U.S. Department of Energy

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UCRL-AR-236665

Site-Wide Record of Decision
Lawrence Livermore National Laboratory
Site 300

July 2008

Environmental Restoration Department

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1. Declaration

1.1. Site Name and Location

This Record of Decision (ROD) is for the following Operable Units (OUs) at Lawrence Livermore National Laboratory (LLNL) Site 300 (United States [U.S.] Environmental Protection Agency [EPA] Superfund Site Identification No. CA 2890090002), located west of Tracy, California:

- Building 834 (OU 2).
- Pit 6 Landfill (OU 3).
- High Explosives (HE) Process Area (OU 4) including Building 815, the HE Lagoons, and the HE Burn Pit.
- Building 850/Pit 7 Complex (OU 5).
- Building 854 (OU 6).
- Building 832 Canyon (OU 7) including Buildings 830 and 832.
- Site-Wide (OU 8) including Buildings 801, 833, 845, and 851 and the Pit 2, 8, 9 Landfills.

LLNL Site 300 has been divided into nine OUs based on the nature and extent of contamination to effectively manage site cleanup. An OU-specific ROD was signed in January 1997 for the General Services Area (GSA) (OU 1) (U.S. Department of Energy [DOE], 1997). Since the cleanup strategy has been determined and implemented for OU 1, the GSA is not included in this Site-Wide ROD. An Interim Site-Wide ROD for LLNL Site 300 (U.S. DOE, 2001) was signed for OUs 2 through 8 in February 2001. The Pit 7 Complex of OU 5 was not included in the Interim Site-Wide ROD. An Amendment to the Interim Site-Wide ROD (U.S. DOE, 2007a) for the Pit 7 Complex was signed in January 2007. However, because cleanup standards were not identified in the ROD Amendment, the Pit 7 Complex is included in this Site-Wide ROD. The Building 812 Complex was designated as OU 9 in April 2007. A Remedial Investigation/Feasibility Study report for the Building 812 OU is scheduled for completion in December 2008, followed by a Proposed Plan in 2010. Because a cleanup remedy for this OU will be selected in an Amendment to the Site-Wide ROD currently scheduled for 2011, Building 812 is not included in this Site-Wide ROD.

A proposed final remedy for PCB-, dioxin-, and furan-contaminated soil is not included the Site-Wide Proposed Plan and ROD because DOE and the regulatory agencies have agreed to conduct remediation of this soil as a non-time-critical removal action. As part of the removal action, DOE evaluated a more cost-effective remedy for PCB-, dioxin-, and furan-contaminated soil in the firing table area in an Engineering Evaluation/Cost Analysis document in 2008. The remediation method to be implemented will be selected in an Action Memorandum scheduled for 2008. Public input will be solicited prior to the selection of the remedial action for this contaminated soil.

The Pit 2 Landfill was moved from OU 5 to OU 8 after the Interim ROD because OU 8 contains the "monitoring only" remedies selected in the Interim ROD.

1.2. Statement of Basis and Purpose

This decision document presents the selected final remedies for the OUs specified above at LLNL Site 300, which were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the National Contingency Plan (NCP). This decision is based on the Administrative Record for Site 300.

The U.S. DOE and the U.S. EPA, Region IX jointly selected the final remedies, and the State of California Department of Toxic Substances Control (DTSC) and the Central Valley Regional Water Quality Control Board (RWQCB) were involved and concur with the selection of the final remedies presented in this Site-Wide ROD.

1.3. Assessment of the Site

The response actions selected in this Site-Wide ROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

1.4. Description of the Selected Remedy

In June 1992, the U.S. EPA, the California DTSC and RWQCB, and DOE signed a Federal Facility Agreement (FFA) for cleanup of the LLNL Site 300 Experimental Test Facility. DOE is the responsible party and lead agency for environmental investigations and cleanup. A number of cleanup alternatives were evaluated in the Site-Wide Feasibility Study (Ferry et al., 1999). DOE's preferred alternatives were presented in the Proposed Plan (Dresen et al., 2000). The selected remedies were presented in the Interim Site-Wide ROD in 2001. The ROD was considered interim because: (1) additional testing and evaluation of technologies was being conducted, (2) final cleanup standards were being negotiated, and (3) some areas of Site 300 needed further investigation. An Amendment to the Interim Site-Wide ROD for the Pit 7 Complex was signed in January 2007 describing the selected remedies for the Pit 7 Complex. Cleanup standards were not identified in the ROD Amendment; therefore, the Pit 7 Complex is included in this Site-Wide ROD. In 2006, DOE completed a Site-Wide Remediation Evaluation Summary (Ferry et al., 2006) that assessed the protectiveness and effectiveness of the 2001 Interim ROD remedies, identified deficiencies, and recommended changes to the interim remedies to address the deficiencies. DOE presented the preferred final remedies based on this analysis and those selected in the Amendment to the Interim Site-Wide ROD for the Pit 7 Complex in the Proposed Plan (U.S. DOE, 2007b). The selected cleanup remedies for each area at Site 300 addressed in this Site-Wide ROD and their estimated costs are shown in Table 1.4-1.

The major components of DOE's cleanup for Site 300 are:

- Monitoring to determine if the cleanup is adequately protecting human health and the environment, to measure cleanup progress, evaluate plume migration, and to detect any future releases from the Pit 2, 8, and 9 Landfills or changes in contaminant concentrations in OU 8 release sites that could impact human health or the environment.

- Risk and hazard management, including institutional/land use controls, to prevent exposure where an unacceptable risk to human health remains.
- Extracting and treating contaminated ground water containing volatile organic compounds (VOCs), TBOS/TKEBS, nitrate, perchlorate, HE compounds, and uranium to meet cleanup standards at the Building 834, HE Process Area, Pit 7 Complex, Building 854, and Building 832 Canyon OUs. (Note that not all contaminants are present in each OU.)
- Extracting and treating soil vapor containing VOCs at the Building 834, Building 854, and Building 832 Canyon OUs. Removing VOC vapors from the soil and bedrock above the water table to reduce risks to humans and protect the underlying ground water from further contamination.
- Monitored natural attenuation to reduce VOC (Pit 6 Landfill OU) and nitrate concentrations (HE Process Area and Building 832 Canyon OUs) and tritium activities (Pit 6 Landfill and Building 850 OUs) in ground water to cleanup standards.
- Installing an engineered drainage diversion system at the Pit 7 Complex (OU 5) to hydraulically isolate the contaminant sources in the landfills and underlying bedrock from subsurface water, thereby preventing infiltration of rainwater runoff that can result in ground water rising into Pits 3, 4, 5, and 7 and releasing contaminants.
- Continue evaluating innovative technologies to expedite cleanup.

The selected cleanup standards are discussed in Section 2.11.4.3. Significant or fundamental changes to the remedies would be supported and documented in an Explanation of Significant Differences or ROD Amendment, respectively.

1.5. Statutory Determinations

The Site 300 selected remedies protect human health and the environment, comply with Federal and State requirements that are applicable or relevant and appropriate to the remedial actions, are cost-effective, utilize permanent solutions and alternative treatment technologies to the maximum extent practicable, and provide adequate protection. These remedies also satisfy the statutory preference for treatment as a principal element of the remedy (i.e., reducing the toxicity, mobility or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment) to the extent practicable. Because these remedies will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted every five years after initiation of remedial action to ensure that the remedies are or will be protective of human health and the environment.

1.6. National Environmental Policy Act (NEPA) Integration

Section II.E. of the DOE Secretarial Policy Statement on the National Environmental Policy Act (NEPA) requires that when DOE remedial actions under CERCLA trigger the procedures set forth in NEPA, the procedural and documentation requirements of NEPA and CERCLA are to be integrated. Integration is to be accomplished by conducting the NEPA and CERCLA environmental planning and review procedures concurrently to avoid duplication, conflicting analysis, and delays in implementing remedial action on procedural grounds.

The NEPA evaluation provides the additional information necessary to evaluate potential environmental impacts of each remedy under NEPA in compliance with the requirements of the DOE NEPA Implementing Procedures (10 CFR 1021), Section II.E. of the Secretarial Policy Statement on NEPA (issued June 1994), and the Council of Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the NEPA (40 CFR 1500–1508, July 1986, as amended).

As appropriate, this evaluation includes a discussion of the:

1. Relationship of the remedy to other activities at LLNL.
2. Environmental setting and potentially affected environment including:
   - Land use and socioeconomics.
   - Vegetation, wildlife, and sensitive species.
   - Air quality.
   - Noise and traffic.
   - Aesthetics.
   - Floodplains and wetlands.
   - Cultural resources.
3. Potential environmental impacts of the remedy.
4. Potential accidents.
5. Cumulative impacts to human health, land use, air quality, and surface water.

Each remedial alternative presented in the Interim ROD was reviewed and evaluated in 2000 for potential environmental impacts under NEPA (U.S. DOE, 2000). Because this Site-Wide ROD establishes cleanup standards and minor modifications to remedies, the 2000 NEPA evaluation remains valid.

The remedial alternative for the Pit 7 Complex presented in the Amendment to the Interim Site-Wide ROD was also reviewed and evaluated for potential environmental impacts under NEPA (U.S. DOE, 2007c). The remedial alternative for the Pit 7 Complex remains unchanged, therefore the 2007 NEPA evaluation remains valid.

1.7. ROD Data Certification Checklist

The following information is included in the noted sections of the Decision Summary portion of this Site-Wide ROD. Additional information can be found in the Administrative Record for this site.

- Contaminants of concern (COCs) and their respective concentrations (Sections 2.5.4 and 2.7.1).

- Baseline risk represented by the COCs (Section 2.7).
- Cleanup standards established for COCs and the basis for these standards (Section 2.11.4.3).
- How source materials constituting principal threat wastes are addressed (Section 2.12).
- Current and reasonably anticipated future land use assumptions and current and potential beneficial uses of ground water (Sections 2.6 and 2.11.4).
- Potential land and ground water use that will be available as a result of the selected remedies (Sections 2.6 and 2.11.4).
- Estimated capital, annual operations and maintenance, costs, and the number of years over which the remedy cost estimates are projected (Section 2.11.3).
- Key factors that led to selecting the remedy (Section 2.11.1).

1.8. Authorizing Signatures and Support Agency Acceptance

Each representative of the undersigned party certifies that he or she is fully authorized to enter into the terms and conditions of this agreement and legally bind such party to this agreement.

IT IS SO AGREED:

Michael M. Montgomery 7/31/08
Date

Michael M. Montgomery
Chief, Federal Facilities Cleanup Branch
Superfund Division
U.S. Environmental Protection Agency
Region IX

Barbara J. Cook 7/15/08
Date

Barbara J. Cook, P.E.
Chief, Northern California Coastal Cleanup Operations Branch
California Department of Toxic Substances Control

Pamela C. Creedon 7/16/08
Date

Pamela C. Creedon
Executive Officer
State of California Regional Water Quality Control Board
Central Valley Region

Camille Yuan-Soo Hoo 8/4/08
Date

Camille Yuan-Soo Hoo
Manager, Livermore Site Office
National Nuclear Security Administration
U. S. Department of Energy

2. Decision Summary

2.1. Site Name, Location, and Description

LLNL Site 300 is a DOE experimental test facility operated by the Lawrence Livermore National Security, Limited Liability Corporation. The facility is located in the eastern Altamont Hills about 17 miles east of Livermore and 8.5 miles southwest of downtown Tracy (Figure 2.1-1). The site covers 11 square miles (mi^2), most of which is in San Joaquin County. The western one-sixth of the site is located in Alameda County.

Site 300 is primarily a high-explosives test facility supporting the LLNL weapons program in research, development, and testing associated with weapon components. Operations at Site 300 include four defense program activities: (1) hydrodynamic testing, (2) charged particle beam research, (3) physical, environmental, and dynamic testing, and (4) HE formulation and fabrication. No actual fissionable material is used in these hydrodynamic tests. Fencing and full-time security guards restrict access to Site 300.

DOE began environmental investigation activities at Site 300 in 1981. Prior to August 1990, investigations of potential chemical contamination at Site 300 were conducted under the oversight of the RWQCB. Site 300 was placed on the National Priorities List (NPL) in August 1990. Since then, all investigations have been conducted in accordance with CERCLA under the oversight of the three supervising regulatory agencies: U.S. EPA, RWQCB, and DTSC.

DOE is the lead agency for all environmental restoration activities at Site 300 and is the sole source of funding. The U.S. EPA Superfund identification number for LLNL Site 300 is CA 2890090002.

2.2. Site History and Enforcement Activities

LLNL currently consists of two non-contiguous sites—Livermore Site and Site 300. Each is designated as a separate and distinct entry on U.S. EPA's NPL. LLNL began weapons research operations at the Livermore Site in 1952. At that time LLNL was a part of what was then the University of California Radiation Laboratory (UCRL). UCRL proposed the Site 300 location for an HE test site along Corral Hollow between Livermore and Tracy in July 1953. Experiments with HE began at Site 300 in 1955. The size of the original site was approximately 3 mi^2. In 1957, the site was enlarged to 11 mi^2. The Livermore Site and Site 300 portion of UCRL became LLNL in 1971. Prior to acquisition by UCRL, land use in the area of Site 300 was limited to sheep and cattle grazing.

During past LLNL Site 300 operations, a number of contaminants were released to the environment including:

- Disposing waste fluids in sumps (dry wells).
- Surface spills from drum storage areas.
- Piping leaks from heat exchange systems.

- Burial of contaminated debris in unlined pits, trenches, and landfills.
- Debris and shrapnel scattered or released during HE detonations at firing tables.
- Open burning of HE compounds.
- Discharging contaminated rinse water to unlined lagoons and retention basins.

2.3. Community Participation

The Proposed Plan was made available to the public in May 2007. This document, as well as other documents related to the cleanup at Site 300 can be found in the Administrative Record file and the Information Repositories located in the LLNL Discovery Center in Livermore, California and in the Tracy Public Library in Tracy, California. A public comment period on the Proposed Plan was held from May 25 to July 25, 2007. DOE extended the original 30-day public comment period to 60 days to accommodate a review period extension requested by Tri-Valley Communities Against a Radioactive Environment (CAREs). In addition, a public meeting was held on June 20, 2007 to present the Proposed Plan to a broader community audience than those that had already been involved in the site's cleanup process. At this meeting, representatives from the DOE, LLNL, U.S. EPA, and the State of California answered questions about environmental contamination at the site and the remedial alternatives. DOE's responses to the comments received during this period and at the community meeting are included in a Responsiveness Summary in Section 3 of this document.

DOE/LLNL has prepared a Community Relations Plan to meet the following objectives:

- Provide information to interested members of the community.
- Provide for an open dialogue on Site 300 cleanup issues between DOE and the public, and factor community concerns into the ongoing environmental investigation.
- Continue to work closely with the neighbors of Site 300.
- Be responsive to the special information needs of elected officials, agency representatives, and interested members of the public, including environmental citizens groups.
- Seek to increase the level of understanding in the community with regard to Site 300 cleanup plans.
- Respond to changes in community concerns and interest levels.

Reviews of the objectives and the methods described in the Community Relations Plan are conducted regularly to assure the objectives are being met.

The public is invited to attend various CERCLA-required and voluntary public meetings and workshops to learn about and comment on planned environmental restoration activities at Site 300. Tri-Valley CAREs has held a Technical Assistance Grant from the U.S. EPA since 1994 and representatives meet quarterly with DOE, regulators, and LLNL staff to discuss on-going and planned project status. The local community is currently provided, and will continue to be provided, with information by way of local information repositories and public workshops.

2.4. Scope and Role of the Response Action

Environmental investigations identified 24 locations at Site 300 where contaminants were released to the environment. All release sites at Site 300 have been assigned to one of nine OUs to more effectively manage the site cleanup. The OU designations are based on the nature and extent of contamination and topographic and hydrologic considerations. Figure 2.4-1 shows the contaminant released to the environment and the assigned OU.

The primary contaminants at Site 300 include trichloroethylene (TCE) and other VOCs, HE compounds, perchlorate, tritium, uranium, nitrate, polychlorinated biphenyls (PCBs), dioxin and furan compounds, silicone oils, and metals. As shown on Figure 2.4-2, ground water contamination has resulted from some of these releases.

Over the past 25 years, significant progress has been made cleaning up Site 300. DOE initiated cleanup activities at Site 300 in the mid-1980s to begin addressing contamination. These activities were conducted as treatability studies, removal actions, or as interim remedial actions under the Interim Site-Wide ROD. Cleanup activities to date have included:

- Installing 21 ground water and soil vapor treatment systems.
- Testing of *in situ* treatment technologies.
- Removing contaminated soil.
- Capping and closing landfills, rinsewater lagoons and burn pits.
- Removing firing table gravels.
- Implementing administrative and engineered controls to prevent workers from being exposed to contamination while cleanup proceeds.

These cleanup activities have resulted in significant reductions in maximum contaminant concentrations, removed contaminant mass from the subsurface, and mitigated risks to onsite workers in many areas.

The overall site cleanup plan for LLNL Site 300 is presented in Table 2.4-1. This table summarizes all past and ongoing responses, as well as those proposed in this ROD.

Sections 2.4.1 through 2.4.9 briefly describe the history of the OUs at the site and COCs released to the environment. Nature and extent of contamination and risks for OUs 2 through 8 are described in Sections 2.5.4 and 2.7, respectively.

2.4.1. General Services Area OU (OU 1)

The General Services Area (GSA) OU is divided into the Central GSA and Eastern GSA and consists of administration offices, equipment fabrication and repair shops, and a sewage treatment pond. In the 1960s and 1970s, rinse water from these operations was disposed of in dry wells, and volatile organic compound (VOC)-contaminated debris was buried in trenches causing VOC contamination of ground water and subsurface soil. The dry wells were used until 1982 and were excavated in 1983 to 1984. Ground water extraction and treatment was initiated in the Eastern GSA in 1991. Ground water and soil vapor extraction and treatment have been performed in the Central GSA since 1993 and 1994, respectively. The 1991 baseline human health risk assessment estimated an unacceptable carcinogenic risk for ingesting ground water from two offsite wells and a hypothetical water-supply well located at the site boundary near the debris burial trench and onsite worker inhalation exposure to TCE volatilizing from the subsurface soil to indoor air within Building 875. No unacceptable risk or hazard was associated with potential exposure to VOCs in surface or subsurface soil. Significant progress has been made in the cleanup of contamination in the GSA OU. Soil vapor extraction has contributed to reducing the excess cancer risk due to inhalation of VOC vapors migrating into Building 875 to acceptable levels by 2000. Remediation has already reduced VOCs in ground water to meet cleanup standards in the Eastern GSA. An OU-specific ROD was signed in 1997. Buildout of the remedial action was completed in 2004. Since the final cleanup strategy has been implemented for this OU, it is not discussed further in this ROD other than to include Institutional/Land Use Controls in Table 2.9-13 and Figure 2.9-11.

2.4.2. Building 834 OU (OU 2)

Since the late 1950s, Building 834 facilities have been used for experiments involving thermal cycling of weapons components. TCE was used as the primary heat transfer fluid in these experiments. Occasionally TCE was mixed with the silicone oils, tetrabutyl ortho silicate (TBOS) and tetrakis (2-ethylbutyl) silane (TKEBS), to prevent degradation of pump seals and gaskets. From 1962 to 1978, intermittent spills and piping leaks resulted in contamination of the subsurface soil and rock and a shallow perched water-bearing rock layer or aquifer. COCs in ground water include VOCs, nitrate, diesel, and silicone oils (TBOS/TKEBS). VOCs are COCs in subsurface soil in the Building 834 OU. There are no COCs in surface soil. The deeper regional aquifer has not been affected. The baseline risk assessment identified a risk to onsite workers who could inhale VOCs evaporating from subsurface soil to air at Building 834. It also identified potential impacts to animals from VOCs in subsurface soil and cadmium in surface soil. Ground water and soil vapor extraction and treatment was initiated at the Building 834 OU in 1995. Remediation has reduced VOC concentrations from a historical maximum of 1,060,000 micrograms per liter (μg/L) in 1993 to a maximum of 236,402 μg/L in 2007. TBOS in ground water has also been reduced from maximum historical concentration of 7,300,000 μg/L in 1995 to a 2007 maximum concentration of 19,000 μg/L.

2.4.3. Pit 6 Landfill OU (OU 3)

From 1964 to 1973, approximately 1,900 cubic yards of laboratory and shop debris and biomedical waste were placed in nine unlined debris trenches and animal pits at the Pit 6 Landfill. Plumes of VOCs and tritium in ground water originate from the landfill. Perchlorate and nitrate have also been detected in ground water to a more limited extent. No COCs were identified in surface or subsurface soil. The baseline risk assessment identified a risk to onsite workers who could inhale VOCs evaporating from the pit waste and Spring 7 to air. It also identified potential impacts to burrowing animals from VOCs in subsurface soil.

An engineered landfill cap was installed in 1997 to prevent further contaminant releases from the landfill and to eliminate the VOC inhalation risk for onsite workers and potential impacts to burrowing animals. The risk for potential inhalation of VOCs volatilizing from Spring 7 were based on an exposure to the maximum historical VOC concentration detected in the spring (110 μg/L). Total VOC concentrations in Spring 7 were 4 μg/L in 2000; the spring has been dry since 2000. Natural attenuation has reduced VOCs in ground water from a historical maximum of 250 μg/L in 1988 to a maximum concentration of 7.7 μg/L in 2007. Tritium activities are well below the Maximum Contaminant Level (MCL) and continue to decrease towards background levels. Perchlorate is not currently detected in any wells. Nitrate concentrations exceeding the MCL continue to be limited to one well.

2.4.4. HE Process Area OU (OU 4)

Facilities in the HE Process Area OU have been in use since the late 1950s for the chemical formulation, mechanical pressing, and machining of HE compounds into shaped detonation devices. Solid HE waste remaining after machining operations was incinerated at the HE Open Burn Facility located near Building 829 in the northern part of the OU. Liquid waste generated during machining operations was discharged to former unlined disposal lagoons. Surface spills from 1958 to 1986 occurred at the drum storage and dispensing area for the former Building 815 steam plant, where TCE was used to clean pipelines. These spills resulted in the release of TCE and other VOCs to ground water and subsurface soil and bedrock. HE compounds, nitrate, and perchlorate have also been detected in ground water and are likely the result of wastewater discharges to former unlined rinsewater lagoons. Similar contaminants were also found in ground water near the former HE Burn Pits. The baseline risk assessment identified a risk to onsite workers who could inhale VOCs evaporating from subsurface soil to air at Building 815 and surface water at Spring 5.

Ground water extraction and treatment was initiated at the HE Process Area OU in 1999. Remediation has reduced VOC concentrations from a historical maximum of 450 μg/L in 1992 to a maximum of 57 μg/L in 2007. Research Department Explosive (RDX) in ground water has also been reduced from maximum historical concentration of 350 μg/L in 1998 to a 2007 maximum concentration of 69 μg/L. Natural denitrification processes are reducing nitrate concentrations in ground water to background levels in ground water. Remediation has mitigated risk to onsite workers in the HE Process Area OU.

2.4.5. Building 850/Pit 7 Complex OU (OU 5)

This OU has been divided into two areas for cleanup evaluation purposes: the Pit 7 Complex and the Building 850 Firing Table area.

2.4.5.1. Building 850 Firing Table (OU 5)

HE experiments have been conducted at the Building 850 Firing Table since 1958. Tritium was used in these experiments, primarily between 1963 and 1978. As a result of the dispersal of test assembly debris during explosions, surface soil was contaminated with metals, polychlorinated biphenyls (PCBs), dioxins, furans, HE compounds, and depleted uranium. Leaching from firing table debris resulted in tritium and depleted uranium contamination in subsurface soil and ground water. Nitrate and perchlorate have also been identified in ground water. PCB-contaminated shrapnel and debris was removed from the area around the firing table in 1998. The baseline risk assessment identified a risk to onsite workers who could inhale, ingest, or contact PCBs, dioxins, or furans in surface soil in the vicinity of the firing table. It also identified a hazard to animals that could be exposed to this soil contamination.

Natural attenuation has reduced tritium activities in ground water from a historical maximum of 566,000 picoCuries per liter (pCi/L) in 1985 to a 2007 maximum of 66,800 pCi/L in the first semester 2007. The extent of the tritium plume with activities that exceed the MCL is limited to seven wells located within 700 feet (ft) of the Building 850 Firing Table. Both tritium activities and the plume extent continue to decrease. Uranium activities remain well below the MCL and are within the range of natural background levels. The extent of nitrate with concentrations exceeding the MCL is limited and does not pose a threat to human health or the environment. The maximum nitrate concentrations are detected upgradient and crossgradient of the firing table and indicate the presence of a natural source of nitrate. The tritium, uranium, and HE compounds in surface soil do not pose a risk to human or ecological receptors or a threat to ground water.

2.4.5.2. Pit 7 Complex (OU 5)

From 1958 until 1988, debris from explosive tests conducted at Site 300 firing tables was disposed in unlined landfill Pits 3, 4, 5, and 7 at the Pit 7 Complex. The waste placed in the pits included wood; plastic; material and debris from tent structures; pea gravel; and exploded test assemblies that were contaminated with tritium and depleted uranium residue. During years of above-normal rainfall (i.e., 1997-1998 El Niño), ground water rose into the bottom of the landfills and the underlying contaminated bedrock. This resulted in the release of tritium, uranium, VOCs, perchlorate, and nitrate to ground water in the Pit 7 Complex area. The results of the baseline risk assessment conducted in 1992 indicated that the only unacceptable risk to human health posed by contaminants in the Pit 7 Complex area was inhalation of tritiated water vapor evaporating from subsurface soil by onsite workers in the vicinity of the Pit 3 Landfill. However, a risk re-evaluation conducted in 2007 for the remedial design indicated that tritium decay has mitigated the risk to onsite workers. No risk or hazard was identified in the baseline risk assessment associated with surface soil at the Pit 7 Complex. There is no risk or hazard to ecological receptors from exposure to COCs at the Pit 7 Complex.

Natural attenuation has reduced tritium activities in ground water from a historical maximum of 2,660,000 pCi/L in 1998 to a 2007 maximum of 293,000 pCi/L in 2007. Uranium activities have also decreased from a historical maximum of 781 pCi/L in 1998 to a 2007 maximum of 130 pCi/L in 2007. VOC concentrations in ground water are currently below MCLs.

2.4.6. Building 854 OU (OU 6)

The Building 854 Complex was used to test the stability of weapons and weapon components under various environmental conditions and mechanical and thermal stresses. TCE was formerly used as a heat-exchange fluid in the Building 854 OU and was released to soil and ground water through leaks and discharges. Nitrate and perchlorate have also been detected in ground water. HE compounds, PCBs, dioxins, furans, tritium, and metals have been detected in surface soil. Risks were identified for onsite workers who could inhale, ingest, or contact PCBs, dioxins, or furans in surface soil in the former Building 855 rinsewater lagoon, inhale VOCs volatilizing from subsurface soil to indoor and outdoor air at Building 854F, and inhale VOCs volatilizing from subsurface soil to indoor air at Building 854A.

Ground water and soil vapor extraction and treatment was initiated at the Building 854 OU in 1999. Remediation has reduced VOC concentrations in ground water from a historical maximum of 2,900 μg/L in 1997 to a maximum of 150 μg/L in 2007. Nitrate concentrations have decreased from a historical maximum of 180 milligrams per liter (mg/L) in 1996 to a maximum of 56 mg/L in the first semester 2007. Perchlorate concentrations in ground water have also decreased and are currently detected at a maximum concentration of 20 μg/L. The PCB-, dioxin-, and furan-contaminated soil in the Building 855 former rinsewater lagoon was excavated in 2005. Remediation has mitigated the risk to onsite workers in the Building 854 OU.

2.4.7. Building 832 Canyon OU (OU 7)

Contaminants were released from Buildings 830 and 832 through piping leaks and surface spills during past activities at these buildings. VOCs, nitrate, and perchlorate have been detected in ground water. VOCs, nitrate, and HE compounds have been detected in subsurface soil. HE compounds have also been detected in surface soil. The baseline risk assessment identified risks to onsite workers who could inhale VOCs volatilizing from subsurface soil to indoor and outdoor air at Building 830, inhale VOCs volatilizing from subsurface soil to indoor air at Building 832F, and from inhaling VOCs volatilizing from surface water at Spring 3 to air.

Ground water and soil vapor extraction and treatment was initiated at the Building 832 Canyon OU in 1999. Remediation has reduced VOC concentrations from a historical maximum of 30,000 μg/L in 1997 to a maximum of 5,700 μg/L in 2007. Perchlorate concentrations in ground water have been reduced from a historical maximum of 27 μg/L in 2003 to a maximum of 20 μg/L in 2007. Nitrate concentrations in ground water remain fairly stable with a maximum of 260 mg/L in 2007, and are possibly the result of the ongoing contribution of nitrate from septic systems and natural sources in the Neroly Formation bedrock. Remediation has mitigated risk to onsite workers in several locations in the Building 832 Canyon OU.

2.4.8. Site-Wide OU (OU 8)

Operable Unit 8 includes the contaminant release sites that have a monitoring-only interim remedy: the Building 801 Dry Well and Pit 8 Landfill, Building 833, Building 845 and Pit 9 Landfill, the Building 851 Firing Table, and the Pit 2 Landfill. Operable Unit 8 release sites have a monitoring-only interim remedy because either: (1) contaminants in surface and subsurface soil/bedrock do not pose a risk to humans or plant and animal populations or a threat to ground water, (2) there is no ground water contamination, (3) contaminant concentrations in ground water do not exceed regulatory standards, and/or (4) the extent of contamination in ground water is limited. These release sites are summarized in Sections 2.4.8.1 through 2.4.8.4.

2.4.8.1. Building 801 and the Pit 8 Landfill (OU 8)

The Building 801 Firing Table was used for explosives testing, and operations resulted in contamination of adjacent soil with metals and uranium. Use of this firing table was discontinued in 1998, and the firing table gravel and some underlying soil were removed. Waste fluid discharges to the Building 801 Dry Well from the late 1950s to 1984, resulted in low concentrations of VOCs in soil and ground water. Perchlorate and nitrate are also COCs in ground water. There is no risk to human or ecological receptors associated with this contamination. Debris from the firing table was buried in the nearby Pit 8 Landfill until 1974.

The Building 801 Dry Well was decommissioned and filled with concrete in 1984. VOC concentrations in the location of the former Building 801 dry well have decreased from a historical maximum of 10 μg/L in 1990 to below MCLs in 2005. Nitrate concentrations are below the MCL and within the range of natural background levels. Perchlorate is not currently detected in ground water. No contaminants have been detected in ground water or other environmental media at the Pit 8 Landfill. There has been no evidence of contaminant releases from the Pit 8 Landfill in the almost 50 years since this landfill has been in place.

2.4.8.2. Building 833 (OU 8)

TCE was used as a heat-exchange fluid at Building 833 from 1959 to 1982 and was released through spills and rinsewater disposal, resulting in TCE-contamination of soil and shallow perched ground water. No contamination has been detected in the deeper regional aquifer. The baseline risk assessment identified a risk to onsite workers who could inhale VOCs evaporating from subsurface soil to air at Building 833. Engineered controls have been implemented at Building 833 to prevent worker exposure to VOCs.

Ground water monitoring performed in the vicinity of Building 833 has shown a decline in VOC concentrations from a historical maximum of 2,100 μg/L in 1992 to 10 μg/L in 2007. In 2007, risk re-evaluation based on current VOC concentrations indicates that the risk to onsite workers is within health-protective levels ($<10^{-6}$). No risk or hazard to ecological receptors was identified at Building 833.

2.4.8.3. Building 845 Firing Table and Pit 9 Landfill (OU 8)

The Building 845 Firing Table was used from 1958 until 1963 to conduct explosives experiments. Leaching from firing table debris resulted in minor depleted uranium and High Melting Explosive (HMX) contamination in subsurface soil at Building 845, however no unacceptable risk or hazard to human or ecological receptors or threat to ground water was identified. Debris generated at the Building 845 Firing Table was buried in the Pit 9 Landfill. No contaminants have been detected in surface soil or in ground water under the Building 845 Firing Table. No contaminants have been detected in ground water or other environmental media at the Pit 9 Landfill. There has been no evidence of contaminant releases from the Pit 9 Landfill in the almost 50 years since this landfill has been in place.

2.4.8.4. Building 851 Firing Table (OU 8)

The Building 851 Firing Table has been used since 1962 to conduct explosives experiments. VOCs and uranium-238 were identified in subsurface soil, and RDX, uranium-238, and metals in surface soil. Uranium and tritium are ground water COCs. However, there is no risk or hazard to humans or animal populations or threat to ground water associated with these contaminants in surface soil or subsurface soil. Uranium has been detected at low concentration in ground water beneath the Building 851, but uranium activities continue to be a fraction of the 20 pCi/L MCL. Recent uranium activities in ground water samples are below the 1.3 pCi/L historical maximum detected in 1990 and are within the range of natural background levels. There is no risk to human or ecological receptors associated with this contamination.

2.4.8.5. Pit 2 Landfill (OU 8)

The Pit 2 Landfill was used from 1956 until 1960 to dispose of firing table debris from Buildings 801 and 802. Ground water data indicate that a discharge of potable water to support a red-legged frog habitat located upgradient from the landfill may have leached depleted uranium from the buried waste. The frogs were relocated and the water discharge was discontinued, thereby removing the leaching mechanism. No risk to human or ecological receptors has been identified at the Pit 2 Landfill. Monitoring data indicate that uranium activities remain below the

MCL with a maximum of 9.9 pCi/L in the first semester of 2007, and continue to decrease since the discharge was discontinued. No contaminants were identified in surface or subsurface soil at the Pit 2 Landfill.

2.4.9. Building 812 OU (OU 9)

The Building 812 Complex was built in the late 1950s-early 1960s and continues to be used to conduct explosives tests and diagnostics in support of national defense programs. Contaminants were released from the Building 812 Complex as a result of experimental activities conducted in this area. The Building 812 Complex was designated as OU 9 in March 2007 based on characterization results that indicated the presence of uranium, VOCs, HMX, nitrate, and perchlorate in environmental media in this area. A Remedial Investigation/Feasibility Study presenting the results of characterization activities and remedial alternatives for the Building 812 OU is scheduled for completion in 2008. A Proposed Plan will subsequently present the alternatives and a preferred remedy for public comment. A remedy will then be selected in an Amendment to this Site-Wide ROD. For this reason, the Building 812 OU 9 is not discussed further.

2.4.10. Building 865

Building 865 facilities were used to conduct high-energy laser tests and diagnostics in support of national defense programs from 1980 to 1995. The Building 865 Complex housed a 275-foot linear electron accelerator called the Advanced Test Accelerator. The Accelerator was designed to produce a repetitively pulsed electron beam for charged particle beam research. Building 865 was not included in the Interim ROD because the area was still being characterized. A Characterization Summary Report for this area was submitted in 2006 (Ferry and Holtzapple, 2006). Impact to ground water and ecological receptors was identified from metals in surface soil. Freon 113, Freon 11, and tetrachloroethene (PCE) were identified as COCs in ground water. The regulatory pathway for Building 865 is currently being negotiated and will be established in a ROD amendment.

2.4.11. Sandia Test Site

From about 1959 to 1960, Sandia National Laboratories (Livermore) operated a small, temporary firing table at Site 300. The facility consisted of a portable building with other structures built into the hillside and surrounded by sandbags. The facility may have been used to test or store high explosives. A Characterization Summary Report for this area was submitted in 2005 (Ferry and Holtzapple, 2005). The characterization data indicate that no releases of contamination have occurred to the environment as a result of activities in this area. The regulatory agencies agreed that the Sandia Test Site area was not a contaminant release site and that no remedial action need be taken.

2.4.12. CERCLA/RCRA Relationship

As stated in the Site 300 FFA, DOE intends to integrate CERCLA response obligations and Resource Conservation and Recovery Act (RCRA) corrective action obligations that relate to the release(s) of hazardous substances, hazardous wastes, pollutants, or contaminants. Therefore, the FFA signatories intend that activities covered by the Site 300 FFA will achieve compliance with CERCLA, 42 U.S.C. Section 96-1 et seq; satisfy the corrective action requirements of RCRA 3004 (u) & (v), 42 U.S.C. Section 6924 (u) & (v) for a RCRA permit, and RCRA

Section 3008 (h), 42 U.S.C. Section 6298 (h) for interim status facilities; and meet or exceed all applicable or relevant and appropriate Federal and State laws and regulations to the extent required by CERCLA Section 121, 42 U.S.C. Section 9621.

DOE also intends that any remedial action selected, implemented, and completed will protect human health and the environment such that remediation of releases covered by this Site-Wide ROD shall obviate the need for further corrective action under RCRA (i.e., no further corrective action shall be required). DOE agrees that with respect to releases of hazardous waste covered by this Site-Wide ROD, RCRA shall be considered an applicable or relevant and appropriate requirement (ARAR) pursuant to CERCLA Section 121, 42 U.S.C. Section 9621.

Two previous response actions have been completed under RCRA. These are:

1. Capping and closure of the Pit 1, Pit 4, and Pit 7 Landfills in 1992, and
2. Capping and closure of the High Explosives Burn Pits in 1998.

Long term monitoring and inspection of these closures is conducted under the RCRA Post-Closure Plans.

2.5. Site Characteristics

This section discusses the characteristics of Site 300 including the physical setting (Section 2.5.1), geology (Section 2.5.2), and hydrogeology (Section 2.5.3).

2.5.1. Physical Setting

Site 300 is located in the southeastern Altamont Hills of the Diablo range. The topography of Site 300 consists of a series of steep hills and canyons generally oriented northwest to southeast. Elevation ranges from about 500 ft in the southeast corner to about 1,750 ft in the northwestern area. The climate of Site 300 is semiarid and windy. The average annual rainfall for the 41-year period from 1965 through 2006 was 10.2 inches.

The seven major plant habitats occurring at Site 300, four upland habitats and three less extensive wetland habitats, consist of 14 plant communities containing 343 plant taxa. The upland habitats are introduced grassland, native grassland, coastal sage scrub, and oak woodland. The rare wetland habitats consist of northern riparian woodland, vernal pool, and herbaceous wetlands. Fauna observed at Site 300 include 20 species of reptiles and amphibians, 70 species of birds, and 25 species of mammals. Mammal species include mice, hares, squirrels, skunks, foxes, and black-tailed deer. Site 300 is the habitat for several rare, threatened, or endangered species of flora and fauna.

2.5.2. Geology

Site 300 is located in an area of Quaternary folding where bedrock sequences have been slightly deformed into several gentle, low-amplitude folds. Bedrock strata exposed within Site 300 have been correlated with five mappable geologic units (Webster-Scholten, 1994). From oldest to youngest, the units are the late Cretaceous Great Valley sequence (Kgv), the late Paleocene to mid-Eocene Tesla Formation (Tts), the mid-Miocene Cierbo Formation (Tmss), the late Miocene Neroly Formation (Tn), and a Pliocene nonmarine unit (Tps). The bedrock units are locally overlain by mid- to late-Pleistocene terrace deposits and late Pleistocene to Holocene floodplain, ravine fill, landslide, and colluvial deposits.

Rocks within Site 300 are pervasively fractured. Fractures include joint sets, fractures subparallel to bedding planes, and shear zones. Frequently, thin-bedded claystones are intensively and randomly fractured. Joint sets are observed most often in the well indurated rocks present within Site 300. These rocks include the Great Valley sequence, Tesla Formation, and Neroly Formation. Joint sets are locally observed in more indurated portions of the Pliocene nonmarine unit, but well-defined joints are uncommon in these sediments and in the poorly indurated Cierbo Formation strata.

2.5.3. Hydrogeology

This section describes the general framework of the Site 300 hydrogeology, including the occurrence of surface water and ground water.

2.5.3.1. Surface Water

There are no perennial streams at Site 300. Runoff occurs within ravines and ephemeral stream channels during and following heavy rains. Except for small areas in the northeastern and northwestern portions of Site 300, runoff that does not infiltrate into the ground may eventually discharge into Corral Hollow Creek. This creek is an intermittent stream that flows west to east near the southern perimeter of the site. Such discharges, however, are rare.

Surface water at the site consists of intermittent runoff, springs, vernal pools, and two man-made ponds. There are 25 springs at Site 300 (Figure 2.5-1); most of which exhibit very low flow rates and are recognized mainly by small marshy areas, pools of water, or vegetation. There are eleven springs located within the designated OUs; six of which contain current or past anthropogenic contamination. There are two onsite man-made surface water bodies: (1) a constructed pond/wetland created as habitat for red-legged frogs south of Building 812, and (2) a sewage treatment pond located in the GSA OU. An offsite man-made pond is located at the Carnegie State Vehicular Recreation Area Park (hereafter referred to as Carnegie State Park) east of the Pit 6 Landfill.

2.5.3.2. Ground Water

Site 300 is a large and hydrogeologically diverse site. Due to the steep topography, and structural complexity, stratigraphic units and ground water contained within many of these units are discontinuous across the site. Consequently, site-specific hydrogeologic conditions govern the occurrence and flow of ground water and the fate and transport of contaminants beneath each OU. This section describes the primary water-bearing zones and their distribution at Site 300.

Hydrostratigraphic units (HSUs) have been defined consisting of one or more stratigraphic intervals that comprise a single hydraulic system within one or more OU. An HSU is a water-bearing zone that exhibits similar hydraulic and geochemical properties. At Site 300, ground water movement and contaminant migration in ground water are discussed in the context of HSUs.

Most ground water contamination at Site 300 occurs primarily in three types of water-bearing zones:

1. Quaternary deposits including the alluvium and weathered bedrock (Qal/WBR HSU), alluvial terrace deposits (Qt), and landslide deposits (Qls HSU).
2. Tertiary perched ground water in fluvial sands and gravels (Tpsg HSU) and semilithified silts and clay of the Tps HSU.
3. Tertiary Neroly Formation bedrock including the $Tnsc_2$, $Tnbs_2$, $Tnsc_{1b}$ $Tnbs_1$, $Tnbs_0$, and $Tnsc_0$ HSUs.

Composite stratigraphic columns showing saturated zones for the northern part and southeast corner of Site 300 is shown in Figure 2.5-2. A ground water potentiometric surface elevation map of the major water-bearing units at Site 300 is presented in Figure 2.5-3. The HSUs are discussed further in the following sections.

Quaternary Deposit HSUs

At Site 300, ground water is present in Quaternary deposits in the Qal/WBR HSU, Qt, and the Qls HSU. These HSUs generally exhibit moderate to high hydraulic conductivity (greater than 10^{-3} centimeters per second [cm/sec]) and characteristics of a porous medium.

The Qal/WBR HSU is comprised of silty clay, sand, and gravel deposited in ravines and surface water drainage courses throughout Site 300 and the weathered bedrock underlying these alluvial deposits. In many parts of Site 300, the Qal/WBR HSU is in hydraulic communication with underlying Neroly bedrock HSUs, where the dipping bedrock HSUs subcrop beneath the Qal/WBR HSU. Depending on the relative hydraulic head between the two zones, ground water and contaminants can flow from one zone into the other. The Qal/WBR HSU has been identified in the HE Process Area OU, the Building 850 area, and the Building 832 Canyon OU.

Qt deposits are comprised of variably saturated silty clay, sand, and gravel alluvial terrace deposits of moderate hydraulic conductivity that are present in the Pit 6 Landfill OU. Qt deposit ground water hydraulically communicates with ground water in the underlying $Tnbs_1$ to form the Qt-$Tnbs_1$ HSU in this area.

The Qls HSU is comprised of heterogeneous silty clay, sand, and gravel deposited as rock and sediment slides from the hillsides. While landslide deposits are present throughout Site 300, they contain contaminated ground water in the Building 854 OU, and therefore have been designated as an HSU in this OU. In the Building 854 OU, the Qls HSU contains variably saturated, ephemeral perched ground water.

Tertiary Perched HSUs

At Site 300, perched ground water occurs in Tertiary sands and gravels of the Tpsg and Tps HSUs. The characteristics and occurrence of these HSUs in Site 300 OUs are described below.

The Tpsg HSU is a shallow, perched water-bearing zone that is present in the Building 834 OU. This HSU exhibits variable but generally low hydraulic conductivity ranging from 10^{-4} to 10^{-6} cm/sec. It overlies 10 to 30 ft of silty clay in the Tps perching horizon that prevents downward migration of ground water into the underlying Lower $Tnbs_1$ HSU. Perched ground water is also present in the Tpsg-Tps HSU at the HE Process Area OU. The areal extent and saturated thickness of these perched water-bearing zones are variable depending on seasonal rainfall.

Tertiary Neroly Formation Bedrock HSUs

At Site 300, ground water is present in a number of HSUs within the Tertiary Neroly Formation bedrock. Tertiary Neroly (Tn) Formation bedrock includes the following stratigraphic units, listed from youngest to oldest:

- $Tnsc_2$ Upper siltstones and claystone.
- $Tnbs_2$ Upper blue sandstone.
- $Tnsc_{1b}$ Middle siltstone and claystone.
- $Tnbs_1$ Lower blue sandstone.
- $Tnbs_0$ basal sandstone.
- $Tnsc_0$ basal siltstone/claystone.

The presence of ground water in these stratigraphic units, as well as ground water gradients and flow direction, are influenced by lithology and regional structure (i.e., bedrock dip, folding, and faulting) that control the recharge and discharge characteristics of ground water within the Neroly bedrock. The Neroly bedrock HSUs exhibit a broad range of hydraulic conductivities (10^{-3} to 10^{-5} cm/sec) and characteristics of both porous and fractured media.

Ground water in Neroly bedrock occurs under unconfined to confined conditions, and generally flows to the east-northeast in the northern part of the site and to the southeast in the southern part of Site 300. Ground water use at Site 300 and on neighboring properties is discussed in Section 2.6.5.

2.5.4. Nature and Extent of Contamination

Environmental investigations at Site 300 began in 1981 to identify and characterize contamination released from past operations at the site. A number of specific release sites within Site 300 have been the focus of many of these environmental investigations. The determination of the nature and extent of contamination at Site 300 is based on a detailed process performed in accordance with EPA guidelines. This process includes: records searches, interviews with operating personnel and retirees, examination of aerial photographs, site visits, and, subsurface investigations which have included soil vapor surveys, and soil, rock, ground water, and surface water analyses.

2.5.4.1. Identification of Contaminants of Concern (COCs)

As part of the Site-Wide Feasibility Study and Remedial Investigation/Feasibility Study for the Pit 7 Complex (Taffet et al., 2005), a screening and evaluation process was conducted for the contaminants of potential concern. The objective of this evaluation process was to determine which contaminants of potential concern were actual COCs based on the:

- Frequency with which each contaminant has been detected.
- Concentration of the contaminant relative to background concentrations.

- Risk or hazard presented by the contaminant.
- Potential for a contaminant present in soil or rock to impact ground water.

The four criteria used in this evaluation process are discussed below:

1. The frequency with which each substance has been detected. This criterion was used because if a substance is detected frequently, it is likely to be both persistent in the environment and relatively widespread. The potential for human exposure is directly related to these parameters as well as to the tendency of the contaminant to migrate within and between environmental media. Contaminants in ground water and surface soil detected at less than 2% frequency of detection were not considered to be COCs.
2. Concentration of the constituent relative to background concentrations. If a compound was detected in an environmental media at Site 300 but was reported at concentrations within the range of natural background concentrations, it is not considered to be a COC. Background levels for naturally-occurring substances (i.e., metals, ions and radionuclides) are discussed in Appendix A of the Site-Wide Feasibility Study and Appendix D of the Remedial Investigation/Feasibility Study for the Pit 7 Complex.
3. Risk or hazard presented by the constituent. Constituents in surface and subsurface soil/rock and surface water are not considered COCs if the calculated cancer risk was less than 10^{-6} (one in one million) and the hazard index was less than one. Contaminants previously identified in ground and surface water but not detected for an extended period of time (at least two years) were screened out as not indicating a degradation of water quality and therefore not requiring remediation. A summary of risk posed by Site 300 contamination is presented in Section 2.7.
4. Potential for a constituent in soil or rock to affect ground water. Constituents in surface soil and subsurface soil or rock are not considered COCs if the constituent does not present a threat to ground water. However, if a constituent in soil or rock did not present a threat to ground water but the calculated risk was greater than 10^{-6} or the hazard index was greater than one, it is still considered a COC.

Additional screening criteria were used in the Site-Wide Feasibility Study including the use of established background and/or statistical limits as part of either a Pit/Landfill Post-Closure Plan or Waste Discharge Requirements monitoring program, the length of time since a chemical of potential concern had been detected in ground water, and if the presence of the substance could be attributed to a source other than an operable unit release.

COCs for each environmental medium were selected based on the following:

- Any constituent detected in surface soil at greater than 2% frequency and above background concentrations is considered to be a COC if: (1) a risk above 10^{-6} or hazard quotient above one was calculated for complete exposure pathways for the contaminant and media, and/or (2) the contaminant presents a potential threat to ground water as determined by modeling.
- Any constituent detected in subsurface soil/rock above its background concentration is considered to be a COC if: (1) a risk above 10^{-6} or hazard quotient above one was calculated for complete exposure pathways for the contaminant and media, and/or (2) the contaminant presents a potential threat to ground water.

- Any constituent detected in ground water at greater than 2% frequency and above background concentrations is considered to be a COC.
- Volatile substances detected in surface water are considered to be COCs if a cancer risk greater than 10^{-6} or hazard quotient greater than one was calculated for an inhalation pathway. Non-VOC constituents detected at greater than 2% frequency and volatile constituents above background but with no associated risk or hazard were compared to COCs in ground water. If a non-VOC constituent (or a VOC constituent above background but with no associated risk or hazard) detected in surface water is present as a COC in ground water, that contaminant will be addressed in ground water remedial alternatives. The contaminant is not considered to be a COC in surface water if either: (1) no complete exposure pathway exists for non-VOC contaminants, or (2) no risk or hazard is associated with the volatile contaminant.

Summaries of the COCs by environmental media and OU are given in Tables 2.5-1 through 2.5-4.

2.5.4.2. Sources of Contamination

As described in Section 2.2, past operations at Site 300 caused contaminants to be released to the environment. Historical information and analytic data have been used to identify the nature and extent of anthropogenic contamination in environmental media. These data were used to identify COCs and support contaminant fate and transport modeling and baseline risk analyses. The release sites are shown in Figure 2.4-1.

2.5.4.3. Nature and Extent of Contamination in Soil and Rock

Surface (0- to 0.5-ft depth) and subsurface (below 0.5-ft depth) soil and bedrock samples were collected and analyzed for a variety of chemicals and radionuclides.

COCs in surface and subsurface soil and the historical maximum concentration or activity by OU are presented in Tables 2.5-1 and 2.5-2, respectively.

2.5.4.4. Nature and Extent of Contamination in Surface Water

Surface water samples have been analyzed for a variety of chemicals and radionuclides, including tritium, uranium, metals, perchlorate, nitrate, and VOCs.

COCs in surface water and the historical maximum concentration or activity by OU are presented in Table 2.5-3.

2.5.4.5. Nature and Extent of Contamination in Ground Water

As discussed in Section 2.5.3.2, ground water has been encountered in multiple hydrogeologic units beneath Site 300. LLNL has installed more than 680 ground water monitor wells throughout Site 300 since environmental investigations began in 1981. Ground water samples from these wells have been analyzed for a variety of chemicals and radionuclides.

COC isoconcentration contour maps and maps posting COC concentration data based on sampling and analysis performed during 2006 are presented for OUs 2 through 8 in Figures 2.5-4 through 2.5-11 and are discussed below.

- Building 834 OU: The distribution of VOCs, TBOS/TKEBS, and nitrate (Figure 2.5-4) in ground water is restricted to a perched zone of limited lateral extent in the Tpsg and Tps-$Tnsc_2$ units. There has been no impact on the underlying $Tnbs_1$ regional aquifer.
- Pit 6 Landfill OU: VOCs, tritium, perchlorate and nitrate have been identified within the Qt-$Tnbs_1$ HSU. Figure 2.5-5 shows the distribution of VOCs and nitrate above cleanup standards in ground water. Tritium activities are well below the cleanup standard and continue to decrease towards background levels. Perchlorate is not currently detected in ground water. Therefore, tritium and perchlorate are not depicted in the figure. The extent of contamination at the Pit 6 Landfill is limited with concentrations near and below cleanup standards. Data from guard wells indicate that there is no contamination offsite.
- HE Process Area OU: Most ground water contamination at the HE Process Area OU is present in the $Tnbs_2$ HSU (Figure 2.5-6). VOCs, perchlorate, and nitrate have been detected in perched ground water in the $Tnsc_{1b}$ HSU beneath the former Building 829 HE Burn Pit and Waste Accumulation Area, located in the northwest portion of the HE Process Area OU. TCE, HE compounds (RDX, HMX, and 4-amino-2,6-dinitrotoluene), and perchlorate have been detected in the Tpsg sands and gravels of the Tpsg-Tps HSU in the vicinity of Building 815, although wells in this area have recently been dry. No contamination has been detected in the Tps portion of the Tpsg-Tps HSU, or the upper and lower $Tnbs_1$ HSUs in the HE Process Area OU.
- Building 850 Firing Table: Tritium, perchlorate, uranium, and nitrate (Figure 2.5-7) have been identified within the Qal/WBR and $Tnbs_1$/$Tnbs_0$ HSUs. Uranium is not depicted on the figure because it is not detected above the 20 picoCuries per liter (pCi/L) Maximum Contaminant Level (MCL) in the Building 850 Firing Table area of OU 5. Tritium activities in ground water in the OU continue to decline.
- Pit 7 Complex: Tritium, perchlorate, VOCs, uranium, and nitrate (Figure 2.5-8) have been identified within the Qal/WBR and $Tnbs_1$/$Tnbs_0$ HSUs. VOCs are not shown on the figure because concentrations are currently below cleanup standards and are decreasing towards background levels. Tritium activities in ground water in the OU continue to decline.
- Building 854 OU: VOCs, nitrate, and perchlorate (Figure 2.5-9) have been identified in the $Tnbs_1$/$Tnsc_0$ HSU.
- Building 832 Canyon OU: VOCs, nitrate, and perchlorate (Figure 2.5-10) have been identified primarily in the $Tnsc_{1a}$, $Tnsc_{1b}$ and Qal/WBR HSUs. Contaminants have also been detected at low concentrations in the $Tnbs_2$ and Upper $Tnbs_1$ HSUs. Total VOC isoconcentration data are posted for the Qal/WBR and $Tnsc_{1a}$ and contoured for the $Tnsc_{1b}$ and Upper $Tnbs_1$ HSUs.
- Building 801/Pit 8 Landfill: VOCs, nitrate, and perchlorate were identified as COCs in the $Tnbs_1$/$Tnbs_0$ HSU ground water due to the past releases from the Building 801 Dry Well. However, VOC and nitrate concentrations are currently below cleanup standards

or background levels. Perchlorate is not currently detected in ground water. No contaminant releases have been identified from the Pit 8 Landfill.

- Building 833: Spills, earthen disposal pits and rinsewater disposal at Building 833 resulted in minor VOC contamination of perched ground water in the Tpsg HSU (Figure 2.5-11). The Tpsg HSU is a shallow, highly ephemeral perched water-bearing zone. During heavy rainfall events, this HSU may become saturated, but quarterly monitoring of the wells from 1993 to 2004 has shown little evidence of saturation. The underlying $Tnbs_1$ regional aquifer has not been impacted.
- Building 845 Firing Table and Pit 9 Landfill: There are no COCs in ground water at Building 845 and the Pit 9 Landfill, as no ground water contamination has been detected.
- Building 851 Firing Table: A small amount of uranium contamination exists in ground water in the Qal-Tmss hydrogeologic unit at activities below the cleanup standard.
- Pit 2 Landfill: The overall distribution of ground water tritium activities in the Pit 2 Landfill area appears to primarily be a result of transport of the Building 850 tritium plume into the Pit 2 Landfill area. While it is possible that some tritium may have been released to ground water from the Pit 2 Landfill, data indicate that tritium activities in ground water immediately downgradient of the landfill are decreasing and are currently a fraction of the historic maxima and cleanup standard. The detection of depleted uranium in the ground water indicates that low activities of depleted uranium have been added to the naturally-occurring uranium in the ground water by the Pit 2 Landfill. The release may have been the result of the discharge of potable water that was used to maintain a wetland habitat for red-legged frogs (a Federally-listed endangered species) within a drainage channel that extends along the northern and eastern margin of the Pit 2 Landfill. This discharge was discontinued in 2005. Uranium activities detected in $Tnbs_1$/$Tnbs_0$ HSU ground water samples from the Pit 2 Landfill monitor wells are historically below the MCL of 20 pCi/L and are decreasing. No other contaminants have been released from the landfill.

COCs in ground water and the historical maximum concentration or activity by OU are presented in Table 2.5-4.

2.6. Current and Potential Future Site and Resource Uses

2.6.1. Current Onsite Land Uses

Site 300 is a federal facility owned by the U.S. DOE that is used to conduct research, development, and testing associated with high explosives materials. This work includes explosives processing, preparation of new explosives, and pressing, machining, and assembly of explosives components. Site 300 activities also include hydrodynamic testing for verifying computer simulation results, obtaining equation-of-state data for explosives materials, evaluating material behavior at assembly joints and welds, evaluating the quality and uniformity of implosion, and evaluating the performance of experimental test design modifications. For this reason, the land use at Site 300 is designated as industrial/Federal materials and research testing.

Access to Site 300 is restricted and DOE control of the site is expected to continue for the foreseeable future.

2.6.2. Reasonably Anticipated Future Onsite Land Use

LLNL Site 300 is a federal facility owned by the DOE and operated by the Lawrence Livermore National Security, Limited Liability Corporation that is currently used as an experimental test facility to support the Department's mission of research, development, and testing of HE materials. While DOE is evaluating the consolidation of activities throughout the DOE complex that could result in changes to activities conducted at Site 300, DOE control of the site is expected to continue for the foreseeable future. There are no plans to open the land for recreational or residential uses. Provisions in the Site 300 FFA and in law assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. Because of DOE's current intentions and these assurances, non-DOE land uses for Site 300 have not been considered in any future land use assumptions. Although DOE may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through another means, DOE shall retain ultimate responsibility for remedy integrity.

The Site 300 Federal Facility Agreement provides:

"Per Section 28.1 of the FFA, DOE shall retain liability in accordance with CERCLA, not withstanding any change in ownership or possession of the real property interests comprising the Federal Facility. DOE shall not transfer any real property interests comprising the Federal Facility except in compliance with Section 120(h) of CERCLA, 42 U.S.C. § 9620 (h)."

CERCLA Section 120 (h) provides:

"Section (3) (A) . . . in the case of any real property owned by the United States on which any hazardous substance was stored for one year or more, known to have been released, or disposed of, each deed entered into for transfer of such property by the United States to any other person or entity shall contain –

(ii) a covenant warranting that

(I) all remedial action necessary to protect human health and the environment with respect to any such substance remaining on the property has been taken before the date of such transfer, and

(II) any additional remedial action found necessary after the date of such transfer shall be conducted by the United States.

[or](C)(i)... the Administrator or Governor, as the case may be, determines that the property is suitable for transfer, based on a finding that –

(I) the property is suitable for transfer for the use intended by the transferee, and the intended use is consistent with protection of human health and the environment; …"

Institutional and land use control to prevent exposure to contamination at Site 300 are discussed in detail in Section 2.9.1.2.

If the property is transferred in the future, DOE will execute a land use covenant at the time of transfer in compliance with Title 22 California Code of Regulations (CCR), Division 4.5, Chapter 39, Section 67391.1. A Memorandum of Understanding between DOE and DTSC will be prepared to document this agreement.

2.6.3. Current Offsite Land Use

Current land use distribution in the vicinity of Site 300 is shown in Figure 2.6-1. Major users of land surrounding Site 300 include:

- Carnegie State Vehicular Recreation Area, an outdoor recreational facility operated by the California Department of Parks and Recreation for riding and racing private and commercial off-road motorcycles and four-wheel drive vehicles.
- SRI International, a private firm that operates an explosives test site in the hills south of the Carnegie State Vehicular Recreation Area.
- The Gallo and Connolly Ranches that are located south of Site 300 and used primarily for cattle grazing.
- Fireworks America, a private firm that operates a fireworks storage facility adjacent to the eastern border of Site 300.
- California Department of Fish and Game ecological reserve located east of Site 300 that currently allows no public access.
- Range land owned by the Mulqueeney, Yroz, and Vieira families immediately north and northwest of Site 300. This land and smaller parcels to the west are used primarily for cattle grazing and are generally absentee ownership.
- Privately owned land northeast of Site 300 where future residential development is planned (Tracy Hills Development).
- Wind turbine generators located north of Site 300.

2.6.4. Reasonably Anticipated Future Offsite Land Use

Site 300 was originally selected as a DOE experimental test site because of the sparsely populated surrounding area. On the basis of residential population, the average density around the perimeter of Site 300 is less than one person per square mile.

Tracy is the closest city to Site 300, located northeast of Site 300. Tracy's location near three interstate (I) freeways (I-580, I-205, and I-5) and railroad lines make it an important warehousing and distribution center. Tracy's population is growing rapidly. In January 1992, the population was 38,000. Commuters moving from the San Francisco and East Bay metropolitan areas in search of affordable housing have increased Tracy's population to approximately 80,500 by 2006. Increased development throughout the Central Valley has become a major concern to area residents, as prime agricultural land is converted to housing, retail, and industrial space. Developers are now locating housing projects in the hilly regions (such as the area surrounding Site 300), to avoid the agricultural versus housing conflict. The Tracy Hills housing project, with a projected population of 28,000 people, is planned for development. This planned housing project is located on property adjacent to the northeast portion of Site 300. The Tracy Hills Specific Plan - Draft Environmental Impact Report prepared by Tracy Hills Development in 1997 for the City of Tracy proposes to designate land adjoining the east portion of the Site 300 north border and the northern portion of the Site 300 east border as open space. The open space would create a buffer of approximately 1 to 1.5 miles in width between Site 300 and residential elements of the development. According to this EIR, the buffer zone would be used for cattle or sheep grazing, and would have limited access points at existing trails for hikers, mountain bicyclists, and equestrians.

2.6.5. Current Ground and Surface Water Uses

At Site 300, ground water is used for a variety of needs including cooling towers, HE processing, and fire suppression. Bottled water is the primary source of onsite drinking water, however potable ground water is available from onsite water-supply Well 20, located in the southeast part of OU 4. This well is screened in the Lower $Tnbs_1$ bedrock HSU at a depth of 387 to 518 ft below ground surface (bgs). Although several nearby ground water monitor wells screened in the shallower $Tnbs_2$ HSU contain TCE, TCE has not been detected in Well 20 because it is sealed through the shallow aquifer. The use of Well 18, also located in the southeast part of OU 4, as a water-supply well was placed on standby due to sporadic detections of TCE in samples from this well. Although Well 18 is inactive, it is considered a backup well to supply water for emergency fire suppression. There is no current onsite use of surface water by humans. The California RWQCB-Central Valley Region's Water Quality Control Plan (Basin Plan) establishes beneficial uses and water quality objectives for ground water and surface waters in the Central Valley region. State Water Resources Control Board (SWRCB) Resolution No. 88-63 specifies that all surface and ground waters of the State are considered suitable or potentially suitable, for municipal or domestic water-supply with the following exceptions: (1) those water bodies with yields below 200 gallons per day (gpd), (2) total dissolved solids exceeding 3,000 mg/L, or (3) contamination that cannot reasonably be treated for domestic use by either best management practices or best economically achievable treatment practices. Ground water wells at and in the vicinity of Site 300 yield approximately 100 to over 200,000 gpd and contain total dissolved solids at concentrations ranging from 300 to 2,000 mg/L. The ground water at Site 300 commonly contains naturally occurring selenium and arsenic above MCLs (Webster-Scholten, 1994). However, in the absence of a Basin Plan Amendment excluding certain ground water bodies, all ground water below Site 300 and adjacent properties is presumed potentially suitable for municipal or domestic supply.

Offsite, ground water is currently used for dust and fire suppression, livestock watering, and irrigation. Some offsite water-supply wells are also used for domestic purposes and as a drinking water source. The locations of these wells are shown in Figure 2.4-2.

DOE/LLNL collect monthly samples from offsite water-supply wells for analyses of contaminants that could potentially impact these wells. Low concentrations (less than 4 μg/L) of VOCs have been sporadically detected in privately-owned offsite wells Gallo-1 and CDF-1 and the owners of these wells are aware of these impacts. VOC contamination has not been detected in well CDF-1 for several years. While VOCs continue to be periodically detected in Gallo-1 at concentrations slightly above the analytical detection limit, this well is not used as a drinking water-supply.

Surface water in the 25 springs located throughout Site 300 (Figure 2.5-1) is not used for water-supply or other human uses at the site. Some of these springs provide wetland habitat for wildlife. Surface water from an offsite pond at the Carnegie State Vehicular Recreation Area Park is used for fire suppression. This pond is primarily replenished by ground water from well CARNRW-1.

2.6.6. Potential Ground and Surface Water Uses

While DOE does not anticipate significant changes in ground water or surface water use at Site 300 in the near future, it has agreements and plans in place to use Hetch-Hetchy water. When this occurs, Well 18 and/or Well 20 will likely be retained as backup water-supply wells for possible use in dust and/or fire suppression. Institutional controls are in place to prevent the drilling of water-supply wells in contaminated areas of Site 300 (Table 2.9-13).

There are plans to develop the land parcel to the east of Site 300 for residential housing (Figure 2.6-1), but DOE has been informally informed by the developer that the water-supply for this development would not be ground water.

2.7. Summary of Site Risks

This section summarizes the results of the baseline risk assessment conducted to evaluate risks to human and ecological receptors that may be exposed to contaminants in soil, air, surface water, or ground water from Site 300 if no remedial actions were implemented. Additional details may be found in the Site-Wide Remediation Investigation, the Building 850 Site-Wide Remediation Investigation Addendum (Taffet et al., 1996), the Building 832 Canyon Characterization Summary Report (Ziagos and Ko, 1997), the Building 854 Characterization Summary Report (U.S. DOE, 1998), the Site-Wide Feasibility Study, and the Pit 7 Complex Remedial Investigation/Feasibility Study.

2.7.1. Basis for Action

The response actions selected in this Site-Wide ROD are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances from this site.

The baseline risk assessment evaluated potential present and future public health and ecological risks associated with environmental contamination from Site 300 using the assumption that no cleanup or remediation activities would take place at the site. The baseline risk assessment provides the basis for implementing a remedial action and identifies the potential exposure pathways that need to be addressed. Selection of a cleanup action was based in part on the extent to which it can reduce human and ecological risks.

Tables 2.5-1 through 2.5-4 list the Site 300 COCs addressed in this Site-Wide ROD, along with the historical maximum concentrations/activities.

2.7.2. Human Health Risks

The human health baseline risk assessment presented in the Site-Wide Remediation Investigation report consists of six components:

1. Identification of contaminants of potential concern.
2. Identification of the contaminated environmental media and exposure pathways.
3. Estimation of potential exposure-point concentrations of contaminants.
4. Human exposure and dose assessment.
5. Toxicity assessment.

6. Risk characterization.

Figure 2.7-1 shows the conceptual site risk and hazard evaluation model for Site 300. It includes the primary sources, release mechanisms, pathways, exposure routes, and receptors.

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to a carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI × SF

where:

risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer.

CDI = chronic daily intake averaged over assumed exposure period (milligrams per kilograms per day [mg/kg-day]).

SF = slope factor, expressed as $(\text{mg/kg-day})^{-1}$.

Risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess lifetime risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to ultraviolet radiation. U.S. EPA requires that cancer risks above one in one million must be addressed by various risk controls and/or remedial actions.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level to which an individual may be exposed that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all COCs that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium, or across all media to which a given individual may reasonably be exposed. An HI less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health. The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where:

CDI = Chronic daily intake.

RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Baseline human health risks and hazards for Site 300 were estimated using industrial adult onsite exposure and offsite residential exposure scenarios. The adult onsite exposure scenario estimates health risk where an adult is assumed to work in the immediate vicinity of worst-case contamination 8 hours a day, 5 days per week, for 25 years. The residential exposure scenario estimates the risk to a family living adjacent to the site with people drinking contaminated ground water or inhaling vapors volatilizing from contaminated surface water over a 30-year period. The risks associated with ingestion of ground water were calculated for residents drinking water from hypothetical wells at the site boundary and from existing private wells near the site. However, no members of the public are currently being exposed to any contaminants from Site 300.

Risk estimates for most release sites and contaminants were well below the protective 1×10^{-6} threshold designated by the U.S. EPA. Onsite worker risks above this threshold were generally associated with: (1) workers inhaling VOCs volatilizing from the subsurface or surface water, (2) direct skin contact and incidental ingestion of PCBs, dioxins, and furans in the soil, and (3) inhalation of tritiated water evaporating from subsurface soil by onsite workers in the vicinity of the Pit 3 Landfill. Risks greater than 10^{-6} and HIs greater than 1 are listed in Table 2.7-1.

A risk for direct exposure to contaminants in the pit waste could not be calculated due to safety restrictions on penetrating landfill waste. Institutional and land use controls discussed in Section 2.9.1.2, based on the potential exposure to contaminants in pit waste, assume that the waste contaminants may pose a risk to human health. Table 2.7.1 contains a summary of human health risks and hazards.

Human health risks for the OUs addressed in this Site-Wide ROD are summarized in the following sections.

2.7.2.1. Summary of Human Risks for the Building 834 OU (OU 2)

The baseline human health risk assessment estimated a cancer risk of 1×10^{-3} (one in one thousand) with an HI of 36 for onsite workers inhaling VOC vapors volatilizing from the subsurface and migrating into indoor air at Building 834D. A cancer risk of 6×10^{-4} (six in ten thousand) with an HI of 22 for onsite workers inhaling VOC vapors volatilizing from the vadose zone into outdoor air in the vicinity of Building 834D was also estimated.

The risks and HIs associated with VOCs in subsurface soil at Building 834D have been re-evaluated annually since 2003 as part of the Risk and Hazard Management Program. Soil vapor extraction at Building 834 has contributed to reducing the human health risk due to inhalation of VOC vapors outside Building 834D to a level that is no longer of concern (less than 10^{-6}) (Dibley et al., 2005). Although Building 834D indoor air continues to present an unacceptable risk (3×10^{-6}), the HI is less than 1 (HI of 0.63), therefore potential toxic noncarcinogenic effects have been eliminated and carcinogenic risk is being reduced. Building 834D continues to be used only for storage and institutional controls are in place to prevent human exposure.

2.7.2.2. Summary of Human Risks for the Pit 6 Landfill OU (OU 3)

The baseline risk assessment estimated a cancer risk of 5×10^{-6} (five in one million) with an HI less than 1 for onsite worker inhaling VOC vapors volatilizing from the landfill and migrating into outdoor air. The landfill cap, installed as part of a CERCLA removal action in 1997, mitigates this inhalation risk.

A cancer risk of 4×10^{-5} (four in one hundred thousand) with an HI of 1.5 was identified for onsite workers inhaling VOC vapors from surface water at Spring 7. Since this spring has been dry since 1992, there is currently no potential for VOC inhalation. In addition, Spring 7 is fed by ground water and VOC concentrations in ground water in the Pit 6 Landfill area have decreased significantly. Therefore DOE/LLNL assume that if surface water were present in this spring, the risk associated with the inhalation of VOCs has likely been reduced. The spring is and will continue to be monitored for the presence of surface water or green hydrophilic vegetation, and if either is observed, ambient air in the vicinity of the spring will be sampled to evaluate risk.

The baseline risk assessment also identified a cancer risk of 3×10^{-6} (three in one million) with an HI of less than 1 for offsite residents inhaling TCE volatilizing from the State Vehicular Recreation Area residence pond located east of the landfill. This risk scenario assumed no cleanup actions would be taken and that VOCs would migrate to the water-supply wells CARNRW-1 and CARNRW-2 used to fill the pond. However, VOCs have not migrated to the water-supply wells, the landfill cap was installed to prevent further releases of VOCs, and ground water TCE concentrations upgradient have substantially decreased.

2.7.2.3. Summary of Human Risks for the HE Process Area OU (OU 4)

The baseline risk assessment estimated a cancer risk of 5×10^{-6} (five in one million) with an HI of less than 1 for onsite workers inhaling VOC vapors volatilizing from the subsurface and migrating into outdoor ambient air in the vicinity of Building 815. The risk associated with VOCs in subsurface soil in the vicinity of Building 815 has been re-evaluated annually since 2003 as part of the Risk and Hazard Management Program. Ground water extraction at Building 815 has contributed to reducing the human health risk due to inhalation of VOC vapors outside Building 815 to a level that is no longer of concern (less than 10^{-6}) (Dibley et. al., 2005).

A cancer risk of 1×10^{-5} (one in one hundred thousand) with an HI of less than 1 was also estimated for onsite workers inhaling TCE and 1, 1-dichloroethlyene (1,1-DCE) volatilizing from surface water at Spring 5. DOE/LLNL were unable to re-evaluate VOC inhalation risk to onsite workers at Spring 5 due to lack of water in this spring. However, the baseline risk was calculated from VOC concentrations in well W-817-03A located adjacent to Spring 5, since the actual flow in the spring is generally too low to measure and the spring consists primarily of moist soil with wetland vegetation. No one regularly works in the vicinity of Spring 5 and VOC concentrations in ground water that feeds the spring have decreased from 150 μg/L in 1987 to 43 μg/L in 2006. Therefore, the cancer risk estimated in the baseline risk assessment has decreased correspondingly. In addition, more than half of the estimated risk resulted from the presence of 1,1-DCE that was detected once in 1987 in ground water sampled from well W-817-03A. The spring is and will continue to be monitored for the presence of surface water or green hydrophilic vegetation, and if either is observed, ambient air in the vicinity of the spring will be sampled to evaluate risk.

A cancer risk of 1×10^{-5} (one in one hundred thousand) with an HI of less than 1 was estimated for offsite residents ingesting contaminated ground water from a hypothetical well located at the Site 300 boundary. This risk was based on modeling of offsite migration of contaminated ground water in the absence of ground water remediation. Ground water extraction and treatment began in 1999 immediately upgradient of the site boundary to prevent offsite contaminant migration. As a result of onsite ground water remediation efforts, contaminant concentrations in upgradient ground water have substantially decreased since the baseline risk assessment was performed.

2.7.2.4. Summary of Human Risks for the Building 850 Firing Table (OU 5)

The baseline risk assessment performed for the Building 850 Firing Table area estimated a cancer risk of 5×10^{-4} (five in ten thousand) for onsite workers from inhaling/ingesting resuspended particulates and direct dermal contact with surface soil contaminated with PCBs and a cancer risk of 1×10^{-4} (one in ten thousand) was estimated for onsite workers from inhaling/ingesting resuspended particulates and direct dermal contact with surface soil contaminated with chlorinated dibenzo-p-dioxins (CDDs) and dibenzofurans (CDFs). The baseline risk assessment also estimated a cancer risk of 1 x 10^{-3} (one in one thousand) for onsite workers from inhaling/ingesting tritium in surface water at Well 8 Spring.

These risks were calculated based on the assumption that a worker spends 8 hours a day, 5 days a week for 25 years exposed to contamination. However, no workers actually spend this amount of time in the contaminated areas. There was no unacceptable risk identified for offsite residents.

2.7.2.5. Summary of Human Risks for Pit 7 Complex (OU 5)

The risk assessment performed for the Pit 7 Complex estimated a cancer risk of 4 x 10^{-6} (four in one million) for onsite workers inhaling tritiated water evaporating from subsurface soil in the vicinity of the Pit 3 Landfill.

The risk was calculated based on the assumption that a worker spends 8 hours a day, 5 days a week for 25 years exposed to contamination. However, no workers actually spend this amount of time in the contaminated area. In addition, radioactive decay continues to reduce the mass of tritium in subsurface soil at the Pit 3 Landfill, thereby reducing the flux of tritium vapors to air. The risk to onsite workers for inhalation of tritium vapors from the Pit 3 Landfill was recalculated, accounting for tritium decay that occurred between 1992 and 2007, for the Pit 7 Complex Remedial Design Document (Taffet et al., 2007 [draft]). A risk of 8 x 10^{-7} was estimated for a worker spending 8 hours a day, 5 days a week for 25 years at the Pit 3 Landfill. There is no longer an unacceptable risk to onsite worker health posed by contaminants in the Pit 7 Complex area. No unacceptable risk was identified for offsite residents.

2.7.2.6. Summary of Human Risks for the Building 854 OU (OU 6)

Cancer risks of 1×10^{-6} (one in one million) and 9×10^{-6} (nine in one million) were estimated for onsite workers inhaling VOC vapors volatilizing from the subsurface and migrating into indoor air at Buildings 854A and 854F, respectively. A cancer risk of 1×10^{-5} (one in one hundred thousand) was estimated for onsite workers inhaling VOC vapors volatilizing from the subsurface and migrating into outdoor air at Building 854F. These risks were based on VOCs detected in ambient air sampling in 1996 (Ziagos and Reber-Cox, 1998). HIs were not calculated. The risks associated with VOCs in subsurface soil at Buildings 854A and 854F have been re-evaluated and the HIs have been calculated annually since 2003 as part of the Risk and Hazard Management Program. Ground water extraction in the OU has contributed to reducing the human health risk due to inhalation of VOC vapors outside Building 854F and inside

Building 854A to levels that are no longer of concern (less than 10^{-6}) (Dibley et al., 2005 and Dibley et al., 2007a). Building 854F was demolished in 2005, and therefore no longer presents an indoor air VOC inhalation risk.

A cancer risk of 7×10^{-5} (seven in one hundred thousand) was also estimated for onsite workers ingesting and direct dermal contact with PCB-contaminated soil. In 2005, PCB-, dioxin-, and furan-contaminated surface and shallow subsurface soil from the former Building 855 lagoon was excavated and disposed, mitigating the unacceptable cancer risk for onsite workers (Holtzapple, 2005).

2.7.2.7. Summary of Human Risks for the Building 832 Canyon OU (OU 7)

A cancer risk of 3×10^{-6} (three in one million) was estimated for onsite workers inhaling VOC vapors volatilizing from the subsurface and migrating into indoor air at Buildings 830 and 832F. A cancer risk of 1×10^{-5} (one in one hundred thousand) was estimated for onsite workers inhaling VOC vapors volatilizing from the subsurface and migrating into outdoor air at Building 830. These risks were calculated using data from ambient air samples collected within Building 830 (Ziagos and Ko, 1997). HIs were not calculated. The risks associated with VOCs in subsurface soil at Buildings 830 and 832F have been re-evaluated and the HIs have been calculated annually since 2003 as part of the Risk and Hazard Management Program. Ground water and soil vapor extraction in the OU has contributed to reducing the human health risk due to inhalation of VOC vapors outside Building 830 and inside Building 832F to levels that are no longer of concern (less than 10^{-6}) (Dibley et al., 2005). VOCs that could volatilize into air inside Building 830 continue to present an unacceptable risk to onsite workers. However, institutional controls are in place and the building is not occupied full-time. This building is scheduled for decontamination and demolition.

The baseline risk assessment estimated a cancer risk of 7×10^{-5} (seven in one hundred thousand) with an HI of 2.3 for onsite workers inhaling VOCs volatilizing from surface water at Spring 3 to ambient air. DOE/LLNL were unable to re-evaluate VOC inhalation risk to onsite workers at Spring 3 due to lack of water in this spring since 2004. There are no site employees that regularly work in the vicinity of Spring 3. The spring is and will continue to be monitored for the presence of surface water or green hydrophilic vegetation, and if either is observed, ambient air in the vicinity of the spring will be sampled to evaluate risk.

2.7.2.8. Summary of Human Risks for the Building 801 Dry Well and Pit 8 Landfill (OU 8)

In the baseline risk assessment, no unacceptable risks or hazards associated with contaminants in surface soil, subsurface soil/bedrock, or ground water were identified for the Building 801 dry well or Pit 8 Landfill. There is no evidence of new releases or contamination that warrant re-evaluation of risk.

2.7.2.9. Summary of Human Risks for the Building 833 (OU 8)

The baseline risk assessment for the Building 833 area estimated a cancer risk of 1×10^{-6} (one in one million) with an HI less than 1 for onsite workers inhaling VOC vapors volatilizing from the subsurface and migrating into indoor air at Building 833. These risks have been re-evaluated annually since 2003 as part of the Risk and Hazard Management Program. The 2006 re-evaluation indicated that Building 833 indoor air levels are no longer of concern (less than 10^{-6}) (Dibley et al., 2007a). The risk will be re-evaluated until it remains below 1 x 10^{-6} for two consecutive years. Engineering controls consisting of enhanced ventilation/positive pressure are in place to prevent infiltration and buildup of VOC vapors inside Building 833 that could result in an unacceptable exposure risk to workers in this building.

2.7.2.10. Summary of Human Risks for the Building 845 Firing Table and Pit 9 Landfill (OU 8)

No unacceptable risks or hazards associated with contaminants in surface soil, subsurface soil/bedrock, or ground water were identified for the Building 845 Firing Table or the Pit 9 Landfill in the baseline risk assessment. There is no evidence of new releases or contamination that warrant re-evaluation of risk.

