DOE/EA-1569

Environmental Assessment for the Proposed Environmental Remediation at Lawrence Livermore National Laboratory Site 300 Pit 7 Complex

January 2007

Department of Energy
National Nuclear Security Administration
Livermore Site Office

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1.0 INTRODUCTION

The U.S. Department of Energy National Nuclear Security Administration (DOE/NNSA) prepared this Environmental Assessment (EA) to analyze the potential environmental consequences of the proposed environmental remediation at the Pit 7 Complex at the Lawrence Livermore National Laboratory (LLNL) Experimental Test Facility (Site 300). Site 300 is located about 13 miles southeast of the main Laboratory site in Livermore and 8.5 miles southwest of Tracy (Figure 1-1). The EA discusses the purpose and need for the proposed action, provides a description of the proposed action and an alternative, and analyzes the potential environmental impacts of the proposed action and the alternative.

The proposed environmental remediation includes the cleanup of contaminated ground water and hydraulic isolation of contaminated soil and landfill waste at the Pit 7 Complex as part of an ongoing process regulated under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). The proposed action analyzed in the EA was identified by DOE, LLNL, and regulatory agencies as the preferred interim remedy for cleanup of the Pit 7 Complex in the *Proposed Plan for Environmental Cleanup at the Pit 7 Complex, Lawrence Livermore National Laboratory Site 300* (DOE 2006), which is a required plan under CERCLA.

The EA was prepared in accordance with the Council on Environmental Quality's "Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act," Code of Federal Regulations (CFR), Title 4, Parts 1500-1508 (40 CFR 1500-1508) and the U.S. Department of Energy's (DOE) National Environmental Policy Act (NEPA) Implementing Procedures (10 CFR 1021). NEPA requires an assessment of the environmental consequences of federal actions that may affect the quality of the human environment. Based upon the potential for impacts described in this EA, DOE/NNSA would either publish a Finding of No Significant Impact (FONSI) or prepare an environmental impact statement (EIS).

1.1 Background

Site 300 is a restricted-access experimental test facility operated for DOE by the University of California. The facility is used in the research, development, and testing of non-nuclear weapon components. During past Site 300 operations, contaminants were released to the environment from surface spills and pipe leaks, leaching from unlined landfills and pits, high explosive test detonations, and disposal of waste fluids in lagoons and dry wells.

LLNL began environmental investigation and restoration activities in 1981, and Site 300 was placed on the Federal National Priorities List (NPL) in 1990.

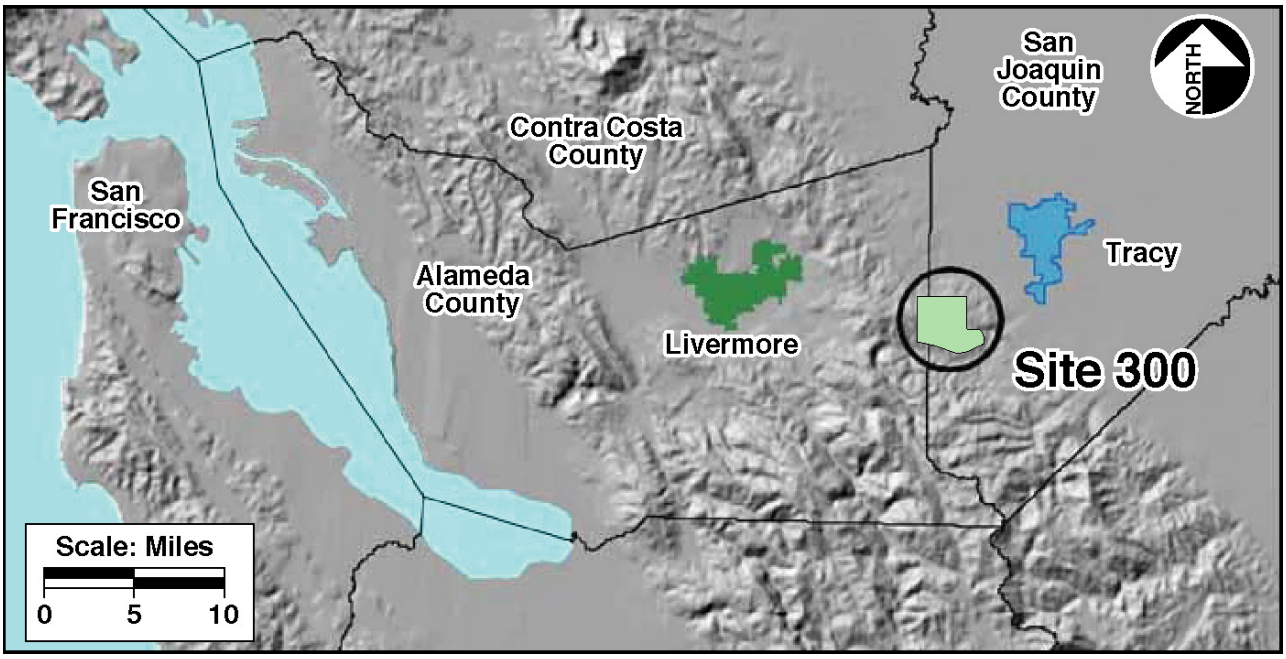

Figure 1-1. Location of LLNL Site 300.

At the Pit 7 Complex, debris from explosives tests conducted in the Site 300 East and West Firing Areas was disposed in unlined landfill Pits 3, 4, 5, and 7 from 1958 to 1988. The Pit 7 Complex is located within the Elk Ravine drainage area in the northwestern part of Site 300 (Figure 1-2). It covers about 2 square miles and includes the Pit 7 Complex landfill release site and associated soil and ground water contamination. It is located within one of the eight defined areas of Site 300, called operable units (OU), that have been identified for remediation. The waste placed in the landfill pits included wood, plastic, and debris from tent structures; pea gravel and exploded test assemblies that were contaminated with volatile organic compounds (VOCs)[1], nitrate[2], perchlorate[3], tritium[4], and depleted uranium[5]. In 1982, DOE/LLNL discovered contamination in ground water under the Pit 7 Complex.

[1] Volatile organic compounds are chemical substances that tend to evaporate easily at room temperature such as solvents, gasoline or paint thinners. Trichloroethylene (TCE) is the most common VOC found at Site 300.
[2] Nitrate is: (1) a byproduct of the natural breakdown of high explosive compounds, (2) found in septic system drainage, and (3) present naturally in the bedrock at Site 300.
[3] Perchlorate is used in the manufacture of high explosives.

[4] Tritium is the common name for hydrogen-3, a radioactive isotope of hydrogen. Although tritium can be a gas, its most common form is in water, because, like non-radioactive hydrogen, radioactive tritium reacts with oxygen to form tritiated water. Like "normal" water, tritiated water can evaporate to the atmosphere as a gas.
[5] Depleted uranium is the less radioactive residue (predominantly uranium-238) remaining after the highly reactive radioactive component (uranium-235) is removed from uranium ore.

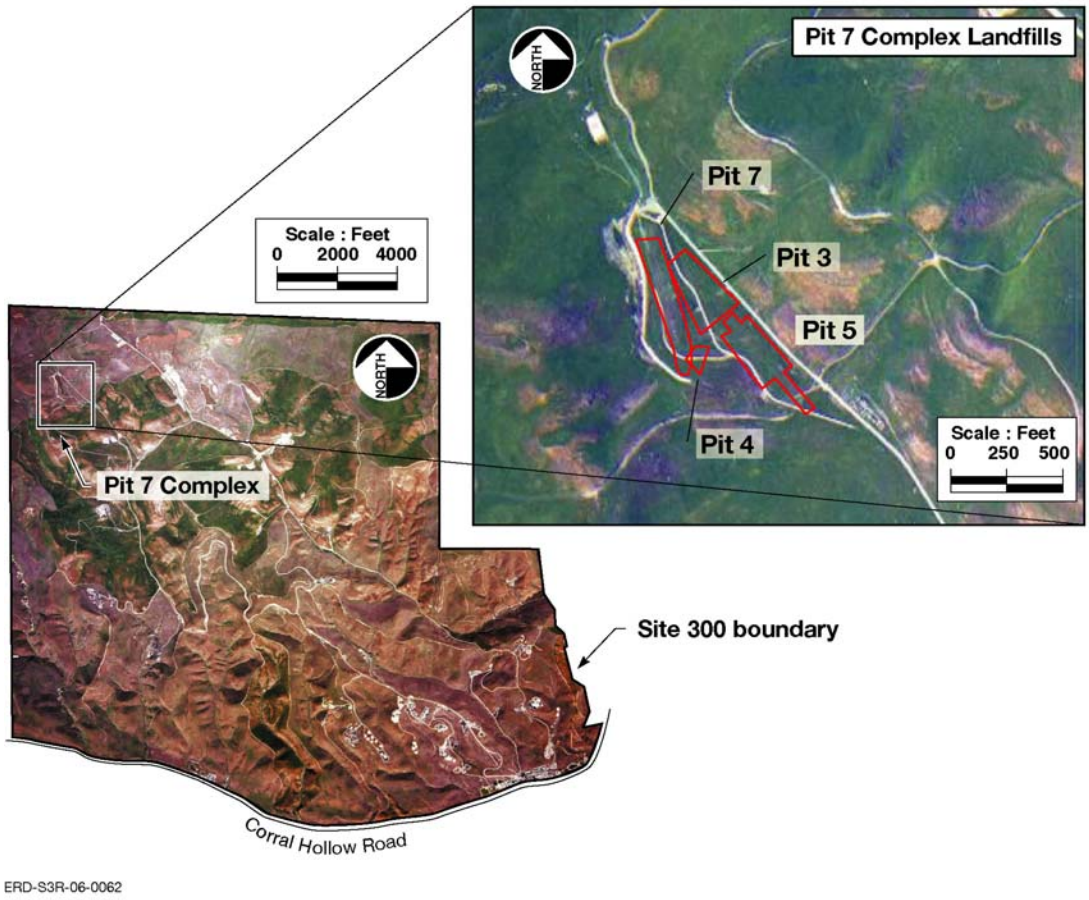

Figure 1-2. Location of the Pit 7 Complex at Site 300.

During periods of heavy rainfall, ground water rises into the bottom of the landfill pits and contaminants in the buried waste. This has resulted in the release of tritium, uranium, VOCs, perchlorate, and nitrate to ground water. Tritium, uranium, nitrate, and perchlorate in the ground water have been detected at concentrations exceeding drinking water standards or Public Health Goals. Remedial investigations conducted at the Pit 7 Complex identified tritium and uranium as Contaminants of Concern (COCs) in subsurface soil and bedrock. COCs in ground water included tritium, uranium, VOCs, perchlorate, and nitrate. Figure 1-3 shows the horizontal extent of contamination in the ground water in the Pit 7 Complex area. No COCs were identified in surface water or surface soil (DOE 2006; Taffet et al. 2005).

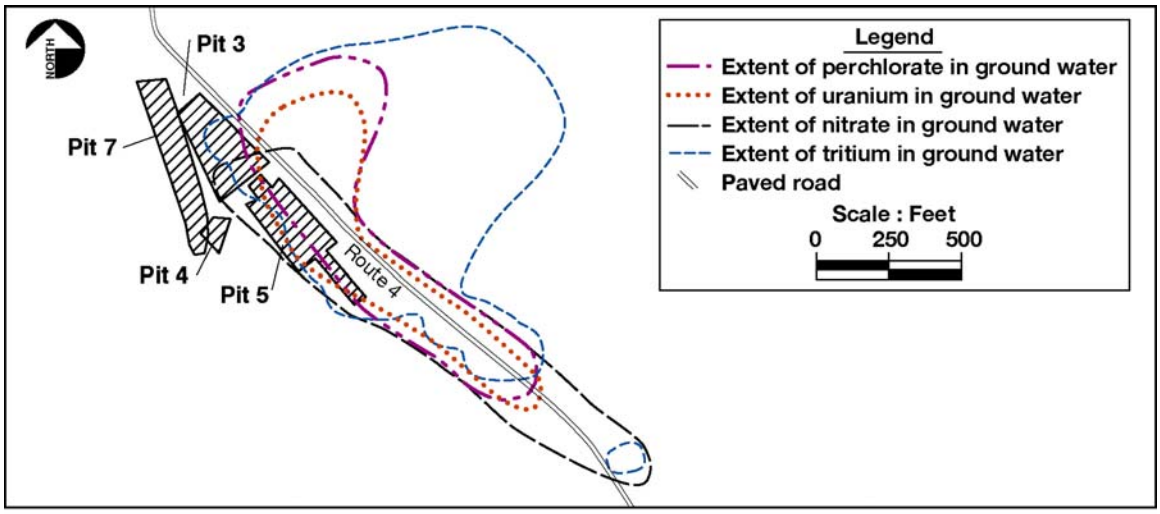

Figure 1-3. Horizontal extent of uranium, tritium, nitrate and perchlorate at concentrations above drinking water standards or public health goals in ground water (2003 or most recent data).

As defined by the U.S. Environmental Protection Agency (EPA), the principal threat at the Pit 7 Complex is the landfill waste because contaminants associated with the waste are found at high concentrations/activities, are toxic, and can be mobilized when ground water rises into the pit waste during periods of heavy rainfall. Contaminants found in subsurface soil/rock are considered a low-level threat[6] because of their impacts to underlying ground water. Although contaminants in ground water exceed drinking water standards, they are not considered a principal threat waste because EPA does not consider ground water to be a contaminant source[7].

Prior to 1988 when waste disposal in the pits was complete, the pits were covered with approximately 3 feet of compacted native soil. In 1992, LLNL constructed an engineered cap over Pits 4 and 7 in compliance with Resource Conservation and Recovery Act (RCRA) requirements. The cap was designed to prevent precipitation from infiltrating and leaching contaminants from the waste. The design included interceptor trenches and drains, a top vegetative layer to prevent erosion and shallow subsurface interflow, a biotic barrier layer to minimize animal burrowing, and a clay layer of very low permeability to prevent precipitation infiltration and leaching of contaminants. The water-diversion devices have probably reduced the volume of water recharging ground water, but are not deep enough to prevent ground water from entering the landfills from below. A licensed Professional Engineer inspects the RCRA cap every year and issues a report on the integrity of the cap, vegetative cover, and drainage channels. Any deficiencies noted in the report are promptly corrected by the Site 300 Plant Engineering Department (Taffet et al. 2005).

[6] The U.S. EPA defines "low-level threat wastes" as contaminant source materials that can be reliably contained and that would present only a low risk in the event of release.
[7] The U.S. EPA defines "principal threat wastes" as contaminant source material that is highly toxic or highly mobile that cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

1.2 Purpose and Need for the Action

The purpose of the proposed action is to reduce contaminant concentrations in soil and ground water at the Pit 7 Complex, mitigate risk to human receptors, and restore water quality to protect beneficial uses of ground water in the impacted areas. The need for the proposed action is to comply with the CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and applicable or relevant and appropriate requirements (ARARs) and remedial action objectives specific to cleanup at Site 300.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVE

Two alternatives are analyzed in this EA: (1) the proposed action, and (2) the no action alternative. Five remediation alternatives were described and evaluated in the Final Remedial Investigation/Feasibility Study for the Pit 7 Complex (RI/FS) (Taffet et al. 2005). Measures included in the remediation alternatives and preferred interim remedy were developed to address the ground water contaminant plumes, as well as control the sources of ground water contamination in the landfill pit waste and underlying soil and rock. Alternative 5a was identified by DOE/LLNL and the regulatory agencies as the preferred "interim" remedy for cleanup of the Pit 7 Complex[8]. This alternative is the proposed action described and analyzed in this EA. DOE/LLNL and the regulatory agencies believe that this remedy best meets the CERCLA evaluation criteria because it best protects human health and the environment in a responsible and cost-effective manner and complies with State and Federal laws and regulations. The regulatory agencies involved in identifying the preferred interim remedy include the EPA, the California EPA Department of Toxic Substances Control (DTSC), and the Central Valley California Regional Water Quality Control Board (RWQCB).

Two remedial alternatives (Alternatives 2 and 3) that include excavation and off-site disposal of landfill wastes from Pits 3 and 5 were described and evaluated in the RI/FS. These alternatives were not selected as the preferred alternative because they would not be as effective in meeting cleanup standards (ARARs) as Alternative 5a, the proposed action. Because only the waste in the landfill pits would be excavated, Alternatives 2 and 3 would not reduce the toxicity, mobility, or volume of contaminants remaining in unsaturated bedrock: ground water could still rise into the contaminated bedrock underlying the pits and further degrade water quality. In addition, the waste would require disposal in an off-site disposal facility.

[8] The term "interim" is used because cleanup at Site 300 is occurring under an Interim Record of Decision (ROD). The final remedy for the Pit 7 Complex, including the selected ground water cleanup standards, will be contained in the Final Site-wide ROD scheduled for 2008.

2.1 Proposed Action

The Proposed Action consists of the following five remediation components: (1) installing an engineered drainage diversion system to isolate contaminant sources; (2) pumping and treating ground water to reduce contaminant concentration; (3) monitoring natural attenuation to allow tritium activities to decline naturally through radioactive decay; (4) conducting ground water monitoring; and (5) implementing institutional controls to manage risk and hazard. These activities are described in section 2.1.1 below. Figure 2-1 shows the approximate locations of the proposed engineered drainage diversion system and existing and/or proposed ground water extraction and injection wells.

