	Annual fourth highest daily maximum 8-hour concentration, averaged over 3 years
Particulate matter	($PM_{2.5}$)	Primary	Annual	9 µg/m³	Annual mean, averaged over 3 years
		Secondary	Annual	15 µg/m³	Annual mean, averaged over 3 years
		Primary and Secondary	24-hour	35 µg/m³	98th percentile, averaged over 3 years
	(PM_{10})	Primary and Secondary	24-hour	150 µg/m³	Not to be exceeded more than once per year on average over 3 years
Sulfur dioxide		Primary	24-hour	0.10 ppm[b]	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
			Annual	0.02 ppm[b]	Not to be exceeded more than once per year
Hydrogen sulfide		Primary	1-hour	0.010 ppm[b]	Maximum allowable 1-hour average, not to be exceeded more than once per year
Total Sulfur		Primary	0.5-hour	0.003 ppm[b]	Maximum allowable one-half hour average

µg/m³ = microgram per cubic meter; $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter; PM_{10} = particulate matter less than 10 microns in diameter; ppm = parts per million

National Ambient Air Quality Standards (40 CFR Part 50) unless otherwise noted.

a New Mexico Administrative Code 20.2.3.111.

b New Mexico Administrative Code 20.2.3.110.

Source: EPA (2024a)

NMED oversees programs for permitting the operation and construction of new stationary sources of air emissions (20.2.70 NMAC and 20.2.72 NMAC, respectively). Individual states set permit rules and standards for emissions based on the size of the emissions units and type of pollutants emitted. Primary stationary sources of air emissions at LANL include evaporative sprayers, open and prescribed burning, internal and external combustion, boilers, degreasers, asphalt production, and beryllium activities.

Considered a major source of air emissions, LANL holds a Title V Operating Permit (P100-R2) with modifications that expired in February 2020 (NMED 2019). The Laboratory submitted a renewal application for the facility-wide Title V Operating Permit in February 2019 and continues to operate under the "Permit Shield" provision of Subsection D of 20.2.70.400 NMAC (LANL 2019a, 2022a, 2024a).

LANL Title V Operating Permit emissions of criteria pollutants, HAPs, and VOCs are presented in Table H-2. The permit limits are derived from various standards (NMED 2019):

- New Source Performance Standard for Small Industrial-Commercial-Institutional Steam Generating Units (40 CFR Part 60, Subpart Dc), which applies to two TA-55 boilers;
- New Source Performance Standard for Hot Mix Asphalt Facilities (40 CFR Part 60, Subpart I);
- New Source Performance Standard for Stationary Gas Turbines (40 CFR Part 60, Subpart GG), which applies to the combustion turbine unit in TA-3;
- National Emission Standards for Stationary Compression Ignition Reciprocating Internal Combustion Engines (40 CFR Part 60, Subpart III), which applies to generators in TA-48 and TA-55;
- National Emission Standards for Hazardous Air Pollutants for Beryllium (40 CFR Part 61, Subpart C), which applies to beryllium operations at TA-3, TA-35, and TA-55;
- National Emission Standards for Hazardous Air Pollutants for Asbestos (40 CFR Part 61, Subpart M), which applies to demolition projects that potentially involve asbestos;
- National Emission Standards for Hazardous Air Pollutants for Radon Emissions from DOE Facilities (40 CFR Part 61, Subpart Q);
- National Emission Standards for Hazardous Air Pollutants for Radionuclides other than Radon from DOE Facilities (40 CFR Part 61, Subpart H), which is discussed further in Section 4.7.1.2 of this SWEIS;
- National Emissions Standards for Halogenated Solvent Cleaning (40 CFR Part 63, Subpart T), which applies to certain activities at TA-55 and specifies applicable controls;
- Servicing of Motor Vehicle Air Conditioners (40 CFR Part 82, Subpart B);
- Recycling and Emissions Reduction (40 CFR Part 82, Subpart F);
- Halon Emissions Reduction (40 CFR Part 82, Subpart H); and
- Ban on Refrigeration and Air Conditioning Appliances Containing Hydrochlorofluorocarbons (40 CFR Part 82, Subpart I), which applies to the entire Laboratory.

Radiological emissions are regulated based on dose limits to the public and radiation workers (10 CFR Part 20, 10 CFR Part 835, and 40 CFR Part 61). These standards and their analysis are not described in this appendix. These standards and the analyses of their effects are described relative to human health and safety in Sections 4.7 and 5.7 respectively.

Mobile emissions are not regulated in the same way that stationary sources of emissions are regulated by EPA and NMED. Instead, mobile sources of emissions are regulated through manufacturing standards as well as annual emissions testing of vehicles. Federal exhaust emissions standards for newly manufactured vehicles are published by the U.S. Department of Transportation

(BTS 2023a, 2023b). In 2022, New Mexico adopted California vehicle emissions standards (20.2.91 NMAC).

Table H-2 Operating Permit Emission Limits (tons per year)

Facility	NOx	CO	VOC	SO_2	PM[a]	HAP
Facility-wide	245	225	200	150	120 total, 120 PM_{10}, 120 $PM_{2.5}$	24 total, 8 individual
Asphalt Production						
TA-60-BDM	50	30	50	50	50 total, 0.04 grains per dry standard cubic feet	NA
Beryllium Activities						
Sigma Facility (TA-3-66)	NA	NA	NA	NA	10 grams/24 hours	NA
Beryllium Technology Facility (TA-3-141)	NA	NA	NA	NA	0.35 gram/24 hours 3.5 grams/year	NA
Target Fabrication Facility (TA-35-213)	NA	NA	NA	NA	1.8×10^{-4} gram/hour 0.36 gram/year	NA
Plutonium Facility (TA-55-PF4)						
Machining Operation	NA	NA	NA	NA	Beryllium • 0.12 gram/24 hours • 2.99 grams/year Aluminum • 0.12 gram/24 hours • 2.99 grams/year	NA
Foundry Operation	NA	NA	NA	NA	Beryllium • 3.49×10^{-5} gram/24 hours • 8.73×10^{-4} gram/year Aluminum • 3.49×10^{-5} gram/24 hours • 8.73×10^{-4} gram/year	NA
External Combustion						
Combined annual emissions[b]	80	80	50	50	50 total, 50 PM_{10}	NA
Chemical Usage						
Facility-wide Chemical Usage	NA	NA	See facility-wide emissions	NA	See facility-wide emissions	NA

Facility	NOx	CO	VOC	SO_2	PM[a]	HAP
Chemical Usage (TA-55-400)	NA	NA	See facility-wide emissions	NA	3.75 (included within facility-wide emissions)	NA
Degreasers						
TA-55-DG-1	NA	NA	See facility-wide emissions	NA	See facility-wide emissions	NA
Internal Combustion						
TA-33-G-1P	18.1	15.2	0.3	2.5	0.6 total, 0.6 PM_{10}	NA
TA-33-G-2	0.21	0.1	See facility-wide emissions	NA	NA	NA
TA-33-G-3	0.21	0.1	See facility-wide emissions	NA	NA	NA
TA-33-G-4	2.33	1.4	0.2	0.16	NA	NA
Data Disintegrator						
TA-52-11	NA	NA	NA	NA	9.9 total, 9.9 PM_{10}	NA
Power Plant						
Combined Boilers (TA-3-22-1, TA-3-22-2, TA-3-22-3)	31.5	21.5	2.8	4.9	4.7 total, 4.4 PM_{10}, 4.2 $PM_{2.5}$	NA
TA-3-22-CT-1	59.4	72.3	1.5	4.2	4.8 total, 4.8 PM_{10}, 4.8 $PM_{2.5}$	NA
Open Burning						
Facility-wide	NA	NA	NA	NA	NA	24 total, 8 individual
Evaporative Sprayers						
Facility-wide	No additional requirements. See facility-wide emissions.					

CO = carbon monoxide; HAP = hazardous air pollutant; NA = not applicable; NO_x = nitrogen oxides; 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; SO_2 = sulfur dioxide; TA = technical area; VOC = volatile organic compound

a Criteria pollutants are reported in tons per year unless otherwise noted. Greenhouse gas emissions are reported in metric tons.

b External combustion emissions are permitted for two facilities in TA-16, two facilities in TA-53, and six facilities in TA-55.

Source: NMED (2019)

H.1.2 Methodologies

This section describes the methods applied to evaluate the No-Action Alternative, Modernized Operations Alternative, and Expanded Operations Alternative. A variety of models and tools were applied to analyze nonradiological criteria air pollution and radiological emissions over the 15-year period 2024–2038. Baseline emissions were first established from trends over the past years, then emissions were calculated for the proposed activities in each alternative. The methods used to calculate emissions were based on the source of the air emissions, available data, and regulatory guidance.

H.1.2.1 Nonradiological Criteria Air Pollutant Emissions

Sources of criteria air pollutant emissions at the Laboratory include facility operation and laboratory testing. Air emissions would also be expected to change from the following activities analyzed using two different methods:

1. Heating and cooling; use of construction equipment during construction, demolition and remediation; land disturbance; and commuting personnel; and
2. Transporting waste and other materials.

Unless new information is available, the analysis assumes that facility operation and laboratory testing would generate emissions at a rate consistent with operations over the past six years. The Laboratory reports emissions on an annual and semiannual basis to NMED to document compliance with permit limits. Facility-wide annual emissions reported from LANL are consistently well below facility-wide permit limits.

Emissions for the 6-year period 2017–2022 are reported from the TA-3 power plant, boilers and heaters, TA-60 asphalt plant, data disintegrator, degreasers, 5 beryllium-machining operations, 11 internal combustion engines (generators), the TA-3 combustion turbine, chemical use from research and development activities, and 6 evaporative sprayers. Table H-3 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 6-year period 2017–2022 (LANL 2019b, 2020, 2021, 2022b, 2023a). The 2008 SWEIS reported increases in emissions during the 2000 Cerro Grande Fire through 2004 because of fire mitigation activities.

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 the air. Annual variations in VOCs and HAPs emissions are attributed to fluctuations in purchases.

Facility-wide emissions for the period 2017–2022 were generally consistent. Deviations in emissions between the years included the addition of a spray evaporator at the Sanitary Effluent Reclamation Facility 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, which is included in the No-Action Alternative (LANL 2022c).

The open burn/open detonation (OB/OD) waste treatment at LANL is reported annually in Yearbooks. High explosives processing facilities include treating hazardous explosive waste by open burning. In 2022, nearly 4,000 pounds of high explosive (HE) waste were treated with nearly 4,500 gallons of propane (LANL 2024f). LANL's current, controlled OB/OD waste treatment operations are below the insignificant activity threshold and do not require Title V permitting under 20.2.70 NMAC; in March 2024 EPA proposed a *de minimis* exemption for facilities generating up to 15,000 pounds annually (EPA 2024c). The open detonation units have not been used since 2013. However, to allow for future open detonation units, LANL began the process to renew the Laboratory's Part A and General Part B RCRA Permit (EPA ID#NM0890010515, HWB-LANL-20-001) in 2020.

Table H-3 Facility-Wide Emissions (tons per year)

Parameter	NO_x	CO	VOC	SO_2	PM	HAP
Multi-Year Average						
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[a]						
2017	30.9	23	10.3	0.32	3.5	5.2
2018	36.3	25.8	11.3	0.6	4	5.9
2019	35	24.6	12	0.5	3.5	4.9
2020	41.9	26.1	6.1	0.8	4.2	4.4
2021	54.3	29	6.8	1.9	6.4	5.7
2022	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; PM = particulate matter; SO_2 = sulfur dioxide; VOC = volatile organic compound

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 in tons per year.

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

Heating and cooling; use of construction equipment during construction, demolition and remediation; land disturbance; and commuting personnel.

The Air Conformity Applicability Model (ACAM) developed by the U.S. Air Force was used to calculate emissions from the heating and cooling of newly constructed facilities, as well as the emissions from constructing and demolishing facilities, grading land, and the commuting of construction and facility personnel. Site grading associated with construction of solar PV arrays was included in the ACAM assumptions to account for air emissions from construction activities. These new air emissions were compared to the General Conformity Rule's *de minimis* threshold values to assess potential effects to air quality.

ACAM standardizes and simplifies emissions calculations based on the proposed activities incorporating default assumptions for emissions from construction equipment and personnel. ACAM offerings summary and detailed outputs that include the assumptions and equations used to calculate emissions. ACAM default parameters were assumed except for construction hauling trips, personnel and construction commute distances, and construction vendor trips. Construction hauling was assumed to average 50 miles round trip (25 miles one way). Personnel commutes were assumed to be 40 miles round trip and 150 miles round trip for construction commutes and construction vendor trips based on data collected during LANL transportation planning efforts.

The analysis performed three simulations of ACAM for each alternative—total emissions in a single year, 20 percent of the total annually for five years simultaneously, and 20 percent of the total annually for five years where the three alternatives occur in separate five-year periods. It would not be likely or feasible to implement all proposed activities for any one alternative in a single year. However, this assumption was simulated to conservatively assess the effects to air quality compared to *de minimis* thresholds. It would be more feasible for the activities to be constructed over multiple years; therefore, activities for each alternative were also divided over a five-year period within the period of analysis (2024–2028 for the No-Action, 2029–2033 for Modernized Operations, and 2034–3038 for Expanded Operations). Finally, ACAM was also simulated to assess the emissions for a scenario when all three alternatives would be constructed over the same five-year period; therefore, combining all potential air quality impacts. Simulating ACAM with alternatives occurring in separate five-year periods and simultaneously over the same five-year period provides a complete understanding of the effects to air quality over the 15-year period of analysis.

Transporting Waste and Other Materials

Emissions from transporting waste were calculated based on average emissions rates for heavy-duty vehicles using diesel and light-duty gasoline (BTS 2023c). Shipments would be expected to include a vehicle shipping the material as heavy-duty diesel and, in some cases, support vehicles as light-duty gasoline. Table H-4 lists exhaust emissions rates for heavy-duty diesel and light-duty gasoline vehicles from 2020 and projected rates for 2030. The most conservative rates were used to project future emissions. Rates of emissions for carbon monoxide, nitrogen oxides, and $PM_{2.5}$ were used to calculate emissions for each alternative based on the number of miles expected annually (see Table H-5). The average truck driver was assumed to drive about 120,000 miles per year based on a 400-mile day, six days per week working 50 weeks per year. The heavy-duty trucks were assumed to average 6.5 miles per gallon of diesel (FreightWaves 2021). Light-duty vehicles average 25 miles per gallon (BTS 2023c).

Table H-4 Estimated U.S. Average Emissions Rates

Exhaust Pollutant[a]	Heavy-Duty Diesel		Light-Duty Gasoline	
	2020	2030 Projected	2020	2030 Projected
Carbon Monoxide (mt/y)	2.000	1.626	5.422	4.013
Nitrogen Oxides (mt/y)	4.169	2.742	0.376	0.201
$PM_{2.5}$ (mt/y)	0.106	0.043	0.007	0.060

Mt/y = metric tons per year, $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
Source: BTS (2023c)

Table H-5 Estimated Annual Mileage from Transporting Waste by Alternative

Alternative	Heavy-Duty Diesel Vehicle	Light-Duty Gasoline Vehicle
No-Action	996,400	79,100
Modernized Operations	1,064,400	79,100
Expanded Operations	1,180,100	106,000

Source: Appendix F of this SWEIS

H.1.2.2 Radiological Emissions

Radiological sources of air emissions at the Laboratory are reported annually in SWEIS Yearbooks. The radiological emissions reported from all sampled stacks in the SWEIS Yearbooks from 2017 through 2022 are presented in Table H-6. Radioactive air emissions from proposed facilities, and changes to existing operations, are proposed 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 or activities, and to address the uncertainty associated with possible emissions from demolition of radiologically contaminated buildings and ongoing remediation activities. Sections to follow for each alternative detail assumptions made from previous studies, ongoing operations, and technology specifications as they apply.

Table H-6 Ranges of Annual Airborne Radioactive Emissions and Averages from LANL Buildings with Sampled Stacks, 2017–2022[a] (curies)

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

Technical Area/ Building Number	Tritium	Americium-241	Plutonium	Uranium	Thorium	Particulate Matter plus Vapor Activation Products	Gaseous Mixed Activation Products
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 (2019b, 2020, 2021, 2022b, 2023a, 2024a)

H.1.3 Analyses

The potential air quality impacts were evaluated from activities that would occur in the No-Action, Modernized Operations, and Expanded Operations alternatives. Facilities that operate under the Laboratory's Title V Operating Permit (P100-R2) represent a major source of air emissions. Any new stationary sources of air emissions could be subject to federal and state air permitting regulations, including Prevention of Significant Deterioration, NESHAP, or New Source Performance Standards. Any new sources of air emissions would be added to the facility's air permit. Both a new source construction permit and a modification to the existing permit could be required.

H.1.3.1 No-Action Alternative

Projects and activities included in the No-Action Alternative are presented in Chapter 3, Section 3.2.

Nonradiological Criteria Air Pollutant Emissions

Nonradiological criteria air pollutant emissions associated with current operations are assumed to remain relatively unchanged from the emissions presented in Table H-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 facility-wide natural gas use by approximately 16 percent, has not been credited in the estimated emissions associated with continued operation of existing facilities.

Heating and cooling; use of construction equipment during construction, demolition and remediation; land disturbance; and commuting personnel. Nonradiological criteria air pollutant emissions for the projects implemented under the No-Action Alternative were estimated for the activities quantified in Table H-7 using ACAM. Site grading associated with construction of a 45-acre solar PV array was included in the ACAM assumptions to account for air emissions from construction activities. As described in Section H.1.2.1, ACAM was simulated assuming total construction of all No-Action Alternative projects in a single year and 20 percent of the total annually for five years, as presented in Table H-7.

Table H-7 ACAM Inputs for the No-Action Alternative (rounded)

Activity	ACAM Input Total[a]	ACAM Input 20 Percent of Total
Construction	1,471	294
Utility building construction	149	30
Demolition	1,630	326
Utility trenching	930	186
Site grading (non-solar PV)	9,000	1,800
Site grading for solar PV	1,960	392
New paving	2,213	443
Personnel	1,530 (number)	306 (number)
Heated area	-9.5[b]	-2[b]

ACAM = Air Conformity Applicability Model
a Thousands of square feet unless otherwise noted.
b Heated area is negative because the demolition area is greater than the constructed area decreasing the overall footprinted of heated facilities.
Source: ACAM

The estimated air pollutant emissions from construction, demolition, utility/infrastructure projects, and operational activities under the No-Action Alternative are presented in Table H-8. Table H-8 also includes least restrictive *de minimis* thresholds for criteria pollutants to determine the level of effects of these emissions sources. Operational emissions include a reduction from heating of buildings since the demolished area would be more than the area of new facilities.

Table H-8 ACAM-Estimated Emissions from the No-Action Alternative Projects (tons per year)[a,b]

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 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 H-8 also presents emissions from the single-year construction simulation, fifth-consecutive year of construction, and operations emissions. The fifth-consecutive year in the 20-percent simulation was thought to provide the most conservative output. Operations from heating facilities and worker commutes would be greatest in the fifth-consecutive year while inputs for construction, demolition, and site grading would be consistent among all five years.

Table H-8 indicates that the incremental pollutant levels from No-Action Alternative projects would be expected to meet the *de minimis* threshold if all construction activities were to occur in a single year, with the exception of PM_{10}. Total site grading under the No-Action Alternative was assumed to be roughly 11 million square feet (Table H-7). It is unrealistic to assume that such a large area would be left as bare soil for a six-month period. However, reasonable precautions should 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.

Criteria pollutants would be expected to be less than *de minimis*, and meet permitted limits if the results of Table H-8 were combined with existing facility-wide emissions in Table H-3 with the exception of particulate matter. The effects of particulate matter on air quality during construction activities would be expected to have short-term significant negative effects if more than 2 million square feet of soil was left graded and bare for more than three consecutive months. The Laboratory would implement best management practices and determine the extent of land that could be graded to bare soil over a defined period of time to maintain air quality standards for particulate matter.

Transporting Waste and Other Materials. Nonradiological and radiological material and waste shipments would travel more than 1 million miles per year under the No-Action Alternative; the equivalent of nine trucks working full time (FreightWaves 2021). Shipments of special nuclear material described in Appendix F Table F.3-2 would also be accompanied by transport vehicles, which would contribute less than 100,000 miles. Table H-9 presents the estimated exhaust emissions generated from transporting material and waste shipments under the No-Action Alternative based on 2020 and projected 2030 emissions.

Table H-9 2020 and Projected 2030 Exhaust Emissions Under the No-Action Alternative based on 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)

Radiological Emissions

No radiological emissions would be expected during construction activities under the No-Action Alternative. Thirteen facilities identified for decontamination, decommissioning, and demolition (DD&D) are known to have radiological contamination. The potential for short-term radiological air emissions exists for demolition 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.

The 2008 SWEIS estimated 34,000 curies of annual radioactive air emissions. Over 30,000 curies per year were associated with the Los Alamos Neutron Science Center (LANSCE). The site has reported an annual release of approximately 300 curies from monitored stacks over the past 14 years. Under the No-Action Alternative, the Laboratory analyzes an increase in annual radioactive air emissions to approximately 2,750 curies per year. These estimates include contributions from the following projects:

- Increased pit production to at least 30 pits per year;
- Light Manufacturing Laboratory operations;
- DD&D of radiologically contaminated facilities; and
- Environmental remediation activities.

Increased pit production. The *2020 Supplemental Analysis of the 2008 SWEIS for the Continued Operation of LANL* reported that the radioactive air emissions from production of 80 pits per year would be 1.2×10^{-7} curies per year of plutonium equivalent (Pu-EQ) (NNSA 2020). Radioactive air emissions from production of 30 pits per year would be about 4.5×10^{-8} curies per year of Pu-EQ. Therefore, for the majority of the 15 years (2024–2038), the Laboratory would expect potential releases to be equivalent to the value presented for 30 pits per year. There is the potential for surge periods of pit production that would be limited in duration that could result in higher potential releases from production of up to 80 pits per year.

Light Manufacturing Laboratory. New facilities for the Light Manufacturing Laboratory would be expected to increase radiological emissions to 100 curies per year of mixed fission products (MFP) released from TA-53 (see the project description in Chapter 3, Section 3.2.1.3).

Environmental remediation activities. Environmental remediation has been ongoing at LANL and would be expected to continue through 2038. Radiological air emissions vary annually based on the location and extent of cleanup activities. Therefore, this SWEIS assumes that they would be represented by the annually reported releases.

The No-Action Alternative for this SWEIS also considers radiological air emissions from previously approved NEPA documents. Including these emissions provides operational flexibility, captures potential emissions from approved missions at existing facilities, and addresses uncertainty associated emissions from DD&D activity and any minor excursions in releases from environmental remediation.

Tritium. Emissions of tritium would be expected to continue under the No-Action Alternative from the operation of facilities in TA-55 (Radiological Laboratory Utility and Office Building [RLUOB] and PF-4) and Weapons Engineering Tritium Facility (WETF). Emissions from operation of TA-55 facilities could be as high as 1,000 curies per year and WETF releases less than 200 curies per year. The 2008 SWEIS projected site-wide releases of 2,400 curies per year and acknowledged that emissions would decrease by 550 curies per year after two tritium facilities underwent DD&D. Therefore, the potential site-wide annual emissions of tritium are conservatively assumed to be up to 1,850 curies per year under the No-Action Alternative.

Venting of four flanged tritium waste containers (FTWC) would also be expected. The project has the potential to release up to 30,000 curies of tritium. The actual release of tritium would be dependent on the efficiency of the tritium capture system. The release would be expected to result in a potential offsite dose contribution for a maximally exposed individual of 8 millirem (see Chapter 5, Section 5.7). FTWC venting would not be a recurring operation. Instead, a one-time release of less than 30,000 curies of tritium would be expected between 2024 and 2038.

