TABLES

Table 2-1. Aerial Photograph Inventory - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Date	Supplier
8/20/1937	National Archives and Records Administration
8/21/1937*	National Archives and Records Administration
8/2/1952*	National Archives and Records Administration
1957	Geonex Cartwright Aerial Surveys, Inc.
6/3/1957*	U.S. Department of Agriculture
7/20/1962	Geonex Cartwright Aerial Surveys, Inc.
5/8/1964*	U.S. Department of Agriculture
1965*	Geonex Cartwright Aerial Surveys, Inc.
4/25/1966	Pacific Aerial Surveys
9/12/1966	Geonex Cartwright Aerial Surveys, Inc.
5/3/1968	Pacific Aerial Surveys
5/28/1968	United States Geological Survey
1970	Geonex Cartwright Aerial Surveys, Inc.
3/21/1970	Geonex Cartwright Aerial Surveys, Inc.
8/31/1970	Pacific Aerial Surveys
7/13/1973*	Geonex Cartwright Aerial Surveys, Inc.
5/14/1979	Pacific Aerial Surveys
11/28/1980	Geonex Cartwright Aerial Surveys, Inc.
4/21/1982	Geonex Cartwright Aerial Surveys, Inc.
1984	Environmental Data Resources, Inc.
7/31/1986	Geonex Cartwright Aerial Surveys, Inc.
7/18/1989	Pacific Aerial Surveys
1993	Environmental Data Resources, Inc.
8/17/1993	Pacific Aerial Surveys
8/2/1995	Pacific Aerial Surveys
1998	Environmental Data Resources, Inc.
2005	Environmental Data Resources, Inc.
8/31/2006*	Merrick & Company

Note:
*Used in this report; see Figures 2-5 through 2-11.

Table 2-2. Chronology of Investigation and Remediation Activities - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Date	Investigation	Scope/Purpose	References
October 1984	Initial Assessment Survey	▪ Assessed radiological and chemical contamination associated with historic Laboratory for Energy-related Health Research (LEHR) activities ▪ Collected surface/subsurface soil samples (22), hand-held meter surveys, wipe sample collection ▪ Interviewed site personnel regarding research, radionuclides used, and handling and disposal practices	Rockwell International, 1984
March 1988	Environmental Survey Preliminary Report	▪ Ranked prioritized areas within the Site based upon previous Site activities (no samples collected) ▪ Assessed potential immediate threats to public health and identified areas in need of further investigation ▪ Indicated disposal practices as source of soil and groundwater contamination	DOE, 1988
1987 and 1988	Phase I Groundwater and Soils Investigations	▪ Evaluated impacts of radioactive contamination to soil and groundwater downgradient of UC Davis and DOE Areas ▪ Nine wells installed; eight in hydrostratigraphic unit(HSU)-1 and one in HSU-2 ▪ 43 soil borings drilled ▪ 15 trenches excavated ▪ Did not locate all documented burial trenches	Wahler and Associates, 1988; Wahler and Associates, 1989
1989	Air Solid Waste Assessment Test (Air SWAT)	▪ Completed an Air SWAT questionnaire for UC Davis areas as required by the California Air Resources Board ▪ Completion of an Air SWAT was not required based upon results of the questionnaire	UC Davis, 1989
June 1989	Evaluation of On-Site Wells	▪ Recommended future use/abandonment of 10 wells at the LEHR facility ▪ Investigated high turbidity in nine monitoring wells installed during 1987 Phase I field work, and recommended 10th well for abandonment (well abandoned in 1990; groundwater samples collected prior to abandonment)	Dames & Moore, 1990a
1990	Solid Waste Assessment Test (SWAT)	▪ Investigated potential leakage from UC Davis Old Campus Landfill units and evaluated potential impacts to groundwater, surface water, and vadose zone ▪ Three disposal areas identified ▪ Five monitoring wells installed upgradient and downgradient of landfill disposal areas; UCD-2 abandoned; four vadose zone wells installed ▪ Soil samples collected from well borings during well installation ▪ Quarterly monitoring performed for one year in nine groundwater wells and Putah Creek surface water	Dames & Moore, 1990b
March 1990	Evaluation of Potential Nitrate and Hexavalent Chromium Sources	▪ Investigated elevated levels of nitrate (as nitrogen) and hexavalent chromium (Cr(VI)) in eight off-Site, private wells	Dames & Moore, 1990c
July 1990	Contaminant Pathway Analysis	▪ Investigated potential migration of contaminants indentified in the 1990 SWAT investigation to assess if pathways extended north of Interstate-80 using air dispersion and groundwater models ▪ Focused on migration from LEHR facility and adjacent sites to the main UC Davis campus ▪ Study conclusions incorporated into environmental documentation for the UC Davis Long Range Development Plan ▪ Potential migration pathways identified: (1) direct contact with surface soils at LEHR; (2) resuspension and air dispersion of fugitive dust from surface soils; (3) migration through soil and groundwater; (4) migration to surface water	Dames & Moore, 1990d
August 1990	Putah Creek Sediment and Water Sampling	▪ Sediment and surface water samples collected during low-flow conditions from Putah Creek upstream and downstream of the LEHR facility to serve as a baseline for low-flow periods	Dames & Moore, 1990e
1991	Waste Burial Trench Investigation	▪ Excavation of 26 exploratory trenches by Wahler and Associates and 18 exploratory trenches by Dames & Moore to investigate the location of waste materials disposed of in waste burial trenches at the Site ▪ Samples collected from 18 trenches ▪ Ground-penetrating radar (GPR) surveys used to locate waste burial trenches ▪ GPR anomalies correlated with burial areas ▪ Three grab soil samples collected from waste burial trenches in the southwest corner of the LEHR Site	Dames & Moore, 1991a
1991	California Environmental Quality Act (CEQA) Preliminary Study for Site Investigation	▪ Preliminary environmental study conducted as part of CEQA to assess potential environmental impacts using post-SWAT characterization studies at the LEHR landfill sites ▪ Impacts found to be eligible for categorical exemption under Title 14 of the California Code of Regulations	Dames & Moore, 1991b
September 1991	Old UC Davis Landfill Additional Characterization	▪ Evaluation of the vertical and lateral extent of constituents detected in SWAT groundwater samples ▪ 31 cone penetrometer test (CPT) penetrations performed and 50 Hydropunch™ groundwater samples collected downgradient of the wells where elevated levels of constituents were detected in groundwater during the 1990 SWAT	Dames & Moore, 1991c
February 1993	Phase II Site Characterization	▪ Objective was to identify potential contaminant sources, define magnitude and extent of impacts, and identify deficiencies in data collected at the Site during previous investigations	Dames & Moore, 1993

Table 2-2. Chronology of Investigation and Remediation Activities - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Date	Investigation	Scope/Purpose	References
		▪ Scope included soil boring (48 samples), sediment sampling (2 samples), and installation of 10 deep and shallow groundwater monitoring wells ▪ Installed seven monitoring wells screened in HSU-1 and three monitoring wells screened in HSU-2 ▪ Soil sampling from on-Site underground domestic septic tanks ▪ Aquifer analyses and pump tests ▪ One year of quarterly sampling at 18 groundwater monitoring wells and six surface water sampling stations on Putah Creek ▪ Soil characterization in DOE areas only (UC Davis areas excluded since no historical or operational information available at the time to indicate UC Davis involvement in those areas)	
September 1994	Draft Final Remedial Investigation (RI) and Feasibility Study (FS) Work Plan	▪ The RI/FS work plan summarized the Site characterization work to date and presented the plan and basis for completing the RI, FS, and Site-wide risk assessment ▪ Included a draft Quality Assurance Project Plan (QAPP) and draft Field Sampling Plan (FSP) ▪ Regulatory agencies decided that the document would not be finalized and subsequent work would be completed under separate work plans and supplemental QAPP and FSP documents	Dames & Moore, 1994
1995	Historical Aerial Photograph Review	▪ Reviewed and interpreted aerial photographs of the Site and surrounding areas ▪ Photographs dated from 1937 through 1989	Dames & Moore, 1995
1995	Geophysical and Soil Gas Investigations	▪ Summarized several geophysical and soil gas investigations ▪ Report identified data gaps needed to be filled before formal evaluation of prescriptive remedial actions for each source area ▪ Summarized surface geophysical investigations performed by Norcal Geophysics in 1994 and soil gas and near-surface soil sampling performed by Dames & Moore in 1995 (references not cited for these investigations) ▪ Up to 157 soil gas locations sampled and analyzed for volatile organic compounds (VOCs) between 2.5 and 12 feet below ground surface (bgs) in UC Davis and DOE areas	PNNL, 1995a; PNNL, 1995b
1995-1996	Groundwater Characterization	▪ Installed and sampled five groundwater monitoring wells and performed Hydropunch™ investigations ▪ 61 locations sampled ▪ Groundwater samples collected surrounding monitoring well UCD1-12 to evaluate the extent of chloroform contamination around the well ▪ Hydropunch samples collected downgradient of Landfill Unit (LFU)-3 to assess potential source of chloroform	PNNL, 1996a; Dames & Moore 1996a
August 1995 - August 1996	Baseline Air Investigation	▪ Conducted fence line air emissions study to evaluate meteorological conditions and concentrations of particulate and gaseous constituents identified as constituents of concern in the RI/FS Work Plan ▪ Samples collected quarterly during 1995 and 1996 from three perimeter air sampling stations and one remote sampling station located five miles west, and upwind, of the Site ▪ Gamma-emitting radiological constituents, cesium-137, lead-212, bismuth-214, and lead-214 found to have higher concentrations on-Site than at the upwind locations, but these concentrations were well below the DOE-derived concentration guides ▪ Thorium-230 and -232 had statistically significant higher concentrations on-Site than at upwind locations ▪ Concentrations of particulate matter with a diameter of less than 10 micrometers on-Site exceeded standards during one sampling event that was characterized by heavy winds ▪ Beryllium was detected at higher concentrations on-Site than off-Site during one sampling event	PNNL, 1996b
1996	Landfill Unit 1 Data Gaps Limited Field Investigation (LFI)	▪ LFU-1 investigation portion of Data Gaps LFI according to Revised Data Gaps Work Plan from May 1996 to assess potential settlement, gas production, cap compatibility with landfill materials, and the potential groundwater impacts, as well as to evaluate the lateral and vertical limits of the landfill ▪ Geophysical investigation of the "X" Building area east of former cobalt-60 field ▪ Thirteen exploratory trenches along the limits of the landfill ▪ Four soil borings advanced through buried waste to depth of 35 feet bgs (just above high groundwater elevation) ▪ Nine waste and four soil gas samples collected within the waste disposal cells ▪ Seven soil samples collected at various depths within and below the waste disposal cells ▪ Waste material encountered in 11 of 13 trenches excavated, and all four soil borings drilled in this investigation	Dames & Moore, 1996b

Table 2-2. Chronology of Investigation and Remediation Activities - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Date	Investigation	Scope/Purpose	References
1996	Landfill Unit 2 Data Gaps Limited Field Investigation	▪ LFU-2 investigation portion of Data Gaps LFI, according to Revised Data Gaps Work Plan from May 1996, to assess potential settlement, gas production, cap compatibility with landfill materials, and the potential groundwater impacts, as well as to evaluate the lateral and vertical limits of the landfill ▪ Thirteen exploratory trenches along limits and within interior of landfill ▪ Three soil borings drilled through buried waste to 35 feet bgs (above high groundwater elevation) ▪ Eleven waste and three soil gas samples collected within waste disposal cells ▪ Seven soil samples collected at various depths within and below the waste disposal cells ▪ Waste material encountered in 11 of 13 trenches excavated and all three soil borings	Dames & Moore, 1996c
1996	Landfill Unit 3 Data Gaps Limited Field Investigation	▪ LFU-3 investigation portion of Data Gaps LFI, according to Revised Data Gaps Work Plan from May 1996, to assess potential settlement, gas production, cap compatibility with landfill materials, and the potential groundwater impacts, as well as to evaluate the lateral and vertical limits of the landfill ▪ Ten exploratory trenches along limits of landfill ▪ Two soil borings drilled through buried waste to 35 feet bgs (above high groundwater elevation) ▪ Ten waste and two soil gas samples collected within the waste disposal cells ▪ Waste material encountered in eight of ten trenches excavated and both soil borings drilled in this investigation	Dames & Moore, 1996d
July - September 1996	Eastern Trenches (ET) Data Gaps Limited Field Investigation	▪ ET investigation portion of Data Gaps LFI according to Revised Data Gaps Work Plan from May 1996 ▪ Evaluated possibility of presumptive remedial alternatives for the ET (containment, partial removal, or treatment) by assessing composition, location, depth of waste, and tritium impacts observed in Site groundwater ▪ Five exploratory trenches within limits of land disposal unit ▪ Three soil borings drilled through buried waste ▪ Soil and waste samples collected from four of five exploratory trenches ▪ Disposal cells with waste material encountered in all five trenches excavated and all three soil borings	Dames & Moore, 1997a
August - September 1996	Southern Trenches (ST) Data Gaps Limited Field Investigation	▪ ST investigation portion of Data Gaps LFI according to Revised Data Gaps Work Plan from May 1996 ▪ Evaluated possibility of presumptive remedial alternatives for the ST (no action, limited action, containment, removal, or treatment) by assessing composition, location, depth of waste, and assessed potential for waste in the ST to impact groundwater ▪ Four exploratory trenches within the limits of the land disposal unit ▪ Three soil borings drilled through buried waste ▪ Waste encountered in three of four exploratory trenches; soil and waste sampled in each trench	Dames & Moore, 1998a
August - September 1996	Waste Burial Holes (WBH) Data Gaps Limited Field Investigation	▪ WBH investigation portion of Data Gaps LFI according to Revised Data Gaps Work Plan from May 1996 ▪ Evaluated possibility of presumptive remedial alternatives for the WBH by assessing composition, location, depth of waste and assessed potential for waste in the WBH to impact groundwater ▪ Six exploratory trenches; waste encountered in five of six trenches ▪ Two shallow cover soil samples collected ▪ Waste encountered in five of six exploratory trenches, soil and solid waste sampled in each ▪ Seven waste burial holes encountered, which correlated with previous geophysical survey results	Dames & Moore, 1998b
1997	Background Soil Data Investigation	▪ Background soil samples collected from six off-Site borings to depth of 40 feet bgs	Dames & Moore, 1997b
1997	Engineering Evaluation/Cost Analysis for Groundwater Interim Remedial Action (IRA)	▪ Evaluated alternatives for capturing, treating, and disposing of groundwater from HSU-2 downgradient of site sources for implementation as a groundwater interim remedial action ▪ Presented background data and information relevant to IRA activities, described the IRA objectives, and evaluated remedial alternatives satisfying the objectives ▪ Identified groundwater constituents ▪ Recommended groundwater extraction with VOC removal and reinjection of treated water	Dames & Moore, 1997c
1997	Groundwater IRA Startup	▪ IRA treatment system installed and started operations in May 1998 to extract and treat groundwater from HSU-2 ▪ Treated extracted groundwater for VOCs (mostly chloroform) ▪ Reinjected upgradient of treatment system ▪ System performance reported in Annual Groundwater Treatment System and Water Monitoring Reports	Geomatrix, 2004