2.7.2.11. Summary of Human Risks for the Building 851 Firing Table (OU 8)

No risk or hazard associated with contaminants in surface soil, subsurface soil/bedrock, or ground water was identified for the Building 851 Firing Table area in the baseline risk assessment. Total uranium activities in ground water have always been well below the 20 pCi/L MCL and at similar levels to those at which uranium naturally occurs in ground water in this area. The water-bearing zone in the Building 851 Firing Table area that is affected by the contamination is not used for drinking water. No unacceptable risk or hazard to human health was identified for VOCs, uranium, RDX, cadmium, copper, and zinc in surface or subsurface soil/rock. Ground water data do not indicate any new sources, releases, or contaminants in the Building 851 Firing Table area.

2.7.2.12. Summary of Human Risks for the Pit 2 Landfill (OU 8)

No unacceptable risks or hazards associated with contaminants in surface soil, subsurface soil/bedrock, or ground water were identified for the Pit 2 Landfill in the baseline risk assessment. Although there is evidence of a possible a new release of depleted uranium from the landfill, re-evaluation of risk is not warranted because total uranium activities are below the cleanup standard and are decreasing, and there is no threat of impacts to water-supply wells.

2.7.3. Ecological Hazard Assessment

The Site 300 baseline ecological assessment performed during the Site-Wide Remedial Investigation evaluated the potential for adverse impact to plants and animals from long-term exposure to contaminants and focused on potential reproductive damage and reductions in reproductive life span rather than the risk of developing cancer.

The ecological risk assessment identified potential impacts to several animal species that could potentially visit or migrate into contaminated areas at Site 300. Table 2.7-2 summarizes ecological hazards identified for each OU.

Ecological hazards for the OUs addressed in this Site-Wide ROD are summarized in the following sections.

2.7.3.1. Summary of Ecological Hazards for the Building 834 OU (OU 2)

The baseline ecological assessment determined that individual juvenile ground squirrels and individual kit fox are at risk from inhalation of TCE and tetrachloroethylene (PCE) (the combined inhalation HI exceeded 1 for these species) and individual adult ground squirrels, kit fox and deer are also at risk from ingestion of cadmium. The combined oral and inhalation pathway HQ exceed 1 for these species, which was driven by the oral pathway.

Surface soil sampling and analysis for cadmium conducted in 2003 indicated that the ecological hazard associated with cadmium in surface soil at Building 834 identified in the baseline ecological assessment was no longer present. The baseline ecological hazard was based on a detection of cadmium in one surface soil sample. In 2003, 24 additional surface soil sampling were collected at Building 834. Cadmium concentrations in all of these surface soil samples were below the detection limit, including samples collected near the location where cadmium had previously been detected. Therefore cadmium was deleted from the list of ecological COCs and will no longer be evaluated and reported in the Compliance Monitoring Reports. Details of the 2003 soil sampling and cadmium analysis were presented in the 2003 Annual Compliance Monitoring Report (Dibley, 2004a).

A burrow air-sampling program was conducted in 2004 to determine current exposure concentrations. The results of the ecological survey program reported in the First Semester 2004 Compliance Monitoring Report (Dibley, 2004b) indicated that burrow air did not contain VOCs at concentrations that would result in a hazard index or quotient greater than 1. Since there is no potential for ecological harm, VOCs in burrow air have been deleted from the list of ecological COCs and will no longer be evaluated and reported in the Compliance Monitoring Reports.

2.7.3.2. Summary of Ecological Hazards for the Pit 6 Landfill OU (OU 3)

The baseline ecological assessment indicated an inhalation risk for individual ground squirrels and kit fox from VOCs volatilizing from the Pit 6 Landfill (the combined inhalation HI exceeded 1 for these species). An engineered layer was installed as part of the landfill cap to prevent exposure of squirrels and kit fox to contaminants in the landfill.

A burrow air sampling program was conducted in 2004 to determine current exposure concentrations. The results of the ecological survey program reported in the First Semester 2004 Compliance Monitoring Report indicated that burrow air did not contain VOCs at concentrations that would result in a hazard index or quotient greater than 1. Since there is no potential for ecological harm, VOCs in burrow air have been deleted from the list of ecological COCs and will no longer be evaluated and reported in the Compliance Monitoring Reports. In addition, surveys for sensitive species at the Pit 6 Landfill has been discontinued. (Note: kit foxes have never been observed in any ecological surveys at Site 300 or by Site 300 personnel working at the site. Risk for this sensitive species was evaluated due to the presence of potential habitat at Site 300.)

2.7.3.3. Summary of Ecological Hazards for the HE Process Area OU (OU 4)

The baseline ecological assessment determined a risk from copper and cadmium existed for aquatic organisms, ground squirrels, and deer. Aquatic organisms are at risk from copper in shallow ground water at a location designated as Spring 5. The Toxicity Quotient using

California Applied Action Levels exceeded 1 for copper in ground water samples from this location. Individual adult ground squirrels and individual adult and juvenile deer are at risk from ingestion of cadmium. The combined oral and inhalation pathway HQ exceed 1 for these species, which was driven by the oral pathway. Surveys for the presence of surface water at Spring 5, and algae and micro-invertebrate bioassays conducted to identify the true risk to aquatic organisms found no current adverse impact. Similarly, site-wide population surveys to identify the current risk to deer and ground squirrels found no adverse impacts.

2.7.3.4. Summary of Ecological Hazards for the Building 850 Firing Table (OU 5)

The baseline ecological assessment determined a risk from copper, zinc, cadmium and PCBs/CDDs/CDFs existed for ground squirrels, deer and kit fox at Building 850. Individual adult ground squirrels and individual adult and juvenile deer are at risk from ingestion of cadmium. The combined oral and inhalation pathway HQ exceeded 1 for these species, which was driven by the oral pathway. Individual ground squirrels, deer and kit fox were determined to be at risk from PCBs/CDDs/CDFs due to the capacity of these contaminants to bioaccumulate in the environment. (Note: kit foxes have never been observed in any ecological surveys at Site 300 or by Site 300 personnel working at the site. Risk for this sensitive species was evaluated due to the presence of potential habitat at Site 300.)

The baseline ecological assessment also indicated that aquatic organisms are at risk from copper and zinc and individual adult ground squirrels are at risk from combined copper and cadmium at Spring 6. The Toxicity Quotient using California Applied Action Levels exceeded 1 for zinc, and exceeded 1 for copper using the Federal Ambient Water Quality criteria. Algae and micro-invertebrate bioassays conducted to identify the current risk to aquatic organisms at Spring 6 found no current impacts. Similarly, site-wide population surveys and area-specific presence/absence surveys to identify the current risk to vertebrate biota found no adverse impacts.

A preliminary exposure analysis for the Western Burrowing Owl to estimate hazard to cadmium and PCBs was completed in 2004 and reported in the First Semester 2004 Compliance Monitoring Report. Results suggest cadmium is unlikely to pose a hazard to burrowing owls nesting in the vicinity of Building 850. However, concentrations of PCBs in the soil at Building 850 may pose a hazard to burrowing owls nesting in the area, as the hazard quotient (HQ) exceeds 1. Various remedial options are currently under consideration for this area. Refinement of the owl model is being considered if necessary to evaluate the remedial options. Field surveys for the presence of important burrowing species such as Western Burrowing Owls are continuing in this area.

2.7.3.5. Summary of Ecological Hazards for the Pit 7 Complex (OU 5)

No unacceptable hazard to ecological receptors has been identified.

2.7.3.6. Summary of Ecological Hazards for the Building 854 OU (OU 6)

No unacceptable hazard to ecological receptors has been identified in the baseline ecological assessment. However, as described in 2003 Annual and First Semester 2004 Compliance Monitoring Reports, PCBs, dioxin, and furan compounds were detected in a lagoon adjacent to

Building 855. In general, the very limited extent of the PCB, dioxin and furan contamination would preclude significant ecological impact due to the limited potential for exposure. However, the lagoon does act as a water catchment during the winter months during which it may contain standing water. Both California tiger salamanders and California red-legged frogs are known to occur in springs and pools in the general vicinity of Building 854. The lagoon could provide limited habitat for either species during the winter months. The contaminated soil was removed in 2005 (Dibley et al., 2006 and Holtzapple, 2005) removing the potential for ecological risk.

2.7.3.7. Summary of Ecological Hazards for the Building 832 Canyon OU (OU 7)

No unacceptable hazard to ecological receptors has been identified.

2.7.3.8. Summary of Ecological Hazards for the Building 801 Dry Well and Pit 8 Landfill (OU 8)

The baseline ecological assessment determined a risk from cadmium existed for ground squirrels, and deer. Individual adult ground squirrels and individual adult and juvenile deer are at risk from ingestion of cadmium. The combined oral and inhalation pathway HQ exceed 1 for these species, which was driven by the oral pathway. Site-wide population surveys to identify the current risk to deer and ground squirrels found no adverse impacts.

2.7.3.9. Summary of Ecological Hazards for the Building 833 (OU 8)

No unacceptable hazard to ecological receptors has been identified.

2.7.310. Summary of Ecological Hazards for the Building 845 Firing Table and Pit 9 Landfill (OU 8)

No unacceptable hazard to ecological receptors has been identified.

2.7.3.11. Summary of Ecological Hazards for the Building 851 Firing Table (OU 8)

The baseline ecological assessment determined a risk from cadmium existed for ground squirrels, and deer. Individual adult ground squirrels and individual adult and juvenile deer are at risk from ingestion of cadmium. The combined oral and inhalation pathway HQ exceed 1 for these species, which was driven by the oral pathway. Site-wide population surveys to identify the current risk to deer and ground squirrels found no adverse impacts.

2.7.3.12. Summary of Ecological Hazards for the Pit 2 Landfill (OU 8)

No unacceptable hazard to ecological receptors has been identified.

2.8. Remedial Action Objectives

The NCP specifies that Remedial Action Objectives (RAOs) be developed which address: (1) COCs, (2) media of concern, (3) potential exposure pathways, and (4) preliminary remediation levels. The development of these goals involves evaluating ARARs and the results of the baseline human and ecological risk assessments.

RAOs for the Site 300 OUs addressed by this Site-Wide ROD are:

For Human Health Protection:

- Restore ground water containing contaminant concentrations above cleanup standards.
- Prevent human ingestion of ground water containing contaminant concentrations (single carcinogen) above cleanup standards.
- Prevent human incidental ingestion and direct dermal contact with contaminants in surface soil that pose an excess cancer risk greater than 10^{-6} or hazard index greater than 1, a cumulative cancer risk (all carcinogens) in excess of 10^{-4}, or a cumulative hazard index (all noncarcinogens) greater than 1.
- Prevent human inhalation of VOCs and tritium volatilizing from subsurface soil to air that pose an excess cancer risk greater than 10^{-6} or hazard index greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 10^{-4}, or a cumulative hazard index (all noncarcinogens) greater than 1.
- Prevent human inhalation of VOCs and tritium volatilizing from surface water to air that pose an excess cancer risk greater than 10^{-6} or hazard index greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 10^{-4}, or a cumulative hazard index (all noncarcinogens) greater than 1.
- Prevent human inhalation of contaminants bound to resuspended surface soil particles that pose an excess cancer risk greater than 10^{-6} or hazard index greater than 1, a cumulative excess cancer risk (all carcinogens) in excess of 10^{-4}, or a cumulative hazard index (all noncarcinogens) greater than 1.
- Prevent human exposure to contaminants in media of concern that pose a cumulative excess cancer risk (all carcinogens) greater than 10^{-4} and/or a cumulative hazard index greater than one (all noncarcinogens).

For Environmental Protection:

- Restore water quality to ground water cleanup standards within a reasonable timeframe and prevent plume migration to the extent technically practicable. Maintain existing water quality that complies with ground water cleanup standards to the extent technically practicable. This will apply to both individual and multiple constituents that have additive toxicology or carcinogenic effects.
- Ensure ecological receptors important at the individual level of ecological organization (listed threatened or endangered, State of California species of special concern) do not reside in areas where relevant hazard indices exceed 1.
- Ensure existing contaminant conditions do not change so as to threaten wildlife populations and vegetation communities.

There is no remedial action objective for human health protection/ARAR compliance for ingestion of surface waters (i.e., water from Site 300 springs) because there is not a complete exposure pathway for ingestion of surface waters for humans at Site 300. Humans do not drink water from Site 300 springs. In addition, the springs in which contaminants are detected do not produce a sufficient quantity of water to be used as a water-supply (greater than 200 gpd).

2.9. Description of the Selected Alternatives

The Site-Wide Feasibility Study and the Pit 7 Complex Remedial Investigation/Feasibility Study described and compared several remedial alternatives for OUs 2 through 8 against the nine EPA evaluation criteria. Based on this evaluation, DOE and the U.S. EPA selected the interim cleanup actions and the State of California RWQCB and DTSC concurred with the selection. The interim cleanup remedies for OUs 2 through 8 are documented in the 2001 Interim Site-Wide ROD and the January 2007 Amendment to the Interim Site-Wide ROD for the Pit 7 Complex. The previous Site-Wide ROD and ROD Amendment were considered interim because ground water cleanup standards were not included.

No Further Action was selected in the Interim Site-Wide ROD as the final remedies for:

- COCs in surface soil in the following locations: HE compounds in the HE Process Area OU; HMX, metals, and uranium at Building 850; HMX, metals, and tritium in the Building 854 OU; HMX in the Building 832 Canyon OU; and uranium, RDX, and metals at Building 851.
- All COCs in subsurface soil/rock in the HE Process Area, Building 850, and the Site-Wide OUs.
- Non-VOC contaminants of concern in subsurface soil/rock in the Buildings 854 and 832 Canyon OUs.

No Further Action was selected because there was no risk to human or ecological receptors, or threat to ground water associated with this contamination. Therefore, while these COCs in surface soil and subsurface soil/rock are listed in the COC tables, their remedies are not discussed further in this ROD.

All the interim remedies have been implemented with the exception of the interim remedies for the Building 850/Pits 7 Complex OU 5. Implementation of the interim remedy for the Pit 7 Complex began in 2007 and will be completed in 2008. A proposed final remedy for PCB-, dioxin-, and furan-contaminated soil is not included the Site-Wide Proposed Plan because DOE and the regulatory agencies have agreed to conduct remediation of this soil as a non-time critical removal action. As part of the removal action, DOE will evaluate a more cost-effective remedy for PCB-, dioxin-, and furan-contaminated soil in the firing table area in an Engineering Evaluation/Cost Analysis document in 2008. The remediation method to be implemented will be selected in an Action Memorandum scheduled for 2008. Public input will be solicited prior to the selection of the remedial action for this contaminated soil. Because the remediation of PCB-, dioxin-, and furan-contaminated soil in the Building 850 Firing Table area is being handled in a separate CERCLA document pathway, it is not included as part of the Building 850 remedy in this ROD.

The 2006 Site-Wide Remediation Evaluation Summary report assessed the protectiveness and effectiveness of the implemented interim remedies that were specified in the Interim ROD, identified deficiencies, and proposed changes to the interim remedies as needed to address identified deficiencies. The preferred final remedies based on this analysis and those selected in the Amendment to the Interim Site-Wide ROD for the Pit 7 Complex were presented in the Site-Wide Proposed Plan in 2007.

As agreed upon at the April 27, 2007 Remedial Project Managers meeting, this section describes the preferred final remedies and those selected in the Amendment to the Interim Site-Wide ROD for the Pit 7 Complex to address COCs for OUs 2 through 8 and a no-action alternative. A no-action alternative is required by the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response for an area, DOE would not be required to perform further remediation, monitoring, reporting, or risk management. For each area at Site 300, a no-action alternative was included as Alternative 1. There are no costs associated with the no-action alternatives. The remedial alternatives for all OUs are summarized in Tables 2.9-1 through 12. Alternative 1 is not included in the tables.

2.9.1. Common Elements of Alternatives

Sections 2.9.1.1 through 2.9.1.5 describe elements that are common to many of the alternatives.

2.9.1.1. Monitoring

Although not considered a ground water response or remedial technology, monitoring is included in all alternatives.

Monitoring consists of collecting ground and surface water samples from monitor wells and surface water bodies for chemical and radiological analyses and ground water elevation measurements.

Ground water monitoring would be conducted at all OUs to:

- Track changes in plume concentrations and size to ensure there are no impacts to downgradient receptors.
- Evaluate the effectiveness of the remedial action in controlling the contaminant sources to prevent further releases, and in reducing contaminant concentrations in ground water to meet ARARs and cleanup standards.
- Determine when ground water cleanup standards are achieved. Ground water cleanup standards are discussed in Section 2.11.4.3 and Table 2.11-1.
- Detect any future releases of contaminants from the landfills.

The monitoring network includes:

- Detection monitoring wells located along the perimeter and immediately downgradient of the landfills.
- Plume tracking wells that monitor for changes in contaminant concentrations and distribution in ground water.
- Guard wells are “clean” wells located downgradient of the distal, leading edge of the contaminant plume used to provide an early indication of plume migration into uncontaminated ground water and/or toward the Site 300 boundary.

Monitoring will include collection and analysis of ground and surface water samples for COCs. The detection monitoring program administered under RCRA to detect any future releases of contaminants from the landfills will continue. However, some modifications to the

RCRA detection monitoring program for the Pit 7 Landfill will be necessary. This is because the drainage diversion system and ground water extraction and treatment system in this area will affect the ability to monitor for contaminant releases using the statistical limit comparison method. Details of the detection monitoring program for the Pit 7 Landfill are contained in the Remedial Design for the Pit 7 Complex. Details of the monitoring program are included in the Site-Wide Compliance Monitoring Plan (CMP) (Ferry et al., 2002). The CMP is scheduled to be revised in 2009.

The monitoring program data will be presented in the Semi-Annual Compliance Monitoring Reports. In addition, these semi-annual reports will include:

- A remediation progress analysis.
- A summary of monitoring data used to determine compliance with regulatory requirements associated with the cleanup remedy.
- An assessment of the performance of the interim remedy.
- An evaluation of current contaminant concentrations and distribution.
- Identification of any performance issues.

Monitoring results will be discussed with the regulatory agencies at Remedial Project Manager's meetings. Any changes in ground water conditions will be evaluated against RAOs to ensure continued protection of human health and the environment. The Site-Wide Contingency Plan contains measures to be implemented if the remedy does not proceed as anticipated.

Consistent with the NCP, the ground water and surface water data obtained as part of the monitoring program will be reviewed at least every five years. If these data indicate that contaminant concentrations, ground water flow direction, and/or velocity have changed and significantly affect the cleanup, the monitoring program and if necessary, the selected remedial action would be re-evaluated.

2.9.1.2. Risk and Hazard Management

The goals of risk management, including institutional/land use controls, are to prevent or limit exposure to contaminants, protect the integrity of the remedy, and ensure future property use is consistent with the current industrial land use.

Risk and hazard management is included where the risk at any exposure point exceeds 1×10^{-6} or the HI is greater than 1, exclusive of ingestion of contaminated ground water. Measures to prevent ingestion of ground water are included in risk management wherever ground water contamination exists above concentrations protective of human health.

The institutional/land use controls are non-engineered actions or measures that will be used to manage risk and prevent exposure as part of the risk and hazard management program. The general types of institutional/land use controls that are used to prevent human exposure to contamination include:

- Access controls – Measures such as fences, signs, and security forces that are used to prevent exposure by controlling and/or restricting access to areas of contamination.

- Administrative controls – Measures such as pre-construction review and controls for limiting or restricting access to contaminated areas and prohibitions on water-supply well drilling.

DOE is responsible for implementing, maintaining, reporting on, and enforcing the land use controls. Tables 2.9-13 through 2.9-21 present a description of: (1) the institutional/land use control objective and duration, (2) the risk necessitating land use controls, and (3) the specific institutional/land use controls and implementation mechanisms used to prevent exposure to contamination. While a final ROD has already been signed for the GSA OU, Table 2.9-13 that lists the institutional/land use controls for this OU has been included at the request of the regulatory agencies. Figures 2.9-1 through 2.9-11 show the OUs at Site 300 where the institutional/land use controls will be implemented and maintained.

Administrative controls are the basis of most risk management measures, i.e., measures to prevent people from drinking contaminated ground water. DOE/LLNL will implement these measures to ensure that the selected remedies protect human health and the environment.

It is assumed that Site 300 will remain under the control of DOE and that the access restrictions to the site (fencing, security patrols) currently in place will continue. All remedies would be re-evaluated if transfer of ownership or change in land use is anticipated. DOE will meet its commitments in the Site 300 FFA, Sections 28 (Transfer of Real Property) and 37 (Facility Closure), regarding its cleanup obligations if property ownership and/or land use changes in the future (see Section 2.6.2 for the details of these provisions).

To ensure that human health is protected, access to Site 300 will continue to be restricted and all personnel working onsite will be briefed on areas of contamination and possible hazards. Site 300 is enclosed within a security fence, posted with signs noting the restricted access, and manned by a full-time security force to prevent unauthorized intrusion. Future property use at those areas identified in this Site-Wide ROD to have baseline cancer risks greater than 10^{-6} or non-carcinogenic hazard indices greater than 1 will be restricted to the current industrial land use, remediation activities, and surface storage of equipment or material, until such time as new risk assessments show the risk and hazard have fallen below those thresholds.

No excavation shall occur within areas of contamination or at landfills except for approved remedial actions. Activities in landfill areas will be restricted to those that will not expose landfill material or compromise the integrity and protectiveness of landfill caps. No activity inconsistent with this use restriction may commence without the prior written concurrence of the FFA signatories. DOE will ensure inspection and maintenance of the Pits 2, 3, 4, 5, 6, 7, 8, and 9 landfill caps and ground water monitoring system as specified in the appropriate post-closure plan or the Site 300 Compliance Monitoring Plan.

The Site 300 Contingency Plan (CP) is being revised in 2009 and will include actions to be proposed in the event a remedy does not achieve RAOs, or if any new contaminants are found for which the selected remedies are not adequate to achieve RAOs. The Site 300 CP will address possible property transfer or change in land use. The Site 300 CP will also address situations where the existing access restrictions are removed or relaxed. No significant or fundamental changes to the remedies chosen herein shall be made without an Explanation of Significant Differences or ROD Amendment, as required by CERCLA and the NCP.

As part of the LLNL program to mitigate impacts to wildlife, biologists will monitor those areas in which the relevant ecological HI exceeds 1 until the HI is reduced to below 1 and/or the contaminants are shown to no longer pose an unacceptable exposure risk to ecological receptors. Biologists will monitor Site 300 for the presence of sensitive species not previously identified. The life history of these species will be reviewed to determine the potential for unacceptable exposure to contaminants present at the site. Should it be determined that new species have a potential risk of exposure, their presence in areas where relevant HIs exceed 1 (such as those for ground squirrels or deer) will be determined and discussed with the regulatory agencies. The current LLNL program of conducting ecological resource surveys prior to the initiation of any ground-disturbing activities will continue to ensure that sensitive species are not negatively impacted by any planned ground-disturbing activities.

The following activities are included in risk and hazard management actions, as appropriate to a release site or OU:

1. Implement institutional controls to manage risks:
   - Establish building occupancy and/or land use restrictions to ensure that the risks and hazards estimated in the baseline risk assessment are not exceeded due to changing conditions at the site, and that the remedy remains protective of human health and the environment.
   - Erect warning signs to ensure compliance with area access restrictions and site-specific building occupancy and land use restrictions.
2. Continue to implement a risk and hazard monitoring and assessment program:
   - Collect and analyze air, water, or soil samples to determine current exposure concentrations of COCs.
   - Where applicable, conduct wildlife surveys by biologists to evaluate the presence of the San Joaquin kit fox or other fossorial vertebrate species of special concern and if found, consult with the appropriate wildlife agencies to develop response actions such as monitoring or animal relocation, and evaluate the presence of new species of special concern.
   - Integrate these data into risk assessment calculations to determine any changes in risks and hazards until no risk is indicated for two successive years.
   - Review these data to evaluate compliance with RAOs.
   - Report results to stakeholders.

The institutional/land use controls will be incorporated in the Risk and Hazard Management Program contained in the Site-Wide Compliance Monitoring Plan. Risk and hazard monitoring results conducted during the year will be submitted to the U.S. EPA and State regulatory agencies in the Annual Site 300 Site-Wide Compliance Monitoring Reports. In addition, DOE will work with LLNL Site 300 Management to incorporate these institutional/land use controls into the Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. The EPA Land Use Control Record of Decision Checklist is presented in Appendix A.

2.9.1.3. Ground Water Extraction and Treatment

Extraction consists of pumping contaminated ground water from specially designed wells, then treating it to remove contaminants before discharge via misting or reinjection/infiltration into the subsurface. The extracted water can be treated using granular activated carbon, bioreactors, or ion-exchange systems, depending on the contaminant. The objectives of extraction may include reducing the amount and concentration of contamination, stopping the spread of contaminants, reducing risk, and/or restoring beneficial uses of ground water.

Ground water will be treated to meet the effluent limitations listed in Table B-1 in Appendix B. DOE will comply with all prohibitions, limitations, specifications and provisions specified in the Substantive Requirements issued by the RWQCB. Ground water cleanup standards are discussed in Section 2.11.4.3 and Table 2.11-1.

2.9.1.4. Soil Vapor Extraction and Treatment

Contaminated vapors in the soil above the water table are pumped from special wells and treated using granular activated carbon to remove contaminants before discharging the cleansed air to the atmosphere. This technology is effective only for volatile contaminants, such as TCE. Soil vapor extraction is often combined with ground water extraction. Subsurface soil and rock cleanup standards are discussed in Section 2.11.4.3.

2.9.1.5. Monitored Natural Attenuation

U.S. EPA's Office of Solid Waste and Emergency Response Directive 9200.4-17 (1997) states that monitored natural attenuation (MNA) may be appropriate as a remedial approach where it can be demonstrated to be capable of achieving a site's remedial objectives within a time frame that is reasonable compared to that offered by other methods and given the particular circumstances of the site. According to this directive, the elements that are important to establish a monitored natural attenuation remedy are: (1) the contamination is not currently posing an unacceptable risk, (2) source control measures have been implemented or the data show that the source is no longer releasing contaminants to the environment, and (3) static or reduction in areal extent of plume contours. Natural attenuation may be demonstrated through a variety of lines of evidence, including static or reduced areal extent of plume concentration contours, the presence of contaminant breakdown products, or the formation or depletion of geochemical indicator compounds.

The following activities would be conducted to monitor the effectiveness of monitored natural attenuation and detect any changes in activities or plume size that could result in impacts to human or ecological receptors:

- Measure ground water levels.
- Sample and analyze ground water.
- Manage, analyze, and present data.
- Install additional monitoring wells, if required.

The Site 300 CP will be modified to include actions to be implemented in the event that MNA does not achieve RAOs or comply with ARARs. If such a situation arose, the remedy would be changed and documented in an Explanation of Significant Difference or a ROD amendment.

2.9.2. Remedial Alternatives for Building 834 (OU 2)

The interim remedy for the Building 834 OU was evaluated in the Site-Wide Remediation Evaluation Summary Report and the Five-Year Review for the Building 834 OU (Dibley et al., 2007b). No deficiencies in the overall approach specified in the interim remedy for the Building 834 OU were identified during the remediation evaluation and the cleanup is progressing as expected to meet cleanup standards. No additional information was identified that would call the protectiveness of the interim remedy into question. The interim remedy was proposed as the final remedy for the Building 834 OU in the Site-Wide Remediation Evaluation Summary Report and the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.2.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all remediation, monitoring, reporting, and risk management activities at the Building 834 OU would cease. There are no costs associated with the no-action alternative.

2.9.2.2. Alternative 2—Monitoring, Risk and Hazard Management, and Ground Water and Soil Vapor Extraction and Treatment

Alternative 2 for the Building 834 OU consists of:

1. Monitoring soil vapor and ground water to evaluate the effectiveness of the remedy in achieving cleanup standards (Section 2.9.1.1), plus post-remediation monitoring.
2. Risk and hazard management to prevent onsite workers exposure to VOCs volatilizing from subsurface soil and impacts to animals until risk and hazard is mitigated through active remediation. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).
3. Extracting and treating soil vapor and ground water to mitigate risk and hazards posed by VOCs in the subsurface soil and reduce VOC, nitrate, and TBOS/TKEBS concentrations in ground water and VOCs in subsurface soil to cleanup standards (Sections 2.9.1.3 and 2.9.1.4).
4. Continue evaluating innovative technologies to improve remediation of VOCs in low-permeability sediments and expedite cleanup.

Ground water and soil vapor extraction and treatment would be continued to: (1) reduce soil VOC concentrations in the vadose zone to acceptable risk- and hazard-based concentrations, (2) reduce soil vapor VOC concentrations in the vadose zone to levels protective of ground water, and (3) reduce COC concentrations in ground water to meet cleanup standards.

COCs in ground water include VOCs, TBOS/TKEBS, and nitrate. All extracted ground water and soil vapor would be treated using the existing treatment systems.

A ground water treatment system (GWTS) and soil vapor extraction (SVE) system have been operating in the Building 834 OU since 1995 and 1998, respectively. The GWTS treats VOCs, nitrate, and TBOS/TKEBS in ground water and the SVE system treats VOCs in the vadose zone.

Ground water and soil vapor are extracted from thirteen extraction wells. Floating hydrocarbon adsorption devices remove the floating silicon oil (TBOS/TKEBS), and any floating diesel, followed by aqueous-phase granular activated carbon (GAC) to remove VOCs and dissolved-phase TBOS/TKEBS and diesel from ground water. Nitrate-bearing treated effluent is then discharged via a misting tower over the landscape for uptake and utilization of the nitrate by indigenous grasses. The SVE system uses vapor-phase GAC for VOC removal. The treated effluent is discharged in accordance with Substantive Requirements issued by the RWQCB. Treated vapors are discharged to the atmosphere under an air permit from the San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD). The spent GAC from the soil vapor and ground water treatment systems is disposed or regenerated at an offsite treatment facility.

This dual-phase extraction is considered a presumptive remedy by EPA for remediation of VOCs and other contaminants in subsurface formations. Because contaminants in low-permeability sediments could significantly extend the time until cleanup standards are achieved in this OU, DOE will continue to evaluate innovative technologies to expedite cleanup.

The total cost calculated in the Site-Wide Remediation Evaluation Summary Report based on the time to reach MCLs (400 years) including monitoring, risk and hazard management, and ground water and soil vapor extraction for the Building 834 OU is $173.9 million (M). Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.3. Remedial Alternatives for the Pit 6 Landfill (OU 3)

The interim remedy for the Pit 6 Landfill OU was evaluated in the Site-Wide Remediation Evaluation Summary Report. No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Pit 6 Landfill OU and the cleanup is progressing as expected to meet cleanup standards. No additional information was identified that would call the protectiveness of the interim remedy into question. The interim remedy was proposed as the final remedy for the Pit 6 Landfill OU in the Site-Wide Remediation Evaluation Summary Report and the Site-Wide Proposed Plan, and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.3.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all monitoring, maintenance, reporting, and risk management activities at the Pit 6 Landfill OU would cease. There are no costs associated with the no-action alternative.

2.9.3.2. Alternative 2—Monitoring, Risk and Hazard Management, and MNA

Alternative 2 for the Pit 6 Landfill OU consists of:

1. Monitoring ground water and surface water to evaluate the effectiveness of the remedy in achieving cleanup standards and to ensure there is no impact to downgradient water-

supply wells (Section 2.9.1.1).

2. Risk and hazard management to prevent onsite worker exposure to VOCs volatilizing from Spring 7. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).

3. MNA to reduce VOC and tritium concentrations in ground water to cleanup standards (Section 2.9.1.5).

4. Inspecting the Pit 6 Landfill cover periodically for damage that could compromise its integrity and repair any damage found.

Source control measures have been implemented at the Pit 6 Landfill through the installation of an engineered landfill cap in 1997.

Because ground water monitoring data for perchlorate and nitrate are limited, DOE will continue to monitor ground water to determine if and when an active remedy for these COCs might be necessary.

No costs were calculated in the Site-Wide Remediation Evaluation Summary Report for the Pit 6 Landfill because the extent of contamination is limited and concentrations are near or below the cleanup standards. The estimated present-worth cost of Alternative 2 for the Pit 6 Landfill OU presented in the Interim Site-Wide ROD is $4.5M based on 30 years of monitoring, risk and hazard management, and monitored natural attenuation. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.4. Remedial Alternatives for the HE Process Area (OU 4)

The interim remedy for the HE Process Area OU was evaluated in the Site-Wide Remediation Evaluation Summary Report and the Five-Year Review for the HE Process Area OU (Dibley et al., 2007c). No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the HE Process Area OU and the cleanup is progressing as expected to meet cleanup standards. The interim remedy was modified based on Site-Wide Remediation Evaluation Summary Report recommendations and proposed as the final remedy for the HE Process Area OU in the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.4.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all remediation, monitoring, reporting, and risk management activities at the HE Process Area OU would cease. There are no costs associated with the no-action alternative.

2.9.4.2. Alternative 2—Monitoring, Risk and Hazard Management, Ground Water Extraction and Treatment, and Monitored Natural Attenuation

Alternative 2 for the HE Process Area OU consists of:

1. Ground water monitoring to evaluate the effectiveness of the remedial action, to determine when cleanup standards are met, and to ensure there is no impact to

downgradient water-supply wells (Section 2.9.1.1).

2. Risk and hazard management to prevent onsite worker exposure to VOCs volatilizing from Spring 5 until risk and hazard is mitigated through active remediation. Annual risk re-evaluation indicates that the inhalation risk for VOCs volatilizing from subsurface soil into outdoor ambient air near Building 815 has been mitigated through remediation. Therefore, risk and hazard management for this exposure pathway is no longer necessary. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).

3. Extracting and treating VOCs, HE compounds, and perchlorate in ground water to mitigate unacceptable VOC inhalation risk for onsite workers, prevent further impacts to ground water and offsite plume migration, and reduce contaminant concentrations in ground water to cleanup standards (Section 2.9.1.3).

4. MNA of nitrate in ground water (Section 2.9.1.5).

Additional information has been gathered since the Interim ROD and summarized in the Site-Wide Remediation Evaluation Summary Report (Ferry et al., 2006) that demonstrates that nitrate is being naturally denitrified to nitrogen gas in the HE Process OU. Therefore, MNA, instead of extraction and treatment, was included in Alternative 2 to reduce nitrate concentrations in ground water to meet cleanup standards.

Ground water extraction and treatment would be continued to reduce VOC, RDX, and, perchlorate concentrations in ground water to meet cleanup standards. All extracted ground water would be treated using the existing treatment systems.

Six GWTSs operate in the HE Process Area OU with the first beginning in 1999. Ground water is extracted from eleven extraction wells. Aqueous-phase GAC removes VOCs and RDX, and ion-exchange columns containing SR-7 resin remove perchlorate. GAC is considered to be a presumptive technology for the treatment of VOCs in ground water. Treated water containing nitrate is injected into the $Tnbs_2$ HSU where a natural denitrification process reduces the nitrate to nitrogen. Ground water extracted at the site boundary does not contain nitrate, therefore the treated water is discharged to the subsurface via an infiltration trench. The ground water extraction and treatment unit in the Building 829 source area extracts ground water from $Tnsc_1$ that is an isolated perched zone. Because the natural denitrification of nitrate has not been demonstrated in the Building 829 area, a biotreatment unit is utilized to treat nitrate before reinjection.

The treated effluent would be discharged in accordance with Substantive Requirements issued by the RWQCB. The spent GAC and ion-exchange resin would be disposed or regenerated at an offsite treatment facility.

The total cost calculated in the Site-Wide Remediation Evaluation Summary Report based on the time to reach MCLs (120 years) including monitoring, risk and hazard management, and ground water extraction and treatment for the HE Process Area OU is $179.5M. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.5. Remedial Alternatives for Building 850 Firing Table (OU 5)

The interim remedy for the Building 850 Firing Table OU was evaluated in the Site-Wide Remediation Evaluation Summary Report. No deficiencies in the interim remedy for uranium, tritium, and nitrate in ground water were identified in the evaluation of the remediation approach for Building 850 Firing Table and the cleanup is progressing as expected to meet cleanup standards. The interim remedy was proposed as the final remedy for the Building 850 area in the Site-Wide Remediation Evaluation Summary Report and the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.5.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all monitoring, reporting, and risk management activities in the Building 850 Firing Table area would cease. There are no costs associated with the no-action alternative.

2.9.5.2. Alternative 2—Monitoring, Risk and Hazard Management, and MNA

Alternative 2 for the Building 850 Firing Table consists of:

1. Monitoring ground water and surface water to evaluate the effectiveness of the remedy in achieving cleanup standards (Section 2.9.1.1).
2. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).
3. MNA to reduce tritium activities in ground water and surface water to cleanup standards (Section 2.9.1.5).

As discussed in Section 2.9, a final remedy for PCB-, dioxin-, and furan-contaminated soil at Building 850 is not included this document because DOE and the regulatory agencies have agreed to conduct remediation of this soil as a non-time critical removal action. As part of the removal action, DOE is evaluating a more cost-effective remedy for PCB-, dioxin-, and furan-contaminated soil in the firing table area in an Engineering Evaluation/Cost Analysis document (Dibley et al., 2007d [draft]). The remediation method to be implemented will be selected in an Action Memorandum scheduled for 2008. Public input will be solicited prior to the selection of the remedial action for this contaminated soil. Risk and hazard management will continue to prevent onsite worker exposure to PCBs, dioxins, and furans in surface soil until the risk and hazard is mitigated by the removal action.

COCs in ground water in the Building 850 Firing Table area are tritium, nitrate, and depleted uranium. Active measures for nitrate in ground water were not included in the remedy because: (1) data do not indicate the presence of a significant source of nitrate in the Building 850 Firing Table area, (2) the extent of nitrate with concentrations exceeding the cleanup standard is limited and does not pose a threat to human health or the environment. In addition, no active remediation for uranium in ground water was included because total uranium activities are below the cleanup standard and the extent of uranium is limited.

Based on the recent identification of perchlorate in ground water, DOE will implement an *in situ* bioremediation treatability study for perchlorate in ground water and discuss possible remedial measures with the regulatory agencies. Public input will be solicited prior to the selection of any remedial action for perchlorate in ground water. The selected remedy will be documented in an Amendment to the Site–Wide ROD.

The total cost calculated in the Site-Wide Remediation Evaluation Summary Report based on the time to reach MCLs (40 years) including monitoring, institutional/land use controls, and MNA for the Building 850 Firing Table is $17M. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.6. Remedial Alternative for the Pit 7 Complex (OU 5)

The Pit 7 Complex was not included in the 2006 Remediation Evaluation Summary Report because an interim remedy was only recently selected in the 2007 Amendment to the Interim Site-Wide ROD. The interim remedy was proposed as the final remedy for the Pit 7 Complex Landfill in the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.6.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all remediation, maintenance, monitoring, reporting, and risk management activities in the Pit 7 Complex area would cease. There are no costs associated with the no-action alternative.

2.9.6.2. Alternative 2—Monitoring, Risk and Hazard Management, MNA, Source Control, and Ground Water Extraction and Treatment

Alternative 2 for the Pit 7 Complex consists of:

1. Monitoring ground water and surface water to determine if the cleanup is adequately protecting human health and the environment and to evaluate the effectiveness of the remedy in achieving cleanup standards (Section 2.9.1.1).
2. Risk and hazard management, including institutional/land use controls, to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).
3. MNA to reduce tritium activities in ground water and surface water to cleanup standards (Section 2.9.1.5).
4. Extracting and treating ground water to reduce uranium, perchlorate, nitrate, and VOC concentrations in ground water to meet cleanup standards (Section 2.9.1.3).
5. Installing an engineered drainage diversion system to hydraulically isolate the contaminant sources in the landfills and underlying bedrock from subsurface water, thereby preventing infiltration of rainwater runoff that can result in ground water rising into Pits 3, 4, 5, and 7 and releasing contaminants.

6. Inspecting the Pit 3, 4, 5, and 7 Landfill covers periodically for damage that could compromise integrity and repair any damage found.

Construction of the Pit 7 Complex interim remedy began in the fall of 2007 and will be completed in 2008. Ground water in the vicinity of the Pit 7 Complex is extracted and treated to remove uranium, VOCs, perchlorate, and nitrate. The wellfield configuration was designed to target the highest depleted uranium concentrations in the Qal/WBR HSU and capture uranium, perchlorate, and VOCs in excess of cleanup standards in both the Qal/WBR and Neroly bedrock ($Tnbs_0$) HSUs. Currently, nitrate concentrations proximal to the landfills are below the cleanup standard. However, nitrate is removed from extracted ground water as part of the treatment process. Aqueous-phase GAC is used to remove VOCs present in extracted ground water, followed by ion-exchange resins to remove uranium, nitrate, and perchlorate. If other more cost-effective media are identified for the treatment of uranium, nitrate, and perchlorate, they may be substituted for ion exchange with regulatory approval. The treatment facility effluent is monitored for compliance with effluent discharge limits and then discharged to an infiltration trench. Because there is currently no viable technology available to treat tritiated ground water, the treated water containing only tritium is reintroduced to the subsurface through the infiltration trench.

Ground water extraction and treatment will be conducted using a phased approach because the drainage diversion system will affect the local hydrologic conditions by reducing ground water recharge in the vicinity of the Pit 7 Complex. As a result, the extent of saturation and volume of ground water available for pumping will likely be reduced in the area of ground water extraction. However, it will be very difficult to predict in advance the magnitude and location of impact that the drainage diversion system will have on water levels in the extraction wells. Once the effects of the drainage diversion system on hydrologic conditions have been determined through performance monitoring and are found to be stable, the capture zones for the extraction wells will be evaluated. Any necessary changes to the extraction well configuration and pumping strategy, and/or the installation of additional extraction wells to optimize contaminant removal will be evaluated and discussed with the regulatory agencies.

An engineered drainage diversion system was installed to reduce recharge to ground water, and prevent subsequent inundation of the Pits 3, 4, 5, and 7 landfills and the underlying contaminated bedrock. This approach will isolate the contaminant sources, effectively preventing further releases from the landfill waste and vadose zone bedrock. In addition, the reduction in recharge to the water table underlying the pits will reduce the hydraulic gradient, slowing the migration of existing contaminants in ground water. The specific design details of hydraulic diversion structure are presented in the Remedial Design Document for the Pit 7 Complex.

The estimated present worth costs calculated in the Amendment to the Interim Site-Wide ROD for the Pit 7 Complex based on 30 years of monitoring, risk and hazard management, MNA of tritium, extraction and treatment of uranium, VOCs, perchlorate, and nitrate in ground water, and source control using a drainage diversion system is $10.8M. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.7. Remedial Alternatives for Building 854 (OU 6)

The interim remedy for the Building 854 OU was evaluated in the Site-Wide Remediation Evaluation Summary Report. No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Building 854 OU and the cleanup is progressing as expected to meet cleanup standards. No additional information was identified that would call the protectiveness of the interim remedy into question. The Site-Wide Remediation Evaluation Summary Report did not identify a need for changes to the interim remedy and overall cleanup approach for the Building 854 OU. Therefore, the interim remedy was proposed as the final remedy for the Building 854 OU in the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.7.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all remediation, monitoring, reporting, and risk management activities at the Building 854 OU would cease. There are no costs associated with the no-action alternative.

2.9.7.2. Alternative 2—Monitoring, Risk and Hazard Management, Ground Water and Soil Vapor Extraction and Treatment

Alternative 2 for the Building 854 OU consists of:

1. Monitoring ground water to evaluate the effectiveness of the remedy in achieving cleanup standards (Section 2.9.1.1).
2. Risk and hazard management to prevent animal exposure to VOCs volatilizing from subsurface soil until risk and hazard are mitigated through active remediation. Annual risk re-evaluation indicates that the inhalation risk for VOCs volatilizing from subsurface soil at Buildings 854A and 854F has been mitigated through remediation. Risk and hazard associated with PCB, dioxin, and furan contaminated surface and subsurface soil was also mitigated through remediation. Therefore, risk and hazard management for these exposure pathways are no longer necessary. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).
3. Extracting and treating VOCs in soil vapor and ground water, and nitrate and perchlorate in ground water to mitigate unacceptable VOC inhalation risk for onsite workers, prevent further impacts to ground water, and reduce contaminant concentrations in ground water to cleanup standards (Section 2.9.1.3 and 2.9.1.4).

Ground water and soil vapor extraction and treatment would be continued to: (1) reduce soil VOC concentrations in the vadose zone to acceptable risk- and hazard-based concentrations, (2) reduce soil vapor VOC concentrations in the vadose zone to levels protective of ground water, and (3) reduce COC concentrations in ground water to meet cleanup standards.

COCs in ground water include VOCs, perchlorate, and nitrate. All extracted ground water and soil vapor would be treated using the existing treatment systems.

Three GWTSs and one SVE system operate in the Building 854 OU with the first beginning in 1999. Ground water is extracted from six extraction wells. Aqueous-phase GAC removes VOCs and ion-exchange columns containing SR-7 resin remove perchlorate. GAC is considered to be a presumptive technology for the treatment of VOCs in ground water. VOCs in soil vapor are extracted from one extraction well and treated using vapor-phase GAC.

Nitrate-bearing treated effluent is then discharged via a misting tower over the landscape for uptake and utilization of the nitrate by indigenous grasses or treated with a biotreatment unit and discharged into an infiltration trench.

The treated effluent would be discharged in accordance with Substantive Requirements issued by the RWQCB. Treated vapors are discharged to the atmosphere under an air permit from the SJVUAPCD. The spent GAC and ion-exchange resin would be disposed or regenerated at an offsite treatment facility.

The total cost calculated in the Site-Wide Remediation Evaluation Summary Report based on the time to reach MCLs (90 years) including monitoring, risk and hazard management, and ground water and soil vapor extraction for the Building 854 OU is $80.3M. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.8. Remedial Alternatives for the Building 832 Canyon (OU 7)

The interim remedy for the Building 832 Canyon OU was evaluated in the Site-Wide Remediation Evaluation Summary Report. No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Building 832 Canyon OU and the cleanup is progressing as expected to meet cleanup standards. No additional information was identified that would call the protectiveness of the interim remedy into question. The interim remedy was modified based on Site-Wide Remediation Evaluation Summary Report recommendations and proposed as the final remedy for the Building 832 Canyon OU in the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.8.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all remediation, monitoring, reporting, and risk management activities at the Building 832 Canyon OU would cease. There are no costs associated with the no-action alternative.

2.9.8.2. Alternative 2—Monitoring, Risk and Hazard Management, MNA, and Ground Water and Soil Vapor Extraction and Treatment

Alternative 2 for the Building 832 Canyon OU consists of:

1. Monitoring ground water to evaluate the effectiveness of the remedy in achieving cleanup standards, and to ensure there is no impact to downgradient water-supply wells (Section 2.9.1.1).
2. Risk and hazard management to prevent onsite worker exposure to VOCs volatilizing from subsurface soil into indoor air at Building 830 and from surface water at Spring 3

until risk and hazard is mitigated through active remediation. Annual risk re-evaluation indicates that the inhalation risk for VOCs volatilizing from subsurface soil into outdoor air near Building 830 and to indoor air at Building 832F has been mitigated through remediation. Therefore, risk and hazard management for this exposure pathway is no longer necessary. Institutional/land use controls will be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).

3. Extracting and treating VOCs in soil vapor and ground water, and perchlorate, and nitrate in ground water to mitigate unacceptable VOC inhalation risk for onsite workers, prevent further impacts to ground water and offsite plume migration, and reduce contaminant concentrations in soil and ground water to cleanup standards (Sections 2.9.1.3 and 2.9.1.4).
4. MNA of nitrate in ground water (Section 2.9.1.5).

Additional information has been gathered since the Interim ROD that demonstrates that nitrate is being naturally denitrified to nitrogen gas in the Building 832 Canyon OU. Therefore, MNA, instead of extraction and treatment, will be used to reduce nitrate concentrations in ground water to meet cleanup standards.

Ground water and soil vapor extraction and treatment would be continued to: (1) reduce soil VOC concentrations in the vadose zone to acceptable risk- and hazard-based concentrations, (2) reduce soil vapor VOC concentrations in the vadose zone to levels protective of ground water, and (3) reduce COC concentrations in ground water to meet cleanup standards.

COCs in ground water include VOCs, perchlorate, and nitrate. All extracted ground water and soil vapor would be treated using the existing treatment systems.

Three GWTSs and two SVE systems operate in the Building 832 Canyon OU with the first beginning in 1999. Ground water is extracted from twenty extraction wells. Aqueous-phase GAC removes VOCs and ion-exchange columns containing SR-7 resin remove perchlorate. GAC is considered to be a presumptive technology for the treatment of VOCs in ground water. VOCs in soil vapor are extracted from four extraction wells and treated using vapor-phase GAC.

Nitrate-bearing treated effluent is currently discharged via a misting tower over the landscape for uptake and utilization of the nitrate by indigenous grasses. However, since MNA has been selected as the remedy for nitrate, nitrate-bearing effluent may be reinjected into the $Tnbs_2$ HSU in the future where natural denitrification will convert the nitrate to nitrogen.

The treated effluent would be discharged in accordance with Substantive Requirements issued by the RWQCB. Treated vapors are discharged to the atmosphere under an air permit from the SJVUAPCD. The spent GAC and ion-exchange resin would be disposed or regenerated at an offsite treatment facility.

Because contaminants in low-permeability sediments could significantly extend the time until cleanup standards are achieved in this OU, DOE will continue to evaluate innovative technologies to expedite cleanup.

The total cost calculated in the Site-Wide Remediation Evaluation Summary Report based on the time to reach MCLs (149 years) including monitoring, exposure control, and ground water and soil vapor extraction for the Building 832 Canyon OU is $157.9M. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.9. Remedial Alternatives for the Building 801 Dry Well and the Pit 8 Landfill (OU 8)

The interim remedy for the Building 801 dry well and the Pit 8 Landfill was evaluated in the Site-Wide Remediation Evaluation Summary Report. No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Building 801 Dry Well and the Pit 8 Landfill. No additional information was identified that would call the protectiveness of the interim remedy into question. The interim remedy was proposed as the final remedy for the Building 801 dry well and the Pit 8 Landfill in the Site-Wide Remediation Evaluation Summary Report and the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.9.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all monitoring, maintenance, and reporting activities in the Building 801 dry well and Pit 8 Landfill area would cease. There are no costs associated with the no-action alternative.

2.9.9.2. Alternative 2—Monitoring and Risk and Hazard Management

Alternative 2 for the Building 801 Dry Well and the Pit 8 Landfill consists of:

1. Monitoring ground water to detect any future releases from the Pit 8 Landfill or changes in contaminant concentrations in ground water that could impact human health or the environment (Section 2.9.1.1).
2. Risk and hazard management to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).
3. Inspecting the Pit 8 Landfill cover periodically for damage that could compromise its integrity and repair any damage found.

Sampling and analysis of ground water from monitor wells in the area will continue to monitor COCs and leak detection analytes in the subsurface. The landfill surface will also be inspected annually to ensure that no damage could result in a release from the waste.

No costs were calculated in the Site-Wide Remediation Evaluation Summary Report for the Building 801 Dry Well and the Pit 8 Landfill. The estimated cost of Alternative 2 for the Building 801 Dry Well and Pit 8 Landfill release sites presented in the Interim Site-Wide ROD is $0.5M based on 30 years of monitoring at the Pit 8 Landfill. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.10. Remedial Alternatives for the Building 833 (OU 8)

The interim remedy for the Building 833 area was evaluated in the Site-Wide Remediation Evaluation Summary Report. No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Building 833. No additional information was identified that would call the protectiveness of the interim remedy into question. The interim remedy was proposed as the final remedy for Building 833 in the Site-Wide Remediation Evaluation Summary Report and the Site-Wide Proposed Plan and is presented below as

Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.10.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all monitoring, maintenance, reporting, and risk management activities in the Building 833 area would cease. There are no costs associated with the no-action alternative.

2.9.10.2. Alternative 2—Monitoring and Risk and Hazard Management

Alternative 2 for the Building 833 consists of:

1. Monitoring ground water to detect changes in TCE concentrations that could impact human health or the environment (Section 2.9.1.1).
2. Risk and hazard management to prevent onsite worker exposure to VOCs volatilizing from subsurface soil into indoor air at Building 833 until risk is mitigated. Institutional/land use controls will continue to be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).

Sampling and analysis of ground water from monitor wells in the area will continue to monitor VOCs in the subsurface until concentrations have been reduced to meet cleanup standards.

No costs were calculated in the Site-Wide Remediation Evaluation Summary Report for the Building 833. The estimated cost of Alternative 2 for the Building 833 release site presented in the Interim Site-Wide ROD is $0.8M based on 30 years of monitoring and exposure control. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.11. Remedial Alternatives for the Building 845 Firing Table and Pit 9 Landfill (OU 8)

The interim remedy for the Building 845 Firing Table and the Pit 9 Landfill was evaluated in the Site-Wide Remediation Evaluation Summary Report. No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Building 845 Firing Table and Pit 9 Landfill. No additional information was identified that would call the protectiveness of the interim remedy into question. The interim remedy was proposed as the final remedy for the Building 845 Firing Table and the Pit 9 Landfill in the Site-Wide Remediation Evaluation Summary Report and the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.11.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all monitoring, maintenance, and reporting activities in the Building 845 dry well and Pit 9 Landfill area would cease. There are no costs associated with the no-action alternative.

2.9.11.2. Alternative 2—Monitoring and Risk and Hazard Management

Alternative 2 for the Building 845 Firing Table and Pit 9 Landfill consists of:

1. Continued monitoring ground water to detect any future releases from the Pit 9 landfill that could impact human health or the environment (Section 2.9.1.1).
2. Risk and hazard management to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).
3. Inspecting Pit 9 Landfill cover periodically for damage that could compromise its integrity and repair any damage found.

Sampling and analysis of ground water from monitor wells in the area will continue to monitor COCs and leak detection analytes in the subsurface. The landfill surface will also be inspected annually to ensure that no damage could result in a release from the waste.

No costs were calculated in the Site-Wide Remediation Evaluation Summary Report for the Building 845 Firing Table and the Pit 9 Landfill. The estimated cost of Alternative 2 for the Building 845 Firing Table and Pit 9 Landfill presented in the Interim Site-Wide ROD is $0.5M based on 30 years of monitoring. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.12. Remedial Alternatives for the Building 851 Firing Table (OU 8)

The interim remedy for the Building 851 Firing Table was evaluated in the Site-Wide Remediation Evaluation Summary Report. No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Building 851 Firing Table. No additional information was identified that would call the protectiveness of the interim remedy into question. Therefore, the interim remedy is proposed as the final remedy. The interim remedy was proposed as the final remedy for the Building 851 Firing Table in the Site-Wide Remediation Evaluation Summary Report and the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.12.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all monitoring, maintenance, and reporting activities in the Building 851 firing table area would cease. There are no costs associated with the no-action alternative.

2.9.12.2. Alternative 2—Monitoring and Risk and Hazard Management

Alternative 2 for the Building 851 Firing Table consists of:

1. Monitor ground water to detect changes in contaminant concentrations that could impact human health or the environment (Section 2.9.1.1).
2. Institutional/land use controls will continue to be implemented to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).

Sampling and analysis of ground water from monitor wells in the area will continue to monitor COCs in the subsurface.

No costs were calculated in the Site-Wide Remediation Evaluation Summary Report for the Building 851 Firing Table. The estimated cost of Alternative 2 for the Building 851 Firing Table release site presented in the Interim Site-Wide ROD is $0.5M based on 30 years of monitoring. Cost assumptions and calculations are discussed in Section 2.11.3.

2.9.13. Remedial Alternatives for the Pit 2 Landfill (OU 8)

The interim remedy for the Pit 2 Landfill was evaluated in the Site-Wide Remediation Evaluation Summary Report. No deficiencies in the interim remedy were identified in the evaluation of the remediation approach for the Pit 2 Landfill. No additional information was identified that would call the protectiveness of the interim remedy into question. The interim remedy was proposed as the final remedy for the Pit 2 Landfill in the Site-Wide Remediation Evaluation Summary Report and the Site-Wide Proposed Plan and is presented below as Alternative 2. As specified by the U.S. EPA, a No Action alternative (Alternative 1) is also presented to provide a baseline for comparison.

2.9.13.1. Alternative 1—No Action

A no-action alternative is required by the U.S. EPA guidance and the NCP to provide a baseline for comparison to other remedial alternatives and is the postulated basis of the baseline risk assessment. Under a no-action response, all monitoring, maintenance, and reporting activities in the Pit 2 Landfill area would cease. There are no costs associated with the no-action alternative.

2.9.13.2. Alternative 2—Monitoring and Risk and Hazard Management

Alternative 2 for the Pit 2 Landfill consists of:

1. Monitoring ground water to detect any future releases from the Pit 2 Landfill or changes in contaminant concentrations that could impact human health or the environment (Section 2.9.1.1).
2. Risk and hazard management to prevent human exposure to contamination and to protect the integrity of the remedy (Section 2.9.1.2).
3. Inspecting the Pit 2 Landfill cover periodically for damage that could compromise its integrity and repair any damage found.

Sampling and analysis of ground water from monitor wells in the area will continue to monitor COCs and leak detection analytes in the subsurface. The landfill surface will also be inspected annually to ensure that no damage could result in a release from the waste.

No costs were calculated in the Site-Wide Remediation Evaluation Summary Report for the Pit 2 Landfill. The estimated cost of Alternative 2 for the Pit 2 Landfill area presented in the Interim Site-Wide ROD is $0.5M based on 30 years of monitoring. Cost assumptions and calculations are discussed in Section 2.11.3.

2.10. Comparative Analysis of Alternatives

The NCP and the U.S. EPA identify nine criteria to be used in the detailed analysis of remedial alternatives, as described in Section 2.10.1. Section 2.10.2 presents the analysis of the selected alternatives against these criteria.

2.10.1. Evaluation Criteria

The nine criteria identified by the NCP and the U.S. EPA for analysis of remedial alternatives are:

1. Overall protection of human health and the environment.
2. Compliance with ARARs and regulations.
3. Long-term effectiveness and permanence.
4. Reduction of toxicity, mobility, and volume through treatment.
5. Short-term effectiveness.
6. Implementability.
7. Cost.
8. State acceptance.
9. Community acceptance.

The first two criteria, called threshold criteria, are the most important since alternatives that do not meet them are not considered viable. Criteria 3 through 7 are called balancing criteria and are used to evaluate trade-offs among the alternatives. The last two criteria, called modifying criteria, are to be considered in the remedy selection and were evaluated after State of California and community comments were received on the Proposed Plan. Each of these criteria are discussed below.

2.10.1.1. Overall Protection of Human Health and the Environment

This criterion addresses whether the alternative provides adequate protection of human health and the environment and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

2.10.1.2. Compliance with ARARs and regulations

Unless a waiver is obtained, the alternative or combination of alternatives that are finally selected must comply with all location-, action-, and applicable chemical-specific ARARs and regulations.

2.10.1.3. Long-Term Effectiveness and Permanence

This criterion is used to evaluate how each alternative maintains reliable protection of human health and the environment over time once cleanup standards have been met.

2.10.1.4. Reduction of Toxicity, Mobility, and Volume through Treatment

This criterion is used to evaluate the anticipated ability of an alternative to reduce the toxicity, mobility, and/or volume through treatment of hazardous components present at the site.

2.10.1.5. Short-Term Effectiveness

This criterion addresses the period of time needed to complete the remedy, and any adverse impact on human health and the environment that may be posed during the construction and implementation period. This includes the safety of workers and the public, disruption of site and surrounding land uses, and time necessary to achieve protective measures.

2.10.1.6. Implementability

This criterion addresses the technical and administrative feasibility of each alternative. Factors considered include:

- Availability of goods and services.
- Flexibility of each alternative to allow additional modified remedial actions.
- Effectiveness of monitoring.
- Generation and disposal of hazardous waste.
- Substantive permitting requirements.

2.10.1.7. Cost

This criterion evaluates the estimated capital, operation, and maintenance costs for each alternative. Cost calculations and assumptions are discussed in Section 2.11.3.

2.10.1.8. State Acceptance

The California DTSC and RWQCB have reviewed and commented on this document. These State agencies have participated in the selection of the remedy described in this Site-Wide ROD.

2.10.1.9. Community Acceptance

A Public Meeting was held on June 20, 2007 during the 60-day comment period for the Proposed Plan to present and receive public input on the proposed remedial alternatives for the Site 300 OUs. Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD.

2.10.2. Comparative Evaluation of Remedial Alternatives

This section presents a comparative evaluation of the characteristics of the selected alternative against the nine EPA criteria specified by the NCP.

2.10.2.1. Comparative Evaluation of Remedial Alternatives for the Building 834 (OU 2)

This section compares the characteristics of the Building 834 OU remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Building 834 OU 2)

The only human health risk is the inhalation of VOC vapors above health-based concentrations inside Building 834D. Although contaminant concentrations exceed cleanup standards in perched ground water, there is no existing exposure pathway for contaminated ground water. There is no current unacceptable hazard to ecological receptors identified. Fate and transport modeling indicate that ground water contaminants from the Building 834 Complex will not impact on- or offsite water-supply wells.

Alternative 1 (no action) would not protect human health and the environment because no active measures are taken to reduce contaminant concentrations in the vadose zone or ground water.

Alternative 2 addresses risk to human health from inhalation of VOC vapors above health-based concentrations by reducing soil vapor VOC concentrations through ground water and soil vapor extraction. The alternative includes institutional/land use controls to prevent exposure while contaminant concentrations are being reduced through active treatment.

Alternative 2 uses active remediation to reduce contaminant concentrations and mass at the Building 834 Complex using ground water and soil vapor extraction and treatment. Therefore, this alternative provides long-term and effective protection of human health and the environment.

Criterion 2. Compliance with ARARs (Building 834 OU 2)

In Alternative 1 (no action), COC concentrations would remain above cleanup standards, and therefore does not comply with ARARs.

Alternative 2 uses active soil vapor and ground water remediation to achieve cleanup standards and comply with ARARs. Monitoring will be conducted to determine when those goals are met.

Criterion 3. Long-Term Effectiveness and Permanence (Building 834 OU 2)

Alternative 1 (no action) does not permanently reduce COC concentrations or provide long-term effectiveness in achieving cleanup standards.

Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations to achieve cleanup standards through active remediation. Ground water and soil vapor extraction that has been ongoing since 1995 at the Building 834 Complex have been demonstrated to be effective in removing VOCs, TBOS/TKEBS, and nitrate from the subsurface. Monitoring is included in Alternative 2 to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Building 834 OU 2)

Alternative 1 (no action) does not remove COCs from the subsurface. Therefore, implementation of this alternative would not reduce the toxicity, mobility, or volume of the COCs.

Alternative 2 reduces the mobility of VOCs, TBOS/TKEBS, and nitrate by removing these COCs from the vadose zone and ground water and adsorbing them to treatment media. The toxicity and volume of the VOCs and TBOS/TKEBS sorbed to GAC are then reduced through thermal destruction. The toxicity and volume of nitrate would be reduced through phytoremediation. Contaminant volume and mobility in the vadose zone and ground water would be reduced irreversibly by soil vapor and ground water extraction, dewatering, plume control, and contaminant recovery. Any residual dense non-aqueous phase liquid would be removed by the dewatering and soil vapor extraction.

Ongoing studies will provide data on the viability of *in situ* bioremediation to further reduce the toxicity, mobility, volume, and concentrations of VOCs in ground water.

Criterion 5. Short-Term Effectiveness (Building 834 OU 2)

Since there would be no remediation-related construction, operation, or monitoring occurring under Alternative 1 (no action), there would be no impact to human or ecological receptors.

Because contamination at the Building 834 Complex is entirely contained onsite and isolated from the regional aquifer, Alternative 2 would have no impact on the public. A health and safety plan has been developed to protect the health of onsite workers during remedial system operation and monitoring activities. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during treatment facility operations and monitoring activities.

Contaminant concentrations in soil vapor and ground water have been significantly reduced during the 12 years of extraction and treatment. The time to cleanup for the Building 834 OU (400 years) was estimated for the technical and economic feasibility analysis of achieving various cleanup standards in the Site-Wide Remediation Evaluation Summary Report. The cleanup approach modeled as part of this analysis was optimized for capture. Optimization for other remediation objectives, such as maximizing mass removal and minimizing cleanup time, were not emphasized in the scenarios. Therefore, the estimated cleanup times and costs are conservative.

However, there are technical and logistical factors that affect cleanup times in the Building 834 OU. The high TCE concentrations and slow release rates from the low-permeability claystone/siltstone perching horizon is the primary process controlling the effectiveness of remediation and therefore, contaminant cleanup times in the Building 834 OU. Modeling indicates that once the maximum TCE concentration in the higher permeability sands and gravels are reduced, remediation will become dependent on the rate of TCE release from the low-permeability sediments and will become diffusion limited. Because of the uncertainty associated with estimating the TCE diffusion rate from the low-permeability sediments to higher-permeability sediments where TCE can be extracted at the wells, there is a higher degree of uncertainty associated with cleanup time estimates for the Building 834 OU areas. DOE will continue to evaluate innovative technologies to expedite cleanup of the fine-grained sediments.

Criterion 6. Implementability (Building 834 OU 2)

Alternative 1 (no action) can be implemented easily by shutting down the existing extraction and treatment systems and discontinuing monitoring activities.

Alternative 2 has already been implemented under the Interim Site-Wide ROD. The treatment technologies used in Alternative 2 are well proven, have been identified as presumptive technologies for VOCs, and are already in place and operating.

Criterion 7. Cost (Building 834 OU 2)

Alternative 1 (no action) has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $173.9M.

Criterion 8. State Acceptance (Building 834 OU 2)

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Building 834 OU remedy.

Criterion 9. Community Acceptance (Building 834 OU 2)

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community commented that they opposed a Technical Impracticability Waiver for the OU. There were no other OU-specific comments applicable to remedy selection. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.2. Comparative Evaluation of Remedial Alternatives for the Pit 6 Landfill (OU 3)

This section compares the characteristics of the Pit 6 Landfill OU remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Pit 6 Landfill OU 3)

Alternative 1 (no action) may not protect human health and the environment. Although contaminant concentrations would be reduced to health- and environmentally-protective levels through natural attenuation, potential changes in plume concentrations/activities and size that could result in impacts to downgradient receptors would not be monitored or detected.

In Alternative 2, contaminant concentrations in ground water would be reduced to meet cleanup standards through natural attenuation. Monitoring would continue to be conducted to evaluate the effectiveness of natural attenuation in achieving cleanup and to detect any future releases from the landfill. Alternative 2 includes measures to prevent exposure to contamination while contaminant concentrations are being reduced through MNA such as institutional/land use controls to prevent access to contaminated ground water and the landfill waste. Therefore, Alternative 2 provides long-term protection of human health and the environment.

Criterion 2. Compliance with ARARs (Pit 6 Landfill OU 3)

In Alternative 1 (no action), natural attenuation will continue to reduce contaminant concentrations to achieve cleanup standards and comply with ARARs. However, there are no provisions in this alternative to monitor the progress of natural attenuation toward achieving cleanup standards and ARAR compliance, or determining when these goals are met.

Alternative 2 uses MNA to reduce contaminant concentrations and mass in ground water to achieve cleanup standards and comply with ARARs, and monitoring to ensure these goals are met. Data indicate that COCs are naturally attenuating and will achieve cleanup standards in a reasonable timeframe. Tritium activities are already well below the cleanup standard and will attenuate to background levels. As of first semester 2007, VOC concentrations are below cleanup standards in all but one well in which the TCE concentration slightly exceeds the MCL.

Criterion 3. Long-Term Effectiveness and Permanence (Pit 6 Landfill OU 3)

Alternative 1 (no action) will permanently reduce COC concentrations and provide long-term effectiveness in achieving cleanup standards, however there are no mechanisms included in this alternative for establishing the achievement of these goals.

Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations in ground water through irreversible chemical degradation and radioactive decay (natural attenuation). Monitoring is included in the alternative to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Pit 6 Landfill OU 3)

While Alternative 1 (no action) does not remove COCs from the subsurface, natural attenuation will result in the long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface. However there are no mechanisms included in this alternative for establishing the achievement of these goals.

Alternative 2 relies on MNA to achieve the long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface and includes a monitoring component to ensure that contaminants in the subsurface are addressed.

Criterion 5. Short-Term Effectiveness (Pit 6 Landfill OU 3)

Since there would be no remediation-related construction or monitoring occurring under Alternative 1 (no action), there would be no short-term impact to human or ecological receptors.

Alternative 2 has minimal impact on the public during monitoring activities. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during ground water sampling activities.

As of first semester 2007, VOC concentrations are below cleanup standards in all but one well in which the TCE concentration slightly exceeds the MCL. Tritium activities are already well below the cleanup standard and will attenuate to background levels. Perchlorate concentrations are below analytical detection limits. Nitrate concentrations exceed the cleanup standard in only one well.

Criterion 6. Implementability (Pit 6 Landfill OU 3)

Alternative 1 (no action) can be implemented easily by discontinuing monitoring activities.

Alternative 2 has already been implemented under the Interim Site-Wide ROD.

Criterion 7. Cost (Pit 6 Landfill OU 3)

Alternative 1 has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $4.5M.

Criterion 8. State Acceptance (Pit 6 Landfill OU 3)

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Pit 6 Landfill OU remedy.

Criterion 9. Community Acceptance (Pit 6 Landfill OU 3)

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community expressed concern about the proximity of the water supply wells used to provide water for the Carnegie State Vehicle Recreation Area (SVRA) to the ground water contamination in the Pit 6 Landfill OU. There were no other OU-specific comments applicable to remedy selection. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.3. Comparative Evaluation of Remedial Alternatives for the HE Process Area (OU 4)

This section compares the characteristics of the HE Process Area OU remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (HE Process Area OU 4)

Alternative 1 (no action) may not protect human health and the environment because no active measures are taken to reduce contaminant concentrations in ground water to health- and environmentally-protective levels. In addition, potential changes in plume concentration and size that could result in impacts to downgradient receptors would not be monitored or detected.

Risk to human health (onsite workers) from potential inhalation of VOC vapors above health-based concentrations at Building 815 has already been mitigated by reducing soil vapor VOC concentrations using ground water extraction through implementation of the Alternative 2 remedy under the Interim Site-Wide ROD. An inhalation risk for onsite workers was also identified for VOCs volatilizing from Spring 5 to ambient air. The spring has been dry since 1997 and ground water concentrations continue to decline in the area, thus the risk is also decreasing. Alternative 2 includes measures to prevent exposure to contamination while contaminant concentrations are being reduced through ground water extraction such as institutional/land use controls to prevent access to or use of contaminated ground water and surface water.

Ecological hazards to ground squirrels and deer to cadmium and aquatic organisms to copper were identified. However, surveys found no impacts to the population.

Ground water extraction and treatment is included in Alternative 2 to continue to reduce contaminant concentrations and mass in ground water and surface water to meet cleanup standards and prevent migration of the contaminant plumes. Natural attenuation is reducing nitrate concentrations to background levels in ground water. Therefore, this alternative provides long-term and effective protection of human health and the environment.

Criterion 2. Compliance with ARARs (HE Process Area OU 4)

In Alternative 1 (no action), COC concentrations would remain above cleanup standards, and therefore does not comply with ARARs.

Alternative 2 will use active ground water remediation to achieve cleanup standards and comply with ARARs. Monitoring will be conducted to determine when those goals are achieved.

Criterion 3. Long-Term Effectiveness and Permanence (HE Process Area OU 4)

Alternative 1 (no action) does not permanently reduce COC concentrations or provide long-term effectiveness in achieving cleanup standards.

Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations to achieve cleanup standards through active remediation. Monitoring is included in the alternative to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (HE Process Area OU 4)

Alternative 1 (no action) does not remove COCs from the subsurface. Therefore, implementation of this alternative would not reduce the toxicity, mobility, or volume of the COCs.

Alternative 2 reduces the mobility of VOCs and HE compounds in the subsurface by removing these COCs from ground water and adsorbing them to carbon treatment media. The toxicity and volume of these contaminants would be reduced through the thermal destruction of the contaminants sorbed to GAC. Ion-exchange resin would remove perchlorate from ground water and be disposed of offsite as hazardous waste, therefore the toxicity and volume of this contaminant would not be reduced. Nitrate would be reinjected into the subsurface where the natural processes would convert nitrate into nitrogen gas or treated with a biotreatment unit, permanently reducing toxicity, mobility and volume of nitrate.

Criterion 5. Short-Term Effectiveness (HE Process Area OU 4)

Since there would be no remediation-related construction occurring under Alternative 1 (no action), there would be no short-term impact to human or ecological receptors.

Alternative 2 has minimal impact to onsite workers and the public during operation of the remedial systems and monitoring activities. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during treatment facility operations and monitoring activities.

Maximum VOC and RDX concentrations in ground water have been significantly reduced during the eight years since extraction and treatment was initiated in the HE Process Area OU. Modeling estimates that continued ground water extraction will reduce contaminant concentrations to meet cleanup standards in 120 years. The time to cleanup for the HE Process Area OU was estimated for the technical and economic feasibility analysis of achieving various cleanup standards in the Site-Wide Remediation Evaluation Summary Report. The cleanup approach modeled as part of this analysis was optimized for capture. Optimization for other remediation objectives, such as maximizing mass removal and minimizing cleanup time, were not emphasized in the scenarios. Therefore, the estimated cleanup times and costs are conservative. Optimized cleanup times would be significantly lower.

There are technical and logistical factors that affect cleanup times in the HE Process Area OU. For example, ground water is being extracted at the site boundary to prevent offsite plume migration which limits the sustainable yield from upgradient extraction wells where higher contaminant concentrations are present. The sustainable yield of an aquifer is related to its total recharge. The site boundary extraction wellfield is near the discharge boundary of this aquifer and the extraction rate exceeds recharge. Therefore exceeding the sustainable yield will cause dewatering of wells near the recharge area. The pumping strategy for the ground water extraction wells at the site boundary must be designed to achieve a balance between preventing offsite plume migration and preventing accelerated migration of contaminants in the upgradient part of the plume toward the site boundary. Over-pumping of ground water from wells at the site boundary could result in more rapid migration of upgradient contamination toward the site boundary and lengthen cleanup times for this area. In addition, due to logistical constraints on extraction well placement (e.g. steep terrain), areas of the TCE plume may become trapped in stagnation zones.

Criterion 6. Implementability (HE Process Area OU 4)

No actions would be necessary to implement Alternative 1.

Alternative 2 has already been implemented under the interim ROD.

Criterion 7. Cost (HE Process Area OU 4)

Alternative 1 has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $179.5M.

Criterion 8. State Acceptance (HE Process Area OU 4)

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the HE Process Area OU remedy.

Criterion 9. Community Acceptance (HE Process Area OU 4)

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community expressed concern about the proximity of water supply wells to the ground water contamination in the HE Process Area OU. There were no other OU-specific comments applicable to remedy selection. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.4. Comparative Evaluation of Remedial Alternatives for the Building 850 Firing Table (OU 5)

This section compares the characteristics of the Building 850 Firing Table remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Building 850 OU 5)

Alternative 1 (no action) may not protect human health or the environment because without monitoring of the ground water COC plumes, there would be no means of determining changes in plume size and location that could impact downgradient receptors. Soil remediation is not part of this alternative.

In Alternative 2, tritium activities in ground water and surface water would be reduced to meet cleanup standards through natural attenuation. DOE is implementing an *in situ* bioremediation treatability study to address perchlorate recently identified in Building 850 ground water. Possible long-term remedial measures will be discussed with the regulatory agencies.

Active measures for nitrate in ground water were not included in the remedy because: (1) the maximum nitrate concentrations are detected in upgradient and crossgradient wells indicating the presences of a natural source of nitrate in Building 850 ground water, and (2) the extent of nitrate with concentrations exceeding the cleanup standard is limited and does not pose a threat to human health or the environment. In addition, no active remediation for uranium in ground water was included because total uranium activities are below the cleanup standard and the extent of uranium is limited. DOE will continue to monitor ground water to detect any changes in nitrate and uranium concentrations and extent that could impact human health.

Alternative 2 provides protection to human health for preventing the ingestion of contaminated ground water as: (1) the tritium and uranium plumes are contained onsite, (2) uranium activities in ground water are below the cleanup standard and within the natural background range, (3) tritium activities continue to decrease and the extent of tritium that exceeds the cleanup standard continues to diminish, and (4) ground water is not currently used for drinking. The risk to onsite workers from potential incidental ingestion and direct dermal contact with PCB-contaminated surface soils will be addressed in a removal action as discussed in Section 2.9.5. Because these soils are contained onsite, there is no risk to the public.

Alternative 2 includes measures to prevent exposure while contaminant concentrations are being reduced through MNA such as institutional/land use controls to prevent access to contaminated ground water. Therefore, Alternative 2 provides long-term protection of human health and the environment.

Criterion 2. Compliance with ARARs (Building 850 OU 5)

In Alternative 1 (no action), natural attenuation will continue to reduce tritium activities to achieve cleanup standards and comply with ARARs. However, without monitoring, there is no means of establishing achievement of these goals.

Alternative 2 relies on MNA to reduce tritium activities in ground water to achieve cleanup standards and comply with ARARs. Data indicate that a diminishing tritium source is present at Building 850 and the continuing decay of tritium will result in the attainment of the tritium cleanup standard in a reasonable timeframe (40 years). Total uranium activities in ground water are already below the cleanup standard and are within the range of background levels.

Criterion 3. Long-Term Effectiveness and Permanence (Building 850 OU 5)

Alternative 1 (no action) will permanently reduce tritium concentrations and provide long-term effectiveness in achieving cleanup standards, however there are no mechanisms included in this alternative for establishing the achievement of these goals.

Alternative 2 provides long-term effectiveness through natural attenuation of contaminants in ground water. Monitoring will be conducted after cleanup standards have been achieved to ensure long-term effectiveness and permanence.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Building 850 OU 5)

While Alternative 1 (no action) does not remove tritium from the subsurface, natural attenuation will result in the long-term reduction of its toxicity, mobility, and volume of contaminants.

Alternative 2 relies on MNA of tritium in ground water to achieve a long-term reduction in toxicity, mobility, and volume of tritium in the subsurface. Radioactive decay reduces tritium activities by half every 12. 3 years, therefore it will result in a long-term reduction in the toxicity, mobility, and volume of tritium in ground water at and downgradient of Building 850. However, because there is no known treatment for tritium that is economically and technically practical and the infeasibility of hydraulically controlling the plume has been demonstrated, the tritium plume will migrate in ground water while it continues to decay. However, tritium above background activities will not cross the site boundary during the time it takes to decay to background levels. Uranium activities in ground water are already below cleanup standards.

Criterion 5. Short-Term Effectiveness (Building 850 OU 5)

Since there would be no monitoring occurring under Alternative 1 (no action), there would be no impact to human or ecological receptors from this type of activity and therefore it would be effective in the short-term.

Alternative 2 has minimal impact on onsite workers during monitoring activities. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent potential exposure during ground water sampling activities. Because the contaminants are wholly contained onsite, there would be no impacts to the public from monitoring activities.

Tritium activities in ground water have been significantly reduced over time and modeling estimates indicate that ground water cleanup standards will be achieved in 40 years.

Criterion 6. Implementability (Building 850 OU 5)

No actions would be necessary to implement Alternative 1.

Alternative 2 has already been implemented under the Interim Site-Wide ROD.

Criterion 7. Cost (Building 850 OU 5)

Alternative 1 (no action) has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $17M.

Criterion 8. State Acceptance (Building 850 OU 5)

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Building 850 remedy.

Criterion 9. Community Acceptance (Building 850 OU 5)

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community expressed dissatisfaction with the selection of industrial standards rather than residential standards for PCBs, dioxins and furans in soil. The community is concerned that on-going operations at the Building 850 Firing Table may continue to contaminate the environment. There were no other OU-specific comments applicable to remedy selection. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.5. Comparative Evaluation of Remedial Alternatives for the Pit 7 Complex (OU 5)

This section compares the characteristics of the Pit 7 Complex remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Pit 7 Complex)

Alternative 1 (no action) may not protect human health or the environment because without monitoring COCs in ground water, there would be no means of determining changes in plume size and location that could impact downgradient receptors.

Under Alternative 2, ground water extraction will reduce activities/concentrations of uranium, nitrate, and perchlorate to levels that are protective of human health and the environment. VOC concentrations are already at or below their cleanup standards and continue to decrease. Natural attenuation will reduce tritium activities in ground water to meet cleanup standards in a reasonable timeframe. The hydraulic diversion component of the alternative will provide long-term protection for human health and the environment by preventing ground water contact with contaminant sources both in the pit waste and underlying bedrock, thereby preventing further releases to ground water. Monitoring of COCs in ground water would continue to detect any changes that could impact human health and the environment and determine when cleanup standards are achieved.

Alternative 2 also includes measures to prevent exposure to contamination while contaminant concentrations are being reduced through MNA and ground water extraction such as institutional/land use controls to prevent access to contaminated ground water.

Therefore, Alternative 2 provides long-term and effective protection of human health and the environment.

Criterion 2. Compliance with ARARs (Pit 7 Complex)

Alternative 1 (no action) may not comply with ARARs. Natural attenuation, primarily the radioactive decay of tritium and uranium, would act to reduce contaminant concentrations. However, there are no provisions in this alternative to monitor for the attainment of ARARs and the timeframe to reduce concentrations to cleanup standards may not be reasonable without source control or source isolation measures to prevent further releases.