Americium-241. Emissions of Am-241 would be expected to be approximately 1.3×10^{-5} curies per year under the No-Action Alternative. The highest annual release of Am-241 between 2017 and 2022 was 8.9×10^{-6} curies. This SWEIS assumes a potential annual release of 1.3×10^{-5} curies to provide a contingency for potential uncertainties over the analytical period.

Plutonium. Plutonium emissions under the No-Action Alternative would be no more than that projected in the 2008 SWEIS, 8.9×10^{-4} curies per year site-wide. The projected releases from increased pit production contributed four percent to this value. The *2020 Supplemental Analysis of the 2008 SWEIS for the Continued* Operation *of LANL* lowered the expected plutonium emissions from pit production. However, to be conservative and consistent with earlier analyses plutonium emissions were assumed to be maintained at the value presented in the 2008 SWEIS under the No-Action Alternative.

Uranium. Air emissions of uranium isotopes under the No-Action Alternative would be 0.15 curies consistent with the 2008 SWEIS. The primary contributor of uranium releases was HE Testing, which would be a diffuse release not a monitored stack release. The peak monitored stack release of uranium from 2017 through 2021 was 4.8×10^{-6} curies. Maintaining the assumed emissions consistent with the 2008 SWEIS would account for potential diffuse emissions from HE Testing activities under the No-Action Alternative.

Particulate and vapor activation products (P/VAP). For P/VAP, this SWEIS analyzes a potential release of 3 curies per year under the No-Action Alternative. The 2008 SWEIS indicated that the mercury-193, mercury-197, germanium-68, and bromine-82 make up the P/VAP and estimated 30 curies would be emitted from LANSCE with very little from other facilities. Monitored radiological air emissions over the past six years indicate that releases from LANSCE were much lower than projected.

Gaseous mixed activation products (GMAP). For GMAP, this SWEIS analyzes a potential release of 800 curies per year under the No-Action Alternative.. The 2008 SWEIS projected 30,600 curies but the highest reported release from TA-53 over the last 5 years was less than 300 curies. Increased accelerator run times and higher than normal operational releases may be necessary. Therefore, the annual GMAP release would be expected to be higher than past years but less than three percent of that projected in the 2008 SWEIS.

Mixed fission products. The Light Manufacturing Laboratory would be expected to release 100 curies of MFP under the No-Action Alternative.

Total radioactive air emissions for the No-Action Alternative would be 2,753 curies per year summarized in Table H-10. Tritium would account for 67 percent of the emissions and GMAP would account for 29 percent.

Table H-10 Potential Radiological Emissions from the No-Action Alternative (curies)

Tritium[a]	GMAP	MFP	P/VAP	Am-241	Pu-EQ	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; Pu-EQ = 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.

H.1.3.2 Modernized Operations Alternative

Activities addressed under the Modernized Operations Alternative would include those activities analyzed for the No-Action Alternative plus projects and activities presented in Chapter 3, Section 3.3.

Nonradiological Criteria Air Pollutant Emissions

Nonradiological criteria air pollutant emissions would be less than the emissions in Table H-3 because planned upgrades would be implemented. The Laboratory would continue to report annual emissions to comply with its 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 in nature 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 associated with operations of the air curtain destructor were evaluated in DOE/EA-1329 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.

Heating and cooling; use of construction equipment during construction, demolition and remediation; land disturbance; and commuting personnel. Nonradiological criteria air pollutant emissions for the Modernized Operations Alternative were estimated for the activities quantified in Table H-11 using ACAM. ACAM inputs represent activities proposed under the Modernized Operations Alternative including 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 presented in Table H-7 for the No-Action Alternative were also simulated in ACAM for the Modernized Operations Alternative.

As described in Section H.1.2.1, ACAM simulations were performed assuming total emissions in a single year and 20 percent of the total annually for five years where the three alternatives occur in separate five-year periods. The ACAM air quality emissions from construction, demolition, utility/infrastructure projects, and operational activities under the Modernized Operations Alternative are presented in Table H-12. These two simulations include emissions from operations of the No-Action Alternative as described in Section H.1.3.1.

Table H-12 indicates that incremental pollutant levels from projects proposed under the Modernized Operations Alternative would be expected to meet the *de minimis* threshold if all construction activities were to occur in a single year, with the exception of PM_{10}. Total site grading under the Modernized Operations Alternative was assumed to be more than 40 million square feet (Table H-11), about half of which would be associated with the 795 acres of proposed solar arrays. It is unrealistic to assume that such a large area would be left as bare soil for a six-month period. 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, reasonable precautions should 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.

Table H-11 ACAM Inputs for the Modernized Operations Alternative (rounded)

Activity	ACAM Input Total[a]	ACAM Input 20 Percent of Total
Construction	3,431	687
Utility building construction	188	16
Demolition	1,216	243
Utility trenching	344	69
Site grading (non-solar fields)	9,235	1,847
Site grading for solar fields	34,630	6,926
New paving	4,304	861
Personnel	780 (number)	156 (number)
Heated area	2,402	460

ACAM = Air Conformity Applicability Model
a Thousands of square feet unless otherwise noted.
Source: ACAM

Table H-12 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 emissions presented in this table assume additional sources of emissions from the heating of new building space and personnel vehicles in the No-Action Alternative. 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.

Criteria pollutants from projects proposed under the Modernized Operations Alternative would be expected to be less than *de minimis*, and meet permitted limits if the results of Table H-12 were combined with existing facility-wide emissions in Table H-3 with the exception of particulate matter as previously mentioned. The effects of particulate matter on air quality during construction activities would be expected to have short-term significant negative effects if more than 2 million square feet of soil were left graded and bare for more than three consecutive months. LANL would implement best management practices and determine the extent of land that could be graded to bare soil over a defined period of time to maintain air quality standards for particulate matter.

Transporting Waste and Other Materials. Nonradiological and radiological material and waste shipments would travel more than 1 million miles per year under the Modernized Operations Alternative (Appendix F Table F.3-2); the equivalent of nine trucks working full time (FreightWaves 2021). The same number of heavy-duty trucks as the No-Action Alternative. Tables H-13 and H-14 present the exhaust emissions generated from transporting waste shipments under the Modernized Operations Alternative based on 2020 and projected 2030 emissions and compare it to the No-Action Alternative.

Table H-13 2020 and Projected 2030 Exhaust Emissions Under the Modernized Operations Alternative based on the Proposed Annual Mileage for a Heavy-Duty Diesel Vehicle (metric tons per year)

Exhaust Pollutant	2020	2030 Projected	Change from No-Action	
			2020	2030 Projected
Carbon monoxide	2.2	1.8	0.1	0.1
Nitrogen oxides	4.7	3.1	0.3	0.2
$PM_{2.5}$	0.1	0.0	0.0	0.0

$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
Source: BTS (2023c)

Table H-14 2020 and Projected 2030 Exhaust Emissions Under the Modernized Operations Alternative based on the Proposed Annual Mileage for a Light-Duty Gasoline Vehicle (metric tons per year)

Exhaust Pollutant	2020	2030 Projected	Change from No-Action	
			2020	2030 Projected
Carbon monoxide	0.4	0.3	0.0	0.0
Nitrogen oxides	0.0	0.0	0.0	0.0
$PM_{2.5}$	0.0	0.0	0.0	0.0

$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
Source: BTS (2023c)

Radiological Emissions

No radiological emissions would be expected during construction activities from the Modernized Operations Alternative. Twenty-nine 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
- DD&D of additional 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.

LANSCE modernization. Radioactive air emissions at LANSCE could increase by approximately 30 percent over the current 6-year average as a result of increasing the beam availability after the implementation of modernization efforts at LANSCE. This increase would be equivalent to 63 curies of GMAP and activated air (primarily Carbon-11).

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.

H.1.3.3 Expanded Operations Alternative

Activities addressed under the Expanded Operations Alternative would include those activities analyzed for the Modernized Operations Alternative plus projects and activities presented in Chapter 3, Section 3.4.

Nonradiological Criteria Air Pollutant Emissions

Nonradiological criteria air pollutant emissions would be expected to be similar to emissions in Table H-3. Planned upgrades would be implemented that may reduce existing 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 3.4.1.1. The analysis uses the following estimates for waste treatment associated with each proposed technology:

- **Contained detonation –** could treat about five percent of the current OB waste stream at LANL and about 50 percent of the LANL open detonation waste stream.
- **Flashing furnace –** could treat about three percent of the current OB waste stream but would not have the capability to treat the OD waste stream.
- **Rotary kiln incinerator –** could treat about 95 percent of the current LANL OB waste stream at LANL and less than one percent of the LANL OD waste stream.

These emissions 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.

Heating and cooling; use of construction equipment during construction, demolition and remediation; land disturbance; and commuting personnel. Nonradiological criteria air pollutant emissions for the Expanded Operations Alternative were estimated for the activities quantified in Table H-15 using ACAM. ACAM inputs represent activities proposed in the Expanded Operations Alternative. The Expanded Operations Alternative ACAM inputs presented in Table H-15 are in addition to inputs in Table H-7 for the No-Action Alternative and in Table H-

11 for the Modernized Operations Alternative. Operational emissions for all three alternatives were simulated in ACAM for this alternative.

Table H-15 ACAM Inputs for the Expanded Operations Alternative (rounded)

Activity	ACAM Input Total[a]	ACAM Input 20 Percent of Total
Construction	887	177
Utility building construction	8	1.6
Demo[b]	-	-
Utility trenching	93	19
Siting Grading (non-solar fields)	5,881	1,176
Site grading for solar fields	-	-
New paving	2,097	245
Personnel	735 (number)	147 (number)
Heated area	895	179

ACAM = Air Conformity Applicability Model
a Thousands of square feet unless otherwise noted.
b There would be no additional DD&D specific to the Expanded Operations Alternative
Source: ACAM

The ACAM air quality emissions from activities under the Expanded Operations Alternative are presented in Table H-16. Both simulations—total emissions in a single year and 20 percent of the total annually for five years simulated in separate five-year periods—included conditions for the No-Action and Modernized Operations alternatives occurring earlier in the project life as described in Sections H.1.3.1 and H.1.3.2. Activities simulated for all three alternatives for the same five-year period are presented in Table H-17. As described in Section H.1.2.1., simulating ACAM with alternatives occurring simultaneously over the same five-year period provides a complete understanding of the effects to air quality over the 15-year period of analysis.

Table H-16 indicates that pollutants would be expected to meet the *de minimis* threshold if all construction activities were to occur in a single year with the exception of PM_{10}. Total site grading under the Expanded Operations Alternative was assumed to be more than 5 million square feet (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 should be taken to prevent dust from becoming airborne.

Criteria pollutants would be expected to be less than *de minimis*, and meet permitted limits if the results of Table H-15 were combined with existing facility-wide emissions in Table H-3 with the exception of particulate matter. The effects of particulate matter on air quality during construction activities would be expected to have short-term significant negative effects if more than 2 million square feet of soil was left graded and bare for more than three consecutive months. LANL would implement best management practices and determine the extent of land that could be graded to bare soil over a defined period of time to maintain air quality standards for particulate matter.

Table H-16 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	23
CO	250	140	135	128
SO_x	250	0.2	0.2	0.2
PM_{10}	250	>250	72	1.6
$PM_{2.5}$	250	1.7	1.2	1.5
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_{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 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 H-17 ACAM-Estimated Total Emissions from the all Three Alternatives Occurring in the Same 5-Year Period[a] (tons per year)

Pollutant	*de minimis* Threshold	Construction Emissions					Operations Emissions
		Year 1	Year 2	Year 3	Year 4	Year 5	
VOC	250	20	22	23	25	26	9
NO_x	250	44	44	45	47	49	18
CO	250	72	96	120	144	168	131
SO_x	250	0.1	0.1	0.2	0.2	0.2	0.2
PM_{10}	250	>250	>250	>250	>250	>250	1
$PM_{2.5}$	250	1.3	1.4	1.5	1.7	1.8	1
Pb	25	0.0	0.0	0.0	0.0	0.0	0.0
NH_3	250	0.5	0.7	0.9	1.0	1.2	0.9

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.

Transporting Waste and Other Materials. Material and waste shipments would travel roughly 1.2 million miles per year under the Expanded Operations Alternative (Appendix F Table F.3-2). The distance would be the equivalent of 10 trucks working full time each year adding one additional heavy-duty truck compared to the No-Action Alternative. Tables H-18 and H-19 present the exhaust emissions generated from transporting waste shipments under the Expanded

Operations Alternative based on 2020 and projected 2030 emissions and compare it to the No-Action Alternative.

Table H-18 2020 and Projected 2030 Exhaust Emissions from the Expanded Operations Alternative based on the Proposed Annual Mileage for a Heavy-Duty Diesel Vehicle (metric tons per year)

Exhaust Pollutant	2020	2030 Projected	Change from No-Action	
			2020	2030 Projected
Carbon Monoxide	2.5	2.0	0.4	0.3
Nitrogen Oxides	5.2	3.4	0.8	0.5
$PM_{2.5}$	0.1	0.1	0.0	0.0

$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
Source: BTS (2023c)

Table H-19 2020 and Projected 2030 Exhaust Emissions from the Expanded Operations Alternative based on the Proposed Annual Mileage for a Light-Duty Diesel Vehicle (metric tons per year)

Exhaust Pollutant	2020	2030 Projected	Change from No-Action	
			2020	2030 Projected
Carbon Monoxide	0.6	0.4	0.1	0.1
Nitrogen Oxides	0.0	0.0	0.0	0.0
$PM_{2.5}$	0.0	0.0	0.0	0.0

$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
Source: BTS (2023c)

Radiological 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:

- Low Enriched Uranium Fuel Fabrication Facility
- Dynamic Mesoscale Materials Science Capability
- LANSCE Enhancements
- Microreactor
- Surplus Plutonium Disposition Program
- Advanced Separations of Plutonium Radiological Laboratory

Table H-20 lists the expected changes in radiological emissions associated with the Expanded Operations Alternative proposed projects. The proposed microreactor, radiological laboratory, and transuranic waste staging area would not be expected to contribute radioactive air emissions beyond the conservative assumptions already considered for site-wide radiological emissions. Therefore, these three projects are not presented in Table H-20. The expected annual increase in radiological emissions for the Expanded Operations Alternative compared to the Modernized

Operations Alternative and No-Action Alternative would be 0.014 curies of uranium, 650 curies of GMAP, 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 H-21.

Table H-20 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}	-

Am-241 = americium-241; 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; Pu-239 = plutonium-239; SPDP = Surplus Plutonium Disposition Program; 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. 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.

Table H-21 Total Potential Radiological Emissions for the Expanded Operations Alternative (curies)

Tritium[a]	GMAP	MFP	P/VAP	Am-241	Pu-EQ	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; Pu-EQ = 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.

H.2 Greenhouse Gas Emissions

This section provides context to GHG emissions at LANL. The baseline, methods used to analyze alternatives, and GHG emissions for each alternative are presented in terms of costs and benefits. Costs presented in this section refer to the social costs of increasing GHG emissions. The social cost of greenhouse gases (SC-GHG), as described by the Interagency Working Group (IWG) on SC-GHG, is "the monetary value of the net harm to society associated with adding a small amount of greenhouse gases to the atmosphere in a given year (IWG-SCGHG 2021)." The SC-GHG aims to "include the value of all future climate change impacts (both negative and positive), including changes in net agricultural productivity, human health effects, property damage from increased flood risk, changes in the frequency and severity of natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services (EPA 2023c)."

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 2023c).

H.2.1 Baseline and Background Information

There is no greater challenge facing the United States and the planet Earth than the climate crisis and addressing the effects of climate change is a top priority for the U.S. Department of Energy (DOE) (DOE 2024a). Climate change also poses threats to national security (Executive Order [EO] 14008; 86 FR 7619; GAO 2022). LANL currently demonstrates its commitment to addressing climate change through scientific and operational contributions, including climate modeling and energy reductions (LANL 2023b) respectively. LANL minimizes its direct and indirect GHG emissions under the Laboratory's environmental sustainability mission.

GHGs include water vapor, carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). GHGs in Earth's atmosphere contribute to regulating the temperature of the planet by trapping solar heat. When solar radiation (sunlight) reaches Earth, part is reflected back into space, and about half is absorbed by the earth's surface and then re-emitted as infrared radiation. The greenhouse effect occurs when GHGs absorb some of this emitted infrared radiation, causing the earth's surface and lower atmosphere's temperature to rise.

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. Roughly half of all CO_2 emissions from human activity have occurred in the decades since 1970. Global GHG emissions equaled approximately 48,940 million metric tons of CO_2 equivalent (CO_2e) in 2018, up from 22,341 million metric tons CO_2e in 1970 and 33,823 million metric tons CO_2e in 1990 (Climate Watch 2022).

Within the United States, overall anthropogenic GHG emissions[1] in 2020 totaled approximately 5,981 million metric tons CO_2e. Annual U.S. emissions have decreased by 7.3 percent from 1990 to 2020; however, emissions decreased in 2008 and 2009 due to the economic slowdown and more recently due to the shift in power generation from coal to natural gas. Additionally, warmer winter conditions in 2016 resulted in decreased heating demand. Emissions also decreased in 2020 as a result of the economic slowdown caused by the global COVID-19 pandemic (EPA 2022).

Carbon dioxide not removed from the atmosphere by natural sinks lingers for thousands of years. This means CO_2 emitted long ago continues to contribute to climate change today. The long lifetime of atmospheric CO_2 is one of the primary reasons why the COVID-19 pandemic–related reduction in greenhouse gas emissions—a decrease of seven percent between 2019 and 2020 had no measurable impact on atmospheric CO_2 concentrations and little effect on global temperatures (Jay et al. 2023).

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 MMT). 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. New Mexicans produce more than 50 tons per

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

person per year, whereas the average in the United States 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. CO_2 makes up 62 percent of New Mexico's emissions profile, followed by CH_4 at 35 percent. Nationally, CO_2 makes up 82 percent of the emissions profile, followed by CH_4 at 10 percent (New Mexico Governor's Office 2021).

The global atmospheric CO_2 concentration in 2020 reached 412 parts per million (ppm), a level that is higher than at any point during the past 800,000 years. The annual rate of increase in atmospheric CO_2 over the past 60 years has been about 100 times faster than during any previous era in history, including the end of the last ice age 11,000–17,000 years ago when Earth underwent a natural warming period (NOAA 2022a). Like CO_2, atmospheric concentrations of other GHGs have also increased since the start of the Industrial Revolution (pre-1750). CH_4 concentrations have increased from approximately 720 parts per billion (ppb) to around 1,896 ppb in 2021 (NOAA 2022b). Global surface temperatures have increased by approximately 1.8 degrees Fahrenheit (°F) (1.0 degree Celsius [°C]) over the last 115 years (1901–2016), which is the warmest in the history of modern civilization (USGCRP 2017).

Since 1850, carbon dioxide concentrations have increased by more than 47 percent, nitrous oxide by 23 percent, and methane by more than 156 percent (Jay et al. 2023). Across the planet, 2023 was the warmest year since global records began in 1850. It was 2.12°F (1.18°C) above the 20th-century average of 57.0°F (13.9°C) and 2.43°F (1.35°C) above the pre-industrial average (1850–1900) (NOAA 2024). The seven years leading up to 2021 were the seven warmest years on record (NASA 2021). Annual average temperature over the contiguous United States also increased by 1.8°F (1.0°C) since the beginning of the 20th century. Along with the increase in annual average temperatures across the United States, the frequency of cold waves has decreased since the early 1900s, and the frequency of heat waves has increased since the mid-1960s. The number of high temperature records set in the past two decades far exceeds the number of low temperature records (USGCRP 2017).

The 2017 National Climate Assessment projects annual average temperature over the contiguous United States will continue to rise in the future. Extreme temperatures in the contiguous United States are projected to increase even more than average temperatures. The temperatures of extremely cold days and extremely warm days are both expected to increase. Cold waves are projected to become less intense, and the number of days below freezing is projected to decline. Heat waves will likely become more intense, and the number of days above 90 °F is expected to rise in the United States (USGCRP 2017).

Updates to the National Climate Assessment in 2023 state that temperatures in the contiguous United States 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 United States 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 (Jay et al. 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 and Rio Grande. For example, between 1913 and 2017, annual average discharge from the Colorado River decreased by 9.3 percent for each degree Celsius of warming. 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 (Jay et al. 2023).

Temperatures in New Mexico have risen more than 2°F since the beginning of the 20th century. The number of extremely hot days and warm nights has also increased. Historically unprecedented warming is projected during this century. Across New Mexico, average temperatures and cooling degree days[2] are projected to increase, with hotter, more frequent, and longer-lasting heat waves. 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 (Jay et al. 2023).

Across the United States over the last 50 years, an increase has occurred in extreme weather events, including prolonged periods of excessively high temperatures, heavy downpours, more intense hurricanes and tornadoes, severe floods, and droughts. As average global temperatures have risen, extreme high temperatures have become more frequent and extreme cold temperatures less frequent. From 2001 to 2012, more than twice as many daily high temperature records were broken in the United States compared with low temperature records. In U.S. cities, heat waves—periods of abnormally hot weather that last days to weeks—have increased by more than 40 days since the 1960s (USGCRP 2018).

Climate Change Relationship to Environmental Justice

As described in Section 4.13, DOE implements its environmental justice requirements and obligations in accordance with DOE's trust responsibilities to tribal nations; EOs on environmental justice; guidance from the Council on Environmental Quality (CEQ) (CEQ 1997); DOE's Environmental Justice Strategy (DOE 2017); 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.

Climate change is an issue that has implications to environmental justice. The 2023 NEPA GHG Guidance reminded "agencies to incorporate environmental justice considerations into their analyses of climate-related effects, consistent with Executive Orders 12898 and 14008." The CEQ Climate and Economic Justice Screening Tool was used to identify communities that are experiencing climate-related burdens (CEJST 2024). Several of the communities in the region of influence are identified as having increased risk of disproportionate and adverse risks from climate impacts. Categories of climate impacts include expected agriculture loss, expected building loss,

[2] A degree day compares the mean outdoor temperature recorded for a location to a standard temperature, usually 65 degrees Fahrenheit in the United States. The more extreme the outside temperature, the higher the number of degree days. A high number of degree days generally results in higher energy use. Cooling degree days are a measure of the difference between the mean daily temperature and the standard temperature on a day when the mean daily temperature is higher (or hotter) than the standard temperature. https://www.eia.gov/energyexplained/units-and-calculators/degree-days.php

projected wildfire risk, projected flood risk, and expected population loss from fatalities and injuries resulting from natural hazards. As a national laboratory engaged in research regarding impacts from climate-related issues, NNSA and the Laboratory would continue to engage with communities on exchanging research on impacts related to agriculture, wildland fires, flooding risks, impacts to water resources, and energy related research.

Environmental factors, underlying health conditions, and demographics (such as age and low-income communities) can lead to certain groups experiencing a disproportionate share of exposures to both environmental pollution and climate change hazards. In this way, climate change adds to the cumulative stresses experienced by environmental justice communities (HHS 2024).

Climate change threatens to disrupt the conditions for critical Indigenous subsistence practices, including, but not limited to, planting, pollination, harvesting, the preparation and storage of food and medicines (i.e., medicinal plants), and subsistence-related travel. Losses of subsistence lifestyles are associated with decreased capacity to cope with climate change. Economic insecurity on subsistence and business can compound existing economic challenges, including poverty, labor exploitation, colonial debts, and inaccessibility of finance mechanisms (Jay et al. 2023).

Continuing drought and water scarcity will make it more difficult to raise food and fiber in the Southwest without major shifts to new strategies and technologies. Extreme heat events will increase animal stress and reduce crop quality and yield, thereby resulting in widespread economic impacts. As people in the Southwest have adapted to drought impacts for millennia, incorporating Indigenous Knowledge with technological innovation can offer solutions to protect food security and sovereignty (Jay et al. 2023).