Table 2-2. Chronology of Investigation and Remediation Activities - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Date	Investigation	Scope/Purpose	References
1998	Additional Background Soil Data Investigation	▪ Additional background soil samples collected to supplement background data provided in the Background Soil Data Investigation (1997) ▪ Six off-Site borings drilled and samples collected to 40 feet bgs ▪ Background levels established for different soil types for constituents showing significant differences in concentrations based on sample depth	Weiss, 1998
1997 and 1998	Fish Sampling in Putah Creek	▪ Fish samples collected from Putah Creek to evaluate the concentrations of mercury, lead, and radionuclides in different fish species in Putah Creek ▪ Results indicated regional existence of constituents	ATSDR, 1997; ATSDR, 1998
1998	Old Wastewater Treatment Plant Data Gaps Limited Field Investigation	▪ One soil boring drilled through former drying bed and one boring drilled 100 feet downgradient of former drying bed	Dames & Moore, 1998c
1998	Additional Hydropunch Investigation	▪ Assessed distribution of chloroform in HSU-2 downgradient of the Site and supplemental data collected by Pacific Northwest National Laboratory in 1995-96 ▪ Eight CPT penetrations and ten Hydropunch™ borings sampled ▪ Hydropunch™ samples collected from upper portion of HSU-2 ▪ Identified the off-Site boundaries of the chloroform plume in HSU-2	Dames & Moore, 1998d
1998	Concrete Lining of Drainage Ditch Adjacent to LFU-3 (IRA)	▪ UC Davis lined the north-south trending ditch with concrete to prevent erosion from LFU-3 ▪ Ditch completed in 1980s as runoff drainage point for south campus ▪ Disturbed the eastern portion of LFU-3; exposed buried construction debris ▪ UC Davis lined the ditch as a maintenance action; no work plan or report generated	Geomatrix, 2004
1998	Evaluation of *in situ* Treatment, Nitrate, and Cr(VI) and VOCs in Groundwater	▪ Evaluated potential for natural attenuation and/or *in situ* reduction, using biological treatment or ion exchange of nitrate, Cr(VI), and VOCs ▪ Data from Air Force remedial activities at Mather and McClellan Air Force Bases was collected for comparison	unpublished data compilation by UC Davis
1999	Study of Mercury Bioaccumulation in Fish in Putah Creek	▪ UC Davis researchers studied mercury bioaccumulation in fish upstream and downstream of LEHR/Old Campus Landfill (OCL) ▪ Concluded that mercury concentrations were present at levels of potential concern in edible muscles of larger fish and small or juvenile fish; may represent a chronic hazard to fish-eating wildlife	Slotton et al., 1999
January 1999	Abandonment of Well 22N	▪ Irrigation well (22N) screened in HSU-2 and HSU-4 abandoned in January 1999 ▪ Well thought to be a conduit for chloroform migration because it was screened between the hydrostratigraphic units ▪ Groundwater monitoring results showed consistent reduction in chloroform concentrations just prior to abandonment that continued falling after the well was abandoned ▪ New HSU-4 well (UCD-44) installed in April 1999, upgradient of abandoned 22N	Dames & Moore, 1999a
August 1998 - November 1998	Groundwater Source Investigation	▪ Purpose of investigation was to collect data to supplement previous data and evaluate the nature and extent of several potential source areas to groundwater ▪ Assessed the effectiveness of addressing the source areas through removal or interim removal actions ▪ Conducted pump test, soil gas surveys, soil gas down hole, and surface flux sampling, and reviewed existing data to assess lateral and vertical extent of VOC plume and natural attenuation potential of chlorinated VOCs in groundwater ▪ Identified groundwater constituents for study, including chloroform and associated VOCs, nitrate, total dissolved solids, Cr(VI), total chromium, carbon-14, and tritium ▪ Pump test performed for HSU-1 to assess hydraulic conductivity near source areas ▪ Compiled and reviewed available regional and Site chromium, nitrate, and total dissolved solids data to evaluate the need for additional source evaluation or treatment ▪ Assessed existing data to evaluate the level of intrinsic biodegradation occurring around the edge of VOC plume ▪ Pump test suggested dual-phase remediation strategy (groundwater extraction and soil vapor extraction)	Dames & Moore, 1999b; Dames & Moore, 2000b Geomatrix, 2004
1999 and 2000	WBH Interim Removal Action	▪ Removed low-level radioactive waste (LLRW), debris, and other source material potentially impacting groundwater in the WBH area ▪ 32 discrete burial holes identified and excavated ▪ 900 cubic yards of waste material and soil excavated ▪ 20 percent waste and 80 percent soil (by volume) ▪ Sorted to produce 157 cubic yards of waste ▪ Waste classified as LLRW and shipped off-Site for disposal	Dames & Moore, 1999c; Dames & Moore, 2000c

Table 2-2. Chronology of Investigation and Remediation Activities - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Date	Investigation	Scope/Purpose	References
		▪ 32 post-excavation soil samples collected from bottom of excavation and from two feet below bottom of selected waste burial holes ▪ Excavated soils used as backfill for the excavation and imported clean fill used to cap excavated area	
2000	Chemical and Aquatic Toxicity Monitoring	▪ Yolo County Department of Environmental Health, UC Davis, and Central Valley Regional Water Quality Control Board (CVRWQCB) performed chemical and aquatic toxicity monitoring in the Cache and Putah Creek watersheds in 1998 and 1999 ▪ Evaluated whether constituents were present in creeks at concentrations affecting organisms' abilities to live, grow, and reproduce ▪ Characterized life toxicity over complete hydrologic cycle using US EPA Three Species Toxicity Tests ▪ Sample collection sites around the LEHR/OCL Site and UC Davis Old Wastewater Treatment Plant (OWTP) ▪ OWTP effluent sampled ▪ Site's contribution of surface water toxicity could be not determined as in-stream sampling events did not correspond to storm water events, but previous storm water sampling has found Site storm water to be non-toxic	CVRWQCB, 2000
2000	Groundwater IRA Treatment/Discharge Options Report	▪ Evaluated potential long-term corrective action alternatives for enhancement of the groundwater IRA ▪ IRA effluent began to exceed monthly average discharge limits for nitrate (N) and total dissolved solids (TDS) in summer 1999 ▪ Groundwater extraction rate reduced to limit transport of nitrate and TDS from HSU-1 to HSU-2 ▪ Chosen alternative involved blending low-nitrate, low-TDS water with IRA effluent in combination with land application	Dames & Moore, 2000a Dames & Moore, 2000d
2000	Land Treatment Pilot Study Work Plan	▪ Designed a pilot irrigation system to use treated removal action effluent for horse pastures to bring effluent water quality into compliance with Administrative Order of Consent #99-16/Waste Discharge Requirements ▪ Designed and constructed a mixing system to blend low-TDS (Berryessa) water with removal action effluent, but was later terminated due to biofouling	MWH, 2000
2000	Pilot Test Expansion; Density Driven Convection (DDC) Well System	▪ Expanded the pilot system for source removal of chloroform and other VOCs ▪ DDC Pilot Study initiated in spring 2001 to test DDC and soil vapor extraction technologies ▪ Designed as chloroform and VOC source removal program for HSU-1 ▪ DDC system performance reported in Annual Groundwater Treatment System and Water Monitoring Reports	Brown and Caldwell, 2002
2001	Background Groundwater Study	▪ Study performed to meet requirements of Amended Scope of Work in US EPA Administrative Order on Consent and Waste Discharge Requirements (WDRs) ▪ Statistical background study for inorganic constituents was required to allow RWQCB to use the data to evaluate discharge limits for groundwater effluent from the removal action to be applied as irrigation water to Land Treatment Pilot Study (LTPS) irrigated pasture without degrading HSU-1 ▪ Groundwater quality data from 1991 to 2000 from well UCD1-18 (screened in HSU-1) used to estimate background concentrations for selected constituents	MWH, 2001a
2001	WBH Characterization	▪ Evaluated surface soils for hazardous waste characteristics and evaluated constituents of concern in soils beneath previous WBH waste; new data combined with previous investigation and post-removal action confirmation sample data to evaluate additional impacts to groundwater as part of the RI/FS ▪ Evaluated if soils remaining after November 1999 WBH removal action would impact groundwater above water quality goals for any chemicals including carbon-14 and tritium ▪ Twenty-one grab samples from 10 boreholes ▪ Samples from clean soil between burial holes, adjacent to waste material, and sorted soil (formerly intermingled with waste material)	MWH, 2001b; MWH, 2001c
2002	2002 Data Gaps Investigation	▪ Previous UC Davis RI/FS activities and removal actions summarized to identify data gaps needed to be filled prior to completion of the RI, FS, and Site-wide Risk Assessment (SWRA) ▪ Collected surface soil samples in non-UC Davis Areas to obtain additional chemical and radiological data for human health and ecological risk evaluations ▪ Collected surface soil samples from selected UC Davis Areas (LFU-1, LFU-2, ET, ST) to provide additional chemical and radiological data for human health and ecological risk evaluations ▪ Collected soil samples from 2.5 to 3 feet bgs, including sorted soil in the WBH area to fill data gaps for waste classification of nickel and evaluate split samples for tritium and carbon-14 analysis	MWH, 2002

Table 2-2. Chronology of Investigation and Remediation Activities - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Date	Investigation	Scope/Purpose	References
		▪ Collected additional surface soil samples from background areas to supplement surface soil Cr(VI) background data for use in the human health and ecological risk evaluations ▪ Collected additional background monitoring well samples; concentrations of organic and inorganic compounds and radionuclides from all background wells from 1994 to 2002 evaluated ▪ Installed new HSU-2 groundwater monitoring well located near chloroform and VOC source area ▪ Collected additional storm water flow measurements ▪ Collected surface water flow data for Putah Creek ▪ Sampled sediment and benthic macroinvertebrates to evaluate potential ecological impacts in Putah Creek	
July 2003	Technical Memorandum - Regional and Site-Specific Occurrence of Hexavalent Chromium in Soil and Groundwater	▪ Reviewed groundwater monitoring results from HSU-1, HSU-2, and HSU-4 for chromium ▪ Sampled soil near UCD1-28 (highest historic concentrations of Cr(VI)) ▪ Conducted literature review focused on natural generation of Cr(VI) in soils to develop a hypothesis explaining the elevated concentrations present at the Site ▪ Researched local, regional, and statewide concentrations of Cr(VI) in groundwater	MWH, 2003
2004	Remedial Investigation Report	▪ Summarized 15 years of investigation and analysis of the Site ▪ Data presented form the basis for making decisions concerning future remedial actions in the FS and SWRA	Geomatrix, 2004
2004, 2005, 2006	Human Health Risk Assessment (HHRA)	▪ Part A of the HHRA, Volume 1, is the human health risk estimate for the entire LEHR/OCL facility, including areas under the responsibility of DOE and UC Davis ▪ Part B of the HHRA is the human health risk characterization for the DOE areas ▪ Part C of the HHRA is the human health risk characterization for the UC Davis areas ▪ Provided a list of constituents of concern to be included in the FS, based on protection of human health and groundwater	MWH, 2004; Weiss, 2005; Brown & Caldwell, 2006
2006	Ecological Risk Assessment	▪ Provided evaluation of potential ecological risks associated with Site, based on data from previous investigations and reports ▪ Site-wide Ecological Risk Assessment (SWERA) included both risk estimate and risk characterization for the entire LEHR/OCL Site ▪ SWERA concluded Landfill Unit Nos. 1, 2, and 3 present potential unacceptable risk to ecological receptors	BBL, 2006
August 2008	Data Gaps Work Plan	▪ Addressed data gaps that needed to be filled prior to completion of the UC Davis FS	Weiss, 2008
July 2009	Prima Environmental Chromium and Manganese Bench Tests	▪ 30 soil samples collected from background and chromium "hot spot" areas used to evaluate whether Cr(VI) is naturally occurring at the LEHR UC Davis Site	Prima Environmental, 2009
July-September 2009	Cr(VI) Reduction Bench Scale Test	▪ Evaluated potential reducing agents for *in situ* reduction of Cr(VI) ▪ Assessed potential for undesirable groundwater impacts	UC Davis, 2009
November 2009	Addendum to Feasibility Study Data Gaps Work Plan	▪ Installed new monitoring well (UCD1-067) to address data gap concerning the northern extent of the chloroform, chromium, and 1,4-dioxane contaminant plumes in HSU-1 ▪ Well location is downgradient of the ET, LFU-2, and WBH	Weiss, 2009
January 2010	Final Pilot Test Work Plan for *in situ* Reduction of Chromium	▪ Pneumatically fractured subsurface media and injected a reducing agent, calcium polysulfide ▪ Twelve new, temporary monitoring wells installed (in addition to one injection well) to aid in assessing the effectiveness of Cr(VI) reduction and potential adverse effects to groundwater	Weiss, 2010a
February 2010	FS Data Gaps Technical Report	▪ Reviewed data and information of potential Cr(VI) source mechanisms to determine sampling locations and analytic plan for Cr evaluation ▪ Collected soil samples from two background and two chromium "hot spot" areas (28 samples collected) ▪ Collected groundwater from two background locations and two "hot spot" locations in HSU-1 and at top of HSU-2 ▪ Delineated the extent of elevated HSU-1 groundwater Cr by collection of six Hydropunch™ groundwater samples to guide locations of two new HSU-1 monitoring wells ▪ Installed three additional HSU-1 monitoring wells and two additional HSU-2 monitoring wells ▪ Provided geochemical and chromium data for new and selected existing wells in HSU-1 and HSU-2 to investigate Cr(VI) source and distribution through quarterly sampling for one year ▪ Incorporated new Data Gaps data with existing Site data to assess the source of elevated Cr in groundwater, the extent and temporal evolution of elevated Cr in HSU-1, the impact of Cr in HSU-1 on HSU-2, and the future fate of elevated Cr in groundwater with or without remediation ▪ Sampled downgradient of LFU-1, in the LFU-2/ET area, and in the east end of the WBH area	Weiss, 2010b

Table 2-2. Chronology of Investigation and Remediation Activities - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Date	Investigation	Scope/Purpose	References
		▪ Installed four new HSU-1 wells to monitor disposal unit impact including: 1) eastern edge of LFU-3; 2) eastern boundary of LFU-2/ET; 3) immediately east of the WBH; 4) northeast corner of LFU-1 ▪ Four quarters of monitoring for groundwater constituents of potential concern (COPCs) and selected other compounds performed	
		▪ Provided baseline analytic data for full suite of COPCs for groundwater in new wells ▪ Used to create analyte list for continual monitoring of the wells and comparison with the predicted groundwater impact based on vadose zone modeling	
		▪ Provided soil, soil gas, first groundwater, and soil physical property data needed for evaluation of potential impact of disposal unit vadose zone COPCs on groundwater ▪ Soil gas data also used for evaluation of potential vapor intrusion risk ▪ Seven soil/groundwater borings (one each in LFU-1, LFU-2, LFU-3, ET, and ST and two in WBH)	
		▪ Evaluated potential risks associated with intrusion of VOCs from UC Davis disposal units into indoor air ▪ Reassessed potential vapor intrusion risk associated with VOCs present in disposal areas, and evaluated whether revision to Human Health Risk Characterization Report is needed ▪ Evaluated potential presence of methane and associated risks ▪ Eight soil gas/groundwater borings (one each in LFU-1, LFU-3, ET, ST, and WBH and three in LFU-2)	
		▪ Developed vadose zone screening levels for groundwater protection, conducted risk characterization, and identified groundwater impact constituents of concern for each disposal unit, based on new and existing Site data ▪ Evaluated potential vapor intrusion to indoor air and methane risk	
1987 - Present	Water Monitoring Programs	▪ 1987 - Groundwater monitoring commenced	Weiss, 2009; Wahler and Associates, 1988; PNNL, 1994;
		▪ 1990 - Comprehensive groundwater monitoring analytical program started -- quarterly monitoring for VOCs, semi-volatile organic compounds (SVOCs), organochlorine pesticides/polychlorinated biphenyls, radiologic parameters, metals, and general chemical parameters	PNNL, 1996a; Dames & Moore, 1999d; Brown & Caldwell, 2002; Dames & Moore, 1990a;
		▪ 1994 - Formalized Water Monitoring Plan including surface and storm water sampling. Putah Creek and storm water runoff samples from LEHR/OCL collected semi-annually from 1994 to 2007	CVRWQCB, 1997
		▪ 1997 - Responsibility for groundwater monitoring transferred from DOE to UC Davis (Memorandum of Agreement); WDRs issued that required some wells to be monitored monthly	
		▪ 1998 - Groundwater monitoring program established based on recommendations in 1998 Water Monitoring Report (Dames & Moore, 1999). Recommendations included monitoring for nitrate-N, TDS, tritium, carbon-14, total chromium, chloroform, and VOCs; eliminated SVOCs, chlorinated pesticides, and other metals monitoring except in new wells. Changes approved by the Remedial Project Managers (RPMs) in September 1999.	
		▪ 2001 - Additional changes proposed in the 2001 Water Monitoring Report; accepted by the RPMs in 2002 ▪ Present - focuses on six constituents of concern: nitrate, TDS, Cr(VI), chloroform (and other VOCs), tritium, and carbon-14	
		▪ Focus is on remedial action monitoring of the groundwater IRA and DDC systems ▪ Groundwater and storm water data summarized and reported with groundwater IRA data annually	