Alternative 2 uses source control, MNA, and active ground water remediation to achieve cleanup standards and comply with ARARs. Because no technology is available to treat or effectively control migration of the tritium plume at the Pit 7 Complex, some portions of the plume with activities above background levels may migrate. However, monitoring and modeling data indicate that the plume will not migrate offsite during the time it takes for tritium activities to attenuate to health-protective levels.

Criterion 3. Long-Term Effectiveness and Permanence (Pit 7 Complex)

Alternative 1 (no action) may provide some long-term effectiveness in meeting ARARs or permanently reducing contaminant concentrations. The radioactive decay of tritium and uranium is irreversible and hence effective in the long term and permanent. However without monitoring, the effectiveness and permanence of the remedy cannot be verified because new releases would not be detected.

Alternative 2 provide long-term effectiveness by using hydraulic diversion to prevent future releases to ground water, through natural attenuation of tritium in ground water, and active treatment of uranium, VOCs, nitrate, and perchlorate. Monitoring is included in the alternatives to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Pit 7 Complex)

While Alternative 1 (no action) does not remove COCs from the subsurface, the natural attenuation of contaminants may result in the long-term reduction of the volume of contaminants if further releases do not occur. However, because no source control measures are included in Alternative 1, further contaminant releases could occur, and the toxicity and mobility of contaminants would not be reduced.

Alternative 2 relies on MNA of tritium in ground water to achieve a long-term reduction in toxicity, mobility, and volume of tritium in the subsurface. Tritiated groundwater has no known treatment that is economically and technically feasible. Tritium plume migration with concentrations above background is occurring, however, concentrations of tritium above background are not predicted to reach the site boundary. DOE has determined that it is not technically practicable to hydraulically control the tritium plume to prevent migration. The extraction and treatment of uranium, VOCs, perchlorate, and nitrate will reduce the mobility and volume of these COCs in ground water. Although the uranium collected in the treatment media is not destroyed, radioactive decay would reduce the toxicity and volume of the uranium removed from ground water. Ion-exchange resin would remove perchlorate and nitrate from ground water and be disposed of offsite, therefore the toxicity and volume of these contaminants would not be reduced. The toxicity and volume of the VOCs sorbed to GAC are reduced through thermal destruction.

Criterion 5. Short-Term Effectiveness (Pit 7 Complex)

Since there would be no remediation-related construction or monitoring occurring under Alternative 1 (no action), there would be no impact to human or ecological receptors.

The ground water and treatment component of Alternative 2 poses short-term exposure risk to onsite workers as contaminants, including tritium, depleted uranium, perchlorate, and VOCs, would be brought to the surface. Workers could potentially be exposed during operation, and maintenance of the treatment system. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during the construction and operation of the treatment system and monitoring activities. Because the drainage diversion system was constructed outside the area of contamination at the Pit 7 Complex, onsite workers were not impacted.

Under Alternative 2, natural attenuation will reduce tritium activities to meet cleanup standards in an estimated 35 years. Human health would be protected because the plume would not significantly migrate once the source is controlled and the ground water in this area is not suitable for potable uses due to naturally high total dissolved solid concentrations in ground water. Also, there are no complete pathways for this ground water to reach human or ecological receptors. Therefore, Alternative 2 provides short-term effectiveness without impacting human health or the environment.

Criterion 6. Implementability (Pit 7 Complex)

No actions would be necessary to implement Alternative 1.

The monitoring, exposure controls, and MNA components of Alternative 2 can all be implemented easily. The ground water extraction and treatment and drainage diversion system components of Alternative 2 are implementable, but would require controls to: (1) protect worker safety, (2) prevent enhanced migration of contaminants during reinjection of the treatment facility effluent, and (3) replace and dispose of spent ground water treatment media.

Criterion 7. Cost (Pit 7 Complex)

Alternative 1 (no action) has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $10.8M.

Criterion 8. State Acceptance (Pit 7 Complex)

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Pit 7 Complex remedy.

Criterion 9. Community Acceptance (Pit 7 Complex)

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community expressed concerns about leaving the landfills onsite and support for excavation of the landfill waste at the Pit 7 Complex. They also expressed concerns about whether the tritium plume will expand, and impact offsite residential water-supply aquifers and downgradient clean ground water during the time it takes for tritium to naturally attenuate to meet cleanup standards. The public concerns are addressed in detail in Section 3 “Public Responsiveness Summary” of this ROD.

2.10.2.6. Comparative Evaluation of Remedial Alternatives for the Building 854 (OU 6)

This section compares the characteristics of the Building 854 OU remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Building 854 OU 6)

Alternative 1 (no action) may not protect human health and the environment because no active measures are taken to reduce contaminant concentrations in the vadose zone or ground water to cleanup standards.

Alternative 2 includes institutional/land use controls to prevent exposure while contaminant concentrations are being reduced through active treatment. Ground water and soil vapor extraction and treatment are used to reduce contaminant concentrations and mass at the Building 854 OU to meet cleanup standards. Therefore, this alternative provides long-term and effective protection of human health and the environment.

Criterion 2. Compliance with ARARs (Building 854 OU 6)

In Alternative 1 (no action), concentrations of COCs would remain above cleanup standards, and therefore does not comply with ARARs.

Alternative 2 will use active ground water and soil vapor remediation to achieve cleanup standards and comply with ARARs. Monitoring will be conducted to determine when those goals are met.

Criterion 3. Long-Term Effectiveness and Permanence (Building 854 OU 6)

Alternative 1 (no action) does not permanently reduce COC concentrations or provide long-term effectiveness in achieving cleanup standards.

Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations to achieve cleanup standards through active remediation. Ground water and soil vapor extraction in the Building 854 OU that have been ongoing since 1999 have been demonstrated to be effective in removing VOCs from the subsurface. Monitoring is included in the alternative to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Building 854 OU 6)

Alternative 1 (no action) does not remove COCs from the subsurface. Therefore, implementation of this alternative would not reduce the toxicity, mobility, or volume of the COCs.

Alternative 2 reduces the mobility of VOCs, perchlorate, and nitrate by removing these COCs from soil and ground water and adsorbing them to treatment media. The toxicity and volume of the VOCs sorbed to GAC are then reduced through thermal destruction. The toxicity and volume of nitrate and some perchlorate are reduced through biochemical processes in the bioreactor or through phytoremediation that convert these COCs to non-toxic by products. Ion-exchange resin removes any remaining perchlorate from ground water and is disposed of offsite as hazardous waste, therefore the toxicity and volume of this contaminant would not be reduced. Contaminant volume and mobility in the vadose zone and ground water would be reduced irreversibly by source mass removal, contaminant concentration reduction, and plume control.

Criterion 5. Short-Term Effectiveness (Building 854 OU 6)

Since there would be no remediation-related construction, operation, or monitoring occurring under Alternative 1 (no action), there would be no impact to human or ecological receptors.

Because the contamination at the Building 854 OU is entirely contained onsite, Alternative 2 would have no impact on the public during operation of the remedial systems and monitoring activities. A health and safety plan has been developed to protect the health of onsite workers during remedial system operation and monitoring activities. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during treatment facility operations and monitoring activities.

Maximum VOC concentrations in ground water have been significantly reduced during the eight years since extraction and treatment was initiated in the Building 854 OU. Modeling estimates that continued ground water extraction will reduce contaminant concentrations to meet cleanup standards in 90 years. The time to cleanup for the Building 854 OU was estimated for the technical and economic feasibility analysis of achieving various cleanup standards in the Site-Wide Remediation Evaluation Summary Report. The cleanup approach modeled as part of this analysis was optimized for capture. Optimization for other remediation objectives, such as maximizing mass removal and minimizing cleanup time, were not emphasized in the scenarios. Therefore, the estimated cleanup times and costs are conservative. Optimized cleanup times would be significantly lower.

There are technical and logistical factors that affect cleanup times in the Building 854 OU. The extraction wellfield yields are low due to subsurface conditions in this area. The amount of flow available for extraction in areas with the highest contaminant concentrations is limited by the sustainable yield of the aquifer. In addition, pumping at the leading edge of the plume to prevent migration creates lower ground water gradients and stagnation zones near highly contaminated areas. This reduces the effectiveness of the extraction wellfield and extends cleanup times.

Criterion 6. Implementability (Building 854 OU 6)

Alternative 1 (no action) can be implemented easily by shutting down the existing extraction and treatment systems and discontinuing monitoring activities.

Alternative 2 has already been implemented under the Interim Site-Wide ROD. The treatment technologies used in Alternative 2 are well proven, have been identified as presumptive technologies for VOCs, and are already in place and operating.

Criterion 7. Cost (Building 854 OU 6)

Alternative 1 has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $80.3M.

Criterion 8. State Acceptance (Building 854 OU 6)

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Building 854 OU remedy.

Criterion 9. Community Acceptance (Building 854 OU 6)

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community expressed concern that PCBs, dioxins and furans in soil that were removed from the Building 854 OU had been remediated to meet industrial standards rather than residential standards. There were no other OU-specific comments applicable to remedy selection. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.7. Comparative Evaluation of Remedial Alternatives for the Building 832 Canyon (OU 7)

This section compares the characteristics of the Building 832 Canyon OU remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Building 832 Canyon OU 7)

Alternative 1 (no action) may not protect human health and the environment because no active measures are taken to reduce contaminant concentrations in the vadose zone or surface water to meet cleanup standards. In addition, potential changes in plume concentration and size that could result in impacts to downgradient receptors would not be monitored or detected.

Alternative 2 addresses risk to human health from potential inhalation of VOC vapors above health-based concentrations at Building 830 and Spring 3 by reducing soil vapor VOC concentrations through ground water and soil vapor extraction.

The alternative includes institutional/land use controls to prevent exposure while contaminant concentrations are being reduced through active treatment. Alternative 2 uses active remediation to reduce VOC and perchlorate concentrations and mass using ground water and soil vapor extraction and treatment. Natural attenuation is reducing nitrate concentrations to background levels in ground water. Therefore, this alternative provides long-term and effective protection of human health and the environment.

Criterion 2. Compliance with ARARs (Building 832 Canyon OU 7)

In Alternative 1(no action), COC concentrations would remain above drinking water cleanup standards, and therefore does not comply with ARARs.

Alternative 2 will use active ground water and soil vapor remediation and MNA to achieve cleanup standards and comply with ARARs. Monitoring will be conducted to determine when those goals are met.

Criterion 3. Long-Term Effectiveness and Permanence (Building 832 Canyon OU 7)

Alternative 1 (no action) does not permanently reduce COC concentrations or provide long-term effectiveness in achieving cleanup standards.

Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations to achieve cleanup standards through active remediation. Ground water and soil vapor extraction that has been ongoing since 1999 at the Building 832 Canyon OU have been demonstrated to be effective in removing VOCs, nitrate, and perchlorate from the subsurface. Monitoring is included in the alternative to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Building 832 Canyon OU 7)

Alternative 1 (no action) does not remove COCs from the subsurface. Therefore, implementation of this alternative would not reduce the toxicity, mobility, or volume of the COCs.

Alternative 2 reduces the mobility of VOCs, perchlorate, and nitrate by removing these COCs from the vadose zone and ground water and adsorbing them to treatment media. The toxicity and volume of the VOCs sorbed to GAC are then reduced through thermal destruction. Ion-exchange resin would remove perchlorate from ground water and be disposed of offsite as hazardous waste, therefore the toxicity and volume of this contaminant would not be reduced. Nitrate would be reinjected into the subsurface where the natural processes would convert nitrate into nitrogen gas, permanently reducing the toxicity and volume of nitrate. Contaminant volume and mobility in ground water would be reduced irreversibly by source mass removal, contaminant concentration reduction, and plume control.

Criterion 5. Short-Term Effectiveness (Building 832 Canyon OU 7)

Since there would be no remediation-related construction, operation, or monitoring occurring under Alternative 1 (no action), there would be no impact to human or ecological receptors.

Alternative 2 would have minimal impact on the public during operation of the remedial systems and monitoring activities. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during treatment facility operations and monitoring activities.

Maximum VOC concentrations in ground water have been significantly reduced during the eight years since extraction and treatment was initiated in the Building 832 Canyon OU. Modeling estimates that continued ground water extraction will reduce contaminant concentrations to meet cleanup standards in 149 years. The time to cleanup for the Building 832 Canyon OU was estimated for the technical and economic feasibility analysis of achieving various cleanup standards in the Site-Wide Remediation Evaluation Summary Report. The cleanup approach modeled as part of this analysis was optimized for capture. Optimization for other remediation objectives, such as maximizing mass removal and minimizing cleanup time, were not emphasized in the scenarios. Therefore, the estimated cleanup times and costs are conservative. Optimized cleanup times would be significantly lower.

The cleanup time estimate is primarily driven by cleanup of the Building 830 source area. The installation of extraction wells in this area is currently limited by logistics (e.g., building location and terrain) and the presence of high concentrations in low-permeability sediments underlying the building. This reduces the effectiveness of the extraction wellfield and extends cleanup times. Building 830 is being considered for demolition, after which additional extraction wells could be installed to increase contaminant mass removal and reduce the cleanup time. Innovative technologies may need to be considered to expedite cleanup of the low-permeability sediments at Building 830.

Criterion 6. Implementability (Building 832 Canyon OU 7)

Alternative 1 (no action) can be implemented easily by shutting down the existing extraction and treatment systems and discontinuing monitoring activities.

Alternative 2 has already been implemented under the Interim Site-Wide ROD. The treatment technologies used in Alternative 2 are well proven, have been identified as presumptive technologies for VOCs, and are already in place and operating.

Criterion 7. Cost (Building 832 Canyon OU 7)

Alternative 1 has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $157.9M.

Criterion 8. State Acceptance (Building 832 Canyon OU 7)

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Building 832 Canyon OU remedy.

Criterion 9. Community Acceptance (Building 832 Canyon OU 7)

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). There were no OU-specific comments applicable to remedy selection. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.8. Comparative Evaluation of Remedial Alternatives for the Building 801 Dry Well and Pit 8 Landfill (OU 8)

This section compares the characteristics of the Building 801 Dry Well and Pit 8 Landfill remedial alternatives with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Building 801 Dry Well and Pit 8 Landfill [OU 8])

Alternative 1 (no action) may not protect human health and the environment if a future release from the landfill occurred and went undetected. Although COC concentrations in ground water are below cleanup standards or background levels, potential changes in COC concentrations would not be monitored or detected in Alternative 1.

Alternative 2 includes measures to prevent exposure to contamination such as institutional/land use controls to prevent access to contaminated ground water and landfill waste. Monitoring would continue to be conducted evaluate contaminant concentrations in ground water and to detect any future releases from the landfill. Therefore, Alternative 2 provides long-term protection of human health and the environment.

Criterion 2. Compliance with ARARs (Building 801 Dry Well and Pit 8 Landfill [OU 8])

Data indicate that COCs at the Building 801 dry well area meet VOC cleanup standards and perchlorate and nitrate background levels. There are no COCs associated with the Pit 8 Landfill. Therefore, both Alternative 1 (no action) and Alternative 2 comply with ARARS. However, there are no provisions in this alternative to monitor contaminant concentrations for continued compliance.

Criterion 3. Long-Term Effectiveness and Permanence (Building 801 Dry Well and Pit 8 Landfill [OU 8])

Alternative 1 (no action) may provide long-term effectiveness as cleanup standards have been met, however there are no mechanisms for long-term monitoring for future releases from the Pit 8 Landfill. Alternative 2 provides long-term effectiveness through monitoring of the Pit 8 Landfill for releases and of ground water COCs in the Building 801 dry well area to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Building 801 Dry Well and Pit 8 Landfill [OU 8])

While Alternative 1 (no action) and Alternative 2 do not remove COCs from the subsurface, the toxicity, mobility, and volume of contamination in the subsurface has already been reduced to meet cleanup standards and/or background levels.

Criterion 5. Short-Term Effectiveness (Building 801 Dry Well and Pit 8 Landfill [OU 8])

Since there would be no remediation-related construction or monitoring occurring under Alternative 1 (no action), there would be no impact to human or ecological receptors.

Alternative 2 would have minimal impact on the public during monitoring activities. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during ground water monitoring activities.

COC concentrations in ground water in the Building 801 Dry Well area have already been reduced to meet cleanup standards and/or background levels. There are no COC in any environmental media associated with the Pit 8 Landfill.

Criterion 6. Implementability (Building 801 Dry Well and Pit 8 Landfill [OU 8])

Alternative 1 (no action) can be implemented easily by discontinuing monitoring activities.

Alternative 2 has already been implemented under the Interim Site-Wide ROD.

Criterion 7. Cost (Building 801 Dry Well and Pit 8 Landfill [OU 8])

Alternative 1 has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $0.5M.

Criterion 8. State Acceptance (Building 801 Dry Well and Pit 8 Landfill [OU 8])

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Building 801 dry well and Pit 8 Landfill remedy.

Criterion 9. Community Acceptance (Building 801 Dry Well and Pit 8 Landfill [OU 8])

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community expressed concerns that monitoring be included as an essential part of the remedy for the Pit 8 Landfill. There were no other OU-specific comments applicable to remedy selection. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.9. Comparative Evaluation of Remedial Alternatives for Building 833 (OU 8)

This section compares the characteristics of the Building 833 remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Building 833 [OU8])

Alternative 1 (no action) may not protect human health and the environment. Although contaminant concentrations are being reduced to meet cleanup standards, potential changes in soil concentrations and VOC concentrations in ground water would not be monitored or detected.

Alternative 2 includes measures to prevent exposure to contamination while contaminant concentrations are being reduced, such as engineered controls in Building 833 to prevent the inhalation of VOC vapors and institutional/land use controls to prevent access to contaminated ground water. VOC contamination in the perched aquifer is declining, and a confining layer prevents contamination of the underlying regional aquifer. Therefore, Alternative 2 provides long-term protection of human health and the environment.

Criterion 2. Compliance with ARARs (Building 833 [OU 8])

Alternative 1 (no action) may achieve cleanup standards and comply with ARARs, if contaminant concentrations continue to decrease. However, there are no provisions in this alternative to monitor contaminant concentrations to determine if these goals are met.

Data indicate that COCs will achieve cleanup standards and comply with ARARs in a reasonable timeframe under Alternative 2. This alternative includes ground water monitoring to determine when these goals are achieved.

Criterion 3. Long-Term Effectiveness and Permanence (Building 833 [OU 8])

Alternative 1 (no action) may provide long-term effectiveness in meeting cleanup standards and permanently reduce COC concentrations. However there are no mechanisms included in this alternative for establishing the achievement of these goals.

Alternative 2 provides monitoring to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Building 833 [OU 8])

While Alternatives 1 (no action) and 2 do not remove COCs from the subsurface, data indicate that the toxicity, mobility, and volume of contamination in the subsurface are being reduced. However, there are no mechanisms included in this alternative for monitoring the progress toward or establishing the achievement of these goals in Alternative 1.

Alternative 2 provides monitoring to establish that a long-term reduction of the toxicity, mobility, and volume of contamination in the subsurface is achieved.

Criterion 5. Short-Term Effectiveness (Building 833 [OU 8])

Since there would be no remediation-related construction or monitoring occurring under Alternative 1 (no action), there would be no impact to human or ecological receptors.

Because contamination at Building 833 is entirely contained onsite and isolated from the regional aquifer, Alternative 2 would have no impact on the public. Alternative 2 would have minimal impact on the public during monitoring activities. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during treatment facility operations and monitoring.

VOC concentrations have been to consistently declining and are currently near cleanup standards, therefore achievement of cleanup standards should be achieved in a reasonable time frame. The inhalation risk at Building 833 has been reduced to health-protective levels.

Criterion 6. Implementability (Building 833 [OU 8])

Alternative 1 (no action) can be implemented easily by discontinuing monitoring activities.

Alternative 2 has already been implemented under the Interim Site-Wide ROD.

Criterion 7. Cost (Building 833 [OU 8])

Alternative 1 has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $0.8M.

Criterion 8. State Acceptance (Building 833 [OU 8])

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Building 833 OU remedy.

Criterion 9. Community Acceptance (Building 833 [OU 8])

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community requested a more detailed description of the remedy for the Building 833 area. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.10. Comparative Evaluation of Remedial Alternatives for the Building 845 Firing Table and Pit 9 Landfill (OU 8)

This section compares the characteristics of the Building 845 Firing Table and Pit 9 Landfill remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Building 845 Firing Table and Pit 9 Landfill [OU 8])

Alternative 1 (no action) may protect human health and the environment because no unacceptable risk or hazard to human health or ecological receptors posed by contaminants has been identified for the Building 845 Firing Table and Pit 9 Landfill and no COCs have been detected in ground water. However, potential impacts to ground water would not be monitored or detected.

Alternative 2 includes measures to prevent exposure to contamination such as institutional/land use controls to prevent access to contaminated ground water and landfill waste. Monitoring would continue to be conducted to detect any future releases from the landfill. Therefore, Alternative 2 provides long-term protection of human health and the environment.

Criterion 2. Compliance with ARARs (Building 845 Firing Table and Pit 9 Landfill [OU 8])

Alternative 1 meets cleanup standards and ARARs, however, there are no provisions in this alternative to monitor contaminant concentrations to assure continued compliance.

Alternative 2 complies with ARARs regarding landfill monitoring.

Criterion 3. Long-Term Effectiveness and Permanence (Building 845 Firing Table and Pit 9 Landfill [OU 8])

Alternative 1 (no action) may provide long-term effectiveness in meeting cleanup standards and permanently reduce COC concentrations in subsurface soil/rock. However, there are no mechanisms included in this alternative for monitoring continued compliance.

Alternative 2 provides monitoring to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Building 845 Firing Table and Pit 9 Landfill [OU 8])

While Alternatives 1 (no action) and 2 do not remove COCs from subsurface soil/bedrock, natural attenuation of contaminants may result in the long-term reduction of toxicity, mobility, and volume of contamination in this media. However, there are no mechanisms included in Alternative 1 for determining if contaminants in subsurface soil/rock impact ground water in the future or for long-term monitoring for future releases from the Pit 9 Landfill.

Alternative 2 provides ground water monitoring to detect any future impacts from COCs in subsurface soil/rock and releases from the Pit 9 Landfill.

Criterion 5. Short-Term Effectiveness (Building 845 Firing Table and Pit 9 Landfill [OU 8])

Since there would be no remediation-related construction or monitoring occurring under Alternative 1(no action), there would be no impact to human or ecological receptors.

Because public access to the Building 845 Firing Table and the Pit 9 Landfill is restricted, Alternative 2 would have no impact on the public. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during ground water monitoring activities.

Criterion 6. Implementability (Building 845 Firing Table and Pit 9 Landfill [OU 8])

No actions would be necessary to implement Alternative 1.

Alternative 2 has already been implemented under the Interim Site-Wide ROD.

Criterion 7. Cost (Building 845 Firing Table and Pit 9 Landfill [OU 8])

Alternative 1 has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $0.5M.

Criterion 8. State Acceptance (Building 845 Firing Table and Pit 9 Landfill [OU 8])

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Building 845 Firing Table and Pit 9 Landfill remedy.

Criterion 9. Community Acceptance (Building 845 Firing Table and Pit 9 Landfill [OU 8])

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community expressed concerns that monitoring be included as an essential part of the remedy for the Pit 9 Landfill. There were no other OU-specific comments applicable to remedy selection. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.11. Comparative Evaluation of Remedial Alternatives for the Building 851 Firing Table (OU 8)

This section compares the characteristics of the Building 851 Firing Table remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Building 851 Firing Table [OU 8])

Alternative 1 (no action) may protect human health as there is no risk or hazard posed by contaminants in this area. Uranium activities in ground water are well below the cleanup standard, within the range of background concentrations for uranium, and declining. Although uranium activities in ground water are below the cleanup standard and within background levels, potential changes in uranium activities would not be monitored or detected in Alternative 1.

Alternative 2 includes monitoring of ground water to indicate any changes in uranium activities and to determine if soil/rock contaminants impact ground water in the future. Therefore, Alternative 2 provides long-term protection of human health and the environment.

Criterion 2. Compliance with ARARs (Building 851 Firing Table [OU 8])

Alternative 1 (no action) meets cleanup standards and complies with ARARs; however, there are no provisions in this alternative to monitor contaminant concentrations to assure compliance.

Alternative 2 also meets cleanup standards, and complies with ARARs, but provides monitoring to assure compliance.

Criterion 3. Long-Term Effectiveness and Permanence (Building 851 Firing Table [OU 8])

Alternative 1 (no action) may provide long-term effectiveness in meeting cleanup standards and permanently reduce COC concentrations in subsurface soil/rock. However, there are no mechanisms included in this alternative for monitoring continued compliance.

Under Alternative 2, monitoring would continue to ensure long-term effectiveness and permanence.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Building 851 Firing Table [OU 8])

While Alternative 1 (no action) and Alternative 2 do not remove COCs from the subsurface, the toxicity, mobility, and volume of contamination in the subsurface has already been reduced to meet cleanup standards and/or background levels.

Criterion 5. Short-Term Effectiveness (Building 851 Firing Table [OU 8])

Since there would be no remediation-related construction or monitoring occurring under Alternative 1 (no action), there would be no impact to human or ecological receptors.

Because contamination at the Building 851 Firing Table is entirely contained onsite and uranium activities in ground water are within the range of background, Alternative 2 would have no impact on the public. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during ground water monitoring activities.

Criterion 6. Implementability (Building 851 Firing Table [OU 8])

Alternative 1 (no action) can be implemented easily by discontinuing monitoring activities.

Alternative 2 has already been implemented under the Interim Site-Wide ROD.

Criterion 7. Cost (Building 851 Firing Table [OU 8])

Alternative 1 has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $0.5M.

Criterion 8. State Acceptance (Building 851 Firing Table [OU 8])

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Building 851 Firing Table remedy.

Criterion 9. Community Acceptance (Building 851 Firing Table [OU 8])

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community expressed concerns that on-going operations at the Building 851 Firing Table may contaminate the environment. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.10.2.12. Comparative Evaluation of Remedial Alternatives for the Pit 2 Landfill (OU 8)

This section compares the characteristics of the Pit 2 Landfill remedial alternatives against each other with respect to the EPA/NCP criteria.

Criterion 1. Overall Protection of Human Health and the Environment (Pit 2 Landfill [OU 8])

Alternative 1 (no action) may protect human health and the environment because no unacceptable risk or hazard to human health or ecological receptors posed by contaminants has been identified for the Pit 2 Landfill. Tritium and uranium activities in ground water in the Pit 2 Landfill area are below cleanup standards and are declining. Although there is no known risk or hazard associated with the Pit 2 Landfill, potential impacts to ground water from future release from the landfill would not be monitored or detected under Alternative 1.

Alternative 2 includes measures to prevent exposure to contamination such as institutional/land use controls to prevent access to landfill waste. Monitoring would continue to be conducted evaluate contaminant concentrations in ground water and to detect any future releases from the landfill. Therefore, Alternative 2 provides long-term protection of human health and the environment.

Criterion 2. Compliance with ARARs (Pit 2 Landfill [OU 8])

Alternative 1 (no action) currently meets cleanup standards and complies with ARARs, however there are no provisions in this alternative to monitor for continued compliance.

Alternative 2 also currently meets cleanup standards and complies with ARARs, but includes monitoring for continued compliance and to detect future releases from the Pit 2 Landfill.

Criterion 3. Long-Term Effectiveness and Permanence (Pit 2 Landfill [OU 8])

Alternative 1 (no action) may provide long-term effectiveness in meeting cleanup standards, however there are no mechanisms included in this alternative to establish the continued compliance in meeting these goals.

Alternative 2 provides long-term effectiveness by monitoring to determine the long-term effectiveness and permanence of the remedy.

Criterion 4. Reduction of Toxicity, Mobility, and Volume through Treatment (Pit 2 Landfill [OU 8])

While Alternative 1 (no action) and Alternative 2 do not remove COCs from the subsurface, the toxicity, mobility, and volume of contamination in the subsurface has already been reduced to meet cleanup standards.

Criterion 5. Short-Term Effectiveness (Pit 2 Landfill [OU 8])

Since there would be no remediation-related construction or monitoring occurring under Alternative 1, there would be no impact to human or ecological receptors.

Because public access to the Pit 2 Landfill is restricted, Alternative 2 would have no impact on the public. A health and safety plan has been developed to protect the health of onsite workers. In addition, workers follow Site 300 operational procedures and use appropriate personal protective equipment and clothing to prevent exposure during ground water monitoring activities.

COC concentrations in ground water in the Pit 2 Landfill area already meet cleanup standards. There are no COC in any other environmental media at the Pit 2 Landfill.

Criterion 6. Implementability (Pit 2 Landfill [OU 8])

Alternative 1 (no action) can be implemented easily by discontinuing monitoring activities.

Alternative 2 has already been implemented under the Interim Site-Wide ROD.

Criterion 7. Cost (Pit 2 Landfill [OU 8])

Alternative 1 has no cost as no remedial action would occur.

The estimated life-cycle cost for Alternative 2 is $0.5M.

Criterion 8. State Acceptance (Pit 2 Landfill [OU 8])

The California DTSC and RWQCB provided ARARs and other requirements that were used as the basis for developing the alternatives. These State agencies reviewed and evaluated the remedial alternatives, participated in the selection of the remedy, and provided oversight and enforcement of state environmental regulations. In addition, the regulatory agencies have monitored, reviewed, and considered public input as part of the selection process for the Pit 2 Landfill remedy.

Criterion 9. Community Acceptance (Pit 2 Landfill [OU 8])

Public comments made during the Public Meeting and 60-day comment period are addressed in the Responsiveness Summary (Section 3) of this ROD. A summary of community concerns and comments on the general cleanup at Site 300 are included at the beginning of the Responsiveness Summary (Section 3). The responding members of the community expressed concerns that monitoring be included as an essential part of the remedy for the Pit 2 Landfill. There were no other OU-specific comments applicable to remedy selection. The public concerns are addressed in detail in Section 3 "Public Responsiveness Summary" of this ROD.

2.11. The Selected Remedies

DOE, U.S. EPA, and California DTSC and RWQCB agree that Alternative 2 is the most appropriate remedial alternative for all areas included in this Site-Wide ROD considering the CERCLA evaluation criteria. Descriptions of the elements of the selected remedies are presented in Tables 2.9-1 through 2.9-12.

2.11.1. Summary of the Rationale for the Selected Remedies

The key factors in selecting the remedies for each of the Site 300 OUs addressed in this Site-Wide ROD are described in the following sections. All of the selected alternatives meet the two U. S. EPA threshold evaluation criteria: protecting human health and the environment and complying with ARARs. All of the selected alternatives are also acceptable to the State of California.

2.11.1.1. Building 834 OU (OU 2)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, and Ground Water and Soil Vapor Extraction and Treatment) for the Building 834 OU meets the threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 permanently removes contaminants from the subsurface and reduces the toxicity, mobility, and volume of contaminants through extraction and treatment. Alternative 2 actively remediates soil/bedrock and ground water to reduce contaminant concentrations in ground water to meet cleanup standards and mitigate VOC inhalation risk inside and in the vicinity of Building 834. Dual-phase ground water and soil vapor extraction and treatment is an established remedial technology, considered by the EPA to be a presumptive remedy for the cleanup of VOCs in soil and ground water. In addition, Alternative 2 uses institutional/land use controls to provide initial protection of human health.

Alternative 2 provides long-term effectiveness and permanence by removing contaminant mass from the subsurface. The toxicity and volume of extracted VOCs and nitrate are eliminated by thermal regeneration of GAC and phytoremediation, respectively. Exposure controls during remediation will ensure short-term effectiveness. This alternative has already been implemented. Ground water and soil vapor extraction and treatment systems have been operating at Building 834 for 17 years, first as a removal action and later as an interim remedial action under the Site-Wide Interim ROD. The risk to an onsite worker from the inhalation of VOCs volatilizing from the subsurface into outdoor air in the vicinity of Building 834D has been reduced to less than 1×10^{-6} and the risk from the inhalation of VOCs volatilizing from the subsurface into air inside Building 834D continues to be reduced. Data indicate that the remedy has been effective in reducing VOCs and nitrate ground water contamination toward cleanup standards in the Building 834 OU. There is no cleanup standard for TBOS/TKEBS.

2.11.1.2. Pit 6 Landfill OU (OU 3)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, and MNA) meets the threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 permanently removes contaminants from the subsurface, and reduces the toxicity, mobility, and volume of contaminants through irreversible chemical degradation and radioactive decay (natural attenuation), and provides a mechanism for establishing achievement of these goals in a timeframe comparable to active remediation. The radioactive decay of tritium and degradation of TCE are irreversible and hence effective in the long term and permanent. The toxicity and volume of VOCs and tritium are reduced by natural degradation and decay and there would be no impacts on the community, onsite workers, or ecological receptors from these processes. Alternative 2 has already been implemented under the Interim Site-Wide ROD. The risk to onsite workers from inhalation of VOCs volatilizing from the landfill was mitigated through installation of an engineered landfill cap. Natural attenuation has already reduced TCE concentrations to near or below the cleanup standard. Tritium activities remain well below the cleanup standard and continue to decrease toward background levels. Perchlorate is not detected in any wells. Nitrate in ground water will continue to be monitored. Nitrate at concentrations exceeding the cleanup standard continue to be limited to one well.

2.11.1.3. High Explosives Process Area OU (OU 4)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, Ground Water Extraction and Treatment, and MNA) meets the two threshold criteria and provides the best balance of trade-offs among the balancing criteria. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations through extraction and treatment of ground water and MNA. Contaminant toxicity will be reduced through thermal destruction of contaminants sorbed to GAC and MNA. Contaminant volume and mobility will be reduced irreversibly by contaminant mass removal and plume control through ground water extraction and MNA. The treatment technologies incorporated into Alternative 2 are well proven and have been identified as presumptive technologies for VOCs in ground water. This alternative has already been implemented. Ground water extraction and treatment systems have been operating in the HE Process Area for eight years, first as a removal action and later as an interim remedial action under the Site-Wide Interim ROD. The risk to an onsite worker from the inhalation of VOCs volatilizing from the subsurface into outdoor air in the vicinity of Building 815 has been reduced to less than 1×10^{-6}. Data indicate that the remedy has been effective in reducing VOC, HE compounds, nitrate, and perchlorate ground water contamination toward cleanup standards. However, additional extraction wells may be needed in the future to fully capture the distal VOC plume.

2.11.1.4. Building 850 Firing Table (OU 5)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, and MNA) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 reduces the toxicity, mobility and volume of contaminants through irreversible radioactive decay (natural attenuation), and provides a mechanism for establishing achievement of these goals in a timeframe comparable to active remediation. The radioactive decay of tritium is irreversible and hence effective in the long term and permanent. The toxicity and volume of tritium are reduced by natural decay and there would be no impacts on the community, onsite workers, or ecological receptors from allowing these processes to occur. Alternative 2 has already been implemented under the Interim Site-Wide ROD. Under this remedy, natural attenuation has already significantly reduced both tritium activities and the extent of tritium in ground water with activities exceeding the cleanup standard. Tritium in ground water will continue to naturally attenuate to background levels. Uranium activities in ground water are below the cleanup standard and within natural background levels. The extent of nitrate with concentrations exceeding the cleanup standard is limited and does not pose a threat to human health or the environment. Perchlorate concentrations in ground water will continue to be monitored and a remedy will be selected with a ROD amendment.

2.11.1.5. Pit 7 Complex (OU 5)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, MNA, Source Control, and Ground Water Extraction and Treatment) protects human health and the environment, complies with action-specific ARARs, and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Under Alternative 2, the contaminant sources in both the pit waste and underlying bedrock are controlled using a drainage diversion system. This component of the alternative prevents further contaminant releases from both the pit waste and underlying bedrock, and local ground water gradients are reduced, effectively slowing migration of the pre-existing tritium and uranium ground water plumes. The extraction and treatment and MNA of COCs in ground water reduces contaminant concentrations to meet cleanup standards and provides long-term and effective protection of human health and the environment. Alternative 2 reduces the toxicity, mobility and volume of tritium through irreversible radioactive decay (natural attenuation), and provides a mechanism for establishing achievement of cleanup standards in a timeframe comparable to active remediation. The radioactive decay of tritium is irreversible and hence effective in the long term and permanent. The toxicity and volume of tritium are reduced by natural decay and there would be no impacts on the community, onsite workers, or ecological receptors from allowing these processes to occur. Alternative 2 is effective in the short-term without impacting human health or the environment. Construction of the drainage diversion system component of Alternative 2 occurred outside the area of contamination at the Pit 7 Complex, and the system diverts clean rainwater runoff and shallow ground water during its operation. The extraction and treatment system component of Alternative 2 was designed as a closed-loop system to prevent worker exposure during ground water treatment. Alternative 2 has been implemented using existing, proven technologies. The ground water monitoring and exposure control measures are largely in-place and functioning.

2.11.1.6. Building 854 OU (OU 6)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, Ground Water and Soil Vapor Extraction and Treatment) protects human health and the environment, complies with action-specific ARARs, and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 permanently removes contaminants from the subsurface and reduces the toxicity, mobility, and volume of contaminants through the extraction and treatment of soil vapor and ground water. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations through active remediation. The toxicity of contaminants would be reduced through thermal destruction of contaminants sorbed to GAC. Contaminant volume and mobility would be reduced irreversibly by contaminant mass removal and plume control. Alternative 2 uses technologies that are proven and identified as a presumptive remedy for VOCs in ground water. This alternative has already been implemented. Ground water extraction and treatment systems have been operating in the Building 854 OU for eight years, first as a removal action and later as an interim remedial action under the Site-Wide Interim ROD. The risk to an onsite worker from the inhalation of VOCs volatilizing from the subsurface into outdoor air in the vicinity of Building 854F and air inside Buildings 854F and 854A have been reduced to less than 1 x 10^{-6}. Data indicate that the remedy has been effective in reducing VOC, nitrate, and perchlorate ground water contamination toward cleanup standards in the Building 854 OU.

2.11.1.7. Building 832 Canyon OU (OU 7)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, MNA of Nitrate, and Ground Water and Soil Vapor Extraction and Treatment) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the five balancing criteria. Alternative 2 permanently removes contaminants from the subsurface and reduces the toxicity, mobility, and volume of contaminants through the extraction and treatment of soil vapor and ground water. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations through active remediation and MNA. The toxicity of contaminants will be reduced through thermal destruction of contaminants sorbed to GAC. Contaminant volume and mobility will be reduced irreversibly by contaminant mass removal and plume control. Alternative 2 uses technologies that are well proven and identified as a presumptive remedy for VOCs in ground water and soil. This alternative has already been implemented. Ground water and soil vapor extraction and treatment systems have been operating in the Building 832 Canyon OU for eight years, first as a removal action and later as an interim remedial action under the Site-Wide Interim ROD. The risk to an onsite worker from the inhalation of VOCs volatilizing from the subsurface into outdoor air in the vicinity of Building 830 and air inside Building 832F have been reduced to less than 1 x 10^{-6} and the risk from the inhalation of VOCs volatilizing from the subsurface into air inside Building 830 continues to be reduced. Data indicate that the remedy has been effective in reducing VOC, nitrate, and perchlorate ground water contamination toward cleanup standards in the Building 832 Canyon OU.

2.11.1.8. Building 801 Dry Well and the Pit 8 Landfill (OU 8)

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) protects human health and the environment and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations and toxicity, mobility, and volume through natural attenuation. Alternative 2 provides institutional controls and monitoring to determine the long-term effectiveness and permanence of the remedy. Alternative 2 has already been implemented under the Interim Site-Wide ROD. There is no risk to human health or impacts to animal populations. VOC, perchlorate, and nitrate concentrations in ground water in the Building 801 Dry Well area are currently below cleanup standards and/or background levels. There are no COCs in any environmental media in the Pit 8 Landfill area and no evidence of contaminant releases from the landfill.

2.11.1.9. Building 833 (OU 8)

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. The toxicity, and possibly volume, of contaminants in the subsurface are being reduced through dispersion, dilution, and/or irreversible chemical degradation. Data indicate that natural processes are reducing VOC concentrations toward cleanup standards. Alternative 2 provides institutional controls and monitoring to determine the long-term effectiveness and permanence of the remedy. Alternative 2 has already been implemented under the Interim Site-Wide ROD.

2.11.1.10. Building 845 and the Pit 9 Landfill (OU 8)

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations and toxicity, mobility, and volume through natural attenuation. Alternative 2 provides institutional controls and monitoring to determine the long-term effectiveness and permanence of the remedy. Alternative 2 has already been implemented under the Interim Site-Wide ROD. There is no risk to human or ecological receptors or threat to ground water associated contamination in subsurface soil at Building 845 and no contaminants have been detected in ground water under the Building 845 Firing Table or Pit 9 Landfill.

2.11.1.11. Building 851 Firing Table (OU 8)

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) meets the two threshold criteria and provides the best balance of trade-offs among the balancing criteria. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations and toxicity, mobility, and volume through natural attenuation. Alternative 2 provides institutional controls and monitoring to determine the long-term effectiveness and permanence of the remedy. Alternative 2 has already been implemented under the Interim Site-Wide ROD. No risk or hazard to human health or impacts to animal populations associated with contaminants in surface soil, subsurface soil/bedrock, or ground water was identified for the Building 851 Firing Table. Modeling indicates the contaminants in surface and subsurface soil will not impact underlying ground water. Total uranium activities in ground water have always been well below the cleanup standard and at similar levels to those at which uranium naturally occurs in ground water in this area.

2.11.1.12. Pit 2 Landfill (OU 8)

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) meets the two threshold criteria and provides the best balance of trade-offs among alternatives in terms of the balancing criteria. Alternative 2 provides long-term effectiveness by permanently reducing contaminant concentrations and toxicity, mobility, and volume through natural attenuation. Alternative 2 provides institutional controls and monitoring to determine the long-term effectiveness and permanence of the remedy. Alternative 2 has already been implemented under the Interim Site-Wide ROD. Contaminant concentrations in Pit 2 Landfill ground water are below cleanup standards and are declining.

2.11.2. Descriptions of the Selected Remedies

This section presents detailed descriptions of the elements of the selected remedies for each OU addressed in this Site-Wide ROD. These details are described in Tables 2.9-1 through 2.9-12 as follows:

Building 834 (OU 2)	Table 2.9-1
Pit 6 Landfill (OU 3)	Table 2.9-2
HE Process Area (OU 4)	Table 2.9-3
Building 850 Firing Table (OU 5)	Table 2.9-4
Pit 7 Complex (OU 5)	Table 2.9-5
Building 854 (OU 6)	Table 2.9-6
Building 832 Canyon (OU 7)	Table 2.9-7
Building 801 Dry Well/Pit 8 Landfill (OU 8)	Table 2.9-8
Building 833 (OU 8)	Table 2.9-9
Building 845 Firing Table/ Pit 9 Landfill (OU 8)	Table 2.9-10
Building 851 Firing Table (OU 8)	Table 2.9-11
Pit 2 Landfill (OU 8)	Table 2.9-12

The descriptions of the remedies are conceptual in scope and are not intended to provide design information. Details on design are contained in the remedial design documents for the Building 834 OU (Gregory et al., 2002), HE Process Area OU (Madrid et al., 2002), Building 850 OU (Taffet et al., 2004), Building 854 OU (Daily et al., 2003), and Building 832 Canyon OU (Madrid et al., 2006). The remedial design for the Pit 7 Complex will be completed in 2008. Remedial designs are not required for monitoring and institution/land use control remedies. Additional information on the monitoring programs, risk and hazard management programs including institutional/land use controls, and contingency plans will be included in the revised CMP/CP scheduled for 2009.

2.11.3. Estimated Costs of the Selected Remedies

Cost estimates were prepared as part of the Site-Wide Remediation Evaluation Summary Report for OUs 2, 4, 5 (Building 850 Firing Table only), 6, and 7 using the life-cycle design for each OU to reach cleanup standards. No discount rates or inflation rates were applied. Additional costing details can be found in the Site-Wide Remediation Evaluation Summary Report.

The costs for OUs 3 and 8 are the same costs presented in the Interim Site-Wide ROD for the selected alternatives because this Site-Wide ROD is not presenting changes to the remedies. These costs include capital, operation and maintenance, and monitoring costs as 1999 present-worth costs using a 5% discount rate. Additional costing details can be found in the Interim Site-Wide ROD.

For the Pit 7 Complex (OU 5), capital, operation and maintenance, and monitoring costs were estimated for each alternative and presented in the Amendment to the Interim Site-Wide ROD as 2004 present-worth costs using a 5% inflation rate. Total costs for all alternatives were estimated within an accuracy of +50% and –30% in accordance with EPA guidance (U.S. EPA, 2000). Additional costing details can be found in the Amendment to the Interim Site-Wide ROD for the Pit 7 Complex.

Because this Site-Wide ROD is: (1) selecting cleanup standards, (2) presenting minor remedy changes, and (3) not using costs to select the remedial alternatives, the cost information is presented for informational purposes only.

2.11.4. Expected Outcomes of the Selected Remedies

2.11.4.1. Available Land Uses

DOE has no plans to release any portion of LLNL Site 300 for residential or industrial use. Some areas will require long-term management due to the presence of COCs. This long-term management would primarily affect land use for LLNL programs.

Long-term waste management will be required because landfills will be left in place. Figures 2.9-1 through 2.9-10 presents the areas of Site 300 where institutional/land use controls will be in affect.

2.11.4.2. Available Ground Water Uses

DOE has agreed to clean up contaminated ground water at Site 300 to meet drinking water MCLs. For this reason, ground water use will be unrestricted upon achievement of cleanup standards. In addition, the point of compliance is assumed to be the ground water underlying the site, consistent with California regulations. Achievement of this cleanup goal in ground water equates to an acceptable risk associated with onsite ground water under a residential exposure scenario. For this reason, the cleanup objective of reducing contaminant concentrations in both onsite and offsite ground water to drinking water MCLs will be sufficiently protective of ground water resources and human health under any current or future land use scenario.

2.11.4.3. Cleanup Standards

Ground Water and Surface Water

The cleanup standards for ground water and surface water at LLNL Site 300 OUs 2 through 8 are Federal drinking water MCLs unless California State MCLs are more stringent, as shown in Table 2.11-1. VOCs and tritium are the only contaminants of concern in surface water (onsite springs) at Site 300.

The ground water cleanup standard for RDX is 1 μg/L, the analytical method detection limit for RDX because there are no Federal or State MCLs. This cleanup standard was selected because the RDX detection limit is slightly above the EPA Region 9 tap water Preliminary Remediation Goal of 0.61 μg/L, therefore the *de facto* cleanup standard is the detection limit.

No ground water cleanup standard has been included for silicone oil (TBOS/TKEBS) because there are no regulatory standards or health effects for these compounds. However, the TBOS/TKEBS in the Building 834 OU is being remediated as part of the VOC cleanup.

As part of the CERCLA process, DOE will prepare a technical and economic feasibility analysis as part of the Five-Year Review after ground water contaminant concentrations have been reduced to MCLs in each OU (2-8). This analysis will be used to determine the technical and economic feasibility of continuing remediation to further reduce contaminant concentrations below MCLs, in accordance with State Water Resources Control Board Resolution 92-49. A range of values will be considered down to water quality numeric limits or background. The technical and economic feasibility analyses will be reviewed and approved by the RWQCB, DTSC, and EPA. If DOE and the regulatory agencies then agree that it is technically and economically feasible, remediation would continue. If it is reasonable to conduct the feasibility analysis sooner than at the Five-Year Review (e.g., contaminant concentrations are reduced below MCLs soon after a Five-Year Review has been completed), DOE will discuss accelerating the feasibility analysis with the regulatory agencies. In addition, DOE will consider and discuss with the regulators conducting the feasibility analysis for a treatment area (e.g., treatment facility and associated extraction wellfield) once MCLs are achieved in that area, rather than waiting for MCLs to be achieved throughout the OU. Any changes to ground water cleanup standards will be proposed to the community and take effect through a ROD amendment.

The details of the approach that will be used to perform the evaluation to determine the technical and economic feasibility of further reducing COC concentrations in ground water to below MCLs will be provided in the forthcoming revision to the Site-Wide Compliance Monitoring Plan/Contingency Plan for LLNL Site 300. In addition, DOE will periodically assess the progress of the remedies in achieving ground water cleanup standards as part of the Five-Year Review process.

Ground water cleanup will be complete when ground water samples demonstrate that cleanup standards are achieved, either as specified in this ROD or in a ROD Amendment following the technical and economic feasibility analyses. This will be achieved when contaminant concentrations in samples collected from all monitor wells within an OU are below the cleanup standards. When contaminant concentrations in ground water have been reduced to the cleanup standards, the ground water extraction and treatment systems will be shut off and placed on standby. Contaminant concentrations may rise in ground water after extraction ceases due to slow desorption from fine-grained sediments. Therefore, ground water post-closure monitoring will be performed for two years after pumping ceases. Should contaminant concentrations in ground water rebound above cleanup standards, reinitiation of remediation efforts will be discussed with the regulatory agencies.

Cleanup will be considered complete when contaminant concentrations in ground water remain below the cleanup standards for two years. After concurrence with the regulatory agencies that cleanup is complete, the extraction wells and monitor wells within the OU will be decommissioned. Wells will be closed by *in situ* casing perforation and pressure grouting, or by well removal as appropriate, consistent with the approved LLNL Livermore Site and Site 300 Environmental Restoration Project Standard Operating Procedures (Goodrich and Wimborough, 2006).

After remediation is complete, the ground water treatment systems and their influent and discharge piping will be decontaminated, dismantled, salvaged, or used at other locations. Any wash water and spent treatment media containing hazardous materials will be collected, sampled, and disposed at offsite RCRA-permitted facilities.

Surface Soil

The Building 850 Firing Table is the only OU that still contains surface soil contamination that poses an unacceptable risk to humans (onsite workers) and animals. These surface soil contaminants include PCBs, dioxin, and furan compounds. A final remedy for contaminated soil at Building 850 is not included the Site-Wide ROD because DOE and the regulatory agencies have agreed to conduct remediation of this soil as a non-time-critical Removal Action, as discussed in Section 2.9. The cleanup standards for PCBs, dioxins, and furans in Building 850 soil were selected in the Interim ROD, are discussed in the Building 850 Engineering Evaluation/Cost Analysis and are presented in the Building 850 Action Memorandum. The Preliminary Remediation Goals for protection of human health are sufficiently low to reduce the hazard to animals to safe levels. There is no threat to ground water posed by PCBs, dioxins, or furans in surface soil at the Building 850 Firing Table. There are no other OUs for which a surface soil cleanup remedy is presented in the Site-Wide ROD. For these reasons, there are no surface soil cleanup standards presented in this Site-Wide ROD.

Subsurface Soil and Rock

No further action was selected in the Interim Site-Wide ROD as the final remedies for all COCs in subsurface soil/rock in the HE Process Area, Building 850, and the Site-Wide OUs, and for non-VOC contaminants of concern in subsurface soil/rock in the Buildings 854 and 832 Canyon OUs because there was no risk to humans, plants, or animals, or threat to ground water associated with this contamination.

The Interim Site-Wide ROD specified that cleanup goals for VOC-contaminated subsurface soil at the Building 834, 854, and 832 Canyon OUs be addressed in the Final Site-Wide ROD. Therefore, the proposed cleanup goals for VOCs in subsurface soil/rock in these OUs are to: (1) mitigate risk and hazard to human health (2) reduce VOC concentrations to meet ground water cleanup standards, and (3) prevent further impacts to ground water to the extent technically and economically feasible.

DOE will continue to annually evaluate the reduction in inhalation risk and hazard resulting from VOC vapor transport to indoor air at Buildings 830, 833, and 834D, and to ambient air near Springs 3, 5, and 7. The evaluation of risk and hazard reduction in indoor air will be conducted using a model that simulates evaporation of VOC vapor into a building. The evaluation of risk and hazard reduction in ambient air near springs will be conducted by collecting air samples for VOC analysis and re-evaluation of risks when water is present in the springs. Institutional and/or engineered controls will prevent exposure until unacceptable risks (greater than one-in-a-million excess cancer risk) are mitigated through remediation. Results of these evaluations will continue to be presented in the Annual Compliance Monitoring Reports.

Contaminant fate and transport modeling, trend analysis, mass balance, and/or other means will be used to determine when the cleanup of VOCs in subsurface soil in the Buildings 834, 854, and 832 Canyon OUs has been achieved (i.e., when remaining VOCs no longer cause concentrations in leachate to exceed the ground water cleanup levels). This determination will include examining the effects of remaining subsurface soil/rock VOC contamination on ground water quality using an appropriate vadose zone model, if necessary. DOE will obtain concurrence from the regulators prior to shutting down any SVE system.

The SVE systems in the Buildings 834, 854, and 832 Canyon OUs will operate until it is demonstrated that: (1) unacceptable VOC inhalation risk to onsite workers has been mitigated, and (2) VOC removal from the vadose zone is no longer technically or economically feasible in meeting the aquifer cleanup standards sooner, more cost effectively, and more reliably. The decision on whether it is appropriate to shut off the soil vapor extraction system will be made based on the results of the "Soil Vapor Extraction System Shut-Off Evaluation" discussed in Appendix C. The evaluation presented in Appendix C was, by design, intended to be applicable to all OUs where soil vapor extraction will be conducted. In addition, site-specific considerations will need to be evaluated.

When a given soil vapor extraction system is shut down, monitoring of ground water and soil vapor will continue. Should site conditions change or monitoring indicate that soil vapor concentrations have rebounded and will cause the ground water to exceed ground water cleanup standards, reinitiation of remediation efforts will be discussed with the regulatory agencies.

Cleanup will be considered complete when it is demonstrated that:

1. Unacceptable VOC inhalation risk to onsite workers has been mitigated.
2. The remaining vadose zone VOC contaminants no longer cause concentrations in the leachate to exceed the ground water cleanup standards, based on an interpretation of soil vapor data using an appropriate vadose zone model. Leachate is the mobile portion of water in the vadose zone containing soluble constituents that has been leached from the soil in the vadose zone. Ground water cleanup levels have been established as MCLs as defined in applicable Federal and State safe drinking water standards.
3. VOCs have been removed to the extent technically and economically feasible in order to meet the ground water cleanup levels sooner, more cost-effectively, and more reliably.

Cleanup completion will be determined in conjunction with the regulatory agencies. The regulatory agencies will have concurred with the decision to shut off the soil vapor extraction system, based on the soil vapor extraction system shut-off evaluation described in Appendix C, before cleanup is considered complete.

After remediation is complete, the Buildings 834, 854 and 832 Canyon OU SVE treatment systems and their influent and discharge piping will be decontaminated, dismantled, salvaged, or used at other locations. Any wash water and spent GAC containing hazardous materials will be collected, sampled, and disposed at offsite RCRA-permitted facilities.

2.12. Principal Threat Waste

The NCP establishes an expectation that the lead agency will use treatment to address the principal threats posed by a site wherever practicable. Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threat wastes are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied. Contaminated ground water is not usually considered a principal threat waste.

Table 2.12-1 summarizes source materials, affected media, and human health risks, and describes how principal threat wastes are addressed by the selected remedies.

2.13. Statutory Determinations

Under CERCLA Section 121 and the NCP, DOE must select remedies that protect human health and the environment, comply with ARARs, are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity or mobility of hazardous wastes as a principal element and a bias against offsite disposal of untreated wastes. Sections 2.13.1 through 2.13.6 discuss how the Site 300 selected interim remedies meet these statutory requirements.

2.13.1. Protection of Human Health and the Environment

Sections 2.13.1.1 through 2.13.1.12 describe how the selected remedies for each OU addressed in this Site-Wide ROD will protect human health and the environment.

2.13.1.1. Building 834 OU (OU 2)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, and Ground Water and Soil Vapor Extraction and Treatment) protects human health and the environment through active remediation and institutional/land use controls. There is no current unacceptable hazard to ecological receptors identified. Alternative 2 prevents ingestion of contaminated ground water and addresses risk to human health from potential inhalation of VOC vapors above health-based concentrations inside Building 834D by reducing soil vapor VOC concentrations through soil vapor extraction and prevents exposure to contamination while contaminant concentrations are being reduced through institutional/land use controls. Thus, Alternative 2 provides long-term protection of human health and restores beneficial uses of ground water. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.2. Pit 6 Landfill OU (OU 3)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, and MNA) protects human health and the environment through MNA and institutional/land use controls. There is no current unacceptable hazard to ecological receptors identified. Alternative 2 prevents ingestion of contaminated ground water and contact with landfill waste through institutional/land use controls. The landfill cap installed in 1997 prevents exposure to VOCs vaporizing from the landfill and animal exposure to the pit contents. Natural attenuation has already reduced TCE concentrations to near or below cleanup standards in ground water. Tritium concentrations remain well below the cleanup standard and continue to decrease toward background levels. Perchlorate is not detected in any wells. The extent of nitrate at concentrations exceeding the cleanup standard continue to be limited to one well. Monitoring would continue to be conducted to evaluate the effectiveness of natural attenuation in achieving cleanup and to detect any future releases from the landfill. Alternative 2 relies on MNA to reduce contaminant concentrations and mass in ground water, thus providing long-term and effective protection of human health and the environment. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.3. High Explosives Process Area OU (OU 4)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, Ground Water Extraction and Treatment, and MNA) protects human health and the environment through active remediation and institutional/land use controls. Ecological hazards to ground squirrels and deer to cadmium and aquatic organisms to copper were identified. However, surveys found no impacts to the population. Alternative 2 prevents ingestion of contaminated ground water through institutional/land use controls. The inhalation risk outside Building 815 has been mitigated. Human health is also protected by preventing exposure to VOCs volatilizing Spring 5 until concentrations in the spring are reduced to health-protective levels through extraction and treatment of ground water. Since Alternative 2 includes measures to reduce contaminant concentrations and mass in ground water and surface water and prevent migration of the contaminant plumes, it provides long-term and effective protection of human health and the environment. There are no short-term risks that cannot be controlled associated with Alternative 2, and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.4. Building 850 Firing Table (OU 5)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, and MNA) protects humans from ingestion of contaminated ground water while contaminant concentrations are naturally attenuating through institutional/land use controls. Natural attenuation has already significantly reduced contaminant concentrations and mass in ground water, and concentrations continue to decline. Modeling indicates that tritium in ground water will attenuate to meet cleanup standards in a reasonable timeframe without migrating offsite, thus providing long-term and effective protection of human health and the environment. Tritium in ground water will continue to naturally attenuate to background levels. An *in situ* bioremediation treatability study is being implemented to address perchlorate recently identified in Building 850 ground water. Ecological hazards to ground squirrels and deer to cadmium, burrowing owls to PCB, dioxin, and furan compounds, and aquatic organisms to copper and zinc were identified. However, surveys found no impacts to the population from cadmium, copper, or zinc. The burrowing owl risk will be mitigated through the soil remediation scheduled for 2008. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.5. Pit 7 Complex (OU 5)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, MNA, Source Control, and Ground Water Extraction and Treatment) protects human health and the environment by preventing exposure to contaminants while the natural attenuation of tritium and extraction and treatment of uranium, VOCs, nitrate, and perchlorate reduces activities/concentrations in ground water to health-protective and ARAR-compliant levels. Monitoring will be used to demonstrate the effectiveness of the remedial measures in reducing contaminant levels to meet State and Federal chemical-specific ARARs in a reasonable timeframe. Contact with landfill waste will be prevented by long-term institutional/land use controls. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.6. Building 854 OU (OU 6)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, Ground Water and Soil Vapor Extraction and Treatment) protects human health and the environment through active remediation and institutional/land use controls. Alternative 2 prevents ingestion of contaminated ground water through institutional/land use controls. The inhalation risks inside and outside Building 854F and inside Building 854A have been mitigated. The human health and ecological risks associated with the PCB, dioxin and furan compound-contaminated soil at the former Building 855 Lagoon have also been mitigated. Alternative 2 provides long-term protection of human health and restores beneficial uses of ground water. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.7. Building 832 Canyon OU (OU 7)

The selected alternative (Alternative 2—Monitoring, Risk and Hazard Management, Ground Water and Soil Vapor Extraction and Treatment) protects human health and the environment through active remediation and institutional/land use controls. No unacceptable hazards to ecological receptors were identified. Alternative 2 addresses risk to human health from potential inhalation of VOC vapors above health-based concentrations at Building 830 and Spring 3 by reducing soil vapor VOC concentrations through ground water and soil vapor extraction. Institutional/land use controls prevent exposure while contaminant concentrations are being reduced through active treatment. The inhalation risk inside Building 832 and outside Building 830 have been mitigated. Since Alternative 2 includes measures to reduce contaminant concentrations and mass in ground water and surface water and prevent migration of the contaminant plumes, it provides long-term and effective protection of human health and the environment. There are no short-term risks that cannot be controlled associated with Alternative 2, and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.8. Building 801 Dry Well and Pit 8 Landfill Area (OU 8)

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) is protective of human health and the environment as no unacceptable risk or hazard to human health were identified for contaminants present in the Building 801 Dry Well area. VOC concentrations in ground water in the Building 801 Dry Well area are currently below cleanup standards and declining. Nitrate concentrations exceed the cleanup standard in two wells, but are within the range of nitrate background levels. Perchlorate is not detected in ground water. An ecological hazard to ground squirrels and deer to cadmium was identified in the Building 801 Dry Well area. However, surveys found no impacts to the population. There are no COCs in any environmental media in the Pit 8 Landfill area. For that reason, there is no risk to human or ecological receptors. Contact with landfill waste will be prevented by long-term institutional/land use controls. There has been no evidence of contaminant releases from the Pit 8 Landfill in almost 50 years since this landfill has been in place, including following El Niño type rainfall years such as occurred in the early 1980s. While no unacceptable risk or hazard to human health was identified, monitoring would continue to be conducted to detect any future releases from the landfill. Thus, Alternative 2 provides long-term and effective protection of human health and the environment. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.9. Building 833 Area (OU 8)

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) protects human health and the environment through monitoring and institutional/land use controls. No unacceptable hazards to ecological receptors were identified. Alternative 2 prevents ingestion of contaminated ground water and addresses risk to human health from potential inhalation of VOC vapors above health-based concentrations inside Building 833 through institutional/land use and engineered controls while contaminants continue to decrease towards cleanup standards. Thus, Alternative 2 provides long-term protection of human health and restores beneficial uses of ground water. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.10. Building 845 Firing Table and Pit 9 Landfill Area (OU 8)

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) is protective of human health and the environment as there is no risk to human or ecological receptors or threat to ground water associated with contamination in subsurface soil at Building 845 and no contaminants have been detected in ground water under the Building 845 Firing Table or Pit 9 Landfill. Contact with landfill waste will be prevented by long-term institutional/land use controls. While no unacceptable risk or hazard to human health was identified, monitoring would continue to be conducted to detect any future releases from the landfill. Thus, Alternative 2 provides long-term and effective protection of human health and the environment. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.11. Building 851 Firing Table Area (OU 8)

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) is protective of human health and the environment because there is no risk or hazard to human health associated with contaminants in surface soil, subsurface soil/bedrock, or ground water identified for the Building 851 Firing Table. Modeling indicates the contaminants in surface and subsurface soil will not impact underlying ground water. Total uranium activities in ground water have always been well below the cleanup standard and at similar levels to those at which uranium naturally occurs in ground water in this area. Alternative 2 includes monitoring of ground water to indicate any changes in uranium activities and to determine if soil/rock contaminants impact ground water in the future. An ecological hazard to ground squirrels and deer to cadmium was identified. However, surveys found no impacts to the population. Therefore, Alternative 2 provides long-term protection of human health and the environment. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.1.12. Pit 2 Landfill

The selected alternative (Alternative 2—Monitoring and Risk and Hazard Management) protects human health and the environment by preventing ingestion of contaminated ground water and contact with landfill waste through institutional/land use controls while contaminants naturally attenuate. Contaminant concentrations in Pit 2 Landfill ground water are below cleanup standards and are declining. While no unacceptable risk or hazard to human health or ecological receptors were identified, Alternative 2 addresses potential changes in the Pit 2 Landfill area that could impact human health and the environment through monitoring. Thus, it provides long-term and effective protection of human health and the environment. There are no short-term risks that cannot be controlled associated with Alternative 2 and no adverse cross-media impacts are expected from the selected interim remedy.

2.13.2. Compliance with ARARs

The selected remedies in this Site-Wide ROD comply with the ARARs identified for Site 300. Table 2.13-1 summarizes how the selected remedies comply with the Site 300 Federal and State ARARs.

2.13.3. Cost-Effectiveness

In DOE's judgment, the selected remedies for the OUs addressed in this Site-Wide ROD are cost-effective and represent a reasonable value for their cost. In making this determination, the following definition was used: "A remedy shall be considered cost-effective if its costs are proportional to its overall effectiveness." [NCP 300.450(f)(1)(ii)(D)]. In addition, Alternative 2 is the only effective alternative presented in the Site-Wide ROD, hence the only cost-effective alternative. The Interim ROD contains a cost-benefit analysis of other alternatives that were considered but not selected. This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., protect human health and the environment and comply with ARARs). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence, reduction in toxicity, mobility and volume through treatment, and short-term effectiveness). Overall effectiveness was then compared to estimated costs to evaluate cost-effectiveness. The relationship of the overall effectiveness of the selected remedial alternatives was determined to be proportional to their costs and hence they represent reasonable value.

The cost of the selected remedies for each of the OUs addressed in this Site-Wide ROD are summarized in Table 1.4-1.

2.13.4. Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

DOE and the regulatory agencies have determined that the selected remedies described in this Site-Wide ROD represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at Site 300 OUs 2 through 8. For each OU, only Alternative 2 utilizes permanent solutions and alternative treatment technologies. The Interim ROD contains a discussion of other alternatives that were analyzed for permanence and alternative technologies but were not selected. Of those alternatives that protect human health and the environment and comply with ARARs, DOE and the regulatory agencies have determined that the selected remedies provide the best balance of trade-offs in terms of the U.S.

EPA/NCP five balancing criteria and two modifying criteria. The selected remedies also consider State and community acceptance, the statutory preference for treatment as a principal element, and a bias against offsite treatment and disposal.

2.13.5. Preference for Treatment as a Principal Element

By using extraction and treatment utilizing GAC, biotreatment, and/or ion exchange to remove contaminants from ground water and soil, the selected remedies for these OUs address the principal threats through the use of treatment technologies. By using treatment as a significant portion of the Site 300 remedies for the OUs addressed in this Site-Wide ROD, the statutory preference for remedies that employ treatment as a principal element is satisfied.

Because there is no effective technology available for the treatment of tritium, the selected remedies at the Pit 6 Landfill, Building 850, and the Pit 7 Complex utilizes natural attenuation to reduce tritium activities in ground water. Because tritium has a short radioactive decay half-life (12.3 years), tritium activities in Building 850 and Pit 7 Complex ground water will be reduced to meet the cleanup standard in a reasonable timeframe. Tritium activities in Pit 6 Landfill ground water are already well below cleanup standards and continue to decrease toward background levels. Ground water data has demonstrated that nitrate in ground water in the HE Process Area and Building 832 Canyon OUs is naturally attenuating to background levels. Treatment is not a practical option for waste left in place at onsite landfills.

2.13.6. Five-Year Review Requirements

Because the remedies for the Site 300 OUs addressed in this Site-Wide ROD will result in hazardous substances remaining onsite above levels allowable for unlimited use and unrestricted exposure, a statutory review will be conducted to ensure that the remedy is, or will be, protective of human health and the environment.

One or more Five-Year Reviews have already been conducted for the interim remedial actions at the Building 834 and HE Process Area OUs. Five-Year Reviews are scheduled for the Buildings 854, 850, and 832 Canyon OUs in 2008, 2009, and 2011, respectively. A Five-Year Review will be scheduled for the Pit 7 Complex within five years after initiation of the remedial action. Five-Year Reviews for the Pit 6 Landfill and Site-Wide OUs will be scheduled within five years after the Site-Wide ROD is signed.

2.14. Documentation of Significant Changes

The Site 300 Proposed Plan was released for public comment on May 25, 2007. The Proposed Plan identified the Preferred Alternatives for the Site 300 OUs addressed in this Site-Wide ROD. DOE and the regulatory agencies reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the remedies as originally identified in the Proposed Plan were necessary and appropriate.

3. Responsiveness Summary

This section responds to public comments directed to DOE/LLNL, U. S. EPA, and the State of California regarding the *Final Proposed Plan for Environmental Cleanup at Lawrence Livermore National Laboratory Site 300*, dated May 25, 2007. Responses to community comments and questions are incorporated into this Site-Wide ROD.

The community group Tri-Valley Communities Against a Radioactive Environment (CAREs) requested a 30-day review extension for the Proposed Plan on May 31, 2007. Therefore the 60-day public comment period began on May 25, 2007 and ended on July 25, 2007. On June 20, 2007, DOE/LLNL and the regulatory agencies held a public meeting at the Community Center in Tracy, California to present the proposed remediation plans and receive public questions and comments on the preferred remedial alternatives. At the meeting, representatives from DOE and LLNL summarized information from the Proposed Plan. Following the presentations, the public was given the opportunity to present their comments into the formal public record. These comments are presented in Section 3.3.

Community acceptance was measured by both the magnitude and substance of comments received. The interested public at Site 300 is made up of residents who live within about a mile of the Site, the nearby community of Tracy, and the local environmental community represented primarily by Tri-Valley CAREs. Six Tri-Valley CAREs representatives, 2 City of Tracy representatives, and 18 local community members signed the Proposed Plan Public Meeting attendance sheet.

Areas of concern related to a specific OU are listed under the Community Acceptance Sections for that OU in Section 2.10.

3.1. Organization of the Responsiveness Summary

Section 3.1 presents the organization of the Responsiveness Summary. Section 3.2 addresses several main areas of public concern regarding the proposed plan for Site 300 cleanup that were identified in numerous comments. Areas of concern related to a specific OU are listed under the Community Acceptance Sections for that OU in Section 2.10. Section 3.3 of this Responsiveness Summary responds to the questions and comments received at the June 20, 2007 public meeting and recorded in the transcript of that meeting. Section 3.4 responds to the written comments received by July 25, 2007. Responses to similar questions or comments are cross-referenced.

DOE, EPA, and the State of California have consulted on the comment responses and agree on their content.

3.2. Areas of Primary Public Concern

Several main areas of public concern regarding the proposed plan for Site 300 cleanup were identified in numerous comments including:

- Whether cleanup standards for Site 300 are sufficiently protective (Section 3.2.1).
- The potential for ongoing operations to impact human health and the environment (Section 3.2.2).
- Concerns that migration of the contaminant plumes, particularly tritium, is not controlled and will impact nearby residents, communities, and ground water downgradient of Site 300 (Section 3.2.3).
- Requests for total or partial excavation of the waste at the Pit 7 Complex landfills (Section 3.2.4).
- Community involvement (Section 3.2.5).
- Whether funding for the long-term cleanup is sufficient (Section 3.2.6).

Because multiple commenters expressed these concerns, Section 3.2 addresses these areas of primary public concern in detail. Responses to individual comments in Section 3.3 regarding these concerns may refer back to Section 3.2 to address the comment.

3.2.1. Cleanup Standards

The public expressed concerns about the cleanup standards proposed for remediation of Site 300. Several commenters recommended that:

- Cleanup reduce contaminants to concentrations suitable for residential land use rather than for industrial land use.
- Ground water should be cleaned up to background levels rather than drinking water Maximum Contaminant Levels (MCLs)

The highest priority of the cleanup effort is to protect workers at Site 300, site neighbors, and the residents of Tracy and nearby communities, which includes many DOE and LLNL employees and their families.

DOE and LLNL conducted extensive investigations to evaluate contamination at Site 300 and potential impacts to site neighbors and nearby communities. This work was performed under the stringent guidelines and oversight of the U.S. Environmental Protection Agency (EPA) and the state environmental regulators. The results of these investigations and evaluations indicate that the contamination at Site 300 will not impact residents of Tracy or any future residents of the Tracy Hills Development.

The Agency for Toxic Substances and Disease Registry, a public health agency of the U.S. Department of Health and Human Services, performed an independent health assessment of contamination at Site 300 in 2005. This assessment concluded that there are no past or current exposures to contaminants associated with Site 300, and the potential for future exposure is unlikely.

All ground water affected by Site 300 contamination will be cleaned up to meet Federal and State drinking water standards (MCLs), at a minimum. Drinking water standards (MCLs) do not differentiate between residential and industrial uses, therefore cleaning up ground water to meet these standards would be protective of residential populations. These are consistent with the standards that U.S. Environmental Protection Agency generally requires for Superfund sites throughout the U.S. However, once drinking water standards have been achieved, DOE will evaluate the feasibility of continuing ground water cleanup to even lower levels. A range of values will be considered down to water quality numeric limits or background. The technical and economic feasibility analyses would be reviewed and approved by the Regional Water Quality Control Board, Department of Toxic Substances Control, and the U.S. Environmental Protection Agency. Any changes to ground water cleanup standards would be proposed to the community and take effect through a Record of Decision amendment. It is important to note that tritium in ground water will continue to decay to background levels, regardless of the cleanup standards.

Industrial cleanup standards have been selected for soil cleanup because: (1) Site 300 is an industrial site, (2) there is no offsite soil contamination or risk to offsite residents of exposure to soil contamination at Site 300, and (3) there is no risk to the site neighbors or residents of nearby communities of exposure to soil contamination at Site 300. Therefore, soil cleanup will be conducted to eliminate any risk to onsite workers and to prevent further impacts to ground water. The Building 850 Firing Table is the only OU that still contains surface soil contamination that poses an unacceptable risk to humans (onsite workers) and animals. The selection of industrial soil cleanup standards at an industrial site is consistent with EPA's guidance for site investigations and cleanup under CERCLA. It would cost the taxpayers significantly more money to fund cleanup to lower levels with no added level of protection under the current land use scenario.

While DOE is evaluating the consolidation of activities throughout the DOE complex that could result in changes to activities conducted at Site 300, DOE control of the site is expected to continue for the foreseeable future. There are no plans to open the land for recreational or residential uses. There are provisions in the Site 300 Federal Facility Agreement that ensure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. If the land use changes, the cleanup remedies and standards would be reviewed to ensure they are consistent with its intended use in accordance with Federal and State laws. Additionally, the Five-Year Review Process and the Site-Wide Compliance Monitoring Plan/Contingency Plan specifically evaluate changes that have either occurred or can be foreseen for the future, including potential changes in land use.

3.2.2. Ongoing Operations

The public has expressed concern that ongoing operations at Site 300, particularly at the firing tables, are continuing to contaminate the environment. DOE appreciates and understands these concerns, and therefore would like to explain measures that have and are being taken that address the potential for contamination from ongoing operations at Site 300 including:

- Changes in waste handling and operational practices.
- Monitoring of operational activities and reporting of monitoring results.
- Current and future use of firing tables at Site 300.

3.2.2.1. Changes in waste handling and operational practices

The contamination at Site 300 was caused primarily by past waste handling practices. For example, wastewater from buildings was discharged directly to the land using dry wells and unlined lagoons before the negative environmental impacts of these practices were known and regulated. These practices have changed significantly since the Laboratory began operation at Site 300 over 50 years ago. Hazardous and radioactive waste currently generated at Site 300 is handled, stored, transported, and disposed in accordance with environmental laws and regulations.

Experiments conducted at the site are now designed with a much better understanding of environmental protection. Program activities are planned and monitored for compliance with the Resource Conservation and Recovery Act (RCRA) and other environmental regulations (such as the Clean Air and Clean Water Acts) to ensure that future harmful releases do not occur. LLNL has extensive environmental protection procedures in place that are designed to prevent any additional contamination.

3.2.2.2. Monitoring and reporting of operational activities

The monitoring of air, soil, vegetation, and wildlife is conducted at Site 300 to evaluate compliance with local, state, and federal laws and regulations and to ensure that human health and the environment are protected and the monitoring results are published and available to the public as discussed below.

Air Monitoring

LLNL performs continuous air sampling at Site 300 to evaluate its compliance with local, state, and federal laws and regulations and to ensure that human health and the environment are protected. Federal environmental air quality laws and U.S. Department of Energy (DOE) regulations include Title 40 of the Code of Federal Regulations Part 61 (40 CFR Part 61)—the National Emissions Standards for Hazardous Air Pollutants (NESHAPs) section of the Clean Air Act; applicable portions of DOE Order 5400.5, Radiation Protection of the Public and the Environment; and American National Standards Institute (ANSI) standards.

Two types of air monitoring are conducted at Site 300: (1) monitoring of facility discharge points during operations, and (2) ambient air monitoring. LLNL evaluates all facility discharge points with the potential to release radionuclides to the air according to 40 CFR Part 61, Subpart H, of the NESHAPs regulations. Monitoring of facility discharge is used to determine if radionuclides are being released from individual facilities during operations and to confirm that the facility emission control systems are operating effectively. LLNL also assesses new operations or changes in operations for the need for continuous monitoring. The U.S. Environmental Protection Agency (EPA) Region IX has enforcement authority for LLNL compliance with radiological air emissions regulations. Enforcement authority for the Clean Air Act regulations pertaining to nonradiological air emissions belongs to the local air district, the San Joaquin Valley Air Pollution Control District (SJVAPCD). Based on air toxics emission inventory and risk assessment required by the California Air Toxics “Hot Spots” Information and Assessment Act of 1987, the SJVAPC have ranked LLNL as a low-risk facility for nonradiological air emissions.

In addition, LLNL monitors ambient air at and near Site 300 to determine whether radionuclides or beryllium are being released by Laboratory operations, what the concentrations are, and if there are trends in these concentrations. There are nine stations located at or near Site 300 that continuously collect ambient air samples. Air sampling locations are grouped into the following categories: site perimeter, upwind, downwind, diffuse sources onsite, areas of known contamination onsite, and special interest locations. The monitoring network continuously collect ambient air samples that are analyzed for particulate, uranium, tritium and gross alpha and beta concentrations.

Soil, Sediment, Vegetation, and Wildlife (Terrestrial) Monitoring

LLNL also monitors the radioactivity present in soil, sediment, and vegetation, and the absorbed gamma radiation dose at ground-level receptors from terrestrial and atmospheric sources. In addition, LLNL monitors the abundance, distribution, and ecological requirements of plant and wildlife species as part of compliance activities and research programs.

The LLNL terrestrial radioactivity monitoring program is designed to measure any changes in environmental levels of radioactivity and to evaluate any increase in radioactivity that might have resulted from LLNL operations. All monitoring activities follow DOE guidance criteria. Monitoring activities at in the vicinity of Site 300 is conducted to detect radioactivity released from LLNL that may contribute to radiological dose to the public or to biota; monitoring at distant locations not impacted by LLNL operations detects naturally occurring background radiation.

Potential terrestrial exposure pathways from LLNL operations that could cause a radiological dose to the public include inhalation or ingestion of resuspended soil particles, infiltration of constituents to groundwater, ingestion of locally grown foodstuffs, and external exposure to contaminated surfaces and radioactivity in air. Potential ingestion doses are calculated from measured concentrations in vegetation; doses from exposure to ground-level external radiation are obtained from direct measurement of environmental radiation. Potential dose to biota is calculated using a screening model that requires knowledge of radionuclide concentrations in soils, sediments, and surface water.

Surface soil samples are also collected from 14 locations at Site 300, including sampling locations around explosive testing areas. Surface soil samples are analyzed for plutonium and gamma-emitting radionuclides. Gamma-emitting radionuclides in surface soils include uranium isotopes, which are used to evaluate the levels of naturally occurring uranium in soil and potential contributions by explosive tests at Site 300. In addition, soils at Site 300 are analyzed for beryllium, a metal that has been used in testing there. Subsurface soil samples are also collected and analyzed for tritium and metals; the results are compared to background levels of these constituents to evaluate potential contributions from site activities.

LLNL has performed routine vegetation sampling on and around Site 300 that measured for tritium alone because tritium is the only nuclide released from LLNL that can be measured in vegetation. Tritium activities in vegetation samples are compared the contribution from background radiation, to determine what, if any, excess dose can be attributed to Laboratory operations.

LLNL also monitors wildlife and plants at Site 300 and conducts research relevant to the protection of rare plants and animals. Some monitoring and research programs are required by existing permits, while other monitoring programs are designed to track the distribution and abundance of rare species. In addition, baseline surveys are conducted to determine distribution of special status species on LLNL property. Monitoring and research of biota on LLNL property is conducted to ensure compliance with requirements of the U.S. Endangered Species Act, the California Endangered Species Act, the Eagle Protection Act, the Migratory Bird Treaty Act, and the California Native Plant Protection Act as they pertain to endangered, threatened, and other special status species, their habitats, and designated critical habitats that exist at both LLNL sites.

Reporting of Monitoring Results

Preventive and mitigating activities and monitoring for any releases are reported in the LLNL Site Annual Environmental Report. The Site Annual Environmental Report provides information on releases and background environmental conditions around Site 300. In addition, a semi-annual Compliance Monitoring Reports are published that describe monitoring conducted under the Comprehensive Environmental Response, Compensation, and Liability Act including remediation system and landfill monitoring and the progress of site cleanup. This report can be found at www-envirinfo.llnl.gov/.

Current and Future Use of Firing Tables at Site 300.

