



DOE/EA-2005

**Draft Environmental Assessment for
Chromium Plume Control Interim
Measure and Plume-Center
Characterization,
Los Alamos National Laboratory,
Los Alamos, New Mexico**

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U.S. Department of Energy
Environmental Management
Los Alamos Field Office

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) Environmental Management follows the Council on Environmental Quality 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 alternative 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.

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. Recent groundwater monitoring well sampling data show increasing chromium concentrations on the plume edges (sidegradient and downgradient), which is indicative of plume migration. In accordance with the Compliance Order on Consent (Consent Order) with the New Mexico Environment Department (NMED), the U.S. Department of Energy (DOE), and Los Alamos National Security, LLC, the LANL management and operating contractor, are required to assess, identify, clean up, and otherwise address contamination at LANL.

DOE's proposed action is to conduct an interim measure to control plume migration and maintain the 50 ppb and greater chromium contamination level within the LANL boundary while long-term corrective action remedies are evaluated and implemented. DOE also proposes to conduct field-scale studies to further characterize the plume center to evaluate the effectiveness and feasibility of implementing a final remedy for the chromium plume. These actions would rely on using infrastructure already in place as a result of ongoing investigations of the chromium plume as well as installing new infrastructure. Existing infrastructure includes a groundwater extraction well; 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. For the proposed action, new infrastructure would include installation of the following:

- Up to 2 additional groundwater extraction wells, approximately 1,000 feet deep;
- Up to 6 injection wells (gravity-fed injection of treated water), approximately 1,000 feet deep;
- Up to 24 alluvial piezometers, up to 40 feet deep;
- 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 covering an area approximately 50 acres, potentially supplemented by mechanical evaporators;
- Buried piping;
- Unpaved access roads; and
- Power lines.

During the proposed action, groundwater extraction would occur at up to three extraction wells, in addition to small volumes periodically extracted at monitoring wells. The total groundwater extraction volume would be up to 230 million gallons (707 acre-feet) annually over the approximately 8-year duration of the project. This water would be treated to ensure that all constituents meet NMED Ground Water Quality Bureau permit requirements before injection into the aquifer through the injection wells, land application using the spray irrigation/evaporation system or water trucks along unpaved access roads, or mechanical evaporation. An option to the proposed action was also evaluated where all treated water would be dispositioned through land application and/or mechanical evaporators; in the event that injection is not feasible, the amount of water pumped would be reduced accordingly.

In addition to the proposed action, DOE evaluated a no action alternative whereby activities under the Consent Order would continue but without the installation of any new extraction or injection wells to control plume migration nor evaluation of potential long-term actions to fully remediate the chromium plume. Alternatives to the proposed action that were considered, but were determined not to meet the project purpose and need, included monitored natural attenuation and in situ treatment; however, one or both of these alternatives could be part of 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 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.
- **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 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 under the proposed action would not increase the flow of contaminants into groundwater.
- **Surface water**—Stormwater runoff from activities would be controlled through best management practices; effects on surface-water quality or quantity would be minimal.
- **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.
- **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 under the proposed action are not likely to affect the Mexican spotted owl, migratory birds, other sensitive species, or floodplain/riparian habitat.

- **Cultural resources**—Historic properties would be avoided during proposed action activities, including construction, 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.
- **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.
- **Traffic and transportation**—Only small amounts of traffic would be generated by proposed action activities; effects on traffic would be negligible.
- **Hazardous materials and waste generation**—Small quantities of construction debris, approximately 30 gallons per year of hazardous waste, and approximately 50,000 gallons 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.
- **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.
- **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.
- **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.
- **Environmental justice**—Pueblo de San Ildefonso residents would be considered a minority population for purposes of identifying environmental justice concerns. Because

the proposed action 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 the proposed action has no other significant environmental impacts, the proposed action would not result in disproportionately high and adverse effects to residents of the Pueblo.

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ACRONYMS AND ABBREVIATIONS

ACHP	Advisory Council on Historic Preservation
AEI	area of environmental interest
AIRFA	<i>American Indian Religious Freedom Act</i>
amsl	above mean sea level
APE	area of potential effects
AQCR	Air Quality Control Region
CAA	<i>Clean Air Act</i>
CEQ	Council on Environmental Quality
CFR	<i>Code of Federal Regulations</i>
CME	corrective measures evaluation
Consent Order	Compliance Order on Consent
CRMP	Cultural Resource Management Plan
DART	days away, restricted, or transferred
dBA	A-weighted decibels
dbh	diameter at breast height
DOE	U.S. Department of Energy
EA	environmental assessment
EM	Environmental Management (DOE)
EM-LA	Environmental Management, Los Alamos Field Office
EO	Executive Order
EP	Environmental Programs (LANL)
EPA	U.S. Environmental Protection Agency
ESA	<i>Endangered Species Act</i>
°F	degrees Fahrenheit
FR	<i>Federal Register</i>
gpm	gallons per minute
HMP	Threatened and Endangered Species Habitat Management Plan
LADPU	Los Alamos Department of Public Utilities
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security, LLC
MBTA	<i>Migratory Bird Treaty Act</i>

NAAQS	National Ambient Air Quality Standards
NAGPRA	<i>Native American Graves Protection and Repatriation Act</i>
NEPA	<i>National Environmental Policy Act</i>
NHPA	<i>National Historic Preservation Act</i>
NM 4	New Mexico State Road 4
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMSA	New Mexico Statutes Annotated
NMWQCC	New Mexico Water Quality Control Commission
NNSA	National Nuclear Security Administration
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
ppb	parts per billion
RCRA	<i>Resource Conservation and Recovery Act</i>
SDWA	<i>Safe Drinking Water Act</i>
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SWEIS	Site-Wide Environmental Impact Statement
SWPPP	Stormwater Pollution Prevention Plan
T&E	threatened and endangered
TRC	total recordable cases
U.S.	United States
U.S.C.	<i>United States Code</i>
USFWS	U.S. Fish and Wildlife Service

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.

air-quality-control region—Geographic subdivisions of the U.S., designed to deal with pollution on a regional or local level. Some regions span more than one state.

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

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

ambient—Surrounding.

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.

arroyo—A steep-sided gully cut by running water in an arid or semiarid region.

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.

biostimulant—A food source to feed microorganisms already present in the groundwater; the microorganisms ultimately break down contaminants in the plume.

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.

corehole—The hole drilled to retrieve a core sample.

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 (DOE) that establish DOE 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.)

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.

geotextile matting—A permeable matting which, when used in association with soil, has the ability to separate, filter, reinforce, protect, or drain.

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* (RCRA). To be considered hazardous, a waste must be a solid waste under RCRA and must exhibit at least one of four characteristics described in 40 *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).

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.)

Miocene—The epoch in the geologic timescale extending from about 23 million to 5.3 million years ago.

mitigate—To (1) avoid an impact altogether by not taking a certain action or parts of an action; (2) minimize impacts by limiting the degree or magnitude of an action and its implementation; (3) rectify an impact by repairing, rehabilitating, or restoring the affected environment; (4) reduce or eliminate the impact over time by preservation and maintenance operations during the life of an action; or (5) 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.

Pliocene—The epoch in the geologic timescale extending from about 5.3 million to 2.6 million years ago.

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.

raptor—A bird of prey that hunts and feeds on other animals.

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.

rhyolite—An igneous, volcanic rock, of felsic (silica-rich) composition.

riparian—Of, on, or relating to the banks of a natural course of water.

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.

sidegradient—The portion of groundwater flow off of, or adjacent to, the main direction of flow.

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.

Theis equation—An analytical solution for radial flow that provides estimates of drawdown at varying distances from a well pumping at a constant rate. Information required to estimate drawdown at existing wells with the Theis equation includes the distance from the pumping well to the existing well, the pumping rate, aquifer transmissivity, and storage coefficient.

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—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.

volcaniclastic—Rocks consisting of volcanic material that has been transported and reworked through mechanical action, such as by wind or water.

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).

1.0 PURPOSE AND NEED FOR AGENCY ACTION

1.1 INTRODUCTION

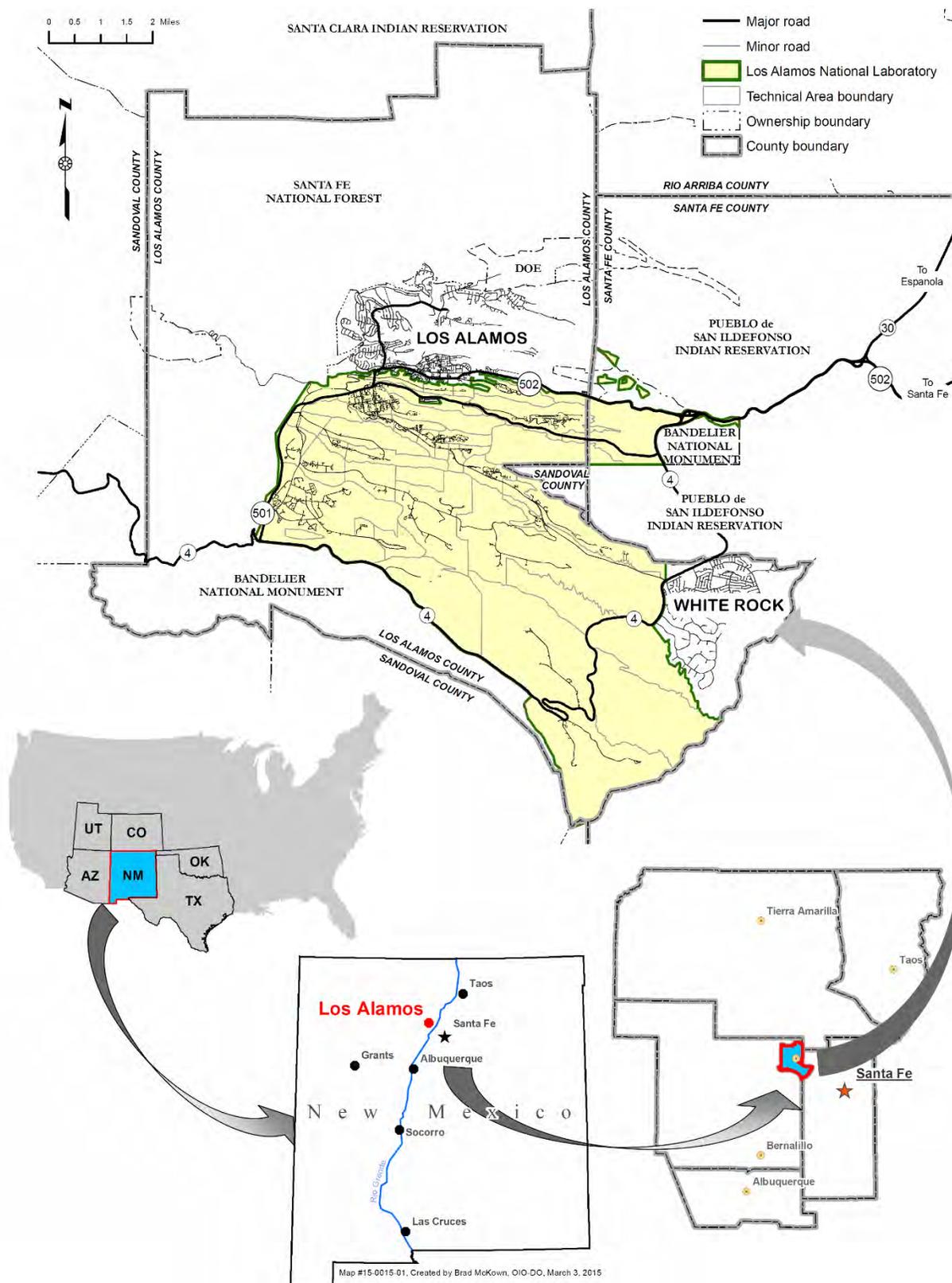
Los Alamos National Laboratory (LANL) is a multidisciplinary research facility, owned by the U.S. Department of Energy (DOE) and managed and operated by Los Alamos Nuclear Security, LLC (LANS), located in north-central New Mexico approximately 60 miles northeast of Albuquerque and 20 miles northwest of Santa Fe, within the incorporated County of Los Alamos (also referred to as Los Alamos County) and Santa Fe County (Figure 1-1). The LANL site consists of an area of approximately 39 square miles, mostly on the Pajarito Plateau, a series of mesas separated by eastward-draining canyons. It also includes part of White Rock Canyon along the Rio Grande to the east. The two primary residential areas within Los Alamos County are the Los Alamos townsite and the White Rock residential area. These two residential areas are home to approximately 17,000 people. Approximately 10,200 people work at LANL, of which roughly one-third reside in Los Alamos County.

Samples from wells in Mortandad Canyon at LANL show the presence of chromium contamination in groundwater at concentrations exceeding the New Mexico drinking water standard of 50 parts per billion (ppb). DOE seeks to implement measures to address the chromium contamination. Specifically, DOE proposes an action consisting of two activities. The first activity, a chromium plume control interim measure, would be implemented to control chromium migration within the groundwater. The second activity, plume-center characterization, would be implemented to evaluate the feasibility of potential long-term actions to fully remediate the chromium plume.

The *National Environmental Policy Act* of 1969 (NEPA), as amended (42 *United States Code* [U.S.C.] 4321 et seq.), requires federal agencies to consider the environmental consequences of proposed actions before making decisions. In complying with NEPA, DOE's Office of Environmental Management (EM) follows the Council on Environmental Quality (CEQ) regulations (40 *Code of Federal Regulations* [CFR] 1500-1508) and DOE's NEPA implementing procedures (10 CFR 1021). In accordance with NEPA requirements and implementing procedures, this environmental assessment (EA) of the proposed DOE action and alternative 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.

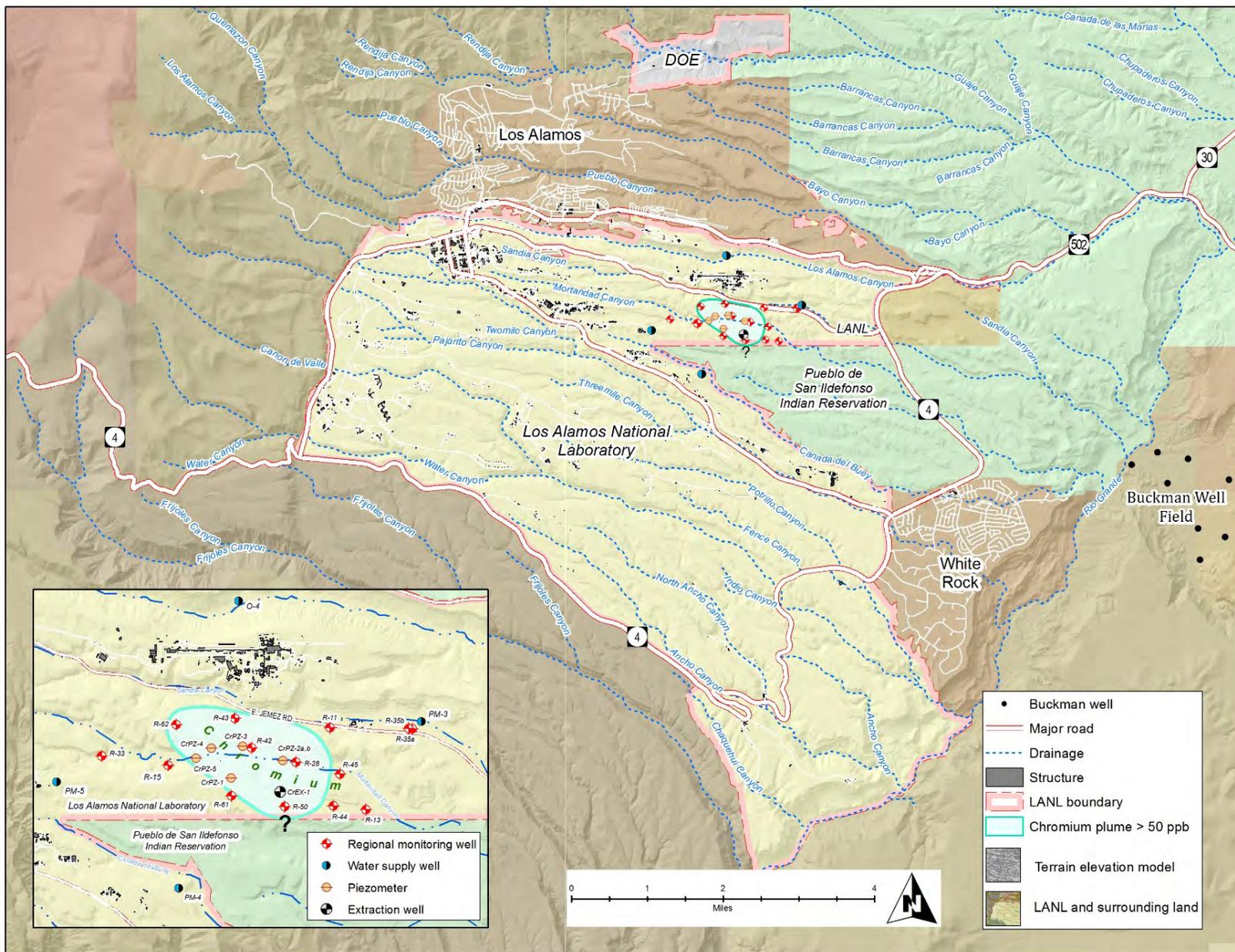
1.2 BACKGROUND

In 2005 and 2006, groundwater samples collected from a new groundwater monitoring well in the regional aquifer beneath Mortandad Canyon at LANL indicated the presence of chromium contamination (Figure 1-2). Subsequent investigations determined that the chromium originated as potassium dichromate, which had been historically used (from 1956 to 1972) as a corrosion inhibitor at LANL's power plant at the head of Sandia Canyon. The chromium was released to the environment in cooling-tower water discharged as part of operational maintenance activities.



Source: LANL Original

Figure 1-1. Location of Los Alamos National Laboratory and nearby residential areas



Source: LANL Original

Figure 1-2. Regional setting of chromium plume (>50-ppb concentration) in Mortandad Canyon

Estimates of the amount of hexavalent chromium (chromium) released during those years range from 31,000 to 72,000 kilograms. Approximately 25 to 40 percent of the chromium was quickly converted to stable trivalent chromium in a several-acre effluent-supported wetland downstream of the outfall in Sandia Canyon. The remaining chromium was transported via surface water for approximately 2 miles beyond the wetland, ultimately infiltrating vertically through a geologically complex 800-foot vadose zone and resulting in a chromium plume in the regional aquifer beneath Mortandad Canyon¹.

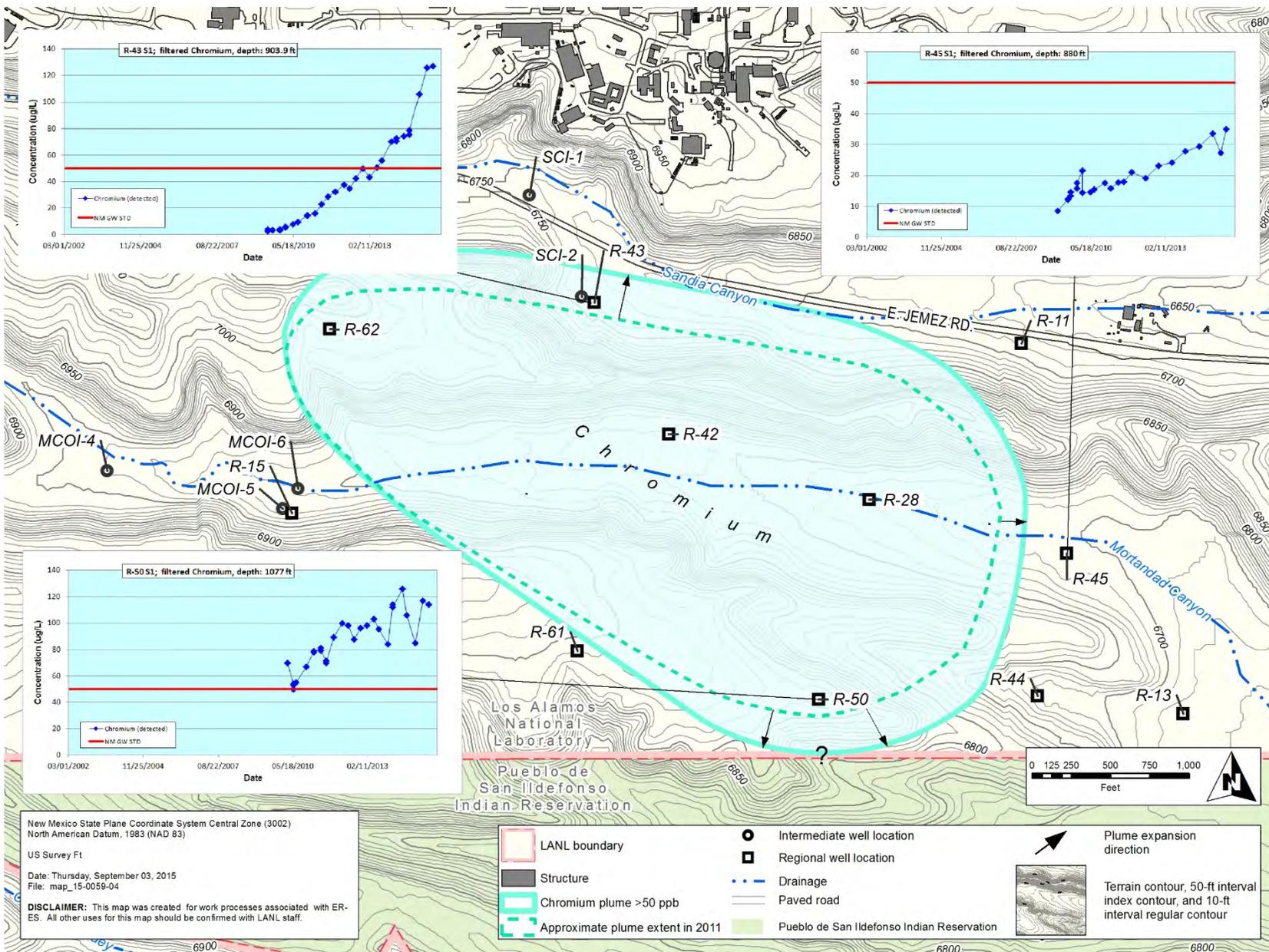
Based on groundwater sampling, the chromium plume has a footprint of less than 1 square mile at concentrations greater than the 50-ppb New Mexico groundwater standard² (Figure 1-2) and is limited to the upper 50 to 75 feet of the aquifer. Chromium concentrations in the plume center are as high as approximately 1,000 ppb. Recent groundwater monitoring well data show increasing chromium concentrations on the plume edges (sidegradient and downgradient), which are indicative of plume migration (Figures 1-3 and 1-4). Chromium migration occurs at a slower rate than groundwater flow because of several factors that retard its migration (U.S. Environmental Protection Agency [EPA] 1999). Groundwater flow velocities in the plume area generally range from approximately 30 to 60 feet per year. The specific rate of chromium migration at the downgradient plume edge is likely substantially less than that, but is not quantified.