Table 2-2. Chronology of Investigation and Remediation Activities, Laboratory for Energy-related Health Research/South Campus Disposal Site, University of California, Davis

Acronyms/Abbreviations:

AOC - Administrative Order on Consent
ATSDR - Agency for Toxic Substances and Disease Registry
BBL - Blasland, Bouck, & Lee, Incorporated
bgs - below ground surface
CEQA - California Environmental Quality Act
COPC - constituent of potential concern
CPT - Cone Penetrometer Test
Cr(VI) - hexavalent chromium
CVRWQCB - Central Valley Regional Water Quality Control Board
DDC - density driven convection
DOE - United States Department of Energy
ET - Eastern Trenches
FS - Feasibility Study
FSP - Field Sampling Plan
GPR - ground-penetrating radar
HHRA - human health risk assessment
HSU - hydrostratigraphic unit
IRA - interim remedial action
LEHR - Laboratory for Energy-related Health Research
LFI - limited field investigation
LFU - landfill unit
LLRW - low-level radioactive waste
MWH - Montgomery Watson Harza
OCL - Old Campus Landfill
OWTP - Old Wastewater Treatment Plant
PCB - polychlorinated biphenyl
PNNL - Pacific Northwest National Laboratory
QAPP - Quality Assurance Project Plan
RI - remedial investigation
RPM - Remedial Project Manager
ST - Southern Trenches
SVOC - semi-volatile organic compounds
SWAT - solid waste assessment test
SWERA - Site-Wide Ecological Risk Assessment
SWRA - Site-Wide Risk Assessment
TDS - total dissolved solids
UC Davis - University of California, Davis
US EPA - United States Environmental Protection Agency
VOC - volatile organic compound
WBH - Waste Burial Holes
WDR - Waste Discharge Requirement
Weiss - Weiss Associates

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Table 2-2. Chronology of Investigation and Remediation Activities, Laboratory for Energy-related Health Research/South Campus Disposal Site, University of California, Davis

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Table 2-3. Summary of Nature, Extent, and Sampling at Land Disposal Units - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

			Landfill Unit No. 1	Landfill Unit No. 2	Waste Burial Holes	Eastern Trenches	Landfill Unit No. 3	Southern Trenches
Nature	Acreage		2.04	2.17	0.22	0.57	1.16	0.19
	Location (Figure 2-1)		250 yards east of Old Davis Road	150 yards east of Old Davis Road, directly north of WBH	Southern border of LFU-2 and ET	Eastern border of LFU-2, extending slightly further to the north	600 yards east of Old Davis Road	50 yards east of Old Davis Road, along the southern boundary of Western Dog Pens
	Site Features		Fence runs through middle of unit; Buildings X-1 through X-5 located in eastern portion; southern edge adjacent to levee	Geriatrics Buildings 1 and 2 overlie a portion of the north side of the landfill unit; Eastern Dog Pens formerly located in southern half of unit; gravel and weathered asphalt from Eastern Dog Pens remain on surface	Vegetation only; adjacent to levee	Northwestern portion paved; small area in northeast portion covered by Cobalt-60 Annex Building	Two percent covered by pavement for raptor research center; concrete-lined drainage channel located on eastern side of unit; waste present beneath channel liner	Adjacent to levee
	Waste Disposal Period		1940s and 1950s	1956 through 1967	1956 through 1974	1957 through 1965	1963 through 1967	1957 through 1965
	Interim Removal/Remedial Actions		None	None	Underwent a removal action in 1999, due to high carbon-14 and tritium activities; waste removed to 12 feet below ground surface	None	North-south-trending ditch along east side of unit was lined with concrete to prevent erosion of waste	None
	Nature of Material Disposed		Campus wastes (mainly glass, metal, ash, and charcoal); potentially some chemical waste and sewage treatment plant sludge[1]	General refuse, animal parts, and laboratory chemicals	Low-level radioactive material, contaminated soil placed back in holes after 1999 removal action	Low-level radioactive materials, general laboratory chemicals, pesticides, bones, and dog pen waste	General municipal waste (mainly glass) and construction debris (mainly rusted metal, concrete, bricks, and ceramic material); potentially minor quantities of laboratory waste	Low-level radioactive materials, bones, animal feces, and laboratory waste mixed with gravel
	Potential Principal Threat Waste Identified by Exploratory Trenching		Blue and green crystalline material	Lead (possibly a battery), ampules, and lead casing with white crystalline powder	Source material removed during 1999 removal action	Bottles/vials with clear/amber/reddish-brown liquids, orange/yellow/yellowish-olive/white powders, light green solid, jars with white crystalline powder, large ceramic crocks with whitish granular powder, olive-colored glass bottle with volatile liquid, wide-mouth bottles with thick liquid, 5-gallon bucket of "weedkiller," and large glass bottles containing fluid	None identified	None identified
	COCs	Soil/solid waste COCs	Arsenic, lead, carbon-14, and benzo(a)pyrene	Lead, carbon-14, cesium-137, potassium-40, strontium-90, Aroclor 1260, benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene	Carbon-14, tritium, strontium-90, cesium-137, and naphthalene	Carbon-14 and tritium	Lead, manganese, carbon-14, cesium-137, strontium-90, and Aroclor 1260	Carbon-14
		Soil gas COCs	1,3-Butadiene	1,2-Dichloropropane, chloroform, tetrachloroethene	None identified	1,2-Dichloroethane, 1,2-dichloropropane, 1,3-butadiene, and chloroform	None identified	None identified
		Soil-to-groundwater COCs	Carbon-14, copper, and selenium	Cadmium, carbon-14, and chloroform	Carbon-14 and tritium	Carbon-14, tritium, chloroform, and 1,2-dichloroethane	Barium, cadmium, copper, and carbon-14	Carbon-14 [a]
	Layer above waste		Silty sand fill	Silty sand fill	No waste; unit was backfilled with soil that was segregated from waste during removal action; 4-12 inches of imported sandy clay cover unit	Silty sand fill	Silty sand with gravel fill	Silty sand fill
	Layer Underneath Waste		Native soil: sand with silt and/or silty clay	Native soil: clayey silt and silty clay	Native soil: clay grading to silty sand	Native soil: silty clay material	Native soil: clayey silt and silty clay to sand with silt	Native sand with gravel and silty clay
Extent	Approximate Waste Orientation		North-south-trending trenches south of the former cobalt-60 field; east-west-trending trenches in eastern portion of unit[2]	Twelve east-west-trending disposal trenches[3]; HFSDA just outside of current area boundaries[4]	Forty-nine 10-foot-deep holes that were filled with waste material (removed during removal action)[5]	Six north-south-trending trenches; five east-west-trending trenches[2]	Two east-west-trending cells[2] approximately 60 feet wide by 120 feet long	Two east-west-trending trenches, each approximately 250 feet long and 2 to 4 feet wide[2, 6]
	Top of Waste Depth (feet below ground surface)		1 to 5	1 to 4	Not applicable, no waste present	Less than 1 to 4	1 to 4	0.5 to 1.5
	Bottom of Waste Depth (feet below ground surface)		4 to 8	8 to 14	Not applicable, no waste present	5 to 6	3 to greater than 11	3 to 5.5
	Estimated Volume of Contaminated Material		39,204 LCY	41,095 LCY	3,488 LCY	5,777 LCY	12,153 LCY	1,274 LCY
Sampling	Number of Exploratory Trenches Dug in Vicinity[7,8]		13[9]	16[3]	Eleven prior to removal action, none after[10]	14[11]	18[12,13]	10[6]
	Number of Exploratory Trenches that Uncovered Waste[7,8]		12[9]	11[3]	Not applicable, no waste present	14[11]	11[12,13]	7[6]
	Number of Soil/Solid Waste Samples		35	44	148	45	48	26
	Number of Locations Sampled for Soil/Solid Waste		18	20	115	23	24	16
	Depth of Soil/Solid Waste Samples (feet below ground surface)		0 to 40	0 to 32.5	0 to 35	2.5 to 40	0 to 35	1.5 to 30
	Number of Soil Gas Samples		3	10	3	3	3	3
	Number of Locations Sampled for Soil Gas		1	3	1	1	1	1

Note:

[a] Based on information provided in HHRA-Part C (Brown & Caldwell, 2006), carbon-14 is designated a constituent of potential concern; subject to change based on additional investigation included in the remedial alternatives.

Acronyms/Abbreviations:

COC - constituent of concern

ET - Eastern Trenches

HFSDA - Hopland Field Station Disposal Area

HHRA - Part C - *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part C – Risk Characterization for UC Davis Areas)*

LCY - loose cubic yards

LFU - landfill unit

UC Davis - University of California, Davis

WBH - Waste Burial Holes

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Table 2-3. Summary of Nature, Extent, and Sampling at Land Disposal Units - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

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Table 2-4. Summary of Human Health Cancer Risks by Exposure Route for Contaminants in Soil - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor/COC[2]	Cancer Risk by Exposure Route[1]								
		Soil Ingestion	Soil Dermal Exposure	Aboveground Plant Ingestion[3]	Belowground Plant Ingestion[3]	External Radiation	Dust Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation[4]	Total Cancer Risk
Eastern Trenches	**Age-Adjusted Adult**									
	Chloroform	---	---	---	---	---	---	2.80E-08	4.00E-06	4.03E-06
	Dieldrin	8.00E-07	1.80E-07	3.00E-06	2.70E-07	---	4.00E-11	---	---	4.25E-06
	Hexachlorobenzene	9.00E-07	2.00E-07	1.50E-06	1.40E-07	---	5.00E-11	---	---	2.74E-06
	Total Risk	1.70E-06	3.80E-07	4.50E-06	4.10E-07	0.00E+00	9.00E-11	2.80E-08	4.00E-06	**1.10E-05**
	On-Site Resident									
	Chloroform	---	---	---	---	---	---	2.00E-08	3.00E-06	3.02E-06
	Dieldrin	5.00E-07	9.00E-08	2.00E-06	2.00E-07	---	3.00E-11	---	---	2.79E-06
	Hexachlorobenzene	5.00E-07	1.00E-07	8.00E-07	1.00E-07	---	4.00E-11	---	---	1.50E-06
	Total Risk	1.00E-06	1.90E-07	2.80E-06	3.00E-07	0.00E+00	7.00E-11	2.00E-08	3.00E-06	**7.31E-06**
	On-Site Resident Child									
	Chloroform	---	---	---	---	---	---	8.00E-09	1.00E-06	1.01E-06
	Dieldrin	3.00E-07	9.00E-08	1.00E-06	7.00E-08	---	1.00E-11	---	---	1.46E-06
	Hexachlorobenzene	4.00E-07	1.00E-07	7.00E-07	4.00E-08	---	1.00E-11	---	---	1.24E-06
	Total Risk	7.00E-07	1.90E-07	1.70E-06	1.10E-07	0.00E+00	2.00E-11	8.00E-09	1.00E-06	**3.71E-06**
	On-Site Indoor Researcher									
	Chloroform	---	---	---	---	---	---	---	1.00E-06	1.00E-06
	Dieldrin	2.00E-07	---	---	---	---	---	---	---	2.00E-07
	Hexachlorobenzene	---	---	---	---	---	---	---	---	0.00E+00
	Total Risk	2.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-06	**1.20E-06**
	On-Site Outdoor Researcher									
	Chloroform	---	---	---	---	---	---	1.00E-08	---	1.00E-08
	Dieldrin	3.00E-07	2.00E-07	---	---	---	5.00E-11	---	---	5.00E-07
	Hexachlorobenzene	---	---	---	---	---	---	---	---	0.00E+00
	Total Risk	3.00E-07	2.00E-07	0.00E+00	0.00E+00	0.00E+00	5.00E-11	1.00E-08	0.00E+00	**5.10E-07**
	On-Site Construction Worker									
	Chloroform	---	---	---	---	---	---	4.00E-10	---	4E-10
	Dieldrin	1.00E-08	4.00E-09	---	---	---	1.00E-11	---	---	1.401E-08
	Hexachlorobenzene	2.00E-08	5.00E-09	---	---		1.00E-11	---	---	2.50E-08
	Total Risk	3.00E-08	9.00E-09	0.00E+00	0.00E+00	0.00E+00	2.00E-11	4.00E-10	0.00E+00	**3.94E-08**
Landfill Unit No. 1	**Age-Adjusted Adult**									
	Arsenic	1.20E-04	8.00E-06	6.00E-04	1.30E-04	---	7.00E-08	---	---	8.58E-04
	Cadmium	1.80E-06	4.00E-09	1.10E-04	1.40E-05	---	1.50E-09	---	---	1.26E-04
	Total Risk	1.22E-04	8.00E-06	7.10E-04	1.44E-04	0.00E+00	7.15E-08	0.00E+00	0.00E+00	**9.84E-04**
	On-Site Resident									
	Arsenic	7.00E-05	4.00E-06	3.00E-04	1.00E-04	---	5.00E-08	---	---	4.74E-04
	Cadmium	1.00E-06	2.00E-09	6.00E-05	1.00E-05	---	1.00E-09	---	---	7.10E-05
	Total Risk	7.10E-05	4.00E-06	3.60E-04	1.10E-04	0.00E+00	5.10E-08	0.00E+00	0.00E+00	**5.45E-04**
	On-Site Resident Child									
	Arsenic	5.00E-05	4.00E-06	3.00E-04	3.00E-05	---	2.00E-08	---	---	3.84E-04
	Cadmium	8.00E-07	2.00E-09	5.00E-05	4.00E-06	---	5.00E-10	---	---	5.48E-05