More detailed descriptions of these components can be found in section 3.3 of the RI/FS (Taffet et al. 2005).

Modeling indicates that under the proposed action it would take up to 150 years for the ground water extraction and treatment system to reduce total uranium activities to health-protective and ARAR-compliant levels. Therefore, DOE/LLNL may need to continue to implement ground water treatment and monitoring, drainage diversion system maintenance, and institutional controls for up to 150 years. Because tritium activities would decrease to the 20,000-picocuries per liter (pCi/L) maximum contaminant level (MCL) after a maximum of 45 years, the time frame required to monitor natural attenuation of tritium would be substantially less. In the event ownership of this property is transferred, DOE would execute a land use covenant at the time of transfer in compliance with Title 22 California Code of Regulations, Division 4.5, Chapter 39, Section 67391: Hazardous Waste Property and Border Zone Property.

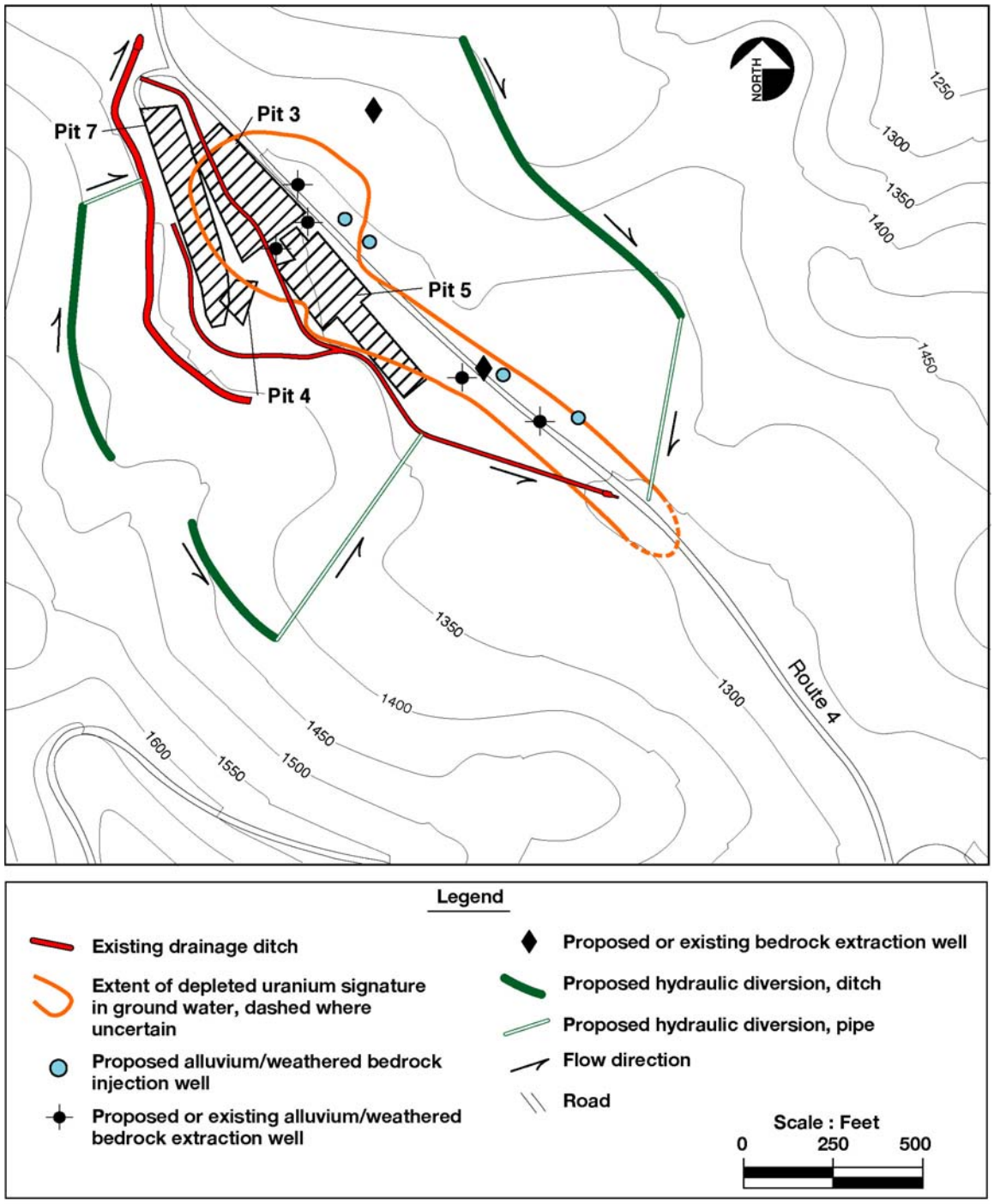

Figure 2-1. Approximate location of proposed engineered drainage diversion system and proposed or existing ground water extraction and injection wells at the Pit 7 Complex.

2.1.1 Description of Remediation Components

2.1.1.1 Engineered Drainage Diversion System

Because residual contamination is present in waste in the Pit 3, 4, 5, and 7 landfills and the adjacent and underlying soil and bedrock, measures are needed to prevent further releases of these contaminants. This would be accomplished by constructing an engineered drainage diversion system consisting of interceptor trenches composed of french drains, horizontal wells, and shallow terrace drains. The engineered drainage system would prevent ground water from rising into the landfill waste by reducing the volume of rainwater that infiltrates and reaches the underlying aquifer. The resulting reduction in recharge to shallow ground water would also slow the migration of pre-existing ground water contaminants in the area.

Hillsides surrounding the Pit 7 Complex cause surface water from rainfall events to flow toward the Pit 7 Complex from three different directions. Therefore, the drainage diversion system would be installed on the three slopes surrounding the landfills (Figure 2-1) to capture this water and divert it away from the Pit 7 Complex. The diversion system would likely include the following components: at least three 5- to 10-foot-deep gravel-filled trenches (hydraulic diversion ditches), several horizontal wells to dewater the slopes, and at least three pipes (hydraulic diversion pipes) to deliver water from the new trenches to existing ditches or natural drainages. The ends of the surface water drainage courses would be filled with energy-dissipating riprap, if necessary. Infiltration galleries[9] would be used to hasten the local infiltration of this water into the subsurface in order to limit sediment transport and erosion. The diverted water would not be expected to produce surface flow more than approximately 50 feet past the ends of the existing drainages shown in Figure 2-1.

The diversion system would be designed to capture surface water flowing toward the Pit 7 Complex as follows:

- Surface water flowing toward the Pit 7 Complex from the west would be captured by a new diversion trench that would be graded to convey water to the north where it would be piped into the existing concrete drainage ditch that empties over a surface water drainage divide to the north.
- Surface water flowing toward the Pit 7 Complex from the southwest would be captured by a new diversion trench that would be graded to convey water to the south where it would then be piped into the existing concrete-lined drainage ditch that drains south into an existing ephemeral channel.
- Surface water flowing toward the Pit 7 Complex from the east would be captured by a new diversion trench that would be graded to convey water to the south where it would then be piped into an existing natural ephemeral channel.

[9] An infiltration gallery is an engineered structure that facilitates infiltration of water into the subsurface. Infiltration galleries may consist of one or more horizontal or vertical perforated pipes, a single gravel-filled trench or a network of such trenches, or a combination of these.

2.1.1.2 Pumping and Treatment of Ground Water

VOCs, tritium, uranium, nitrate, and perchlorate are contaminants that have been released from Pit 7 Complex landfills and have impacted ground water in this area. Contaminated ground water present in the shallow bedrock would be removed by pumping from extraction wells. The extraction wells would be placed within the areas where uranium, nitrate, and perchlorate concentrations exceed drinking water standards or other appropriate water quality objectives in ground water.

Ground water pumped from the extraction wells would be treated in an aboveground treatment system designed to remove VOCs, uranium, nitrate, and perchlorate. The resins used in the treatment system are almost 100 percent efficient in removing these contaminants. VOCs, uranium, nitrate, and perchlorate concentrations would be reduced to trace levels. Because there is currently no viable technology available to treat tritium in ground water, the treated water containing tritium would be re-injected into the alluvial aquifer near the ground water extraction locations. Ground water in the alluvial aquifer at this location already contains tritium at activities above background levels. Treated water containing tritium above background levels would not be disposed of or re-injected into pristine ground water outside of the tritium plume boundary. The well field design would maintain the volume of water being extracted out of and re-injected into the aquifer. This would prevent ground water from rising into the waste and causing additional releases of tritium. Also the re-injected water would not affect the size and spread of tritium in the plume.

The treatment facility would be installed adjacent to the existing paved road at the site. Up to ten extraction wells would be installed by either converting existing monitor wells to extraction wells and/or drilling new wells. Aboveground pipelines would convey water from these wells to the treatment facility. The treatment facility would be designed to remove VOCs, uranium, nitrate, and perchlorate from extracted ground water. The treated ground water would then be conveyed by aboveground pipelines and re-injected into new injection wells.

2.1.1.3 Monitored Natural Attenuation of Tritium in Ground Water

Monitored natural attenuation allows contaminants to degrade naturally in the environment. For this approach to be implemented, appropriate long-term monitoring must be conducted, there must be no active source of contamination, and human health and the environment must be protected. A monitored natural attenuation remedy must also achieve cleanup in a time frame comparable to active remediation. This method has proven effective for radionuclides with short half-lives, such as tritium. The half-life of tritium is 12.3 years.

As discussed in Section 2.1.1.1, the contaminant source in the landfills and underlying bedrock will be controlled using an engineered drainage diversion system. Modeling results at the Pit 7 Complex show that natural attenuation would reduce tritium activities in ground water to meet remedial objectives with a reasonable time frame (45 years). There are no water-supply wells near the tritium plume, and modeling indicates that this plume would not migrate off site and would not impact any off-site water-supply wells. There are currently no effective or reasonable technologies available to clean up tritium in ground water.

2.1.1.4 Ground Water Monitoring

Monitoring would provide an indication of changes in the nature and extent of contaminants in ground water that could impact human or environmental receptors, while source control measures, active remediation, and natural attenuation reduce COC concentrations in ground water. Sampling and analysis of ground water from monitoring wells in the area would be conducted to (1) track changes in the concentrations and distribution of contaminants to ensure there is no impact to down-gradient water-supply wells; (2) evaluate the effectiveness of the overall remediation action; (3) evaluate the effectiveness of source control measures and the natural attenuation of contaminants to meet cleanup standards; (4) detect and analyze deviations from expected rates of natural attenuation of contaminants; and (5) verify the attainment of cleanup standards.

2.1.1.5 Risk and Hazard Management

The overall goals of risk and hazard management are to control exposure to contaminants and to ensure the remedy protects human health and the environment. Institutional controls, such as restricting access to areas of contamination and measures to prevent people from drinking contaminated ground water, is the basis of risk management. DOE intends to retain ownership of Site 300, and the site access restrictions currently in place (fencing and security patrols) will continue for the foreseeable future. In the event that the property is transferred in the future, the interim remedy for the Pit 7 Complex would be re-evaluated, and DOE would execute a land use covenant at the time of transfer in compliance with Title 22 California Code of Regulations.

The following administrative/institutional controls are already in place at the Pit 7 Complex and at Site 300 and would be maintained throughout the cleanup:

- Access is restricted and controlled by fencing and a full-time security force.
- Land use is controlled by Site 300 Management.
- Safety briefings are required of all personnel working at Site 300, and these discuss access requirements and areas of contamination.
- There are no drinking water wells in the Pit 7 Complex area, and any new water-supply wells at Site 300 are subject to review, with environmental considerations in mind.
- Operational Safety Plans are required for all construction activities, including checks for hazardous materials.

2.1.2 Description of Construction Activities

Proposed remediation at the Pit 7 Complex would involve the following construction activities: construction of an engineered drainage diversion system consisting of interceptor trenches composed of french drains, horizontal wells, and shallow terrace drains; construction of a ground water treatment facility; installation of ground water extraction, injection, and monitoring wells; and construction of internal access roads to the wells. Construction may also include excavation of a trench up to 3,000 feet long to run an electrical power conduit from Building 850 to the ground water treatment facility if a solar-powered ground water treatment system is not used. Excavated soil would be returned to the trench after placement of the conduit. Construction work would either be performed by LLNL Plant Engineering Department staff or by an off-site contractor. Construction would last approximately three to four months.

Construction activities would occur within the approximate 975,000-square-foot (22.4-acre) area shown in Figure 2-2. A portion of this area has already been disturbed by the construction of the landfill cap, concrete drainage channels, dirt roads, and monitoring wells. Heavy equipment, such as backhoes and bulldozers, would be used to excavate and construct the trenches and drainage channels. A drill rig would be used to install ground water extraction and injection wells.

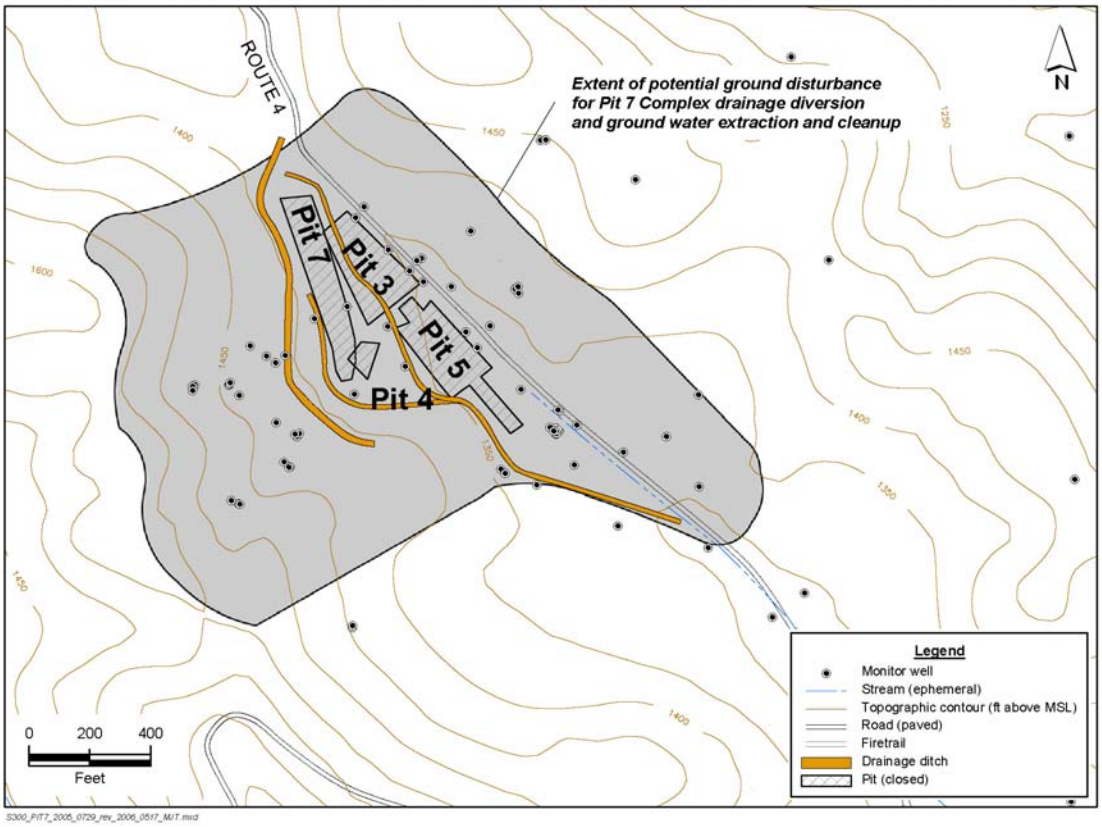

Figure 2-2. Extent of potential ground disturbance.

Construction would be conducted to minimize erosion and to prevent increased sediment load from entering ephemeral stream drainages. Since the project would impact an area exceeding one acre, work would be conducted in compliance with substantive requirements of the State of California's General Construction Activity Storm Water Permit, Order No. 99-08-DWQ, National Pollution Discharge Elimination System (NPDES) permit for discharges of storm water associated with construction activity (NPDES General Permit No. CAS000002), and a specific construction storm water pollution prevention plan. Best Management Practices would be implemented during construction to prevent the mobilization of pollutants, including but not limited to sediment during construction. The final project design would incorporate appropriate measures to stabilize all areas disturbed by the construction activities as described in section 4.1.2.1.

It is estimated that construction of the engineered drainage system would involve the removal of a maximum of 10,000 cubic yards (7,600 cubic meters) of soil and rock. Because the engineered drainage system components would be constructed outside the landfill area, the soil and rock removed are not anticipated to be contaminated and would remain on site for reuse. Installation of ground water extraction, injection, and monitoring wells would remove an additional estimated maximum of eight drums of soils and rock, some of which could be contaminated.

Any contaminated soil and rock would be disposed of as radioactive, hazardous, or mixed waste, as described in section 2.1.3.