The groundwater beneath Mortandad Canyon also has perchlorate contamination locally above the screening level of 4 ppb (LANL 2006a; Figure 1-4). The primary source of perchlorate is from perchloric acid, a strong oxidizing acid used in actinide research and processing at facilities in the Mortandad Canyon watershed. Perchlorate was present in effluent discharged into Mortandad Canyon. Starting in 2002, improvements in perchlorate removal technology were made at the LANL Radiological Liquid Waste Treatment Facility resulting in substantial decreases in perchlorate concentrations in effluent. The perchlorate contamination is not being specifically addressed as part of the proposed action but will be incorporated into final remediation strategies proposed at a future date.

Since 1989, the DOE EM has annually funded the Environmental Program (EP) at LANL to complete the cleanup of the environmental legacy contamination brought about from seven decades of nuclear weapons development and management as well as government-sponsored nuclear science and energy research. This legacy cleanup work is conducted under the Compliance Order on Consent (Consent Order) by the DOE EM, Los Alamos Field Office (EM-LA). In March 2005, DOE and the University of California (then the management and operating contractor for LANL) signed the Consent Order with the New Mexico Environment Department (NMED 2012, as revised). The purposes of the Consent Order are (1) to fully determine the

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.

² The stated maximum acceptable limit for chromium in groundwater per the New Mexico groundwater standard (New Mexico Administrative Code [NMAC] 20.6.2) is 0.05 milligrams per liter. For readability, this environmental assessment specifies concentrations in ppb (0.05 milligrams per liter is equivalent to 50 ppb).



Source: LANL Original

Figure 1-3. Migration of chromium plume since 2011 (>50-ppb concentration)

nature and extent of releases of contaminants at or from LANL; (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 contaminants at or from LANL; and (3) to implement such corrective measures. NMED reviews all work plans, schedules, reports, or other deliverable documents, and may either approve the document as submitted, approve it with modifications, or disapprove the document.

1.3 PURPOSE AND NEED

The purpose and need for DOE's action is to limit downgradient migration of the chromium plume edge in the regional aquifer. Recent data indicate that, in the absence of any action, plume migration will continue toward the boundary LANL shares with Pueblo de San Ildefonso. DOE therefore needs to employ a measure that can be quickly operational with rapid effect on plume migration. DOE also needs to evaluate the effectiveness and feasibility of implementing a final remedy for the chromium plume by conducting field-scale studies to further characterize the plume center.

1.4 RELEVANT NEPA DOCUMENTS AND SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

In 2008, DOE prepared the *Final Site-Wide Environmental Impact Statement for Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico* ([SWEIS] DOE 2008). The SWEIS documents 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). However, as actions required under the Consent Order are refined through continued investigations and approved by NMED, the specific locations and nature of many of these future actions were unknown at the time the SWEIS was prepared, and the scope and scale of these activities could not be analyzed in detail.

The SWEIS remains the primary document under which DOE and LANS perform Consent Order activities because those activities fall within the bounds of the SWEIS analysis. 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 chromium plume control interim measure and plume-center characterization because the scale of the activity is not clearly bounded by the SWEIS. In an effort to present material in a clear and concise manner, this EA incorporates information (tiers) from the SWEIS; where relevant, information from the SWEIS is either summarized in this EA or incorporated by reference.

Prior actions related to investigation of the chromium plume were analyzed as general Consent Order actions within the 2008 SWEIS or were determined to meet the criteria for a categorical exclusion in 2014 (DOE 2014a). These previously analyzed actions include installation, placement, and/or operation of the following elements:

- Extraction well CrEX-1, with well pad

- Five coreholes/piezometers, CrCH-1/CrPZ-1 through CrCH-5/CrPZ-5, with pads
- Eighteen 20,000-gallon portable storage tanks
- Three portable treatment units
- Eight lined water storage basins
- One 4-inch-diameter pipeline, approximately 1,070 feet long, from CrEX-1 to the treatment system
- An unpaved road into Mortandad Canyon and unpaved roads to infrastructure elements
- 13.2-kilovolt power lines
- Monitoring wells
 - Intermediate-level groundwater (Mortandad Canyon): MCOI-5, MCOI-6
 - Regional aquifer (Mortandad Canyon): R-1, R-13, R-15, R-28, R-42, R-44, R-45, R-50, R-61, R-62
 - Intermediate-level groundwater (Sandia Canyon): SCI-1, SCI-2
 - Regional aquifer (Sandia Canyon): R-11, R-35a, R-35b, R-36, R-43
- Irrigation system for treated effluent

This EA does not include an analysis of a final remedy addressing the chromium groundwater plume. The proposed action consists of activities associated with the plume control interim measure or plume-center characterization and does not involve the specific selection or implementation of a final remedy. Rather, evaluations and analyses performed during proposed action implementation would contribute to recommendations of a final remedy. Through the corrective measures evaluation (CME) process, those recommendations would be presented to NMED. NMED would then select a remedy or remedies. The interim measure would control downgradient migration of the plume while a final remedy is selected and implemented. When NMED has selected the final remedy, DOE would perform a NEPA evaluation.

1.5 PUBLIC INVOLVEMENT

In accordance with DOE NEPA Implementing Procedures 10 CFR 1021.301(c), DOE provided written notification of this EA on June 19, 2015, to Jemez Pueblo, Pueblo de Cochiti, Pueblo de San Ildefonso, Santa Clara Pueblo, the State of New Mexico, and Los Alamos County. In accordance with 10 CFR 1021.301(d), DOE will provide the state and tribes with an opportunity to review and comment on the EA before DOE finalizes the EA. DOE has also notified a broader list of stakeholders and provided the opportunity for comment. The public review period for this EA is 30 days after its publication, after which DOE will consider all comments received before modifying or approving the EA. Additional information regarding consultation and coordination is provided in Section 7.0.

2.0 DESCRIPTION OF ALTERNATIVES

2.1 INTRODUCTION

This section of the EA provides a discussion of the alternatives considered for addressing chromium-plume migration while determining a final remedy for the entire plume. Specifically, this section describes

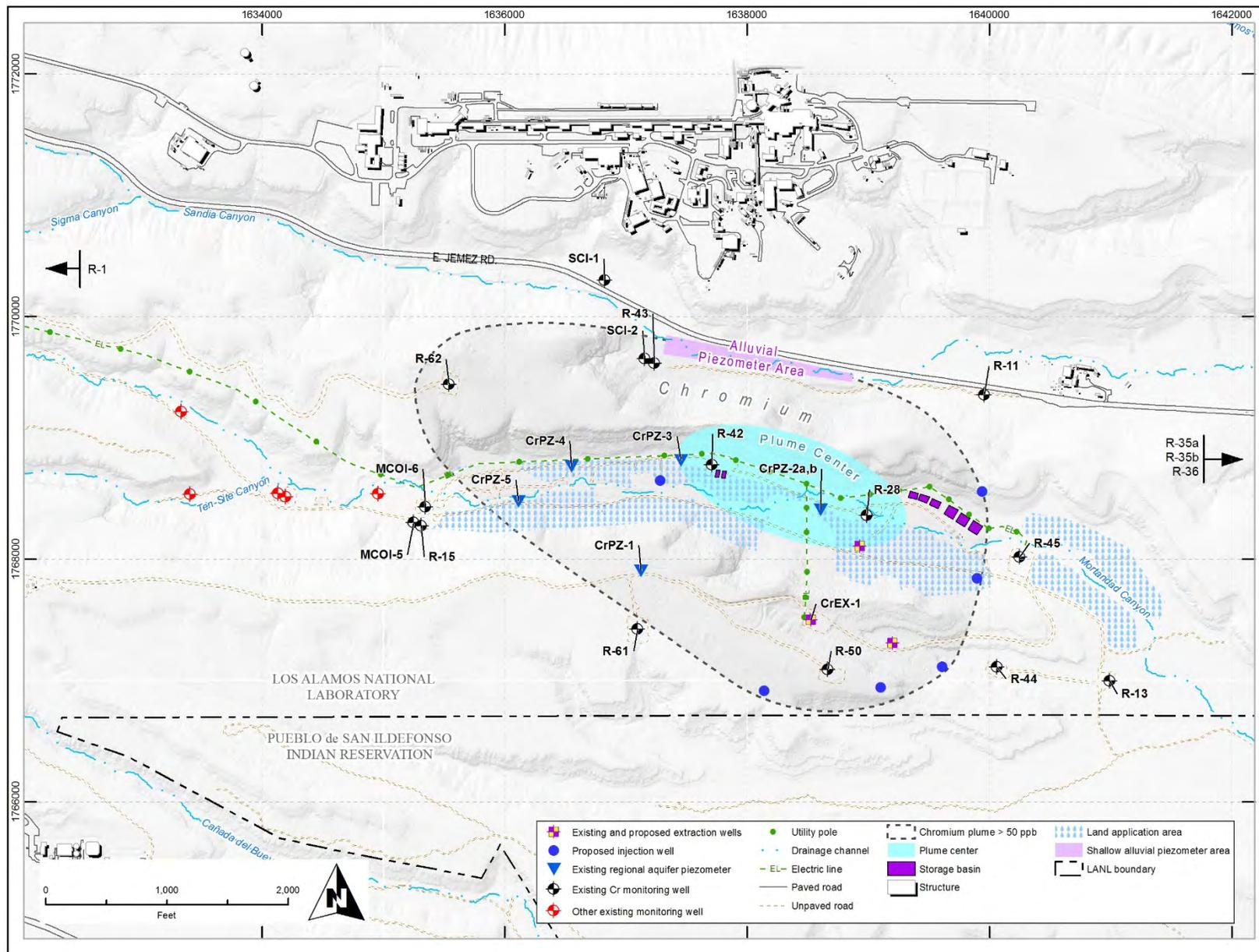
- The proposed action for a chromium plume control interim measure and plume-center characterization;
- A “no action” alternative; and
- Alternatives considered but not evaluated in this EA.

2.2 PROPOSED ACTION ALTERNATIVE

DOE proposes to implement project activities to begin addressing and further evaluating chromium contamination in groundwater beneath Mortandad Canyon. This proposed action alternative consists of two activities: chromium plume control (interim measure) and plume-center characterization. Brief summaries of these activities are provided in the paragraphs below; detailed descriptions are provided in subsequent sections.

Activities under the proposed action alternative would take place primarily within Mortandad and Sandia Canyons, including adjacent mesas and mesa slopes. Figure 2-1 shows the greater-than-50-ppb plume footprint and the general locations of the major infrastructure elements. Some of this infrastructure is already in place from previous investigations of the chromium plume, including one extraction well, five monitoring wells, five piezometers, water treatment system infrastructure (e.g., tanks, manifold, storage basins, pumps, power lines), and unpaved access roads. Major project infrastructure to be installed and operated under the proposed action alternative includes:

- Up to 2 additional groundwater extraction wells, approximately 1,000 feet deep;
- Up to 6 injection wells (gravity-fed injection of treated water), approximately 1,000 feet deep;
- Up to 24 alluvial piezometers, up to 40 feet deep;
- 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 covering an area approximately 50 acres, potentially supplemented by mechanical evaporators;
- Buried piping;
- Unpaved access roads; and
- Power lines.



Source: LANL Original. Note that the actual locations of wells and other planned project infrastructure elements may vary slightly from locations shown in this figure because of topography, geotechnical factors, and avoidance of sensitive ecological or cultural resources.

Figure 2-1. Plume footprint and existing and generalized proposed locations of project infrastructure

The first activity, the chromium plume control interim measure, would be implemented to control the migration of the chromium plume near the LANL boundary. Plume control would be achieved using extraction and injection wells to hydraulically control groundwater flow. Chromium would be removed from extracted water via a treatment system before the water is injected into the aquifer, land-applied, or evaporated. It is anticipated that once hydraulic control of the plume has been achieved, intermittent operation of the extraction and injection wells would be used to maintain hydraulic control of the plume. Operation of this system would continue until a final remedy is proposed, selected, and implemented. It is anticipated it will take up to 8 years for this process, as DOE will need to (1) collect and evaluate data from both the interim measure and the plume-center characterization; (2) prepare and submit a CME report that recommends a final remedy, for NMED selection of a final remedy, and for the public to comment on the final remedy; (3) prepare a final design; and (4) implement the final remedy.

The plume control interim measure would use the existing extraction well CrEX-1 and the existing water treatment system infrastructure (e.g., tanks, manifold, storage basins, pumps, power lines) and would require installation of injection wells and, potentially, an additional extraction well. Piping and mechanical infrastructure for the injection wells and potential new extraction well would be required. The majority of the piping would be buried to protect against freezing. The interim measure would be conducted under a work plan approved by NMED. The work plan was submitted to NMED for review in May 2015 (LANL 2015a).

The second activity, plume-center characterization, would be implemented to evaluate various longer-term actions to fully remediate the chromium plume. The characterization activities would require the installation of an additional extraction well and the use of additional temporary tanks and sampling/monitoring equipment. Existing infrastructure would also be used. It is expected that this characterization activity would be completed within the first few years of the estimated 8-year period of operation of the plume control interim measure. The characterization would be implemented under a work plan approved by NMED. The work plan was submitted to NMED for review in July 2015 (LANL 2015b).

The two proposed project activities would be implemented in accordance with regulatory processes under the Consent Order with NMED. Neither activity under the proposed action alternative would include implementation of a final remedy for addressing the chromium groundwater contamination. Rather, the results and analyses from the proposed action alternative would be used to develop recommendations for a final remedy to be presented to NMED for approval in accordance with the CME process, as described in the Consent Order.

2.2.1 CHROMIUM PLUME CONTROL INTERIM MEASURE

The chromium plume control interim measure would be implemented using a method of hydraulic capture that includes a configuration of extraction wells and injection wells to control migration of chromium contaminated groundwater. One extraction well, CrEX-1, exists. The proposed activity includes an additional extraction well (for a total of two extraction wells) and the installation of up to six injection wells and related infrastructure. The extraction wells and

injection wells would be located within, or immediately adjacent to, Mortandad Canyon. The proposed well locations are shown in Figure 2-1.

The priority locations for installation of injection wells are those along the southern edge of the plume near the LANL property boundary with the Pueblo de San Ildefonso. LANS is currently evaluating the use of angle drilling technology to install the injection wells along the southern plume edge so that wells could be drilled using existing well pads. If angle drilling is demonstrated to be a technically viable approach, not all of the potential pads would be constructed. In the event that changes are necessary to meet the objectives, additional NEPA analysis may be performed.

Until injection wells are operational, treated water would be land-applied or evaporated as a means of disposition. Once injection wells are operational, a small portion of the treated water would continue to be land-applied via a spray irrigation/evaporation system, used for dust control on unpaved roads, and/or evaporated using mechanical evaporators.

Depending upon the outcome of NMED's review and comments on the work plans, changes may be required. Should the changes be outside the bounding conditions in the EA, they would need to be evaluated for possible environmental impacts.

Major Infrastructure Components and Operations

Access roads to the new extraction and injection wells would be unpaved, generally 12- to 15-foot wide, with a maximum width of 24 feet. Stormwater controls, including wattles, ditches, and/or culverts, would be installed to minimize runoff. Base course, possibly supplemented by geotextile, would be used for the road surface. New and existing access roads would require maintenance, including additional base course.

Before a vertical extraction or injection well is installed, it would be necessary to install a well pad³ by grading an area and covering it with base course. For angle-drilled extraction or injection wells, existing well pads would be used, when possible. The well pad would be used to stage equipment such as drill rigs, generators, light plants, pumps, well casing, water tanks, a small supply trailer, and support trucks during well installation. Each extraction and injection well pad (vertical or angle drilled) would have lined pits for containing drilling mud, drill cuttings, and water. Drill cuttings would be sampled to determine whether they could be land-applied. The pits would be backfilled once the water has evaporated and cuttings are dry enough to compact. Stormwater Pollution Prevention Plans (SWPPPs)⁴ require stormwater controls to be in place during drilling and until the site is stabilized following well installation. Accordingly, the pads would also have stormwater controls incorporated into the design to minimize runoff. When a

³ Well pads provide a flat, stable surface for the drill rig to operate on and remove combustible materials such as grass and brush from the area to prevent fires from welding operations.

⁴ A SWPPP is prepared for activities resulting in ground disturbance of more than 1 acre. The SWPPP describes the nature and sequencing of activities, potential sources of pollution, and identifies the best management practices to minimize the potential for erosion and stormwater pollution. SWPPPs would be developed by LANS in accordance with provisions of the *Clean Water Act* (33 U.S.C. 1251-1387, as amended), and regulations established by EPA.

well pad is no longer needed for equipment, it would be reduced in size and revegetated. New stormwater controls would be integrated into the footprint of the new well pad.

Ultimately, an extraction or injection well would have a completed well head, associated valves and instrumentation, and a related electrical panel. Extraction and injection wells would be fitted with concrete aprons. Portable storage tanks would be located on each well pad. Electric lines would be installed to the extraction and injection wells for operation. Use of portable generators is likely only for short periods during well installation and development.

Chromium would be removed from extracted groundwater to less than 50 ppb via processing through a treatment system. The treated groundwater would meet the requirements included in a discharge permit approved by NMED before land application, evaporation, or injection into the regional aquifer. The additional water treatment system capacity needed to support the potential new extraction well would be gained by increasing operational hours of the existing system in lieu of physically expanding the treatment system.

The treatment system is designed to be modular and uses portable components, allowing for process changes and system maintenance. These components are located inside portable structures to protect them from damage and to allow them to be located near extraction wells or at a centralized treatment location near well R-28. Portable storage tanks and other containers would be painted to minimize visual impact. The water would be processed through the treatment system and pumped to the injection wells or stored pending land application or evaporation.

Most of the treated water would be returned to the aquifer via the injection wells. Until the injection wells are operable, treated water would be land-applied and/or evaporated. Treated water would be stored in existing synthetically lined storage basins in Mortandad Canyon, then conveyed through an existing system of basin pumps and piping for disposition by any of the following methods: (1) irrigation-type sprinklers using an array of sprinkler heads, (2) mechanical evaporators, or (3) 3,000- to 10,000-gallon water trucks with high-pressure sprayers. The area for land application by the irrigation system or evaporation is shown in Figure 2-1. The water trucks would apply treated water to unpaved roads and road shoulders in Mortandad Canyon up to 100 feet either side of the center line, except in cultural areas. Use of the irrigation system and/or mechanical evaporators would be prioritized over use of water trucks to minimize vehicle traffic. A small portion of treated water could be land-applied and/or evaporated throughout the project. The storage basins would be retained for short-term storage of treated water if injection wells are temporarily out of service. Based on experience to date with the existing treatment system in Mortandad Canyon, treated effluent meets all limits for contaminant concentrations specified in the NMED Ground Water Quality Bureau discharge permit.

In addition to vegetation removal for new well pad or road development, vegetation would be cleared to mitigate wildfire potential. This would involve mowing the weeds/grasses along the roads and well pads as well as removing any hazard trees in accordance with the *Environmental Assessment for the Wildfire Hazard Reduction and Forest Health Improvement Program at*

Los Alamos National Laboratory, Los Alamos, New Mexico (DOE 2000) and the LANL Habitat Management Plan (Hathcock et al. 2014b). If a tree needed to be removed, it would be ground up on-site and used as grub for stormwater controls. The proposed laydown areas for the project would be at existing pads or previously disturbed areas.

2.2.2 PLUME-CENTER CHARACTERIZATION

The plume-center characterization activity would involve a series of field tests to collect detailed information on processes within the aquifer that would guide the approach for full remediation of the plume. Field tests would be conducted using existing infrastructure as well as new infrastructure described below.

One of the field tests would involve the installation of a third extraction well to test the feasibility of optimized removal of chromium from the high-concentration portion (center) of the plume as a potential final remedy. The operational mode would likely include pumping for various durations (typically months) at different pumping rates (e.g., 50, 100, 150 gallons per minute [gpm]) for an overall testing period of approximately 2 years. These pumping tests would involve treating pumped water and dispositioning the water using the same treatment infrastructure and injection wells as described for the chromium plume control interim measure, above. Data from this testing would provide insight into the feasibility and design of a potential chromium removal pump-and-treat system or in situ remedial alternatives presented in the CME report.

Another field test would involve use of existing piezometers to conduct cross-hole studies. These piezometers were installed for water-level monitoring and occasional water-quality sampling from the regional aquifer. These tests would involve injection at the piezometers and monitoring at nearby monitoring wells. These studies would use tracers and/or chemicals or biostimulants to evaluate the feasibility of in situ remedies to convert chromium to the stable, nonmobile, nontoxic trivalent form. Pumping may occur in the monitoring wells to draw tracer towards the well. Pumped water would be treated in accordance with permits. Monitoring well pumping would be conducted at rates between 3 and 30 gpm. Introduction of any compounds into the aquifer as part of these tests, or other tracer tests, would be implemented under approved permits from NMED.