Table 2-4. Summary of Human Health Cancer Risks by Exposure Route for Contaminants in Soil - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor/COC[2]	Cancer Risk by Exposure Route[1]								
		Soil Ingestion	Soil Dermal Exposure	Aboveground Plant Ingestion[3]	Belowground Plant Ingestion[3]	External Radiation	Dust Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation[4]	Total Cancer Risk
Landfill Unit No. 1	**On-Site Resident Child (continued)**									
	Total Risk	5.08E-05	4.00E-06	3.50E-04	3.40E-05	0.00E+00	2.05E-08	0.00E+00	0.00E+00	**4.39E-04**
	On-Site Indoor Researcher									
	Arsenic	2.00E-06	---	---	---	---	2.00E-08	---	---	2.02E-06
	Cadmium	1.00E-08	---	---	---	---	5.00E-10	---	---	1.05E-08
	Total Risk	2.01E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-08	0.00E+00	0.00E+00	**2.03E-06**
	On-Site Outdoor Researcher									
	Arsenic	4.00E-06	8.00E-07	---	---	---	6.00E-09	---	---	4.81E-06
	Cadmium	2.00E-08	1.00E-10	---	---	---	5.00E-11	---	---	2.02E-08
	Total Risk	4.02E-06	8.00E-07	0.00E+00	0.00E+00	0.00E+00	6.05E-09	0.00E+00	0.00E+00	**4.83E-06**
	On-Site Construction Worker									
	Arsenic	2.00E-06	2.00E-07	---	---	---	2.00E-08	---	---	2.22E-06
	Cadmium	3.00E-08	1.00E-10	---	---	---	5.00E-10	---	---	3.06E-08
	Total Risk	2.03E-06	2.00E-07	0.00E+00	0.00E+00	0.00E+00	2.05E-08	0.00E+00	0.00E+00	**2.25E-06**
Landfill Unit No. 2	**Age-Adjusted Adult**									
	Benzo(a)pyrene	3.00E-06	1.00E-06	4.00E-06	5.00E-07	---	2.60E-10	---	---	8.50E-06
	Benzo(k)fluoranthene	7.00E-07	1.80E-07	7.00E-05	8.00E-06	---	1.10E-11	---	---	7.89E-05
	Cadmium	1.90E-06	6.00E-09	1.40E-04	2.50E-05	---	2.60E-09	---	---	1.67E-04
	Cesium-137	7.00E-09	---	2.70E-08	---	3.80E-06	3.40E-14	---	---	3.83E-06
	Chloroform	---	---	---	---	---	---	2.70E-07	1.50E-05	1.53E-05
	Copper	NA	NA	NA	NA	NA	NA	---	---	NA
	Tetrachloroethene	---	---	---	---	---	---	8.00E-08	7.00E-06	7.08E-06
	Total Risk	5.61E-06	1.19E-06	2.14E-04	3.35E-05	3.80E-06	2.87E-09	3.50E-07	2.20E-05	**2.80E-04**
	On-Site Resident									
	Benzo(a)pyrene	2.00E-06	5.00E-07	2.00E-06	4.00E-07	---	2.00E-10	---	---	4.90E-06
	Benzo(k)fluoranthene	4.00E-07	9.00E-08	4.00E-05	6.00E-06	---	8.00E-12	---	---	4.65E-05
	Cadmium	1.00E-06	3.00E-09	8.00E-05	2.00E-05	---	2.00E-09	---	---	1.01E-04
	Cesium-137	5.00E-09	---	2.00E-08	---	3.00E-06	3.00E-14	---	---	3.03E-06
	Chloroform	---	---	---	---	---	---	2.00E-07	1.00E-05	1.02E-05
	Copper	NA	NA	NA	NA	NA	NA	---	---	NA
	Tetrachloroethene	---	---	---	---	---	---	6.00E-08	5.00E-06	5.06E-06
	Total Risk	3.41E-06	5.93E-07	1.22E-04	2.64E-05	3.00E-06	2.21E-09	2.60E-07	1.50E-05	**1.71E-04**
	On-Site Resident Child									
	Benzo(a)pyrene	1.00E-06	5.00E-07	2.00E-06	1.00E-07	---	6.00E-11	---	---	3.60E-06
	Benzo(k)fluoranthene	3.00E-07	9.00E-08	3.00E-05	2.00E-06	---	3.00E-12	---	---	3.24E-05
	Cadmium	9.00E-07	3.00E-09	6.00E-05	5.00E-06	---	6.00E-10	---	---	6.59E-05
	Cesium-137	2.00E-09	---	7.00E-09	---	8.00E-07	4.00E-15	---	---	8.09E-07
	Chloroform	---	---	---	---	---	---	7.00E-08	5.00E-06	5.07E-06
	Copper	NA	NA	NA	NA	NA	NA	---	---	NA
	Tetrachloroethene	---	---	---	---	---	---	2.00E-08	2.00E-06	2.02E-06
	Total Risk	2.20E-06	5.93E-07	9.20E-05	7.10E-06	8.00E-07	6.63E-10	9.00E-08	7.00E-06	**1.10E-04**

Table 2-4. Summary of Human Health Cancer Risks by Exposure Route for Contaminants in Soil - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor/COC[2]	Cancer Risk by Exposure Route[1]								
		Soil Ingestion	Soil Dermal Exposure	Aboveground Plant Ingestion[3]	Belowground Plant Ingestion[3]	External Radiation	Dust Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation[4]	Total Cancer Risk
Landfill Unit No. 2	**On-Site Indoor Researcher**									
	Benzo(a)pyrene	---	---	---	---	---	---	---	---	0.00E+00
	Benzo(k)fluoranthene	---	---	---	---	---	---	---	---	0.00E+00
	Cadmium	3.00E-08	---	---	---	---	---	---	---	3.00E-08
	Cesium-137	1.00E-10	---	---	---	3.00E-07	---	---	---	3.00E-07
	Chloroform	---	---	---	---	---	---	---	6.00E-06	6.00E-06
	Copper	NA	---	---	---	---	---	---	---	0.00E+00
	Tetrachloroethene	---	---	---	---	---	---	---	3.00E-06	3.00E-06
	Total Risk	3.01E-08	0.00E+00	0.00E+00	0.00E+00	3.00E-07	0.00E+00	0.00E+00	9.00E-06	**9.33E-06**
	On-Site Outdoor Researcher									
	Benzo(a)pyrene	---	---	---	---	---	---	---	---	0.00E+00
	Benzo(k)fluoranthene	---	---	---	---	---	---	---	---	0.00E+00
	Cadmium	6.00E-08	4.00E-10	---	---	---	1.00E-10	---	---	6.05E-08
	Cesium-137	2.00E-10	---	---	---	1.00E-06	3.00E-15	---	---	1.00E-06
	Chloroform	---	---	---	---	---	---	8.00E-08	---	8.00E-08
	Copper	NA	NA	---	---	---	NA	---	---	0.00E+00
	Tetrachloroethene	---	---	---	---	---	---	2.00E-08	---	2.00E-08
	Total Risk	6.02E-08	4.00E-10	0.00E+00	0.00E+00	1.00E-06	1.00E-10	1.00E-07	0.00E+00	**1.16E-06**
	On-Site Construction Worker									
	Benzo(a)pyrene	6.00E-08	2.00E-08	---	---	---	5.00E-11	---	---	8.01E-08
	Benzo(k)fluoranthene	1.00E-08	4.00E-09	---	---	---	3.00E-12	---	---	1.40E-08
	Cadmium	4.00E-08	1.00E-10	---	---	---	6.00E-10	---	---	4.07E-08
	Cesium-137	2.00E-10	---	---	---	7.00E-08	5.00E-16	---	---	7.02E-08
	Chloroform	---	---	---	---	---	---	4.00E-09	---	4.00E-09
	Copper	NA	NA	---	---	---	NA	---	---	0.00E+00
	Tetrachloroethene	---	---	---	---	---	---	1.00E-09	---	1.00E-09
	Total Risk	1.10E-07	2.41E-08	0.00E+00	0.00E+00	7.00E-08	6.53E-10	5.00E-09	0.00E+00	**2.10E-07**
Landfill Unit No. 3	**Age-Adjusted Adult**									
	Aroclor 1260	1.20E-06	4.00E-07	1.30E-06	1.30E-07	---	1.20E-11	---	---	3.03E-06
	Cadmium	5.00E-06	1.00E-08	3.00E-04	4.00E-05	---	4.00E-09	---	---	3.45E-04
	Cesium-137	1.80E-08	---	9.00E-08	---	1.30E-05	1.00E-13	---	---	1.31E-05
	Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Strontium-90	3.00E-07	---	8.00E-06	---	3.90E-07	4.50E-12	---	---	8.69E-06
	Total Risk	6.52E-06	4.10E-07	3.09E-04	4.01E-05	1.34E-05	4.02E-09	0.00E+00	0.00E+00	**3.70E-04**
	On-Site Resident									
	Aroclor 1260	7.00E-07	2.00E-07	7.00E-07	1.00E-07	---	9.00E-12	---	---	1.70E-06
	Cadmium	3.00E-06	5.00E-09	2.00E-04	3.00E-05	---	3.00E-09	---	---	2.33E-04
	Cesium-137	1.00E-08	---	7.00E-08	---	1.00E-05	9.00E-14	---	---	1.01E-05
	Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Strontium-90	2.00E-07	---	6.00E-06	---	3.00E-07	4.00E-12	---	---	6.50E-06
	Total Risk	3.91E-06	2.05E-07	2.07E-04	3.01E-05	1.03E-05	3.01E-09	0.00E+00	0.00E+00	**2.51E-04**

Table 2-4. Summary of Human Health Cancer Risks by Exposure Route for Contaminants in Soil - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor/COC[2]	Cancer Risk by Exposure Route[1]								
		Soil Ingestion	Soil Dermal Exposure	Aboveground Plant Ingestion[3]	Belowground Plant Ingestion[3]	External Radiation	Dust Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation[4]	Total Cancer Risk
Landfill Unit No. 3	**On-Site Resident Child**									
	Aroclor 1260	5.00E-07	2.00E-07	6.00E-07	3.00E-08	---	3.00E-12	---	---	1.33E-06
	Cadmium	2.00E-06	5.00E-09	1.00E-04	1.00E-05	---	1.00E-09	---	---	1.12E-04
	Cesium-137	8.00E-09	---	2.00E-08	---	3.00E-06	1.00E-14	---	---	3.03E-06
	Manganese	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Strontium-90	1.00E-07	---	2.00E-06	---	9.00E-08	5.00E-13	---	---	2.19E-06
	Total Risk	2.61E-06	2.05E-07	1.03E-04	1.00E-05	3.09E-06	1.00E-09	0.00E+00	0.00E+00	**1.19E-04**
	On-Site Indoor Researcher									
	Aroclor 1260	9.00E-09	---	---	---	---	---	---	---	9.00E-09
	Cadmium	5.00E-08	---	---	---	---	---	---	---	5.00E-08
	Cesium-137	3.00E-10	---	---	---	1.00E-06	---	---	---	1.00E-06
	Manganese	NA	---	---	---	---	---	---	---	0.00E+00
	Strontium-90	4.00E-09	---	---	---	3.00E-08	---	---	---	3.40E-08
	Total Risk	6.33E-08	0.00E+00	0.00E+00	0.00E+00	1.03E-06	0.00E+00	0.00E+00	0.00E+00	**1.09E-06**
	On-Site Outdoor Researcher									
	Aroclor 1260	2.00E-08	2.00E-08	---	---	---	4.00E-13	---	---	4.00E-08
	Cadmium	8.00E-08	5.00E-10	---	---	---	2.00E-10	---	---	8.07E-08
	Cesium-137	6.00E-10	---	---	---	4.00E-06	6.00E-15	---	---	4.00E-06
	Manganese	NA	NA	---	---	---	NA	---	---	0.00E+00
	Strontium-90	7.00E-09	---	---	---	1.00E-07	2.00E-13	---	---	1.07E-07
	Total Risk	1.08E-07	2.05E-08	0.00E+00	0.00E+00	4.10E-06	2.01E-10	0.00E+00	0.00E+00	**4.23E-06**
	On-Site Construction Worker									
	Aroclor 1260	2.00E-08	9.00E-09	---	---	---	3.00E-12	---	---	2.90E-08
	Cadmium	8.00E-08	2.00E-10	---	---	---	1.00E-09	---	---	8.12E-08
	Cesium-137	5.00E-10	---	---	---	2.00E-07	2.00E-15	---	---	2.01E-07
	Manganese	NA	NA	---	---	---	NA	---	---	0.00E+00
	Strontium-90	8.00E-09	---	---	---	8.00E-09	7.00E-14	---	---	1.60E-08
	Total Risk	1.09E-07	9.20E-09	0.00E+00	0.00E+00	2.08E-07	1.00E-09	0.00E+00	0.00E+00	**3.27E-07**
Waste Burial Holes	**Age-Adjusted Adult**									
	Strontium-90	6.00E-08	---	1.30E-06	---	9.00E-08	7.90E-13	---	---	1.45E-06
	Total Risk	6.00E-08	0.00E+00	1.30E-06	0.00E+00	9.00E-08	7.90E-13	0.00E+00	0.00E+00	**1.45E-06**
	On-Site Resident									
	Strontium-90	4.00E-08	---	1.00E-06	---	7.00E-08	7.00E-13	---	---	1.11E-06
	Total Risk	4.00E-08	0.00E+00	1.00E-06	0.00E+00	7.00E-08	7.00E-13	0.00E+00	0.00E+00	**1.11E-06**
	On-Site Resident Child									
	Strontium-90	2.00E-08	---	3.00E-07	---	2.00E-08	9.00E-14	---	---	3.40E-07
	Total Risk	2.00E-08	0.00E+00	3.00E-07	0.00E+00	2.00E-08	9.00E-14	0.00E+00	0.00E+00	**3.40E-07**
	On-Site Indoor Researcher									
	Strontium-90	1.00E-09	---	---	---	7.00E-09	---	---	---	8.00E-09
	Total Risk	1.00E-09	0.00E+00	0.00E+00	0.00E+00	7.00E-09	0.00E+00	0.00E+00	0.00E+00	**8.00E-09**

Table 2-4. Summary of Human Health Cancer Risks by Exposure Route for Contaminants in Soil - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor/COC[2]	Cancer Risk by Exposure Route[1]								
		Soil Ingestion	Soil Dermal Exposure	Aboveground Plant Ingestion[3]	Belowground Plant Ingestion[3]	External Radiation	Dust Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation[4]	Total Cancer Risk
Waste Burial Holes	**On-Site Outdoor Researcher**									
	Strontium-90	2.00E-09	---	---	---	3.00E-08	6.00E-14	---	---	3.20E-08
	Total Risk	2.00E-09	0.00E+00	0.00E+00	0.00E+00	3.00E-08	6.00E-14	0.00E+00	0.00E+00	**3.20E-08**
	On-Site Construction Worker									
	Strontium-90	1.00E-09	---	---	---	2.00E-09	1.00E-14	---	---	3.00E-09
	Total Risk	1.00E-09	0.00E+00	0.00E+00	0.00E+00	2.00E-09	1.00E-14	0.00E+00	0.00E+00	**3.00E-09**

Notes:

[1] Source data from HHRA - Part A, Tables 7 and 8 (MWH, 2004).

[2] Receptor/COCs are the COCs considered and recommended for inclusion in the Feasibility Study from the HHRA - Part C (Brown and Caldwell, 2006).

[3] Homegrown produce. For radionuclides, plant ingestion is not subdivided into aboveground and belowground produce.

[4] The indoor air inhalation risk = vapor intrusion risk. See Section 6.3.1 of HHRA - Part A for more information.

Acronyms/Abbreviations:

--- - not applicable - cancer risks were not calculated for contaminant/exposure route
COC - constituent of concern
HHRA - human health risk assessment
NA - not applicable - cancer risks were not calculated because the constituent is not a carcinogen
UC Davis - University of California, Davis

References:

Brown and Caldwell, 2006. *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part C – Risk Characterization for UC Davis Areas),* April.

Montgomery Watson Harza (MWH), 2004. *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part A – Risk Estimate) LEHR/SCDS Environmental Restoration* , March.

