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Chromium Interim Measure and Final Remedy Environmental Assessment

Los Alamos, New Mexico

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The National Environmental Policy Act of 1969 (NEPA), as amended (42 United States Code 4321 et seq.), requires Federal agencies to consider the environmental consequences of proposed actions before making decisions. In complying with NEPA, the U.S. Department of Energy's (DOE's) Office of Environmental Management follows the Council on Environmental Quality (CEQ) regulations (40 Code of Federal Regulations 1500–1508) and DOE's NEPA-implementing procedures (10 Code of Federal Regulations 1021). In accordance with NEPA requirements and implementing procedures, this Environmental Assessment of the proposed DOE action and alternatives provides DOE with sufficient evidence and analysis to determine whether to issue a Finding of No Significant Impact or to prepare an environmental impact statement.

In July 2020, the CEQ comprehensively updated its NEPA regulations, which went into effect on September 14, 2020. On April 20, 2022, CEQ issued the Phase 1 Final Rule, which finalized a narrow set of changes to generally restore regulatory provisions that were in effect before the 2020 rule. On July 28, 2023, CEQ announced a Phase 2 Notice of Proposed Rulemaking—the "Bipartisan Permitting Reform Implementation Rule"—to revise its regulations for implementing the procedural provisions of NEPA, including to implement the amendments to NEPA by the Fiscal Responsibility Act of 2023. However, this Chromium Interim Measure and Final Remedy Environmental Assessment was started prior to the effective date of the revised CEQ regulations, and the Office of Environmental Management Los Alamos Field Office has elected to complete this Environmental Assessment pursuant to the April 20, 2022, Phase 1 Final Rule.

SUMMARY

Groundwater sampling data from monitoring wells at Los Alamos National Laboratory (LANL) indicate the presence of chromium contamination in the regional aquifer resulting from historical use of potassium dichromate, a corrosion inhibitor, in cooling tower water that was discharged to an outfall as part of operational maintenance activities. Concentrations of chromium within the groundwater plume beneath Mortandad Canyon exceed the New Mexico groundwater standard of 50 parts per billion (ppb) near the property boundary between LANL and the Pueblo de San Ildefonso and are as high as 1,000 ppb in the plume center. In 2015, the U.S. Department of Energy (DOE) prepared the *Environmental Assessment for Chromium Plume Control Interim Measure and Plume-Center Characterization, Los Alamos National Laboratory* (DOE/EA-2005) (referred to as the 2015 Interim Measures EA) (DOE, 2015). The purpose of the 2015 Interim Measures EA was to analyze the environmental impacts associated with implementing the chromium interim measure for plume control and plume characterization.

The DOE Office of Environmental Management Los Alamos Field Office (EM-LA) initiated sustained operations of the southern portion of the interim measure in 2018 and the remaining portions of the interim measure were brought online at a later date, mostly toward the end of 2019. While the groundwater underlying Sandia and Mortandad Canyons is currently being treated as an interim measure, DOE is evaluating alternatives for groundwater remediation with the primary goal of chromium mass removal or remediation to achieve compliance with groundwater quality standards.

DOE's Proposed Action for a final remedy is a combination of treatment options whereby EM-LA would use adaptive site management (ASM) to select, implement, and manage removal of hexavalent chromium from source areas and the groundwater. The use of ASM helps develop effective cleanup strategies by ensuring continuous planning, implementation, and monitoring that accommodates new information and changing site conditions. The Proposed Action includes four options noted below, that can be utilized individually or as a combination to remediate chromium contaminated groundwater below Sandia and Mortandad Canyons. This approach will provide DOE the flexibility to make timely environmental cleanup decisions related to cost, impacts, and effectiveness as work progresses. The Proposed Action options are:

- Option 1: Mass Removal via Expanded Treatment—Under this option, additional extraction, injection, and monitoring wells would be added to raise the rate of groundwater extraction and increase the rate of mass removal, treatment, and injection.
- Option 2: Mass Removal with Land Application—This option would use land application of treated groundwater as a disposition method.
- Option 3: Mass Removal via In-situ Treatment—This option would use in-situ treatments to supplement treatment of the contaminated groundwater.
- Option 4: Monitored Natural Attenuation—Monitored natural attenuation (MNA) relies on natural physical, chemical, or biological processes to reduce concentrations, toxicity, or mobility of chromium and incorporates regular monitoring to verify that MNA is working.

The Proposed Action would use infrastructure already in place as a result of ongoing investigations of the chromium plume and install new infrastructure. Existing infrastructure includes injection, extraction, and monitoring wells; piezometers; a water treatment system with portable storage tanks, storage basins, and associated connecting pipelines; unpaved access roads; power lines; and an irrigation system for land application of treated water. The Proposed Action would include installation of the following new infrastructure:

- Up to 15 injection wells in the regional aquifer: 70 gallons per minute (gpm) (1,000 gpm max total capacity).
- Up to 15 extraction wells in the regional aquifer: 70 gpm (1,000 gpm max total capacity).
- Up to 15 new monitoring wells in the regional aquifer. One existing well would be converted into a monitoring well in the regional aquifer, for a total of 16 monitoring wells.
- Up to 20 piezometers in the shallow zone (i.e., the alluvial aquifer) in Sandia Canyon Wetlands source area.
- Up to 10 piezometers in the deep vadose zone (i.e., the intermediate-perched aquifer) in Mortandad Canyon.
- A new 10,000 square foot groundwater treatment facility.
- Well pads and infrastructure to support installation and operation of the wells, including well heads, shipping containers (or similar shelters), portable storage tanks, and piping.
- Spray irrigation/evaporation system.
- Buried piping.
- Unpaved access roads.

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. EM-LA would avoid disturbing sensitive ecological and cultural resources. Water would be treated to verify all constituents meet New Mexico Environmental Department (NMED) Ground Water Quality Bureau permit requirements before injection into the aquifer through the injection wells or land application.

In addition to the Proposed Action, DOE evaluated a No Action Alternative. The No Action Alternative is the continuation of the preferred alternative in the 2015 Interim Measures EA (DOE/EA-2005) (DOE, 2015) and Finding of No Significant Impact (December 2015), whereby EM-LA would control plume migration and maintain chromium contamination concentrations within the LANL boundary while continuing to evaluate long-term corrective action remedies, including options for chromium mass removal. EM-LA would continue conducting field-scale studies to further characterize the plume to evaluate the effectiveness and feasibility of implementing a final remedy.

The environmental effects of the Proposed Action would be as follows:

- **Land use**—Activities would take place within the LANL boundary in an area of active groundwater investigation; activities would be compatible with existing land uses.
- **Geology and soils**—Installation and operation of wells would have little to no impacts on geology. Some soil erosion by wind and stormwater would likely occur in disturbed

areas. Soil erosion would be controlled by adherence to best management practices (BMPs) and would be minor.

- **Groundwater**— Environmental consequences to groundwater and groundwater quality relate to the well construction and the operation of the extraction/injection operations. Well construction would have minor impacts on water quality and minor temporary impacts on water levels. Operating extraction wells would alter the groundwater quality by reducing the chromium concentration in the well's vicinity. Similarly, injection wells would alter the groundwater quality by injecting treated water. The intent overall is to return the majority of extracted water back into the regional aquifer. Water injected into the aquifer through injection wells, land-applied, or evaporated would meet NMED Ground Water Quality Bureau permit standards. The Proposed Action would have positive environmental consequences from chromium mass reduction.
- **Surface water**— Soil disturbance resulting from infrastructure development, operation, and maintenance activities associated with the Proposed Action could result in sedimentation to surface waters. With anticipated soil disturbance totaling 75 acres and implementation of BMPs, potential environmental consequences to surface waters are expected to be minor.
- **Air quality**— Implementing the Proposed Action would result in air emissions of criteria pollutants, hazardous air pollutants, and greenhouse gas emissions from road construction, installation of well pads, well development, pipeline installation, and construction of the treatment facility. The intermittent nature of operational emissions and emissions from installation activities, in combination with air quality mitigation measures, would not contribute to an exceedance of an ambient air quality standard at locations outside the LANL site. Impacts to air quality would be minimal.
- **Ecological resources**—Impacts to ecological resources from the Proposed Action could include temporary and permanent disturbances; degradation or loss of habitat from land clearing activities; disturbance or displacement of wildlife due to an increase in noise and human activity; habitat fragmentation; and an increase in human-wildlife interactions. The Proposed Action would follow all BMPs, monitoring plans and measures related to ecological resources established for LANL. Implementing the Proposed Action with identified controls would not result in significant impacts to these species or resources.
- **Cultural resources**—Historic properties would be avoided to the maximum extent possible during Proposed Action activities. Erosion control measures would be incorporated to limit direct and indirect impacts to archaeological sites from stormwater runoff or erosion. Regular consultation with Pueblos de San Ildefonso would be implemented to discuss how to best limit impact. No significant impacts to archaeological or historic properties would be anticipated.
- **Utilities and infrastructure**— The proposed chromium treatment facility would require a connection to the existing LANL electrical system. No new electrical lines would be required for connection. The potable water supply and existing water-supply infrastructure would accommodate project use. Impacts to electrical and water infrastructure would be minor. The project area is largely in a less frequently travelled area of LANL. Other than construction of new access roads, activities under the

Proposed Action would not affect road infrastructure, and overall effects on the road infrastructure at LANL would be minimal.

- **Traffic and transportation**—The Proposed Action would increase the number of personal commuter vehicles and number of truck deliveries for the construction of the groundwater treatment facility, well pads, wells, and piezometers. Routine daily traffic volumes would be expected to decrease after construction of the proposed groundwater treatment facility is completed. Proposed traffic improvements (a new Pajarito Road roundabout and widening of Diamond Drive) would help alleviate congestion and traffic safety issues on Pajarito Road. As such, adverse traffic impacts are expected to be minor.
- **Hazardous materials and waste generation**—Small quantities of industrial (i.e., construction debris) and hazardous wastes would be generated from the Proposed Action. Waste would be handled in accordance with LANL's waste management procedures. The waste quantities generated under the Proposed Action would be minimal, thus impacts to on-site waste operations or off-site disposal facilities are anticipated to be small.
- **Noise**—The Proposed Action would generate noise from construction activities and from the use of equipment, machinery, and vehicles, which could affect noise-sensitive receptors. Elevated noise levels would generally be limited to the immediate area of the noise source and are expected to dissipate before reaching publicly accessible areas. Any adverse noise impacts would generally be minor.
- **Visual resources**—There would be little to no substantial dominant visual change in Mortandad Canyon or Sandia Canyon as observed from outside vantage points, no substantial change in visibility caused by predicted air pollutant emissions, no conflict with Federal land management agency visual standards, and no long-term dominant visual interruption of existing or unique viewsheds.
- **Human health and worker safety**—The Proposed Action would not involve direct hazards to the public. Chromium in public water supply wells is monitored by LANL and the Los Alamos County Department of Public Utilities (LADPU), and there is no indication that the chromium plume has affected water supply wells. Access to the project area is restricted and noise-generating activities and air emissions would be unlikely to affect members of the public at the nearest publicly accessible points. Effects on human health would be negligible. Applicable safety and health training and monitoring, personal protective equipment, and work-site hazard controls would be required for workers; activities would not be expected to have any adverse health effects on workers.
- Socioeconomics—The direct workforce requirements for the Proposed Action would be very small and comprise less than (<) 0.1 percent of the existing workforce in the region (0.02 percent). Similarly, the total population influx from implementing any of the ASM options would comprise <0.1 percent of the total population in the region (0.02 percent). Potential adverse impacts from the Proposed Action options would be expected to be small on the housing market and community services within the region of influence because the expected worker and population influx is expected to be very small. The small increase in employment (direct and indirect jobs) from both construction and

operation would be expected to result in small and beneficial impacts on the local economy and ROI from the increase in jobs, income and salaries, as well as expenditures and revenue from state and local taxes.

- **Environmental justice**—Implementation of the Proposed Action would not result in disproportionate and adverse impacts in the resource areas of concern for minority and low-income populations, especially health and safety. In addition, the Proposed Action would not have lasting or irreversible adverse effects. However, representatives of Pueblo de San Ildefonso previously anticipated a direct, adverse impact from the proposed Chromium Plume Control Interim Measure and Plume-Center Characterization Project to Tribally important resources and practices associated with the Sacred Area. However, these representatives also understood that the currently proposed ASM implementing options would offset those concerns by reducing the chromium plume contamination.

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FIGURES

TABLES

ACRONYMS AND ABBREVIATIONS

<	less than
>	greater than
AADT	annual average daily traffic
AOC	Area of Concern
APE	area of potential effects
AQB	Air Quality Bureau
ASM	adaptive site management
ATEM	Accord Technical Exchange Meeting
BMP	best management practice
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CME	corrective measures evaluation
CMIP	Corrective Measures Implementation Plan
Cr(III)	trivalent chromium
Cr(VI)	hexavalent chromium, or chromium 6+
CrEX	chromium extraction
CrIN	chromium injection
CRMP	Cultural Resources Management Plan
CWA	Clean Water Act
DART	days away, restricted, or transferred
dBA	A-weighted decibel
DOE	U.S. Department of Energy
DOE-EM	U.S. Department of Energy Office of Environmental Management
DP	Discharge Permit
DPU	Los Alamos County Department of Public Utilities
EA	Environmental Assessment
EIS	Environmental Impact Statement
EM-LA	U.S. Department of Energy Office of Environmental Management, Los Alamos
EO	Executive Order
EPA	U.S. Environmental Protection Agency
FEHM	Finite Element Heat and Mass Transfer Code
FONSI	Finding of No Significant Impact
FR	Federal Register
ft^2	square feet
ft^3	cubic feet
g	standard unit of gravity
gpd	gallons per day
gpm	gallons per minute
gpy	gallons per year
GHG	greenhouse gas
HAP	hazardous air pollutant
IM	Interim Measure
kV	kilovolt
LANL	Los Alamos National Laboratory
LADPU	Los Alamos County Department of Public Utilities
lbs	pounds
μg/L	micrograms per liter
MNA	monitored natural attenuation
N3B	Newport News Nuclear BWXT-Los Alamos, LLC
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act
NM	New Mexico State Road
NMAC	New Mexico Administrative Code
NMDOT	New Mexico Department of Transportation
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of State Engineer
NMSA	New Mexico Statutes Annotated
NNLEMS	Network of National Laboratories for Environmental Management and Stewardship
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWQCC	New Mexico Water Quality Control Commission
OSHA	Occupational Safety and Health Administration
PA	Programmatic Agreement
PGA	peak ground acceleration
ppb	parts per billion
RCRA	Resource Conservation and Recovery Act
ROI	region of influence
SDWA	Safe Drinking Water Act
SR	State Road
SWEIS	Site-Wide Environmental Impact Statement
SWPPP	Stormwater Pollution Prevention Plan
TA	Technical Area
TPS	Thin-Plate Spline
TRC	total recordable case
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USCB	U.S. Census Bureau
USFWS	U.S. Fish and Wildlife Service
yd^3	cubic yards
ZVI	zero-valent iron

1.0 PURPOSE AND NEED FOR AGENCY ACTION

1.1 INTRODUCTION

The Los Alamos National Laboratory (LANL) site is located in Los Alamos County in north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (see Figure 1-1). The U.S. Department of Energy (DOE) is the Federal agency responsible for managing the LANL site. The DOE Los Alamos Field Offices include the National Nuclear Security Administration (NNSA), a semiautonomous agency within DOE, and the DOE Office of Environmental Management (DOE-EM). The NNSA Los Alamos Field Office oversees the management and operating contract for LANL, and the DOE-EM Los Alamos (EM-LA) Field Office is responsible for legacy waste cleanup at the LANL site.

The LANL site is about 40 square miles and sits on the Pajarito Plateau, a series of mesas separated by east-west trending canyons, at the eastern edge of the Jemez Mountains. Large tracts of land north, west, and south of the site are managed by the Santa Fe National Forest, the U.S. Bureau of Land Management, Bandelier National Monument, and Los Alamos County. The town of Los Alamos borders LANL to the north. The Pueblo de San Ildefonso and the town of White Rock border LANL to the east. Santa Clara Pueblo is north of LANL, but does not share a border. The two primary residential areas within Los Alamos County are the Los Alamos townsite and the White Rock residential area. Approximately 345,000 people live within a 50-mile radius of LANL (EPA, 2023a). At the end of calendar year 2021, the LANL site employed 14,380 employees (including DOE contractor employees) (LANL, 2023a).

In 2004, samples from a newly constructed monitoring well exceeded the New Mexico Water Quality Control Commission (NWQCC) groundwater standard for human health of 50 micrograms per liter (µg/L) of chromium. As a result, under LANL's 2005 Order on Consent with the New Mexico Environment Department (NMED) Hazardous Waste Bureau, LANL was required to submit an interim measures report for hexavalent chromium (i.e., Cr(VI)). An interim measure is a formal process under the Resource Conservation and Recovery Act (RCRA) that allows actions and activities to be used to control or abate ongoing risks to human health or the environment in advance of the final remedy.

In 2015, EM-LA completed the *Environmental Assessment for Chromium Plume Control Interim Measure and Plume-Center Characterization* (DOE/EA-2005) (DOE, 2015) (referred to as the 2015 Interim Measures EA) to analyze the environmental impacts of conducting an interim measure to control migration of a plume of chromium contaminated groundwater and conducting field-scale studies to further characterize the plume center. The 2015 Interim Measures EA for the interim measure and plume-center characterization did not include an analysis of a final remedy to address chromium contaminated groundwater in Sandia and Mortandad Canyons. Based on analyses in the 2015 Interim Measures EA, DOE EM-LA determined that its proposed action would not result in any significant adverse impacts and issued a Finding of No Significant Impact (FONSI).

EM-LA initiated interim measure operations in 2018 to prevent migration of the plume beyond the LANL site boundary and to perform scientific studies to obtain data necessary to evaluate and recommend a final remedy. DOE now seeks to address the Cr(VI) contamination by evaluating appropriate final remedial actions that (1) can be implemented quickly, safely, and efficiently; (2) are cost-efficient; and (3) protect human health and the environment.

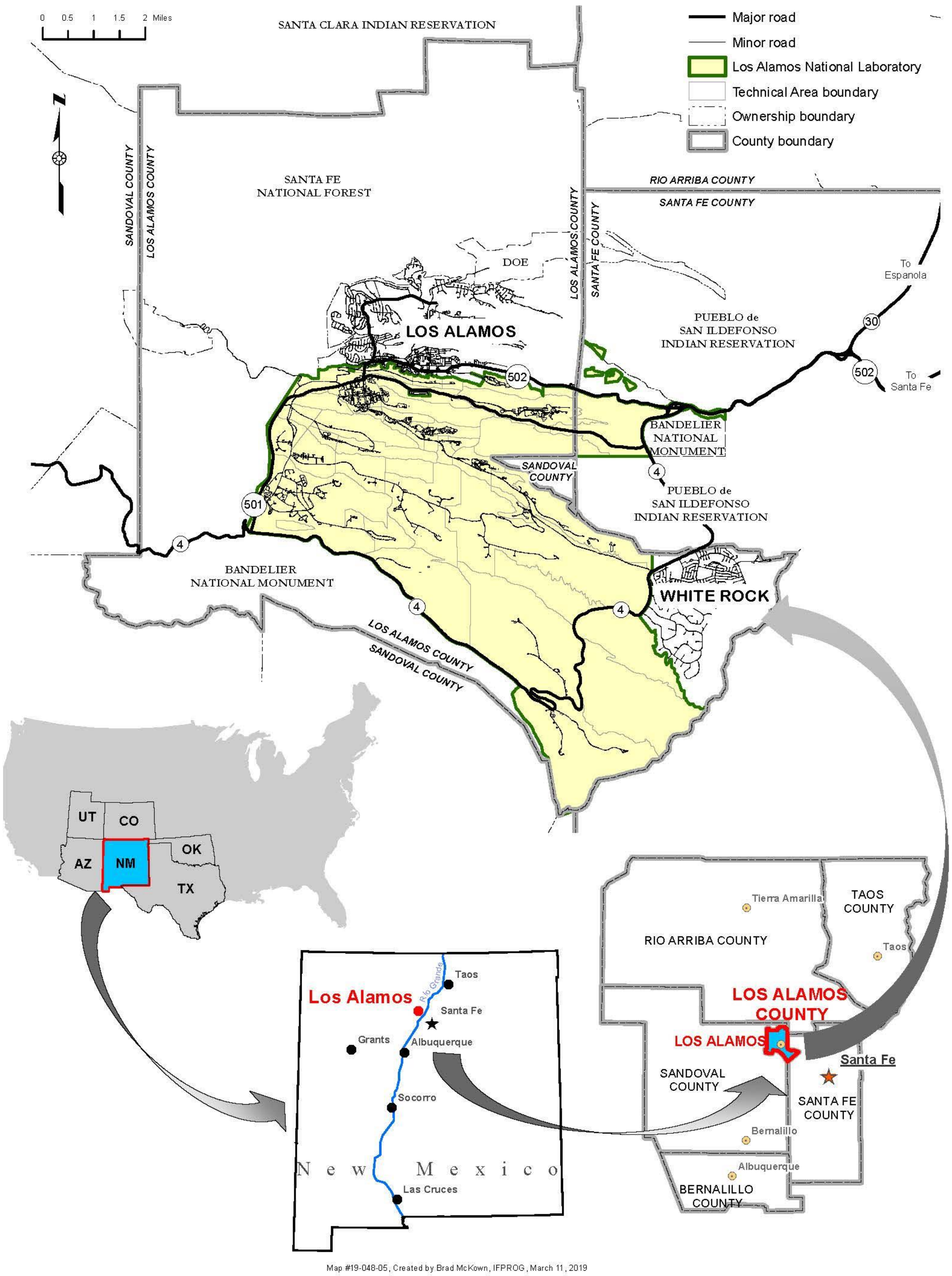

Figure 1-1. Regional location of Los Alamos National Laboratory

1.2 BACKGROUND

In 2004, groundwater samples collected from groundwater monitoring well R-28 screened in the upper portion of the regional aquifer beneath Mortandad Canyon at LANL indicated the presence of Cr(VI) contamination. Subsequent investigations determined that the Cr(VI) plume originated from LANL's non-nuclear power plant at the head of Sandia Canyon. From 1956 to 1972, water containing potassium dichromate (with chromium in its hexavalent form [Cr^{+6} or Cr(VI)]) was utilized as a corrosion inhibitor for the plant cooling towers. This water was discharged into the headwaters of Sandia Canyon, releasing as much as 160,000 pounds (lbs) of potassium dichromate (LANL, 2018a). This discharge was part of operational maintenance activities through a National Pollutant Discharge Elimination System (NPDES) Permit NM0028355 that empties into upper Sandia Canyon on the south rim.

Much of the discharged chromium was converted to a lower toxicity form of chromium (Cr^{+3} or trivalent chromium [Cr(III)]) in a several-acre effluent-supported wetland immediately downstream of the NPDES outfall in Sandia Canyon. The remaining chromium, in predominantly hexavalent form, was transported via surface water down Sandia Canyon. Approximately 2 miles east of the wetland, a porous unit of the Bandelier Tuff bedrock at the surface enabled part of this discharge to infiltrate vertically through a 1,000- to 1,230-foot-thick geologically complex zone that is mostly unsaturated by water and referred to as the vadose zone (N3B, 2023a). The infiltration of these Cr(VI) waters ultimately created the chromium plume in the portion of the regional aquifer that lies beneath Mortandad Canyon. The concentrations of Cr(VI) are at levels above the NMED groundwater standard of 50 µg/L in an area estimated to be approximately 1 mile in length and about a half-mile wide.[1] Hexavalent chromium contamination generally occurs within the upper 100 feet of the regional aquifer. A few locations (e.g., well R-70 area) are known to have chromium deeper than 100 feet (Figure 1-2). Additional investigations are underway to complete the delineation of the lateral and vertical extent of that contamination. While natural background concentrations (4 to 10 µg/L) of Cr(VI) are detected in many of the wells screened in the regional aquifer, regular sampling of nearby potable water supply wells indicates this plume has not affected any of them.

In 2015, DOE prepared the 2015 Interim Measures EA and FONSI (DOE, 2015). The proposal included drilling additional extraction wells and installing associated infrastructure to improve the effectiveness of the system to control chromium plume migration.

The interim measure infrastructure currently consists of five extraction wells (referred to as CrEX wells, for chromium extraction), an ion exchange treatment system, and five injection wells (referred to as CrIN wells, for chromium injection), with the latter component located along the downgradient portion of the plume to hydraulically control plume migration (see Figure 1-2) (N3B, 2023a). The approach is to extract chromium contaminated groundwater, treat it at the surface using ion exchange, and reinject treated water into the aquifer downgradient from where it was extracted in an effort to reverse the water table gradient to mitigate the movement of chromium in the southerly direction. The treated water is tested to verify that constituents meet NMED Ground Water Quality Bureau permit requirements before it is injected into the aquifer through the injection wells or sent for land application. Discharge Permit (DP)-1793 authorizes the EM-LA cleanup contractor to land-apply the treated groundwater using spray irrigation, an evaporation system, or

[1] This EA uses the term *chromium* by itself, to mean total chromium (hexavalent and trivalent); however, the groundwater plume is almost entirely hexavalent chromium.

water trucks along unpaved access roads, though those practices have been implemented only on a very limited basis to date. Land application as specified in the permit is limited in geographic area, months of the year, and time of day for when it can be applied, and at best could only dispose of ten percent of the treated water produced by the interim measure system when in full operational mode.

EM-LA initiated operations of the southern portion of the interim measure in the spring of 2018, due to the proximity of the plume leading edge to the property boundary with Pueblo de San Ildefonso. The remaining portions of the interim measure were brought online at a later date, mostly toward the end of 2019. Although there is still uncertainty with respect to the vertical and lateral distribution of the chromium plume in the plume centroid and the northeastern regions of the plume, the hydraulic and geochemical data and information indicate that interim measure operations have generally contained the plume within the LANL site boundary (N3B, 2023a).

Perchlorate is a co-contaminant in the Cr(VI) plume. The primary source of perchlorate is historic discharges released from the Radioactive Liquid Waste Treatment Facility from 1963 until March 2002. Starting in 2002, improvements in perchlorate removal technology were made at the Radioactive Liquid Waste Treatment Facility, resulting in substantial decreases in perchlorate concentrations in effluent. The NMED Toxic Pollutant Standard for perchlorate is 13.8 µg/L, and concentrations in the regional aquifer beneath Sandia and Mortandad Canyons rarely exceed this concentration except at three locations next to extraction well CrEX-2. During interim measure operations, the ion exchange largely removes chromium, and perchlorate is largely untreated by this process. Perchlorate is partly removed by the Cr(VI) ion exchange treatment process in concentrations generally ranging from 0.05 µg/L to 0.232 µg/L. The ion exchange system could be modified to remove perchlorate. However, chromium is the contaminant of highest concern because it exceeds 50 µg/L in the regional aquifer beneath Mortandad Canyon and Sandia Canyon. Therefore, perchlorate contamination is not being specifically addressed in this Environmental Assessment (EA). The 2016 Compliance Order on Consent (Consent Order) between DOE and NMED is the principal regulatory document governing nonradioactive legacy cleanup at the LANL site. Legacy low-level mixed-waste cleanup is also regulated by NMED due to the hazardous waste component. The Consent Order sets forth the corrective action process, including the development of Corrective Measures Evaluation (CME) Reports. The purposes of the Consent Order are (1) to fully determine the nature and extent of releases of contaminants at or from the LANL site; (2) to identify and evaluate, where needed, alternatives for corrective measures, to clean up contaminants in the environment, and to prevent or mitigate the migration of contaminants at or from the LANL site; and (3) to implement such corrective measures.

EM-LA is preparing this EA under the National Environmental Policy Act (NEPA), as amended, (Title 42 United States Code [U.S.C.] Section 4321 et seq.) to evaluate alternatives for remedial action as part of the Chromium Interim Measures and Characterization Campaign identified in Appendix A of the Consent Order. In accordance with the Consent Order, EM-LA will identify and evaluate potential corrective measures alternatives for removal, containment, and/or treatment of the Cr(VI) plume in the CME report and recommend a preferred alternative for remediation. NMED will then review the CME, issue a Statement of Basis, engage in a public comment period, provide an opportunity for a public hearing on the remedy, and aid in the selection of a final remedy.

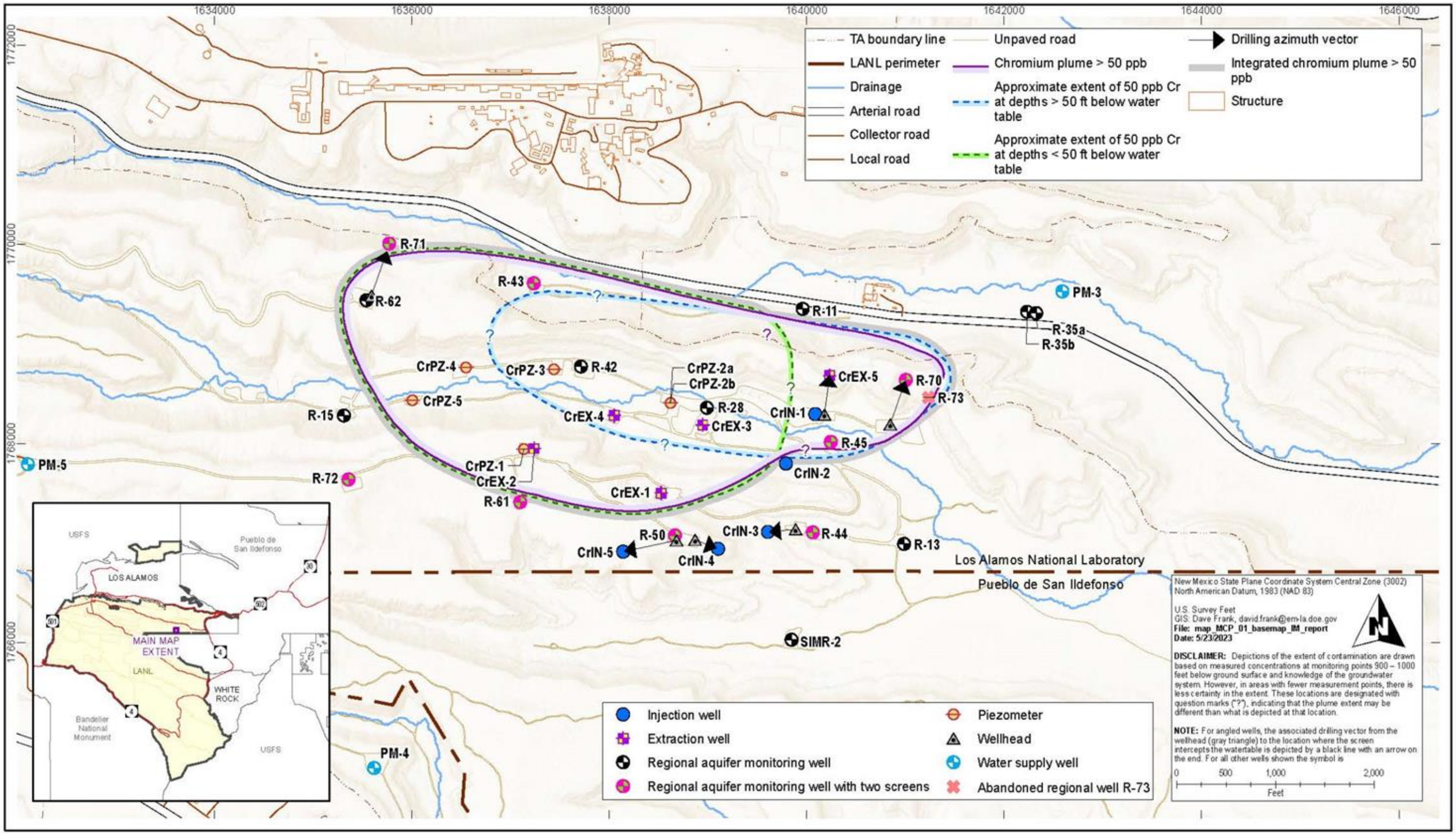

Figure 1-2. Present-day plume depiction, along with symbols depicting the level of chromium concentration (>50 or <50 µg/L) at sampling locations

1.3 PURPOSE AND NEED

NEPA requires Federal agencies to consider the environmental consequences of proposed actions before making decisions. In complying with NEPA, EM-LA follows the Council on Environmental Quality (CEQ) regulations (Title 40 Code of Federal Regulations [CFR] Parts 1500–1508) and DOE's NEPA-implementing procedures (10 CFR 1021). In accordance with NEPA requirements and implementing procedures, EM-LA is preparing this EA to evaluate the environmental impacts of corrective measures to remediate contaminated groundwater below Sandia and Mortandad Canyons and to determine whether to issue a FONSI or to prepare an Environmental Impact Statement (EIS).

In accordance with applicable Federal and state regulations, and the Consent Order, DOE-EM needs to assess, identify, clean up, and otherwise address environmental contamination at LANL.

The purpose of the Proposed Action is to remediate chromium contaminated groundwater below Sandia and Mortandad Canyons. While the groundwater underlying Sandia and Mortandad Canyons was treated as an interim measure, DOE is evaluating corrective measures for a final remedy that achieves permanence, cost effectiveness, and cleanup requirements. Whereas the primary objective of the interim measure was to prevent migration of the chromium plume past the LANL boundary (hydraulic control), with the incidental benefit of removing chromium mass from the regional aquifer, DOE now needs to evaluate alternatives for groundwater remediation with the primary goal of chromium mass removal or remediation to achieve compliance with groundwater quality standards.

1.4 RELEVANT NEPA DOCUMENTS AND SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

In 2010, the NNSA Los Alamos Field Office prepared the *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, Los Alamos, New Mexico* (DOE/EA-1736) (NNSA, 2010) (referred to as the SERF Expansion EA) to assess the potential environmental consequences of implementing two expansion action alternatives at the SERF. The SERF Expansion EA addressed the expanded treatment capacity that the SERF would need to treat discharges from the Sanitary Wastewater System Plant, the Strategic Computing Complex and Laboratory Data Communications Center cooling tower blowdown, and Power Plant boiler blowdown discharged to Outfall 001. It also addressed contamination in upper Sandia Canyon sediments from chromium and polychlorinated biphenyls. This EA incorporates information (tiers) from the 2010 SERF Expansion EA.

In 2008, DOE prepared the *Final Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE/EIS-0380) (DOE, 2008) (referred to as the SWEIS). The SWEIS and subsequent supplement analyses to the SWEIS document a comprehensive analysis of all LANL activities foreseen at the time of preparation, including actions required under the Consent Order. DOE anticipated that future actions could include installing wells, and pumping, sampling, and treating groundwater (described in Appendix I of the SWEIS). This EA has been prepared to present a detailed evaluation of proposed Consent Order activities related to, and potential environmental impacts associated with, the Mortandad Canyon Cr(VI) plume. This EA incorporates information (tiers) from the SWEIS.

In 2015, EM-LA prepared the 2015 Interim Measures EA (DOE, 2015) to analyze the environmental impacts associated with implementing the interim measure for Cr(VI) plume control and plume-center characterization. This EA incorporates information (tiers) from the 2015 Interim Measures EA; where relevant, information is either summarized in this EA or incorporated by reference.

1.5 PUBLIC INVOLVEMENT

On April 28, 2023, EM-LA gave notice of two public scoping meetings, which they hosted in person on May 8, 2023, and via interactive webcast on May 9, 2023. Notices were published in the *Los Alamos Daily Post*, *Los Alamos Reporter*, *Santa Fe New Mexican*, and the *Rio Grande Sun*. Notices were also sent to interested stakeholders and non-governmental organizations.