2.1.3 Description of Operations and Maintenance Activities

The major operation and maintenance activities for the proposed remedy at the Pit 7 Landfill Complex include the following:

- Quarterly inspections of the engineered drainage diversion system to identify any problems that would impact its effectiveness (e.g., debris in the drainage trenches, concrete cracks).
- Maintenance and repairs to the drainage diversion system as necessary to correct problems identified during the inspections.
- An annual elevation survey of the engineered caps on the Pits 4 and 7 landfills to detect differential settling or other earth movement.
- An annual inspection of the pit cap by a state-certified Professional Engineer for excessive erosion, animal burrowing, or other penetrative damage.
- Repairs to the pit cap, as necessary to correct problems identified during inspections.
- Inspections of the surface water runoff and drainage system for the landfill annually and after each major storm event for erosion and accumulated debris.
- When necessary, the drainage channels are cleared of blockage and repaired to maintain the drainage system design capacity.
- Routine inspections and maintenance of the ground water treatment system, and extraction and injection wells, pumps, pipelines, and flow meters associated with the system.
- Replacement of spent reactive media (i.e., granular activated carbon [GAC] and ion exchange resin) in the treatment system as needed to ensure compliance with effluent discharge requirements. The determination of when treatment media change-outs should occur would be made by sampling for breakthrough of COCs between in-line treatment canisters prior to the final treatment canister.
- Routine inspections and maintenance of the ground water monitoring wellfield.

Under normal operating conditions, the ground water extraction and treatment system would generate the following wastes: filter bags, filter baskets, and sludge from the filtration unit; spent treatment resin; spent GAC media from the GAC vessel; and GAC media from backwashing the GAC vessel. These materials could contain very low concentrations of contaminants including uranium, nitrate, perchlorate, and VOCs. These wastes could be considered mixed low-level waste (if they contain listed wastes and uranium), low-level radioactive waste, or hazardous waste. The quantity of waste removed from the site would be equivalent to approximately three 55-gallon drums (.63 cubic meters) per year. The waste would consist mostly of inert filter materials contaminated with several grams of uranium, a fraction of a gram of VOCs, less than one gram of perchlorate, and several thousand grams of nitrate. The spent treatment media/waste would not be expected to contain tritium as it does not sorb to treatment media.

Waste minimization practices such as recycling the filter media would be employed to reduce generation of waste where possible. All remaining waste would be prepared for off-site shipment

at the Site 300 waste characterization facilities in accordance with applicable Federal and State regulations, permits obtained under these regulations, and DOE orders, and shipped in accordance with U.S. Department of Transportation regulations.

The ground water treatment facility would either be solar powered or would require an estimated 12,000 kilowatt-hours per year of electricity to operate.

2.2 No Action Alternative

Under the no action alternative, no environmental remediation activities would be conducted at the Pit 7 Complex. The existing surface drainage diversion system associated with the RCRA cap on the Pits 4 and 7 landfills would remain in place and continue to be maintained, and ground water monitoring at selected wells would continue as specified in the RCRA post-closure plan for these landfills (California RWQCB, CVR, 1993 and 1998). Institutional controls already in place would provide a degree of protection to on-site workers by restricting access to, or activities in, certain areas of contamination.

3.0 DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1 Geology and Soils

3.1.1 Description

The Pit 7 Complex is located within the Elk Ravine drainage area that is characterized by a series of grass-covered linear, northwest-southeast trending ridges and incised valleys. Elk Ravine and Doall Ravine are located to the east and south of the Pit 7 Complex, respectively.

A veneer of soil and colluvium covers most northeast-facing slopes in the Pit 7 Complex area, while southwest-facing slopes tend to be steeper as they are commonly formed by resistant sandstone outcrops of the Neroly Formation. Valley bottoms contain ephemeral drainage channels and associated Quaternary alluvial material (Qal) consisting of fine-grained soil, decomposed bedrock, and colluvium eroded from nearby hill slopes. The ephemeral drainage channel located just east of the Pit 7 Complex extends southeastward where it merges with the northeast-trending drainage channel in Doall Ravine.

The bedrock geology in the Pit 7 Complex area consists primarily of inter-bedded siltstone, sandstone, conglomerate, and minor claystone of the lower Neroly Formation ($Tnbs_1$), and inter-bedded siltstone, claystone, and minor sandstone of the $Tnsc_0$ stratigraphic interval. At the base of the $Tnbs_1$ is an 8- to 10-foot-thick silty sandstone referred to as the $Tnbs_0$. The $Tnbs_0$ is continuous in the subsurface throughout the area. The $Tnbs_0$ is overlain by a 2- to 3-foot-thick claystone confining layer and underlain by 50 to 100 feet of inter-bedded siltstone, claystone, and minor sandstone of the $Tnsc_0$ stratigraphic interval. The $Tnsc_0$ overlies gray, quartz-rich sandstone of the Cierbo Formation.

The main geologic structures in the area include the northwest-trending shear zones associated with the Elk Ravine Fault zone and a southeast-trending syncline that parallels the Elk Ravine

Fault directly east of the Pit 7 Complex. The east-west trending axis of the Patterson Anticline is located about 1 mile south of the Pit 7 Complex (Taffet et al. 2005).

The principal geologic faults in the vicinity of Site 300 are the Carnegie-Corral Hollow, Black Butte, and Midway faults. The active Carnegie Fault of the Carnegie-Corral Hollow Fault zone crosses the southwest portion of Site 300. This fault is judged capable of generating an earthquake in the range of 6.3 to 7.1 on the Richter magnitude scale. The Midway Fault is classified as potentially active (Ferry et al. 1999). The inactive Elk Ravine Fault crosses Site 300 from the northwest corner to the southeast corner. No significant recorded earthquakes have occurred on any of the local faults. The region surrounding Site 300 has experienced strong ground shaking during historic earthquakes. Potential sources for future ground motion at Site 300 include several major regional faults as well as smaller faults. The potential for surface faulting exists adjacent to the Carnegie-Corral Hollow Fault, which is located several miles south of the Pit 7 Complex. The Elk Ravine Fault also could produce minor amounts of surface rupture, but is unlikely to do so because it is an inactive fault (There has been no evidence of movement along the fault within the last 10,000 years). Liquefaction is unlikely at much of Site 300 because it is underlain largely by bedrock and clay loam soils, which are not liquefiable. The Pit 7 Complex alluvium and colluvium that is sandy may be liquefiable. The potential exists for seismically induced landslides at Site 300, and the potential for non-seismically initiated landslides is great along canyon walls (DOE/NNSA 2005). Landslides are unlikely at the Pit 7 Complex because the soils on the slopes above are shallow, and the slopes are gentle.

3.1.2 Contamination in Soil and Rock

Remedial investigation results indicated that ground water rises into the bottom of the Pit 7 Complex landfill during years of heavy rainfall. As a result, contaminants in the buried waste were released to subsurface soil and rock. Tritium and uranium were identified as COCs in subsurface soil and rock, with maximum activities generally detected at a depth of 20 to 25 feet below ground surface. Significant contamination in subsurface soil and rock was not detected outside the immediate vicinity of Pits 3 and 5 (DOE 2006).

Spatial analysis of soil data from within and adjacent to Pits 3 and 5 indicate that a total of 12 curies (Ci) of tritium and 1.5 Ci of depleted uranium (uranium-238) still exist in this source area. Of the 12 Ci of tritium, 2.4 Ci remain in Pit 3, 0.5 Ci remain in Pit 5, and 9.1 Ci reside in the vadose zone[10] surrounding the pits. Of the 1.5 Ci of depleted uranium remaining, 0.5 Ci remains in the pits and 1.0 Ci remains in the underlying vadose zone. Uranium and tritium sources appear to be collocated in both pits. The most significant tritium source appears to be located near the bottom of Pit 3 and in the underlying vadose zone. Based on continued releases of depleted uranium to ground water down-gradient, Pit 7 is also considered to contain depleted uranium in the buried waste (Taffet et al. 2005).

[10] Vadose zone is the unsaturated portion of earth between land surface and the water table.

3.2 Water Resources

3.2.1 Surface Water

3.2.1.1 Description

Surface water at Site 300 consists of seasonal runoff, springs, and natural and man-made ponds. The canyons that dissect the hills and ridges at Site 300 drain into intermittent streams. The majority of the intermittent streams drain south to Corral Hollow Creek, also intermittent, which runs along the southern boundary of Site 300 toward the east into the San Joaquin Valley. There are 25 springs at Site 300. Most of the springs have very low flow rates and are recognized only by small marshy areas, pools of water, or vegetation (DOE/NNSA 2005).

In the Pit 7 Complex area, natural surface water is relatively rare. It has been observed as surface runoff during heavy rainfall events, as ponding in surface depressions, and as discharges from natural springs. Surface runoff is generally not observed during typical winter storms, but may be generated during heavy El Niño-type events. When present, this water generally flows southeastward toward Doall Ravine in an ephemeral alluvial drainage channel located just east of the Pit 7 Complex. Water within Doall Ravine flows to the northeast into Elk Ravine and ultimately into Corral Hollow Creek, about 1.5 miles east of Site 300. A small portion of the Pit 7 Complex watershed flows north toward an unnamed tributary that drains north and east toward Tracy. These surface water drainage features are considered tributaries to waters of the U.S. Because there are no contaminants of concern in surface soil at the Pit 7 Complex, there is no mechanism for contamination of surface runoff from this area.

Spring 24 is the only perennial natural surface water in the vicinity of the Pit 7 Complex area. It is situated about 0.5 miles southeast of the Complex, immediately north of where Doall Ravine merges with Elk Ravine.

Several man-made drainage channels, including diversion trenches and metal culverts, are located within the Pit 7 Complex area. These were installed as part of the capping of Pits 4 and 7 in 1992 under RCRA. Concrete drainage channels were installed around the Pits 4 and 7 landfills to divert surface runoff away from these landfill caps during heavy rainfall events. The concrete drainage channels are connected to horizontal drains that extend into the hill slope west of Pit 7, and receive flow from two gravel-filled interceptor trenches that run up the center of two prominent depressions on the hill slope. Both concrete channels discharge to the ground surface: one discharges north of Pits 4 and 7 landfills and the other discharges to the south (Taffet et al. 2005).

3.2.1.2 Contamination

Spring 24 is the only perennial surface water in the vicinity of the Pit 7 Complex area. Spring 24 is most likely a discharge (or lead) point for confined ground water from the $Tnbs_0$ water-bearing silty sandstone along the Elk Ravine Fault (Taffet et al. 2005). Tritium is the only elevated anthropogenic constituent that has been identified in Spring 24 water. All samples collected exceed background tritium activities in ground water. Tritium contamination in surface water at

Spring 24 is addressed as part of the remedy for the Building 850 area because Building 850 is the closest up-gradient source and likely the predominant source of tritium detected in Spring 24. For this reason, tritium was not identified as a COC in surface water for the Pit 7 Complex area.

3.2.2 Floodplains

There are no 100-year floodplains at Site 300, and the 100-year base flood event would be contained within all channels. However, due to the steep slopes and high runoff potential, velocities within these channels could be high during a peak flood event (DOE/NNSA 2005).

3.2.3 Ground Water

3.2.3.1 Hydrogeology

Site 300 is a large and hydrogeologically complex site. Due to steep topography and structural complexity, the stratigraphic units and ground water contained within many of these units are discontinuous across the site. Consequently, locally unique hydrogeologic conditions govern the occurrence and flow of ground water and the fate and transport of contaminants (DOE/NNSA 2005). At the Pit 7 Complex area, a shallow, ephemeral water-bearing zone in the alluvium and weathered bedrock (Qal/WBR) is in contact with the underlying Neroly Formation basal sandstone unit ($Tnbs_0$) bedrock water-bearing zone. The distribution of ground water in this area is influenced by several factors including episodic El Niño-type rainfall events, hill slope steepness and ground cover, geologic structures (including bedding orientation, fractures, and faults), and the inclined axes of alluvial drainage channels. During heavy rainfall events, hill slopes and alluvial drainage channels transmit surface and shallow ground water within the Pit 7 Complex area toward Doall Ravine, which discharges to Elk Ravine and ultimately to Corral Hollow Creek (Taffet et al. 2005).

The interaction between the Qal/WBR water-bearing zone and the underlying fractured $Tnbs_0$ bedrock is important to ground water flow and contaminant transport in the Pit 7 Complex area. These processes are accelerated during episodic winter rainfall, especially heavy storm events. It is during these events that shallow ground water rises, inundates the landfill pits, and comes in contact with the pit contents. During these periods of high water levels, two ground water flow directions exist: one is to the southeast, along the axis of an ephemeral drainage channel in the Qal/WBR, and the second a east-northeast flow direction in the underlying $Tnbs_0$ bedrock water-bearing zone. During the dry season and drought periods, the alluvial (Qal/WBR) water-bearing zones eventually drain and become unsaturated and hydraulically disconnected from the ground water in the underlying $Tnbs_0$ bedrock (Taffet et al. 2005).

3.2.3.2 Ground Water Supply

Two regional aquifers or major water-bearing zones have been identified at Site 300: an upper water table aquifer in the sandstones and conglomerates of the Neroly Formation, and a deeper confined aquifer located in Neroly sandstones just above the Neroly/Cierbo Formation contact (DOE/NNSA 2005). The deep confined aquifer (400 to 500 feet deep) is present beneath the southern part of Site 300. This confined aquifer provides the Site 300 water supply. Pumping

tests performed in Site 300 water-supply wells affirm the integrity of the aquitard separating the shallow and deeper aquifers within the lower Neroly Formation. Neither of these two water-supply aquifers is present beneath the Pit 7 Complex.

As stated in section 3.2.3.1, two water-bearing zones occur beneath the Pit 7 Complex: (1) the Qal/WBR hydrostratigraphic unit (HSU), and (2) the $Tnbs_0$ HSU. The maximum sustainable yields of wells completed in both of these water-bearing zones are less than 0.5 gallon per minute. For this reason, ground water beneath the Pit 7 Complex does not constitute a credible source of water for residential, stock, or industrial use.

3.2.3.3 Ground Water Quality

Tritium, uranium, VOCs (primarily trichloroethylene), perchlorate, and nitrate have been identified as COCs in ground water in the Pit 7 Complex area. Of these, tritium, uranium, nitrate, and perchlorate have been detected at concentrations exceeding drinking water standards or Public Health Goals. Depth of contamination in alluvial/weathered bedrock ground water extends to a maximum of 35 to 40 feet below ground surface, and to a maximum of 275 to 300 feet below the hilltops in the shallow bedrock water-bearing zone (DOE 2006). In 2004, the maximum tritium activity detected in ground water in the Pit 7 Complex area was 16,169 bequerels per liter (Bq/L) (437,000 pCi/L) in $Tnbs_0$ bedrock. The maximum detected total uranium activity in ground water that contained some depleted uranium was 4.16 Bq/L (112.4 pCi/L) and was detected in a sample from the Qal/weathered bedrock (LLNL 2004).

3.3 Biological Resources

3.3.1 Vegetation

Site-wide vegetation surveys conducted at Site 300 have identified a total of 406 plant species at the site. The following vegetation types have been identified at Site 300: annual grassland, native grassland, coastal scrub, coastal sage scrub oak, poison oak scrub, cottonwood riparian forest/woodland, Great Valley willow scrub, Mexican elderberry, blue oak woodland, valley oak forest/woodland, juniper-oak woodland/scrub, juniper-oak cismontane woodland, disturbed land, and urban habitat. Annual grassland covers more than 5,000 acres and is dominated by introduced grasses; native grassland covers more than 700 acres (DOE/NNSA 2005). Vegetation in the Pit 7 Complex area consists primarily of introduced grassland, with limited areas of native grassland (Taffet et al. 2005).

No known populations of rare or endangered/threatened plant species are known to occur within the project impact area or immediate vicinity. However, over the past ten years, five rare plants listed by the California Native Plant Society have been observed at various locations near the Pit 7 Complex. These are big tarplant (*Blepharizonia plumosa*), round-leaved filaree (*Erodium macrophyllum*), gypsum-loving larkspur (*Delphinium gypsophilum*), California androsace (or California rock jasmine) (*Androsace elongata*), and stinkbells (*Fritillaria agrestis*) (Carlsen et al. 2001; Jones & Stokes 2002; Paterson et al. 2005). All of these species occur at a distance of 1,500 to 2,500 feet from the Pit 7 Complex, with the exception of the California androsace, which occurs within approximately 500 feet of the Complex.

3.3.2 Wildlife

Wildlife surveys at Site 300 were initially conducted in 1986 with new surveys conducted on a continuous basis. Recent surveys looked for mesocarnivores, bats, small mammals, breeding raptors and passerines, special-status reptiles and amphibians, wet season branchiopods, and valley elderberry longhorn beetles. Wildlife at Site 300 consists of 22 species of mammals, 23 species of reptiles and amphibians, 111 species of birds, and numerous species of invertebrates. These species are listed in Appendix E of the 2005 Site-wide Environmental Impact Statement (DOE/NNSA 2005). Mammal species observed at the Pit 7 Complex are typical of grassland species and include kangaroo rats, cottontails, ground squirrels, red foxes, and black-tailed deer. Numerous resident and migratory raptor species, such as golden eagles and ferruginous hawks, are frequently observed hunting in the area. Various reptile species of lizard and snake (e.g., gopher snakes, rattlesnakes) occur on the project site. Seasonal passerine birds include meadowlarks and horned larks. Amphibians, such as chorus frogs and western toads, are known to occur at Well 8 Spring and breed at other local pooled water sources.