Climate Change Relationship to Human Health

As described in Section 4.7, 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 accordance with DOE Order 450.2 and DOE Order 440.1B. In 2009, based on the scientific assessments of the U.S. Global Change Research Program (USGCRP), the National Research Council, and the Intergovernmental Panel on Climate Change (IPCC), EPA issued a finding that the changes in climate caused by elevated concentrations of GHG in the atmosphere are reasonably anticipated to endanger the public health and public welfare of current and future generations (74 FR 66496).

The influences of weather and climate on human health are significant and varied. They range from the clear threats of temperature extremes and severe storms to connections that may seem less obvious. Climate and weather can affect water and food quality in particular areas, with implications for human health. In addition, the effects of global climate change on mental health and well-being are integral parts of the overall climate-related human health impact. As the climate continues to change, the risks to human health continue to grow. Across the United States, people and communities differ in their exposure, their inherent sensitivity, and their adaptive capacity to respond to and cope with climate-change-related health threats (USGCRP 2016).

Increases in extreme heat, drought, flooding, and wildfire activity are negatively impacting the physical health of Southwest residents. Individuals particularly vulnerable to increasing climate change impacts include older adults, outdoor workers, and people with low income. Evidence indicates that extreme heat disproportionately impacts the health of frontline and overburdened communities in the Southwest, including the unhoused, outdoor workers, and migrant farmworkers as well as those with low income and older adults (USCGRP 2023).

Impacts of climate-driven changes are experienced disproportionately by certain communities in the Southwest, including Indigenous communities. Indigenous Peoples face harms and risks from climate change that negatively affect their health and well-being, economic sustenance, and cultural integrity and continuity. Indigenous concepts of health and well-being often remain closely tied to the health of the environment, waters, and more-than-human relatives that provide for subsistence and cultural needs (Jay et al. 2023).

Climate change generally has had detrimental health impacts to Indigenous Peoples. Negative health outcomes and deaths have increased from extreme weather events, including heatwaves, flooding, changing ice conditions, hurricanes/typhoons, and wildfires. These negative health outcomes include post-traumatic stress disorder, anxiety, suicide, and other mental, spiritual, and social–emotional health challenges which can be exacerbated by intergenerational trauma and breakdowns in family and community relationships. These negative health impacts can amplify existing stressors on Indigenous health and well-being, including inadequate infrastructure, high rates of certain health conditions, high burdens of pollution, limited access to healthcare, water scarcity, poor sanitation, risks to occupational safety, and disproportionately high rates of environmental justice–related violence and human rights violations, many of which are especially burdensome for women (Jay et al, 2023).

GHG Reduction Policy

Global. The Paris Agreement is a legally binding international treaty on climate change. It was adopted by 196 parties (including the United States) at the United Nations Climate Change Conference in Paris, France, in December 2015 and went into effect in 2016 (UNCC 2023). Its overarching goal is to hold "the increase in the global average temperature to well below 2°C above pre-industrial levels" and pursue efforts "to limit the temperature increase to 1.5°C above pre-industrial levels." However, in recent years, world leaders have stressed the need to limit global warming to 1.5°C (34.7°F) by the end of this century. To limit global warming to 1.5°C, GHG emissions must peak before 2025 at the latest and decline 43 percent by 2030.

On November 4, 2019, the United States Government provided formal notice of intention to withdraw the Paris Agreement (State 2019). The withdrawal took effect on November 4, 2020. On January 20, 2021, EO 14008 was signed ordering the United States to rejoin the Paris Agreement (EO 14008; 86 FR 7619). The United States formally rejoined the Paris Agreement on February 19, 2021. As part of this agreement, the United States has committed to an economy-wide target of reducing its net greenhouse gas emissions by 50–52 percent below 2005 levels in 2030.

National. 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°C (35.6°F) and to pursue efforts to hold the rise to 1.5°C. 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. EO 14057 sets defined metrics that must be met by specific deadlines:

- One hundred percent carbon-pollution-free electricity by 2030, including 50 percent on a 24/7 basis.
  - Facilities shall consume 100 percent carbon-pollution-free electricity on an annual basis and 50 percent carbon-pollution-free electricity on an hourly basis by FY2030.
- One hundred percent zero-emissions vehicle (ZEV) acquisitions by 2035, including 100 percent light-duty acquisitions by 2027:
  - All light-duty vehicle acquisitions must be ZEVs by FY2027. In addition, DOE must develop a strategy for obtaining a zero-emission fleet and set targets throughout the transition process.
- Net-zero emissions buildings by 2045, including a 50 percent reduction by 2032:
  - LANL must reach net-zero emissions across all buildings, campuses, and installations by FY2045 and reduce greenhouse gas emissions by 50 percent by FY2032 (compared with FY2008 baseline data).
- Net-zero emissions procurement by 2050:
  - This goal includes policy to promote use of construction materials with lower embodied emissions (emissions from the production of a product).
- Net-zero emissions operations by 2050, including a 65 percent reduction by 2030.
- Climate-resilient infrastructure and operations.

Recognizing that EO 14057 sets agency-wide goals, LANL has interpreted them as goals for the Laboratory as well.

- DOE Order 436.1A, "Departmental Sustainability," was issued in April 2023, with a purpose to establish "an agency-wide integrated, performance-based approach to implement sustainability in the DOE operations. The Order ensures the Department conducts its missions in a sustainable manner that addresses national energy security and global environmental challenges; 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 Executive Orders (EOs)."

State of New Mexico. In 2019, an Executive Order for the State of New Mexico was signed to join the United States Climate Alliance and set an economy-wide GHG emissions target of 45 percent below 2005 levels by 2030 (New Mexico Governor's Office 2019). In addition to instructing state agencies to incorporate climate adaptation into their programs and operations. EO 2019-003 (New Mexico Office of the Governor 2019) established a Climate Change Task Force to evaluate policies and strategies to achieve the target, including increasing the ambition of the state Renewable Portfolio Standard, implementing Low Emission Vehicle and ZEV standards, updating building codes, and developing a comprehensive, statewide, enforceable regulatory framework to reduce oil and gas sector methane emissions and prevent waste from new and existing sources (NMED 2024).

Following EO 2019-003, in January 2024, the New Mexico Energy Minerals and Natural Resources Department released *New Mexico Climate Adaptation and Resilience Plan* (New Mexico EMNRD 2024). The plan identifies key climate-related concerns including water, aridity, and drought. The plan also identifies resilience themes and provides strategies and priority actions to implement those strategies.

The 2019 New Mexico Energy Transition Act was developed with collaboration by 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. The law transitions New Mexico away from coal and toward clean energy, ensuring greater renewable energy production and reducing costs for consumers, and provides tens of millions of dollars of economic and workforce support for communities impacted by coal plant closures, as well as the development of renewable replacement power in San Juan County (Prospt 2019).

Los Alamos County, New Mexico. As of 2024, Los Alamos County is creating an official plan that will help achieve the County Council's strategic goal of Environmental Stewardship and keep Los Alamos County on target to reduce greenhouse gas emissions. In December 2023, Los Alamos County completed a community-wide and County operations comprehensive greenhouse gas emissions baseline study using a 2022 inventory year to inform its first Climate Action Plan (LAC 2023).

The geographic community-wide emissions inventory accounts for emissions that are produced by actions from residents, visitors, schools, county operations, and businesses within the county's geographic bounds within the 2022 calendar year. The Laboratory's emissions were not included in the community-wide total, however the impact of LANL's emissions on the community was considered for informational purposes within the study. The county operations emissions inventory accounts for emissions that are produced by county owned and operated facilities and activities.

H.2.2 Methodologies

The methods applied to calculate GHG emissions are based on 2023 CEQ NEPA Guidance on Consideration of GHG Emissions and Climate Change (88 FR 1196; January 9, 2023), which uses metric tons per year. The guidance states that "agencies generally should quantify gross increases or reductions (including both direct and indirect emissions) individually by GHG, as well as aggregate in terms of total carbon dioxide (CO_2) equivalence by factoring in each pollutant's global warming potential (GWP),…" The guidance goes on to state that "they [agencies] should apply the best available estimates of SC-GHG to the incremental metric ton of each individual GHG emission" referencing the *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990* released by the Interagency Working Group on Social Cost of Greenhouse Gases (IWG-SCGHG 2021).

In June 2024, DOE issued a Memorandum for the Heads of Departmental Elements regarding the use of SC-GHG estimates, directing use of updated 2023 SC-GHG estimates from EPA "going forward" (DOE 2024). EPA's 2023 report presents SC-GHG estimates that incorporate recommendations of a National Academies of Sciences 2017 study. The estimates were generated using a modular approach based on socioeconomics and emissions, climate, damages, and discounting.

DOE has been extensively involved in the IWG process and related work on the SC-GHGs for over a decade. This involvement includes DOE's role as the federal technical monitor for the seminal 2017 report on SC-GHG issued by the National Academies of Sciences, Engineering, and Medicine (NAS), which provided extensive recommendations on how the IWG could strengthen and update the SC-GHG estimates (NAS 2017). DOE has also participated in the IWG's work since 2021, which has heavily informed the 2023 SC-GHG estimates. DOE technical experts involved in this work reviewed the 2023 SC-GHG methodology and report in light of the NAS's recommendations and DOE's understanding of the state of the science. Based on this review, DOE determined that the updated 2023 SC-GHG estimates represent a significant improvement in estimating the SC-GHG through incorporating the most recent advancements in the scientific literature and by addressing recommendations on prior methodologies. In particular, the 2023 SC-GHG estimates implement the key recommendations of the NAC, and they incorporate the extensive scientific findings and methodological advances that have occurred since the last IWG updates in 2013, 2015, and 2016. Table H-22 provides SC-GHG and near-term Ramsey discount rates reported by EPA (EPA 2023c).

Emissions factors of 265 and 28 were applied to projected emissions of nitrous oxide (N_2O) and methane (CH_4), respectively, and added to CO_2 to calculate the total CO_2 equivalence (referenced as GHG or CO_2e). These emissions factors were defined in the Fifth IPCC based on the GWP over 100-years compared to CO_2 (IPCC 2014). In other words, N_2O would be expected to have a GWP 265 times that of CO_2 for 100-years. GHG emissions in metric tons were then used to calculate the SC-GHG consistent with 2023 SC-GHG estimates from the EPA (EPA 2023c).

Table H-22 EPA Estimates of the Social Cost of Greenhouse Gases (SC-GHG), 2020–2080 (2020 dollars)

Emission Year	SC-GHG and Near-Term Ramsey Discount Rate								
	$SC-CO_2$ (2020 dollars per metric ton of CO_2)			$SC-CH_4$ (2020 dollars per metric ton of CH_4)			$SC-N_2O$ (2020 dollars per metric ton of N_2O)		
	Near-Term Rate			Near-Term Rate			Near-Term Rate		
	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%	2.5%	2.0%	1.5%
2020	120	190	340	1,300	1,600	2,300	35,000	54,000	87,000
2030	140	230	380	1,900	2,400	3,200	45,000	66,000	100,000
2040	170	270	430	2,700	3,300	4,200	55,000	79,000	120,000
2050	200	310	480	3,500	4,200	5,300	66,000	93,000	140,000
2060	230	350	530	4,300	5,100	6,300	76,000	110,000	150,000
2070	260	380	570	5,000	5,900	7,200	85,000	120,000	170,000
2080	280	410	600	5,800	6,800	8,200	95,000	130,000	180,000

$SC-CO_2$ = social cost of carbon dioxide; $SC-CH_4$ = social cost of methane; $SC-N_2O$ = social cost of nitrous oxide
Source: EPA (2023c)

Los Alamos National Laboratory (site-wide) emissions

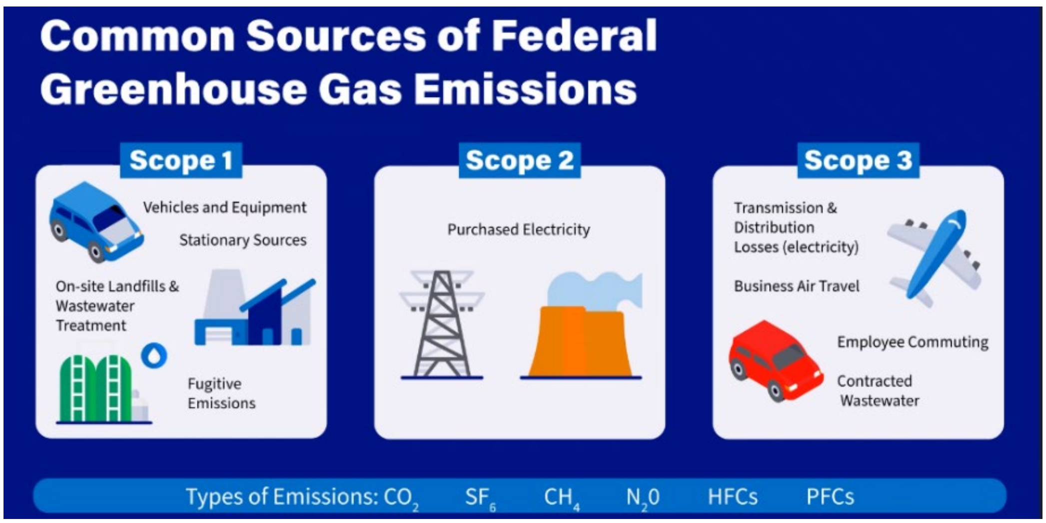
The GHG emissions reported in the annual Site Sustainability Plan for FY 2023 are presented in Table H-23. Figure H-1 illustrates the sources of emissions quantified to meet corporate standards for reporting GHG emission; these three standard scopes are consistent with DOE's reporting requirements: direct emissions occurring onsite are Scope 1, indirect emissions associated with purchased electricity are Scope 2, and indirect emissions from purchased electricity affected by an organization like business travel are Scope 3.

Site-wide GHG emissions during the period 2017–2022 also represent reduced GHG emissions during the pandemic when remote work increased and personnel commutes and business air travel were reduced. GHG emissions generated from construction activities and increases in numbers of personnel in 2023 were determined to be more representative than conditions averaged over the period 2017–2022. These conservative values from Table H-23 were used as a baseline for ongoing site-wide emissions in the evaluation of potential effects.

Table H-23 Greenhouse Gas Emissions for Fiscal Year 2023 from Los Alamos National Laboratory (metric tons per year)[a]

Scope	Total (MTCO2e)[a]
Scope 1[a]	155,293
Scope 2	106,488
Scope 3	98,234
TOTAL	**360,015**

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



Source: LANL (2024c)

Figure H-1 Greenhouse Gas Emissions Scopes and Emissions

Heating and cooling; use of construction equipment during construction, demolition and remediation; land disturbance; and commuting personnel

As identified earlier for criteria pollutants, the ACAM was used to estimate the incremental GHG emissions from the heating and cooling of newly constructed facilities, as well as the emissions from constructing and demolishing facilities, grading land, and the commutes of construction and facility personnel for the projects in each of the alternatives. Site grading associated with construction of solar PV arrays was included in the ACAM assumptions to account for GHG emissions from construction activities. GHG emissions were estimated by ACAM on an annual basis from an estimated start date through the expected life cycle of the alternative. ACAM outputs "steady state" emissions when the net gain/loss in emission is stabilized and the action is fully implemented.

The ACAM results from alternatives occurring in separate five-year periods were carried forward in the analysis of SC-GHG. The estimated annual costs of each of the GHG emissions increase annually. Therefore, the selected approach would distribute the construction activities over the full analysis period.

Transporting Waste and Other Materials

GHG emissions from the transport of waste and other materials were calculated based on the EPA GHG emissions rate of 10.180×10^{-3} metric tons of CO_2 per gallon of diesel (EPA 2023b). This rate of CO_2 per gallon was multiplied by the estimated mileage in Table H-5 assuming an average of 6.5 miles per gallon (FreightWaves 2021). Calculations for N_2O and CH_4 were made based on rates from 81 FR 206, *Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy Duty Engines and Vehicles-Phase 2*. EPA set the N_2O and CH_4 standards at 0.05 grams per mile for both pollutants. These three pollutants (N_2O, CH_4, and CO_2) were summed while applying emissions factors of 265 and 28 to N_2O and CH_4 respectively to calculate the GHG emissions for the proposed mileage (IPCC 2014).

Solar PV Arrays

The addition of solar PV arrays would be expected to reduce operational emissions by offsetting the generation of electricity from fossil fuels.

The potential for solar power generation is based on a variety of factors including the number of hours of sun each day and system efficiencies. EPA maintains a database of emissions and generation resources (eGrid) that includes emissions rates by state. Table H-24 presents the total output rates for annual N_2O, SO_2, and GHG emissions in pounds per megawatt-hour from New Mexico (EPA 2023a). These are the emissions associated with power generation using fossil fuels and present the potential emissions avoided through the use of solar PV arrays or other renewable energy technologies.

Table H-24 New Mexico Power Generation Emission Rates (pounds per megawatt-hour)

State	Annual NO_x	SO_2	CO_2	CH_4	N_2O
New Mexico	0.7	0.167	1,134.3	0.097	0.014

CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; NO_x = oxides of nitrogen; SO_2 = sulfur dioxide
Source: EPA (2023b)

The DOE's National Renewable Energy Laboratory (NREL) PVWatts Calculator[3] was used to estimate energy production and calculate the emissions offset by the solar PV arrays. The analysis used the default assumptions for a standard fixed, open array system in Los Alamos, New Mexico. The calculator estimates monthly solar radiation and energy output in kWh to develop an annual system output. The annual system output was converted to megawatts, 1,720 MWh/yr (NREL 2023). Megawatt hours per year were multiplied by the emissions rates and converted from pounds to metric tons.

Offsets to GHG emissions, and the corresponding benefits to SC-GHG, were calculated from the proposed megawatt hours of generation and 2023 LANL/LAPP electrical grid and emissions estimates. Therefore, 0.90395 metric tons of CO_2e per MWh was applied to calculate offsets. Table H-25 presents the GHG emissions calculated from production of 1 megawatt of electricity using a standard solar PV array. This value from Table H-25 is used to calculate the reduction in SC-GHG for each alternative based on the amount of renewable energy proposed.

[3] https://pvwatts.nrel.gov/index.php

Table H-25 Net Emissions Offset from Power Generation

MW	MWh/yr	MT/MWh	CO2e Offset ($MTCO_2e$)
1	1,720	0.90395	1,555

$MTCO_2e$ = metric tons of carbon dioxide equivalents; MW = megawatt; MWh/yr = megawatt-hour per year; MT/MWh = metric ton per megawatt-hour
Source: EPA (2023b)

H.2.3 Analyses

The potential GHG emissions were calculated from activities that would occur in the No-Action, Modernized Operations, and Expanded Operations alternatives.

H.2.3.1 No-Action Alternative

GHG emissions from the No-Action Alternative would be expected to be similar to existing site-wide emissions presented in Table H-23. Negligible changes would be expected in the annual GHG emissions presented in Table H-23 from the indirect effects of other GHG emissions described in this section. As identified in Section H.1.3.1, steam plant upgrades would replace two existing boilers and add a heat recovery steam generator. These GHG emissions would be expected to decrease by at least 16 percent following these system upgrades. Installation of the heat recovery steam generator would be meant to capture exhaust heat from the combustion gas turbine generator lowering GHG emissions.

Heating and cooling; use of construction equipment during construction, demolition and remediation; land disturbance; and commuting personnel.

ACAM generated the estimated annual GHG emissions for construction and demolition activities for the projects implemented under the No-Action Alternative assuming implementation occurred from 2024 through 2028 (Table H-26). These emissions also include the site grading of 45 acres

Table H-26 ACAM-Estimated Greenhouse Gas Emissions from the No-Action Alternative Projects (metric tons per year rounded)

Year	CO_2	CH_4	N_2O	CO_2e
2024	4,580	0.16	0.04	4,600
2025	5,630	0.21	0.06	5,650
2026	6,620	0.26	0.07	6,650
2027	7,640	0.30	0.09	7,670
2028	8,710	0.35	0.10	8,750
2029	5,480	0.25	0.09	5,510
2030	5,480	0.25	0.09	5,510
2031	5,480	0.25	0.09	5,510
2032	5,480	0.25	0.09	5,510
2033	5,480	0.25	0.09	5,510
2034	5,480	0.25	0.09	5,510
2035	5,480	0.25	0.09	5,510
2036	5,480	0.25	0.09	5,510
2037	5,480	0.25	0.09	5,510
2038	5,480	0.25	0.09	5,510

CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide; CO_2e = carbon dioxide equivalent during construction of the 10 MW solar PV array. ACAM results support a portion of the GHG emissions analysis but they do not provide the whole picture. Additional analyses were performed outside of ACAM to include emissions from transporting waste and other materials.

Transporting Waste and Other Materials

GHG emissions from transporting waste and other materials were calculated using the methods described in Section H.2.2. Table H-27 provides the results for each alternative and includes the GHG emissions from the aggregated CO_2, N_2O and CH_4 based on average fuel economy of 6.5 miles per gallon of a semi-truck and 25 miles per gallon from a light-duty gasoline truck (FreightWaves 2021; BTS 2023c).

Table H-27 Greenhouse Gas Emissions from Transporting Waste and Other Materials

Pollutant	Fuel Economy (mpg)	No-Action Alternative (mt/y)	Modernized Operations Alternative (mt/y)	Expanded Operations Alternative (mt/y)
CO_2		**1,704**	**1,814**	**2,022**
	6.5	1,640	1,751	1,936
	25	64	64	86
N_2O		**0.08**	**0.09**	**0.10**
	6.5	0.08	0.09	0.10
	25	0.00	0.00	0.00
CH_4		**0.08**	**0.09**	**0.10**
	6.5	0.08	0.09	0.10
	25	0.00	0.00	0.00
CO_2e[a]		**1,728**	**1,841**	**2,051**

Mt/y = metric ton per year, mpg = miles per gallon; CO_2 = carbon dioxide; CH_4 = methane; N_2O = nitrous oxide, CO_2e = carbon dioxide equivalents; GWP = global warming potential

a Greenhouse gas emissions were calculated from CO_2+N_2O*265+CH_4*28 where 265 and 28 are the GWP of N_2O and CH_4, respectively, from IPCC (2014) presented as metric tons per year.

Source: NREL (2023); EPA (2023d)

Total GHG Emissions

The GHG emissions produced from the operation of existing site-wide facilities (*see* Table H-23), construction and operation of new facilities (*see* Table H-26), and transport of waste and materials (*see* Table H-27) were combined to quantify estimated GHG emissions for the 15-year analytical period. Loads (emissions) from existing site-wide activities and transporting waste and materials were assumed to be fixed from the first year of the period. These fixed annual loads were added to the annual loads from construction and operation of new facilities to present total annual GHG emissions in Table H-28. The values in Table H-28 are rounded to reflect two significant figures. GHG emissions from construction and operation of new facilities and transport of waste and materials would account for a three- to four-percent annual increase in site-wide GHG emissions.

Estimated Costs

Emissions in Table H-28 were applied to SC-GHG presented in Table H-22 to calculate present value and annualized value site-wide SC-GHG for the No-Action Alternative (Table H-29). 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.