The public scoping meetings and notices provided the public with information about the NEPA process and the *Chromium Interim Measure and Final Remedy Environmental Assessment* and invited public comments on the scope of this EA.

Questions from the public were welcomed at both meetings. Participants at the in-person meeting were instructed to provide their comments as either verbal comments to the EA project's stenographer or in writing by submitting a comment form to the EM-LA representatives at the meeting. Webcast and in-person participants were also invited to provide their comments after the meeting via email or mail.

This public scoping period closed on June 6, 2023. No comments were received at the meetings, but afterwards, DOE received seven comment documents in which 99 comments were identified. The scoping comments and EM-LA's responses are summarized in Appendix A, *Scoping Comments Summary*.

2.0 DESCRIPTION OF ALTERNATIVES

2.1 INTRODUCTION

The CEQ regulations in 40 CFR 1508.9(b) require that an EA include a brief discussion of reasonable alternatives to a proposed action. EM-LA considered alternatives for chromium mass removal in source areas and regional groundwater below Sandia and Mortandad Canyons. For alternatives to be reasonable, they must meet the following criteria:

- Control migration of chromium in groundwater
- Reduce the mass of chromium in groundwater
- Control, reduce, or eliminate the sources of chromium in groundwater
- Achieve cleanup objectives
- Protect human and ecological receptors
- Manage remediation waste in accordance with state and Federal regulations.

This section describes the Proposed Action, the No Action Alternative, and alternatives considered but eliminated from further analysis. A more detailed description of the Proposed Action can be found in Appendix B, *Description of Alternatives Supporting Information*.

2.2 NO ACTION ALTERNATIVE

The No Action Alternative establishes a baseline against which this EA compares the Proposed Action. "No action" does not necessarily mean doing nothing but involves maintaining or continuing the existing status or condition. In this document, the No Action Alternative is the continuation of the preferred alternative in the 2015 Interim Measures EA (DOE, 2015) and FONSI (December 2015), which prioritized the Chromium Plume Interim Measure and Plume Characterization. Under the No Action Alternative, EM-LA would control plume migration and maintain chromium contamination concentrations within the LANL boundary while continuing to evaluate long-term corrective action remedies, including options for chromium mass removal. EM-LA would continue conducting field-scale studies to further characterize the plume to evaluate the effectiveness and feasibility of implementing a final remedy. Evaluations and analyses performed during implementation of the No Action Alternative would continue to contribute to recommendations of a final remedy. When EM-LA has identified a final remedy, they would perform a NEPA evaluation.

2.3 PROPOSED ACTION

In 2022, the Network of National Laboratories for Environmental Management and Stewardship (NNLEMS) completed *the Independent Review of Groundwater Remediation Strategy for Hexavalent Chromium and RDX Groundwater Plumes at Los Alamos National Laboratory* (NNLEMS, 2022). The report documents an independent technical review by scientists from the DOE NNLEMS to provide recommendations for potential near-term actions to address and optimize remediation for the Cr(VI) plume. The overarching recommendation of the NNLEMS review team is that the Cr(VI) plume should be addressed in context of the emerging "management of complex sites" paradigm. A primary goal of the complex site paradigm is to recognize that it is difficult to generate advanced knowledge sufficient to provide a technically defensible basis for the final remediation decision, design, and implementation. Instead, an adaptive management strategy encourages a focus on what can be done now with the information that is known, what can be done to stabilize the plume and mitigate risk, and what achievable interim objectives can be added as part of the adaptive management process that will allow success.

Under the Proposed Action, EM-LA would use adaptive site management (ASM) to select and implement options to remediate Cr(VI) contamination in Mortandad and Sandia Canyons. The use of ASM helps develop effective cleanup strategies by ensuring continuous planning, implementation, and monitoring that accommodates new information and changing site conditions. Remediation under ASM addresses what is known while acknowledging what is not fully understood; it includes plans to collect the necessary information to reduce uncertainties and achieve a final, protective remedy for the site. This approach allows work to proceed in some areas while additional data collection and testing of responses is conducted to determine the appropriate level of remediation in remaining areas. ASM has been implemented at many complex remediation sites and is recommended by the U.S. Environmental Protection Agency (EPA) (EPA, 2022).

The Proposed Action provides four options for implementing the ASM approach to remediate chromium contaminated groundwater below Sandia and Mortandad Canyons. EM-LA would utilize these options individually or in combination, to improve the effectiveness of remediation, the cost of remediation, or minimize potential effects resulting from the Proposed Action. More detailed descriptions of these options are included in Appendix B, *Description of Alternatives Supporting Information*, including numeric estimates of key information used to bound and assess the environmental impacts (Table B-1).

- <u>Option 1: Mass Removal via Expanded Treatment</u>—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. The additional wells and the larger groundwater treatment capability would raise the rate of groundwater extraction and increase the rate of mass removal, groundwater treatment, and injection in the affected areas. The combined extraction rate for the existing and new extraction wells would be approximately 550,000,000 gallons per year (gpy). However, current extraction rates for the interim measure are limited by water rights authorized by the New Mexico Office of State Engineer (NMOSE) and is currently limited to a groundwater extraction rate of up to 648,000 gallons per day (gpd), or up to a maximum diversion of groundwater of 679 acre-feet per year. This translates into maximum extraction and injection rates of approximately 450 gallons per minute (gpm) for the interim measure (N3B, 2023a). Any additional extraction for the Proposed Action above the current rates authorized for the interim measure would require authorization from NMOSE.

- <u>Option 2: Mass Removal with Land Application</u>—This option would use land application of treated groundwater as a disposition method. Land application would only occur in permitted areas per a NPDES DP that regulates land application rates. Land application would be limited in geographic area, months of the year, and time of day, for when it can be applied. Land application of treated water in permitted areas would encompass about 50 acres of land. The areas for land application under the Proposed Action are the same as those currently available for this activity under the interim measure.

- Option 3: Mass Removal via In-situ Treatment—This option would use in-situ treatment to address Cr(VI) 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. In-situ treatment would be used to target both source area contamination in Sandia Canyon as well as groundwater contamination beneath Mortandad Canyon.
- Option 4: Monitored Natural Attenuation—Monitored natural attenuation (MNA) relies on natural physical, chemical, or biological processes to reduce concentrations, toxicity, or mobility of chromium and incorporates regular monitoring to verify that MNA is working. In the case of chromium, attenuation occurs via the reduction of mobile Cr(VI) to insoluble Cr(III). EM-LA would consider MNA when contamination poses relatively low risks, the plume is stable or shrinking, and the natural attenuation processes are projected to achieve remedial objectives in a reasonable timeframe, compared to more active methods.

In addition to these options, other measures to achieve the final remedy through source removal could be instituted in the shallow and vadose zone groundwater. The discharge of treated waters could be released into Sandia Canyon or through LANL's NPDES outfall for treated effluent. The details related to these other measures are shown in Appendix B, *Description of Alternatives Supporting Information*, Table B-1.

The SERF Expansion EA (NNSA, 2010) evaluated the environmental impacts of installing grade- control structures in the Sandia Canyon source area to create a stable area of moist soils to minimize erosion of contaminated sediment. DOE installed these structures in 2015, and periodic wetlands sampling indicates that chromium in the wetland sediments is predominantly present in the geochemically stable Cr(III). The presence of Cr(III) is not likely to become a future source of chromium contamination in groundwater, especially if saturated conditions are maintained within the wetland. Prior to the installation of the grade-control structures, natural reducing conditions in the Sandia Canyon wetland had created a viable MNA scenario, which the grade-control structures supplemented with more active water level and saturation control. Therefore, continuation of MNA is the proposed treatment option for the Sandia Canyon source area.

The Proposed Adaptive Site Management Approach

A National Environmental Policy Task Force prepared a report for the CEQ in 2003 concerning modernizing NEPA implementation[2]. One part of that report (i.e., Chapter 4) focuses on ASM and monitoring in the preparation of NEPA documents. Their guidance or recommendation is that a NEPA document should describe the proposed ASM approach, how the approach is reflected in the alternatives being considered, the monitoring protocols, desired outcomes, and

[2] https://ceq.doe.gov/docs/ceq-publications/report/finalreport.pdf

performance measures and factors. These aspects of the proposed ASM approach are addressed hereafter.

In addition, the NNLEMS published an *Independent Review of Groundwater Remediation for Hexavalent Chromium and RDX Groundwater Plumes at Los Alamos National Laboratory* for DOE[3]. The Executive Summary provided DOE short- and long-term ASM recommendations for complex sites, which have been used to guide this project's site-specific approach.

The specifics of the ASM approach would be resolved through the RCRA decision-making process[4] enforced by NMED through the Consent Order where EM-LA will develop recommendations for a final remedy to be presented to NMED for agreement in accordance with the CME process, as described in the Consent Order. EM-LA will then prepare a Corrective Measures Implementation Plan (CMIP) explaining the design, construction, operation, maintenance, and monitoring of the corrective measure or measures. EM-LA will define the adaptive management approach (i.e., the monitoring protocols, desired outcomes, performance measures, interim objectives, and other factors) in the CMIP.

Reflection of the Adaptive Management Approach in the Alternatives

EM-LA has determined from prescreening that the four Proposed Action options represent a range of the most viable methods and technologies to address Cr(VI) mass removal and reductions in groundwater concentrations. EM-LA eliminated some methods and technologies from consideration during prescreening, and these are cited in Appendix B, *Description of Alternatives Supporting Information*. Some of these options have been successfully implemented at the project site (e.g., pump, treat, and inject). Together, the four options are the available approaches that EM-LA can use through ASM to provide flexibility to remedial actions to optimize the pace, thoroughness, and cost-effectiveness of remediation. For instance, in the pump, treat, and inject scenario, a well which is initially utilized for extraction may reduce the chromium concentration well below the New Mexico groundwater standard of 50 ug/L. At that point, it may be advantageous to repurpose the well for monitoring or injection purposes.

Monitoring Protocols

Monitoring supports continuous learning about remediation effectiveness, provides information to guide the planning of future actions, and facilitates decision-making. In general, there are three monitoring types: (1) compliance monitoring, which is required by permits and other regulatory documents with the goal of determining whether remediation actions have been completed as planned; (2) effectiveness monitoring, which measures achievement of targets; and (3) explorative research or explorative monitoring, which tests a conceptual model by evaluating hypotheses with targeted research. Monitoring under the ASM approach may include these three types of monitoring as well as the following elements, which, as noted above, would be defined in the CMIP:

- Groundwater – Perform routine in-situ/ex-situ (as appropriate) chemical sampling of groundwater for Cr(VI) concentrations in injection, extraction, monitoring, and water

[3] See https://www.energy.gov/sites/default/files/2023-07/Network-of-National-Laboratories-for-Environmental-Management-and-Stewardship-NNLEMS-2022-00003_R.1%20final-20233-07-10.pdf.
[4] See https://www.epa.gov/hw/learn-about-corrective-action#theprocess for more information.

supply wells within the project area to evaluate increasing/decreasing trends above the 50-parts-per-billion (ppb) water quality standard.

- Surface Water – Perform chemical sampling of perennial and ephemeral surface waters for Cr(VI) concentrations in the project area to evaluate increasing/decreasing trends in Cr(VI) above the 50-ppb water quality standard.
- Potentiometric Mapping – Map the potentiometric surface of the regional aquifer's water table, with measurements gathered from monitoring wells and piezometers, to evaluate the effectiveness of the hydraulic barrier near the southern boundary with the Pueblo de San Ildefonso as well as the effectiveness of the extraction wells in creating a cone of depression.
- Flow and Solute Modeling – Run the groundwater models to assess through particle-tracking/well capture, and solute transport analysis the effects of adding or removing injection, extraction wells, or new water supply wells.

Appendix F of the Consent Order gives guidance on the methods used to conduct investigation, corrective action, and monitoring activities. Site-specific work plans are developed and include data quality objectives to fulfill the requirements of the Consent Order and provide accurate data for the evaluation of site conditions, the nature and extent of contamination and contaminant migration, and for corrective measures selection and implementation. Future monitoring would be performed, as appropriate and as approved by pertinent regulatory agencies (e.g., NMED), and may be verified by quality assurance comparisons with duplicate and split sampling data taken by oversight agencies (e.g., NMED).

Desired Outcome

In adaptive management, the outcomes of decisions, assessed through monitoring, are compared against explicit predictions of those outcomes, with the comparative results fed back into decision-making to produce more effective decision-making. The ASM approach would involve implementing the remedial options, individually or in combination, to achieve the following Desired Outcomes:

- Control migration of Cr(VI) in groundwater
- Remove the mass of Cr(VI) in groundwater
- Control, reduce, or eliminate the sources of Cr(VI) in groundwater
- Protect human and ecological receptors
- Manage remediation waste in accordance with Federal and state regulations

Performance Measures

The remedial options would allow EM-LA to use multiple technologies in combination or sequentially, guided by technology performance. Performance measures guide evaluations of how remediation is progressing toward the Desired Outcomes. The Proposed Action incorporates the following performance measures:

- Conduct an annual assessment to determine compliance with the following performance measures and evaluate whether the methods and technologies employed are effective.
- Annually observe reductions in Cr(VI) concentrations in groundwater along the plume's 50 ppb water quality standard perimeter.
- Annually observe a reduction in the area encompassed by the 50 ppb Cr(VI) iso-concentration contour lowering progressively.
- Annually achieve a reduction (or conversion to Cr(III) from in-situ treatment) of the estimated mass of Cr(VI) in groundwater from implementation of the remedy.
- Dispose of Cr(VI) when removed from groundwater, in accordance with Federal and state regulations.
- Ensure extracted and treated groundwater to be used for injection, land application, or mechanical evaporation meets Federal and state requirements for the intended purpose.
- Ensure no human or ecological receptors are affected by the Proposed Action.
- Continue mitigation measures associated with the 2015 Interim Measures EA previously agreed to (FY 2020 Mitigation Action Plan for LANL Operations, December 2, 2020; https://www.energy.gov/nepa/articles/mitigation-action-plan-lanl-operations-september-2020) in Sandia Canyon.

The Proposed Action would use infrastructure already in place as a result of ongoing investigations of the chromium plume and install new infrastructure. Existing infrastructure includes injection, extraction, and monitoring wells; piezometers; a water treatment system with portable storage tanks, storage basins, and associated connecting pipelines; unpaved access roads; power lines; and an irrigation system for land application of treated water. The Proposed Action would include installation of the following new infrastructure:

- Up to 15 injection wells in the regional aquifer: 70 gpm (1,000 gpm max total capacity).
- Up to 15 extraction wells in the regional aquifer: 70 gpm (1,000 gpm max total capacity).
- Up to 15 new monitoring wells in the regional aquifer. One existing well would be converted into a monitoring well in the regional aquifer, for a total of 16 monitoring wells.
- Up to 20 piezometers in the shallow zone (i.e., the alluvial aquifer) in Sandia Canyon Wetlands source area.
- Up to 10 piezometers in the deep vadose zone (i.e., the intermediate-perched aquifer) in Mortandad Canyon.
- A new 10,000 square foot (ft^2) groundwater treatment facility.
- Well pads and infrastructure to support installation and operation of the wells, including well heads, shipping containers (or similar shelters), portable storage tanks, and piping.
- Spray irrigation/evaporation system.
- Buried piping.
- Unpaved access roads.

Associated infrastructure improvements also include temporary, remote pumping stations. Remote pumping stations would be temporarily installed on previously constructed well pads or other previously disturbed areas. Pipelines to and from the groundwater treatment facility and pumping stations would also be installed in previously disturbed or developed areas (e.g., in existing road rights-of-way).

Table 2-1 summarizes the potential surface disturbance from implementing the Proposed Action.

Table 2-1. Summary of potential surface disturbance from implementing the Proposed Action

Proposed New Infrastructure	Potential New Disturbance	Total New Land Disturbance
Up to 15 injection wells in the regional aquifer [a]	0.70 acres per well	10.5 acres
Up to 15 extraction wells in the regional aquifer [a]	0.70 acres per well	10.5 acres
Up to 15 new monitoring wells in the regional aquifer [a,b]	0.70 acres per well	10.5 acres
Up to 20 piezometers in the shallow zone in Sandia Canyon Wetlands source area	100 ft^2 per piezometer	0.05 acres
Up to 10 piezometers in the deep vadose zone in Mortandad Canyon [a,c]	0.70 acres per piezometer	10.5 acres
New 10,000 ft^2 treatment facility	Located in previously disturbed area.	0 acres
Spray irrigation/evaporation system	No new disturbance. The areas for land application under the Proposed Action are the same as those currently available for this activity under the interim measure.	
Buried Piping	No new or additional disturbance. Would be located along access roads and in previously disturbed areas.	0 Acres
Unpaved Access Roads	0.60 acres per well and deep vadose zone piezometer	33 acres
	Total New Disturbance	**75 acres**

Key: ft^2 = square feet
Notes:
[a] The area of disturbance for new wells and deep vadose zone piezometers includes well pads and infrastructure to support installation and operation of the wells, including well heads, shipping containers (or similar shelters), portable storage tanks, and piping.
[b] The Proposed Action includes operation and maintenance activities for up to 16 monitoring wells in the regional aquifer, but one of these monitoring wells would be an existing well that would be converted to a monitoring well. Additional surface disturbance is not anticipated for the activities necessary to convert the well.
[c] The deep vadose zone piezometers are likely to require less surface disturbance, time for construction, casing materials, and other associated infrastructure than extraction, injection, and monitoring wells. For the purposes of this analysis, the area of disturbance for these piezometers is considered to be bounding.

If EM-LA determines there is no future use for the installations, the disturbed areas would be restored and rehabilitated according to requirements in place at that time. EM-LA would consult with the surrounding Pueblos and others to develop the final state of the chromium final remedy operations areas.

Appendix B, *Description of Alternatives Supporting Information*, gives a detailed description of treatment technologies, construction, and other activities comprising the Proposed Action.

2.4 ALTERNATIVES CONSIDERED BUT NOT EVALUATED

EM-LA considered other alternatives in the development of potential actions to remediate the hexavalent chromium plume. Many technologies were considered for mass removal and control of chromium migration in regional groundwater below Mortandad Canyon and treatment of the chromium sources in Sandia Canyon sediment, shallow/vadose zone groundwater, and intermediate groundwater. For example, EM-LA determined that MNA alone would be insufficient to control plume advancement and maintain chromium contamination within the Laboratory's boundary, based on current concentrations and plume migration; therefore, MNA does not meet the purpose and need or the screening criteria and was eliminated from further analysis as a stand-alone alternative. However, as part of the ASM approach, MNA was kept as an option that EM-LA could consider at any time during or after the implementation of other remedial options when controlling migration of chromium in groundwater is most likely to be sustained, does not pose a risk for off-site migration or to water supply wells, or meets the other evaluation criteria. Other alternatives that EM-LA evaluated, but removed from consideration, are listed in Appendix B, *Description of Alternatives Supporting Information*, Table B-2.

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 INTRODUCTION AND REGIONAL SETTING

Introduction

This section provides a brief description of the existing conditions of resource areas that may be affected by the Proposed Action. Discussion of the present day setting in this document is limited to environmental information that relates to the scope of the Proposed Action. The level of detail varies depending on the potential for impacts for each resource area. This section summarizes several site-specific and recent project-specific documents that describe the affected environment and incorporates these documents by reference.

As described in Section 2.2, *No Action Alternative*, Cr(VI) plume remediation activities at LANL would continue under interim measure operations, and the Proposed Action would not be implemented. EM-LA completed the 2015 Interim Measures EA to evaluate the environmental impacts of implementing the interim measure. Based on analyses in the EA, EM-LA determined that conducting the interim measure to control migration of the Cr(VI) plume and field-scale studies to further characterize the plume center would not result in any significant adverse impacts. A detailed description of the interim action and plume characterization studies, together with a discussion of the associated environmental consequences, are in the 2015 Interim Measures EA, which is incorporated by reference. The No Action Alternative would not result in impacts to resources at LANL beyond those captured in the discussion of the affected environment and as previously analyzed in the relevant NEPA documents listed in Section 1.4, *Relevant NEPA Documents and Scope of this Environmental Assessment*. These impacts are summarized in Section 3.16.

The ASM approach enables EM-LA to monitor and evaluate changing conditions, acquire information during the implementation of the Proposed Action, and report the findings to NMED. Based on this evaluation, EM-LA can propose future changes that could affect the remediation strategy and construction of associated infrastructure, including the number and location of extraction and injection wells. This approach is guided by the development of interim objectives and performance metrics in parallel with remedial options to protect human health and the environment. Application of the performance measures, monitoring protocols, project design features, and other engineering and administrative controls are described in Chapter 2, *Description of Alternatives*, and Appendix B, *Description of Alternatives Supporting Information*. These descriptions demonstrate that the proposed remediation options are capable of meeting the criteria listed in Section 2.1, *Introduction*, and can be implemented to improve the effectiveness of remediation, the cost of remediation, and minimize adverse environmental impacts resulting from the Proposed Action. The performance of these methods and technologies would be routinely evaluated and reported to EM-LA and NMED to aid in the decision-making process.

Because the specific combination of remedial options to be implemented is unknown, the analysis of impacts in this EA is based on conservative assumptions using maximum reasonably foreseeable disturbance and impact levels. EM-LA could choose from the “menu” of the four Proposed Action options based on changing site conditions and could implement the options individually or in combination. The bounding approach to the analysis of environmental impacts in this EA assumes that EM-LA would implement all options in a combination[5], and is designed to identify the maximum range of potential impacts. Therefore, the impacts of the activities that could occur under the Proposed Action evaluated in this EA are considered bounding.

Important ASM considerations are discussed in resource areas, as applicable, in accordance with CEQ's direction to discuss impacts in proportion to their significance (40 CFR 1502.2(b)). The regulatory framework of the Consent Order includes the process for establishing the specifics of the ASM. This ensures that the ASM specifics are by design protective of the public and environment.

In addition, cumulative impacts can result from individually minor, but collectively significant, on-site or off-site actions occurring over time (40 CFR 1508.7). Those actions within the spatial and temporal boundaries (i.e., project impact zone) of the Proposed Action are considered in this EA. DOE reviewed the resources at risk; geographic boundaries; past, present, and reasonably foreseeable future actions; and baseline information in determining the significance of cumulative impacts. Actions that have little or no impact generally do not result in cumulative impacts. Conclusions regarding cumulative impacts are included in the following sections.

Regional Setting

LANL is located in Los Alamos and Santa Fe counties, in north-central New Mexico, approximately 60 miles north-northeast of Albuquerque and 25 miles northwest of Santa Fe (see Figure 1-1). The Laboratory sits on the Pajarito Plateau at the eastern edge of the Jemez Mountains. The Sierra de los Valles range of the Jemez Mountains is directly west of the Laboratory, and White Rock Canyon, containing the Rio Grande, is east. The Pajarito Plateau is a series of mesas separated by east-west trending canyons. Mesa tops range in elevation from about 7,800 feet on the western side to about 6,200 feet on the eastern side.

Los Alamos County has a semiarid climate, meaning that more water is lost from the soil and plants through evaporation and transpiration than is received as annual precipitation. The average annual precipitation (which includes both rain and the water equivalent of snow, hail, and other frozen precipitation) is about 17 inches. The average annual snowfall is about 43 inches. Annual temperatures and amounts of precipitation vary across the county because of the 5,000-foot change in elevation and the complex topography.

Four distinct seasons occur in Los Alamos County. Winters are generally mild with occasional snowstorms. Spring is the windiest season. Summer is the rainy season with frequent afternoon thunderstorms. Fall is typically dry, cool, and calm.

On average, winter temperatures range from 30°F to 50°F during the day and from 15°F to 25°F during the night. The Sangre de Cristo Mountains to the east of the Rio Grande act as a barrier to wintertime arctic air masses, making the occurrence of subzero temperatures rare. On average, summer temperatures range from 70°F to 88°F during the day and from 50°F to 59°F during the night.

The rainy season begins in early July and ends in early September. Afternoon thunderstorms form in the summer as moist air from the Pacific Ocean and the Gulf of Mexico lifts over the Jemez Mountains and then often moves eastward across the Laboratory. These thunderstorms produce short, heavy downpours and an abundance of lightning. Local lightning density is estimated at 15 strikes per square mile per year.

[5] DOE would only implement MNA when it can verify contamination poses relatively low risks, the plume is stable or shrinking, and the natural attenuation processes are projected to achieve remedial objectives in a reasonable timeframe.

The complex topography of the Pajarito Plateau influences local wind patterns. Daytime winds in the Los Alamos area are predominantly from the south, as heated daytime air moves up the Rio Grande valley. Nighttime winds on the Pajarito Plateau are lighter and more variable than daytime winds and are typically from the west, a result of prevailing upper-level winds from the west and the downslope flow of cooled mountain air.

The Proposed Action includes construction and operation of the groundwater treatment facility; wells, well pads, and access road stubs; pipelines; and other infrastructure in Sandia and Mortandad Canyons, as described in Chapter 2, *Description of Alternatives*, and detailed in Appendix B, *Description of Alternatives Supporting Information*. Figure 3-1 depicts the project area for the chromium interim measures and final remedy.

3.2 LAND USE

Land use is the term used to describe the human development and use of land. It represents the economic and cultural activities (e.g., agriculture, residence, and industry) that are practiced at a given place.

3.2.1 LAND USE – AFFECTED ENVIRONMENT

LANL is located on approximately 40 square miles of land in north-central New Mexico (see Figure 1-1). Commercial and residential development in Los Alamos County is confined to several mesa tops that are north (the Los Alamos townsite), or southeast (the community of White Rock) of the core LANL developed area (DOE, 2015).

LANL is divided into 46 contiguous technical areas (see Table 3-1). In total, approximately 20 percent of LANL is developed. The highest concentration of facilities and workers is found in Technical Area (TA)-03, TA-53, and along the Pajarito Corridor in TA-35, TA-46, TA-48, TA-50, TA-55, and TA-66. Future development will likely take place in and near these areas because they have the appropriate accessibility and infrastructure for expansion (DOE, 2015).

Buildings and facilities at LANL total approximately 8.2 million ft^2 (gross), including approximately 850 permanent and 500 temporary and miscellaneous structures. There are no agricultural activities on the LANL site (including prime farmlands), nor are there residential areas. However, the Elk Ridge Mobile Home Park, surrounded by TA-61 along East Jemez Road, is a privately owned mobile home community containing 180 residential rental sites, ten recreational vehicle pads, and associated amenities (DOE, 2022a).

In December 2014, the Manhattan Project National Historical Park was established. DOE and the Department of Interior developed a Memorandum of Understanding to complete a Park Management Plan. Three park sites were established at LANL and, although no public access exists to these facilities, tours offered by the National Park Service are available to the public three times a year to historic buildings associated with the Manhattan Project (DOE, 2015).

In the 1970s, DOE established National Environmental Research Parks within their land holdings to serve as field laboratories for ecological research and the study of environmental impacts of energy developments. In 1976, the National Environmental Research Parks was established at LANL and includes the entire 40 square miles of the Laboratory.

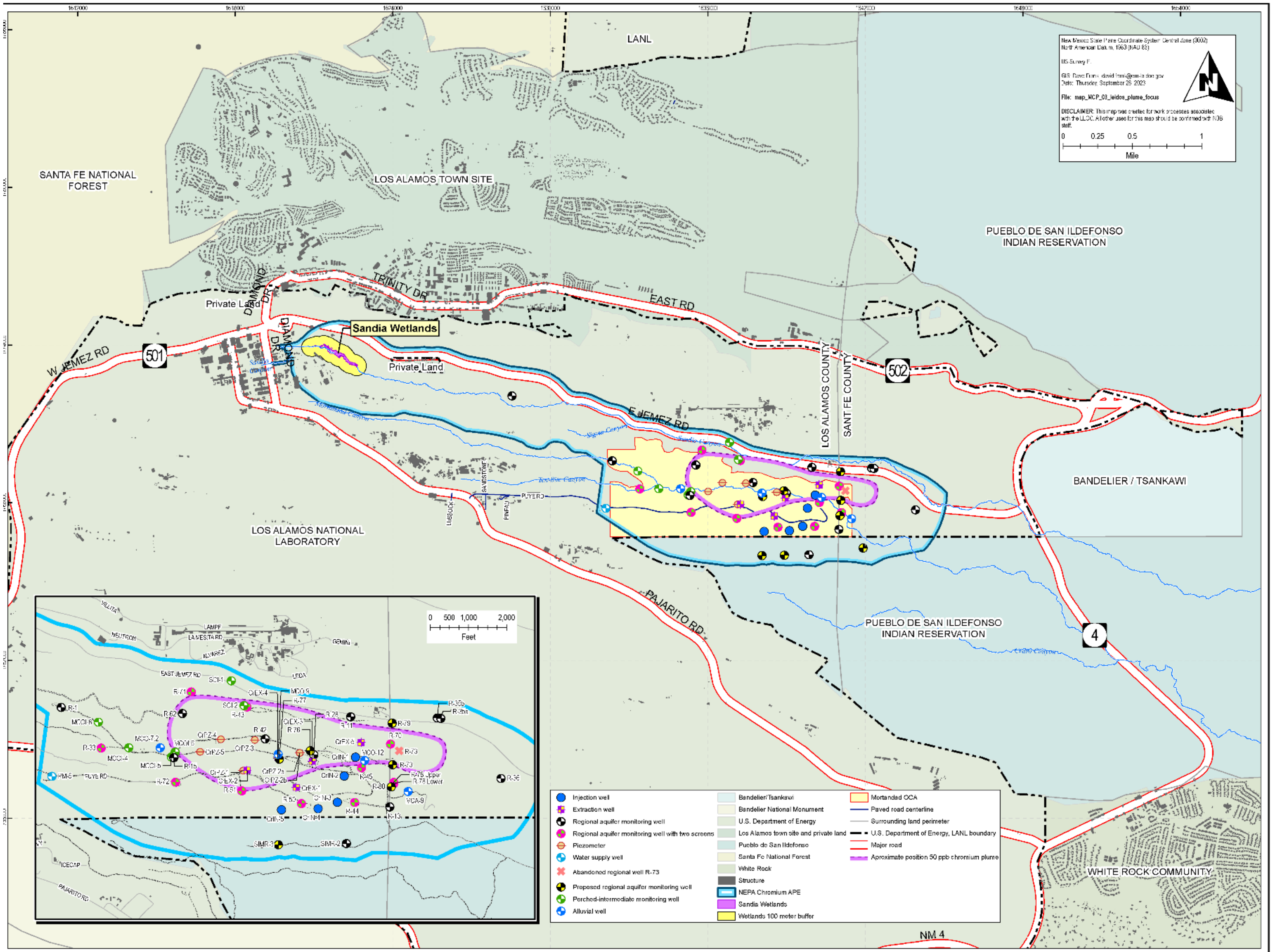

Figure 3-1. Chromium Interim Measure and Final Remedy project area

Table 3-1. Land use categories at Los Alamos National Laboratory

Category	Description/Use
Administration, Service, and Support	Administrative functions, services, and support for LANL management and employees
Experimental Science	Applied research and development activities tied to major programs
High-Explosives Research and Development	Research and development of new explosive materials (land in this category is isolated for security and safety)
High-Explosives Testing	Large, isolated, exclusive-use areas required to maintain safety and environmental compliance during testing of newly developed explosive materials and new uses for existing materials (land in this category includes exclusion and buffer areas)
Nuclear Materials Research and Development	Isolated, secured areas for conducting research and development involving nuclear materials (land in this category includes security and radiation hazard buffer zones, but not waste disposal sites)
Physical and Technical Support	Includes roads, parking lots, and associated maintenance facilities; infrastructure such as communications and utilities; facility maintenance shops; and maintenance equipment storage (land in this category is generally free from chemical, radiological, or explosives hazards)
Public and Corporate Interface	Provides links with the public and other outside entities conducting business at LANL, including technology transfer activities
Reserve	Areas not otherwise included in one of the other categories (it may include environmental core and buffer areas, vacant land, and proposed land transfer areas)
Theoretical and Computational Science	Interdisciplinary activities involving mathematical and computational research and related support activities
Waste Management	Activities related to the handling, treatment, and disposal of all generated waste products, including solid, liquid, and hazardous materials (chemical, radiological, and explosive)

Source: (DOE, 2015)

Under the LANL Trails Management Program, there are certain open spaces throughout the site (e.g., TA-70 and TA-71) with trails used for hiking and other recreational purposes (LANL, 2022a). While there are multiple hiking trails and recreational uses of land surrounding LANL (e.g., Los Alamos County, Bandelier National Monument, and Santa Fe National Forest), there are no hiking trails or recreational uses of LANL land available to the public.

Access to the area of LANL near the project site is restricted. The project area encompasses approximately 2,025 acres, of which about 235 acres (about 12 percent) is currently developed (see Appendix C, *Environmental Resources Supporting Information*, Figure C-8). Infrastructure associated with previous work within the canyon, including a network of monitoring, extraction, and injection wells, have been installed within and around the Cr(VI) plume perimeter area (see Appendix C, Figure C-2). These wells and associated infrastructure support the interim measure efforts to characterize the plume and to halt the plume's movement. The remainder of the project area is generally undeveloped.

3.2.2 LAND USE – ENVIRONMENTAL CONSEQUENCES

3.2.2.1 Proposed Action (Adaptive Site Management)

Option 1 – Mass Removal via Expanded Treatment

Option 1 would result in the construction of a 10,000-ft^2 (0.23 acres) groundwater treatment facility situated in a previously disturbed area within Mortandad Canyon. The construction, operation, and maintenance of the groundwater treatment facility would be compatible with the current use of the area. There would be an additional ground disturbance of approximately 75 acres for the installation of new infrastructure and access roads. Option 1 would not result in any change of land ownership or modification of existing land uses. LANL would remain restricted for public recreational activities such as those available in surrounding areas.

Actions under Option 1 would not have any irreversible impacts and would not hinder current or future public or private land uses in the areas surrounding LANL. Up to four of the proposed monitoring wells would be installed on San Ildefonso Pueblo land. Section 3.7, *Cultural Resources*, addresses potential impacts to San Ildefonso Pueblo lands and cultural resources identified within the area of potential effects (APE) of the project.

Option 2 – Mass Removal with Land Application

Option 2 would involve the same activities as discussed under Option 1, but also includes land application of treated water in permitted areas on about 50 acres of land. The areas for land application under the Proposed Action are the same as those currently available for this activity under the interim measure. Potential impacts to land use would be essentially the same as discussed under Option 1. Option 2 would not result in any change of land ownership, modification of existing land uses, or irreversible impact to land use in the areas surrounding LANL.

Option 3 – Mass Removal via In-Situ Treatment

Option 3 has the potential to involve the same amount of ground disturbance as Options 1 and 2, depending on the number of wells and other infrastructure EM-LA decides to construct and where and when in-situ treatments are implemented. Option 3 would not result in any change of land ownership, modification of existing land uses, or irreversible impact to land use in the areas surrounding LANL.

Option 4 – Monitored Natural Attenuation

Option 4 has the potential to involve the same amount of ground disturbance as Options 1 and 2, depending on when EM-LA determines MNA would be a viable treatment option. Option 4 would not result in any change of land ownership, modification of existing land uses, or irreversible impact to land use in the areas surrounding LANL.

3.2.2.2 Cumulative Impacts

As previously described, impacts from the Proposed Action on land use would be small and limited to the project area. Because impacts would be small, they would not substantially contribute to cumulative impacts on land use.