Based upon a review of the U.S. Fish and Wildlife Service species index for the Site 300 area, and seasonal biological surveys of Site 300 and the Pit 7 Complex area undertaken over the past 20 years, Federally or State-listed or special concern wildlife species known to occur at the Pit 7 Complex or nearby, are:

- Western burrowing owl (*Athene cunicularia*)—Species of concern, Federal; Species of special concern, State.
- California tiger salamander (*Ambystoma californiense*)—Threatened, Federal; Species of special concern, State.
- Golden eagle (*Aquila chrysaetos*)—Protected, Federal; Fully-protected & Species of special concern, State.
- Ferruginous hawk (*Buteo regalis*)—Species of concern, Federal; Species of special concern, State.
- Loggerhead shrike (*Lanius ludovicianus*)—Species of concern, Federal; Species of special concern, State.
- San Joaquin coachwhip (*Masticophis flagellum*)—Species of concern, Federal; Species of special concern, State.
- Coast horned lizard (*Phrynosoma coronatum frontale*)—Species of concern, Federal; Species of special concern, State.

Western burrowing owls breed and occupy territories outside the southern boundary of the area of impact. During the breeding season (February to August), active nest sites of western burrowing owls are granted a 100-meter (328-foot) buffer radius that excludes activities within them that would negatively impact the species. This distance is the preferred area of exclusion supported by the California Department of Fish and Game and has been implemented at Site 300 on other occasions.

California tiger salamanders are recognized as having a known range of movement within 2 kilometers of their breeding pool (U.S. Fish and Wildlife Service 2004). This 2-kilometer

radius is used to describe areas of California tiger salamander presence and activity by the federal agency and is used as a tool to gauge species/habitat impacts associated with both upland and wetland areas (both the breeding and non-breeding habitats of the California tiger salamander). The Pit 7 Complex exists within the 2-kilometer radius of a known California tiger salamander breeding site (Ambrosino Pool) lying to the west of the construction area. Although the Pit 7 Complex has no water feature evident on the surface (except the concrete drainage collection system), it does offer potential upland habitat to California tiger salamander, especially subterranean refugia present in the surrounding ground squirrel colonies.

Golden eagles, ferruginous hawks, and loggerhead shrikes appear to use the area only for foraging purposes. Nest sites are only available on powerpole structures (no trees or shrubs are available). Eagles have never been documented as nesting in this area historically, and ferruginous hawks are winter visitors (non-nesting). Powerpoles are inappropriate nest sites for shrikes.

San Joaquin coachwhip (snake) and the coast horned lizard may occur in the Pit 7 Complex area. Reported observations or sightings of their presence in the vicinity have been noted.

3.3.3 Wetlands

In August 2001, a wetland delineation study at Site 300 identified 46 wetlands and determined that the total size of wetlands was 8.61 acres. A total of 4.39 acres were found to meet criteria for jurisdictional wetlands. These wetlands are small and include freshwater seeps, cooling tower discharges from some Site 300 buildings, vernal pools, and seasonal ponds. Many of the wetlands occur at springs in the bottom of deep canyons in the southern half of the site. They typically range in width from 5 to 30 feet wide with most being 10 to 20 feet wide. Most are relatively short, with lengths of 100 to 600 feet (DOE/NNSA 2005).

Three seasonal pools are situated about 1,000 to 1,500 feet west and northwest of the Pit 7 Complex project area. One of them is an artificial wetland formed by the impoundment of water in swales behind berms created by fire trails. This wetland has been enhanced to mitigate the loss of potential habitat elsewhere on site. The other two (Ambrosino Pool and Harrier Pool), which are depressions that have been enhanced with berms, are inundated for a period sufficient for the breeding of the California tiger salamander, and long enough to provide breeding habitat for the California red-legged frog. The Ambrosino Pool is a known breeding site for the California red-legged frog and the tiger salamander. These pools are not within the drainage basin for the Pit 7 Complex, and therefore would not be impacted by contamination or remediation activities at the Pit 7 Complex. An herbaceous wetland is found at Spring 24, located about 0.5 mile southeast of the Pit 7 Complex project area, and a northern riparian woodland is found at Spring 6, about 1.5 miles southeast of the complex in Elk Ravine (Taffet et al. 2005).

3.3.4 Ecological Risk Assessment

An ecological risk assessment was conducted as part of the Site-wide Remedial Investigation (Webster-Scholten 1994) and updated for the RI/FS (Taffet et al. 2005). An ecological risk

assessment evaluates the potential for adverse impact to plants and animals from long-term exposure to chemicals. It focuses on potential reproductive damage and reduction in reproductive life span. The results of the ecological risk assessment undertaken for the Pit 7 Complex indicated that there were no unacceptable hazards for plants and animals residing in this area. This determination was based on an evaluation of potential hazards from exposure to contaminants conducted for native grasslands, mammals, amphibians, and birds that could potentially inhabit this area, including threatened and endangered species (Taffet et al. 2005; Ferry et al. 1999).

3.4 Noise

San Joaquin County's noise ordinance stipulates maximum allowable noise exposure levels associated with proposed activities. Maximum noise levels are restricted to 70 decibels for day and evening hours. The ordinance exempts noise sources associated with construction occurring from 6 a.m. to 9 p.m. on any day. Noise sources at LLNL are, for the most part, common to other local industrial/commercial settings. The contribution of these on-site activities to noise levels off-site is small. Occasionally, noise may also be heard from the pistol and rifle firing range. These activities are not in conflict with land use compatibility guidelines. LLNL is somewhat unique in the category of impulse (short-blast) noise associated with explosives research testing. High explosive tests are conducted regularly at Site 300, within the Contained Firing Facility and on open firing tables. Impulse noise associated with new stationary source activities is regulated (DOE/NNSA 2005).

The only noise sources at the Pit 7 Complex are the vehicles brought to the site by facility maintenance and ground water monitoring personnel. This noise is not detected by any sensitive off-site receptors. The closest Site 300 boundary to the Pit 7 Complex project area is about 2,500 feet to the north adjacent to private ranch land used primarily for cattle grazing.

3.5 Aesthetics

Site 300 is largely composed of grasslands and contains low shrubs in areas ranging in topography from gently rolling hills to steeply sloping ridges and drainages. View sheds in the area around Site 300 are severely constrained by topography. Sensitive views around Site 300 include the Carnegie State Vehicular Recreation Area and scenic routes designated by Alameda County or San Joaquin County. Site 300 is not within the view shed of any of the designated scenic corridors except for a very short section of Tesla Road at the eastern end of Alameda County. Site 300 can be seen from the Carnegie State Vehicular Recreation Area, which lies directly south of Site 300 across Corral Hollow Road. Building 899, a single-story structure, and its surrounding light posts are visible from the recreation area. From the picnic area near the park entrance, the view of Site 300 consists primarily of undeveloped hillsides. Corral Hollow Road follows the southern boundary of Site 300 and affords views of the site, including parking areas, several single-story structures, and a 3-foot-high wire fence surrounding the site. The remainder of the view of Site 300 from Corral Hollow Road consists of rolling hillsides and a few scattered small structures on the hilltops (DOE/NNSA 2005). The Pit 7 Complex is not visible from publicly accessible viewpoints, including Corral Hollow Road, Tesla Road, and the Carnegie State Vehicular Recreation Area.

3.6 Air Quality

Site 300 activities are subject to air quality regulations and standards established under the Clean Air Act, by the State of California, and under the rules and regulations of the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) and the Bay Area Air Quality Management District (BAAQMD), as well as internal policies and requirements by NNSA and the University of California.

Under the Clean Air Act, all activities at LLNL are evaluated to determine the need for air permits from the SJVUAPCD and/or the BAAQMD. Certain operations at Site 300 require permits from SJVUAPCD. No air permits are or anticipated to be required for operational activities at the Pit 7 Complex. The total estimated criteria air pollutant emissions during 2004 from operations (permitted and exempt sources) at Site 300 is 3.65 kilograms per day. This is well below the SJVUAPCD emission threshold of 10 tons per year that trigger a requirement for no net increase and the BAAQMD threshold of 50 tons per year. The emission sources that release the greatest amounts of criteria pollutants at Site 300 include internal combustion engines, boilers, a gasoline dispensing facility, prescribed burns, paint spray booths, drying ovens, and soil vapor extraction equipment (LLNL 2004).

LLNL also compiles an inventory of toxic air contaminants under the California Air Toxics "Hot Spots" program. On the basis of the air toxics inventories, SJVUAPCD and BAAQMD have ranked LLNL as a low-risk facility for non-radiological air emissions (DOE/NNSA 2005).

To demonstrate compliance with the National Emission Standards for Hazardous Air Pollutants (NESHAPs) for radiological emissions, LLNL is required to monitor certain air release points and evaluate all potential sources of radionuclide air emissions to determine the maximum possible dose to the public. These evaluations include modeling based on radionuclide inventory data, air effluent (source emission) monitoring, and air surveillance monitoring. The LLNL NESHAPs 2004 annual report submitted to DOE and EPA reported that the estimated maximum radiological doses to the public were 0.26 microsievert (μSv) (0.026 millirem [mrem]) for Site 300 in 2004, which is well below the EPA limit of 10 mrem per year. Point source emissions from firing table explosives experiments accounted for 97 percent of this total, while 0.0086 μSv (0.00086 mrem), or about 3 percent, was contributed by diffuse sources. Practically the entire calculated dose was due to the isotopes uranium-238, uranium-235, and uranium-234 in depleted uranium (LLNL 2004).

Sources of air emissions at the Pit 7 Complex are the vehicles brought to the site by facility maintenance and ground water monitoring personnel. These vehicles emit particles and ozone precursors (NOx and VOCs). Also see section 3.16 for a discussion of tritium in subsurface soils.

3.7 Cultural Resources

Archaeological surveys undertaken at Site 300, including the general project area, over the past 30 years have resulted in the recordation of 31 archaeological sites and isolated artifacts (UC LLNL 2005). The prehistoric archaeological sites indicate that the area was used by early populations for hunting, and for collecting and processing seasonal plant foods. This use is evidenced by small lithic scatters and rockshelters that contain bedrock mortars and possible small midden deposits. The historic archaeological sites provide evidence that homesteading, ranching, and mining were the predominant activities in the area during the historic period. The historic sites include an early 20th century homestead site; a sheep herders cabin; remnants of water and sewer lines; possible remnants of a small wood bridge; small trash dumps; a historic power/telegraph line; and a mine adit and associated features. Site 300 also contains remnants of the residential section of the former town of Carnegie. Carnegie was the location of a brick and pottery plant and town from about 1895 to 1912.

Of the 31 archaeological resources recorded at Site 300, the DOE NNSA, as the federal agency responsible for historic properties at LLNL, concluded that 5 qualify for listing in the National Register of Historic Places because of their ability to yield information important in prehistory or history, and their association with events that have made a significant contribution to the broad patterns of our history. The California State Historic Preservation Officer (SHPO) concurred with this determination (Donaldson 2005a). The closest National Register archaeological site to the Pit 7 Complex project area is situated 1.6 miles away.

An assessment of LLNL's buildings, structures, and objects for potential historic significance that was undertaken in 2004 and follow-on consultation between NNSA and the SHPO did not identify the Pit 7 Complex as an LLNL structure that is eligible for listing in the National Register of Historic Places within a local, State, regional, or national context (Donaldson 2005b).

3.8 Paleontological Resources

Several vertebrate fossil deposits have been found at Site 300 and in the vicinity of Corral Hollow Road. Most finds have been a result of road improvement or erosion along stream banks. Nearly all bone fragments found are considered to be Miocene age and are scattered within the Neroly Formation. An assortment of mammalian groups is represented: camelids, mastodon, assorted early horses, shrews, beavers, and squirrels. Fossil finds are generally widely scattered and consist of one or a few fragments of bone, although in 1991 numerous fossil bones and bone fragments were found on the fire trail and road improvement areas along a ridge in the southern portion of Site 300. Invertebrate shells, primarily oysters, have been recovered from the Cierbo Formation. Stem and leaf fossils are found in many places within the finer-grained sediments of the Lower Neroly Formation. No significant invertebrate or botanical fossil locales have been identified on Site 300 or in the surrounding area (DOE/NNSA 2005).

No paleontological materials have been reported for the Pit 7 Complex area. LLNL's paleontological resource sensitivity map for Site 300 indicates that there is potential for such materials to be present on the ridge situated about 150 feet to the east of the Pit 7 Complex.

3.9 Land Use

The majority of land uses surrounding Site 300 are agricultural, primarily grazing cattle and sheep. Two other smaller, privately operated research and testing facilities are located near Site 300. The property east of and adjacent to Site 300 is owned by Fireworks America and is presently being used to store pyrotechnics. A portion of the property is leased to Reynolds Initiator Systems, Inc., and is used to manufacture initiators, which are agents that cause a chemical reaction to commence. A facility operated by Stanford Research Institute International, that conducts explosives tests, is approximately 0.6 mile south of Site 300 (DOE/NNSA 2005). The Site 300 northern boundary is approximately 2,500 feet from the Pit 7 Complex. Land use outside the northern boundary is private ranch land (Taffet et al. 2005).

The portion of Site 300 in San Joaquin County is designated as public and quasi-public. Areas north and east of Site 300 are designated as general agriculture. Areas south of Site 300 along Corral Hollow Road are designated as recreation and conservation areas. Areas to the north and west are designated as general agriculture.

The portion of Site 300 in San Joaquin County is zoned AG-160 for general agriculture with a 160-acre minimum parcel size. Hazardous industrial operations using explosives are permitted within the agricultural zone, subject to use permits. The portion of Site 300 in Alameda County is zoned A for agricultural use. The Alameda County ordinance code specifies “remote testing facilities” as a conditional use within the A district, subject to approval by the zoning administrator for Alameda County.

The City of Tracy Community Areas Map designates the Site 300 area as Federal Reserve/Open Space. Site 300 borders the City of Tracy’s sphere of influence, which is designated as the Tracy Hills area. (DOE/NNSA 2005).

3.10 Socioeconomics

As of September 2002, approximately 8,850 persons were employed by LLNL; 240 of them work at Site 300. This total does not include contractor personnel involved in various technical and administrative support or facility construction operations, which at Site 300 may include up to 50 additional persons.

Of the approximately 8,850 total employees at LLNL, the majority resides in Alameda County, with the largest concentration (approximately 3,270 employees) residing in the City of Livermore and the second largest concentration in Tracy. Pleasanton is home to approximately 550 LLNL employees, and about 420 reside in Manteca.

The total annual LLNL payroll for fiscal year 2002 was approximately $668 million, not including temporary labor and contractor personnel. This amount represents 1.7 percent of the total combined payroll generated by all business establishments in Alameda and Contra Costa counties. LLNL also contributes considerably to this region’s economy through its direct purchases of goods and services. LLNL purchased a total of $568 million in goods and services in fiscal year (FY) 2001. Of that total, more than half ($348 million) was purchased in

California. Of the amount purchased in California, $142 million in goods and services were purchased in the Bay Area.

LLNL jobs and expenditures generate indirect jobs in the region. An estimated total of 17,400 jobs in the region are attributable to LLNL. In effect, one out of every 95 jobs (or 17,400 out of 1,644,500) in the region is directly or indirectly attributable to LLNL (DOE/NNSA 2005).

The ongoing facility maintenance and ground water monitoring that occurs at the Pit 7 Complex is conducted by LLNL employees as part of their general program support function at LLNL.

3.11 Environmental Justice

A total population of 6,406,704 resides within a 50-mile radius of Site 300. Of these, 3,343,660, or 52.2 percent, are minorities. There are, however, no block groups within a 5-mile radius that are categorized as minority. Several areas of San Joaquin County, approximately 9 miles north and northeast of Site 300, are categorized as minority. Within 20 miles, higher concentrations of minorities are found within western portions of San Joaquin and Stanislaus counties in the Central Valley.

Of the total population within a 50-mile radius of Site 300, 654,156, or 10.2 percent, are low-income. There are no block groups within a 5-mile radius of Site 300 that have percentages of low-income populations greater than the State average. Two areas of western San Joaquin County, within 10 miles to the north and northeast of Site 300, are categorized as low-income. Within 20 miles, some high concentrations of low-income populations are located in the western portions of San Joaquin and Stanislaus counties and the northern portion of Santa Clara County (DOE/NNSA 2005).

3.12 Public Services

This section describes Site 300 fire protection and emergency services, police protection and security services, and nonhazardous and nonradioactive solid waste disposal services.

3.12.1 Fire Protection and Emergency Services

Fire protection and emergency services at LLNL are provided by the LLNL Emergency Management Division and by off-site fire protection agencies through mutual aid agreements with several agencies that could serve Site 300, including the City of Tracy and the California Department of Forestry. The general emergency response policies and procedures for Site 300 are contained in the Site 300 emergency plan.

LLNL Fire Station No. 2 is located on Site 300. This facility is part of the overall Emergency Management Division of LLNL and is operated under the direction of the LLNL fire chief. At a minimum, four personnel are on duty 24 hours a day at Fire Station No. 2. The Fire Station is equipped with three pumpers and one ambulance.

The dispatcher at the LLNL Livermore Site, who dispatches fire personnel and equipment from Fire Station No. 2, monitors alarms at Site 300. The average Site 300 fire station response time on site is 4.5 minutes. One vehicle and four personnel respond from the Site 300 fire station. In addition, a vehicle from the Livermore Site responds as a "cover" in case an additional fire breaks out.

The Site 300 ambulance transports patients to a medical facility that offers care commensurate with the severity of the injury. These facilities include Sutter Hospital in the City of Tracy or the nearest trauma center (DOE/NNSA 2005).

3.12.2 Police Protection and Security Services

The Office of Investigative Services and Protective Force Division of the Safeguards and Security Department provides police protection and security services at LLNL. It is the function of the Protective Force Division to provide protection for LLNL personnel and assets. This protection is provided through several channels, including access control, fixed access and surveillance points, random vehicle and foot patrols, response elements, and special response team elements.