Potential short-term tests may be conducted at existing or new monitoring wells and piezometers in the project area.

Measuring shallow water levels for additional characterization of the hydrologic system would require installation of up to 24 individual shallow alluvial piezometers in Sandia Canyon. The 24 piezometers would be used to characterize lateral and vertical variability within the shallow alluvium in the canyon floor and would vary in depth with a maximum depth of approximately 40 feet. The piezometers would be installed on terraces on either side of the channel in lower Sandia Canyon within 24 separate boreholes of varying depth or bundled in a lesser number of boreholes within the proposed piezometer installation area. The piezometers would be installed with a concrete pad but would not require additional infrastructure.

Major Infrastructure Components

The only major infrastructure associated with the characterization studies would be the new extraction well, well pad, storage tank, pumps, and associated piping. The pad dimensions and associated elements would be as described in Section 2.2.1 for extraction and injection wells.

2.2.3 GROUNDWATER EXTRACTION VOLUMES

During the chromium plume control interim measure and plume-center characterization, groundwater extraction would occur from multiple wells. The total groundwater extraction volume would be up to 230 million gallons (707 acre-feet) annually over the approximately 8-year duration of the project.

2.2.4 INJECTION WELLS

Under the proposed action alternative, underground injection control wells (injection wells) would be installed to contribute to hydraulic control of the downgradient plume. The wells would inject treated groundwater into the aquifer in the same area and at similar depths from which the water was extracted. Groundwater modeling indicates that injection of treated water along the plume edge would facilitate hydraulic control near the injection wells (LANL 2015a). In addition to hydraulic control, injection of treated water supports groundwater resource conservation.

Operation of these injection wells would require a discharge permit (DP-1835) from the NMED Ground Water Quality Bureau. Treated water would flow from the portable storage tanks to the injection wells through single-walled piping. Water quality would be monitored post-treatment to ensure water injected into the aquifer meets permit standards. Injection wells would each have an injection capacity of approximately 75 gpm, with the system permitted to inject up to 648,000 gallons of water per day, or approximately 230 million gallons per year, with continuous system operation. Flow rates, pressures, and water levels for the injection wells would be remotely monitored and controlled. Injection would operate through gravity using a valve at the bottom of the injection well column pipe to control the release of the water into the well; water would fill the well and flow into the aquifer.

2.2.5 MONITORING

Both water-quality and pumping-volume monitoring would be required under the various permits issued by the State of New Mexico for extraction, treatment, injection, land application, and evaporation. Monitoring would consist of sampling treated water and aquifer metering for both extraction and injection to ensure the treatment system is performing as designed.

2.2.6 DECOMMISSIONING

At the conclusion of the proposed project, components not incorporated into the final remedy would be decommissioned. For example, unneeded storage tanks would be removed, pipelines

would be closed in place, storage basins would be backfilled (after the liners are removed and disposed), and the storage-basin area would be regraded and vegetated. Extraction and injection wells may be converted to monitoring wells if their original function is no longer needed. The specific decommissioning activities would be finalized after the final remedy is selected and designed.

2.2.7 EMPLOYMENT

Approximately 80 full-time-equivalent employees would be required to implement the proposed action alternative. Most of these employees would be existing staff assigned to the project on a full- or part-time basis and temporary subcontractors hired to support particular project tasks, support, and maintenance.

2.2.8 PROPOSED ACTION ALTERNATIVE WITHOUT INJECTION OPTION

As described in Sections 2.2.1, 2.2.2, and 2.2.4, treated water generated by activities under the proposed action alternative would be dispositioned through land application (especially in the early stages of the project), mechanical evaporators, and injection wells. However, if during implementation of the proposed action alternative, DOE determines that injection wells cannot be used (e.g., initial injection wells indicate that required injection rates cannot be sustained because of geotechnical/hydrological factors) or are less effective than modeled, then the project could disposition all treated water via land application and/or mechanical evaporators.

Land application and/or mechanical evaporators as the only means of treated water disposition would limit the cumulative pumping rate for all wells in the project area to approximately 55 million gallons (169 acre-feet) per 8-month period within a year as these disposition methods would be limited to 10 hours per day (per the requirements of the NMED discharge permit). Land application, via a spray irrigation/evaporation system and water truck for dust suppression on roads and well pads, or use of mechanical evaporators would be constrained to areas already identified within the project area (Figure 2-1).

2.3 NO ACTION ALTERNATIVE

Under the no action alternative, DOE would continue to perform activities under the Consent Order but would not install any new extraction or injection wells or related infrastructure to address chromium plume migration nor evaluate potential long-term actions to fully remediate the chromium plume. Accordingly, the chromium groundwater plume would be expected to continue to migrate.

Activities that would be conducted under the no action alternative include monitoring of existing wells to characterize the nature, extent, fate, and transport of contaminants and maintenance of existing infrastructure within Mortandad Canyon. Infrastructure in Mortandad Canyon installed to support pumping of CrEX-1 would remain in place; however, pumping of CrEX-1 would be limited to volumes required for monitoring and well maintenance. Under DOE's and LANS's continued Consent Order compliance activities, additional monitoring wells or piezometers may

be installed in the project area, if required by NMED. LANS would perform limited road maintenance (e.g., grading, drainage) to maintain access to existing wells in the project area.

2.4 ALTERNATIVES CONSIDERED BUT NOT EVALUATED

Other alternatives were considered in the development of potential actions to address the Mortandad Canyon chromium plume; however, these alternatives were eliminated from further consideration once it was determined they would not meet DOE's stated purpose and need. Further evaluation of these alternatives is not provided in this EA.

The other alternatives considered were as follows:

- **Monitored natural attenuation**—This approach relies on natural physical, chemical, or biological processes to reduce concentrations, toxicity, or mobility of chromium.
- **In situ treatment**—This approach involves the introduction of amendments directly into the aquifer to either favorably reduce the concentration or toxicity of the contaminants or to enhance naturally occurring biological processes that favorably reduce the concentration or toxicity of groundwater contaminants.
- **Proposed action alternative with treated effluent pipeline option**—Under this variant of the proposed action alternative, some or all treated groundwater would be pumped from the project area for reuse within LANL or for discharge to surface water. Treated water discharged to the surface could potentially be amended to enhance chromium reduction as it infiltrates into the aquifer.

DOE has determined that monitored natural attenuation alone would be insufficient to control plume advancement and maintain the 50-ppb-and-greater chromium-contamination levels within the LANL boundary, based on current concentrations and continued plume migration. Several existing monitoring wells, including one near the Pueblo de San Ildefonso boundary, have shown steadily increasing chromium concentrations for several years (LANL 2015c). Left unaddressed, the plume may expand beyond the LANL boundary, potentially complicating future remediation activities and increasing remediation cost. The specific rate of chromium migration is generally slower than that of groundwater flow and is not yet quantified at the plume edge; however, increasing concentrations at downgradient well R-50 provide clear evidence of plume migration.

Site-specific information on in situ treatment is currently being evaluated and will be available for consideration in the CME. In situ treatment is not evaluated in this EA as an alternative, because it would not be considered an interim measure. Evaluations of the effectiveness and feasibility of in situ treatment are ongoing, with larger, field-scale studies included in the proposed action alternative, plume-center characterization, described in Section 2.2.2.

The proposed action alternative with treated effluent pipeline option would have the benefit of providing a source of water for LANL to reuse, with any excess water discharged directly into Sandia Canyon via an existing, permitted outfall. Treated water discharged to the surface could potentially be amended to enhance chromium reduction as it infiltrates the aquifer. To implement this option, the outfall permit would need to be modified to accommodate a new source of water.

While some use of existing facilities would be possible, it was determined that considerable upgrades to pumping, storage, and control systems would be required. As the time frame for planning, designing, and constructing these improvements was estimated to be 2 to 3 years, this option was determined not to be effective in meeting the time frame requirements of the project.

Monitored natural attenuation, in situ treatment, and treated effluent conveyance through a pipeline may eventually be applied, all or in part, during remediation of the chromium plume. A final evaluation of technologies, including ranking and cost benefit, would be provided in a CME report to NMED. Sections 1.4 and 2.2 provide more information on the CME process.

3.0 AFFECTED ENVIRONMENT

3.1 INTRODUCTION

This section of the EA describes the natural and human environment that could be affected by implementing the proposed project. The environmental resources potentially affected are identified and addressed based on the “sliding-scale approach”⁵. Table 3-1 identifies the sections where environmental resources are discussed or notes why they are not addressed in this document.

Table 3-1. Potential environmental issues applicable to this EA

Resource Area	Applicability	Subsection
Land Use	Yes	3.3
Geology and Soils	Yes	3.4
Water Resources	Yes	3.5
Air Quality	Yes	3.6
Ecological Resources	Yes	3.7
Cultural Resources	Yes	3.8
Utilities and Infrastructure	Yes	3.9
Traffic and Transportation	Yes	3.10
Hazardous Materials and Waste Generation	Yes	3.11
Noise	Yes	3.12
Visual Resources	Yes	3.13
Human Health and Worker Safety	Yes	3.14
Environmental Justice	Yes	3.15
Socioeconomics	No. Activities under the proposed action alternative are projected to require approximately 80 full-time-equivalent employees, primarily existing LANS staff and short-term subcontractors; this is within the annual variability of LANS staffing and would have negligible effects on the local economy.	N/A

3.2 REGIONAL SETTING

The proposed activities would be located within the area of Los Alamos County that includes LANL. LANL covers a large portion of Los Alamos County and extends into Santa Fe County. LANL is situated on the Pajarito Plateau along the eastern flank of the Jemez Mountains (DOE 2008). The Pajarito Plateau slopes to the east, bounded to the west by the Sierra de los Valles and to the east by the valley of the Rio Grande (Broxton and Vaniman 2005). The Pajarito Plateau is eroded into a sequence of narrow, finger-like mesas separated by canyons. Mesa-top

⁵ The “sliding-scale approach” is the basis for the evaluation of potential environmental effects in this EA. In this approach, the EA focuses “on significant environmental issues and alternatives” and discusses impacts “in proportion to their significance” (DOE 2004).

elevations on the plateau range from approximately 7,900 feet along the Jemez Mountains to 6,200 feet at the edge of White Rock Canyon. The canyons are generally deeper and narrower in the western portion of the plateau and wider and shallower towards the east. The proposed project activities would be limited to the areas of Mortandad and Sandia Canyons, both of which are located along the southeastern border of LANL.

Los Alamos County is in a semiarid, temperate mountain climate characterized by seasonable, variable rainfall. Precipitation ranges from 10 to 20 inches per year and precipitation rates within the County decline toward the Rio Grande Valley. The town of Los Alamos is less arid (dry) than the area near the Rio Grande, which is arid continental. Mean temperatures range from 17.4 degrees Fahrenheit (°F) in January to 80.6 °F in July, with an extreme low temperature of -18 °F and an extreme high temperature of 95 °F. Normal temperatures (30-year mean) in the town of White Rock range from 14.6 °F in January to 85.6 °F in July (DOE 2011).

Precipitation in Los Alamos County during July and August is 36 percent of the annual average value due to thunderstorms. Los Alamos County averages 60 thunderstorms per year, with intense and frequent lightning that has caused fires. Flash flooding from heavy thunderstorms does occur in canyons and low-lying areas. Winter precipitation falls as snow, with an average snowfall of 59 inches. Snowfall levels vary year to year, ranging from 9 inches to 153 inches (DOE 2011).

Windspeed averages 7 miles per hour in Los Alamos County. As a result of storms and cold fronts, windspeeds are lowest in December and January and highest from March to June. Given the complex terrain surface, winds vary dramatically with time of day, location, and elevation (DOE 2011).

3.3 LAND USE

LANL is located on approximately 37 square miles (23,680 acres) and is divided into 47 contiguous technical areas with location and spacing that reflect the site's historical development patterns, regional topography, and functional relationships. The various technical areas are used for building sites, experimental areas, and waste disposal locations. In total, about 20 percent of the site is developed with facilities and structures; however, major constraints to development exist and include such factors as topography, slope, soils, vegetation, geology and seismology, climate, endangered species, archaeological and cultural resources, and surface hydrology. Undeveloped portions of the site provide security, safety, and expansion possibilities for future mission-support requirements (DOE 2011).

Land use at LANL falls into 10 categories (DOE 2011):

- **Administration, Service, and Support**—Areas used for administrative functions, services, and support for LANL management and employees.
- **Experimental Science**—Areas used for applied research and development activities tied to major programs.

- **High-Explosives Research and Development**—Areas used for research and development of new explosive materials. This land is isolated for security and safety.
- **High-Explosives Testing**—Large, isolated, exclusive-use areas required to maintain safety and environmental compliance during testing of newly developed explosive materials and new uses for existing materials. This land also includes exclusion and buffer areas.
- **Nuclear Materials Research and Development**—Isolated, secured areas for conducting research and development involving nuclear materials. This land use includes security and radiation hazard buffer zones. It does not include waste disposal sites.
- **Physical and Technical Support**—Includes roads, parking lots, and associated maintenance facilities; infrastructure such as communications and utilities; facility maintenance shops; and maintenance equipment storage. This land use generally is free from chemical, radiological, or explosives hazards.
- **Public and Corporate Interface**—Areas providing links with the general public and other outside entities conducting business at LANL, including technology transfer activities.
- **Reserve**—Areas that are not otherwise included in one of the other categories. It may include environmental core and buffer areas, vacant land, and proposed land transfer areas.
- **Theoretical and Computational Science**—Areas used for interdisciplinary activities involving mathematical and computational research and related support activities.
- **Waste Management**—Areas for activities related to the handling, treatment, and disposal of all generated waste products, including solid, liquid, and hazardous materials (chemical, radiological, and explosive).

Commercial and residential development in Los Alamos County is confined primarily to several mesa tops lying north of the core LANL development, in the case of the Los Alamos townsite, or southeast, in the case of the community of White Rock. The lands surrounding Los Alamos County are largely undeveloped wooded areas that are administered by the Pueblo de San Ildefonso, U.S. Department of Agriculture (Santa Fe National Forest); the U.S. Department of the Interior, National Park Service (Bandelier National Monument); the U.S. Department of the Interior, and Bureau of Land Management. (DOE 2005; see Figure 1-2). Land immediately adjacent to the project area on the north, east, and west are within the LANL boundary. The LANL boundary with Pueblo de San Ildefonso is immediately south of the project area (see Figure 1-2).

Access to the area of LANL near the project site is restricted. Infrastructure associated with previous work within the canyon, as well as investigation of the chromium plume, is currently at the site (see Figure 2-1). The remainder of the project area is undeveloped, with primarily grassland vegetation. Section 3.7.1 describes vegetation in the project vicinity.

3.4 GEOLOGY AND SOILS

3.4.1 GEOLOGY

Mortandad and Sandia Canyons are narrow canyons that head on the central part of the Pajarito Plateau. The canyons were cut by stream channel erosion through ash-flow/ignimbrite sequences of the Bandelier Tuff. Mortandad, Sandia, and other similar canyons in the area separate multiple linear mesas that parallel the stream channels.

The stratigraphic sequence of geologic units near the project area are associated with three assemblages of rock units (Figure 3-1). These include

- The Quaternary Bandelier Tuff and associated intervals;
- The Pliocene Cerros del Rio basalts and Puye Formation; and
- The Miocene Bearhead Rhyolite sediments and Chamita deposits.

In the project area, the regional aquifer occurs in the Puye Formation. Occurrence of groundwater is discussed in more detail in Section 3.5.1.

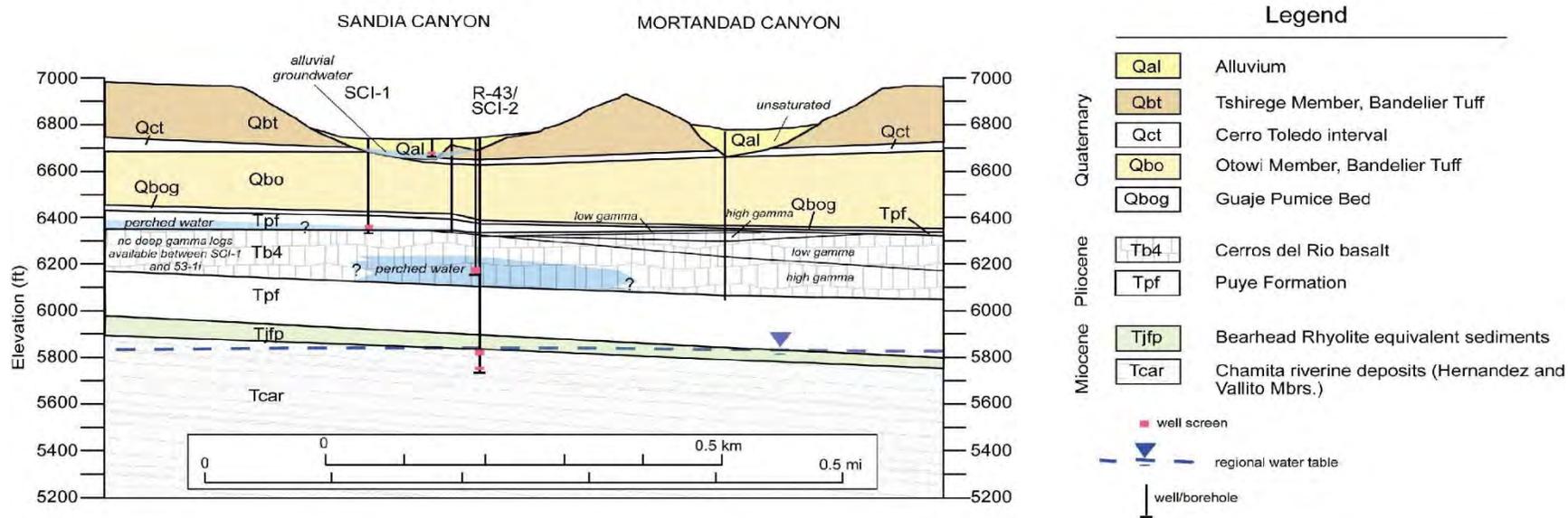
LANL is located in the seismically active Rio Grande Rift. The Pajarito fault system is part of the Rio Grande Rift structure and consists of the Pajarito, the Rendija Canyon and the Guaje Mountain Faults (Gardner and House 1987). The Pajarito Fault is identified in the U.S. Quaternary fault database (Kelson 1997). The Pajarito fault system and, secondarily, background earthquakes within the Rio Grande Rift, have been identified as potential seismic sources for seismic hazard investigations in the Pajarito Plateau.

3.4.2 SOILS

Soils and sedimentary deposits on mesa surfaces and adjacent canyons of the Pajarito Plateau show a complex history of both erosion and deposition inferred to be a result of climatic fluctuations (Reneau et al. 1996). 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 (Broxton and Vaniman 2005). Variability in soil erosion on mesa tops is controlled by the intensity of summer thunderstorm activity and is locally affected by vegetation cover.

Within the project area, over half of the area is identified as rock outcrop. Soil types identified in the remaining area include (Natural Resources Conservation Service 2015):

- Totavi loamy sand. These soils are formed from stream alluvium derived from tuff and are 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.
- 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



Source: adapted from LANL 2009a

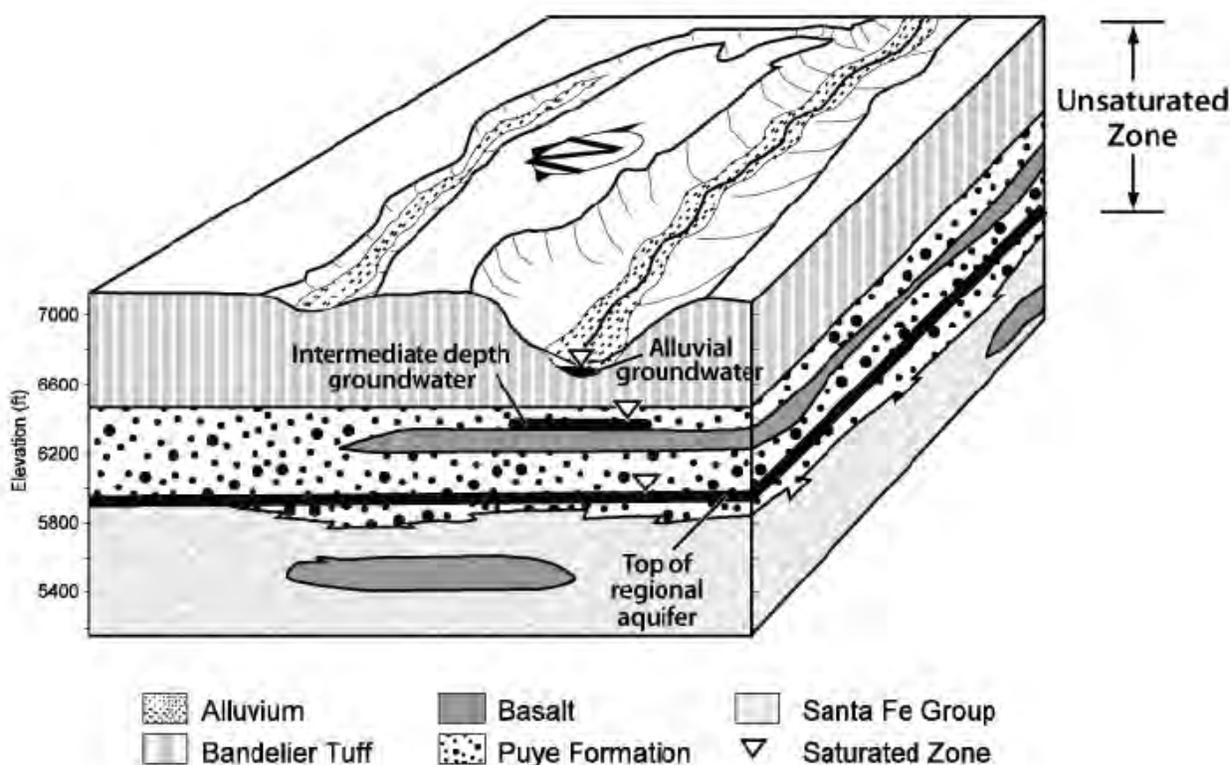
Figure 3-1. Geologic cross section through Mortandad and Sandia Canyons

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.