3.3 GEOLOGY AND SOILS

Geologic resources are consolidated or unconsolidated earth materials, including ore and aggregate materials, fossil fuels, and significant landforms. Soil resources are the loose surface materials of the earth in which plants grow, usually consisting of disintegrated rock, organic matter, and soluble salts.

3.3.1 GEOLOGY AND SOILS – AFFECTED ENVIRONMENT

Geology

LANL lies along a continental rift called the Rio Grande Rift, which trends north to south through central New Mexico. The Jemez Mountains and associated Pajarito fault system form the western margin of the rift (DOE, 2022a). Continental rifts occur where tectonic plates in the earth's crust move apart; a rift allows magma (molten rock) to rise near the earth's surface, and volcanoes are common features of rifts. The Jemez Mountains are the remnants of a cluster of volcanoes. Many of the rock formations that make up the Pajarito Plateau come from materials expelled during volcanic eruptions (LANL, 2022b).

The mesas of the Pajarito Plateau are mostly composed of Bandelier Tuff, which is a type of soft rock that forms from hardened volcanic ash. The Bandelier Tuff is more than 1,000 feet thick in the western part of the plateau and thins to about 260 feet thick on the eastern edge of the plateau near the Rio Grande. On the western side of the Pajarito Plateau, the Bandelier Tuff overlaps the Tschicoma Formation of the Jemez Mountains. The Tschicoma Formation is an older rock layer of volcanic dacite. Eastward near the Rio Grande, the Puye Formation, a layer of sand and gravel that underlies the Bandelier Tuff, becomes visible in places. Basalt rocks originating from the Cerros del Rio volcanoes east of the Rio Grande mix with the Puye Formation along the river and extend beneath the Bandelier Tuff in places. The Santa Fe Group sedimentary rocks lie below the Puye Formation and Bandelier Tuff, extends between the Jemez and Sangre de Cristo Mountains, and is more than 3,300 feet thick in places (LANL, 2022b). Figure 3-2 shows the stratigraphic sequence of geologic units under the project area.

See the *Interim Facility-Wide Groundwater Monitoring Plan for the 2024 Monitoring Year* (EM-LA, 2023a) for a more detailed description of the rock units beneath the site. The occurrence of groundwater is discussed in Section 3.4, *Water Resources*.

Mortandad and Sandia Canyons are narrow canyons on the central part of the Pajarito Plateau. The canyons were cut by stream channel erosion through the Bandelier Tuff. Mortandad, Sandia, and other similar canyons in the area separate multiple linear mesas that parallel the canyons (DOE, 2015).

The Pajarito fault system is part of the Rio Grande Rift structure and consists of the Pajarito, Rendija Canyon, and Guaje Mountain Faults. Although large historical earthquakes have not occurred in the Pajarito fault system, geologic evidence indicates that it is seismically active. The latest (horizontal) probabilistic peak ground acceleration (PGA) map from the United States Geologic Survey, used to indicate seismic hazard, shows a maximum PGA between 0.2 and 0.3 g for the central LANL area. The PGA values cited corresponding to an annual occurrence probability of about 1 in 2,500. The potential for seismically induced land subsidence at LANL is considered to be low, and for soil liquefaction, negligible (DOE, 2022a).

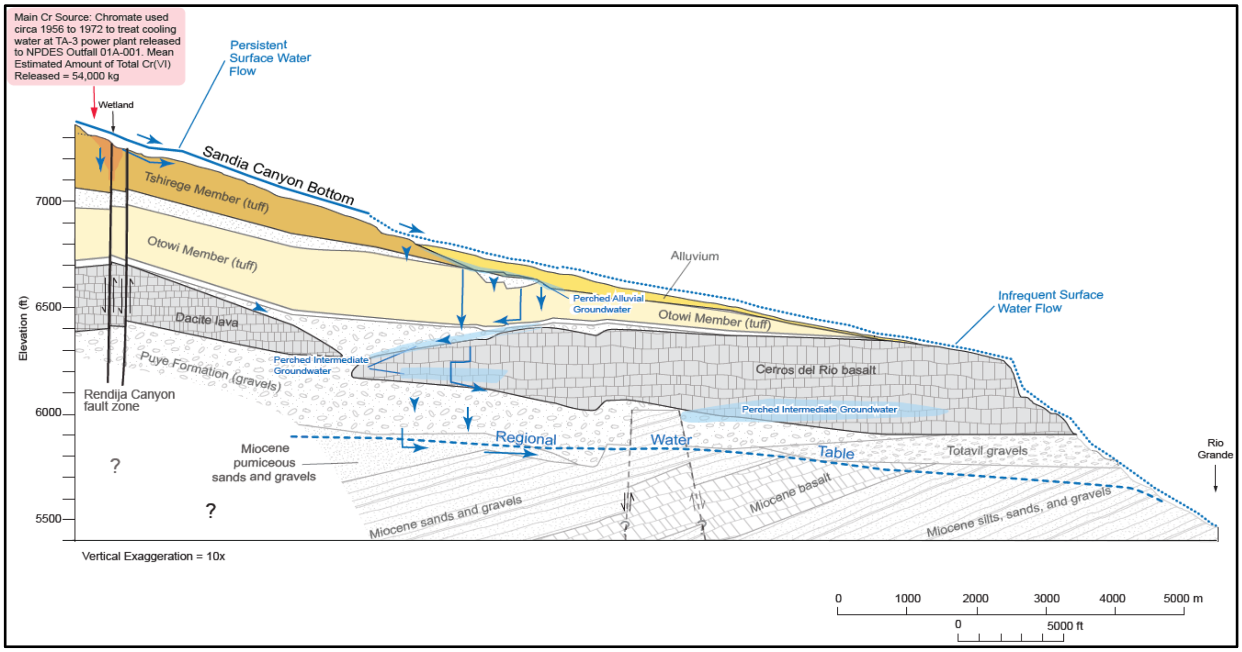

Figure 3-2. Geologic units and conceptual flow model

Volcanism in the vicinity of the LANL site is very unlikely over the next 50 to 100 years. The recurrence rate for an eruption that could produce major impacts at LANL was estimated to be 1×10^{-5} per year. Because of the low recurrence rate, the risk from volcanic events is low (DOE, 2022a).

Potential mineral resources at LANL consist of rock and soil for use as backfill or borrow material. Sand and gravel are primarily used at LANL for road building, and pumice is used for landscaping. The only borrow pit currently in use at LANL is the East Jemez Road Borrow Pit in TA-61, which is cut into the upper Bandelier Tuff. No sizable, economically valuable geologic deposits are known to occur in the vicinity. Numerous commercial offsite borrow pits and quarries in the vicinity of LANL produce sand, gravel, and volcanic pumice. Eleven pits or quarries are located within 30 miles of LANL, which is the distance considered the upper economically viable limit for hauling borrow material to LANL (DOE, 2022a).

Soils

Soils in the project area have developed from the decomposition of volcanic and sedimentary rocks within a semiarid climate, and they range in texture from clay and clay loam to gravel. Soils that formed on the mesa tops of the Pajarito Plateau are well drained and range from very shallow (0 to 10 inches) to moderately deep (20 to 40 inches); the greatest depth to the underlying Bandelier Tuff is about 60 inches. Soils that develop in canyon settings can be locally much thicker than those on the mesa tops (DOE, 2022a). Alluvium thickness within Mortandad Canyon is 1 to 2 feet near its headwaters and more than 100 feet near the LANL boundary, east of the project area (DOE, 2015).

Approximately half of the area is identified as rock outcrop (NRCS, 2023). Within the project area, soils were mapped differently in Los Alamos and Sandoval Counties versus Santa Fe County. The major soil types identified in the project area in Los Alamos and Sandoval Counties are as follows:

- **Hackroy-Nyjack association**. These soils are composed of nearly equal percentages of Hackroy and Nyjack soils. A typical profile for a Hackroy soil is shallow with sandy loam from 0 to 3 inches above clay extending from 3 to 13 inches in depth overlying bedrock. These soils are formed from sediment weathered from tuff and found on mesas and plateaus. The low saturated hydraulic conductivity gives Hackroy soils a high potential for runoff. A typical profile for Nyjack soil is composed of loam from 0 to 3 inches, clay loam from 3 to 24 inches, and gravelly sandy loam from 24 to 39 inches in depth. These soils are formed from eolian deposits over slope alluvium derived from tuff and are found on mesas and plateaus. Nyjack soils have a medium runoff potential (DOE, 2015).
- **Totavi loamy sand**. These soils are formed from stream alluvium derived from tuff and found on stream terraces, valley floors, and closed depressions. A typical profile can extend as deep as 5 feet and has a very low runoff potential because of its high saturated hydraulic conductivity (DOE, 2015).
- **Carjo loam**. A typical profile for Carjo loam soil is moderately deep with loam from 0 to 4 inches, above clay loam extending from 4 to 12 inches in depth, overlying clay from 12 to 20 inches, overlying very fine sandy loam from 20 to 25 inches, overlying bedrock. These soils are residuum weathered from tuff and found on mesa shoulders and sides on 1 to 9 percent slopes. The slow permeability makes these soils well drained (NRCS, 2008).

The major soil types identified in the project area in Santa Fe County are as follows:

- **Navajita complex**. A typical profile for a Navajita complex soil is very deep with loam from 0 to 13 inches, above sandy clay loam extending from 13 to 32 inches in depth, overlying coarse sandy loam from 32 to 63 inches, and overlying paragravelly loamy coarse sand from 63 to 110 inches. These soils are eolian deposits and slope alluvium derived from rhyolitic tuff and found on north-facing valley sides on 2 to 15 percent slopes. The moderate permeability makes these soils well drained (NRCS, 2009).
- **Totavi ashy loamy coarse sand**. A typical profile for a Totavi soil is very deep with ashy loamy coarse sand from 0 to 3 inches above ashy coarse sand extending from 3 to 31 inches in depth, overlying gravelly ashy loamy sand and coarse sand from 31 to 80 inches. These soils are alluvium derived from latite, dacite, and rhyolitic tuff, and found on stream terraces on valley floors on 1 to 3 percent slopes. The very rapid permeability makes these soils somewhat excessively drained (NRCS, 2009).

No soils at the LANL site are classified as prime farmland. Soils at LANL are acceptable for standard construction techniques (DOE, 2022a).

3.3.2 GEOLOGY AND SOILS – ENVIRONMENTAL CONSEQUENCES

3.3.2.1 Proposed Action (Adaptive Site Management)

Geology

Option 1: Mass Removal via Expanded Treatment

Under Option 1, the installation, operation, maintenance, and monitoring of wells (which are similar to existing nearby County wells) and piezometers (which are similar to existing monitoring wells) would have small impacts on geology. This EA assumes that each well pad, deep vadose zone piezometer, and access road would require 800 cubic yards (yd^3) of crushed stone. This would be 44,000 yd^3 of crushed stone for the installation of 55 wells. No additional fill material would be needed. The 44,000 yd^3 of crushed stone would be a relatively small quantity of a regionally plentiful resource and would not be a significant impact.

The wells, including the deep vadose zone piezometers, would be installed to a depth of up to 1,400 to 2,000 feet below grade. The operation of injection wells would contribute to hydraulic control of the chromium plume and to return treated water to the aquifer in the same area and at similar depths from which the water was extracted. Water injection into the aquifer would be gravity fed. Injection well operation would have negligible impacts on geology. The operation of the groundwater treatment plant, monitoring and maintenance of wells, and other related site infrastructure would have little to no impacts on geology.

Options 2, 3, and 4

Under Option 2, *Mass Removal with Land Application*, wells and their associated infrastructure would be constructed and operated as described in Option 1, although less water would be reinjected into the aquifer under Options 2 and 3. Instead, treated water would be applied to land surfaces in approved locations in accordance with permits. Land application would have no impacts on geology. Impacts to geology would be bounded by the groundwater extraction and injection option previously discussed (Option 1). Option 3, *Mass Removal via In-Situ Treatment*, would add in-situ treatment. Although it is not known exactly which treatment methods might be used, and some treatment methods might physically or chemically change the rock that the groundwater flows through, in-situ treatment would likely be used to target specific areas or levels of chromium, and therefore would not impact large areas of rock. Therefore, in-situ treatment is not expected to have significant impacts on geology. Option 4, *Monitored Natural Attenuation*, would not remove or add water to the aquifer and would not add treatment compounds. Therefore, Option 4 would have no impacts on geology.

Soils

Option 1: Mass Removal via Expanded Treatment

Under Option 1, infrastructure development, operation, and maintenance activities associated with the Proposed Action would cause effects to soil profiles from soil disturbance. Soil disturbance would be necessary for well pad installation for the new extraction wells, injection wells, and piezometers, for short access roads, and for installation of a larger groundwater treatment plant.

This EA conservatively assumes 0.73 acres would be disturbed for each well pad and deep vadose zone piezometer and 0.60 acres for the associated access road stub. As described in Appendix B, *Description of Alternatives Supporting Information*, a total of about 75 acres of land could be disturbed under the Proposed Action. Some soil erosion by wind and stormwater would likely occur in these disturbed areas. Soil erosion would be mitigated by adherence to best management practices (BMPs) and would not be expected to be significant. BMPs could include installation of ground cover, straw wattles, or silt fencing, and dust suppression by soil watering.

Lined pits would be required for well drilling to contain drill cuttings, drilling mud, and water. After well completion, the drill cuttings in the lined pit would be sampled, and if cuttings meet the residential soil screening levels, the liner would be removed and the pit backfilled. If the cuttings do not meet the criteria for land application, they would be disposed of off-site in a permitted, approved landfill. After the pits are backfilled, the overall well pad footprint would be reduced (DOE, 2015).

Excavations would be required to direct-bury piping to the new extraction wells, injection wells, and treatment plant. Stabilization controls and BMPs would limit soil erosion.

Options 2, 3, and 4

Under Option 2, *Mass Removal with Land Application*, wells, piezometers, and other associated infrastructure would be constructed and operated as described in Option 1, although less water would be reinjected into the aquifer under Option 2. Impacts to soils from well installation, operation, maintenance, and monitoring would be the same as under Option 1. Treated water that is not reinjected would be applied to the surface in approved locations in accordance with permits (see Appendix B, *Description of Alternatives Supporting Information*, Figure B-3). Because of controls implemented as part of the permit conditions (e.g., land application must be conducted in a manner that maximizes infiltration and evaporation, no ponding of water, no runoff, and no application on slopes greater than [>] 5 percent), land application would have minimal impacts on soils. Option 3, *Mass Removal via In-Situ Treatment*, would add in-situ treatment. Although it is not known exactly which treatment methods might be used, in-situ treatment would not have impacts on soils. Likewise, Option 4, *Monitored Natural Attenuation*, would not remove or add water to the aquifer and would not add treatment compounds. Therefore, Option 4 would have no impacts on soils.

3.3.2.2 Cumulative Impacts

As previously described, impacts from the Proposed Action on geology would be small. Because impacts would be small, they would not substantially contribute to cumulative impacts on geology.

The LANL site is located on approximately 26,058 acres of land with approximately 20 percent (5,200 acres) of the site developed (DOE, 2022a). As previously described, impacts to soils would be mitigated by permit conditions and adherence to BMPs and would not be expected to be significant. The approximate 75 acres of soils disturbed under the Proposed Action would be approximately 0.3 percent of the total LANL land area and 1.4 percent of the developed land at LANL. The relatively small amounts of soils disturbed under the Proposed Action would not substantially contribute to cumulative impacts on soils.

3.4 WATER RESOURCES

3.4.1 WATER RESOURCES – AFFECTED ENVIRONMENT

3.4.1.1 Groundwater and Groundwater Quality

Groundwater in the Sandia and Mortandad Canyon area occurs in three types of settings: as shallow alluvial groundwater in canyon-floor sediments; as intermediate-depth perched groundwater in bedrock units of the vadose zone; and as deep groundwater in the regional aquifer (Figure 3-3). Alluvial water is found in the upper reaches of Sandia Canyon predominantly sustained by effluent from a NPDES outfall (Permit No. NM002835) (N3B, 2022). Alluvial water ultimately infiltrates through the vadose zone to accumulate and pass through perched zones above the regional aquifer (Figure 3-3).

The regional aquifer below Mortandad and Sandia Canyons is part of a system of aquifers within the Espanola Basin that underlies the Chromium Measures and Final Remedy project area (Figure 3-1 in Section 3.1, *Introduction and Regional Setting*). Depth to the top of the regional aquifer from the mesa tops decreases eastward from approximately 1,230 feet in the western part of the plateau to approximately 920 feet in the eastern parts of the plateau near the eastern boundary of LANL. Existing Los Alamos County water supply wells in the area penetrate approximately 1,400 to 1,800 feet into the regional aquifer. Water produced for public consumption from the regional aquifer water supply wells meets Federal and state drinking water standards (LADPU, 2023).

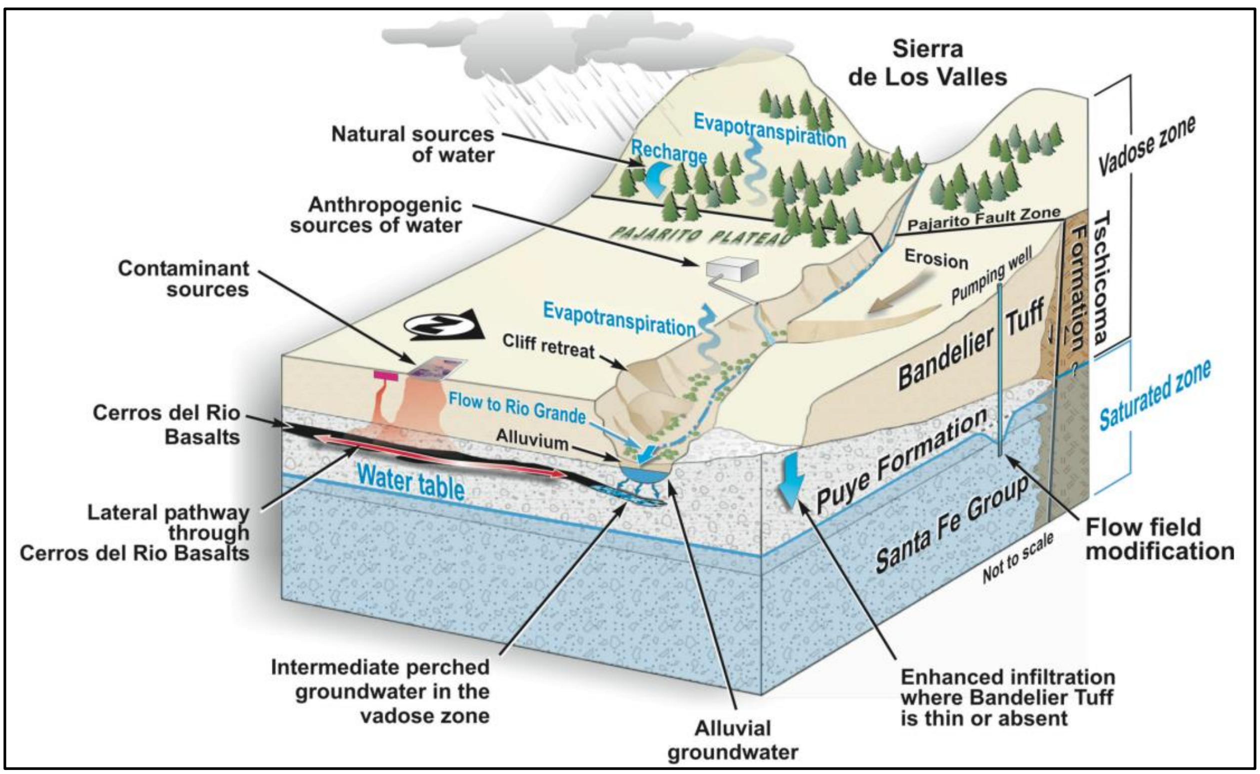

Figure 3-3. Groundwater components at Los Alamos National Laboratory (Figure 1-2 from LANL, 2005)

After the initial discovery of Cr(VI) in the regional aquifer, a discrete plume of Cr(VI) was identified that was above the NWQCC groundwater standard of 50 ppb (or µg/L) (Heikoop et al., 2014; LANL, 2008; DOE, 2015; LANL, 2018a; LANL, 2018b; LANL, 2018c; N3B, 2023a; Vesselinov et al., 2013). The lateral extent of the Cr(VI) plume in upper and lower zones of the regional aquifer is displayed in Appendix C, *Environmental Resources Supporting Information*, Figure C-2 (Neptune and Company, 2023a). Cr(VI) was also found to exist in two perched-intermediate zone wells (MCOI-6 and SCI-2) (see Figure C-2) at levels well above the 50-ppb standard (Figure 5-15 in LANL, (2022b)).

Subsequent to finding Cr(VI) in the regional aquifer, DOE installed monitoring wells to further identify the extent of contamination. Increasing Cr(VI) concentrations in some monitoring wells along the plume's southeastern edge in 2015 indicated possible plume expansion (LANL, 2015), and as a result, DOE proposed to NMED to conduct an interim measure under the 2016 Consent Order (NMED, 2016) to control and reduce plume migration while a final remedy was being evaluated, as described in Section 1.0, *Purpose and Need for Agency Action*.

The >50 ppb plume is approximately 1 mile long, 0.5 miles wide, and 50 to 75 feet thick. Projected estimates of the plume growth rate prior to implementing the interim measure are around 30 to 60 feet per year. After contamination was first observed and starting in 2007, both DOE and the Los Alamos County Department of Public Utilities (LADPU) have monitored County water supply wells for chromium (LADPU, 2015). In 2013, total chromium was detected at concentrations from 4.06 to 9.9 ppb in Los Alamos County water supply wells, substantially below the New Mexico groundwater standard of 50 ppb (LADPU, 2015). As reported in the 2022 Annual Drinking Water Quality Report for Los Alamos County, chromium was detected at a concentration of approximately 4 ppb (LADPU, 2023). Those concentrations are consistent with background concentrations of chromium within the regional aquifer (DOE, 2015).

Appendix C, *Environmental Resources Supporting Information*, Figure C-3 shows a water table or potentiometric map for May 1, 2020, 1:00 a.m., which represents ambient ("baseline") conditions without interim measures functioning. Figure C-4 shows a water table map for November 1, 2021, 1:00 a.m., which includes nearly full interim measure operation (with the exception of CrEX-1 and CrIN-3). These are representative only of the upper regional aquifer.

Figure C-5 and Figure C-6 are maps of the hydraulic heads representing "baseline" and full interim measure operating conditions of the deeper zone. The deeper zone represented in Figure C-3 as a blue dashed line is at depths >50 feet. There are fewer deeper zone data points to prepare these maps. Effects of the interim measure operations are indicated by lowering heads on the order of 2 to 3 feet across the plume area.

The injection wells were designed to both dispose of the treated water and create a hydraulic barrier, or mound of water, along the southern boundary to slow or reverse flow in the regional aquifer away from the boundary. An analysis was conducted to evaluate the effectiveness and performance of the Cr(VI) plume interim measure at LANL. Conclusions of this report (Neptune and Company, 2023a) are summarized as follows:

- During periods when interim measure operations are off, groundwater flows toward the east to southeast.
- Small, but quantifiable, impacts on hydraulic gradients from county supply well PM-4 pumping are observed in the chromium plume.

- The operation of extraction and injection wells as part of the interim measure is observed to result in large, systematic changes on hydraulic gradients within the vicinity of the chromium plume (i.e., the interim measure changes the direction of flow). Hydraulic gradients appear stronger in magnitude upgradient of the interim measure as a result of operations, with a shift in direction generally toward the extraction wells.
- Changes in hydraulic gradients as the result of interim measure operations are at least 50 percent greater compared to that from PM-4 in all areas of the chromium plume; hydraulic gradients close to the extraction and injection wells indicate impacts from the interim measure are at least 10 times greater.
- Vertical gradient changes due to the onset of interim measure operations were apparent at all dual-screened well pairs in the chromium plume (R-43, R-44, R-45, R-50, and R-61). Small ambient downward vertical gradients were observed at most wells during periods when interim measure operations were off. Most well pairs show a small but systematic increase, on the order of 0.01 to 0.001 foot per foot, in the downward gradient as a result of interim measure operations.

These impacts are likely to have a greater effect in the upper portion of the regional aquifer. Injection and extraction wells operated under the interim measure seem to indicate that injected water migrates within the upper approximate 50 feet of the aquifer (Neptune and Company, 2023b). When the interim measure is not operating, sustained pumping at PM-4 has the largest impact on water levels and hydraulic gradients with respect to the Cr(VI) plume (Neptune and Company, 2023a). However, local to the interim measure capture zone (i.e., where extraction wells pull in contaminated water), interim measure pumping has more effect on the direction of flow of groundwater than PM-4 during interim measure operations (except at monitoring well R-33) (Neptune and Company, 2023a).

Operation of the interim measure for Cr(VI) remediation appears to have reduced Cr(VI) concentrations within the plume; Cr(VI) concentrations have decreased at all five extraction wells since initiating the interim measure (N3B, 2023a).

In Los Alamos County, there is a total of 5,547.1-acre-feet per year water rights for municipal, industrial, and related purposes (N3B, 2023a). These rights are jointly owned by DOE and Los Alamos County, with a 30/70 split, respectively. Los Alamos County leased the 30 percent DOE-owned water rights from 2001 to 2011 and once again in 2020. To support the chromium interim measure, DOE and Los Alamos County submitted a joint application to the NMOSE in May 2016 to change the water right. A request for emergency authorization also accompanied the application, which was granted in September 2016. The emergency authorization allowed for the extraction of water of up to 648,000 gpd, or up to a maximum diversion of groundwater of 679 acre-feet per year. This translates into maximum extraction and injection rates of approximately 450 gpm for the interim measure. As of 2019, the permit had not been issued, prompting DOE to submit an updated joint application and request for emergency authorization in September 2019, and the request for emergency authorization was approved that same month. To date, the interim measure, when operational, operates under the 2019 emergency authorization.

3.4.1.2 Surface Water

Surface water in the LANL area flows primarily as ephemeral streams in response to local precipitation or snowmelt. Streams that drain the LANL area are dry for most of the year; only about 2 miles of the over 85 miles of watercourses within LANL boundaries are naturally occurring perennial streams. Additionally, approximately 3 miles of watercourses are perennial waters created by supplemental flows from wastewater discharges (DOE, 2008).

Two ephemeral streams pass through the project area: one within Mortandad Canyon and one within Sandia Canyon. These ephemeral streams have been designated as “impaired,” meaning they are not supporting one or more “designated uses,” such as livestock watering and aquatic life (NMED, 2022). Streams are considered to be impaired, or not supporting the designated use, if data from stream sample analyses exceed one or more parameters when compared with the standards for the stream’s designated use(s), in accordance with Section 303(d) of the Clean Water Act (CWA). Table 3-2 summarizes the impairment status of each of these ephemeral waterways, as well as the cause.

Table 3-2. Impairment status of surface waters within the study area

Designated Use	Attainment Status	Cause
Mortandad Canyon		
Limited Aquatic Life	Not Supporting	Copper, dissolved
Livestock Watering	Not Supporting	Gross alpha, adjusted
Secondary Contact	Not Assessed	---
Wildlife Habitat	Not Supporting	Polychlorinated biphenyls
Sandia Canyon		
Limited Aquatic Life	Not Supporting	Polychlorinated biphenyls Copper, dissolved Aluminum, total recovered
Livestock Watering	Not Supporting	Gross alpha, adjusted
Secondary Contact	Not Assessed	---
Wildlife Habitat	Not Supporting	Mercury, total Polychlorinated biphenyls

Source: (NMED, 2022)
Key: --- = not available

Several additional drainage channels exist within the project area. While these channels are among the drainageways that are typically dry, they may convey water eastward toward the perennial Rio Grande following precipitation events or during snowmelt.

A wetland area, located at the head of Sandia Canyon, is within the project area. Occupying a small footprint in the 1950s, the wetland has grown as a result of receiving effluent from LANL and now encompasses approximately 3.65 acres. Two NPDES-permitted outfalls (001 and 03A199) discharge to the wetland; a third outfall discharged effluent from 2012 to 2016. As a result of these discharges, contaminants such as chromium, polychlorinated biphenyls, and polycyclic aromatic hydrocarbons have been detected in the wetland sediments. A grade-control structure was installed in 2013 in an effort to contain contaminants of concern and prevent further downgradient migration. Annual performance reports detail the state of the Sandia wetland since 2014 following a 2012 to 2014 baseline assessment. Per the 2021 performance report, the wetland continues to be stable following installation of the grade-control structure, even as effluent volumes entering the wetland have decreased. Chromium concentrations remain below the New Mexico water quality standard (N3B, 2022).

3.4.2 WATER RESOURCES – ENVIRONMENTAL CONSEQUENCES

3.4.2.1 Proposed Action (Adaptive Site Management)

In this EA, the ASM options are designed to address the environmental consequences of implementing remedial measures to achieve the Desired Outcomes listed in Section 2.3, *Proposed Action.* The ASM Monitoring Protocols in Section 2.3, *Proposed Action*, are also selected to evaluate success in achieving the Desired Outcomes. Other monitoring protocols could be identified in the future that would help in assessing the Desired Outcomes. As described in Section 2.3, *Proposed Action*, EM-LA would use results from monitoring to evaluate success in meeting the Performance Measures and Desired Outcomes.

<u>Groundwater and Groundwater Quality</u>

Option 1 – Mass Removal via Expanded Treatment

Option 1 includes expanded chromium mass removal through new extraction wells, expanded water treatment operations, and expanded treated water injection beyond the interim measure levels. Along with these changes, additional regional aquifer monitoring wells and piezometers would be constructed. Environmental consequences to groundwater and groundwater quality relate to well construction and the operation of the extraction and injection operations.

When EM-LA decides it is necessary to drill any type of well, the locations, drilling, and well construction design would be determined through the Consent Order process with NMED. Directional drilling for regional aquifer wells could be required for installation near canyon walls.

Under this option, existing extraction, injection, or monitoring wells, and piezometers, would still be used and operated.

The combined extraction rate for the existing and new extraction wells would be approximately 550,000,000 gpy. The combined injection rate for the existing and new injection wells also would be approximately 550,000,000 gpy. However, current extraction rates for the interim measure are limited by water rights authorized by NMOSE, and as previously noted, is currently limited to a groundwater extraction rate of up to 648,000 gpd, or up to a maximum diversion of groundwater of 679 acre-feet per year. This translates into maximum extraction and injection rates of approximately 450 gpm for the interim measure (N3B, 2023a). Any additional extraction for the Proposed Action above the current rates authorized for the interim measure would require authorization from NMOSE.

By intent, extraction wells alter the groundwater quality by reducing the intended contaminant concentration, such as Cr(VI) in the well's vicinity. Similarly, injection wells alter the groundwater quality by injecting treated water absent of the contaminant—in this case, Cr(VI).

Extraction wells lower the water table and draw water surrounding them to the intake zones or well screens. The water table surface surrounding the extraction well exhibits an inverted drawdown funnel-shape indicating the pressure is lowest at the well and higher away from the well. The injection well is essentially the opposite creating a mounding of the water table in the vicinity of the well. The degree of drawdown or mounding are dependent upon a number of factors relating to the hydrologic characteristics of the aquifer and the well construction and operation.

Extraction wells remove Cr(VI) mass and are used currently near the plume perimeter to pull back the Cr(VI) plume defined by a 50 ppb Cr(VI) concentration. Injection wells are currently constructed downgradient or down slope from extraction wells and the Cr(VI) plume. The effect of the injection well is to raise the pressure head of water so that the slope of the water table is reversed (i.e., aiming toward, not from), slowing the flow rate of water away from the plume or, if possible, reversing it entirely, stopping the migration altogether.

Newly constructed extraction wells may also be used for removing mass of Cr(VI) in the center and high Cr(VI) concentration areas of the plume. This would increase the rate of mass removal. Newly constructed injection wells would be used as before to create a hydraulic barrier to migration, but they may also be located in areas outside the plume for excess water disposal so as to not affect the plume. The intent overall is to return the majority of water extracted back into the regional aquifer after it has been treated.

Since it is not known where new extraction or injection wells would be located, it is not reasonable to try and project through water particle tracking, capture zone, or solute transport modeling the effects on the plume geometry, as the number of permutations is excessive. It would also not change the result that the plume would still be reduced, and Cr(VI) mass would be removed at an increased rate. As noted in the affected environment section, the interim measures have been shown to be effective at pulling back the 50 ppb Cr(VI) plume contour away from the Laboratory's southern boundary and removing Cr(VI) mass. Therefore, it is known that the approach of pump and treat is effective.

The adverse environmental consequences on groundwater quality and availability for this option would be localized near the extraction and injections wells and would be minor. Through the years, EM-LA has developed procedures to utilize well construction techniques that minimize introduction of contaminants from drilling fluids into water bearing zones (e.g., drilling with air, and using casing-advance or sonic drilling). Similarly, EM-LA utilizes well development procedures that clean and optimize the hydraulic properties of the aquifer zones open to each well. Together these procedures ensure minimal and very local impact on groundwater quality, and minor temporary impacts to water levels during well construction. This option would also result in positive environmental consequences on groundwater quality, as instituting Option 1 results in Cr(VI) mass reduction and working towards achieving the ASM Desired Outcomes.

Option 2 – Mass Removal with Land Application

The environmental consequences for this option to groundwater and groundwater quality are essentially the same as Option 1: minor. The difference is that less water would be injected into the regional aquifer. Under this option, the extraction rate for existing and new extraction wells would be the same at 550,000,000 gpy; the injection rate for existing and new injection wells would be reduced to 462,500,000 gpy and the land applications rate would be 87,500,000 gpy (350,000 gpd for 250 days per year). Land application would only occur in permitted areas per an NPDES DP. Permit restrictions associated with land application—for example, the limited land area where land application can occur; time-of-day restrictions; and the inability to land-apply water when temperatures are below freezing, during precipitation events, and under ponding conditions— are likely to reduce the amount of water that can be land applied to an amount well below the 87,500,000 gpy. Water that could not be land applied would be reinjected into the regional aquifer.

The adverse environmental consequences for this option would be the same as Option 1 and would be minor for groundwater levels and availability. Because of controls implemented as part of the permit conditions (e.g., land application must be conducted in a manner that maximizes infiltration and evaporation, no ponding of water, no runoff, and no application on slopes >5 percent), land application would have minimal impacts on groundwater. Additionally, treated water would need to meet NMED Ground Water Quality Bureau permit standards before being land applied or evaporated. This option would result in positive environmental consequences on groundwater quality as instituting Option 2 results in Cr(VI) mass reduction.

Option 3 – Mass Removal via In-Situ Treatment

Depending on where and when EM-LA determines in-situ treatment is a viable option, the rates of extraction and injection into the regional aquifer and land application for Option 3 has the potential to be the same as for Options 1 and 2, and the environmental consequences for these activities are bounded by the impacts for Options 1 and 2, which are minor.

Many chemicals can be added to the aquifer to serve as reducing agents (see Appendix B, *Description of Alternatives Supporting Information*, Section B.2.3). These amendments would be reviewed for applicability, effectiveness, toxicity, etc. and not be used if they would contribute to additional contamination. Introduction of any compounds into the aquifer as part of in-situ treatment would be implemented under approved permits from NMED.

The adverse environmental consequences on groundwater quality for this option would be controlled through permit conditions and would be minor for groundwater levels and availability. This option would result in positive environmental consequences on groundwater quality, as instituting Option 3 results in Cr(VI) mass reduction.