The Protective Force Division has contingency plans to cover credible emergencies, including work stoppages, bomb threats, natural disasters, site-wide evacuations, callout procedures, satellite command center activation procedures, executive protection, alarm response procedures, and civil disorders. LLNL participates in emergency response agreements with the Livermore Police Department, the Alameda County Sheriff's Department, the San Joaquin County Sheriff's Department, the California Highway Patrol, and the Federal Bureau of Investigation (DOE/NNSA 2005).

3.13 Waste Management

3.13.1 Nonhazardous and Nonradioactive Solid Waste Management

Nonhazardous and nonradioactive waste generated at Site 300 is transported to the Tracy Material Recovery and Solid Waste Transfer Station, a facility where waste is sorted for recycling. A 16-cubic-yard trash truck (compactor) collects waste an average of two times per month. A 10-cubic-yard dump truck collects waste an average of one time per month. Site 300 has waste reduction and recycling programs in effect, including cardboard, paper, and metal salvage activities. During 2002, approximately 200 tons of nonhazardous solid waste was transported from Site 300 (DOE/NNSA 2005). The only waste generated at the Pit 7 Complex is a small amount of solid waste generated as a result of routine maintenance activities. (See section 2.1.3 for CERCLA wastes generated from Pit 7 operations and maintenance activities.)

3.13.2 Hazardous and Radioactive Waste Management

Waste management activities at LLNL consist of managing, treating, storing, and preparing for off-site disposal of all wastes in accordance with applicable Federal and State regulations, permits obtained under these regulations, and DOE orders. The waste categories routinely

generated on site under normal operations include radioactive waste (low-level waste, mixed low-level waste, transuranic [TRU] waste, and mixed TRU waste) and hazardous waste. Hazardous and radioactive wastes generated by remediation activities under CERCLA are considered non-routine due in part to the fluctuation of year-to-year waste quantities. Table 1 lists the types and amounts of Site 300 waste generated in FY 2005. There were 24 waste shipments from Site 300 in FY 2005.

Table 1. Site 300 Waste Generated in FY 2005.

Waste Type	Generated (lb)
Hazardous	180,517
Low-Level Radioactive	3,621
Mixed Low-Level Radioactive	895
Transuranic	0
Mixed Transuranic	0
Total	185,033

3.14 Utilities and Energy

3.14.1 Water Supply and Use

Site 300 draws drinking water from two on-site ground water production wells in the southeastern part of Site 300. These wells draw from the deep confined aquifer (400 to 500 feet deep) that is present beneath the southern part of Site 300. Water is subject to the Safe Drinking Water Act of 1974 regulations. The system includes a primary drinking water-supply well and a backup well, several holding tanks, and a distribution network. Water production from these wells has declined from a peak of 32.7 million gallons in 1992 to 25 million gallons in 2002. LLNL disinfects well water with chlorine and monitors the quality of this water at the well and throughout the distribution system. In addition, the Hazards Control Department reviews the data to ensure that drinking water standards are met. Site 300 Plant Engineering submits the required reports to the California State Department of Health Services. In the near future, it is expected that Site 300 will obtain its drinking water from the Hetch Hetchy Aqueduct system. LLNL will maintain the on-site drinking water wells as a backup supply and will be responsible for the Site 300 Drinking Water Permit requirements.

Site 300 consumed an average of 23.8 million gallons per year (67,900 gallons per day) from 1998 to 2002. Water consumption rates at Site 300 have remained relatively constant during the past 5 years (DOE/NNSA 2005).

3.14.2 Electricity Consumption

Pacific Gas and Electric supplies electrical power to Site 300. From 1998 to 2002, Site 300 consumed an average of 16.3 million kilowatt-hours per year. Electricity consumption rates at

Site 300 have remained stable over the past 5 years. The electrical load at Site 300 averages 2.7 megawatts (DOE/NNSA 2005).

3.14.3 Natural Gas Consumption

No natural gas is used at Site 300. Fuel oil is used mostly for backup electric power generation, for comfort heating, and in some experiments. Fuel oil consumption averages 16,600 gallons per year (DOE/NNSA 2005).

3.15 Traffic and Transportation

3.15.1 Traffic

Regional access to Site 300 is from I-580 to Corral Hollow Road. Alternately, travel between the Livermore Site and Site 300 is by way of Tesla Road. Tesla Road is an east-west arterial highway located one mile south of the Livermore Site. The name of the road changes to Corral Hollow Road at the boundary between Alameda County and San Joaquin County near the western end of Site 300. The access for Site 300 is located on Corral Hollow Road, 13.1 miles east of Greenville Road. Between Site 300 and Greenville Road, the daily traffic on Tesla Road averages approximately 4,500 vehicles per day. Posted speed limits range from 45 to 55 miles per hour in the vicinity of Site 300. Tesla Road is receiving increased usage during commute periods because of congestion on I-580 through the Altamont Pass.

Personal vehicles are only allowed on Site 300 in the parking area just beyond the entry gate. The parking stall availability is adequate to meet demand. Only government and contractor's company vehicles are allowed on Site 300 roads. Traffic on Site 300 roads is extremely light (DOE/NNSA 2005). The only traffic at the Pit 7 Complex is the vehicles used by employees who conduct ground water monitoring and facility maintenance.

3.15.2 Hazardous and Radioactive Waste Transportation

LLNL ships approximately 4,000 containers per year of hazardous and radioactive waste to approximately 50 different treatment, storage, or disposal facilities across the U.S. This results in about 200 separate shipments of hazardous waste, low-level radioactive waste, and mixed low-level radioactive waste from the Livermore Site and Site 300. Transuranic waste shipments from the Livermore Site began in 2004 with a shipment of approximately 1,000 drums of legacy waste. A small number of shipments of this type of waste is anticipated annually. Most of the shipments from Site 300 are hazardous waste shipments. Radioactive waste shipments are infrequent and contain little radioactivity. In FY2005 there were 23 shipments of hazardous waste and 1 shipment of mixed low-level radioactive waste from Site 300. All off-site shipments are conducted in accordance with U.S. Department of Transportation regulations.

Hazardous and radioactive wastes are also transported within the boundaries of Site 300 from their point of generation to the Site 300 waste characterization, handling, and packaging facilities. All such on-site transports are conducted in accordance with the *Onsite Packaging and Transportation Safety Manual* (LLNL 2005). This manual specifies responsibilities,

requirements, and controls for the packaging and on-site movement of hazardous materials, substances, and wastes and provides internal policies for compliance with applicable orders and other regulations governing on-site transfers of such materials.

3.16 Human Health

A baseline human health risk assessment was conducted as part of the Remedial Investigation/Feasibility Study process for the Pit 7 Complex process. It indicates what risks might exist if no remediation was performed at the Pit 7 Complex and provides the basis for implementation of a remedial action. The methods and results of the risk assessment are described in detail on pages 31 through 38 of the Final Remedial Investigation/Feasibility Study for LLNL Pit 7 Complex (Taffet et al. 2005). The analysis is hereby incorporated by reference and is summarized below.

The estimated baseline human health risks and hazards for the Pit 7 Complex were evaluated for adult on-site exposure and off-site residential exposure, as well as additive risk. Risk for humans is expressed as the probability of developing cancer over a lifetime and as the potential for non-cancer adverse health effects to occur due to long-term exposures. For example, an excess cancer risk of one in one million (expressed as 10^{-6}) indicates the probability of one additional cancer risk in a population of one million people. An excess cancer risk of 10^{-6} is an acceptable level according to the National Contingency Plan (40 CFR Part 30). An excess cancer risk between 10^{-4} (one in ten thousand) and 10^{-6} may be acceptable provided that the risk is sufficiently managed.

The results of the risk assessment for the Pit 7 Complex indicated that the only unacceptable risk to human health posed by the contaminants in the Pit 7 Complex area was inhalation of tritium evaporating from subsurface soil by on-site workers. This risk was estimated to be 4×10^{-6}, or 4 in one million, and was calculated based on the assumption that a worker spends 8 hours a day, 5 days a week for 30 years at the Pit 7 Complex. (There are only periodic monitoring activities that are conducted at the landfills, and no workers actually spend this amount of time in the area.) In addition, there is some potential for on-site workers to be exposed to the contaminants in the landfill pit waste if waste were to be unintentionally excavated or exposed. Because the landfill pit contents are not completely characterized as to concentration and distribution of contaminants due to safety concerns related to drilling into landfills, it is not possible to quantify this potential risk.

Residential exposure risk was evaluated for drinking ground water from hypothetical water-supply wells at the eastern site boundary. Contaminants are present at concentrations that exceed regulatory standards for the unrestricted use of ground water in the Pit 7 Complex area. However, the risk assessment indicated that ground water contaminants from the Pit 7 Complex would not impact these hypothetical wells at the site boundary; therefore, there is no risk to current or future off-site residents. In addition, ground water from the Pit 7 Complex is not currently used and is not anticipated to be used in the near future, since the DOE intends to retain control of Site 300 in the foreseeable future.

4.0 POTENTIAL IMPACTS OF THE PROPOSED ACTION AND ALTERNATIVE

This section describes the potential impacts of the proposed action (preferred alternative) for the remediation of the Pit 7 Complex (section 4.1) and the no action alternative (section 4.2).

4.1 Proposed Action

Preliminary analysis indicated that the proposed action would have minimal or no impact on the following elements of the human environment: floodplains, aesthetics, land use, socioeconomics, environmental justice, wetlands, cultural resources, paleontological resources, noise, utilities/energy, public services, and traffic and transportation. These elements are, therefore, dismissed from further study and discussion in the EA for the reasons provided in the following paragraphs. More detailed discussion and analysis is provided for potential construction-related impacts in the areas of soils and surface water quality, biological resources, air quality, hazardous and radioactive waste management, and human health; and for facility operations and remediation implementation-related impacts in the areas of geology and soils, ground water quality and supply, air quality, hazardous and radioactive waste management, and human health. Separate discussions are also provided for potential accidents and cumulative impacts.

Floodplains—There are no 100-year floodplains on Site 300, and the 100-year base flood event is contained within all channels. As described under 4.1.2.1 (Geology and Soils), the project would be engineered so as not to create or contribute runoff water that would exceed the capacity of drainage systems.

Aesthetics—The proposed facilities under the proposed action are visually similar to facilities that already exist on the Pit 7 Complex site and within Site 300 as a whole. The project site is not visible from an off-site roadway, other publicly accessible viewpoints, or from sensitive land uses.

Land Use—The proposed action would not introduce a new land use and would be consistent with San Joaquin and Alameda counties and the City of Tracy permitted land uses for Site 300.

Socioeconomics—The proposed action would have a minimal effect on the local economy and no effect on housing demand or population growth due to the short duration of project construction. The only off-site services needed would be the use of an engineering firm to prepare final project design and possibly a construction contractor for facilities construction, which would take place over a 3- to 4-month period.

Environmental Justice—No adverse human health or environmental effects have been identified for the proposed action. There are no blocks of minority or low-income groups within close proximity of Site 300. Therefore, the proposed action would not result in disproportionately high and adverse human health or environmental effects on minority populations and/or low-income populations.

Wetlands—There are five wetlands situated within 1.5 miles of the project site with the closest being about 1,000 feet to the west. These wetlands are not within the drainage basin of the Pit 7 Complex area and would not be directly or indirectly affected by the proposed project.

Cultural Resources—The closest National Register-eligible archaeological site to the proposed project area is 1.6 miles away. It would not be directly or indirectly affected by the proposed project. Should such resources be discovered during construction, as is standard LLNL practice, work would cease in the immediate vicinity of the find, and a qualified archaeologist would be contacted to assess the find and take appropriate action. If human remains were found, the Native American Heritage Commission would be contacted for reference to the most likely descendant. This individual would be given an opportunity to inspect the find and provide recommendations with respect to treatment and disposition of the remains. Historic assessments of LLNL's buildings, structures, and objects did not identify the Pit 7 Complex as National Register eligible.

Paleontological Resources—No paleontological materials have been reported for the Pit 7 Complex area. Should such resources be discovered during construction, as is standard LLNL practice, work would be halted in the immediate vicinity and the University of California Museum of Paleontology staff would be consulted to assess the scientific significance of the find.

Noise—The proposed project would not expose any off-site sensitive receptors to the short-term construction noise generated at the project site; the closest boundary is about 2,500 feet to the north, adjacent to private ranch land. Long-term noise generation would be minor and consist of operation of small pumps in the ground water treatment system and vehicle traffic needed for monitoring and maintenance activities.

Utilities/Energy—Water needed during construction would be obtained from temporary portable water storage tanks maintained at the project site. Electricity may be needed throughout the proposed project operation to power the ground water treatment system. It is estimated that approximately 12,000 kilowatt-hours per year of electricity would be needed to run the treatment system. This amount represents less than .001 percent of the 16.3 million kilowatt-hours per year average consumption rate for the entire Site 300. A solar-powered ground water treatment system may be chosen, which would not require electricity. No natural gas would be needed for the project.

Public Services—Because of the short construction phase, the type of facilities being constructed, the low probability for upset, and the few employees needed to maintain the facility and conduct monitoring, the need for assistance from LLNL's fire protection and emergency services and police and security services would not noticeably increase and would not affect off-site services. Nonhazardous solid waste generated would consist of wastes typically generated by small construction projects.

Traffic and Transportation—The proposed project would not cause a substantial increase in traffic on on- or off-site roads. If LLNL utilizes off-site contractors for construction, they would generate 5 to 10 vehicle trips per day for 3 to 4 months. The proposed ground water treatment system would be maintained by the same employees and vehicles that maintain the other

treatment systems at Site 300 and would therefore not generate additional on- or off-site traffic or parking requirements. This additional five to ten vehicles per day is not expected to affect access to the site by emergency response vehicles.

Approximately eight 55-gallon drums of soil and rock contaminated with hazardous, low-level radioactive, or mixed low-level radioactive wastes would be generated during project construction. Approximately three drums of hazardous, radioactive, or mixed low-level radioactive waste would be generated annually during proposed project operations. Transport of this waste from its point of generation at the Pit 7 Complex would be in accordance with LLNL's *Onsite Packaging and Transportation Safety Manual*, which establishes procedures to minimize impacts to workers, the public, and the environment from these activities. Off-site transportation of these wastes would be in accordance with U.S. Department of Transportation requirements.

4.1.1 Facilities Construction

4.1.1.1 Soils and Surface Water Quality

Potential impacts to soils during project construction are wind- and water-induced erosion within a small portion of the approximately 975,000-square-foot area in which the construction would occur. Potential wind-induced erosion would be controlled by such measures as water spraying of disturbed areas and covering exposed piles of excavated materials. To minimize water-induced erosion and prevent increased sediment load from entering ephemeral stream drainages, work would comply with requirements of the State of California's General NPDES permit for discharges of storm water associated with construction activity (NPDES General Permit CAS000002).

Best Management Practices would be implemented during construction to prevent the mobilization of pollutants, including but not limited to sediment during construction. Sediment and erosion control measures would be installed at the surface water outflows for the drainage diversion system and in the areas of construction of interceptor trenches. These details would be described in the project's construction storm water pollution prevention plan.

4.1.1.2 Biological Resources

No known populations of rare or endangered/threatened plant species are known to occur within the project impact area or immediate vicinity. However, over the past ten years, five rare plants listed by the California Native Plant Society have been observed at various locations within 500 to 2,500 feet of the Pit 7 Complex. At the appropriate time of year, plant surveys would be undertaken within the project impact area prior to construction to determine if any of these or other protected plant species was present. If California Native Plant Society-listed plant species were found, to the extent feasible, their seeds would be collected and retained for future plant community restoration activities. If threatened/endangered or rare plant species were found, LLNL would consult with the U.S. Fish and Wildlife Service to identify appropriate measures. These measures could include plant avoidance or relocation, or collection and retention of seeds.

Federally or State-listed or special concern wildlife species known to occur at the Pit 7 Complex or nearby, are:

- Western burrowing owl (*Athene cunicularia*)—Species of concern, Federal; Species of special concern, State.
- California tiger salamander (*Ambystoma californiense*)—Threatened, Federal; Species of special concern, State.
- Golden eagle (*Aquila chrysaetos*)—Protected, Federal; Fully-protected & Species of special concern, State.
- Ferruginous hawk (*Buteo regalis*)—Species of concern, Federal; Species of special concern, State.
- Loggerhead shrike (*Lanius ludovicianus*)—Species of concern, Federal; Species of special concern, State.
- San Joaquin coachwhip (*Masticophis flagellum*)—Species of concern, Federal; Species of special concern, State.
- Coast horned lizard (*Phrynosoma coronatum frontale*)—Species of concern, Federal; Species of special concern, State.

No Federally or State-listed or special concern wildlife species are expected to be substantially affected by the proposed project for the following reasons.

Past biological surveys at Site 300 have indicated that western burrowing owls breed and occupy territories outside the southern boundary of the project impact area. Consistent with California Department of Fish and Game preference, during the breeding season (February to August), active nest sites at Site 300 are granted a 100-meter buffer radius that excludes activities that would negatively impact the species.