Table 2-5. Summary of Human Health Non-Cancer Hazards by Exposure Route for Contaminants in Soil - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor/COC[2]	Non-Cancer Hazards by Exposure Route[1]: Soil Ingestion	Soil Dermal Exposure	Aboveground Plant Ingestion	Belowground Plant Ingestion	Dust Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation	Total Non-Cancer Hazard
Eastern Trenches	**Age-Adjusted Adult**								
	Chloroform	---	---	---	---	---	NA	NA	NA
	Dieldrin	6.20E-03	1.56E-03	2.24E-02	1.62E-03	2.79E-07	---	---	3.18E-02
	Hexachlorobenzene	4.24E-03	1.10E-03	7.50E-03	5.60E-04	NA	---	---	1.34E-02
	Total Hazard	1.04E-02	2.66E-03	2.99E-02	2.18E-03	2.79E-07	0.00E+00	0.00E+00	**4.52E-02**
	On-Site Resident								
	Chloroform	---	---	---	---	---	NA	NA	NA
	Dieldrin	1.40E-03	2.60E-04	4.40E-03	6.70E-04	9.90E-08	---	---	6.73E-03
	Hexachlorobenzene	9.40E-04	1.80E-04	1.50E-03	2.30E-04	NA	---	---	2.85E-03
	Total Hazard	2.34E-03	4.40E-04	5.90E-03	9.00E-04	9.90E-08	0.00E+00	0.00E+00	**9.58E-03**
	On-Site Resident Child								
	Chloroform	---	---	---	---	---	NA	NA	NA
	Dieldrin	4.80E-03	1.30E-03	1.80E-02	9.50E-04	1.80E-07	---	---	2.51E-02
	Hexachlorobenzene	3.30E-03	9.20E-04	6.00E-03	3.30E-04	NA	---	---	1.06E-02
	Total Hazard	8.10E-03	2.22E-03	2.40E-02	1.28E-03	1.80E-07	0.00E+00	0.00E+00	**3.56E-02**
	On-Site Indoor Researcher								
	Chloroform	---	---	---	---	---	---	NA	NA
	Dieldrin	6.20E-04	---	---	---	---	---	---	6.20E-04
	Hexachlorobenzene	---	---	---	---	---	---	---	0.00E+00
	Total Hazard	6.20E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**6.20E-04**
	On-Site Outdoor Researcher								
	Chloroform	---	---	---	---	---	NA	---	NA
	Dieldrin	1.10E-03	7.30E-04	---	---	1.70E-07	---	---	1.83E-03
	Hexachlorobenzene	---	---	---	---	---	---	---	0.00E+00
	Total Hazard	1.10E-03	7.30E-04	0.00E+00	0.00E+00	1.70E-07	0.00E+00	0.00E+00	**1.83E-03**
	On-Site Construction Worker								
	Chloroform	---	---	---	---	---	NA	---	NA
	Dieldrin	1.20E-03	3.60E-04	---	---	1.10E-06	---	---	1.56E-03
	Hexachlorobenzene	8.30E-04	2.50E-04	---	---	NA	---	---	1.08E-03
	Total Hazard	2.03E-03	6.10E-04	0.00E+00	0.00E+00	1.10E-06	0.00E+00	0.00E+00	**2.64E-03**
Landfill Unit No. 1	**Age-Adjusted Adult**								
	Arsenic	1.68E+00	1.31E-01	8.90E+00	1.48E+00	NA	---	---	1.22E+01
	Cadmium	3.08E-02	8.00E-05	1.88E+00	2.03E-01	NA	---	---	2.11E+00
	Total Hazard	1.71E+00	1.31E-01	1.08E+01	1.68E+00	0.00E+00	0.00E+00	0.00E+00	**1.43E+01**
	On-Site Resident								
	Arsenic	3.80E-01	2.10E-02	1.80E+00	6.10E-01	NA	---	---	2.81E+00
	Cadmium	6.80E-03	1.30E-05	3.80E-01	8.30E-02	NA	---	---	4.70E-01
	Total Hazard	3.87E-01	2.10E-02	2.18E+00	6.93E-01	0.00E+00	0.00E+00	0.00E+00	**3.28E+00**
	On-Site Resident Child								
	Arsenic	1.30E+00	1.10E-01	7.10E+00	8.70E-01	NA	---	---	9.38E+00
	Cadmium	2.40E-02	6.70E-05	1.50E+00	1.20E-01	NA	---	---	1.64E+00
	Total Hazard	1.32E+00	1.10E-01	8.60E+00	9.90E-01	0.00E+00	0.00E+00	0.00E+00	**1.10E+01**
	On-Site Indoor Researcher								
	Arsenic	1.40E-02	---	---	---	---	---	---	1.40E-02
	Cadmium	8.80E-05	---	---	---	---	---	---	8.80E-05
	Total Hazard	1.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**1.41E-02**
	On-Site Outdoor Researcher								
	Arsenic	2.40E-02	4.80E-03	---	---	NA	---	---	2.88E-02
	Cadmium	1.60E-04	1.00E-06	---	---	NA	---	---	1.61E-04
	Total Hazard	2.42E-02	4.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**2.90E-02**
	On-Site Construction Worker								
	Arsenic	3.40E-01	3.00E-02	---	---	NA	---	---	3.70E-01
	Cadmium	6.00E-03	1.80E-05	---	---	NA	---	---	6.02E-03
	Total Hazard	3.46E-01	3.00E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**3.76E-01**
Landfill Unit No. 2	**Age-Adjusted Adult**								
	Benzo(a)pyrene	NA	NA	NA	NA	NA	---	---	NA
	Benzo(k)fluoranthene	NA	NA	NA	NA	NA	---	---	NA
	Cadmium	3.73E-02	9.70E-05	2.37E+00	2.40E-01	NA	---	---	2.65E+00
	Chloroform	---	---	---	---	---	NA	NA	NA
	Copper	2.96E-01	0.00E+00	2.50E+01	1.18E+00	NA	---	---	2.65E+01
	Tetrachloroethene	---	---	---	---	---	NA	NA	NA
	Total Hazard	3.33E-01	9.70E-05	2.74E+01	1.42E+00	0.00E+00	0.00E+00	0.00E+00	**2.91E+01**
	On-Site Resident								
	Benzo(a)pyrene	NA	NA	NA	NA	NA	---	---	NA
	Benzo(k)fluoranthene	NA	NA	NA	NA	NA	---	---	NA
	Cadmium	8.30E-03	1.60E-05	4.70E-01	1.00E-01	NA	---	---	5.78E-01
	Chloroform	---	---	---	---	---	NA	NA	NA
	Copper	6.60E-02	0.00E+00	5.00E+00	4.90E-01	NA	---	---	5.56E+00
	Tetrachloroethene	---	---	---	---	---	NA	NA	NA
	Total Hazard	7.43E-02	1.60E-05	5.47E+00	5.90E-01	0.00E+00	0.00E+00	0.00E+00	**6.13E+00**
	On-Site Resident Child								
	Benzo(a)pyrene	NA	NA	NA	NA	NA	---	---	NA
	Benzo(k)fluoranthene	NA	NA	NA	NA	NA	---	---	NA
	Cadmium	2.90E-02	8.10E-05	1.90E+00	1.40E-01	NA	---	---	2.07E+00
	Chloroform	---	---	---	---	---	NA	NA	NA
	Copper	2.30E-01	0.00E+00	2.00E+01	6.90E-01	NA	---	---	2.09E+01
	Tetrachloroethene	---	---	---	---	---	NA	NA	NA
	Total Hazard	2.59E-01	8.10E-05	2.19E+01	8.30E-01	0.00E+00	0.00E+00	0.00E+00	**2.30E+01**

Table 2-5. Summary of Human Health Non-Cancer Hazards by Exposure Route for Contaminants in Soil - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor/COC[2]	Non-Cancer Hazards by Exposure Route[1]: Soil Ingestion	Soil Dermal Exposure	Aboveground Plant Ingestion	Belowground Plant Ingestion	Dust Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation	Total Non-Cancer Hazard
Landfill Unit No. 2	**On-Site Indoor Researcher**								
	Benzo(a)pyrene	---	---	---	---	---	---	---	---
	Benzo(k)fluoranthene	---	---	---	---	---	---	---	---
	Cadmium	2.40E-04	---	---	---	---	---	---	2.40E-04
	Chloroform	---	---	---	---	---	---	NA	NA
	Copper	5.80E-04	---	---	---	---	---	---	5.80E-04
	Tetrachloroethene	---	---	---	---	---	---	NA	NA
	Total Hazard	8.20E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**8.20E-04**
	On-Site Outdoor Researcher								
	Benzo(a)pyrene	---	---	---	---	---	---	---	---
	Benzo(k)fluoranthene	---	---	---	---	---	---	---	---
	Cadmium	4.20E-04	2.80E-06	---	---	NA	---	---	4.23E-04
	Chloroform	---	---	---	---	---	NA	---	NA
	Copper	1.10E-03	0.00E+00	---	---	NA	---	---	1.10E-03
	Tetrachloroethene	---	---	---	---	---	NA	---	NA
	Total Hazard	1.52E-03	2.80E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**1.52E-03**
	On-Site Construction Worker								
	Benzo(a)pyrene	NA	NA	---	---	NA	---	---	NA
	Benzo(k)fluoranthene	NA	NA	---	---	NA	---	---	NA
	Cadmium	7.30E-03	2.20E-05	---	---	NA	---	---	7.32E-03
	Chloroform	---	---	---	---	---	NA	---	NA
	Copper	5.80E-02	0.00E+00	---	---	NA	---	---	5.80E-02
	Tetrachloroethene	---	---	---	---	---	NA	---	NA
	Total Hazard	6.53E-02	2.20E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**6.53E-02**
Landfill Unit No. 3	**Age-Adjusted Adult**								
	Aroclor 1260	NA	NA	NA	NA	NA	---	---	NA
	Cadmium	7.70E-02	2.02E-04	4.87E+00	5.10E-01	NA	---	---	5.46E+00
	Manganese	2.95E-01	0.00E+00	2.75E+00	2.05E-01	1.31E-01	---	---	3.38E+00
	Total Hazard	3.72E-01	2.02E-04	7.62E+00	7.15E-01	1.31E-01	0.00E+00	0.00E+00	**8.84E+00**
	On-Site Resident								
	Aroclor 1260	NA	NA	NA	NA	NA	---	---	NA
	Cadmium	1.70E-02	3.20E-05	9.70E-01	2.10E-01	NA	---	---	1.20E+00
	Manganese	6.50E-02	0.00E+00	5.50E-01	8.50E-02	4.60E-02	---	---	7.46E-01
	Total Hazard	8.20E-02	3.20E-05	1.52E+00	2.95E-01	4.60E-02	0.00E+00	0.00E+00	**1.94E+00**
	On-Site Resident Child								
	Aroclor 1260	NA	NA	NA	NA	NA	---	---	NA
	Cadmium	6.00E-02	1.70E-04	3.90E+00	3.00E-01	NA	---	---	4.26E+00
	Manganese	2.30E-01	0.00E+00	2.20E+00	1.20E-01	8.50E-02	---	---	2.64E+00
	Total Hazard	2.90E-01	1.70E-04	6.10E+00	4.20E-01	8.50E-02	0.00E+00	0.00E+00	**6.90E+00**
	On-Site Indoor Researcher								
	Aroclor 1260	NA	---	---	---	---	---	---	NA
	Cadmium	3.30E-04	---	---	---	---	---	---	3.30E-04
	Manganese	2.70E-03	---	---	---	---	---	---	2.70E-03
	Total Hazard	3.03E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**3.03E-03**
	On-Site Outdoor Researcher								
	Aroclor 1260	NA	NA	---	---	NA	---	---	NA
	Cadmium	6.00E-04	4.00E-06	---	---	NA	---	---	6.04E-04
	Manganese	4.80E-03	0.00E+00	---	---	7.10E-03	---	---	1.19E-02
	Total Hazard	5.40E-03	4.00E-06	0.00E+00	0.00E+00	7.10E-03	0.00E+00	0.00E+00	**1.25E-02**
	On-Site Construction Worker								
	Aroclor 1260	NA	NA	---	---	NA	---	---	NA
	Cadmium	1.50E-02	4.60E-05	---	---	NA	---	---	1.50E-02
	Manganese	5.80E-02	0.00E+00	---	---	4.90E-01	---	---	5.48E-01
	Total Hazard	7.30E-02	4.60E-05	0.00E+00	0.00E+00	4.90E-01	0.00E+00	0.00E+00	**5.63E-01**

Notes:

[1] Source data from HHRA - Part A, Tables 7 and 8 (MWH, 2004).

[2] Receptor/COCs are the COCs considered and recommended for inclusion in the Feasibility Study from the HHRA - Part C (Brown and Caldwell, 2006).

Acronyms/Abbreviations:

--- - not applicable - non-cancer risks were not calculated for contaminant/exposure route

COC - constituent of concern

HHRA - Human Health Risk Assessment

NA - not applicable - cancer risks were not calculated because the constituent is not a carcinoger

UC Davis - University of California, Davis

References:

Brown and Caldwell, 2006. *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part C – Risk Characterization for UC Davis Areas),* April.

Montgomery Watson Harza (MWH), 2004. *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part A – Risk Estimate) LEHR/SCDS Environmental Restoration*, March.

Table 2-6. Summary of Human Health Cancer Risks by Exposure Route for Contaminants in Groundwater - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor/COC[2]	Cancer Risk by Exposure Route[1]: Domestic Water Use Ingestion[3]	Domestic Water Use Air Inhalation[3]	Outdoor Air Inhalation[4]	Indoor Air Inhalation[4]	Total Cancer Risk
HSU-1 or HSU-1/2	**Age-Adjusted Adult**					
	1,1,2-Trichloroethane	4.00E-06	1.00E-05	8.00E-11	2.70E-07	1.43E-05
	1,2-Dichloroethane	2.90E-06	8.00E-06	8.00E-11	2.70E-07	1.12E-05
	1,2-Dichloropropane	8.00E-07	1.00E-06	5.00E-12	1.50E-08	1.82E-06
	1,4-Dichlorobenzene	1.40E-07	2.70E-06	1.20E-11	4.00E-08	2.88E-06
	Benzene	1.50E-06	2.70E-06	2.70E-11	1.00E-07	4.30E-06
	Chloroform	NA	1.10E-03	4.00E-08	1.20E-04	1.22E-03
	Chromium (VI)	NA	---	---	---	---
	Nitrate	NA	---	---	---	---
	Tetrachloroethene	NA	1.40E-06	7.00E-11	2.70E-07	1.67E-06
	Total Risk	9.34E-06	1.13E-03	4.03E-08	1.21E-04	**1.26E-03**
	On-Site Resident					
	1,1,2-Trichloroethane	3.00E-06	7.00E-06	6.00E-11	2.00E-07	1.02E-05
	1,2-Dichloroethane	2.00E-06	6.00E-06	6.00E-11	2.00E-07	8.20E-06
	1,2-Dichloropropane	6.00E-07	7.00E-07	4.00E-12	1.00E-08	1.31E-06
	1,4-Dichlorobenzene	1.00E-07	2.00E-06	9.00E-12	3.00E-08	2.13E-06
	Benzene	1.00E-06	2.00E-06	2.00E-11	7.00E-08	3.07E-06
	Chloroform	NA	8.00E-04	3.00E-08	9.00E-05	8.90E-04
	Chromium (VI)	NA	---	---	---	---
	Nitrate	NA	---	---	---	---
	Tetrachloroethene	NA	1.00E-06	5.00E-11	2.00E-07	1.20E-06
	Total Risk	6.70E-06	8.19E-04	3.02E-08	9.07E-05	**9.16E-04**
	On-Site Resident Child					
	1,1,2-Trichloroethane	1.00E-06	3.00E-06	2.00E-11	7.00E-08	4.07E-06
	1,2-Dichloroethane	9.00E-07	2.00E-06	2.00E-11	7.00E-08	2.97E-06
	1,2-Dichloropropane	2.00E-07	3.00E-07	1.00E-12	5.00E-09	5.05E-07
	1,4-Dichlorobenzene	4.00E-08	7.00E-07	3.00E-12	1.00E-08	7.50E-07
	Benzene	5.00E-07	7.00E-07	7.00E-12	3.00E-08	1.23E-06
	Chloroform	NA	3.00E-04	1.00E-08	3.00E-05	3.30E-04
	Chromium (VI)	NA	---	---	---	---
	Nitrate	NA	---	---	---	---
	Tetrachloroethene	NA	4.00E-07	2.00E-11	7.00E-08	4.70E-07
	Total Risk	2.64E-06	3.07E-04	1.01E-08	3.03E-05	**3.40E-04**
	On-Site Indoor Researcher					
	1,1,2-Trichloroethane	---	---	---	9.00E-08	9.00E-08
	1,2-Dichloroethane	---	---	---	9.00E-08	9.00E-08
	1,2-Dichloropropane	---	---	---	7.00E-09	7.00E-09
	1,4-Dichlorobenzene	---	---	---	1.00E-08	1.00E-08
	Benzene	---	---	---	3.00E-08	3.00E-08
	Chloroform	---	---	---	4.00E-05	4.00E-05
	Chromium (VI)	---	---	---	---	---
	Nitrate	---	---	---	---	---
	Tetrachloroethene	---	---	---	9.00E-08	9.00E-08
	Total Risk	0.00E+00	0.00E+00	0.00E+00	4.03E-05	**4.03E-05**
	On-Site Outdoor Researcher					
	1,1,2-Trichloroethane	---	---	2.00E-11	---	2.00E-11
	1,2-Dichloroethane	---	---	3.00E-11	---	3.00E-11
	1,2-Dichloropropane	---	---	2.00E-12	---	2.00E-12
	1,4-Dichlorobenzene	---	---	4.00E-12	---	4.00E-12
	Benzene	---	---	8.00E-12	---	8.00E-12
	Chloroform	---	---	1.00E-08	---	1.00E-08
	Chromium (VI)	---	---	---	---	---
	Nitrate	---	---	---	---	---
	Tetrachloroethene	---	---	2.00E-11	---	2.00E-11
	Total Risk	0.00E+00	0.00E+00	1.01E-08	0.00E+00	**1.01E-08**
	On-Site Construction Worker					
	1,1,2-Trichloroethane	---	---	1.00E-12	---	1.00E-12
	1,2-Dichloroethane	---	---	1.00E-12	---	1.00E-12
	1,2-Dichloropropane	---	---	7.00E-14	---	7.00E-14
	1,4-Dichlorobenzene	---	---	2.00E-13	---	2.00E-13
	Benzene	---	---	3.00E-13	---	3.00E-13
	Chloroform	---	---	5.00E-10	---	5.00E-10
	Chromium (VI)	---	---	---	---	---
	Nitrate	---	---	---	---	---
	Tetrachloroethene	---	---	9.00E-13	---	9.00E-13
	Total Risk	0.00E+00	0.00E+00	5.03E-10	0.00E+00	**5.03E-10**

Notes:

[1] Source data from HHRA - Part A, Tables 7 and 8 (MWH, 2004).