Option 4 – Monitored Natural Attenuation

This approach relies on natural physical, chemical, or biological processes to reduce concentrations, toxicity, or mobility of chromium. Regular monitoring must be conducted to ensure that MNA is an effective treatment. EM-LA has determined that MNA alone would be insufficient to control plume advancement and maintain the 50-ppb-and-greater chromium contamination concentrations within the Laboratory’s boundary, based on current concentrations and plume migration. EM-LA would consider proposing MNA at any time during or after the implementation of other remedial options when controlling migration of chromium in groundwater is most likely to be sustained and does not pose a risk for offsite migration or to water supply wells.

Option 4 has little, if any, adverse environmental consequence to groundwater and groundwater quality if closely monitored and applied under the circumstances previously described.

Surface Water

Option 1 – Mass Removal via Expanded Treatment

Under Option 1, soil disturbance resulting from infrastructure development, operation, and maintenance activities associated with the Proposed Action could result in sedimentation to surface waters. The primary location where this could be an issue would be for the installation of piezometers in the Sandia Canyon Wetlands. Section 3.3, *Geology and Soils*, provides further details regarding potential impacts to soils and associated BMPs. With anticipated soil disturbance to be about 75 acres throughout the project area and limited to about 0.05 acres in the Sandia Wetlands, potential environmental consequences to surface waters are expected to be minor. The potential impacts to surface waters, including floodplains and wetlands, would be further reduced through implementation of the following BMPs identified by Newport News Nuclear BWXT-Los Alamos, LLC (N3B) (N3B, 2023c), which would mitigate impacts from ground disturbance and or hazardous materials, chemicals, fuels, and/or oils:

- Disturbed areas would be revegetated using an appropriate native seed mix.
- Erosion and sediment control measures would be installed during construction.
- Heavy equipment would not be used within the wetland.
- Permanent equipment staging areas would not be located within the floodplains or wetland.
- All equipment would be refueled at least 100 feet from the floodplains and wetland.
- Hazardous materials, chemicals, fuels, and oils would not be stored within the floodplains or wetland.
- If any spillage occurs, all contaminated soil would immediately be containerized and relocated.
- Portable generators, compressors, and other fuel-driven equipment would be staged on bermed plastic sheeting as a form of secondary containment. Construction equipment (e.g., graders, dozers, excavators, etc.) and light vehicles would not be subject to this restriction.
- Support structures, such as the treatment facility, personnel trailers, storage tanks, or permanent laydown yards would not be installed within the floodplains or wetland.
- Project would remove all trash and debris (e.g., construction material) from the floodplains and wetland after completion.
- Well pads and roads would be reinforced to minimize erosion and/or flooding following project completion.
- Any excavation within the source area (i.e., Sandia Wetland) would require an additional Wetland Assessment to determine the potential impacts of that proposed action on the Sandia Wetland.

Option 2 – Mass Removal with Land Application

Option 2 would involve the same activities discussed under Option 1; therefore, impacts to surface water resources as discussed under Option 1 would also be applicable under Option 2. Option 2 includes the added use of land application and evaporation as additional means of treated water disposition. Under this option, the bounding land applications rate would be 87,500,000 gpy (350,000 gpd for 250 days per year). Land application of this much water over an area of 50 acres would have minor impacts as controlled by the NMED permit conditions summarized in Appendix B, *Description of Alternatives Supporting Information*. The proposed land application is not anticipated to result in ponding or runoff. Therefore, anticipated environmental consequences to surface water resources would be minor.

Option 3 – Mass Removal via In-Situ Treatment

Depending on where and when EM-LA determines in-situ treatment is a viable option, Option 3 has the potential to include all activities discussed under Options 1 and 2; therefore, impacts to surface water resources as discussed under Options 1 and 2 would also be applicable under Option 3. Option 3 includes the use of in-situ treatment for the contaminated groundwater. This option involves injecting reducing agents into the groundwater and does not involve surface water. No surface water environmental consequences are expected to occur beyond those discussed for Options 1 and 2, which are minor.

Option 4 – Monitored Natural Attenuation

Option 4 involves MNA which occurs only in groundwater. There are no environmental consequences to surface water.

3.4.2.2 Cumulative Impacts

As previously described, environmental consequences to water resources from the four proposed ASM Options would be either positive (i.e., from removing Cr(VI) mass) or minor. Because environmental consequences would be minor and limited in areal extent, they would not substantially contribute to cumulative impacts on water resources from other actions. Any potential environmental consequences to water resources would be mitigated by adherence to Federal and state regulations, continuation of mitigation efforts (LANL, 2022b), and compliance with the NMED Consent Order.

3.5 AIR QUALITY

3.5.1 AIR QUALITY – AFFECTED ENVIRONMENT

The EPA established the National Ambient Air Quality Standards (NAAQS) to regulate the following criteria pollutants: ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter less than or equal to 10 microns in diameter (PM_{10}), particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead. The Clean Air Act (CAA) and its subsequent amendments establish air quality regulations and the NAAQS and delegate the enforcement of these standards to the states. Under the CAA, state and local agencies may establish ambient air quality standards and regulations of their own, provided these are at least as stringent as the Federal requirements. The NMED Air Quality Bureau (AQB) is responsible for enforcing air pollution regulations in New Mexico. The AQB enforces the NAAQS and state ambient air quality standards by monitoring air quality, developing rules to regulate and to permit stationary sources of air emissions, and contributing to air quality attainment planning processes statewide.

In addition to criteria pollutants, the EPA also regulates hazardous air pollutants (HAPs). HAPs are emitted from a range of industrial facilities and vehicles. EPA sets Federal regulations to reduce HAP emissions from stationary sources in the National Emission Standards for Hazardous Air Pollutants (EPA, 2023b).

Currently, the area encompassing LANL and Los Alamos County is classified as an attainment area for all NAAQS (EPA, 2023c). Therefore, no conformity determination is required.

LANL borders the Tsankawi unit of the Bandelier National Monument CAA Class I area to the east (about 0.5 miles from the project area) and the main portion of the Monument (about 3.5 miles southwest of the project area). The CAA provides special protection for air quality and air quality-related values in Class I areas, where any appreciable deterioration of air quality is considered significant. Air monitoring shows a trend of gradually improving visibility within the Bandelier National Monument during the period of available data (1992 through 2021) (National Park Service, 2023).

LANL is considered a major source of air pollutants under the CAA, based on its potential to emit nitrogen oxides (NO_x), carbon monoxide, and volatile organic compounds (LANL, 2022b). In accordance with Title V of the CAA and AQB regulations, emission sources at LANL operate under a site-wide Title V Operating Permit. Prior to construction, the AQB requires air permits for new stationary emission sources, depending on their design and operations. Operations at LANL emit criteria pollutants primarily from combustion sources, such as boilers, generators, and motor vehicles. Estimated actual emissions of air pollutants for LANL in 2021 were substantially below the facility annual Title V Operating Permit facility-wide levels.

The project site generates minor amounts of air emissions when the interim measure is operating. Sources mainly include gasoline- and diesel-powered vehicles and nonroad equipment and fugitive dust due to the operation of vehicles on unpaved surfaces.

Recent scientific evidence indicates a correlation between increasing global temperatures over the past century and the worldwide proliferation of greenhouse gases (GHGs) emitted by mankind. Climate change associated with this global warming is predicted to produce negative environmental, economic, and social consequences across the globe (IPCC, 2021; USGCRP, 2018). Detailed predictions of future climate change and environmental impacts for the Southwest region that encompasses LANL are available in the *Fourth National Climate Assessment – Volume II – Impacts, Risks, and Adaptation in the United States* (USGCRP, 2018).

On January 9, 2023, the CEQ released interim guidance that describes how Federal agencies should consider the effects of GHGs and climate change in their NEPA reviews (CEQ, 2023)The air quality analysis for this EA considers aspects of the CEQ 2023 interim guidance.

Atmospheric levels of GHGs and their resulting effects on climate change are due to innumerable sources of GHGs across the globe. The direct environmental effect of GHG emissions is an increase in global temperatures, which indirectly causes numerous environmental and social effects. Therefore, the region of influence (ROI) and potential effects of GHG emissions from the project are by nature global and cumulative.

3.5.2 AIR QUALITY – ENVIRONMENTAL CONSEQUENCES

3.5.2.1 Proposed Action (Adaptive Site Management)

Implementation of the Proposed Action would result in air emissions of criteria pollutants, HAPs, and GHGs. The following evaluates projected emissions relative to air quality conditions within the project region.

Option 1 – Mass Removal via Expanded Treatment

Air quality impacts from the Proposed Action under Option 1 would occur from (1) combustive emissions from fossil-fuel-powered equipment, trucks, and worker commuter vehicles; and (2) fugitive dust emissions from operating equipment and vehicles on exposed soils and the handling of soils and aggregates. The main sources of emissions from installation activities would occur from road construction, installation of well pads, well development, pipeline installation, and construction of the treatment facility.

The Proposed Action would implement best management practices to minimize fugitive dust emissions during installation activities (listed in Appendix C, *Environmental Resources Supporting Information*, Section C.2). In addition, stationary sources of emissions, such as diesel-powered generators for well development, could require a construction permit from the AQB, which would limit their emissions and resulting impacts. As a result of these measures and regulations, the transport of project emissions at least 0.5 miles to the LANL boundary would result in dispersed concentrations of air pollutants at locations outside the LANL site. Therefore, emissions from project construction activities would not contribute to an exceedance of an ambient air quality standard.

Wells, pumps, and the treatment facility would be electrified and would not generate substantial emissions. The intermittent nature of operational emissions, in combination with emissions from installation activities, would not contribute to an exceedance of an ambient air quality standard at locations outside the LANL site.

Air emissions from the Proposed Action would have the potential to affect the Bandelier National Monument Class I area. Meteorological data collected within Mortandad Canyon show that winds blow on average almost 60 percent of the time from the sector (west-southwest to west-northwest) that would transport project emissions to the Monument (see Appendix C, *Environmental Resources Supporting Information*, Figure C-7). The transport of project emissions at least 0.5 miles to the border of the Monument would substantially dilute their concentrations. However, they could affect visibility within the Monument, especially fugitive dust emissions. Therefore, to minimize project air quality impacts within the Monument, the Proposed Action would implement the following mitigation measures:

- Where feasible, electrify fossil fuel-powered well development generators and stationary engines.
- Use only ultra-low sulfur diesel fuel in equipment and vehicles.

- Provide economic incentives to drilling contractors to use equipment with engines that meet EPA nonroad Tier 4 emission standards.
- Designate personnel to monitor the dust control program and to increase control measures, as necessary, to prevent the transport of project dust emissions beyond the LANL boundary.

Implementing these mitigation measures would ensure that the Proposed Action would negligibly affect air quality-related values within the Bandelier National Monument pristine Class I area.

The atmospheric evaporation of groundwater with chromium compounds would be a source of HAPs from project activities, particularly Cr(VI). Given that Option 1 of the Proposed Action would operate water systems that are closed to the atmosphere, emissions of chromium compounds and resulting ambient impacts would be minimal.

Option 2 – Mass Removal with Land Application

Air quality impacts under Option 2 would be nearly identical to those estimated for Option 1. However, implementation of land application of treated water would result in slightly higher releases of chromium compounds into the atmosphere. Since it is expected that the concentration of chromium compounds in treated water would be very low, the release of these HAPs into the atmosphere would result in minimal ambient impacts. Implementation of the air quality mitigation measures proposed for Option 1 would ensure that the Proposed Action under Option 2 would result in less than significant air quality impacts.

Option 3 – Mass Removal via In-Situ Treatment

Option 3 has the potential to involve the same activities as Options 1 and 2 depending on the number of wells and other infrastructure EM-LA decides to construct and where and when in-situ treatments are implemented. Air quality impacts from construction and operation of the Proposed Action under Option 3 would be nearly identical to those estimated for the Proposed Action under Options 1 and 2.

In-situ treatment generally involves introducing amendments to groundwater (see Appendix B, *Description of Alternatives Supporting Information*, Section B.2.3). These amendments would be reviewed for applicability, effectiveness, toxicity, etc. and not be used if they would contribute to impacts on air quality. Implementation of the air quality mitigation measures proposed for Option 1 would ensure that the Proposed Action under Option 3 would result in less than significant air quality impacts.

Option 4 – Monitored Natural Attenuation

Subsequent to the completion of the approved chromium mass removal option, monitoring activities under Option 4 would produce lower amounts of air emissions due to equipment and vehicle usages and fugitive dust compared to construction and operation activities. Implementation of the air quality mitigation measures proposed for Option 1 would ensure that the Proposed Action under Option 4 would result in less than significant air quality impacts.

3.5.2.2 Cumulative Impacts

The nearest locations of cumulative project emissions would occur from facilities within TA-53 and vehicles along Jemez Road. These emissions are far enough away and of such low magnitude that when transported to the project site, they would produce low ambient pollutant concentrations. When combined with mitigated project emissions, the transport of these cumulative emissions at least 0.5 miles to the LANL boundary would result in dispersed concentrations of air pollutants at locations outside the LANL site that would not contribute to an exceedance of an ambient air quality standard or negligibly affect air quality-related values within the Bandelier National Monument Class I area. Therefore, the Proposed Action would not substantially contribute to cumulative impacts on air quality.

Options 1 through 4 of the Proposed Action would emit GHGs due to the operation of fossil fuel-powered equipment, trucks, and worker commuter vehicles. The total GHGs emitted from the transport of materials by truck for each option are estimated to be 1,053 metric tons. These emissions, in combination with GHG emissions from the operation of fossil fuel-powered equipment and worker commuter vehicles, would be substantially less than the annual GHGs emitted from all stationary sources at the LANL facility (77,243 metric tons in 2022) (LANL, 2023b). The GHG emissions from Options 1 through 4 of the Proposed Action would result in a negligible contribution to cumulative impacts on climate change. To minimize GHG emissions from each Option, emission sources would comply with applicable regulations and GHG policies, and for mobile sources, Federal vehicle clean fuels, mileage efficiencies, and emissions regulations.

The social cost of GHGs is the monetary value (in U.S. dollars) of the net harm to society associated with adding GHG emissions to the atmosphere (IWG, 2021). In principle, it includes the value of all climate change impacts, including (but not limited to) changes in net agricultural productivity, human health effects, property damage from increased natural disasters, disruption of energy systems, risk of conflict, environmental migration, and the value of ecosystem services. The social cost of GHG values estimated for GHGs emitted from the transport of materials by truck would range from $14,400 to $160,000, based on different discount rates presented in the Interagency Working Group methodology (IWG, 2021). Inclusion of all GHG emissions from Options 1 through 4 of the Proposed Action would result in somewhat higher social cost of GHG values.

Environmental justice communities located near LANL could experience disproportionate impacts from climate change. In areas surrounding LANL, drought would negatively impact subsistence farming, which occurs in the neighboring Pueblos. Communities located within canyons also could be subject to increased flooding and potential displacement. In accordance with the 2021 Climate Adaptation and Resilience Plan, DOE facilities address climate change within neighboring communities by coordinating with Tribal, state, and local governments, as well as Federal agencies to provide communities near DOE sites with climate and extreme weather information and resources necessary to implement climate adaptation and mitigation measures (DOE, 2021). Also, DOE is identifying and providing opportunities to engage energy and environmental justice communities for meaningful involvement in agency decision-making, as well as providing resilience and reductions in pollution and emissions (DOE, 2022b). Implementation of these measures would mitigate climate change impacts to environmental justice communities near LANL from activities associated with the Proposed Action.

Climate change could impact implementation of the Proposed Action at LANL and the adaptation strategies needed to respond to future conditions. For the region surrounding the LANL project site, the main effect of climate change is increased temperature and aridity (USGCRP, 2018). These analyses predict that in the future, the region will experience (1) increases in temperatures, droughts, and wildfires, and (2) scarcities of water supplies. Current operations at LANL have adapted to droughts, high temperatures, wildfires, and scarce water supplies. However, exacerbation of these conditions in the future could impede site activities during extreme events. Due to Federal and agency mandates, LANL develops adaptation measures to compensate for future climatic events. For example, in the 2021 Climate Adaptation and Resilience Plan, DOE described the priority actions planned to promote climate change adaptation and resilience at DOE sites (DOE, 2021), which includes reducing energy and water needs for site operations. At LANL, planning is underway for a 10 megawatt photovoltaic electric generating station (LANL, 2022b). Lastly, as part of their adaptive process, DOE routinely monitors climate change analyses and, where appropriate, would implement measures to make facilities more resilient to future climate impacts. Implementation of these measures would mitigate the effects of climate change at the project site.

3.6 ECOLOGICAL RESOURCES

3.6.1 Ecological Resources – Affected Environment

Ecological resources include the plant and animal species, habitats, and relationships of the land and water areas within the ROI, which is the area directly or indirectly affected by the Proposed Action. Particular consideration is given in the ROI to sensitive species, which are those species protected under Federal or state law, including threatened and endangered species, migratory birds, and bald and golden eagles. Ecological resources at LANL are monitored by the Environmental Protection and Compliance Division, Los Alamos National Laboratory. The program implements management plans (e.g., LANL Threatened and Endangered Species Habitat Management Plan (LANL, 2022c), Wildland Fire Mitigation and Forest Health Plan (LANL, 2019a), Sensitive Species Best Management Practices Source Document (LANL, 2020a), Invasive Plant Species Management Plan (LANL, 2022d), and Migratory Bird Best Management Practices Source Document (LANL, 2020b) and Pollinator Protection Plan (LANL, 2021a)). The program also implements comprehensive species monitoring via routine plant and animal surveys. Historical reports and further information on ecological resources are available on the LANL website (LANL, 2023c).

3.6.1.1 Vegetation

LANL provides habitat for a diverse assemblage of vegetation. The landscape is primarily undeveloped with land cover types from forests, woodlands, shrublands, and grasslands to wetlands and waterways. Between 2001 and 2014, the Los Alamos region experienced drought, bark beetle outbreaks, widespread tree mortality, and severe wildfires (the Cerro Grande fire in 2000 and the Las Conchas fire in 2011) (LANL, 2018d). These disturbances caused substantial changes in vegetative communities over a relatively short period of time and with ongoing abnormal climate patterns, additional changes to the land cover types are expected.

In 2018, 28 land cover classes were reported in the Los Alamos Region (LANL, 2018d). Within the Sandia and Mortandad Canyon project area, 18 vegetation types occur (see Appendix C, *Environmental Resources Supporting Information*, Figure C-8). Mixed conifer, juniper woodland, ponderosa pine woodlands, nonforested wetland/riparian, and developed or sparsely vegetated rock areas have the highest proportion of cover, with grasslands and shrublands also present (Table 3-3). Tree and shrub species such as juniper (*Juniperus monosperma*), ponderosa pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), limber pine (*Pinus flexilis*), oneseed juniper (*Juniperus monosperma*), and piñon (*Pinus edulis*) are characteristic species. The nonforested wetland/riparian areas contain wetland shrubs or herbaceous species such as coyote willow (*Salix exigua*), skunkbush sumac (*Rhus trilobata*), cattails (*Typha* sp.) and a variety of sedges, rushes, and grasses (N3B, 2023b).

Table 3-3. Vegetation and land cover types within the project area

Vegetation Type	Acres	Proportion of Project Area Percent (%)
Asphalt road	96.12	4.75
Blue grama grassland	39.46	1.95
Dense juniper woodland	246.58	12.18
Dense oak shrubland	38.55	1.9
Developed	234.63	11.59
Forested riparian	16.5	0.81
Las Conchas recovering grassland	4.24	0.21
Mixed conifer	289.45	14.29
Mixed species shrubland	28.95	1.43
Nonforested wetland/riparian	222.97	11.01
Ponderosa pine regeneration	21.24	1.05
Ponderosa pine woodland	236.55	11.68
Semievergreen shrubland	7.47	0.37
Sparse juniper woodland	276.24	13.64
Sparse oak shrubland	63.06	3.11
Sparsely vegetated – bare rock	187.05	9.24
Sparsely vegetated – bare soil	14.43	0.71
Submontane grassland	1.66	0.08

Sources: (N3B GIS)
Note: Details and description of each vegetation type is provided in (LANL, 2018d).

The Sandia Wetland is located at the head of Sandia Canyon and since the early 1950s has expanded from a relatively small footprint to 3.65 acres in response to liquid effluent released by LANL (N3B, 2023b). The project area also lies within the 100-year floodplains of Mortandad and Sandia Canyons. A floodplain and wetland assessment would be prepared to support this project in accordance with 10 CFR Part 1022, "Compliance with Floodplain and Wetland Environmental Review Requirements." The upper Sandia and Mortandad Canyons floodplains are largely undeveloped with a single dirt road providing access to the Sandia Wetland, monitoring wells, and stormwater monitoring infrastructure. The Sandia Wetland drains into a perennial waterway that reaches Sigma Canyon (N3B, 2023c). Lower Sandia and Mortandad Canyons are more developed with a commuter access. Additional information on the floodplains is included in Appendix C, *Environmental Resources Supporting Information*.

3.6.1.2 Wildlife

The LANL region functions as a refuge for wildlife because of restricted access to certain areas, the lack of permitted hunting, and management of contiguous Bandelier National Monument and U.S. Forest Service lands. Sandia and Mortandad Canyons provide habitat for a variety of terrestrial wildlife species. Mammals observed include elk (*Cervus elaphus*), deer (*Odocoileus hemionus*), bear (*Ursus americanus*), mountain lions (*Puma concolor*), coyotes (*Canis latrans*), and rodents. There are also numerous species of bats, reptiles, amphibians, invertebrates, and a myriad of resident, seasonal, and migratory birds.

The Sandia Wetlands provides year-round water access and dense vegetative habitat and serves as an important food resource and nesting habitat. More than 100 species of birds have been detected throughout the year including species of special concern (e.g., western bluebird [*Sialia mexicana*] and pine siskin [*Spinus pinus*]) (N3B, 2023b). Further information of wildlife species documented on LANL is available on the LANL website (LANL, 2023c).

3.6.1.3 Threatened and Endangered Species

Threatened and endangered species include those listed by U.S. Fish and Wildlife Service (USFWS) as threatened or endangered under the Endangered Species Act of 1973 (16 U.S.C. 1531), species that are candidates for listing, and designated critical habitat (USFWS, 2023). Other sensitive species include those listed at the state level under the New Mexico Wildlife Conservation Act, species included in the New Mexico State Wildlife Action Plan (NMDGF, 2016), Natural Heritage New Mexico database, and Partners in Flight watch list (Partners in Flight, 2021). LANL maintains a list of threatened, endangered, and sensitive species (see Appendix C, *Environmental Resources Supporting Information*, Section C.3). Further details on sensitive species at LANL can be found in the Status of Federally Listed Threatened and Endangered Species at Los Alamos National Laboratory (LANL, 2021b) and in *Sensitive Species Best Management Practices Source Document*, Revision 5 (LANL, 2020a).

Federally listed threatened or endangered species are managed under the Threatened and Endangered Species Habitat Management Plan for LANL (LANL, 2022c). Five federally listed species have been reported in the vicinity of LANL: the Mexican spotted owl (*Strix occidentalis lucida*), Jemez mountains salamander (*Plethodon neomexicanus*), southwestern willow flycatcher (*Empidonax traillii extimus*), yellow-billed Cuckoo (*Coccyzus americanus*), and the New Mexico meadow jumping mouse (*Zapus hudsonius luteus*). At LANL, suitable habitats for three of these species (Mexican spotted owl, southwestern willow flycatcher, and Jemez mountains salamander), along with a protective buffer area surrounding the habitats, have been designated as Areas of Environmental Interest. Of these species, only the Mexican spotted owl has been reported within the project area. The current Mexican spotted owl Area of Environmental Interest inventory consists of five areas spanning seven canyons at LANL. Designated critical habitat occurs on Bandelier National Monument property west-southwest of LANL.

Mexican spotted owls prefer mixed conifer, pine-oak woodlands and Gambel oak (*Quercus gambelli*) forests throughout the mountains and canyons. Although seasonal movements vary among owls, adults commonly remain within their summer home ranges throughout the year. Mexican spotted owl surveys have been conducted on LANL property since 1994. Each spring, focused surveys are conducted in six canyons. In 2004, 2005, and 2006, a territory in Mortandad Canyon was occupied by at least one Mexican spotted owl. This area was re-occupied in 2013 and continues to be occupied to date with a pair of owls (LANL, 2021b; LANL, 2023d). Mexican spotted owls occupy a large portion of Mortandad Canyon, and the project area contains core and buffer habitat for this species (see Appendix C, *Environmental Resources Supporting Information*, Figure C-9).

3.6.1.4 Migratory Birds and Sensitive Species

Migratory birds are protected under the Federal Migratory Bird Treaty Act of 1918 (16 U.S.C. 703). Bird species can be yearlong residents or migrants and can also be special-status species including bald and golden eagles (with special status under the Federal Bald and Golden Eagle Protection Act), and species listed by USFWS as Birds of Conservation Concern (USFWS, 2021). Migratory birds at LANL are managed under the *Migratory Bird Best Management Practices Source Document* (LANL, 2020b). No nesting habitat for bald or golden eagles has been reported near the project area, but eagles are known to travel through and could forage at the site.

3.6.2 Ecological Resources – Environmental Consequences

3.6.2.1 Proposed Action (Adaptive Site Management)

The Proposed Action is subject to existing management practices and would follow all BMPs, monitoring plans and measures related to ecological resources established for LANL (see Appendix C, *Environmental Resources Supporting Information*, Section C.3).

Option 1 – Mass Removal via Expanded Treatment

Detailed locations are not yet known for the proposed 10,000-ft^2 treatment facility; injection, extraction, and monitoring wells; or any associated infrastructure, such as access roads, electrical lines, and pipelines to and from any new well pads. It is assumed that under Option 1, about 75 acres of the 2,025 acre project area, including access roads, would be disturbed during infrastructure development.

Impacts to ecological resources from implementation of Option 1 could include temporary and permanent disturbances, degradation or loss of habitat from land clearing activities, disturbance or displacement of wildlife due to increased noise, vibration, lights, and human. Impacts could also include fragmentation of remaining habitats and an increase in human-wildlife interactions (such as encounters and collisions between wildlife and motor vehicles).

Groundwater wells and access routes already exist in the project area, and vegetation and wildlife habitat in the vicinity have been disturbed by installation of this infrastructure and associated activities. Personnel and equipment accessing the project area for the Proposed Action would temporarily disturb wildlife in the local area and have minor and minimal adverse impacts on vegetation and wildlife habitat. These impacts would be minimized by pre-installation surveys, avoidance of sensitive habitats and nesting birds, using pollinator friendly practices, and monitoring. These localized impacts would generally be short term and would not be anticipated to result in long-term or permanent impacts to surrounding vegetation communities.

Vegetation would be restored and the introduction of invasive plant species and impacts to pollinators would be minimized by following the Invasive Plant Species Management Plan (LANL, 2022d) and Pollinator Protection Plan (LANL, 2021a). Initially, it would be very difficult to rehabilitate native vegetation similar in species composition, structure, and ecological function to that originally present, but over time the area is expected to recover and serve similar ecological functions.

Impacts to the Sandia Wetlands would be localized and riparian habitat would be avoided. The project would minimize long-term, adverse impacts to the floodplains and wetland in the project area through the implementation of BMPs, including erosion and sediment controls. Most impacts would conclude upon completion of construction activities. The Proposed Action would not significantly modify the existing floodplains and wetland within the project area and not adversely impact natural and beneficial floodplain and wetland values.

Construction of the treatment facility and well drilling for 24 hours per day, 7 days per week could cause disturbances (e.g., noise and vibration) to wildlife. Species in the vicinity of the construction area would likely move to suitable habitat nearby. Delaney et al. (1999) noted that Mexican spotted owl flush responses increased in response to closer and louder noise sources. Noise (i.e., chainsaws) below 46 A-weighted decibels (dBA) did not generate a flush response; however, the alert distance was considerably longer (Delaney et al., 1999). Noise studies on LANL found that current noise levels have increased in developed areas around Sigma Mesa but have not increased in undeveloped areas that are lower in elevation (LANL, 2019b). Noise levels at 50 feet from the project could reach 91 dBA and would attenuate to 71 dBA (at 500 feet), 61 dBA (at 1,500 feet), 57 dBA (at 0.5 miles), and 51 dBA (at 1 mile). The local topography would substantially lower noise levels to below the noise level estimates beyond a half a mile, and elevated noise levels would likely be faint or not detected. Heavy trucks would typically have noise levels between 74 dBA and 85 dBA at 50 feet and could generate noise levels ranging from 54 dBA to 65 dBA at 500 feet (FHWA, 2006). The recovery plan for the Mexican spotted owl species recommends that activities that generate noise levels exceeding 69 dBA be restricted within 165 feet of an owl site during the breeding season. Foraging individuals present within 500 feet of construction activity would be subjected to construction-specific increases in noise, general disturbance, and human presence, and would likely avoid the area for the duration of the disturbance. Noise levels would be subject to the guidelines on disturbance or habitat alterations for threatened and endangered and other special-status species. Further impacts to noise to species is discussed in the *Noise Study for the Mexican Spotted Owl Sandia-Mortandad Area of Environmental Interest* (LANL, 2019b).

Impacts to threatened and endangered species, including removal of Mexican spotted owl core and buffer habitat, would be minimized and mitigated in compliance with the Threatened and Endangered Species Habitat Management Plan (LANL, 2022c). Surface and vegetation disturbing activities would avoid nesting seasons for the various groups of birds protected under the Migratory Bird Treaty Act or considered sensitive or be preceded by surveys to confirm the absence of nesting birds. Any potential for sensitive plant species habitat in the project area would be surveyed prior to disturbance and appropriate mitigation would be implemented.

Multiple hazards (e.g., accidental spill from treated water, storage basins) pose a risk for potential deleterious effects on vegetation and wildlife such as decline in species diversity, mortality, growth rate, vigor, and genetic mutations.

Option 2 – Mass Removal with Land Application

Option 2 would involve all activities as discussed under Option 1, except for the land application of treated water in permitted areas, which would encompass about 50 acres of land. The areas for land application under the Proposed Action are the same as those currently available for this activity under the interim measure. Therefore, impacts to ecological resources discussed under Option 1 would also be applicable. The actual amount of treated water injected into the aquifer would be less; and the treated water volume applied to the land and the duration of land application would increase. Land application would only occur in permitted areas per NPDES land permit and not within wetlands, water courses, waterways or drainages, slopes >2 percent if the site is poorly vegetated (less than [<] 50 percent ground cover), or slopes >5 percent if the site is well vegetated (>50 percent ground cover), thus reducing impacts to ecological resources.

Option 3 – Mass Removal via In-Situ Treatment

Option 3 would be similar to Option 1 and 2 and no further impacts to ecological resources are expected to occur beyond those discussed for Options 1 and 2.

Option 4 – Monitored Natural Attenuation

Option 4 has the potential to involve the same amount of ground disturbance as Options 1 and 2, depending on when EM-LA determines MNA would be a viable treatment option, thus impacts to ecological resources would be the same as Options 1 and 2.

3.6.2.2 Cumulative Impacts

Reasonably foreseeable cumulative projects in the region that require ground disturbance, vegetation clearing, grading, and excavations could result in localized effects to ecological resources that may be individually comparable to those associated with Option 1.

Potential cumulative impacts associated with the loss and disturbance of ecological resources from the Proposed Action could result in long-term impacts due to the intense effort needed to restore the habitat. However, impacts would be reduced with implementation of BMPs, monitoring plans, and measures related to ecological resources established for LANL described in the affected environment section and as summarized in Appendix C, *Environmental Resources Supporting Information*, Section C.3. Ongoing coordination and consultation with appropriate agencies would occur prior to any new action that would impact ecological resources.

The spatial and temporal extent of potential impacts on ecological resources from other cumulative projects are expected to be limited due to implementation of BMPs and permit conditions that would maximize conservation of threatened and endangered and sensitive species. As a result, the Proposed Action is not expected to substantially contribute to cumulative impacts on ecological resources.

3.7 CULTURAL RESOURCES

3.7.1 CULTURAL RESOURCES – AFFECTED ENVIRONMENT

3.7.1.1 Definition and Regulatory Framework

The definition of cultural resources, as well as the regulatory setting and methodology of analysis, are found in Appendix C, *Environmental Resources Supporting Information.*

3.7.1.2 Area of Potential Effects

The APE, as defined in 36 CFR 800.16[d], is the area within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE for this project includes the areas within which direct land disturbance from infrastructure installation, access road development, operations, and reclamation activities are planned to occur, as well as the area that could be subject to vibrations from project operations. This APE also includes those areas in which there is the potential for indirect impacts, including changes to erosion patterns and inadvertent damage. Accordingly, for the proposed project, the APE for archaeological sites includes the area surrounding the proposed project facilities and infrastructure in the Mortandad Canyon bottom as well as along the northern and southern mesa tops and cliff faces adjacent to the canyon.

While the APE for historic properties has been defined, identifying a similar bounding geographic area for Tribal cultural resources is challenging due to the complexity of the relationships and interactions between these resources and important Tribal practices and beliefs. Thus, an APE for Native American resources is not defined and potential for impacts to such resources has been assessed through consultation with representatives of the Pueblo de San Ildefonso.

3.7.1.3 Cultural Resource Investigations

Cultural resource investigations helped develop the information needed to assess the potential impacts of the proposed project on cultural resources and to meet compliance requirements under Section 106 of the National Historic Preservation Act of 1966 (NHPA). These investigations included archaeological survey, testing, and Tribal consultation; they were conducted in accordance with the Cultural Resources Management Plan (CRMP), state, and Federal requirements. Investigations to identify cultural resources in the APE are described more fully in Appendix C, *Environmental Resources Supporting Information*.

3.7.1.4 Cultural Resources in the Area of Potential Effects

As a result of the archaeological survey, testing, and Tribal consultation, DOE identified archaeological sites and Tribal cultural resources that were considered when assessing the potential impact of the project. These resources are further described in this section.

Archaeological Sites

Based on the archaeological survey and testing investigations described in Appendix C, *Environmental Resources Supporting Information*, 114 archaeological sites are located within the APE. The condition of the sites is generally quite good, in part because of the restricted access at LANL. Almost all the sites have experienced some level of impact from water runoff, although this has occurred mainly as sheet wash and not in the development of drainage cuts. Other impacts to the sites include damage from construction of dirt roads on the mesa tops that were developed historically, vandalism or limited pot hunting at two of the sites, and modern graffiti at one site.

Of the 114 sites in the APE, DOE determined 80 sites eligible for listing in the National Register of Historic Places (NRHP), 18 sites not eligible for the NRHP, and 16 sites either potentially eligible for the NRHP or unevaluated. Shovel testing and geomorphological analysis previously conducted in areas where proposed interim measure project infrastructure would occur close to known sites revealed that no intact sediments or cultural deposits exist within those areas (DOE, 2015), which may be an indication of the potential for subsurface deposits at other sites in the expanded APE.

Historic Buildings

There are 12 historical buildings within the APE, all of which were built during the Cold War between 1959 and 1986 (see Appendix C, *Environmental Resources Supporting Information*, Table C-3, Los Alamos National Laboratory Historic Buildings in the Area of Potential Effects). Five of them have been determined eligible for listing in the NRHP (two under Criterion A, and three under Criterions A and C). The other seven buildings are not evaluated or currently undergoing assessment for significance or NRHP eligibility and are managed as NRHP-eligible until a final determination is made. The APE does not encompass any building or site within the legislative boundary of the Manhattan Project National Historical Park.