Although no western burrowing owl breeding sites have been observed within 100 meters of the project impact area, there is potential that such sites could be documented prior to initiation of construction activities during biological surveys of the project area. If this occurs, then no construction-related activities that would cause greater impacts than those already occurring at the site under normal conditions would be allowed within the exclusion zone. Once the breeding season was over, the exclusion zone would diminish in size to a fraction of its original area but to no less than a 15-meter (50-foot) radius. Should a natal burrowing owl den be discovered in the project area during biological surveys, this exclusion zone would be demarcated to protect the owls from construction activities until the breeding season has passed.

California tiger salamanders are recognized as having a known range of movement within 2 kilometers (1.2 miles) of their breeding pool (U.S. Fish and Wildlife Service 2004). This 2-kilometer radius is used to describe areas of tiger salamander presence and activity by U.S. Fish and Wildlife Service (Service) and is used as a tool to gauge species/habitat disturbance associated with both upland and wetland area impacts (both breeding and non-breeding habitats). The Pit 7 Complex exists within the 2-kilometer radius of a known California tiger salamander breeding site (Ambrosino Pool) lying to the west of the project area. Although the Pit 7 Complex itself has no water feature evident on the surface (except the concrete drainage collection system), it does offer potential upland habitat to this species, especially subterranean refugia

present in the surrounding ground squirrel colonies. The Service may require compensation for lost upland habitat in the Pit 7 Complex area if construction is determined to be greater than a temporary loss of habitat value to the species. Specific measures to minimize impacts to the California tiger salamander and compensate for any permanent loss of habitat as a result of the construction and/or operation of the proposed remedial action at the Pit 7 Complex would be developed in DOE/NNSA's consultation with the Service.

Golden eagles, ferruginous hawks, and loggerhead shrikes appear to use the area only for foraging purposes. Eagles have never been documented as nesting in this area historically, and ferruginous hawks are winter visitors (non-nesting). Therefore, the project is not expected to impact these bird species. Should a nest be discovered in the project area during biological surveys, an exclusion zone would be demarcated to protect the nesting birds from construction activities until the breeding season has passed.

San Joaquin coachwhips and coast horned lizards may occur in the Pit 7 Complex area. Pre-project surveys for special-status species would be conducted prior to construction-related activities, and a biologist would be available to respond to findings of special-status species in the project area during construction phases. Therefore, it is considered unlikely that species would be impacted by the project.

4.1.1.3 Air Quality

Construction elements with the potential to impact air quality are mobile sources, such as truck and earth-moving equipment that would emit particulates and ozone precursors (NOx and VOCs). Emissions from these sources would be minor and would be in conformance with the State implementation plan. Ground-disturbing activities associated with construction could generate fugitive dust (PM_{10}). Potential fugitive dust emissions generated by project construction activities would be controlled in accordance with air district requirements, which include measures such as water spraying of disturbed areas and covering exposed piles of excavated materials (DOE/NNSA 2005). Soil stabilization in disturbed areas may also include hydroseeding.

4.1.1.4 Hazardous and Radioactive Waste Management

The amount of hazardous and radioactive wastes that would be generated during construction represents a small percentage of Site 300's annual waste generation rate. Approximately eight 55-gallon drums of contaminated soil and rock would be generated by drilling the ground water extraction, injection, and monitoring wells. This soil would be disposed as low-level radioactive, hazardous, or radioactive low-level mixed waste, as appropriate. Eight 55-gallon drums of contaminated soil represents approximately .03 percent of the waste generated annually at Site 300. All waste would be prepared for off-site shipment at the Site 300 waste characterization facilities in accordance with applicable Federal and State regulations, permits obtained under these regulations, and DOE orders, and shipped in accordance with U.S. Department of Transportation regulations.

4.1.1.5 Human Health

Minimal, short-term health risks may be posed to on-site workers during the construction phase from exposure to on-site contaminants. The results of the risk assessment for the Pit 7 Complex indicated that an unacceptable long-term exposure risk to human health is posed by the contaminants in the Pit 7 Complex area through inhalation of tritium evaporating from subsurface soil by any on-site workers who spend 8 hours a day, 5 days a week for 30 years at the Pit 7 Complex. This risk was estimated to be 4×10^{-6} (or 4 in one million). Based upon this analysis, there would be a minor short-term health risk to on-site workers during the construction phase from inhalation of evaporating tritium because the construction phase would last only 3 to 4 months. Workers would use appropriate protective procedures, clothing, and equipment, as specified by LLNL Hazards Control, to prevent exposure during the installation of the extraction and treatment system. Construction of the hydraulic drainage diversion system occurs primarily outside the areas of contamination at the Pit 7 Complex. Exposure control measures would not be needed for work outside the areas of contamination.

4.1.2 Facilities Operation/Remediation Implementation

4.1.2.1 Geology and Soils

The proposed action would have a beneficial effect of preventing the spread of contaminants in saturated subsurface soil and rock adjacent to and beneath the Pit 7 Complex area. There is some potential that a seismic event could result in a leak or rupture of the treatment system causing a release of untreated ground water containing low concentrations of uranium, perchlorate, nitrate, or tritium to the ground. It is estimated that at a maximum, several hundred gallons of untreated water could leak into the ground. Maximum contaminant concentrations that could exist in this released ground water are estimated at 100 pCi/L of uranium, 20 milligrams per liter (mg/L) of perchlorate, tens of mg/L of nitrate, and several hundred thousand pCi/L of tritium. Any leakage from the conveyance piping or treatment facility could potentially leak into the ground and infiltrate to the shallow contaminated aquifer from which it was extracted. Because the ground water in the treatment system and piping contains equivalent contaminant concentrations as the underlying ground water, it would not impact clean ground water. Any potential contamination of surface soil resulting from leaks would be addressed through sampling and, if necessary, removal of contaminated soil. Given the low concentrations of these chemicals and low volume of extracted ground water generated by this activity, these materials would not create a substantial hazard to the public or environment.

The project has the potential to cause soil erosion and siltation along and within the drainage channels that would receive surface water that is diverted away from the Pit 7 Complex landfills. To reduce this potential, the project would be engineered so as not to create or contribute runoff water that would exceed the capacity of drainage systems or that would cause sediment transport and erosion. Such engineering features would be designed to dissipate the increase in energy and volume of runoff due to increased impervious areas by filling the ends of the surface water drainage courses with energy-dissipating riprap, if necessary, and designing the system to hasten the local infiltration of surface water into the subsurface by the use of infiltration galleries.

4.1.2.2 Ground Water Quality and Supply

The principal threat to ground water quality at the Pit 7 Complex is the landfill waste because contaminants associated with the waste are found at high concentrations, are toxic, and can be mobilized when ground water rises into the pit waste and underlying bedrock. The proposed project would improve this condition by (1) constructing an engineered drainage system to prevent ground water from rising into the Pit 7 landfill waste during periods of heavy rainfall and releasing contaminants, and (2) slowing the migration of pre-existing ground water contaminants in the area by reducing recharge to shallow ground water. It also would remove contaminated ground water present in the Qal/weathered bedrock and bedrock water-bearing zones by pumping and treating the water in a system designed to remove VOCs, uranium, nitrate, and perchlorate. Long-term sampling and analysis of ground water from monitor wells would be implemented to (1) track changes in the concentration and distribution of contaminants in ground water to ensure there is no impact to down-gradient water-supply wells, (2) evaluate the effectiveness of the overall remediation action, and (3) evaluate the effectiveness of source control measures and the natural attenuation of contaminants in ground water to meet cleanup goals. Institutional controls, described in Section 2.1.1.5, would be implemented to control exposure to contaminants and to ensure the remedy protects human health and the environment.

The project would not substantially deplete ground water supply or interfere substantially with ground water recharge such that there would be a net deficiency in aquifer volume or a lowering of the local ground water table level. All water extracted from extraction wells would be re-injected following treatment to remove contaminants. Any horizontal de-watering wells would drain to the pre-existing concrete surface water channels. Diverted surface water would be available for ground water recharge further north and south of the Pit 7 Complex.

4.1.2.3 Air Quality

Elements of project operations with the potential to impact air quality are the use of backup generators to supplement the solar power in the event that solar power is used to run the ground water treatment facility and mobile sources, such as vehicles, brought to the site to conduct ground water monitoring and facility maintenance. These vehicles would emit particulates and ozone precursors (NOx and VOCs). Emissions from these sources would be minor and would be in conformance with the State implementation plan.

4.1.2.4 Hazardous and Radioactive Waste Management

Under normal operating conditions, the ground water extraction and treatment system would generate less than three 55-gallon drums (.63 cubic meters) of waste per year. The waste would consist mostly of inert filter materials, contaminated with several grams of uranium, a fraction of a gram of VOCs, less than one gram of perchlorate, and several thousand grams of nitrate. Waste minimization practices such as recycling the filter media would be employed to reduce generation of waste where possible. This waste represents less than .02 percent of the annual waste generation rate at Site 300. All waste would be prepared for off-site shipment at the Site 300 waste characterization facilities in accordance with applicable Federal and State regulations,

permits obtained under these regulations, and DOE orders, and shipped in accordance with U.S. Department of Transportation regulations.

4.1.2.5 Human Health

The proposed action would have a beneficial effect on human health by (1) permanently controlling contaminant releases from the Pit 7 landfill waste and vadose zone through hydraulic diversion; (2) providing long-term permanent reduction of uranium, nitrate, and perchlorate in ground water through ground water extraction and treatment; (3) implementing site controls to prevent accidental exposure; and (4) providing a mechanism to monitor the effectiveness of the remedies.

On-site workers would be exposed to a minimal, short-term health risk during operations from exposure to on-site contaminants. The results of the risk assessment for the Pit 7 Complex indicated that an unacceptable risk to human health is posed by the contaminants in the Pit 7 Complex area through inhalation of tritium evaporating from subsurface soil by on-site workers. This risk was estimated to be 4×10^{-6}, or 4 in one million, and was calculated based on the assumption that a worker spends 8 hours a day, 5 days a week for 30 years at the Pit 7 Complex. Based on this analysis, although there would be some risk to on-site workers from inhalation of evaporating tritium, this risk would be minimal because there would be no full-time workers housed in the area. As is currently the case, occasional workers spending limited time in this area would include Environmental Protection Department staff conducting monitoring, characterization, and remediation activities; Plant Engineering staff performing maintenance on the landfill caps; and LLNL fire department personnel during controlled burns in the area (Taffet et al. 2005).

In addition, ground water extraction and treatment would pose a short-term exposure risk by bringing uranium-contaminated and tritiated ground water to the surface for treatment. Exposure control measures would be implemented to prevent exposure until uranium and tritium activities decay to health-protective levels. The extraction and treatment system would be designed as a closed-loop system to prevent workers from contacting contaminated ground water during system operations and maintenance. In addition, there would be minimal short-term exposure risk posed to treatment facility operators when handling contaminated spent reactive material (i.e., ion exchange resin) from the treatment facility. The LLNL Hazards Control team would evaluate the need for personal protective equipment during treatment system sampling activities. Workers would follow operational safety procedures and use appropriate protective procedures, clothing, and equipment specified by LLNL Hazards Control, to prevent exposure.

4.1.3 Accident Analysis

On-site workers may be potentially exposed to Pit 7 Complex landfill contents or contaminated subsurface soil should they inadvertently excavate the landfill pits. However, institutional controls, such as the prohibition of ground-disturbing activities within the footprint of the landfills, are in place to prevent inadvertent excavation within the landfills. This prohibition is enforced through administrative controls, such as the required review of proposed construction activities at the site by Site 300 Management and Space and Site Planning.

There is some potential that a leak or rupture of the treatment system could occur causing a release of untreated ground water containing low concentrations of tritium, uranium, perchlorate, or nitrate to the ground. Any leakage from the conveyance piping could leak to ground and infiltrate to the shallow contaminated aquifer from which it was extracted. Because ground water in the treatment system and piping contains equivalent contaminant concentrations as the underlying ground water, it would not impact clean ground water quality. Any potential contamination of surface soil resulting from leaks would be addressed through sampling and, if necessary, removal of contaminated soil. Treatment facility operators conduct regular inspections of the treatment facility and pipelines to identify leaks or any other system malfunctions that could result in a release of contaminated water to the environment.

It is very unlikely that the proposed action would be the target of an Intentional Destructive Act. The Pit 7 Complex is located in the remote northwest corner of Site 300, and is protected by site access control and a full time security force. Consequences of an unlikely destructive act would be bounded by the accidents discussed in this section (DOE/NEPA).

4.1.4 Cumulative Impacts

As described in section 4.1, the proposed action would have no impacts on floodplains, aesthetics, noise levels, wetlands, cultural and paleontological resources, utilities/energy, aesthetics, environmental justice, and off-site police and fire protective services. Therefore, the proposed action would not contribute to any adverse impacts related to past, present, or reasonably foreseeable future actions. The minimal environmental impacts from the proposed action in the areas of socioeconomics, water use, traffic, air quality, and biological resources would not contribute substantially to any significant cumulative impacts in these areas.

4.2 No Action Alternative

Under the no action alternative, no environmental remediation activities would be conducted at the Pit 7 Complex. No new facilities would be constructed, and no additional ground-disturbing activities would take place. Therefore, there would be no new impacts on the following elements of the human environment: surface water, ground water supply, floodplains, aesthetics, land use, socioeconomics, wetlands, air quality, cultural and paleontological resources, biological resources, noise, utilities/energy, public services, traffic and transportation, hazardous and radioactive waste management, and air quality. The following paragraphs discuss potential impacts to soils, ground water quality, human health, and environmental justice under the no action alternative, and also address cumulative impacts.

The no action alternative does not meet the U.S. EPA threshold criteria of (1) protecting human health and the environment and (2) complying with applicable laws and regulations. In addition, this alternative does not meet the remedial action objective to prevent potential inhalation of tritium by on-site workers above health-based concentration in the vicinity of Pit 3. Without source control for Pits 3 and 5, contaminant concentration may remain above MCLs, which would not meet the requirement of the Water Quality Control Plan (Basin Plan) for the Central

Valley Regional Water Quality Control Board[11] or State Water Resources Control Board Resolutions 68-16[12] and 92-49[13]. The long-term effectiveness and permanence of this alternative relies solely on natural attenuation to reduce contaminant concentrations and to restrict the mobility and reduce the toxicity and volume of tritium, uranium, VOCs, perchlorate, and nitrate in ground water. It is possible that without source control measures for Pits 3 and 5, this may not be achieved in a reasonable time frame.

4.2.1 Soils

Under the no action alternative, the existing contaminants present in subsurface soils in the Pit 7 Complex area would remain. Additional areas may be contaminated during periods of heavy rainfall as ground water continues to rise into the bottom of the landfills, releasing the contaminants that are contained therein. Over time, natural attenuation, primarily radioactive decay of tritium and uranium, would act to reduce contaminant concentrations.

4.2.2 Ground Water Quality

Under the no action alternative, during periods of heavy rainfall, ground water would continue to rise into the bottom of the landfills and underlying bedrock. As a result, tritium, uranium, VOCs, perchlorate, and nitrate in the buried waste would continue to be released to ground water.

No water-supply wells are currently contaminated with VOCs, tritium, uranium, nitrate, or perchlorate originating from the Pit 7 Complex or are located near plumes in this area. Fate and transport modeling predicts that the 20-pCi/L contour for uranium will not extend more than 1,000 feet beyond the Pit 7 Complex landfills and that all uranium activities in the area would diminish to below the State drinking water standard of 20 pCi/L in less than 500 years. Fate and transport modeling of tritium in ground water indicate that even if all the tritium in the landfills is added to the pre-existing ground water plumes, tritium activities would decrease to the State drinking water standard of 20,000 pCi/L after a maximum of 45 years without impacting ground water off-site above background activities. The limited extent and low concentrations of VOCs, nitrate, and perchlorate present in Pit 7 Complex ground water indicates that these chemicals will not impact off-site ground water in the future.

Because ground water monitoring for plume size and location would not occur under the no action alternative, there would be no means of determining changes that could potentially impact down-gradient receptors (Taffet et al. 2005).

4.2.3 Human Health

The baseline risk assessment that was conducted as part of the Remedial Investigation/Feasibility Study for the Pit 7 Complex indicates what potential risks might exist under the no action

[11] Establishes beneficial uses and water quality objectives for ground water and surface waters in the Central Valley Region as well as implementation plans to meet water quality objectives and protect beneficial uses.
[12] Requires that high quality surface and ground water be maintained to the maximum extent possible.
[13] Establishes requirements for investigation and cleanup and abatement of discharges.

alternative. The estimated baseline for human health risks and hazards for the Pit 7 Complex were evaluated for adult on-site exposure, residential exposure for the ingestion of contaminants in ground water that could potentially migrate to off-site water-supply wells, as well as additive risk. The results of the risk assessment indicated that the only unacceptable risk to human health posed by the contaminants in the Pit 7 Complex area was inhalation of tritium evaporating from subsurface soil by on-site workers. This risk was estimated to be 4×10^{-6}, or 4 in one million, and was calculated based on the assumption that a worker spends 8 hours a day, 5 days a week for 30 years at the Pit 7 Complex. Under the no action alternative, no environmental remediation activities would be conducted at the Pit 7 Complex. Because the occasional workers that access this area to conduct ground water monitoring would no longer work on the site, risks to Site 300 workers would be minimal.

The residential exposure evaluated was from drinking ground water from a hypothetical water-supply well at the eastern site boundary. As discussed in section 4.2.2, fate and transport modeling indicate that uranium levels above the drinking water standard would not extend more than 1,000 feet beyond the Pit 7 Complex landfills, and tritium activities would decay to background levels before reaching ground water off site (Taffet et al. 2005). The limited extent and low concentrations of VOCs, nitrate, and perchlorate present in Pit 7 Complex ground water indicate that these chemicals will not impact off-site ground water in the future.