Table H-28 No-Action Alternative Site-Wide Greenhouse Gas Emissions (rounded)

Year	$MTCO_2e$
2024	366,300
2025	367,300
2026	368,400
2027	369,500
2028	370,500
2029	367,300
2030	367,300
2031	367,300
2032	367,300
2033	367,300
2034	367,300
2035	367,300
2036	367,300
2037	367,300
2038	367,300

$MTCO_2e$ = metric tons of carbon dioxide equivalents

Table H-29 Total Present and Annualized Values of all GHG Emissions (CO_2, CH_4, and N_2O) not including Solar Projects (millions of $)

GHG	Total	Total	Total
Discount Rate	2.5%	2.0%	1.5%
No Action Alternative			
Present Value in 2024 (2020$)	$680	$1,119	$1,930
Annualized Value (15 years, 2020$)	$55	$87	$145
Modernized Operations Alternative			
Present Value in 2024 (2020$)	$697	$1,147	$1,978
Annualized Value (15 years, 2020$)	$56	$89	$148
Expanded Operations Alternative			
Present Value in 2024 (2020$)	$701	$1,153	$1,988
Annualized Value (15 years, 2020$)	$57	$90	$149

Estimated Benefits

Displaced (or offset) electricity from the construction of solar PV arrays would provide a net reduction of GHG emissions by reducing the demand for electricity from GHG-emitting sources. The emissions offset values presented in Table H-25 were used to calculate the benefits of solar PV arrays. Implementation of a 10 MW solar array would result in an offset of 15,548 metric tons of CO_2e per year; a total of roughly 233,000 metric tons of CO_2e over the 15-year SWEIS. 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. At a 2.0-percent discount rate, 2024 present value would be $47 million and the annualized value would be $3.7 million. At a 2.5-percent discount rate, the 2024 present value would be $29 million and the annualized value would be $2.3 million.

H.2.3.2 Modernized Operations Alternative

Existing site-wide GHG emissions for continued operations under the Modernized Operations Alternative were assumed to be similar to the No-Action Alternative. Changes in GHG emissions were quantified from other activities as described in this section. Activities addressed under the Modernized Operations Alternative would include those activities analyzed for the No-Action Alternative plus projects and activities presented in Chapter 3, Section 3.3.

Heating and cooling; use of construction equipment during construction, demolition and remediation; land disturbance; and commuting personnel.

Table H-30 presents the ACAM output for the annual GHG emissions for construction and demolition activities in the Modernized Operations Alternative which were simulated from 2029 through 2033. These emissions also include the site grading of 795 acres during construction of the total area of proposed solar PV arrays.

Table H-30 ACAM-Estimated Greenhouse Gas Emissions from the Modernized Operations Alternative Projects (metric tons per year rounded)

Year	Carbon Dioxide	Methane	Nitrous Oxide	$MTCO_2e$
2024	4,510	0.16	0.04	4,530
2025	5,570	0.21	0.05	5,600
2026	6,620	0.26	0.07	6,650
2027	7,690	0.30	0.09	7,730
2028	8,710	0.40	0.10	8,750
2029	15,350	0.50	0.16	15,400
2030	17,830	0.60	0.20	17,890
2031	20,330	0.60	0.25	20,390
2032	22,820	0.70	0.30	22,890
2033	25,330	0.70	0.34	25,400
2034	17,950	0.60	0.31	18,010
2035	17,950	0.60	0.31	18,010
2036	17,950	0.60	0.31	18,010
2037	17,950	0.60	0.31	18,010
2038	17,950	0.60	0.31	18,010

$MTCO_2e$ = metric tons of carbon dioxide equivalents

Transporting Waste and Other Materials

GHG emissions from transporting waste and other materials under the Modernized Operations Alternative are presented in Table H-27. GHG emissions from the aggregated CO_2, N_2O and CH_4 were calculated to be roughly 1,840 metric tons of CO_2e per year.

Total GHG Emissions

The GHGs produced from existing site-wide emissions (*see* Table H-23), construction and operation of new facilities (*see* Table H-30), and transport of waste and materials (*see* Table H-27) 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).

Consistent with ACAM assumptions, implementation of the Modernized Operations Alternative was assumed to occur in a five-year period. Loads from existing site-wide activities and from the No-Action Alternative were added to the transport of waste and materials shipments from the Modernized Operations Alternative. These fixed 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 (*see* Table H-31). GHG emissions from construction and operation of new facilities and transport of waste and materials would account for a six- to eight-percent annual increase in existing site-wide GHG emissions, a five-percent annual increase from the No-Action Alternative.

Table H-31 Modernized Operations Alternative Site-Wide Greenhouse Gas Emissions (rounded)

Year	$MTCO_2e$
2024	366,300
2025	367,300
2026	368,400
2027	369,500
2028	370,500
2029	377,300
2030	379,700
2031	382,200
2032	384,700
2033	387,300
2034	379,900
2035	379,900
2036	379,900
2037	379,900
2038	379,900

$MTCO_2e$ = metric tons of carbon dioxide equivalents

Estimated Costs

Emissions in Table H-30 were applied to the annual SC-GHG presented in Table H-22 to calculate site-wide the SC-GHG for the Modernized Operations Alternative at a 2024 present value with a 1.5-percent discount rate in 2020 dollars of $1.978 million ($1.147 million at a 2.0-percent discount rate and $697 million at a 2.5-percent discount rate) and an annualized value over the 15-year period at a 1.5-percent discount rate of $148 million ($89 million at a 2.0-percent discount rate and $56 million at a 2.5-percent discount rate) (*see* Table H-29). Of this total, roughly

$6.6 million of the annualized values at a 1.5-percent discount rate ($4 million at a 2.0-percent discount rate and $2.5 million at a 2.5-percent discount rate) would be expected from construction and operation of new facilities and transport of waste and materials.

Estimated Benefits

Displaced (offset) electricity from solar PV arrays would provide a reduction of GHG emissions under the Modernized Operations Alternative by reducing the demand for electricity from GHG-emitting sources. Conservative assumptions were used to calculate the benefits of solar PV arrays understanding that the total proposed area, 795 acres and associated 158.8 MWs, may not be constructed in the 15-years from 2024 to 2038. Instead, CO_2e offset by roughly half the proposed solar PV arrays (79.4 MWs) were assumed to be conservative. An estimated 136,568 MWh/yr would be associated with the 79.4 MW. Once operational, 123,451 metric tons of CO_2e would be offset annually by solar PV arrays proposed in 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 additional arrays were distributed across a five-year period 2029–2033. Spreading these benefits over this five-year period would result in an offset of nearly 988,000 metric tons of CO_2e over the SWEIS 15-year 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. The 2.0-percent discount rate 2024 present value would be $198 million with an annualized value of $22 million. The 2.5-percent discount rate 2024 present value would be $120 million with an annualized value of $14 million.

H.2.3.3 Expanded Operations Alternative

GHG emissions from the ongoing site-wide activities under the Expanded Operations Alternative were assumed to be similar to the No-Action Alternative. Changes in GHG emissions were quantified as described in this section. Activities addressed under the Expanded Operations Alternative would include those activities analyzed for the Modernized Operations Alternative plus projects and activities presented in Chapter 3, Section 3.4.

Heating and cooling; use of construction equipment during construction, demolition and remediation; land disturbance; and commuting personnel.

Table H-32 presents the ACAM output for the annual GHG emissions for construction and demolition activities in the Expanded Operations Alternative inclusive of the No-Action and Modernized Operations alternatives.

Table H-32 ACAM-Estimated Greenhouse Gas Emissions from the Expanded Operations Alternative Projects (metric tons per year rounded)

Year	Carbon Dioxide	Methane	Nitrous Oxide	$MTCO_2e$
2024	4,510	0.16	0.04	4,530
2025	5,570	0.21	0.06	5,600
2026	6,620	0.26	0.07	6,650
2027	7,690	0.30	0.09	7,730
2028	8,710	0.35	0.10	8,750
2029	15,350	0.49	0.16	15,400
2030	17,830	0.55	0.20	17,890
2031	20,330	0.61	0.25	20,390
2032	22,820	0.67	0.30	22,890
2033	25,330	0.73	0.34	25,400
2034	21,430	0.66	0.35	21,490
2035	22,610	0.69	0.37	22,690
2036	23,900	0.73	0.39	23,970
2037	25,130	0.76	0.41	25,200
2038	26,470	0.80	0.44	26,550

$MTCO_2e$ = metric tons of carbon dioxide equivalents

Transporting Waste and Other Materials

GHG emissions from transporting waste and other materials under the Expanded Operations Alternative are presented in Table H-27. GHG emissions from the aggregated CO_2, N_2O and CH_4 were calculated to be roughly 2,050 metric tons per year; a difference of nearly 320 metric tons per year compared with the No-Action Alternative.

Total GHG Emissions

The GHG emissions produced site-wide (*see* Table H-23), construction and operation of new facilities (*see* Table H-32) and transport of waste and materials (*see* Table H-27) were combined to quantify GHG emissions expected under the Expanded Operations Alternative for the 15-year analytical period. Loads (emissions) from existing facilities and transporting waste and materials were assumed to be equal to the No-Action Alternative for the first five years of the project life as described in Section H.2.3.2 for the Modernized Operations Alternative. 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 in Table H-33. GHG emissions from construction and operation of new facilities and transport of waste and materials would account for a roughly eight-percent annual increase in existing site-wide GHG emissions, a five-percent annual increase from the No-Action Alternative.

Table H-33 Expanded Operations Alternative Site-Wide Greenhouse Gas Emissions (metric tons per year rounded)

Year	CO_2e
2024	366,300
2025	367,300
2026	368,400
2027	369,500
2028	370,500
2029	377,300
2030	379,700
2031	382,200
2032	384,700
2033	387,300
2034	383,600
2035	384,800
2036	386,000
2037	387,300
2038	388,600

CO_2e = carbon dioxide equivalents

Estimated Costs

Emissions in Table H-33 were applied to the annual SC-GHG presented in Table H-22 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 SWEIS period at a 1.5-percent discount rate of $149 million. At a 2.0-percent discount rate, 2024 present value would be $1,153 million with an annualized value of $90 million. At a 2.5-percent discount rate, the 2024 present value would be $701 million with an annualized value of $57 million (*see* Table H-29). Of this total, roughly $7.4 million of the annualized value at a 1.5-percent discount rate ($4.5 million at a 2.0-percent discount rate and $2.8 million at a 2.5-percent discount rate) would be expected from construction and operation of new facilities and transport of waste and materials.

Estimated Benefits

Offset electricity from solar PV arrays would provide a reduction of GHG emissions under the Expanded Operations Alternative that would be equal to 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.

H.3 Embodied Carbon in Concrete from Construction Materials

LANL implements a variety of programs to decrease overall energy and water consumption (LANL 2024b). CEQ's NEPA Guidance on Consideration of GHG Emissions and Climate Change (88 FR 1196, January 9, 2023), proposes agencies consider additional mitigation measures including enhanced energy efficiency, lower-GHG-emitting technology, and reduced embodied carbon in construction materials. Embodied carbon—also known as embodied greenhouse gas

(GHG) emissions—refers to the amount of GHG emissions associated with upstream—extraction, production, transport, and manufacturing—stages of a product's life. Embodied carbon in concrete represents 10 percent of the GHG emissions from the industrial sector (EPA 2021), which represents nearly 33 percent of U.S. GHG emissions (EPA 2024b).

Embodied carbon in construction materials is an indirect effect of the proposed action. Emissions generated during the production of concrete are not controlled by NNSA. In the future however, NNSA may choose to use concrete that emits less GHGs during production. Quantifying embodied carbon in this SWEIS offers LANL an opportunity to document progress in achieving EO 14057's goal to promote use of construction materials with lower embodied carbon.

There are a variety of types of concrete. This analysis assumed a Portland-limestone cement consistent with current LANL construction activities. Embodied carbon in Portland-limestone cement is assumed to be 846 kg of CO_2e per metric ton (Waldman et al 2023).

H.3.1 Analyses

Concrete's embodied carbon was calculated for facility construction that would occur in the No-Action, Modernized Operations, and Expanded Operations alternatives. Table H-34 defines the proposed cubic yards of concrete for each alternative and the equivalent embodied carbon from concrete. Opportunities to use materials with reduced embodied carbon would be sought during construction of facilities.

Table H-34 Embodied Carbon from Concrete for the No-Action, Modernized Operations, and Expanded Operations Alternatives (rounded)

Alternative	Cubic Yards of Concrete	Embodied Carbon ($MTCO_2e$)
No-Action	89,000	56,600
Modernized Operations	275,000	175,000
Expanded Operations	65,000	41,300
TOTAL	**2,093,000**	**273,000**

$MTCO_2e$ = metric tons of carbon dioxide equivalents

The total concrete embodied carbon for all three alternatives over the 15-year SWEIS period was averaged to 18,000 metric tons of CO_2e annually. In 2019 cement plants reported 67 million metric tons of CO_2e, roughly 10 percent of the facility report industrial emissions that year (EPA 2021). The annually averaged embodied carbon from proposed construction activities in all three alternatives of this SWEIS would be 0.03 percent of the cement plant emissions reported in 2019.

H.4 References

BTS (Bureau of Transportation Statistics) 2023a. "Federal Exhaust Emissions Certification Standards for Newly Manufactured Gasoline- and Diesel-Powered Light Duty Vehicles." Available online: https://www.bts.dot.gov/content/federal-exhaust-emission-certification-standards-newly-manufactured-gasoline-and-diesel-1

BTS (Bureau of Transportation Statistics) 2023b. "Federal Exhaust Emissions Certification Standards for Newly Manufactured Gasoline- and Diesel-Powered Heavy Duty Vehicles." Available online: https://www.bts.dot.gov/content/federal-exhaust-emissions-certification-standards-newly-manufactured-gasoline-and-diesel

BTS (Bureau of Transportation Statistics) 2023c. "Estimated Average Vehicle Emissions Rates Vehicle by Vehicle Type Using Gasoline and Diesel." Available online: https://www.bts.gov/content/estimated-national-average-vehicle-emissions-rates-vehicle-vehicle-type-using-gasoline-and

CEJST (Climate and Economic Justice Screening Tool) 2024. "Climate and Economic Justice Screening Tool." Available online: https://screeningtool.geoplatform.gov/en/.

Climate Watch. 2022. *Climate Watch Data Explorer*. Available online: https://www.climatewatchdata.org/.

DOE (Department of Energy) 2023. Subject: Departmental Sustainability. DOE O 436.1A. Approved April 25, 2023. Available online: https://sustainabilitydashboard.doe.gov/PDF/Resources/o436.1A.pdf. Accessed April 2024.

DOE (Department of Energy) 2024a. Combating the Climate Crisis. Available online: https://www.energy.gov/combating-climate-crisis. Accessed April 2024.

DOE Order 436.1A. "Departmental Sustainability." Approved April 25, 2023. Available online: https://www.directives.doe.gov/directives-documents/400-series/0436.1-BOrder-a/@@images/file

EPA (U.S. Environmental Protection Agency) 2021. *U.S. Cement Industry Carbon Intensities*. EPA 430-F-21-004. Available online: https://www.epa.gov/system/files/documents/2021-10/cement-carbon-intensities-fact-sheet.pdf. Accessed April 2024.

EPA (U.S. Environmental Protection Agency) 2022. "Initial List of Hazardous Air Pollutants with Modifications." https://www.epa.gov/haps/initial-list-hazardous-air-pollutants-modifications

EPA (U.S. Environmental Protection Agency) 2022. *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2020*. Available online: https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks.

EPA (U.S. Environmental Protection Agency) 2023a. *eGrid Summary Tables 2021.*

EPA (U.S. Environmental Protection Agency) 2023b. *Greenhouse Gases Equivalencies Calculator – Calculations and References.* Accessed online: https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references.

EPA (U.S. Environmental Protection Agency) 2023c. *Supplementary Material for the Regulatory Impact Analysis for the Final Rulemaking, "Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review.* EPA-HQ-OAR-2021-0317. Available online: https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf.

EPA (U.S. Environmental Protection Agency) 2024a. *NAAQS Table*. Available online: https://www.epa.gov/criteria-air-pollutants/naaqs-table.

EPA (U.S. Environmental Protection Agency) 2024b. "What is Embodied Carbon?" Available online: https://www.epa.gov/greenerproducts/what-embodied-carbon#:~:text=Embodied%20carbon%E2%80%94also%20known%20as,stages%20of%20a%20product%27s%20life.

EPA (U.S. Environmental Protection Agency) 2024c. *Revisions to Standards for the Open Burning/Open Detonation of Explosive Wastes*. Available online: https://www.epa.gov/system/files/documents/2024-04/slides_for_the_public_webinar_for_ob_od_proposal_april_18_2024_v2.pdf.

Executive Order 12898. "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." Feb. 16, 1994. Available online: https://www.archives.gov/files/federal-register/executive-orders/pdf/12898.pdf

Executive Order 13175. "Consultation and Coordination with Indian Tribal." Nov. 6, 2000. Available online: https://www.achp.gov/digital-library-section-106-landing/executive-order-no-13175-consultation-and-coordination-indian

Executive Order 13990. "Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis." January 20, 2021. Available online: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/20/executive-order-protecting-public-health-and-environment-and-restoring-science-to-tackle-climate-crisis/

Executive Order 14008. "Tackling the Climate Crisis at Home and Abroad." January 27, 2021. Available online: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/01/27/executive-order-on-tackling-the-climate-crisis-at-home-and-abroad/

Executive Order 14057. "Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability." January 19, 2024. Available online: https://www.whitehouse.gov/briefing-room/presidential-actions/2021/12/08/executive-order-on-catalyzing-clean-energy-industries-and-jobs-through-federal-sustainability/

FreightWaves 2021. *What is the carbon footprint of a truck?* Available online: https://www.freightwaves.com/news/what-is-the-carbon-footprint-of-a-truck

HHS (U.S. Department of Health and Human Services) 2024. "Climate Change & Health Equity, and Environmental Justice at HHS." Available online: https://www.hhs.gov/climate-change-health-equity-environmental-justice/index.html

GAO (U.S. Government Accountability Office) 2022. *National Security Snapshot: Climate Change Risks to National Security*. GAO-22-105830. Available online: https://www.gao.gov/products/gao-22-105830

IPCC (Intergovernmental Panel on Climate Change) 2014. *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland.

IWG-SCGHG (Interagency Working Group on Social Cost of Greenhouse Gases) 2021. *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide*. Interim Estimates under Executive Order 13990. June 3. Available online: https://www.whitehouse.gov/wp-content/uploads/2021/06/Social-Cost-of-Greenhouse-Gas-Emissions.pdf

Jay, A.K., A.R. Crimmins, C.W. Avery, T.A. Dahl, R.S. Dodder, B.D. Hamlington, A. Lustig, K. Marvel, P.A. Méndez-Lazaro, M.S. Osler, A. Terando, E.S. Weeks, and A. Zycherman. 2023. "Ch. 1. Overview: Understanding risks, impacts, and responses." In *Fifth National Climate Assessment*. Crimmins, A.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, B.C. Stewart, and T.K. Maycock, Eds. U.S. Global Change Research Program, Washington, DC, USA. https://doi.org/10.7930/NCA5.2023.CH1 . Available online: https://nca2023.globalchange.gov/

LAC (Los Alamos County). 2023. *Greenhouse Gas Emissions Inventory and Climate Action Plan*. Available online: https://www.losalamosnm.us/Initiatives/Sustainability-and-Conservation-Initiatives/Greenhouse-Gas-Emissions-Inventory-and-Climate-Action-Plan. Accessed April 2024.

LANL (Los Alamos National Laboratory) 2019a. "Los Alamos National Laboratory 2019 Title V Permit Renewal Application." Available online: https://www-archive.env.nm.gov/air-quality/wp-content/uploads/sites/2/2020/07/AQBP-Final-PDF-A_P100_R3_LANL.pdf

LANL (Los Alamos National Laboratory) 2019b. *SWEIS Yearbook 2017 Comparison of 2017 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-19-20119. February 20. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-19-20119

LANL (Los Alamos National Laboratory) 2020. *SWEIS Yearbook 2018 Comparison of 2018 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-19-32158. February 18. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-19-32158

LANL (Los Alamos National Laboratory) 2021. *SWEIS Yearbook 2019 Comparison of 2019 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-20-30217. February 9. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-20-30217

LANL (Los Alamos National Laboratory) 2022a. *Los Alamos National Laboratory 2021 Annual Site Environmental Report*. LA-UR-22-29103. Revision 2. September 28. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-29103

LANL (Los Alamos National Laboratory) 2022b. *SWEIS Yearbook 2020: Comparison of 2020 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-22-20010. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-20010

LANL (Los Alamos National Laboratory) 2022c. *Emissions Inventory Report Summary for Los Alamos National Laboratory for Calendar Year 2021*. LA-UR-22-30520. October. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-30520

LANL (Los Alamos National Laboratory) 2023a. *SWEIS Yearbook 2021 Comparison of 2021 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-22-32473. January. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-22-32473

LANL (Los Alamos National Laboratory) 2023b. A net-zero national lab. Published November 2023. Available online: https://discover.lanl.gov/publications/national-security-science/2023-winter/a-net-zero-national-lab.

LANL (Los Alamos National Laboratory) 2024a. *SWEIS Yearbook 2022: Comparison of 2022 Data with Projections of the 2008 Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory*. LA-UR-24-22037. May 1. Rev. 1. Available online: https://permalink.lanl.gov/object/tr?what=info:lanl-repo/lareport/LA-UR-24-22037

LANL (Los Alamos National Laboratory) 2024b. *The Sustainability Program at LANL*. Available online: https://environment.lanl.gov/sustainability/goals-and-progress/

LANL (Los Alamos National Laboratory) 2024c. *Fiscal Year 2023 Greenhouse Gas Emissions Data as Reported to the Department of Energy, DOE Dashboard*. UI-DO:2024-009. Memorandum Sustainability Program, UI-OSI.

NAS (National Academies of Sciences, Engineering, and Medicine) 2017. *Valuing Climate Damages: Updating Estimation of the Social Cost of Carbon Dioxide.* Washington, DC: The National Academies Press. Available online: https://nap.nationalacademies.org/catalog/24651/valuing-climate-damages-updating-estimation-of-the-social-cost-of

NASA (National Aeronautics and Space Administration) 2021. "2020 Tied for Warmest Year on Record, NASA Analysis Shows." Available online: https://www.nasa.gov/press-release/2020-tied-for-warmest-year-on-record-nasa-analysis-shows

New Mexico EMNRD (Energy, Minerals, and Natural Resource Department, Climate Policy Bureau). 2024. *New Mexico Climate Adaptation and Resilience Plan*. Contributing Authors: Finkelstein, R.; M. Lohmann; R. Gomez; A. Petersen; M. Ferris; R. Pierce; A. Bell; T. Harrison; T. Even; K. Williams; A. Sussman; S. Reece; M. Meko; D. DuBois; D. Ferguson; K. Glabo. January. Available online: https://www.climateaction.nm.gov/wp-content/uploads/sites/39/2024/04/NM-C.A.R.P._03.06.24-1.pdf

NMED (New Mexico Environment Department) 2019. "Air Quality Bureau Title V Operating Permit P100-R2M4 shall be attached to P100-R2M1."

NMED (New Mexico Environment Department) 2024. "Climate Change Bureau." Available online: https://www.env.nm.gov/climate-change-bureau/.

New Mexico Office of the Governor. 2019. *Executive Order on Addressing Climate Change and Energy Waste Prevention. Executive Order 2019-003*. Available online: https://www.governor.state.nm.us/wp-content/uploads/2019/01/EO_2019-003.pdf

New Mexico Office of the Governor 2021. *Progress & Recommendations by New Mexico Interagency Climate Change Task Force*. Available online: https://www.climateaction.nm.gov/wp-content/uploads/sites/39/2023/07/NMClimateChange_2021_final.pdf

NNSA (National Nuclear Security Administration) 2008. *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE/EIS-0380. May. Available online: https://www.energy.gov/nepa/downloads/eis-0380-final-site-wide-environmental-impact-statement

NNSA (National Nuclear Security Administration) 2000. *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico*. DOE-EA-1329. August 10. Available online: https://www.energy.gov/sites/default/files/nepapub/nepa_documents/RedDont/EA-1329-FEA-2000.pdf.