3.5 WATER RESOURCES

3.5.1 GROUNDWATER

Groundwater on the Pajarito Plateau occurs generally in three types of settings, as represented schematically in Figure 3-2: 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. Deep perched water in bedrock is found in spatially limited extent below larger canyons that have their headwaters in the mountain fronts and contain surface water and/or alluvial groundwater on a regular basis. Perched zones can also occur in smaller canyons that receive anthropogenic discharges.



Source: LANL 2014a

Figure 3-2. Occurrence of groundwater on Pajarito Plateau

The regional aquifer below Mortandad and Sandia Canyons is part of an extensive system of highly compartmentalized aquifers within the Española Basin (Keating et al. 2005). 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; no other public or private water wells are known to exist in or near the project area. A test conducted at Los Alamos County water-supply well PM-2, approximately 2 miles south of the project area, indicated that the regional aquifer near PM-2 can be understood as a high-yielding, leaky-confined aquifer (McLin 2005).

The Sierra de los Valles, on the west side of the Pajarito Plateau, is considered to be an important recharge area for the regional aquifer. This underflow from the mountain fronts (and to a smaller extent from the larger, wet canyons) provides most of the recharge to the regional system. Discharge occurs through deep flow to the Albuquerque and Santo Domingo basins to the south (Keating et al. 2005).

Groundwater chemistry of the regional aquifer beneath the Pajarito Plateau shows the influence of the volcanic setting and varies across the plateau. Natural groundwater within the Sierra de los Valles has a calcium-sodium bicarbonate composition transitioning to a sodium-calcium bicarbonate composition east and northeast of LANL (Birdsell et al. 2005). Concentrations of trace elements are higher in the regional aquifer than in the alluvial and intermediate-perched waters and also increase from west to east (Birdsell et al. 2005).

The regional aquifer is the only aquifer in the vicinity of LANL with the capacity to meet industrial and domestic water-use requirements for LANL and surrounding communities (Purtymun 1995). Water produced from the regional aquifer continues to meet Federal and State drinking water standards (Los Alamos Department of Public Utilities [LADPU] 2015).

Since 2007, both DOE and the 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 (LADPU 2015). Those concentrations are not inconsistent with background concentrations of chromium within the regional aquifer. The chromium and perchlorate plumes beneath Mortandad Canyon are described in detail in Section 1.2.

3.5.2 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. The New Mexico Water Quality Control Commission (NMWQCC) has

designated these ephemeral streams as “impaired”⁶ (NMWQCC 2014). For streams listed as impaired, sources of contamination in surface water are assigned as unknown until NMED completes an assessment. Operational controls at LANL reduce the potential for the following sources to impact local surface water resources (DOE 2008):

- Industrial effluents discharged through National Pollutant Discharge Elimination System–permitted outfalls
- Stormwater runoff
- Activities within perennial, intermittent, or ephemeral watercourses
- Sediment transport

3.6 AIR QUALITY

3.6.1 CLEAN AIR ACT REQUIREMENTS

The *Clean Air Act* (CAA) of 1970, as amended (42 U.S.C. 7401 et seq.), establishes air-quality standards for criteria air pollutants, hazardous air pollutants, and other toxic air pollutants to protect public health and the environment from the harmful effects of air pollution. Six criteria air pollutants are listed in National Primary and Secondary Ambient Air Quality Standards (40 CFR 50): ozone, carbon monoxide, nitrogen dioxide, sulfur oxides, respirable particulate matter (including particulate matter equal to or less than 10 microns in diameter and particulate matter equal to or less than 2.5 microns in diameter), and lead. For each of these criteria pollutants, the EPA has developed numerical concentration-based standards (National Ambient Air Quality Standards [NAAQS]) that represent the maximum allowable concentrations.

The EPA classifies the ambient air quality in an air quality control region (AQCR) or in subareas of an AQCR, according to whether the concentrations of criteria pollutants in ambient air exceed the NAAQS. For each of the six criteria pollutants, areas within each AQCR are designated as follows:

- **Nonattainment:** any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air-quality standard for the pollutant.
- **Attainment:** any area that meets the national primary or secondary ambient air-quality standard for the pollutant.
- **Unclassifiable:** any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air-quality standard for the pollutant.

⁶ Impaired means not supporting one or more “designated uses”, such as livestock watering or aquatic life. The EPA alternately describes “designated use” for a stream (or stream reach) as the “desired use” that should be attained from that waterbody, as determined by Federal and State governments (EPA 2012). Streams are considered to be impaired or “not supporting” 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*.

Hazardous air pollutants are those listed in Title I of the CAA and those regulated by the National Emissions Standards for Hazardous Air Pollutants (40 CFR 61). The CAA applies to new stationary sources of emissions and any modified structure that emit or may emit an air pollutant. To prevent a significant deterioration in air quality, the CAA additionally requires evaluation of specific emission increases, especially in consideration of Bandelier National Monument—a Federally designated Class I area under the CAA that borders LANL on the south and east, a portion of which lies approximately 2 miles from the project area. As a minor air source, LANL is not currently subject to this type of evaluation and permitting.

The CAA gives the authority to states to establish air-quality rules and regulations. The EPA is the regulating authority for the CAA; however, the EPA has granted NMED primacy for regulating nonradioactive air emissions under an EPA-approved State Implementation Plan (SIP). With the exception of the National Emission Standards for Hazardous Air Pollutants for radionuclides (40 CFR 61), provisions of the Stratospheric Ozone Protection section (40 CFR 82), and the Risk Management Program (40 CFR 68), New Mexico has adopted all CAA regulations as part of the SIP. The SIP is regulated under the New Mexico *Air Quality Control Act* (New Mexico Statutes Annotated [NMSA] 74-2-1 through 74-2-17).

3.6.2 CAA AS APPLICABLE TO LANL

The project area lies within the Upper Rio Grande Valley Intrastate AQCR 157, consisting of Santa Fe, Taos, and Los Alamos Counties and a portion of Rio Arriba County (NMED 2015a). AQCR 157 has been designated unclassifiable/attainment (meeting the standard or expected to be meeting the standard despite a lack of monitoring data) for the six criteria pollutants (EPA 2015).

Work at LANL is performed in accordance with Federal, State, DOE, LANS, and local regulations and/or requirements by the CAA and NMED SIP. Air surveillance is conducted in and around LANL to determine the air-quality effects of LANL operations. LANS staff calculate actual annual LANL emissions of regulated air pollutants and report the results annually to NMED in an Emissions Inventory Report. The ambient air quality in and around LANL meets all State, EPA, and DOE standards for protecting the public and workers (LANL 2009b).

Under New Mexico air-quality requirements, excavation and construction activities and equipment are not considered stationary sources of regulated air pollutants. Therefore, these activities are not subject to permitting under Title 20 of the New Mexico Administrative Code (NMAC), Parts 2.70 and 2.72. This exemption does not require notification to NMED because NMED does not regulate dust and other emissions from excavation or construction activities and equipment; however, LANS workers take appropriate steps during project activities to control fugitive dust emissions using the best achievable control measures. Mobile sources, such as automobiles, are additional sources of air emissions; however, NMED does not regulate mobile sources.

LANL's current Title V Operating Permit from NMED was issued in 2015 and includes facility-wide emission limits and recordkeeping and reporting requirements. Emissions from LANL have remained well within permit limits (LANL 2015d).

3.7 ECOLOGICAL RESOURCES

Ecological resources include all plants and animals, with special emphasis on Federally listed threatened and endangered (T&E) species protected by the *Endangered Species Act* (ESA) of 1973 (16 U.S.C. 1531 et seq.), and floodplains and wetlands.

3.7.1 VEGETATION

The Pajarito Plateau is biologically diverse. This diversity is partly from the pronounced 5,000-foot elevation gradient from the Rio Grande to the Jemez Mountains and partly from the many canyons that dissect the region. Five major vegetation cover types are found within LANL: juniper (*Juniperus monosperma*) savannas; piñon (*Pinus edulis*) juniper woodlands; ponderosa pine (*Pinus ponderosa*) forests; mixed conifer forests (Douglas fir [*Pseudotsuga menziesii*], ponderosa pine, and white fir [*Abies concolor*]); and grasslands (McKown et al. 2003). The plant communities in the vicinity of the project area are primarily juniper savannas, piñon juniper woodlands, and grasslands (Figure 3-3). There are also some small areas of ponderosa pine forest in the canyon bottom (Figure 3-4). The project area lies entirely within the perimeter of the 2000 Cerro Grande fire, and most of this area was subject to low- to moderate-severity burn at that time. The grasslands in the project area generally represent early successional plant communities with some shrubs and trees noted.

In addition, wetlands and riparian areas enrich the diversity of plant and animal life at LANL. The majority of the wetlands in the LANL area is associated with canyon stream channels or is present on mountains or mesas as isolated meadows often in association with springs or seeps. There are no wetlands in the project area. However, some of the proposed project area lies within the 100-year floodplain in Mortandad and Sandia Canyons, which provides habitat for some sensitive biota.

3.7.2 WILDLIFE

The diverse plant communities at LANL provide habitat for a variety of animal life, including herds of elk (*Cervus elaphus*) and deer (*Odocoileus hemionus*); bear (*Ursus americanus*); mountain lions (*Puma concolor*); coyotes (*Canis latrans*); rodents; numerous species of bats, reptiles, amphibians, invertebrates; and a myriad of resident, seasonal, and migratory birds. In addition, Federally listed T&E species occur at LANL. Much of the region functions as a refuge for wildlife because of restricted access to certain LANL areas, the lack of permitted hunting, and management of contiguous Bandelier National Monument and U.S. Forest Service lands.



Figure 3-3. Juniper savanna in Mortandad Canyon

3.7.3 THREATENED AND ENDANGERED SPECIES

The U.S. Fish and Wildlife Service (USFWS) has the responsibility to identify and conserve species protected by the Federal government under the ESA. These species are listed as either threatened or endangered. In addition, the USFWS identifies species that are candidates for listing.

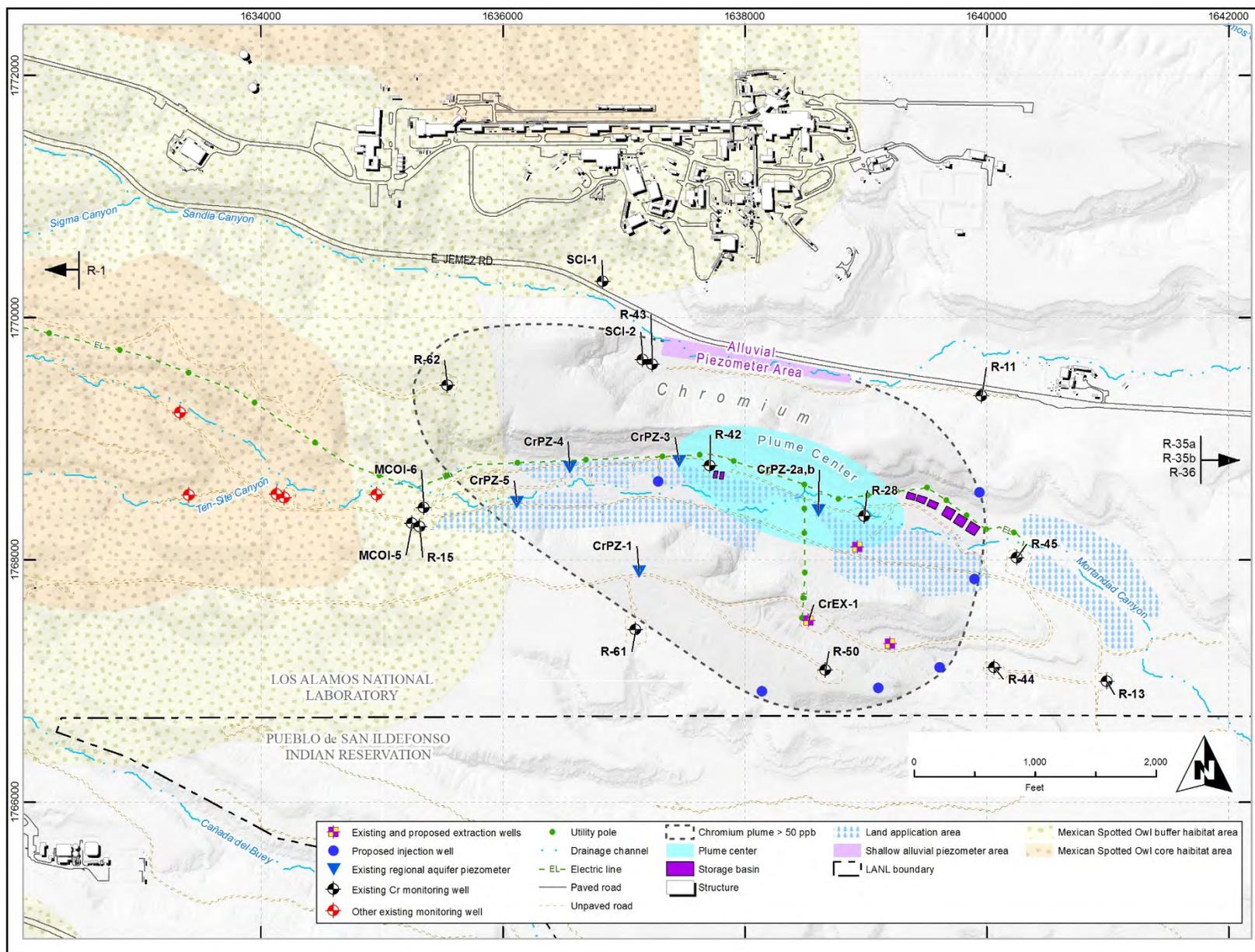
A list of T&E species found at LANL is provided in the SWEIS (DOE 2008) and is updated in the 2014 Threatened and Endangered Species Habitat Management Plan (HMP) (Hathcock et al. 2014b). Among the species potentially affected by project activities, only the Mexican spotted owl (*Strix occidentalis lucida*) has core and buffer habitat within the proposed project boundaries (Figure 3-5). Core and buffer habitat, and the related restrictions imposed in those areas, are defined in the HMP. The other T&E species at LANL—the southwestern willow flycatcher, Jemez Mountains salamander, yellow-billed cuckoo, and New Mexico meadow jumping mouse—lack suitable habitat within the area of the proposed project.



Figure 3-4. Ponderosa pine in Mortandad Canyon

The Mexican spotted owl generally inhabits mixed conifer and ponderosa pine, and Gambel oak (*Quercus gambelli*) forests in mountains and canyons (Hathcock et al. 2014b). A high-canopy closure, high-stand diversity, multilayered canopy resulting from an uneven-aged stand, large, mature trees, downed logs, snags, and stand decadence as indicated by the presence of mistletoe, are characteristic of Mexican spotted owl habitat. Some owls have been found in second-growth forests (i.e., younger forests that have been logged); however, these areas were found to contain characteristics typical of old-growth forests. Mexican spotted owls in the Jemez Mountains seem to prefer cliff faces in canyons for their nest sites (Johnson and Johnson 1988). The recovery plan for the Mexican spotted owl recommends that mixed conifer and pine-oak woodland types on slopes greater than 40 percent be protected for the conservation of this owl.

The HMP for the Mexican spotted owl includes some restrictions on activities in the core or buffer habitat for this species (Hathcock et al. 2014b). For example, noise greater than 6 decibels above ambient during the breeding season, from March 1 to mid-May (or August 31, if occupied), is not permitted. Removal of trees greater than 9 inches diameter at breast height (dbh) is not allowed. In 2014, a plan for infrastructure work related to groundwater pumping was reviewed by LANS biologists, and the activities were approved with conditions based on the Mexican spotted owl HMP (Hathcock et al. 2014b). One of these conditions was that no trees



Source: LANL Original. Note that the actual locations of wells and other planned project infrastructure elements may vary slightly from locations shown in this figure because of topography, geotechnical factors, and avoidance of sensitive ecological or cultural resources.

Figure 3-5. Mexican spotted owl core and buffer habitat

greater than 9 inches dbh would be removed from the Mexican spotted owl core habitat (DOE 2000; Hathcock et al. 2014b). This restriction was thought by LANS staff to apply only during the breeding season and not year-round. As a result, 19 trees greater than 9 inches dbh were cut down in Mexican spotted owl core habitat. This violation of the HMP was reported by LANS to the DOE, National Nuclear Security Administration (NNSA) Field Office, and to the USFWS in Albuquerque. As a result of this violation, DOE required that mitigations be completed (Rael 2014).

On May 29, 2014 the New Mexico Avian Protection working group made a presentation on avian power line protection guidelines. LANS purchased raptor retrofit equipment for power poles. DOE and LANS completed the Lessons Learned and Causal Analysis on the incident. In addition, a restoration project was completed in Sandia Canyon, over 100 native riparian plants were planted, and a fencing project was completed on Sigma Mesa above the active owl nest in Mortandad Canyon. Lastly, an informational assessment was prepared for the DOE NNSA Field Office and the USFWS (Hathcock et al. 2014a), stating “The [Habitat Management Plan] violation was unfortunate, but as indicated by the confirmed occupancy in 2014, it did not deter the Mexican spotted owls from staying in Mortandad Canyon. Various process improvements have been implemented and awareness has been increased across the institution for the compliance requirements for threatened and endangered species.”

3.7.4 MIGRATORY BIRDS AND SENSITIVE SPECIES

In addition to T&E species, the affected environment must include consideration of migratory birds and other sensitive species. The *Migratory Bird Treaty Act* (MBTA) of 1918 is the main driver for protection of migratory birds in the U.S. The original 1918 statute implemented the 1916 Convention between the U.S. and Great Britain (for Canada) for the protection of migratory birds. Later amendments implemented treaties between the U.S. and Mexico, the U.S. and Japan, and the U.S. and the Soviet Union (now Russia).

In the biological sense, a migratory bird is a bird that has a seasonal and somewhat predictable pattern of movement. For the MBTA, migratory birds are defined as all species covered by the four bilateral treaties. Generally, this includes all native birds in the U.S., except those nonmigratory species such as quail and turkey that are managed by individual states. Hathcock and Keller (2012) provide lists of migratory birds documented during winter or breeding season surveys in ponderosa pine or juniper woodlands. Best management practices related to migratory bird species are described in the *Migratory Bird Best Management Practices Source Document for Los Alamos National Laboratory* (Hathcock et al. 2011).

LANS has also identified sensitive species to cover those biota not covered by the ESA or the MBTA. LANS maintains a list of sensitive species at <http://www.lanl.gov/community-environment/environmental-stewardship/protection/wildlife-protection/sensitive-species>. Some sensitive species are associated with riparian habitat, including the ringtail and several bird species (Hathcock et al. 2015). Best management practices related to sensitive species are described in the *Sensitive Species Best Management Practices Source Document* (Hathcock et al. 2015).

3.8 CULTURAL RESOURCES

3.8.1 DEFINITION

Cultural resources are physical manifestations of culture, specifically archaeological sites, architectural properties, ethnographic resources, and other historical resources relating to human activities, society, and cultural institutions that define communities and link them to their surroundings. They include expressions of human culture and history in the physical environment, such as prehistoric and historic archaeological sites, buildings, structures, objects, and districts, which are considered important to a culture, subculture, or community. Cultural resources can also include locations of important historic events and aspects of the natural environment, such as natural features of the land or biota, which are part of traditional lifeways and practices.

The National Register of Historic Places (NRHP) is a listing maintained by the Federal government of prehistoric, historic, and ethnographic buildings, structures, sites, districts, and objects that are considered significant at a national, state, or local level. Listed resources can have significance in the areas of history, archaeology, architecture, engineering, or culture. Cultural resources listed on the NRHP, or determined eligible for listing, have been documented and evaluated according to uniform standards and have been found to meet criteria of significance and integrity. Cultural resources that meet the criteria for listing on the NRHP, regardless of age, are called historic properties. Resources that have undetermined eligibility are treated as historic properties until a determination otherwise is made.

3.8.2 REGULATORY FRAMEWORK

A number of Federal laws and Executive Orders (EOs) address cultural resources and Federal responsibilities regarding them. Foremost among these statutory provisions, and most relevant to the current analysis, is the *National Historic Preservation Act* (NHPA) (54 U.S.C. 300101 et seq.). Section 106 of the NHPA requires Federal agencies to take into account the effect of their undertakings on historic properties. The Advisory Council on Historic Preservation (ACHP) 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. The NHPA does not mandate preservation of historic properties, but it does ensure that 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.

DOE has multiple policies, orders, plans, agreements, and protocols that stipulate how the agency manages the cultural resources on lands under its jurisdiction and provide DOE with guidance on implementing actions in accordance with Federal laws and regulations. Specific to DOE's responsibilities at LANL, DOE has executed a Programmatic Agreement (DOE 2006) with the ACHP and the New Mexico State Historic Preservation Officer (SHPO) that outlines how the agency will administer its activities that have the potential to affect historic properties to satisfy the agency's responsibilities under Section 106 of the NHPA. The LANL Cultural

Resources Management Plan (CRMP) is a comprehensive plan that defines the responsibilities, requirements, and methods for managing cultural resources located on DOE-administered lands at LANL, focusing on effective management of those cultural resources that warrant long-term protection (LANL 2006b).