4.2.4 Environmental Justice

No adverse human health or environmental effects have been identified for off-site receptors under the no action alternative. Therefore, there would be no disproportionately high and adverse human health or environmental effects on minority populations and/or low-income populations.

4.2.5 Cumulative Impacts

As discussed in section 4.2, there would be no impacts in the areas of surface water, ground water supply, floodplains, aesthetics, land use, socioeconomics, wetlands, air quality, cultural and paleontological resources, biological resources, noise, utilities/energy, public services, traffic, air quality, and environmental justice. Therefore, the no action alternative would not contribute to impacts related to any past, present, or reasonably foreseeable future actions.

Cumulative impacts from existing site contamination at Site 300 were fully analyzed in the 2005 Site-wide Environmental Impact Statement (DOE/NNSA 2005). The analysis states that without remediation, cumulative impacts could result either from LLNL ground water contamination commingling with other plumes causing exceedance of water quality criteria in the combined plume or from a limitation of aquifer/land usability as the volume or area extent of contaminated ground water/soil makes the aquifer/land substantially less suitable for its designated purposes.

5.0 ACRONYMS AND ABBREVIATIONS

ARARs	applicable or relevant and appropriate requirements
BAAQMD	Bay Area Air Quality Management District
Bq/L	bequerels per liter
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
Ci	curies
COC	Contaminant of Concern
DOE	Department of Energy
DTSC	(California) Department of Toxic Substances Control
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FONSI	Finding of No Significant Impact
GAC	granular activated carbon
HSU	hydrostratigraphic unit
LLNL	Lawrence Livermore National Laboratory
MCL	maximum contaminant level
mg/L	milligrams per liter
mrem	millirem
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NNSA	National Nuclear Security Administration
NOx	oxides of nitrogen
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
OU	operable unit
pCi/L	picocuries per liter
PM_{10}	particulate matter less than 10 microns in size
Qal	Quaternary alluvium
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
ROD	record of decision
RWQCB	Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SHPO	(California) State Historic Preservation Officer
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
$Tnbs_0$	Tertiary Neroly basal sandstone
$Tnbs_1$	Tertiary Neroly lower blue sandstone
$Tnsc_0$	Tertiary Neroly basal siltstone/claystone
TRU	transuranic
VOCs	volatile organic compounds
WBR	weathered bedrock

6.0 REFERENCES

Carlsen, Tina, Erin Espeland and Abigail Smith, 2001. Rare Plant Restoration and Monitoring at Lawrence Livermore National Laboratory Site 300, Project Progress Report Fiscal Year 2000, Lawrence Livermore National Laboratory, Environmental Protection Department, UCRL-AR-142408, February.

California Regional Water Quality Control Board, Central Valley Region, Order No. 93-100
Post-Closure Waste Discharge Requirements for University of California Lawrence Livermore National Laboratory and U.S. Department of Energy Landfill Pits 1 and 7, San Joaquin County (July 1, 1993)

Revised Monitoring and Reporting Program for Order No. 93-100 (September 29, 1998)

Donaldson, Milford Wayne, 2005a. Letter from the California State Historic Preservation Officer to Karin King, Department of Energy, National Nuclear Security Administration, regarding Inventory and Evaluation of Archaeological Resources at Lawrence Livermore National Laboratory, Site 300, Alameda and San Joaquin Counties, California, April 26.

Donaldson, Milford Wayne, 2005b. Letter from the California State Historic Preservation Officer to Karin King, National Nuclear Security Administration, regarding Historic Context and Building Assessments for the Lawrence Livermore National Laboratory Built Environment – Livermore, Alameda County, California. April 5.

Ferry, L., R. Ferry, W. Isherwood, R. Woodward, T. Carlsen, Z. Demir, R. Qadir, and M. Dresen, 1999. *Final Site-Wide Feasibility Study for Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, Livermore, Calif. (UCRL-AR-132609).

Jones & Stokes, 2002. *Special-Status Plant Species Surveys and Vegetation Mapping at Lawrence Livermore National Laboratory* prepared for Lawrence Livermore National Laboratory, Livermore by Jones & Stokes, Sacramento, September.

Lawrence Livermore National Laboratory, 2005. Onsite Packaging and Transportaiton Safety Manual, Lawrence Livermore National Laboratory, UCRL-MA-108269, October.

Paterson, Lisa, Erin Espeland and Tina Carlson, 2005. *Rare Plant Restoration and Monitoring at Lawrence Livermore National Laboratory Site 300, Project Progress Report Fiscal Years 2003 & 2004,* Lawrence Livermore National Laboratory, Environmental Protection Department, UCRL-AR-142408-03/04, September.

Taffet, M., L. Ferry, V. Madrid, T. Carlsen, Z. Demir, J. Valett, M. Dresen, W. Daily, S. Coleman, and V. Dibley, 2005. *Final Remedial Investigation/Feasibility Study for the Pit 7 Complex at Lawrence Livermore National Laboratory Site 300,* Lawrence Livermore National Laboratory, Livermore, California, UCRL-AR-202492.

University of California, Lawrence Livermore National Laboratory (UC LLNL), 2005. Inventory and Evaluation of Archaeological Resources at Lawrence Livermore National Laboratory, Site 300, Alameda and San Joaquin Counties, California. Prepared for Department of Energy, National Nuclear Security Administration, Livermore, California. February.

U.S. Department of Energy, National Nuclear Security Administration (DOE/NNSA), 2005. *Final Site-wide Environmental Impact Statement for Continued Operation of Lawrence Livermore National Laboratory and Supplemental Stockpile Stewardship and Management Programmatic Environmental Impact Statement*, DOE/EIS-0348 and DOE/EIS-0236-S3.

U.S. Department of Energy (DOE), 2006. Draft Final Proposed Plan for Environmental Cleanup at the Pit 7 Complex, Lawrence Livermore National Laboratory Site 300, UCRL-AR-215719-draft final, February.

U.S. Department of Energy (DOE/NEPA), 2006. Memorandum from Carol M. Borgstrom, Director, Office of NEPA Policy and Compliance to DOE NEPA Community, regarding Need to Consider Intentional Destructive Acts in NEPA Documents, December 1.

U.S. Fish and Wildlife Service (USFWS). 2004. *Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the California Tiger Salamander; and Special Rule Exemption for Existing Routine Ranching Activities; Final Rule* (69:149 FR August 4, 2004).

Webster-Scholten, C.P., Ed. (1994). *Final Site-wide Remedial Investigation Report, Lawrence Livermore National Laboratory Site 300*, Lawrence Livermore National Laboratory, Livermore, California, UCRL-AR-108131.

Comment Responses for the Draft Environmental Assessment for the Proposed Environmental Remediation at Lawrence Livermore National Laboratory Site 300 Pit 7 Complex

Robert Sarvey, Tracy, CA

Comment #1: Thank you for the opportunity to comment on the Environmental Assessment for the proposed Environmental Remediation at Lawrence Livermore National Laboratory Site 300 Pit 7 complex. As a citizen of Tracy I have participated in all the meetings for the last 10 years on the labs cleanup proposals at Site 300. The Pit seven complex represents the most dangerous area of contamination that has been found to date. Your current preferred plan for cleanup at the pit seven complex and your environmental assessment are inadequate. On page 38 of your EA you state, "Because the landfill contents are not completely characterized as to the concentration and distribution of contaminates..... it is not possible to quantify the potential risk." Since you have not characterized completely what is contained in the pits your entire environmental assessment is inadequate and your choice of cleanup options premature. Further characterization is necessary for you to do an assessment of the environmental consequences of your proposed cleanup option.

Response: Characterization of the landfill waste was conducted from 1985 to 2004 and included: (1) a soil tritium moisture survey in Pits 3 and 5, (2) volatile organic compound (VOC) soil vapor surveys, (3) Tritium and isotopic uranium analysis of cores from Pits 3 and 5 and underlying bedrock, (4) a helium-3 survey of pit vapor from which tritium activities within the landfills were determined, and (5) seismic, induction, and magnetometer surveys that provided data on variations in pit depth and density; and definition of metal objects within the waste.

LLNL also conducted extensive interviews of past and current LLNL personnel that worked at the firing tables where the landfill debris was generated, we well as those who participated in the placement of the waste into the landfills. Several historical photos showing the pit contents while the landfills were still in use were obtained and reviewed. These sources verified that the waste placed in the pits primarily consisted of wood, plastic, material and debris from tent structures, pea gravel, and exploded test assemblies from Site 300 firing tables that were contaminated with VOCs, nitrate, perchlorate, tritium, and depleted uranium.

In addition to investigations conducted within the pits, DOE/LLNL collected and analyzed surface soil samples, soil and bedrock samples from boreholes, and thousands of ground water samples from over 85 monitor wells installed in the vicinity of the landfills to identify contaminants released from the landfills. The regulatory agencies have concurred that the nature and extent of the contamination associated with the Pit 7 landfills has been characterized sufficiently to propose and select a cleanup remedy.

Comment #2: On page 6 of your EA you state that "Tritium activities would decrease to 20,000-picocuries per liter (pCi/L) Maximum contaminant level (MCL) after a maximum of 45 years." As you know the new state public health goal for tritium is 400 pCi/L and your EA should be reissued to reflect that reality. Your environmental assessment needs to reassess the time it will take for your current plan to meet these state health based standards.

Response: DOE is committed to meeting the California State drinking water Maximum Contaminant Level (MCL) for tritium of 20,000 pCi/L. Ground water with tritium levels below the MCL are considered safe for drinking water supplies by the State of California and the U.S. Environmental Protection Agency.

Tritium activities will continue to naturally decay after the MCL is reached, and will eventually reach background levels. Tritium will not migrate offsite above background levels, and will not impact water supply wells, or threaten human health or plant and animal communities.

Comment #3: You also state that the DOE will need to continue to implement groundwater treatment and monitoring, drainage diversion maintenance, and institutional controls for up to 150 years. Is this a practical solution considering the amount of time this will take you to cleanup this site to state health based standards. Further your cleanup plan and environmental assessment does not address the remaining debris that you will have isolated in the pits with your hydraulic diversion plan. It is well known that U-238 is contained in those pits and while you estimate that it will take 150 years to clean up the groundwater with your ground water extraction and treatment system what is your plan for the remaining U-238 and the health and environmental risks associated with those contaminates.

Response: The proposed cleanup alternative combining hydraulic diversion, groundwater treatment and monitoring, and institutional controls was evaluated in the LLNL Site 300 Pit 7 Complex Remedial Investigation/Feasibility Study (RI/FS) and found to be health protective and cost effective when compared to the other alternatives evaluated. In particular, excavation of the landfills and surrounding contaminated media for offsite shipment and disposal was extremely expensive and would result in a large number of shipments of contaminated material to waste disposal facilities outside of California. It was determined in the RI/FS that there would be no net risk benefit for the added cost for the excavation alternative.

The material remaining in the landfills are not expected to be a significant contributor to health risk upon completion of the proposed remedial alternative. Monitoring, maintenance, institutional controls and risk management will continue throughout the duration of this of the remedial action to verify that this is the case.

Comment #4: The Tracy City Council sent you a letter several months ago requesting that the debris form these pits be removed to address exactly this concern. I am disappointed that the DOE does not value the opinion of our elected officials and

disregards the health and safety of our community. Your proposed plan fails your community acceptance criteria.

Response: DOE appreciates the Tracy City Council's interest in the remediation at Site 300 and values their comments. Community Acceptance is one of nine evaluation criteria used in selecting a preferred alternative for the Pit 7 Complex. We have worked with the U.S. Environmental Protection Agency and the State environmental regulatory agencies to develop and evaluate remedial alternatives to address contamination at the Pit 7 Complex. As part of this evaluation, DOE, LLNL, and these regulatory agencies rigorously evaluated alternatives to identify the best, most cost effective cleanup remedy.

The proposed remedy of hydraulic drainage diversion, groundwater extraction and treatment, monitoring, and risk and hazard management is more effective than excavation in controlling the source of contamination and preventing further contaminant releases. Excavation also has a greater potential to expose workers to contamination during waste excavation and disposal. Cleanup of existing ground water contamination can be achieved more effectively and faster using the proposed cleanup alternative than excavation. The highest priority of the cleanup effort is to protect workers at Site 300, site neighbors, and the residents of Tracy and nearby communities.

Comment #5: You also state on page 6 of your EA that in the event that ownership of the property is transferred DOE would execute a land use covenant at the time of transfer in compliance with Title 22. Presumably you expect to isolate the Pit 7 area with institutional controls for the 4.5 billion year half life of the U-238 since you refuse to remove the U-238. Is this a practical solution and where in your environmental assessment do you address this reality?

Response: Currently the site is operated under administrative controls (such as limiting public access) that protect the public from exposure to contaminants identified as present in the Pit 7 Complex. Utilizing land use covenants is one of the methods that DOE intends to use in order to protect the public from unsafe exposures to hazards that might be left in place if it is ever decided to close Site 300. Recorded land use restrictions (such as limiting public access or maintaining monitoring systems), or covenants, are written into legal documents and these documents are legally bound to the title to the property, which is the evidence of ownership. Land use covenants can be structured to guarantee that information about property containing residual contamination is available to local governments and the public; to disclose to real estate transaction participants (buyers, sellers, lending institutions) that they are purchasing land that contains hazards; to ensure that long-term mitigation measures or monitoring requirements are carried out and maintained; and to ensure that subsequent property owners will assume the responsibility for any land use restrictions pertaining to the contamination upon taking over the property. Land use covenants entered into or required by DOE can be structured to "run with the land," making them binding on current and any subsequent property owners, and as such they remain in effect until they are formally removed or modified. For example, land use covenants may be terminated if the hazards at the site have been mitigated and the property is suitable for unrestricted land use. As a result of these legal

protections, DOE determined that the use of land use covenants was practical and would protect public health far into the future at levels equal to or above what exists under administrative controls.

If it were decided to excavate the waste material from the Pit 7 Complex and dispose of it at another site, that site would be subject to similar types of administrative controls or land use covenants to protect the public from unsafe exposures. These types of controls would need to be implemented no matter where the excavated material was dispositioned.

Comment #6: On page 1 of your EA you state that the city of Tracy is 8.5 miles from the Site 300 boundary this is incorrect. On page 24 of your environmental assessment you state that Site 300 borders the City of Tracy's sphere of influence this is no longer correct. We have annexed to your Site Boundary and a local developer has plans to use this area near your boundary as open space to the public. Until you have restored Site 300's soil and groundwater to residential standards this should not be allowed. Further I am requesting that you post signs near that boundary forbidding entry and warning citizens of the toxic wastes that are contained in Site 300 soils and groundwater. These signs should be clearly posted every 500 feet at the border of the open space boundary and all around the perimeter of Site 300. We do not want unattended children or uninformed residents trespassing on or near Site 300 property.

Response: The distance of Site 300 to the City of Tracy being referenced in the Site 300 documents is based on the location of the downtown area of Tracy, and is used to give the reader perspective on the location of Site 300. A human health risk assessment was conducted to determine the potential for residential exposure to ground water contaminants from the Pit 7 Complex. The exposure scenario used in the risk assessment assumed that water-supply wells would be drilled at the site boundary and was developed in consideration of the fact that the land in the vicinity of Site 300 has been subject to development. As part of the assessment, DOE/LLNL conducted fate and transport modeling of tritium and uranium to the site boundary. The modeling results indicated that tritium and uranium activities would not exceed background levels in hypothetical wells at the site boundaries. Therefore, there is no risk of exposure to these ground water contaminants to existing or potential residential populations.

In addition, geologic mapping and cross-sections that were constructed out to the Tracy water-supply wells show that the geologic unit that contains contaminated ground water from the Pit 7 Complex has been eroded away and/or is unsaturated near the Site 300 boundary. As a result, the ground water containing contaminants is hydraulically isolated from the aquifer below the City of Tracy and any proposed residential development.

Site 300 is protected by fencing and signage that indicate it is a high-explosive test site and trespassing is prohibited. Access to the Site 300 property by members of the general public is prohibited and prevented by fences and security guards.

Comment #7: Cleanup alternative 3(b) in conjunction with 5(a) is the most comprehensive cleanup possible and the two alternatives should be implemented simultaneously. Alternative 5 (a) your hydraulic diversion will reduce the toxicity, mobility, and volume of contaminates remaining in unsaturated rock. Alternative 3(b) will eliminate the residual waste in the unlined pits. Procrastination on the removal of the radioactive contamination in the unlined pits will only lead to higher costs later as the DOE will be required to completely remediate this site by state and federal regulations.

Response: Please refer to the response to Mr. Sarvey's comment #3.

Comment #8: In conclusion the entire site must be remediated to residential soil and groundwater standards as quickly as possible. Hydraulic diversion merely relies on the natural attenuation of the tritium contamination in the Pit seven complex but does not address the U-238 contained in the unlined pits that will be isolated. Additionally further characterization is necessary to understand exactly what is contained in those pits and in other areas of Site 300. You are aware that every year the citizens of Tracy must pressure the DOE to keep current funding levels in place for cleanup at Site 300. Obviously we will not be around 150 years from now to ensure that the DOE will meet their cleanup obligations. The DOE must guarantee full funding for this cleanup so that we and our great, great, great grandchildren are not forced to lobby our elected representatives every year to force you to do what you are legally required to do.