NNSA (National Nuclear Security Administration) 2001. *Finding of No Significant Impact for the Wildfire Hazard Reduction and Forest Health Improvement Program at Los Alamos National Laboratory, Los Alamos, New Mexico.* Available online: https://www.energy.gov/sites/default/files/nepapub/nepa_documents/RedDont/EA-1329-FONSI-02-2001.pdf.

NNSA (National Nuclear Security Administration) 2020. *Supplement Analysis of the 2008 Site-Wide Environmental Impact Statement for the Continued Operation of Los Alamos National Laboratory*. DOE/EIS-0380-SA-06. September 1. Available online: https://www.energy.gov/nepa/downloads/doeeis-0380-sa-06-final-supplement-analysis

NOAA (National Oceanic and Atmospheric Administration). 2022a. *Climate Change: Atmospheric Carbon Dioxide. Science Information for a Climate-Smart Nation*. Available on: https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide.

NOAA 2022b. *Trends in Atmospheric Methane*. Recent Global CH_4. Global Greenhouse Gas Reference Network. Earth System Research Laboratory. Global Monitoring Division. Available on: https://gml.noaa.gov/ccgg/trends_ch4/.

NOAA. 2024. *Climate Change: Global Temperature*. Published January 18, 2024. Available online: https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature

NREL (National Renewable Energy Laboratory) 2023. "Results of PVWatts Model."

Propst, S.C. 2019. New Mexico's Energy Transition Act. Available online: https://www.nmlegis.gov/handouts/NMFA%20091820%20Item%201%20NM%20Energy%20Transition%20Act.pdf

State (U.S. Department of State) 2019. *On the U.S. Withdrawal from the Paris Agreement*. Available online: https://2017-2021.state.gov/on-the-u-s-withdrawal-from-the-paris-agreement/.

UNCC (United Nations Climate Change) 2023. *The Paris Agreement*. Available online: https://unfccc.int/process-and-meetings/the-paris-agreement

USGCRP (U.S. Global Change Research Program) 2016. *The Impacts of Climate Change on Human Health in the United States: A Scientific Assessment*. Crimmins, A., J. Balbus, J.L. Gamble, C.B. Beard, J.E. Bell, D. Dodgen, R.J. Eisen, N. Fann, M.D. Hawkins, S.C. Herring, L. Jantarasami, D.M. Mills, S. Saha, M.C. Sarofim, J. Trtanj, and L. Ziska, Eds. Washington, DC, 312 pp. http://dx.doi.org/10.7930/J0R49N. Available online: https://health2016.globalchange.gov/

USGCRP (U.S. Global Change Research Program) 2017. *Climate Science Special Report: Fourth National Climate Assessment (NCA4)*. Volume I. D. J. Wuebbles, D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock, Eds. Washington, DC, 470 pp. DOI: 10.7930/J0J964J6. Available online: https://science2017.globalchange.gov

USGCRP (U.S. Global Change Research Program) 2018. *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II*. Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart Eds. Washington, DC, 1515 pp. doi: 10.7930/NCA4.2018. Available online: https://nca2018.globalchange.gov/

Waldman, B., Hyatt, A., Carliele, S. Palmeri, J., and Simonen, K. 2023. 2023 *Carbon Leadership Forum North American Material Baselines, Category Appendices* (version 2). Carbon Leadership Forum, University of Washington. Seattle, WA. August 2023. Available online: https://carbonleadershipforum.org/clf-material-baselines-2023/.

APPENDIX I
Categorical Exclusion Summary

CONTENTS

ACRONYMS AND ABBREVIATIONS

ARM	Atmospheric Radiation Measurement
CFR	Code of Federal Regulations
CT	computed tomography
DOE	U.S. Department of Energy
HVAC	heating, ventilation, and air conditioning
LANL	Los Alamos National Laboratory
LIDAR	light detection and ranging
NDA	nondestructive assay
NEPA	National Environmental Policy Act
PCB	polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act
SOP	standard operating procedure
SWEIS	Site-Wide Environmental Impact Statement
SWMU	solid waste management unit
TA	Technical Area
UAS	unmanned aerial systems
USDOT	U.S. Department of Transportation

I CATEGORICAL EXCLUSION SUMMARY

The U.S. Department of Energy (DOE) National Environmental Policy Act (NEPA) Implementing Procedures identify classes of actions that DOE has determined do not individually or cumulatively have a significant effect on the human environment (Title 10 Code of Federal Regulations [CFR] Part 1021 Subpart D). Appendix B of Subpart D, "Categorical Exclusions Applicable to Specific Agency Actions," identifies conditions that are integral elements of the classes of action that are categorically excluded. These conditions are that a proposed activity would not threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety or health, including requirements of DOE and Executive Orders; require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities; disturb hazardous substances, pollutants, or contaminants that preexist in the environment such that there would be uncontrolled or unpermitted releases; or adversely affect environmentally sensitive resources. These classes of items are normally "categorically excluded" from the need for the preparation of an environmental assessment or environmental impact statement.

The Los Alamos National Laboratory (LANL) NEPA review history has shown that there are groups of actions or activities that meet the standard for receiving a categorical exclusion from further NEPA analysis. These activities range from facility work, such as routine maintenance and safety and environmental improvements, to research and development activities in chemistry, materials science, detector technology, geology, and other areas.

Umbrella categorical exclusions were incorporated into Appendix L of the 2008 SWEIS, which provided a summary of activities that have previously been categorically excluded from additional NEPA analyses. In July 2009, the DOE/NNSA NEPA Compliance Officer formalized the direction to LANL to cite Appendix L for actions that clearly fell within the actions described in the appendix. This coverage was to be cited as "categorically excluded from the need to prepare either an environmental assessment or an environmental impact statement (EIS), per 10 CFR 1021, Subpart D, Appendix B [x], as further identified in the 2008 LANL SWEIS (DOE/EIS-0380), Appendix L."

The following sections describe the range and types of activities that are performed at LANL that would typically receive a categorical exclusion.

I.1 Facility Operations and Support Activities

Many activities are conducted at LANL to support research and development, including maintaining, preserving, and upgrading facilities and infrastructure, and maintaining general shop capabilities. These support activities range from routine maintenance and improvements for personnel safety and environmental health to support structure additions, changes, and upgrades and carpentry and electronic shop operations. These are described in detail below with the Applicable DOE Categorical Exclusion from DOE 10 CFR 1021, Subpart D.

I.1.1 General Agency Actions

LANL personnel perform administrative, planning, contractual, non-experimental research, and technical assistance or exchange activities. The activities include general LANL business activities, award of contracts, a variety of information gathering techniques including literature surveys, inventories, site visits, and audits; data processing and analysis, including but not limited to statistical analyses, simulation, and computer modeling; document preparation; information disseminated by electronic and hard copy publication and distribution, oral presentation, and electronic communication; technical advice, assistance, and exchange, including technical consulting, outreach, and education to international, national, state, and local organizations; and planning for emergency preparedness or documentation prepared in response to formal requirements.

I.1.1.1 Routine Business Actions

Description: Actions necessary to support the normal conduct of LANL business limited to administrative, financial, and personnel actions, including:

- financial management and planning
- program and project planning
- auditing and assessment
- administrative oversight
- janitorial services
- document destruction
- supplies purchase and delivery
- classroom-style training

Applicable DOE Categorical Exclusion: A1, Routine DOE Business Actions

I.1.1.2 Awards of Certain Contracts

Description: LANL awards of contracts for technical support services, management and operation of a government-owned facility, and personal services. Examples of contracts include technical, professional, or consulting contracts; purchase of equipment, goods, and supplies; technical support contracts awarded to subcontractors; leasing facilities or equipment

Applicable DOE Categorical Exclusion: A8, Awards of Certain Contracts

I.1.1.3 Information Gathering, Analysis, and Dissemination

Description: LANL performs information gathering (including, but not limited to, literature surveys, inventories, site visits, and audits), data analysis (including, but not limited to, computer modeling), document preparation (including, but not limited to, conceptual design, feasibility studies, and analytical energy supply and demand studies), and information dissemination (including, but not limited to, document publication and distribution, and classroom training and informational programs), but not including site characterization or environmental monitoring.

Examples of information gathering:

- accessing published data and literature through online databases and clearinghouses
- exchanging information and data at professional conferences
- soliciting data, published information, and expertise from trained professionals and recognized experts
- auditing internal and external scientific projects and/or programs

Examples of data analyses:

- extracting, classifying, inspecting, cleaning, transforming, or modeling data
- application of statistical, structural, exploratory, and confirmatory models
- computer simulation and visualization data mining

Examples of information dissemination:

- publishing data, information, and research results
- sharing data, information, and research results among colleagues, universities, government agencies, other institutions, and the public via print, electronic, or other media

Applicable DOE Categorical Exclusion: A9, Information Gathering, Analysis, and Dissemination

I.1.1.4 Technical Advice and Assistance to Organization

Description: LANL provides technical advice, training, and planning assistance to international, national, state, and local organizations.

Examples of technical assistance and exchange include: Providing technical assistance to a university student or researcher; advising a Native American tribe based on the findings of scientific research; providing technical assistance and training on the operation of a scientific instrument to foreign or domestic visitors provided export control requirements are met; serving on multidisciplinary teams supporting other governmental agencies; identifying and analyzing another country's energy, security, and environmental resources, needs, and options; appointment to advisory groups or participation in workshops.

Applicable DOE Categorical Exclusion: A11, Technical Advice and Assistance to Organization

I.1.1.5 Emergency Preparedness Planning

Description: LANL conducts emergency preparedness planning activities, including, but not limited to, the designation of onsite evacuation routes.

Examples of emergency preparedness planning include support emergency preparedness, response activities and offsite recovery associated with a potential release of radiological or nonradiological materials from the DOE sites; maintaining emergency preparedness plans for onsite and offsite actions, training and operations support to provide reasonable assurance that the health and safety of the populace within the 10-mile emergency planning zone surrounding LANL are protected.

Applicable DOE Categorical Exclusion: A12, Emergency Preparedness Planning

I.1.1.6 Procedural Documents

Description: Administrative, organizational, or procedural policies, orders, notices, manuals, and guides.

Examples of procedural documents include preparing of plans or internal LANL documents that assist in the planning or organization of LANL operations; preparing documents in support of or modification to formal policies, orders, notices, manuals, and guides.

Applicable DOE Categorical Exclusion: A13, Procedural Documents

I.1.1.7 Approval of Technical Exchange Arrangements

Description: LANL approves technical exchange arrangements for information, data, or personnel with other countries or international organizations (including, but not limited to, assistance in identifying and analyzing another country's energy resources, needs and options).

Examples of technical assistance and exchange include; providing technical assistance to a university student or researcher; advising a Native American tribe based on the findings of scientific research providing technical assistance and training on the operation of a scientific instrument while hosting an international scientist at LANL; serving on multidisciplinary teams supporting other governmental agencies; identifying and analyzing another country's energy, security, and environmental resources, needs, and options; appointment to advisory groups or participation in workshops.

Applicable DOE Categorical Exclusion: A14, Approval of Technical Exchange Arrangements

I.1.2 Routine Maintenance Activities

Description: Maintenance activities are frequently and routinely performed for operational support of LANL facilities and property. These actions range from ongoing custodial services to corrective and preventive actions required to maintain and preserve buildings, structures, roads, infrastructures, and equipment in a condition suitable for fulfillment of their designated purpose. These activities are intended to maintain current operations and do not substantially extend the useful life of a facility or allow for substantial upgrades or improvements. Routine maintenance includes maintenance, repair, replacement in kind, removal, relocation, fabrication, and installation actions. These activities take place at all LANL technical areas and occasionally at offsite leased facilities.

Applicable DOE Categorical Exclusions: B1.3 Routine Maintenance, B1.4 Air Conditioning Systems for Existing Equipment, B1.7 Electronic Equipment, B1.33 Stormwater Runoff Control, and B5.4 Repair or Replacement of Pipelines

LANL performs routine maintenance on its facilities. Examples of these actions include, but are not limited to, the following:

- correction of drainage problems around buildings
- minor/spot decontamination of equipment, rooms, and hot cells by actions including wiping, using strippable latex, and vacuuming
- repair of minor storm water erosion controls, retrofitting low impact development projects in developed areas, and storm water management associated with new development.(examples include vegetated infiltration, and use of swales, control basins, and filter basins)
- painting/plastering/staining/waterproofing of interior and exterior surfaces
- physical rearrangements of equipment
- provide temperature, humidity, and electrical equipment and controls to maintain ambient environment for proper operation of equipment
- testing/repair of back flow preventers
- testing/repair of emergency lighting
- maintenance and repair of
  - LANL facilities
  - cafeteria equipment
  - compressed air systems (breathing air, liquid nitrogen, argon)
  - construction equipment doors, windows, walls, ceilings, roofs, floors, stairways
  - electrical equipment (compressors, generators, transformers, pumps)
  - elevators

- fencing, gates
- filtration media in wastewater treatment processes
- fire alarm equipment (heat detectors, smoke detectors, alarm panels)
- fire control equipment (fire doors and fire dampers)
- fire suppression equipment (sprinklers, standpipes, extinguishing systems)
- lightning protection equipment
- locks and cores
- mechanical testing equipment
- monitoring equipment
- office equipment
- pressure vessels
- product storage
- safety equipment (alarm systems, eyewash stations, showers, self- contained breathing apparatus)
- security systems (security alarm systems, camera equipment, towers)
- spill containment systems
- steam, condensate, chill water, chlorination, and reverse osmosis/deionization systems
- structural platforms, catwalks, walkways, concrete pads

I.1.2.1 Roads, Vehicles, and Grounds

LANL performs routine maintenance on the roads, vehicles and grounds for which it is responsible. Examples of these actions include, but are not limited to, the following:

- installation and repair of parking signs, safety signs, direction markers, traffic signs
- installation and repair of culverts and other means of road drainage
- regrading of road shoulders and bar ditches
- surfacing /repair of roads and parking lots
- maintenance/repair of
  - guardrails, traffic barriers, traffic signals, curbs, gutters, sidewalks
  - highway vehicles, snow removal equipment, emergency response vehicles, drill rigs, trucks, construction vehicles, buses, tractors
  - pedestrian and vehicular bridges
  - unpaved access roads, fire roads

- soil conservation efforts, such as
  - application of fertilizers and other soil enhancements
  - ditch cleaning
  - erosion control
  - placement of straw waddles
  - reseeding
  - revegetation
  - hydromulching
  - soil stabilization

- repair of slope stabilization and rock fall techniques, such as
  - replacement of draped or pinned mesh

  - replacement or repair of rock dowels and rock anchors
  - repair of the existing shotcrete

I.1.2.2 Utilities

LANL performs routine maintenance on the utilities in and around its facilities. Examples of these utilities include, but are not limited to, the following:

- communications systems
- cooling towers
- electrical wiring, gauges, valves, switches
- exhaust/drain systems
- gas lines
- heating, ventilation, and air conditioning (HVAC) systems and components (electrical, solar, natural gas, forced air)
- interior and exterior lighting systems
- plumbing
- steam and boiler plant equipment, natural gas heaters
- telephone or electrical distribution utility poles, cables, insulators
- unused equipment and facilities (disconnect utilities)

LANL repairs, replaces, upgrades, rebuilds, and relocates pipelines within existing rights-of-way, provided that the actions are in accordance with applicable requirements.

I.1.2.3 Routine Inspections, Support Services, and Custodial Services

Routine inspections/analyses, including:

- asbestos surveys
- environmental monitoring, sampling, and analysis (onsite, local, and regional agricultural products, plants, animals, water, soil, and sediments)
- equipment inspections
- identification of PCB containing equipment
- routine sampling for chemical and radiation hazards
- safety inspections
- tests, inspections of fire protection systems
- water supply sampling and analysis

Support services for facility operation, including:

- delivery of supplies and equipment
- destructive/nondestructive testing of products for quality control or quality assurance purposes
- equipment calibration
- laundry/dry cleaning
- material shipping in accordance with U.S. Department of Transportation (USDOT) regulation
- mobile equipment gas/fuel service
- moving furniture

- pick-up and recycling of paper, scrap metal, surplus equipment
- printing/photographic services
- removal of contaminated expendable supplies (labware, gloves, clothing) and treatment/disposal in permitted facilities
- removal of outmoded, inadequate, underutilized, unused, or abandoned equipment, machinery, vehicles, and fixtures (ductwork, pipes, lighting, wiring) for salvage or disposal
- safety, emergency response, and other worker training
- testing and certification of technicians
- transportation of excess chemicals for reuse on site
- waste transportation and permitted treatment/disposal for existing waste streams resulting from routine maintenance and custodial activities
- custodial services

Cleaning of offices and other facilities, including:

- landscaping, lawn care including weed mitigation and mowing
- snow removal, road sanding (using sand, salt or other materials)
- trash collection
- vegetation and pest control in accordance with regulations

I.1.3 Safety, Environmental, and Equipment Improvements

Description: LANL routinely conducts safety, security, and environmental improvements to facilities, including installation of and improvements to equipment for personnel safety and health. Other environmental improvements include minor operational changes and equipment additions or modifications that reduce the volume of waste produced and facilitate reuse and recycling of materials. These activities are conducted at all technical areas, including leased spaces outside the LANL site boundaries and do not result in a significant change in the expected useful life, design capacity, or function of the modified facility.

Applicable DOE Categorical Exclusions: B1.35 Drop-off, Collection, and Transfer Facilities for Recyclable Materials, B2.1 Workplace Enhancements, B2.2 Building and Equipment Instrumentation, B2.3 Personnel Safety and Health Equipment, and B2.5 Facility Safety and Environmental Improvements

I.1.3.1 Facility Safety and Environmental Improvements

LANL reduces risks of personnel injury by installation, replacement, modification, and upgrade of:

- alarm systems and monitors
- anchors/bolts/braces/brackets/safety chains for equipment and furniture; pipe hangers and brackets
- bollards or other posts to prevent vehicles from crossing
- bottled gas racks
- cable trays and covers
- cages for controlled access equipment
- cages for sprinklers, lightning, ladders, and similar equipment
- chemical supply cabinets

- compressed gas regulators
- continuous air monitors (CAMs)
- convex traffic mirrors (personnel, vehicles)
- door or equipment interlocks/disconnects
- electrical wiring, electrical components, and electrical safety devices (e.g., ground fault circuit interrupters, circuit breakers, conduits, surge protectors, outlet covers, outlet strips, fusible links, permanent wiring)
- emergency exits
- emergency shutoffs
- fencing of areas with safety hazards
- fire protection and control systems (detectors, sprinklers, standpipes, fire doors, fire extinguishers)
- flashback protectors
- floodlights and safety lighting
- gratings and plates over wall, ceiling, or floor openings
- guard rails, stair rails
- guards and other shields for equipment with moving parts (toe boards, guards for pulleys, pump shafts, fans, belts)
- handicap facilities (access ramps, toilets, sinks, handrails)
- inspection ports on equipment
- lightning protection systems
- non-skid flooring and steps
- physical barriers between waste handling/staging areas and worker/operations areas
- radiation shielding
- shock absorbers, bumpers, and stops on tracks, trolleys, roller drawers, cranes, hoists and similar equipment
- spark arrestors
- stairs, ladders, guardrails, handrails, walkways, and supports
- transformers, capacitors, generators and other small power supply systems
- wind socks
- wire glass windows, vision panels

I.1.3.2 Reducing Safety Risks

LANL reduces safety risks at its facilities by:

- designating or installing satellite waste storage areas (areas for storage of less than 55 gallons of non-acutely hazardous waste and less than one quart of acutely hazardous waste)
- improving containment (such as tanks, drums, containers, enclosures) of radioactive or hazardous materials
- installing or improving inert atmosphere supplies to areas using flammable, pyrophoric, or explosive materials
- installing or improving remote handling equipment
- installing, improving, or replacing backup (redundant) power supplies and safety systems

- installing, modifying, and improving safe, secure storage areas for radioactive and fissile material in existing facilities currently used for activities involving the stored material
- providing access to equipment, pipes, monitors, and filters for repairs and inspections
- providing adequate fire protection capabilities (fire detection and alarm systems; fire suppression systems)
- providing sanitary waste handling (sanitary holding tanks, septic tank systems, waste collection systems, lift stations, backflow preventers)
- providing structural bracing for reduction of seismic or other geological or meteorological hazards
- segregating incompatible process or waste materials (e.g., by installing firewalls or physically relocating materials)
- segregating previously common air exhaust, potable water, industrial water, wastewater, and fire control systems for different process areas
- separating radioactive materials management areas from offices and other areas where radioactive material control is not required
- upgrading components by replacing them with parts that have improved safety controls or are less susceptible to failure

I.1.3.3 Reducing Risks to the Public

LANL reduces risks to the public by reducing amounts of regulated substances in air emissions or water effluents by:

- reducing or eliminating contaminants in outfalls
- installing, modifying, replacing, removing, or improving
  - above and underground storage tanks, if there is no evidence of leakage
  - air and water filtration devices
  - effluent holding tanks, containment/release valves
  - ion-exchange devices
  - pH-adjustment and deionization systems
  - sand filters, flash tanks, pH neutralization tanks, aeration basins, and similar control systems in water/sewage treatment plants and steam plants
  - sanitary holding tanks, septic tank systems
  - scrubbers
  - settling tanks, equalization basins
  - spill control and containment structures
  - stacks and stack monitors
  - water disinfection tanks

I.1.3.4 Building and Equipment Instrumentation

LANL installs, modifies, and improves building and equipment instrumentation to protect human health and safety. This instrumentation includes, but is not limited to:

- announcement and emergency warning systems
- communications systems
- computer systems
- control systems to provide automatic shutdown

- criticality and radiation monitors and alarms
- float valves and shutoffs on tanks
- monitors and alarms for hazardous/radioactive substance concentration levels
- monitors and gauges on underground storage tanks and other product/waste storage containment structures
- nondestructive assay instruments (e.g., neutron counting instruments, gamma/x-ray counting instruments, calorimeters)
- oxygen concentration monitors
- pH probes/monitors
- pressure gauges
- pressure relief and control valves
- remote control panels
- remote monitoring systems
- safeguards and security equipment (badge readers, palm readers, outdoor lighting, camera mounts/towers, alarms and surveillance systems)
- scanning and alarm monitoring wiring and other liquid level gauges
- substation recording equipment

I.1.3.5 Personnel Safety and Health Equipment

LANL installs, modifies, and improves its environmental systems, equipment, and controls including, but not limited to, the following systems:

- HVAC equipment and ductwork
- humidifiers/dehumidifiers/air dryers for humidity control
- air and water filtration devices (at intake and release points)
- surge protectors and power conditioning
- uninterruptible power supplies

LANL reduces potential personnel exposures by installing, modifying, and improving the exhaust systems for its existing operations. Quantities of emitted substances and rates of emission are not increased, nor are new types of pollutants be produced as a result of these upgrades. Exhaust systems include, but are not limited to, the following:

- air filtration systems
- ducts
- equipment for maintaining positive air pressure flow
- exhaust gas monitors
- fan controls
- fans
- fume hoods
- gloveboxes

LANL installs, modifies, replaces, or stores equipment and utilities to facilitate recycling of and decreased use of materials. Examples of these actions include, but are not limited to, the following:

- filtration systems to remove particulates and permit reuse of liquid or solid constituents
- distillation systems to separate and/or recover liquids of different degrees of volatility (for example, acids, solvents, etc.)