As a Federal agency, DOE has a trust responsibility to American Indian tribes (Tribes) to protect tribal cultural resources and to consult with Tribes on a government-to-government basis regarding those resources. Section 101(d)(6) of the NHPA mandates that Federal agencies consult with Tribes and other Native American groups who either historically occupied the project area or may attach religious or cultural significance to historic properties in the region. The NEPA implementing regulations link to the NHPA, as well as to the *American Indian Religious Freedom Act* (AIRFA) (42 U.S.C. 1996), EO 13007 Indian Sacred Sites (61 Federal Register [FR] 26771), EO 13175 Consultation and Coordination with Indian Tribal Governments (65 FR 67249), and the Executive Memorandum on Government-to-Government Relations with Native American Tribal Governments (59 FR 22951). These requirements call on agencies to consult with American Indian tribal leaders and others knowledgeable about cultural resources important to them. DOE Order 144.1, American Indian and Alaska Natives Tribal Government Policy, outlines the principles to be followed by the department in its interactions with Tribes. Both the Programmatic Agreement and LANL CRMP address consultation to be undertaken by DOE with Tribes in furtherance of compliance with environmental and cultural resource laws.

3.8.3 AREA OF POTENTIAL EFFECTS

The area of potential effects (APE) is the area within which impacts to historic properties could occur as the result of a project or undertaking. The APE, as defined in the NHPA, is,

... the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking. (36 CFR 800.16[d])

DOE adopted this definition for assessing the potential effects of the proposed project on archaeological sites that are evaluated as historic properties and determined that the proposed project would have the potential to affect such historic properties through direct and indirect physical impacts to resources from project activities. Using the definition above, 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. This APE also includes those areas within which there is the potential for indirect impacts, including vibrations, 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 potential impacts to historic properties has been defined, a similar bounding geographic area for tribal cultural resources, potentially impacted by the project, is challenging. The relationships among tribal cultural resources and the interactions between these resources and important tribal practices and beliefs are complex. For tribal cultural resources, an APE is not defined and potential for impacts to such resources has been assessed through consultation with representatives of the Pueblo de San Ildefonso.

3.8.4 CULTURAL RESOURCE INVESTIGATIONS

Cultural resource investigations have been undertaken to 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 NHPA. These investigations included archaeological survey, testing, and tribal consultation and were conducted in accordance with the CRMP, State, and Federal requirements.

Archaeological Survey and Testing

Previous archaeological investigations have been conducted in Mortandad Canyon and areas surrounding it. These investigations, dating to as early as 1967, included site recording, surveying, and periodic monitoring. Most recently, an intensive investigation was conducted following the Cerro Grande fire in 2000 (LANL 2002). The report of this work provides information regarding fire effects on archaeological sites located within and adjacent to Mortandad Canyon. The report recommends annual monitoring, and archaeological sites are periodically revisited by LANS archaeologists and updated as part of on-going cultural resources site monitoring. For the cultural resource investigations conducted for the proposed project, all previously identified cultural resources were revisited for the purpose of updating the site recording forms and obtaining additional data for NRHP eligibility determinations.

At the direction of DOE, LANS archaeologists conducted intensive pedestrian surveys of the portions of the APE that were not previously surveyed to identify archaeological sites that meet the criteria for eligibility for listing on the NRHP (LANL 2015e). The newly surveyed areas included the upper portion of Mortandad Canyon and the north-facing cliff face and slope. The pedestrian survey was conducted using evenly spaced 33-foot (10-meter) transects and transects that followed slope topography. Newly identified resources were recorded in the field; this effort included in-field analyses of artifacts and features, creation of sketch maps, collection of geographic information system data, and photographs of the site, features, and artifacts. Boundaries at some revisited sites were expanded to include additional associated features that had not been previously identified.

To determine if proposed buried pipeline infrastructure would impact historic properties, shovel testing was conducted in two areas along the proposed pipeline route where there was a high probability for buried cultural materials based on the proximity of the pipeline corridor to known archaeological sites (LANL 2015e). Testing consisted of shovel test units measuring 16 inches by 16 inches (40 centimeters by 40 centimeters) placed within the pipeline corridor at 33-foot (10-meter) intervals. One area of testing occurred where the pipeline corridor is adjacent to the

existing unpaved road between the R-13 and the R-44 well pads. The other area of testing occurred along both sides of the R-50 well pad road (see Figure 2-1).

DOE evaluated all identified archaeological sites for NRHP eligibility, determined the potential for effects to eligible properties from the proposed project, and submitted a report of its findings and determinations to the New Mexico SHPO for review and concurrence (DOE 2015b).

Tribal Consultation

The purposes of consultation are to elicit from tribal representatives concerns for potential impacts from the proposed project on the Tribe or resources that are important to the Tribe and to identify possible measures to avoid, minimize, or mitigate potential impacts.

Tribes that have shown an interest in, or claimed affiliation to, cultural resources located on LANL property include Pueblo de San Ildefonso, Santa Clara Pueblo, Pueblo de Cochiti, Jemez Pueblo, Acoma Pueblo, Mescalero Apache Tribe, Hopi Tribe, and Jicarilla Apache Tribe (LANL 2006b). Acoma Pueblo, Mescalero Apache Tribe, and the Hopi Tribe have all indicated to DOE that they do not need to be active participants in cultural resource consultations for activities at LANL. Jicarilla Apache Tribe, Jemez Pueblo, Pueblo de Cochiti, and Santa Clara Pueblo all claim cultural affiliation to resources that are located in portions of LANL property outside of the project area. Representatives from the Pueblo de San Ildefonso view the entire project area to be within their ancestral land use areas and claim cultural affiliation to the Ancestral Pueblo cultural remains within it (LANL 2006b). DOE recognizes the affiliation for all of these Pueblos, however, in this area of LANL property the Pueblo de San Ildefonso is the recognized affiliated Pueblo. For this reason, DOE has focused its tribal consultation for this project on Pueblo de San Ildefonso.

DOE consulted with the government leadership and other representatives of the Pueblo multiple times during development of the project and alternatives. DOE met with staff at the San Ildefonso Department of Environmental and Cultural Protection in June 2015 (DOE 2015a), specifically to discuss the potential for impacts to cultural resources of importance to the Pueblo and Pueblo cultural practices. Input received from the Pueblo de San Ildefonso representatives during this meeting is included in this EA.

During the time between the availability of this draft EA and the issuance of the final EA and DOE's decision document, DOE will continue to consult with Pueblo de San Ildefonso to ensure that tribal concerns are addressed to the extent practicable.

3.8.5 EVALUATION OF ARCHAEOLOGICAL SITE SIGNIFICANCE

DOE evaluated the sites identified during archaeological surveys and testing efforts to determine their eligibility for listing on the NRHP. Evaluation was conducted to determine those resources that have status as historic properties, which is needed to determine the effect of the project on historic properties under Section 106 of the NHPA and 36 CFR 800. Properties eligible for the NRHP must have significance in American history, archaeology, architecture, engineering, or culture. The guidelines for evaluation of significance can be found in 36 CFR 60.4. For a cultural

resource to be considered significant, the resource must meet at least one of four significance criteria:

- A. Association with events that have made a significant contribution to the broad patterns of our history.
- B. Association with the lives of persons significant in our past.
- C. Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
- D. Have yielded, or may be likely to yield, information important in prehistory or history.

The property must also possess integrity or the ability to convey its significance. The NRHP recognizes seven aspects or qualities that, in varying combinations, define integrity. These are as follows: location, design, setting, materials, workmanship, feeling, and association. In the case of properties that possess traditional cultural significance, it is also important to consider the integrity of relationship and condition.

3.8.6 CULTURAL RESOURCES IN THE APE

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 described in this section.

Archaeological Sites

Based on the archaeological survey and testing investigations, 50 archaeological sites are located within the APE. The report documenting these investigations, *Cultural Resources Investigation for the Chromium Plume Control Interim Measure and Plume-Center Characterization Project in Technical Area 05, Los Alamos National Laboratory, Los Alamos, New Mexico* (LANL 2015e), details the work conducted and the results, which are summarized here.

The majority of the sites consist of two site types: cavate sites and pueblo or roomblock sites. The 13 cavate sites identified in the APE are predominantly located along the south-facing wall of Mortandad Canyon, although some cavates are located along the north-facing canyon wall. Cavate sites include plastered walls, sooted ceilings, vent holes, niches, rock art, viga holes, evidence of talus rooms (located out front of the cavate entrances), and stairways of hand and foot holds in the bedrock near the cavate entrances. Few artifacts are usually present, and none of the cavate sites have identified middens (trash mounds).

The 24 pueblos or roomblock sites, which are all located on the mesa tops north and south of Mortandad Canyon, generally range in size from 1 to 3 rooms, to 30 to 40 rooms. One site has 20 to 40 rooms surrounding a plaza, and another has 100-plus rooms surrounding a plaza with an identifiable kiva (subterranean ceremonial room). These sites have scatters containing many artifacts and sometimes large, distinct middens. Shaped tuff blocks are present at most of the

sites, and one site contains adobe blocks; sometimes these are seen in their original wall alignments.

The remaining 13 sites found in the APE include two fieldhouses, five artifact scatters with no evidence of architecture, a game trap carved into bedrock, a prehistoric trail, a prehistoric stairway of hand and foot holds carved into bedrock, a site with both a prehistoric trail and stairway, a Homestead period wagon road, and a Homestead period trash scatter.

Artifacts found at the sites include ceramic sherds of multiple types; flaked stone tools and debris comprised of obsidian, chert, chalcedony, basalt, quartzite, and petrified wood; and ground stone tools of sandstone, quartzite, basalt, and granite that include manos (hand-held grinding tools), metates (surface on which grinding occurred), and bedrock grinding slicks. Other than the two Homestead period sites and three of the artifact scatters deposited during the Late Archaic (800 B.C. to A.D. 600), these sites represent occupations occurring during the Coalition (A.D. 1150 to 1325) and Classic (A.D. 1325 to 1600) cultural periods, which is consistent with the ages of cultural resources found throughout LANL.

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.

DOE evaluated all 50 archaeological sites to determine their eligibility for listing on the NRHP. Of the 50 sites, 2 are determined not eligible to the NRHP. The 2 sites determined not eligible are in poor condition because of erosion and existing road impacts and do not retain enough integrity to demonstrate their historical significance. These sites are also located directly on bedrock and thus lack the presence of subsurface cultural deposits that would give the sites significance for their information potential. Shovel testing and geomorphological analysis were conducted in areas where proposed project infrastructure would occur close to known sites because of a concern for possible impacts to buried cultural deposits. The testing and analysis revealed that no intact sediments or cultural deposits exist within those areas. Although some artifacts were observed during testing, the limited number and fragmentary nature of the artifacts indicate they are present in secondary colluvial deposits derived from sediment and artifacts eroding downslope from nearby roomblocks.

Tribal Cultural Resources

During their meeting with DOE, Pueblo de San Ildefonso representatives described the cultural resources and activities within and surrounding the project area in the following way (DOE 2015a): 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 thus 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.

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 imbue 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.

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 2015a).

3.8.7 SECTION 106 COMPLIANCE STATUS

DOE conducted archaeological survey, testing, and tribal consultation in an effort to determine the effect of the project on eligible historic properties. DOE submitted the cultural resource inventory report to the New Mexico SHPO on July 13, 2015, for review and consultation, per Section 9 of the LANL CRMP (LANL 2006b). A response from the SHPO on DOE’s determination of effect was received August 14, 2015 (Ensey 2015). The SHPO agreed with DOE that the proposed action alternative and the no action alternative would have no effect on historic properties through avoidance.

3.9 UTILITIES AND INFRASTRUCTURE

Infrastructure consists of the basic physical structures and facilities needed to support DOE operations at LANL. For this EA, infrastructure encompasses LANL utilities and physical structures. Roads are also considered part of the infrastructure (use of roads is discussed in Section 3.10).

3.9.1 ELECTRICITY

Electrical service to LANL is supplied through a cooperative arrangement with Los Alamos County, known as the Los Alamos power pool. Electric power is supplied to the pool through two existing regional 115-kilovolt transmission lines. The import capacity of the power pool is approximately 115 megawatts from a number of hydroelectric, coal, and natural gas-powered generators throughout the western U.S. (DOE 2008). The DOE-maintained electric distribution system at LANL consists of various low-voltage transformers at LANL facilities and approximately 34 miles of 13.8-kilovolt distribution lines. Further information on the LANL electric distribution system and major electricity uses is provided in Section 4.8.2.1 the SWEIS (DOE 2008).

LANL peak demand in 2013 was approximately 66 megawatts, with an electrical use of approximately 435,000 megawatt-hours (LANL 2015d). The power pool import capacity of 115 megawatts is expected to be exceeded in 2018. Reconductoring is planned to increase the import capacity to 131 megawatts, allowing LANL to be fully served by off-site generation until 2021 (LANL 2015d). On-site generation and seasonal transmission line rating increases can be used to supplement import capacity to meet LANL power needs, if necessary, while LANS pursues increases in transmission import capability (LANL 2015d).

The existing power lines in the project area are identified on Figure 2-1. Power drops are installed 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.

3.9.2 WATER

Before 1998, DOE and its predecessor agencies provided utility services to LANL, the Los Alamos townsite, and White Rock. Water was produced under a total water right of 5,541 acre-feet (1,806 million gallons) per year, which represented a combination of previously declared surface and ground water rights for municipal, industrial, and related purposes. In 2001, DOE transferred ownership of the water production system to Los Alamos County, along with 70 percent (3,879 acre-feet [1,264 million gallons] annually) of DOE water rights. The remaining 30 percent (1,662 acre-feet [542 million gallons] annually) of the water rights were leased by DOE to the County for 10 years but have since reverted back to DOE (DOE 2014b).

Los Alamos County operates the water-production system that supplies potable water to the County, including LANL and Bandelier National Monument. Deep water-supply wells are located in three well fields (Guaje, Otowi, and Pajarito). Water is pumped into production lines, and booster pump stations lift this water to reservoir tanks for distribution. DOE purchases water from Los Alamos County for LANL use.

3.9.3 ROADS

LANL is served by a limited number of public roadways, mainly because of sparsely populated Federal and tribal lands bordering the facility and regional topography that consists of widely varied elevations. LANL and the Los Alamos townsite can be accessed from three public thoroughfares that branch off New Mexico State Road 4 (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 (DOE- or LANL-badged) personnel. The restricted portion of Pajarito Road provides the only vehicle access to and from the project area by means of Puye Road, which leads from Pajarito Road into Mortandad Canyon; the portion of Puye Road near Pajarito Road is paved, while the portion within Mortandad Canyon is unpaved. Existing roads are shown in Figure 2-1.

3.10 TRAFFIC AND TRANSPORTATION

Motor vehicles in the vicinity of LANL travel along the roadways are described in Section 3.9.3. Traffic onto LANL is regulated through vehicle-access portals. On state routes, these portals provide members of the public with access to and from NM 4 to the west.

Motor vehicles are the primary means of transportation to LANL. These consist primarily of privately owned vehicles; park-and-ride services are also provided. Trucks containing hazardous, radioactive, industrial, or commercial wastes and recyclable materials are driven to, from, and within the LANL site during routine operations. Regulations and requirements governing the transportation of hazardous and radioactive materials include those of the U.S. Department of Transportation, U.S. Nuclear Regulatory Commission, DOE, U.S. Federal Aviation Administration, International Air Traffic Association, and LANL. Further information on traffic volume, accidents, and shipments is provided in Section 4.10 of the SWEIS (DOE 2008).

Studies conducted before traffic restrictions were implemented on Pajarito Road in 2011 showed traffic delays at several intersections during peak traffic hours, particularly at the intersection of NM 4 and East Jemez Road during the afternoon peak. With Pajarito Road restrictions currently in place, the level of service at this intersection is likely at or approaching “F,” indicating a delay “considered unacceptable to most drivers” (Transportation Research Board 2000, Wilson & Co. 2010).

3.11 HAZARDOUS MATERIALS AND WASTE GENERATION

A wide range of waste types are generated through activities at LANL related to research, production, maintenance, construction, decontamination, decommissioning, demolition, and environmental restoration. Wastes are handled, treated, transported, and disposed in accordance with Federal and State regulations applicable to specific waste classifications. Institutional requirements for waste management activities are determined and documented by DOE and LANS, providing details on proper management of all process wastes and contaminated environmental media. LANL’s waste management operation tracks waste-generating processes, quantities, chemical and physical characteristics, regulatory status, permitted treatment and

disposal standards, and final disposition of the waste (DOE 2008). Further information on LANL waste generation and pollution prevention is provided in Section 4.9 of the SWEIS (DOE 2008).

3.12 NOISE

Noise (considered to be unpleasant, loud, annoying, or confusing sounds to humans); air blasts (also known as air-pressure waves or overpressures); and ground vibrations are intermittent aspects of the LANL area environment. Receptors can be human or wildlife. The vigor and well-being of area wildlife and sensitive Federally protected bird populations suggest that environmental conditions are acceptable for most wildlife species and sensitive nesting birds found at LANL (DOE 2008). Ecological resources are discussed in detail in Section 3.7.

At LANL, several factors influence how noise and vibrations can be both attenuated (lessened) and channeled away from receptors:

- The forested condition of much of LANL (especially where explosives testing areas are located),
- Prevailing area atmospheric conditions, and
- The regional topography that consists of widely varied elevations and rock formations.

These factors are jointly responsible for there being little environmental noise pollution to the area resulting from DOE operations (DOE 2008).

Within Mortandad Canyon, manmade noise is primarily limited to that associated with periodic Consent Order activities such as vehicle traffic and small machinery operation. Noise from most of these activities is inaudible in residential areas of the Los Alamos townsite or White Rock, 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 existing monitoring well R-13 (Figure 2-1). Within Sandia Canyon, manmade noise is primarily from vehicle traffic along East Jemez Road.

3.13 VISUAL RESOURCES

The natural setting of LANL is panoramic and scenic. The mountain landscape, unusual geology, varied plant communities, burned-over areas, and archaeological heritage of the area create a diverse visual environment. The topography is rugged; mesa tops are cut by deep canyons, creating sharp angles in the landform. In some cases, slopes are nearly vertical. A variety of vegetation occurs in the region, the density and height of which may change over time and can affect the visibility of an area within the LANL viewshed (i.e., the environment visible from LANL). Often, little vegetation grows on steep slopes, exposing the geology, with contrasting horizontal strata varying from bright reddish-orange to almost white in color (DOE 2008).

The most obvious modern alteration of the natural landscape is development. Many buildings at LANL were built as temporary structures and present an austere, utilitarian appearance.

Prominent visual features include water storage towers and emission stacks. Further information on the LANL visual environment is provided in Section 4.1.2 of the SWEIS (DOE 2008).

The overall visual character of the project area is mixed, with large portions of the Mortandad Canyon rim and slopes essentially in an undeveloped state, featuring juniper savannas, piñon juniper woodlands, and grasslands (see Section 3.7.1). While vegetation is also extensive on the canyon bottom, manmade visual features are also prominent including well pads, portable storage tanks, treatment units, storage basins, and unpaved access roads (Figures 3-6, 3-7, and 3-8). These manmade features are clearly visible from the canyon rim in addition to other LANL structures in the distance. Within the canyon bottom, these manmade features are more prominent in the viewshed.

Within Sandia Canyon, the most prominent feature in the viewshed is East Jemez Road. An unpaved LANL access road lies parallel to East Jemez Road in the project area.

3.14 HUMAN HEALTH AND WORKER SAFETY

3.14.1 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 through operational controls and verified through monitoring. Health risks can be posed through exposure to chemicals or radionuclides (through ingestion, respiration, or skin contact), or from direct physical harm. The LANL 2013 Annual Site Environmental Report (LANL 2014a) and 2013 SWEIS Yearbook (LANL 2015d) provide descriptions of the public health baseline, and radionuclides and chemicals in the environment surrounding LANL.

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 approximately 2 miles to the northwest of the project area, and White Rock, approximately 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, approximately 250 feet south of monitoring well R-13 and approximately 300 feet south of proposed drill sites for extraction and injection wells (Figure 2-1).

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 3.5.1).



Figure 3-6. Mortandad Canyon featuring storage basins near Well R-28 (facing east from north side of Mortandad Canyon)

3.14.2 WORKER SAFETY

Operations at LANL are required to be in compliance 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. LANS applies an Integrated Safety Management process to work activities.

For the 12-month period ending January 2014, LANL recorded a total recordable cases (TRC) rate of 1.22, and days away, restricted, or transferred (DART) rate of 0.47 per 200,000 hours worked (LANL 2014c). These rates compare favorably with 2013 national (TRC 3.3, DART 0.7) and New Mexico (TRC 3.2, DART 0.6) rates (Bureau of Labor Statistics 2014).

3.15 ENVIRONMENTAL JUSTICE

Under EO 12898, DOE is responsible for identifying and addressing potential disproportionately high and adverse human health and environmental effects on minority or low-income populations. Minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other



Figure 3-7. Mortandad Canyon featuring portable storage tanks and other infrastructure near well R-28 (facing south from north side of Mortandad Canyon)

Pacific Islander, or multi-racial (with at least one race designated as a minority race under CEQ guidelines [CEQ 1997]). Persons whose income is below the Federal poverty threshold are designated as low income.

The project area lies within an access-controlled portion of LANL. The nearest publicly accessible locations to the project area are within the Pueblo de San Ildefonso, approximately 250 feet south of monitoring well R-13 and approximately 300 feet south of the proposed drill sites for extraction and injection wells. Based on the Native American status of the Pueblo de San Ildefonso, residents of the Pueblo would be considered a minority population for purposes of identifying environmental justice concerns. In addition to the Pueblo land itself, representatives of the Pueblo de San Ildefonso have identified tribal cultural resources existing within the project area on LANL, as described in Section 3.8.6.