At present (April 2008), the Building 851 and Building 812 firing tables are the only locations where outdoor firing tables are used to conduct explosives testing for the DOE Weapons Program. Under the current plan, use of outdoor firing tables for the DOE Weapons Program explosives testing will be discontinued by the end of 2009. The Building 851 Firing Table area was characterized as part of the Site-Wide Remedial Investigations conducted at Site 300. No risk or hazard associated with surface soil, subsurface soil/rock, or ground water was identified for the Building 851 Firing Table in the baseline risk assessment. Uranium activities in ground water at Building 851 are a fraction of the 20 pCi/L drinking water standard (maximum uranium activities of 0.8 pCi/L in 2007) and are within the range of background levels.

Use of the Building 850 Firing Table for DOE Weapons Program explosives testing was discontinued in January 2008. Plans are underway to implement cleanup of contaminated soil at the Building 850 firing table in 2008-2009. Cleanup to address contamination in ground water and surface water at Building 850 was implemented in 2001. Use of the Building 812 Firing Table for DOE Weapons Program explosives testing is being discontinued in 2008. A ground water extraction and treatment system was constructed as a treatability study in 2007. A Feasibility Study is currently underway to formulate cleanup alternative options for long-term contaminant cleanup in the Building 812 area.

While use of some firing tables at Site 300 is being considered for LLNS Work-for-Others Projects (e.g., Department of Homeland Security, Department of Defense), LLNS will evaluate these projects for potential environmental impacts prior to approval of the experiments, and any necessary controls will be implemented to minimize and mitigate contamination.

3.2.3. Plume Migration

The public expressed concerns about impacts of the contaminant plumes, particularly tritium at Site 300 on nearby communities and on downgradient ground water. Several commentors recommended implementing hydraulic control measures to prevent migration of tritium in ground water.

One of the Remedial Action Objectives for Site 300 cleanup is to prevent plume migration to the extent technically practicable. This objective is achievable for all but one contaminant (tritium) in Site 300 ground water and the twenty ground water extraction and treatment systems operating at the site are designed to prevent the migration of volatile organic compounds, high explosives compounds, uranium, perchlorate, and nitrate in ground water. However, there is no technically feasible technology to remove tritium from ground water. During the timeframe necessary for tritium activities to be reduced to drinking water standards and background levels, the tritium will not migrate offsite, impact water-supply wells, or threaten human health or plant and animal communities.

A discussion of the hydraulic control and the migration of the tritium plumes are discussed in Sections 3.2.3.1 and 3.2.3.2, respectively.

3.2.3.1. Hydraulic Control of the Tritium Plumes

The remedy for the Pit 7 Complex Landfills includes measures to hydraulically control contaminant sources in the landfills and underlying bedrock. A hydraulic control (drainage diversion) system was installed to prevent further contaminant releases from both the landfill waste and underlying bedrock, and to reduce local ground water gradients, effectively slowing migration of the pre-existing tritium and uranium ground water plumes. Ground water data collected from the Building 850 Firing Table area indicates that there is no longer a significant source of tritium present that could impact ground water.

In response to similar public comments on the Remedial Investigation/Feasibility Study (RI/FS) for the Pit 7 Complex (2005), DOE evaluated the feasibility of preventing migration of the tritium plume downgradient of the Pit 7 Complex using hydraulic control measures (e.g., partial and complete hydraulic capture and recirculation of ground water.) The objective of hydraulic recirculation would be to prevent tritium plume migration by extracting tritium-bearing ground water within the downgradient portion of the plume and injecting this ground water at upgradient locations to allow more time for radioactive decay and dispersion to attenuate the plume. A summary of this evaluation was included in the Pit 7 Complex RI/FS (Appendix F, Section F-16).

Hydraulic recirculation was not included as part of the remedy for the Pit 7 Complex because the results of an evaluation of this technology showed that neither a complete nor partial recirculation system could be implemented that would not create worse environmental problems than it would solve. The U.S. Environmental Protection Agency (EPA) and the State environmental regulatory agencies concurred with this conclusion.

The results of the evaluation indicated that the recirculation of ground water in both the alluvium/weathered bedrock and bedrock aquifers would result in the following adverse impacts:

1. Pit inundation,
2. Additional release of contaminants,
3. Accelerating migration of the high activity portion of the plume, and

4. Discharge of contaminated ground water at the surface.

The bedrock aquifer underlying the Pit 7 Complex consists of low permeability, consolidated sandstone in which the rate of ground water movement is 0.01 to 0.03 foot per day and wells typically produce less than 1 gallon per minute. These characteristics limit the amount of water that can be reinjected, stored in, and moved through the aquifer. For this reason, continuous reinjection of ground water into the upgradient portion of the plume near the contaminant source area (the pits), would cause ground water levels to rise into the pits and push contaminants downgradient faster. To achieve even partial hydraulic capture and recirculation of the tritium plume at the Pit 7 Complex would upset the local water balance and exceed the amount of water the aquifer could hold, resulting in significant rises in ground water and possible inundation of the pits. Attempting partial hydraulic capture and recirculation of the tritium plume by reinjecting ground water downgradient of the pits would also have negative impacts; causing the lateral expansion of the plume into uncontaminated ground water. Although the alluvial aquifer consists of more permeable material than the bedrock aquifer, tritium plume migration is currently limited due to extended periods of dry conditions at Site 300. The alluvial/weathered bedrock aquifer is not saturated for significant periods during the year, therefore, measurable downgradient plume migration does not occur. Hydraulic recirculation would create a continuously saturated pathway year-round in the higher conductivity alluvial/weathered bedrock aquifer, resulting in faster migration of the tritium plume. Therefore, both partial and complete hydraulic capture and recirculation of the tritium plume is not a technically feasible technology for controlling tritium plume migration at the Pit 7 Complex.

DOE/LLNL also evaluated the feasibility of using hydraulic recirculation technology to prevent further migration of the tritium plume in the Building 850 OU. Hydraulic recirculation consists of extracting tritiated ground water in the downgradient portion of the plume, and reinjecting it upgradient. The applicability of hydraulic recirculation of the tritiated ground water to prevent migration of the plume with activities above background is limited by site conditions including the permeability and storage capacity of the $Tnbs_1/Tnbs_0$ HSU. This HSU consists of a low permeability, consolidated sandstone in which the rate of ground water movement is 0.01 to 0.03 foot per day and wells typically produce less than 1 gallon per minute. These characteristics limit the volume of water that can be reinjected, stored in, and moved through the aquifer. For this reason, continuous reinjection of ground water into the upgradient portion of the plume near the Building 850 firing table would increase the hydraulic gradient and increase the tritium plume migration rate. To achieve even partial hydraulic capture and recirculation of the tritium plume would upset the local water balance and exceed the volume of water the aquifer could hold, also resulting in increased plume migration rates. Attempting partial hydraulic capture and recirculation of the tritium plume by reinjecting ground water downgradient of the Building 850 firing table would also have negative impacts, causing the lateral expansion of the plume into uncontaminated ground water.

Although the Qal/WBR HSU consists of more permeable material than the bedrock aquifer, tritium plume migration is currently limited due to extended dry periods at Site 300. The saturated thickness of the Qal/WBR HSU is minimal for the majority of the year. Therefore, downgradient plume migration in this HSU is not significant during the dry season. Despite minimal transport during the dry season, tritium has migrated over 3,000 ft in the Qal/WBR HSU due to transport during wet periods since the release of tritium from Building 850 began in the early 1970s**.** Hydraulic recirculation would create a continuously saturated pathway year-round in the higher conductivity Qal/WBR HSU, resulting in faster migration of the tritium plume.

Therefore, both partial and complete hydraulic capture and recirculation of the tritium plume is not a technically feasible technology for controlling tritium plume migration at the Building 850 Firing Table because it would result in exceedence of the HSU storage capacitiy, increase the hydraulic gradient, and accelerate plume migration.

3.2.3.2. Tritium Plume Migration

The tritium in ground water with activities that exceed drinking water standards extends approximately 1,300 ft (1/4 mile) from the source areas at the Pit 7 Complex and Building 850, and remains more that 2 miles from the site boundary. The portion of the tritium plumes with activities above drinking water standards are stable or shrinking in both the Building 850 and Pit 7 Complex areas.

Ground water modeling results show that the portion of the plume in excess of drinking water standards (20,000 picoCuries per liter) will not migrate offsite during the 42 years necessary for all tritium activities to decline to below this standard. While tritium is present in ground water above background levels at a greater distance from these source areas, this tritium will decay to background levels without migrating offsite or impacting site neighbors, nearby communities, or plants and animals at or near the site. There is no risk of exposure to tritium or uranium in ground water to existing or potential residential populations near Site 300. Tritium and uranium in ground water from the Pit 7 Complex and Building 850 areas do not extend outside the Site 300 boundary and is geologically isolated from the water-supply aquifer used by the City of Tracy. Modeling indicates that neither tritium nor uranium will migrate offsite during the time it will take to clean up these contaminants. The cleanup remedy for the Pit 7 Complex is designed to reduce ground water contamination to meet drinking water standards, at a minimum.

There are also significant geologic and hydrogeologic constraints to the movement of tritium-contaminated ground water in bedrock in the vicinity of and northeast of the Pit 7 Complex. A thick low-permeability claystone aquitard ($Tnsc_0$) underlies the $Tnbs_0$ sandstone water-bearing unit in the vicinity of the Pit 7 Complex and in the northern part of Site 300. As a result, the underlying Cierbo Formation is hydraulically isolated from tritium-contaminated ground water in the overlying $Tnbs_0$ sandstone. Ground water in the $Tnbs_0$ sandstone bedrock flows to the northeast of the pit area at a low velocity (6 to 12 ft/year). The $Tnbs_0$ sandstone is unsaturated (does not contain ground water) to the east and northeast of the Site 300 boundary. All Neroly Formation strata, including the $Tnbs_0$ sandstone bedrock, and the underlying Cierbo Formation bedrock are eroded away in northeastern Site 300 and to the east, and therefore there is no continuous saturated pathway between the plume and offsite receptors such as the City of Tracy water-supply wells. In addition, significant water level mounding occurs across the Elk Ravine Fault, located east-northeast of the pits. The decreases in water elevation across the fault indicate that the fault significantly retards the flow of ground water in the east-northeast direction. These geologic and hydrogeologic conditions indicate that there is not a complete pathway to existing water-supply wells east or north of Site 300.

In addition, DOE conducted fate and transport modeling of tritium and uranium to the site boundary as part of the human health risk assessment 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 land in the vicinity of Site 300 have been subject to development. The modeling results indicate 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.

There is an extensive ground water monitoring network in place at the site that is regularly sampled to evaluate migration of the tritium plume. Hundreds of samples are collected each year and the results of this monitoring are reported to the regulatory agencies and general public semi-annually.

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 Site 300 to ensure continued protection of human health and the environment. DOE regularly reviews and discusses 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-evaluating and implementing changes to the remedy if cleanup does not proceed as expected.

3.2.4. Excavation of Pit 7 Complex Landfill Waste

The public expressed concerns about the waste at the Pit 7 Complex Landfills remaining onsite and recommended total excavation of the waste or the excavation of hot spots within the landfill waste.

Excavation of landfill waste was evaluated as a remedial alternative in the Remedial Investigation/Feasibility Study for the Pit 7 Complex. Public comments suggesting excavation of waste in the Pit 7 landfills were considered and discussed by DOE, the U.S. Environmental Protection Agency, and the State regulatory agencies. Following evaluation of the remedial alternatives and discussion of public comments, the regulatory agencies concurred with DOE that landfill waste excavation would not be the most effective means of preventing contaminant releases from the Pit 7 Complex landfills and the underlying bedrock. This rationale for this decision is discussed below.

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) tritium and isotopic uranium analysis of cores from Pits 3 and 5 and underlying bedrock, (3) a helium-3 (a daughter product of tritium) survey of pit vapor from which tritium activities within the landfills were determined, (4) seismic, induction, and magnetometer surveys that provided data on variations in pit depth and density, and (5) definition of metal objects within the waste. The results of these investigations indicated 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 ("hot spots") that could be preferentially excavated from the pits to reduce or prevent potential releases from the pits. In addition, radioactive material is essentially pulverized during explosive tests, leaving behind little to no discernable chunks of radioactive material that would have been placed in the landfill creating "hot spots". Therefore, selective excavation of contaminant hot spots within the pit waste is not a viable cleanup option, because none have been identified.

Analytical results from waste samples collected from within the landfills and soil/rock samples collected from beneath the landfills indicate that the highest tritium activities are present in the soil and rock beneath the landfills. This data was used in a 3-dimensional contaminant property model to characterize the location and magnitude of residual tritium and uranium sources with respect to the landfill boundaries. This analysis indicated that 70% to 80% of the residual uranium and tritium resides in the soil and rock underneath the landfill. Therefore, excavation of the pit waste would not prevent further releases to ground water because the majority of the tritium and uranium are present in the bedrock underlying the pits and would still remain as a contaminant source after waste excavation.

For these reasons, DOE, the U.S. EPA and the State regulatory agencies concurred that landfill waste excavation would not be effective in preventing contaminant releases from the both the Pit 7 Complex landfills and the underlying bedrock. In addition, there is the potential for short-term exposure for onsite workers during waste excavation and disposal. This is likely to increase the number of exposure pathways, as well as disrupt habitat, increasing the potential for short-term exposure and impacts to the environment.

The hydraulic drainage diversion system source control component of the remedy for the Pit 7 Complex will prevent further contaminant releases from both the landfills and underlying bedrock. It will also effectively slow the migration of the existing tritium and uranium ground water plumes by reducing local ground water gradients. Therefore, DOE and the regulatory agencies considered the hydraulic drainage diversion system to be more protective of human health and ground water and able to better meet federal and state laws and regulations than excavation of the landfill waste. As part of the remedy, this source control technology is coupled with the extraction and treatment of ground water to remove contaminants already released to ground water. Regardless of the source control technology selected (e.g., waste excavation or hydraulic drainage diversion), institutional and land use controls are necessary to prevent exposure to the landfill waste.

3.2.5. Community Involvement

The public expressed concern about whether there is a mechanism for long-term community involvement in the Site 300 cleanup process after the Record of Decision is completed.

DOE will hold community workshops following completion of the Record of Decision to discuss cleanup progress and solicit community input as long as there is sufficient interest in the community. Notices of the time and place for these community workshops will be placed in local newspapers and letters will be sent notifying and inviting neighbors, local government, and other interested community members to attend these workshops. DOE will also periodically issue Fact Sheets to the public discussing the progress in site cleanup. The Public Repositories, that contain documents relevant to site cleanup, will continue to be maintained at the Tracy Public Library and LLNL Discovery Center. Information on site cleanup will also be available on the LLNL Environmental Community Relations website at envirinfo@llnl.gov. In addition, the public can contact Claire Holtzapple, the DOE Site 300 Remedial Project Manager, at holtzapple1@llnl.gov or (925) 422-0670 with any questions or concerns regarding the cleanup project at Site 300. In addition, the public can contact the LLNL Public Affairs Office (925) 422-4599 for any questions or concerns about ongoing operations at Site 300.

3.2.6. Cleanup Funding

Several commenters expressed concern that funding is not guaranteed for cleanup of existing contamination or for any new contamination that might be discovered in the future.

This Record of Decision represents a legally binding commitment by DOE to continue the cleanup of contamination at Site 300, including requests to Congress for continued funding of the cleanup activities. The Site-Wide Compliance Monitoring Plan/Contingency Plan for Site 300, that was reviewed and approved by the U.S. Environmental Protection Agency (EPA) and State regulatory agencies, includes measures to be taken in the event that new, undiscovered contamination is discovered at Site 300. If new contamination was identified that warrants cleanup, a request for additional funding would be submitted to Congress.

DOE submits annual funding requests to Congress for the cleanup of Site 300. The funding requests for the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) cleanup effort submitted to Congress are separate from funding requests made for other activities conducted at LLNL. The funding requests are based on cleanup commitments and regulatory deliverables agreed upon with the regulatory agencies and contained in the Federal Facility Agreement, the Records of Decision, and other CERCLA cleanup documents. Actual funding levels received for DOE site cleanup, which do not always match the funding requests, are based on decisions made and allocated at the Congressional level based on national priorities, not at the local DOE office level.

3.3. Public Meeting (June 20, 2007 at the Tracy Community Center in Tracy, CA)

Verbal comments from the transcript of public comments.

Garth Foreman — 2816 Daisy Lane, Tracy, California

Mr. Foreman comment #1*: My name is Garth Forman, 2816 Daisy Lane, Tracy, California. You know, a couple, I guess in the record, and I still didn't quite understand, "back to normal," "before people showed up at Site 300," how long to clean up in years, to that level? Can we get that somewhere? There has got to be a date or a year or a best guess back to normal if that is ever going to happen.*

Response: There are different areas of contamination at Site 300 and cleanup time will depend on how much contamination is present and how difficult it is to remove it at a specific location. The rate of cleanup of each area or operable unit is limited by such variables as the volume of contaminated ground water or soil, the type of contaminant, and characteristics of the rocks containing the ground water contamination. Some contaminated areas have already been cleaned up. Much of the site contamination will be cleaned up in several decades. Other areas will take longer where contaminants are locked up in subsurface rocks that contain clay from which it is very difficult to remove contamination. DOE is utilizing the best available technologies for the cleanup of ground water contamination at Site 300. However, we are continually searching for new technologies that can help speed up the cleanup.

Mr. Foreman comment #2*: And maybe more of a layman's term what happens when one year it is extremely wet or for three years in a row it is extremely wet and water, there is more run off, there is more water ground swell, does that cause a problem as it relates to the* *agriculture and as it relates to the pumping of groundwater and is there any chance of that ever happening to contaminate crops, fields in the San Joaquin Valley -- and that kind of leads into my major comment and concern being part of the agricultural industry. If you look into Salinas Valley; if you look into the Alar scare in apples, it may or may not have been -- it may not have been an accurate assessment but as the media got a hold of it, it crushed industries. The Salinas or San Benito County is currently running about 138 million dollars behind in agriculture based on one groundwater contamination of E.coli that spread into less than a one acre field that got to 200 servings of salad. Not sure where it came from. Not exactly sure if that is really what happened. But from a contamination standpoint and from a fear standpoint it devastated an industry in a small valley. San Joaquin County Site 300 is a major employer but in San Joaquin I still think agriculture is the largest employer and where most of our money comes back to the community. So a concern from one a media stand point, from two the information as it gets out there and people realize that we are talking about radioactive contamination and not the stuff that is actually found naturally, what, what is our plan to make sure that doesn't happen and can we ever control that when it happens?*

Response: The vast majority of contaminated ground water at Site 300 is contained within the site boundaries. Currently, there are only three offsite monitor wells that contain contamination emanating from the site that are located within 150 feet of the site boundary. This water is not used to irrigate crops. One of the highest priorities for site cleanup is to clean up any offsite contamination and to prevent further offsite plume migration. For example, ground water extraction and treatment was initiated in 1991 to begin cleanup of an offsite plume. This plume was successfully cleaned up in 2007. Ground water extraction and treatment continues near the location of the three offsite ground water monitor wells to clean up contamination. Ground water cleanup at Site 300 will continue until contaminant concentrations are reduced to drinking water standards and will not affect agricultural uses in the San Joaquin Valley during the timeframe it takes to reach this goal, even under high rainfall scenarios. DOE will continue to monitor ground water levels and plume distribution throughout the cleanup to evaluate any changes in conditions that could impact human health and the environment. In addition, DOE will continue to work with the U.S. Environmental Protection Agency and State environmental regulatory agencies to discuss and review the progress of cleanup and evaluate if the remedies are working to clean up the site as expected. There is a Contingency Plan in place that provides a means for changing the cleanup remedies if necessary to protect human health, including agricultural uses of ground water in the Central Valley.

To ensure communication remains open and the public is well informed, news and information regarding Site 300 cleanup is regularly provided to the surrounding community through direct mailings, newsletters, newspaper notices and public presentations. The public also learns about Site 300 through the news media, which receives information about the site through LLNL/DOE news releases, fact sheets and personal interviews with representatives of the Lab and DOE. As always, should the news media develop any misunderstanding about the activities at Site 300, the Laboratory's Public Affairs Office would employ its resources to quickly correct false rumors or inaccurate information.

Mr. Foreman comment #3: *Then just a few other questions. What is the competence level that -- we mentioned an RDX, I just wanted some more explanation of what RDX was and what the problem there is or what the concern was.*

Response: Research Department Explosive known as RDX is a high explosive compound. This compound was present in rinsewater that was once placed in unlined ponds in the High Explosives Process Area Operable Unit at Site 300, and subsequently migrated into the underlying ground water. The ponds were closed and are no longer used at Site 300. There are no federal or state drinking water standards established by Environmental Protection Agency or the State of California for RDX, although it is a suspected human carcinogen if inhaled or ingested. There are several ground water extraction and treatment systems operating in the High Explosives Process Area Operable Unit to clean up RDX in ground water. To date, this cleanup effort has significantly reduced RDX contamination in ground water from a historical maximum concentration of 204 parts per million in 1992 to a maximum concentration of 39 parts per million in 2007.

Mr. Foreman comment #4: *And really, I guess, as a group of people that work for the Site, and a kind of a better understanding of why cleaning the Site up or continuing to operate a site that is testing explosive material is really kind pushing the limit in such a populated area, why isn't cleaning it up to a normal or back to where it was before, why isn't that our goal? I mean, why do we feel confident that something less than where it was when we got here is acceptable and I guess I would like a comment on that, also.*

Response: One of the goals of the environmental restoration effort is to restore ground water quality, at a minimum, to ground water cleanup standards that are protective of beneficial uses within a reasonable timeframe and preventing plume migration to the extent technically and economically practicable. Other goals include preventing human and ecological receptor exposure to unacceptable concentrations of contaminants.

Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

Mr. Foreman comment #5*: And I think one of the questions that was similar, is there any information out there, and I realize at this point in time, we don't believe it's leached into the environment, but I don't -- I hate to hear words like "it has not" and "we are sure" and "we are confident over the last 50 years." Has there been any comparison studies to the people in Livermore or the people in Tracy down wind on what the illness rates are and what -- is it higher in certain areas? Is it higher in certain neighborhoods or just in general the people of Tracy, is that illness, has that ever been compared to other neighborhoods somewhere in the Midwest, somewhere that doesn't have these type of superfunds operating near them and that is it. Thank you.*

Response: The Agency for Toxic Substances and Disease Registry conducted an independent health assessment of Site 300 contamination in 2005 that concluded that there are no past or current exposures to contaminants associated with LLNL – Site 300, and the potential for future exposure is unlikely. This report is available online at www-envirinfo.llnl.gov/. DOE/LLNL is unaware of the performance of a local epidemiological study.

Loulena Miles — Staff Attorney at Tri-Valley CAREs

Ms. Miles comment #1: *Good evening. My name's Loulena Miles. I am a staff attorney at Tri-Valley CAREs. We are a nonprofit organization with around 5,000 members that's been monitoring the contamination cleanup and recontamination of Site 300 for about 25 years now. And in 2000 we were given the EPA's first ever Citizens Excellence in Community Involvement*

Award. First, I wanted to say that it is surreal for me to listen to this careful presentation about how cleanup is so fool proof. During cleanup, a different part of the same Department of Energy, is busy attempting to increase the testing at Site 300 by eight-fold and seeking permits to increase the depleted uranium used in the order of potentially tons, all in the service of developing and modernizing nuclear weapons. How can we be able to assess this cleanup when new contamination is proposed by the Department of Energy everyday.

Response: Please refer to Section 3.2.2 for a detailed discussion of measures that have and are being taken that address the potential for contamination from ongoing operations at Site 300 and impacts to human health and the environment.

Ms. Miles comment #2: *I also would like to just point out that in Leslie Ferry's presentation she discussed the Department of Energy's concern for animals on site including the endangered and threatened species. There was the point made that the Lab works closely with The Fish and Wildlife Service and we have been waiting for roughly three years for an Endangered Species Act Compliant Biological Opinion for Site 300. Biological Opinion is what Fish and Wildlife Service issues in response to Department of Energy's application to go forward with activities at the Site. The Department of Energy acknowledged that the endangered species take or kill of endangered species would need to be greater than previously permitted, but, based upon communications with The Fish and Wildlife Service and the outcome we have received from Freedom of Information Act requests, it does not appear that the Lab is in possession of an Endangered Species Act Compliant Biological Opinion as it moves forward with cleanup activities and also as it moves forward with proposals for a new contamination.*

Response: DOE has consulted with the U.S. Fish and Wildlife Service in accordance with the Endangered Species Act regulations for interagency cooperation since the preparation of the 1992 Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for continued operations of LLNL. The consultations have resulted in the U.S. Fish and Wildlife Service issuing and later amending a Biological Opinion for proposed projects and maintenance activities at Site 300, including proposed environmental cleanup activities.

A Biological Opinion for Routine Maintenance and Operations Projects was issued in May 2002 and addressed potential impacts to California red-legged frog and Alameda whipsnake. The 2002 opinion was amended in July 2007 to take into account new projects and activities and potential impacts of Site 300 operations to California tiger salamander. California tiger salamanders were a candidate for listing in 2002 and were therefore addressed separately as the subject of a technical assistance request at the time. The Biological Opinion, as amended, concluded that proposed projects and maintenance activities would not jeopardize the continued existence of California red-legged frogs (Threatened species status), Alameda whipsnakes (Threatened species status), or California tiger salamander (Threatened species status) nor would they adversely affect designated critical habitat. It also authorized a specified amount of take for each species ("taking" is defined to include harm, harass, kill, trap, etc.) that DOE and LLNL must not exceed without further consultation with the Service.

The Biological Opinion, as amended, also established measures that DOE and LLNL are required to implement to maintain the take authorization. These measures include project-specific actions (such as performing pre-construction surveys, moving individual frogs or salamanders out of harms way when appropriate, training construction personnel on endangered species protection requirements, among other measures) and on-going actions (such as controlling bullfrogs if they are found at the site) are designed to avoid or minimize such taking and contribute to overall conservation of these protected species. In the 2007 consultation with the U.S. Fish and Wildlife Service, DOE and LLNL did not request an increase to the amount or extent of take (killing, injuring, harming, or harassing) of California red-legged frogs and Alameda whipsnakes that was authorized in the 2002 Biological Opinion. The 2007 Biological Opinion amendments issued by the U.S. Fish and Wildlife Service did not increase the amount of take for California red-legged frogs or Alameda whipsnakes, and established take levels for California tiger salamanders in a manner consistent with the levels set for California red-legged frogs and Alameda whipsnakes. The measures outlined in the Biological Opinion designed to avoid or minimize impacts to threatened or endangered species have been and continue to be consistently implemented.

Ms. Miles comment #3: *I'd like to give my concerns about this cleanup and a couple of proposals. A robust cleanup is crucial for a number of reasons. First, Tracy is growing in size and population. The land adjacent to Site 300 has been annexed and over 5,000 homes are planned for the area. Contamination does not stop at man-made fence lines. While it may be believed that contamination would not leave the Site I just want to point out that the geology of the seismically active site is largely unknown and it is not clear exactly what would happen in the case of a design basis earthquake, for example, this in California, is a real concern.*

Response: The geology and seismology of the site has been studied and well documented for approximately 20 years and we actually know a great deal about the geology, hydrogeology, and fault systems at the site. The maximum credible earthquake magnitude would not create a preferential pathway such as continuous fracture network for contamination in Site 300 ground water to rapidly migrate the 5 or more miles to the Tracy water supply aquifer or wells. An earthquake of the magnitude that could create this type of scenario has not been observed during historic time. For example, the Elk Ravine fault, near the Pit 7 Complex has been evaluated extensively and is classified as a non-active fault (there are no indications of movement on this fault within the last 10,000 years). Because an extensive monitoring network is in place to track the movement of the tritium and other contaminants in ground water, the monitoring data would provide an early indication of changes in ground water movement that could impact human health (e.g. accelerated migration towards Tracy). If such an event occurred and there was evidence of accelerated plume migration, DOE would discuss possible measures to prevent the plume from reaching Tracy's water-supplies.

Ms. Miles comment #4*: Regardless of whether Site 300 and other areas adjacent to it are ultimately developed for residential use, the future of the Site is unknown and cleanup must take into account a wide range of possible future uses. We know that the University of California's offering part of the Site right now to the Department of Homeland Security to become one of the biggest and most dangerous biodefense labs in the world. This would essentially be a biodefense campus for testing the world's deadliest bioagents on large animals on 30 to 100 acres. I shudder to think of potential synergistic affects of mixing contaminated animal materials with tritium or high explosive compounds. Cleanup should be finalized before new activities are approved on the Site.*

Response: Site 300 is no longer being considered for the location of the National Zoonotic and Agriculture Research Center.

***Ms. Miles comment #5**: Third the land is biologically rich and should be protected. There are at least 124 federally and state listed threatened endangered and other special status plant and animal species known to occur at Livermore Lab and Site 300. The red-legged frog and the tiger salamander have been spotted throughout Site 300 and 60 percent of the site is critical habitat for the frog. The Department of Energy describes it as one of the largest native grasslands in California. I just want to say that open spaces are becoming rarer and rarer. Undeveloped land and pristine water are precious resources in California. For these reasons it is incumbent upon the Department of Energy to take responsibility for a full clean up. The people of Northern California deserve better resource management. So with this in mind, I offer the following amendments to the proposed plan. First, to make a commitment to stop the forward migration of the contaminant plume so that contaminants are not allowed to migrate into pristine waters.*

Response: Please refer to Section 3.2.3 for a detailed discussion of contaminant plume migration.

***Ms. Miles comment #6**: Excavate the unlined pits at Site 300 so that the uranium and other contaminants are not allowed to migrate or at an absolute minimum undertake a hot spot removal of contaminants in unlined dumps.*

Response: Please refer to Sections 3.2.3 and 3.2.4 for detailed discussions of contaminant plume migration, and of the results of the evaluation of the excavation of hot spots for the waste in the Pit 7 Complex landfills, respectively.

***Ms. Miles comment #7**: We ask that you do not solely comply with the most minimal requirements but seek to attain the health base cleanup levels recommended by the EPA and the State of California. The maximum contaminant health based level -- wait, I am sorry. The maximum contaminant level is 20,000 picocuries per liter but California's health based goals are 400, much lower and EPA's preliminary remediation goals recommend 144 picocuries per liter, dramatically lower than the 20,000 as the federal level. We urge you to adopt the most health protective limit. At a minimum, incorporate the lower levels as ARARs in the record of decision. Clean up the Site so that its future is not restricted. Alter the assumptions about future land use because the population growth of the area is likely to affect hydraulic movement under ground and finally continue to involve the public in the clean up process.*

Response: Please refer to Sections 3.2.1 and 3.2.5 for detailed discussions of the protectiveness of cleanup standards proposed for remediation of Site 300, and continued community involvement in the cleanup process, respectively.

***Ms. Miles comment #8**: Establish a mechanism for long-term community involvement that is empowering, responsive and informative. Public workshops and print updates should be given periodically after the last record of decision to discuss problems and progress. And I just want to say this I was very disappointed with the way that this was initially advertised to the public because it was not advertised as a hearing where the public, it was advertised as something where the public could come and ask questions rather than to give testimony and I just wonder whether that is even legal, actually. Thank you.*

Response: DOE followed the legal requirements per the National Contingency Plan and EPA guidelines for noticing the Public Meeting for the Proposed Plan by placing notices in two local newspapers. These notices stated that the public was invited to comment on the proposed plan for cleanup of Site 300 at the meeting or to submit written comments through the mail. In addition to these legal requirements, DOE placed display ads in the Tracy Press and Stockton Record, and mailed letters with a copy of the Proposed Plan notifying and inviting neighbors, local government, and other interested community members to attend the Public Meeting and comment on the proposed cleanup plan for Site 300. In these notices, ads, and letters, DOE used the term "Public Meeting" which is the legal designation in the 40 Code of Federal Regulations 300.430 (f)(3)(d) for the meeting to relay information on the proposed cleanup plan and receive public input.

Please refer to Section 3.2.5 for a detailed discussion of continued community involvement in the Site 300 cleanup process.

Robert Cronejo — 45 Beliz Court, Tracy, California

Mr. Cronejo comment #1: *My name is Robert Cronejo. I live at 45 Beliz Court in Tracy. Three years a Tracy resident I moved out here for Tracy and after the fact, sad to learn, very disappointed that I am neighbor to Site 300, very disappointed. Although, I believe you are doing your best the pseudo conservative plan doesn't negate for me the threat of this site. I do not feel sheltered and I don't believe the citizens of Tracy feel sheltered either. It also boggles my mind that there is an application for the San Joaquin Air Control District to increase testing, and I believe the Site was, there was one fire, forgive me about the terminology, one fire site 850, am I getting this right? Firing table, thank you. And that it is heavily contaminated and I would assume it's the only one. I would assume that that would be the firing site where they would increase this testing and we have a Superfund contamination here. Why would we compound the problem. I don't want this stuff in my neighborhood. I don't want this airborne radioactive toxic waste flying in my backyard, no thank you, the wind blows my way. All the wind is traveling over the Altamont towards Tracy, it is freaking me out, I am sorry.*

Response: DOE has formulated and funded a restoration project for Site 300 intended to characterize and clean up contamination resulting from past operations to protect human health and the environment and restore beneficial uses of natural resources in a cost-effective, efficient, and compliant manner. It is important to note that there are no unacceptable health risks to the general public from Site 300's ground water or soil.

Please refer to Section 3.2.2 for a detailed discussion of measures that have and are being taken that address the potential for contamination from ongoing operations at Site 300 and impact human health and the environment.

Mr. Cronejo comment #2: *Recently in the mail I have received these very attractive post cards inviting the community to come to Site 300, go for a tour, check it out, kids in the laboratory, looking under the microscope and if I am wrong, then forgive me, but I don't remember receiving a nice postcard inviting me to this meeting. One is fun stuff, but this is serious stuff. Shouldn't you be marketing this stuff in the same manner with the same impact. We should be getting everyone out here, not for tours, that's fun. This is serious.*

Response: DOE has conducted many community outreach efforts over the years to inform the neighboring residents and communities about the contamination and cleanup at Site 300 and to provide a forum for public input into the cleanup process. These have included:

- Conducting public workshops and meetings in the City of Tracy since 1994.

- Holding quarterly Technical Assistance Grant meetings.
- Posting site cleanup information and documents on the LLNL Environmental Community Relations website (www-envirinfo.llnl.gov/).
- Placing documents related to site investigations and cleanup in the Tracy Public Library and LLNL Discovery Center.
- Holding meetings with City of Tracy officials and other neighbors to discuss contamination and cleanup efforts.

In an attempt to encourage public participation in the Public Meeting held on June 20, 2007, DOE placed public notices and display ads in the Tracy Press and Stockton Record, and mailed letters with a copy of the Proposed Plan notifying and inviting neighbors, local government, and other interested community members to attend the Public Meeting and comment on the proposed cleanup plan for Site 300. However, we will evaluate additional means for advertising future meetings to better inform the community. Please refer to Section 3.2.5 for a detailed discussion of continued community involvement in the cleanup process at Site 300.

Mr. Cronejo comment #3*: From the Tracy press. The proposed plan does not include excavation of hot spots in the underlying toxic waste dumps at Site 300, the Tracy City Council specifically requested that the Livermore Lab excavate radioactive debris from the dumps so that the radioactivity would not continue to leak into the surrounding groundwater yet doing this is not in the current plan. Wouldn't it be in your best interest to partner with Tracy on their most concerned issues? Thank you.*

Response: Please refer to Section 3.2.4 for a detailed discussion of the results of the evaluation of the hot spot and total excavation of waste from the Pit 7 Complex landfill.

With regard to the Tracy City Council, the LLNL and DOE are committed to keeping Council members, as with the surrounding community, informed of activities at Site 300, including issues regarding site cleanup. Members of the City Council and Tracy Tomorrow and Beyond (a city council advisory group) have been invited and participated in presentations and tours at Site 300 that provided information about both programmatic and environmental restoration activities. The presentations and tours included visits and discussions of cleanup sites for which the City Council had expressed particular concerns. Public tours of programmatic and environmental restoration activities at Site 300 have also been conducted regularly.

Peter Strauss — Technical Advisor for Tri-Valley CAREs, PM Strauss & Associates

Mr. Strauss comment #1*: Peter Strauss, I am the technical advisor for Tri-Valley CAREs, PM Strauss & Associates. In 2000 at the interim rod hearing I made a suggestion and that was that as the Lab was considering cleaning up MCL water quality objectives or background, that they choose the latter and that -- that as a goal, and that as they went along in the remediation process, they can establish whether that's feasible or not. I think that's the same comment that I have today.*

Response: Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

Mr. Strauss comment #2*: And I want to say that it's -- I mean, call me a cynic ascended, but the first El Nino event that really affected Site 300 was in the mid 80's when it washed out the* *pits that contained the tritium and the uranium. In 1998 we had another El Nino event. We are first now talking about doing source control. That's fine, but what happened in those intervening years?*

Response: Extensive characterization and investigation of the Pit 7 Complex area was conducted from the mid-1980s through the 1990s to determine the nature and extent of contamination in this area. In 1999, a Site-Wide Feasibility Study was prepared that presented alternatives for cleanup of contamination at the Pit 7 Complex, which included source control measures and extraction and treatment of ground water contaminants. In 2001, interim cleanup remedies for Site 300 were selected in the Interim Site-Wide Record of Decision to address contamination at the site. However, the regulatory agencies requested that additional site characterization and evaluation of cleanup options be performed prior to selecting a remedy for the Pit 7 Complex, therefore the Pit 7 Complex was not included in the Interim Site-Wide Record of Decision.

Additional investigations conducted at the Pit 7 Complex since that time included: (1) installing and sampling of additional ground water monitor wells, (2) performing geophysical and helium-3 soil vapor surveys of the pits, (3) conducting a water budget study to refine the hydrogeological conceptual model, (4) additional ground water modeling to evaluate the movement of contaminants in ground water, (5) updates to the risk assessments, and (6) evaluation and screening of technologies to address contamination at the Pit 7 Complex. The Final Remedial Investigation/Feasibility Study for the Pit 7 Complex was completed in 2005, followed by the Proposed Plan and Public Meeting for Environmental Cleanup of the Pit 7 Complex in 2006. The Site-Wide Record of Decision Amendment for the Pit 7 Complex was finalized in 2007. Implementation of a long-term cleanup remedy for the Pit 7 Complex began in 2007.

***Mr. Strauss comment #3**: We also know that many of the drinking water standards, the MCLs that we are referring to were established in the mid 80's. I will give you one example. In 2001, the EPA did a health assessment of TCE, which is a major contaminant at the Site. It found that it was much more riskier, it imposed much more of a risk than previously thought. Has the MCL been changed? No. So it leads me to reiterate the first man's comment: Why do you feel that it is comfortable, why do you feel comfortable in cleaning up to a level that is more than when DOE first came here? Thank you.*

Response: Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

K. Leo Pullin — 515 Peerless Way, Tracy, California

***Ms. Pullin comment #1**: Good evening. K. Leo Pullin, 515 Peerless Way, Tracy. I think that the Lab did somewhat better tonight with their presentation than you've done in the past. I appreciate that. In particular I appreciate the EPA representative attempting to directly answer the question I asked. The Lab, it still appears to me that the first instinct of Lawrence Livermore National Lab employees at these public meetings is to dance around questions and concerns. I would ask you to consider thinking proactively, not defensively at these meetings when answering questions; when discussing issues brought up by members of the audience. Just be direct. Maybe change your attitudes by consider what I've said before: That science is not private knowledge, it is only the understanding of our natural world. Tracy has an interested* *community. We are coming to these meetings, we are raising issues, we are asking questions, we would like these questions to be answered, we would like our concerns to be met head on. Some of the best scientists in the world work at Lawrence Livermore National Lab. Please consider using this expertise to educate your own employees first to understand how important it is to communicate technical knowledge about activities at the Lab and how they impact the environment. This is what the laws of the State of California and the federal government demand. Communication with stakeholders, addressing our concerns about the air, the water, the soil. Then act proactively, explain the nature of the eco system, the contaminants and the cleanup. Whenever people ask these questions, raise specific issues about the pits, about the groundwater, treat people of the community of Tracy as if we were exactly what we are, a group of educated concerned stakeholders with a interest and concern in our environment, our ecosystem. So in the future, take offense at the pollutants, not our questions and concerns and just directly answer our questions, don't move around them. Take an example from EPA who at least tried to focus on what was being asked.*

Response: Thank you for your comment. DOE and the employees of LLNL are not intentionally trying to be evasive or non-responsive to questions from the community. The Site 300 Environmental Restoration Project's charter is to clean up the legacy contamination while other organizations are responsible for the on-going high explosive testing operations at the site. DOE and LLNL Environmental Restoration staff are not qualified to answer many of the questions related to on-going high explosive operations and hesitate to respond to questions outside their expertise.

Members of the community that attend the public meetings and workshops also have widely varying knowledge and understanding of the Site 300 Environmental Restoration Project. Some people have been following the progress of the project since it's inception over 20 years ago, and this was the first meeting for others. We try to answer questions and address the concerns of community as best we can, but it is sometimes difficult to answer questions in a way that is understandable to everyone. Those involved in the Site 300 Environmental Restoration Project consider the members of the community as very important stakeholders and will continue to strive to communicate with the public in a clear and concise way to the best of their abilities.

Susan Sarvey — 26139 Corral Hollow Road, Tracy, California

Ms. Sarvey comment #1: *I am really glad we had this meeting tonight because I have a new concern that I haven't had previously because I got new information. You've known since 1982 or 1983 that we had a serious Superfund toxic cleanup problem. Here we are 25 years later still got the problem; still don't have a solution that is agreeable to the community and to the Lab and I am very concerned if you resume explosive testing while we are in the process of eradicating this very serious problem, how do we know that the cleanup is working when we are adding the same contaminants to the area -- how are we allowing for measuring the added contaminants that you are blowing up to the cleanup process? How are they being included in that? And are we going to be having new explosive testing and 25 years from now you are going to come in and say: Oops, we made a mistake and we didn't have that in the cleanup, right, and you were right after all, it is a bigger problem. It disturbs me that we are 25 years later and it's still here; we are still not sure how to get rid of it; we want to add to it when we don't know how to solve the problem and what -- I understand what we are doing to cleanup, but what are we doing so that it doesn't take us 25 years to discover we have a problem and another 25 years to argue* *about a solution. So how are we going to account for the new contaminants that we are putting in our environment while you are cleaning our environment and who is going to monitor to make sure we aren't creating a whole new problem and potentially making it impossible to solve our existing problem due to our current activities and I don't have an answer, I am hoping you do.*

Response: Over the past 25 years, significant progress has been made cleaning up Site 300. DOE/LLNL initiated cleanup activities at Site 300 in the mid-1980s to begin addressing contamination. Cleanup activities to date have included installing 21 ground water and soil vapor treatment systems; removing contaminated soil; capping and closing landfills, rinsewater lagoons and burn pits; removing firing table gravels; and implementing administrative and engineered controls to prevent workers from being exposed to contamination while cleanup proceeds. These cleanup activities have resulted in significant reductions in maximum contaminant concentrations throughout the site and mitigated risks to onsite workers in many areas. The Proposed Plan explains how DOE intends on continuing this clean up.

Please refer to Section 3.2.2 for a detailed discussion of measures that have and are being taken that address the potential for contamination from ongoing operations at Site 300 and impacts to human health and the environment.

As described in Section 2.10 of the Site-Wide Record of Decision, DOE and the regulatory agencies evaluated the cleanup remedies based on the nine Environmental Protection Agency criteria: 1) overall protection of human health and the environment, 2) compliance with applicable or relevant and appropriate requirements, 3) long-term effectiveness and permanence, 4) reduction of toxicity, mobility, or volume through treatment, 5) short-term effectiveness, 6) implementability, 7) cost, 8) state acceptance, and 9) community acceptance. Criteria 1 and 2 are considered “threshold criteria,” which are requirements that each alternative must meet in order to be eligible for selection. Criteria 3 through 7 are “balancing criteria,” which are used to weigh major trade-offs among alternatives. Criteria 8 and 9 are “modifying criteria,” which may be considered in the final balancing of trade-offs between alternatives upon which the final remedy selection is based. Community acceptance was evaluated based on the comments on the proposed cleanup plan provided by the community. Although some public comments expressed concern about the cleanup plan, DOE and the regulatory agencies agreed that the selected remedies are protective of human health and the environment, meet ARARs, and provide the best balance of trade-offs among the five balancing criteria.

Beverly King — Volunteer with Tri-Valley CAREs

Ms. King comment #1: *My name is Beverly King and I am a volunteer with Tri-Valley CAREs in Livermore. I also taught near in Tracy for almost 20 years and so I have a personal concern for everyone's interests in both areas. The Superfund cleanup is a vital interest to Tracy and the surrounding areas. I have received a packet from the Livermore site office of the National Nuclear Security Administration concerning what has been done and what is being planned and I know that the environmental scientists are very conscientious and deeply concerned that the best possible cleanup is accomplished, but they are restricted by the rules of the DOE and other agencies. Many areas need to be more carefully considered and I will only name a few, and I am no scientist. I have watched Tracy grow from a farm town to a sprawling suburb that will reach Site 300 soon. Residential standards must be the criteria for cleanup, not industrial ones. These are inadequate for the area's growing population.*

Response: Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

Ms. King comment #2: *The proposed plan does not include cleanup for future bomb-blasts and other activities that could possibly further contaminate Site 300.*

Response: Please refer to Section 3.2.2 for a detailed discussion of measures that have and are being taken that address the potential for contamination from ongoing operations at Site 300 and impacts to human health and the environment.

Ms. King comment #3: *Funding for future cleanup is not guaranteed.*

Response: Please refer to Section 3.2.6 for a detailed discussion funding for long-term cleanup at Site 300.

Ms. King comment #4: *Also, cleanup must be given first consideration before any future bomb creating tests are planned. Releasing contaminants of any variety into the soil, groundwater and surface water is unthinkable. I see no sense in cleaning up today and dirtying the Site again tomorrow without a plan and funds. Little is known about the hydraulic system of the area; therefore, little reliance should be based on modeling. Long term field testing should be prominent in case the modeling is inaccurate. Every precaution must be taken to ensure that Site 300 is free of all contamination under all circumstances. Although tritium has a short life span, it is a critically lethal substance in its 12 years of life. In heavy rainfall, it gets into the groundwater. To prevent this, the plan must include better ways of isolating tritium; in unlined dumps to hydraulic control of the plum to prevent further migration and three, aggressive monitoring to ensure minimal migration. All means must be used to prevent further movement of tritium.*

Response: Ground water and its movement in rock underlying Site 300 has been studied and documented extensively over the past 25 years. These studies have enabled us to identify over 10 separate water-bearing rock units from what was published as one rock formation (Neroly Formation) in geologic maps in the mid-1980s. The evaluation of contaminant movement in the subsurface will continue to be an ongoing process throughout the cleanup effort. Decisions are not based solely on computer modeling. Modeling is only one tool used in the cleanup decision-making process. DOE collects and analyzes thousands of ground water samples and measures water elevation from over 680 monitor wells at Site 300 throughout each year to: (1) track ground water contamination, (2) define any changes in local ground water chemistry and flow, (3) to be certain that modeling assumptions and results continue to be valid, and (4) to validate that the cleanup actions being taken at the site are progressing as expected and continue to be protective of human health and the environment.

At the areas of Site 300 where tritium is present in ground water, the cleanup plan includes measures to control and isolate the source of tritium to prevent further releases. However, there are no technologies available to remove tritium that has already been released to ground water. The remedy for the Pit 7 Complex prevents contaminant migration to the extent possible without creating additional releases and accelerating plume migration. During the timeframe necessary to achieve drinking water standards (45 years), contaminants in the Pit 7 Complex ground water will not migrate offsite, impact water-supply wells, or threaten human health or plant and animal communities. Please refer to Section 3.2.3 for a detailed discussion of plume migration and controls.

***Ms. King comment #5**: Last, the community must be informed and involved in decisions that make -- that affect the community. The people's lives and health depend on the environment free of all radioactive substances and other dangerous materials. Our government owes this to us. The proposed plan must be reconsidered to include every precaution available for the health and welfare of the environment and the people. Thank you.*

Response: DOE is committed to informing and involving the community in decisions regarding Site 300 cleanup. To this end, DOE has conducted many community outreach efforts over the years to inform the neighboring residents and communities about the contamination and cleanup at Site 300 and to provide a forum for public input into the cleanup process. These have included:

- Conducting public workshops and meetings in the City of Tracy since 1994.
- Holding quarterly Technical Assistance Grant meetings.
- Posting site cleanup information and documents on the LLNL Environmental Community Relations website (www-envirinfo.llnl.gov/).
- Placing documents related to site investigations and cleanup in the Tracy Public Library and LLNL Discovery Center.
- Holding meetings with City of Tracy officials and other neighbors to discuss contamination and cleanup efforts.

DOE will continue these community outreach efforts in the future. Please refer to Section 3.2.5 for a detailed discussion of continued community involvement in the cleanup process at Site 300.

The highest priority of the cleanup effort is to protect workers at Site 300, site neighbors, and the residents of Tracy and nearby communities, which includes many DOE and LLNL employees and their families. The Agency for Toxic Substances and Disease Registry, a public health agency of the U.S. Department of Health and Human Services, performed an independent health assessment of contamination at Site 300 in 2005. The results of this assessment concluded that there are no past or current exposures to contaminants associated with Site 300, and the potential for future exposure is unlikely.

Marylia Kelley — Executive Director at Tri-Valley CAREs

***Ms. Kelley comment #1:** Good evening. My name is Marylia Kelley and I am executive director at Tri-Valley CAREs and as Loulena mentioned we have more than 5,000 members. Most of our membership is in the Tri-Valley and increasingly here in Tracy and in the Central Valley and we monitor activities at Livermore Lab main site and Site 300. Tri-Valley CAREs with our technical advisor Peter Strauss is preparing technical comments. I apologize, I can hear that this is sort of going in and out, the sound. I am okay? All right. And I have some copies of our draft, if anybody would like it and then when the final is completed and turned in, it will be on our web-site so please feel free to get involved in that way. We also have a four-page comment letter on our web-site and copies at the table if you'd like to take one. I will make just a few comments until my five minutes is up and the hook comes to take me away, because this is an extremely important point in the cleanup process and I think that wasn't made clear enough. The record of decision is the legal document that codifies how clean is clean and the cleanup requirements. There was a slide that said that the ROD doesn't lock in the cleanup, that is in* *some ways not true. If it is not in the ROD, folks, they are not legally required to do it, so the ROD is incredibly important and I have to say that this cleanup plan, and I have worked a great deal with the regulators and with the Lab is a good start, but it is not yet complete and it should not be signed off on without improving it.*

Response: While we agree that the Record of Decision is an important document, the monitoring and evaluation of the effectiveness of the remedial actions to cleanup Site 300 is part of the remedies selected in this document, and therefore is a legally binding agreement. The results of this monitoring are legally required to be reported to the regulatory agencies and general public semi-annually in the Site 300 Compliance Monitoring Reports. The Site 300 semi-annual Compliance Monitoring Reports are available on the website: www-envirinfo.llnl.gov/ and at the Tracy Library and LLNL Discovery Center. In addition to the semi-annual reporting, the effectiveness of the remedy and any changes in risks or legal requirements are reviewed every five years during the Five-Year Review process that is required by Federal Law. The public is included during this process. Any deficiencies in the remedial design would be identified and addressed.

In addition, the U.S. Environmental Protection Agency, and State environmental regulatory agencies will continue to provide oversight of all aspects of the cleanup process to ensure that it meets Federal and State laws and requirements and protects public health until cleanup is complete.

Ms. Kelley comment #2*: Kathy Setian mentioned that there were a couple of things in the initial document that the regulatory agency said it was not good enough and that the Department of Energy had to come back and propose something different. I'm here to say that this cleanup plan, too, in certain key areas is not good enough and that the Department of Energy has to come back with a better, improved, more strong, more stringent plan. For example, the plan does not commit to stopping the migration of radioactive and toxic contaminants that are moving underground in the groundwater. There are engineering controls that could be tried and they are not in the plan and there is no commitment to stop the willy-nilly migration of these contaminants.*

Response: Please refer to Section 3.2.3 for a detailed discussion of plume migration and controls.

Ms. Kelley comment #3*: The proposed plan does not include active excavation of the hot spots where contaminants have been put in these unlined dumps that were spoken about at Site 300. This is particularly the uranium, now uranium 238, folks, has a radioactive half life of over four billion years and tritium, which has a radioactive half life of just over 12 years. That means that in that amount of time, half of it will have degraded into a different substance and then in that amount of time again half of it again will decay into a different substance. The City of Tracy specifically requested that the Lab excavate the radioactive debris in the unlined dumps, yet that is not in the proposed plan. There is not even anything in the proposed plan that says they will look for hot spots within those dumps which are areas that have particularly high concentrations of uranium or tritium or toxic material and at least excavate the hot spots so the plan is not acceptable until those things are included. This is a discussion of how clean is clean, folks. That's what this is all about and this plan doesn't go far enough.*

Response: Please refer to Section 3.2.4 for a detailed discussion of the results of the evaluation of the excavation of hot spots within the waste from the Pit 7 Complex landfill.

***Ms. Kelley comment #4**: The proposed plan does not propose to cleanup soil and groundwater to the most stringent requirements, to the cleanest levels possible; instead, it proposes most of the time to clean up only to the most lax standard possible. For example the proposed plan only considers radioactive tritium contamination in water above 20,000 picocuries per liter, that is the maximum contaminant level. As has been mentioned the State of California has a health protective standard that is 400 picocuries per liter. It is a hell of a lot less concentrated than 20,000 and EPA actually has a health protective standard that is 144. Maybe the debate can be between 144 and 400, but not 20,000, and that as where it's set right now. Site 300 must be cleaned up to residential standards which will allow unrestricted future use – a half a minute. Okay. I am going to make a couple of final points. You've heard tonight that the Department of Energy is committing in the proposed plan to cleanup to the maximum contaminant levels and to the most lax standards and when we do that decades from now in some cases, we are going to sit down with the regulators and see whether we can go to a lower level. That's not the way the proposed plan should be written. That is not the way the record of decision should be written. The record of decision must be written with the most stringent standard. There is a bureaucratic process called technical infeasibility. If the record of decision has the most stringent standard, then the Department of Energy can come back to the regulators and explain why it isn't feasible and then a decision can be made but the difference is then the onus is on the Department of Energy to show why it is not feasible. The way it is now, some future administration – — That is fine. I am concluding, give me a minute. Some future administration, decades from now, is going to sit down and negotiate. We don't even know what that is going to look like. And I will be turning in, as I said, longer technical comments and hope to continue this dialogue. When you have five minutes, you don't get to say what you appreciate, you only get to say some of what still needs to be done, so I want you to know I appreciate the improvements that have been made but need to focus on the extraordinarily important improvements that still need to be made including the non-degradation policy that the Regional Water Quality Control Board has. Thank you very much. Thanks guys.*

Response: Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

Amy Fallavena — 2816 Daisy Lane, Tracy, California

Ms. Fallavena comment #1: *I am a resident of Tracy and my address is 2816 Daisy Lane. I am a mom of two very small children and just recently moved back to Tracy about a year ago after being gone -- why? I left for college and didn't come back until now because my extended family is still here. And when I moved here I actually landed in a neighborhood quite close to Site 300. Knowing full well that it was there but not doing my due diligence when I moved back to town and this last year I have been very disappointed to hear about everything that has been going on since when I left to go away to college this all, the cleanup and discovery hadn't started yet. So, my family is gravely concerned and I just want to make sure that I bring a voice here from a young family because my concern is primarily my children and where they are growing up and what's going to happen to them. I think one of the things that I am very fortunate for is that I do have the means to leave Tracy and it is something that my family has seriously considered because of this, and it is disappointing because our extended family is here and we would like to raise our children with our extended family. So I would like -- one of the things I wanted to note or that I noted as I was sitting here is that the speakers that are coming up here from community not necessarily Tri-Valley CAREs but from the community are clearly in* *opposition of what is going on -- of the current plan that's in place and want to see more and I think that's very interesting because this meeting was a public opinion meeting, not a public opposition meeting and I haven't seen any resident of the community come up in support of the current plan and I hope that that's really clear to all of your agencies to note that I don't see any residents coming forth in support of the current plan. I hope that all of your agencies will consider increasing the plan's performance and making it a much more aggressive timeline and also a more aggressive cleanup plan. 40 years just to cleanup the drinking water to standards that I, even though they are federal and California standards, I personally don't like them and Mike, you made an interesting comment earlier that resonated with me and that was you were talking about the water that comes out of our fountain and began to say you know the water you drink, then you said, well, actually the water that you put in your orange juice or your coffee and that is because most of us probably filter our water that we drink or buy bottled water because we are afraid of our city water and I think that is common in most cities but we are afraid of the City water that is regulated by the Federal and State agencies that say what levels drinking water should be at but we are still afraid of it. So if we are so afraid of that and then we also have Site 300 here and are supposed to be comfortable -- and again, I want to make it a point that we clearly aren't comfortable that the current plan is efficient enough that, that drinking water is not, not -- you know, 40 years is just not pleasing us.*

Response: We appreciate your comments and concerns. While it is a long, difficult, and time-consuming process to investigate and characterize site contamination, and evaluate, select, and implement cleanup technologies for a large site such as Site 300, we would like to assure you that much has already been done to clean up contamination at Site 300. Since contamination was first discovered in the early 1980s, DOE has been working with Federal and State regulatory agencies to implement an environmental restoration program to clean up soil and ground water contamination at Site 300. Cleanup activities at Site 300 were initiated in the mid-1980s to begin addressing contamination and have included:

- Installing over 21 remediation systems to extract and treat contaminated ground water and soil vapor.
- Removing contaminated soil.
- Capping and closing landfills, rinsewater lagoons and burn pits.
- Removing contaminated firing table gravels.

Through these efforts, considerable progress has been made in cleaning up the site. One ground water contaminant plume has already been fully remediated. Contaminant concentrations in both soil and ground water have been significantly reduced throughout the site. The cleanup effort at Site 300 will continue until cleanup standards are met.

The highest priority of the cleanup effort is to protect workers at Site 300, site neighbors, and the residents of Tracy and nearby communities, which includes many LLNL employees and their families. DOE conducted extensive investigations to evaluate contamination at Site 300 and potential impacts to site neighbors and nearby communities. This work was performed under the stringent guidelines and oversight of the U.S. Environmental Protection Agency and the state environmental regulators. The results of these investigations and evaluations indicate that the contamination at Site 300 will not impact residents of Tracy or any future residents of the Tracy Hills Development. The Agency for Toxic Substances and Disease Registry, a public health agency of the U.S. Department of Health and Human Services, performed an independent health assessment of contamination at Site 300 in 2005. The results of this assessment concluded that there are no past or current exposures to contaminants associated with Site 300, and the potential for future exposure is unlikely.

As discussed in Mr. Foreman's comment #1, there are different areas of contamination at Site 300 and cleanup time will depend on how much contamination is present and how difficult it is to remove it at a specific location. The rate of cleanup of each area or operable unit is limited by variables such as the volume of contaminated ground water or soil, the type of contaminant, and characteristics of the rocks containing the ground water contamination. Some contaminated areas have already been cleaned up. Much of the site contamination will be cleaned up in several decades. Other areas will take longer where contaminants are locked up in subsurface rocks that contain clay from which it is very difficult to remove contamination. DOE is utilizing the best available technologies for the cleanup of ground water contamination at Site 300. However, we are continually searching for new technologies that can help speed up the cleanup.

As described in Section 2.10 of the Site-Wide Record of Decision, DOE and the regulatory agencies evaluated the cleanup remedies based on the nine Environmental Protection Agency criteria: 1) overall protection of human health and the environment, 2) compliance with applicable or relevant and appropriate requirements, 3) long-term effectiveness and permanence, 4) reduction of toxicity, mobility, or volume through treatment, 5) short-term effectiveness, 6) implementability, 7) cost, 8) state acceptance, and 9) community acceptance. Criteria 1 and 2 are considered "threshold criteria," which are requirements that each alternative must meet in order to be eligible for selection. Criteria 3 through 7 are "balancing criteria," which are used to weigh major trade-offs among alternatives. Criteria 8 and 9 are "modifying criteria," which may be considered in the final balancing of trade-offs between alternatives upon which the final remedy selection is based. Community acceptance was evaluated based on the comments on the proposed cleanup plan provided by the community. Although some public comments expressed concern about the cleanup plan, DOE and the regulatory agencies agreed that the selected remedies are protective of human health and the environment, meet ARARs, and provide the best balance of trade-offs among the five balancing criteria.

Ms. Fallavena comment #2*: In addition there was a woman that spoke earlier or was asking a question earlier about testing people in our community and I think one of the things that I have learned just as I have researched this topic as well as other topics, environmentally for my family is that I have noticed a lot of the studies and tests are not done on children and children having a smaller support system don't tend to withstand certain levels that are quote standard for us to -- for an adult to withstand and those children are the ones that are affected much more greatly and I think that's when we see issues like leukemia and different issues that come out and I really hope that your agencies will think about doing some studies that do include children, if you haven't already, I am not certain of that, but I have noticed that in a lot of cases children are not the ones that are used or noticed and there was comments that there was some sort of public health assessment done here in the area but I didn't hear when that was done, what the results of that were, so I would certainly like to hear more about that because I think these generic studies versus specific studies of our community are very important.*

Response: As mentioned in the previous response, the results of DOE's investigations and evaluations indicate that the contamination at Site 300 will not impact residents of Tracy or any future residents of the Tracy Hills Development. The Agency for Toxic Substances and Disease Registry's independent health assessment of Site 300 contamination that concluded that there are no past or current exposures to contaminants associated with LLNL – Site 300, and the potential for future exposure is unlikely. Site 300 contamination is contained within the site boundaries with the exception of three offsite monitor wells located within 150 feet of the site boundary. These three wells are not used for drinking water and there is no mechanism for the Tracy city water-supply well to become contaminated from releases at Site 300. Remediation systems are in place and operating to continue to reduce contaminant concentrations in the three offsite monitor wells and in all onsite ground water to drinking water standards.

One of the highest priorities for site cleanup is to clean up any offsite contamination and to prevent further offsite plume migration. For example, ground water extraction and treatment was initiated in 1991 to begin cleanup of an offsite plume. This plume was successfully cleaned up in 2007. Ground water extraction and treatment continues near the location of the three offsite ground water monitor wells to clean up contamination. Ground water cleanup at Site 300 will continue until contaminant concentrations are reduced to drinking water standards.

Ms. Fallavena comment #3*: Also, the charts that were up there about the public involvement, I feel like, again, being – newly reentering the community that the information out there and the opportunities out here to provide public opinion and learn about what is going on is not very clear. As a small business owner here in the community I have worked hard to educate my own clients about it as I have learned about it but I read the Tracy Press every day and I don't always see things about this and I have gravitated towards Tri-Valley CAREs because I have found that there is nobody out there that is helping me and that's really the only place that I can see that residents can go because I don't -- I know a lot about several of your agencies and I don't see that as a place that will support me. So thank you very much.*

Response: We are more than happy to address any questions or concerns you might have about the Site 300 cleanup project. You can contact Claire Holtzapple, the DOE Site 300 Remedial Project Manager, at holtzapple1@llnl.gov or (925) 422-0670 with any questions or concerns regarding the cleanup project at Site 300. Information and documents about site cleanup are also available on the LLNL Environmental Community Relations website (www-envirinfo.llnl.gov/) and documents related to site investigations and cleanup are available in the Tracy Public Library and LLNL Discovery Center. We will also keep you informed about upcoming public workshops and meetings via newspaper announcements, community mailings, and/or fact sheets as appropriate. In addition, you can contact the LLNL Public Affairs Office (925) 422-4599 for any questions or concerns you might have about ongoing operations at Site 300. Also, please refer to Section 3.2.5 for a detailed discussion about continued public involvement in the Site 300 cleanup process.

Michael Stanker — Legal Intern for Tri-Valley CAREs

Mr. Stanker comment #1: *Hello, I am Michael Stanker and I am a legal intern for Tri-Valley CAREs, we are located at 2582 Old First Street in Livermore. I would like to reiterate that in 2000 we were given the EPA Citizen's Excellence and Community Involvement Award and that many of our 5,000 members reside in the Tri-Valley and Central Valley as well. We all know that Site 300 is Lawrence Livermore Laboratory's High explosive test range and that it is located only 6-and-a-half miles away from downtown here. Also the city has recently annexed land that extends right by the border of Site 300 and it will probably be developed for residential* *uses. I would like to mention a few of the more toxic and radioactive substances. There is a two mile radioactive tritium plum at Site 300 and while it was said it won't leave the Site before the half life caused it to evolve into other substances it is migrating at a variable rate. It is migrating from ten to 100 feet per year so if the subsurface conditions are in favor of the tritium, it could get here faster. Also depleted uranium or uranium 238 is in the ground, is in the groundwater and the soil at the Site 300 and that is associated with all manner of cancers and the Gulf War syndrome. Also many volatile organic compounds are located off Corral Hollow Road the most common being TCE that was in a movie, Civil Action. So if you want to see what that does you can watch that movie and it is based upon real events. It is also worth noting that it can take up to hundreds of years to cleanup these substances from the environment, that 40 years is an extremely favorable estimate. Many of these substances have polluted the soil and groundwater because they are placed into unlined dump sites. Overtime they leached into the soil and groundwater and are making their way here towards Tracy. If you can't dump motor oil in your backyard why should the federal government be able to dump toxic and radioactive substances into our back yard. The government should take responsibility and clean this mess up to the most protective standards possible. Unfortunately, the current plan often adheres to a very lenient interpretation of what the law demands and I think we should demand better.*

Response: Please refer to Section 3.2.2 for a detailed discussion of measures that have and are being taken that address the potential for contamination from ongoing operations at Site 300 and impacts to human health and the environment.

An important component of the cleanup remedy for the Pit 7 Complex is to implement measures to control the source of contamination in the landfills and underlying bedrock to prevent further releases of tritium and uranium. The extraction and treatment of ground water is part of the cleanup remedy to remove uranium, solvents, and other contaminants in Pit 7 Complex area. Active cleanup remedies have already been implemented and have made significant progress in reducing concentrations of trichloroethylene (TCE) and other contaminants in ground water throughout Site 300. For example, the TCE plume in the Eastern General Services Area that formerly extended offsite has already been cleaned up.

However, there is no effective technology currently available to remove tritium from ground water. The tritium in ground water with activities that exceed drinking water standards extends approximately 1,300 ft (1/4 mile) from the source areas at the Pit 7 Complex and Building 850, and remains more that 2 miles from the site boundary. The portion of the tritium plumes with activities above drinking water standards are stable or shrinking in both the Building 850 and Pit 7 Complex areas. Ground water modeling results show that the portion of the plume in excess of drinking water standards (20,000 picoCuries per liter) will not migrate during the 45 years necessary for all tritium activities to decline to below this standard.

There is no risk of exposure to tritium or uranium in ground water to existing or potential residential populations near Site 300. Tritium and uranium in ground water from the Pit 7 Complex and Building 850 areas do not extend outside the Site 300 boundary and is geologically isolated from the water-supply aquifer used by the City of Tracy. Modeling indicates that neither tritium nor uranium will migrate offsite during the time it will take to clean up these contaminants. The cleanup remedy for the Pit 7 Complex is designed to reduce ground water contamination to meet drinking water standards, at a minimum.

There are also significant geologic and hydrogeologic constraints to the movement of tritium-contaminated ground water in bedrock in the vicinity of and northeast of the Pit 7 Complex. Ground water in the sandstone bedrock flows to the northeast of the pit area at a low velocity (6 to 12 ft/year). The sandstone is unsaturated (does not contain ground water) to the east and northeast of the Site 300 boundary. This sandstone bedrock is eroded away in northeastern Site 300 and to the east, and therefore there is no continuous saturated pathway between the plume and offsite receptors such as the City of Tracy water-supply wells. In addition, significant water level mounding occurs across the Elk Ravine Fault, located east-northeast of the pits. The decreases in water elevation across the fault indicate that the fault significantly retards the flow of ground water in the east-northeast direction. These geologic and hydrogeologic conditions indicate that there is not a complete pathway to existing water-supply wells east or north of Site 300.

In addition, DOE/LLNL conducted fate and transport modeling of tritium and uranium to the site boundary as part of the human health risk assessment 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 land in the vicinity of Site 300 have been subject to development. The modeling results indicate 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.

There is an extensive monitoring system consisting of over 680 wells that are sampled regularly to evaluate the progress of cleanup and to ensure that human health and the environment continue to be protected. Offsite water-supply wells are also monitored on a monthly basis.

Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

Mr. Stanker comment #2: *You also might have noticed that the unlined dumpsites are not being excavated under the current plan. The City of Tracy sent a letter requesting that they be excavated. However, this has been unceremoniously dismissed and has not been mentioned at all in the plan. This means that those substances will continue to leach into the soil and groundwater and what I propose is that at a minimum the hot spots should be removed.*

Response: Please refer to Section 3.2.4 for a detailed discussion of the results of the evaluation of the excavation of waste from the Pit 7 Complex landfill.

Members of the City Council and Tracy Tomorrow and Beyond (a city council advisory group) have been invited and participated in presentations and tours at Site 300 that provided information about both programmatic and environmental restoration activities. The presentations and tours included visits and discussions of cleanup sites for which the City Council had expressed particular concerns. Public tours of programmatic and environmental restoration activities at Site 300 have also been conducted regularly. DOE is committed to keeping Tracy City Council members, as with the surrounding community, informed of activities at Site 300, including issues regarding site cleanup. Members of the City Council and Tracy Tomorrow and Beyond (a city council advisory group) have been invited and participated in presentations and tours at Site 300 that provided information about both programmatic and environmental restoration activities. The presentations and tours included visits and discussions of cleanup sites for which the City Council had expressed particular concerns. Public tours of programmatic and environmental restoration activities at Site 300 have also been conducted regularly.

Mr. Stanker comment #3: *Finally, the plan does not guarantee future cleanup funds for the new -- for new and as yet undiscovered pollution at Site 300 and that needs to be addressed also. This plan must be certified by the EPA and one of the factors that must be considered is community acceptance so the more we can state our opposition to this plan the more the EPA has to legally take note of that and that can provide a basis for them to not sign off on this plan. In addition to this meeting there is the written comment period that has mentioned that ends July 25th so please write in your concerns. Please tell your friends and other residents in the community to write in their concerns as well. This is really going to be the only way we can make Site 300 clean. My request to the Department of Energy is to please rewrite their plan on the own. My request to the EPA is to not sign off on the plan until it has been strengthened. Thank you.*

Response: This Record of Decision represents a legally binding commitment by DOE to continue the cleanup of contamination at Site 300, including requests to Congress for continued funding of the cleanup activities. The Site-Wide Compliance Monitoring Plan/Contingency Plan for Site 300, that was reviewed and approved by the U.S. Environmental Protection Agency (EPA) and State regulatory agencies, includes measures to be taken in the event that new, undiscovered contamination is discovered at Site 300. DOE, the U.S. EPA, and State regulatory agencies discussed and considered community comments and concerns prior to selection of the remedies presented in this document. Please refer to Section 3.2.6 for a detailed discussion funding for long-term cleanup at Site 300.

As described in Section 2.10 of the Site-Wide Record of Decision, DOE and the regulatory agencies evaluated the cleanup remedies based on the nine Environmental Protection Agency criteria: 1) overall protection of human health and the environment, 2) compliance with applicable or relevant and appropriate requirements, 3) long-term effectiveness and permanence, 4) reduction of toxicity, mobility, or volume through treatment, 5) short-term effectiveness, 6) implementability, 7) cost, 8) state acceptance, and 9) community acceptance. Criteria 1 and 2 are considered "threshold criteria," which are requirements that each alternative must meet in order to be eligible for selection. Criteria 3 through 7 are "balancing criteria," which are used to weigh major trade-offs among alternatives. Criteria 8 and 9 are "modifying criteria," which may be considered in the final balancing of trade-offs between alternatives upon which the final remedy selection is based. Community acceptance was evaluated based on the comments on the proposed cleanup plan provided by the community. Although some public comments expressed concern about the cleanup plan, DOE and the regulatory agencies agreed that the selected remedies are protective of human health and the environment, meet ARARs, and provide the best balance of trade-offs among the five balancing criteria**.**

Sheyda Sabetan — Intern with Tri-Valley CAREs

Ms. Sabetan comment #1: *Good evening. My name is Sheyda Sabetan I am also a intern with Tri-Valley CAREs. I am a college student who has recently become familiar with the current deliberation regarding cleaning up contamination at Site 300. After reviewing the* *proposed plan for the final record of decision I commend Livermore National Laboratory on its efforts to rectify a situation that has become so dangerous, however, I would like to address some serious oversights encountered in the plan in an effort to make the cleanup of Site 300 comprehensive and representative of the ideal model of environmental appreciation in addition to showing its responsibility to the communities right to health.*

Response: The residents of Tracy and Livermore are not in danger of being exposed to environmental contamination at Site 300 that is being addressed under Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This contamination is contained within the site boundaries with the exception of three offsite wells located within 150 feet of the site that are used solely for monitoring purposes and not for drinking water. One of the highest priorities for site cleanup is to clean up any offsite contamination and to prevent further offsite plume migration. For example, ground water extraction and treatment was initiated in 1991 to begin cleanup of an offsite plume. This plume was successfully cleaned up in 2007. Ground water extraction and treatment continues near the location of the three offsite ground water monitor wells to clean up contamination. Ground water cleanup at Site 300 will continue until contaminant concentrations are reduced to drinking water standards. In the time in which it will take to clean up ground water to drinking water standards, the contamination will not impact residents of Livermore, Tracy, or any future residents of the Tracy Hills Development. The exposure of onsite workers to contamination is prevented through institutional and engineered controls until cleanup can be completed. The Agency for Toxic Substances and Disease Registry conducted an independent health assessment of Site 300 contamination in 2005 that concluded that there are no past or current exposures to contaminants associated with LLNL – Site 300, and the potential for future exposure is unlikely. This report is available online at www-envirinfo.llnl.gov/.

Ms. Sabetan comment #2: *As stated previously presence of tritium and other contamination in especially in the groundwater is certainly alarming. Tritium has now contaminated the groundwater to a level of 2 million picocuries per liter which is above California's MCL of 20,000 picocuries per liter and significantly higher than California's health protective standard of only 400 picocuries per liter. The proposed plan states: "There is no cost effective technology available to remove tritium from water" unquote, therefore, contaminated areas must be meticulously isolated, prevented from spreading and future experiments that will release Tritium into the environment must be forbidden.*

Response: Natural attenuation has successfully reduced tritium activities by over an order of magnitude from the historical maximum activity detected in 1998 and cited in your comment to the maximum tritium concentration at Site 300 during the first half of 2007 of 293,000 picoCuries per liter.

Source control measures are included as part of the remedy for the Pit 7 Complex to prevent further releases of tritium from the Pit 7 Landfill to ground water. As discussed in Section 3.2.3, DOE evaluated measures to prevent tritium plume migration by partial and complete hydraulic capture and recirculation. DOE are not pursuing hydraulic re-circulation because the results of an evaluation of this technology showed that neither a complete nor partial recirculation system could be implemented that would not create worse environmental problems than it would solve. The U.S. Environmental Protection Agency and the State environmental regulatory agencies concurred with this conclusion.

However, the tritium plume with activities above drinking water standards at the Pit 7 Complex is more than 2 miles from the site boundary, is stable to decreasing in activity, and does not pose a threat to existing or potential offsite receptors. The tritium in ground water will decrease to meet drinking water standards within a reasonable timeframe, and will continue to decrease to background levels.

Ms. Sabetan comment #3*: While reducing contamination to the federal and state levels is a credible goal, more praiseworthy would be for the Lab to aim to the cleanest levels possible rather than the maximum allowable amounts. Furthermore, for many of the toxins there is no maximum contaminant level established so standards of contamination should be determined based on a thorough investigation of human health risk in the particular location of Site 300 and in the surrounding area. As well as taking into consideration synergistic risks which our health hazards will be much higher due to the compounding of numerous toxic contaminants.*

Response: Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

Ms. Sabetan comment #4*: The plan also mentions measures of conservation that will be taken to protect various threatened wildlife whose territory is unfortunately located at Site 300. It would be pleasing if the plan included more detail about measures taken to protect these animals. Relocating the animals to cleaner areas is definitely a viable solution; however, care must be taken to ensure that the second habitat must not only be free from contamination but will promote healthy life spans and encourage procreation for these rare species.*

Response: The site cleanup plan is designed to prevent harmful impacts to plants and animals at the site, particularly threatened and endangered species. All cleanup activities are carefully monitored by LLNL wildlife biologists to ensure that special status plants and animals are protected. The biologists work very closely with the U.S. Fish and Wildlife Service to ensure compliance with laws and regulations protecting threatened and endangered species. Following any remediation construction activities, any habitat that has been disturbed is restored. 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. As part of this program, DOE has created protected habitat at the site for several endangered species including the California red-legged frog, California tiger salamander, and the Large-flowered fiddleneck.

Ms. Sabetan comment #5*: Finally, the success of the cleanup and continued efforts to prevent conditions from reaching this level of severity in the future is principally dependent on sufficient funding from the Department of Energy. A review of the 2008 budget revealed that 8.9 million dollars allotted for cleanup which comes out to be less than one percent of their overall annual budget. Such clearly skewed priorities is a main factor of the various problems with the proposed plan in its ability to restore the area, ideally, back to its original conditions. Clean up should not be considered as an afterthought or a task apart for any experiment. It should be considered as an obligatory factor as an experiment and treated according so that the act of cleanup itself becomes an ongoing routine. This refocus of priorities should take root from the Department of Energy itself, so that its various institutions and laboratories it takes an unquestioned precedence. A preliminary step must be to ensure that the long-term existence and* *authority of the Office of the Legacy Management to enforce cleanup undertakings.*

Response: Please refer to Section 3.2.6 for a detailed discussion regarding funding for long-term cleanup at Site 300.

***Ms. Sabetan comment #6**: Previous neglect to follow through with the responsibility of cleanup and thus putting workers lives in danger unacceptable and inexcusable. Exposure to carcinogens is a risk that the Lab is taking and this risk has already imposed serious consequences on lab employees. The Livermore Lab must revise the above mentioned aspects of the plan, in addition, they must be conscientious of future testing and either prevent or thoroughly clean and eradicate any hazardous materials. As we know relatively little about such serious ailments as cancer, it is shameful that the Lab would not do everything in its power to discontinue its employees exposure to contaminates that are known to be carcinogenetic thus easily preventing the contraction of this devastating disease. Thank you for considering my request.*

Response: In areas where a risk to LLNL onsite workers from potential exposure to contamination at Site 300 has been identified, engineered controls or institutional controls (such as access and building occupancy restrictions) are in place to prevent worker exposure until the risk is mitigated through cleanup measures. Site cleanup activities have already mitigated the risk to onsite workers in many areas of the site. No LLNL employees are being exposed to contaminated ground water or soil above regulatory acceptable levels.

Bob Sarvey — 501 West Grant Line Road, Tracy, California

***Mr. Sarvey comment #1:** My name is Bob Sarvey, 501 West Grant Line Road. I am a resident of Tracy and a businessman here. As Lawrence Livermore National Lab conducts their activities here in Tracy, they often forget a very important law, it is called the California Environmental Quality Act and they tend to focus on things -- and make it microscopic. They don't look at the whole of their activities. And they became painfully aware of that last year when the Pollution Control District revoked their permit for increased testing and I am surprised to hear that you would consider a cleanup plan without considering the additional pollution that is going to be generated from this increased explosive testing and other activities at the Site, particularly that the State regulators that are present here today would not recognize their CEQA duties here and I want to remind you that California Environmental Quality Act is going to rule over this entire proceeding even though the EPA is involved. California Environmental Quality Act requires you, as I said before, to look at past, present and future uses at that site, in terms of your cleanup plan. Your cleanup plan is an action that is controlled by the California Environmental Quality Act so in doing your analysis, don't look at it with tunnel vision. You have to look at what's going on, what's going to happen later on. We have got a permit reapplication right now that's calling for testing of up to 8,000 pounds per year of explosives; 4500 pounds of that could potentially be depleted uranium and if your release fraction is correct from your atmospheric deposition people, 17 percent of that is going to leave the Site, 83 percent of that is going to stay on site, so is that approximately 3600 to 4,000 pounds a year of depleted uranium that is going to be continually rained on that site. So don't look at this in tunnel vision. The cleanup -- part of your job is to make sure that you take into account the continuing contamination, that is the California Environment Quality Act.*

Response: The objective of the Site-Wide Record of Decision is to select final cleanup remedies and standards for legacy contamination resulting primarily from past waste handling practices at Site 300. The California Department of Toxic Substances Control conducted a California Environmental Quality Act (CEQA) Initial Study of the proposed remedies for the cleanup of Site 300 and issued a Negative Declaration that the remedies will not have a significant impact on the environment. The San Joaquin Valley Unified Air Pollution Control District is currently reviewing LLNL's application for explosives testing at Site 300. It is our understanding the San Joaquin Valley Unified Air Pollution Control District's permit review will include a CEQA evaluation and a public comment process. Because your comment regarding current ongoing operations are outside the scope of this document, we would suggest that the public comment period for the Air District's CEQA evaluation might be the best forum for this issue.