- piping systems to allow reuse of fluids (for example, cooling water, lubricants, machining oils, etc.)
- recovery systems to precipitate or collect materials (for example, silver in photo processing systems, lead, solvents, etc.)
- devices for decreasing the use of water (water-saving toilets, low-flow shower head, etc.)
- storage for chemicals to be reused or recycled
- storage for other materials to be reused or recycled, such as shielding blocks

LANL provides improved personnel access to safety equipment by installation of, improvements to, or replacement of:

- breathing air supply ports and lines
- eye wash stations and safety showers
- first aid kits
- protective clothing cabinets
- safety line rigging
- scaffolding
- self-contained breathing apparatus/respirator racks and cabinets
- spill kits

LANL reduces waste production by installing equipment and implementing operational changes that

- identify waste streams and waste minimization options in project planning stages
- consolidate work activities to limit wastes generated from entry/exit or start/stop processes
- permit the use of smaller quantities of hazardous or radioactive materials to achieve the same results as do larger quantities of the same materials
- permit the use of microchemistry techniques to reduce chemical wastes
- substitute nonhazardous for hazardous materials to avoid production of hazardous or mixed waste
- substitute materials so that existing waste treatment can be more efficient and effective
- substitute reusable equipment and materials for disposable/one-time use items
- substitute radionuclides with short half-lives for those with long half-lives so that on- site decay
- eliminate radioactive waste
- modify processes so that resulting waste streams are more easily treated or contain more easily recycled constituents
- separate co-mingled waste streams
- reduce the volume of liquid materials used (including water)
- compact solid waste to reduce volumes
- establish tool, equipment, and material staging areas in controlled areas to prevent unnecessary contamination

I.1.4 Support Activities

Description: LANL sites, constructs, relocates, and operates small-scale support buildings and structures at all technical areas, including leased spaces outside the LANL site boundaries. Other activities include relocating structures, contents of structures, and processes; modifying support structures to provide space and furnishings necessary for support activities and to enhance workplace habitability; constructing short new access roads or modifying existing access roads to improve access; and decontaminating and decommissioning vacant structures.

Applicable DOE Categorical Exclusions: B1.13 Pathways, short access roads, and rail lines, B1.15 Support buildings, B1.22 Relocation of buildings, B1.23 Demolition and disposal of buildings, B1.27 Disconnection of utilities, B1.28 Placing a facility in an environmentally safe condition,, B1.31 Installation or Relocation Of Machinery And Equipment, B2.1 Workplace Enhancements, and B2.2 Building and equipment instrumentation

I.1.4.1 Support Buildings

LANL sites, constructs, relocates and operates small-scale support buildings and support structures within or contiguous to a developed area. Examples of these structures include, but are not limited to, the following:

- small permanent buildings
- transportables
- transportainers
- lockers
- tension domes
- temporary structures for field work

The structures are used for activities supporting the main scientific research and development mission of LANL. Support structures include, but are not limited to, the following:

- cafeterias, kitchens, lunchrooms
- control rooms and guard stations
- data processing facilities
- electronic equipment testing, fabrication, and repair shops
- substations
- garages for equipment and vehicles (forklifts, dump trucks, passenger vehicles, vans, emergency response vehicles)
- health services facilities
- libraries, museums, exhibit areas
- mechanical property testing shops (provided no explosive or radioactive materials are used)
- offices
- passageways
- photographic processing darkrooms (provided hazardous waste recovery systems are connected to sanitary drainlines)
- radio dispatch facilities
- recreation facilities, exercise/fitness facilities
- security, safety, and environmental monitoring stations
- shipping and receiving facilities for commercial materials, laboratory supplies and standards

- shipping and receiving facilities for soil, rock, and other site characterization and monitoring samples
- shops for such activities as carpentry, welding, calibration, printing and machining
- solid waste compaction (excluding radioactive, hazardous, or explosive waste)
- storage space for materials, equipment, and supplies (computer components, radio and electronic equipment, compressed gases, custodial supplies, tools, janitorial supplies, packing and absorbent materials, water treatment chemicals, construction materials, administrative supplies, archaeological, biological, and geological specimens, publications and reference material, automotive parts, lubricants and additives)
- training/conference areas
- vehicle maintenance and servicing facilities
- visitor reception areas
- waste collection areas
- waste staging areas

LANL constructs, installs, operates, and modifies short term and long term safe, secure storage areas for its classified documents, radioactive material, and fissile material. LANL installs or constructs new safe, secure storage areas in existing facilities currently used for activities involving the stored materials. Examples of safe, secure storage areas include, but are not limited to, the following:

- vaults
- vault-type rooms
- cages
- floor holes

LANL modifies its existing support structures and existing buildings to provide space and furnishings necessary for support activities. Examples of these remodeling modifications include, but are not limited to, the following:

- add new furniture, carpeting, pictures, bulletin boards, desks, whiteboards, bookcases, dividers, monitoring equipment, audio-visual equipment
- install walls, baseboards, thresholds, doors, windows, ceilings, cabinets, benches, sinks, restrooms, partitions, door hardware
- relocate furniture, workbenches, equipment, and utility connections
- remove walls, baseboards, thresholds, doors, windows, ceilings, cabinets, benches, sinks, restrooms, partitions, door hardware

LANL sites, constructs, modifies, and replaces-in-kind elements needed for the proper functioning of its existing support structures and buildings. Examples of these elements include, but are not limited to:

- above-ground storage tanks of 5,000 gallons or less for petroleum products (diesel fuel, gasoline), lubricants, non-PCB dielectric fluids, detergents/surfactants, water conditioning chemicals
- access roads in previously cleared, developed areas
- catwalks, structural platforms, railings, ramps, walkways, ladders, stairs, loading docks
- fencing in developed areas

- freight and personnel elevators
- infrastructure in developed areas
  - communications and electrical cables and ducts
  - gas, water, and sanitary wastewater distribution and collection lines to existing mains
  - sanitary wastewater holding tanks
  - water tanks
  - other water supply and distribution system appurtenances
  - water booster, pump, and lift stations
  - water, sewer, and gas mains in existing utility corridors
- parking lots, parking structures, sidewalks in developed areas
- photovoltaic charging stations
- spill containment structures (curbing, berms, dikes, trenches, sumps, ponds and vaults, modular tanks) and associated pumps and piping
- temporary access roads to facilitate repairs to existing roads
- traffic signs and signals, turn lanes, bar ditches, culverts, dry arroyo crossings, guardrails, pullouts, and similar modifications to existing roads and highways
- weather protection structures (canopies, roofs, rain gutters) for outdoor equipment, loading docks, entryways

I.1.4.2 Relocation of Materials, Buildings, Structures, and Utilities

LANL relocates materials (such as clean fill, equipment, construction materials) and small buildings and structures (such as transportables, transportainers, trailers, lockers, tension domes, temporary structures for field work) and associated utilities from one site to another within LANL boundaries. The buildings, structures, and associated utilities are moved to developed areas where major utilities and roads are available. Only relocations for which there are no changes in overall operations or increases in emissions or waste streams are included.

Examples of the uses of these buildings and structures include, but are not limited to, the following:

- cafeterias, kitchens, lunchrooms
- communication facilities
- control rooms, guard stations, security towers, and security, safety, and environmental monitoring stations
- data processing facilities
- electronic equipment testing, fabrication, and repair shops
- equipment calibration facilities
- garages for vehicles (forklifts, dump trucks, passenger vehicles, vans, emergency response vehicles) and vehicle maintenance
- health services facilities
- laboratories
- libraries, museums, exhibit areas
- mechanical property testing shops
- mobile environmental monitoring or sample analysis facilities (trailers and vans)
- offices

- photographic processing darkrooms (providing hazardous waste recovery systems are connected to sanitary drainlines)
- recreation facilities, exercise/fitness facilities
- shops for such activities as carpentry, welding, and machining
- storage for nonhazardous, nonradioactive materials, equipment, and supplies (computer components, radio and electronic equipment, custodial supplies, tools, janitorial supplies, packing and absorbent materials, construction materials, administrative supplies, archaeological, biological, and geological specimens, publications and reference material, automotive parts and lubricants/additives)
- storage of products used for routine maintenance
- storage of chemical reagents
- training/conference areas
- vehicle maintenance and servicing facilities
- visitor reception facilities

Relocations normally include the removal of construction debris, waste material, and unused utilities at the areas from which structures or facilities are removed. Restoration activities at the affected sites may include revegetation, reseeding, erosion control, or recontouring.

LANL relocates ancillary structures and facilities within developed areas at LANL for:

- waste staging and collection points, such as dumpsters
- material delivery drop-off points
- utility distribution and collection lines and connections to existing trunks or mains
- staging or storage clean fill or clean demolition debris in designated sites, such as the TA-61 borrow pits, the TA-60 clean fill yard or recycling and reuse of these materials in other project areas

LANL relocates mobile units from and to both onsite and offsite locations. Activities performed by personnel with the mobile units include, but are not limited to, the following:

- site characterization
- environmental sampling and analysis
- environmental monitoring
- communications
- emergency response
- accident response

I.1.4.3 Workplace Enhancements and Building and Equipment Instrumentation

LANL modifies its existing buildings, structures, infrastructure, and equipment to enhance workplace habitability. These modifications include, but are not limited to, the installation, modification, replacement, and improvement of:

- awnings, canopies, decks, and similar structures
- clothes closets, racks, hooks
- computer workstations
- drinking water fountains
- electrical distribution and branch circuits

- ergonomic furniture and accessories
- handicap facilities (access ramps, toilets, sinks, handrails, Braille markings/labels)
- HVAC systems:
  - heating systems (including components such as boilers, hot water heaters, space heaters, gas or electrical heating furnaces, thermostats, ducts)
  - ventilation (including components such as window screens, exhaust fans, ducts, ceiling fans, forced air flow)
  - air conditioning (including components such as central air conditioning, ducts, window air conditioning units, evaporative coolers, covers for roof mounted/window mounted coolers and refrigeration units)

- humidifiers and dehumidifiers
- insulation, skirting, weather stripping, and other heat loss reduction materials
- kitchen areas and lunchrooms (including appliances such as refrigerators, microwave ovens, bottled water coolers, coffee makers, icemakers, dishwashers)
- lighting
- noise absorption materials (carpeting, ceiling materials)
- non-glare screens for windows and computer terminals
- radiation shielding
- recreation facilities, exercise/fitness facilities
- restrooms (including components such as toilets, showers, sinks, paper towel dispensers, soap dispensers, aerators and vacuum breakers on faucets, shower doors, mirrors, water-saving devices)
- wind deflectors/barriers, rain gutters
- window blinds and shades
- windows

I.1.4.4 Pathways and Short Access Roads

LANL constructs short new access roads and modify existing access roads within LANL technical areas to improve access to and within LANL technical areas and improve safety for workers. These modifications include, but are not limited to:

- constructing new onsite access roads
- changing road alignment
- widening roads
- adding turn lanes
- adding acceleration/deceleration lanes
- adding bike lanes and pedestrian lanes
- upgrading entries and exits
- grading
- shoring up
- installing erosion control measures
- adding guardrails to existing roadways

Major modifications to the principal LANL road corridors (Pajarito Road, East West Jemez Road, etc) and those that would change overall access to LANL by workers and the public are not included. Consolidation or expansion of operations and facilities within existing TAs are also not included.

I.1.4.5 Installation or Relocation of Machinery and Equipment

LANL installs and relocates and operation of machinery and equipment (including, but not limited to, laboratory equipment, electronic hardware, manufacturing machinery, maintenance equipment, and health and safety equipment). Uses of the installed or relocated items are consistent with the general missions of the receiving structure. Actions include modifications to an existing building, within or contiguous to a previously disturbed or developed area, that are necessary for equipment installation and relocation.

I.1.5 Decontamination, Decommissioning, and Demolition of Vacated Structures

Description: LANL decontaminates and decommissions vacant structures (including buildings and other structures such as septic tanks and manholes) determined to be excess to current and foreseeable needs. Decontamination may be a part of demolition activities. For each structure proposed for demolition, expected waste volumes, date of construction, and the National Register of Historic Places status are identified prior to demolition. Septic tanks are not expected to contain radioactive waste but are sampled and characterized during the decontamination and decommissioning process.

Applicable DOE Categorical Exclusion: B1.23 Demolition and Disposal of Buildings

I.1.6 Security and Protective Force Operations

Description: LANL conducts training exercises and simulations (including, but not limited to, firing-range training, small-scale and short-duration force-on-force exercises, emergency response training, fire fighter and rescue training, and decontamination and spill cleanup training) conducted under appropriately controlled conditions and in accordance with applicable requirement

LANL provides training to personnel from LANL, other DOE facilities, and other federal and state agencies in the use of radiation detectors and monitors. Training may include detection of radiological devices, radioactive materials, and hazardous materials. The monitors and detectors used during training uses of sources containing small quantities of radionuclides in order to check or calibrate the instruments. Some detectors use isotopic sources for active interrogation including, but not limited to, californium, plutonium-beryllium, or americium-lithium.

Training may be focused on vehicles, equipment, buildings, or other structures. The purpose of the training is to teach and demonstrate the procedures for determining the contents of training standards containing radiation sources, hazardous material surrogates, or radioactive materials, including small quantities of special nuclear material. Radiation sources are either sealed or unsealed. Unsealed sources and special nuclear material are clad or encapsulated and all applicable control procedures are followed. Occasionally, short-lived radioactive materials may be used in indoor or outdoor exercises to provide realistic training scenarios. Training is conducted in buildings and outdoor areas that meet safety and authorization basis criteria for the proposed training. Training exercises are subject to environmental regulations and best practices and to the directions of a radiological control technician and are performed in accordance with applicable DOE Orders and LANL requirements, including adherence to the 'as low as reasonably achievable' principle. Handling and storage of sources and materials are performed in accordance with existing standard operating procedures (SOPs). Monitors and detectors used during training conducted at other LANL and offsite locations are operated by qualified personnel with appropriate training and all applicable work requirements are followed. The packaging and transportation of radioactive material used during offsite training exercises is conducted according to all applicable LANL procedures and U.S. DOT regulations.

Applicable DOE Categorical Exclusions: B1.2 Training Exercises and Simulations, B1.15 Support Buildings

I.2 Environmental Restoration and Environmental Research

I.2.1 Environmental Characterization and Limited Removals

Description: LANL conducts site characterization activities to identify potential release sites (PRSs) - landfills, pits, Material Disposal Areas, and Solid Waste Management Units (SWMUs); canyon side disposal areas; major canyon systems; septic and disposal tanks; waste and drain lines, leach fields, and outfalls; storage drums, tanks, and facilities; firing ranges and impact areas; existing or former buildings and bunkers; and subsurface contamination areas. LANL also conducts final disposition of those areas proposed for no further investigation.

Applicable DOE Categorical Exclusions: B3.1 Site Characterization and Environmental Monitoring, B6.1 Cleanup Actions, B6.2 Waste Collection, Treatment, Stabilization, and Containment Facilities

I.2.1.1 Site Characterization and Environmental Monitoring

Field investigations are designed to determine the type and location of contaminants. Radiological screening and screening for volatile organic vapors may be performed during the field sampling activities. Temporary onsite immunoassay laboratory and equipment are used to aid in the screening process. All soils removed during sampling are staged in a pre-determined staging area. Other contamination could include: PCB transformers; operational releases; spills; contamination under existing and former buildings; and other miscellaneous SWMUs.

Some limited, small-scale studies may be implemented in these canyons, including outdoor monitoring activities such as surface water flow monitoring or sedimentation characterization. LANL may also engage in expedited cleanups, such as limited removals to facilitate site characterization, interim measures (as defined in RCRA), or full-scale cleanup or closure of sites recognized as having a perceived public risk associated with them.

I.2.1.2 Limited Removal Activities

In addition to the site characterization activities, some limited removal activities, voluntary corrective actions, are performed during this time to facilitate site characterization and to eliminate possible source term or human health risk or perceived risk. These removals may include non-active septic tanks and associated piping, near-surface piping, drainlines and other near-surface debris with probable internal contamination, and small localized spots of contaminated soils. All materials removed are evaluated to ensure proper handling in accordance with health and safety requirements.

I.2.2 Environmental Research

Environmental research at LANL encompasses a number of different capabilities, including geology, geochemistry, and hydrology research; atmospheric, climate, and environmental dynamics; geotechnical engineering; environmental geology and spatial analysis; geophysics; and planetary physics.

I.2.2.1 Geology, Geochemistry, and Hydrology Research

Description: Basic and applied geology, geochemistry, and hydrology research studies are conducted on rock, concrete, soil, and other geological samples. Research is focused on various areas, including transport of contaminants in saturated and unsaturated hydrologic systems, carbon sequestration, basin-scale hydrology, zero-emission coal technology, volcanic geology and hazards, and planetary astrobiology and geology.

Research laboratory and outdoor activities are conducted. Thousands of geological samples are analyzed annually. In addition, instrumentation for conducting these studies is designed, tested, or modified.

Applicable DOE Categorical Exclusions: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

Research Laboratory Activities

Researchers study Earth materials and Earth systems. A number of different laboratories are used, including a wet chemistry laboratory, an x-ray diffraction laboratory, thermal analysis capabilities, optical equipment, a light-stable isotope laboratory, electron microanalysis, an x-ray fluorescence laboratory, and a mass spectrometry laboratory. Equipment used includes, but is not limited to, electron microprobe, infrared spectrometers, optical microscopes, scanning electron microscope, scanning probe microscope, inductively coupled plasma emission spectrometer, gas chromatographs, mass spectrometers, ion-liquid chromatograph, atomic absorption spectrometer, high-pressure liquid chromatograph, gas chromatograph, x-ray diffractometers, x-ray fluorescent spectrometer, autoclave, and other similar equipment.

Outdoor Activities

Researchers conduct outdoor field experiments at study plots located at in different areas around LANL. Hydrological studies (such as erosion and water balance), carbon sequestration and carbon inventory studies, and other geochemistry and geology research are conducted. Laser-induced breakdown spectroscopy, light detection and ranging (LIDAR), and other high- energy sources are used, as well as soil sampling equipment, runoff collection systems, and other equipment and materials.

I.2.2.2 Atmospheric, Climate and Environmental Dynamics

Researchers conduct modeling, simulation, field measurements, and data analysis in the atmospheric, ocean, and ecohydrologic sciences. Types of activities include:

- atmospheric, climate, and ocean modeling, such as wildfire behavior modeling, biogeochemistry and ocean carbon cycle modeling, climate applications to high performance computing
- ecology, such as semiarid systems ecology, soil science, carbon sequestration, micrometeorological instrumentation and analysis
- hydrology, such as surface and subsurface modeling, water resource prediction, contaminant fate and transport, erosion
- weapons phenomenology and infrasound, such as physics and chemistry of atmospheric composition, theory and modeling of electromagnetic radiation, data analysis from satellites and ground sensors

Prior to the deployment of the next Atmospheric Radiation Measurement (ARM) campaign, the ARM Mobile Facilities are brought back to Los Alamos at TA-51. The eight to twelve containers that contain the infrastructure, instruments, and equipment needed to collect data for meteorological and climate are setup at TA-51. The mobile facilities are inventoried, cleaned and checked to ensure everything is working. LANL works with PNNL, ANL, BNL, and several other Laboratories for the ARM Program to ensure everything is done correctly and up to codes.

Applicable DOE Categorical Exclusions: A9 Information Gathering, Analysis, and Dissemination, B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects, and B3.8 Outdoor Terrestrial Ecological and Environmental Research

I.2.2.3 Geotechnical Engineering and Research

Description: Geotechnical research involves underground and surface geologic, seismic, volcanic, hydrologic, hydrogeologic, geophysical, and geochemical field testing, monitoring experiments, and managing samples. Past and present research has involved evaluating engineering barrier systems, coordinating field testing, and studying the potential effects of a volcanic eruption. Other geotechnical studies could be conducted at LANL or other locations.

During the planning phase of a construction project, geotechnical investigations of a site are performed prior to construction to validate the civil design.

Applicable DOE Categorical Exclusion: B3.1 Site Characterization and Environmental Monitoring

I.2.2.4 Environmental Geology and Spatial Analysis

Description: Environmental geology and spatial analysis research focuses on the study of uncertainties associated with complex natural environmental systems and finding solutions to problems that arise as the result of human activities. Research capabilities include: volcanic and seismic hazards, geomorphology and surface processes, geochemistry, geographic information systems, environmental modeling and risk assessment, and quality assurance and data validation.

Applicable DOE Categorical Exclusions: B3.1 Site Characterization and Environmental Monitoring

I.2.2.5 Geophysics

Description: Basic and applied geophysics research at LANL focuses on exploring the seismic and acoustic signals that provide information about disturbances, both natural and manmade, within the earth's crust. Research is conducted in the following areas: 1) nuclear explosion monitoring—processing and interpreting geophysical and geological data for the national ground-based nuclear explosion monitoring program; 2) geodynamics—developing and applying computational tools and experimental methods for predicting the response of geological materials to large and rapid deformations; 3) seismic modeling and imaging—conducting basic and applied research in wave propagation, seismic imaging, scattering, and the interaction of acoustic waves with rock mass structure, fabric, and pore fluids; 4) drilling—developing advanced drilling methods and tools for drilling operations; and 5) national defense— offering geology/geophysics expertise in the geologic phenomena associated with explosion dynamics both subsurface and above ground, and intelligence gathering and interpretation using remote sensing techniques.

Applicable DOE Categorical Exclusions: A9 Information Gathering, Analysis, and Dissemination and B3.1 Site Characterization and Environmental Monitoring

I.2.2.6 Planetary Physics

Description: Research is conducted in the following areas:

- Astrophysics, such as theoretical, observational, and instrumentation research on gamma-ray astrophysics, space instrumentation, stellar dynamics
- space physics, such as theoretical, computational, and observational research into the plasma environment of the earth
- solid planetary geoscience, such as numerical, seismic, paleomagnetic, and laboratory studies of the geophysical and geochemical structure, properties, processes, and fluid dynamics of terrestrial and giant planets

Applicable DOE Categorical Exclusions: A9 Information Gathering, Analysis, and Dissemination and B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.2.2.7 Archaeological Site Evaluation

Description: LANL evaluates archaeological sites located at LANL technical areas and surrounding locations (such as U.S. Forest Service land). Sites are evaluated to establish site integrity that is subsequently used to determine the National Register of Historic Places eligibility of the site. Work includes flagging areas for avoidance.

Applicable DOE Categorical Exclusions: B3.1 Site Characterization and Environmental Monitoring and B3.3 Research Related to Conservation of Fish, Wildlife, and Cultural Resources

I.2.2.8 Biological Field Studies

Description: LANL biologists conduct field studies to inventory, monitor, and assess vegetation and animal populations. Small-scale netting or live trapping is conducted to collect specimens for examination. Data collection includes recording reproductive patterns, species distribution, *presence/absence surveys* and densities, and habitat use. Specimens may be marked before release for later identification. Some trapping methods result in negligible mortality rates for small mammals, reptiles, and insects. Some samples may be collected from road-kills to evaluate diet or contamination.

Vegetation, fruit, and produce samples may be collected from LANL or offsite locations for analysis of biomass, fuel-loading, contamination, or other attributes. Sample areas may be fenced for the duration of a study to prevent disturbance between scheduled fieldwork. LANL may also conduct phytoremediation and bioremediation studies both in natural and constructed settings.

Applicable DOE Categorical Exclusions: B3.1 Site Characterization and Environmental Monitoring and B3.3 Research Related to Conservation of Fish, Wildlife, and Cultural Resources

I.2.2.9 Water and Soil Monitoring

Description: Water monitoring stations are installed, maintained, and operated to measure flows, evaluate water quality, and test for contamination. Locations for monitoring stations are based on the characteristics to be studied. The locations are reviewed by cultural and biological resources specialists to ensure protection of sensitive resources. Soils and sediments are sampled on a regular basis from a variety on locations at LANL and off site.

Groundwater monitoring wells are also established to monitor groundwater characteristics and to determine the presence of contamination. Locations are reviewed by cultural and biological resources specialists to ensure protection of sensitive resources. Monitoring wells are designed to prevent surface contamination from reaching subsurface water.

Wetland delineation fieldwork is conducted at LANL to determine the boundary between uplands and wetlands on a property. hydrology, hydric soils, and hydrophytic vegetation characteristics indicate the presence of wetlands.