Figure 3-8. Mortandad Canyon featuring storage basins and R-42 well pad (facing southeast from north side of Mortandad Canyon)

4.0 ENVIRONMENTAL CONSEQUENCES

This section presents an evaluation of the potential environmental consequences of implementing the proposed action and no action alternatives. Mitigation or avoidance actions beyond those inherently part of these alternatives are identified and included in the evaluations by resource area.

4.1 LAND USE

Proposed Action Alternative

Additional infrastructure elements would be installed or placed in the project area under the proposed action alternative:

- Up to 2 additional groundwater extraction wells, approximately 1,000 feet deep;
- Up to 6 injection wells (gravity-fed injection of treated water), approximately 1,000 feet deep;
- Up to 24 alluvial piezometers, up to 40 feet deep;
- 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 covering an area approximately 50 acres, potentially supplemented by mechanical evaporators;
- Buried piping;
- Unpaved access roads; and
- Power lines.

The locations of proposed extraction and injection wells, piezometers, storage basins, unpaved access roads, and power lines are shown in Figure 2-1.

Project infrastructure development, operation, and maintenance of these project elements would be compatible with the current use of the area as a site for groundwater investigation. No change in land ownership would occur. Access controls currently restrict use of the site for public recreational activities such as those available at nearby areas. Activities under the proposed action alternative would not have any irreversible impacts and would not preclude current or potential future public land uses to the north, east, and west.

The proposed action alternative would employ measures to reduce the potential of land-use impacts. Well pad size would be minimized and the areas would be revegetated after well construction to reduce project footprint. Each piezometer pad would cover only a small area, approximately 40 square feet. No permanent structures would be required for operation of the approximately 50-acre irrigation system. Land-applied water would meet quality standards specified in the NMED discharge permit and would not result in contamination that could restrict potential future land use. Many of the existing elements used for the project (e.g., portable

storage tanks, pumps) are portable and can be easily removed at the end of the project; Section 2.2.6 discusses other decommissioning measures that would be conducted at project completion.

Land use under the proposed action alternative would be managed in compliance with the Programmatic Agreement concerning management of the historic properties of LANL (DOE 2006). Compatibility with Pueblo de San Ildefonso land uses is discussed in Section 4.6.2.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed⁷, resulting in a smaller project infrastructure footprint. Impacts to land use would be bounded by the evaluation of the proposed action alternative, above.

No Action Alternative

Under the no action alternative, monitoring, and maintenance of existing infrastructure would continue. No changes to current land use would occur. Compatibility with Pueblo de San Ildefonso land use is discussed in Section 4.6.3.

4.2 GEOLOGY AND SOILS

4.2.1 GEOLOGY

Proposed Action Alternative

There would be minimal impacts to geology under the proposed action alternative. The installation, operation, and maintenance of extraction wells (which are similar to existing nearby County wells) and piezometers (which are similar to existing monitoring wells) would have negligible impact on geology. Six injection wells would be installed to 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. Flow rates, pressures, and water levels for the injection wells would be monitored and controlled using a supervisory control and data acquisition system. Injection well operation would have a negligible impact on geology.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed. Impacts to geology would be bounded by the evaluation of the proposed action alternative discussed above.

⁷ As discussed in Section 2.2.8, if during implementation of the proposed action alternative DOE/LANS determine that injection wells cannot be utilized (e.g., initial injection wells indicate that required injection rates cannot be sustained because of geotechnical/hydrological factors), the project would need to transition to disposition of treated water solely via land application and/or evaporation. In this scenario, it is possible that DOE/LANS would make this determination before installation of all proposed injection wells.

No Action Alternative

There would be no impact on geology as a result of the no action alternative. Consent Order activities described in the SWEIS (DOE 2008) and subsequent NEPA documentation would continue.

4.2.2 SOILS

Proposed Action Alternative

Project infrastructure development, operation, and maintenance activities associated with the proposed project would cause small effects to soil profiles from soil disturbance. Under the proposed action alternative, grading would be necessary for well pad installation for the new extraction wells, injection wells, and piezometers. Although angle drilling would be pursued for new extraction and injection wells to avoid cultural sites, this assessment of potential soil impacts conservatively assumed new well pads would be required for all new well installations.

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 off-site in a permitted, approved landfill. After the pits are backfilled, the overall well pad footprint would be reduced. Excavations would be required to direct-bury piping to the proposed extraction and injection wells. Stabilization controls would limit or control soil erosion and rockfalls. Best management practices would be applied.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in a smaller project infrastructure footprint and less soil disturbance. Impacts to soils would be bounded by the evaluation of the proposed action alternative, above.

No Action Alternative

There would be no substantial changes to soil from ongoing monitoring and maintenance activities under the no action alternative.

4.3 WATER RESOURCES

4.3.1 GROUNDWATER

The basis for evaluating potential impacts from project water extraction is described in this section. The evaluation method is applied to the proposed project withdrawals and the impacts to nearby wells are presented. This evaluation focuses on potential impacts of project groundwater drawdowns on nearby Los Alamos County water-supply wells.

4.3.1.1 Drawdown

Evaluation Basis

This evaluation considers both economic impacts and physical limits to groundwater drawdown.

Allowable economic drawdown to existing wells is assessed by the New Mexico Office of the State Engineer (Morrison 2006) using a 70 percent water-level decline from all sources as a threshold. This threshold corresponds to the point at which well yields decrease more rapidly as the water column is reduced beyond two-thirds of its nonpumping value (Driscoll 1986).

Physical limits on the water level (to maintain well production) are imposed by well installation, aquifer, and pump characteristics. For example, physical limits on pumping water levels depend on the required pumping rate, pump characteristics, and the pump location in the water column, among other factors. Based on these characteristics, the pumping water level required to physically maintain the required well yield is estimated. For wells such as the Los Alamos County water-supply wells, where water levels are considerably above the top of the well screen, a location 20 to 30 feet above the top of the well screen is used for the lowest practical pumping level (Morrison 2006).

Evaluation Method

The evaluation method consists of three steps: (1) estimating the current water columns in existing Los Alamos County water-supply wells; (2) estimating the total drawdown at the existing Los Alamos County wells resulting from the proposed action alternative and regional water use; and (3) identifying any factors that impose physical limitations on the lowest practical pumping level.

Potential water-supply wells where water declines may occur from project pumping are identified based on the proposed locations of the project extraction wells. The current lengths of the water columns in these existing wells are estimated using information from well logs, well completion diagrams, and current water-level measurements. Current water columns in the Los Alamos County water-supply wells are estimated as the difference between the elevations of the current nonpumping water level and the base of the well screen.

The total drawdown in the existing water-supply wells is estimated as the sum of regional drawdown, drawdown from the project extraction wells, and dynamic drawdown, which is the difference in elevation between the water table and the pumping water level in the existing well, as described below:

- An estimate of regional drawdown is obtained from published water-level monitoring data.
- Drawdown from the proposed pumping of the project extraction wells is estimated using the Theis equation (Marsily 1986). The Theis equation is an analytical solution for radial flow that provides estimates of drawdown at varying distances from a well pumping at a constant rate. Information required to estimate drawdown at existing wells with the Theis

equation includes the distance from the pumping well to the existing well, pumping rate, aquifer transmissivity, and storage coefficient.

- Dynamic drawdown is estimated from water-level measurements recorded by sensors located in the Los Alamos County water-supply wells.

For the evaluation, the estimated total drawdown is compared with values of allowable economic and physical drawdown calculated for the Los Alamos County wells to determine the potential impact.

Proposed Action Alternative

The proposed action alternative includes two activities that require evaluation: pumping for the plume control interim measure and pumping for the plume-center characterization.

Identification of Potentially Affected Wells

The chromium plume control interim measure consists of extraction of water from the regional aquifer at up to two locations and injection at up to six other locations. Although injection would mitigate potential effects of extraction on well drawdown, injection is not considered in this evaluation.

An additional extraction well is planned for use in plume-center characterization for testing the feasibility of optimized removal of chromium mass from within the centroid of the plume. In addition, two existing monitoring wells are proposed for potential cross-hole experiments.

Pumping of the extraction wells would lower the water table, producing a cone-shaped depression in water level for each pumping well with the depression the greatest at the well. The depression occurs only when the wells are pumping and extends outward from the well with decreasing drawdown as the distance from the pumping well increases. Evaluations were conducted to ensure that the extraction wells would not produce drawdown sufficiently large to impact other nearby wells. The farther existing wells are from the extraction wells, the less likely the well water levels would be affected by pumping the extraction wells. Based on the location of the project wells, five existing Los Alamos County water-supply wells in the Pajarito Mesa well field, PM-1, PM-2, PM-3, PM-4, and PM-5, were evaluated for potential impact. A proposed County well, PM-6, is also included in the evaluation. The County well Otowi-4 was not explicitly considered in the analysis because it is located a similar distance from the plume as the PM wells, and the effect of the proposed action alternative on Otowi-4 would be consistent with that determined in this analysis for the PM wells.

Estimation of Available Water Column

Well construction information for the five Los Alamos County water-supply wells is shown in Table 4-1. This information includes the elevations of the top and bottom of the screened intervals, nonpumping water elevations, and pump intake elevations (Purtymun 1995, Koch and Schmeer 2011). The available water column is calculated by subtracting the elevation of the bottom of the well screen from the nonpumping water level. The water column above the top of

the screen is calculated similarly by subtracting the elevation of the top of the well screen from the nonpumping water level. These water column values are used to evaluate the influence of proposed project water extraction on Los Alamos County well operation.

Table 4-1. Construction and water column parameters for nearby Los Alamos County water-supply wells

Well ID	Screen Elevation (feet amsl)		Nonpumping Water Elevation (feet amsl)	Available Water Column (feet)	Water Column Above Top of Screen (feet)	Pump Intake Elevation (feet amsl)
	Bottom	Top				
PM-1	4041	5575	5738	1697	163	5643
PM-2	4435	5711	5834	1399	123	5735
PM-3	4078	5654	5825	1747	171	5780
PM-4	4066	5660	5835	1769	175	5710
PM-5	4023	5655	5842	1819	187	5711
PM-6 ^a	4000	5550	5766	1766	216	—

Sources: Purtymun (1995), Koch and Schmeer (2011)

amsl: above mean sea level

^a Values for the proposed supply well PM-6 were estimated; pump intake elevation has not been determined.

Estimation of Regional Drawdown

Water-level declines at existing County wells are characterized in two terms: long-term regional water-level decline and dynamic drawdown (short term).

Long-term annual water-level declines in the Pajarito Mesa well field were interpolated from a plot of regional water-level declines (Birdsell et al. 2005). These values are shown in Table 4-2, including a value estimated for the PM-6 well based on its proposed location.

Dynamic drawdown refers to the temporary depression in the water table from active pumping at a well. This depression in the water table has an inverted conical shape, which is steepest in the vicinity of the well. The depression in the water level from pumping is greatest within the well casing. This self-induced decrease in water level within the well is the dynamic drawdown.

Dynamic drawdown was estimated from measurements from sensors located in the PM wells.

The value used for PM-6 was estimated to be the same as that measured for PM-5. Dynamic drawdown values used for this evaluation are shown in Table 4-2.

The regional and dynamic drawdowns shown in Table 4-2 are independent of the proposed action alternative. They represent long-term regional declines and local drawdowns in the Los Alamos County water wells when the pumps are cycled on. The drawdowns from Table 4-2 are included in the calculation of estimated total drawdown for evaluating the potential effects of the proposed action alternative.

Table 4-2. Annual water-level declines in nearby Los Alamos County water-supply wells and dynamic drawdown measurements

Well ID	Annual Water Level Decline from Regional Drawdown (feet per year)	Dynamic Drawdown (feet)
PM-1	0.2	27.9
PM-2	0.9	66.9
PM-3	0.8	24.9
PM-4	0.8	55.1
PM-5	0.6	73.5
PM-6 ^a	1.0	73.5

Source: Birdsell et al. 2005

^a Values for the proposed supply well PM-6 were estimated.

Estimation of Drawdown from the Proposed Action Alternative

Calculation of drawdown using the Theis equation requires estimates of aquifer transmissivity and storage coefficient. Values were estimated from aquifer tests conducted by LANS in the Pajarito Mesa well field (LANL 2014b). These tests provided 35 estimates of both the transmissivity and storage coefficient for the evaluation. Based on these aquifer tests, a median value of 5,930 square feet per day was used for the transmissivity, and a mean value of 0.008 was used for the storage coefficient.

The maximum annual pumping for the proposed action alternative would be 707 acre-feet (230 million gallons). This evaluation considers the impacts of pumping the maximum annual amount each year for the entire 8-year duration of the proposed action alternative. This assumption likely overstates actual pumping rates because it does not account for any reduction in pumping during the term of the project.

Total drawdowns after 8 years of pumping are shown in Table 4-3. The 8-year regional drawdown is calculated as the sum of 8 years of drawdown at the annual drawdown rate shown in Table 4-2. Drawdown from the proposed 8-year project is calculated as discussed above. The “Total [drawdown] at End of Project Period” is calculated as the sum of the regional, dynamic, and project drawdowns.

Table 4-4 compares the total drawdown (determined in Table 4-3) to both economic and physical limits. With regard to evaluation of economic impact, the allowable economic drawdown is estimated as 70 percent of the available water column shown in Table 4-1. The estimated pumping water elevations at the end of the 8-year project period are calculated by subtracting the total drawdown for all project years (determined in Table 4-3) from the nonpumping water elevations shown in Table 4-1. As shown in Table 4-4, all projected Los Alamos County well water elevations would be higher than the allowable economic drawdown elevations, resulting in a negligible economic impact.

Table 4-3. Calculation of total drawdown in nearby Los Alamos County water-supply wells over the 8-year project period (feet)

Well ID	From Regional Drawdown	From Dynamic Drawdown	From Project	Total at End of Project Period
PM-1	1.6	27.9	4.7	34.2
PM-2	6.8	66.9	5.0	78.8
PM-3	6.4	24.9	6.4	37.7
PM-4	6.4	55.1	6.3	67.8
PM-5	4.8	73.5	5.3	83.6
PM-6 ^a	8.0	73.5	4.8	86.3

Source: Original

^a Values for the proposed supply well PM-6 were estimated.

Table 4-4. Comparison of total drawdown in nearby Los Alamos County water-supply wells to economic and physical limits

Well ID	Allowable Economic Drawdown (feet)	Allowable Economic Drawdown Elevation (feet amsl)	Lowest Practical Pumping Elevation (feet amsl)	Pump Intake Elevation (feet amsl)	Estimated Pumping Water Elevation at End of Project Period (feet amsl)
PM-1	1188	4550	5605	5643	5704
PM-2	980	4855	5741	5735	5756
PM-3	1223	4602	5684	5780	5787
PM-4	1238	4597	5690	5710	5767
PM-5	1273	4569	5685	5711	5758
PM-6 ^a	1236	4530	5580	—	5680

Sources: Koch and Schmeer 2011, original

amsl: above mean sea level

^a Values for the proposed supply well PM-6 were estimated; pump intake elevation has not been determined.

Example: The allowable economic drawdown for PM-1 is estimated to be 1188 feet in the well based on an allowable 70 percent reduction of the current water column (from Table 4-1). This drawdown corresponds to a water-level elevation at the well of 4550 feet. The sum of all drawdowns at PM-1 at the end of the project is calculated to be 34.2 feet (Table 4-2). This drawdown corresponds to a water-level elevation at the well of 5704 feet, an elevation substantially above the allowable economic drawdown elevation of 4550 feet.

With regard to evaluation of physical limitations, the recommended lowest practical pumping level to avoid impairment from physical limitations is a projected pumping water level 20 to 30 feet above the top of the screen. The lowest practical pumping elevations based on requiring a 30-foot water column above the top of the screen and the current pump intake elevations are shown in Table 4-4. For all wells evaluated, the estimated pumping water elevation remains above the lowest practical pumping elevation.

The results of this evaluation indicate that proposed project groundwater withdrawal would be unlikely to impair the operation of nearby Los Alamos County water-supply wells. Specifically, the projected County well water elevations would be higher than the allowable economic drawdown elevations and the estimated pumping water elevations (after the proposed 8-year project) would remain above the lowest practical pumping elevations (as well as the current pump intake elevations).

Note that this evaluation uses two assumptions that would tend to overestimate the economic and physical impacts of the proposed action alternative on nearby water-supply wells. The first is that the influence of the proposed injection wells on drawdown is not considered. The second is that modeled project groundwater withdrawals are the maximum 707 acre-feet (230 million gallons) per year for the duration of the proposed action alternative.

Because this evaluation shows that project drawdowns would be small and localized, broader environmental effects of the proposed action alternative on the regional aquifer system, such as those to regional aquifer discharge areas, would be negligible.

Proposed Action Alternative without Injection Option

Under the without injection option, injection wells would not return water to the regional aquifer. However, the groundwater drawdown analysis provided above for the proposed action alternative does not account for the mitigating effects on drawdown from the injection of water. In addition, the without injection option would limit the groundwater extracted to volumes of approximately 169 acre-feet (55 million gallons) per year, substantially less than those analyzed for the proposed action alternative. Accordingly, the potential impacts on groundwater drawdown for the without injection option would be bounded by those described for the proposed action alternative discussed above.

No Action Alternative

Under the no action alternative, extraction wells would not be operated. Groundwater extraction in the project area would be limited to minimal quantities associated with ongoing monitoring and well-maintenance activities. This level of groundwater withdrawal would have negligible effects on the nearby Los Alamos County water-supply wells.

4.3.2 GROUNDWATER QUALITY

Groundwater quality was examined qualitatively to determine whether implementation of the proposed action alternative would alter groundwater contaminant levels within the regional aquifer.

Concentrations of chromium within the groundwater plume exceed the New Mexico groundwater standard of 50 ppb. In addition, the groundwater beneath Mortandad Canyon has perchlorate contamination locally above the Consent Order screening level of 4 ppb (LANL 2006a). The perchlorate contamination is not being specifically addressed as part of the proposed action alternative but will be incorporated into final remediation strategies proposed at a future date.

Proposed Action Alternative

Under the proposed action alternative, methods for disposition of treated groundwater extracted from the aquifer, with potential effects on groundwater quality, would be land application and injection into the aquifer. Water-quality standards that must be met before land application are specified in NMED Ground Water Quality Bureau discharge permit DP-1793 (NMED 2015b). Water-quality standards for treated water to be injected will be provided in NMED Ground Water Quality Bureau discharge permit DP-1835.

Introduction of tracers, chemicals, and/or biostimulants into the aquifer during cross-hole studies would be performed under NMED-issued permits. Any negative effects to groundwater quality would be localized and temporary.

Land-applied treated water would not adversely affect the water quality of the regional aquifer because treated water would meet the groundwater standards required by the NMED discharge permit. Additionally, the low volumes and limited duration of water applied over such a large area would be unlikely to increase the flow rate of contaminants into the regional aquifer, and no known sources of contamination exist within the land-application area that would be mobilized by land-applied water. NMED may also require monitoring of shallow alluvial wells to ensure that water quality of the aquifer is protected. Injection of treated water directly into the aquifer would not increase the flow rate of contaminants into the aquifer largely because the water would have been treated to meet NMED discharge-permit requirements. Achieving hydraulic control of the groundwater plume would reduce plume size relative to the no action alternative. Through extraction of contaminated water, treatment, and injection of treated water, an overall reduction in regional aquifer contaminant concentrations in this location could occur but only if the amount of chromium extracted exceeds the continued chromium inflow from the unsaturated zone.

Proposed Action Alternative without Injection Option

Under the without injection option, the effectiveness of the hydraulic capture approach to address plume migration would be reduced because of lower pumping rates. The levels of chromium contamination and the potential for plume migration would likely remain higher than with injection of treated water until a final remediation system could be implemented.

Land-applied treated water is unlikely to increase the flow rate of contaminants into the regional aquifer as the treated water would meet NMED discharge-permit requirements for quality, and no known sources of contamination exist within the land-application area that would be mobilized by land-applied water.

No Action Alternative

Under the no action alternative, contaminants would continue to migrate in the predominant direction of groundwater flow (see Figure 1-4). The plume would likely migrate beyond the LANL boundary with Pueblo de San Ildefonso (see Sections 4.6.3 and 4.13 for a discussion of potential environmental justice-related impacts of groundwater contamination).

4.3.3 SURFACE WATER

Proposed Action Alternative

Project activities taking place in the floodplain have the potential to cause adverse effects to surface water. The use of heavy equipment, such as bulldozers, can affect both the hydrology and water quality within and outside of the project area. Potential impacts include increased turbidity, sedimentation, overland flow, flooding, and/or contamination of water bodies through accidental spills or leaks of fuel or oil. The potential for such adverse impacts would be minimized through implementation of project controls specified in SWPPPs developed for each project element. Examples of these controls are as follows:

- Ensuring erosion and sediment controls remain in effective operating condition during the project activities.
- Refueling equipment at least 100 feet from any storm drain, drainage, or wetland, including dry arroyos.
- Inspecting equipment regularly for safety, cleanliness, and leaks, and implementing appropriate controls at staging areas. Leaking equipment would be removed from service and repaired.
- Protecting material and soil stockpiles from contact with stormwater using a perimeter sediment barrier.

Effects of runoff attributable to the project (e.g., from well pads) would be small and readily controlled through these measures.

The R-28 well pad and a portion of the unpaved access road between existing monitoring wells R-28 and R-42 are within the floodplain (see Figure 2-1). Maintenance activities at the R-28 well pad and for this portion of the access road would be subject to measures specified in project element-specific SWPPPs; the effects to surface water would be minimal. Piezometers in Sandia Canyon would be expected to be installed outside the stream channel. If siting issues require placement in the stream channel, a floodplain assessment and additional permitting may be required.

The proposed action alternative would require some land application of the treated water in the floodplain. As a permit condition for land application, no surface runoff of land-applied water would be allowed, and land application of water would not be allowed within a watercourse. Accordingly, effects on surface water quality or quantity would be minimal.