Native American Cultural Resources

DOE recognizes the affiliation for all Tribes that have shown an interest in, or claimed affiliation to, cultural resources located on LANL property (as listed in Appendix C, *Environmental Resources Supporting Information*). However, in this area of LANL property, the Pueblo de San Ildefonso is the recognized affiliated Pueblo. For this reason, DOE will focus its Tribal consultation for this project on Pueblo de San Ildefonso.

During their previous meetings with DOE for the 2015 Interim Measures EA, Pueblo de San Ildefonso representatives described the cultural resources and activities within and surrounding the project area in the following way (DOE, 2015): The Pueblo representatives consider the entire area on which LANL is located to be part of a larger Sacred Area that has been used and inhabited by their ancestors for over a thousand years. This Sacred Area is of great importance to the Pueblo and continues to be used by Pueblo members today. The resources located within the Sacred Area that contribute to its importance include naturally occurring water, animals, plants, springs, rocks, and soil as well as cultural-defined places such as archaeological sites and deposits; religious or ceremonial features and places; traditional areas used for gathering plants, clay, or other materials; hunting areas; and viewsheds. Important traditional activities conducted in the Sacred Area include hunting, gathering, collecting, and ceremonial practices. It should be noted that this list is likely not exhaustive. (DOE, 2015)

According to the Pueblo representatives, the Sacred Area plays a very important role in the history, culture, and religious practices of the Pueblo, and this forms the basis for its importance. Because of this intrinsic significance, the Sacred Area is used only for traditional cultural and religious activities by Pueblo members. By conducting these activities in the Sacred Area, or by using resources collected from the Sacred Area, the importance of the Sacred Area is transferred to those activities and materials, instilling in them cultural "power" and ensuring their efficacy. In turn, the conduct of these activities within the Sacred Area and the use of these materials imbues the Sacred Area with even greater importance. This illustrates the circular relationship between the Sacred Area, the resources and activities located within it, and explains the Pueblo's consideration of the Sacred Area and its resources as important. (DOE, 2015)

Pueblo representatives explained that, though varied in character, the resources in the Sacred Area are not distinguished into types such as natural, cultural, economic, secular, or sacred. Rather, the resources of the Sacred Area are regarded as comprising an integrated "whole," connected with one another through physical, functional, and spiritual relationships. This "whole" is regarded as essential to the continued survival of the Pueblo, and thus all the resources contained within it are considered cultural. The resources located within the project area and in the areas adjacent to it, both on and off LANL property, are considered to be a part of and connected to this whole (DOE, 2015).

3.7.1.5 Section 106 Compliance Status

Consultation with federally recognized Tribes for the Proposed Action commenced during the public scoping period, beginning with a courtesy phone call to the environment department of each of the Accord Pueblos (e.g., Pueblo de Cochiti, Pueblo de San Ildefonso, Pueblo of Jemez, Santa Clara Pueblo) ahead of the public scoping meeting, followed by letters regarding the scoping with an offer for in-person consultation. Consultation for this proposal is ongoing, and cultural resources in the APE within the Pueblo de San Ildefonso Reservation, and the Pueblo cultural resources concerns for the chromium plume area have yet to be identified. However, Pueblo concerns of cultural resources for the chromium plume area from previous consultation is available and summarized here. EM-LA also held an in-person meeting on the scoping with Pueblo de San Ildefonso environment department.

Compliance with Section 106 of the NHPA and 36 CFR 800 at LANL follows the Programmatic Agreement (PA) executed in 2006 (amended and updated in 2015, 2017, and 2022) between DOE, NNSA, Los Alamos Field Office, the New Mexico State Historic Preservation Office and the Advisory Council on Historic Preservation (LANL, 2022e).

3.7.2 CULTURAL RESOURCES – ENVIRONMENTAL CONSEQUENCES

The definition of cultural resources, regulatory setting, and methodology of analysis are found in Appendix C, *Environmental Resources Supporting Information*.

3.7.2.1 Proposed Action (Adaptive Site Management)

Option 1 – Mass Removal via Expanded Treatment

<u>Historic Properties</u>

Archaeological Resources

Detailed locations are not yet known for the proposed 10,000-ft^2 treatment facility; injection, extraction, and monitoring wells; and any associated infrastructure required, such as access roads, electrical lines, and pipelines to or from any new well pads. However, DOE would situate the 10,000-ft^2 treatment facility in a previously disturbed area and is committed to avoiding direct impacts to all known historic properties, to the maximum extent possible, for the siting, construction, and operation of proposed project facilities and infrastructure.

Seven archaeological sites are located along and bisected by historically established Puye Road, which accesses the project area in Mortandad Canyon from the mesa top to the south. Six of these sites have been determined eligible for the NRHP and one, a historic wagon road, has been determined not eligible. Increased use and maintenance of the road associated with the Proposed Action could potentially create additional impacts to these seven sites. Preemptive BMPs have already been implemented along Puye Road to address the risk for potential impacts from existing use and maintenance, and continuation of these measures would prevent additional potential impacts from the Proposed Action (DOE, 2015)

Installation and development of project infrastructure and increased activity during operations could result in changes to, or increases in, erosional processes and patterns in the vicinity of archaeological sites, resulting in potential impacts to those sites. Incorporated into the activities planned under the Proposed Action are BMPs to control stormwater runoff and erosion, including the use of retention basins, berming around facility perimeters, placement of sediment control structures, and placement of base-course gravel. These measures would be implemented in accordance with the project Stormwater Pollution Prevention Plan (SWPPP), as needed (see Section 3.4, *Water Resources*). To provide additional protection, erosion controls, such as straw wattles, would be installed in and around the archaeological sites in close proximity to stormwater runoff paths. These erosion control measures would limit indirect impacts to archaeological sites from stormwater runoff or erosion associated with the Proposed Action.

N3B cultural resource staff would implement monitoring throughout the duration of the Proposed Action. Ground-disturbing activities occurring in the vicinity of archaeological sites would be monitored to ensure inadvertent trespass does not occur and to address any subsurface archaeological discoveries. The effectiveness of erosion and stormwater runoff controls also would be monitored periodically and evaluated to determine if additional or modified controls are necessary. Discoveries of previously unrecorded archaeological deposits or impacts to archaeological materials would be identified, recorded, and evaluated in accordance with the procedures in the LANL CRMP (LANL, 2017) and the PA (LANL, 2022e). Discoveries of human remains, funerary objects, sacred objects, and objects of cultural patrimony would be treated in accordance with the Native American Graves Protection and Repatriation Act and its LANL standard operating procedure (LANL, 2020c).

With the protective measures already in place for Puye Road, along with implementation of the stormwater runoff and erosion control measures and archaeological monitoring that would be conducted for the project, no significant impacts to archaeological historic properties would be anticipated to occur from Option 1. As previously stated, DOE is committed to locate proposed project facilities and infrastructure to avoid impact to any known archaeological sites, to the maximum extent possible. However, as project facilities planning advances, and given the constraints of topography in the APE, a new well pad, access road, pipeline, or electrical line could cross the site buffer area of one or more sites. If this were the case, DOE would propose appropriate measures to mitigate any determined effect and would consult with the New Mexico State Historic Preservation Officer and concerned Tribes to negotiate a memorandum of agreement that details those measures, in accordance with stipulations in the PA.

In accordance with the LANL PA, DOE would follow the NHPA Section 106 review, determination of effects, and consultation process for archaeological historic properties as described above in Section 3.7.1.5, *Section 106 Compliance Status*.

Architectural Resources

All new facilities and infrastructure would be located within the chromium plume area previously analyzed in the 2015 Interim Measures EA (DOE, 2015). Under the Proposed Action, there would be no substantial dominant visual change as observed from any of the 12 Cold War Era historic buildings in the APE and no long-term dominant visual interruption of unique historic viewsheds.

No impacts to historic architectural historic properties would be anticipated to occur due to Option 1 of the Proposed Action.

Tribal Cultural Resources

Consultation for this proposal is ongoing, and cultural resources in the APE within the Pueblo de San Ildefonso Reservation, and the Pueblo cultural resources concerns for the chromium plume area have yet to be identified. However, Pueblo cultural resources concerns for the chromium plume remediation from previous consultation is available and summarized here.

Representatives of Pueblo de San Ildefonso previously anticipated a direct, adverse impact from the interim measure to Tribally important resources and practices located within the entire Sacred Area, which would concurrently impact the traditional culture and people of the Pueblo (DOE, 2015). The Pueblo representatives explained that because all resources within the Sacred Area are culturally meaningful and connected to one another, a change or impact to one resource in one location would simultaneously impact all of the resources, resulting in a holistic impact to the resources and associated practices. This detrimental impact would extend to the people depending on those resources and practices as well as to their traditional culture. The associated mental and emotional effects to the people would, in turn, affect their ceremonies and rituals.

The Pueblo representatives understood that the proposed chromium plume control interim measures were intended to reduce the impacts, and they viewed this as a necessary offset. The representatives reported that knowledge of the chromium plume had already curbed use of the Sacred Area in the vicinity of LANL property by their people because of concerns about contamination. However, the Pueblo representatives perceived that there would be impacts from the proposed interim measures, even though these would be a trade-off for the impacts of the chromium plume. Addressing those impacts through regular consultation with Pueblo de San Ildefonso throughout implementation of Option 1 of the Proposed Action, and avoiding to the maximum extent possible any potentially impacted resources, would limit the impacts.

Option 2 – Mass Removal with Land Application

Under Option 2, the proposed new facilities and infrastructure would be the same as Option 1; the actual amount of treated water injected into the aquifer would be less; and the treated water volume applied to the land and the duration of land application would increase. Land application of treated water in permitted areas would encompass about 50 acres of land. The areas for land application under the Proposed Action are the same as those currently available for this activity under the interim measure. Impacts to cultural resources, both historic properties and Tribal cultural resources, would be bounded by the evaluation of impacts discussed for Option 1. As with Option 1, EM-LA would perform NHPA Section 106 review for each new proposed activity in accordance with the LANL PA as project design advances and would assess and determine the effects per the process specified in Stipulation 10 of the PA. Impacts to cultural resources, both historic properties and Tribal cultural resources, would be bounded by the evaluation of impacts discussed for Option 1.

Option 3 – Mass Removal via In-Situ Treatment

Option 3 has the potential to involve the same activities as Options 1 and 2, depending on the number of wells and other infrastructure EM-LA decides to construct and where and when in-situ treatments are implemented. EM-LA would follow the same process as described under Options 1 and 2 for NHPA Section 106 review in accordance with the LANL PA. Therefore, the impacts to cultural resources, both historic properties and Tribal cultural resources, from implementing Option 3 would be similar to those for Options 1 and 2.

Option 4 – Monitored Natural Attenuation

Under the MNA option, the proposed new facilities and infrastructure, the amounts of treated water injected into the aquifer and applied to the land and the duration of land application have the potential to be the same as under Options 1 and 2. Impacts to cultural resources, both historic properties and Tribal cultural resources, would be bounded by the evaluation of Option 1.

3.7.2.2 Cumulative Impacts

Because the Proposed Action is not anticipated to result in significant impacts to cultural resources, there would be no substantive contribution to cumulative impacts on cultural resources under the Proposed Action.

3.8 UTILITIES AND INFRASTRUCTURE

Infrastructure consists of the basic physical structures, facilities, and services needed to support planned and continued operations at LANL. LANL manages all utility systems that serve programmatic mission needs. Systems analyzed in this EA include electric power, water, and roads. While roads are often considered part of the infrastructure, they are only briefly described in this section. The roadway network outside and within LANL, including volume and condition, is discussed in greater detail in Section 3.9, *Traffic and Transportation*.

3.8.1 UTILITIES AND INFRASTRUCTURE – AFFECTED ENVIRONMENT

3.8.1.1 Electricity

LANL participates in an electric coordination agreement for its electric power supply, known as the Los Alamos Power Pool, with Los Alamos County. The Public Service Company of New Mexico is the transmission operator serving LANL. Electric power is supplied to the site via two 115 kilovolt (kV) import transmission lines: the Norton Line that terminates at the Eastern TA substation in TA-05 and the Reeves Line that terminates at the Southern TA substation in TA-71. A third, planned import transmission line would connect the Norton substation to the Southern TA substation, providing added system capacity, redundancy, and reliability. LANL operates and maintains the transmission and distribution resources serving all on-site facilities (LANL, 2022a).

LANL also operates a combustion gas turbine generator on the 13.8 kV distribution system to generate power on-site from natural gas and maintains several emergency combustion engine generators that utilize diesel fuel (LANL, 2022a). In FY 2021, LANL consumed 605,969 megawatt hour from the Los Alamos Power Pool and 77 megawatt of the peak load demand (DOE, 2022a).

In the project area, power drops are located at wells CrEX-1, R-42, R-28, and R-62. An existing power line extends to well R-45, from which there are local power drops to the storage basins to support land-application pumps and associated controls (DOE, 2015).

3.8.1.2 Water

Los Alamos County operates the water-production system that supplies potable water to LANL. LANL operates and maintains its water-distribution system. County deep water supply wells are located in three municipal well fields (Guaje, Otowi, and Pajarito). The county supplies water from wells to primary storage tanks for distribution throughout LANL. In general, the LANL distribution system lines begin at primary storage tanks maintained by the county (DOE, 2015; LANL, 2022a). LANL's sitewide, gravity fed water distribution system supplies both domestic and fire-protection requirements, and the system uses approximately 270 million gallons of water per year. Water is pumped into production lines and booster pump stations lift this water to 1 of 16 distribution water tanks that provide water storage at high and intermediate storage points within the system (DOE, 2015; LANL, 2022a).

3.8.1.3 Roads

LANL is served by a limited number of public roadways. LANL and the town of Los Alamos can be accessed from public thoroughfares branching from New Mexico State Road (NM) 4, from the east by NM 502 and by East Jemez Road, and from the southwest by NM 501. A fourth paved road, Pajarito Road, leads to LANL from the southeast, but through traffic is limited to authorized personnel. Approximately 83 miles of paved roads and parking surfaces are currently present on the site. A portion of Pajarito Road restricted to the public provides the only vehicle access to and from the project area by means of Puye Road, which leads from Pajarito Road into Mortandad Canyon. Puye Road near Pajarito Road is paved, while the portion within Mortandad Canyon is unpaved (DOE, 2015).

3.8.2 Utilities and Infrastructure – Environmental Consequences

3.8.2.1 Proposed Action (Adaptive Site Management)

<u>Electricity</u>

Option 1 – Mass Removal via Expanded Treatment

Under Option 1, the proposed chromium treatment facility would require a connection to the LANL electrical system with the total power requirement to be determined by the final facility design. Three-phase 480-volt power is already available at the proposed facility location, and no new electrical lines would be required. Once treatment wells are constructed and operational, they would be connected to the existing electrical system. During construction of wells and piezometers, portable generators would be used. Total electricity used for construction and operation under Option 1 would be 473,040 kilowatt-hours per year, which would be <1 percent of total yearly usage for LANL. The overall increase in demand and effect of the capacity of the electrical system at LANL would be minor under Option 1.

Option 2, 3, and 4

Option 2 would involve all activities as discussed under Option 1; therefore, impacts to the electrical system at LANL would be the same as discussed under Option 1. Option 2 includes the use of land application and evaporation of treated water as a disposition method; overall impacts to the electrical system at LANL would remain minor under Option 2. The use of in-situ treatments under Option 3 would not require the use of additional electricity. Under Option 4, groundwater monitoring and well maintenance would require electricity, but less than that required under Options 1 and 2. Overall impacts to the electrical system at LANL are anticipated to be minor.

Water

Option 1 – Mass Removal via Expanded Treatment

Under Option 1, water would be required during construction (e.g., to suppress fugitive dust). Well construction would use off-site water and portable toilets. Some water would be required for potable use and for toilets (potable or non-potable) at the treatment facility. Water used would be derived from the same system operated by Los Alamos County and maintained by LANL. Total water usage for construction is estimated up to 5,000,000 gpy and usage for operation of the treatment facility and wells is estimated to be up to 500,000 gpy, which is estimated to be <1 percent of the total yearly water use at LANL. Therefore, the overall increase in demand and effect of the capacity of the water delivery and distribution system at LANL would be minor under Option 1.

Option 2, 3, and 4

Options 2, 3, and 4 would use approximately the same yearly volume of water as Option 1; therefore, the overall increase in demand and effect of the capacity of the water delivery and distribution system at LANL also would be minor.

Roads

Option 1 – Mass Removal via Expanded Treatment

Access to the project area would be made via paved and unpaved roads as described in Section 3.8.1.3, *Roads*. The Proposed Action would generate increased traffic volumes from commuting workers and from trucks transporting equipment, supplies, and materials to and from the project sites. Trucks would be required during construction and operation of the treatment facility and wells for fill, crushed stone, concrete, well casing, piping, ion exchange resin, and other materials and equipment. Access to the proposed treatment facility would be achieved through existing paved and unpaved roads. Construction of new road surfaces and some improvements to existing roads in the project area would be required. Any new road construction would be undertaken using BMPs including use of wattles, ditches, and culverts to minimize sediment transport and erosion. Considering that the project area under Option 1 is largely in a less frequently travelled area of LANL, other than construction of additional access roads, activities under Option 1 would not affect road infrastructure, and overall effects on the road infrastructure at LANL would be minimal.

Section 3.9.2, *Traffic – Environmental Consequences*, describes the potential effects of the Proposed Action on the volume and capacities of the existing roadway network and traffic within LANL and the surrounding area.

Option 2, 3, and 4

Options 2, 3, and 4 would result in the same increased traffic and truck transportation trips to the project area as Option 1. This option would also result in the same level of road construction and upgrade of existing roads; therefore, potential impacts to road infrastructure at LANL would be the same as under Option 1.

3.8.2.2 Cumulative Impacts

As described in the previous sections, overall impacts to utilities and infrastructure would be small considering the total capacities described in Section 3.8.1, *Utilities and Infrastructure – Affected Environment*. Because impacts from the Proposed Action would be small when compared to total usage at LANL, they would not substantially contribute to cumulative impacts on utilities and infrastructure.

3.9 TRAFFIC AND TRANSPORTATION

3.9.1 TRAFFIC AND TRANSPORTATION – AFFECTED ENVIRONMENT

Regional access to LANL is provided by State Road (SR)-502 from the east and north; SR-4 from the east and south; and SR-501 from the west. Smaller public roadways that directly serve LANL include Jemez Road and Diamond Drive. The town of Los Alamos can be accessed from three public roadways that branch off from SR-4: from the east by SR-502 and Jemez Road, and from the southwest by SR-501. The community of White Rock is served by SR-4, east of LANL. The roadway system surrounding LANL is shown in Figure 1-1.

Main entry into LANL is via a controlled entry gate located on SR-501/West Jemez Road near its intersection with Diamond Drive, in the northwest portion of LANL. Near this entry, Diamond Drive directly connects to the town of Los Alamos. A controlled entry gate is also located further south on SR-501/West Jemez Road, near its intersection with West Road.

Pajarito Road is a restricted access road (limited to authorized personnel) with a controlled entry gate located at its intersection with SR-4. This road traverses from the southeast (at SR-4) to the northwest, leading to the LANL administration area and connecting to SR-501/West Jemez Road. The restricted portion of Pajarito Road provides the only vehicle access to and from the project area by means of Puye Road, which extends from Pajarito Road into Mortandad Canyon and the project site. The community of White Rock is located immediately east of the intersection of Pajarito Road and SR-4; traffic movement at this intersection is signalized. Local roadways surrounding LANL are presented in Figure 3-1.

Annual average daily traffic (AADT) data for key roadway segments at or near LANL was obtained from New Mexico's Department of Transportation (NMDOT) database and is presented in

Table 3-4. AADT is a measure of the average daily number of vehicles that pass through a given segment of roadway and is indicative of traffic conditions (i.e., higher AADT volumes lead to increases in traffic congestion and delays). The key roadway segments listed in Table 3-4 have exhibited declines or slight increases in traffic volumes since 2018. Based on recent AADT data, SR-4 (between Pajarito Road and SR-502) and Pajarito Road continue to be relatively busy roads.

Table 3-4. Annual average daily traffic on key roadway segments near project site

Street (Location)	Roadway Functional Class	Number of Lanes	2018 AADT (vehicles per day)	2022 AADT (vehicles per day) [percent change]
SR-4 (north of East Jemez Road intersection)	Minor arterial	2	11,883	11,995 [+1%]
SR-4 (between East Jemez Road and Pajarito Road)	Minor arterial	2	10,663	10,713 [+0.5%]
SR-501/West Jemez Road (west of LANL main gate, between Pajarito Road and Diamond Drive)	Minor arterial	4	8,232	2,294 [-72%]
Pajarito Road (northwest of SR-4)	Minor arterial	2	11,579	12,438 [+7%]
Pajarito Road (southeast of SR-501)	Minor arterial	2	11,041	10,771 [-2%]

Source: (NMDOT, 2023a)
Key: % = percent; AADT = Annual Average Daily Traffic; LANL = Los Alamos National Laboratory; SR = State Route

Prior to work restrictions in March 2020 due to the Coronavirus Disease of 2019 pandemic, traffic congestion at LANL was evident and travel delays and parking inconveniences were common issues with commuting workers (LANL, 2022f). Key traffic areas of concern included the northwestern portion of LANL (administration area) and the SR-4 corridor along the eastern boundary of LANL (between White Rock and SR-502). More specifically, traffic congestion occurred in the afternoon exit commute along Diamond Drive and the approaches to the intersection of SR-4 and East Jemez Road. Traffic movement at the intersection of SR-4 and East Jemez Road is controlled by a traffic signal. As work restrictions lifted, traffic congestion and delays have remained at or below levels exhibited prior to March 2020 due to telecommuting, hybrid work schedules, and staggered shifts (LANL, 2022f).

3.9.2 TRAFFIC – ENVIRONMENTAL CONSEQUENCES

3.9.2.1 Proposed Action (Adaptive Site Management)

The Proposed Action would generate increased traffic volumes from personal vehicles of commuting workers and from trucks transporting equipment, supplies, and materials to or from the project sites. For all Proposed Action options, access to the project site would remain the same as current operations. The majority of project-related vehicles would enter LANL from the main entrance at Jemez Road to Diamond Drive, then onto Pajarito Road. Pajarito Road connects to Puye Road, the direct access road leading into the project area. A limited number of vehicles could enter from the controlled entry gate at the eastern terminus of Pajarito Road, at its intersection with SR-4.

The project-related traffic volumes could lead to an increase in traffic congestion and delays at the LANL entrances and on the roadways during peak commuting hours, a degradation in the operating capacity of a roadway and intersection, or an increase in traffic safety hazards. Generally, the surrounding public roadways would have the excess capacity to handle any additional traffic volumes associated with the project and adverse traffic impacts would be considered short term and minor for all options under the Proposed Action. Potential traffic impacts for each Proposed Action option are described in greater detail in the following subsections.

Option 1 – Mass Removal via Expanded Treatment

Option 1 would involve an increase in the number of personal vehicles from commuting personnel and number of truck deliveries for the construction of the groundwater treatment facility, well pads, wells, and piezometers. For the construction of the groundwater treatment facility and associated infrastructure, routine daily vehicles from personnel and trucks would be up to approximately 50 roundtrips per day. For the construction of wells (a maximum of 2 wells could be constructed simultaneously), routine daily vehicles from personnel and trucks would be up to 100 roundtrips per day. Simultaneous construction of the new treatment facility and two well pads would generate up to 150 roundtrips per day (or 300 single vehicle trips per day). This value represents the maximum daily traffic volume that could occur during a peak construction period. Routine daily traffic volumes would be expected to decrease after construction of the proposed groundwater treatment facility is completed.

It is assumed that limited project-related traffic would access the project sites from SR-4, hence it would contribute to negligible traffic impacts on this roadway. As shown in Table 3-4, SR-501/West Jemez Road (between Pajarito Road and Diamond Drive) has experienced a great decline in traffic volumes since 2018; therefore, it is expected that this roadway would have the excess capacity to handle the additional project-related traffic. Project-related peak traffic would increase daily traffic volumes on Pajarito Road by approximately 5 percent and would cause an increase in congestion and delays on this roadway and at the main entrance, especially during peak commuting hours. However, the increase in project traffic volumes would be reduced after construction of the proposed groundwater treatment facility is completed (LANL, 2022f). As such, adverse traffic impacts are expected to be minor under Option 1.

Option 2 – Mass Removal with Land Application

Option 2 would involve all activities discussed under Option 1; therefore, traffic impacts as discussed under Option 1 would also be applicable under Option 2. Additionally, Option 2 includes the use of land application and evaporation of treated water as a disposition method. One of the land application methods proposed is the use of water trucks. However, the water trucks would remain within LANL property and would not travel on public roadways. Therefore, there would be a negligible incremental increase in traffic impacts and overall traffic impacts would remain minor under Option 2.

Option 3 – Mass Removal via In-Situ Treatment

Option 3 would potentially involve all activities as discussed under Options 1 and 2; therefore, traffic impacts as discussed under Options 1 and 2 would also be applicable under Option 3.

Additionally, Option 3 includes the use of in-situ treatment for the contaminated groundwater. A limited increase in daily traffic volumes is expected from routine personnel and trucks associated with the in-situ treatment, and, therefore, they would result in a negligible incremental increase in traffic impacts. As such, overall traffic impacts would remain minor under Option 3.

Option 4 – Monitored Natural Attenuation

Option 4 would involve MNA potentially following the completion of other remedial actions within the ASM; therefore, traffic impacts as discussed under Options 1, 2, and 3 would also be applicable under Option 4. A limited increase in daily traffic volumes is expected from routine personnel and trucks associated with monitoring wells; therefore, they would result in a negligible incremental increase in traffic impacts. As such, overall traffic impacts would remain minor under Option 4.

3.9.2.2 Cumulative Impacts

Increases in traffic volumes are predicted on the roadways within and surrounding LANL as an increase in workforce at LANL is projected over the next several years. Because Pajarito Road and SR-4 are relatively busy, cumulative traffic impacts are expected to range from minor to moderate, although the contribution from the Proposed Action would be expected to be small and would not substantially contribute to cumulative impacts on traffic. Traffic continues to be a top priority at LANL and several traffic projects are planned to help alleviate congestion. Strategies, such as conducting a transit options study and implementing a pilot bus service, are also being developed to reduce employee-owned single-occupancy vehicles on-site (LANL, 2022f). Additionally, NMDOT is conducting an alignment study for SR-4 (from SR-502 to Rover Boulevard in White Rock), which will identify existing deficiencies and identify any improvements needed to bring the roadway to current standards (NMDOT, 2023b).

3.9.3 Transportation – Environmental Consequences

This section presents human health considerations associated with transport elements of the Proposed Action. In this EA, the transportation activities do not involve radioactive wastes and material transports and would be limited to nonradiological health impacts from construction and support equipment supplies.

3.9.3.1 Proposed Action Alternative (Adaptive Site Management)

The major transportation activities in this EA include the transport of materials and infrastructure supports for implementing the Proposed Action. Major project infrastructure to be installed and operated under the Proposed Action alternative is described in Section 2.3, *Proposed Action*, and in more detail in Appendix B, *Description of Alternatives Supporting Information.*

Prior to installing an injection or extraction well or deep vadose zone piezometer, it would be necessary to grade an area approximately 200 feet by 200 feet and cover it with gravel-base coarse material. Each well would have the completed well head and associated valves and instrumentation and would be fitted with a concrete pad approximately 10 feet by 15 feet. Each piezometer is expected to have a concrete pad size of <6 feet by 6 feet (DOE, 2014). Based on these considerations, it is estimated that the installation of each extraction, injection, deep vadose zone piezometer, or monitoring well pad and related road would require approximately 72 loads of base course from dump trucks, resulting in approximately 4,030 total loads that would be brought into the site (EM-LA, 2023b; DOE, 2015). In addition, for the duration of the project, an estimated 4 inches of base course would need to be brought in for annual road maintenance, resulting in approximately 1,807 loads of base course per year for the new roads, and 225 loads for the existing roads (DOE, 2015).

Concrete would also be required to install the pads at the injection, extraction, and monitoring wells, as well as the deep vadose zone and shallow piezometers. Extraction and injection well pads would require a total of approximately 110 truckloads of concrete into the site. Shallow piezometers in Sandia Canyon would require a total of approximately five truckloads of concrete (DOE, 2015).

The ion exchange in the treatment facilities would need replacement and regeneration periodically. Based on the past experience with five extraction wells operating, there were five ion exchange module exchanges per month on average in the 2022 calendar year (EM-LA, 2023c). Under the Proposed Action, the water treatment capacity would be about five times larger than that of the existing operation; therefore, it is estimated that there would be 25 ion exchange module exchanges per month. If each module contains 30 cubic feet (ft^3) of resin and between three to four modules are shipped to be regenerated and brought back (EM-LA, 2023b), then the ion exchange operation would need between 75 to 100 truck shipments (or an average of 88 shipments) annually. If the decision is made to use larger, 60 ft^3 contactors, along with the permanent treatment contactors with ion exchange resin regenerated off-site and delivered via tanker truck (EM-LA, 2023b), considering a truck capacity of 600 ft^3 (Evoqua, 2023), then 30 tanker truck deliveries would be needed annually.

Piping from the extraction wells to the treatment system would be double-walled pipe. Piping to injection wells would be single-walled pipe. It is estimated that the additional 15 injection and 15 extraction wells would each need about 30,000 feet of double- and single-walled pipe, respectively (or a total of 60,000 feet)[6]. Also, the connections between the existing and the new treatment facilities would need about 500 feet of double- and single-walled pipe, each. Based on the assumption of a 6-inch pipe diameter dimension and about 4,000 linear feet of piping per truck load (note the truck load would be cargo-sized limited), it is estimated that about 16 shipments of the piping would be needed.

It is also estimated that drilling activity for each injection, extraction, and monitoring well and deep vadose zone piezometer would require 10 deliveries of the required materials (including the well casing piping) per month for the duration of its construction, which is assumed to be 9 months (EM-LA, 2023b). Hence, for drilling 45 wells and 10 deep vadose zone piezometers[7], a total of 4,950 truck deliveries would be needed.

[6] This estimate is based on the locations of existing injection wells and their average distance to the groundwater treatment facility (about 1,500 linear feet). It also includes consideration of an additional 30 percent increase on the estimated pipe lengths to cover the uncertainties on the locations of the 15 new extraction and 15 new injections wells, with respect to the groundwater treatment facility.

[7] These include 15 extraction wells, 15 injection wells, 10 deep vadose zone piezometers, and 15 monitoring wells. Note: it was assumed that the monitoring wells would have similar depths and needs as those of extraction/injection wells, for conservatism.

Based on the previous discussion, the construction and operation of the new wells and piezometers would need about a total of about 3, 960 truckloads of course base fill, about 130 truckloads of concrete and piping, 4,950 truck deliveries for the drilling operations, 2,011 truckloads of road fills, and 88 truckloads ion exchange resin for the annual road maintenance and treatment facilities operation. Assuming one-way distances of about 20 miles for the course base fill; about 40 miles for the concrete, piping, and drilling support; about 100 miles for the delivery and regeneration of ion exchange resins; and using the New Mexico State truck accident and fatality rates of 1.77×10^{-7} and 1.69×10^{-8} per kilometer (Saricks & Tompkins, 1999; UMTRI, 2003), the likelihood of a truck shipment being involved in an accident of any type during the initial construction and the annual operations, thereafter would be approximately 16 percent and 3 percent, respectively. These operations are unlikely, however, to lead to a single traffic accident fatality during the initial construction (0.02 per year) and the follow-up operations (0.003 per year). If the U.S. average truck accident and fatality rates of 5.77×10^{-7} and 2.34×10^{-8} per kilometer were to be used, then the likelihood of a truck shipment being involved in an accident of any type during the initial construction, and the annual operations, thereafter, would be approximately 52 percent and 9 percent, respectively. Again, these operations are unlikely to lead to a single traffic accident fatality during the initial construction (0.02 per year) and the follow-up operations (0.004 per year). Table 3-5 summarizes the transportation impacts for each option under the Proposed Action. Hence, the consequences of any accidents from transportation of aforementioned construction materials would be small.

Table 3-5. Summary of transportation impacts – all potential options under the Proposed Action

Materials	Shipment Numbers	Travel Distance one way (mi)	Total Distance round trip (km)	U.S. Average Truck		New Mexico Truck	
				Accidents	Fatalities	Accidents	Fatalities
Construction							
Course base fill	3,960	20	254,870	0.15	0.006	0.05	0.004
Concrete	115	40	14,800	0.009	0.0003	0.003	0.0003
DW/SW piping	16	40	2,060	0.001	0.00005	0.0004	0.00003
Drilling supplies	4,950	40	637,160	0.4	0.015	0.1	0.01
Subtotal	9,041	-	908,890	52%	2%	16%	2%
Operation							
Road maintenance	2,011	20	129,460	0.07	0.003	0.02	0.002
Ion exchange resin replacement	88	100	28,320	0.02	0.0007	0.005	0.0005
Subtotal	2,099	-	157,780	9%	0.4%	3%	0.3%

Key: % = percent; - = not applicable; DW = double-walled; km = kilometer; mi = mile; SW = single walled; US = United States
Notes: Operation impacts are occurring annually.
Because the individual impacts are rounded to single digits, their sums may differ from the subtotal impacts.

3.10 HAZARDOUS MATERIALS AND WASTE GENERATION

3.10.1 HAZARDOUS MATERIALS AND WASTE GENERATION – AFFECTED ENVIRONMENT

Radioactive and chemical wastes are generated by production, maintenance, and remediation activities at LANL. Radioactive wastes categories include (1) low-level radioactive waste, (2) mixed low-level radioactive waste, and (3) transuranic waste including mixed transuranic waste. Chemical wastes categories include (1) hazardous (i.e., designated under RCRA regulations), (2) toxic, (3) hazardous construction and demolition debris, and (4) mining and milling special waste as defined under Subtitle C of the RCRA. Waste quantities vary with different operations, construction activities, and implementation of waste minimization activities. Site-wide capabilities to manage all waste categories generated at LANL are analyzed in the 2008 SWEIS under the solid radioactive and chemical waste facilities and the radioactive liquid waste treatment facility. Activities and capabilities for waste management include waste characterization, packaging, and labeling; waste transport, receipt, and acceptance; waste treatment; waste staging; waste disposal; and radioactive liquid waste treatment. All wastes are handled, treated, transported, and disposed in accordance with Federal and state regulations applicable to specific waste classifications.

3.10.2 HAZARDOUS MATERIALS AND WASTE GENERATION – ENVIRONMENTAL CONSEQUENCES

3.10.2.1 Proposed Action (Adaptive Site Management)

Under the ASM implementing options, small quantities of industrial (i.e., construction debris) and hazardous wastes would be generated. The annual quantities of these waste categories generated at LANL, as reported in the Annual Site Environmental Reports, are approximately 1,600 tons and 40,000 kilograms, respectively. No other category of wastes discussed in Section 3.10.1, *Hazardous Materials and Waste Generation – Affected Environment*, would be generated under any of the implementing options under the Proposed Action.

Hazardous waste generation would be associated with the use of ion exchange resins to remove chromium under the non-in-situ mass reduction implementing options, chemicals in field kits used for sample analyses, and well maintenance. Treatment of water for chromium removal would involve the use of ion exchange resins; that resin would then be sampled and analyzed to determine if it is a hazardous material before being returned to the vendor for regeneration. If the sampling and analysis determined the resin to be hazardous, it would be manifested and shipped as a hazardous material and returned to the vendor for regeneration. Under previous mass removal activities involving the use of ion exchange resins, no samples have tested as hazardous.