[2] Receptor/COCs are the COCs considered and recommended for inclusion in the Feasibility Study from the HHRA - Part C (Brown and Caldwell, 2006).

[3] Domestic water use ingestion risks and domestic water use air inhalation risks are from HSU-1 and HSU-2.

[4] Outdoor air inhalation risks and indoor air inhalation risks are from HSU-1.

Acronyms/Abbreviations:

--- - not applicable - cancer risks were not calculated for contaminant/exposure route
COC - constituent of concern
HHRA - human health risk assessment
HSU - hydrostratigraphic unit
NA - not applicable - cancer risks were not calculated because the constituent is not a carcinogen
UC Davis - University of California, Davis

References:

Brown and Caldwell, 2006. *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part C – Risk Characterization for UC Davis Areas),* April.
Montgomery Watson Harza (MWH), 2004. *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part A – Risk Estimate) LEHR/SCDS Environmental Restoration* , March.

Table 2-7. Summary of Human Health Non-Cancer Hazards by Exposure Route for Contaminants in Groundwater - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor/COC[2]	Non-Cancer Hazards by Exposure Route[1]: Domestic Water Use Ingestion[3]	Domestic Water Use Air Inhalation[3]	Outdoor Air Inhalation[4]	Indoor Air Inhalation[4]	Total Non-Cancer Hazard
HSU-1 or HSU-1/2	**Age-Adjusted Adult**					
	1,1,2-Trichloroethane	9.30E-05	NA	NA	NA	9.30E-05
	1,2-Dichloroethane	NA	NA	NA	NA	---
	1,2-Dichloropropane	NA	1.22E-01	6.50E-07	2.34E-03	1.24E-01
	1,4-Dichlorobenzene	NA	1.47E-03	6.80E-09	2.32E-05	1.49E-03
	Benzene	NA	NA	NA	NA	---
	Chloroform	2.33E+00	NA	NA	NA	2.33E+00
	Chromium (VI)	2.64E+00	---	---	---	2.64E+00
	Nitrate	7.40E-01	---	---	---	7.40E-01
	Tetrachloroethene	1.45E-02	NA	NA	NA	1.45E-02
	Total Hazard	5.72E+00	1.23E-01	6.57E-07	2.36E-03	**5.85E+00**
	On-Site Resident					
	1,1,2-Trichloroethane	3.30E-05	NA	NA	NA	3.30E-05
	1,2-Dichloroethane	NA	NA	NA	NA	---
	1,2-Dichloropropane	NA	4.30E-02	2.30E-07	8.40E-04	4.38E-02
	1,4-Dichlorobenzene	NA	5.20E-04	2.40E-09	8.20E-06	5.28E-04
	Benzene	NA	NA	NA	NA	---
	Chloroform	8.30E-01	NA	NA	NA	8.30E-01
	Chromium (VI)	9.40E-01	---	---	---	9.40E-01
	Nitrate	2.60E-01	---	---	---	2.60E-01
	Tetrachloroethene	5.10E-03	NA	NA	NA	5.10E-03
	Total Hazard	2.04E+00	4.35E-02	2.32E-07	8.48E-04	**2.08E+00**
	On-Site Resident Child					
	1,1,2-Trichloroethane	6.00E-05	NA	NA	NA	6.00E-05
	1,2-Dichloroethane	NA	NA	NA	NA	---
	1,2-Dichloropropane	NA	7.90E-02	4.20E-07	1.50E-03	8.05E-02
	1,4-Dichlorobenzene	NA	9.50E-04	4.40E-09	1.50E-05	9.65E-04
	Benzene	NA	NA	NA	NA	---
	Chloroform	1.50E+00	NA	NA	NA	1.50E+00
	Chromium (VI)	1.70E+00	---	---	---	1.70E+00
	Nitrate	4.80E-01	---	---	---	4.80E-01
	Tetrachloroethene	9.40E-03	NA	NA	NA	9.40E-03
	Total Hazard	3.69E+00	8.00E-02	4.24E-07	1.52E-03	**3.77E+00**
	On-Site Indoor Researcher					
	1,1,2-Trichloroethane	---	---	---	NA	---
	1,2-Dichloroethane	---	---	---	NA	---
	1,2-Dichloropropane	---	---	---	4.70E-04	4.70E-04
	1,4-Dichlorobenzene	---	---	---	4.60E-06	4.60E-06
	Benzene	---	---	---	NA	---
	Chloroform	---	---	---	NA	---
	Chromium (VI)	---	---	---	---	---
	Nitrate	---	---	---	---	---
	Tetrachloroethene	---	---	---	NA	---
	Total Hazard	0.00E+00	0.00E+00	0.00E+00	4.75E-04	**4.75E-04**
	On-Site Outdoor Researcher					
	1,1,2-Trichloroethane	---	---	NA	---	---
	1,2-Dichloroethane	---	---	NA	---	---
	1,2-Dichloropropane	---	---	1.20E-07	---	1.20E-07
	1,4-Dichlorobenzene	---	---	1.20E-09	---	1.20E-09
	Benzene	---	---	NA	---	---
	Chloroform	---	---	NA	---	---
	Chromium (VI)	---	---	---	---	---
	Nitrate	---	---	---	---	---
	Tetrachloroethene	---	---	NA	---	---
	Total Hazard	0.00E+00	0.00E+00	1.21E-07	0.00E+00	**1.21E-07**
	On-Site Construction Worker					
	1,1,2-Trichloroethane	---	---	NA	---	---
	1,2-Dichloroethane	---	---	NA	---	---
	1,2-Dichloropropane	---	---	3.90E-08	---	3.90E-08
	1,4-Dichlorobenzene	---	---	4.30E-10	---	4.30E-10
	Benzene	---	---	NA	---	---
	Chloroform	---	---	NA	---	---
	Chromium (VI)	---	---	---	---	---
	Nitrate	---	---	---	---	---
	Tetrachloroethene	---	---	NA	---	---
	Total Hazard	0.00E+00	0.00E+00	3.94E-08	0.00E+00	**3.94E-08**

Notes:

[1] Source data from HHRA - Part A, Tables 7 and 8 (MWH, 2004).

[2] Receptor/COCs are the COCs considered and recommended for inclusion in the Feasibility Study from the HHRA - Part C (Brown and Caldwell, 2006).

[3] Domestic water use ingestion hazards and domestic water use air inhalation hazards are from HSU-1 and HSU-2.

[4] Outdoor air inhalation hazards and indoor air inhalation hazards are from HSU-1.

Acronyms/Abbreviations:

--- - not applicable - hazard quotients were not calculated for contaminant/exposure route
COC - constituent of concern
HSU - hydrostratigraphic unit
HHRA - human health risk assessment
NA - not applicable - hazard quotients were not calculated because the constituent is a carcinogen
UC Davis - University of California, Davis

References:

Brown and Caldwell, 2006. *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part C – Risk Characterization for UC Davis Areas),* April.
Montgomery Watson Harza (MWH), 2004. *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part A – Risk Estimate) LEHR/SCDS Environmental Restoration* , March.

Table 2-8. Summary of Cumulative Human Health Cancer Risks by Exposure Route - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor	Soil/Solid Waste Cancer Risks[1]									Groundwater Cancer Risks[2]					Total Cancer Risk[3]
		Soil Ingestion	Soil Dermal Exposure	Aboveground Plant Ingestion	Belowground Plant Ingestion	External Radiation	Dust Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation	Total Soil/Solid Waste Cancer Risk	Domestic Water Use Ingestion	Domestic Water Use Air Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation	Total Groundwater Cancer Risk	
Eastern Trenches	Age-Adjusted Adult	1.70E-06	3.80E-07	4.50E-06	4.10E-07	0.00E+00	9.00E-11	2.80E-08	4.00E-06	**1.10E-05**	9.34E-06	1.13E-03	4.03E-08	1.21E-04	**1.26E-03**	**1.27E-03**
	On-Site Resident	1.00E-06	1.90E-07	2.80E-06	3.00E-07	0.00E+00	7.00E-11	2.00E-08	3.00E-06	**7.31E-06**	6.70E-06	8.19E-04	3.02E-08	9.07E-05	**9.16E-04**	**9.23E-04**
	On-Site Resident Child	7.00E-07	1.90E-07	1.70E-06	1.10E-07	0.00E+00	2.00E-11	8.00E-09	1.00E-06	**3.71E-06**	2.64E-06	3.07E-04	1.01E-08	3.03E-05	**3.40E-04**	**3.44E-04**
	On-Site Indoor Researcher	2.00E-07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-06	**1.20E-06**	0.00E+00	0.00E+00	0.00E+00	4.03E-05	**4.03E-05**	**4.15E-05**
	On-Site Outdoor Researcher	3.00E-07	2.00E-07	0.00E+00	0.00E+00	0.00E+00	5.00E-11	1.00E-08	0.00E+00	**5.10E-07**	0.00E+00	0.00E+00	1.01E-08	0.00E+00	**1.01E-08**	**5.20E-07**
	On-Site Construction Worker	3.00E-08	9.00E-09	0.00E+00	0.00E+00	0.00E+00	2.00E-11	4.00E-10	0.00E+00	**3.94E-08**	0.00E+00	0.00E+00	5.03E-10	0.00E+00	**5.03E-10**	**3.99E-08**
Landfill Unit No. 1	Age-Adjusted Adult	1.22E-04	8.00E-06	7.10E-04	1.44E-04	0.00E+00	7.15E-08	0.00E+00	0.00E+00	**9.84E-04**	9.34E-06	1.13E-03	4.03E-08	1.21E-04	**1.26E-03**	**2.24E-03**
	On-Site Resident	7.10E-05	4.00E-06	3.60E-04	1.10E-04	0.00E+00	5.10E-08	0.00E+00	0.00E+00	**5.45E-04**	6.70E-06	8.19E-04	3.02E-08	9.07E-05	**9.16E-04**	**1.46E-03**
	On-Site Resident Child	5.08E-05	4.00E-06	3.50E-04	3.40E-05	0.00E+00	2.05E-08	0.00E+00	0.00E+00	**4.39E-04**	2.64E-06	3.07E-04	1.01E-08	3.03E-05	**3.40E-04**	**7.79E-04**
	On-Site Indoor Researcher	2.01E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.05E-08	0.00E+00	0.00E+00	**2.03E-06**	0.00E+00	0.00E+00	0.00E+00	4.03E-05	**4.03E-05**	**4.23E-05**
	On-Site Outdoor Researcher	4.02E-06	8.00E-07	0.00E+00	0.00E+00	0.00E+00	6.05E-09	0.00E+00	0.00E+00	**4.83E-06**	0.00E+00	0.00E+00	1.01E-08	0.00E+00	**1.01E-08**	**4.84E-06**
	On-Site Construction Worker	2.03E-06	2.00E-07	0.00E+00	0.00E+00	0.00E+00	2.05E-08	0.00E+00	0.00E+00	**2.25E-06**	0.00E+00	0.00E+00	5.03E-10	0.00E+00	**5.03E-10**	**2.25E-06**
Landfill Unit No. 2	Age-Adjusted Adult	5.61E-06	1.19E-06	2.14E-04	3.35E-05	3.80E-06	2.87E-09	3.50E-07	2.20E-05	**2.80E-04**	9.34E-06	1.13E-03	4.03E-08	1.21E-04	**1.26E-03**	**1.54E-03**
	On-Site Resident	3.41E-06	5.93E-07	1.22E-04	2.64E-05	3.00E-06	2.21E-09	2.60E-07	1.50E-05	**1.71E-04**	6.70E-06	8.19E-04	3.02E-08	9.07E-05	**9.16E-04**	**1.09E-03**
	On-Site Resident Child	2.20E-06	5.93E-07	9.20E-05	7.10E-06	8.00E-07	6.63E-10	9.00E-08	7.00E-06	**1.10E-04**	2.64E-06	3.07E-04	1.01E-08	3.03E-05	**3.40E-04**	**4.50E-04**
	On-Site Indoor Researcher	3.01E-08	0.00E+00	0.00E+00	0.00E+00	3.00E-07	0.00E+00	0.00E+00	9.00E-06	**9.33E-06**	0.00E+00	0.00E+00	0.00E+00	4.03E-05	**4.03E-05**	**4.96E-05**
	On-Site Outdoor Researcher	6.02E-08	4.00E-10	0.00E+00	0.00E+00	1.00E-06	1.00E-10	1.00E-07	0.00E+00	**1.16E-06**	0.00E+00	0.00E+00	1.01E-08	0.00E+00	**1.01E-08**	**1.17E-06**
	On-Site Construction Worker	1.10E-07	2.41E-08	0.00E+00	0.00E+00	7.00E-08	6.53E-10	5.00E-09	0.00E+00	**2.10E-07**	0.00E+00	0.00E+00	5.03E-10	0.00E+00	**5.03E-10**	**2.10E-07**
Landfill Unit No. 3	Age-Adjusted Adult	6.52E-06	4.10E-07	3.09E-04	4.01E-05	1.34E-05	4.02E-09	0.00E+00	0.00E+00	**3.70E-04**	9.34E-06	1.13E-03	4.03E-08	1.21E-04	**1.26E-03**	**1.63E-03**
	On-Site Resident	3.91E-06	2.05E-07	2.07E-04	3.01E-05	1.03E-05	3.01E-09	0.00E+00	0.00E+00	**2.51E-04**	6.70E-06	8.19E-04	3.02E-08	9.07E-05	**9.16E-04**	**1.17E-03**
	On-Site Resident Child	2.61E-06	2.05E-07	1.03E-04	1.00E-05	3.09E-06	1.00E-09	0.00E+00	0.00E+00	**1.19E-04**	2.64E-06	3.07E-04	1.01E-08	3.03E-05	**3.40E-04**	**4.59E-04**
	On-Site Indoor Researcher	6.33E-08	0.00E+00	0.00E+00	0.00E+00	1.03E-06	0.00E+00	0.00E+00	0.00E+00	**1.09E-06**	0.00E+00	0.00E+00	0.00E+00	4.03E-05	**4.03E-05**	**4.14E-05**
	On-Site Outdoor Researcher	1.08E-07	2.05E-08	0.00E+00	0.00E+00	4.10E-06	2.01E-10	0.00E+00	0.00E+00	**4.23E-06**	0.00E+00	0.00E+00	1.01E-08	0.00E+00	**1.01E-08**	**4.24E-06**
	On-Site Construction Worker	1.09E-07	9.20E-09	0.00E+00	0.00E+00	2.08E-07	1.00E-09	0.00E+00	0.00E+00	**3.27E-07**	0.00E+00	0.00E+00	5.03E-10	0.00E+00	**5.03E-10**	**3.27E-07**
Waste Burial Holes	Age-Adjusted Adult	6.00E-08	0.00E+00	1.30E-06	0.00E+00	9.00E-08	7.90E-13	0.00E+00	0.00E+00	**1.45E-06**	9.34E-06	1.13E-03	4.03E-08	1.21E-04	**1.26E-03**	**1.26E-03**
	On-Site Resident	4.00E-08	0.00E+00	1.00E-06	0.00E+00	7.00E-08	7.00E-13	0.00E+00	0.00E+00	**1.11E-06**	6.70E-06	8.19E-04	3.02E-08	9.07E-05	**9.16E-04**	**9.17E-04**
	On-Site Resident Child	2.00E-08	0.00E+00	3.00E-07	0.00E+00	2.00E-08	9.00E-14	0.00E+00	0.00E+00	**3.40E-07**	2.64E-06	3.07E-04	1.01E-08	3.03E-05	**3.40E-04**	**3.40E-04**
	On-Site Indoor Researcher	1.00E-09	0.00E+00	0.00E+00	0.00E+00	7.00E-09	0.00E+00	0.00E+00	0.00E+00	**8.00E-09**	0.00E+00	0.00E+00	0.00E+00	4.03E-05	**4.03E-05**	**4.03E-05**
	On-Site Outdoor Researcher	2.00E-09	0.00E+00	0.00E+00	0.00E+00	3.00E-08	6.00E-14	0.00E+00	0.00E+00	**3.20E-08**	0.00E+00	0.00E+00	1.01E-08	0.00E+00	**1.01E-08**	**4.21E-08**
	On-Site Construction Worker	1.00E-09	0.00E+00	0.00E+00	0.00E+00	2.00E-09	1.00E-14	0.00E+00	0.00E+00	**3.00E-09**	0.00E+00	0.00E+00	5.03E-10	0.00E+00	**5.03E-10**	**3.50E-09**