Please refer to Section 3.2.2 for a detailed discussion of measures that have been and are being taken that address the potential for contamination from ongoing operations at Site 300 and impact human health and the environment.

Mr. Sarvey comment #2*: A lot of people have been talking to you about the Tracy City Council had made a request that you dig up the depleted uranium in the pit 7 complex. That is the letter I have given you here. You can take this back to your superiors. You can show it to them, there is no community acceptance for your pit 7 plan. If you look on the second page, this is the plan that was advanced, alternative was 5A, the city of Tracy is endorsing 3B removing all depleted uranium from the Site and the pit 7 complex and elsewhere. So as far as community acceptance goes you, have no community acceptance of your treatment at pit 7.*

Response: Please refer to Section 3.2.4 for a detailed discussion of the results of the evaluation of the excavation of waste from the Pit 7 Complex landfill.

Members of the Tracy City Council and their advisory group, Tracy Tomorrow and Beyond were invited and attended presentations and tours at Site 300. DOE/LLNL presented information to explain that the excavation of waste from the Pit 7 Complex landfill would not be effective in preventing contaminant releases from the both the Pit 7 Complex landfills and the underlying bedrock.

As described in Section 2.10 of the Site-Wide Record of Decision, DOE and the regulatory agencies evaluated the cleanup remedies based on the nine Environmental Protection Agency criteria: 1) overall protection of human health and the environment, 2) compliance with applicable or relevant and appropriate requirements, 3) long-term effectiveness and permanence, 4) reduction of toxicity, mobility, or volume through treatment, 5) short-term effectiveness, 6) implementability, 7) cost, 8) state acceptance, and 9) community acceptance. Criteria 1 and 2 are considered "threshold criteria," which are requirements that each alternative must meet in order to be eligible for selection. Criteria 3 through 7 are "balancing criteria," which are used to weigh major trade-offs among alternatives. Criteria 8 and 9 are "modifying criteria," which may be considered in the final balancing of trade-offs between alternatives upon which the final remedy selection is based. Community acceptance was evaluated based on the comments on the proposed cleanup plan provided by the community. Although some public comments expressed concern about the cleanup plan, DOE and the regulatory agencies agreed that the selected remedies are protective of human health and the environment, meet ARARs, and provide the best balance of trade-offs among the five balancing criteria.

***Mr. Sarvey comment #3**: The City of Tracy is rapidly expanding on your borders. Sometime in the near future you will have close neighbors with 5,500 luxury homes. Earlier, it was said that you are going to clean the water here to California Drinking Water Standards but what was not said is that the soil remediation that you plan is going to be to U.S. EPA industrial soil standards and that is inadequate. We want that to California Standards, we want that to the lowest possible, as a matter of fact we want it to the background that it was there originally. The community has continually asked you clean up the groundwater back to the standards and we expect that out of your plan and you owe that to the community to restore the Site to the original state before you started your operations there.*

Response: Please refer to Section 3.2.6 for a detailed discussion regarding funding for long-term cleanup at Site 300.

***Mr. Sarvey comment #4**: Your reasons for not meeting the communities expectations, as I read, revolve around the cost of cleanup and not the feasibility of cleanup. You expect to spend around ten million dollars every year to cleanup the mess you made and at the same time you intend to spend over a billion dollars creating new contamination with your activities at the main site and at Site 300. Your cleanup budget is less than one percent of your operating budget. I would ask that you give our community the respect we deserve and spend the money to clean up the Site to a level that the community actually accepts.*

Response: Please refer to Section 3.2.6 for a detailed discussion regarding funding for long-term cleanup at Site 300.

Cost was only one of the criteria used to evaluate cleanup alternatives for Site 300. The cleanup alternatives considered and remedies selected for Site 300 must first and foremost meet the U.S. Environmental Protection Agency's two threshold criteria to: (1) protect human health and the environment and (2) meet federal and state laws and regulations. Cost was one of the five balancing criteria that are used to find the best balance in trade-offs among the alternatives.

***Mr. Sarvey comment #5:** You must also withdraw your application for increased outdoor explosives testing. This plan will have no community acceptance until you discontinue the outdoor testing which results in additional pollution in the community and at the Site. You've constructed a contained firing facility and we very glad that you've done that and as you say you've done that to minimize offsite blast pressure and noise to neighbors and debris to the environment. Use that contained firing facility, stop contaminating our neighborhoods, stop contaminating the Site, stop contaminating the Carnegie Recreational Vehicle area and use that contained firing facility and if that blast is too big to use there take it out to your test site in Nevada. That is what we are asking. As part of this cleanup, we want you to stop polluting the Site. I can't emphasize that enough. No matter what you do, if you just keep continuing to pollute it, it doesn't matter how you clean it up, so please do that for us, thank you.*

Response: Please refer to Section 3.2.2 for a detailed discussion of measures that have been and are being taken that address the potential for contamination from ongoing operations at Site 300 and impacts to human health and the environment.

Jim Howell — 340 Hunter Trail, Tracy, California

***Mr. Howell comment #1:** My name is Jim Howell, I live at 340 Hunter Trail here in Tracy. Earlier in your presentation a reference was made to the possibility that there was at some point in time a public health risk assessment done but it was unknown whether that was really actually* *in fact done and when and any of the details. I would like to make a formal request that this study be found, if it exists, that it be published on your web-site, that a complete document be put in the Tracy City Library and multiple copies so that it can be reviewed. If it hasn't been done, I would like that information posted on the web-site, I would like it started immediately if it hasn't been done because it certainly should be done. The public needs to know if such a risk assessment has been completed, who completed it, when it was completed, what its findings were and it also needs to know if none was done. And I find it difficult to understand with the level of expertise here at this meeting that you don't know whether or one has been done or not and the specific details. You can tell me how many microcuries of whatever is in the ground, you certainly should have been able to tell us that. So I am a little disappointed with that. Thank you very much.*

Response: A baseline risk assessment was conducted in the early 1990s to identify risk to humans and animals if contamination at Site 300 was not cleaned up. The results of the risk assessment were used to determine where and what type of cleanup was needed at the site. Table 2.7-1 and 2.7-2 of the Record of Decision present the results of the baseline risk assessment for humans and animal respectively. In these tables, a risk that exceeds 1×10^{-6} (one-in-a-million excess cancer risk) or a hazard indices (HI) that exceeds 1 is considered unacceptable by the U.S. Environmental Protection Agency. As indicated in these tables, cleanup activities at the site have already mitigated risk and hazard in many areas of the site. A risk or hazard is considered to be mitigated if it is below 1×10^{-6} and 1, respectively. In addition, the Agency for Toxic Substances and Disease Registry conducted an independent health assessment of Site 300 contamination in 2005 that concluded that there are no past or current exposures to contaminants associated with LLNL – Site 300, and the potential for future exposure is unlikely. This report is available online at www-envirinfo.llnl.gov/. DOE mailed a copy of the report to the public meeting attendees that left a mailing address. If you did not receive a copy of this report and would like one, please contact Claire Holtzapple at (925) 422-0670 for a copy.

Table 2.5-4 of this document lists the maximum historical concentrations of contaminants (pre-remediation) detected in Site 300 ground water, as well as the current maximum concentrations. From this table you may note the significant reductions in ground water contaminant concentrations over time as a result of cleanup activities conducted at the site. Tables 2.5.1 and 2.5.2 list maximum historical concentrations of contaminants (pre-remediation) detected in surface soil and subsurface soil/rock at Site 300. Soil removal and soil vapor extraction activities have been conducted to reduce contamination in surface soil and subsurface soil/rock at Site 300.

3.4. Written Comments, Received by July 25, 2007

Pamela Richard — 4382 Fitzwilliam Street, Dublin, California

I have just become aware that you are taking comments from residents of near-by communities. I have been thinking about the pollution that is entering the air and water from your facility. It worries me extremely because I live here with my daughter, her husband and my two grandchildren. It is actually frightening to take my granddaughter out for walks, worrying if we will be bombarded with some stray radiation.

Do you have children or grandchildren that live in this area? Do you want to see an innocent child put at risk from unsafe practices in the past that need clean-up or possible future dangerous radioactive testing? Please take the recommendations of our community research group, Tri-Valley Cares to do a strict & thorough clean-up.

I hold the hope that someday you will be able to convert the facility into a "World Class Center for Civilian Science". With all the problems of global warming & toxic pollution, there are limitless opportunities for the intelligent people that work there.

Response: We appreciate your concerns, but would like to assure you that you and your family are not at risk of exposure to contamination at Site 300. The cleanup effort at Site 300 is not a theoretical exercise conducted from afar without true regard and concern for the adequacy of cleanup or the effects on nearby residents. Thousands of Laboratory employees and their families reside in Tracy, Manteca, Stockton, Livermore, Dublin, Pleasanton, and nearby communities. The health and safety of site workers and neighboring residents and communities remains the highest priority for the cleanup effort.

DOE and LLNL conducted extensive investigations to evaluate contamination at Site 300 and potential impacts to site neighbors and nearby communities. This work was performed under the stringent guidelines and oversight of the U.S. Environmental Protection Agency (EPA) and the state environmental regulators. The results of these investigations and evaluations indicate that the contamination at Site 300 will not impact residents of Tracy or any future residents of the Tracy Hills Development.

The Agency for Toxic Substances and Disease Registry's independent health assessment of Site 300 contamination that concluded that there are no past or current exposures to contaminants associated with LLNL – Site 300, and the potential for future exposure is unlikely. Site 300 contamination is contained within the site boundaries with the exception of three offsite monitor wells located within 150 feet of the site boundary. These three wells are not used for drinking water and there is no mechanism for the Tracy city water-supply well to become contaminated from releases at Site 300.

Since contamination was first discovered in the early 1980s, DOE has been working with Federal and State regulatory agencies to implement an environmental restoration program to clean up soil and ground water contamination at Site 300. Cleanup activities at Site 300 were initiated in the mid-1980s to begin addressing contamination and have included:

- Installing over 21 remediation systems to extract and treat contaminated ground water and soil vapor.
- Removing contaminated soil.
- Capping and closing landfills, rinsewater lagoons and burn pits.
- Removing contaminated firing table gravels.

Through these efforts, considerable progress has been made in cleaning up the site. One ground water contaminant plume has already been fully remediated. Contaminant concentrations in both soil and ground water have been significantly reduced throughout the site. The cleanup effort at Site 300 will continue until cleanup standards are met.

Bob Sarvey — 501 West Grant Line Road, Tracy, California

Mr. Sarvey comment #1: *Lately I have been getting some very nice and very expensive mailers from "Site 300 like the one I am holding here. I imagine a mailer like this cost maybe $50,000. So the DOE is spending lots of money promoting the positive aspects of Site 300. This mailer talks about environmental stewardship and the new contained firing facility and its ability to eliminate the dispersal of radioactive and high explosive contaminates from explosive testing at Site 300. So I was a little disappointed that for an important meeting like tonight the DOE sent out nothing to the community. In fact I didn't even know about this meeting until my friends in Livermore called me about it. I've only been working on cleanup issues at site 300 for about 15 years every since Bert Hefner retired I don't even hear about the meetings.*

Response: In an attempt to encourage public participation in the Public Meeting held on June 20, 2007, DOE placed public notices and display ads in the Tracy Press and Stockton Record, and mailed letters with a copy of the Proposed Plan notifying and inviting neighbors, local government, and other interested community members to attend the Public Meeting and comment on the proposed cleanup plan for Site 300. You were mailed and should have received one of these mailings. However, we will evaluate additional means for advertising future meetings to better inform the community. Please refer to Section 3.2.5 for a detailed discussion of continued community involvement in the cleanup process at Site 300.

Mr. Sarvey comment #2: *Deficiencies in cleanup plan – The clean up plan proposed here has many deficiencies but I want to focus only on the major ones. First in the Pit 7 operable unit you intend to leave pockets of depleted uranium in the soil and presumably use institutional controls to keep people away from the buried depleted uranium. There's only one problem with that strategy and it is the fact that depleted uranium has a half life of 4.5 billion years. Your cleanup plan is completely silent on that issue. In your proposed plan for the cleanup of the pit seven complex issued February 2006 you proposed several alternatives one of them being alternative 3b which is the excavation and removal of the depleted uranium. Our City Council voted unanimously on April 18, 2006 to support alternative 3b and sent you a letter that I have here and I have a copy for all the regulators present. Please take this letter back to your superiors and inform them that this portion of your cleanup plan fails the community acceptance criteria and has no support in Tracy.*

Response: Please refer to Section 3.2.4 for a detailed discussion of the results of the evaluation of the excavation of waste from the Pit 7 Complex landfill.

DOE is committed to keeping Tracy City Council members, as with the surrounding community, informed of activities at Site 300, including issues regarding site cleanup. Members of the City Council and Tracy Tomorrow and Beyond (a city council advisory group) have been invited and participated in presentations and tours at Site 300 that provided information about both programmatic and environmental restoration activities. The presentations and tours included visits and discussions of cleanup sites for which the City Council had expressed particular concerns. Public tours of programmatic and environmental restoration activities at Site 300 have also been conducted regularly.

Mr. Sarvey comment #3: *Firing tables continue to test – Another failure in your plan is your remediation plans for firing tables 850, 851, 812, and 845. As your plan states historical firing table experiments have resulted in releases to soil and groundwater. Your recent application to* *the San Joaquin valley air pollution control district requests permission to resume open detonations of explosive charges at these firing tables. The explosive charges will be as large as 350 pounds and with as much as 240 pounds of depleted uranium and an undisclosed amount of tritium. Your application allows you to increase outdoor testing by 800% to 8,000 pounds with as much as 4,500 pounds of the charges being depleted uranium and up to 22 grams of tritium. If you're going to continue the practice of open detonations that caused the problem in the first place by the California environmental Quality Act standards you must look at the cumulative impacts of your activities. If the release fraction in your application for increased explosive testing is correct and I doubt that it is you will deposit 3,800 pounds of depleted uranium on site per year. You will be polluting the soil and water faster that you can clean up it up. Why don't you include in your cleanup remedy the exclusive use of the contained firing facility for testing and eliminate all outdoor testing. Without that the remainder of your plan has no community acceptance either.*

Response: Please refer to Section 3.2.2 for a detailed discussion of measures that have been and are being taken that address the potential for contamination from ongoing operations at Site 300 and impacts to human health and the environment.

Mr. Sarvey comment #4: *The city of Tracy is rapidly encroaching on your borders. Sometime in the near future you will be close neighbors with 5,500 luxury homes. Cleaning the soil up to U.S. EPA industrial soil standards is inadequate. Your cleanup standards must be the most stringent possible. The community has continually asked that you can clean up the groundwater to background standards not just federal and state drinking water standards. You owe it to the community to restore this site to its original state.*

Response: Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

Mr. Sarvey comment #5: *Finally your reasons for not meeting the community's expectations revolve around the cost of cleanup and not the feasibility of the cleanup. You expect to spend around 10 million dollars every year to clean up the mess you have made. At the same time you intend to spend over a billion dollars a year creating new contamination with your activities at the Livermore main site and Site 300. Your cleanup budget is less than 1% of your operating budget. Give our community the respect we deserve and spend the money to clean this site up to a level the community actually accepts. You must also withdraw your application for increased outdoor explosives testing. This plan will have no community acceptance until you discontinue the out door testing which results in additional pollution in the community and at the site. You have constructed a contained firing facility to as you say "minimize offsite blast pressure and noise to neighbors and debris to the environment. Use it stop contaminating the site and our neighborhoods. Additionally we are not interested in any potential biological contamination you would like to expose our city to with your level 4 biolab. Our city council has also sent you a letter opposing this. Biolab Enough is enough. Come back with an acceptable plan and quit adding contamination to the site.*

Response: Please refer to Section 3.2.6 for a detailed discussion regarding funding for long-term cleanup at Site 300.

Cost was only one of the criteria used to evaluate cleanup alternatives for Site 300. The cleanup alternatives considered and remedies selected for Site 300 must first and foremost meet the U.S. Environmental Protection Agency's two threshold criteria to: (1) protect human health and the environment and (2) meet federal and state laws and regulations. Cost was one of the five balancing criteria that are used to find the best balance in trade-offs among the alternatives.

Site 300 is no longer being considered for the location of the National Zoonotic and Agriculture Research Center.

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Tri-Valley CAREs Community Acceptance Criteria #1: *Complete the Site 300 cleanup project in a timely manner. Set a schedule for cleanup activities and adhere to it. The goal should be to complete cleanup ten years after the Dept. of Energy's (DOE) last scheduled Record of Decision (ROD), with up to 30 additional years monitoring of residual contamination. As part of the plan, schedule milestones addressing total mass removal and trends toward achievement of clean-up goals should be established and committed to by the DOE. Areas that will still be contaminated should be identified. We recognize that cleanup in 10 years after the last ROD will be difficult to achieve in some small areas. Also, because of the nature of tritium, EPA and California drinking water standards will not be attained for that contaminant in the near future.*

Response: Although it is DOE's goals to achieve cleanup at Site 300 as soon as possible, it is not technically feasible to randomly select a timeframe such as 10 years to achieve cleanup even if unlimited funds were available. There are different areas of contamination at Site 300 and cleanup time will depend on how much contamination is present and how difficult it is to remove it at a specific location. The rate of cleanup of each area or operable unit is limited by such variables as the volume of contaminated ground water or soil, the type of contaminant, and characteristics of the rocks containing the ground water contamination.

For example, cleanup of the volatile organic compound (VOC) plume at the Eastern General Services Area of Site 300 started in 1991 using a best-available, presumptive technology. Ground water in this area was contained in porous sediments from which we were able to extract large volumes of contaminated ground water for treatment. Even under this best-case scenario, it took 15 years to remediate VOCs to meet cleanup standards. Other areas of the site will take longer where contaminants are locked up in subsurface rocks that contain clay from which it is very difficult to remove contamination or in rocks that yield very low volumes of ground water. The best available technologies for the cleanup of ground water contamination are being utilized at Site 300, however, we are continually searching for new technologies that can help speed up the cleanup.

The Environmental Restoration Project adheres to cleanup milestones for buildout of the treatment systems and Comprehensive Environmental Response, Compensation and Liability Act-required documents. After initiation of a treatment system, the mass removal rate typically tapers off because the contaminants that are readily accessible are removed, leaving the contamination that is more difficult to remove. Therefore, mass removal rates tend to be poor indicators of remediation progress. The mass of contamination removed, contaminant concentrations trends, and remediation progress are evaluated regularly and reported in the Site 300 semi-annual Compliance Monitoring Reports are available on the website: wwwenvirinfo.llnl.gov/ and at the Tracy Library and LLNL Discovery Center.

Tri-Valley CAREs Community Acceptance Criteria #2: *Cleanup levels should support multiple uses of the property. Assumptions about land-use need to be altered. As we can see, residential development is beginning to take place up near the site boundary. Any modeling assumptions should assumed large residential communities relying on the regional aquifer for drinking water, thus speeding up groundwater movement. Second, we do not believe that Site 300 will necessarily always remain a DOE site. The "need" for testing nuclear weapons and components (particularly of new and modified designs) is a political decision, not a technically necessary mandate, and, in our opinion this testing should cease. We recommend that Site 300 future land use assumptions include mixed residential, recreational, ecological preserve and industrial land uses. Yet as it now stands, DOE assumes that Site 300 will remain in DOE's control in perpetuity. We recommend that Site 300 assume to be mixed residential, recreational, ecological preserve and industrial land uses. Without full cleanup to standards appropriate for residential use, the residual contamination will remain in place and will restrict the future use of the property. The Proposed Plan must commit to cleaning up to residential standards – – this will ensure that a whole new cleanup will not need to be undertaken at a later date to go after the significant residual contamination that industrial standards would leave behind.*

Response: Please refer to Section 3.2.1 for a detailed discussion of land use and the protectiveness of cleanup standards proposed for remediation of Site 300.

Tri-Valley CAREs Community Acceptance Criteria #3: *The strictest state and federal government cleanup levels should be used. We believe that the strictest cleanup levels should be met in cleaning up the site. Federal and state Maximum Contaminant Levels (MCLs) for all groundwater (on-site and off-site) should be the "bottom line below which the cleanup will not fall." In many cases the technology exists (and/or can be developed) that will clean up contamination to "background" levels — that is to the level that existed in nature at the site before Livermore Lab took over in 1955 and began polluting it. In such cases where "background" clean up levels that are more protective of human health and the environment can be achieved, they should be achieved. Moreover, the U.S. EPA has published "preliminary remediation goals" for many contaminants that are more stringent than the Maximum Contaminant Levels. The State of California has also cleanup goals that are more strict than the MCLs. In this regard, Tri-Valley CAREs concurs with a strict interpretation of the California Regional Water Quality Control Board's non-degradation policy for groundwater. Migration of contaminants into pristine waters should be halted. At a minimum, the standard of 1 in 1 million excess cancer deaths should be adhered to, as well as meeting a hazard index of less that 1 (on-cancer health effects). The Proposed Plan must commit to the strictest cleanup standard promulgated by appropriate state and/or federal regulatory agencies like EPA and the Regional Water Quality Control Board, not the most lax.*

Response: Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

Tri-Valley CAREs Community Acceptance Criteria #4: *Remedies that actively destroy contaminants are preferable. In order of preference, Tri-Valley CAREs recommends the following types of cleanup measures: a) remedies that destroy contaminants (i.e. by breaking* *them down into non hazardous constituents), such as ultra-violet light/hydrogen peroxide, permeable barriers, or biodegradation; b) active remedies that safely treat or remove contaminants from the contaminated media; c) monitored natural attenuation in so far as it relies on natural degradation (and not further dispersion of the pollution) within a reasonable time frame. What is called "risk and hazard management" (i.e., restrictions on land use, fencing, signs and institutional controls) is not a valid cleanup in our eyes. In no case do we think that "point of use cleanup" (e.g., merely placing filters on off-site drinking water wells) is appropriate. In all cases, hydraulic control should be established to halt migration of contaminant plumes to pristine waters. When soil excavation takes place, it should be properly controlled to minimize releases of contaminated soil into the air, and onto adjacent properties.*

Response: Comprehensive Environmental Response, Compensation and Liability Act includes a preference for remedies that employ treatment that reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against offsite disposal of untreated wastes. The remedial technologies include technologies that reduce the volume, toxicity, or mobility of contaminants to the extent possible. Institutional controls (risk and hazard management) are implemented to protect onsite workers and the public from exposure and to ensure the integrity of the remedy where waste will remain in place (e.g., the landfills). Point-of-use treatment is not included as part of the cleanup remedies for any Site 300 Operable Unit. One of the remedial action objectives of the Site 300 Environmental Restoration Project is to prevent plume migration to the extent technically and economically practicable. Controls are used to minimize releases contaminated soil into the air during soil excavation activities. Offsite properties will not be impacted by soil removal activities.

Tri-Valley CAREs Community Acceptance Criteria #5: *The tritium source and plume at Site 300 should be controlled. Continued forward momentum of the tritium plume must be halted. The tritium plume, about two miles long and growing, cannot be cleaned up in the usual sense of the word, since it is not feasible to separate the radioactive hydrogen (tritium) component from the water. Therefore, Tri-Valley CAREs recommends the following: a) isolation of the tritium contaminated wastes in the unlined dumps at site 300 to prevent further and continuing contamination of the groundwater; b) hydraulic control of the underground water plume to prevent further migration; c) aggressive monitoring to ensure minimal migration while the tritium decays; and, d) a stringent contingency plan in case these methods fail. As it currently stands, groundwater rises into the waste dumps during heavy rainfall and picks up additional tritium. Isolation of the wastes may be accomplished by means of drains, by capturing groundwater upstream from the pits before it is inundated, and, where feasible, by removing the tritium-contaminated debris from the pits and storing it above ground in a monitored facility. The Proposed Plan must commit to these actions as needed to prevent further movement of tritium.*

Response: The tritium in ground water with activities that exceed drinking water standards extends approximately 1,300 ft (1/4 mile) from the source areas at the Pit 7 Complex and Building 850, and remains more that 2 miles from the site boundary. The portion of the tritium plumes with activities above drinking water standards are stable or shrinking in both the Building 850 and Pit 7 Complex areas. Ground water modeling results show that the portion of the plume in excess of drinking water standards (20,000 picoCuries per liter) will not migrate during the 45 years necessary for all tritium activities to decline to below this standard. While tritium is present in ground water above background levels at a greater distance from these source areas, this tritium will decay to background levels without impacting site neighbors or nearby communities.

a) The remedy for the Pit 7 Complex includes measures to control/isolate contaminant sources in the landfills and underlying bedrock. A drainage diversion system was installed to prevent further contaminant release from both the pit waste and underlying bedrock, and local ground water gradients will be reduced, effectively slowing migration of the pre-existing tritium and uranium ground water plumes. The drainage diversion system is considered to be more protective of human health and ground water and able to better meet federal and state laws and regulations than excavation of the pit waste. Characterization data indicates that the majority of the tritium and uranium has already migrated from the pit waste into the underlying bedrock. Therefore, while excavation would remove the source of contamination in the pits, it would not prevent further releases of contaminants present in the underlying bedrock to ground water. Ground water data collected from the Building 850 Firing Table area indicates that there is not longer a significant source of contaminant present that could impact ground water.

b) Please refer to Section 3.2.3 for a detailed discussion of tritium plume migration and controls, including the results of the evaluation of hydraulic recirculation.

c) There is an extensive ground water monitoring network in place at the site that is regularly sampled to evaluate migration of the tritium plume. Hundreds of samples are collected each year and the results of this monitoring are reported to the regulatory agencies and general public semi-annually.

d) 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 Site 300 to ensure continued protection of human health and the environment. DOE regularly reviews and discusses 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-evaluating and implementing changes to the remedy if cleanup does not proceed as expected.

Tri-Valley CAREs Community Acceptance Criteria #6: *Radioactive substances should be isolated from the environment. Contaminants should be removed, where possible, and stored to prevent future leakage. As is the case with tritium, there are several underground plumes containing Uranium-238, also called depleted uranium. Technology exists to separate this contaminant from the groundwater. Tri-Valley CAREs recommends that this contaminant be stored in above ground monitored facilities after separation from groundwater. This will prevent it from polluting a new location in the future.*

Response: This TVC community acceptance criteria is met in that selected cleanup remedy for uranium in ground water in the Pit 7 Complex includes pumping uranium-contaminated ground water from the subsurface and treating it to remove the uranium using ion-exchange resins. The uranium becomes attached to resin that eventually becomes saturated and must be replaced with new resin in order to be able to continue to effectively remove the uranium. The uranium-saturated resin will be shipped offsite to an approved offsite disposal facility that is designed to prevent releases of uranium to the environment.

Tri-Valley CAREs Community Acceptance Criteria #7: *The ecosystem should be protected in the cleanup remedy. Site 300 is home to endangered species and critical habitat. Site 300 sits* *on 11 square miles of land about 30 miles east of San Francisco. It sits on a series of steep hills and canyons, covered by grasslands. Seven major plant communities occur at Site 300, including: coastal sage scrub, native grassland, introduced grassland, oak woodland and 3 types of wetland. Twenty species of reptiles and amphibians, 70 species of birds, and 25 species of mammals also occur. Special, rare and endangered species may live there, including the burrowing owl, the San Joaquin Kit Fox and the Large-Flowered Fiddleneck. In order to protect the ecosystem, ecological risks should be no greater than those for humans (i.e., a Hazard Index of less than one for selected species, based on recent data). This involves making sure that cleanup activities do not inadvertently destroy unique habitat. This could occur from too quickly pumping groundwater, with the effect of destroying natural springs, or by capping large areas and replacing the vegetation with non-native species. The Proposed Plan must be rewritten to be more protective of endangered species at Site 300.*

Response: As discussed in the Proposed Plan, LLNL wildlife biologists closely monitor potentially impacted species as part of a continuing ecological risk management program at Site 300 and have found no adverse effects due to contamination. The site cleanup plan is designed to prevent harmful impacts to plants and animals at the site, particularly threatened and endangered species. All cleanup activities are carefully monitored by LLNL wildlife biologists to ensure that special status plants and animals are protected. The biologists work very closely with the U.S. Fish and Wildlife Service to ensure compliance with laws and regulations protecting threatened and endangered species. Following any remediation construction activities, any habitat that has been disturbed is restored. 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. As part of this program, DOE has created protected habitat at the site for several endangered species including the California red-legged frog, California tiger salamander, and the Large-flowered fiddleneck.

The presence of the San Joaquin kit fox has not been confirmed at Site 300, although there have been confirmed sightings on adjacent ranch land. Both California red-legged frog and California tiger salamander occur at Site 300. Although a large portion of Site 300 was initially proposed by the U.S. Fish and Wildlife Service as critical habitat, the recent final critical habitat listing did not include Site 300. Although Site 300 is no longer considered critical habitat, potential impacts to any endangered species are considered as part of ecological risk assessment activities conducted at Site 300. In addition, DOE/LLNL has created protected habitat at the site for several endangered species including the California red-legged frog, California tiger salamander, and the Large-flowered fiddleneck.

Tri-Valley CAREs Community Acceptance Criteria #8: *Decisions should not rely on modeling alone. The Site Wide Feasibility Study for the Site 300 cleanup and other documents point out just how complex the hydrogeology of the site is, and how little is known about it. Given this, Tri-Valley CAREs believes that over-reliance on modeling to predict the fate and transport of contaminants is not a good idea. Computer modeling should be used as a tool only, and continually updated by field testing as that information becomes available. We believe that if it necessary to base decisions primarily on modeling, the most conservative assumptions should be used. The Proposed Plan must include adequate, long-term field testing.*

Response: Ground water and its movement in rock underlying Site 300 has been studied and documented extensively over the past 25 years. These studies have enable us to identify over 10 separate water-bearing rock units from what was published as one rock formation (Neroly Formation) in geologic maps in the mid-1980s. The evaluation of contaminant movement in the subsurface will continue to be an ongoing process throughout the cleanup effort. Decisions are not based solely on computer modeling. Modeling is only one tool used in the cleanup decision-making process. DOE collects and analyzes thousands of ground water samples and measures water elevation from over 680 monitor wells at Site 300 throughout each year to: (1) track ground water contamination, (2) define any changes in local ground water chemistry and flow, (3) to be certain that modeling assumptions and results continue to be valid, and (4) to validate that the cleanup actions being taken at the site are progressing as expected and continue to be protective of human health and the environment.

Tri-Valley CAREs Community Acceptance Criteria #9: *Additional site characterization is needed. Adequate site characterization can ensure that the cleanup technologies built will be the ones needed for he pollutants in that specific area. It is apparent from the cleanup planning documents to date that additional characterization (e.g. of soil, ground water, waste dumps etc.) is necessary, and will have to be budgeted for many years to come. This should be specified in the Proposed Plan.*

Response: Shortly after contamination was discovered at Site 300, DOE began extensive environmental investigations throughout Site 300 to determine:

- How, where, and what type of contaminants had been released.
- What environmental media (i.e., soil, bedrock, ground water, and surface water) had been affected.
- How far contamination had spread and where it could migrate in the future.
- What were the risks to humans, plants, and animals that could be exposed to the contamination.

Environmental investigation activities included:

- Records searches and interviews.
- Drilling of boreholes to collect soil and bedrock samples.
- Installation of over 680 ground water monitor wells.
- Analysis of tens of thousands of soil, bedrock, ground water and surface water samples.
- Soil vapor and geophysical surveys.
- Hydraulic testing.
- Observing water level responses to rainfall events.
- Geologic mapping.
- Ground water transport modeling.
- Geologic and hydrogeologic characterization.
- Risk assessments.

The U.S. Environmental Protection Agency and the State regulatory agencies have concurred that the nature and extent of the contamination has been characterized sufficiently to propose and select a cleanup remedies.

Tri-Valley CAREs Community Acceptance Criteria #10: *A contingency plan should be completed and subject to public review. We recommend that a site wide contingency plan be discussed in the Proposed Plan and fully delineated in the Record of Decision document. This is needed because the cleanup of a few sites are put off until the future, there are many uncertainties, innovative technologies will be used, and contingent actions should be part of the cleanup plan and thus incorporated into the site wide Record of Decision.*

Response: Following completion of the Site-Wide Interim Record of Decision in 2001, a Site-Wide Contingency Plan was prepared and approved in 2002 and is available for review at the Tracy Library and at the LLNL Discovery Center. The Contingency Plan is scheduled to be revised in 2009 to reflect any changes in site conditions or cleanup remedies that have occurred since the 2002 Contingency Plan was approved. As with other draft documents, the draft Contingency Plan will be submitted to Tri-Valley CAREs for review, and the final document will be available to the public online and at the Tracy Library and LLNL Discovery Center.

Tri-Valley CAREs Community Acceptance Criteria #11: *The public should be involved in cleanup decisions. A mechanism for long-term community involvement must be established. As it now stands, public involvement takes place through the Technical Assistance Grant (TAG) with Tri-Valley CAREs and at public meetings and hearings. After ROD is signed, there are no mandatory public hearings or workshops. Therefore, we would like a commitment from the Lab to find a mechanism for regularly keeping the public informed. A public record of cleanup activities should be updated regularly, maintained and made accessible at a local public library. Public workshops should be held periodically after the last ROD to discuss problems and progress.*

Response: DOE/LLNL has an ongoing public participation process, as defined in LLNL's Community Relations Plan, to involve members of the public and local government in its cleanup projects. This plan exceeds the requirements of Federal regulations. As required by the Plan, information repositories have been established to allow public access to Site 300 environmental documents to provide accurate and timely information to interested members of the community.

Please refer to Section 3.2.6 for a detailed discussion regarding funding for long-term cleanup at Site 300.

Tri-Valley CAREs Community Acceptance Criteria #12: *Cleanup should be given priority over further weapons development. Perhaps most important of all, Tri-Valley CAREs insists that cleanup of Site 300 be given a priority over further bomb-creating enterprises. Tri-Valley CAREs objects to Livermore Lab increasing its outdoor explosive bomb tests 8-fold, and is participating in an effort to prevent the above-ground blasts with depleted uranium and other contaminants. These new tests will pile additional pollution on top of what is already being cleaned up under the Superfund law. We request, instead of more pollution, that adequate, stable, long-term funding be assured so that the current Superfund cleanup job gets done right. The fiscal year 2007/2008 allocation of about one percent of Livermore Lab's annual budgets to cleanup at Site 300 (and only another 1 percent to cleanup at the Lab's main site) is insufficient.*

Response: Issues of priority of weapons work versus cleanup are beyond the scope of the Proposed Plan or the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process. Public input on these issues can always be provided through public agencies and elected representatives.

DOE submits annual funding requests to Congress for the cleanup of the LLNL Livermore Site and Site 300. The funding requests for the CERCLA cleanup effort submitted to Congress are separate from funding requests made for other activities conducted at LLNL. The funding requests are based on cleanup commitments and regulatory deliverables agreed upon with the regulatory agencies and contained in the Federal Facility Agreement, the Records of Decision, and other CERCLA cleanup documents. Actual funding levels received for DOE site cleanup, which do not always match the funding requests, are based on decisions made and allocated at the Congressional level based on national priorities, not at the local DOE office level.

Tri-Valley CAREs Community Acceptance Criteria #13: *Future activities at Site 300 should be designed to prevent releases. Releases to soil, air, groundwater and surface water from weapons are not acceptable. Any activities, if they must occur, should take all necessary precautions to avoid any releases to the environment of radionuclides and chemical pollutants. Tri-valley CAREs is leading the struggle to prevent the collocation of "bugs and bombs" at Site 300 by opposing a massive bio-warfare agent research facility that will experiment with deadly biological agents such as live anthrax, plague, mad cow disease and many others.*

Response: Please refer to Section 3.2.2 for a detailed discussion of measures that have been and are being taken that address the potential for contamination from ongoing operations at Site 300 and impacts to human health and the environment.

Site 300 is no longer being considered for the location of the National Zoonotic and Agriculture Research Center.

Additional comments from Peter Strauss and Marylia Kelley on behalf of Tri-Valley CAREs — 2582 Old First Street, Livermore, California

Tri-Valley CAREs comment #1: *Public Outreach and Access to Information. In general, Public Outreach and access to information has been less than adequate. We therefore find that this is in conflict with Community Acceptance Criteria 11 (The public should be involved in cleanup decisions.) Below are the reasons for reaching this conclusion.*

Comment 1a: *There has been little public outreach for the public meeting on the Proposed Plan (held on June 20, 2007). Tri-Valley CAREs (TVC) has tried to publicize it, but this is the responsibility of the DOE. We note that the public received the rewritten notice of this meeting (approximately June 9) with information regarding the location of the repository. TVC was granted a 30-day extension for written comments on behalf of the community. These two things are appreciated, but, overall, the public outreach has been insufficient.*

Response: In an attempt to encourage public participation in the Public Meeting held on June 20, 2007, DOE placed public notices and display ads in the Tracy Press and Stockton Record, and mailed letters with a copy of the Proposed Plan notifying and inviting neighbors, local government, and other interested community members to attend the Public Meeting and comment on the proposed cleanup plan for Site 300. However, we will evaluate additional means for advertising future meetings to better inform the community.

Comment 1b: *Proposed Plan should contain a table delineating DOE's analysis of the remedy(ies) against the nine EPA evaluation criteria. This analysis is not included, and it is difficult for the community to comment on how DOE and the regulators are evaluating the remedy. These criteria are: Overall Protection of Human Health and the Environment; Compliance with ARARs; Long-term Effectiveness and Permanence; Reduction of Toxicity, Mobility and Volume; Short-term Effectiveness; Implementability; Cost; State Acceptance; and, Community Acceptance.*

Response: An analysis of the proposed remedies against the nine U.S. Environmental Protection Agency (EPA) evaluation criteria was presented in the Proposed Plan for the Interim Remedies (2000) and the Proposed Plan for the Pit 7 Complex (2006). The remedies in these two documents were considered interim because cleanup standards were not selected. There are only minor adjustments to the interim remedies presented in the Site-Wide Proposed Plan (2007) with the main emphasis on the selection of cleanup standards. The results of the analysis of the remedies to the nine EPA criteria are the same as previously presented.

Comment 1c: *Information regarding Pits 2, 8, and 9, contained in Operational Unit (OU) 8 has not been made available to TVC. As such, we cannot fully evaluate the remedy. A presentation on monitoring the pits was given to the Remedial Project Managers (RPMs). The date of the presentation is not known, although on June 7, 2007, EPA sent a letter to DOE expressing some concerns. In an e-mail to Claire Holtzapple dated June 8, Peter Strauss requested that materials on the monitoring of the Pits be send to him and TVC. Ms. Holtzapple responded that discussions between DOE and the regulators regarding the monitoring plans for the pits are in the early stages, and therefore the request was denied. As there is no further action proposed for these Pits, monitoring is an essential part of the remedy.*

Response: The remedies for the Pits 2, 8, and 9 Landfills consists of monitoring and institutional/land use controls, not "no further action." The DOE/LLNL comment responses to the U.S. Environmental Protection Agency comments on the plan to install the vadose zone monitoring systems for the Pits 2, 8, and 9 were reviewed at the July 26, 2007 Remedial Project Manager's Meeting. The lack of available drilling locations due to topography, the limited ability of lysimeters to detect contaminants released to unsaturated rock, and the difficulty retrofitting an existing landfill were discussed. Because there is no risk to human or ecological receptors associated with these landfills, there has been no evidence of releases of contaminants from the Pits 8 and 9 Landfill in the almost 50 years since these landfills have been in place, only 10 inches of rain fall at Site 300 on average, the maximum depth for surface infiltration is 3 feet, and the high cost of installation and maintenance of lysimeters, the regulating agencies agreed that the installation of additional landfill vadose monitoring systems was not warranted.

Tri-Valley CAREs comment #2: *Cleanup Standards. TVC believes that the proposed cleanup standards do not satisfy Evaluation Criteria 1 (Overall protection of human health and the environment, Criteria 2 (Compliance with ARARs), and Criteria 3 (Long-term effectiveness and permanence). They also fail to meet Community Acceptance Criteria 2 (Cleanup levels should support multiple uses of the property), and 3 (the strictest state and federal government cleanup levels should be used). Below are the reasons for reaching this conclusion.*

Comment 2a: *The interim ROD did not contain cleanup standards. DOE had committed to cleanup the groundwater to a level between background and levels that are set by EPA in the Safe Water Drinking Act (i.e., the maximum contaminant level or MCL), or the state MCL. Yet,* *with few exceptions, DOE has opted for groundwater cleanup standards that are MCLs. Many of the MCLs were first established in the 1980s and have not undergone a serious review since then. For example, although EPA identified TCE as having a greater toxicity in 2001, the MCL has remained the same (i.e., 5 ppb). It is also worthwhile to note that a bill was recently introduced in the Senate that would force EPA to modify the MCL for TCE within 180 days, and notes that the ATSDR recommends setting the MCL at 1 microgram per liter (i.e., 1 ppb). DOE has stated that after it reaches MCLs, it will evaluate whether it can meet a more stringent cleanup level such as the state water quality numeric limits (WQNLs) (formally the water quality objectives). Tri-Valley CAREs (TVC) believes that at the very least the goals for this cleanup should be more stringent; either the WQNLs or background. If they cannot be met, then the ROD can be modified at a later date. We note that in 2000 at the public hearing, we (Peter Strauss) recommended that the most cleanup goals be established (i.e., background), after which DOE can determine at a later date whether it can meet those goals. We believe that this is the correct approach, rather than establishing the most lenient groundwater standard. We believe that the community articulated this point in several of its public comments. It is a fact that there is increasing residential growth in the Bay Area. Combining this fact with the increasing strain on water resources throughout the state, demands that the highest level of cleanup of all potential drinking water supplies be given the highest priority.*

Response: Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

As cleanup progresses, the cleanup remedies will be evaluated as part of the Five-Year Review process to assess whether they continue to be protective of human health and the environment. An evaluation of changes in cleanup standards, as well as land use and contaminant toxicity, are included in these reviews. For example, EPA's recent assessment of TCE toxicity is discussed in recent Five-Year Reviews for Site 300.

Comment 2b: *For soil, industrial cleanup standards were used. 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. 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.*

Response: Please refer to Section 3.2.1 for a detailed discussion of land use and the protectiveness of cleanup standards proposed for remediation of Site 300.

Comment 2c: *TVC opposes the use of industrial standards for PCBs, dioxins and furans, based on EPA industrial PRGs. These are long lived contaminants, and will be a continual source of contamination for future users of the site. As such, these standards fail to meet long-term effectiveness and permanence.*

Response: Please refer to Section 3.2.1 for a detailed discussion of land use and the protectiveness of cleanup standards proposed for remediation of Site 300.

Comment 2d: *In all cases, we recommend that the cleanup standard for carcinogens be no less stringent than one in one million incremental lifetime cancer risk (10^{-6}) for residential use.*

This can be done using the PRGs developed by EPA. Without that, we believe that the remedy is not protective of human health and the environment.

Response: The cleanup standards proposed are protective of the public. It is very important to note that the general public is not being exposed to contamination at Site 300 because there is no current exposure pathway (i.e., no one drinks the water or has access to the soil). Please refer to Section 3.2.1 for a detailed discussion of the protectiveness of cleanup standards proposed for remediation of Site 300.

Comment 2e: *TVC strongly reiterates that State Water Resource Control Board Resolution (SWRCB) 68-16 (i.e., the non-degradation policy) applies to groundwater at this site, not merely to discharges of treated water. This resolution applies to discharges: either underground or above ground discharges as is commonly understood by the general term discharge. Resolution 92-49, paragraph III.G, may be the more stringent of ARARs for setting in-situ cleanup standards. Paragraph III. F states that cleanup and abatement activities (emphasis added) shall conform to the provisions of Resolution 68-16. As such, the migration of a contaminated plume is in opposition to this Resolution and compliance with ARARs.*

Response: One of the Site 300 Environmental Restoration Project's Remedial Action Objectives is to prevent plume migration to the extent technically and economically practicable. This objective is achievable for all but one contaminant (tritium) in Site 300 ground water and the twenty ground water extraction and treatment systems at the site are designed to prevent the migration of volatile organic compounds, high explosives compounds, uranium, perchlorate, and nitrate in ground water.

However, there is no technically feasible technology to remove tritium from ground water. During the timeframe necessary for tritium activities to be reduced to drinking water standards, the tritium will not migrate offsite, impact water-supply wells, or threaten human health or plant and animal communities.

DOE conducted an evaluation of the feasibility of preventing migration of the tritium plume at the Pit 7 Complex 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 hydraulic recirculation would be to prevent tritium plume migration 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. A summary of this evaluation was included in the Pit 7 Complex RI/FS (Appendix F, Section F-16).

DOE/LLNL are not pursuing hydraulic re-circulation because the results of an evaluation of this technology showed that neither a complete nor partial recirculation system could be implemented that would not create worse environmental problems than it would solve. The U.S. Environmental Protection Agency and the State environmental regulatory agencies concurred with this conclusion. The Regional Water Quality Control Board oversees the cleanup at Site 300 and provides input on all applicable State Water Resource Control Board applicable and relevant or appropriate requirements (ARARs).

Comment 2f: *We also point out that the in 2001, EPA presented a new health risk assessment of TCE and found considerable evidence that disease occurrence was considerably higher than previously thought. Region 9 of EPA took these results and established a provisional PRG for TCE in the air. It was up to 40 times higher (more stringent) than prior* *estimates. Because of controversy surrounding the 2001 study, the National Academy of Sciences is evaluating it. Nevertheless, we think that eventually, the TCE MCL will be adjusted downwards, probably to less than the PRG and the California Public Health Goal of 2.3 ppb. Yet the MCL for TCE in groundwater is 5 ppb. We therefore encourage DOE to take this opportunity to set its goals high and be in front of the curve. Without doing so, the remedy is not protective and is not effective in the long-term.*

Response: As pointed out, there is controversy surrounding the referenced study. The protectiveness of cleanup standards are reviewed every five years during the Five-Year Review process and any changes will be made if deemed appropriate by DOE and the regulatory agencies. For example, the Environmental Protection Agency's recent assessment of trichloroethylene toxicity is discussed in recent Five-Year Reviews for Site 300. As mentioned above, the cleanup standards proposed are protective of the public. The general public is not being exposed to contamination at Site 300 because there is no current exposure pathway (i.e., no one drinks the water or has access to the soil).

Comment 2g: *Regarding the cleanup standard for tritium, TVC recommends using the EPA PRG number for tap water of 144 picoCuries per liter (pCi/L), as opposed to the State and Federal MCL of 20,000 pCi/L. Using the MCL would equate to an incremental cancer risk level of approximately one in ten thousand (10^{-4}). As such, the standards are not protective of human health and the environment, nor do they meet Community Acceptance criteria.*

Response: It should be noted that there is no technology that can efficiently treat tritium-contaminated ground water. As a result, monitored natural attenuation is the only feasible cleanup remedy for tritium. Monitored natural attenuation relies primarily on the natural decay of tritium. Tritium activities decrease by half every 12 years, therefore, it is only a matter of time before tritium reaches 20,000, 400, and 144 picocuries per liter eventually reaching background levels.

Tri-Valley CAREs comment #3: *Land-Use Assumptions. The land-use assumptions are critical to the remedy selection. We find that these assumptions (i.e., continued stewardship by DOE) contribute to the lack of attainment of Evaluation Criteria 1 (Overall protection of human health and the environment) and 3 (long-term effectiveness and permanence), as well as Community Acceptance Criteria 2 (Cleanup levels should support multiple uses of the property), 3 (the strictest state and federal government cleanup levels should be used), 12 (Cleanup should be given priority over further weapons development), and 13 (Future activities at Site 300 should be designed to prevent releases). Below are the reasons for reaching this conclusion.*

Comment 3a: *TVC recommends that cleanup be driven by the assumption that most, if not all areas, of Site 300 will be returned to unrestricted land use. Other areas where contaminants cannot be removed should be so designated and used for other compatible purposes, including recreation, ecological preserve, industrial research, and agriculture. TVC also recommends that Site 300 be cleaned up to a level that avoids the need for long-term stewardship. We also recognize that at a few selected areas this may not be possible due to the nature of the contaminants. Where cleanup to such a level is not practical due to current technical constraints, commitments should be inserted into the final remedy decision detailing the stewardship plan and funding.*

Response: DOE control of the site is expected to continue for the foreseeable future. There are no plans to open the land for recreational or residential uses.

Section 28 of the Federal Facility Agreement (FFA) states: "The Department of Energy shall retain liability in accordance with CERCLA, not withstanding any change in ownership of the real property interests... shall not transfer any real property interests ... except in compliance with Section 120 (h) of CERCLA..." This provision ensures that DOE will not transfer lands with unmitigated contamination that could cause potential harm. If the land use changes, the cleanup remedies and standards would be reviewed to ensure they are consistent with its intended use in accordance with Federal and State laws. Additionally, the Five-Year Review Process and the Site-Wide Compliance Monitoring Plan/Contingency Plan specifically evaluate changes that have either occurred or can be foreseen for the future, including potential changes in land use.

Please refer to Section 3.2.1 for a detailed discussion of land use and the protectiveness of cleanup standards proposed for remediation of Site 300.

Comment 3b: *Once decisions are made to leave a contaminant in place, it is difficult to continue research on how the contaminant could be safely treated, thereby avoiding or reducing the need for long-term stewardship measures. DOE should to establish a dedicated program that keeps an eye towards the future and continually looks for solutions to these problems.*

Response: The Five-Year Review process provides mechanisms for the ongoing evaluation of the progress of remediation to ensure continued protection of human health and the environment. DOE regularly reviews and discusses monitoring data and remediation progress with the U.S. Environmental Protection Agency and State regulatory agencies. The Five-Year Review process contains mechanisms for re-evaluating and implementing changes to the remedy if cleanup does not proceed as expected. In addition, DOE will continue to evaluate new technologies to expedite cleanup.

Comment 3c: *Tri-Valley CAREs continues to recommend that a possible mission change or change in ownership of the site should be considered in remedy selection and cleanup goals. The 2007 Fiscal Year Budget Request by DOE contains an evaluation of the test capability of Site 300 to determine shutting down operations by 2011. This presents a substantial change from assumptions used in the interim ROD: that is, DOE maintained that it would control the site indefinitely. The "reasonably expected land-use" for Site 300 is no longer as certain as DOE has portrayed it to be in earlier documents.*

Response: While DOE is evaluating the consolidation of activities throughout the DOE complex that could result in changes to activities conducted at Site 300, DOE control of the site is expected to continue for the foreseeable future. There are no plans to open the land for recreational or residential uses. There have been no changes in assumptions as implied in the comment.

Comment 3d: *Because the Bay Area is growing so rapidly, and because there has been such high growth in the surrounding and abutting City of Tracy, residential growth is beginning to occur near Site 300. It would be unfortunate if the cleanup levels decided in 2007 (the current timetable for the final ROD) were to dictate how this 11 square mile site will be used in the future. It is our position that the remedies and cleanup levels that are eventually chosen should not limit tomorrow's land-use decisions. The remediation plan detailed in the Record of Decision*

(ROD) must fully consider the possibility that future residences will be developed up to the boundary of Site 300, as well as within the site boundary.

Response: See response to comment 3a.

Tri-Valley CAREs comment #4: *Process-Related Issues. The process used to reach the final remedy for Site 300 is flawed. In our opinion, it contributed to not attaining Evaluation Criteria 8 (State Acceptance), and Community Acceptance Criteria 8 (Decisions should not rely on modeling alone), 11 (The public should be involved in cleanup decisions) and 13 (Future activities at Site 300 should be designed to prevent releases). Below are the reasons for reaching this conclusion.*

Comment 4a: *The Interim ROD stated that it is considered interim for three primary reasons: 1) issues related to groundwater standards remain; 2) DOE/LLNL is continuing to evaluate treatment technologies, and; 3) further characterization is occurring in some areas. The Proposed Plan does not address how these issues have been resolved in the intervening years. Consequently, it is difficult for the community to gauge how these were resolved.*

Response: There are no issues related to ground water cleanup standards. The State regulatory agencies have concurred with the ground water cleanup standards presented in this Record of Decision. DOE agreed to prepare a technical and economic feasibility analysis as part of the first Five-Year Review after ground water contaminant concentrations have been reduced to Maximum Contaminant Levels (MCLs) in each Operable Unit (2-8). This analysis will be used to determine the technical and economic feasibility of continuing remediation to further reduce contaminant concentrations below MCLs.

The Site-Wide Remediation Evaluation Summary report (2006) was prepared to document the results of the evaluation of treatment technologies that were specified in the Interim Site-Wide Record of Decision (2001). DOE and the regulatory agencies delayed the selection of cleanup standards in 2001 so that the interim remedies could be implemented and performance data could be collected to support the selection of cleanup standards. The Site-Wide Remediation Evaluation Summary report presents the results of this evaluation and provided the basis for the Proposed Plan. DOE held a public workshop to explain the results of the Site-Wide Remediation Evaluation Summary to the public.

At the time of the Interim Record of Decision, three areas were still under investigation, Building 812, Building 865, and the Sandia Test Site to determine if contaminants have been released and whether cleanup is necessary. Additional characterization has been completed and characterization summary reports have been completed and shared with Tri-Valley CAREs.

Comment 4b: *We also want to point out that the process to arrive at this proposed plan did not include preparation of a Final Feasibility Study. Rather, a Site-Wide Remedial Evaluation Summary Report (RE) was prepared in November 2006. This included many of the elements found in a Feasibility Study; however, much of the effort was focused on modeling the time and cost to meet different cleanup standards. Predictably, the models predicted that meeting the most lenient of the cleanup standards was feasible. This document had no regulatory teeth: some of TVC's comments about critical assumptions, agreed to by the EPA, were not incorporated into the final report. However, as is described below, some of the Remedial Action Objectives (RAOs) were changed in this latter document. It also seems that decisions were reached based on this* *document, although it was not fully vetted. Furthermore, it was not discussed in the Interim Site-Wide ROD.*

Response: A final feasibility study was not required by the Comprehensive Environmental Response, Compensation and Liability Act process. As discussed in the responses to comment 1b and 4a, the interim remedies were considered interim because cleanup standards were not selected. There are only minor technical differences between the "final" remedies and the interim remedies based on the analysis presented in the Site-Wide Remediation Evaluation Summary report. The Site-Wide Remediation Evaluation Summary report assessed the effectiveness and protectiveness of the interim remedies provided the basis for the proposed "final" remedies described in the Proposed Plan.

In the 2001 Site-Wide Record of Decision, DOE had agreed to include a technical and economic feasibility analysis for various capture scenarios and cleanup levels to guide the cleanup standard selection negotiations in Site-Wide Remediation Evaluation Summary report as requested by the Regional Water Quality Control Board. As mentioned in comment 4b, this analysis was a modeling exercise. Unfortunately, DOE and the U.S. Environmental Protection Agency could not agree on the assumptions used for the technical and economic feasibility analysis so DOE and regulatory agencies agreed to perform this analysis once the cleanup standards are met. No decisions on cleanup standards were made based on this document.

Comment 4c: *Remedial Action Objectives (RAOs) should be listed in Proposed Plan. If Remedial Action Objectives have changed from the Interim ROD to the present plan, please add a discussion explaining what has changed and why. These should be thoroughly vetted. Without that, the public cannot fully participate in the decision-making process. We note, for example that the RAOs were modified from the Interim ROD to the Remedial Evaluation (RE) under Human Health Protection: to prevent human ingestion of ground water containing contaminant concentrations "above State and Federal MCLs and any more stringent WQNLs" (water quality numeric levels, which are the same as the old water quality objectives). Second, an RAO for environmental protection was changed. The RAO in the RE reads, "Restore water quality, at a minimum, to WQNLs that are protective of beneficial uses within a reasonable timeframe and to prevent plume migration to the extent technically and economically feasible." The former comparable RAO in the Interim ROD was to restore water quality, at a minimum, to protect beneficial uses within a reasonable time frame, and prevent migration of contaminants into pristine waters.*

Also note that previously, Previously, Tri-Valley CAREs suggested (without success) that additional remedial action objectives (RAOs) be incorporated into the remedial action plan:

a) Attain the preliminary remediation goals (PRGs) set by EPA Region 9 (PRGs are based on an estimated health risk of one in one million additional cancer deaths).

Response: The Proposed Plan was finalized by the time this comment was received, therefore it could not be modified to include the Remedial Action Objectives for Site 300 cleanup. However, the Remedial Action Objectives are presented in Section 2.8 of this Record of Decision. The Regional Water Quality Control Board suggested that DOE change the Remedial Action Objective to, "…to prevent plume migration to the extent technically and economically feasible" because there is no feasible technology available to prevent the migration of the tritium plume into pristine water. DOE evaluated but did not pursue hydraulic recirculation to prevent migration of the tritium plume because the results of an evaluation of this technology showed that neither a complete nor partial recirculation system could be implemented that would not create worse environmental problems than it would solve. Partial and complete hydraulic capture and recirculation of the tritium plume would cause ground water levels to rise into the pits and cause contaminants to migrate downgradient more rapidly. Therefore, preventing the migration of the tritium is not technically feasible. The U.S. Environmental Protection Agency and the State environmental regulatory agencies concurred with this conclusion.

However, during the timeframe necessary for tritium activities to be reduced to drinking water standards and background levels, the tritium will not migrate offsite, impact water-supply wells, or threaten human health or plant and animal communities. DOE will closely monitor the tritium plume to determine if conditions change that could impact the effectiveness of the natural attenuation of tritium in meeting cleanup standards or protecting human health and the environment.

Tri-Valley CAREs comment #5: *Conduct cleanup in such a way as to minimize time for remediation.*

Comment 5a: *The plan should contain milestones by which the success of the subsequent cleanup can be evaluated. The remedies and the accompanying plan should contain measurable goals. It is important that the plan contain a measurable schedule and performance standards which can be verified. The interim ROD also stated that DOE/LLNL will evaluate compliance with SWRCB Resolution 92-49, "including the feasibility of achieving background ground water quality or some concentration between background and the applicable water quality objectives." This was to be done in by modeling the time and cost it would take to achieve background, WQNLs, and MCLs in a Remediation Evaluation Summary (RE) that was finalized in November 2006. The model that accompanies each OU is a good place to begin to develop milestones. Without doing this, the public will have difficulty measuring progress at the site.*

Response: The Environmental Restoration Project adheres to cleanup milestones for buildout of the treatment systems and Comprehensive Environmental Response, Compensation and Liability Act-required documents. The mass of contamination removed, contaminant concentrations trends, and remediation progress are evaluated regularly and reported in the Site 300 semi-annual Compliance Monitoring Reports are available on the website: www-envirinfo.llnl.gov/ and at the Tracy Library and LLNL Discovery Center.

Comment 5b: *The document does not include basic information such as the Applicable or Relevant and Appropriate Requirements (ARARs). We note that without this information, the general public cannot make reasonable judgment about the remedy.*

Response: Proposed Plans are not intended to be an all-inclusive document, rather a summary of the cleanup remedies and standards proposed for the site. U.S. Environmental Protection Agency guidance for preparation of Proposed Plan does not specify that Applicable or Relevant and Appropriate Requirements (ARARs) be included. However, ARARs for Site 300 cleanup have been extensively documented and shared with the Tri-Valley CAREs and community in numerous documents, including the Interim Record of Decision (2001), the Site-Wide Remediation Summary Report (2006), the Interim Record of Decision Amendment for the

Pit 7 Complex (2007), and this document, the Site-Wide Record of Decision (2008). The ARARs for Site 300 cleanup are presented in Table 2.13-1 of this document.

Comment 5c: *Risk assessment and modeling are imperfect sciences. Risk assessment defines the pathways through which contaminants may reach human populations. For example, the risk assessment will define how contaminants (i.e., chemicals of concern) are mobilized in the environment, and how humans can be exposed. Therefore, when using health-based risk assessments in cleanup decision-making, the future use of the site is either implicitly or explicitly assumed. If the site is assumed to be used for purposes similar to current uses, risks may fail to provide a sound basis for long-term environmental cleanup. For example, because groundwater is not currently used at the site for drinking water, the risk assessment fails to identify it as a risk, even though drinking groundwater may pose a risk to a future resident.*

Response: The risk assessment assumptions are reviewed every five years as part of the Five-Year Review process. Any changes in assumptions, such as land use, will be evaluated by DOE and the regulatory agencies. If the land use changes, the cleanup remedies and standards would be reviewed to ensure they are consistent with its intended use, in accordance with Federal and State laws, and the remedial actions will be adjusted as necessary. The point-of-compliance for ground water cleanup at Site 300 is the ground water at the site. Because the ground water cleanup standards selected for the site are Federal Maximum Contaminant Levels (MCLs) unless California State MCLs are more stringent and drinking water standards do not differentiate between residential and industrial uses, cleanup to meet these standards would be protective of residential populations.

Comment 5d: *Risk assessment methods are based on limited information: based on a snapshot in time and by limited data. Even if we had good and representative data, our limitation of knowledge about toxicity is a major deficiency in risk assessment. We advocate using the Precautionary Principle (which states in part, that when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically).*

Response: DOE/LLNL followed the "Risk Assessment Guidance for Superfund (RAGS)" to develop the risk estimates for the Site 300. A risk assessment, the framework of the U.S. Environmental Protection Agency human health evaluation, is a characterization of the probability of adverse effects from human exposures to environmental hazards if no cleanup were to occur. Risk assessments are quantitative, chemical-oriented characterizations that use statistical and biological models to calculate numerical estimates of risk to health. Data from human epidemiological investigations are used in the risk assessment, when available, and when human toxicological data are unavailable, the results of animal toxicology studies are used. The standard exposure factors used to calculate intake of a chemical are intended to be used for calculating reasonable maximum exposure levels. The risk estimate is upper bound because it is an estimate based on conservative dose-response modeling and the true risk may in fact be lower and protective of the general population.

Comment 5e: *The Remedial Evaluation report suggested that at B-834, DOE "may" submit a Technical/Economic Impractability (TI) Waiver for the perched HSU, because it may not be able to clean it up, and it is isolated from the regional aquifer. This is not mentioned in the Proposed Plan. TVC opposes a TI Waiver for this site; however, if it is being considered it requires discussion in the Proposed Plan.*

Response: DOE is not requesting a Technical/Economic Impractability at this time.

Tri-Valley CAREs comment #6: *Funding Priorities. We are concerned that funding for the remediation is well below what would be optimal, if LLNL were free to deal with cleanup unrestricted by DOE's weapons programs. This would violate Community Acceptance Criteria 12 (Cleanup should be given priority over further weapons development). Below is the reason for reaching this conclusion.*

The budget for remediation of pollution at Site 300 should be adequate, stable and assured over the many decades it will take to actually complete this momentous task. The DOE must not renege on its obligation to the community to clean up its mess. Currently, the money for cleanup of Site 300 hovers at 1% of Livermore Lab's annual budget.

Response: Please refer to Section 3.2.6 for a detailed discussion regarding funding for long-term cleanup at Site 300.

Tri-Valley CAREs comment #7: *Remediation. The remedy that has been selected contributes to not attaining Evaluation Criteria 1 (Overall protection of human health and the environment) and 3 (long-term effectiveness and permanence), and Community Acceptance Criteria 1 (Complete the Site 300 cleanup project in a timely manner), 2 (Cleanup levels should support multiple uses of the property), 3 (the strictest state and federal government cleanup levels should be used), 5 (The tritium source and plume at Site 300 should be controlled), 9 (The ecosystem should be protected in the cleanup remedy) and 11 (The public should be involved in cleanup decisions). Below are the reasons for reaching this conclusion.*

Comment 7a: *Where MNA is chosen for any OU, we feel very strongly that a reasonable time frame for cleanup that is acceptable to stakeholders must be established prior to the signing of the ROD. DOE responded to our question in the Interim ROD regarding how a reasonable time frame would be established by stating that it would be established in the Site 300 ROD (we assumed final ROD) and subsequent contingency plan, "in consort with the regulatory agencies". We believe that DOE must speak to this issue and receive input directly from the community. Furthermore, MNA as a remedy is controversial, and the time frame in which it is accomplished is one of the most important facets of it. Establishing it in the post interim ROD contingency plan is not acceptable to us. We recommended that this Proposed Plan lay out the guidelines of how an acceptable time frame will be established so that there is room for public debate. TVC re-iterates from previous comments that if MNA is selected, most of the contaminant mass must be reduced through degradation. We propose that an objective for any remedy that uses MNA have at least 75 percent of the reduction take place through biological, chemical or radiological degradation. Additionally, we propose that if MNA is selected, a reasonable timeframe should be no more than the smaller of the following options:*

a) 50 years, or;

b) 125% of the time it would take to achieve cleanup goals through an active technology.

Response: Monitored Natural Attenuation (MNA) is proposed for tritium in the Building 850/Pit 7 Complex and Pit 6 Landfill Operable Units (OU), volatile organic compounds (VOC) in the Pit 6 Landfill OU, and nitrate in the Building 832 Canyon and High Explosives Process Area OUs.

MNA is the only feasible cleanup remedy for tritium because there is no technology that can efficiently treat tritium-contaminated ground water. MNA of tritium relies primarily on the natural decay of tritium. Tritium activities decrease by half every 12 years, therefore the timeframe for cleanup of tritium is dependent on the activities present. The estimated timeframe for cleanup of tritium at Site 300 is less then 50 years.

MNA is proposed for a small VOC ground water plume in the Pit 6 Landfill OU. The concentrations of VOCs are already at or below the maximum contaminant level and meets the Tri-Valley CAREs criteria above.

Nitrate is also a candidate for MNA in the Building 832 Canyon and High Explosives Process Area OU ground water because nitrate is being biologically reduced to nitrogen in the subsurface as the ground water migrates toward the site boundary.

Comment 7b: *Vapor intrusion is the phenomena whereby contaminants in the groundwater or the soil change phases (in this case liquid to gas), and are emitted into the overlying air. If there is a building above contaminated soil or groundwater, there is a danger that vapor will mix with the air in buildings, either through cracks in the foundation or from the outside air. This is a growing concern throughout the country, and many Superfund sites with high levels of VOCs such as TCE are now being re-evaluated to understand the risk that this new pathway may pose. In addition, the toxicity of TCE has also been re-evaluated by EPA and its findings are that this chemical poses a much greater risk than previously thought. DOE changed its prior position to conduct air sampling within the vadose zone to ambient air modeling (both indoors and outdoors). The risk assessment for the various buildings is based on old data pertaining to TCE vapors. LLNL should revise its risk assessments using the latest information on this chemical. Therefore, we believe that the remedy is not protective of human health and the environment.*

Response: In August 2001, U.S. EPA's Office of Research and Development released the draft "Trichloroethylene Health Risk Assessment: Synthesis and Characterization" that has since been undergoing external peer review (U.S. EPA, 2001b). As pointed out in Tri-Valley CAREs comment 2f, there is controversy surrounding the referenced study. Since review of the toxicity value for trichloroethylene may continue for a number of years, this issue will be updated in future Five-Year Reviews.

Both the Interim Site-Wide Record of Decision (ROD) (2001) and this Site-Wide ROD includes provisions for the annual reevaluation of the risk and hazard associated with volatile contaminants in the subsurface migrating upward into indoor and outdoor ambient air and being inhaled by workers be re-evaluated annually using current data. This reevaluation has been performed since 2003 and reported to Tri-Valley CAREs, the regulatory agencies and the public in the semi-annual Compliance Monitoring Reports and is available at the Tracy Library, online at www-envirinfo.llnl.gov/, and at the LLNL Discovery Center. Where a health risk still exists, institutional controls are in place to prevent onsite worker exposure. Therefore, the remedy is protective of human health and the environment.

Comment 7c: *TVC believes that the remedy for Pit 7 should contain an element of downstream hydraulic control. We have submitted our comments on the proposed plan for the Pit 7 separately, but we wish to repeat them here. Tri-Valley CAREs is still strongly convinced that active hydraulic control of the distal end of the tritium plume should be part of the remedy,* *at least as a contingency, if the hydraulic diversion does not "prevent migration". (We note the subtle change in remedial action objective in the RAO in the Final Amendment to the Interim Site-Wide ROD for the Pit 7 Complex that adds the words "to the extent technically and economically feasible" after "to prevent plume migration".) TVC does not believe that the remedy is adequate unless the tritium plume is contained. The lack of hydraulic control does satisfy the requirement of Long-Term Effectiveness and Permanence, nor the Community Acceptance Criteria.*

Response: As explained at the November 16, 2004 Technical Assistance Grant meeting and responses to comments on the Pit 7 Complex Remedial Investigation/Feasibility Study (2005), Proposed Plan for the Pit 7 Complex (2006), and Site-Wide Record of Decision Amendment for the Pit 7 Complex, hydraulic control of the Pit 7 Complex tritium plume is not technically feasible. LLNL staff studied the problem of the Pit 7 Complex tritium plume migration. At the request of the Regional Water Quality Control Board (RWQCB) and Tri-Valley CAREs, DOE 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. A summary of this evaluation was included in the Pit 7 Complex RI/FS (Appendix F, Section F-16).

Please refer to Section 3.2.3 for a detailed discussion of plume migration and controls.

Comment 7d: *There are ecological receptors of special status and several rare and endangered species at Site 300 that may be affected by the contamination and the remedy selection. (e.g., the flower Amsinckia grandiflora, the California Red-Legged Frog, the Alameda Whipsnake, and the Tiger Salamander). There is virtually no discussion of these species in the Proposed Plan. TVC recommends that a section of this document list the ecological receptors of special status and several rare and endangered species at Site 300, and provide a discussion of potential harm (e.g., drinking from a contaminated spring), and how the remedy will increase or decrease this risk. Without this, the remedy selection may not be protective of the environment, and the general public has difficulty analyzing the effectiveness of the remedy.*

Response: As discussed in the Proposed Plan, LLNL wildlife biologists closely monitor potentially impacted species as part of a continuing ecological risk management program at Site 300 and have found no adverse effects due to contamination.

The site cleanup plan is designed to prevent harmful impacts to plants and animals at the site, particularly threatened and endangered species. All cleanup activities are carefully monitored by LLNL wildlife biologists to ensure that special status plants and animals are protected. The biologists work very closely with the U.S. Fish and Wildlife Service to ensure compliance with laws and regulations protecting threatened and endangered species. Following any remediation construction activities, any habitat that has been disturbed is restored. 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. As part of this program, DOE has created protected habitat at the site for several endangered species including the California red-legged frog, California tiger salamander, and the Large-flowered fiddleneck.

Tri-Valley CAREs comment #8: *Specific Comments on the Proposed Plan. Referring to page 4, the Proposed Plan states that "Risk estimates for most release sites and contaminants were well below the thresholds designated as being protective by the U.S. EPA." Precisely what risk thresholds are being referred to here?*

Response: The second paragraph on page 4, defines the thresholds: "For carcinogens, risk for humans is expressed as the probability of developing cancer over a lifetime. For example, an additional cancer risk of one in one million (10^{-6}) means that a person exposed to a specified concentration of that chemical over the course of a lifetime could potentially increase their cancer risk by one in one million. An excess cancer risk between one in ten thousand (10^{-4}) to one in one million (10^{-6}) is considered acceptable by the U.S. Environmental Protection Agency. However, the 10^{-6} risk level is the point of departure for determining cleanup levels. For noncarcinogens, a Hazard Index is calculated. Hazard Indices less than one are considered protective."

Tri-Valley CAREs comment #9: *Referring to page 4, the Proposed Plan states that "There are no past or current offsite exposures to contaminants at Site 300." Is this statement historically correct? There are at least six water supply wells located outside of Site 300 that are of concern. CDF-1 and CON-1 are active wells located in close proximity to the GSA southern boundary. Two inactive wells, CON-2 and GALLO-2 are also in the area. In the 1990s, TCE was detected in groundwater offsite at 2.85 ppb, measured approximately 200 feet outside of the Site 300 boundary. Additionally, groundwater under the Pit 6 area is present in several water bearing layers throughout the area. Two active water supply wells are located approximately 1,000 feet from the landfill. They provide water for the Carnegie State Vehicle Recreation Area (SVRA) and are monitored monthly.*

Response: The statement that there are no past or current offsite exposures to contaminants at Site 300 is correct. Although there is offsite contamination, there is no complete exposure pathway, e.g., no one is using the water for drinking, or the contamination is below the maximum contaminant levels. There must be a complete pathway for an exposure to occur. In addition, the Agency for Toxic Substances and Disease Registry conducted an independent health assessment of Site 300 contamination in 2005 that concluded that there are no past or current exposures to contaminants associated with LLNL – Site 300, and the potential for future exposure is unlikely. This report is available online at www-envirinfo.llnl.gov/.

Tri-Valley CAREs comment #10: *Regarding the section on Proposed Final Cleanup Actions, specific actions for each Operable Unit are not included about the proposed final remedy. We find that the description is confusing and difficult to "consume". We suggest that the subsection for each Proposed Remedy be moved to the top of each OU, followed by Extent of Contamination, Interim remedy, etc. Additionally, please be more specific about differences in the remediation approach for various contaminants (e.g., at B-834, distinguish approach for VOCs, nitrate and TBOS).*

Response: The Proposed Plan has been finalized, therefore changes cannot be made to the document at this time. If Tri-Valley CAREs submitted this comment on the Draft or Draft Final version of the Proposed Plan that DOE provided for their comments, the suggestion could have been incorporated. Tri-Valley CAREs did not provide any comments on the Draft or Draft Final version of the Proposed Plan. However, we will consider your comment for future Proposed Plan documents.

Tri-Valley CAREs comment #11: *Regarding Proposed Final Cleanup Actions, B-850, please be more specific about the proposed final remedy (p.10). Please provide details on the cleanup standards that are being applied for each of the chemicals (HE compounds, uranium, metals, PCBs, dioxins and furans) in **soil** and in groundwater. There appears to be no active remediation, except that which will be included as a non-time critical removal action (i.e., soil contaminated with PCBs, dioxin and furan). Also, specify actions to remediate perchlorate.*

Response: The remedy for the Building 850 area is discussed in Section 2.9.5 of this Record of Decision. A detailed discussion of cleanup standards for ground water, surface water, surface soil, and subsurface soil/rock is included in Section 2.11.4.3 of this Record of Decision. Ground water cleanup standards are also shown in Table 2.11-1 of this Record of Decision. DOE will implement an *in situ* bioremediation treatability study for perchlorate in ground water and discuss possible remedial measures with the regulatory agencies. Public input will be solicited prior to the selection of any remedial action for perchlorate in ground water.

Tri-Valley CAREs comment #12: *Additionally, as part of the remedy for the Pit 7 Complex is implemented (the groundwater diversion project), monitoring should be located upstream from the B-850 plume to ensure that diverted water does not alter the groundwater hydrology.*

Response: Monitoring of ground water is part of the remedy (item #1) as shown on page 10 of the Site-Wide Proposed Plan. The remedy for Building 850, including the monitoring component, is also discussed in Section 2.9.5.2 of the Draft Final and Final Site-Wide ROD. In addition, water level monitoring upgradient of Building 850 and downgradient of the Pit 7 Complex is included as part of the remedy for the Pit 7 Complex to determine potential effects of the hydraulic drainage diversion system on the hydraulic conditions in the area.

Tri-Valley CAREs comment #13: *Regarding Proposed Final Cleanup Actions, B-854, please provide details on the cleanup standards that have been applied for each of the chemicals in **soil** and in groundwater (nitrate, perchlorate, HE compounds, tritium, metals, TCE, PCBs, dioxins and furans.)*

Response: Cleanup standards for the specific contaminants of concern in ground water and surface water at Site 300 are shown in the table on page 15 of the Proposed Plan and Table 2.11-1 of this Record of Decision. Surface soil cleanup standards were selected in the Interim Site-Wide Record of Decision (2001). Page 15 of the Proposed Plan described the methodology that will be used to determine when subsurface soil cleanup goals are met. A detailed discussion of cleanup standards for ground water, surface water, surface soil, and subsurface soil/rock is also included in Section 2.11.4.3 of this Record of Decision.

Tri-Valley CAREs comment #14: *The inhalation, both outdoor and indoors, needs a thorough evaluation. The discussion on page 15 is incomplete and should be in the appropriate discussion of Cleanup Actions. Furthermore, merely stating that DOE will annually evaluate this pathway by a "model that simulates evaporation of VOC vapor into a building" will lead to an incomplete evaluation.*

Response: As discussed in the response to comment 7b, both the Interim Site-Wide Record of Decision (ROD) (2001) and this Site-Wide ROD includes provisions for the annual reevaluation of requires that the risk and hazard associated with volatile contaminants in the subsurface migrating upward into indoor and outdoor ambient air and being inhaled by workers be re-evaluated annually using current data. This reevaluation has been performed since 2003 and reported to Tri-Valley CAREs, the regulatory agencies and the public in the semi-annual Compliance Monitoring Reports and is available at the Tracy Library, online at www-envirinfo.llnl.gov/, and at the LLNL Discovery Center. The methodology used to evaluate vapor intrusion has been approved by the regulatory agencies and is explained in the Compliance Monitoring Reports.

Tri-Valley CAREs comment #15: *In the Proposed Plan, five release sites are included in Operable Unit 8: B-801 Dry well and Pit 8; B-833; B-845 firing table and Pit 9 Landfill, B-851, and Pit 2. However, there is no mention of B-812, B-865, and the Sandia Test Site. We have been informed that these areas will be covered in a ROD Amendment. Please add a brief discussion of these sites and identify their status.*

Response: As mentioned in the response to comment 4a, at the time of the Interim Record of Decision (ROD), three areas were still under investigation, Building 812, Building 865, and the Sandia Test Site to determine if contaminants have been released and whether cleanup is necessary. Additional characterization has been completed and characterization summary reports have been completed and shared with Tri-Valley CAREs. DOE and the regulatory agencies recently designated Building 812 as an Operable Unit (9). A separate Comprehensive Environmental Response, Compensation and Liability Act document pathway for the Building 812 Operable Unit was established, beginning with a Remedial Investigation/Feasibility Study (RI/FS) due in 2008. Following the RI/FS, DOE and the regulatory agencies will identify a preferred remedy that will be presented to the public for comment. A remedy will be selected to address contamination at Building 812 in an Amendment to the Site-Wide ROD.

The regulatory agencies are currently reviewing the Characterization Summary Reports for the Sandia Test Site and Building 865 and have not determined a regulatory pathway for those areas at this time.

Tri-Valley CAREs comment #16: *Although contamination levels at Building 833 have been greatly reduced, they are still above the MCL. Describe the remedial approach that is expected.*

Response: Operable Unit 8 includes the contaminant release sites that have a monitoring-only interim remedy, including Building 833. Operable Unit 8 release sites have a monitoring-only interim remedy because either: (1) contaminants in surface and subsurface soil/bedrock do not pose a risk to humans or plant and animal populations or a threat to ground water, (2) there is no ground water contamination, (3) contaminant concentrations in ground water do not exceed regulatory standards, and/or (4) the extent of contamination in ground water is limited.

Monitoring-only and risk and hazard management was selected for Building 833 because:

- The ground water contamination at Building 833 is very limited. The ground water in the area consists of a shallow, highly ephemeral perched water-bearing zone. Quarterly monitoring of the wells from 1993 to 2007 has shown little evidence of saturation. The underlying regional aquifer has not been impacted. There is no current exposure to ground water.
- Ground water monitoring performed in the vicinity of Building 833 has shown a decline in volatile organic compound (VOC) concentrations in shallow, highly ephemeral perched ground water underlying Building 833 has decreased from a historical maximum of 2,100 micrograms per liter (μg/L) in 1993 to 10 μg/L in 2007.

- In the baseline risk assessment an inhalation risk for onsite workers was identified for VOCs volatilizing from subsurface soil at Building 833. The 2006 re-evaluation indicated that Building 833 indoor air levels are no longer of concern (less than 10^{-6}). The risk will be re-evaluated until it remains below 1 x 10^{-6} for two consecutive years. Engineering controls are in place to prevent infiltration and buildup of VOC vapors inside Building 833 that could result in an unacceptable exposure risk to workers in this building. No unacceptable hazards to ecological receptors were identified.

Therefore, the remedy for Building 833 is protective of human health and the environment.

Tri-Valley CAREs comment #17: *Site 300 is traversed by at least two earthquake faults, the Corral Hollow-Carnegie Fault and the Elk Ravine Fault. In particular, the Corral Hollow-Carnegie Fault is listed as "active" by the USGS. Before selecting a final remedy, additional consideration of potential quake activity at Site 300 is warranted. As Livermore suffered a significant earthquake in 1980 that centered on the Greenville Fault, which had been listed by USGS as "inactive," potential activity on either or both faults should be considered.*

Response: The geology of the site including Site 300 faults have been studied and well documented for approximately 20 years. Detailed information about the geology including faults identified at Site 300 and their affect on ground water movement, the hydrogeology (ground water and surface water), the nature and extent of contamination, exposure risks associated with the contamination, and the proposed cleanup alternatives including the monitoring program are presented in detail in the Site-Wide Remedial Investigation and Feasibility Study and Remedial Investigation/Feasibility Study for the Pit 7 Complex. These documents are available to public in the Tracy Public Library and the LLNL Discovery Center.

Remedial actions are designed to hold up to credible seismic activity. The Compliance Monitoring Plan/Contingency Plan (2002) describes the actions that would be taken in the event of natural disasters such as floods and earthquakes. This document is also available to the public in the Tracy Public Library and the LLNL Discovery Center.