Well maintenance activities would also occur periodically. Wastewater with chemical additives would be produced. The wastewater from this activity would be collected and sampled and then a determination would be made for disposal. It is anticipated that most of the wastewater could be disposed of with other treated waters.

All waste would be handled in accordance with LANL's waste management procedures. The waste quantities generated by all implementing options under the Proposed Action would be minimal, thus impacts to on-site waste operations or off-site disposal facilities are anticipated to be small.

3.10.2.2 Cumulative Impacts

Small quantities of construction debris and hazardous materials and wastes would be generated throughout the duration of all implementing options under the Proposed Action. All waste would be handled in accordance with LANL's waste management procedures. As previously described, impacts on waste management from the Proposed Action would be small. Because impacts would be small, they would not substantially contribute to cumulative impacts on waste management.

3.11 NOISE

3.11.1 Noise – Affected Environment

The area surrounding the project site is characterized as being predominantly natural, surrounded by canyonlands with vegetation dotting the landscape. Regionally, elevated noise levels mainly result from vehicular traffic on the highways. The closest manmade structures within the project boundary are numerous access roads and LANL facilities. Primary noise contributors in the project area include natural sounds (e.g., the wind and occasionally wildlife) and manmade sounds, including vehicular traffic and activities associated with DOE and LANL.

Within LANL property, the vegetation cover and regional topography quickly attenuate noise and vibrations with distance from the noise source. Because much of LANL is forested and the topography consists of widely varied elevations and rock formations, these factors greatly reduce how far noise and vibration travel from DOE operations. As such, existing noise levels within and surrounding the project area are relatively low.

The residential areas closest to the project boundary are in the communities of White Rock and Los Alamos, located 3 miles to the southeast and 2 miles northwest, respectively. Noise-sensitive receptors also include wildlife (see Section 3.6, *Ecological Resources*), the Pueblo de San Ildefonso Indian Reservation (adjacent to the project's southern border) and the Tsankawi section of Bandelier National Monument, about 0.5 miles to the east and across the LANL boundary and SR-4.

Within Mortandad Canyon, manmade noise is primarily limited to that associated with periodic Consent Order activities, including vehicular traffic and equipment and machinery operation (DOE, 2015). Noise from most of these activities is inaudible in the communities of Los Alamos or White Rock and the Bandelier National Monument (Tsankawi) and are barely audible or are inaudible at the LANL boundary with the Pueblo de San Ildefonso, to the south. Some activities at the east end of the project area are audible at the Pueblo de San Ildefonso boundary, approximately 250 feet from the existing monitoring well R-13. Within Sandia Canyon, manmade noise is primarily from vehicle traffic along East Jemez Road (DOE, 2015).

3.11.2 Noise – Environmental Consequences

3.11.2.1 Proposed Action (Adaptive Site Management)

The Proposed Action would generate noise from construction activities and from the use of equipment, machinery, and vehicles, which could affect noise-sensitive receptors. Elevated noise levels would generally be limited to the immediate area of the noise source, with noise levels quickly attenuating from the source due to the topography of the project region (e.g., steep canyon walls would limit the propagation of sound).

Elevated noise levels can affect the health and safety of personnel, result in annoyance/disturbance to receptors nearby, and disturb wildlife. It can degrade the quality of outdoor space, including public recreational areas. Noise-sensitive receptors evaluated for this project include on-site workers, residential areas, the Pueblo de San Ildefonso, the Bandelier National Monument (Tsankawi), public recreational areas, and wildlife.

Project-related noise could adversely impact areas of the Pueblo de San Ildefonso and is discussed in Section 3.7, *Cultural Resources*. Additionally, elevated noise levels could adversely impact wildlife, which is discussed in Section 3.6, *Ecological Resources*.

In general, noise impacts are expected to be greatest during construction of the proposed groundwater treatment facility and new wells. Any adverse noise impacts would generally be minor due to the topography of the project area. Potential noise impacts for each of the Proposed Action options are described in greater detail in the following subsections.

Option 1 – Mass Removal via Expanded Treatment

Option 1 involves the construction of a groundwater treatment facility, well pads, wells, and piezometers. Although the locations of the additional wells and piezometers have not yet been determined, it would be within the boundary of the project area as shown in Figure 3-1.

Site preparation and construction of the proposed facilities, including the groundwater treatment facility and wells, would involve heavy equipment that generate high levels of noise. Drilling of a single well would occur over 5 months. Two wells can be drilled simultaneously, with approximately 6 well pads being constructed in a given year. During construction of a well, drill rigs would be active 24 hours per day, 7 days per week until well installation is completed.

Except for the drilling of wells, all construction activities would occur during the daytime. The transport of equipment, materials, supplies, and personnel would also be limited to daylight hours. Table 3-6 presents typical noise levels of standard heavy construction equipment that could be used during construction.

Table 3-6. Typical noise levels of construction equipment

Construction Equipment	Noise Level (dBA) at 50 Feet
Air Compressor	80
Generator	82
Drill Rig	84
Cement Pump	82
Roller	85
Loader	80
Excavator	81
Dozer	85
Grader	85
Scraper	85
Trucks	84

Sources: (FTA, 2018); (FHWA, 2006)
Key: dBA = A-weighted decibel

Conservatively assuming simultaneous use of some of the loudest noise-generating construction equipment listed in Table 3-6, intermittent elevated noise levels would be at approximately 91 dBA) (at 50 feet). It is assumed that this noise level would occur for the construction of a treatment facility and associated infrastructure (e.g., pipelines), a well pad, or a well.

At 91 dBA (at 50 feet), construction noise levels would attenuate to 71 dBA (at 500 feet), 61 dBA (at 1,500 feet), 57 dBA (at 0.5 miles), and 51 dBA (at 1 mile). Beyond half a mile, any elevated noise levels would likely be faint or not detected as the local topography would substantially lower noise levels to below the noise level estimates. Heavy trucks would typically have noise levels between 74 dBA and 85 dBA at 50 feet (FHWA, 2006). Therefore, heavy trucks could generate noise levels ranging from 54 dBA to 65 dBA at 500 feet.

Project-related sound levels would be expected to dissipate to background levels before reaching most publicly accessible areas. The closest residential communities are located over a mile from the closest project boundary and therefore would not detect project-related noise except for small increases in vehicular traffic on SR-4, SR-502, and other major highways serving the LANL region. As the Bandelier National Monument (Tsankawi unit) is located approximately 0.5 miles from the eastern most boundary of the project area and abutting SR-4, it is expected that project-related noise would not be detected or would not be discernable over existing traffic noise on SR-4 at this location.

Adverse noise impacts would be minimized to the extent possible by using standard noise controls on equipment (e.g., mufflers) and implementing additional noise control measures, such as project scheduling (e.g., scheduling construction activities outside of the breeding season of the Mexican spotted owl, as outlined in the Threatened and Endangered Species Habitat Management Plan; see Section 3.6, *Ecological Resources*). Personal protective equipment would be used per Occupational Safety and Health Administration (OSHA) regulations to protect on-site personnel. As such, adverse noise impacts would be minor under Option 1.

Option 2 – Mass Removal with Land Application

Option 2 would involve all activities as discussed under Option 1; therefore, noise impacts as discussed under Option 1 would also be applicable under Option 2. Option 2 includes the additional use of land application and evaporation of treated water as a disposition method. One of the land application methods proposed is the use of 3,000- to 10,000-gallon water trucks with high-pressure sprayers. Trucks would only operate during daylight hours and could be active up to 10 hours per day, for approximately 8 months during the year, as restricted by the NMED DP.

Elevated noise levels would be limited to the immediate area surrounding the truck and potential adverse impacts would be limited to personnel and wildlife. Personnel would be required to adhere to OSHA regulations regarding the use of personal protective equipment for the safety of workers. For the protection of wildlife, observance of activity restrictions as outlined in the Threatened and Endangered Species Habitat Management Plan would be observed as discussed in Section 3.6, *Ecological Resources*. As such, adverse noise impacts would remain minor under Option 2.

Option 3 – Mass Removal via In-Situ Treatment

Option 3 would potentially involve all activities as discussed under Options 1 and 2; therefore, noise impacts as discussed under Options 1 and 2 would also be applicable under Option 3. Additionally, Option 3 includes the use of in-situ treatment for the contaminated groundwater. The in-situ treatment is not expected to generate any additional noise levels except for a limited amount of increase in vehicular traffic from personnel and the transport of equipment or supplies. As such, adverse noise impacts would remain minor under Option 3.

Option 4 – Monitored Natural Attenuation

Under the MNA option, the proposed new facilities and infrastructure, the amounts of treated water injected into the aquifer and applied to the land, and the duration of land application have the potential to be the same as other options; therefore, noise impacts as discussed under Options 1, 2, and 3 would also be applicable under Option 4. Increases in traffic related to routine well-monitoring activities would be very small. As such, overall noise impacts would remain minor under Option 4.

3.11.2.2 Cumulative Impacts

As previously described, due to the topography of the region, and the general decrease in noise with distance from the source, increases in noise levels would remain near the source and impacts to off-site receptors would be small. Because noise impacts would be small, they would not substantially contribute to cumulative impacts on off-site receptors.

3.12 VISUAL RESOURCES

Visual resources are natural and manmade features that provide character and aesthetic quality to a landscape, which can contribute to public perception and enjoyment of a given environment. Visual resources can describe the collective effect on a viewer of natural landforms, vegetation, water features, and human modifications (structures, infrastructure, and cultural landscape features).

3.12.1 VISUAL RESOURCES – AFFECTED ENVIRONMENT

Much of the development within LANL has occurred out of public view and on mesa tops (DOE, 2015; LANL, 2023a). Much of LANL remains undeveloped as grasslands, shrublands, woodlands, and forests. The most visible developments at LANL include a limited number of tall structures; facilities at relatively high, exposed locations; or facilities beside publicly accessible and well-travelled roads. The eight-story National Security Sciences Building is visible from most locations in Los Alamos (DOE, 2015; DOE, 2011).

Areas with line of sight to LANL land and facilities include the towns of Los Alamos and White Rock, the Pueblo of San Ildefonso, Bandelier National Monument (including the Tsankawi section), the Santa Fe National Forest, and the Valles Caldera National Preserve. At night, the lights of LANL, Los Alamos, and White Rock can be directly visible from various locations across the viewshed and as far away as the towns of Española and Santa Fe (DOE, 2022a).

Over the last several years, light pollution from LANL has become more noticeable in a region where dark skies are noted as a draw for tourism. In 2021, Valles Caldera National Preserve received an International Dark Sky Park Certification and Bandelier National Monument has applied for this certification. An International Dark Sky Park is a land area possessing an exceptional or distinguished quality of starry nights and a nocturnal environment specifically protected for its scientific, natural, educational, cultural heritage, and/or public enjoyment. However, this certification does not carry any legal or regulatory authority (International Dark Sky, 2023; PEEC, 2023).

The Cerro Grande fire of 2000 burned approximately 9,000 acres and 100 buildings on LANL but virtually all portions of the Laboratory were affected(LANL, 2002). Prior to the Cerro Grande Fire, the view of most LANL property from many stretches of area roadways and other viewsheds was woodlands and low brushy areas. Although the visual environment remains diverse and panoramic, portions of the visual landscape affected by the fire are stark, with burn scars still noticeable in many places and rock layers underlying burned forest areas visible. Grasses and shrubs are slowly replacing forest stands, thus contributing to the visual contrast between the burned and unburned areas for many years to come (DOE, 2011).

The project area includes TA-05, located in the north-central area of LANL. The footprint of TA-05 encompasses both mesa tops and a large, open area in the bottom of Mortandad Canyon. TA-05 was established in the 1940s as a research-scale test-firing site but has remained largely undeveloped to the present day. The overall visual character of the project area is mixed, with large portions of the Mortandad Canyon rim and slopes undeveloped, with vegetation consisting of juniper savannas, piñon juniper woodlands, and grasslands (see Section 3.6, *Ecological Resources*, for a more detailed description of vegetation and flora at LANL and in the project area) (DOE, 2015). The only substantial physical assets within TA-05 are the Eastern TA Substation Complex and a variety of other utility infrastructure, including those associated with the interim measure, including groundwater wells, overhead electrical lines, water lines, water treatment and equipment storage buildings, and roads that generally run west to east with the topography (LANL, 2022a). Within Sandia Canyon, the most prominent feature in the viewshed is East Jemez Road to the north (DOE, 2015).

3.12.2 Visual Resources – Environmental Consequences

3.12.2.1 Proposed Action (Adaptive Site Management)

Option 1 – Mass Removal via Expanded Treatment

Under Option 1, there would be little to no substantial dominant visual change in Mortandad Canyon or Sandia Canyon as observed from outside vantage points, no substantial change in visibility caused by predicted air pollutant emissions (impacts to air quality are discussed in Section 3.5.2.1, *Proposed Action (Adaptive Site Management)*), no conflict with Federal land management agency visual standards, and no long-term dominant visual interruption of existing or unique viewsheds. Direct visual observation in the project area is locally limited to portions of Los Alamos to the north and the Pueblo of San Ildefonso to the east, where a small portion of the Mortandad Canyon is visible.

Construction activities associated with Option 1 could potentially affect scenic views and visibility from the visual intrusion of vehicles, equipment, workers, vegetation clearing, and new infrastructure. However, these impacts would be temporary and limited to the two-year window estimated for the construction of the treatment facility and monitoring, extraction, and injection wells.

As discussed in Section 3.5.2.1, *Proposed Action (Adaptive Site Management)*, air emissions associated with Option 1 have the potential to affect the Tsankawi section of Bandelier National Monument. However, implementation of BMPs and mitigation measures identified in that section would ensure that air quality-related values would be negligibly affected within the Monument.

Although construction activities would be conducted 24 hours a day, few impacts are expected from light pollution, as light sources would be small, localized, and downward pointing. The treatment facility would operate during nighttime, but exterior lighting of the facility would be expected to comply with LANL Master Specifications, STD-342-200, Section 26 5600, *Exterior Lighting*, which indicates that each exterior lighting unit exceeding 6,400 lumens[8] would comply with the New Mexico Night Sky Protection Act and no light would be emitted above a horizontal plane through the lowest light-emitting part of the unit.

Option 2, 3, and 4

Impacts to visual resources during construction and operation would be nearly identical to those described under Option 1. Land application of treated water would occur in permitted areas encompassing about 50 acres of land. The areas for land application under Option 2 are the same as those currently available for this activity under the interim measure. As with Option 1, the implementation of BMPs and mitigation measures under Options 2 and 3, and would ensure that less than significant impacts to visual resources would result from the Proposed Action.

3.12.2.2 Cumulative Impacts

As previously described, impacts on visual resources from the Proposed Action would be small. Because impacts would be small, they would not substantially contribute to cumulative impacts on visual resources.

3.13 HUMAN HEALTH AND WORKER SAFETY

3.13.1 Human Health and Worker Safety – Affected Environment

3.13.1.1 Human Health

For this EA, the topic of human health encompasses the baseline health condition of area residents, workers, and uninvolved workers who could be negatively or positively affected by implementation of a project.

The nature of some LANL activities present potential human health risks that are avoided or mitigated though operational controls and verified through monitoring. Health risks can be caused through exposure to chemicals or radionuclides (through ingestion, respiration, or skin contact) or from direct physical harm. The LANL 2021 *Annual Site Environmental Report* (LANL, 2022b) and 2021 SWEIS Yearbook (LANL, 2023a) gives descriptions of the public health baseline, radionuclides, and chemicals in the environment surrounding LANL. Annual air, water, soil, and

[8] For comparison, a standard 60-watt incandescent light bulb produces about 800 lumens of light.

biota monitoring data indicate public exposures to LANL emissions are maintained at or below permitted or recommended levels and protect public health and welfare.

The project area is located in an access-controlled portion of LANL. The nearest residential areas are two neighborhoods of the Los Alamos townsite, each about 2 miles to the northwest of the project area, and within White Rock, about 3 miles to the southeast. The nearest publicly accessible locations to the project area are along East Jemez Road, approximately 0.2 miles to the north, and along the boundary between the Pueblo de San Ildefonso and LANL, about 250 feet south of monitoring well R-13 (Figure 3-1). DOE recognizes that the area immediately south of the boundary between the Pueblo de San Ildefonso and LANL near the project area is actively used by members of the Pueblo year-round.

The regional aquifer is the primary source of drinking water for Los Alamos County residents. Water supplied by the LADPU meets all Federal and state drinking water standards. Chromium in public water supply wells is monitored by LANL and LADPU (see Section 3.4.1, *Water Resources – Affected Environment*).

3.13.1.2 Worker Safety

Operations at LANL are required to comply with the DOE requirements for worker health and safety. DOE environmental, safety, and health programs regulate the work environment and seek to minimize the likelihood of work-related exposures, illnesses, and injuries. These programs are controlled by the safety and health regulations for DOE contractor workers governed by 10 CFR 851, which establishes requirements for worker safety and health programs to ensure that DOE contractor workers have a safe work environment. Provisions are included to protect against occupational injuries and illnesses, accidents, and hazardous chemicals.

For the 12-month period ending January 2022, LANL recorded a total recordable case (TRC) rate of 1.65, and days away, restricted, or transferred (DART) rate of 0.51 per 200,000 hours worked (DOE, 2023). These rates compare favorably with 2022 Federal rates (TRC 1.05, DART 0.77) (DOE, 2023) and New Mexico rates (TRC 2.8, DART 1.4) (U.S. Bureau of Labor Statistics, 2023).

3.13.2 Human Health and Worker Safety – Environmental Consequences

3.13.2.1 Proposed Action (Adaptive Site Management)

Human Health

Under the ASM implementing options, project activities would not involve direct hazards to the public. The regional aquifer is the primary source of drinking water for Los Alamos County residents. Water supplied by the LADPU meets all Federal and state drinking water standards. Chromium in public water supply wells is monitored by LANL and LADPU (see Section 3.4.1, *Water Resources – Affected Environment*). While low concentrations (4 to 10 µg/L) of Cr(VI) due to natural conditions are detected in many of the wells screened in the regional aquifer, there is no indication that this plume has affected water supply wells. Access to the Mortandad Canyon portion of the project area is restricted and not readily accessible to the public. Sandia Canyon, while not fenced from East Jemez Road, is posted as "no trespassing." Noise-generating activities and fugitive dust would be unlikely to affect members of the public at the nearest publicly accessible points. Land application of treated water would be in accordance with an NMED DP and would not pose inhalation risks to members of the public. The hexavalent chrome, when removed from groundwater, would be disposed of in accordance with state and Federal regulations. Extracted and treated groundwater to be used for injection, land spreading, or mechanical evaporation would meet all state and Federal regulatory permits. Introduction of any compounds into the aquifer as part of in-situ treatment would be implemented under approved permits from NMED.

The level of exposure to hazards, the regulatory requirements for managing those hazards, and existing exposures are not anticipated to change. Therefore, the direct, indirect, and cumulative impacts from exposure to normal industrial hazards would be small. Effects on human health would be negligible.

Worker Safety

Activities planned under the Proposed Action would not be expected to have any adverse health effects on workers. Under the ASM implementing options, various heavy equipment would be used for well installation: front end loader, bulldozer, grader, dump truck, drill rig, and forklift. Pipeline installation would require an excavator or trencher, loader, and dump trucks. Electrical installation would require an auger and a line truck. Road maintenance would require a grader. Water trucks would be used to land-apply water. A forklift would also be used occasionally for moving supplies.

Primarily support and maintenance contractors would be involved in site clearing, earth moving, heavy-equipment operations, access road maintenance, well drilling, electrical installation, and land-application activities. LANL employees would serve mostly in oversight roles. Approximately 120 workers would be involved during periods of peak activity. Applicable safety and health training and monitoring, personal protective equipment (e.g., steel-toed boots, hardhats, hearing protection), and work-site hazard controls would be required for workers.

Potentially serious exposures to various hazards or injuries are possible during the infrastructure development activities. Hazards include direct injury; noise; heat stress; slips, trips and falls; and rattlesnake bites. Effects could range from relatively minor events (such as cuts or sprains) to major injuries (such as broken bones or fatalities). To minimize the potential of serious injuries, workers would be required to adhere to a health and safety plan while performing project activities. Adherence to an approved plan, use of personal protective equipment and engineered controls, and completion of appropriate hazards training would be expected to help prevent adverse acute or chronic health effects to workers.

Adverse health effects associated with Cr(VI) exposure include occupational asthma, eye irritation and damage, perforated eardrums, respiratory irritation, kidney damage, liver damage, pulmonary congestion and edema, upper abdominal pain, nose irritation and damage, respiratory cancer, skin irritation, and erosion and discoloration of the teeth. Some workers can also develop an allergic skin reaction, called allergic contact dermatitis. This reaction occurs from handling liquids or solids containing Cr(VI). However, workers are unlikely to contact or be exposed to chromium contaminated groundwater because extracted groundwater in pumped through pipes to the treatment facility through pipes where it treated by ion exchange. There is a potential for exposure to Cr(VI) chromium contaminated groundwater during well drilling, operational maintenance, and during changeout of ion exchange vessels.

Per 10 CFR 851 (2012), employee exposures to hazardous agents are maintained below the American Conference of Governmental Industrial Hygienists threshold limit values, the OSHA permissible exposure limits, and other applicable standards as defined by DOE.

Standard industrial hazards are hazards that are routinely encountered in general industry and construction; for these hazards national consensus codes and standards, such as OSHA standards and DOE-prescribed occupational safety and health standards, guide project activities.

The level of exposure to industrial hazards, the regulatory requirements for managing those hazards, and existing exposures are not anticipated to change. Therefore, the direct and indirect impacts from exposure to normal industrial hazards would be small.

3.13.2.2 Cumulative Impacts

As previously described, impacts on human health and worker safety from the Proposed Action would be small. Because impacts would be small, they would not substantially contribute to cumulative impacts on human health and worker safety.

3.14 SOCIOECONOMICS

Industrial projects have the potential to affect the socioeconomic dynamics of the communities in or around which they are situated. Capital expenditures and the migration of workers and their families into a community may influence factors such as regional income; employment levels; local tax revenue; housing availability; and area community services such as healthcare, schools, and law enforcement (police and fire). The Proposed Action includes the implementation of optional measures to remediate the Cr(VI) contaminated groundwater below Sandia and Mortandad Canyons.

3.14.1 SOCIOECONOMICS – AFFECTED ENVIRONMENT

This EA focuses primarily on population, employment and unemployment, as well as income and housing data, where the potential for adverse impact from an in-migrating population (workers and their families) would be greatest. Specifically, summary data are evaluated for the socioeconomic ROI, which is defined for this analysis as a four-county region encompassing the Los Alamos County (host county for LANL) and immediately adjacent counties (Rio Arriba, Sandoval, Santa Fe Counties) in New Mexico, where the majority of workers for proposed chromium plume remediations would be expected to reside and spend most of their salary. This is also where the majority of the current LANL workforce resides. Detailed county and subject-specific data tables are provided in Appendix C, *Environmental Resources Supporting Information*. Summary data for 2021 (LANL, 2023a; USCB, 2023a; USCB, 2023b; USCB, 2023c; USCB, 2023d) for the ROI are included in Table 3-7:

Table 3-7. Region of influence summary data for select socioeconomic conditions

Parameter	Los Alamos	ROI	New Mexico
Population			
2022	19,187	368,400	2,113,344
2021	19,169	360,475	2,109,366
2020	19,419	363,439	2,117,522
2010	17,950	333,027	2,059,179
Housing			

Parameter	Los Alamos	ROI	New Mexico
Total units	8,593	161,833	937,397
Occupied	8.029	140,745	297,596
Vacant	564	21,088	139,801
Vacancy rate	6.6% 0.9% vacancy rate for owner occupied units 1.7% rental vacancy rate	13% 1.1% vacancy rate for owner occupied units 5.5% rental vacancy rate	14.9% 1.5% vacancy rate for owner occupied units 7.3% rental vacancy rate
Median value	$343,100	$179,800 (lowest value in Rio Arriba County)	$184,800
Income			
Median Household income	$123,677	$46,994 (lowest value in Rio Arriba County)	$54,020
Per capita income	$64,521	$25,342 (lowest value in Rio Arriba County)	$29,624
Employment			
Civilian labor force	10,599	171,734	952,564
Employed	10,269	161,591	889,428
Unemployed	330	10,143	63,136
Unemployment rate	3.1%	5.9%	6.6%
LANL employees (laboratory, contractor, guard force): 15,707 (as of 9/30/2022)	5,225 (37%) [5,187 (Triad + N3B CY 2021 from SWEIS 2021 Yearbook)]	Rio Arriba: 2,175 (15.5%) [2,191 CY 2021] Sandoval: 580 (4.1%) Santa Fe: 3,460 (24.6%) [3,239 CY 2021]	Other NM: 1,558 Outside NM: 1,056

Sources: (LANL, 2023f; LANL, 2023e; USCB, 2023a; USCB, 2023b; USCB, 2023c; USCB, 2023d)
Key: % = percent; CY = calendar year; LANL = Los Alamos National Laboratory; N3B = Newport News Nuclear BWXT Los Alamos; NM = New Mexico; ROI = region of influence; SWEIS = Site-wide Environmental Impact Statement

LANL benefits New Mexico by creating jobs, generating income, and purchasing goods and services from local businesses. Local DOE activities directly and indirectly account for more than a third of employment, wage and salary income, and business activity in the region. Based on a 3-year study, LANL expended an average of $752.6 million on procurement of goods, services, and construction within the ROI, New Mexico, and out of state. Just over one-half of those purchases were from New Mexico-based businesses (UNM, 2019). Expenditures by LANL and its full-time equivalents generated $1.65 billion in sales for businesses within the ROI.

As of 2018, LANL had a total direct labor income of $1.34 billion. Indirectly, LANL supported 19,122 jobs and those jobs equal $1.57 billion in labor income to the State of New Mexico (UNM, 2019). An update to the 2019 Economic Report identified the annual salary at LANL at 1.53 billion ($689,636,978 in Los Alamos County) and the Laboratory spent $915,988,873 on procurement in New Mexico (LANL, 2023e).

3.14.2 Socioeconomics – Environmental Consequences

The trigger for adverse socioeconomic impacts is the need to relocate construction and operations workers, and their families, into local communities. The severity of socioeconomic impacts is proportional to the level of stress placed on housing and community services (i.e., educational services, police, fire, and health services) by the relocated workers and their families. In addition, the increases in jobs and income from construction and operation of the proposed facilities would have both direct and indirect impacts on the local and regional economy. To the extent these increases would help reduce existing unemployment levels and boost the economy through increased income and revenue, they are considered to be beneficial.

The estimated workforce for each of the ASM options and the No Action Alternative are detailed in Appendix B, *Description of Alternatives Supporting Information*, Table B-1. The total peak workforce is anticipated to be 75 workers for the No Action Alternative and 120 workers for ASM options. The number of total workers who would migrate into the area (associated with drilling crews) would include 24 and 36 for construction and operations, respectively, for each ASM option and 16 and 24 construction and operation personnel, respectively, under the No Action Alternative. Indirect jobs created as a result of the Proposed Action would be small (a maximum of 100, based on a multiplier of 1.06 used in the 2008 SWEIS) and are assumed to be local hires within the ROI, resulting in no population influx.

For construction and operation of the new treatment facility, it is assumed that the same employees counted in the drilling crews also would construct the facility, and that operation of the facility would be conducted by existing contractor staff. Based on the short-term nature of the work, it is unlikely that the drilling crews would bring their families with them. However, the analysis assumes they would bring their families in order to provide a more conservative bounding scenario. In some cases, the same worker may stay on to drill subsequent wells on-site during the course of the project. It is estimated that 50 to 75 (all ASM options) of these employees (and their families), or 81.1 percent, would live within the ROI based on existing residence rates.

3.14.2.1 Proposed Action (Adaptive Site Management)

The direct workforce requirements for the ASM options would be very small and comprise <0.1 percent of the existing workforce in the region (0.02 percent). Similarly, the total population influx from implementing any of the ASM options would comprise <0.1 percent of the total population in the region (0.02 percent). Each would represent approximately 0.3 percent and 0.5 percent of the existing workforce and total population, respectively, in Los Alamos County (host county), if all were to relocate there. For comparison, only 25 percent of the LANL employees currently reside in Los Alamos County. Furthermore, due to the temporary nature of the well drilling work, the majority (if not all) of the in-migrating workforce would be expected to find temporary (i.e., rental) housing and not purchase a new home.

Potential adverse impacts from the Proposed Action options would be expected to be small on the housing market and community services within the ROI because the expected worker and population influx is expected to be very small. With respect to housing, a 2019 study on the Los Alamos County housing market needs identified a housing shortage for both rental homes and available homes for sale. However, it also identified housing projects in the development pipeline, including development on properties that the county has released to developers for affordable rental housing and market rate single family and rental housing (LAC, 2019). In addition, not all in-migrating workers would necessarily settle in Los Alamos County, but rather would be expected to distribute throughout the ROI (as only 25 percent of the existing LANL workforce currently reside in Los Alamos County), and there are a large number of vacant units within the ROI. Finally, temporary accommodation (e.g., hotels, motels, and mobile home parks) also could help supplement the available housing vacancies if needed.

The small increase in employment (direct and indirect jobs) from both construction and operation would be expected to result in small and beneficial impacts on the local economy and ROI from the increase in jobs, income and salaries, as well as expenditures and revenue from state and local taxes. The extent of beneficial impacts would depend on the number of jobs created and where the new workers choose to reside within the ROI (e.g., distributed evenly or targeting one county).

3.14.2.2 Cumulative Impacts

As previously described, the expected population influx associated with the ASM options would be small and no adverse effects have been identified. Because impacts would be small, they would not substantially contribute to cumulative impacts on socioeconomics. Potential beneficial economic impacts from the creation of new jobs would be small but would further support LANL's already significant role in supporting the local and regional economies.

3.15 ENVIRONMENTAL JUSTICE

Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The background and affected environment information in this section summarizes information and supporting data tables found in Appendix C, *Environmental Resources Supporting Information*, Section C.6.

3.15.1 ENVIRONMENTAL JUSTICE – AFFECTED ENVIRONMENT

The proposed ROI for environmental justice in this EA is a 5-mile radius surrounding the project area; this is a conservative approach that includes an area slightly larger than the defined project area (e.g., used analysis of groundwater and health and safety impacts) to ensure full capture of nearby populated areas and Tribal lands areas (see Appendix C, *Environmental Resources Supporting Information*, Section C.6, for additional information regarding the ROI). The ROI lies within a part of Los Alamos County (primarily within LANL site boundary), and very small portions of Rio Arriba, Santa Fe, and Sandoval Counties, New Mexico. The small portion of Sandoval County has no population found there. The analysis of minority and low-income populations focuses on U.S. Census Bureau (USCB) data for geographic units (i.e., block groups) that represent, as closely as possible, the potentially affected areas. Table 3-8 shows the minority and low-income composition of the potentially affected area surrounding the chromium plume.

Table 3-8. Communities within 5 miles of groundwater plume, Los Alamos National Laboratory, New Mexico

Area Name	Total Population 7/1/22	Minority	% Minority	Population for Whom Poverty is Determined 2021 [past 12 months]	Low-Income Population	% Low Income
New Mexico	2,109,366	1,349,449	64.3%	2,067,620	378,896	18.3%
Los Alamos County, New Mexico [includes Census tracts 1-4]	19,169	5,608	29.2%	19,092	802	4.2%

Area Name		Total Population 7/1/22	Minority	% Minority	Population for Whom Poverty is Determined 2021 [past 12 months]	Low-Income Population	% Low Income
Sandoval County [Census tract 9403]		147,327	85,519	58%	148,075	15,023	10.3%
Santa Fe County, New Mexico [census tracts 102.04, 109, 9403]		153,632	88,666	57.7%	151,070	18,515	12.3%
Rio Arriba County, New Mexico [census tract 9408]		40,347	35,580	88.2%	40,137	8,951	22.3%
Block Group by Tract		**Total Population**	**Minority**	**% Minority**	**Population for Whom Poverty is Determined**	**Low-Income Population**	**% Low Income**
Census Tract 4	Block Group 2	1083	601	55.5%	1,083	86	7.9%
Census Tract 9403*	Block Group 1	822	743	90%	812	165	20.3%
Census Tract 9408	Block Group 3	1,427	1400	98%	1,422	311	21.9%

Source: (USCB, 2023)
Key: % = percent; NM = New Mexico; ROI = region of influence
Note: *Found in Santa Fe County; note that no population is found in the portion of Sandoval County that contains part of Census Tract 9403.

Minority populations were evaluated using the Fifty Percent analyses for potentially affected block groups within the ROI, which offers a more conservative approach (i.e., results in larger numbers) in identifying minority populations given the already high percentage of minorities in the reference community (i.e., state of New Mexico), at 64.3 percent. If a block group’s percentage of minority individuals was >50 percent of the total population, then the block group was identified as having a minority population. This is consistent with the method used in the SWEIS (DOE, 2008).According to 2021 census data, approximately 8,030 individuals out of 23,283, residing within the 5-mile radius of the plume were identified as minority population, which represents approximately 34 percent of the study area population. Based on Census data, three of the 21 block groups within the ROI have a percentage that exceeds the 50 percent threshold for minority populations (Table 3-8).

The total population of New Mexico for whom poverty is determined is 2,067,620, of which 18.3 percent would be considered members of a low-income population. Census block groups were considered low-income block groups if the percentage of the populations living below the Federal poverty threshold exceeded 18.3 percent. Based on Census data, two of the 21 block groups within the ROI have percentages that would meet the threshold for low-income populations (Table 3-8). However, it should be noted that two additional blocks (Census Tract 102.4, Block Group 2, and Census Tract 109, Block Group 2), have percentages that are just under the threshold, at 17.6 and 17.1 percent, respectively. According to 2021 Census data, approximately 1,602 individuals residing within the 5-mile radius of LANL were identified as living below the Federal poverty threshold, which represent approximately 6.9 percent of the study area population.

Detailed minority and low-income population results for each block group within the 5-mile radius is found in Appendix C, *Environmental Resources Supporting Information*, Table C-5. Another useful tool of note to explore the locations of disadvantaged populations (including federally recognized Tribes) within the U.S. is the Climate and Economic Justice screening (https://screeningtool.geoplatform.gov/en/#6.84/36.223/-96.082). To respect Tribal sovereignty and self-government, and to fulfill Federal trust and treaty responsibilities to Tribal Nations, land within the boundaries of federally recognized Tribes are designated as disadvantaged on the map.

The four Accord Tribes (Santa Clara Pueblo, Pueblo de Cochiti, Pueblo of Jemez and Pueblo de San Ildefonso) have individual cooperative agreements that enable the Los Alamos Pueblos Project Tribal program personnel to obtain the training to monitor and sample soil, air, groundwater, and other media, and facilitate development of Pueblo environmental programs to analyze and monitor the impact, if any, of DOE operations to Pueblo lands (EM-LA, 2021).

3.15.2 Environmental Justice – Environmental Consequences

3.15.2.1 Proposed Action (Adaptive Site Management)

Although there are minority and low-income populations located within the ROI, impacts would not be disproportionate and adverse. No affected block groups are located directly within the contaminated plume boundary, although Census Tract 9403 is located directly east and south of the plume, both on Pueblo de San Ildefonso Tribal lands. With the implementation of best management practices, potential impacts from all proposed ASM options are expected to be minor (to no impacts). In particular, there would be no direct health and safety impacts on the surrounding public, as described in Section 3.13.2, *Human Health and Worker Safety – Environmental Consequences*. Therefore, no adverse impacts would be anticipated to nearby minority and low-income populations, including the Pueblo.