Notes:

[1] Summary of soil/solid waste cancer risks from Table 2-4.

[2] Summary of groundwater cancer risks from Table 2-6.

[3] Total cancer risk is the sum of soil/solid waste and groundwater cancer risks.

Acronyms/Abbreviations:

UC Davis - University of California, Davis

Table 2-9. Summary of Cumulative Human Health Non-Cancer Hazards by Exposure Route - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

UC Davis Area	Receptor	Soil/Solid Waste Non-Cancer Hazards[1]								Groundwater Non-Cancer Hazards[2]					Total Non-Cancer Hazard[3]
		Soil Ingestion	Soil Dermal Exposure	Aboveground Plant Ingestion	Belowground Plant Ingestion	Dust Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation	Total Soil/Solid Waste Non-Cancer Hazard	Domestic Water Use Ingestion	Domestic Water Use Air Inhalation	Outdoor Air Inhalation	Indoor Air Inhalation	Total Groundwater Non-Cancer Hazard	
Eastern Trenches	Age-Adjusted Adult	1.04E-02	2.66E-03	2.99E-02	2.18E-03	2.79E-07	0.00E+00	0.00E+00	**4.52E-02**	5.72E+00	1.23E-01	6.57E-07	2.36E-03	**5.85E+00**	**5.90E+00**
	On-Site Resident	2.34E-03	4.40E-04	5.90E-03	9.00E-04	9.90E-08	0.00E+00	0.00E+00	**9.58E-03**	2.04E+00	4.35E-02	2.32E-07	8.48E-04	**2.08E+00**	**2.09E+00**
	On-Site Resident Child	8.10E-03	2.22E-03	2.40E-02	1.28E-03	1.80E-07	0.00E+00	0.00E+00	**3.56E-02**	3.69E+00	8.00E-02	4.24E-07	1.52E-03	**3.77E+00**	**3.81E+00**
	On-Site Indoor Researcher	6.20E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**6.20E-04**	0.00E+00	0.00E+00	0.00E+00	4.75E-04	**4.75E-04**	**1.09E-03**
	On-Site Outdoor Researcher	1.10E-03	7.30E-04	0.00E+00	0.00E+00	1.70E-07	0.00E+00	0.00E+00	**1.83E-03**	0.00E+00	0.00E+00	1.21E-07	0.00E+00	**1.21E-07**	**1.83E-03**
	On-Site Construction Worker	2.03E-03	6.10E-04	0.00E+00	0.00E+00	1.10E-06	0.00E+00	0.00E+00	**2.64E-03**	0.00E+00	0.00E+00	3.94E-08	0.00E+00	**3.94E-08**	**2.64E-03**
Landfill Unit No. 1	Age-Adjusted Adult	1.71E+00	1.31E-01	1.08E+01	1.68E+00	0.00E+00	0.00E+00	0.00E+00	**1.43E+01**	5.72E+00	1.23E-01	6.57E-07	2.36E-03	**5.85E+00**	**2.02E+01**
	On-Site Resident	3.87E-01	2.10E-02	2.18E+00	6.93E-01	0.00E+00	0.00E+00	0.00E+00	**3.28E+00**	2.04E+00	4.35E-02	2.32E-07	8.48E-04	**2.08E+00**	**5.36E+00**
	On-Site Resident Child	1.32E+00	1.10E-01	8.60E+00	9.90E-01	0.00E+00	0.00E+00	0.00E+00	**1.10E+01**	3.69E+00	8.00E-02	4.24E-07	1.52E-03	**3.77E+00**	**1.48E+01**
	On-Site Indoor Researcher	1.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**1.41E-02**	0.00E+00	0.00E+00	0.00E+00	4.75E-04	**4.75E-04**	**1.46E-02**
	On-Site Outdoor Researcher	2.42E-02	4.80E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**2.90E-02**	0.00E+00	0.00E+00	1.21E-07	0.00E+00	**1.21E-07**	**2.90E-02**
	On-Site Construction Worker	3.46E-01	3.00E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**3.76E-01**	0.00E+00	0.00E+00	3.94E-08	0.00E+00	**3.94E-08**	**3.76E-01**
Landfill Unit No. 2	Age-Adjusted Adult	3.33E-01	9.70E-05	2.74E+01	1.42E+00	0.00E+00	0.00E+00	0.00E+00	**2.91E+01**	5.72E+00	1.23E-01	6.57E-07	2.36E-03	**5.85E+00**	**3.50E+01**
	On-Site Resident	7.43E-02	1.60E-05	5.47E+00	5.90E-01	0.00E+00	0.00E+00	0.00E+00	**6.13E+00**	2.04E+00	4.35E-02	2.32E-07	8.48E-04	**2.08E+00**	**8.21E+00**
	On-Site Resident Child	2.59E-01	8.10E-05	2.19E+01	8.30E-01	0.00E+00	0.00E+00	0.00E+00	**2.30E+01**	3.69E+00	8.00E-02	4.24E-07	1.52E-03	**3.77E+00**	**2.68E+01**
	On-Site Indoor Researcher	8.20E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**8.20E-04**	0.00E+00	0.00E+00	0.00E+00	4.75E-04	**4.75E-04**	**1.29E-03**
	On-Site Outdoor Researcher	1.52E-03	2.80E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**1.52E-03**	0.00E+00	0.00E+00	1.21E-07	0.00E+00	**1.21E-07**	**1.52E-03**
	On-Site Construction Worker	6.53E-02	2.20E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**6.53E-02**	0.00E+00	0.00E+00	3.94E-08	0.00E+00	**3.94E-08**	**6.53E-02**
Landfill Unit No. 3	Age-Adjusted Adult	3.72E-01	2.02E-04	7.62E+00	7.15E-01	1.31E-01	0.00E+00	0.00E+00	**8.84E+00**	5.72E+00	1.23E-01	6.57E-07	2.36E-03	**5.85E+00**	**1.47E+01**
	On-Site Resident	8.20E-02	3.20E-05	1.52E+00	2.95E-01	4.60E-02	0.00E+00	0.00E+00	**1.94E+00**	2.04E+00	4.35E-02	2.32E-07	8.48E-04	**2.08E+00**	**4.02E+00**
	On-Site Resident Child	2.90E-01	1.70E-04	6.10E+00	4.20E-01	8.50E-02	0.00E+00	0.00E+00	**6.90E+00**	3.69E+00	8.00E-02	4.24E-07	1.52E-03	**3.77E+00**	**1.07E+01**
	On-Site Indoor Researcher	3.03E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	**3.03E-03**	0.00E+00	0.00E+00	0.00E+00	4.75E-04	**4.75E-04**	**3.50E-03**
	On-Site Outdoor Researcher	5.40E-03	4.00E-06	0.00E+00	0.00E+00	7.10E-03	0.00E+00	0.00E+00	**1.25E-02**	0.00E+00	0.00E+00	1.21E-07	0.00E+00	**1.21E-07**	**1.25E-02**
	On-Site Construction Worker	7.30E-02	4.60E-05	0.00E+00	0.00E+00	4.90E-01	0.00E+00	0.00E+00	**5.63E-01**	0.00E+00	0.00E+00	3.94E-08	0.00E+00	**3.94E-08**	**5.63E-01**
Waste Burial Holes[4]	Age-Adjusted Adult	---	---	---	---	---	---	---	**0.00E+00**	5.72E+00	1.23E-01	6.57E-07	2.36E-03	**5.85E+00**	**5.85E+00**
	On-Site Resident	---	---	---	---	---	---	---	**0.00E+00**	2.04E+00	4.35E-02	2.32E-07	8.48E-04	**2.08E+00**	**2.08E+00**
	On-Site Resident Child	---	---	---	---	---	---	---	**0.00E+00**	3.69E+00	8.00E-02	4.24E-07	1.52E-03	**3.77E+00**	**3.77E+00**
	On-Site Indoor Researcher	---	---	---	---	---	---	---	**0.00E+00**	0.00E+00	0.00E+00	0.00E+00	4.75E-04	**4.75E-04**	**4.75E-04**
	On-Site Outdoor Researcher	---	---	---	---	---	---	---	**0.00E+00**	0.00E+00	0.00E+00	1.21E-07	0.00E+00	**1.21E-07**	**1.21E-07**
	On-Site Construction Worker	---	---	---	---	---	---	---	**0.00E+00**	0.00E+00	0.00E+00	3.94E-08	0.00E+00	**3.94E-08**	**3.94E-08**

Notes:

[1] Summary of soil/solid waste non-cancer hazards from Table 2-5.

[2] Summary of groundwater non-cancer hazards from Table 2-7.

[3] Total non-cancer hazard is the sum of soil/solid waste and groundwater non-cancer hazards.

[4] There is no hazard quotient data for the Waste Burial Holes

Acronyms/Abbreviations:

--- - not applicable - non-cancer hazards were not calculated for the Waste Burial Holes

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Table 2-10. Comparison of HHRA – Part C Potential Constituents of Concern with Updated Constituents of Concern Identified in Appendix C of the FS - Volume 1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Land Disposal Unit	FS - Volume 1 COCs	HHRA - Part C COCs (0-10 feet)[a]	Eliminated from or Added to Risk Assessment List	Reason for Addition/Exclusion in FS - Volume 1 COC List
Eastern Trenches				
0-10 feet bgs	Tritium (Hydrogen-3)	---	Added	EPC > US EPA PRG and BGD
	Carbon-14	---	Added	EPC > US EPA PRG and BGD (det. freq.= 2/33)
	---	Dieldrin	Eliminated	95% UCL < SV
	---	Hexachlorobenzene	Eliminated	95% UCL < SV
10-20 feet bgs	Carbon-14	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C
Landfill Unit No. 1				
0-10 feet bgs	**Arsenic**	**Arsenic**	**Same**	---
	Lead	---	Added	EPC > CHHSL and BGD; not considered above BGD in HHRA - Part C
	Carbon-14	---	Added	EPC > US EPA PRG and BGD (det. freq. = 2/14)
	Benzo(a)pyrene	---	Added	EPC > US EPA RSL; did not exceed risk-based screening value in HHRA - Part C (det. freq. = 1/23)
	---	Cadmium	Eliminated	95% UCL < SV
10-20 feet bgs	Carbon-14	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C
Landfill Unit No. 2				
0-10 feet bgs	---	Cadmium	Eliminated	Maximum concentration < SV
	Lead	---	Added	EPC > CHHSL and BGD; not considered above BGD in HHRA - Part C
	Carbon-14	---	Added	EPC > US EPA PRG and BGD
	Cesium-137	**Cesium-137**	**Same**	---
	Aroclor 1260	---	Added	EPC > US EPA RSL (det. freq. = 2/14)
	Benzo(a)anthracene	---	Added	EPC > US EPA RSL (det. freq. = 2/22)
	Benzo(a)pyrene	**Benzo(a)pyrene**	**Same**	--- (det. freq. = 2/22)
	Benzo(b)fluoranthene	---	Added	EPC > US EPA RSL (det. freq. = 2/22)
	---	Benzo(k)fluoranthene	Eliminated	Maximum concentration < SV
	---	Copper	Eliminated	95% UCL < SV
10-20 feet bgs	Lead	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C
	Potassium-40	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C; 89% of risk posed by potassium-40 is due to background
	Carbon-14	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C
	Strontium-90	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C
Landfill Unit No. 3				
0-10 feet bgs	---	Cadmium	Eliminated	Maximum value < SV
	Lead	---	Added	EPC > CHHSL and BGD; not considered above BGD in HHRA - Part C
	Manganese	**Manganese**	**Same**	---
	Carbon-14	---	Added	EPC > US EPA PRG and BGD
	Cesium-137	**Cesium-137**	**Same**	---
	Strontium-90	**Strontium-90**	**Same**	---
	Aroclor 1260	**Aroclor 1260**	**Same**	--- (det. freq. = 4/21)
10-20 feet bgs	Carbon-14	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C
Southern Trenches				
0-10 feet bgs	Carbon-14	---	Added	EPC > US EPA PRG and BGD; did not exceed risk-based screening value in HHRA - Part C; however, because of poor data quality and low det. freq. = 1/21 it is designated an FS - Volume 1 COPC until further evaluation
Waste Burial Holes				
0-10 feet bgs	Carbon-14	---	Added	EPC > US EPA PRG and BGD
	Tritium (Hydrogen-3)	---	Added	EPC > US EPA PRG and BGD
	Strontium-90	**Strontium-90**	**Same**	---
	Cesium-137	---	Added	EPC > US EPA PRG and BGD; did not exceed risk-based screening value in HHRA - Part C (det. freq. = 2/11)
	Naphthalene	---	Added	EPC > US EPA RSL; did not exceed risk-based screening value in HHRA - Part C (det. freq. = 2/15)
10-20 feet bgs	Carbon-14	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C
	Tritium (Hydrogen-3)	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C
	Strontium-90	---	Added	No COCs identified below 10 feet bgs in HHRA - Part C

Notes:

Bold text indicates COC identified in both the HHRA - Part C and FS - Volume 1.