Applicable DOE Categorical Exclusion: B3.1 Site Characterization and Environmental Monitoring

I.3 Applied and Material Science

LANL conducts a variety of basic and applied materials science research, which is conducted on a wide variety of materials, including ultra-high strength and high energy density materials, radioactive materials, high explosives, heavy metals, gases, geological samples, ceramics, amino acids, superconductors, intermetallic compounds, and others materials of interest. Materials are characterized and modified using a wide range of techniques, such as lasers, spectrometers, x-rays, and optical devices.

Materials are often synthesized, tested, and analyzed. Work is conducted in many facilities, such as LANSCE, , the National High Magnetic Field Laboratory, and small laboratories, using a vast array of equipment and materials. Custom materials and commercial components are frequently integrated to produce new instruments or materials for specific industrial and military applications.

LANL conducts a wide range of basic science on the characteristics of materials and their behavior under varying conditions. The basic science is frequently translated into applications for industry, education, and government agencies.

I.3.1 Automation and Robotics Research and Development

Description: Researchers develop automated and robotic systems (such as mills, lathes, etc.) in support of the stockpile stewardship programs and other applications. These systems increase worker productivity, reduce human exposure to hazardous situations, and minimize overall waste production. Prototypes are developed and tested in nonradiological laboratories, then transferred to radiological and nonradiological facilities throughout the DOE nuclear complex. Personnel design and produce parts on a small scale, assemble and integrate mechanical and electrical components, operate and integrate systems, and test prototype instruments on nonhazardous materials. This research involves:

- parts design and small-scale production using hand tools and machine tools in existing laboratories and machine shops
- mechanical assembly and integration of robotic and other mechanical systems. Personnel use cranes, hand tools, power tools, ladders, and other equipment to accomplish this task
- electrical assembly. Integration, and testing of electrical systems used within the instruments
- system operation and integration, which includes system operation, including testing algorithms, and other operational issues
- proving, in which a variety of prototype instruments (such as mills, lathes) are tested on lumber, cardboard, and other nonhazardous materials

Personnel use a variety of materials and equipment to construct the automated and robotic systems. These include, but are not limited to: chillers, compressors, induction power equipment, radiofrequency generators, heat exchangers, heating equipment, hydraulics, lasers, leak detectors, machine shop equipment (bench saws, drills, grinders, lathes, welders, hand tools), forklifts, cranes, motors, electronic equipment, low-power x-ray equipment, epoxies, wood, cardboard, and solder.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.2 Electronic Systems Fabrication

Description: Electronic systems are designed, developed, tested, and evaluated for industrial, academic, and federal agency applications. These systems control, and communicate with, many different apparatuses, such as remote handling systems, radiofrequency systems, lasers, experimental devices, surveillance equipment, alarm and safety equipment, measurement systems, and many others. Electronic systems also monitor performance, control operating parameters, serve as sensors in optics and other equipment, and serve other similar functions.

Personnel assemble electronic modules into these various systems. Electronic modules are typically obtained from a commercial vendor; however, LANL conducts some design and prototyping of electronic modules in existing facilities. The control and communications systems are integrated with various apparatuses and software is written to operate the system. System integration is often conducted at the facility contracting the work. Personnel follow hazard control plans and wear any appropriate personal protective equipment. Waste is disposed of according to facility procedures.

Applicable DOE Categorical Exclusions: B1.15 Support Buildings and B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.3 Small-Scale Basic Laser Science Research and Development

Description: Small-scale research and development projects and small-scale pilot projects in the fields of basic and applied chemistry use traditional analytical instrumentation combined with lasers. Some researchers study the kinetics of chemical processes and the rates of energy transfer processes, while others develop ways to identify and/or quantify trace materials such as contaminants or small quantities of radioisotopes. In some projects, personnel research and develop client-specified unique laser instrumentation and/or applications. They research ways to identify and quantify various hazardous or toxic materials in the soil, water or air on or near DOE facilities.

Researchers develop and test unique lasers as specified by clients with specialized application needs, and they develop and confirm innovative, client-specified laser applications. Research is conducted in the areas of high-temperature/high-pressure fluid chemistry, materials processing and characterization, chemical kinetics, spectroscopic characterization, chemical diagnostics, and mass spectrometry diagnostics. Scientists investigate electroweak interactions in nuclei and apply optical trapping techniques to nonproliferation issues.

Most of the projects are conducted in a laboratory setting within existing facilities requiring no major modifications. A few of the projects, such as remote sensing of environmental phenomena, and specific laser studies are conducted outdoors.

The following activities are examples of small-scale research and development projects and small-scale pilot projects that are carried out in existing facilities and conducted to verify a concept before demonstration actions. Each project generally continues for two years or less. Some of the projects use traditional analytical instrumentation and lasers in new ways by:

- combining two methodologies into one instrument
- developing field-usable instruments for measuring real-time samples by modifying existing instrumentation and or procedures
- developing new sampling techniques such that current analytical technologies may be used for the detection and/or quantification of chemical constituents at lower levels or in the field for real-time analysis
- developing new uses for existing analytical instrumentation
- integrating existing analytical instrument with lasers to develop one instrument in order to facilitate field-use, remote sensing and real-time application, where appropriate
- demonstrating unique laser propagation processes such as laser filamentation

Research and development of unique lasers or unique laser applications is also conducted as directed by clients (including industrial, commercial, military or academic institutions) for the client's specialized application. Personnel build to suit the specifications of the client, then perform in-laboratory testing and verification of the applicability of the laser. The development of these unique lasers may involve modifications to existing lasers or a completely new design. The lasers may be used for the ultra-sensitive detection of radioisotopes. Often these projects could involve joint research efforts with commercial, military and/or academic institutions.

Many of the projects covered under this document involve analytical instrumentation, much of which is currently used at LANL. Examples of the types of instruments that may be involved include, but are not limited to:

- inductively coupled plasma mass spectroscopy instruments
- radiation detectors (non-ionizing)
- gas chromatographs
- light detecting and ranging (lidar) systems
- laser ablation coupled plasma spectrometer
- fiber optic sensors
- near infrared communication diode laser sensors
- Fourier transform infrared absorption spectroscopy
- ultraviolet/visible/infrared absorption spectroscopy
- atomic absorption spectroscopy
- mass spectrometers
- magneto-optical traps

Applicable DOE Categorical Exclusions: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.4 Industrial Hygiene Research and Development

Description: LANL conducts industrial hygiene-related research and development activities that anticipate, recognize, evaluate, and control health and safety hazards in the workplace. Much of the industrial hygiene R&D work conducted by LANL includes design and testing of respiratory protection and other personal protective devices. The types of devices designed and tested include respirators, respirator cartridges or canisters, protective suits, self-contained breathing apparatus, and other similar equipment.

Personnel construct respirators, canisters, and other apparatus using commercially available equipment and components or components specially fabricated in LANL shops. After constructing or obtaining commercial equipment, the respirators or other equipment are tested for efficiency, breakthrough time, and other parameters.

Equipment is tested in a variety of ways. Personnel test respirators, cartridges, and other equipment by using either nonhazardous or hazardous materials, such as acid vapors. Only small amounts of acids or other materials are used each day. Some vapors may be released from the testing equipment. These vapors are contained within a glovebox, greatly diluted with air, then vented through a fume hood. Other materials are also used to conduct this work, including, liquid air (made by condensing gaseous air to liquid, or mixing liquid nitrogen and liquid oxygen), cryogens, glues, acids and other chemicals, activated carbon, and other materials.

Applicable DOE Categorical Exclusions: B2.3 Personnel Safety and Health Equipment and B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.5 Sensor Research and Development

LANL develops sensitive and fast sensors and imaging systems for a variety of weapons and non-weapons applications, including "smart" weapons and tracking systems. These sensors are also used for high speed data acquisition and imaging. Researchers test the sensors and construct imaging systems around them. Researchers use a variety of equipment to develop these sensors and imaging systems, including computers; general laboratory equipment such as oscilloscopes, voltmeters, arbitrary function generators, radiometers, signal amplifiers, image monitors, optical light sources, etc.; high-voltage power supplies; commercial and in-house fabricated charge coupled device cameras; commercial image intensifiers; a Class IV laser; hand tools, such as screwdrivers, pliers, wire strippers, etc; and soldering irons.

They use a variety of materials to assemble components, including solder, alcohol, sealant, solvent flux remover, immersion oil, silicon rubber, solder kits, heat sink compound, spray paint, and other similar materials. Researchers conduct all work in existing laboratories requiring no major modifications and follow all hazard control plans and/or SOP. They wear personal protective equipment as needed.

I.3.5.1 Radiation Monitoring Techniques

Description: Researchers develop and test techniques and systems for nondestructive assay (NDA) measurements on nuclear and hazardous materials. Radiation monitors are also developed and tested. Personnel conduct conceptual research, engineering, implementation, and training related to NDA measurement, instrumentation, and analysis.

Personnel design, fabricate, and install NDA instrumentation for safeguards organizations throughout the world. They also further develop both active and passive techniques to more accurately measure nuclear materials. LANL shops fabricate most small mechanical parts used for these instruments; offsite machine shops fabricate larger mechanical items. LANL personnel also design and build most of the custom electronics, although external sources may fabricate some electronics parts. LANL personnel design, assemble, test, calibrate, develop software, and verify the performance of the instrumentation.

Most of the instrumentation consists of printed circuit boards, electronics equipment, and mechanical assemblies. A variety of tools and instruments are used to assemble, calibrate, and test the instrumentation. These include, but are not limited to, small hand tools, soldering irons, welding equipment, exhaust hood, milling machines, lathes and similar machine shop equipment, general laboratory electronic instruments such as oscilloscopes, high- and low-voltage power supplies, encapsulated radioactive sources, environmental test chamber, neutron generators, high-voltage x-ray sources, and computers.

Applicable DOE Categorical Exclusions: B1.15 Support Buildings, B2.2 Building and Equipment Instrumentation, B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects, and B3.10 Particle Accelerators

I.3.5.2 Physical Detector Research and Development

Description: LANL develops a wide variety of detectors for use in physical science research that are capable of identifying ionizing radiation, X-rays, photons, electrical and magnetic fields, chemicals, gases, pressure, gravity, explosives, biological materials, dense materials, and other phenomena. The detectors consist of a medium that responds to the primary condition of interest, such as liquid (e.g., mineral oil), solid (e.g., crystalline materials), or gaseous (e.g., isobutane) materials, in a support housing for mechanical/electrical stability, coupled to electronic circuitry and assemblies. Activities include materials characterization, fabrication and testing of detectors, and support capabilities.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.5.3 Advanced Image Sensor Research and Development

Description: LANL develops sensitive and fast sensors and imaging systems for a variety of weapons and non-weapons applications, including "smart" weapons and tracking systems. These sensors are also used for high speed data acquisition and imaging. Researchers test the sensors and construct imaging systems around them.

Researchers use a variety of equipment to develop these sensors and imaging systems, including computers; general laboratory equipment such as oscilloscopes, voltmeters, arbitrary function generators, radiometers, signal amplifiers, image monitors, optical light sources, etc.; high-voltage power supplies; commercial and in-house fabricated charge coupled device cameras; commercial image intensifiers; a Class IV laser; hand tools, such as screwdrivers, pliers, wire strippers, etc; and soldering irons.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.6 Space and Atmospheric Instrumentation

Description: Flight hardware, atmospheric instrumentation, satellite instrumentation and small satellite systems are developed at LANL. Much of this instrumentation is used for remote sensing applications, such as nonproliferation, detection of nuclear explosions, climate studies, and environmental measurements. Types of instrumentation typically developed include optical and infrared remote sensing instruments; x-ray, gamma-ray, neutron, alpha particle, radiofrequency, and energetic particle instruments; astrophysical instruments for conducting studies of the atmosphere, ionosphere, magnetosphere, and solar wind; and other instrumentation for deployment on satellites or other atmospheric testing vehicles. Outdoor experiments are often conducted as part of this research, and involve measuring fluctuations in the atmosphere and ionosphere and calibrating satellite receivers that are in orbit. Outdoor experiments are conducted at various locations around Los Alamos, the United States, and at other locations around the world.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.7 Materials Characterization Research and Development

Description: Researchers study various materials to determine molecular structure, intrinsic defects within the material, defects introduced by the environment or radiation, thermal conductivity, thermal expansion, nuclear spin magnetization, electronic magnetization, resistance, heat capacity, and other properties. A number of different materials are studied, including non-metallic materials (such as ceramics, crystals, amino acids, and polymers); transition metals; transition metal oxides; and transition and rare earth metal intermetallic compounds. These materials may be mixed compounds, or layered structures, in powder or crystalline form. This research also includes developing techniques for improved sensitivity of equipment in detecting these responses.

Samples are prepared, as necessary, by cutting, shaping, pressing, and grinding using wafering and wire saws, polishing tables, sonic baths, and other tools and equipment. The samples are then characterized using photon sources (such as mercury pen lamps, ultraviolet lights, x-ray sources, and other optical equipment); fiber optic laser interferometry; nuclear magnetic resonance; and other experimental apparatus that subjects the sample to controlled environments, including cryogenic conditions and magnetic fields.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.7.1 General Optical Characterization and Calibration

Description: Researchers characterize optical components used for a variety of applications, such as measuring solar radiation; measuring the reflectance from computer chips and wafer samples; measuring different spectral wavelengths resulting from explosives tests; measuring low-light level signals in darkened conditions; selectively measuring narrow frequencies in a light signal; monitoring motion (motion detection); and other similar light detection applications.

Personnel measure reflectance and transmission (or absorbance) of light. Using a variety of light signals (different lamps with different wavelengths, such as visible, infrared, ultraviolet and vacuum ultra violet), they shine the light onto the component and use calibrated detectors and other measuring devices (such as reflectometers) to measure the reflectance or transmission of the light. They use low-power lasers to align the light signal onto the detector being characterized.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.7.2 Ultra-High Strength and High Energy Density Materials Research and Development

Description: LANL researchers investigate, evaluate, and demonstrate new ultra-high strength materials and very high energy density materials. Ultra-high strength materials are produced using a variety of metals (such as copper, silver, or aluminum) encapsulated in glass, which are then heated and drawn into small wires. Thin-film samples of high energy density materials are synthesized under non-equilibrium conditions. Both materials are characterized by measuring the material composition, chemical structure, mechanical and thermal properties, and energy content and release of these materials.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.7.3 X-Ray Tomography and Ultrasound Testing

Description: LANL researchers x-ray [using computed tomography (CT)] and ultrasonically analyze various samples. CT equipment is used to generate three-dimensional images, detect cracks or flaws, generate three-dimensional density maps, or precisely locate parts or features within an object. The ultrasonic equipment is used to detect cracks, voids, and inclusions, and density variations. It can also be used on samples that require small resolution. Ultrasonics can also be used to inspect surface characteristics and bulk properties (such as porosity) of a sample. Researchers combine the x-ray CT and ultrasonic methods to see if data fusion techniques improve the evaluation of the sample.

A variety of samples and specimens are analyzed, including sand, soil, plastics, foam, mock high explosives, composite materials, pressure vessels, or other nonradioactive samples. Researchers also analyze specimens containing naturally occurring radioactivity (NORM), such as rocks, soils, etc. The specimens vary in size, depending on the equipment being used. The CT equipment can analyze objects up to 10 inches in diameter by 15 inches high, while the ultrasonic equipment can analyze up to either a 12 inch by 12 inch flat plate or a 10 inch by 12 inch cylinder. Samples come from a number of different sources and are either shipped through traditional methods, or hand-carried by personnel requesting the tests. The samples are delivered to LANL, then shipped or picked up when analysis is complete. Samples containing naturally occurring radioactivity are transported according to Department of Transportation and DOE regulations.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.3.8 Unmanned Aerial Systems

Description: LANL uses various unmanned aerial systems (UAS), such as remote-controlled airplanes and helicopters and tethered aerostats and helikites (moored weather balloons) of various sizes and capabilities anywhere within the LANL restricted airspace boundary. UAS are used for research and development, emergency management, sensor testing, training, security, and surveillance activities. Additionally, UAS are used for outdoors sealed source detection and monitoring. Generally, weather balloons are used for atmospheric research.

Kelly Field at TA-49 is an Inter-agency UAS and robotics training facility for LANL, other DOE facilities and other state and federal organizations. It supports a variety of LANL and local agency missions including; Wildland Fire Program; The Los Alamos Fire and Police Departments, Emergency Management, U.S. Forest Service, U.S. Park Service, and other internal LANL groups requiring the use of UAS flights in support of their missions.

Applicable DOE Categorical Exclusion: B2.3 Aviation Activities and B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.4 Basic and Applied Chemistry Research and Development

Description: LANL's basic and applied chemistry research program brings together multidisciplinary capabilities for the study of a wide range of topics, including actinide and fission product chemistry, inorganic and organometallic chemistry, catalysis, surface chemistry, surface analysis, radioisotope production and distribution, chemical and electrical engineering, detection technologies, nanoscience and nanotechnology, analytical chemistry, environmental chemistry, nuclear and radiochemistry, physical chemistry, chemical and nuclear physics, and optical and vibrational spectroscopy.

Many organizations at LANL contribute to chemistry and chemical research. These organizations are responsible for a variety of different projects, funded through the DOE, Department of Defense , National Institutes of Health , Laboratory Directed Research and Development , and others. Studies conducted within LANL have numerous internal and external collaborations that provide flexibility in direction and scope. Collaborations are internal to groups and divisions, between various divisions at LANL, and with external collaborators such as visiting scientists.

Applicable DOE Categorical Exclusions: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects, B3.10 Particle Accelerator, and B3.15 Small-scale Indoor Research and Development Projects using Nanoscale Materials

I.4.1 Electronic and Electrochemical Materials and Devices Research and Development

Description: LANL conducts research involving electrochemistry and electronic materials. Research capabilities include projects that involve the disciplines of chemistry, electrical engineering, electrochemistry, mathematics, materials science, and physics, which are teamed on a wide variety of projects contributing to the nation's defense and economic security. Specific areas of research include electrochemistry and the fuel cell program, semiconductor physics research and device development, high-temperature superconductivity, electrochemical testing, general electronic materials characterization and theory, and nondestructive testing through acoustic techniques.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.4.2 Advanced Oxidation Technology Research and Development

Description: LANL conducts bench-scale and pilot-scale Advanced Oxidation Technology research, which involves the generation and use of highly reactive free radicals, such as O, OH, H, and N, as efficient chemical energy sources for breaking molecular bonds in organic compounds. High-energy electrical power sources are used to create modified ("hot") electrons. The "hot" electrons have very high energy potentials (typically 1-10 electron volts); they collide with other molecules to produce the free radicals. Advanced Oxidation Technologies are non-thermal and require no chemical additives; therefore, large secondary waste streams are not generated.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

I.4.3 High-Temperature/High-Pressure Fluids Research and Development

Description: LANL conducts research and development projects designed to develop, test, and verify high-temperature/high-pressure fluid technologies. These technologies include hydrothermal processing, "supercritical" water oxidation, "supercritical" carbon dioxide, and other similar technologies. When certain fluids are driven to high temperatures and pressures, in the "supercritical" region, they may be used as a gas and as a liquid.

These supercritical fluids are particularly useful as solvents. Gases, most organic molecules, and some inorganic salts are completely soluble in these supercritical fluids, and the fluids can be used for a variety of purposes, as described below.

Personnel conduct basic research on the physical properties of fluids and other materials, reaction kinetics and process parameters, oxidation and reduction chemistry, and other related chemical reactions. They apply these technologies to a variety of different uses, including precision cleaning, extraction of contaminants and residual solvents, chemical synthesis, polymer synthesis, chemical waste destruction (such as hazardous, mixed, or high explosives waste), semiconductor processing, chemical separations, materials modification, and other related applications.

Applicable DOE Categorical Exclusion: B3.6 Small-scale Research and Development, Laboratory Operations, and Pilot Projects

APPENDIX J
Public Notices

CONTENTS

analysis, monitoring student enrollment, calculating default rates, monitoring program participants and verifying student aid eligibility. This is a request for an extension to the current information collection 1845–0035 based on a decrease in the number of participants providing information to the system.

Dated: August 15, 2022.

Kun Mullan,

PRA Coordinator, Strategic Collections and Clearance Governance and Strategy Division, Office of Chief Data Officer, Office of Planning, Evaluation and Policy Development.

[FR Doc. 2022–17845 Filed 8–18–22; 8:45 am]

BILLING CODE 4000–01–P

DEPARTMENT OF ENERGY

National Nuclear Security Administration

Notice of Intent To Prepare a Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory

AGENCY: National Nuclear Security Administration, Department of Energy.

ACTION: Notice of intent.

SUMMARY: The National Nuclear Security Administration (NNSA), a semi-autonomous agency within the Department of Energy (DOE), announces its intent to prepare a new Site-Wide Environmental Impact Statement (SWEIS) for the Los Alamos National Laboratory (LANL or Laboratory) in Los Alamos, New Mexico (DOE/EIS–0552) in compliance with the National Environmental Policy Act of 1969 (NEPA). The SWEIS will analyze the potential environmental impacts of the reasonable alternatives for continuing operations of the Laboratory for approximately the next 15 years. The continued operation of the Laboratory is critical to NNSA's Stockpile Stewardship Program to prevent the spread and use of nuclear weapons worldwide and to many other areas impacting national security and global stability. The SWEIS will also analyze environmental impacts of legacy waste remediation conducted by DOE's Office of Environmental Management (DOE–EM). The purpose of this Notice is to invite public participation in the process and to encourage public involvement on the scope of analysis (*e.g.,* range of alternatives, impacts, and actions) and alternatives that should be considered in the SWEIS. Following completion of the SWEIS, NNSA will decide which reasonable alternatives to implement and will announce its decisions through a Record of Decision (ROD). Absent any *new* decisions associated with this SWEIS process, NNSA would continue to implement decisions announced in previous RODs.

DATES: NNSA invites other federal agencies, state and local governments, federally recognized Indian tribes and the public to comment on the scope of the LANL SWEIS. The public scoping period begins with the publication of this Notice in the **Federal Register** and continues until October 3, 2022 (the Comment Period). NNSA will accept public participation in written and oral form, and comments concerning the scope of the SWEIS will be given equal weight regardless of method of delivery. For receiving oral comments, NNSA will host two virtual public scoping meetings. The decision to hold only virtual meetings is based on the continuing high level of community spread of COVID–19 in the areas where in-person meetings would be held, as measured and reported by the U.S. Centers for Disease Control and Prevention. Meeting details will be provided in a future notice posted on the following website: *www.energy.gov/nnsa/nnsa-nepa-reading-room.* NNSA will hold the scoping meetings no earlier than 15 days from the posting of the notice. Details of the public meetings will also be announced in local media outlets.

ADDRESSES: Written comments will be considered if received or postmarked by the end of the Comment Period. Comments received or postmarked after the Comment Period will be considered to the extent practicable. Written comments on the scope of the SWEIS or requests for information related to the SWEIS should be sent via postal mail to LANL SWEIS Comments, 3747 W Jemez Road, Los Alamos, New Mexico 87544 or by email to: *LANLSWEIS@nnsa.doe.gov.* Before including your address, phone number, email address, or other personally identifiable information in your comment, please be advised that your entire comment—including your personally identifiable information—might be made publicly available. If you wish for NNSA to withhold your name and/or other personally identifiable information, please state this prominently at the beginning of your comment. You may submit comments anonymously.