It should be noted that consultation with the Tribes for this proposal is ongoing, and cultural resources in the APE within the Pueblo de San Ildefonso, as well as the Tribal cultural resources concerns for the chromium plume area have yet to be identified. While some cultural impacts would be expected to disproportionately affect members of the Pueblo de San Ildefonso (e.g., generation of noise and artificial lighting during infrastructure development, presence of nearby work on traditional hunting activities, visual impacts to viewshed over the Sacred Area from Tribal lands), addressing such impacts through regular consultation with the Pueblo people to address and mitigate these impacts, including avoiding to the maximum extent possibly any potentially impacted resources, would help limit the impacts, as discussed in Section 3.7, *Cultural Resources*.

Furthermore, as previously described and in Appendix C, *Environmental Resources Supporting Information*, Section C.6, DOE maintains cooperative agreements with four Pueblos to develop and maintain groundwater monitoring programs, among other media, including the development of Pueblo environmental programs to analyze and monitor the potential impact of DOE operations to Pueblo lands. EM-LA also provides numerous educational and training briefings to Pueblo members to enhance awareness of ongoing efforts regarding remediation and reduction of legacy waste and continues to pursue additional opportunities to inform, train, and educate these disadvantaged communities regarding ongoing cleanup projects in and around LANL (EM-LA, 2021).

EM-LA has reached out to the four Accord Pueblos as part of the NEPA process for this EA, including an offer for in-person consultation and an in-person meeting with Pueblo de San Ildefonso, as the project ROI extends onto their lands (Chandler, 2023). In addition, Pueblo site-specific training has been held with EM-LA and contractor staff to enhance cultural awareness and strengthen the DOE consultation capacity (see Appendix C.6 for recent Tribal outreach efforts).

3.15.2.2 Cumulative Impacts

Implementation of the ASM options would not result in adverse impacts in the resource areas of concern for minority and low-income population, especially health and safety. In addition, the Proposed Action would not have lasting or irreversible adverse effects. Therefore, the Proposed Action would not contribute to potential cumulative impacts on minority and low-income populations when combined with past, present, and reasonably foreseeable actions occurring at LANL.

Potential long-term impacts relating to changing climate conditions could disproportionately affect environmental justice communities located near LANL, as described in Section 3.5, *Air Quality*. These include potential negative impacts on subsistence farming, which occurs in the neighboring Pueblos, and potential displacement from increased flooding to communities located within canyons. Implementation of DOE's 2021 Climate Adaptation and Resilience Plan, which requires coordination, information sharing, engagement opportunities and necessary resource provisions (where identified), would mitigate climate change impacts to environmental justice communities near LANL from activities associated with the Proposed Action.

3.16 CONCLUSION

Table 3-9 lists a summary of the anticipated environmental impacts from the No Action Alternative and the Proposed Action. Implementing the Proposed Action would not result in any significant adverse impacts. In addition, these impacts, in conjunction with other past, present, and reasonably foreseeable future actions, would not result in discernible cumulative impacts.

Table 3-9. Summary of environmental impacts for the No Action Alternative and the Proposed Action

Resource Area	No Action Alternative [(a)]	Proposed Action
Land Use	Activities would take place within the LANL boundary in an area of active groundwater investigation; activities would be compatible with existing land uses.	Activities would take place within the LANL boundary in an area of active groundwater investigation; activities would be compatible with existing land uses.
Geology and soils	Installation and operation of extraction and injection wells would have minimal to negligible effects to geology. Small effects to soil profiles would occur from soil disturbance associated with grading.	Installation and operation of wells would have little to no impacts on geology. Some soil erosion by wind and stormwater would likely occur in disturbed areas. Soil erosion would be controlled by adherence to BMPs and would be minor.
Groundwater	Nearby Los Alamos County water-supply wells draw water from the regional aquifer. Pumping from proposed extraction wells would result in temporary increases in drawdown of up to 6.4 feet at county wells in the Pajarito Mesa wellfield. This drawdown would likely not affect	Well construction would have minor impacts on water quality and minor temporary impacts on water levels. Operating extraction wells would alter the groundwater quality by reducing the chromium concentration in the well's vicinity. Similarly, injection wells would alter the groundwater quality by

Resource Area	No Action Alternative [a]	Proposed Action
	the economic or physical characteristics of the wells. Water injected into the aquifer through injection wells, land-applied, or evaporated would meet NMED Ground Water Quality Bureau permit standards; activities would not increase the flow of contaminants into groundwater.	injecting treated water. The intent overall is to return the majority of extracted water back into the regional aquifer. Water injected into the aquifer through injection wells, land-applied, or evaporated would meet NMED Ground Water Quality Bureau permit standards. The Proposed Action would have positive environmental consequences from chromium mass reduction.
Surface water	Stormwater runoff from activities would be controlled through best management practices; effects on surface-water quality or quantity would be minimal.	Soil disturbance resulting from infrastructure development, operation, and maintenance activities could result in sedimentation to surface waters. With anticipated soil disturbance totaling 75 acres and implementation of BMPs, potential environmental consequences to surface waters are expected to be minor.
Air quality	Activities would produce criteria-pollutant, hazardous air-pollutant, and/or greenhouse-gas emissions from earth-moving activities (dust), use of equipment (exhaust), and operation of mechanical evaporators (particulate matter). Effects on air quality would be small to negligible.	The Proposed Action would result in air emissions of criteria pollutants, hazardous air pollutants, and greenhouse gas emissions from road construction, installation of well pads, well development, pipeline installation, and construction of the treatment facility. The intermittent nature of operational emissions and emissions from installation activities, in combination with air quality mitigation measures, would not contribute to an exceedance of an ambient air quality standard at locations outside the LANL site. Impacts to air quality would be minimal.
Ecological resources	A portion of the activity area lies within buffer habitat for the Mexican spotted owl. Potential effects to the Mexican spotted owl from direct disturbance, noise, or treated-water disposition would be avoided through annual biological surveys to ensure the project area is not occupied or nest locations are farther than 1,300 feet from project activities and restricting activities, such as land application within the buffer area, from March 1 to August 31. Activities are not likely to affect the Mexican spotted owl, migratory birds, other sensitive species, or floodplain/riparian habitat.	Impacts to ecological resources from could include temporary and permanent disturbances; degradation or loss of habitat from land clearing activities; disturbance or displacement of wildlife due to an increase in noise and human activity; habitat fragmentation; and an increase in human-wildlife interactions. The Proposed Action would follow all BMPs, monitoring plans and measures related to ecological resources established for LANL. Implementing the Proposed Action with identified controls would not result in significant impacts to these species or resources.
Cultural resources	Historic properties would be avoided during activities, including construction,	Historic properties would be avoided to the maximum extent possible during

Resource Area	No Action Alternative [a]	Proposed Action
	maintenance, and land application of treated water. Road improvements would be used to minimize the risk of impacts to archaeological sites from road use and maintenance. Stormwater runoff control measures would be employed to minimize erosion.	Proposed Action activities. Erosion control measures would be incorporated to limit direct and indirect impacts to archaeological sites from stormwater runoff or erosion. Regular consultation with Pueblos de San Ildefonso would be implemented to discuss how to best limit impact. No significant impacts to archaeological or historic properties would be anticipated.
Utilities and infrastructure	Electricity to operate project infrastructure would be supplied from existing power lines; impacts to electrical infrastructure would be small. The potable water supply and existing water-supply infrastructure would accommodate project use; effects on water infrastructure would be negligible. Unpaved access roads to new well pads would be constructed and measures would be taken to construct and/or maintain roads in a manner protective of archaeological sites; effects on road infrastructure would be small.	The proposed chromium treatment facility would require a connection to the existing LANL electrical system. No new electrical lines would be required for connection. The potable water supply and existing water-supply infrastructure would accommodate project use. Impacts to electrical and water infrastructure would be minor. The project area is largely in a less frequently travelled area of LANL. Other than construction of new access roads, activities would not affect road infrastructure, and overall effects on the road infrastructure at LANL would be minimal.
Traffic and transportation	Only small amounts of traffic would be generated by the No Action Alternative activities; effects on traffic would be negligible.	The Proposed Action would increase the number of personal commuter vehicles and number of truck deliveries for the construction of the groundwater treatment facility, well pads, wells, and piezometers. Routine daily traffic volumes would be expected to decrease after construction of the proposed groundwater treatment facility is completed. Proposed traffic improvements (a new Pajarito Road roundabout and widening of Diamond Drive) would help alleviate congestion and traffic safety issues on Pajarito Road. As such, adverse traffic impacts are expected to be minor.
Hazardous materials and waste generation	Small quantities of construction debris, approximately 30 gal per year of hazardous waste, and approximately 50,000 gal of treated water annually from maintenance at each injection well would be generated. All waste would be handled in accordance with LANL's waste management procedures. Impacts to on-site waste operations or off-site disposal facilities would be	Small quantities of industrial (i.e., construction debris) and hazardous wastes would be generated. Waste would be handled in accordance with LANL's waste management procedures. The waste quantities generated would be minimal, thus impacts to on-site waste operations or off-site disposal facilities are anticipated to be small.

Resource Area	No Action Alternative [(a)]	Proposed Action
	small.	
Noise	Heavy equipment would be used during some project activities; noise generated would be confined to locations near the project area and effects would be small.	The Proposed Action would generate noise from construction activities and from the use of equipment, machinery, and vehicles, which could affect noise-sensitive receptors. Elevated noise levels would generally be limited to the immediate area of the noise source and are expected to dissipate before reaching publicly accessible areas. Any adverse noise impacts would generally be minor.
Visual resources	There would be no substantial dominant visual change as observed at sensitive viewer locations, no substantial change in visibility caused by predicted air pollutant emissions, no conflict with visual standards identified by a Federal land management agency, and no long-term dominant visual interruption of unique viewsheds; impacts to visual resources would be small.	There would be little to no substantial dominant visual change in Mortandad Canyon or Sandia Canyon as observed from outside vantage points, no substantial change in visibility caused by predicted air pollutant emissions, no conflict with Federal land management agency visual standards, and no long-term dominant visual interruption of existing or unique viewsheds.
Human health and worker safety	Access to the project area is restricted and noise generating activities and air emissions would be unlikely to affect members of the public at the nearest publicly accessible points. Effects on human health would be negligible. Applicable safety and health training and monitoring, personal protective equipment, and work-site hazard controls would be required for workers; activities would not be expected to have any adverse health effects on workers.	The Proposed Action would not involve direct hazards to the public. Chromium in public water supply wells is monitored by LANL and the LADPU, and there is no indication that the chromium plume has affected water supply wells. Access to the project area is restricted and noise-generating activities and air emissions would be unlikely to affect members of the public at the nearest publicly accessible points. Effects on human health would be negligible. Applicable safety and health training and monitoring, personal protective equipment, and work-site hazard controls would be required for workers; activities would not be expected to have any adverse health effects on workers.
Socioeconomics	Activities would require approximately 80 full-time-equivalent employees, primarily existing staff and short-term subcontractors; this is within the annual variability of LANL staffing and would have negligible effects on the local economy.	Activities would require approximately 120 full-time workers. The direct workforce requirements would comprise <0.1% of the existing workforce in the region (0.02%). Similarly, the total population would comprise <0.1% of the total population in the region (0.02%). Potential adverse impacts from the Proposed Action options would be expected to be small on the housing market and

Resource Area	No Action Alternative [a]	Proposed Action
		community services within the ROI. The small increase in employment would be expected to result in small and beneficial impacts on the local economy. No adverse effects have been identified
Environmental justice	Representatives of Pueblo de San Ildefonso previously anticipated a direct, adverse impact from the proposed Chromium Plume Control Interim Measure and Plume-Center Characterization Project to Tribally important resources and practices associated with the Sacred Area. However, these representatives also understood that the currently proposed ASM implementing options would offset those concerns by reducing the chromium plume contamination. Because the No Action Alternative would reduce risks to human health and welfare in the region by removing contaminants from the environment and containing the off-site migration of groundwater contamination onto Pueblo de San Ildefonso lands, and has no significant environmental impacts, the No Action Alternative would not result in disproportionate and adverse effects to residents of the Pueblo.	The Proposed Action would not result in disproportionate and adverse impacts for minority and low-income populations. Representatives of Pueblo de San Ildefonso previously anticipated a direct, adverse impact from the proposed Chromium Plume Control Interim Measure and Plume-Center Characterization Project to Tribally important resources and practices associated with the Sacred Area. However, these representatives also understood that the currently proposed ASM implementing options would offset those concerns by reducing the chromium plume contamination.

Key: < = less than; % = percent; ASM = adaptive site management; BMP = best management practice; gal = gallon; LANL = Los Alamos National Laboratory; LADPU = Los Alamos County Department of Public Utilities; NMED = New Mexico Environment Department; ROI = region of influence

Note:

[a] (DOE, 2015)

4.0 REGULATORY COMPLIANCE

This section presents the Federal and state laws and regulations applicable, or potentially applicable, to the Proposed Action and No Action Alternatives.

4.1 FEDERAL LAWS AND REGULATIONS

LANL has several Federal permits for wastewater and storm water discharges applicable to Cr(VI) contamination. These permits fall under the Federal regulations identified.

- LANL Industrial Wastewater Permit NPDES Permit No. NM0028355 – EPA regulates discharges under the referenced NPDES individual permit. However, a state Water Quality Certification is required by the Federal CWA Section 401 to ensure that the action is consistent with New Mexico state law (see the State Laws and Regulations section). The NPDES permit was issued August 12, 2014, modified May 1, 2015; reissued by EPA on March 30, 2022; effective May 1, 2022; and expires April 30, 2027. An EPA permit authorizing LANL to discharge industrial and sanitary liquid effluents through outfalls under specific conditions, including water quality and monitoring requirements. (https://www.epa.gov/nm/los-alamos-national-laboratory-lanl-industrial-wastewater-permit-final-npdes-permit-no-nm0028355)
- 2021 EPA Multi-Sector General Permit for stormwater discharge applies in areas of the country where EPA is the NPDES permitting authority and has made the permit available for coverage. These areas include New Mexico. This permit was issued on February 19, 2021; effective March 1, 2021; modified September 29, 2021; and expires on February 28, 2026. (https://www.epa.gov/sites/default/files/2021-01/documents/2021_msgp_-_permit_parts_1-7.pdf)
- 2010 EPA Individual Permit authorization under the CWA to discharge (from SMUs and areas of concern [AOCs]) under the NPDES Permit No. NM0030759 into receiving waters: Tributaries or main channels of Mortandad Canyon, Canada del Buey, Los Alamos Canyon, DP Canyon, Sandia Canyon, Ten Site Canyon, Canyon de Valle, Water Canyon, Ancho Canyon, Bayo Canyon, Chaquehui Canyon, Fence Canyon, Pajarito Canyon, Twomile Canyon, Threemile Canyon, Potrillo Canyon, Pueblo Canyon, and Rendija Canyon, in Water Body Segment No. 20.6.4.98, 20.6.4.126, 20.6.4.128 or 20.6.4.114 of the Rio Grande Basin. Current permit reissued on August 1, 2022, and set to expire on July 31, 2027. (https://www.epa.gov/system/files/documents/2022-06/NM0030759%20-%20Final%20Permit.pdf)
- U.S. Army Corps of Engineers (USACE) and NMED, Section 404 of the CWA requires LANL to obtain permits from USACE to perform work within perennial, intermittent, or ephemeral watercourses. Section 401 of the CWA requires NMED to certify that Section 404 permits issued by USACE will not prevent attainment of New Mexico-mandated stream standards. NMED reviews Section 404/401 joint permit applications and issues separate Section 401 certification letters, which may include additional permit requirements to meet state stream standards for individual LANL projects. This

nationwide Section 404/401 permit was effective January 4, 2021 and expires January 3, 2026. The specific portion of the permit that is currently applicable is the Mortandad Wetland Enhancement. (https://cdn.lanl.gov/files/document-23_85e7b.pdf)

- LANL Hazardous Waste Permit is issued pursuant to the authority of NMED under the New Mexico Hazardous Waste Act, New Mexico Statutes Annotated (NMSA) 1978, §§ 74-4-1 through 74-4-14, in accordance with the New Mexico Hazardous Waste Management Regulations, 20.4.1 New Mexico Administrative Code (NMAC). Pursuant to the RCRA, 42 U.S.C. §§ 6901 to 6992k, and 40 CFR 271 and 272 Subpart GG, the State of New Mexico, through the NMED, is authorized to administer and enforce the state hazardous waste management program under the Hazardous Waste Act in lieu of the Federal program. The Secretary of the NMED issues this permit for hazardous waste management at LANL to DOE, the owner and co-operator of LANL (EPA ID Number NM 0890010515); and Triad National Security, LLC (Triad) and N3B, co-operators of LANL. (https://www.env.nm.gov/hazardous-waste/wp-content/uploads/sites/10/2021/10/HWB-LANL-Permit-Parts-1-11_-October-2021.pdf)

4.1.1 National Environmental Policy Act

NEPA of 1969, as amended (42 U.S.C. 4321 et seq.), requires Federal agencies to consider the potential impacts to the human and natural environment from their proposed actions before making a decision to undertake such actions. NEPA also requires Federal agencies to solicit and consider public and agency input in the decision-making process, and to document the environmental impact analysis. Where possible, NEPA recommends that Federal agencies implement measures to protect, restore, and enhance the environment. The CEQ has published implementing regulations (40 CFR 1500-1508) and DOE has published implementing procedures (10 CFR 1021) that govern DOE's compliance with NEPA. Updated CEQ NEPA regulations became effective on May 20, 2022. DOE's NEPA regulations were revised, effective January 4, 2021, to update CX B5.7, and remove CX B5.8 and classes of action C13, D8, and D9. These changes relate to natural gas export authorizations. To the extent that CEQ guidance issued prior to September 14, 2020, is in conflict with the updated regulations, the provisions of the updated regulations apply. (https://www.energy.gov/nepa/articles/10-cfr-1021-national-environmental-policy-act-implementing-procedures-doe-2011-rev)

4.1.2 Clean Water Act

The CWA of 1972, as amended (33 U.S.C. 1251-1387), was enacted to "restore and maintain the chemical, physical, and biological integrity of the Nation's water." The CWA prohibits the "discharge of toxic pollutants in toxic amounts" to navigable waters of the United States. Section 313 of the CWA requires all branches of the Federal government engaged in any activity that might result in a discharge of runoff of pollutants to surface waters to comply with Federal, state, interstate, and local requirements.

Under Section 404 of the CWA, authorization from USACE is required when dredged or fill material is discharged into waters of the United States, including wetlands. This includes excavation activities that result in the discharge of dredged material that could destroy or degrade waters of the United States.

The CWA also provides guidelines and limitations for effluent discharges from point-source discharges and establishes the NPDES permit program. In New Mexico, the NPDES program is administered by EPA. In 2012, EPA issued a construction general permit that covers discharges of stormwater from construction sites. The 2012 NPDES General Permit for Storm Water Discharges from Construction Activity includes the following requirements:

- Conduct a critical habitat and threatened and endangered species study.
- Develop and implement a SWPPP in accordance with good engineering practices.
- Submit an NOI.
- Install and maintain erosion and stormwater controls, and apply BMPs.
- Perform and document stormwater inspections during construction and site stabilization.
- Amend the SWPPP as necessary.
- Submit a notice of termination following project completion and final stabilization of disturbed areas.

Authorization to discharge stormwater is required under the construction general permit for both large and small construction projects disturbing more than 1 acre or part of a larger common plan of development that collectively disturbs more than 1 acre.

4.1.3 ENDANGERED SPECIES ACT

The Endanger Species Act of 1973, as amended (16 U.S.C. 1531 et seq.):

- Protects listed (i.e., threatened and endangered) plants and animals that are threatened by habitat destruction, pollution, overharvesting, disease, predation, or other natural or manmade factors.
- Stipulates that listed species cannot be taken without a special permit. "Take," as defined under the Endanger Species Act of 1973, means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." All Federal agencies must ensure that their activities do not jeopardize a listed species or its critical habitat.
- Provides for review of pesticide formulations and their application methods and rates to determine if pesticide use may have potential adverse effects on listed species or their critical habitats Section 7 of the Endanger Species Act of 1973 requires Federal agencies that have reason to believe that a prospective action may affect an endangered or threatened species or its habitat to consult with the USFWS of the U.S. Department of the Interior or the National Marine Fisheries Service of the U.S. Department of Commerce to ensure the action does not jeopardize the species or destroy its habitat. If despite reasonable and prudent measures to avoid or minimize such impacts the species or its habitat would be jeopardized by the action, a review process is specified to determine whether the action may proceed as an incidental taking.

4.1.4 MIGRATORY BIRD TREATY ACT

The Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. 703-712), protects migratory birds by making it unlawful to pursue, take, attempt to take, capture, possess, or kill any migratory bird, or any part, nest, or egg of any such bird, unless and except as permitted by regulation. The act is intended to protect birds that have common migratory patterns within the United States, Canada, Mexico, Japan, and Russia. Section 704 of the act states that the U.S. Secretary of the Interior is authorized and directed to determine if, and by what means, the take of migratory birds should be allowed and to adopt suitable regulations permitting and governing take.

4.1.5 NATIONAL HISTORIC PRESERVATION ACT

Section 106 of the NHPA, as amended (54 U.S.C. 300101 et seq.), requires Federal agencies to consider the effect of their undertakings on historic properties. The Advisory Council on Historic Preservation regulations that implement Section 106 (36 CFR 800) describe the process for identifying and evaluating resources; assessing effects of Federal actions on historic properties; and consulting to avoid, minimize, or mitigate those adverse effects. NHPA does not mandate preservation of historic properties, but it does ensure Federal agency decisions concerning the treatment of these properties result from meaningful consideration of cultural and historical values and identification of options available to protect the properties. The regulations allow for agencies to develop alternate procedures to implement Section 106, which are subsequently set forth in a PA.

4.1.6 ARCHAEOLOGICAL RESOURCES PRESERVATION ACT

The Archaeological Resources Protection Act of 1979, as amended (16 U.S.C. 470aa-mm), secures the protection of archaeological resources and sites on both public and Indian lands. The act prescribes penalties and fines for a detailed list of prohibited acts and sets forth uniform regulations for excavation, removal, disposition, exchange, and information disclosure of archaeological resources.

4.1.7 CLEAN AIR ACT

The CAA and the CAA Amendments of 1990, as amended (42 U.S.C. 7401 et seq.), establish air quality standards for protection of public health and the environment. The ambient air quality in an area is characterized in terms of whether or not it complies with the primary and secondary NAAQS. The CAA, as amended, requires EPA to set NAAQS for pollutants considered harmful to public health and the environment. Within 1 year of starting operations, this permit would need to be incorporated into LANL's Title V Operating Permit, if any activities are applicable. Construction activities and mobile equipment are not regulated under the CAA [20 NMAC 2.72.202(3)], and test drilling for characterization is exempt [20 NMAC 2.72.202(7)].

4.1.8 RESOURCE CONSERVATION AND RECOVERY ACT

The RCRA (42 U.S.C. 6901 et seq.) establishes a system for managing nonhazardous and hazardous solid wastes in an environmentally sound manner. Specifically, it provides for the management of hazardous wastes from the point of origin to the point of final disposal (i.e., "cradle to grave"). RCRA also promotes resource recovery and waste minimization.

4.1.9 SAFE DRINKING WATER ACT

The Safe Drinking Water Act of 1974 (SDWA), as amended (42 U.S.C. 300f et seq.), manages potential threats of contamination to groundwater. The act instructs the EPA to establish a national program to prevent underground injection of contaminated fluids that would endanger drinking water sources. Drinking water standards established under the SDWA are used to determine groundwater protection regulations under a number of other statutes (e.g., RCRA). Therefore, many of the SDWA requirements apply to DOE activities, especially cleanup of contaminated sites and storage and disposal of materials containing inorganic chemicals, organic chemicals, and hazardous wastes.

4.1.10 Native American Graves Protection and Repatriation Act

The Native American Grave Protection and Repatriation Act of 1990 (25 U.S.C. 3001-3013), and its implementing regulations (43 CFR 10), direct the treatment and disposition of recovered Native American human remains, funerary objects, sacred objects, and objects of cultural patrimony.

4.1.11 Executive Order 11988 and Executive Order 11990

Executive Order (EO) 11988, *Floodplain Management*, and EO 11990, *Protection of Wetlands*, require Federal agencies to assess the effects their actions may have on floodplains and wetlands and to consider alternatives to avoid adverse effects and incompatible development on floodplains.

4.1.12 Executive Order 12898

EO 12898, *Environmental Justice*, directs Federal agencies to identify and address potential disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations. The order also directs each agency to develop a strategy for implementing environmental justice.

4.1.13 Executive Order 13007

EO 13007, *Indian Sacred Sites*, directs Federal agencies to accommodate access to, and ceremonial use of, Indian sacred sites by Indian religious practitioners and to avoid adversely affecting the physical integrity of those sacred sites. This EO includes providing reasonable notice of proposed actions or land management policies that may restrict access to, or affect the physical integrity of, sacred sites. This EO also directs Federal agencies to keep confidential information pertaining to such sites.

4.1.14 Executive Order 13175

EO 13175, *Consultation and Coordination with Indian Tribal Governments*, requires Federal agencies to establish regular and meaningful consultation and collaboration with Tribal officials in the development of Federal policies that have Tribal implications.

4.1.15 Executive Order 13751

In accordance with EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species*, DOE identifies invasive species and treats isolated invasive plant species populations. Larger, well-established populations of some species like Siberian elm (*Ulmus pumila*), Russian olive (*Elaeagnus angustifolia*), and salt cedar (*Tamarix ramosissima*) are removed opportunistically, in conjunction with other construction projects. A Mitigation Action Plan for LANL Operations (September, 2020) describes the approach to address this issue. (https://www.energy.gov/nepa/articles/mitigation-action-plan-lanl-operations-september-2020)

4.1.16 Executive Order 14008

EO 14008, *Tackling the Climate Crisis at Home and Abroad*, set a goal of conserving 30 percent of land and water by 2030, among other goals. The DOE submitted its first conservation action plan under the America the Beautiful Initiative associated with this executive order in December 2021

In July 2021, interim implementation guidance for the Justice40 Initiative was released as a new requirement of EO 14008. The aim of this initiative is to secure environmental justice and spur economic opportunity for disadvantaged communities that have been historically marginalized and overburdened by pollution and underinvestment in housing, transportation, water and wastewater infrastructure, and health care. The Justice40 Initiative provides guidance on how certain Federal investments might be made toward a goal that 40 percent of the overall benefits from Federal investments flow to disadvantaged communities. The Environmental Management – Los Alamos Field Office was selected as one of five DOE pilot programs to implement this requirement of the EO.

4.1.17 Executive Order 14096

EO 14096, *Revitalizing Our Nation's Commitment to Environmental Justice for All*, builds on and supplements the foundational efforts of EO 12828, through implementation of a policy to pursue a whole-of-government approach to environmental justice. It fully integrates the consideration of underserved and overburdened communities and populations into all aspects of Federal agency planning and delivery of services, calling for greater collaboration, including with Tribal communities, in evaluating pollutant-causing activities, and better protecting overburdened communities from pollution and environmental harm.

4.1.18 DOE Policies and Orders

The Atomic Energy Act authorizes DOE to establish standards to protect health and minimize the dangers to life or property from activities under DOE's jurisdiction. Through a series of DOE Orders and regulations, an extensive system of standards and requirements has been established to ensure safe operation of DOE facilities. A number of DOE Orders have been issued in support of environmental, safety, and health programs. DOE policies and orders potentially applicable to the Proposed Action and No Action Alternatives are identified below:

- DOE Order 144, Administrative Change 1—American Indian Tribal Government Interactions and Policy, dated November 6, 2009, establishes responsibilities, and transmits the DOE American Indian and Alaska Native Tribal Government Policy. The policy outlines the principles to be followed by DOE in its interactions with federally recognized American Indian Tribes. It is based on Federal policy treaties, Federal law, and DOE's responsibilities as a Federal agency to ensure that Tribal rights and interests are identified and considered pertinent during decision-making.
- DOE Order 422, Change 4—Conduct of Operations, dated February 3, 2022, defines the requirements for establishing and implementing conduct of operations programs at DOE (including NNSA) facilities and projects. A conduct of operations program consists of formal documentation, practices, and actions implementing disciplined and structured operations that support mission success and promote worker, public, and environmental protection.

- DOE Order 436.1A—Departmental Sustainability, dated April 25, 2023, provides requirements and responsibilities for managing sustainability to ensure DOE carries out its missions in a sustainable manner that addresses national energy security and global environmental challenges.
- DOE Order 440.1B, Change 4—Worker Protection Program for DOE (including the NNSA) Federal Employees, dated May 2, 2022, establishes the framework for an effective worker protection program to reduce or prevent injuries, illnesses, and accidental losses by providing DOE Federal workers with a safe and healthful workplace. The order also requires contractors to comply with the requirements of 10 CFR 851, Worker Safety and Health Program.
- DOE Order 451.1—NEPA Compliance Program, dated December 21, 2017, establishes DOE internal requirements and responsibilities for implementing NEPA, the CEQ Regulations Implementing the Procedural Provisions of NEPA, and the DOE NEPA-Implementing Procedures.
- DOE Policy 141.1, Administrative Change 1—Department of Energy Management of Cultural Resources, dated November 6, 2009, establishes cultural resource management as a necessary part of DOE program implementation and establishes program responsibilities, requirements, and authorities.
- DOE Policy 450.4A, Change 1—Integrated Safety Management Policy, dated January 18, 2018, presents a framework for work to be conducted safely and efficiently and in a manner that ensures protection of workers, the public, and the environment.

4.2 STATE LAWS AND REGULATIONS

Certain environmental requirements have been delegated to state authorities for implementation and enforcement. It is DOE policy to conduct its operations in an environmentally safe manner that complies with all applicable statutes, regulations, and standards, including state laws and regulations. The following State of New Mexico laws are potentially applicable to the Proposed Action and No Action Alternatives:

- New Mexico Water Quality Act (NMSA 74-6-1 through 74-6-17). Establishes water-quality standards and permit requirements for the construction or modification of a water discharge source.
- New Mexico Hazardous Waste Act (NMSA 74-4-1 through 74-4-14). Establishes permit requirements for construction, operation, modification, and closure of a hazardous waste management facility.
- New Mexico Air Quality Control Act (NMSA 74-2-1 through 74-2-17). Establishes air quality standards and requires a permit before construction or modification of an air contaminant source. Also imposes emission standards for HAPs.
- New Mexico Solid Waste Act (NMSA 74-9-1 through 74-9-43). Establishes a program to ensure protection of groundwater by requiring completion of groundwater monitoring and remediation at solid waste facilities.

Compliance Order on Consent (Consent Order) - In accordance with provisions of these acts, in June of 2016 the State of New Mexico and DOE entered into a Consent Order pursuant to Section 74-4-10 of the Hazardous Waste Act, 74-9-36(D) of the Solid Waste Act, and 20.9.9.14 of the NMAC. The Consent Order requires DOE to conduct investigations and cleanup contamination at LANL in accordance with the procedures and schedules set forth in the Consent Order. The Consent Order was established for the limited purpose of addressing the corrective action activities, including requirements, concerning groundwater contaminants listed at 20.6.2.3103 NMAC, toxic pollutants listed at 20.6.2.7.WW NMAC. One of these groundwater contaminants and toxic pollutants is Cr(VI). (https://www.energy.gov/sites/prod/files/2020/01/f70/2016%20Consent%20Order_February%202017.pdf)

Under the Consent Order under Appendix C: Campaigns (updated January 2023) (https://www.energy.gov/em-la/2016-consent-order), there are two campaigns associated with chromium contamination:

- Campaign "A" is identified as the Chromium Interim Measures and Characterization Campaign

  "This campaign includes installation and operation of wells and associated equipment necessary to meet three primary objectives: 1) provide interim measures to prevent migration of the plume beyond the Laboratory boundary; 2) perform scientific studies and aquifer testing to obtain data necessary to conduct a Corrective Measures Evaluation; and 3) conduct a Corrective Measures Evaluation. (Solid Waste Management Units [SWMUs]/AOCs: 0)"

- Campaign "I" is identified as the Chromium Final Remedy Campaign

  "Building on the Chromium interim measure and Characterization Campaign, following NMED's selection of a remedy, this campaign includes preparation, submittal, and approval of the Corrective Measures Implementation Plan. This campaign is to install infrastructure and implement the remedy. (SWMUs/AOCs: 0)"

Water Resources - In the State of New Mexico, water resources are protected under the CWA (see Section 4.1.2, *Clean Water Act*) and the New Mexico Water Quality Act. The NWQCC regulations (NMAC 20.6.2) implementing the New Mexico Water Quality Act regulate liquid discharges onto or below the ground surface to protect all groundwater in New Mexico. Under the regulations, when required by NMED, a facility must submit a discharge plan and obtain a DP from NMED (or approval from the New Mexico Oil Conservation Division for energy or mineral-extraction activities). Subsequent discharges must be consistent with the requirements of a DP. Under the state's regulatory programs:

- A DP (DP-1835) for the discharge of treated groundwater to the regional aquifer from Class V underground injection control wells was issued by NMED on August 31, 2016. On July 21, 2017, NMED approved minor updates to DP-1835. The term of DP-1835 is 7 years from the effective date or 5 years from the date the discharge commenced, whichever comes first. Discharge commenced on December 1, 2016, and expired on December 1, 2021. On July 8, 2021, a renewal and modification application was submitted to NMED. Approval of the permit is pending.

- A DP (DP-1793) for the land application of treated groundwater was originally issued on July 27, 2015. On February 6, 2020, NMED approved the renewal application for this permit keeping conditions as they were in the original application. In order to continue operations under DP-1793, a renewal application will be required within 5 years from the last approval and is required to be submitted to NMED at least 180 days before the DP-1793 expires. This LANL-wide permit requires project-specific work plans to be submitted to NMED for approval prior to operation, each of which requires a 30-day public review period.

- LANL Industrial Wastewater Permit NPDES Permit No. NM0028355 – EPA regulates discharges under the referenced NPDES individual permit (see the Federal Laws and Regulations section). However, a state Water Quality Certification is required by the CWA Section 401 to ensure that the action is consistent with state law (New Mexico Water Quality Act, New Mexico Statutes Annotated [NMSA] 1978, Sections 74-6-1 to -17) and complies with the State of New Mexico Water Quality Standards at 20.6.2 and 20.6.4 NMAC, Water Quality Management Plan and Continuing Planning Process, including Total Maximum Daily Loads, and Antidegradation Policy. The NPDES Permit was issued August 12, 2014, modified May 1, 2015, reissued by EPA on March 30, 2022; effective May 1, 2022; and expires April 30, 2027. EPA permit authorizing the Laboratory to discharge industrial and sanitary liquid effluents through outfalls under specific conditions, including water quality and monitoring requirements.

- LANL's 2019 Title V Operating Permit from NMED AQB P100-R2M4 (20.2.70 NMAC), was previously issued in 2015 and includes facility-wide emission limits and recordkeeping and reporting requirements. The current permit is dated July 18, 2019, and is in effect for 5 years.