Proposed Action Alternative without Injection Option

Under the without injection option, the chances for runoff from land-applied water would be greater because of the increased volume and duration of water discharge; however, land application would be performed under the supervision of LANL operations personnel who would take measures to avoid runoff. For example, operators would be required by the NMED discharge permit to cease land application of water while precipitation is occurring. Other

impacts to surface water would be bounded by the evaluation of the proposed action alternative, discussed above.

No Action Alternative

Under the no action alternative, existing well R-28 would require access for monitoring activities, and the road between existing wells R-28 and R-42 would require maintenance. Implementation of project controls, SWPPPs, and best management practices, as described above for the proposed action alternative, would minimize the potential of adverse impacts to surface water.

4.4 AIR QUALITY

Proposed Action Alternative

Potential temporary effects on air quality would be associated with the proposed action alternative. Well installation would result in temporary, localized emissions associated with vehicle and equipment exhaust as well as particulate (dust) emissions from earth moving; however, air emissions would not be expected to exceed the NAAQS or the New Mexico Ambient Air Quality Standards. Air pollutant emission volumes from the proposed action alternative would be small compared with volumes from LANL as a whole; the effects on air quality would be small.

It is estimated that generators and equipment used during well installation, road maintenance, sampling, and other project activities would use approximately 95,000 gallons of diesel and 1,500 gallons of gasoline per year. Drilling contractors would use portable generators during the installation of new wells. The largest generators would be approximately 200 kilowatts and would only be in use for 2 to 3 weeks (continuous operation) during well installation. Injection wells would require a generator for periodic maintenance; capacity would be on the order of 200 kilowatts, operating over a period of a few weeks. The 200-kilowatt generators would be rental units. Generators (25 kilowatts) would be used for the sampling of the monitoring wells, which is conducted quarterly (approximately 6 hours per well). Portable generators (3 kilowatts) would be located in the back of pickup trucks and would be used for water-level measurements. New portable generators may require minor source New Source Review air permits under 20 NMAC 2.72, depending on intended use and potential emission rates. Subcontractors to the project would be responsible for obtaining any required permits for generators they own. Effects on air quality from generators would be negligible.

Mechanical evaporators may be used to disposition some treated groundwater. These units would be sources of regulated air pollutants. Mechanical evaporators create a plume of water droplets which quickly evaporate in air. As the droplets evaporate, dissolved solids present in the water can become airborne as particulate matter. Depending on the number and size of the evaporators, a minor source New Source Review air permit may be required before evaporator operation begins. These units may also be subject to permitting and inclusion in the LANL Title V operating permit. Effects on air quality from mechanical evaporators would be small.

Greenhouse Gases

CEQ recommends that climate should be considered in NEPA analyses. As noted by CEQ in the Revised Draft Guidance for Greenhouse Gas Emissions and Climate Change Impacts (79 FR 77802), Federal agencies should consider both the potential effects of a proposed action on climate change (as indicated by its estimated greenhouse gas emissions and climate impacts) and the implications of climate change for the environmental effects of a proposed action. The guidance also emphasizes that agency analyses should be commensurate with projected greenhouse-gas emissions and climate impacts, and should employ appropriate quantitative or qualitative analytical methods to ensure useful information is available.

Greenhouse gases would be generated by the project through use of diesel and gasoline for equipment, as described above. In addition, electricity used for the project would be at least partially generated through burning of fossil fuels, including coal (DOE 2008). Electricity use is described in Section 4.7.1. A quantitative analysis of climate change is required if greenhouse-gas emissions from the action are expected to exceed 25,000 metric tons carbon-dioxide equivalent on an annual basis (79 FR 77802). Based on emission factors for diesel and gasoline combustion and electricity generation (DOE 2010), activities under the proposed action alternative would be expected to generate approximately 1,600 metric tons carbon-dioxide equivalent per year; therefore, no quantitative analysis is required for this action.

Climate change would not be expected to negatively impact the project or increase its environmental effects. Any warming of the climate could allow for an extended period over which treated water could be land-applied, subject to discharge-permit requirements.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in the potential of slightly lower air emissions related to construction, but greater air emissions related to operation of water trucks and mechanical evaporators (if used). However, this would not result in a substantial increase of air emissions; impacts to air quality would be bounded by the evaluation of the proposed action alternative as discussed above.

No Action Alternative

Under the no action alternative, generators (25 kilowatts and 3 kilowatts) would be used during Consent Order activities, including well sampling and water-level measurements. Limited road maintenance would also be performed, resulting in temporary particulate (dust) emissions. Air pollutant volumes would be negligible; greenhouse gas emissions would be minimal.

4.5 ECOLOGICAL RESOURCES

Proposed Action Alternative

The proposed project activities are subject to the requirements of the HMP (Hathcock et al. 2014b) and best management practices for migratory birds and sensitive species (Hathcock et al. 2011, Hathcock et al. 2015). The HMP received concurrence from the USFWS in 1999. As

discussed in Section 3.7.3, the Mexican spotted owl is the only T&E species potentially affected by the proposed action alternative.

Potential impacts to ecological resources were considered for three aspects of the proposed action alternative:

- Direct disturbance from installation and operation of proposed new infrastructure and associated vehicle traffic;
- Noise associated with installation and the operational phase of the proposed action alternative; and
- Impacts associated with treated-water disposition through land application, evaporation, and storage basins.

Based on the requirements of the HMP and best management practices for migratory birds and sensitive species, DOE determined that the proposed action alternative is not likely to affect the Mexican spotted owl, migratory birds, other sensitive species, and floodplain/riparian habitat. Further discussion is provided below.

The Mortandad Canyon Mexican spotted owl core area of environmental interest (AEI) is located approximately 500 feet upstream from the nearest project activity in Mortandad Canyon, the area in which land application and/or evaporation would occur. Several of the monitoring wells in Mortandad Canyon are in the core AEI; any activities at these existing wells would be managed per existing requirements. Although the project activities are outside the core AEI, some are in the buffer area (1,300 feet from the core habitat) and could impact the core AEI via disturbance (e.g., from noise, light)⁸. Restrictions applicable to undeveloped, occupied Mexican spotted owl AEIs would be of concern from increased noise and/or light from the buffer area that overlaps the far western part of the land-application area. No construction or installation activities are planned for the western part of the project area, so there would be no impacts to the Mexican spotted owl AEI buffer area from direct disturbance or noise. Such restrictions are seasonal and apply from March 1 to August 31 to occupied AEIs and buffer areas. Although there is the potential for negative effects from increased noise from the spraying of water on the land-application area and use of mechanical evaporators, land application is likely to have direct beneficial effects on the quality of the habitat by stimulating the growth of plants. Since the storage basins are not covered, they could be a water source for birds and potentially attract other wildlife as well. Given their location, effects on the Mexican spotted owl would be minimal.

In the proposed action alternative, the potential for impacts on the Mexican spotted owl would be avoided through implementation of at least one of the following measures:

- Annual biological surveys to show the Mortandad Canyon AEI is not occupied or the nest location is further than 1,300 feet from project activities.

⁸ Road access to the project area goes through the southern boundary of the AEI, but there are no restrictions on vehicle traffic on developed gravel roads per the HMP (Hathcock et al. 2014b).

- Restricting activities, such as land application, within the buffer area from March 1 to August 31.

Some of the proposed project activities would occur in the canyon bottoms (Mortandad and Sandia Canyons) and have the potential to impact the 100-year floodplain and sensitive species found in riparian habitat. For example, up to 24 piezometers are to be installed on terraces adjacent to the stream channel (Sandia Canyon). Some of the land-application area (approximately 50 acres of additional irrigation system) would be in the 100-year floodplain and could also impact riparian species. The sensitive species best management practices identify the Ringtail and several bird species as being associated with riparian habitat (Hathcock et al. 2015). The potential for impacts on Ringtails' foraging opportunities or other behaviors is deemed unlikely, given the broad home range for this species in comparison to the potential localized impacts in the 100-year floodplain and associated riparian habitat. However, the floodplain and associated riparian habitat would be monitored and protected as part of the project activities. Mitigation measures related to migratory bird species are discussed below.

Habitat disturbance planned for areas not in the 100-year floodplain or in the Mexican spotted owl AEI may affect ecological resources for migratory birds. To minimize the potential of effects to migratory birds, vegetation removal (including dead trees) would not occur during June and July without consulting a biologist (Hathcock et al. 2011) to ensure nesting migratory birds are not present.

Land application of water along unpaved access roads during the growing season would stimulate plant growth and in that sense improve habitat quality. Water trucks would apply the water from the existing unpaved access road in Mortandad Canyon and therefore would not be subjected to any restrictions per the HMP (Hathcock et al. 2014b).

Proposed Action Alternative without Injection Option

Land-applying 55 million gallons of water annually for up to 8 years under the without injection option would have uncertain consequences. It is possible that applying supplemental water over the project duration would eventually permit native species associated with moister, higher-elevation environments to become established. It is also possible that nonnative species might become established for the period when water is applied. Such changes would be limited to the land-application area and would be transitory; the plant community would be expected to revert to undisturbed native vegetation over time. Given the transitory nature of changes to the vegetation community and relatively small area of project land application in comparison to habitat modification associated with development at LANL and nearby residential and commercial areas, effects on ecological resources would be small.

No Action Alternative

There would be no impact to ecological resources as a result of the no action alternative because there is no pathway from the chromium groundwater plume under its current or projected future location to ecological resources. Activities under the Consent Order described in the SWEIS

(DOE 2008) would continue to be governed by ecological management plans (Hathcock et al. 2011, Hathcock et al. 2014b, and Hathcock et al. 2015).

4.6 CULTURAL RESOURCES

4.6.1 METHODOLOGY

The following analysis details the anticipated direct and indirect effects of the proposed action alternative and the no action alternative on cultural resources. Potential effects were identified through application of the Section 106 Criteria of Adverse Effects (36 CFR Part 800.5) to historic properties and through consultation with the Pueblo de San Ildefonso to learn about potential impacts to tribal cultural resources and practices. Potential effects to historic properties were determined based on the proximity of the property to project facilities or infrastructure; proximity to project infrastructure development, operations, or reclamation activities; and the presence of workers in the area. Because historic properties are a finite resource and cannot be regenerated, all physical impacts to historic properties are considered to be permanent in duration.

Criteria of Adverse Effects

Section 106 of the NHPA requires Federal agencies to take into account the effects of their actions on any district, site, object, building, or structure included in, or eligible for inclusion in, the NRHP. An adverse effect occurs when an undertaking diminishes the integrity of those characteristics of an historic property that qualify it for inclusion in the NRHP. Implementing regulations for Section 106 provide specific criteria for identifying effects on historic properties. The types of possible adverse effects include:

- Physical destruction of or damage to all or part of a property;
- Physical alteration of a property;
- Removal of a property from its historic location;
- Change in the character of a property's use or of physical features within a property's setting that contribute to its historic significance;
- Introduction of visual, atmospheric, or auditory elements that diminish the integrity of a property's significant historic features;
- Neglect of a property which causes its deterioration, except where such neglect and deterioration are recognized qualities of a property of religious and cultural significance; and
- Transfer, lease, or sale of property out of Federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of a property's historic significance (36 CFR 800.5[a][2]).

DOE applied the criteria of adverse effects to the activities planned under the proposed action alternative and the no action alternative to identify potential effects to historic properties identified within the APE.

Tribal Consultation

On June 30, 2015, DOE met with staff from the Pueblo de San Ildefonso's Department of Environmental and Cultural Protection and representatives from the Pueblo to identify tribal cultural resources and potential impacts to these resources or associated traditional practices arising from the proposed action and no action alternatives. This meeting assisted DOE in analyzing the potential impacts of the proposed project under NEPA.

In July 2015, DOE provided sections of the EA that were specific to the concerns/issues raised during the June 30 meeting to Mr. Raymond Martinez and former Governor Terry Aguilar. DOE received comments from Terry Aguilar and integrated them where appropriate. The revised sections and supporting information were provided to the Pueblo in August 2015 for review to ensure that DOE had incorporated the Pueblos' comments and concerns appropriately.

Continued consultation will help guide future project activities. Such consultations will be ongoing throughout the project under Federal regulations, LANS procedures, and formal agreements with the Pueblo.

4.6.2 PROPOSED ACTION ALTERNATIVE

Historic Properties

Proposed project facilities and infrastructure would avoid direct impacts to all known historic properties. All areas used for land application of treated effluent would be located to avoid known historic properties.

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 to the NRHP under criterion D, and one, a historic wagon road, has been determined not eligible. Increased use and maintenance of the road associated with the proposed action alternative could potentially create additional impacts to these seven sites. Preemptive best management practices have already been implemented along Puye Road to address the risk for potential impacts from existing use and maintenance, and these measures would prevent additional potential impacts from the proposed action alternative (LANL 2015e). These practices include:

- Geotextile matting was placed within the previously existing roadside ditch. The matting extends up the embankment approximately 2 feet beyond the roadbed on both sides to help protect the bisected sites from eroding into the roadbed. The matting allows vegetation to grow through it.
- The previously existing roadbed that bisects the archaeological sites was covered with Tensar TriAx Geogrid™ liner. This liner provides protection for any buried cultural

deposits that may exist within the roadbed and is a visual indicator during road maintenance activities.

- Base-course gravel ranging in depth between 12 to 18 inches (depending on the height of the original road grade) was placed over the Tensar TriAx Geogrid™ liner to provide a driving surface that will not affect the original ground surface. Additionally, the base-course gravel can be maintained without potential impacts to the bisected sites.
- “Whiskers” (plastic stake markers that are highly visible and durable) were anchored within the base course to provide an additional visual indicator to road maintenance crews. These were placed 6 inches above the original roadbed within the base course. Blading and road maintenance will not occur below the depth of the whiskers.
- The new road surface was sloped so stormwater runoff will not impact the bisected sites.
- The bisected archaeological sites were fenced along the road to act as a visual indicator to maintenance and spray crews. These fenced areas were also marked with “No Spray” signs to prevent land application spray crews from spraying treated water in these areas.

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 alternative are best management practices to control stormwater runoff and erosion, including the use of retention basins, berming around facility perimeters, placement of sediment control structures, and placement of gravel base courses. These measures would be implemented in accordance with the project SWPPP, as needed. To provide additional protection, erosion controls such as straw wattles are being installed in and around 46 of the archaeological sites. These erosion control measures will limit indirect impacts to archaeological sites from stormwater runoff or erosion associated with the proposed action alternative.

LANS cultural resource staff would implement monitoring throughout the duration of the proposed action alternative. 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 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 2006b). 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* (NAGPRA) and the LANL NAGPRA standard operating procedure (LANL 2008).

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 impacts to historic properties would occur as a result of the proposed action alternative. In accordance with the LANL CRMP, DOE’s determination of

effect for the project under Section 106 is “No Effect through Avoidance.” DOE submitted its determination of effect to the New Mexico SHPO for consultation, per Section 9 of the LANL CRMP. A response from the New Mexico SHPO agreeing with DOE’s determination of effect was received on August 14, 2015 (Ensey 2015).

As discussed in Section 2.2.1, the proposed action alternative would use angle drilling for the injection wells, if possible, to use existing well pads for these wells. However, if angle drilling is determined not to be viable, additional well pads would need to be constructed to install vertical injection wells. With regard to cultural resources, the only potential effect identified with respect to new well-pad installation relates to a proposed injection well angle-drilled from the existing well pad at R-50. Specifically, if angled drilling is not successful for the injection well, then installation of a new well pad, in addition to an access road, electrical line, and pipeline from R-50 to the new well pad, would be required. The new well pad would be positioned to avoid impact to any known archaeological sites; however, given the constraints of topography, the access road, pipeline, and electrical line would cross the site buffer area of LA 21346. This site is a 20–40 room Ancestral Pueblo roomblock, with an enclosing wall and plaza, which appears to have been two stories high. Two locations in the rubble mound appear to have been partially excavated by pothunters, but despite these areas of vandalism and general site erosion, the site is in good condition. The site has been determined eligible to the NRHP by the DOE. The corridor containing the road, pipeline, and electrical line would run along the edge of the site and would not impact the roomblock itself. If the new well pad, access road, electrical line, and pipeline are developed, it would adversely affect site LA 21346. If this were the case, DOE would propose appropriate measures to mitigate any determined effect and would consult with the New Mexico SHPO and concerned Tribes to negotiate a memorandum of agreement that details those measures.

Tribal Cultural Resources

Representatives of Pueblo de San Ildefonso anticipate a direct, adverse impact from the proposed action alternative 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 2015a). 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 and to their traditional culture. The associated mental and emotional effects to the people would, in turn, affect their ceremonies and rituals.

Specific examples of impacts anticipated by Pueblo de San Ildefonso representatives include (DOE 2015a) the following:

- Activities occurring during project infrastructure development and operations, including the generation of noise and artificial lighting and the presence of additional facilities and infrastructure, would interrupt animal movement through the Sacred Area and have an effect on successful calving.

- The presence of workers near the boundary between LANL and the Pueblo de San Ildefonso, paired with a concern for worker safety, would have an effect on where and when traditional hunting activities could occur.
- New facilities and infrastructure would result in additional visual impacts to the viewshed over the Sacred Area from tribal lands.
- Potential impacts to buried archaeological deposits during infrastructure development would likely occur.

The Pueblo representatives understand that the proposed action alternative is intended to lessen the impacts of the chromium plume, and they view this as a necessary offset. The representatives reported that knowledge of the chromium plume has 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 perceive that there would be impacts from the proposed action alternative, even though these would be a trade-off to the impacts of the chromium plume.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in a smaller project infrastructure footprint and less heavy-equipment operation. The actual amount of water extracted from the aquifer would be less; however, the treated water volume applied to the land and the duration of land application would increase. As under the proposed action alternative, land application would be prohibited in areas where historic properties or archaeological sites are present. Impacts to cultural resources, both historic properties and tribal cultural resources, would be bounded by the evaluation of the proposed action alternative, above.

4.6.3 NO ACTION ALTERNATIVE

Under the no action alternative, DOE and LANS would continue to monitor existing wells and conduct maintenance of existing infrastructure (e.g., wells, roads) within Mortandad Canyon. LANS would perform limited road maintenance (e.g., grading, drainage) to maintain access to existing wells in the project area. With the protective measures already in place for Puye Road and continued use of stormwater runoff and erosion control measures in accordance with the current SWPPP, there would be no effects to historic properties as a result of the no action alternative.

Pueblo de San Ildefonso representatives anticipate a direct, adverse impact from the no action alternative to tribal cultural resources and practices located within the entire Sacred Area because of the continued presence of the chromium plume (DOE 2015a). These anticipated impacts would be similar to those described for the proposed action alternative, and, as with that alternative, would be holistic in nature and extent. According to the Pueblo representatives, impacts to resources and traditional practices have already been experienced by the Pueblo from the presence of the plume, as explained above, and these would be expected to continue and worsen. Thus, the Pueblo representatives perceive that the impacts of the no action alternative to traditional cultural resources and practices may be more substantial than those impacts that

would arise from the proposed action alternative. As with the proposed action alternative, under the no action alternative, DOE would consult with Pueblo de San Ildefonso representatives to reduce impacts to tribal cultural resources and practices, in accordance with Federal law.

4.7 UTILITIES AND INFRASTRUCTURE

4.7.1 ELECTRICITY

Proposed Action Alternative

Power lines to support the proposed project would extend from existing power lines in Mortandad Canyon to proposed extraction and injection wells (Figure 2-1). These would be a “raptor safe” design to minimize the potential of bird electrocution. Under the proposed action alternative, the majority of electricity would be used to operate extraction wells, injection wells, irrigation pumps for land application of water, evaporators, and water treatment units. Total project annual electricity usage is estimated at 1,000 megawatt-hours, only 0.2 percent of total LANL usage. The existing electrical infrastructure would accommodate project use; impacts to the electrical infrastructure would be small.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in less electricity usage. Impacts to electrical infrastructure would be bounded by the evaluation of the proposed action alternative, above.

No Action Alternative

Under the no action alternative, extraction wells, irrigation pumps, evaporators, and water treatment units would not be operated. Electricity use would be less than that described above for the proposed action alternative, resulting in negligible impacts to electrical infrastructure.

4.7.2 WATER

Proposed Action Alternative

Under the proposed action alternative, potable water would be required for drilling wells and dust suppression on roads near sensitive areas. Approximately 400,000 gallons of water per year would be used for well drilling during the first 2 years of the project. The volume of potable water proposed per year for dust suppression around the sensitive areas would be 260,000 gallons per year for the project duration. The maximum projected annual water use of 660,000 gallons per year would be only 0.2 percent of total recent LANL usage, a quantity well within the range of LANL’s annual water-use variability. The potable water supply and existing infrastructure would accommodate project use; effects on water infrastructure would be negligible.

DOE will be submitting an Application for Permit to Change an Existing Water Right to the New Mexico Office of the State Engineer for three supplemental wells and existing monitoring

wells to be used in connection with the control of chromium contaminated groundwater at LANL.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in a smaller amount of water extracted than under the proposed action alternative (because of the limitations related to land application and evaporation processes). Use of potable water would remain the same as would impacts to water infrastructure.

No Action Alternative

Under the no action alternative, well drilling and dust-suppression activities would be minimal; corresponding water use would be substantially less than the proposed action alternative.

4.7.3 ROADS

Proposed Action Alternative

Under the proposed action alternative, unpaved access roads would be constructed off the existing main road to the new well pads. The roads would be constructed in accordance with the LANL Best Management Practices Manual, including use of wattles and/or ditches and culverts to minimize sediment transport and erosion.

For roads near archaeological sites, measures would be employed to ensure that road use and runoff would not damage the sites. An example of measures that may be employed is provided in Section 4.6.2 (see discussion of Puye Road). To maintain the road into Mortandad Canyon, approximately 4 to 6 inches of base course would need to be added to the surface annually. In culturally sensitive areas, road maintenance would be restricted only to the roadway surface and would only include snow removal or placement of additional gravel; wattles would be used for runoff control. If other maintenance is required, such as grading below final grade, a LANS archeologist would be present to monitor work and avoid impacts to cultural sites.