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5. Acronyms and Abbreviations

1,1-DCE	1, 1-Dichloroethylene
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	Below ground surface
CAREs	Communities Against a Radioactive Environment
CCR	California Code of Regulations
CDDs	Chlorinated dibenzo-p-dioxins
CDFs	Chlorinated dibenzofurans
CDI	Chronic daily intake
CEQ	Council of Environmental Quality
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
CIWMB	California Integrated Waste Management Board
CMP	Compliance Monitoring Plan
cm/sec	Centimeters per second
COCs	Contaminants of Concern
CP	Contingency Plan
DOE	Department of Energy
DTSC	(California) Department of Toxic Substances Control
EPA	Environmental Protection Agency
FFA	Federal Facility Agreement
ft	Feet
GAC	Granular activated carbon
gpd	Gallons per day
GSA	General Services Area
GWTS	Ground water treatment system
HE	High Explosives
HI	Hazard Index
HMX	High Melting Explosive
HQ	Hazard quotient
HSU	Hydrostratigraphic unit
I	Interstate
IC	Institutional control

Kgv	Cretaceous Great Valley Sequence
LLNL	Lawrence Livermore National Laboratory
LUC	Land use control
MCL	Maximum Contaminant Level
mi^2	Square mile
mg/kg	Milligrams per kilogram
mg/L	Milligrams per liter
MNA	Monitored natural attenuation
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NPL	National Priorities List
OU	Operable Unit
PCBs	Polychlorinated biphenyls
PCE	Perchloroethylene, also known as tetrachloroethylene
pCi/L	PicoCuries per liter
PHG	Public Health Goal (California)
PRG	Preliminary Remediation Goal (EPA)
Qal/WBR	Quaternary alluvium and weathered bedrock
Qls	Quaternary landslide deposits
Qt	Quaternary terrace deposits
RAOs	Remedial Action Objectives
RCRA	Resource Conservation and Recovery Act
RDX	Research Department Explosive
RfD	Reference dose
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RWQCB	(California) Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SF	Slope factor
SJVUAPCD	San Joaquin Valley Unified Air Pollution Control District
SVE	Soil vapor extraction
SWESR	Site-Wide Remediation Evaluation Summary Report
SWRCB	(California) State Water Resources Control Board
SWRI	Site-Wide Remedial Investigation
TAG	Technical Assistance Grant
TBOS	Tetrabutyl orthosilicate

TCE	Trichloroethylene
TKEBS	Tetrakis (2-ethylbutyl) silane
Tmss	Tertiary Cierbo Formation
Tn	Tertiary Neroly Formation
$Tnbs_0$	Tertiary Neroly Silty Sandstone
$Tnbs_1$	Tertiary Neroly Lower Blue Sandstone
$Tnbs_2$	Tertiary Neroly Upper Blue Sandstone
$Tnsc_0$	Tertiary Neroly Lower Siltstone/Claystone Basal Unit
$Tnsc_2$	Tertiary Neroly Upper Siltstones and Claystone
$Tnsc_{1b}$	Tertiary Neroly Lower Siltstone/Claystone Unit 1b
Tps	Tertiary Pliocene nonmarine sediments
Tpsg	Tertiary Pliocene sand and gravel
Tts	Tertiary Tesla Formation
UCRL	University of California Radiation Laboratory
VOCs	Volatile organic compounds
WBR	Weathered bedrock
WQNLs	Water Quality Numeric Limits
U.S.	United States
μg/L	Micrograms per liter

Figures

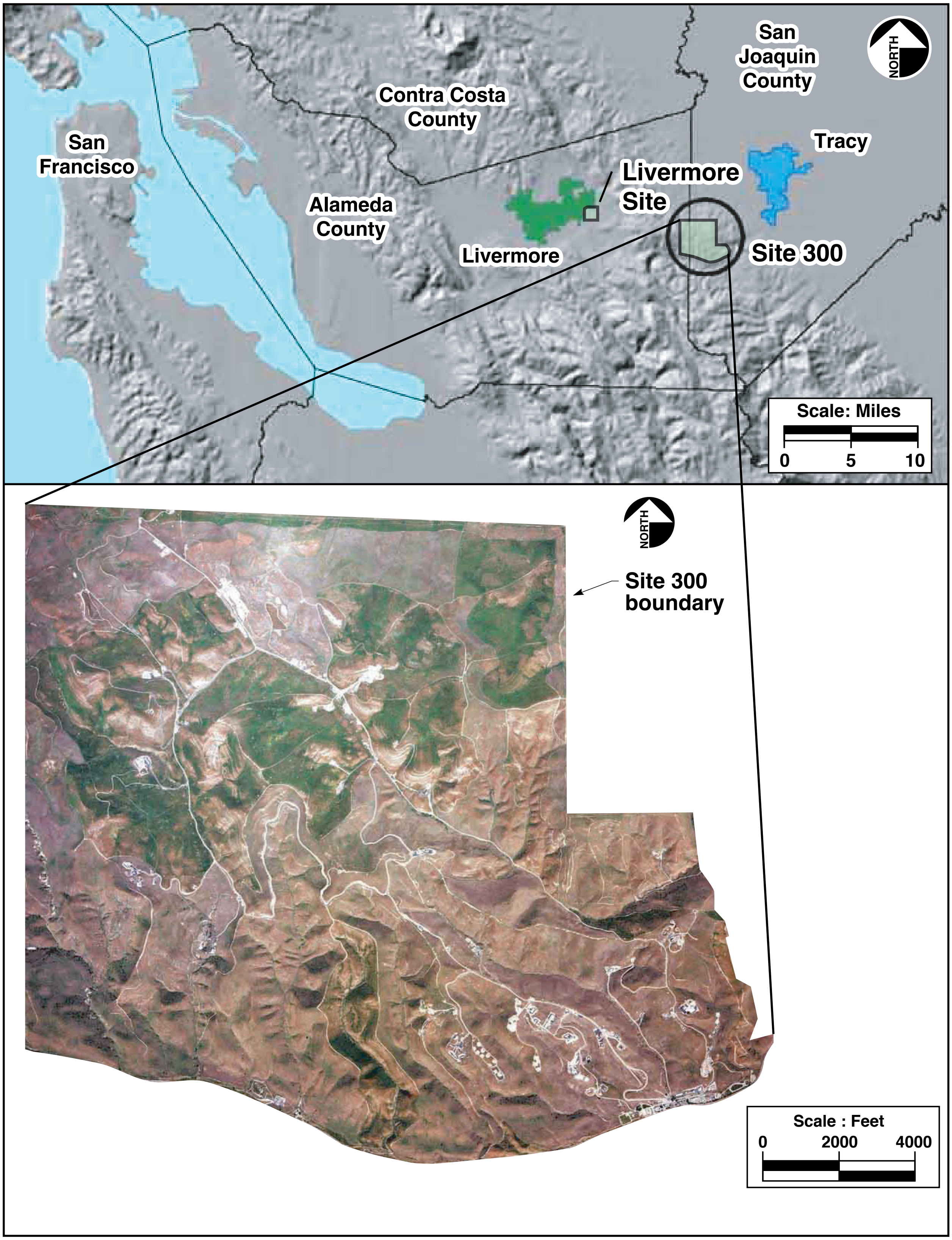

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Figure 2.1-1. Location of LLNL Site 300.

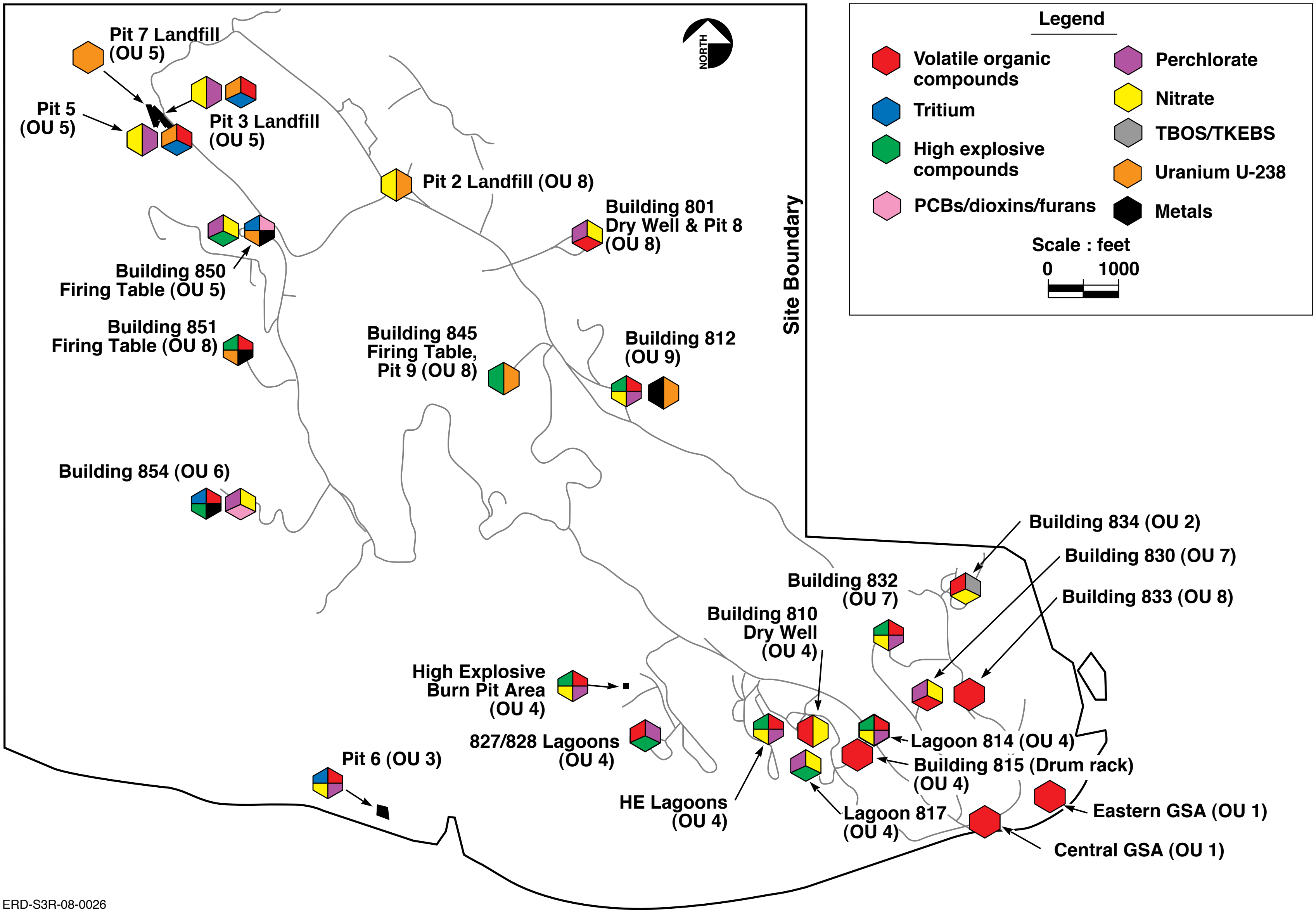


Figure 2.4-1. Site 300 release sites and Operable Units (OUs).

Figure 2.4-2. Map of Site 300 showing operable units with ground water plume outlines and water-supply wells.

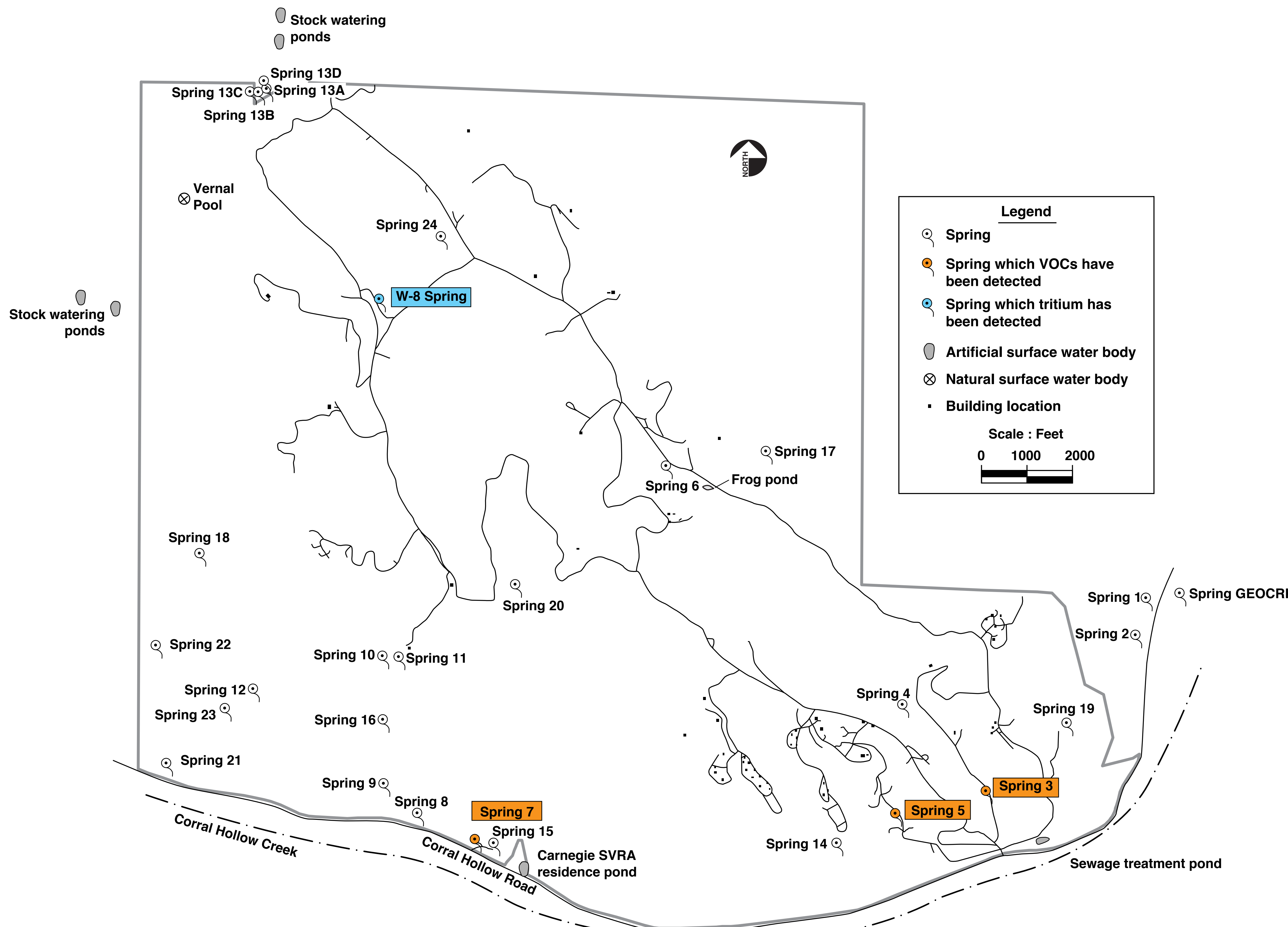


Figure 2.5-1. Springs and surface water body locations at Site 300.

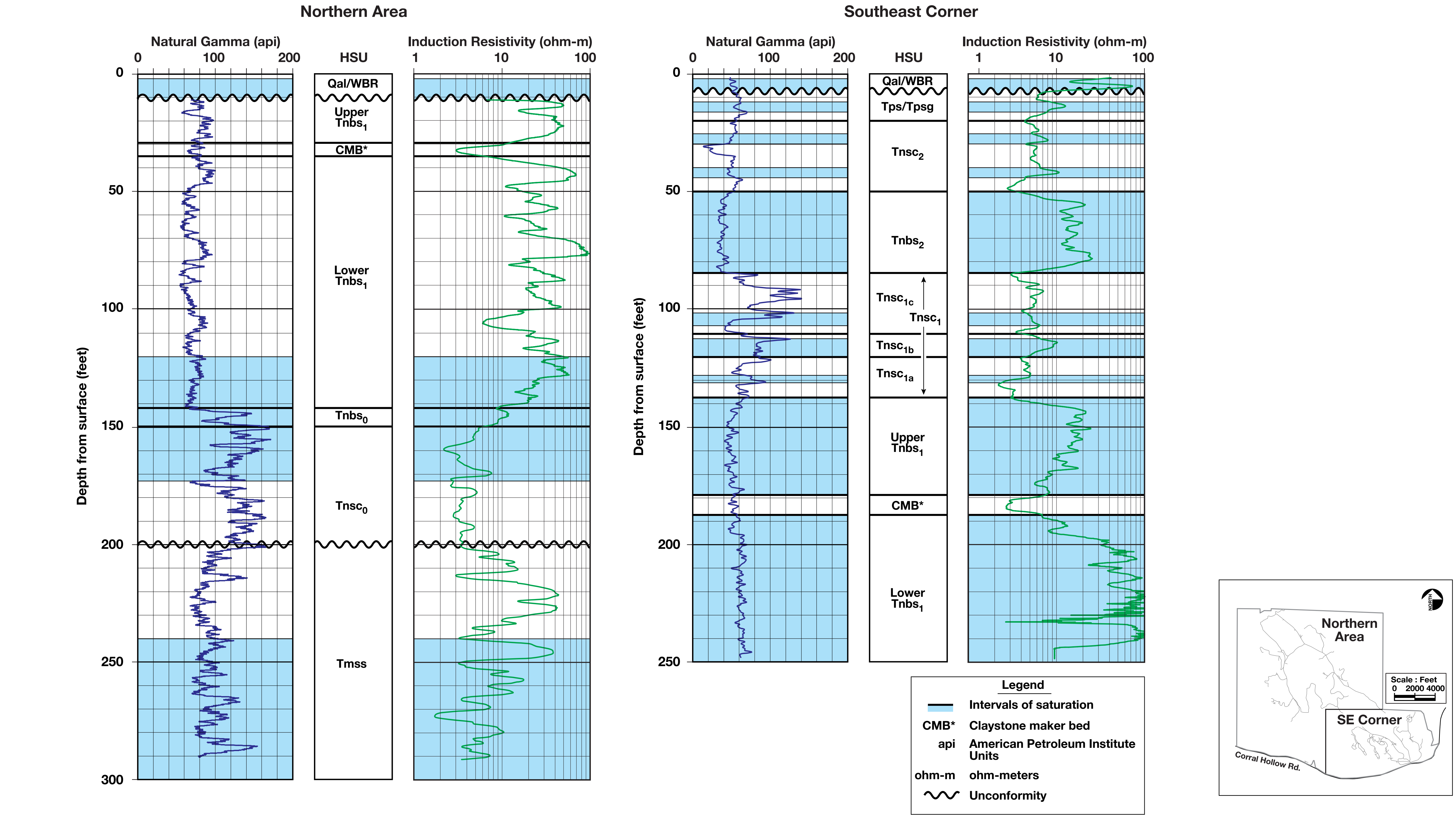
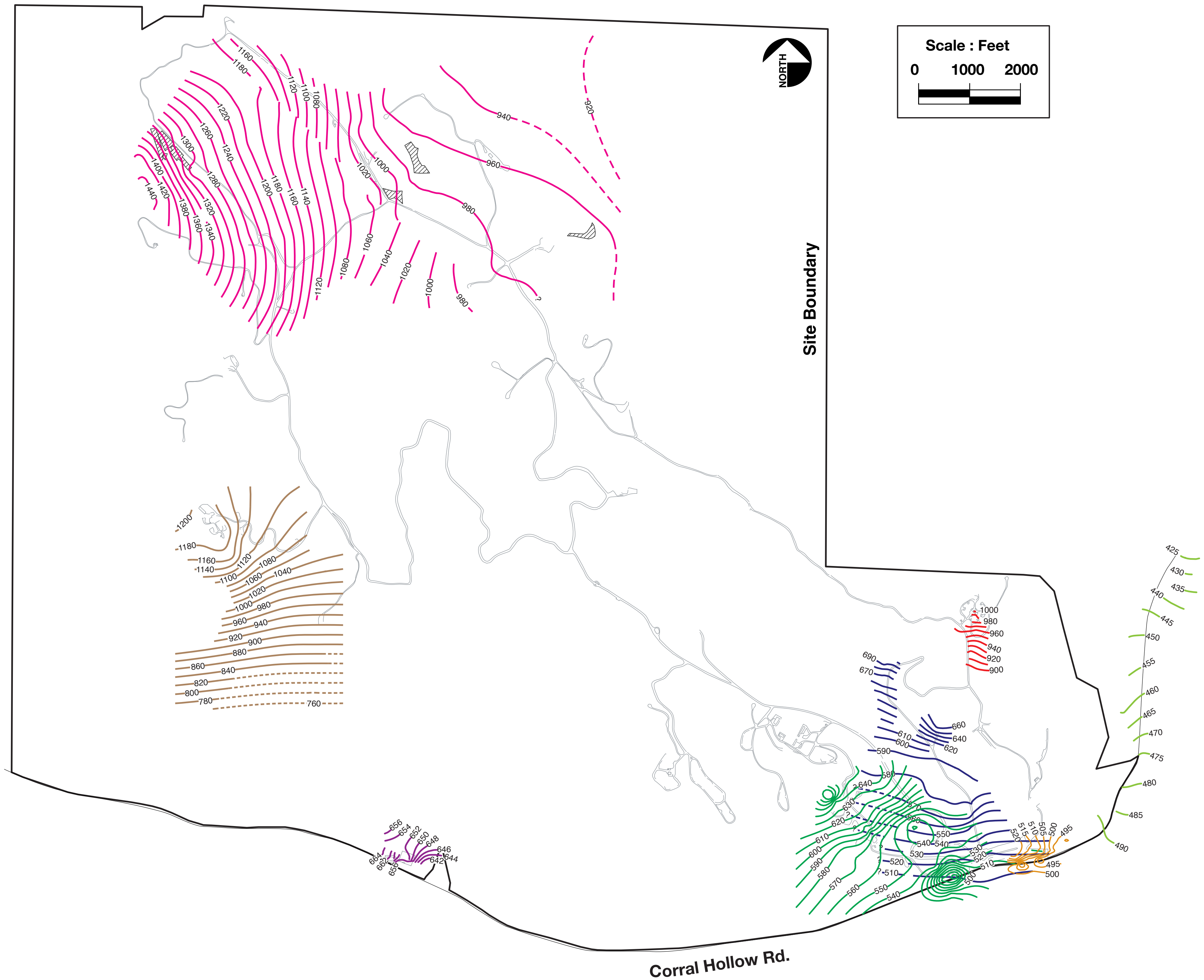


Figure 2.5-2. Composite hydrostratigraphic columns for Site 300 showing saturated hydrostratigraphic units (HSUs).



Legend

Tnbs$_0$/Tnbs$_1$ HSU (Northern Site 300)
Potentiometric surface contours are based on water elevations from wells completed in the Neroly Formation lower blue sandstone (Tnbs$_1$) and basal sandstone (Tnbs$_0$) stratigraphic units. Tnbs$_1$ is unsaturated in the Pit 7 Complex, but is saturated elsewhere in the contoured region. Ground water is unconfined to confined in this HSU.

Tnbs$_1$/Tnsc$_0$ HSU (Building 854 Area)
Potentiometric surface contours are based on water elevations from wells completed in the Neroly Formation lower blue sandstone (Tnbs$_1$) and basal claystone (Tnsc$_0$) stratigraphic units. Ground water is unconfined in this HSU.

Qt-Tnbs$_1$ HSU (Pit 6 Area)
Potentiometric surface contours are based on water elevations from wells completed in Quaternary Terrace deposits (Qt) and underlying vertically-dipping Neroly Formation lower blue sandstone (Tnbs$_1$) strata south of the Carnegie-Corral Hollow Fault Zone and shallow-dipping Neroly Tnbs$_1$ strata within and north of the fault zone. Ground water is generally unconfined in this HSU.

Tpsg HSU (Building 834 Area)
Potentiometric surface contours are based on water elevations from wells completed in Pliocene non-marine gravelly sediments (Tpsg). Ground water is perched and unconfined in this HSU.

Tnsc$_{1b}$ HSU (Building 832 Canyon Area)
Potentiometric surface contours are based on water elevations from wells completed in Neroly Formation lower silty claystone unit 1b (Tnsc$_{1b}$) strata. Ground water is under unconfined to artesian conditions in this HSU.

Tnbs$_2$ HSU (HE Process Area)
Potentiometric surface contours are based on water elevations from wells completed in Neroly Formation upper blue sandstone (Tnbs$_2$). Several cones of depression depicted by the contours arise from ground water pumping to treatment systems in the area. Ground water is generally unconfined in the northern portion of the area and confined to flowing artesian in the southern portion of the area.

Qt-Tnsc$_1$ and Qal-Tnbs$_1$ HSUs (Southeastern Site 300)
Potentiometric surface contours are based on water elevations from wells completed in the Quaternary Terrace Deposits (Qt) and Neroly Formation lower silty claystone (Tnsc$_1$) HSU and the Quaternary Alluvium (Qal) and Neroly Formation Lower Blue sandstone HSU. Several cones of depression depicted by the contours arise from ground water pumping to treatment systems in the area. Ground water is unconfined in this HSU.

Qal-Tnbs$_1$ HSU (Eastern General Services Area [GSA] and Offsite)
Potentiometric surface contours are based on water elevations from wells completed in the Quaternary Alluvium (Qal) and Neroly Formation Lower Blue sandstone HSU. Ground water is unconfined in this HSU.

Ground water potentiometric surface elevation contours in feet above mean sea level, dashed were approximately located and queried where uncertain.

Notes: Ground water elevation data from the first semester 2006. Potentiometric surface contours are taken from figures presented in the 2006 Annual Compliance Monitoring Report (Dibley et al., 2006). Water elevation data are included in Appendix A of that report.

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Figure 2.5-3. Potentiometric surface elevation map of major hydrostratigraphic units (HSUs) at Site 300.

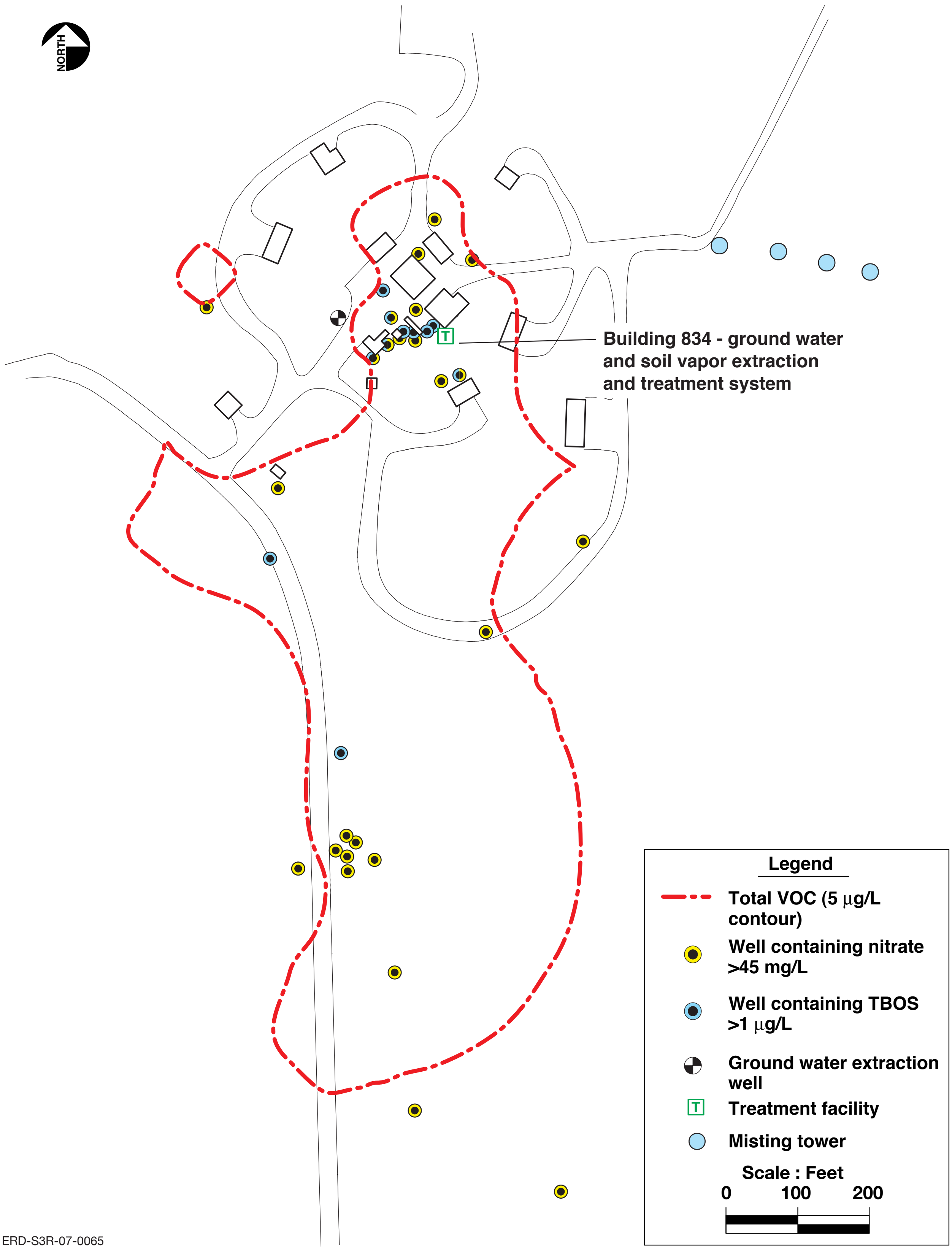

Figure 2.5-4. Building 834 Operable Unit (OU 2) contaminants of concern in ground water above cleanup standards.

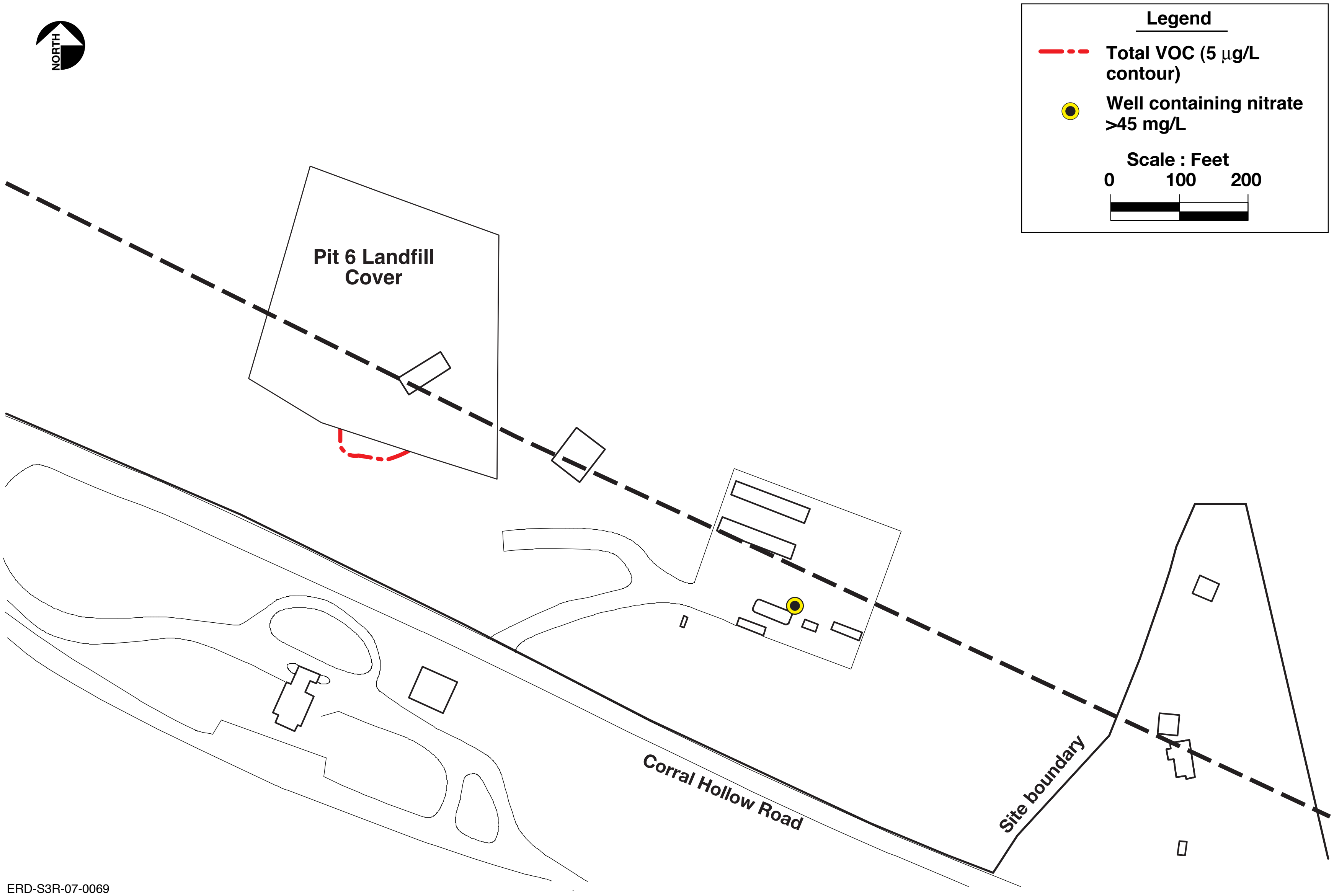

Figure 2.5-5. Pit 6 Landfill Operable Unit (OU 3) contaminants of concern in ground water above cleanup standards.

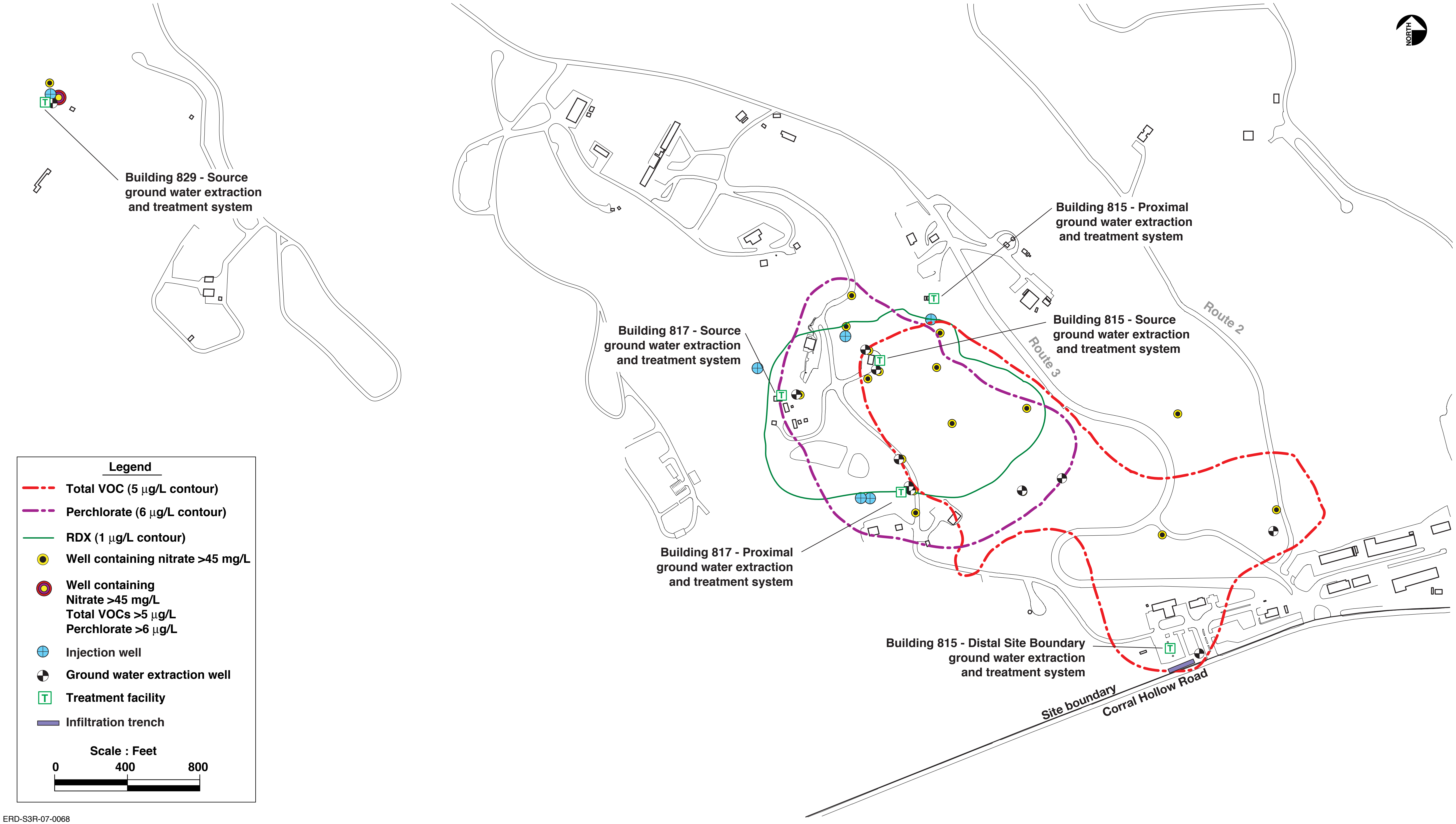

Figure 2.5-6. High Explosives Process Area Operable Unit (OU 4) contaminants of concern in ground water above cleanup standards.

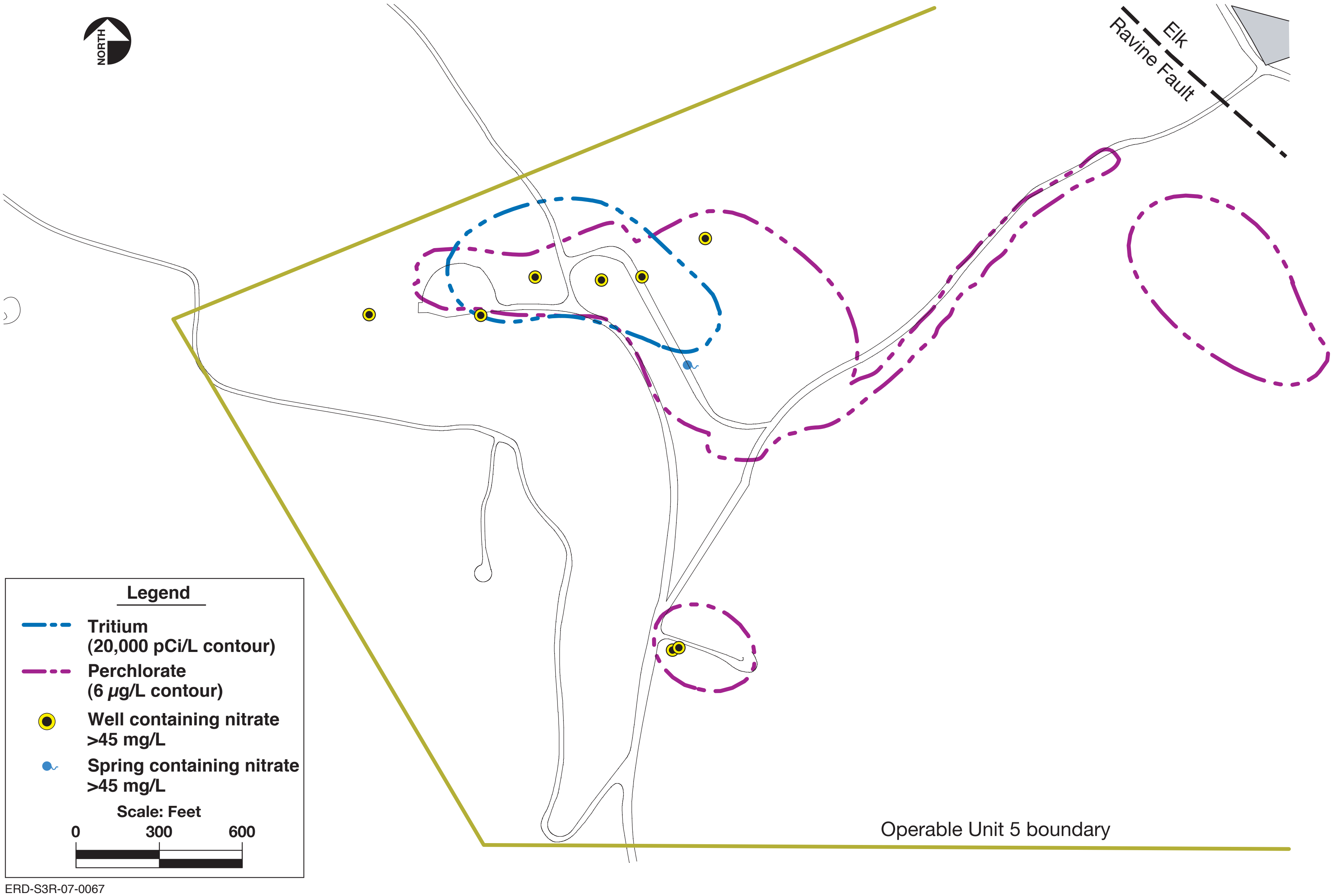

Figure 2.5-7. Building 850 Firing Table (OU 5) contaminants of concern in ground water above cleanup standards.

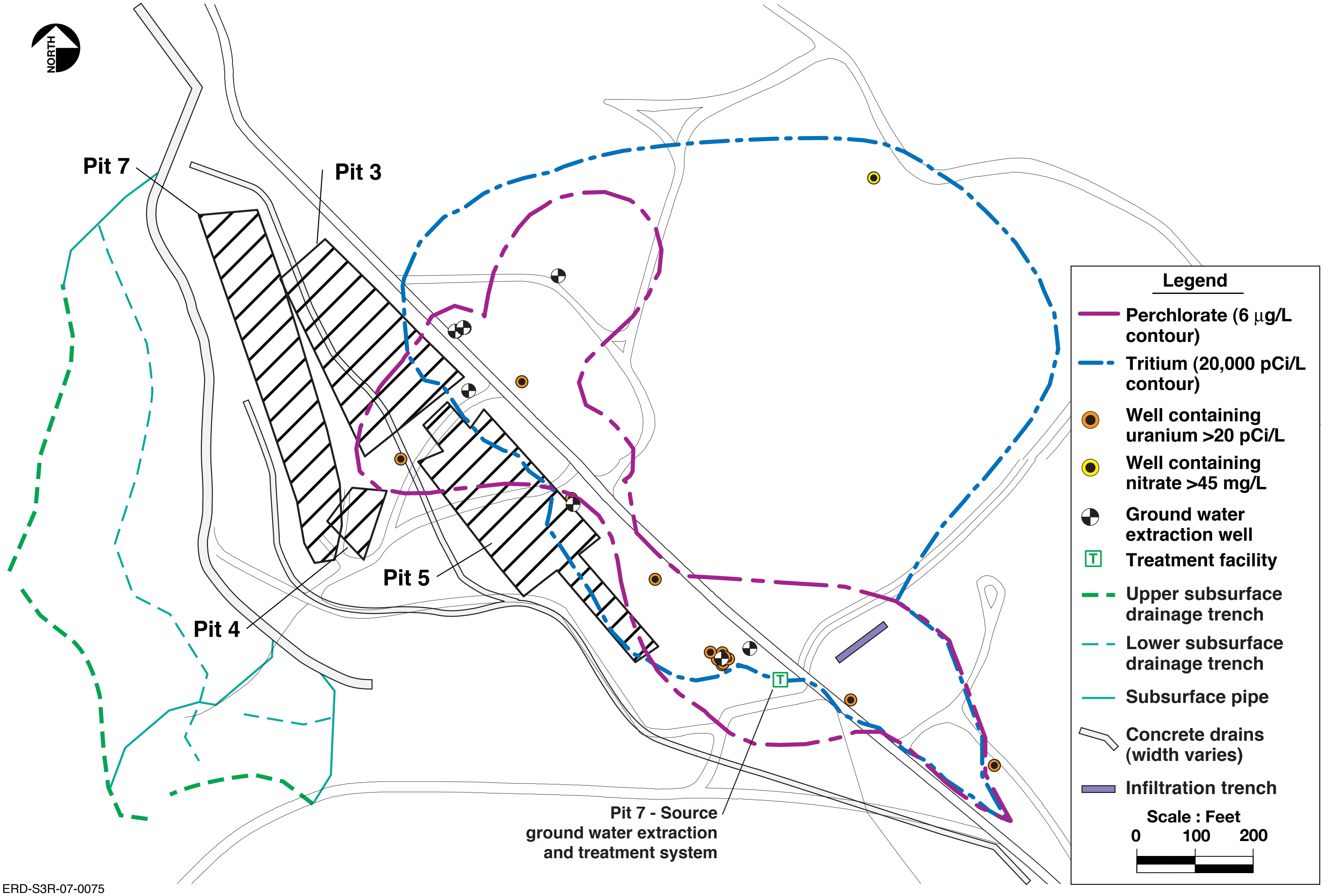

Figure 2.5-8. Pit 7 Complex (OU 5) contaminants of concern in ground water above cleanup standards.

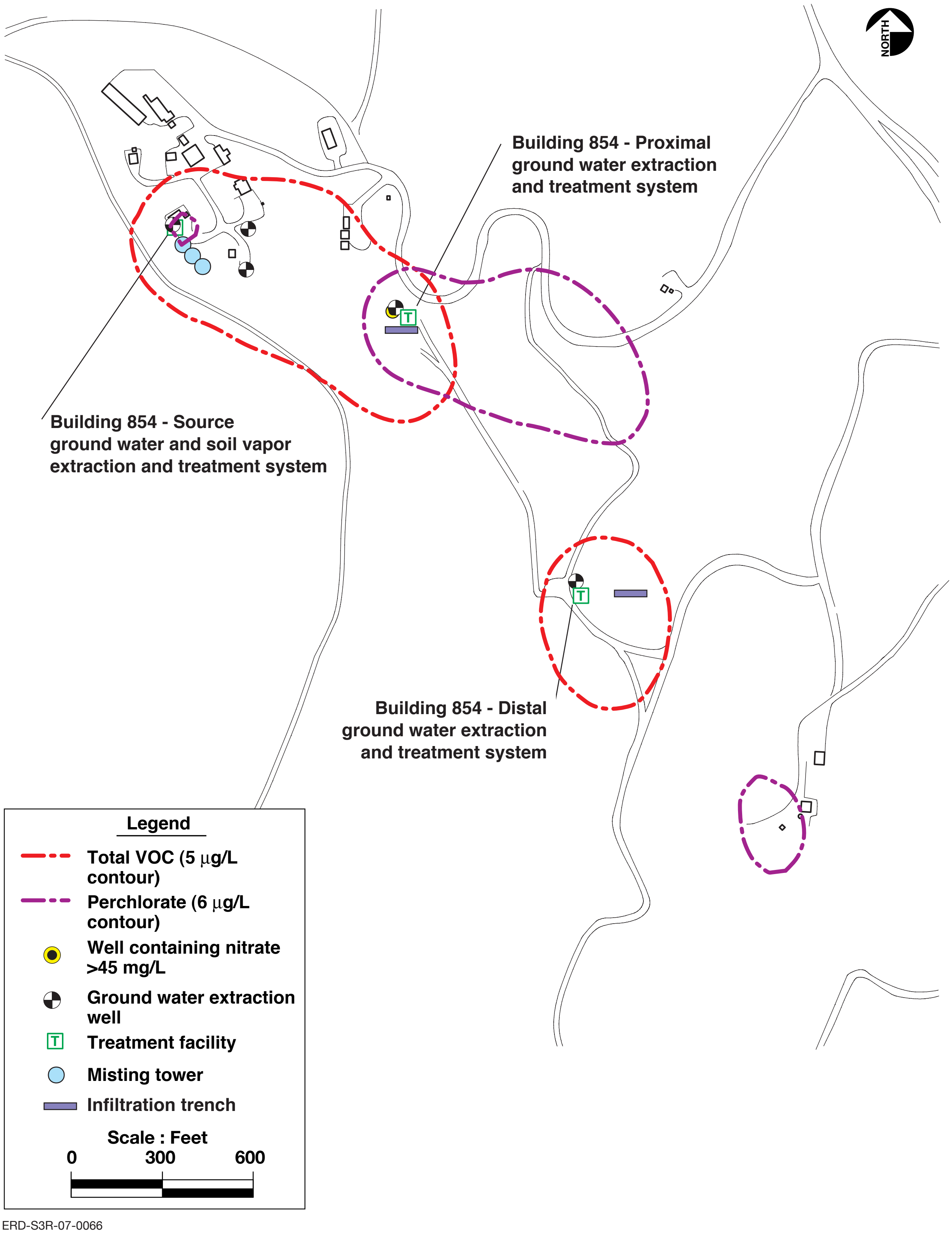

Figure 2.5-9. Building 854 Operable Unit (OU 6) contaminants of concern in ground water above cleanup standards.

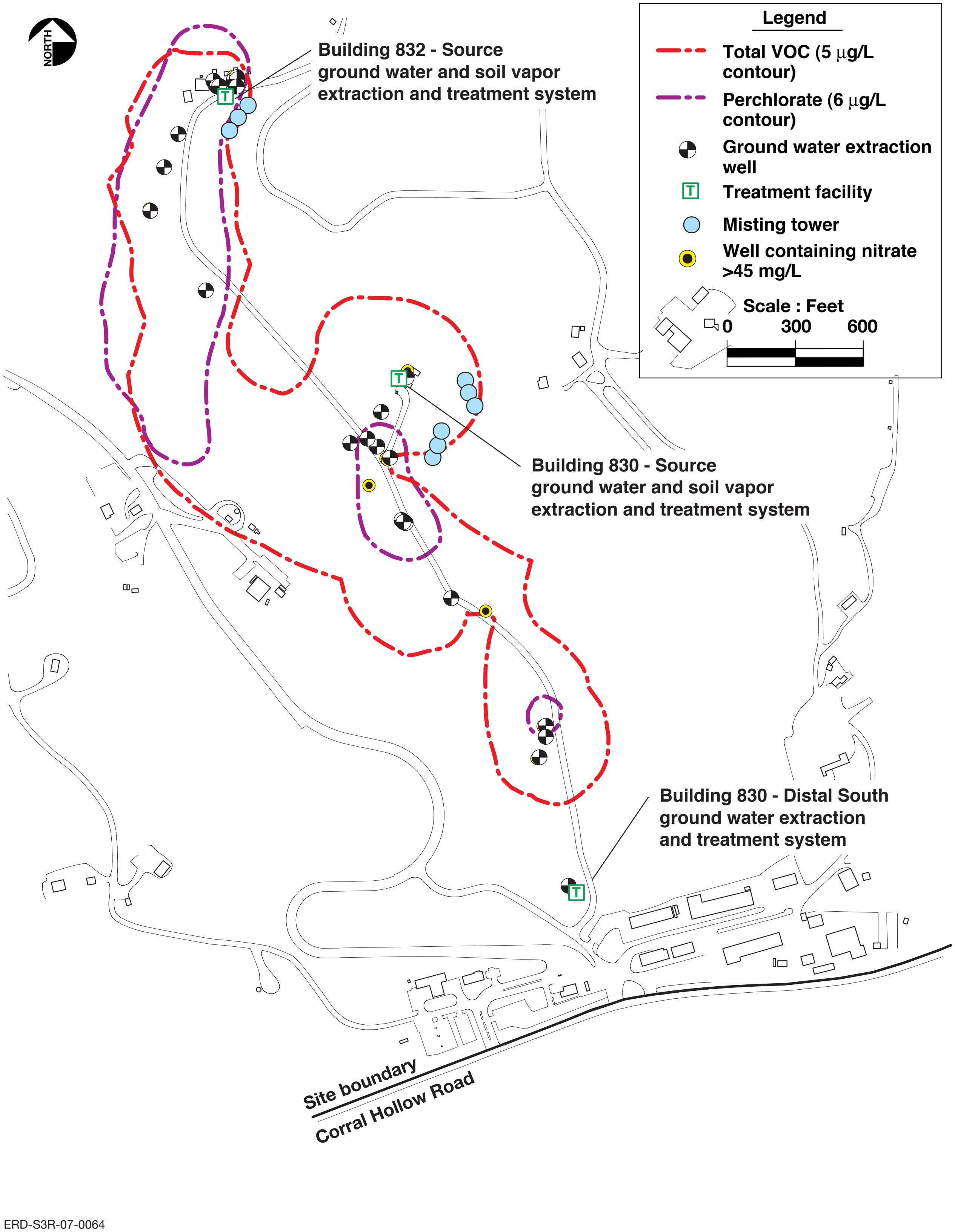

Figure 2.5-10. Building 832 Canyon Operable Unit (OU 7) contaminants of concern in ground water above cleanup standards.

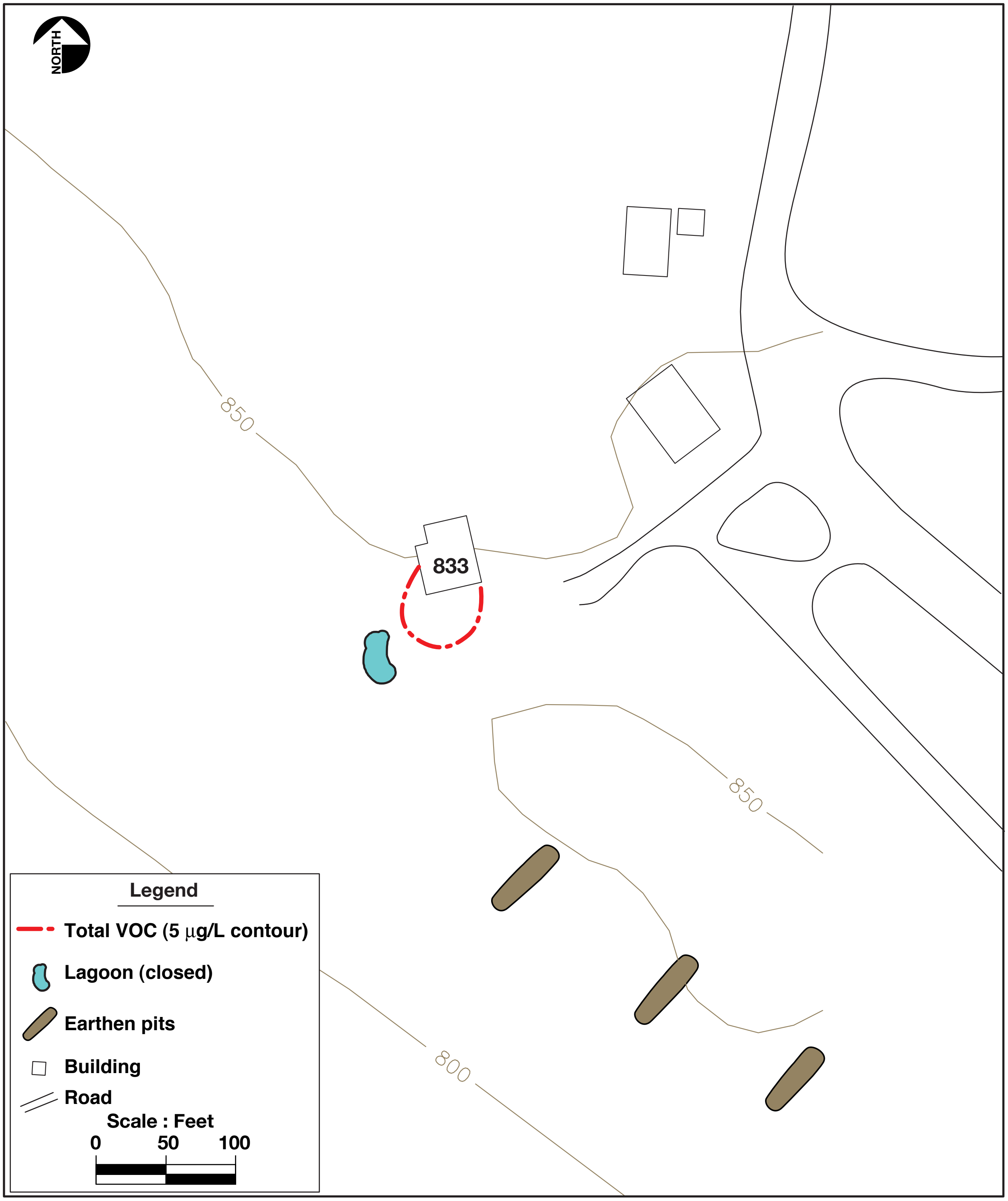

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Figure 2.5-11. Building 833 (OU 8) contaminants of concern in ground water above cleanup standards.

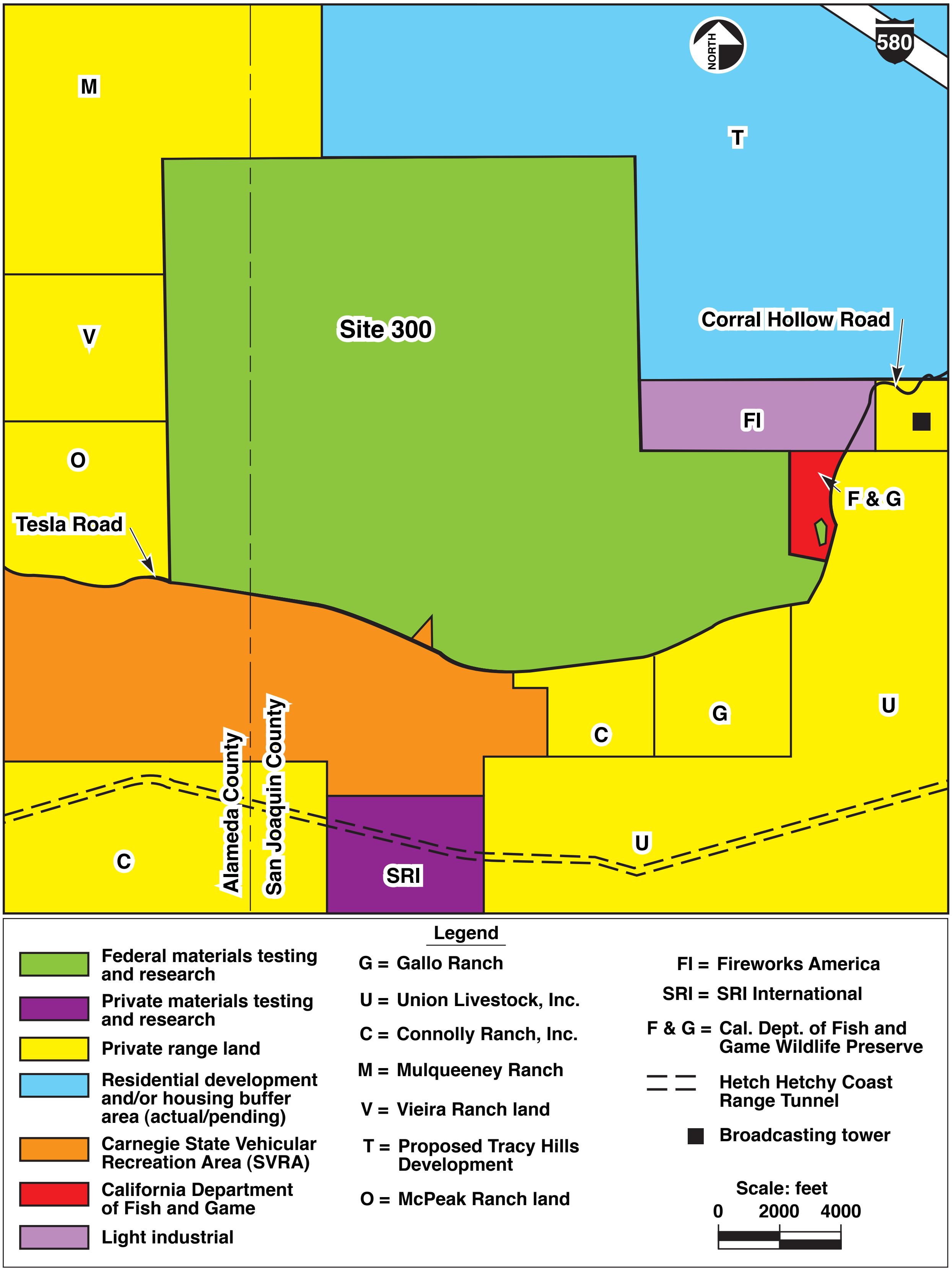

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Figure 2.6-1. Land use in the vicinity of Site 300.

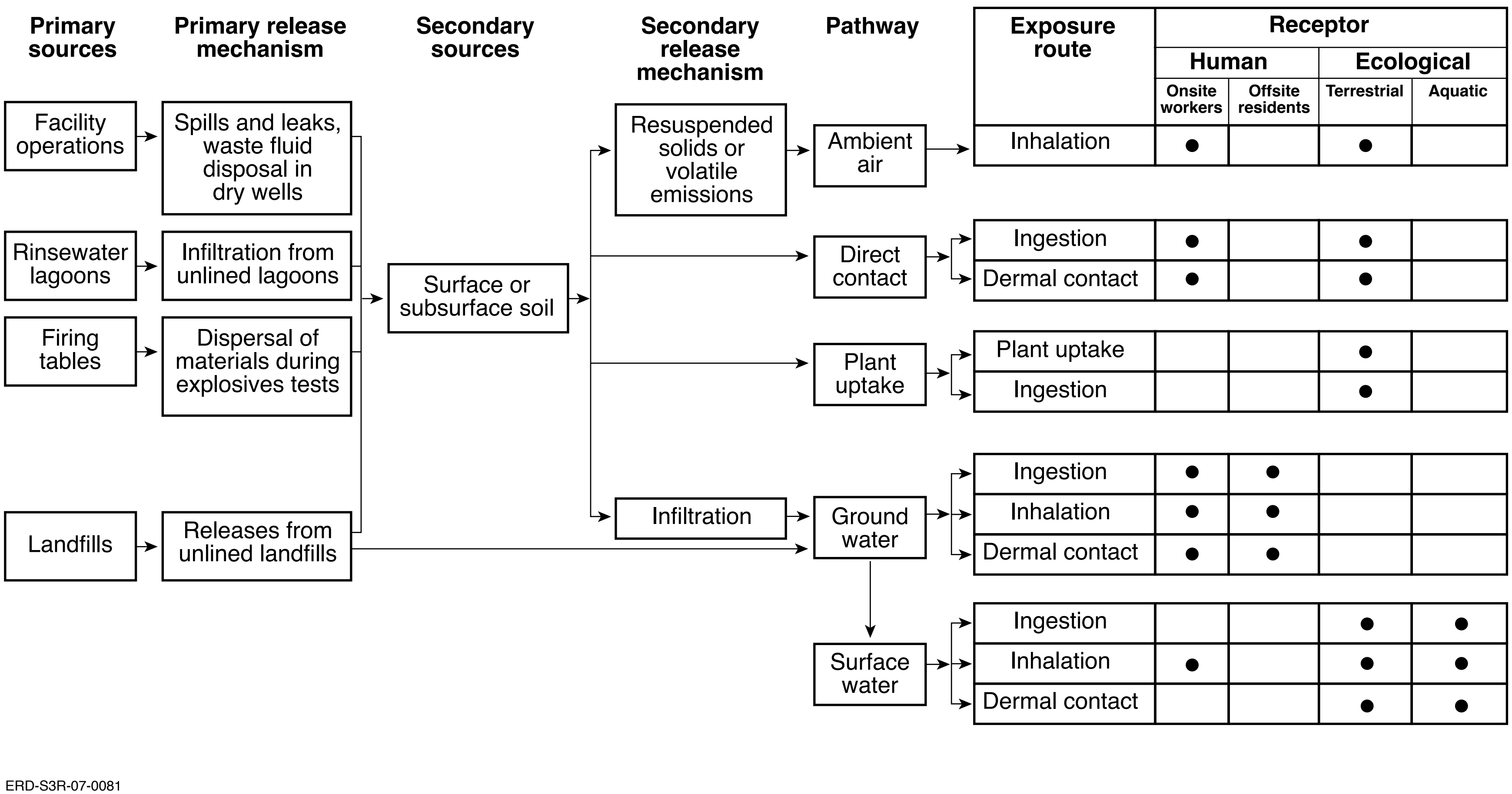

Figure 2.7-1. Conceptual site model for risk and hazard.

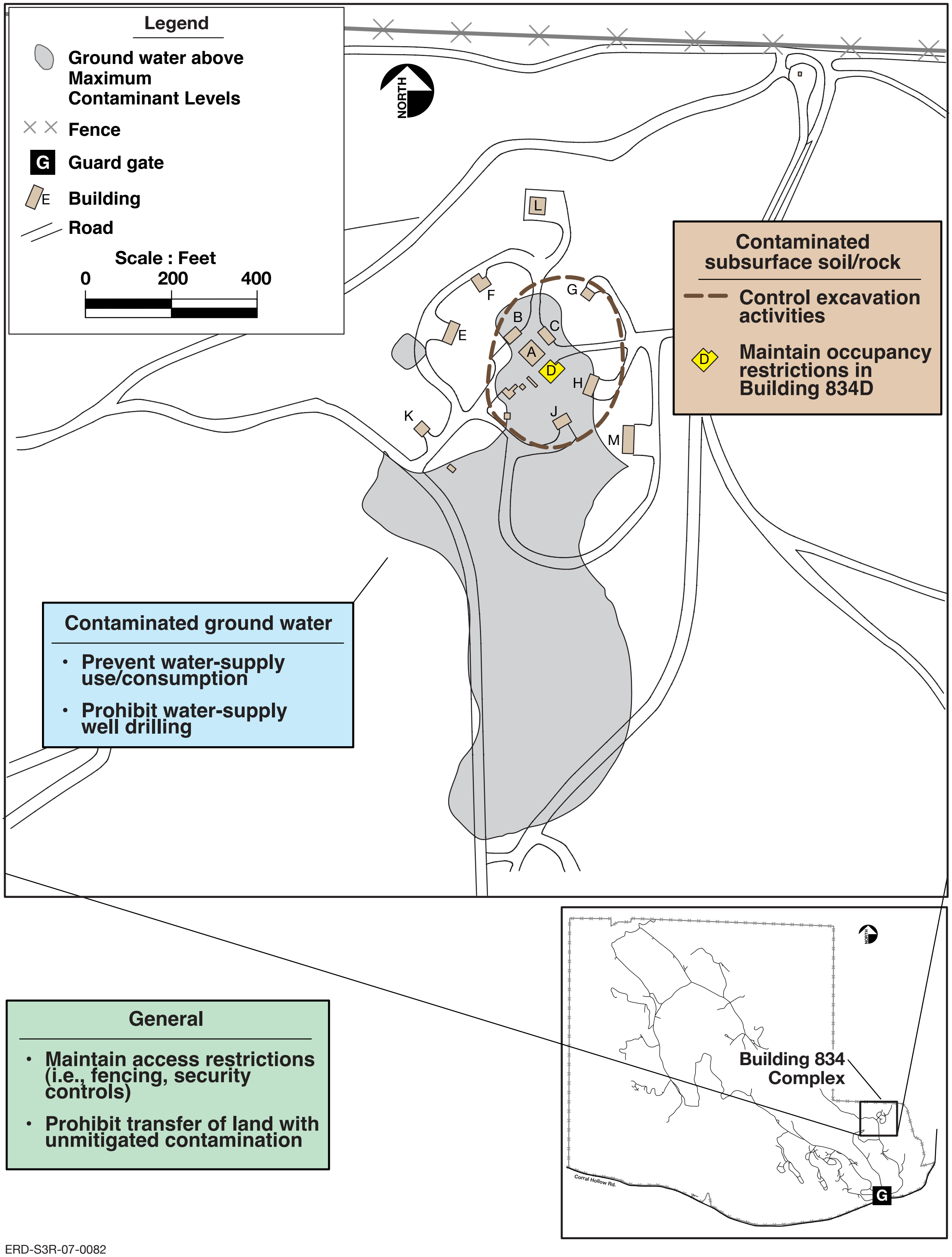

Figure 2.9-1. Building 834 Operable Unit institutional/land use controls.

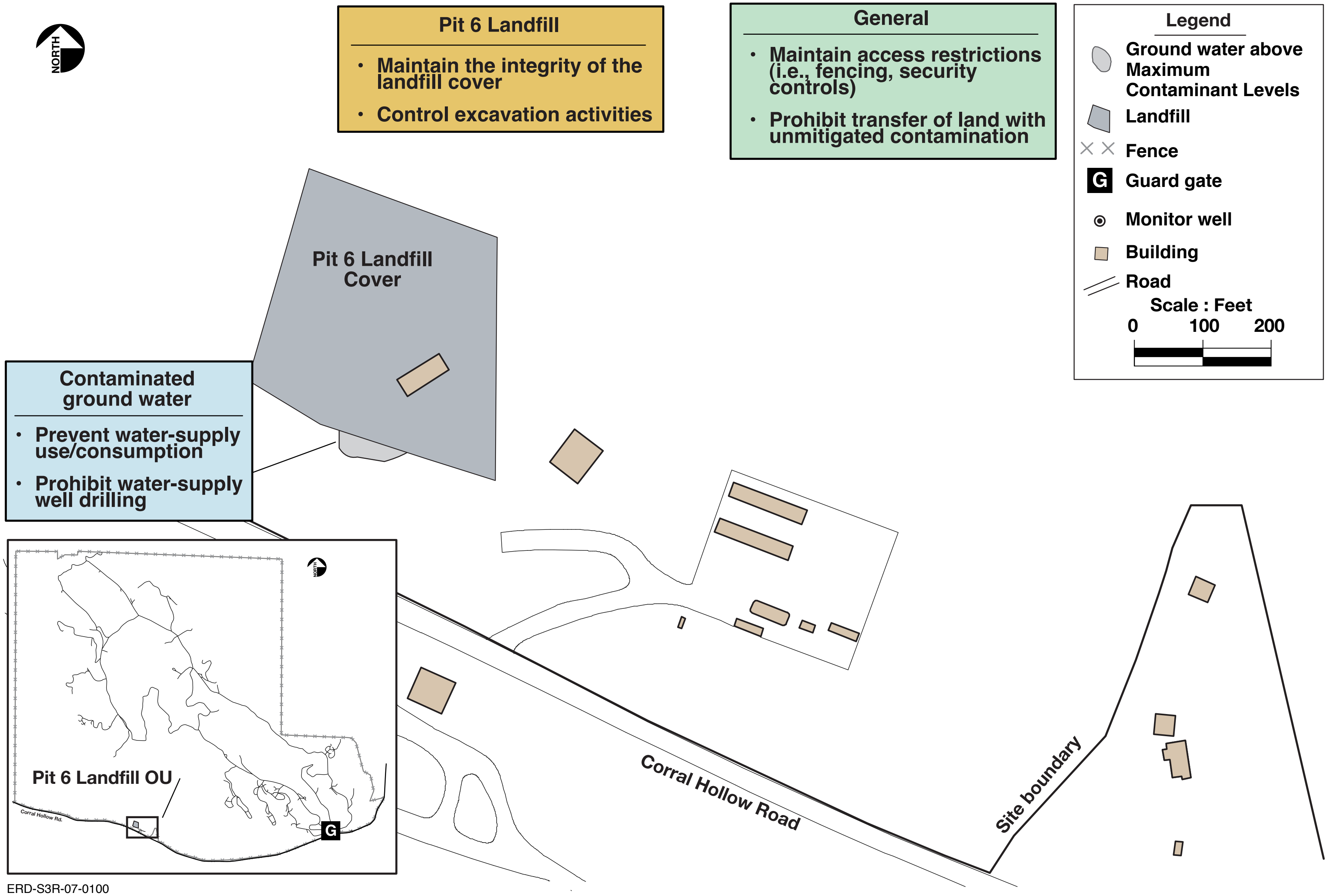

Figure 2.9-2. Pit 6 Landfill Operable Unit institutional/land use controls.

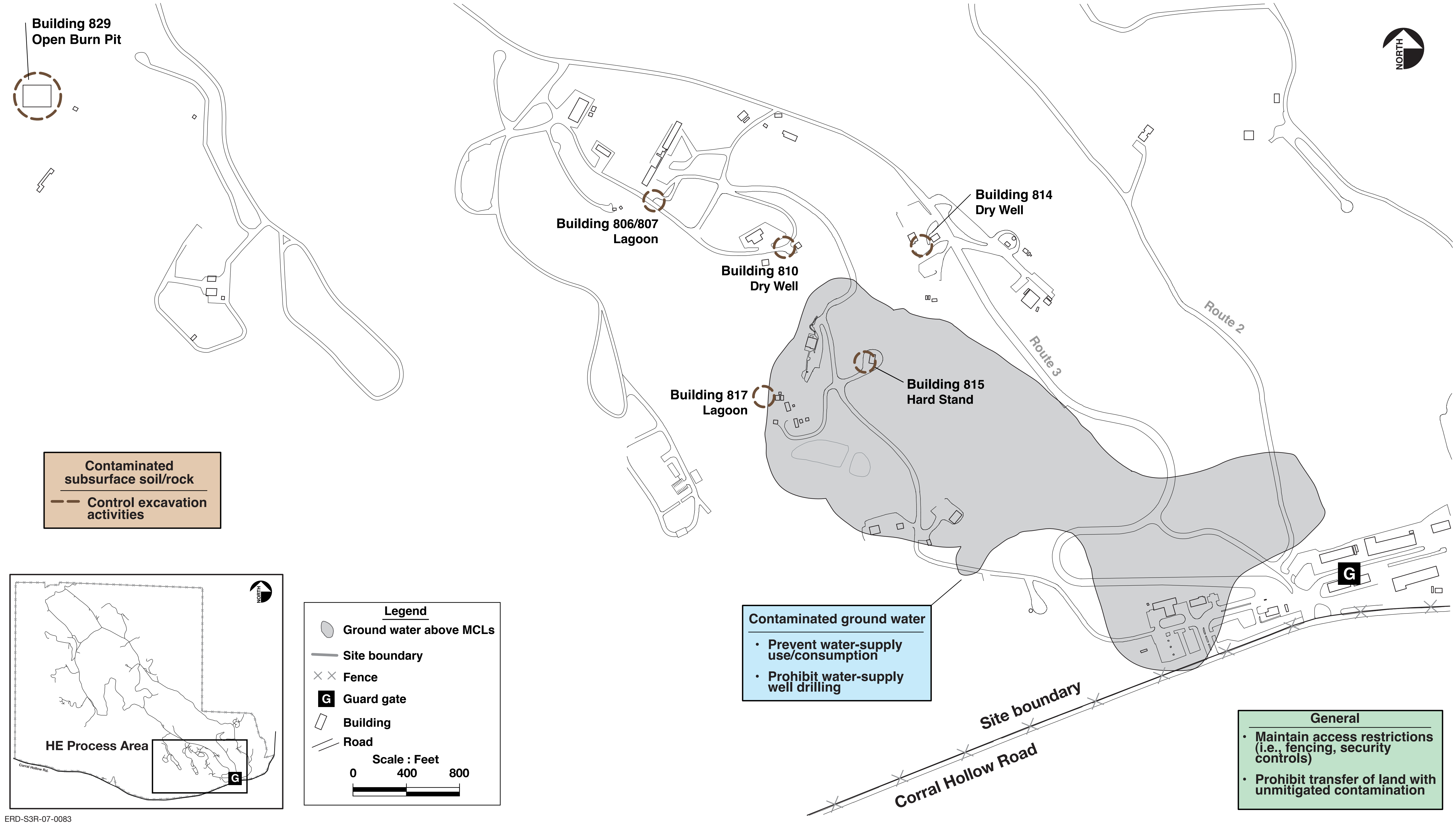

Figure 2.9-3. High Explosives Process Area Operable Unit institutional/land use controls.

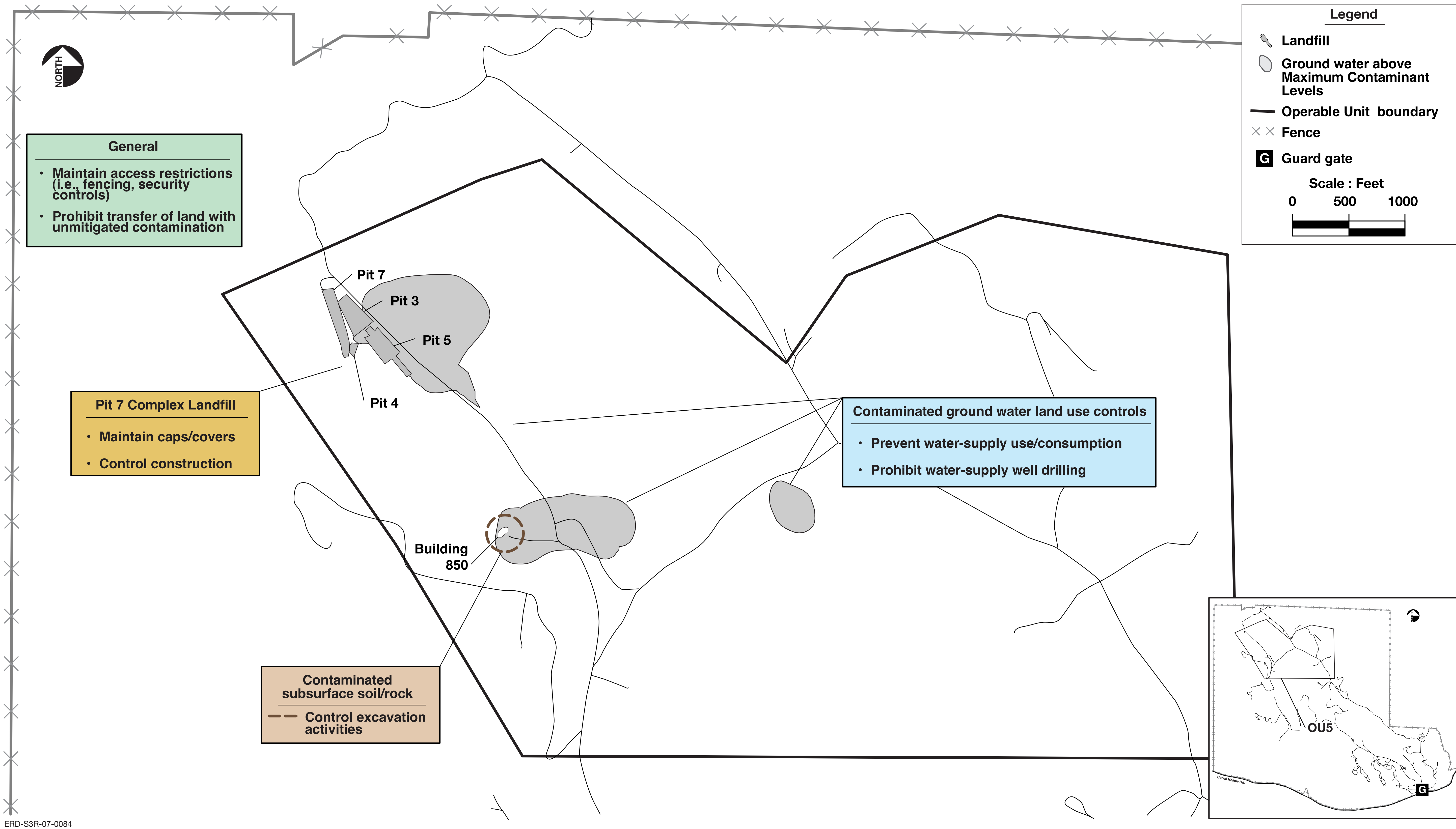

Figure 2.9-4. Building 850/Pit 7 Complex Operable Unit institutional/land use controls.

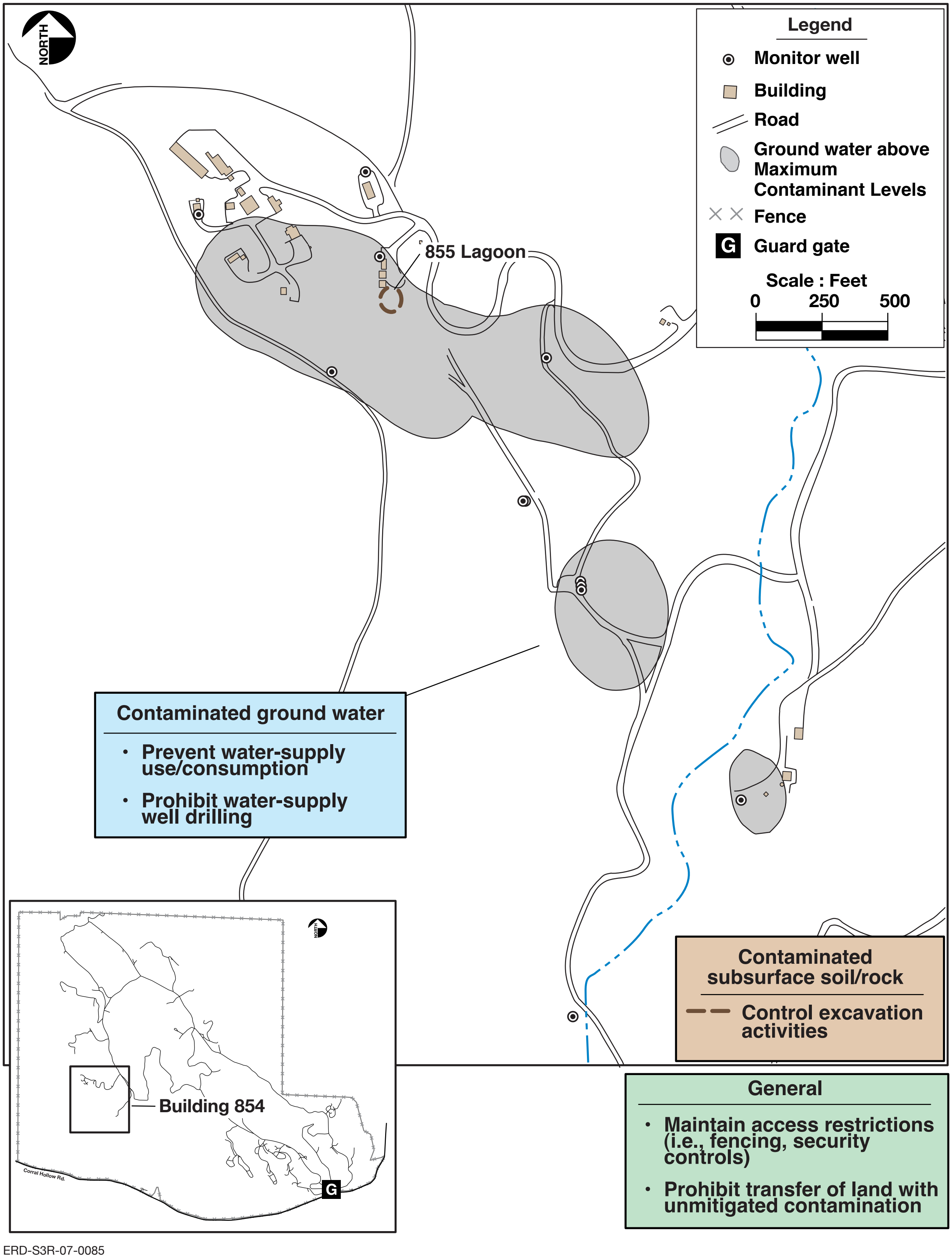

Figure 2.9-5. Building 854 Operable Unit institutional/land use controls.