5.0 CONSULTATION AND COORDINATION

NEPA drives Federal agencies to evaluate environmental resources, which may include a consultation process in accordance with other environmental laws. This section describes environmental consultations that are associated with the Proposed Action. Additional details on these environmental resources are provided in Chapter 3.

Each of the Accord Pueblos (Pueblo de Cochiti, Pueblo de San Ildefonso, Pueblo of Jemez, Santa Clara Pueblo) received a courtesy phone call to the Pueblo environment department ahead of the public scoping meetings, followed by letters regarding public scoping and an offer for in-person consultation. EM-LA also conducted an in-person meeting on the scoping with the Pueblo de San Ildefonso environment department. Additionally, EM-LA CMEs presented at the Accord Technical Exchange Meeting on July 11, 2023, regarding the NEPA process for this EA. Representatives from each of the Accord Pueblos were in attendance for that meeting of the Accord Technical Exchange Meeting.

Prior to releasing the Draft EA, EM-LA would issue additional letters to the Accord Pueblos with an accompanying offer to consult followed by a presentation to the Accord Technical Exchange Meeting on the Draft EA. Pueblo de San Ildefonso has notified EM-LA that they plan to request consultation at that time.

Table 5-1 lists the agencies and organizations to whom EM-LA provided advance letters of notification of DOE's intent to prepare this EA.

Table 5-1. List of agencies and organizations provided with advance notification of DOE's intent to prepare the Environmental Assessment

Stakeholder/Accord Pueblos	Title	Name
Los Alamos County	County Manager	Steven Lynn
	County Deputy Manager	Linda Matteson
	County Deputy Manager	Annie Laurent
	Intergovernmental Affairs Manager	Danielle Duran
Santa Fe County	Commission Chair	Anna Hansen
NM State Representative	State Representative District 43	Christine Chandler
Senator Heinrich	Santa Fe Field Representative	Rita O'Connell
Senator Lujan	Santa Fe Field Representative	Eric Chavez
Rep. Leger-Fernandez	Staffer	Matt Miller
New Mexico Environment Department	Director, Water Protection Division	John Rhoderick
New Mexico Environment Department	Director, Resource Protection Division	Rick Shean
Pueblo de Cochiti	Governor	Pete Herrera
	Lieutenant Governor	Kai-t Blue-Sky
	Tribal Administrator	Tracy Codero
	Director, Department of Natural Resources	Jayson Romero
Pueblo of Jemez	Governor	Dominic Gachupin
	Lieutenant Governor	Daryl Lucero
	Director, Department of Natural Resources	Clarice Madalena
Santa Clara Pueblo	Governor	J. Michael Chavarria
	Director, Department Natural Resource	Dino Chavarria
	Department Natural Resource	Rose Suazo
Pueblo de San Ildefonso	Governor	Christopher Moquino
	Governor's Assistant	Kitty Montoya
	Director, Environmental & Cultural Preservation	Raymond Martinez

6.0 REFERENCES

CEQ. (2023). *National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change (issued Jan. 9, 2023).* Council on Environmental Quality. Retrieved from https://ceq.doe.gov/guidance/ceq_guidance_nepa-ghg.html.

Chandler, S. (2023). Personal communication, email from Sarah Chandler, Community Outreach Manager, TekPro Support Services, to Jenifer Nordstrom, Leidos. Re: Chromium EA Outreach and Justice40 Information. August 1.

Delaney et al. (1999). Delaney, D.K., T.G. Grubb, and P. Beier. Activity Patterns of Nesting Mexican Spotted Owls. *The Condor, 101*, 42–49.

DOE. (2008). *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico (DOE/EIS-0380).* U.S. Department of Energy, National Nuclear Security Administration, Los Alamos Site Office. May.

DOE. (2011). *Final Supplemental Environmental Impact Statement for the Nuclear Facility Portion of the Chemistry and Metallurgy Research Building Replacement Project at Los Alamos National Laboratory, Los Alamos, New Mexico.* DOE/EIS-0350-S1. U.S. Department of Energy.

DOE. (2014). *Chromium Plume Control Interim Measure and Corrective Measures Study Scope.* U.S. Department of Energy.

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

DOE. (2021). *2021 Climate Adaptation and Resilience Plan.* U.S. Department of Energy. Retrieved from https://www.energy.gov/sites/default/files/2021-10/DOEClimateAdaptationandResiliencePlan.pdf.

DOE. (2022a). *Draft Environmental Impact Statement for the Surplus Plutonium Disposition Program.* DOE/EIS-0549. U.S. Department of Energy.

DOE. (2022b). *2022 Department of Energy Sustainability Plan.* U.S. Department of Energy. Retrieved from https://www.sustainability.gov/pdfs/doe-2022-sustainability-plan.pdf.

DOE. (2023). *Computerized Accident/Illness Reporting System (CAIRS)*. Retrieved from Injury and Illness Dashboard: https://data.doe.gov/MS/asp/Main.aspx. August 16.

EM-LA. (2021). EM-LA Justice40 Pilot Program, with Tribal Nations Policy (December 2020) and DOE Implementation Plan (September 2021). *EM-LA Stakeholder Engagement Plan*. U.S. Department of Energy, Office of Environmental Management, Los Alamos Office.

EM-LA. (2023a). *Interim Facility-Wide Groundwater Monitoring Plan for the 2024 Monitoring Year, October 2023–September 2024, EM2023-0265, pages 4 and 5.* Los Alamos, NM.

EM-LA. (2023b). *Information provided by DOE EM-LA for preparation of the Environmental Assessment (Data Call Response).* U.S. Department of Energy, Office of Environmental Management, Los Alamos Field Office.

EM-LA. (2023c). *Annual Progress Report on Chromium Plume Control, Interim Measure Performance, April 2022 through March 2023.* EMID-702801. EMLA-23-BF25 l-2-l. U.S. Department of Energy, Office of Environmental Management, Los Alamos Field Office. Retrieved from https://ext.em-la.doe.gov/GovFTPFiles/api/GetFiles/GetFile?fileName=EMID-702801_EMLA-23-BF251-2-1_Cr_IM_Annual_Prog_Rpt_Apr22-Mar23_062923.pdf.

EPA. (2022). Adaptive Site Management - A Framework for Implementing Adaptive Management at Contaminated Sediment Superfund Sites. U.S. Environmental Protection Agency. June.

EPA. (2023a). *EJScreen*. Retrieved from EPA Environmental Justice Screenning Tool: https://ejscreen.epa.gov/mapper/. June 29.

EPA. (2023b). *National Emission Standards for Hazardous Air Pollutants (NESHAP)*. Retrieved May 17, 2021, from https://www.epa.gov/stationary-sources-air-pollution/national-emission-standards-hazardous-air-pollutants-neshap-8

EPA. (2023c). *Nonattainment Areas for Criteria Pollutants (Green Book)*. Retrieved from U.S. Environmental Protection Agency: https://www.epa.gov/green-book.

Evoqua. (2023). *Ion Exchange Resin Tanker Delivery Service*. Retrieved August 16, 2023, from Marketing materials. https://www.evoqua.com/en/evoqua/products--services/services/ion-exchange-services/ion-exchange-resin-tanker-delivery-service/.

FHWA. (2006). *FHWA Highway Construction Noise Handbook.* Federal Highway Administration.

FTA. (2018). *FTA Transit Noise and Vibration Impact Assessment Manual.* Federal Transit Administration.

Heikoop et al. (2014). Heikoop, J. M., Johnson, T. M., Birdsell, K. H., Longmire, P., Hickmott, D. D., Jacobs, E. P., ... & Basu, A. Isotopic Evidence for Reduction of Anthropogenic Hexavalent Chromium in Los Alamos National Laboratory Groundwater. *Chemical Geology*, *373*.

International Dark Sky. (2023). *Valles Caldera National Preserve Receives International Dark Sky Park Certification.*

IPCC. (2021). *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.* Geneva, Switzerland: Cambridge University Press.

IWG. (2021). *Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990.* Washington, D.C.: Interagency Working Group. Retrieved from https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf. February.

LAC. (2019). *Los Alamos Housing Market Needs Analysis.* Retrieved July 12, 2023, from Los Alamos County: https://www.losalamosnm.us/UserFiles/Servers/Server_6435726/File/Government/Depart ments/Community%20Development/Housing/Los%20Alamos%20County%20Housing%20Analysis%20Final%2012-10-2019.pdf.

LADPU. (2015). *2014 Annual Drinking Water Quality Report, Los Alamos Department of Public Utilities.* Los Alamos Department of Public Utilities. April.

LADPU. (2023). *2022 Annual Drinking Water Quality Report.* Los Alamos, NM: Los Alamos Department of Public Utilities.

LANL. (2002). *Cerro Grande Fire Assessment Project: An Assessment of the Impact of the Cerro Grande Fire on Cultural Resources at Los Alamos National Laboratory, New Mexico, Cultural Resource Report No. 211, LAUR025713.*

LANL. (2008). *Fate and Transport Investigations Update for Chromium Contamination from Sandia Canyon.* Los Alamos, NM: Los Alamos National Laboratory. LA-UR-08-4702. April.

LANL. (2015). *Interim Measures Work Plan for Chromium Plume Control.* Los Alamos, NM. Los Alamos National Laboratory. LA-UR-15-23126. May.

LANL. (2017). *A Plan for the Management of the Cultural Heritage at Los Alamos National Laboratory, New Mexico, LA-UR-19-21590.* Los Alamos: Los Alamos National Laboratory.

LANL. (2018a). *Compendium of Technical Reports Conducted Under the Work Plan for Chromium Plume Center Characterization.* Los Alamos, NM: Los Alamos National Laboratory.

LANL. (2018b). *Chromium Plume Control Interim Measure Performance Monitoring Work Plan.* Los Alamos, NM: Los Alamos National Laboratory. LA-UR-18-23082.

LANL. (2018c). *Evaluation of Chromium Plume Control Interim Measure Operational Alternatives for Injection Well CrIN-6.* Los Alamos, NM: Los Alamos National Laboratory. LA-UR-18-23385.

LANL. (2018d). *An Updated Land Cover Map and Descriptions of Vegetative Communites for Los Alamos National Laboratory and Surrouding Areas.* Prepared by: Leslie A. Hansen, Alexei N. Skurikhin, and Ben J. Sutter Environmental Protection and Compliance Division Los Alamos National Laboratory. U.S. Department of Energy National Nuclear Security Administration Los Alamos Field Office.

LANL. (2019a). *Wildland Fire Mitigation and Forest Health Plan.* Los Alamos National Laboratory.

LANL. (2019b). *Noise Study for the Mexican Spotted Owl Sandia-Mortandad Area of Environmental Interest.* Prepared by Audrey A. Sanchez and Chuck Hathcock, Environmental Protection and Compliance Division, Los Alamos National Laboratory.

LANL. (2020a). *Sensitive Species Best Management Practices Source Document, Revision 5.* Prepared by Jesse T. Berryhill, Jenna E. Stanek, Elisa J. Abeyta, and Charles D. Hathcock Environmental Protection and Compli. Los Alamos National Laboratory.

LANL. (2020b). *Migratory Bird Best Management Practices Source Document.* Los Alamos National Laboratory.

LANL. (2020c). *Standard Operating Procedure for the Inadvertent Discovery of Native American Human Remains and Associated Funerary Objects, Sacred Objects of Cultural Patrimony at Los Alamos National Laboratory LA-UR-20-2293*. Los Alamos National Laboratory.

LANL. (2021a). *Pollinator Protection Plan for Los Alamos National Laboratory*. Prepared by Environmental Protection and Compliance Division Environmental Stewardship Group, Resources Managment Team Los Alamos National Laboratory. Los Alamos National Laboratory.

LANL. (2021b). *Status of Federally Listed Threatened and Endangered Species at Los Alamos National Laboratory*. Prepared by Brent E. Thompson, Chauncey R. Gadek, and Milu S. Velardi Environmental Protection and Compliance Division Resources Management Team Los Alamos National Laboratory. National Nuclear Security Administration Los Alamos Field Office.

LANL. (2022a). *Los Alamos National Laboratory 2021 Campus Master Plan, LA-UR-22-21424.*

LANL. (2022b). *Los Alamos National Laboratory 2021 Annual Site Environmental Report, LA-UR-22-29103*. Los Alamos, NM.

LANL. (2022c). *Threatened and Endangered Species Habitat Management Plan for Los Alamos National Laboratory*. Environmental Protection and Compliance Division Resrouces Managment Team Los Alamos National Laboratory. Los Alamos National Laboratory.

LANL. (2022d). *Invasive Plant Species Managment Plan for Los Alamos National Laboratory*. Author(s) Jenna Stanek, Brent Thompson, Karla Sartor, Lyken Merrill, Environmental Protection and Compliance Division Environmental Stewardship Group, Resources Management Team Los Alamos National Laboratory. U.S. Department of Energy/National Nuclear Security Administration, Los Alamos Field Office.

LANL. (2022e). *Amendment to Programmatic Agreement among the U.S. DOE, NNSA Los Alamos Field Office, the New Mexico SHPO and the ACHP Concerning Management of the Historic Properties of Los Alamos National Laboratory, Los Alamos, New Mexico (AGREEMENT)*. Los Alamos National Laboratory. LA-UR-22-27894. August 1, 2022.

LANL. (2022f). *Transportation Plan Los Alamos National Laboratory Fiscal Year 2023*. Los Alamos National Laboratory.

LANL. (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*. Marjorie Alys Wright, Los Alamos National Laboratory. February 22.

LANL. (2023b). *Memorandum - Subject: 2022 EPA Greenhouse Gas Report Electronic Submittal*. Los Alamos National Laboratory Document LA-UR-23-22104.

LANL. (2023c). *Connections Newsletter Archive*. Retrieved 2023, from Los Alamos National Laboratory: https://www.lanl.gov/news-archive/publications/connections/.

LANL. (2023d). *Personal communication from Environmental Management Division Los Alamos National Laboratory to Leidos Ecological Resources Analyst, Tara Schoenwetter*. Los Alamos National Laboratory. August.

LANL. (2023e). *2022 Economic Impact on New Mexico. ROSY-ID-CBF0FF10.* Retrieved July 12, 2023, from Los Alamos National Laboratory: https://discover.lanl.gov/highlights/economic-impact-new-mexico/.

LANL. (2023f). *Laboratory Employee Demographics and housing demand. Information for the construction industry. ROSY ID: #38238398.* Los Alamos National Laboratory. May 1, 2023.

N3B. (2022). *2021 Sandia Wetland Performance Report.* April 2022. EM2022-0012. Retrieved from https://ext.em-la.doe.gov/eprr/repo-file.aspx?oid=0902e3a68010ba82&n=EMID-701996-01.pdf.

N3B. (2023a). *Initial Five-Year Evaluation of the Interim Measures for Chromium Plume Control with an Assessment of Potential Modifications to Operations.* Los Alamos, NM: N3B-Los Alamos.

N3B. (2023b). *2022 Sandia Wetland Performance Report.*

N3B. (2023c). *Floodplain and Wetland Assessment for Chromium Remediation in Sandia and Mortandad Canyons, Los Alamos National Laboratory.* Newport News Nuclear BWXT-Los Alamos, LLC (N3B). September.

National Park Service. (2023). *Air Quality Conditions and Trends, Bandelier National Monument*. Retrieved from Air Resources Division, Denver, Colorado: https://www.nps.gov/subjects/air/park-conditions-trends.htm?tabName=trends&parkCode=BAND&paramCode=Visibility&startYr=1989&endYr=2021&monitoringSite=BAND1%20(IMPROVE)&timePeriod=Long-term.

Neptune and Company. (2023a). *Chromium Interim Measure Capture Zone Analysis.* Neptune and Company, Inc. June 16.

NMDGF. (2016). *State Wildlife Action Plan for New Mexico (SWAP).* Sante FE, NM: New Mexico Department of Game and Fish. Retrieved from https://www.wildlife.state.nm.us/download/conservation/swap/New-Mexico-State-Wildlife-Action-Plan-SWAP-Final-2019.pdf.

NMDOT. (2023a). *NMDOT*. Retrieved from NMDOT Transportation Data Management System (MS2): https://nmdot.public.ms2soft.com/tcds/tsearch.asp?loc=Nmdot. July 22.

NMDOT. (2023b). *New Mexico Department of Transportation Active Projects - NM-4 Alignment Study*. Retrieved from New Mexico Department of Transportation: https://www.dot.nm.gov/projects/active-projects/.

NMED. (2016). Compliance Order on Consent, U.S. Department of Energy, Los Alamos National Laboratory. New Mexico Environment Department. June.

NMED. (2022). *2022-2024 State of New Mexico Clean Water Act Section 303(d)/Section 305(b) Integrated Report.* New Mexico Environment Department, Surface Water Quality Bureau. Retrieved August 2023, from https://cloud.env.nm.gov/water/pages/view.php?ref=8234&k=c19431341b. April 26.

NNLEMS. (2022). *Independent Review of Groundwater Remediation Strategy for Hexavalent Chromium and RDX Groundwater Plumes at Los Alamos National Laboratory.* Network of National Laboratories for Environmental Management and Stewardship. November.

NNSA. (2010). Final Environmental Assessment for the Expansion of the Sanitary Effluent Reclamation Facility and Envrionmental Restoration of Reach S-2 of Sandia Canyon at Los Alamos National Laboratory Los Alamos, New Mexico. *DOE/EA-1736*. Los Alamos, New Mexico: U.S. Department of Energy National Nuclear Security Administration. August 24.

NRCS. (2008). *Soil Survey of Sandoval County Area, New Mexico, Parts of Los Alamos, Sandoval, and Rio Arriba Counties.* Natural Resources Conservation Service.

NRCS. (2009). *Soil Survey of Santa Fe County Area, New Mexico.* Natural Resources Conservation Service.

NRCS. (2023). *Custom Soil Resource Report for Sandoval County Area, New Mexico, Parts of Los Alamos, Sandoval, and Rio Arriba Counties; and Santa Fe County Area, New Mexico, LANL Chromium Plume Study Area.* Natural Resources Conservation Service.

Partners in Flight. (2021). *Avian Conservation Assessment Database, version 2021*. Retrieved from https://pif.birdconservancy.org/.

PEEC. (2023). *Dark Skies.* Pajarito Environmental Education Center.

Saricks, C., & Tompkins, M. M. (1999). State Level Accident Rates for Surface Freight Transportation: A Reexamination, ANL/ESD/TM 150, April. Argonne, Illinois: Argonne National Laboratory, Energy Systems Division, Center for Transportation Research.

U.S. Bureau of Labor Statistics. (2023). *Employer-Reported Workplace Injuries and Illnesses in New Mexico — 2021*. Retrieved from https://www.bls.gov/regions/southwest/news-release/workplaceinjuryandillness_newmexico.htm#:~:text=In%20New%20Mexico%2C%20all%20private,an%20additional%201%2C900%20recordable%20cases. August 16.

UMTRI. (2003). *Evaluation of the Motor Carrier Management Information System Crash File, Phase One, UMTRI-2003-6.* University of Michigan Transportation Research Institute, Center for National Truck Statistics.

UNM. (2019). *The Economic Impact of Los Alamos National Laboratory.* University of New Mexico Bureau of Business and Economic Research report for Los Alamos National Laboratory. Retrieved from http://nuclearactive.org/wp-content/uploads/2021/03/UNMBBER_LANLImpactAnalysis_Revised_101419.pdf#:~:text=Expenditures%20by%20LANL%20and%20its%20employees%20directly%20generated,billion%20in%20business%20revenues%20in%20the%20seven%20counties. June.

USCB. (2023a). *Quick Facts (queries for New Mexico and associated counties)*. Retrieved from U.S. Census Bureau: https://www.census.gov/quickfacts/fact/table/NM,US/PST045222.

USCB. (2023b). *American Community Survey (5-year average 2017-2021). Queries for New Mexico and associated counties. DP03 Selected Economic Characteristics*. Retrieved from U.S. Census Bureau: https://data.census.gov/table?tid=ACSDP1Y2021.DP03.

USCB. (2023c). *American Community Survey (5-year average 2017-2021). Queries for New Mexico and associated counties. DP04 Selected Housing Characteristics*. Retrieved from U.S. Census Bureau: https://data.census.gov/table?tid=ACSDP1Y2021.DP04.

USCB. (2023d). *American Community Survey (5-year average 2017-2021). Queries for New Mexico and associated counties. DP05 ACS Demographic and Housing Estimates*.

Retrieved from U.S. Census Bureau: https://data.census.gov/table?tid=ACSDP1Y2021.DP05.

USFWS. (2021). *Birds of Conservation Concern.* Washington, DC: U.S. Fish and Wildlife Service, Migratory Birds Program. Retrieved from https://www.fws.gov/sites/default/files/documents/birds-of-conservation-concern-2021.pdf.

USFWS. (2023). *IPAC Information for Planning and Consultation*. Retrieved from U.S. Fish and Wildlife Service: https://ipac.ecosphere.fws.gov/.

USGCRP. (2018). *Fourth National Climate Assessment - Volume II - Impacts, Risks, and Adaptation in the United States.* Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.). U.S. Global Change Research Program. Retrieved from https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.

Vesselinov et al. (2013). Vesselinov, V. V., Katzman, D., Broxton, D., Birdsell, K., Reneau, S., Vaniman, D., ... & Mishra, P. Data and Model-Driven Decision Support for Environmental Management of a Chromium Plume at Los Alamos National Laboratory (LANL). *Waste Management Symposium, February 24–28, 2013.* Phoenix, AZ.

7.0 GLOSSARY

air pollutant—Generally, an airborne substance that could, in high enough concentrations, harm living things or cause damage to materials. From a regulatory perspective, an air pollutant is a substance for which emissions or atmospheric concentrations are regulated or for which maximum guideline levels have been established because of its potential harmful effects on human health and welfare.

allowable economic drawdown—The percent of the water column that can be lost before the well loses economic viability. In the absence of more reliable data, a value of 70 percent of the water column may be assumed as the allowable economic drawdown.

alluvium—Sediment deposited by flowing water, as in a riverbed, flood plain, or delta.

ambient air—The surrounding atmosphere as it exists around people, plants, and structures. ambient—Surrounding.

ambient air quality standards—The level of pollutants in the air prescribed by regulations that may not be exceeded during a specified time in a defined area. Air quality standards are used to provide a measure of the health-related and visual characteristics of the air.

amendment—A material added to a medium to alter its chemical or physical properties.

aquifer—An underground geological formation, group of formations, or part of a formation that is capable of yielding a significant amount of water to wells or springs.

archaeological site—Any location where humans have altered the terrain or discarded artifacts during either prehistoric or historic times.

area of potential effects—The area within which impacts to historic properties could occur as the result of a project or undertaking.

artifact—An object produced or shaped by human workmanship of archaeological or historical interest.

basalt—The most common volcanic rock, dark gray to black in color, high in iron and magnesium and low in silica. It is typically found in lava flows.

base course—A layer of material of specified thickness constructed to serve one or more functions, such as distributing loads, providing drainage, or minimizing frost action. Typically, base course consists of compacted gravel and/or crushed mineral aggregate.

bedrock—The solid rock that lies beneath soil and other loose surface materials.

best management practices—Structural, nonstructural, and managerial techniques, other than effluent limitations, to prevent or reduce pollution of surface water. They are the most effective and practical means to control pollutants that are compatible with the productive use of the resource to which they are applied. Best management practices are used in both urban and agricultural areas and may include schedules of activities; prohibitions of practices; maintenance procedures; treatment requirements; operating procedures; and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

bounded—Producing the greatest consequences of any assessment of impacts associated with normal or abnormal operations.

cavate—A room carved into a cliff face within the Bandelier Tuff geological formation. The category includes isolated cavates, multi-roomed contiguous cavates, and groups of adjacent cavates that together form a cluster or complex.

Compliance Order on Consent (Consent Order)—An enforcement document signed by the New Mexico Environment Department, the U.S. Department of Energy, and the Regents of the University of California (then the management and operations contractor for Los Alamos National Laboratory) on March 1, 2005, that prescribes the requirements for corrective action at Los Alamos National Laboratory. The purposes of the Consent Order are (1) to fully determine the nature and extent of releases of contaminants at or from Los Alamos National Laboratory; (2) to identify and evaluate, where needed, alternatives for corrective measures, including interim measures, to clean up contaminants in the environment, and to prevent or mitigate the migration of contamination at or from Los Alamos National Laboratory; and (3) to implement such corrective measures.

criteria pollutant—An air pollutant that is regulated by National Ambient Air Quality Standards. The U.S. Environmental Protection Agency must describe the characteristics and potential health and welfare effects that form the basis for setting, or revising, the standard for each regulated pollutant. Criteria pollutants include sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, and two size classes of particulate matter, less than or equal to 10 micrometers (0.0004 inch) in diameter and less than or equal to 2.5 micrometers (0.0001 inch) in diameter. New pollutants may be added to, or removed from, the list of criteria pollutants as more information becomes available.

critical habitat—Habitat essential to the conservation of an endangered or threatened species that has been designated as critical by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 *Code of Federal Regulations* 424). (See endangered species and threatened species.)

cultural resources—Archaeological materials (artifacts) and sites that date to the prehistoric, historic, and ethnohistoric periods and that are currently located on the ground surface or buried beneath it; standing structures and/or their component parts that are over 50 years of age and are important because they represent a major historical theme or era, including the Manhattan Project and the Cold War era, and structures that have an important technological, architectural, or local significance; cultural and natural places, select natural resources, and sacred objects that have importance for American Indians; American folklife traditions and arts; "historic properties" as defined in the National Historic Preservation Act; "archaeological resource" as defined in the Archaeological Resources Protection Act; and "cultural items" as defined in the Native American Graves Protection and Repatriation Act.

cumulative impacts—The impacts on the environment that result from the incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of the agency (Federal or non-Federal) or person who undertakes such other actions. Cumulative impacts may result from individually minor but collectively significant actions taking place over a period of time.

decibel (dB)—A unit for expressing the relative intensity of sounds on a logarithmic scale where 0 is below human perception and 130 is above the threshold of pain to humans. For traffic and industrial noise measurements, the A-weighted decibel, a frequency-weighted noise unit, is widely used. The A-weighted decibel scale corresponds approximately to the frequency response of the human ear and thus correlates well with loudness.

DOE Orders—Requirements internal to the U.S. Department of Energy that establish its policy and procedures, including those for compliance with applicable laws.

downgradient—The direction that groundwater flows; similar to “downstream” for surface water.

drawdown—The difference in elevation between the level of water in a well and the level of groundwater in the area in which the well is located.

dynamic drawdown—The self-induced decline of water level inside the casing of an existing well as pumps are turned on.

ecological resources—Terrestrial resources, wetlands, aquatic resources, and protected and sensitive species.

effluent—A waste stream flowing into the atmosphere, surface water, groundwater, or soil.

endangered species—Plants or animals that are in danger of extinction through all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations. (See threatened species.)

environmental justice—The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Fair treatment means that no group of people, including racial, ethnic, or socioeconomic groups, should bear a disproportionate share of the negative environmental consequences resulting from industrial, municipal, and commercial operations or the execution of Federal, state, local, and Tribal programs and policies. Executive Order 12898 directs Federal agencies to make achieving environmental justice part of their missions by identifying and addressing disproportionately high and adverse effects of agency programs, policies, and activities on minority and low-income populations. (See minority population and low-income population.)

environmental remediation—Environmental remediation is the process of removing contaminants or pollutants from soil, water, and other components of the natural environment.

ephemeral stream—A stream that flows only after a period of heavy precipitation.

extraction well—A well used to extract fluids from the subsurface. Extraction is usually accomplished by a pump located within the well.

field-scale studies—Deployed studies in an actual work location that include environmental variables conducted at a size that is less than full-scale actual systems but greater than laboratory-scale studies.

final remedy—A regulatory term concluding the method and corresponding activities by which an environmental issue, such as contamination, would be cleaned up, and the final condition of the site.

floodplain—The lowlands and relatively flat areas adjoining inland and coastal waters and the flood-prone areas of offshore islands. Floodplains include, at a minimum, that area with at least a 1-percent chance of being inundated by a flood in any given year.

formation—In geology, the primary unit of formal stratigraphic mapping or description. Most formations possess certain distinctive features.

grading—Any stripping, cutting, filling, stockpiling, or combination thereof that modifies the land surface.

greenhouse gas—A gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in Earth's atmosphere are water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

groundwater—Water below the ground surface in a zone of saturation.

habitat—The environment occupied by individuals of a particular species, population, or community.

hazardous material—A material, including a hazardous substance, as defined by 49 Code of Federal Regulations 171.8, that poses a risk to health, safety, and property when transported or handled.

hazardous waste—A category of waste regulated under the Resource Conservation and Recovery Act. To be considered hazardous, a waste must be a solid waste under the act and must exhibit at least one of four characteristics described in 40 Code of Federal Regulations 261.20-24 (ignitability, corrosivity, reactivity, or toxicity) or be specifically listed by the U.S. Environmental Protection Agency in 40 Code of Federal Regulations 261.31-33.

historic property—Any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the National Register of Historic Places; such term includes artifacts, records, and remains that are related to such district, site, building, structure, or object.

historic—After the advent of written history, dating to the time of the first European-American contact in an area.

hydraulic conductivity—A measure of the ability of a rock or soil to transmit a fluid.

hydrogeologic—Pertaining to the distribution and movement of groundwater in the soil and rocks of the Earth's crust (commonly in aquifers).

hydrologic—Pertaining to the properties, distribution, and circulation of water on and below the Earth's surface and in the atmosphere.

In-situ remedy/treatment—Chemical, physical, biological, thermal, or electrical processes that remove, degrade, chemically modify, stabilize, or encapsulate contaminants within soil or groundwater (matrices) without removing those matrices from the ground.

injection well—A well that takes water from the surface into the ground, either through gravity or by mechanical means.

ion exchange resin—An organic polymer that functions as an acid or base. These resins are used to remove ionic material from a solution (such as removing dissolved chromium from water).

interim measure—An interim measure is a set of actions that have a high probability of meeting environmental protection goals until a final remedy is implemented.

kilowatt—A unit of power equal to 1,000 watts.

legacy contamination—Contamination of the environment resulting from pre-1999 Los Alamos National Laboratory activities and waste-management practices within environmental management scope.

loam—Soil material that is composed of 7 percent to 27 percent clay particles, 28 percent to 50 percent silt particles, and less than 52 percent sand particles.

low-income population—Defined in terms of Bureau of the Census annual statistical poverty levels, may consist of groups or individuals who live in geographic proximity to one another or who are geographically dispersed or transient (such as migrant workers or American Indians), where either group experiences common conditions of environmental exposure or effect. (See environmental justice and minority population.)

megawatt—A unit of power equal to 1,000,000 watts.

migration—The natural movement of a material through the air, soil, or groundwater.

minority population—Minority populations exist where either (a) the minority population of the affected area exceeds 50 percent, or (b) the minority population percentage of the affected area is meaningfully greater than in the general population or other appropriate unit of geographic analysis (such as a governing body's jurisdiction, a neighborhood, census tract, or other similar unit). "Minority" refers to individuals who are members of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic. "Minority populations" include either a single minority group or the total of all minority persons in the affected area. They may consist of groups of individuals living in geographic proximity to one another or a geographically dispersed/transient set of individuals (such as migrant workers or American Indians), where either group experiences common conditions of environmental exposure or effect. (See environmental justice and low-income population.)

mitigate—To avoid an impact altogether by not taking a certain action or parts of an action; minimize impacts by limiting the degree or magnitude of an action and its implementation; rectify an impact by repairing, rehabilitating, or restoring the affected environment; reduce or eliminate the impact over time by preservation and maintenance operations during the life of an action; or compensate for an impact by replacing or providing substitute resources or environments.

monitoring well—A well designed and installed to obtain representative groundwater quality samples and hydrogeologic information.

natural attenuation—An approach to remediation that relies on natural processes occurring within the aquifer to reduce concentrations or toxicity of target contaminants.

noise—Undesirable sound that interferes or interacts negatively with the human or natural environment. Noise may disrupt normal activities (hearing, sleep), damage hearing, or diminish the quality of the environment.

outfall—The discharge point of a drain, sewer, or pipe as it empties into the environment.

perennial stream—A stream that flows throughout the year.

piezometer—A device that measures the pressure (more precisely, the piezometric head) of groundwater at a specific point.

plume—The elongated volume of contaminated water or air originating at a pollutant source. A plume eventually diffuses into a larger volume of less contaminated material as it is transported away from the source.

power drops—Electrical power outlets to serve specific pieces of equipment.

prehistoric—Predating written records. Prehistoric archaeological resources generally consist of artifacts that may alone or collectively yield otherwise inaccessible information about the past.

Pueblo roomblock—The remains of a contiguous, multiroom habitation structure (four or more rooms with no enclosed plaza) constructed of adobe, jacal, or masonry.

Quaternary—The second geologic time period of the Cenozoic era, dating from about 2.6 million years ago to the present. It contains two epochs: the Pleistocene and the Holocene. It is characterized by glacial episodes and the first appearance of human beings on Earth.

regional aquifer—An aquifer system of large areal extent, commonly consisting of several layered sedimentary formations that may extend to several kilometers in depth. Regional aquifers typically supply water for industrial, irrigation, and domestic uses in many areas.

remediation—The process, or a phase in the process, of rendering radioactive, hazardous, or mixed waste environmentally safe, whether through processing, entombment, or other methods.

runoff—The portion of rainfall, melted snow, or irrigation water that flows across the ground surface, and eventually enters streams.

sediment—Soil, sand, and minerals washed from land into water that deposit on the bottom of a water body.

seismic—Pertaining to any Earth vibration, especially an earthquake.

soils—All unconsolidated materials above bedrock. Natural earthy materials on the Earth's surface, in places modified or even made by human activity, containing living matter, and supporting or capable of supporting plants out of doors.

Stormwater Pollution Prevention Plan (SWPPP)—Describes the nature and sequencing of activities, potential sources of pollution, and identifies the best management practices to require stormwater controls to be in place during drilling and until a site is stabilized following well installation. A SWPPP is prepared for activities resulting in ground disturbance of more than 1 acre.

surface water—All bodies of water on the surface of the Earth and open to the atmosphere, such as rivers, lakes, reservoirs, ponds, seas, and estuaries.

technical area (TA)—A geographically distinct administrative unit established for the control of Los Alamos National Laboratory operations.

threatened species—Any plants or animals that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and that have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set out in the Endangered Species Act and its implementing regulations (50 *Code of Federal Regulations* 424). (See endangered species.)

tracer—A substance introduced into groundwater to provide information on the direction of movement and/or velocity of the water and potential contaminants which might be transported by the water. Tracers can also help determine hydrogeologic parameters.

treated effluent (or treated water)—A waste stream flowing into the atmosphere, surface water, groundwater, or soil that has been processed to reduce contaminants to levels meeting regulatory requirements.

treatment—The use of a chemical, physical, or biological agent to preserve or give particular properties to something.

tuff—A fine-grained rock composed of ash or other material formed by volcanic explosion or aerial expulsion from a volcanic vent.

vadose zone—The portion of Earth between the land surface and the water table.

viewshed—The extent of an area that may be viewed from a particular location. Viewsheds are generally bounded by topographic features such as hills or mountains.

water column—The difference between the current non-pumping water level and depth to the base of the well screen within the primary production zone.

water table—The boundary between the unsaturated zone and the deeper, saturated zone. The upper surface of an unconfined aquifer.

watt—A unit of power equal to 1 joule per second.

wattle—A tube, typically of rice straw, used for erosion control, sediment control and stormwater runoff control.

wetland—Wetlands are "... those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" (33 Code of Federal Regulations 328.3).

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