Other than construction of additional access roads and potential application of measures to new or existing roads to protect archaeological sites, activities under the proposed action alternative would not affect road infrastructure; overall effects on road infrastructure would be small.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in fewer roads to construct and maintain. Impacts to roads would be bounded by the evaluation of the proposed action alternative discussed above.

No Action Alternative

Under the no action alternative, existing roads would be maintained as described for the proposed action alternative. However, new roads could be constructed for access to new wells required under the Consent Order, as analyzed in the SWEIS (DOE 2008).

4.8 TRAFFIC AND TRANSPORTATION

Proposed Action Alternative

Traffic into and out of the project area would travel the restricted-access portion of Pajarito Road, connecting with public roadways at either NM 4 to the southeast, or NM 501 to the northwest (from the publicly accessible, but still on LANL property, portion of Pajarito Road).

The installation of each new extraction or injection well pad would require approximately 30 loads of fill from dump trucks, resulting in approximately 250 loads of fill that would be brought into the site over the first 2 years of the project. For the duration of the project, an estimated 4 inches of base course would need to be brought in for annual road maintenance (approximately 225 loads of base course per year). In addition, fill would be brought into the site for the reclamation of the storage basins, as needed⁹. Total potential fill material to be brought into the site is estimated to be 2,500 dump-truck loads over the 8-year project period, excluding other minor potential fill uses (e.g., fill for influent/effluent pipelines).

Concrete would also be required to install the pads at the injection/extraction wells and piezometers. Extraction and injection well pads would require a total of approximately 16 truckloads of concrete into Mortandad Canyon. Piezometers in Sandia Canyon would require a total of approximately 6 truckloads of concrete over a 2-day period.

Routine vehicle traffic to and from Pajarito Road would be an estimated 40 round trips (approximately 6 miles) per day. This estimate covers all vehicles including work trucks, drill rigs, and heavy equipment.

Much of the traffic generated by the project under the proposed action alternative would enter or exit the project area via Pajarito Road to the northwest, toward the main portion of LANL. Vehicles traveling to or from the Los Alamos townsite would likely pass through the intersection of West Jemez Road and Diamond Drive. In 2008, traffic volume on this portion of West Jemez Road was measured at approximately 2,500 vehicles in each direction (Wilson & Co. 2010). Project traffic would be minimal in relation to the volume of other LANL traffic. No decline in the level of service of roadways would be anticipated; effects on traffic would be negligible.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in less need to develop project infrastructure. Impacts to traffic and transportation would be bounded by the evaluation of the proposed action alternative, above.

No Action Alternative

Under the no action alternative, no extraction or injection wells and influent/effluent pipelines would be constructed. No piezometers would be constructed. The need for fill would be limited primarily to road maintenance. Concrete requirements would be limited to monitoring well

⁹ Currently, two storage basins near R-42 are planned to be reclaimed, requiring approximately 40 loads of fill.

installation required under the Consent Order. Traffic generated under the no action alternative would be minimal.

4.9 HAZARDOUS MATERIALS AND WASTE GENERATION

Proposed Action Alternative

Industrial waste (i.e., construction debris) generated from the proposed project would be approximately 50 cubic yards per year. This waste would be shipped to various facilities outside Los Alamos for disposal. The only hazardous waste generation anticipated from the project would be associated with chemicals used in field kits used for sample analyses (approximately 30 gallons per year). Hazardous waste would be managed in accordance with LANL's established waste management procedures.

Treatment of water for chromium removal may involve the use of an ion-exchange resin. Use of resins would be tracked and a vessel would be removed from service once the resin capacity is exhausted. The resin in the exhausted vessel would be sampled and analyzed to determine if it is a hazardous waste before the resin is returned to the vendor for regeneration. If a sample determined the resin to be a hazardous waste, the resins would be manifested and shipped as hazardous waste but still returned to the vendor for regeneration. Under current treatment operations related to extraction well CrEX-1, no resin samples have tested as hazardous.

Injection well maintenance would occur once per year, per well. Approximately 50,000 gallons of treated water with chemical additives would be produced from each well-maintenance activity. The wastewater from this activity would be collected and sampled and a determination would be made for disposal. It is anticipated that most of the wastewater could be disposed of with the other treated water.

All waste would be handled in accordance with LANL's waste management procedures. The waste quantities generated by the project under the proposed action alternative would be minimal. Impacts to on-site waste operations or off-site disposal facilities are anticipated to be small.

Proposed Action Alternative without Injection Option

Under the without injection option, injection well maintenance would not be performed, resulting in less waste generation. Waste-generation impacts would be bounded by the evaluation of the proposed action alternative discussed above.

No Action Alternative

Under the no action alternative, no spent resins or treated water with chemical additives would be generated. However, small quantities of waste would be generated from field kits used for sample analyses performed under the Consent Order. This waste would be handled in accordance with LANL's waste management procedures. Impacts to on-site waste operations or off-site disposal facilities are anticipated to be small.

4.10 NOISE

Proposed Action Alternative

The proposed action alternative would result in limited short-term increases in noise levels near the project area associated with various infrastructure development activities. Following the completion of these activities, noise levels would return to existing levels. With project-prescribed measures, effects of noise generated by project activities on members of the public (Section 4.12.1), LANL workers (Section 4.12.2), and ecological resources (Section 4.5) are expected to be small.

Earth-moving activities and drilling related to well installation would require the use of heavy equipment. Heavy equipment, such as front-end loaders and bulldozers, would produce intermittent noise levels approximately 74 to 88 A-weighted decibels (dBA) at 50 feet from the work site under normal working conditions (Federal Transit Administration 2006; Table 4-5). Heavy equipment would generally operate during normal work hours (8 am to 5 pm). During drilling operations, drill rigs would typically be active 24 hours per day, 7 days per week until well installation is complete. Trucks used in land application of water could be active up to 10 hours per day, for approximately 8 months during the year, as restricted by the NMED discharge permit. Personal protective equipment would protect workers' hearing. Sound levels would be expected to dissipate to background levels before reaching most publicly accessible areas. Traffic noise from vehicles driving to and from the project area would not be expected to noticeably increase over the present traffic noise level on roads at LANL.

Potential effects of noise specific to Pueblo de San Ildefonso, as related to the proposed action alternative, are discussed in Section 4.6.2 and would be of limited duration.

Table 4-5. Noise emission characteristics of construction equipment

Type of Equipment	Typical Noise Level, dBA at 50 feet
Roller	74
Backhoe	80
Excavator/Shovel	82
Bulldozer	85
Loader	85
Grader	85
Truck	88

Source: Federal Transit Administration 2006
dBA: A-weighted decibels

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in less noise from heavy equipment. Sprinklers and/or mechanical evaporators would be used to a greater extent than under the proposed action alternative, operating more hours per day and over a longer portion of the project. Otherwise, potential noise impacts would be bounded by the evaluation of the proposed action alternative.

No Action Alternative

Under the no action alternative, noise would be limited to activities associated with monitoring well sampling. In the absence of infrastructure development activities and heavy equipment use, noise is anticipated to be within background levels at publicly accessible locations.

4.11 VISUAL RESOURCES

Proposed Action Alternative

Under the proposed action alternative, 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, as discussed below.

The proposed action alternative would affect scenic quality resulting from the visual intrusion of vehicles, equipment, workers, vegetation clearing, and emplacement of new infrastructure. However, vantage points are not available to the public within Mortandad Canyon. Piezometers in Sandia Canyon would be visible to motorists from East Jemez Road, but finished concrete piezometer pads are only approximately 6 feet × 6 feet in size and would not be an obvious component of the viewshed.

A small portion of the Mortandad Canyon project area is visible from the Pueblo de San Ildefonso. Potential visual impacts related to activities at Pueblo de San Ildefonso are discussed in Section 4.6.2.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in a smaller project infrastructure footprint and fewer vehicles. Impacts to visual resources would be bounded by the evaluation of the proposed action alternative, above.

No Action Alternative

Under the no action alternative, infrastructure development activities would be limited to monitoring wells required under the Consent Order in Mortandad Canyon. No activities would take place in Sandia Canyon. Impacts to visual resources would be small.

4.12 HUMAN HEALTH AND WORKER SAFETY

4.12.1 HUMAN HEALTH

Proposed Action Alternative

Project activities under the proposed action alternative would not involve direct hazards to the public. Access to the Mortandad Canyon portion of the project area is restricted and not readily accessible to the public. The piezometer area in 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 discharge permit and would not pose inhalation risks to members of the public. Effects on human health would be negligible.

Proposed Action Alternative without Injection Option

Under the without injection option, effects to human health would be unchanged from the evaluation of the proposed action alternative discussed above.

No Action Alternative

Under the no action alternative, activities would be limited to sampling and possible monitoring well installation in Mortandad Canyon, an area not accessible to the public. Expansion of the groundwater plume would continue; however, as groundwater within the plume area or the anticipated migration area is not currently used as a drinking water source, no adverse impacts to human health would be anticipated before the final remedy is implemented.

4.12.2 WORKER SAFETY

Proposed Action Alternative

Under the proposed action alternative, 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/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.

Activities planned under the proposed action alternative would not be expected to have any adverse health effects on workers. Primarily support and maintenance contractors would be involved in site clearing, earth moving, heavy-equipment operations, access-road maintenance, drilling, electrical installation, and land-application activities. LANS employees would serve mostly in oversight roles. Approximately 80 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 long-term health effects on workers.

Proposed Action Alternative without Injection Option

Under the without injection option, some injection wells and associated infrastructure might not be installed, resulting in less infrastructure development activity, although hazards would be the same as those described above. Impacts to worker safety would be bounded by the evaluation of the proposed action alternative discussed above.

No Action Alternative

Under the no action alternative, the use of heavy equipment would be limited to possible installation of monitoring wells as required under the Consent Order, road maintenance, and periodic well monitoring. Hazards described for the proposed action alternative would exist, but at a lower level of activity. Work under the no action alternative would not be expected to have any adverse health effects on workers.

4.13 ENVIRONMENTAL JUSTICE

Proposed Action Alternative

As discussed in Section 3.15, based on the Native American status of the Pueblo de San Ildefonso, residents of the Pueblo would be considered a minority population for purposes of identifying environmental justice concerns.

The express purpose of the proposed action alternative is to reduce risks to human health and welfare in the region by removing contaminants from the environment and to contain the off-site migration of groundwater contamination onto Pueblo de San Ildefonso lands. There would be no significant impacts from the proposed action alternative; therefore, the proposed action alternative would not result in disproportionately high and adverse effects to residents of the Pueblo.

Proposed Action Alternative without Injection Option

Environmental justice-related impacts would be as described in the evaluation of the proposed action alternative discussed above.

No Action Alternative

Under the no action alternative, chromium contamination would continue to migrate in the predominant direction of groundwater flow. The plume would likely migrate onto Pueblo de

San Ildefonso lands. Therefore, the no action alternative could potentially result in disproportionately high and adverse effects to residents of the Pueblo.

5.0 CUMULATIVE IMPACTS

The CEQ regulations implementing NEPA define cumulative impacts as “the impact on the environment which results from the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions” (40 CFR 1508.7). The cumulative effects evaluation for this EA consists of evaluating contributions of other LANL and nearby activities to proposed project activities and potential environmental consequences over the operational period of the proposed action alternative.

Potential impacts affecting the following resources analyzed in this EA would not contribute substantially to cumulative effects because the proposed action alternative would not have long-term or irreversible effects on the resource in a cumulative manner and no past, present, and reasonably foreseeable actions are known such that additive effects would exceed the potential effects described in this EA:

- **Land use**—No actions in the area are known that would alter land use such that additive effects of the proposed action alternative would contribute to incompatible land uses.
- **Geology and soils**—No actions in the area are known to contribute to substantive geologic effects or alteration of soil profiles.
- **Groundwater (drawdown)**—The regional aquifer could be affected in a cumulative manner by groundwater withdrawal associated with the proposed action alternative. Drawdown is inherently an aspect of the resource subject to cumulative impacts within a region where the project, under the proposed action alternative, is extracting water from the same aquifer that is used by Los Alamos County for water supply. Because drawdown is an existing condition from continual pumping by Los Alamos County water-supply wells, the analysis of potential drawdown impacts from the project cannot be analyzed separately. Therefore, the cumulative analysis is contained within the analysis presented in Section 4.3.1.1. It should be noted that even though the proposed action alternative has projected annual groundwater withdrawals of 707 acre-feet (230 million gallons) over most of the project duration, planned injection wells could largely offset the effect of these withdrawals on the aquifer. Under the without injection option, less groundwater would be extracted. Additionally some of the water would be returned to the regional aquifer via land application but much less compared with the water quantity returned through use of the injection wells.
- **Groundwater (quality)**—No sources of groundwater contamination or potential groundwater contamination are known within the project area other than those described in this EA. The groundwater beneath Mortandad Canyon also has perchlorate contamination locally above the Consent Order screening level of 4 ppb (LANL 2006a). The perchlorate contamination is not being specifically addressed as part of the proposed action alternative. The existing perchlorate plume, described in Section 1.2, would not contribute to project effects. Some perchlorate present in the groundwater may be

incidentally removed and treated as a result of the proposed action alternative. Treated water injected into the aquifer under the proposed action alternative would meet NMED discharge permit requirements for all constituents.

- **Surface water**—No sources of surface water contamination or runoff are known that would substantively add to potential project effects.
- **Air quality**—No sources of air emissions are known that would substantively add to criteria pollutant, hazardous air pollutant, or greenhouse-gas emissions from the project.
- **Ecological resources**—No actions in the area are known that would substantively contribute to potential project effects on T&E species.
- **Cultural resources and environmental justice**—Because the proposed action would not result in disproportionately high and adverse effects to a minority population, there would be no cumulative effects related to environmental justice under the proposed action alternative. There would be some cumulative impacts under the no action alternative.
- **Utilities and infrastructure**—No actions are known that would substantively contribute to potential project effects on electricity, water, or road infrastructure.
- **Traffic and transportation**—No actions are known that would substantively contribute to potential project effects on traffic and transportation.
- **Hazardous materials and waste generation**—No sources of hazardous materials or waste are known that would substantively contribute to potential project effects.
- **Noise**—No sources of noise are known that would substantively contribute to potential project effects.
- **Visual resources**—New project infrastructure would not combine with existing infrastructure to substantively alter the viewshed.
- **Human health and worker safety**—No actions or sources of contamination are known that would substantively contribute to potential human-health or worker-safety effects.

6.0 COMPLIANCE WITH APPLICABLE LAWS, REGULATIONS, AND OTHER REQUIREMENTS

This section presents the Federal and State laws and regulations applicable, or potentially applicable, to the proposed action alternative.

6.1 FEDERAL

6.1.1 NATIONAL ENVIRONMENTAL POLICY ACT (NEPA)

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 the DOE has published implementing procedures (10 CFR 1021) that govern DOE's compliance with NEPA.

6.1.2 CLEAN WATER ACT

The *Clean Water Act* 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 *Clean Water Act* prohibits the “discharge of toxic pollutants in toxic amounts” to navigable waters of the U.S. Section 313 of the *Clean Water Act* requires all branches of the Federal government engaged in any activity that might result in a discharge of runoff of pollutants to surface waters to comply with Federal, state, interstate, and local requirements.

Under Section 404 of the *Clean Water Act*, authorization from the U.S. Army Corps of Engineers is required when dredged or fill material is discharged into waters of the U.S., including wetlands. This includes excavation activities that result in the discharge of dredged material that could destroy or degrade waters of the U.S.

The *Clean Water Act* also provides guidelines and limitations for effluent discharges from point-source discharges and establishes the National Pollutant Discharge Elimination System (NPDES) permit program. 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 T&E species study;
- Develop and implement a SWPPP in accordance with good engineering practices;
- Submit a notice of intent;

- Install and maintain erosion and stormwater controls, and apply best management practices;
- Perform and document stormwater inspections during construction and site stabilization;
- Amend the SWPPP as necessary; and
- 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 one acre or part of a larger common plan of development that collectively disturbs more than one acre.

6.1.3 ENDANGERED SPECIES ACT (ESA)

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

- Protects listed (i.e., T&E) 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 ESA, 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 ESA 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.

6.1.4 MIGRATORY BIRD TREATY ACT (MBTA)

The MBTA 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 U.S., 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.

6.1.5 NATIONAL HISTORIC PRESERVATION ACT (NHPA)

Section 106 of the NHPA of 1966, as amended (54 U.S.C. 300101 et seq.), requires Federal agencies to consider the effect of their undertakings on historic properties. The ACHP 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 Programmatic Agreement.

6.1.6 ARCHAEOLOGICAL RESOURCES PROTECTION 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.

6.1.7 CLEAN AIR ACT (CAA)

The CAA of 1970 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 the EPA to set NAAQS for pollutants considered harmful to public health and the environment.

The CAA would not be applicable to activities associated with the project unless DOE decides to use mechanical evaporators that would emit particulate matter. If mechanical evaporators are used, an NMED Construction Air Quality Permit would need to be obtained. This permit would need to be received before operation of the evaporators. Within 1 year of starting operations, this permit would need to be incorporated into LANL's Title V Operating Permit.

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)]. Although extraction and injection wells under the proposed action alternative are not monitoring wells, it is believed they would not be regulated because they would be considered mobile equipment and associated with construction activities.

6.1.8 RESOURCE CONSERVATION AND RECOVERY ACT

The *Resource Conservation and Recovery Act* of 1976 ([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.

6.1.9 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.

6.1.10 NATIVE AMERICAN GRAVES PROTECTION AND REPATRIATION ACT

The NAGPRA 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.

6.1.11 EXECUTIVE ORDER 11988

EO 11988, Floodplain Management, requires Federal agencies to assess the effects their actions may have on floodplains and to consider alternatives to avoid adverse effects and incompatible development on floodplains.

6.1.12 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.

6.1.13 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.

6.1.14 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.

6.1.15 DOE POLICIES AND ORDERS

DOE policies and orders potentially applicable to the proposed action alternative are identified below:

- DOE Order 144.1—American Indian Tribal Government Interactions and Policy, dated January 16, 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 422.1—Conduct of Operations, dated December 3, 2014, 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 436.1—Departmental Sustainability, dated May 2, 2011, 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—Worker Protection Program for DOE (including the National Nuclear Security Administration) Federal Employees, dated May 17, 2007, 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 451.1B—NEPA Compliance Program, dated January 19, 2012, 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—Department of Energy Management of Cultural Resources, dated May 2, 2001, establishes cultural resource management as a necessary part of DOE program implementation and establishes program responsibilities, requirements, and authorities.

- DOE Policy 450.4A—Integrated Safety Management Policy, dated April 25, 2011, 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.

6.2 STATE

The following State laws may be applicable to the project under the proposed action alternative:

- *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 hazardous air pollutants.

In New Mexico, water resources are protected under the Federal *Clean Water Act* (see Section 6.1.2) and the *New Mexico Water Quality Act*. NMWQCC regulations (NMAC 20.6.2) implementing the *New Mexico Water Quality Act* control 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 discharge permit from NMED (or approval from the New Mexico Oil Conservation Division for energy/mineral-extraction activities). Subsequent discharges must be consistent with the requirements of a discharge permit. A discharge-permit application (DP-1835) for injection of treated groundwater was submitted to the NMED Ground Water Quality Bureau on April 9, 2015; the NMED Ground Water Quality Bureau is in the process of drafting the permit. The discharge permit (DP-1793) for the land application of treated groundwater was issued on July 27, 2015 (NMED 2015b). This LANL-wide permit required a project-specific work plan to be submitted to NMED for approval prior to operation. The work plan was submitted to the NMED Ground Water Quality Bureau on September 3, 2015, and requires a 30-day public review period.

7.0 CONSULTATION AND COORDINATION

DOE and LANS have provided information and updates on the status of chromium plume investigations and planned activities to Federal and tribal governments, State agencies, and citizen groups both before and during development of this EA. This information has been in the form of formal written communications as required by the Consent Order, permit applications, presentations, and informal conversations. Feedback from the public has been used to identify issues to be addressed in this EA. A summary of consultation and coordination activities for this EA is presented in Table 7-1.

Table 7-1. Summary of consultation and coordination activities

Date	Audience	Communications Method
September 17, 2014	Los Alamos County Board of Public Utilities	Presentation
October 17, 2014	Regional Coalition of LANL Communities	Presentation
January 28, 2015	Northern New Mexico Citizens Advisory Board Meeting	Presentation
March 4, 2015	Pueblo de San Ildefonso technical staff	Presentation/discussion
March 11, 2015	Northern New Mexico Citizens Advisory Board Combined Committee Meeting	Presentation
March 12, 2015	Non-Governmental Organizations	Presentation/discussion during quarterly meeting
March 25, 2015	City of Santa Fe and County of Santa Fe technical staff	Meeting
April 7, 2015	Los Alamos County Administrator	Presentation
April 16, 2015	Briefing to Senator Martin Heinrich's Staff	Briefing
April 28, 2015	Pueblo de San Ildefonso meeting with Mark Whitney	Introductory Meeting
May 12, 2015	New Mexico Representative for Santa Fe County	Briefing/tour
May 27, 2015	New Mexico Representative for Los Alamos County	Briefing/tour
June 10, 2015	Northern New Mexico Citizens Advisory Board	Tour
June 18, 2015	Pueblo de San Ildefonso—Governor	Presentation
June 18, 2015	Los Alamos County Public Utilities, Legal	Presentation
June 30, 2015	Pueblo de San Ildefonso—Cultural, Sacred Area, Noise, and Visual Impacts	Consultation with Pueblo staff
July 6, 2015	Pueblo de San Ildefonso Tribal Council Meeting	Presentation/discussion
July 20, 2015	Accord Pueblos Technical Environmental Meeting	Presentation

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