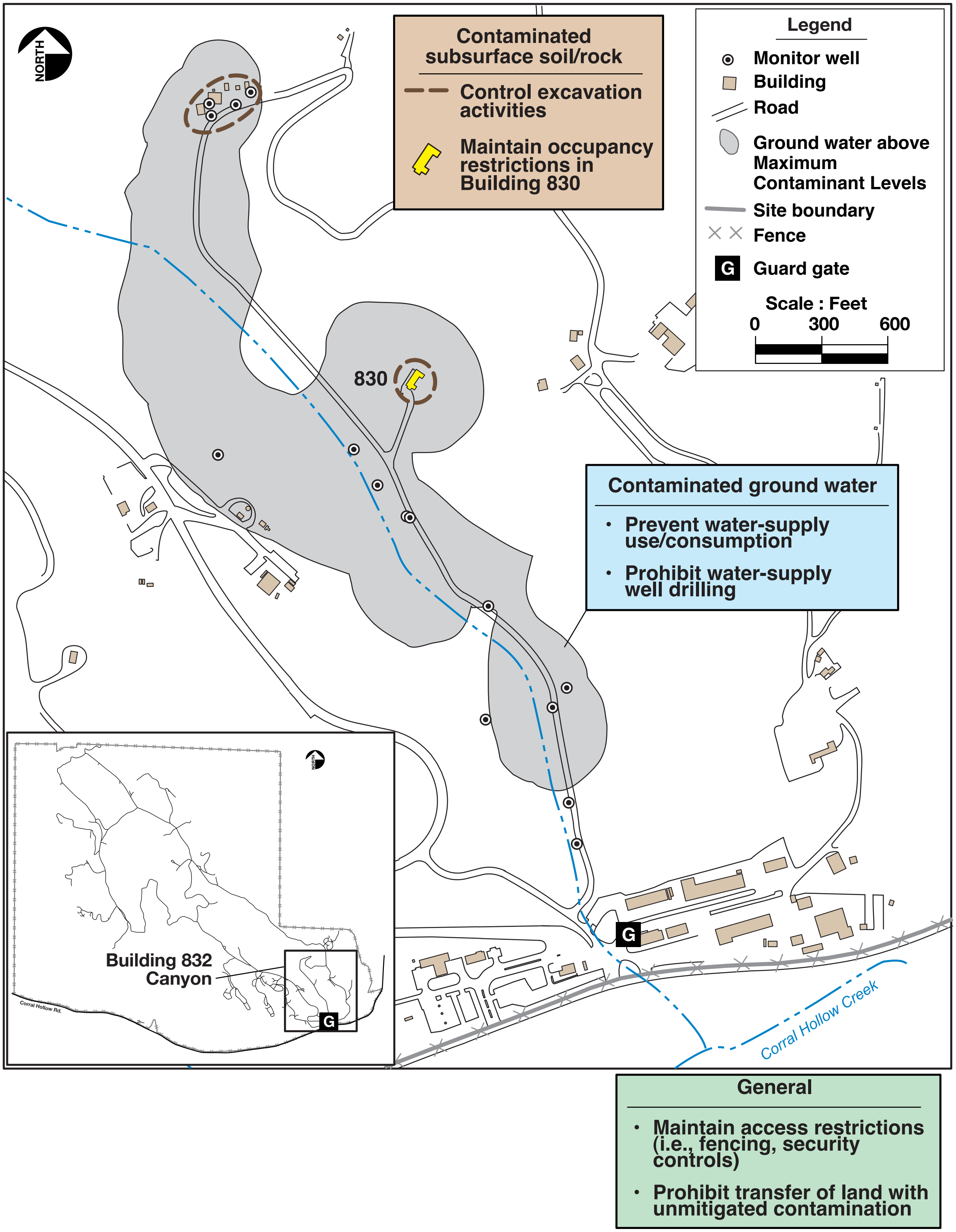

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Figure 2.9-6. Building 832 Canyon Operable Unit institutional/land use controls.

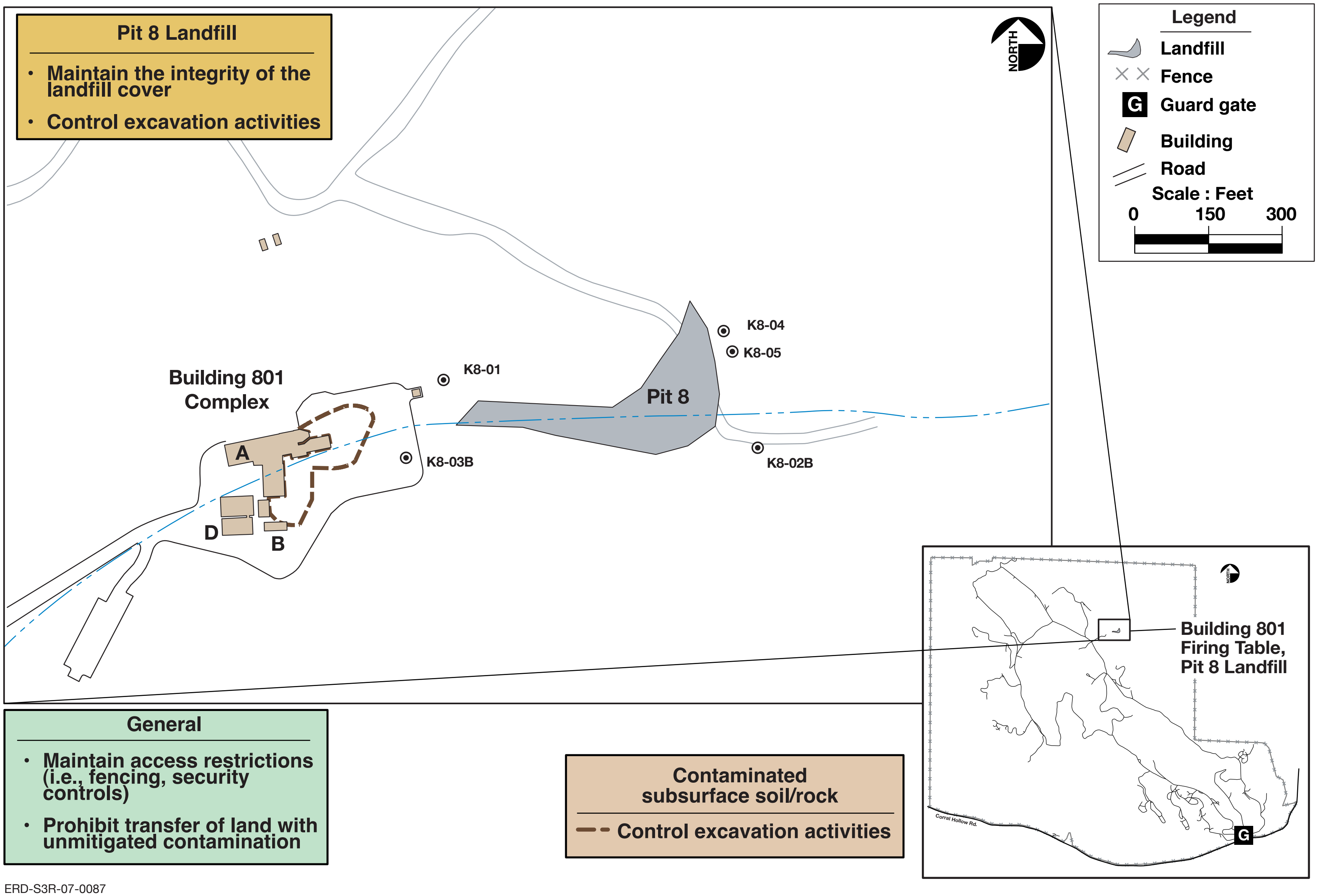

Figure 2.9-7. Building 801 Firing Table and Pit 8 Landfill institutional/land use controls.

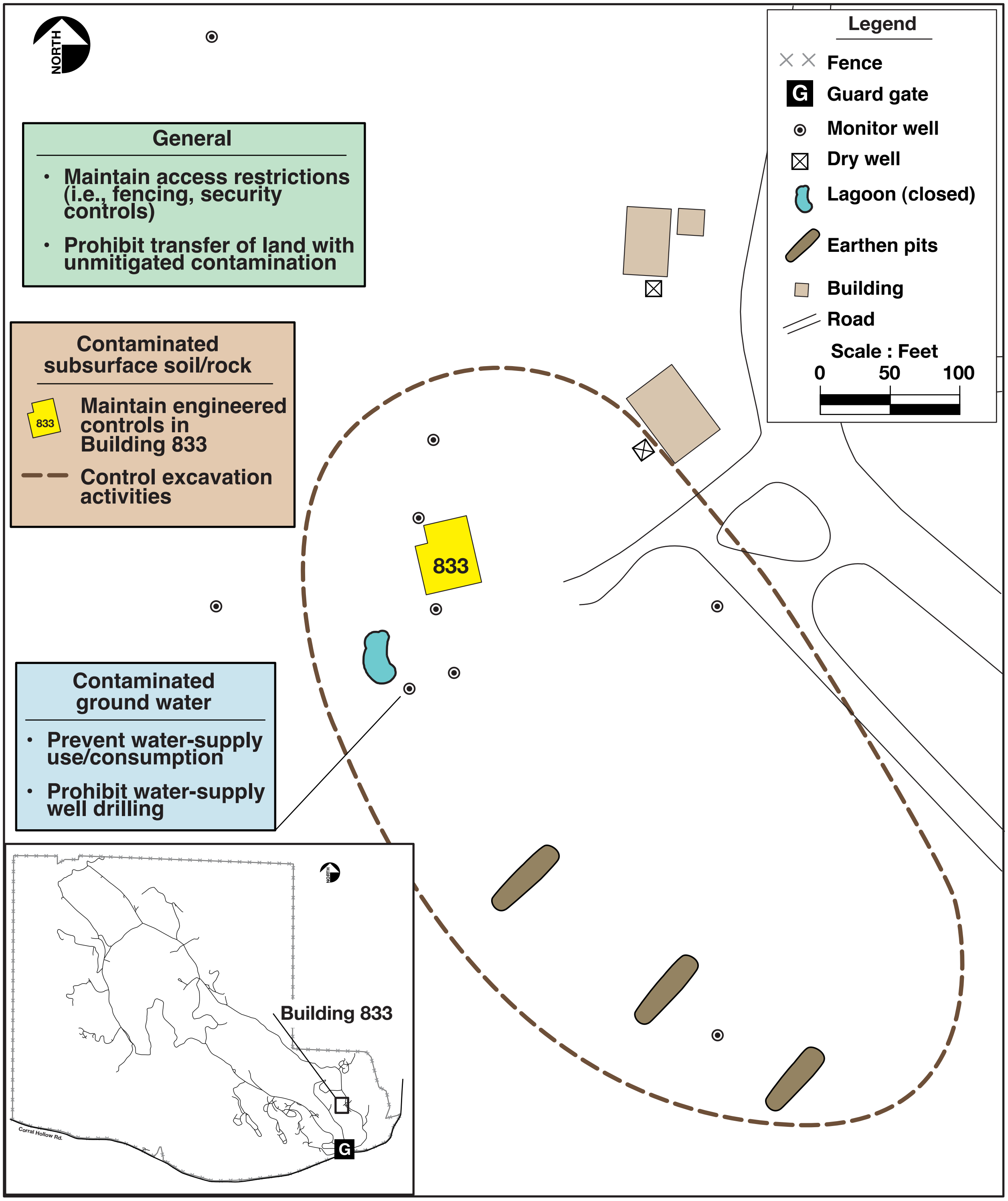

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Figure 2.9-8. Building 833 institutional/land use controls.

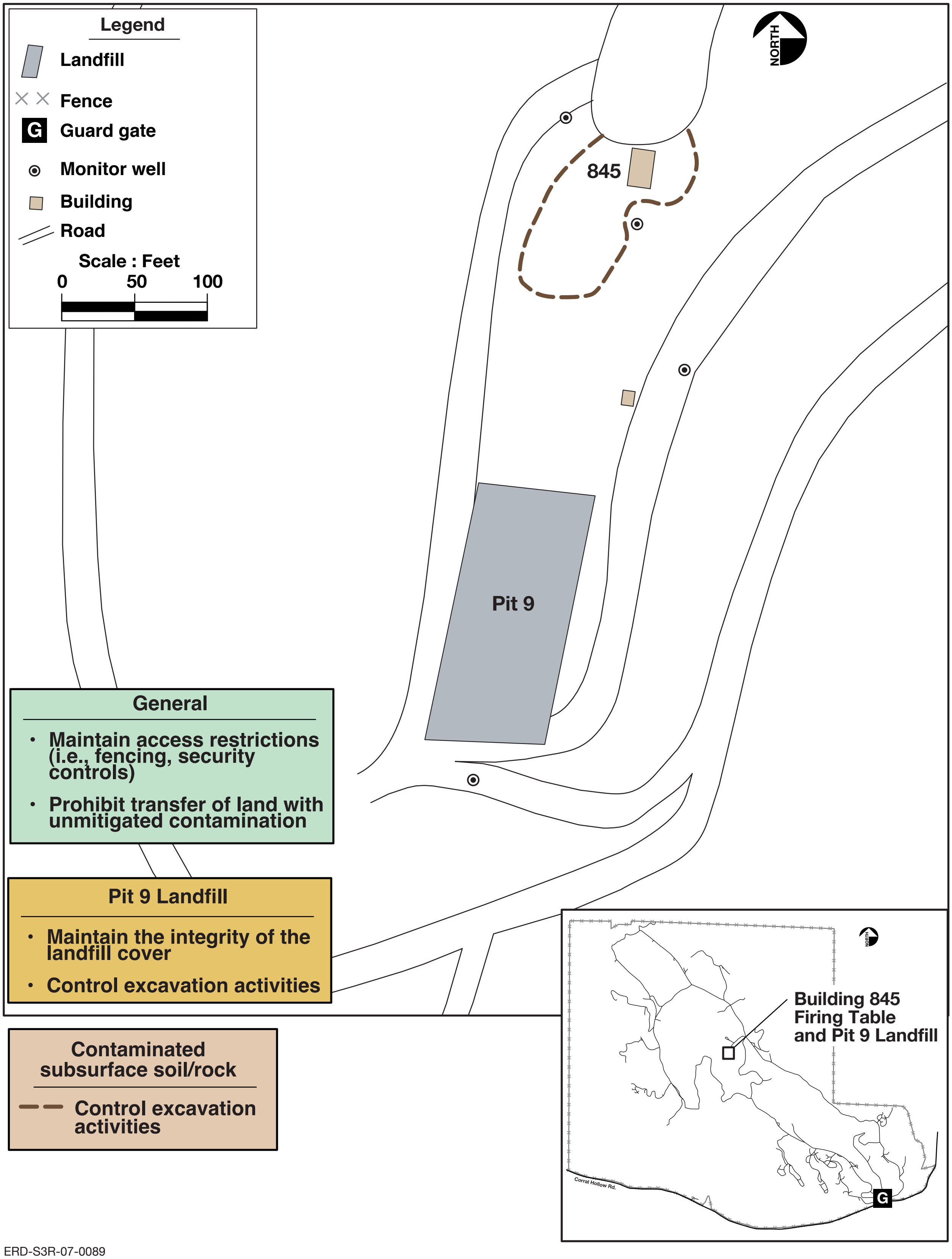

Figure 2.9-9. Building 845 Firing Table and Pit 9 Landfill institutional/land use controls.

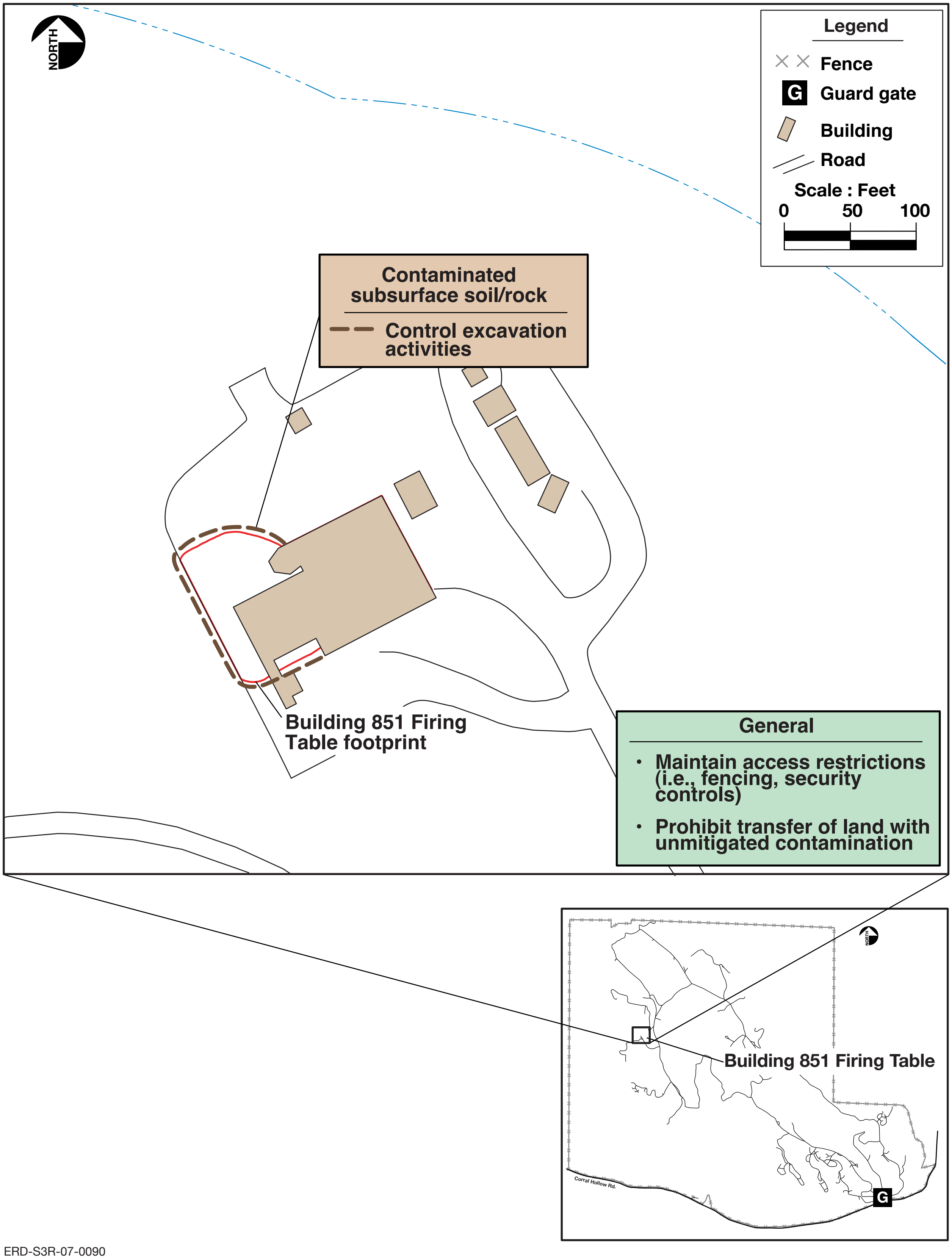

Figure 2.9-10. Building 851 institutional/land use controls.

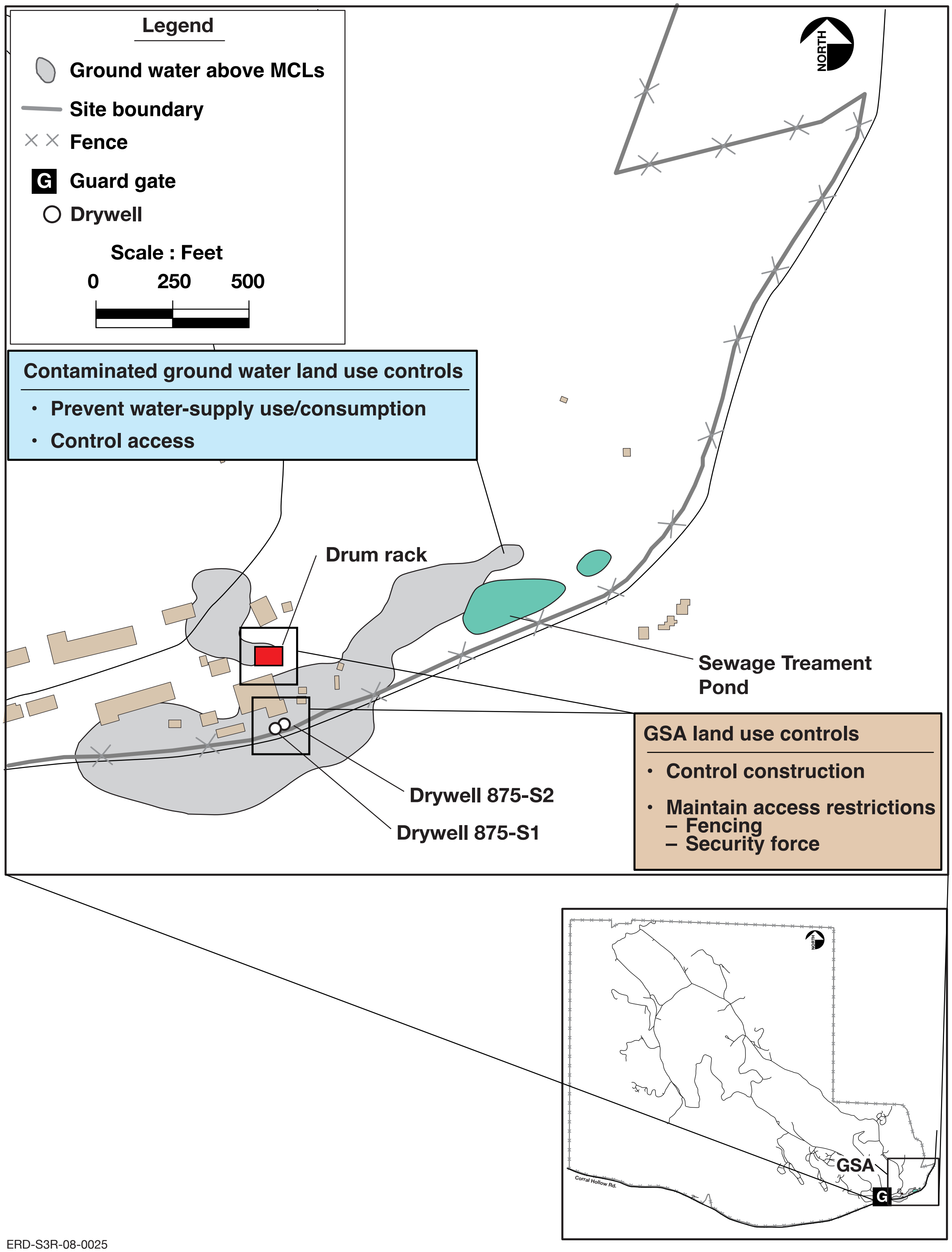

Figure 2.9-11. General Services Area (GSA) Operable Unit institutional/land use controls.

Tables

Table 1.4-1. Technologies comprising the selected remedies for LLNL Site 300.

Technology	Building 834 OU	Pit 6 Landfill OU	HE Process Area OU	Building 850 Firing Table	Pit 7 Complex	Building 854 OU	Building 832 Canyon OU	Building 801 Dry Well and Pit 8 Landfill	Building 833	Building 845 Firing Table and Pit 9 Landfill	Building 851 Firing Table	Pit 2 Landfill
Monitoring	√	√	√	√	√	√	√	√	√	√	√	√
Risk and hazard management	√	√	√	√	√	√	√	√	√	√	√	√
Monitored natural attenuation		√	√	√	√		√					
Ground water extraction	√		√		√	√	√					
Soil vapor extraction	√					√	√					
Source control					√							
Total cost	\$173.9M[a]	\$4.5M[b]	\$179.5M[a]	\$17.0M[a]	\$10.8M[c]	\$80.3M[a]	\$157.9M[a]	\$0.5M[b]	\$0.8M[b]	\$0.5M[b]	\$0.5M[b]	\$0.5M[b]

Notes:

OU = Operable Unit.

M = Million.

[a] Total cost shown is as presented in the 2006 Site-Wide Remediation Evaluation Summary Report, Appendix C for scenario 1 (cleanup to Maximum Contaminant Levels). Cost estimates were calculated for the expected life-cycle without applying discount or inflation rates. Capital costs were not included because the alternatives have been implemented.

[b] Total cost shown is as presented in the 2001 Interim Record of Decision. Costs for Operable Units 3 and 8 were not calculated in the Site-Wide Remediation Evaluation Summary Report. Present worth cost estimates were calculated for a 30-year design life assuming a 5% discount rate.

[c] Total cost shown is as presented in the 2007 Amendment to the Interim Site-Wide Record of Decision for the Pit 7 Complex. Costs for the Pit 7 Complex (OU 5) were not included in the Site-Wide Remediation Evaluation Summary Report or Interim Record of Decision. The net present value cost estimate was calculated for a 30-year design life assuming a 5% interest rate.

Table 2.4-1. Overall site cleanup plan for LLNL Site 300.

Area	Past and ongoing responses	Responses proposed in this Site-Wide ROD
General Services Area OU	**Ongoing ground water and soil vapor extraction as documented in the Final GSA OU ROD (1997).**	**None. Final GSA OU ROD signed in 1997.**
Building 834 OU	**Excavation of VOC-contaminated soil (1983).** **Ongoing ground water and soil vapor extraction and treatment (since 1995).** **Surface water drainage diversion (1998).**	**Monitoring.** **Exposure control through risk and hazard management.** **Continued ground water extraction and treatment of VOCs, tetrabutyl orthosilicate/tetrakis (2-ethylbutyl) silane, and nitrate (ongoing since 1995).** **Continued soil vapor extraction and treatment of VOCs (ongoing since 1995).**
Pit 6 Landfill OU	**Exhumed waste containing depleted uranium (1971).** **Capped landfill as a Comprehensive Environmental Response, Compensation and Liability Act removal action (1997).**	**Monitoring (including a monitoring-only response for nitrate and perchlorate in ground water.)** **Exposure control through risk and hazard management.** **Monitored natural attenuation of VOCs and tritium in ground water.** **Inspection and maintenance of the landfill cap.**
High Explosives Process Area OU	**Closed HE Rinsewater Lagoons under Regional Water Quality Control Board oversight (1985-1989).** **Sealed and abandoned water-supply wells 4 (1990) and 6 (1989).** **Capped HE Burn Pits under Resource Conservation and Recovery Act (1998).** **Ongoing ground water extraction and treatment (since 1999).** **No further action remedy selected for VOCs and HE compounds in subsurface soil and bedrock in the Interim Site-Wide ROD (2001).** **Closed HE surface impoundments (2005).**	**Monitoring.** **Exposure control through risk and hazard management.** **Monitored natural attenuation of nitrate in ground water.** **Continued ground water extraction and treatment of VOCs at the leading edge of the TCE plume, VOCs, HE compounds, perchlorate from the Building 815 and HE rinsewater lagoons, and VOCs, nitrate, and perchlorate from the HE Burn Pit.**

Table 2.4-1. Overall site cleanup plan for LLNL Site 300. (Continued)

Area	Past and ongoing responses	Responses proposed in this Site-Wide ROD
Building 850 Firing Tab1e	**Removed/replaced contaminated gravel from Building 850 Firing Table (1988).** **Removed PCB-contaminated debris from vicinity of Building 850 Firing Table (1998).**	**Monitoring.** **Exposure control through risk and hazard management.** **Monitored natural attenuation of tritium in ground water.**
Pit 7 Complex	**Capped Pits 4 and 7 under Resource Conservation and Recovery Act (1992).** **Installed an engineered drainage diversion system (2008).** **Ongoing ground water extraction and treatment (since 2008).**	**Monitoring.** **Exposure control through risk and hazard management.** **Monitored natural attenuation of tritium in ground water.** **Continue ground water extraction and treatment of uranium, VOCs, perchlorate, and nitrate.** **Installation, operation and maintenance of an engineered drainage diversion system.** **Inspection and maintenance of the landfill cap/cover.**
Building 854 OU	**Excavated TCE-contaminated soil at Buildings 854H and 854F (1983).** **Ongoing ground water extraction and treatment (since 1999).** **No further action remedy selected for metals, HMX and tritium in surface soil in the Interim Site-Wide ROD (2001).** **Ongoing soil vapor extraction and treatment (since 2005).** **Excavated PCB and dioxin and furan compound-contaminated soil at the Building 855 Lagoon (2005).**	**Monitoring.** **Exposure control through risk and hazard management.** **Continued ground water extraction and treatment of VOCs, perchlorate, and nitrate.** **Continued soil vapor extraction and treatment of VOCs.**

Table 2.4-1. Overall site cleanup plan for LLNL Site 300. (Continued)

Area	Past and ongoing responses	Responses proposed in this Site-Wide ROD
Building 832 Canyon OU	**Ongoing ground water extraction and treatment (since 1999).** **Ongoing soil vapor extraction and treatment (since 1999).** **Downgradient ground water extraction using siphon with *ex situ* treatment of VOCs by iron filings (2000).** **No further action remedy selected for HMX in surface soil and nitrate in subsurface soil and bedrock at Building 830, and HMX and nitrate in subsurface soil and bedrock at Building 832 in the Interim Site-Wide ROD (2001).**	**Monitoring.** **Exposure control through risk and hazard management.** **Monitored natural attenuation of nitrate in ground water.** **Continued ground water extraction and treatment of VOCs and perchlorate.** **Continued soil vapor extraction and treatment of VOCs.**
Building 801 Dry Well and Pit 8 Landfill	**Sealed Dry Well 801D (1981).** **Removed/replaced firing table gravel periodically since 1988.** **No further action remedy selected for VOCs in subsurface soil at the Building 801 Dry Well in the Interim Site-Wide ROD (2001).**	**Monitoring.** **Institutional/land use controls.** **Inspection and maintenance of the landfill cover.**
Building 833	**None.**	**Monitoring.** **Exposure control through risk and hazard management.**
Building 845 Firing Table and Pit 9 Landfill	**Removed/replaced firing table gravel periodically since 1988.** **No further action remedy selected for HMX and uranium in subsurface soil and bedrock in the Interim Site-Wide ROD (2001).**	**Monitoring.** **Institutional/land use controls.** **Inspection and maintenance of the landfill cover.**
Building 851 Firing Table	**Removed/replaced firing table gravel periodically since 1988.** **No further action remedy selected for VOCs and uranium in subsurface soil and bedrock and for RDX and metals in surface soil in the Interim Site-Wide ROD (2001).**	**Monitoring.** **Institutional/land use controls.**

Table 2.4-1. Overall site cleanup plan for LLNL Site 300. (Continued)

Area	Past and ongoing responses	Responses proposed in this Site-Wide ROD
Pit 2 Landfill	Landfill covered (1960).	Monitoring. Institutional/land use controls.

Notes:

GSA = General Services Area.
HE = High Explosives.
HMX = High Melting Explosive.
LLNL = Lawrence Livermore National Laboratory.
OU = Operable Unit.
PCBs = Polychlorinated biphenyls.
RDX = Research Department Explosive.
ROD = Record of Decision.
TCE = Trichloroethylene.
VOCs = Volatile Organic Compounds.

Table 2.5-1. Contaminants of concern in surface soil at Site 300.

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in mg/kg unless otherwise indicated)
Building 834 (OU 2)		
	None	NA
Pit 6 Landfill (OU 3)		
	None	NA
HE Process Area (OU 4)		
	HMX	24 (1998)
	RDX	0.18 (1987)
Building 850 Firing Table (OU 5)		
	Beryllium	15 (1989)
	Cadmium	8.6 (1989)
	Copper	1,000 (1989)
	HMX	2.4 (1994)
	PCB 1254	180 (1994)
	1,2,3,4,6,7,8 HpCDD	6×10^{-5} (1994)
	1,2,3,4,6,7,8-HpCDF	6.4×10^{-4} (1994)
	1,2,3,4,7,8,9-HpCDF	2×10^{-4} (1994)
	1,2,3,4,7,8-HxCDD	8.6×10^{-7} (1994)
	1,2,3,4,7,8-HxCDF	2.3×10^{-3} (1994)
	1,2,3,6,7,8-HxCDD	3.7×10^{-6} (1994)
	1,2,3,6,7,8-HxCDF	2.1×10^{-3} (1994)
	1,2,3,7,8,9-HxCDD	2.4×10^{-6} (1994)
	1,2,3,7,8,9-HxCDF	2.5×10^{-4} (1994)
	1,2,3,7,8 PeCDF	2.6×10^{-3} (1994)
	2,3,4,6,7,8-HxCDF	7.5×10^{-4} (1994)
	2,3,4,7,8-PeCDF	9.1×10^{-3} (1994)
	2,3,7,8-TCDD	1.4×10^{-6} (1994)
	2,3,7,8-TCDF	9.6×10^{-3} (1994)
	Other HpCDFs	1.3×10^{-3} (1994)
	Other HpCDDs	1×10^{-4} (1994)
	Other HxCDFs	1.1×10^{-2} (1994)
	Other HxCDDs	2×10^{-5} (1994)
	OcCDFs	1.1×10^{-4} (1994)
	OcCDDs	5.5×10^{-4} (1994)
	Other PeCDFs	5.7×10^{-2} (1994)
	TCDFs	4.8×10^{-2} (1994)
	Other TCDDs	4.3×10^{-6} (1994)
	Uranium-238	24.8 pCi/g (1994)
Pit 7 Complex (OU 5)		
	None	NA

Table 2.5-1. Contaminants of concern in surface soil at Site 300. (Continued)

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in mg/kg unless otherwise indicated)
Building 854 (OU 6)		
	Lead	98 (1995)
	Zinc	1,400 (1995)
	HMX	150 (1995)
	PCB 1242	34 (1995)
	PCB 1248	59 (2003)
	Tritium	317 pCi/L_{sm} (1996)
Building 832 Canyon (OU 7)		
	HMX	0.2 mg/kg (1994)
Building 801 Dry Well and the Pit 8 Landfill (OU 8)		
	None	NA
Building 833 Area (OU 8)		
	None	NA
Building 845 Firing Table and the Pit 9 Landfill (OU 8)		
	None	NA
Building 851 Firing Table (OU 8)		
	Cadmium	9 (1989)
	Copper	79 (1989)
	Zinc	360 (1989)
	RDX	0.131 (1991)
	Uranium-238	14.1 pCi/g (1989)
Pit 2 Landfill (OU 8)		
	None	NA

Notes:

DD = Dibenzodioxin.

DF = Dibenzofuran.

HMX = High melting explosive.

HpC = Heptachlorinated.

HxC = Hexachlorinated.

mg/kg = Milligrams per kilograms

NA = Not applicable.

OcC = Octachlorinated.

OU = Operable Unit.

PCB = Polychlorinated biphenyl.

pCi/g= PicoCuries per gram.

pCi/L_{sm}= PicoCuries per liter soil moisture.

PeC = Pentachlorinated.

RDX = Research department explosive.

TC = Tetrachlorinated.

Table 2.5-2. Contaminants of concern in subsurface soil at Site 300.

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in mg/kg unless otherwise indicated)
Building 834 (OU 2)		
	PCE	2.3 (2000)
	TCE	970 (1986)
	Toluene	0.052 (1988)
Pit 6 Landfill (OU 3)		
	None	NA
HE Process Area (OU 4)		
	Benzene	0.9 (1986)
	Chloroform	0.4 (1986)
	cis-1,2-DCE	0.026 (1990)
	Ethylbenzene	0.0006 (1988)
	Freon 113	0.0031 (1987)
	Freon 12	0.0024 (1991)
	Methylene chloride	0.013 (1987)
	PCE	0.0034 (1989)
	Toluene	0.003 (1990)
	TCE	33 (1987)
	Total xylenes	0.021 (1987)
	HMX	28 (1998)
	RDX	18 (1998)
Building 850 Firing Table (OU 5)		
	Tritium	11,000,000[a] pCi/L_{sm} (1988)
	Uranium-238	28.2 pCi/g (1989)
Pit 7 Complex (OU 5)		
	Tritium	8,089,000 pCi/L_{sm} (1984)
	Uranium-238	210 pCi/g (1999)
Building 854 (OU 6)		
	TCE	30.7[b] (1983)
Building 832 Canyon (OU 7)		
	Freon 113	0.0016 (1996)
	Methylene chloride	0.099 (2001)
	TCE	6.3 (1983)
	HMX	0.2 (1994)
	Nitrate	35 (1999)
Building 801 Dry Well and the Pit 8 Landfill (OU 8)		
	TCE	0.057 (1989)
Building 833 Area (OU 8)		
	TCE	1.5 (1991)

Table 2.5-2. Contaminants of concern in subsurface soil at Site 300. (Continued)

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in mg/kg unless otherwise indicated)
Building 845 Firing Table and the Pit 9 Landfill (OU 8)		
	HMX	0.054 (1988)
	Uranium-238	1.2 pCi/g (1988)
Building 851 Firing Table (OU 8)		
	cis-1,2-DCE	0.012 (1990)
	TCE	0.0003 (1990)
	Uranium-238	11 pCi/g (1990)
Pit 2 Landfill (OU 8)		
	None	NA

Notes:

DCE = Dichloroethylene.
HMX = High melting explosive.
mg/kg= Milligrams per kilograms
NA = Not applicable.
OU = Operable Unit.
PCB = Polychlorinated biphenyl.
PCE = Tetrachloroethylene.
pCi/g= PicoCuries per gram.
pCi/L_{sm}= PicoCuries per liter soil moisture.
RDX = Research department explosive.
TCE = Trichloroethylene.

[a] Soil with 11,000,000 pCi/L_{sm} removed with firing table gravel (Lamarre and Taffet, 1998).

[b] Soil with a reported maximum of 1,000 mg/kg was excavated.

Table 2.5-3. Contaminants of concern in surface water at Site 300.

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in μg/L unless otherwise indicated)	Most recent concentration[a] (in μg/L unless otherwise indicated)
Building 834 (OU 2)			
	None	NA	NA
Pit 6 Landfill (OU 3)			
Spring 7 (BC6-13)	cis-1,2-DCE	12 (1990)	1 (2000)[a]
	trans-1,2-DCE	33 (1990)	1 (2000)[a]
	PCE	1.4 (1988)	<0.5 (2000)[a]
	TCE	110 (1988)	2 (2000)[a]
HE Process Area (OU 4)			
Spring 5 (W-817-03A)	cis-1,2-DCE	3.3 (1993)	<0.5 (2007)
	TCE	150 (1987)	42 (2007)
Building 850 Firing Table (OU 5)			
Well 8 Spring	Tritium	770,000 pCi/L (1972)	17,000 pCi/L (2006)
Pit 7 Complex (OU 5)			
	None	NA	NA
Building 854 (OU 6)			
	None	NA	NA
Building 832 Canyon (OU 7)			
Spring 3	TCE	200 (1985)	31 (2007)
Building 801 Dry Well and the Pit 8 Landfill (OU 8)			
	None	NA	NA
Building 833 Area (OU 8)			
	None	NA	NA
Building 845 Firing Table and the Pit 9 Landfill (OU 8)			
	None	NA	NA
Building 851 Firing Table (OU 8)			
	None	NA	NA
Pit 2 Landfill (OU 8)			
	None	NA	NA

Notes:

DCE = Dichloroethylene.
NA = Not applicable.
OU = Operable Unit.
PCE = Tetrachloroethylene.
TCE = Trichloroethylene.
pCi/L = PicoCuries per liter.
μg/L = Micrograms per liter.

[a] Spring 7 and well BC6-13 have been dry since 2000.

Table 2.5-4. Contaminants of concern in ground water at Site 300.

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in μg/L unless otherwise indicated)	Most recent concentration[a] (in μg/L unless otherwise indicated)
Building 834 (OU 2)			
	Chloroform	950 (1989)	2
	cis-1,2-DCE	540,000 (1990)	5,200
	PCE	10,000 (1993)	1,200
	1,1,1-TCA	33,000[b] (1991)	<0.5
	TCE	800,000 (1993)	230,000
	TBOS/TKEBs	7,300,000 (1995)	19,000
	Nitrate (as NO_3)	749 mg/L (1997)	280 mg/L
Pit 6 Landfill (OU 3)			
	Chloroform	14 (1994)	<0.5
	1,2-DCA	1.7 (1991)	<0.5
	cis-1,2-DCE	12 (1990)	2.4
	trans-1,2-DCE	33 (1990)	<0.5
	PCE	3.2 (1988)	1.4
	1,1,1-TCA	13 (1990)	<0.5
	TCE	250 (1988)	7.7
	Tritium	2,520 pCi/L (1999)	444 pCi/L
	Nitrate (as NO_3)	228 mg/L (1998)	220 mg/L
	Perchlorate	65.2 (1998)	6.6
HE Process Area (OU 4)			
Building 815	Chloroform	5.8 (1992)	2.1
	1,1-DCE	4.7 (1998)	1.7
	cis-1,2-DCE	3.3 (1993)	1.4
	TCE	450 (1992)	57
HE Lagoons	RDX	350 (1998)	69
	HMX	67[c] (1998)	14
	4-Amino-2,6-dinitrotoluene	24 (1997)	7.69 (2005)
	Nitrate (NO_3)	370 mg/L (1999)	140 mg/L
	Perchlorate	50 (1998)	35
HE Burn Pit	cis-1,2-DCE	12 (1993)	<1
	TCE	1,000 (1993)	1.8
	Nitrate (as NO_3)	240 mg/L (2000)	26 mg/L
	Perchlorate	29 (2000)	8.8 (2006)

Table 2.5-4. Contaminants of concern in ground water at Site 300. (Continued)

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in μg/L unless otherwise indicated)	Most recent concentration[a] (in μg/L unless otherwise indicated)
Building 850 Firing Table (OU 5)			
	Nitrate (as NO_3)	140 mg/L (1995)	88 mg/L
	Perchlorate	75.2 (2005)	71
	Tritium	566,000 pCi/L (1985)	28,400 pCi/L
	Uranium-238	18.4 pCi/L (1996)	2.87 pCi/L
Pit 7 Complex (OU 5)			
	1,1-DCE	11 (1985)	0.72
	TCE	15 (1995)	2.5
	Tritium	2,660,000 pCi/L (1998)	293,000 pCi/L
	Uranium	781 pCi/L (1998)	130 pCi/L
	Nitrate (as NO_3)	363 mg/L (2003)	69 mg/L
	Perchlorate	29 (2005)	15
Building 854 (OU 6)			
	TCE	2,900 (1997)	150
	Nitrate (as NO_3)	260 mg/L (2006)	260 mg/L
	Perchlorate	30 (2006)	20
Building 832 Canyon (OU 7)			
Building 830[d]	Chloroform	30 (1986)	1.7
	cis-1,2-DCE	1.4 (1998)	30
	PCE	20 (2006)	13
	TCE	30,000 (1997)	5,700
	Nitrate (as NO_3)	501 mg/L (1998)	150 mg/L
	Perchlorate	51 (1998)	6.8
Building 832	cis-1,2-DCE	72 (2005)	3.8
	TCE	1,800 (1998)	590
	Nitrate (as NO_3)	177 mg/L (1998)	140 mg/L
	Perchlorate	17 (1999)	22
Building 801 Dry Well and the Pit 8 Landfill (OU 8)			
	Chloroform	2.4 (1992)	<0.5
	1,2-DCA	5 (1990)	<0.5
	TCE	6 (1988)	1.9
	Nitrate (as NO_3)	64 mg/L (2002)	32 mg/L
	Perchlorate	5 μg/L (2003)	<4
Building 833 Area (OU 8)			
	cis-1,2-DCE	58 (1993)	<0.5
	TCE	2,100 (1992)	10

Table 2.5-4. Contaminants of concern in ground water at Site 300. (Continued)

Operable unit (OU)	Contaminant of concern	Historical maximum concentration (in μg/L unless otherwise indicated)	Most recent concentration[a] (in μg/L unless otherwise indicated)
Building 845 Firing Table and the Pit 9 Landfill (OU 8)			
	None	**NA**	**NA**
Building 851 Firing Table (OU 8)			
	Uranium-238	**1.3 pCi/L (1990)**	**0.21 pCi/L (2006)**
Pit 2 Landfill (OU 8)			
	Nitrate (as NO_3)	**186 mg/L (1993)**	**29 mg/L**

Notes:

DCA = **Dichloroethane.**
DCE = **Dichloroethylene.**
HMX = **High melting explosive.**
NA = **Not applicable.**
mg/L = **Milligrams per liter.**
OU = **Operable Unit.**
PCE = **Tetrachloroethylene.**
RDX = **Research department explosive.**
TCA = **Trichloroethane.**
TCE = **Trichloroethylene.**
TBOS/TKEBs = **Tetrabutyl orthosilicate/tetrakis (2-ethylbutyl) silane.**
pCi/L = **PicoCuries per liter.**
µg/L = **Micrograms per liter.**

[a] **Most recent concentration is the maximum concentration detected during the first semester of 2007 unless noted.**

[b] **Extreme outlier; not consistent with other data.**

[c] **Duplicate sample was <5 μg/L. Next highest historical concentration was 58 μg/L in 1993.**

[d] **Acetone was identified as a COC for the Building 830 area in the Interim Record of Decision because an adequate sampling history was not available. Acetone has been below the analytical reporting limit in thirty-three samples collected since the only detection of acetone in 1996 confirming it is not a COC.**

Table 2.7-1. Summary of human health risks and hazards.

Exposure media	Exposure pathway	Baseline Risk Assessment Risk/HI
Building 834 Operable Unit (OU 2)		
Volatilization of VOCs from subsurface soil	Inhalation inside Building 834D	1×10^{-3}/36
Volatilization of VOCs from subsurface soil	Inhalation outside Building 834D	6×10^{-4}/22; Risk/HI are currently below 10^{-6}/1[a]
Pit 6 Landfill Operable Unit (OU 3)		
Volatilization of VOCs from subsurface soil	Inhalation at Pit 6 Landfill	5×10^{-6}/<1; Risk/HI are currently below 10^{-6}/1[b]
Volatilization of VOCs from surface water	Inhalation at Spring 7	4×10^{-5}/1.5
Volatilization of VOCs from surface water	Inhalation at SVRA pond[c]	3×10^{-6}/<1
High Explosives Process Area Operable Unit (OU 4)		
Volatilization of VOCs from subsurface soil	Inhalation outside Building 815	5×10^{-6}/<1; Risk/HI are currently below 10^{-6}/1[a]
Volatilization of VOCs from surface water	Inhalation at Spring 5	1×10^{-5}/<1
VOCs and RDX in ground water	Ingestion at hypothetical well at site boundary[c]	1×10^{-5}/<1
Building 850 Firing Table (OU 5)		
PCBs in surface soil	Inhalation, ingestion, and dermal contact	5×10^{-4}/NC
Dioxins and furans in surface soil	Inhalation, ingestion, and dermal contact	1×10^{-4}/NC
Volatilization of tritium from surface water	Inhalation at Well 8 Spring	1×10^{-3}/NC
Pit 7 Complex (OU 5)		
Volatilization of tritium from subsurface soil	Inhalation at the Pit 3 Landfill	4×10^{-6}/NC; Risk/HI are currently below 10^{-6}/1[d]

Table 2.7-1. Summary of human health risks and hazards. (Continued)

Exposure media	Exposure pathway	Baseline Risk Assessment Risk/HI
Building 854 Operable Unit (OU 6)		
Volatilization of VOCs from subsurface soil	**Inhalation inside Building 854F**	**9×10^{-6}/NC; Risk/HI are currently below 10^{-6}/1[a]**
Volatilization of VOCs from subsurface soil	**Inhalation outside Building 854F**	**1×10^{-5}/NC; Risk/HI are currently below 10^{-6}/1[a]**
PCBs in surface soil	**Inhalation, ingestion, and dermal contact in the Building 855 Lagoon**	**7×10^{-5}/NC; Risk/HI are currently below 10^{-6}/1[e]**
Volatilization of VOCs from subsurface soil	**Inhalation inside Building 854A**	**6×10^{-6}/NC; Risk/HI are currently below 10^{-6}/1[a]**
Building 832 Canyon Operable Unit (OU 7)		
Volatilization of VOCs from subsurface soil	**Inhalation outside Building 830**	**1×10^{-5}/NC; Risk/HI are currently below 10^{-6}/1[a]**
Volatilization of VOCs from subsurface soil	**Inhalation inside Building 830**	**3×10^{-6}/NC**
Volatilization of VOCs from subsurface soil	**Inhalation inside Building 832F**	**3×10^{-6}/NC; Risk/HI are currently below 10^{-6}/1[a]**
Volatilization of VOCs from surface water	**Inhalation at Spring 3**	**7×10^{-5}/2.3**
Building 833 (OU 8)[f]		
Volatilization of VOCs from subsurface soil	**Inhalation inside Building 833**	**1×10^{-6}/<1**

Notes appear on the following page.

Table 2.7-1. Summary of human health risks and hazards. (Continued)

Notes:

HE = **High Explosives.**

HI = **Hazard Index.**

NC = **Not calculated.**

OU = **Operable Unit.**

PCBs = **Polychlorinated biphenyls.**

SVRA = **State Vehicle Recreation Area.**

VOCs = **Volatile Organic Compounds.**

[a] **Risk and hazard associated with volatile contaminants in the subsurface migrating upward into indoor and outdoor ambient air is re-evaluated annually using current data and reported in the Compliance Monitoring Reports. The risk and hazard management is complete for a building when the estimated risk is below 10^{-6} and the hazard index is below 1 for two consecutive years.**

[b] **Risk was mitigated through the installation of an engineered landfill cap in 1997.**

[c] **Risk was estimated using fate and transport modeling of maximum VOC concentrations in 1991 to receptor point assuming no remediation or natural attenuation occurred.**

[d] **Risk re-evaluation, based on tritium decay between 1992 and 2007 indicates the estimated risk was below 10^{-6}.**

[e] **Risk was mitigated through excavation and disposal of contaminated soil in 2005.**

[f] **No human health risks or hazards were identified in the other OU 8 release sites.**

Table 2.7-2. Summary of ecological hazards.

Potential Ecological Hazard[a]	Baseline Hazard Index	Current Hazard Index	Comments
Building 834 Operable Unit (OU 2)			
VOCs in burrow air			**Surveys found no impact to deer or ground squirrel, and found no evidence of kit fox in area; initial hazard index based on limited data, additional sampling showed no contaminant exposure resulting in current hazard index <1.**
Individual ground squirrels and kit fox	**>1**	**<1**	
Cadmium in surface soil			
Individual ground squirrels, deer and kit fox	**>1**	**<1**	
Pit 6 Landfill Operable Unit (OU 3)			
VOCs in burrow air			**Surveys found no impact to ground squirrel, populations, and found no evidence of kit fox in area; initial hazard index based on limited data, additional sampling showed no contaminant exposure resulting in current hazard index <1.**
Individual ground squirrels and kit fox	**>1**	**<1**	
High Explosives Process Area Operable Unit (OU 4)			
Cadmium in surface soil			**Surveys found no impact to deer or ground squirrel populations.**
Individual ground squirrels and deer	**>1**	**<1**	
Building 850 Firing Table (OU 5)			
PCBs/dioxins/furans in surface soil			**Individual animals potentially at risk due to bioaccumulate potential; surveys found no impact to deer or ground squirrel populations, no evidence of kit fox in the areas, however burrowing owls are present and area is within tiger salamander range; remedial alternatives are under evaluation.**
Individual ground squirrels, deer and kit fox	**NC**	**Exposure still present**	
Cadmium			
Individual ground squirrels, and deer	**>1**	**>1**	**Surveys found no impact to deer or ground squirrel populations and no evidence of kit fox in area; new hazard index determined for burrowing owl.**
Building 854 Operable Unit (OU 6)			
PCBs/dioxins/furans in surface soil			**Contaminated soil removed, exposure eliminated.**
Individual ground squirrels, deer and kit fox	**NC**	**NA**	

Table 2.7-2. Summary of ecological hazards. (Continued)

Potential Ecological Hazard[a]	Baseline Hazard Index	Current Hazard Index	Comments
Building 801 Dry Well and Pit 8 Landfill (OU 8)			
Cadmium in surface soil			**Surveys found no impact to deer or ground squirrel populations.**
Individual ground squirrels and deer	**>1**	**>1**	
Building 851 Firing Table (OU 8)			
Cadmium in surface soil			
Individual ground squirrels and deer	**>1**	**>1**	**Surveys found no impact to deer or ground squirrel populations.**

Notes:

HE = **High Explosives.**

NA = **Not applicable.**

NC = **Not calculated.**

OU = **Operable Unit.**

PCBs = **Polychlorinated biphenyls.**

VOCs = **Volatile Organic Compounds.**

[a] **No ecological hazards were identified for the Building 832 Canyon OU, Pit 7 Complex, or the other OU 8 release sites.**

Table 2.9-1. Description of the selected remedy for Building 834 Operable Unit (Alternative 2).

Element	Scope
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor and extraction wells.** • **Report results in the semiannual Compliance Monitoring Reports.**
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-14 for the Building 834 Operable Unit.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Continue to implement the risk and hazard monitoring and assessment program[a]:** 1. **Estimate risk for indoor ambient air annually for VOCs in Building 834D; until risk <10^{-6} and HI <1 for at least 2 years;** 2. **Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and** 3. **Review these data to evaluate compliance with RAOs.**
Ground water and soil vapor extraction and treatment	• **Continue to simultaneously extract ground water and soil vapor from extraction wells.** • **Continue to treat extracted ground water and soil vapor using the existing system. Ground water will be treated using aqueous-phase GAC to treat VOCs, floating hydrocarbon devices to remove floating TBOS or diesel, and phytoremediation to treat nitrate.** • **Continue to treat extracted soil vapor using vapor-phase GAC.** • **Discharge effluent using the existing misting system.** • **Dispose spent GAC and hydrocarbon devices offsite.** • **Continue evaluating innovative technologies to expedite cleanup of VOCs in low-permeability sediments.**

Notes:

GAC = Granular activated carbon.

HI = Hazard index.

RAOs = Remedial Action Objectives.

TBOS = Tetrabutyl orthosilicate.

VOCs = Volatile organic compounds.

[a] **The risk and hazard management program for the Building 834 Operable Unit is contained in the Site-Wide Compliance Monitoring Plan (2002).**

Table 2.9-2. Description of the selected remedy for the Pit 6 Landfill Operable Unit (Alternative 2).

Element	Scope
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor wells.** • **Sample and analyze surface water from two springs (Spring 7 at well BC6-13).** • **Report results in the semiannual Compliance Monitoring Reports.**
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-15 for the Pit 6 Landfill Operable Unit.** • **Review land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Inspect the Pit 6 Landfill cover periodically for damage that could compromise the integrity and repair any damage found.** • **Continue to implement the risk and hazard monitoring and assessment program[a]:** 1. **Sample outdoor ambient air annually for VOCs near Spring 7 when surface water is present; until risk $<10^{-6}$ for at least 2 years;** 2. **Integrate new data into risk assessment calculations to determine any changes in risks and hazards; and** 3. **Review these data to evaluate compliance with RAOs.**
Monitored natural attenuation of VOCs and tritium	• **Continue to monitor VOCs and tritium in ground water to track the spatial distribution of these COCs over time and evaluate the effectiveness of natural attenuation in reducing the concentrations of these COCs to meet RAOs, ARARs, and cleanup standards.**

Notes:

ARARs = Applicable or relevant and appropriate requirements.

COCs = Contaminants of concern.

RAOs = Remedial Action Objectives.

VOCs = Volatile organic compounds.

[a] The risk and hazard management program for the Pit 6 Landfill Operable Unit is contained in the Site-Wide Compliance Monitoring Plan (2002).

Table 2.9-3. Description of the selected remedy for the High Explosives Process Area Operable Unit (Alternative 2).

Element	Scope
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor and extraction wells.** • **Sample and analyze surface water from Spring 5 at well W-817-03A.** • **Report results in the semiannual Compliance Monitoring Reports.**
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-16 for the High Explosives Process Area Operable Unit.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Continue to implement the risk and hazard monitoring and assessment program[a]:** 1. **Sample outdoor ambient air annually for VOCs near Spring 5 when surface water is present; until risk <10^{-6} for at least 2 years;** 2. **Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and** 3. **Review these data to evaluate compliance with RAOs.**
Monitored natural attenuation of nitrate	• **Continue to monitor nitrate in ground water to track its spatial distribution and evaluate the effectiveness of natural attenuation in reducing the nitrate concentrations to meet RAOs, ARARs, and cleanup standards.** • **Develop contingency criteria for determining whether a more active remediation is necessary to address nitrate.**
Ground water extraction and treatment	• **Continue to extract ground water from ground water extraction wells.** • **Continue to treat extracted ground water using the existing six systems. Ground water will be treated using aqueous-phase GAC to remove VOCs and HE compounds, and ion-exchange to remove perchlorate.** • **Continue to treat extracted ground water at the Building 829-Source area using a biotreatment unit to remove nitrate.** • **Inject treated effluent into injection wells or infiltration trench.** • **Dispose spent GAC and ion-exchange resin offsite.**

Notes:

ARARs = Applicable or relevant and appropriate requirements.

GAC = Granular activated carbon.

HE = High explosives.

RAOs = Remedial Action Objectives.

VOCs = Volatile organic compounds.

[a] **The risk and hazard management program for the HE Process Area Operable Unit is contained in the Site-Wide Compliance Monitoring Plan (2002).**

Table 2.9-4. Description of the selected remedy for Building 850 Firing Table (Alternative 2).

Element	Scope
Monitoring	• **Sample and analyze ground water and measure water levels wells.** • **Sample and analyze surface water at Well 8 Spring.** • **Evaluate ground water sampling data to evaluate any changes in nitrate concentrations that could adversely affect human health and the environment and the efficacy of the monitoring-only remedy for nitrate.** • **Report results in the semiannual Compliance Monitoring Reports.**
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-17 for the Building 850 Firing Table.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Implement the risk and hazard monitoring and assessment program:** 1. **Estimate risk for ambient air annually for tritium near Well 8 Spring, until risk is <10^{-6} for at least two years;** 2. **Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and** 1. **Review these data to evaluate compliance with RAOs.**
Monitored natural attenuation of tritium	• **Continue to monitor tritium in ground water to track its spatial distribution over time and evaluate the effectiveness of natural attenuation in reducing tritium activities to meet RAOs, ARARs, and cleanup standards.**

Notes:

ARARs = Applicable or relevant and appropriate requirements.

PCBs = Polychlorinated biphenyl.

RAOs = Remedial Action Objectives.

ARARs = Applicable or relevant and appropriate requirements.

Table 2.9-5. Description of the selected remedy for the Pit 7 Complex (Alternative 2).

Element	Scope
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor and extraction wells.** • **Sample and analyze surface water from Spring 24.** • **Report results in the semiannual Compliance Monitoring Reports.**
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-18 for the Pit 7 Complex.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Inspect the Pit 7 Landfill covers periodically for damage that could compromise the integrity and repair any damage found.**
Monitored natural attenuation of tritium	• **Continue to monitor tritium in ground water to track its spatial distribution over time and evaluate the effectiveness of natural attenuation in reducing tritium activities to meet RAOs, ARARs, and cleanup standards.** • **Develop contingency criteria for determining whether a more active remediation is necessary to address tritium.**
Source control by installing a drainage diversion system	• **Install a drainage diversion system on the eastern and western valley hillslopes to prevent ground water from rising into the landfills and underlying contaminated bedrock and releasing further contamination to ground water.**
Ground water extraction and treatment of VOCs, uranium, nitrate, and perchlorate	• **Extract ground water from ground water extraction wells.** • **Treat extracted ground water using aqueous-phase GAC to remove VOCs and ion-exchange resins to remove uranium, nitrate, and perchlorate.** • **Inject treated effluent into an infiltration trench.** • **Dispose spent GAC and ion-exchange resin offsite.**

Notes:

ARARs = Applicable or relevant and appropriate requirements.

RAOs = Remedial Action Objectives.

Qal/WBR = Quaternary alluvium and weathered bedrock.

$Tnbs_0$ = Neroly silty sandstone.

Remediation-specific details, such as the number and location of extraction wells used for pump-and-treat, and actual site- and technology-specific details will be based on additional data and design criteria presented in Remedial Design document.

Table 2.9-6. Description of the selected remedy for Building 854 Operable Unit (Alternative 2).

Element	Scope
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor and extraction wells.** • **Report results in the semiannual Compliance Monitoring Reports.**
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-19 for the Building 854 Operable Unit.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.**
Ground water and soil vapor extraction and treatment	• **Continue to extract ground water and soil vapor from extraction wells.** • **Continue to treat extracted ground water and soil vapor using the existing four systems. Ground water will be treated using aqueous-phase GAC to remove VOCs, ion-exchange to remove perchlorate, and bioremediation or phytoremediation to remove nitrate.** • **Continue to treat extracted soil vapor using vapor-phase GAC to remove VOCs.** • **Discharge effluent using the existing misting system or infiltration trench.** • **Dispose spent GAC and ion-exchange resin offsite.**

Notes:

GAC = Granular activated carbon.

RAOs = Remedial Action Objectives.

VOCs = Volatile organic compounds.

Table 2.9-7. Description of the selected remedy for the Building 832 Canyon Operable Unit (Alternative 2).

Element	Scope
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor and extraction wells.** • **Sample and analyze surface water from Spring 3.** • **Report results in the semiannual Compliance Monitoring Reports.**
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-20 for the Building 832 Canyon Operable Unit.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Continue to implement the risk and hazard monitoring and assessment program[a]:** 1. **Estimate risk for indoor ambient air annually for VOCs in Building 830, until risk is <10^{-6} and HI <1 for at least two years;** 2. **Sample outdoor ambient air annually for VOCs near Spring 3 when surface water is present, until risk is <10^{-6} for at least two years;** 3. **Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and** 4. **Review these data to evaluate compliance with RAOs.**
Monitored natural attenuation of nitrate	• **Continue to monitor nitrate in ground water to track its spatial distribution and evaluate the effectiveness of natural attenuation in reducing the nitrate concentrations to meet RAOs, ARARs, and cleanup standards.** • **Develop contingency criteria for determining whether a more active remediation is necessary to address nitrate.**
Ground water and soil vapor extraction and treatment	• **Continue to extract ground water and soil vapor from extraction wells.** • **Continue to treat extracted ground water and soil vapor using the existing five systems. Ground water will be treated using aqueous-phase GAC to remove VOCs and ion-exchange to remove perchlorate.** • **Continue to treat extracted soil vapor using vapor-phase GAC.** • **Inject effluent into injection wells, or use existing misting systems.** • **Dispose spent GAC and ion-exchange resin offsite.**

Notes:

ARARs = Applicable or relevant and appropriate requirements.

GAC = Granular activated carbon.

HI = Hazard index.

RAOs = Remedial Action Objectives.

VOCs = Volatile organic compounds.

[a] The risk and hazard management program for the Building 832 Canyon Operable Unit is contained in the Site-Wide Compliance Monitoring Plan (2002).

Table 2.9-8. Description of the selected remedy for Building 801 and the Pit 8 Landfill (Alternative 2).

Element	Scope
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-21 for the Operable Unit 8.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Inspect the Pit 8 Landfill cover periodically for damage that could compromise the integrity and repair any damage found.**
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor wells.** • **Report results in the semiannual Compliance Monitoring Reports.**

Table 2.9-9. Description of the selected remedy for Building 833 (Alternative 2).

Element	Scope
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor wells.** • **Report results in the semiannual Compliance Monitoring Reports.**
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-21 for the Operable Unit 8.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Continue to implement the risk and hazard monitoring and assessment program[a]:** 1. **Estimate risk for indoor ambient air annually for VOCs in Building 833, until risk is <10^{-6} and HI <1 for at least two years;** 2. **Integrate these data into risk assessment calculations to determine any changes in risks and hazards; and** 3. **Review these data to evaluate compliance with RAOs.**

Notes:

HI = Hazard index.

RAOs = Remedial Action Objectives.

VOCs = Volatile organic compounds.

[a] **The risk and hazard management program for Building 833 is contained in the Site-Wide Compliance Monitoring Plan (2002).**

Table 2.9-10. Description of the selected remedy for Building 845 and the Pit 9 Landfill (Alternative 2).

Element	Scope
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-21 for the Operable Unit 8.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Inspect the Pit 9 Landfill cover periodically for damage that could compromise the integrity and repair any damage found.**
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor wells.** • **Report results in the semiannual Compliance Monitoring Reports.**

Table 2.9-11. Description of the selected remedy for Building 851 (Alternative 2).

Element	Scope
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-21 for the Operable Unit 8.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.**
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor wells.** • **Report results in the semiannual Compliance Monitoring Reports.**

Table 2.9-12. Description of the selected remedy for the Pit 2 Landfill (Alternative 2).

Element	Scope
Risk and hazard management	• **Maintain institutional/land use controls specified in Table 2.9-21 for the Operable Unit 8.** • **Review facility and land use to evaluate changes in exposure pathway conditions that could affect the risk assessment assumptions and calculations.** • **Inspect the Pit 2 Landfill cover periodically for damage that could compromise the integrity and repair any damage found.**
Monitoring	• **Sample and analyze ground water and measure water levels in ground water monitor wells.** • **Report results in the semiannual Compliance Monitoring Reports.**

Table 2.9-13. Description of institutional/land use controls for the General Services Area Operable Unit.

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prevent water-supply use/consumption of contaminated ground water until ground water cleanup standards are met.	VOC concentrations in ground water exceeding cleanup standards.	**Central GSA:** There are no existing or planned water-supply wells in the Central GSA Operable Unit. Any proposed well drilling activities would be submitted to the LLNL Work Induction Board, and are reviewed by LLNL Environmental Restoration Department to ensure that new water-supply wells are not located in areas of ground water contamination. Existing offsite downgradient water-supply wells are monitored monthly for contaminants of concern in ground water that could potentially impact the wells. There is a Memorandum of Understanding with the owners of the offsite downgradient water-supply wells that includes point-of-use treatment if VOCs above MCLs are detected in the well. **Eastern GSA:** In 2006, VOC concentrations in Eastern GSA ground water have been reduced to below ground water cleanup standards (MCLs) through remediation, therefore this institutional/land use control is no longer needed.
Control excavation activities to prevent onsite worker exposure to VOCs in subsurface soil until it can be verified that concentrations do not pose an exposure risk to onsite workers.	Potential exposure to VOCs at depth in subsurface soil at the Building 875 dry well pad[a].	**Central GSA:** All proposed excavation activities must be cleared through the LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, LLNL Hazards Control ensures that hazards are adequately evaluated and the necessary controls are identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination. Controls for excavation activities will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. **Eastern GSA:** Institutional/land use controls are not necessary to prevent worker exposure to VOCs in surface and subsurface soil because concentrations are below the U.S. EPA's industrial and residential Preliminary Remediation Goals.

Table 2.9-13. Description of institutional/land use controls for the General Services Area Operable Unit. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain engineering controls to prevent onsite site worker inhalation exposure to VOCs inside Building 875 until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	A pre-remediation risk of 1×10^{-5} was identified for onsite workers from inhalation of VOCs volatilizing from subsurface soil into ambient air inside Building 875 (Central GSA).	**Central GSA:** Engineering controls (heating, ventilating, and air-conditioning system for Building 875) were implemented to prevent onsite worker exposure to VOCs that could migrate from the subsurface into the building until the inhalation risk was mitigated through remediation. The risk has been successfully reduced to less than 10^{-6} through ground water and soil vapor extraction and treatment in the Building 875 area as of 2000 (see Section 3.5), therefore this institutional/land use control is no longer needed. **Eastern GSA:** There is no risk or hazard associated with soil in the Eastern GSA.
Prohibit transfer of lands with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	Potential exposure to contaminated waste and/or environmental media.	The Site 300 Federal Facilities Agreement contains provisions that assure DOE will not transfer lands with unmitigated contamination that could cause potential harm. In the event that the Site 300 property is transferred in the future, DOE will 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 67391.1. Development will be restricted to industrial land usage. These restrictions will remain in place until and unless a risk assessment is performed in accordance with then current U.S. EPA risk assessment guidance and is agreed by the DOE, U.S. EPA, DTSC, and RWQCB as adequately showing no unacceptable risk for residential or unrestricted land use. These restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning document.

Notes:

DOE = United States Department of Energy.
DTSC = California Department of Toxic Substances Control.
GSA = General Services Area.
LLNL = Lawrence Livermore National Laboratory.
MCLs = Maximum Contaminant Levels.
RWQCB = California Regional Water Quality Control Board.
U.S. EPA = United States Environmental Protection Agency.
VOCs = Volatile organic compounds.

[a] **Risk for onsite worker exposure to VOCs at depth in subsurface soil could not be re-calculated as there are no new subsurface soil data. Land use controls based on the potential exposure to VOCs in subsurface soil during ground-breaking construction activities conservatively assume that the VOCs in subsurface soil may pose a risk to human health.**

Table 2.9-14. Description of institutional/land use controls for the Building 834 Operable Unit.

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prevent water-supply use/consumption of contaminated groundwater until ground water cleanup standards are met.	VOCs and nitrate concentrations in ground water exceeding drinking water standards.	There are no existing or planned water-supply wells in the Building 834 Operable Unit. Any proposed well drilling activities would be submitted to the LLNL Work Induction Board, and are reviewed by LLNL Environmental Restoration Department to ensure that new water-supply wells are not located in areas of ground water contamination. Prohibitions on drilling water-supply wells in areas of ground water contamination will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. Contamination is limited to onsite ground water and modeling indicates the plumes will not migrate offsite. Therefore, land use controls are not needed to prevent offsite water-supply use/consumption of contaminated ground water.
Control excavation activities to prevent onsite worker exposure to VOCs in subsurface soil until it can be verified that concentrations do not pose an exposure risk to onsite workers.	Potential exposure to VOCs at depth in subsurface soil at the Building 834 Complex[a].	All proposed excavation activities must be cleared through the LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, the LLNL Site 300 Hazards Control Department ensures that hazards are adequately evaluated and the necessary controls are identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination. Controls for excavation activities will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.
Maintain building occupancy restriction to prevent onsite worker inhalation exposure to VOCs inside Building 834D until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	A pre-remediation risk of 1×10^{-3} was identified for onsite workers from inhalation of VOCs volatilizing from subsurface soil into ambient air inside Building 834D.	Building 834 D is not currently occupied. Warning signs are in place and will be maintained prohibiting full time occupancy without notification and authorization by LLNL Site 300 Management. Any significant changes in activities conducted in Building 834D must be cleared through LLNL Work Induction Board. The Work Induction Board coordinates with the LLNL Environmental Restoration Division to identify if there is a potential for exposure to contaminants as a result of the proposed building usage. If a potential for contaminant exposure is identified as a result of the changes in building use, the LLNL Site 300 Hazards Control Department will be notified and determine any necessary engineered control requirements to prevent exposure. If full-

Table 2.9-14. Description of institutional/land use controls for the Building 834 Operable Unit. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Building occupancy restrictions *(continued)*		time building occupancy is proposed, engineering controls will be implemented to prevent onsite worker exposure that could migrate from the subsurface into the building until the inhalation risk was mitigated through remediation. This building occupancy restriction will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. DOE will conduct annual risk re-evaluations to determine when the tritium inhalation risk inside Building 834D has been mitigated. The risk re-evaluation results will be reported in the Annual Site-Wide Compliance Monitoring Reports. The baseline risk assessment also identified a pre-remediation risk of 6 x 10^{-4} for onsite workers continuously inhaling VOC vapors volatilizing from the vadose zone into outdoor air in the vicinity of Building 834D over a 25-year period. However this risk has been successfully mitigated through ground water and soil vapor extraction and treatment, therefore institutional/land use controls are no longer needed to prevent onsite worker exposure to VOCs in outdoor air.
Prohibit transfer of lands with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	Potential exposure to contaminated waste and/or environmental media.	The Site 300 Federal Facility Agreement contains provisions that assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. In the event that the Site 300 property is transferred in the future, DOE will 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 67391.1. Development will be restricted to industrial land usage. These restrictions will remain in place until and unless a risk assessment is performed in accordance with then current U.S. EPA risk assessment guidance and is agreed by the DOE, U.S. EPA, DTSC, and the RWQCB as adequately showing no unacceptable risk for residential or unrestricted land use. These restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning document.

Notes:

DOE = United States Department of Energy.
DTSC = California Department of Toxic Substances Control.
U.S. EPA = United States Environmental Protection Agency.
LLNL = Lawrence Livermore National Laboratory.
RWQCB = California Regional Water Quality Control Board.
VOCs = Volatile organic compounds.

[a] **Risk for onsite worker exposure to VOCs at depth in subsurface soil could not be re-calculated as there are no new subsurface soil data. Land use controls based on the potential exposure to VOCs in subsurface soil during ground-breaking construction activities conservatively assume that the VOCs in subsurface soil may pose a risk to human health.**

Table 2.9-15. Description of institutional/land use controls for the Pit 6 Landfill Operable Unit.

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prevent water-supply use/consumption of contaminated groundwater until ground water cleanup standards are met.	VOCs, and nitrate concentrations in ground water exceeding drinking water standards.	There are no existing or planned water-supply wells in the Pit 6 Landfill Operable Unit. Any proposed well drilling activities would be submitted to the LLNL Work Induction Board, and are reviewed by the LLNL Environmental Restoration Department to ensure that new water-supply wells are not located in areas of ground water contamination. Prohibitions on drilling water-supply wells in areas of ground water contamination will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. Contamination is limited to onsite ground water. TCE is present in only one well at a concentration slightly exceeding the drinking water standard; all other VOCs in ground water are below drinking water standards. Nitrate is detected at a concentration exceeding the drinking water standard in only one well. The elevated nitrate is likely due to septic system discharge rather than from the Pit 6 Landfill. Therefore, land use controls are not needed to prevent offsite water-supply use/consumption of contaminated ground water.
Maintain the integrity of landfill cap as long as the pit waste remains in place.	Potential exposure to contaminants in pit waste[a].	DOE will inspect and maintain the landfill cap, and ground water monitoring system. Landfill cap maintenance and inspection requirements are specified in post-closure plan for the Pit 6 Landfill.
Control construction and other ground-breaking activities on the Pit 6 Landfill to prevent cap/cover damage and/or inadvertent exposure to pit waste as long as the pit waste remains in place.	Potential exposure to contaminants in pit waste[a].	All proposed ground-breaking construction activities must be cleared through LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, the LLNL Hazards Control ensures that hazards are adequately evaluated and necessary controls identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination. Controls for construction and other ground-breaking activities will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.

Table 2.9-15. Description of institutional/land use controls for the Pit 6 Landfill Operable Unit. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain access restrictions to prevent inadvertent exposure of onsite workers to the pit waste as long as the waste in the Pit 6 Complex Landfill remains in place.	Potential exposure to contaminants in pit waste[a].	Signage is in place and will be maintained at the Pit 6 Landfill access points prohibiting unauthorized access and requiring notification and authorization by LLNL Site 300 Management to enter, dig, excavate, or otherwise disturb soil or vegetation in this area (see administrative controls for ground-breaking construction activities above). These access restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.
Maintain access restrictions to prevent inadvertent exposure of unauthorized trespassers to the pit waste as long as the waste in the Pit 6 Complex Landfill remains in place.	Potential exposure to contaminants in pit waste[a].	Site access by unauthorized trespassers is prevented by fences and warning signs at the site boundary and control entry systems at Site 300. These measures are maintained by the LLNL Security Department. There is no offsite contamination associated with the Pit 6 Landfill to which the public could be exposed. These access restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.
Maintain land use restriction in the vicinity of Spring 7 until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	A 4 x 10^{-5} risk was identified for onsite workers continuously inhaling VOC vapors volatilizing from Spring 7 into outdoor air.	Spring 7 has been dry since 2003. Current activities in the vicinity of the Well 8 Spring are restricted to semi-annual spring sampling. The time spent sampling is well below the exposure scenario for which the unacceptable exposure risk was calculated, which assumed a worker would spend 8 hours a day, five days a week for 25 years working at Spring 7. DOE will conduct annual risk re-evaluations when water is present in Spring 7 to determine when the inhalation risk has been mitigated. The risk re-evaluation results will be reported in the Annual Site-Wide Compliance Monitoring Reports. Any significant changes in activities conducted in the Spring 7 area must be cleared through the LLNL Work Induction Board. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants as a result of the proposed area usage. If a potential for contaminant exposure is identified as a result of these changes in activities or area use, LLNL Hazards Control is notified and determines any necessary personal protective equipment to prevent exposure.

Table 2.9-15. Description of institutional/land use controls for the Pit 6 Landfill Operable Unit. (continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prohibit transfer of lands with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	Potential exposure to contaminated waste and/or environmental media.	The Site 300 Federal Facility Agreement contains provisions that assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. In the event that the Site 300 property is transferred in the future, DOE will 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 67391.1. Development will be restricted to industrial land usage. These restrictions will remain in place until and unless a risk assessment is performed in accordance with then current U.S. EPA risk assessment guidance and is agreed by the DOE, U.S. EPA, DTSC, and the RWQCB as adequately showing no unacceptable risk for residential or unrestricted land use. These restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning document.

Notes:

DOE = U.S. Department of Energy.

DTSC = California Department of Toxic Substances Control.

U.S. EPA = United States Environmental Protection Agency.

LLNL = Lawrence Livermore National Laboratory.

RWQCB = California Regional Water Quality Control Board.

TCE = Trichloroethylene.

VOCs = Volatile organic compounds.

[a] **A risk for exposure to contaminants in the pit waste could not be calculated due to safety restrictions on penetrating landfill waste. Land use controls based on the potential exposure to contaminants in pit waste conservatively assume that the waste contaminants may pose a risk to human health.**

Table 2.9-16. Description of institutional/land use controls for the High Explosives Process Area Operable Unit.

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prevent water-supply use/consumption of contaminated groundwater until ground water cleanup standards are met.	VOCs, RDX, nitrate, and perchlorate concentrations in ground water exceeding drinking water standards.	There are two onsite water-supply wells in the HEPA Operable Unit (Wells 18 and 20). Contamination in HEPA ground water is contained in an aquifer that is 250 ft above, and hydraulically separated from the deeper, clean aquifer in which Well 20 is screened. While Well 18 is no longer used as a water supply well, it is a backup well for emergency fire suppression. Well 18 is cased through the contaminated aquifer. Therefore, onsite workers are not at risk from drinking contaminated water from Wells 18 and 20. Well 18 and 20 are sampled monthly for contamination. Any proposed well drilling activities would be submitted to the LLNL Work Induction Board, and are reviewed by the LLNL Environmental Restoration Department to ensure that new water-supply wells are not located in areas of ground water contamination. Prohibitions on drilling water-supply wells in areas of ground water contamination will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. Ground water extraction is underway at the site boundary to prevent offsite migration of the VOC plume. Therefore, land use controls are not needed to prevent offsite water-supply use/consumption of contaminated ground water.
Control excavation activities to prevent onsite worker exposure to contaminants in subsurface soil until it can be verified that concentrations do not pose an exposure risk to onsite workers.	Potential exposure to VOCs, HMX, and RDX at depth in subsurface soil at the HEPA OU[a].	All proposed excavation activities must be cleared through the LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, LLNL Hazards Control ensures that hazards are adequately evaluated and necessary controls identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination.
Maintain land use restriction in the vicinity of Building 815 until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	Pre-remediation risk of 5×10^{-6} for onsite workers from inhalation of VOCs volatilizing from the subsurface soil into outdoor air in the vicinity of Building 815.	This risk has been successfully mitigated since 2004 through ground water extraction and treatment, therefore this institutional/land use control is no longer needed.