FOR FURTHER INFORMATION CONTACT: For further information about this Notice, please contact Kristen Dors, NEPA Compliance Officer, U.S. Department of Energy, National Nuclear Security Administration, Los Alamos Field Office, 3747 W Jemez Road, Los Alamos, New Mexico 87544; phone: (505) 667–5491; or via email at *LANLSWEIS@nnsa.doe.gov.* This Notice and related NEPA documents are available at: *www.energy.gov/nnsa/nnsa-nepa-reading-room.*

SUPPLEMENTARY INFORMATION:

Background

The Laboratory has been operating for nearly 80 years in Northern New Mexico. Today, the Laboratory is a national security laboratory, as defined by 50 *United States Code* (U.S.C.) 2471, and operated as an NNSA facility by a Management and Operating (M&O) contractor with an annual budget of approximately $4.6 billion and a workforce of approximately 14,000 people. The Laboratory exists to support NNSA missions, which are established by law, including: (1) to enhance U.S. national security through the military application of nuclear energy; (2) to maintain and enhance the safety, reliability, and performance of the U.S. nuclear weapons stockpile, including the ability to design, produce, and test, in order to meet national security requirements; (3) to promote international nuclear safety and nonproliferation; (4) to reduce global danger from weapons of mass destruction; (5) to support U.S. leadership in science and technology. NNSA missions are carried out in a manner that is consistent with the principles of: (1) Protecting the environment; (2) Safeguarding the safety and health of the public and of the workforce; (3) Ensuring the Security of the nuclear weapons, nuclear material, and classified information. As a Federally Funded Research and Development Center, the Laboratory is primarily sponsored by NNSA but does work for other federal agencies and partners with a wide variety of entities. LANL also has an important legacy waste remediation mission, which is overseen by DOE–EM. The potential impacts of these ongoing DOE–EM remediation activities will be included in the LANL SWEIS. This Notice signifies the fourth site-wide EIS undertaken for the Laboratory since 1976.

Purpose and Need for Agency Action

The purpose of the continued operation of the Laboratory has not changed and continues to be to provide support for NNSA's core missions as directed by the 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. For the foreseeable future, NNSA, on behalf of the U.S. Government, will need to continue its nuclear weapons research and development, surveillance, computational analysis, components manufacturing, and nonnuclear aboveground experimentation. Currently, many of these activities are conducted solely at the Laboratory. A curtailment or cessation of these activities would run counter to national security policy as established by the 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; supporting U.S. leadership in science and technology.

The 2016 Compliance Order on Consent between the State of New Mexico Environmental Department and the Department of Energy (the Consent Order) is the principal regulatory driver for legacy waste cleanup at LANL. The Consent Order contains requirements for investigation and cleanup as well as enforceable deadlines for achieving desired remediation milestones, which may include the submission of documents such as investigation work plans, investigation reports, periodic monitoring reports, and corrective measures evaluation reports.

Requirements To Fulfill DOE NEPA Compliance

The SWEIS will be prepared pursuant to NEPA (Title 42 U.S.C. 4321 *et seq.*), the Council on Environmental Quality's NEPA regulations (40 CFR parts 1500–1508) and the DOE NEPA implementing procedures (10 CFR part 1021). The DOE regulations (10 CFR 1021.330) require preparation of site-wide documents for certain large, multiple-facility sites, such as the Laboratory. The purpose of a SWEIS is to provide the public with an analysis of the potential environmental impacts from ongoing and reasonably foreseeable new and modified operations and facilities, and reasonable alternatives, to provide a basis for site-wide decisionmaking and to improve and coordinate agency plans, functions, programs, and resource utilization. The SWEIS provides an overall NEPA baseline, so that the environmental effects of proposed future changes in programs and activities can be compared to the baseline. A SWEIS allows NNSA to ''tier'' its later project-specific NEPA analyses at the same site. Tiering is a method used in NEPA analysis that allows agencies to eliminate repetitive discussion of the same issues and to focus on the specific issues in future proposed actions.

The NEPA process enables federal, state and local governments, federally recognized Indian tribes, and public participation in the environmental review process.

Preliminary Alternatives

The scoping process is an opportunity for the public to assist NNSA in determining the alternatives, issues, or analyses that should be included in the SWEIS. NNSA welcomes specific comments or suggestions on the content of these alternatives or on other alternatives that could be considered. A preliminary set of alternatives and issues for evaluation in the SWEIS is identified below; during the development of the SWEIS, NNSA could include other reasonable alternatives.

No-Action Alternative: Continue Current Operations

The No-Action Alternative would continue current operations throughout the Laboratory that support currently assigned missions. NEPA regulations require analysis of the No-Action Alternative to provide a benchmark for comparison with environmental effects of action alternatives. This alternative includes the programs and activities for which NEPA reviews and decisions have been made, such as DOE–EM legacy waste cleanup activities pursuant to the 2016 Consent Order. The No-Action Alternative includes, for currently assigned mission scope: (1) construction of minor replacement facilities; (2) upgrades to existing facilities and infrastructure; (3) decontamination, decommissioning, and demolition (DD&D) projects.

Modernizing Current Operations Alternative

The programmatic context for the Modernizing Current 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 above, plus additional modernization activities. This alternative includes: (1) construction of replacement facilities; (2) more significant upgrades to existing facilities and infrastructure; (3) more significant 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 proposed DD&D of older facilities would eliminate excess facilities and reduce costs and risk. This alternative would not expand capabilities and operations at LANL beyond those that currently exist.

Expanded Operations Alternative

The Expanded Operations Alternative includes the modernization actions included in the Modernizing Current 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: (1) construction and operation of new facilities, and (2) significant upgrades to existing facilities that result in changing the nature and capabilities of these facilities. This alternative would expand capabilities at LANL beyond those that currently exist. For example, under an Expanded Operations Alternative NNSA may consider the construction and operation of an additional supercomputing complex that would enable NNSA to expand the capabilities of that program. In the Draft SWEIS, NNSA will identify and analyze other actions that could expand the capabilities at LANL.

The Draft SWEIS will identify the specific actions associated with the alternatives and will assess the potential impacts of implementing the alternatives. The Draft SWEIS will also identify and evaluate any actions related to environmental management and land transfer that are reasonable for each of the alternatives.

Other Potential Reasonable Alternatives

The 1999 and 2008 LANL SWEISs included a Reduced Operations Alternative. Those SWEISs were prepared at times when DOE/NNSA deemed a reduction in Laboratory operations to be a reasonable alternative. For the foreseeable future, NNSA does not consider reducing operational or environmental remediation missions at LANL as reasonable. However, the timeframe for the SWEIS analysis is approximately 15 years into the future, and NNSA recognizes that requirements, needs, opportunities, and vision may change over such a long planning horizon. Consequently, NNSA has not made a final decision on whether to include a Reduced Operations Alternative in this SWEIS. NNSA welcomes input on this and any other alternative the public thinks are reasonable and should be analyzed in the SWEIS.

Alternatives that NNSA will not consider reasonable are (1) the complete closure and DD&D of the Laboratory and (2) transfer of current missions/operations from the Laboratory to other sites, as those actions would be inconsistent with the LANL mission defined by NNSA. Such possibilities were considered as recently as 2008 when NNSA prepared the Complex Transformation Supplemental Programmatic EIS (CT SPEIS). 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.'' That conclusion has not changed today. In addition, as one of only three NNSA national security 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 Laboratory performs the basic research, design, system engineering, development testing, reliability and assessment, surveillance, and certification of nuclear weapons safety, reliability, and performance. From a broader national security perspective, the core intellectual and technical competencies of the Laboratory help provide the technical basis for the pursuit of U.S. arms control and nuclear nonproliferation objectives.

The CT SPEIS also considered and evaluated the transfer of missions and operations to and from the Laboratory, 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/from the Laboratory.

Preliminary Environmental Analysis

The following issues have been identified for analysis in the SWEIS. The list is tentative and intended to facilitate public comment on the scope of the SWEIS. It is not intended to be all inclusive, nor does it imply any predetermination of potential impacts. The NNSA specifically invites suggestions for the addition or deletion of items on this list.

- Potential effects on the public and workers from exposures to radiological and hazardous materials during normal operations, construction, reasonably foreseeable accidents (including from natural phenomena hazards), and intentional destructive acts
- Impacts on surface and groundwater, floodplains and wetlands, and on water use and quality
- Impacts on air quality from potential releases of radiological and nonradiological pollutants and greenhouse gases
- Impacts to plants and animals and their habitats, including species that are federally or state-listed as threatened or endangered, or of special concern
- Impacts on physiography, topography, geology, and soil characteristics
- Impacts to cultural resources, such as those that are historic, prehistoric, archaeological, scientific, or paleontological
- Socioeconomic impacts to affected communities
- Environmental justice impacts, particularly whether or not activities at the Laboratory have a disproportionately high and adverse effect on minority and/or low-income populations
- Potential impacts on land use and applicable plans and policies
- Impacts from traffic and transportation of radiological and hazardous materials and waste on and off the Laboratory campus
- Pollution prevention and materials, and waste management practices and activities
- Impacts on visual aesthetics and noise levels of Laboratory facilities on the surrounding communities and ambient environment
- Impacts to community services, including fire protection, police protection, schools, and solid waste disposal to landfills
- Impacts from the use of utilities, including water and electricity consumption, fuel use, sewer discharges, and resource conservation
- Impacts from site contamination and remediation
- Unavoidable adverse impacts
- Environmental compliance and inadvertent releases
- Short-term uses and long-term productivity
- Irreversible and irretrievable commitment of resources
- Cumulative effects of past, present, and reasonably foreseeable future actions
- Mitigation commitments

LANL SWEIS Process and Schedule

Fourteen years have passed since the publication of the 2008 LANL SWEIS. Because of comprehensive site planning activities that are under consideration, as well as other reasons, NNSA determined that it was appropriate to revisit the 2008 SWEIS analysis. The scoping process is intended to involve all interested agencies (federal, state, and local), public interest groups, federally recognized Indian tribes, local businesses, and members of the general public. Interested parties are invited to participate in the SWEIS process to refine the preliminary alternatives and identify environmental issues that are reasonable or pertinent for analysis. Input from the scoping process will assist NNSA in formulating the alternatives and defining the scope of the SWEIS analysis.

Following the scoping process announced in this Notice, and after consideration of comments received during scoping, NNSA will prepare a Draft SWEIS for the continued operation of the Laboratory. NNSA expects to issue the Draft SWEIS in 2023. NNSA will announce the availability of the Draft SWEIS in the **Federal Register** and local media outlets. NNSA will hold one or more public hearings for the Draft SWEIS. Any comments received on the Draft SWEIS will be considered and addressed in the Final SWEIS. NNSA could then issue a Record of Decision no sooner than 30 days after publication by the Environmental Protection Agency of a Notice of Availability of the Final SWEIS.

Signing Authority

This document of the Department of Energy was signed on August 15, 2022 by Jill Hruby, Under Secretary for Nuclear Security and Administrator, National Nuclear Security Administration, pursuant to delegated authority from the Secretary of Energy. That document with the original signature and date is maintained by DOE. For administrative purposes only, and in compliance with requirements of the Office of the Federal Register, the undersigned DOE Federal Register Liaison Officer has been authorized to sign and submit the document in electronic format for publication, as an official document of the Department of Energy. This administrative process in no way alters the legal effect of this document upon publication in the **Federal Register**.

Signed in Washington, DC, on August 16, 2022.

Treena V. Garrett,

Federal Register Liaison Officer, U.S. Department of Energy.

[FR Doc. 2022–17901 Filed 8–18–22; 8:45 am]

BILLING CODE 6450–01–P

DEPARTMENT OF ENERGY

Federal Energy Regulatory Commission

Combined Notice of Filings #1

Take notice that the Commission received the following electric corporate filings:

Docket Numbers: EC22–103–000.
Applicants: Sonny Solar, LLC, PGR 2021 Lessee 13, LLC.
Description: Joint Application for Authorization Under Section 203 of the Federal Power Act of Sonny Solar, LLC, et al.
Filed Date: 8/12/22.
Accession Number: 20220812–5217.
Comment Date: 5 p.m. ET 9/2/22.

Docket Numbers: EC22–104–000.
Applicants: Allora Solar, LLC, PGR 2021 Lessee 19, LLC.
Description: Joint Application for Authorization Under Section 203 of the Federal Power Act of Allora Solar, LLC, LLC, et al.
Filed Date: 8/12/22.
Accession Number: 20220812–5219.
Comment Date: 5 p.m. ET 9/2/22.

Docket Numbers: EC22–105–000.
Applicants: Gunsight Solar, LLC, PGR 2021 Lessee 15, LLC.
Description: Joint Application for Authorization Under Section 203 of the Federal Power Act of Gunsight Solar, LLC, et al.
Filed Date: 8/12/22.
Accession Number: 20220812–5222.
Comment Date: 5 p.m. ET 9/2/22.

Docket Numbers: EC22–106–000.
Applicants: Cabin Creek Solar, LLC, PGR 2021 Lessee 12, LLC.
Description: Joint Application for Authorization Under Section 203 of the Federal Power Act of Cabin Creek Solar, LLC, et al.
Filed Date: 8/12/22.
Accession Number: 20220812–5224.
Comment Date: 5 p.m. ET 9/2/22.

Docket Numbers: EC22–107–000.
Applicants: Bulldog Solar, LLC, PGR 2021 Lessee 9, LLC.
Description: Joint Application for Authorization Under Section 203 of the Federal Power Act of Bulldog Solar, LLC, et al.
Filed Date: 8/12/22.
Accession Number: 20220812–5227.
Comment Date: 5 p.m. ET 9/2/22.

Docket Numbers: EC22–108–000.
Applicants: Northern States Power Company, a Minnesota Corporation, Northern Wind Energy Redevelopment, LLC.
Description: Joint Application for Authorization Under Section 203 of the Federal Power Act of Northern States Power Company, et al.
Filed Date: 8/15/22.
Accession Number: 20220815–5113.
Comment Date: 5 p.m. ET 9/6/22.

Docket Numbers: EC22–109–000.
Applicants: Northern States Power Company, a Minnesota Corporation, Rock Aetna Power Partners, LLC.
Description: Joint Application for Authorization Under Section 203 of the Federal Power Act of Northern States Power Company, a Minnesota Corporation, et al.
Filed Date: 8/15/22.
Accession Number: 20220815–5124.
Comment Date: 5 p.m. ET 9/6/22.

Take notice that the Commission received the following electric rate filings:

Docket Numbers: ER21–2455–003.
Applicants: California Independent System Operator Corporation.
Description: Compliance filing: 2022–08–15 Compliance Filing—FERC Order No. 2222 to be effective 6/16/2022.
Filed Date: 8/15/22.
Accession Number: 20220815–5078.
Comment Date: 5 p.m. ET 9/6/22.

Docket Numbers: ER22–2494–000.
Applicants: FirstEnergy Service Company.
Description: FirstEnergy Service Company Submits Request for Limited Waiver of Affiliate Rules.
Filed Date: 7/25/22.
Accession Number: 20220725–5180.
Comment Date: 5 p.m. ET 8/19/22.

Docket Numbers: ER22–2656–000.
Applicants: PJM Interconnection, L.L.C.
Description: § 205(d) Rate Filing: Original ISA/ICSA Nos. 6555 and 6556; Queue No. AC1–086 to be effective 7/14/2022.
Filed Date: 8/15/22.
Accession Number: 20220815–5036.
Comment Date: 5 p.m. ET 9/6/22.

Docket Numbers: ER22–2657–000.
Applicants: PJM Interconnection, L.L.C.
Description: § 205(d) Rate Filing: Cost Responsibility Agreement, SA No. 6557; Non-Queue No. NQ–173 to be effective 7/19/2022.
Filed Date: 8/15/22.
Accession Number: 20220815–5080.
Comment Date: 5 p.m. ET 9/6/22.

Docket Numbers: ER22–2659–000.
Applicants: Midcontinent Independent System Operator, Inc.
Description: § 205(d) Rate Filing: 2022–08–15_SA 2927 Duke Energy-Duke Energy 2nd Rev GIA (J453 J1189) to be effective 8/5/2022.
Filed Date: 8/15/22.
Accession Number: 20220815–5131.
Comment Date: 5 p.m. ET 9/6/22.

Docket Numbers: ER22–2660–000.
Applicants: Southwest Power Pool, Inc.
Description: § 205(d) Rate Filing: SPS Formula Rate Revisions to Incorporate Changes Accepted in ER22–201 to be effective 5/19/2021.
Filed Date: 8/15/22.
Accession Number: 20220815–5151.
Comment Date: 5 p.m. ET 9/6/22.

Docket Numbers: ER22–2661–000.
Applicants: California Independent System Operator Corporation
Description: § 205(d) Rate Filing: 2022–08–15 Flexible Ramping Product Enhancements to be effective 12/31/9998.
Filed Date: 8/15/22.
Accession Number: 20220815–5159.
Comment Date: 5 p.m. ET 9/6/22.

Docket Numbers: ER22–2662–000.
Applicants: Aron Energy Prepay 14 LLC.
Description: Baseline eTariff Filing: Market-Based Rate Application to be effective 10/15/2022.
Filed Date: 8/15/22.
Accession Number: 20220815–5167.
Comment Date: 5 p.m. ET 9/6/22.

Take notice that the Commission received the following qualifying facility filings:

Docket Numbers: QF22–854–000.
Applicants: Radford University.
Description: Form 556 of Radford University.
Filed Date: 8/15/22.
Accession Number: 20220815–5033.
Comment Date: 5 p.m. ET 9/6/22.

The filings are accessible in the Commission's eLibrary system (*https://elibrary.ferc.gov/idmws/search/fercgensearch.asp*) by querying the docket number.

Any person desiring to intervene or protest in any of the above proceedings must file in accordance with Rules 211 and 214 of the Commission's Regulations (18 CFR 385.211 and 385.214) on or before 5:00 p.m. Eastern time on the specified comment date. Protests may be considered, but intervention is necessary to become a party to the proceeding.

eFiling is encouraged. More detailed information relating to filing requirements, interventions, protests, service, and qualifying facilities filings can be found at: *http://www.ferc.gov/docs-filing/efiling/filing-req.pdf.* For other information, call (866) 208–3676 (toll free). For TTY, call (202) 502–8659.

From: Los Alamos National Laboratory <lanl@service.govdelivery.com>
Sent: Friday, September 16, 2022 7:53 AM
To: Dors, Kristen <kristen.dors@nnsa.doe.gov>
Subject: [EXTERNAL] Comment Period Extended on new LANL Site-wide EIS

Comment Period Extended on Notice of Intent to prepare a new Los Alamos National Laboratory Site-Wide Environmental Impact Statement

The Department of Energy's National Nuclear Security Administration (DOE/NNSA) has extended the public scoping comment period to October 18 for the new *Site-wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory* (LANL SWEIS).

The public is invited participate in this process to determine the scope of analysis (*e.g.*, range of alternatives, impacts, and actions) and alternatives that should be considered in the SWEIS. NNSA will accept comments from all interested agencies (federal, state, and local), public interest groups, federally-recognized Tribes, businesses, and members of the public on the SWEIS.

The new LANL SWEIS (DOE/EIS-0552) will be done in compliance with the National Environmental Policy Act of 1969 (NEPA). The SWEIS will analyze the potential environmental impacts of the reasonable alternatives for continuing operations of the Laboratory for approximately the next 15 years. The continued operation of the Laboratory is critical to NNSA's Stockpile Stewardship Program, to preventing the spread and use of nuclear weapons worldwide, and to many other areas impacting national security and global stability. The SWEIS will also analyze environmental impacts of legacy waste remediation conducted by DOE's Office of Environmental Management (DOE-EM).

The SWEIS will analyze at least three alternatives, the No Action Alternative: Continue Current Operations, the Modernizing Current Operations Alternative, and the Expanded Operations Alternative. The No Action Alternative, which provides a benchmark for comparison with the environmental effects of the other alternatives, is to continue current LANL program operations in support of assigned missions, without foreseeable new operations or facilities for approximately the next 15 years. The programmatic context for the Modernizing Current 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 above, plus additional modernization activities. This alternative includes: (1) construction of replacement facilities; (2) more significant upgrades to existing facilities and infrastructure; (3) more significant decontamination, decommissioning, and demolition (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 proposed DD&D of older facilities would eliminate excess facilities and reduce costs and risk. This alternative would not expand capabilities and operations at LANL beyond those that currently exist. The Expanded Operations Alternative includes the modernization actions included in the Modernizing Current 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: (1) construction and operation of new facilities, and (2) significant upgrades to existing facilities that result in changing the nature and capabilities of these facilities. This alternative would expand capabilities at LANL beyond those that currently exist. In the Draft SWEIS, NNSA will identify and analyze other actions that could expand the capabilities at LANL.

At this time, we are also initiating Government-to-Government Tribal consultation under the authority of the National Historic Preservation Act (NHPA) for the SWEIS. We invite Tribes to consult on this undertaking and look forward to discussing it as we move forward.

Written and oral comments will be given equal weight and NNSA will consider all comments received or postmarked by the end of the comment period in preparing the Draft SWEIS. The comment period has been extended and now ends October 18, 2022.

Written comments on the scope of the SWEIS or requests for information related to the SWEIS should be sent to LANL SWEIS Comments, 3747 West Jemez Road, Los Alamos, NM 87544, or email to: LANLSWEIS@nnsa.doe.gov.

###

APPENDIX K
Contractor Disclosure Statements

NEPA DISCLSOURE STATEMENT FOR
PREPARATION OF THE SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT
FOR CONTINUED OPERATION OF LOS ALAMOS NATIONAL LABORATORY

Council on Environmental Quality regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR Part 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for purposes of this disclosure is defined in the March 23, 2981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations" (46 FR 18026, Question 17a and b).

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" (see 46 FR 18026).

In accordance with these requirements, the prime contractor and any subcontractors hereby certify that to the best of their knowledge and belief, they have no financial or other interest in the outcome of the project.

Certified by:

Signature

Maher Itani
Name (printed)

Vice President
Title

Tetra Tech, Inc.
Company

May 3, 2024
Date

NEPA DISCLSOURE STATEMENT FOR
PREPARATION OF THE SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT
FOR CONTINUED OPERATION OF LOS ALAMOS NATIONAL LABORATORY

Council on Environmental Quality regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR Part 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for purposes of this disclosure is defined in the March 23, 2981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations" (46 FR 18026, Question 17a and b).

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" (see 46 FR 18026).

In accordance with these requirements, the prime contractor and any subcontractors hereby certify that to the best of their knowledge and belief, they have no financial or other interest in the outcome of the project.

Certified by:

Joseph W Rivers Jr

Digitally signed by Joseph W Rivers Jr
DN: cn=Joseph W Rivers Jr, o=Rivers Consulting, ou=President, email=jrivers@jwrivers.com, c=US
Date: 2024.05.03 12:20:14 -04'00'

Signature

Joseph W. Rivers, Jr

Name (printed)

President

Title

Rivers Consulting, inc.

Company

May 3, 2024

Date

NEPA DISCLSOURE STATEMENT FOR
PREPARATION OF THE SITE-WIDE ENVIRONMENTAL IMPACT STATEMENT
FOR CONTINUED OPERATION OF LOS ALAMOS NATIONAL LABORATORY

Council on Environmental Quality regulations at 40 CFR 1506.5(c), which have been adopted by DOE (10 CFR Part 1021), require contractors who will prepare an EIS to execute a disclosure specifying that they have no financial or other interest in the outcome of the project. The term "financial interest or other interest in the outcome of the project" for purposes of this disclosure is defined in the March 23, 2981, guidance "Forty Most Asked Questions Concerning CEQ's National Environmental Policy Act Regulations" (46 FR 18026, Question 17a and b).

"Financial or other interest in the outcome of the project" includes "any financial benefit such as a promise of future construction or design work in the project, as well as indirect benefits the contractor is aware of (e.g., if the project would aid proposals sponsored by the firm's other clients)" (see 46 FR 18026).

In accordance with these requirements, the prime contractor and any subcontractors hereby certify that to the best of their knowledge and belief, they have no financial or other interest in the outcome of the project.

Certified by:

____
Signature

Abe Zeitoun
____
Name (printed)

Senior Vice President
____
Title

SC&A, Inc.
____
Company

May 27, 2024
____
Date