Response: DOE has committed to remedial actions that are designed and implemented to clean up ground water at Site 300 to drinking water standards at a minimum, unless the regulatory agencies concur that it is technically impracticable.

Please refer to the response to Mr. Sarvey's comment #1 concerning characterization of the Pit 7 Complex.

DOE submits annual funding requests to Congress for the cleanup of Site 300. The funding requests are based on cleanup commitments and regulatory deliverables agreed upon with the regulatory agencies and contained in the Federal Facilities Agreement, the Records of Decision, and other CERCLA documents. Actual funding levels received for DOE site cleanup, which do not always match the funding requests, are based on decision made and allocated at the Congressional level based on national priorities, not at the local DOE office level. Petitioning your elected officials is an appropriate mechanism to ensure that actual cleanup funding requests are met.

Marylia Kelley, Tri-Valley CAREs

Comment #1: One of the Chemicals of Concern (VOCs) is mentioned on page 3 of the EA, and the description of the pump and treat system (p. 9). The pump and treat system described in the proposed plan does not address remediation of VOCs through pump and treat. Please resolve. Also, does the resin-based technology used in the system treat VOCs, as it is stated?

Response: Concentrations of volatile organic compounds (VOCs) in the ground water at the Pit 7 Complex are currently below drinking water standards. VOC's are listed as a Contaminant of Concern (COC) to meet the Regional Water Quality Control Board requirement that any constituent with concentrations exceeding background in ground water be listed as a COC. The aboveground treatment system described on page 9 of the Environmental Assessment and page 7 of the Proposed Plan for Environmental Cleanup at the Pit 7 Complex would be designed to remediate VOC's, uranium, nitrate, and perchlorate.

Comment #2: TVC does not believe that the remedy is adequate unless the tritium plume is contained. (Note that we have not used the word "captured", as we believe that there is some flexibility in meeting the goal of preventing plume migration.) We think that the goal of hydraulic control does not have to be complete stabilization or capture of the plume. TVC has suggested in previous comments that the extraction/injection well gallery be expanded with a few additional extraction wells that would serve the purpose of slowing down the tritium plume. In or opinion, this would provide LLNL with an adaptable strategy that could be optimized at any of a number of points, as the remedy is staged and data indicates. Hydraulic control should slow the migration of the tritium plume to the extent practicable, which would allow more time for the tritium to decay.

We have proposed a staged remedy that includes all the elements of the proposed remedy, plus additional extraction of hotspots if the diversion system fails to prevent further inundation of the pits. (We also note that the City of Tracy and other Tracy residents have advocated a complete removal of the contents of the Pits.) In addition, if these measures (which includes extraction and re-injection of groundwater to treat uranium, nitrates and perchlorate, but does not treat tritium) fail to "prevent plume migration", then and only then do we envision hydraulic control that extracts tritiated groundwater at the distal end of the plume, and re-injects it upstream in the already contaminated plume (i.e., a recirculation system).

We realize that "models" indicate potentially adverse effects. In DOE's response to TVC's comments contained in the CERCLA Draft Amendment to the Interim ROD, it goes into great detail that an evaluation of hydraulic control through a groundwater recirculation system would upset the water balance of the area and would have potentially adverse effects. These include 1) pit inundation, 2) additional release of contaminants, 2) acceleration of high activity plume hot spots, and, 4) discharge of contaminated water at the surface. This response reflects a misunderstanding of what we have proposed. We expect that after the diversion system is in place, there will be somewhat more "space" for re-injection. Moreover, LLNL could design a system so that the water balance in any area of the recirculation system would not cause any of the aforementioned adverse effects. Obviously, TVC is not suggesting how to design this system, but we are cognizant that it must be done with a great deal of care.

We and the community which we represent are somewhat befuddled by DOE's insistence of not including this as a possibility of last resort. We are not suggesting that

contaminated water be re-injected into "a clean aquifer reservoir", as you have suggested in responses to comments on the Proposed Plan (see Draft Amendment to the Interim Site-Wide ROD for the Pit 7 Complex, July 2006). We note that the language in the EA states that the re-injection wells for the pump and treat system would not place tritium-contaminated water outside of the tritium plume. We would expect that this same standard be used for any hydraulic control re-injection wells. We would support all designs that prevent the adverse effects from occurring: yet we believe that it can be done with care, if needed. The analysis which is summarized in the RI/FS does not reflect partial extraction of the distal plume, nor does it state exactly where the water would be extracted/re-injected and under what assumptions extraction/re-injection be cycled on and off to prevent the adverse effects enumerated above.

Furthermore, the staged remedy would provide LLNL with an adaptable strategy that could be optimized at any of a number of points, as the remedy is staged and data indicates. Optimization could take place in the upstream hydraulic diversion, extraction of source material, ex-situ treatment and re-injection, and partial hydraulic control.

Response: Characterization of the landfill waste was conducted from 1985 to 2004 as discussed in the response to Robert Sarvey's comment #1. The results of this characterization indicate that the distribution of tritium and uranium within the landfills is fairly homogeneous and did not indicate the presence of localized areas of elevated tritium or uranium activities that could be preferentially excavated from the pits to reduce or prevent potential releases from the pits.

At the request of the Regional Water Quality Control Board and Tri-Valley CAREs, DOE/LLNL conducted an evaluation of the feasibility of hydraulically controlling the tritium plume using recirculation with both partial and complete hydraulic capture as part of the Remedial Investigation/Feasibility Study (RI/FS) for the Pit 7 Complex. The objective of the hydraulic recirculation would be to prevent the tritium plume from adversely impacting downgradient waters of the State by extracting tritium-bearing ground water within the plume and injecting this ground water at upgradient locations to allow more time for radioactive decay and dispersion to attenuate the plume. Hydraulic recirculation was simulated using both partial and complete plume capture scenarios in the alluvial and bedrock aquifer ground water. The results of the evaluation indicated that the recirculation of ground water in both the alluvium/weathered bedrock and bedrock aquifers would result in inundation of the pits, additional release of contaminants, and discharge of contaminated ground water at the surface.

DOE, LLNL, and the regulatory agencies believe the monitored natural attenuation of tritium in the proposed cleanup alternative for the Pit 7 Complex will be protective of human health and the environment because:

- The portion of the tritium plume that exceeds drinking water standards remains over two miles from the site boundary, and is shrinking through natural attenuation.
- The tritium plume will not migrate offsite at activities above background levels.

- There are no existing or planned water supply wells in the tritium plume.
- There is no pathway for the tritium-contaminated ground water to reach existing water-supply wells.

The proposed cleanup alternative meets the remedial objective of preventing plume migration to the extend possible because is contains a component to extract and treat uranium, perchlorate, nitrate, and VOCs in ground water, and there are no other technologies, including partial hydraulic recirculation, that would completely control migration of the tritium plume through active measures without causing additional contaminant releases and enhancing plume migration.

The Site 300 Contingency Plan, the Five-Year Review process, and the semi-annual Compliance Monitoring reports provide multiple mechanisms for the ongoing evaluation of the progress of remediation at the Pit 7 Complex and at Site 300 to ensure continued protection of human health and the environment. DOE regularly reviews and discussed monitoring data and remediation progress with the U.S. EPA and State regulatory agencies. Both the Site 300 Contingency Plan and the Five-Year Review process contain mechanisms for re-evaluation and implementing changes to the remedy if cleanup does not proceed as expected.

Comment #3: Tri-Valley CAREs disagrees that industrial standards should be used for Site 300. As we have stated in our Community Acceptance Criteria for Site 300, the strictest clean-up standards should be applied to the site.

Basically, we propose that standards be set at no more than one in one million additional cancer fatalities. This includes the new state public health goal for tritium of 400 pCi/L. We also recommend that DOE/LLNL take account that TCE standards are likely to become stricter as the National Academy of Sciences has endorsed EPA's 2001 health evaluation of TCE. If TCE is present in any area of the Pit 7 Complex, we recommend that DOE consult with EPA as to the appropriate residential standard (see comment # 1).

We recognize that residential standards may not be feasible in a few small places, but on the whole, residential standards should be used. In the future, this would allow DOE to more easily dispose of the property and limit its liability. Also, because the Bay Area is growing so rapidly, and residential growth is beginning to occur in Tracy and near Site 300, it would be unfortunate if the cleanup performed in 2005 - 2006 dictate how this 11 square mile site will be used in the future. We are also aware that DOE is actively discussing whether Site 300 will be used for testing in the future, which makes a compelling case for using the stricter cleanup standards.

Response: All proposed and existing cleanup remedies at Site 300, including the proposed remedy for the Pit 7 Complex, are designed to cleanup ground water to drinking water standards, at a minimum, to the extent that it is technically possible. Drinking

water standards do not differentiate between residential and industrial uses; therefore, cleanup to meet these standards would be protective of residential populations.

Though DOE is evaluating the consolidation of activities throughout the DOE complex that could result in changes to activities conducted at Site 300, DOE control and ownership of the site is expected to continue for the foreseeable future. There are no plans to open the land for recreational or residential uses.

Comment #4: We recommend that both the United States Fish and Wildlife Service and the California Department of Fish and Game it be provided the opportunity to comment on this document before a decision is final. We note that there are three wetlands (p. 20) described in the EA that could be affected by activities at Pit 7. We are especially concerned that the diversion system, which we expect will reduce the amount of water flowing to the site, will not destroy these wetlands. There is no mention in the EA of mitigating this effect, or how to monitor for it, and we question the conclusion that there would be no impacts on the wetlands.

Response: DOE and LLNL discussed the proposed cleanup remedy for the Pit 7 Complex with the U.S. Fish and Wildlife Service (USFWS) in January, 2006. Additional consultation will take place with the USFWS to discuss the detailed design of the hydraulic diversion facility as it is developed for the Pit 7 Complex, and discuss any mitigation measures necessary for the area. The draft EA was reviewed by the California Department of Fish and Game with no comments provided.

The three seasonal pools discussed on page 20 of the draft EA are located 1,000 to 1,500 feet west and northwest of the Pit 7 Complex project area. The pools are not within the drainage basin of the Pit 7 Complex and would not be impacted by either the construction or operation of the hydraulic diversion system.

Comment #5: The description of the proposed hydraulic diversion found in the EA (p.8) is more specific than that found in the Proposed Plan or Draft Amendment to the Interim ROD. We would appreciate that the two documents provide the same level of detail in the proposed plan. However, it is still not clear to us how the diversion system will be designed so that it keeps groundwater from periodically saturating the Pits and surrounding areas.

Realizing that much of this is a design challenge, we believe that additional language should be added to the EA and the ROD so that we have a good idea of how this system will work. Without such design information, it is unclear how DOE can come to the conclusion that there will be no impact from this system on surrounding areas, wetlands, biological resources or that it will perform as intended.

Response: Detailed design of the drainage diversion system proposed for the Pit 7 Complex is planned to be developed during the spring of 2007 after the EA has been completed, and the Amendment to the Interim Site-Wide Record of Decision for the Pit 7

Complex has been approved. The description of the proposed diversion system in all the documents is still very general at this point.

The geology and hydrogeology of Site 300, and the Pit 7 Complex in particular, have been characterized in great detail. Drainage diversion systems are commonly used in building and transportation construction projects. Important criteria in the selection of a contractor to design and build this drainage diversion facility will be experience and successful application of this type of diversion system to ensure that this system will perform as intended.

Comment #6: Specific recommendations on some of the land-use controls needed to compliment the engineered remedy need to be added to the EA.

Response: Since land use controls would encompass all of Site 300, including the Pit 7 Complex, they will be included in the Site-Wide Final Record of Decision for Site 300 scheduled for completion in 2008.

K. Leo Pullin, Tracy, CA

Has the proposed remediation for the Site 300 Pit 7 Complex weighed competing interests of possible risk, monetary costs, and timelines and come up with a plan for remediation this particular section of Site 300 that is suited to clean up existing contamination in a timely fashion at a reasonable cost? The plan itself looks reasonable in terms of what is planned, its necessary footprint, associated costs, the timeline to accomplish it, and whether or not nature can do just as well on its own.

There are two exceptions to the overall feasibility of the plan:

1. *except* for the failure of Lawrence Livermore National Laboratory to address removing the contributing contaminants from the landfills, and
2. *except* for the failure of LLNL to accurately survey the vegetation at Site 300, while in possession of surveyor's reports that mention the inadequacy of the vegetation surveys.

The first issue has to be addressed. A country should not create a mess it cannot clean up, particularly one that continues to diminish the environmental quality.

However, the second issue should be raised in light of any type of remediation at Site 300 being accepted by the public, because LLNL's apparent lack of good faith efforts to fully document the vegetation at Site 300 in compliance with the intent of CEQA in regards to special status plants should raise community concerns.

As an example, *Eriogonum truncatum* is a special status species not found on the site by the surveyors, although listed on source lists as a plant that might be found at LLNL Site 300. However, the limited time frames of vegetation surveys done at the site

might not be sufficient to find a small annual that blooms late spring to summer without an additional survey specifically charged with locating the plant. Because the California Native Plant Society has noted in the past the *E. truncatum* is a species likely to be rediscovered, as it was, and because it has 2 historical sightings in the vicinity of Site 300, LLNL had an obligation to survey for the plant on Site 300 after it was rediscovered in May 2005 on Mount Diablo and report the results of these surveys to the public.

Site 300 is characterized by Jones & Stokes as a "fairly species rich" site in comparison with similar Coast Ranges sites, and also noted are the unusual number of "unique" species found in plant survey by different groups at different times of the year. Taken all together, LLNL has been negligent in conducting vegetation surveys of a sufficient depth and over a sufficient time frame for stakeholders in the conservation of this flora to adequately judge the risks to the environment associated with any particular activity at LLNL Site 300, including remediation of the Pit 7 Complex.

For some reason, seasonal wetlands at Site 300 were surveyed during the dry season. The low diversity of vernal pool endemics at the site could simply be a function of this: failure to survey during a time frame to show the presence of unique early- to mid-spring vernal pool endemics.

I am also concerned that LLNL was unable to locate the vegetation surveys in its records for over 4 months when I requested specific information about the timing of the surveys.

Taken altogether, the low time range coverage of the vegetation surveys, surveying seasonal wetlands during the dry season, difficulties answering the most basic public questions about the vegetation surveys, and failing to maintain records of the surveys, LLNL has shown a serious lack of concern for the ecosystem where Site 300 sits and a major lack of compliance with CEQA, and lack of good faith in dealing with the stakeholders on environmental issues at Site 300.

Response: Other remedial alternatives for the Pit 7 Complex, including waste excavation and off-site disposal of the landfill wastes from pits 3 and 5 were thoroughly described and evaluated in the Remedial Investigation/Feasibility Study (RI/FS) for the Pit 7 Complex. These alternatives were not selected as the preferred alternative because they would not be as effective in meeting cleanup standards as the proposed action as described in the EA. Because only the waste in the landfill pits would be excavated, this alternative would not reduce the toxicity, mobility, or volume of contaminants remaining in the saturated bedrock, ground water could still rise into the contaminated bedrock underlying the pits and further degrade water quality. In addition, the waste would require disposal in an off-site disposal facility.

An ecological risk assessment was conducted to evaluate potential impacts to plants and animals from exposure to contamination at the Pit 7 Complex using EPA risk assessment guidelines. This assessment indicated that there is no threat to animals or plants, including endangered and threatened species, from exposure to contaminants in

the Pit 7 Complex area. DOE/LLNL works with the U.S. Fish and Wildlife Service during the detailed design and construction of cleanup actions to mitigate any potential impacts to endangered and threatened species. In addition, DOE/LLNL has an ongoing program to ensure the continued health and protection of threatened and endangered species and plant and animal communities at the Site. This program includes annual surveys of special status species, evaluations of all Site 300 activities for possible impacts to plant and animal communities, and regular consultations with the U.S Fish and Wildlife Service.

Site 300 has shown a commitment to the preservation and restoration of rare plant species. Site 300's rare plant program includes: 1) site wide florist surveys conducted approximately every ten years, 2) an annual monitoring and research program, and 3) pre-activity surveys.

The most recent site wide floristic surveys of Site 300 were published by Jones & Stokes in 2002. These surveys included 203 person-hours of field surveys conducted between April 30 and May 12 of 1997 and 223 person-hours of botanical surveys conducted between March 27 and April 3 of 2002. A list of special status plant species with the potential to occur at Site 300 was prepared for these surveys and Mt. Diablo buckwheat *(Eriogonum truncatum)* was included in this list. Although Mt. Diablo buckwheat was not identified during the Jones & Stokes surveys, several other special status plants were identified. These floristic surveys (conducted between late March and early May) were appropriately timed to identify vernal pool endemics in the seasonal pools located at Site 300.

Site 300 supports an annual monitoring and research program. The program focuses on tracking the location and abundance of known rare plant populations, ecological research to determine the causes of rarity and potential restoration techniques for Site 300's rare plants, and restoration of the critically endangered large-flowered fiddleneck (*Amsinckia grandiflora).* In addition, the Site 300 seasonal pools are routinely visited several times each winter and spring to monitor populations of special status amphibians and invertebrates. Results of the Site 300 rare plant monitoring and research program are presented in reports prepared every two years.

Pre-activity surveys are routinely conducted for ground disturbing activities that have the potential to impact rare plants. Pre-activity surveys for special status plants will be conducted in the Pit 7 area in spring of 2007. These pre-activity surveys will include early spring and late spring site visits.