Table 2.9-16. Description of institutional/land use controls for the High Explosives Process Area Operable Unit. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain land use restriction in the vicinity of Spring 5 until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	1 x 10^{-5} risk for onsite workers continuously inhaling VOC vapors volatilizing from Spring 5 into outdoor air over a 25-year period.	The spring has been dry since 2003. There are currently no active facilities located in the vicinity of the Spring 5 and there is no surface water present in the spring. Current activities in the vicinity of the Spring 5 are restricted to semi-annual spring sampling. The time spent sampling is well below the exposure scenario for which the unacceptable exposure risk was calculated, which assumed a worker would spend 8 hours a day, five days a week for 25 years working at Spring 5. DOE will conduct annual risk re-evaluations when water is present in Spring 5 to determine when the inhalation risk has been mitigated. The risk re-evaluation results will be reported in the Annual Site-Wide Compliance Monitoring Reports. Any significant changes in activities conducted in the Spring 5 area must be cleared through LLNL Work Induction Board. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants as a result of the proposed area usage. If a potential for contaminant exposure is identified as a result of these changes in activities or area use, LLNL Hazards Control is notified and determines any necessary personal protective equipment to prevent exposure.
Prohibit transfer of lands with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	Potential exposure to contaminated waste and/or environmental media.	The Site 300 Federal Facility Agreement contains provisions that assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. In the event that the Site 300 property is transferred in the future, DOE will 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 67391.1. Development will be restricted to industrial land usage. These restrictions will remain in place until and unless a risk assessment is performed in accordance with then current U.S. EPA risk assessment guidance and is agreed by the DOE, the U.S. EPA, DTSC, and the RWQCB as adequately showing no unacceptable risk for residential or unrestricted land use. These restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning document.

Notes appear on the following page.

Table 2.9-16. Description of institutional/land use controls for the High Explosives Process Area Operable Unit. (Continued)

Notes:

DOE =	**United States Department of Energy.**
DTSC =	**California Department of Toxic Substances Control.**
U.S. EPA =	**United States Environmental Protection Agency.**
HEPA =	**High Explosives Process Area.**
HMX =	**High melting explosive.**
LLNL =	**Lawrence Livermore National Laboratory.**
RDX =	**Research department explosive.**
RWQCB =	**California Regional Water Quality Control Board.**
VOCs =	**Volatile organic compounds.**

[a] Risk for onsite worker exposure to VOCs, RDX, and HMX at depth in subsurface soil during excavation activities was not calculated as this was not considered a long-term exposure scenario. As a result, land use controls based on the potential exposure to VOCs, RDX, and HMX in subsurface soil during excavation conservatively assume that the these COCs in subsurface soil may pose a risk to human health.

Table 2.9-17. Description of institutional/land use controls for the Building 850 Firing Table.

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prevent water-supply use/consumption of contaminated groundwater until ground water cleanup standards are met.	Tritium, depleted uranium, and nitrate concentrations in ground water exceeding drinking water standards.	There are no existing or planned water-supply wells in the Building 850 Firing Table area. Any proposed well drilling activities would be submitted to the LLNL Work Induction Board, and are reviewed by the LLNL Environmental Restoration Department to ensure that new water-supply wells are not located in areas of ground water contamination. Prohibitions on drilling water-supply wells in areas of ground water contamination will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. Contamination is limited to onsite ground water and modeling indicates the plumes will not migrate offsite. Therefore, land use controls are not needed to prevent offsite water-supply use/consumption of contaminated ground water.
Control excavation activities to prevent onsite worker exposure to contaminants in subsurface soil until it can be verified that subsurface soil does not pose an exposure risk to onsite workers.	Potential exposure to tritium and depleted uranium at depth in subsurface soil at the Building 850 Firing Table[a].	All proposed excavation activities must be cleared through the LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, LLNL Hazards Control ensures that hazards are adequately evaluated and necessary controls identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination.
Maintain land use restrictions in the vicinity of Building 850 Firing Table until remediation of PCB-, dioxin-, and furan-contaminated soil reduces the risk to onsite workers to less than 10^{-6}.	5×10^{-4} and 1×10^{-4} risk for onsite workers from inhalation or ingestion of resuspended particulates and dermal contact with PCBs, and dioxin and furan compounds in surface soil at the Building 850 Firing Table, respectively.	Current activities in the vicinity of the Building 850 Firing Table are well below the exposure scenario for which the unacceptable exposure risk was calculated, which assumed a worker would spend 8 hours a day, five days a week for 25 years on the firing table. Any significant changes in activities conducted in the Building 850 Firing Table must be cleared through LLNL Work Induction Board. The Work Induction Board coordinates with the LLNL Environmental Restoration Department.

Table 2.9-17. Description of institutional/land use controls for the Building 850 Operable Unit. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain land use restriction in the vicinity of Well 8 Spring until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	1×10^{-3} risk for onsite workers inhaling tritium volatilizing from Well 8 Spring into outdoor air.	There are currently no active facilities located in the vicinity of the Well 8 Spring and there is no surface water present in the spring. Current activities in the vicinity of the Well 8 Spring are restricted to semi-annual spring sampling. The time spent sampling is well below the exposure scenario for which the unacceptable exposure risk was calculated, which assumed a worker would spend 8 hours a day, five days a week for 25 years working at Well 8 Spring. DOE will conduct annual risk re-evaluations when water is present in Well 8 Spring to determine when the inhalation risk has been mitigated. The risk re-evaluation results will be reported in the Annual Site-Wide Compliance Monitoring Reports. Any significant changes in activities conducted in the Well 8 Spring area must be cleared through LLNL Work Induction Board. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants as a result of the proposed area usage. If a potential for contaminant exposure is identified as a result of these changes in activities or area use, LLNL Hazards Control is notified and determines any necessary personal protective equipment to prevent exposure.
Prohibit transfer of lands with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	Potential exposure to contaminated environmental media.	The Site 300 Federal Facility Agreement contains provisions that assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. In the event that the Site 300 property is transferred in the future, DOE will 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 67391.1. Development will be restricted to industrial land usage. These restrictions will remain in place until and unless a risk assessment is performed in accordance with then current U.S. EPA risk assessment guidance and is agreed by the DOE, the U.S. EPA, DTSC, and the RWQCB as adequately showing no unacceptable risk for residential or unrestricted land use. These restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning document.

Notes appear on the following page.

Table 2.9-17. Description of institutional/land use controls for the Building 850 Operable Unit. (Continued)

Notes:

DOE = **United States Department of Energy.**

DTSC = **California Department of Toxic Substances Control.**

U.S. EPA = **United States Environmental Protection Agency.**

LLNL = **Lawrence Livermore National Laboratory.**

PCB = **Polychlorinated biphenyl.**

RWQCB = **California Regional Water Quality Control Board.**

[a] **Risk for onsite worker exposure to tritium and depleted uranium at depth in subsurface soil during excavation activities was not calculated as this was not considered a long-term exposure scenario. As a result, land use controls based on the potential exposure to tritium and depleted uranium in subsurface soil during excavation/construction activities conservatively assume that the tritium and depleted uranium in subsurface soil may pose a risk to human health.**

Table 2.9-18. Description of institutional/land use controls for the Pit 7 Complex.

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prevent water-supply use/consumption of contaminated ground water until ground water cleanup levels are met.	Uranium, tritium, nitrate, and perchlorate concentrations in ground water exceeding drinking water standards or California Public Health Goal.	There are no existing or planned water-supply wells in the Pit 7 Complex area. Any proposed onsite well drilling activities will be submitted to the LLNL Work Induction Board, and reviewed by the LLNL Environmental Restoration Department to ensure that new water-supply wells are not located in areas of ground water contamination. Prohibitions on drilling water-supply wells in areas of ground water contamination will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. Contamination is limited to onsite ground water and modeling indicates the plumes will not migrate offsite. Therefore, land use controls are not needed to prevent offsite water-supply use/consumption of contaminated ground water.
Maintain the integrity of Pit 7 Complex landfill covers and the drainage diversion system as long as the pit waste remains in place.	Potential exposure to contaminants in pit waste[a].	DOE will inspect and maintain the landfill covers and the drainage diversion system, and ground water monitoring systems. Landfill cap maintenance and inspection requirements are specified in post-closure plans for the landfills and will be included in the revision to the Site-Wide Compliance Monitoring Plan/Contingency Plan for LLNL Site 300.
Control construction and other ground-breaking activities on the Pit 7 Complex landfills to prevent cap/cover damage and/or inadvertent exposure to pit waste as long as the pit waste remains in place.	Potential exposure to contaminants in pit waste[a].	All proposed ground-breaking construction activities must be cleared through LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, LLNL Hazards Control ensures that hazards are adequately evaluated and necessary controls identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination. Controls for construction and other ground-breaking activities will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. In addition, health and safety procedures will be developed as part of the Remedial Design Report for the Pit 7 Complex for both construction and long-term maintenance of the remedial action to ensure worker safety and the proper handling of all hazardous materials.

Table 2.9-18. Description of institutional/land use controls for the Pit 7 Complex. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain access restrictions to prevent inadvertent exposure of onsite workers to the pit waste as long as the waste in the Pit 7 Complex Landfills remain in place.	Potential exposure to contaminants in pit waste[a].	There are currently no active facilities located in the vicinity of the Pit 7 Complex. Signage is in place and will be maintained at the Pit 7 Landfill Complex access points prohibiting unauthorized access and requiring notification and authorization by LLNL Site 300 Management to enter, dig, excavate, or otherwise disturb soil or vegetation in this area (see administrative controls for ground-breaking construction activities above). These access restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.
Maintain access restrictions and activities at the Pit 3 Landfill to prevent onsite site worker inhalation exposure to tritium until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	4×10^{-6} risk to onsite workers from inhalation of tritium from subsurface soil in the vicinity of the Pit 3 Landfill.	There are currently no active facilities located in the vicinity of the Pit 7 Complex, and the Pit 3 Landfill was closed and covered with native soil fill in 1967. Current activities in the vicinity of the Pit 3 Landfill are restricted to quarterly sampling of monitor wells. The time spent sampling is well below the exposure scenario for which the unacceptable exposure risk was calculated, which assumed a worker would spend 8 hours a day, five days a week for 25 years working at the Pit 3 Landfill. Any significant changes in activities conducted in the vicinity of the Pit 3 Landfill must be cleared through the LLNL Work Induction Board. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants as a result of the proposed area usage. If a potential for contaminant exposure is identified as a result of these changes in activities or area use, LLNL Hazards Control is notified and determines any necessary personal protective equipment or engineered control requirements to prevent exposure. Signage is in place and will be maintained at the Pit 7 Landfill Complex access points prohibiting unauthorized access and requiring notification and authorization by LLNL Site 300 Management to enter, dig, excavate, or otherwise disturb soil or vegetation in this area. All ground-breaking construction activities must be cleared through the LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, LLNL Hazards Control is notified and provides project hazard control requirements to prevent exposure during construction. These access restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.

Table 2.9-18. Description of institutional/land use controls for the Pit 7 Complex. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Access restrictions continued.		DOE will conduct annual risk re-evaluations to determine when the tritium inhalation risk at the Pit 3 Landfill has been mitigated. The risk re-evaluations mechanism, methodology, and frequency will be documented in the Remedial Design Report for the Pit 7 Complex.
Prohibit transfer of lands at Site 300 with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	Potential exposure to contaminated waste and/or environmental media.	The Site 300 Federal Facility Agreement contains provisions that assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm (as described in Section 2.8.2). In the event that the Site 300 property is transferred in the future, DOE will 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 67391.1. Development will be restricted to industrial land usage. These restrictions will remain in place until and unless a risk assessment is performed in accordance with then current U.S. EPA risk assessment guidance and is agreed by the DOE, U.S. EPA, DTSC, and the RWQCB as adequately showing no unacceptable risk for residential or unrestricted land use. These restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning document.

Notes:

DOE = United States Department of Energy.

DTSC = California Department of Toxic Substances Control.

U.S. EPA = United States Environmental Protection Agency.

LLNL = Lawrence Livermore National Laboratory.

RWQCB = California Regional Water Quality Control Board.

[a] **A risk for exposure to contaminants in the pit waste could not be calculated due to safety restrictions on penetrating landfill waste. Land use controls based on the potential exposure to contaminants in pit waste conservatively assume that the waste contaminants may pose a risk to human health.**

Table 2.9-19. Description of institutional/land use controls for the Building 854 Operable Unit.

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prevent water-supply use/consumption of contaminated groundwater until ground water cleanup standards are met.	VOCs, nitrate, and perchlorate concentrations in ground water exceeding drinking water standards.	There are no existing or planned water-supply wells in the Building 854 Operable Unit. Any proposed well drilling activities would be submitted to the LLNL Work Induction Board, and are reviewed by the LLNL Environmental Restoration Department to ensure that new water-supply wells are not located in areas of ground water contamination. Prohibitions on drilling water-supply wells in areas of ground water contamination will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. Contamination is limited to onsite ground water and modeling indicates the plumes will not migrate offsite. Therefore, land use controls are not needed to prevent offsite water-supply use/consumption of contaminated ground water.
Control excavation activities to prevent onsite worker exposure to VOCs in subsurface soil until it can be verified that concentrations do not pose an exposure risk to onsite workers.	Potential exposure to VOCs at depth in subsurface soil at the Building 854 Complex[a].	All proposed excavation activities must be cleared through the LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, the LLNL Site 300 Hazards Control Department ensures that hazards are adequately evaluated and necessary controls identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination.

Table 2.9-19. Description of institutional/land use controls for the Building 854 Operable Unit. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain building occupancy restriction to prevent onsite site worker inhalation exposure to VOCs inside Building 854A until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	Pre-remediation risk of 1 x 10^{-6} for onsite workers from inhalation of VOCs volatilizing from subsurface soil into ambient air inside Buildings 854A.	Building 854A is not currently occupied. Warning signs will be maintained prohibiting full time occupancy without notification and authorization by LLNL Site 300 Management. Any significant changes in activities conducted in Building 854A must be cleared through the LLNL Work Induction Board. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants as a result of the proposed building usage. If a potential for contaminant exposure is identified as a result of the changes in building use, LLNL Hazards Control will be notified and determine any necessary engineered control requirements to prevent exposure. If full-time building occupancy is proposed, engineering controls will be implemented to prevent onsite worker exposure that could migrate from the subsurface into the building until the inhalation risk was mitigated through remediation. The building occupancy restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. DOE will conduct annual risk re-evaluations to determine when the inhalation risk inside Building 854A has been mitigated. The risk re-evaluation results will be reported in the Annual Site-Wide Compliance Monitoring Reports. A pre-remediation risk of 9.3 x 10^{-6} was identified for onsite workers from potential inhalation of VOCs volatilizing from subsurface soil into ambient air inside Building 854F. Building 854F was demolished in 2005 removing the exposure pathway, therefore this institutional/land use control is no longer needed to prevent onsite worker exposure to VOCs in indoor air. The baseline risk assessment also identified a human cancer risk of 1 x 10^{-5} for onsite workers continuously inhaling VOC vapors volatilizing from the vadose zone into outdoor air in the vicinity of Building 854F over a 25-year period, however this risk has been successfully mitigated since 2004 through ground water extraction and treatment, therefore this institutional/land use control is no longer needed to prevent onsite worker exposure to VOCs in outdoor air.

Table 2.9-19. Description of institutional/land use controls for the Building 854 Operable Unit. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain land use restrictions at the former Building 855 lagoon until remediation of PCB-, dioxin-, and furan-contaminated soil reduces the risk to onsite workers to less than 10^{-6}.	A pre-remediation risk of 1 x 10^{-6} was identified for onsite workers from inhalation or ingestion of resuspended particulates and dermal contact with PCBs, and dioxin and furan compounds in surface soil at the former Building 855 lagoon.	In 2005, PCB-, dioxin-, and furan-contaminated soil in the former Building 855 lagoon was excavated for offsite disposal as a remedial action. As a result, the risk to onsite workers was reduced to less than 10^{-6}. Therefore, this institutional/land use control is no longer needed to prevent onsite worker exposure to PCBs, and dioxin and furan compounds in soil at the former Building 855 lagoon. However, a very limited volume of subsurface soil remains at a depth of approximately 8 feet below ground surface with PCBs, and dioxin and furan compound concentrations above residential preliminary remediation goals. The land transfer prohibition control described below prevents exposure under a residential land use.
Prohibit transfer of lands with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	Potential exposure to contaminated waste and/or environmental media.	The Site 300 Federal Facility Agreement contains provisions that assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. In the event that the Site 300 property is transferred in the future, DOE will 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 67391.1. Development will be restricted to industrial land usage. These restrictions will remain in place until and unless a risk assessment is performed in accordance with then current U.S. EPA risk assessment guidance and is agreed by the DOE, U.S. EPA, DTSC, and the RWQCB as adequately showing no unacceptable risk for residential or unrestricted land use. These restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning document.

Notes:

DOE = United States Department of Energy.
DTSC = California Department of Toxic Substances Control.
U.S. EPA = United States Environmental Protection Agency.
LLNL = Lawrence Livermore National Laboratory.
RWQCB = California Regional Water Quality Control Board.
VOCs = Volatile organic compounds.

[a] **Risk for onsite worker exposure to VOCs at depth in subsurface soil during excavation activities was not calculated as this was not considered a long-term exposure scenario. As a result, land use controls based on the potential exposure to VOCs in subsurface soil during excavation activities conservatively assume that the VOCs in subsurface soil may pose a risk to human health.**

Table 2.9-20. Description of institutional/land use controls for the Building 832 Canyon Operable Unit.

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prevent water-supply use/consumption of contaminated groundwater until ground water cleanup standards are met.	VOCs, nitrate, and perchlorate concentrations in ground water exceeding drinking water standards.	There are no existing or planned water-supply wells in the Building 832 Canyon Operable Unit. Any proposed well drilling activities would be submitted to the LLNL Work Induction Board, and are reviewed by the LLNL Environmental Restoration Department to ensure that new water-supply wells are not located in areas of ground water contamination. Prohibitions on drilling water-supply wells in areas of ground water contamination will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. Contamination is limited to onsite ground water and ground water extraction is underway at the distal portion of the VOC plume to prevent offsite migration. Therefore, land use controls are not needed to prevent offsite water-supply use/consumption of contaminated ground water.
Control excavation activities to prevent onsite worker exposure to VOCs in subsurface soil until it can be verified that concentrations do not pose an exposure risk to onsite workers.	Potential exposure to VOCs, HMX, and nitrate at depth in subsurface soil at the Building 832 Canyon Operable Unit[a].	All proposed excavation activities must be cleared through the LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, LLNL Hazards Control ensures that hazards are adequately evaluated and necessary controls identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination.

Table 2.9-20. Description of institutional/land use controls for the Building 832 Canyon Operable Unit. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain building occupancy restriction to prevent onsite site worker inhalation exposure to VOCs inside Building 830 until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	A pre-remediation risk of 3 x 10^{-6} was identified for onsite workers from inhalation of VOCs volatilizing from subsurface soil into ambient air inside Building 830.	Building 830 is not currently occupied. Warning signs will be maintained prohibiting full time occupancy without notification and authorization by LLNL Site 300 Management. Any significant changes in activities conducted in Building 830 must be cleared through the LLNL Work Induction Board. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants as a result of the proposed building usage. If a potential for contaminant exposure is identified as a result of the changes in building use, LLNL Hazards Control will be notified and determine any necessary engineered control requirements to prevent exposure. If full-time building occupancy is proposed, engineering controls will be implemented to prevent onsite worker exposure that could migrate from the subsurface into the building until the inhalation risk was mitigated through remediation. The building occupancy restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. DOE will conduct annual risk re-evaluations to determine when the inhalation risk inside Building 830 has been mitigated. The risk re-evaluation results will be reported in the Annual Site-Wide Compliance Monitoring Reports. A pre-remediation risk of 3 x 10^{-6} was identified for onsite workers from potential inhalation of VOCs volatilizing from subsurface soil into ambient air inside Building 832F. The indoor air risk for Building 832F has been successfully mitigated since 2004 through ground water and soil vapor extraction and treatment, therefore this institutional/land use control is no longer needed to prevent onsite worker exposure to VOCs inside Building 832F. The baseline risk assessment also identified a human cancer risk of 1 x 10^{-5} for onsite workers continuously inhaling VOC vapors volatilizing from the vadose zone into outdoor air in the vicinity of Building 830 over a 25-year period, however this risk has been successfully mitigated since 2004 through ground water and soil vapor extraction and treatment, therefore this institutional/land use control is no longer needed to prevent onsite worker exposure to VOCs in outdoor air.

Table 2.9-20. Description of institutional/land use controls for the Building 832 Canyon Operable Unit. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain land use restriction in the vicinity of Spring 3 until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	A pre-remediation risk of 7×10^{-5} for onsite workers inhaling VOC vapors volatilizing from Spring 3 into outdoor air.	The spring has been dry since 2004. There are currently no active facilities located in the vicinity of the Spring 3and there is no surface water present in the spring. Current activities in the vicinity of the Spring 3 are restricted to semi-annual spring sampling. The time spent sampling is well below the exposure scenario for which the unacceptable exposure risk was calculated, which assumed a worker would spend 8 hours a day, five days a week for 25 years working at Spring 3. DOE will conduct annual risk re-evaluations when water is present in the spring to determine when the inhalation risk at Spring 3 has been mitigated. The risk re-evaluation results will be reported in the Annual Site-Wide Compliance Monitoring Reports. Any significant changes in activities conducted in the Spring 3 area must be cleared through the LLNL Work Induction Board. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants as a result of the proposed area usage. If a potential for contaminant exposure is identified as a result of these changes in activities or area use, LLNL Hazards Control is notified and determines any necessary personal protective equipment to prevent exposure.
Prohibit transfer of lands with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	Potential exposure to contaminated waste and/or environmental media.	The Site 300 Federal Facility Agreement contains provisions that assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. In the event that the Site 300 property is transferred in the future, DOE will 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 67391.1. Development will be restricted to industrial land usage. These restrictions will remain in place until and unless a risk assessment is performed in accordance with then current U.S. EPA risk assessment guidance and is agreed by the DOE, U.S. EPA, DTSC, and the RWQCB as adequately showing no unacceptable risk for residential or unrestricted land use. These restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning document.

Notes appear on the following page.

Table 2.9-20. Description of institutional/land use controls for the Building 832 Canyon Operable Unit. (Continued)

Notes:

DOE =	**United States Department of Energy.**
DTSC =	**California Department of Toxic Substances Control.**
U.S. EPA =	**United States Environmental Protection Agency.**
LLNL =	**Lawrence Livermore National Laboratory.**
RWQCB =	**California Regional Water Quality Control Board.**
VOCs =	**Volatile organic compounds.**

[a] **Risk for onsite worker exposure to VOCs at depth in subsurface soil during excavation activities was not calculated as this was not considered a long-term exposure scenario. As a result, land use controls based on the potential exposure to VOCs in subsurface soil during excavation activities conservatively assume that the VOCs in subsurface soil may pose a risk to human health.**

Table 2.9-21. Description of institutional/land use controls for the Operable Unit 8.

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Prevent water-supply use/consumption of contaminated groundwater until ground water cleanup standards are met.	*Buildings 801 and 833* VOC concentrations in ground water exceeding drinking water standards.	There are no existing or planned water-supply wells in the vicinity of Buildings 801 or 833. Any proposed well drilling activities would be submitted to the LLNL Work Induction Board, and are reviewed by LLNL Environmental Restoration Department to ensure that new water-supply wells are not located in areas of ground water contamination. Prohibitions on drilling water-supply wells in areas of ground water contamination will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents. 1.2-DCA in Building 801 ground water is limited to only 2 wells at concentrations only slightly exceeding the state drinking water standard and are decreasing. All other VOCs in Building 801 ground water are below drinking water standards. VOCs in Building 833 ground water are limited to a shallow, perched, ephemerally saturated aquifer. There is no pathway for the VOC in ground water to migrate offsite. Therefore, land use controls are not needed to prevent offsite water-supply use/consumption of contaminated ground water.
Control excavation activities to prevent onsite worker exposure to contaminants in subsurface soil until it can be verified that concentrations do not pose an exposure risk to onsite workers.	*Building 801 Dry Well* Potential exposure to VOCs at depth in subsurface soil[a]. *Building 845 Firing Table* Potential exposure to depleted uranium and HMX at depth in subsurface soil[a]. *Building 851 Firing Table* Potential exposure to depleted uranium and VOCs at depth in subsurface soil[a]. *Building 833* Potential exposure to VOCs at depth in subsurface soil[a].	All proposed excavation activities must be cleared through the LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, LLNL Hazards Control ensures that hazards are adequately evaluated and necessary controls identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination.

Table 2.9-21. Description of institutional/land use controls for the Operable Unit 8. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain engineering controls to prevent onsite site worker inhalation exposure to VOCs inside Building 833 until annual risk re-evaluation indicates that the risk is less than 10^{-6}.	A risk of 1×10^{-6} was identified for onsite workers from potential inhalation of VOCs volatilizing from subsurface soil into ambient air inside Building 833.	Engineering controls (heating, ventilating, and air-conditioning system for Building 833) were implemented to prevent onsite worker exposure to VOCs that could migrate from the subsurface into the building until the inhalation risk was mitigated through remediation.
Maintain the integrity of landfill covers as long as the pit waste remains in place.	*Pit 2, 8 and 9 Landfills* Potential exposure to contaminants in pit waste[b].	DOE will inspect and maintain the landfill covers and ground water monitoring systems. Landfill cap maintenance and inspection requirements are specified in the Site 300 Compliance Monitoring Plan.
Control construction and other ground-breaking activities on the landfills to prevent cap/cover damage and/or inadvertent exposure to pit waste as long as the pit waste remains in place.	*Pit 2, 8 and 9 Landfills* Potential exposure to contaminants in pit waste[b].	All proposed ground-breaking construction activities must be cleared through the LLNL Work Induction Board and require an excavation permit. The Work Induction Board coordinates with the LLNL Environmental Restoration Department to identify if there is a potential for exposure to contaminants in the proposed construction areas. If a potential for contaminant exposure is identified, LLNL Hazards Control ensures that hazards are adequately evaluated and necessary controls identified and implemented prior to the start of work. The Work Induction Board including the LLNL Environmental Analyst will also work with the Program proposing the construction project to determine if the work plans can be modified to move construction activities outside of areas of contamination. Controls for construction and other ground-breaking activities will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.

Table 2.9-21. Description of institutional/land use controls for the Operable Unit 8. (Continued)

Institutional/land use control performance objective and duration	Risk necessitating institutional/land use control	Institutional/land use controls and implementation mechanism
Maintain access restrictions to prevent inadvertent exposure of onsite workers to the pit waste as long as the waste remains in place.	*Pit 2, 8 and 9 Landfills* Potential exposure to contaminants in pit waste[b].	Signage will be maintained at the landfill access points prohibiting unauthorized access and requiring notification and authorization by LLNL Site 300 Management to enter, dig, excavate, or otherwise disturb soil or vegetation in this area (see administrative controls for ground-breaking construction activities above). These access restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.
Maintain access restrictions to prevent inadvertent exposure of unauthorized trespassers to the pit waste as long as the waste remains in place.	*Pit 2, 8 and 9 Landfills* Potential exposure to contaminants in pit waste[b].	Site access by unauthorized trespassers is prevented by fences and warning signs at the site boundary and control entry systems at Site 300. These measures are maintained by the LLNL Security Department. There is no offsite contamination associated with the Pit 2, 8, or 9 landfills to which the public could be exposed. These access restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.
Prohibit transfer of lands with unmitigated contamination that could cause potential harm under residential or unrestricted land use.	Potential exposure to contaminated waste and/or environmental media.	The Site 300 Federal Facility Agreement contains provisions that assure that DOE will not transfer lands with unmitigated contamination that could cause potential harm. In the event that the Site 300 property is transferred in the future, DOE will 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 67391.1. Development will be restricted to industrial land usage. These restrictions will remain in place until and unless a risk assessment is performed in accordance with then current U.S. EPA risk assessment guidance and is agreed by the DOE, U.S. EPA, DTSC, and the RWQCB as adequately showing no unacceptable risk for residential or unrestricted land use. These restrictions will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning document.

Notes appear on the following page.

Table 2.9-21. Description of institutional/land use controls for the Operable Unit 8. (Continued)

Notes:

DCA = **Dichloroethane.**

DOE = **United States Department of Energy.**

DTSC = **California Department of Toxic Substances Control.**

U.S. EPA = **United States Environmental Protection Agency.**

HMX = **High melting explosive.**

LLNL = **Lawrence Livermore National Laboratory.**

RWQCB = **California Regional Water Quality Control Board.**

VOCs = **Volatile organic compounds.**

[a] **Risk for onsite worker exposure to contaminants at depth in subsurface soil during excavation activities was not calculated as this was not considered a long-term exposure scenario. As a result, land use controls based on the potential exposure to contaminants in subsurface soil during ground-breaking construction activities conservatively assume that these subsurface soil contaminants may pose a risk to human health.**

[b] **A risk for exposure to contaminants in the pit waste could not be calculated due to safety restrictions on penetrating landfill waste. Land use controls based on the potential exposure to contaminants in pit waste conservatively assume that the waste contaminants may pose a risk to human health.**

Table 2.11-1. Cleanup standards for Site 300 ground and surface water.

Contaminants of concern	Cleanup standard
Volatile Organic Compound (VOCs):	
Chloroform	80 μg/L[a,b]
Cis-1,2-dichloroethylene	6 μg/L[c]
1,2-Dichloroethane	0.5 μg/L[c]
1,1-Dichloroethylene	6 μg/L[c]
Tetrachloroethylene (PCE)	5 μg/L[d]
1,1,1-Trichloroethane	200 μg/L[d]
Trichloroethylene (TCE)	5 μg/L[d]
High Explosive Compounds:	
Research department explosive (RDX)	1 μg/L[e]
Radionuclides:	
Tritium	20,000 pCi/L[d]
Uranium	20 pCi/L[c]
Other:	
Nitrate (as NO_3)	45 mg/L[d]
Perchlorate	6 μg/L[c]
Tetrabutyl orthosilicate (TBOS)	None[f]

Notes:

mg/L = Milligrams per liter.

pCi/L = PicoCuries per liter.

μg/L = Micrograms per liter.

[a] State and Federal Maximum Contaminant Level (MCL) for total trihalomethanes.

[b] Current chloroform concentrations (maximum of 2.1 μg/L) in Site 300 ground water are well below the 80 μg/L cleanup standard and continue to decrease.

[c] State MCL.

[d] State and Federal MCL.

[e] No Federal or State MCLs for RDX. Preliminary Remediation Goal is below the detection limit, therefore the *de facto* cleanup standard is the detection limit.

[f] No Federal or State MCLs for TBOS. To be remediated as part of the VOC cleanup.

Table 2.12-1. Principal and low level threat wastes at LLNL Site 300.

Parameter	Medium[a]	Source classification	Maximum human health risk[b]	Comments	How does the selected remedy address principal threat and low level waste?
Building 834 Operable Unit (OU 2)					
VOCs	Subsurface soil	Principal	1×10^{-3}	Ongoing impact to ground water, human health risk	Ground water and soil vapor extraction
TBOS	Subsurface soil	Low level	$<10^{-6}$	Low toxicity, low mobility	Ground water extraction
Pit 6 Landfill Operable Unit (OU 3)					
Landfill contents	Landfill waste	Principal	—	Landfill capped in 1997	Long-term monitoring and landfill cap maintenance
TCE	Subsurface soil	Low level	5×10^{-6} (Risk has been mitigated)	Declining concentrations in ground water	Natural degradation
High Explosives Process Area Operable Unit (OU 4)					
TCE	Subsurface soil	Low level	5×10^{-6} (Risk has been mitigated)	Low concentrations, limited distribution	No Further Action selected in Interim Site-Wide ROD (2001); ground water extraction
HMX, RDX	Subsurface soil	Low level	$<10^{-6}$	Sources (lagoons) closed in 1982-1985	No Further Action selected in Interim Site-Wide ROD (2001); ground water extraction

Table 2.12-1. Principal and low level threat wastes at LLNL Site 300. (Continued)

Parameter	Medium[a]	Source classification	Maximum human health risk[b]	Comments	How does the selected remedy address principal threat and low level waste?
Building 850 Firing Table (OU 5)					
Depleted uranium	Surface/Subsurface soil	Low level	$<10^{-6}$	Depleted source; low activities; no significant impact to ground water	Current activities meet cleanup standards in ground water
Tritium	Subsurface soil	Low level	$<10^{-6}$	Depleted source	Natural decay
PCBs	Surface soil	Principal	5×10^{-4}	High toxicity	To be addressed through a Non-Time Critical Removal Action
Dioxins, furans	Surface soil	Principal	1×10^{-4}	High toxicity	To be addressed through a Non-Time Critical Removal Action
Metals	Surface soil	Low level	$<10^{-6}$	Low concentration, low mobility; no impact or threat to ground water	No Further Action selected in Interim Site-Wide ROD (2001)
HMX	Surface soil	Low level	$<10^{-6}$	Low concentration, low mobility; no impact or threat to ground water	No Further Action selected in Interim Site-Wide ROD (2001)
Pit 7 Complex (OU 5)					
Landfill contents	Landfill waste	Principal	—	High concentration, mobility, and toxicity	Engineering and source controls
Uranium	Subsurface soil	Low level	$<10^{-6}$	Low concentration, limited extent	Ground water extraction and treatment
Tritium	Subsurface soil	Low level	4×10^{-6} (Risk has been mitigated)	Declining concentration in ground water	Natural decay

Table 2.12-1. Principal and low level threat wastes at LLNL Site 300. (Continued)

Parameter	Medium[a]	Source classification	Maximum human health risk[b]	Comments	How does the selected remedy address principal threat and low level waste?
Building 854 Operable Unit (OU 6)					
VOCs	**Subsurface soil**	**Principal**	**1×10^{-5} (Risk has been mitigated)**	**Ongoing impact to ground water**	**Ground water and soil vapor extraction**
PCBs	**Surface soil**	**Principal**	**7×10^{-5} (Risk has been mitigated)**	**High toxicity**	**PCB-contaminated soil has been removed.**
Metals	**Surface soil**	**Low level**	**$<10^{-6}$**	**Low concentration, low mobility; no impact or threat to ground water**	**No Further Action selected in Interim Site-Wide ROD (2001)**
HMX	**Surface soil**	**Low level**	**$<10^{-6}$**	**Low concentration, low mobility; no impact or threat to ground water**	**No Further Action selected in Interim Site-Wide ROD (2001)**
Tritium	**Surface soil**	**Low level**	**$<10^{-6}$**	**Low concentration, limited extent; no impact or threat to ground water**	**No Further Action selected in Interim Site-Wide ROD (2001)**
Building 832 Canyon Operable Unit (OU 7)					
VOCs	**Subsurface soil**	**Principal**	**1×10^{-5} (Risk has been mitigated)**	**Ongoing impact to ground water**	**Ground water and soil vapor extraction**
HMX	**Surface/Subsurface soil**	**Low level**	**$<10^{-6}$**	**Low concentration, low mobility; no impact or threat to ground water**	**No Further Action selected in Interim Site-Wide ROD (2001)**
Nitrate	**Subsurface soil**	**Low level**	**$<10^{-6}$**	**Low concentration**	**No Further Action selected in Interim Site-Wide ROD (2001)**

Table 2.12-1. Principal and low level threat wastes at LLNL Site 300. (Continued)

Parameter	Medium[a]	Source classification	Maximum human health risk[b]	Comments	How does the selected remedy address principal threat and low level waste?
Building 801 Dry Well and Pit 8 Landfill (OU 8)					
VOCs	Subsurface soil	Low level	$<10^{-6}$	Low concentration, limited extent	No Further Action selected in Interim Site-Wide ROD (2001)
Landfill contents	Landfill contents	Low level	—	No evidence of releases	Ground water monitoring
Building 833 (OU 8)					
VOCs	Subsurface soil	Low level	1×10^{-6}	Low concentration, limited extent	Natural degradation; ground water monitoring
Building 845 Firing Table and Pit 9 Landfill (OU 8)					
Depleted uranium	Subsurface soil	Low level	$<10^{-6}$	Low concentration, low mobility; no impact or threat to ground water	No Further Action selected in Interim Site-Wide ROD (2001)
HMX	Subsurface soil	Low level	$<10^{-6}$	Low concentration, low mobility; no impact or threat to ground water	No Further Action selected in Interim Site-Wide ROD (2001)
Landfill contents	Landfill contents	Low level	—	No evidence of releases	Ground water monitoring
Building 851 Firing Table (OU 8)					
Depleted uranium	Surface soil	Low level	$<10^{-6}$	Low concentration, low mobility	No Further Action selected in Interim Site-Wide ROD (2001)
RDX	Surface soil	Low level	$<10^{-6}$	Low concentration, low mobility; no impact or threat to ground water	No Further Action selected in Interim Site-Wide ROD (2001)

Table 2.12-1. Principal and low level threat wastes at LLNL Site 300. (Continued)

Parameter	Medium[a]	Source classification	Maximum human health risk[b]	Comments	How does the selected remedy address principal threat and low level waste?
Building 851 Firing Table (OU 8)					
VOCs	**Subsurface soil**	**Low level**	**$<10^{-6}$**	**Low concentration, limited extent; no impact or threat to ground water**	**No Further Action selected in Interim Site-Wide ROD (2001)**
Metals	**Surface soil**	**Low level**	**$<10^{-6}$**	**Low concentration, low mobility; no impact or threat to ground water**	**No Further Action selected in Interim Site-Wide ROD (2001)**
Pit 2 Landfill (OU 8)					
Landfill contents	**Landfill contents**	**Low level**	**—**	**Low concentration, limited extent**	**Ground water monitoring**

Notes:

HMX = High Melting Explosive.

PCBs = Polychlorinated biphenyls.

RDX = Research Department Explosive.

TBOS = Tetrabutyl orthosilicate.

TCE = Trichloroethylene.

VOCs = Volatile organic compounds.

[a] **Contaminated ground water is not usually considered a principal threat waste.**

[b] **Maximum risk for exposure media and pathway (exclusive of ground water) when 1 x 10^{-6} or greater.**

Table 2.13-1. ARARs for Site 300 selected remedies.

Action(s)	Source	Description	Application
Monitored natural attenuation (MNA), ground water extraction and treatment, *in situ* treatment, containment and hydraulic control	***Federal:***		
	Safe Drinking Water Act (42 United States Code Annotated [USCA] 300 and 40 Code of Federal Regulations [CFR] 141.11-141.16, 141.50-141.51) **(Relevant and appropriate, chemical-specific)**	**Establishes treatment standards for current potential drinking water sources by setting Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs).**	**Contaminants will be reduced to concentrations no higher than MCLs in all Site 300 ground water.**
	State:		
	State Water Resources Control Board (SWRCB) Resolution 92-49, Paragraph IIIG **(Relevant and appropriate[a], chemical-specific)**	**Establishes requirements for investigation and cleanup and abatement of discharges. Among other requirements, dischargers must cleanup and abate the effects of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored. Requires the application of Title 23, CCR, Section 2550.4, requirements to cleanup.**	**Final cleanup standards for ground water in the final Record of Decision (ROD) will be equal to background concentrations unless such levels are technically and economically infeasible to achieve. In such cases, cleanup standards will not exceed applicable MCLs, or any more stringent Water Quality Objectives (WQOs).**
	Cal. Safe Drinking Water Act [California Health and Safety Code Section 4010.1 et. seq., Title 22, CCR, Division 4, Chapter 15] **(Relevant and appropriate, chemical-specific)**	**Establishes treatment standards for current potential drinking water sources by setting MCLs which are used as cleanup standards.**	**Contaminants will be reduced to concentrations no higher than MCLs in all Site 300 ground water.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
MNA, ground water extraction and treatment, *in situ* treatment, containment and hydraulic control *(continued)*	**CCR, Title 27, Section 20410** **CCR, Title 23, Section 2550.6[b]** **(Relevant and appropriate, chemical-specific)**	**Requires monitoring for compliance with remedial action objectives for three years from the date of achieving ground water and subsurface soil cleanup standards.**	**Applies to ground water and subsurface soil remedial actions.**
	CCR, Title 27, Section 20080 (d) **CCR, Title 23, Section 2510 (d)[b]** **(Relevant and appropriate[c], action-specific)**	**Requires monitoring programs for existing units (landfills). Existing units are those operating which were operating prior to November 27, 1984.**	**Existing landfills.**
	CCR, Title 27, Section 20385 (c) **(Relevant and appropriate[c], action-specific)**	**Requires a detection monitoring program concurrent with corrective action to monitor for any additional releases from the landfills.**	**Applies to monitoring of existing landfills.**
	CCR, Title 27, Section 20400 **CCR, Title 23, Section 2550.4[b]** **(Relevant and appropriate[c], action-specific)**	**Requires the discharger to propose either background or an alternative to background as the concentration limit. In the Interim ROD, the concentration limit is used for determining the analytical detection limits and the adequacy of the monitoring network to evaluate the extent of polluted ground water above background.**	**Applies to detection limits and to determine the extent of the ground water plume above background concentrations.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
MNA, ground water extraction and treatment, *in situ* treatment, containment and hydraulic control *(continued)*	**CCR, Title 27, Section 20415 (b)(1)(A)** **CCR, Title 23, Section 2550.7[b]** **(Relevant and appropriate[d], action-specific)**	**Requires a sufficient number of background monitoring points to yield ground water samples representative of ground water that has not been affected by releases from the landfills.**	**Applies to background monitoring for polluted ground water.**
	CCR, Title 27, Section 20415 (b)(1)(D) **CCR, Title 23, Section 2550.7[b]** **(Applicable, action-specific)**	**Lists the requirements for the number, location and depths of monitoring points for a corrective action monitoring program.**	**Applies to plume monitoring.**
	CCR, Title 27, Section 20415 (b)(2) **CCR, Title 23, Section 2550.7[b]** **(Relevant and appropriate[d], action-specific)**	**Allows background locations not hydraulically upgradient of the landfill if they are representative of the background quality of ground water.**	**Applies to background monitoring for polluted ground water.**
	CCR, Title 27, Section 20415 (b)(3) **CCR, Title 23, Section 2550.7** **(Applicable, action-specific)**	**Requires copies of driller's logs be available to the Regional Water Board.**	**Applies to drilling monitor wells as part of the remedial action. Copies of the well logs will be available electronically to the Regional Water Board.**
	CCR, Title 27, Section 20415 (b)(4) **CCR, Title 23, Section 2550.7[b]** **(Applicable, action-specific)**	**Describes the monitoring well performance standards.**	**Applies to drilling monitor wells as part of the remedial action.**
	CCR, Title 27, Section 20415 (c)(2)(D) **CCR, Title 23, Section 2550.7[b]** **(Applicable, action-specific)**	**Requires adequate surface water monitoring to assess corrective action.**	**Applies to surface water monitoring.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
MNA, ground water extraction and treatment, *in situ* treatment, containment and hydraulic control *(continued)*	**CCR, Title 27, Section 20415 (e)(1-9)** **CCR, Title 23, Section 2550.7[b]** **(Applicable, action-specific)**	**Describe general monitoring requirements.**	**Applies to all ground water monitoring.**
	CCR, Title 27, Section 20420 **CCR, Title 23, Section 2550.8[b]** **(Relevant and appropriate[d], action-specific)**	**Describes detection monitoring requirements for landfills.**	**Applies to all detection ground water monitoring for landfills.**
	CCR, Title 27, Section 20430 (d) **CCR, Title 23, Section 2550.10[b]** **(Applicable, action-specific)**	**Describes the requirements for establishing a corrective action program.**	**Applies to all corrective action ground water monitoring.**
	Water Quality Control Plan (Basin Plan) for the Central Valley Regional Water Quality Control Board (CVRWQCB), Chapter II **(Applicable, chemical-specific)**	**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.** **Ground water at Site 300 is considered as suitable or potentially suitable, at a minimum, for municipal and domestic water supply (MUN), agricultural supply (AGR), industrial service supply (IND), and industrial process supply (PRO).**	**Applies to any activity which may affect beneficial uses of ground water, including, but not limited to, the discharge of contaminated soils or waters or *in situ* treatment or containment of contaminated soils or waters. These activities must not result in actual ground or surface water quality to exceed WQOs.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
MNA, ground water extraction and treatment, *in situ* treatment, containment and hydraulic control *(continued)*	**Water Quality Control Plan (Basin Plan) for the CVRWQCB, Chapter III** **(Applicable, chemical-specific**	**Requires that ground waters not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum ground waters designated for use as MUN shall not contain chemical constituents in excess of the MCLs specified in Title 22. To protect all beneficial uses, the Regional Water Board may apply limits more stringent the MCLs. Ground water shall be maintained free of toxic substances in concentrations that produce detrimental physiological response in human, plant, animal, or aquatic life associated with designated beneficial uses. Ground waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses[d,e].**	**Applies to remediation including MNA, extraction and treatment, in situ treatment, and containment and hydraulic control of ground waters at Site 300. Ground water remediation will continue until, at a minimum, ground water quality does not exceed the MCLs, does not contain toxic substances at detrimental levels, nor contain substances in concentrations that cause nuisance or adversely affect beneficial uses[d,e].**
	SWRCB Resolution 88-63 **(Applicable, chemical-specific)**	**Designates all ground and surface waters in the State as drinking water sources with specific exceptions.**	**Contaminant concentrations in ground water will be reduced to levels protective of beneficial uses[e].**
	SWRCB Resolution 68-16 **(Applicable, action-specific)**	**Requires that high quality surface and ground water be maintained to the maximum extent possible.**	**This applies to enhanced *in situ* bioremediation of ground water. The levels of residual injected materials or by-products will be below WQOs.**
	CCR, Title 27, Section 20365 (c) and (e) and Title 23, Section 2546 (c) and (e) **(Relevant and appropriate, action-specific)**	**Provides performance standards for the design, construction and maintenance of diversion and drainage facilities.**	**Applies to the drainage diversion system at the Pit 7 Complex.**
	Clean Water Act, Section 401 (33 CFR Chapter 26, Section 1341) and Section 404 (33 CFR Chapter 26, Section 1344) **(Relevant and Appropriate, action-specific**	**Requires substantive compliance with the requirement that any discharge to waters of the U.S. during construction and operation of a facility complies with applicable effluent limitations and water quality standards.**	**Applies to any discharge to waters of the U.S. during construction and operation of a treatment facility or other remedial action (e.g., drainage diversion system).**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
Soil vapor extraction (SVE)	***State:***		
	Water Quality Control Plan (Basin Plan) for CVRWQCB, Chapter II **(Applicable, chemical-specific)**	**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[d].**	**As part of the selected remedies, volatile organic compound (VOC) concentrations in soil vapor will be remediated until soil vapor containing VOCs will not cause soil leachate to impact underlying ground water to exceed MCLs, or until the SVE System Shut-off Evaluation has been conducted and the U.S. Department of Energy (DOE) and the regulatory agencies concur to permanently shutoff the SVE system based on the evaluation results[f].**
	Water Quality Control Plan (Basin Plan) for the CVRWQCB, Chapter III **(Applicable, chemical-specific**	**Requires that ground waters not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum ground waters designated for use as MUN shall not contain chemical constituents in excess of the MCLs specified in Title 22. To protect all beneficial uses, the Regional Water Board may apply limits more stringent than MCLs. Ground water shall be maintained free of toxic substances in concentrations that produce detrimental physiological response in human, plant, animal, or aquatic life associated with designated beneficial uses. Ground waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses[d].**	**SVE will continue until soil vapor containing VOCs will not cause soil leachate to impact underlying ground water to exceed MCLs, or until the SVE System Shut-off Evaluation has been conducted and DOE and the regulatory agencies concur to permanently shutoff the SVE system based on the evaluation results[f].**
	Chapter 15, CCR, Title 23, Sections 2550.7, 2550.10 **(Applicable, chemical-specific)**	**Requires monitoring of the effectiveness of the remedial actions.**	**Contaminant concentration in *in situ* soil vapor will be measured during and after remediation.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
(SVE) ***(continued)***	**22 CCR 66264.601, Article 16, Miscellaneous Units** **(Relevant and Appropriate, action-specific)**	**Provides performance standards for operation of SVE units.**	**Operation of all SVE units must comply with the substantive requirements of this provision.**
Discharge of treated ground water to land surface	***State:*** **SWRCB Resolution 68-16 (Anti-degradation policy)** **(Applicable, chemical-specific)**	**Requires that high quality surface and ground water be maintained to the maximum extent possible.**	**Applies to the discharge of treated ground water. Ground water treatment system effluent will be monitored to ensure that surface and ground water quality will be maintained to the maximum extent possible.**
	Water Quality Control Plan (Basin Plan) for CVRWCB, Chapter II **(Applicable, chemical-specific)**	**Establishes beneficial uses and WQOs for ground water in the Central Valley Region as well as implementation plans to meet water quality objectives and protect beneficial uses.**	**Specific applicable portions of the Basin Plan include beneficial uses of affected water bodies and water quality objectives to protect those uses. Surface discharge of treated ground water must not cause underlying ground water to exceed water quality objectives.**
	Water Quality Control Plan (Basin Plan) for CVRWCB, Chapter III **(Applicable, chemical-specific)**	**Requires that ground waters not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum ground waters designated for use as MUN shall not contain chemical constituents in excess of the MCLs specified in Title 22. To protect all beneficial uses, the Regional Water Board may apply limits more stringent than MCLs. Ground water shall be maintained free of toxic substances in concentrations that produce detrimental physiological response in human, plant, animal, or aquatic life associated with designated beneficial uses. Ground waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses.**	**Treated ground water must be sampled and analyzed to ascertain that treatment complies with the Substantive Requirements issued by the Regional Water Board for ground water extraction, treatment and discharge.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
Treated ground water reinjection	***Federal:***		
	Safe Drinking Water Act Underground Injection Control Program (40 CFR 144.12(a)) **(Applicable, action-specific)**	**Prohibits any injection activity that would cause the movement of contaminants into underground sources of drinking water that would violate the primary drinking water regulations or adversely affect human health.**	**Treated ground water will be analyzed to verify removal of contaminants to regulatory treatment standards, prior to reinjection. Hydrogeologic analysis will be conducted to ensure contaminants above MCLs would not be introduced into drinking water sources.**
	State:		
	SWRCB Resolution 68-16 (Anti-degradation policy) **(Applicable, action-specific)**	**Requires that high quality ground water be maintained to the maximum extent possible.**	**During implementation of the selected remedies, treated ground water will be analyzed to verify complete removal of contaminants to regulatory treatment standards, prior to re-injection.** **In addition, ground water downgradient of the injection trench or injection wells will be monitored for contaminants of concern (COCs) to confirm that reinjection is not causing the ground water plume to increase in pollutant concentration or increase migration of the ground water plume.**
	Water Quality Control Plan (Basin Plan) for CVRWCB, Chapter II **(Applicable, chemical-specific)**	**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.**	**During implementation of the selected remedies, monitoring will be conducted to preclude any activity, including but not limited to, discharge of contaminated waters, from resulting in actual water quality exceeding WQOs.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
Treated ground water reinjection ***(continued)***	**Water Quality Control Plan (Basin Plan) for CVRWCB, Chapter III** **(Applicable, chemical-specific)**	**Requires that ground waters not contain chemical constituents in concentrations that adversely affect beneficial uses. At a minimum ground waters designated for use as MUN shall not contain chemical constituents in excess of the MCLs specified in Title 22. To protect all beneficial uses, the Regional Water Board may apply limits more stringent than MCLs. Ground water shall be maintained free of toxic substances in concentrations that produce detrimental physiological response in human, plant, animal, or aquatic life associated with designated beneficial uses. Ground waters shall not contain taste- or odor-producing substances in concentrations that cause nuisance or adversely affect beneficial uses[d].**	**Treated ground water must be sampled and analyzed to ascertain that treatment complies with the Substantive Requirements issued by the Regional Water Board for ground water extraction, treatment and discharge by injection at the Pit 7 Complex.**
Treated soil vapor discharge	***Local:*** **San Joaquin Valley Unified Air Pollution Control District (SJVUAPCD) Rules and Regulations, Rules 4651 and 2201** **(Applicable, chemical-specific)**	**Regulates stationary sources of air contaminants and limits VOC emissions from the excavation and treatment of contaminated soil.**	**Soil vapor will be treated before discharge to the atmosphere. The compliance standards for treated soil vapor are contained in the Permits to Operate issued by the SJVUAPCD.**
Landfill cap inspection, monitoring, and maintenance	***State:*** **Title 22, CCR, 66264.91 - .100; 66264.310 (b) (1), (b) (3) and (b) (4); and 23 CCR 2550.1 - .10, and 27 CCR 20950 (c) (3), (C) (4) and (e)** **(Relevant and appropriate, action-specific)**	**Provide requirements for inspecting, maintaining, and monitoring landfill caps.**	**Applies to the landfill pits.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
Landfill cap inspection, monitoring, and maintenance *(continued)*	**CCR, Title 27, Sections 20950, 22207 (a), 22212 (a), and 22222** **CCR, Title 23, Sections 2550.0 (b), 2580, 2580 (f).** **(Applicable, action-specific)**	**General closure requirements, including continued maintenance of waste containment, drainage controls, and ground water monitoring throughout the closure and post-closure maintenance periods.**	**Applies to the landfill pits.**
	CCR, Title 27, Section 21090 (c) (1), (3), (4), and (5). **(Applicable, action-specific)**	**Requires maintenance of a final cover constructed in accordance with specific prescriptive standards as long as wastes pose a threat to ground water.**	**Applies to wastes contained or left in place at the end of remedial actions that could affect water quality, e.g., the landfills.**
	CCR, Title 27, Section 20415(b)(1)(B) and Title 23, Section 2550.7(b)(1)(B). **(Applicable, action-specific)**	**Requires sufficient monitoring points for a detection monitoring program.**	**Applies to landfill pits at Site 300.**
	CCR, Title 27, Section 20415(b)(1)(C) and Title 23, Section 2550.7(b)(1)(C). **(Applicable, action-specific)**	**Requires sufficient monitoring points for an evaluation monitoring program.**	**Applies to landfill pits at Site 300.**
	Title 27, CCR, Section 20390 and Title 23. CCR, Section 2550.2. **(Applicable, action-specific)**	**Requires establishment of a water quality standard consisting of constituents of concern, concentration limits, compliance monitoring points and point of compliance.**	**Applies to landfill pits at Site 300.**
	Title 27, CCR, Section 20395 and Title 23, CCR, Section 2550.3. **(Applicable, action-specific)**	**Requires development of a list of constituents of concern which include all waste constituents that are reasonably expected to be present in the waste from discharges to land and that could adversely affect water quality.**	**Applies to landfill pits at Site 300.**
	Title 27, CCR, Section 20405 and Title 23, CCR, Section 2550.5. **(Applicable, action-specific)**	**Requires identification of a point of compliance hydraulically downgradient of the area where waste was discharged to land.**	**Applies to landfill pits at Site 300.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
Landfill cap inspection, monitoring, and maintenance *(continued)*	**Title 27, CCR, Section 20410 and Title 23, CCR, Section 2550.6.** **(Applicable, action-specific)**	**Requires monitoring for compliance with ground water and subsurface soil cleanup standards for three years from the date of achieving these standards.**	**Applies to subsurface soil and ground water remedial actions.**
	Title 27, CCR, Section 20425 and Title 23, CCR, Section 2550.9. **(Applicable, action-specific)**	**Requires evaluation monitoring to determine the nature and extent of a new release including a determination of the spatial distribution, horizontally and vertically, and concentration of each constituent. The evaluation monitoring is required to design a corrective action program as required in Section 20430.**	**Applies to landfill pits at Site 300 at which monitoring results show statistically significant evidence of release.**
Disposition of hazardous waste	***State:***		
	Title 22, CCR, Chapter 11, Section 66261 **(Applicable, action-specific)**	**Requires identification and listing of hazardous waste.**	**Applies to the spent treatment media (granular activated carbon [GAC] and resin).**
	Title 22, CCR, Chapter 12, Section 66262.10-89 **(Applicable-action specific)**	**Establishes requirements applicable to generators of hazardous waste.**	**Applies to the spent treatment media (GAC and resin).**
	Title 22, CCR, Chapter 18, Sections 66268.1-124 **(Applicable, action-specific)**	**Identifies hazardous waste restricted from land disposal unless specific treatment standards are met.**	**Applies to the spent treatment media (GAC and resin).**
	Title 22, CCR, Chapter 13, Section 66263.10-50 **(Applicable, action-specific)**	**Governs transportation of hazardous materials.**	**Applies to the offsite transportation of spent treatment media (GAC and resin).**
	Health and Safety Code, Chapter 6.5, Sections 25100-25250.26 **(Applicable, action-specific)**	**Establishes hazardous waste control measures.**	**Applies to the spent treatment media (GAC and resin).**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
Disposition of hazardous waste *(continued)*	**Title 23, CCR, Division 3, Chapter 15, Article 2, Section 2521 (b)** **(Applicable, action-specific)**	**Requires that hazardous wastes shall be discharged only at a Class I waste management units which comply with the applicable provisions of Chapter 15.**	**Applies to the offsite disposal of spent treatment media (GAC and resin).**
	California Health and Safety Code, Division 20, Chapter 6.5, CCR, Title 22, Division 4.5, Chapters 11 and 12: Minimum Standards for Management of Hazardous and Extremely Hazardous Wastes **(Applicable, action-specific)**	**Controls hazardous wastes from point of generation through accumulation, transportation, treatment, storage, and ultimate disposal.**	**Applies to the offsite transportation of spent treatment media (GAC and resin).**
Closure	***State:*** **22 CCR 66264.110-120** **(Applicable, action-specific)**	**Requires that a facility be closed in a manner that minimizes the need for further maintenance and protects human health and the environment, and provides for post-closure care.**	**Any facility closures must meet this State equivalent of Resource Conservation and Recovery Act (RCRA).**
Storm water controls	***Federal:*** **40 CFR Parts 122, 123, 124, National Pollution Discharge Elimination System, implemented by California Storm Water Permit for Industrial Activities, State Water Resources Control Board Order #97-03-DWQ** **(Applicable, action-specific)**	**Regulates pollutants in discharges of storm water associated with hazardous waste treatment, storage, and disposal facilities, wastewater treatment plants, landfills, land application sites, and open dumps. Requirements to ensure storm water discharges do not contribute to a violation of surface water quality standards.**	**Applies to storm water discharges from industrial areas. Includes measures to minimize and/or eliminate pollutants in storm water discharges and monitoring to demonstrate compliance.**
	40 CFR Parts 122, 123, 124, National Pollution Discharge Elimination System, implemented by State Water Resources Control Board Order No. 99-08 DWQ **(Applicable, action-specific)**	**Regulates pollutants in discharges of storm water associated with construction activity (clearing, grading, or excavation) involving the disturbance of 1 acre or more. Requirements to ensure storm water discharges do not contribute to a violation of surface water quality standards.**	**Applies to construction areas over one acre or more in size. Includes measures to minimize and/or eliminate pollutants in storm water discharges and monitoring to demonstrate compliance. Projects meeting the disturbance threshold will develop project- specific construction Storm Water Pollution Prevention Plans.**

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Action(s)	Source	Description	Application
Protection of endangered species	***Federal:***		
	Endangered Species Act of 1973, 16 USC Section 1531 et seq. 50 CFR Part 200, 50 CFR Part 402 [40 CFR 257.3-2] **(Applicable, location-specific)**	**Requires that facilities or practices not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife.**	**Prior to any well installation, facility construction, or similar potentially disruptive activities, wildlife surveys will be conducted and mitigation measures implemented if required.**
	State:		
	California Endangered Species Act, California Department of Fish and Game Sections 2050-2068 **(Applicable, location-specific)**	**Requires that facilities or practices not cause or contribute to the taking of any endangered or threatened species of plants, fish, or wildlife.**	**Prior to any well installation, facility construction, or similar potentially disruptive activities, wildlife surveys will be conducted and mitigation measures implemented if required.**
Land use controls	**Hazardous Waste Property [22 CCR 67391.1 (a)(1) and (2), (d), (e)(1) and (2)]** **(Relevant and appropriate, action-specific)**	**Prohibits the federal government from transferring land where hazardous substances remain at levels that do not allow unrestricted use of the land, unless a land use covenant or other institutional control is used to ensure that future land use will be compatible with the levels of remaining hazardous materials.**	**Would apply in the event that DOE transfers property at Site 300 to another owner.**

Notes appear on the following page.

Table 2.13-1. ARARs for Site 300 selected remedies. (Continued)

Notes:

AGR =	**Agricultural supply.**	**MNA =**	**Monitored Natural Attenuation.**
CCR =	**California Code of Regulations.**	**MUN =**	**Municipal and domestic water supply.**
CEQA =	**California Environmental Quality Act.**	**PRO =**	**Industrial process supply.**
CFR =	**Code of Federal Regulations.**	**RCRA =**	**Resource Conservation and Recovery Act.**
COCs =	**Contaminants of Concern.**	**ROD =**	**Record of Decision.**
CVRWQCB =	**Central Valley Regional Water Quality Control Board.**	**SJVUAPCD =**	**San Joaquin Valley Unified Air Pollution Control District.**
DOE =	**Department of Energy.**	**SVE =**	**Soil Vapor Extraction.**
GAC =	**Granular Activated Carbon.**	**SWRCB =**	**State Water Resources Control Board.**
IND =	**Industrial service supply.**	**U.S. =**	**United States.**
MCLGs =	**Maximum Contaminant Level Goals.**	**USCA =**	**United States Code Annotated.**
MCLs =	**Maximum Contaminant Levels.**	**VOC =**	**Volatile Organic Compound.**

[a] **The RWQCB considers 92-49 applicable to the remediation of LLNL Site 300, but agrees to disagree with EPA for inclusion of 92-49 as relevant and appropriate in the Site-Wide Record of Decision.**

[b] **EPA considers the referenced CCR Title 23 and 27 sections to be parallel provisions.**

[c] **The RWQCB considers the landfill provisions of CCR Title 23 and Title 27 applicable, but agrees to disagree with EPA for inclusion of these sections of CCR Title 23 and Title 27 as relevant and appropriate in the Site-Wide Record of Decision.**

[d] **The following two policies in Chapter IV of the Basin Plan explain how appropriate cleanup levels are determined. Policy for Application of Water Quality Objectives explains how the Regional Water Board applies numerical and narrative water quality objectives to ensure the reasonable protection of beneficial uses of water and how the Regional Water Board applies Resolution No. 68-16 to promote the maintenance of existing high quality waters. Policy for Investigation and Cleanup of Contaminated Sites explains how cleanup levels are established for soils and ground water.**

[e] **DOE has agreed to prepare an analysis to determine the technical and economic feasibility of continuing ground water cleanup to further reduce contaminant concentrations below MCLs. A range of values will be considered down to water quality numeric limits or background. The technical and economic feasibility analysis will be reviewed and approved by the RWQCB, DTSC, and EPA. Any changes to ground water cleanup standards will be proposed to the community and take effect through a ROD amendment.**

[f] **The soil vapor extraction system shut-off evaluation methodology is described in Appendix B of the ROD.**

Appendix A

Environmental Protection Agency
Land Use Control Record of Decision Checklist

Appendix A

Environmental Protection Agency Land Use Control Record of Decision Checklist

1. **Map/Figure showing boundaries of the land use controls (LUCs)**

   Figures 2.9-1 through 2.9-10 show the boundaries of the land use controls.

2. **Document risk exposure assumptions and reasonably anticipated land uses, as well as any known prohibited uses which might not be obvious based on the reasonably anticipated land uses. (For example, where "unrestricted industrial" use is anticipated, list prohibited uses such as on-site company day-care centers, recreation areas, etc.)**

   Section 2.6 describes current and potential land uses. Section 2.7 describes site risks including assumptions. Section 2.9.12 describes land use restrictions. Tables 2.9-13 through 2.9-21 also describe the risks, and land use restrictions.

3. **Describe the risks necessitating the LUCs.**

   Section 2.7 and Tables 2.9-13 through 2.9-21 describe site risks necessitating the LUCs.

4. **State the LUC performance objectives. We have had comments on these because several of the objectives have not been clear. The following are some examples of what we have been looking for:**

   1. **Prevent access or use of the groundwater until cleanup levels are met.**
   2. **Maintain the integrity of any current or future remedial or monitoring system such as monitoring wells, impermeable reactive barriers.**
   3. **Maintain the 12-inch vegetative soil layer to limit ecological contact.**
   4. **Prohibit the development and use of property for residential housing, elementary and secondary schools, child care facilities and playgrounds.**

   Tables 2.9-13 through 2.9-21 describe LUC performance objectives and duration.

5. **Generally describe the LUC, the logic for its selection and any related deed restrictions/notifications**

   Tables 2.9-13 through 2.9-21 describe the LUCs, the logic for its selection, and any related deed restrictions/notifications. Section 2.9.1.2 also discusses transfer of land.

6. **Duration language: "Land Use Controls will be maintained until the concentration of hazardous substances in the soil and groundwater are at such levels to allow for unrestricted use and exposure."**

   Tables 2.9-13 through 2.9-21 describe the LUC performance objectives and duration.

7. **Include language that DOE is responsible for implementing, maintaining, reporting on, and enforcing the land use controls. This may be modified to include another party should the site-specific circumstances warrant it.**

   Language that DOE is responsible for LUC implementing, maintaining. reporting on, and enforcing the land use controls is included in Section 2.9.1.2.

8. **Where someone else will or DOE plans that someone else will ultimately be implementing, maintaining, reporting on, and enforcing land use controls, the following language should be included:**

   "Although DOE may later transfer [has transferred] these procedural responsibilities to another party by contract, property transfer agreement, or through other means, DOE shall retain ultimate responsibility for remedy integrity."

   Not applicable.

9. **Refer to the remedial design (RD) or remedial action work plan (RAWP) for the implementation actions. Because this is a new idea (i.e., including the LUC implementation actions in either or both of these two primary documents), to ensure that the requirement is clear and enforceable, we developed the following language where it makes sense:**

   "A LUC Remedial Design will be prepared as the land use component of the Remedial Design. Within 90 days of ROD signature, DOE shall prepare and submit to EPA for review and approval a LUC remedial design that shall contain implementation and maintenance actions, including periodic inspections."

   Another option is to refer to the enforceable schedule in the IAG (FFA) for the RD or RAWP.

The Remedial Design documents and the Remedial Action Work Plans for the Site 300 remedies have been completed prior to this Site-Wide ROD and the land use controls have been implemented. The land use controls are documented in Tables 2.9-13 through 2.9-21 of the Site-Wide ROD, which is legally enforceable under the FFA. In addition, the institutional and land use controls will be incorporated into the LLNL Site 300 Integrated Strategic Plan or other appropriate institutional planning documents.

Appendix B

Effluent Discharge Limitations for Ground Water Treatment Systems

Table B-1. Effluent Discharge Limitations for Ground Water Treatment Systems[a].

Contaminants of concern	Maximum daily concentration	Monthly median concentration[b]
Volatile Organic Compounds (VOCs):		
Cis-1,2-dichloroethylene	5 µg/L	0.5 µg/L
1,2-Dichloroethane	5 µg/L	0.5 µg/L
1,1-Dichloroethylene	5 µg/L	0.5 µg/L
Tetrachloroethylene (PCE)	5 µg/L	0.5 µg/L
1,1,1-Trichloroethane	5 µg/L	0.5 µg/L
Trichloroethylene (TCE)	5 µg/L	0.5 µg/L
Total VOCs[c]	5 µg/L	0.5 µg/L
High Explosive Compounds:		
High melting explosive (HMX)	1 µg/L	1 µg/L
Research department explosive (RDX)	1 µg/L	1 µg/L
4-amino 2, 6-dinitrotoluene	7.3 µg/L	2 µg/L
Radionuclides:		
Uranium (total)	20 pCi/L or 30 µg/L	Background[d]
Other:		
Nitrate (as NO_3)	45 mg/L[e]	45 mg/L[e]
Perchlorate	6 µg/L	4 µg/L
pH (in pH units)	>6.5 and <8.5	>6.5 and <8.5

Notes:

µg/L = Micrograms per liter.

mg/L = Milligrams per liter.

pCi/L = PicoCuries per liter.

[a] These discharge limits apply to OUs 2, 4, 5, 6, and 7. There are no treatment facilities in OUs 3 or 8.

[b] Using EPA Method 601 with a reporting limit of 0.5 µg/L or less for halogenated VOCs; EPA Method 8330 with a reporting limit of 1 µg/L for RDX and HMX and 2 µg/L for 4-aminodinitrotolene; EPA Method 300.0 with a reporting limit of 0.5 mg/L for nitrate; EPA Method 300.0 with a reporting limit of 4 µg/L for perchlorate; and EPA Method 200.7 (mass spectroscopy), ICPMS, or Kinetic Phosphorescence Analysis (KPA) for total uranium.

[c] Total VOCs will be the sum of all VOCs detected above the 0.5 µg/L concentrations. Discharge of individual VOCs other than those listed in the table above the 5.0 µg/L maximum daily concentration and the 0.5 µg/L monthy median concentration using EPA Method 601 is prohibited.

[d] Monthly median total uranium concentration limits will be the high end of the range of background concentrations for total uranium in ground water in the effluent discharge area.

[e] Discharge limits for nitrate apply to discharge of effluent to ground or by reinjection where active remediation is the selected remedy for nitrate. The discharge limit does not apply to Operable Units (HE Process Area OU 4 and Building 832 Canyon OU 7) that have a monitored natural attenuation remedy for nitrate or where nitrate-bearing effluent is misted.

No effluent limitations were set for TBOS/TKEBs because there is no Federal or State MCLs, California Public Health Goal (PHG), or other California Water Quality Numeric Limits (WQNL) established for these silicone oils.

Appendix C

Soil Vapor Extraction System Shut-off Evaluation

Appendix C

Soil Vapor Extraction System Shut-off Evaluation

C-1. Introduction

This Appendix presents a methodology for evaluating whether a soil vapor extraction (SVE) system can be shut off. This decision requires a comprehensive evaluation of site characterization issues, trend analysis of soil vapor concentrations and mass removal rates, human health risk, and SVE system performance. This methodology is potentially applicable to any SVE system at Site 300. It is based on similar evaluations presented in the General Services Area (GSA) Record of Decision (ROD) (U.S. Department of Energy [DOE] [1997]), U.S. Army Corps of Engineers (1995), and an unpublished report on SVE shut-off criteria for Castle Air Force Base (1999).

As presented in the SVE System Shut-off flow chart (Figure C-1), this evaluation is subdivided into three parts:

- Prerequisites to begin an SVE System Shut-off Evaluation.
- SVE System Shut-off Evaluation.
- Resolution of the SVE Shut-off Evaluation.

DOE/LLNL will make the decision to shut off the SVE system permanently only after receiving concurrence from the regulatory agencies for this action. The evaluation methodology presented here is intended to provide a framework to facilitate this decision. Other factors may be considered upon agreement with the regulatory agencies.

C-2. Prerequisites to begin an SVE System Shut-off Evaluation

An evaluation may begin after all parties agree that existing data are adequate to address the following characterization, human health risk, and SVE system performance issues:

1. There is no immediate or unacceptable human health risk.
2. The site has been adequately characterized.
    - Unsaturated (vadose) and saturated zone contamination is delineated.
    - SVE wells and soil vapor monitoring points are located appropriately both in the horizontal and vertical planes.
    - Subsurface parameters influencing soil vapor migration are quantified (i.e., moisture content, air permeability, porosity, retardation, partitioning coefficients, carbon content, etc.).
    - Geologic features that influence soil moisture and soil vapor migration are identified (i.e., low permeability zones, preferential vapor and moisture pathways, etc.).
    - Ground water flow direction, elevation changes, and other sources of ground water contamination are determined.

3. The site conceptual model is supported by subsurface and treatment facility operational data.
    - Borings, wells, and soil vapor monitoring points installed over time yield expected geologic, pressure, and chemistry data.
    - Initial and current estimates of subsurface contaminant mass agree with cumulative mass removed at the treatment facility.
4. Trend analysis of soil vapor concentration data indicate that:
    - Soil vapor and ground water concentrations in wells show decreasing trends immediately down gradient from the vadose zone sources without active ground water remediation.
    - Soil vapor concentrations show decreasing trends in all wells.
    - No significant soil vapor concentration gradients exist toward potential receptors.
    - Soil vapor concentrations have reached asymptotic levels in all wells.
    - Soil vapor concentrations in wells do not significantly increase after temporary events of SVE system shut off and subsequent restart.
5. The SVE system is designed appropriately and optimized as best as possible.
    - Vacuum influence tests show that soil vapor is extracted from contaminated areas, unsaturated zone contamination is fully captured, and maximum flushing rates are obtained in the high concentration zones.
    - SVE well field management has been optimized over time to maximize mass removal (flow rates, alternating SVE well use, etc.).
    - Mass removal rate at the treatment facility has reached asymptotic levels with no significant increase after temporary events of SVE system shutdown.
    - SVE system zone of influence reaches all contaminated areas, including potential stagnation zones in the subsurface.

C-3. SVE System Shut-off Evaluation

This evaluation can be grouped into the following three general topics:

- Quantitative analysis.
- Relationship to ground water cleanup.
- Cost/benefit analysis.

These topics represent different approaches to SVE System Shut-off Evaluation. They are not listed in order of priority and they do not all need to be satisfied to shut off an SVE system. A series of questions are presented under each topic to facilitate the evaluation. The answers to these questions will provide a basis for negotiations between DOE/LLNL and the regulatory agencies regarding whether to continue or discontinue SVE system operation.

1. Quantitative analysis for evaluating potential impact to ground water (and/or other potential receptors) from residual vadose zone contamination, using predictive tools.
    - What is the estimated residual mass in vadose zone in each media (soil vapor, soil moisture, separate phase)?

- How is the residual contamination distributed in the subsurface?
- What is the site-specific infiltration and percolation rates from rainfall recharge?
- What are the estimated values of soil vapor and soil moisture migration parameters such as, relative permeability, porosity, moisture content, carbon content, intrinsic biodegradation rates, etc.?
- What is the lowest observed depth to water at the site, and how much does it fluctuate?
- Based on the above information, does the predicted concentration of leachate in the vadose zone (using an appropriate vadose zone partitioning model) exceed ground water cleanup standard?
- Based on the leachate concentration, do the predicted ground water concentrations (using an appropriate vadose zone and ground water transport model) exceed ground water cleanup standard?

2. Assessment of SVE system operation relative to the state of ground water remediation, to determine if continued operation of the SVE system further assists reaching the overall cleanup standards.
   - What are the location and capture zones of ground water extraction wells relative to the vadose zone contamination?
   - What is the predicted time to cleanup for ground water (using a ground water transport model) with and with out operation of the SVE system?
   - Does the operation of the SVE system enhance or impede ground water remediation system performance?
   - Does the operation of the SVE system enhance or impede intrinsic degradation processes in ground water and/or vadose zone?
3. Preparation of a detailed, comparative cost-benefit analysis to assess the feasibility of long-term costs under continued operation versus shut-off scenarios.
   - What is the cost per unit contaminant mass removed from the subsurface by the SVE and ground water extraction (GWE) systems?
   - What is the predicted time to cleanup and cost (using appropriate vadose zone and ground water transport models) for the vadose zone and ground water contamination when both SVE and GWE systems are operational?
   - What is the predicted time to cleanup and cost (using appropriate vadose zone ground water transport models) for the vadose zone and ground water contamination when only the GWE system is operational and there is additional impact from residual contamination from the vadose zone?
   - Based on the above information, does the operation of the SVE system significantly reduce the time and cost to reach ground water cleanup standards?
   - What are the predicted effectiveness and cost of further enhancements to the SVE system (e.g., additional SVE wells, air injection, air-sparging, bioventing) beyond optimization of the existing system?

- How does the mass removed by operating the SVE system under asymptotic concentrations compare to the resulting environmental impact of operating the SVE system?

C-4. Resolution of the SVE Shut-off Evaluation

There are five general outcomes from an SVE Shut-off Evaluation:

1. The vadose zone remediation is determined to be complete and the SVE system can be permanently shut off.
2. The residual mass of contaminants in the vadose zone will not impact ground water at concentrations exceeding cleanup standards. Therefore continued soil vapor and ground water monitoring without SVE system operation is appropriate.
3. The residual mass of contaminants in the vadose zone will impact ground water at concentrations exceeding cleanup standards, however, continued SVE system operation will not significantly reduce the time to reach ground water cleanup standards. Therefore continued ground water extraction without SVE system operation is appropriate.
4. The residual vadose zone contamination will impact ground water at concentrations exceeding cleanup standards, therefore continued SVE system operation is appropriate.
5. The residual vadose zone contamination will impact ground water at concentrations exceeding cleanup standards and continued SVE system operation is not adequate to remediate the residual contamination. Therefore, the deployment of an SVE enhancement technology (air-sparging, bioventing, permeability enhancement methods, thermal or chemical enhancement methods, etc.) and/or another remedial solution (excavation, vitrification, barometric pumping, horizontal wells, etc.) is appropriate.

Ground water and soil vapor monitoring will be conducted throughout the life of the Buildings 834, 854, and 832 Canyon OU remediation projects. Monitoring data will be used to continually optimize treatment system operation and provide input for this evaluation.

C-5. References

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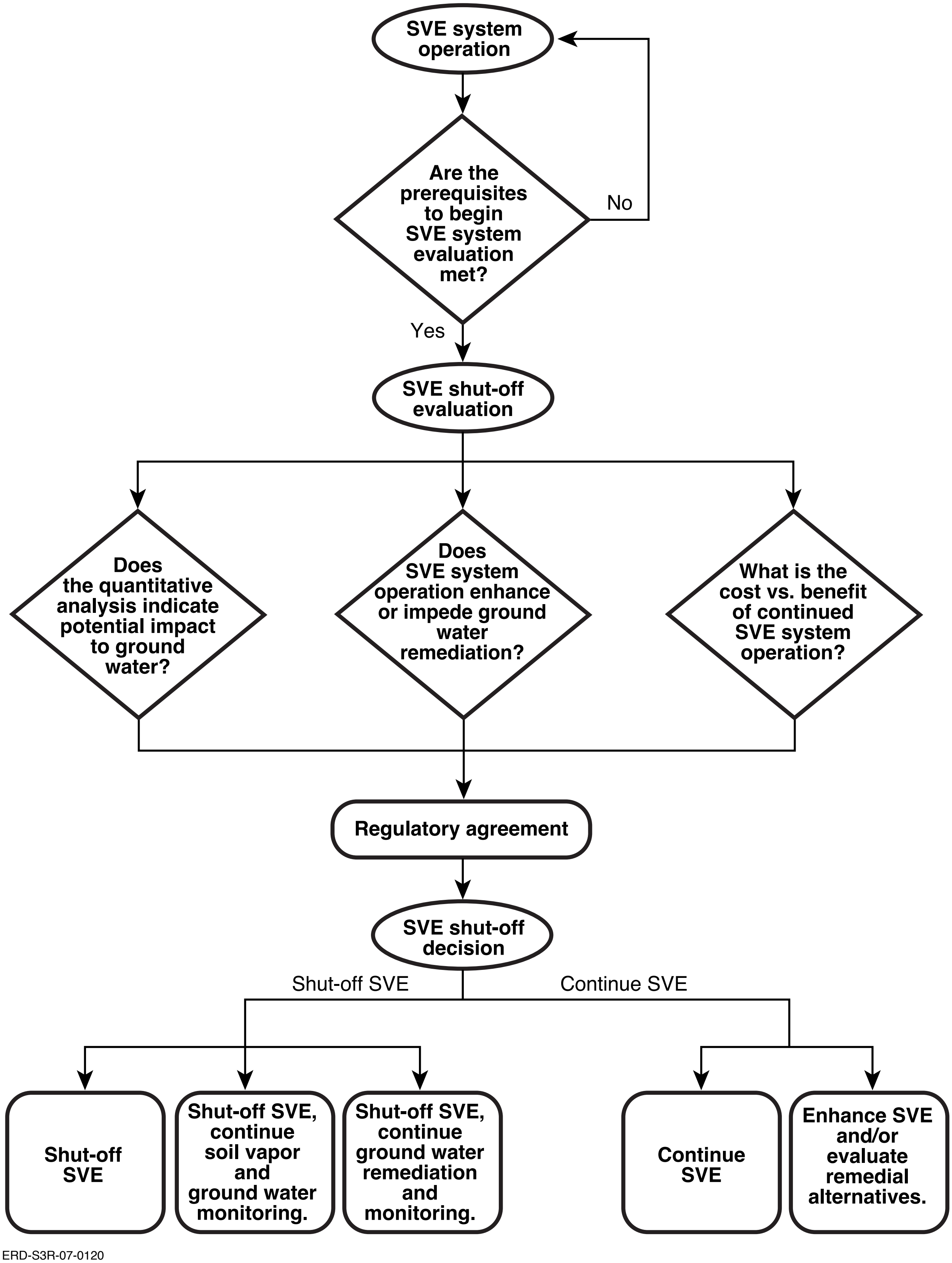

Figure C-1. Soil vapor extraction (SVE) system shut-off evaluation flow chart.

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