[a] The HHRA - Part C designated soil/solid waste COCs for the 0-10 foot bgs depth interval only

Acronyms/Abbreviations:

BGD - background

bgs - below ground surface

CHHSL - California Human Health Screening Level

Table 2-10. Comparison of HHRA – Part C Potential Constituents of Concern with Updated Constituents of Concern Identified in Appendix C of the FS - Volume 1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Acronyms/Abbreviations (continued):

COC - constituent of concern

COPC - constituent of potential concern

det. freq. - detection frequency

EPC - exposure point concentration

FS - Feasibility Study

HHRA - Human Health Risk Assessment

PRG - Preliminary Remediation Goal

RSL - Regional Screening Level

SV - screening value

UCL - upper confidence limit

US EPA - United States Environmental Protection Agency

--- - not applicable

< - less than

> - greater than

Reference:

Brown & Caldwell, 2006. *Site-Wide Risk Assessment, Volume I Human Health Risk Assessment (Part C – Risk Characterization for UC Davis Areas)* , LEHR/SCDS Environmental Restoration, April.

Table 2-11. Summary of Updated Human Health Residential Cancer Risks - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Landfill Disposal Unit	EPC [1] [mg/kg or pCi/g]	Residential Screening Value[2] [mg/kg or pCi/g]	Residential Risk[3]
Eastern Trenches			
0-10 feet bgs			
Tritium (Hydrogen-3)	58	0.88	6.6E-05
Carbon-14	0.68	0.48	1.4E-06
Total Risk			**6.8E-05**
10-20 feet bgs			
Carbon-14	6.7	0.48	1.4E-05
Total Risk			**1.4E-05**
Total Risk 0-20 feet bgs			**8.2E-05**
Landfill Unit No. 1			
0-10 feet bgs			
Arsenic	50	0.39	1.3E-04
Carbon-14	2.4	0.48	5.0E-06
Benzo(a)pyrene	0.022	0.015	1.5E-06
Total Risk			**1.4E-04**
10-20 feet bgs			
Carbon-14	2.5	0.48	5.3E-06
Total Risk			**5.3E-06**
Total Risk 0-20 feet bgs			**1.4E-04**
Landfill Unit No. 2			
0-10 feet bgs			
Carbon-14	1.7	0.48	3.5E-06
Cesium-137	0.15	0.062	2.4E-06
Aroclor 1260	0.31	0.22	1.4E-06
Benzo(a)anthracene	0.28	0.15	1.9E-06
Benzo(a)pyrene	0.20	0.015	1.3E-05
Benzo(b)fluoranthene	0.19	0.15	1.3E-06
Total Risk			**2.3E-05**
10-20 feet bgs			
Potassium-40	16	0.12	1.4E-04
Carbon-14	2.4	0.48	5.0E-06
Strontium-90	0.26	0.24	1.1E-06
Total Risk			**1.4E-04**
Total Risk 0-20 feet bgs			**1.6E-04**
Landfill Unit No. 3			
0-10 feet bgs			
Carbon-14	1.4	0.48	3.0E-06
Cesium-137	0.47	0.062	7.7E-06
Strontium-90	1.8	0.24	7.5E-06
Aroclor 1260	0.49	0.22	2.2E-06
Total Risk			**2.0E-05**
10-20 feet bgs			
Carbon-14	0.69	0.48	1.4E-06
Total Risk			**1.4E-06**
Total Risk 0-20 feet bgs			**2.2E-05**

Table 2-11. Summary of Updated Human Health Residential Cancer Risks - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Landfill Disposal Unit	EPC [1] [mg/kg or pCi/g]	Residential Screening Value[2] [mg/kg or pCi/g]	Residential Risk[3]
Southern Trenches			
0-10 feet bgs			
Carbon-14	5.1	0.48	1.1E-05
Total Risk			**1.1E-05**
Total Risk 0-20 feet bgs			**1.1E-05**
Waste Burial Holes			
0-10 feet bgs			
Carbon-14	42	0.48	8.8E-05
Tritium (Hydrogen-3)	184	0.88	2.1E-04
Strontium-90	0.56	0.24	2.3E-06
Cesium-137	1,236	0.062	2.0E-02
Naphthalene	43	3.6	1.2E-05
Total Risk			**2.0E-02**
10-20 feet bgs			
Carbon-14	4.8	0.48	1.0E-05
Tritium (Hydrogen-3)	454	0.88	5.1E-04
Strontium-90	12	0.24	4.8E-05
Total Risk			**5.7E-04**
Total Risk 0-20 feet bgs			**2.1E-02**

Notes:

Lead is not included on this table as toxicity is measured by blood-lead levels rather than cancer risk.

[1] Exposure point concentration is calculated as the lower of the 95 percent upper confidence limit on the mean and the maximum sample concentration (Appendix C).

[2] Screening values for non-radiologic constituents are the US EPA RSLs updated in November 2011, accessed January 2012 (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table). The screening values for radiologic constituents are US EPA PRGs updated in August 2010, accessed January 2012 (http://epa-prgs.ornl.gov/radionuclides/download.shtml).

[3] Calculated risk posed by current EPCs to a potential on-Site resident.

Acronyms/Abbreviations:

bgs - below ground surface
EPC - exposure point concentration
mg/kg - milligrams per kilogram
pCi/g - picocuries per gram
PRG - Preliminary Remediation Goal
RSL - Regional Screening Level
US EPA - United States Environmental Protection Agency

Table 2-12. Summary of Updated Human Health Residential Non-Cancer Hazards - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Landfill Disposal Unit	EPC [1] [mg/kg]	Residential Screening Value[2] [mg/kg]	Residential Hazard Quotient[3]
Eastern Trenches	NA	--	--
Landfill Unit No. 1	NA	--	--
Landfill Unit No. 2	NA	--	--
Landfill Unit No. 3			
0-10 feet bgs			
Manganese	3,926	1,800	2.2
Total Hazard			**2.2**
Southern Trenches	NA	--	--
Waste Burial Holes	NA	--	--

Notes:

Lead is not included on this table as toxicity is measured by blood-lead levels rather than non-cancer hazard.

[1] Exposure point concentration is calculated as the lower of the 95 percent upper confidence limit on the mean and the maximum sample concentration (Appendix C).

[2] Screening values for non-radiologic constituents are the US EPA RSLs updated in November 2011, accessed January 2012 (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table).

[3] Calculated hazard quotient posed by current EPCs to a potential on-Site resident.

Acronyms/Abbreviations:

bgs - below ground surface
EPC - exposure point concentration
mg/kg - milligrams per kilogram
NA - not applicable, exposure point concentration below screening value
RSL - Regional Screening Level
US EPA - United States Environmental Protection Agency
-- - not applicable

Table 2-13. Risk Evaluation Summary for List 2 Constituents of Potential Ecological Concern and Receptors, Landfill Unit No. 1 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Plants		Invertebrates		Botta's Pocket Gopher		American Robin		Ornate Shrew		Horned Lark		Rock Dove		Redtail Hawk		Northern Harrier	
COPEC	LOEC Low HQ	LOEC High HQ	LOEC Low HQ	LOEC High HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Arsenic	1.7E+00	NA	---	---	---	---	---	---	2.3E+00	1.5E-01	---	---	---	---	---	---	---	---
Barium	---	---	1.1E+00	NA	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cadmium	---	---	---	---	1.9E+00	4.3E-02	2.7E+01	2.1E-01	4.8E+01	1.1E+00	3.7E+01	2.8E-01	---	---	---	---	---	---
Copper	4.9E+00	NA	7.5E+00	NA	1.6E+00	6.6E-03	7.3E+00	3.2E-01	2.9E+00	1.2E-02	6.7E+00	2.9E-01	---	---	---	---	---	---
Lead	7.0E+00	NA	---	---	4.2E+00	1.8E-02	3.7E+03	6.0E+00	4.3E+01	1.8E-01	4.1E+03	6.5E+00	2.0E+00	3.2E-03	3.2E+00	5.2E-03	1.1E+00	1.7E-03
Manganese	1.4E+00	NA	---	---	---	---	1.6E+00	1.6E-01	1.1E+01	9.2E-01	2.1E+00	2.1E-01	---	---	---	---	---	---
Selenium	4.9E+00	NA	---	---	7.4E+00	3.1E-01	2.6E+00	6.4E-01	1.3E+01	5.3E-01	3.2E+00	7.9E-01	---	---	---	---	---	---
Silver	2.4E+00	NA	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Thallium	2.0E+00	NA	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Zinc	4.2E+01	NA	1.0E+01	NA	5.0E+00	1.2E-01	1.3E+01	1.3E+00	2.4E+01	5.6E-01	1.6E+01	1.6E+00	---	---	---	---	---	---
4,4'-DDE	---	---	---	---	---	---	1.3E+00	1.9E-02	---	---	1.7E+00	1.9E-02	---	---	---	---	---	---

Acronyms/Abbreviations:

COPEC - constituent of potential ecological concern

HQ - hazard quotient

LOAEL - lowest observed adverse effect level

LOEC - lowest observed effect concentration

NA - benchmark or toxicity reference value not available

NOAEL - no observed adverse effect level

--- - COPEC is not List 2 for specified receptor

Adapted from:

Blasland, Bouck, & Lee, Inc. (BBL), 2006. *Site-Wide Ecological Risk Assessment, LEHR/SCDS* , Prepared for the University of California, Davis, July.

Table 2-14. Risk Evaluation Summary for List 2 Constituents of Potential Ecological Concern and Receptors, Landfill Unit No. 2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Plants		Invertebrates		Botta's Pocket Gopher		Ornate Shrew		American Robin		Horned Lark		Redtail Hawk	
COPEC	LOEC Low HQ	LOEC High HQ	LOEC Low HQ	LOEC High HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Antimony	---	---	---	---	---	---	8.5E+00	4.1E-01	---	---	---	---	---	---
Cadmium	---	---	---	---	2.1E+00	4.8E-02	5.6E+01	1.3E+00	3.2E+01	2.4E-01	4.3E+01	3.3E-01	---	---
Copper	7.7E+00	NA	1.2E+01	NA	2.1E+00	8.8E-03	3.7E+00	1.6E-02	1.1E+01	4.7E-01	9.4E+00	4.1E-01	---	---
Lead	2.0E+00	NA	---	---	1.5E+00	6.2E-03	1.5E+01	6.2E-02	1.2E+03	1.9E+00	1.4E+03	2.2E+00	1.3E+00	2.1E-03
Manganese	1.6E+00	NA	---	---	---	---	1.2E+01	1.0E+00	1.8E+00	1.8E-01	2.3E+00	2.3E-01	3.2E+00	5.2E-03
Molybdenum	2.3E+00	NA	---	---	---	---	---	---	---	---	---	---	---	---
Silver	4.9E+00	NA	---	---	---	---	---	---	---	---	---	---	---	---
Thallium	1.2E+00	NA	---	---	---	---	---	---	---	---	---	---	---	---
Zinc	1.4E+01	NA	3.4E+00	NA	2.5E+00	5.9E-02	1.6E+01	3.8E-01	7.7E+00	7.7E-01	9.8E+00	9.8E-01	---	---
4,4'-DDD	---	---	---	---	---	---	---	---	3.0E+00	NA	3.9E+00	NA	---	---
4,4'-DDE	---	---	---	---	---	---	---	---	6.7E+00	1.0E-01	8.7E+00	1.3E-01		
4,4'-DDT	---	---	---	---	---	---	---	---	2.7E+00	1.6E-02	3.5E+00	2.1E-02	---	---

Acronyms/Abbreviations:

COPEC - constituent of potential ecological concern

HQ - hazard quotient

LOAEL - lowest observed adverse effect level

LOEC - lowest observed effect concentration

NA - benchmark or toxicity reference value not available

NOAEL - no observed adverse effect level

--- - COPEC is not List 2 for specified receptor

Adapted from:

Blasland, Bouck, & Lee, Inc. (BBL), 2006. *Site-Wide Ecological Risk Assessment, LEHR/SCDS* , Prepared for the University of California, Davis, July.

Table 2-15. Risk Evaluation Summary for List 2 Constituents of Potential Ecological Concern and Receptors, Landfill Unit No. 3 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Plants		Invertebrates		Botta's Pocket Gopher		Ornate Shrew		American Robin		Horned Lark		Rock Dove		Redtail Hawk		Northern Harrier	
COPEC	LOEC Low HQ	LOEC High HQ	LOEC Low HQ	LOEC High HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ	NOAEL HQ	LOAEL HQ
Antimony	2.8E+00	NA	---	---	1.1E+00	5.1E-02	5.0E+01	2.4E+00	---	---	---	---	---	---	---	---	---	---
Barium	---	---	1.1E+00	NA	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cadmium	---	---	---	---	3.2E+00	7.2E-02	9.8E+01	2.2E+00	5.6E+01	4.3E-01	5.7E+01	4.4E-01	---	---	---	---	---	---
Copper	4.4E+00	NA	6.7E+00	NA	1.5E+00	6.1E-03	2.8E+00	1.2E-02	6.7E+00	2.9E-01	4.6E+00	2.0E-01	---	---	---	---	---	---
Lead	2.1E+01	NA	1.5E+00	NA	1.1E+01	4.6E-02	1.1E+02	4.4E-01	1.0E+04	1.6E+01	8.0E+03	1.3E+01	3.2E+00	5.2E-03	4.8E+00	7.7E-03	1.1E+00	1.7E-03
Manganese	5.1E+00	NA	---	---	2.4E+00	2.1E-01	3.8E+01	3.3E+00	5.8E+00	5.8E-01	5.5E+00	5.5E-01	---	---	---	---	---	---
Molybdenum	4.0E+00	NA	---	---	1.0E+00	NA	1.5E+00	NA	---	---	---	---	---	---	---	---	---	---
Selenium	2.7E+00	NA	---	---	3.9E+00	1.6E-01	8.3E+00	3.4E-01	1.6E+00	4.0E-01	1.5E+00	3.7E-01	---	---	---	---	---	---
Silver	1.5E+01	NA	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Zinc	2.3E+01	NA	5.8E+00	NA	3.5E+00	8.1E-02	1.9E+01	4.5E-01	9.7E+00	9.7E-01	9.1E+00	9.1E-01	---	---	---	---	---	---
Aroclor 1260	---	---	---	---	---	---	---	---	1.1E+00	7.7E-02	1.1E+00	7.7E-02	---	---	---	---	---	---

Acronyms/Abbreviations:

COPEC - constituent of potential ecological concern

HQ - hazard quotient

LOAEL - lowest observed adverse effect level

LOEC - lowest observed effect concentration

NA - benchmark or toxicity reference value not available

NOAEL - no observed adverse effect level

--- - COPEC is not List 2 for specified receptor

Adapted from:

Blasland, Bouck, & Lee, Inc. (BBL), 2006. *Site-Wide Ecological Risk Assessment, LEHR/SCDS* , Prepared for the University of California, Davis, July.

Table 2-16. Predicted Vadose Zone Travel Times for Constituents - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Constituents	K_d Value Used for Vadose Zone Modeling[1] (cm^3/g)	Retardation Factor Relative to Rainwater (unitless)	Average Groundwater Velocity of Constituent (feet/year)	Predicted Time to Reach Groundwater (years)	Mobility Category[2]
Inorganic Compounds					
Arsenic	29	196	0.007	2,797	Low
Lead	16,000	107,485	0.00001	1,535,500	Low
Manganese	750	5,039	0.0003	71,990	Low
Barium	41	NA	NA	0 [3,4]	High
Cadmium	75	NA	NA	0 [3,4]	High
Copper	4	NA	NA	770 to 4,000 [4,5]	Low
Selenium	5	NA	NA	0 [3,4]	High
Organic Compounds					
Aroclor 1260	24,500	164,586	0.00001	2,351,227	Low
Benzo(a)anthracene	3,580	24,051	0.00006	343,579	Low
Benzo(a)pyrene	1,020	6,853	0.0002	97,902	Low
Benzo(b)fluoranthene	10,500	70,537	0.00002	1,007,677	Low
Naphthalene	11.9	81	0.017	1,156	Low
Radionuclides					
Carbon-14	0.0[6]	NA	NA	0 to 140[5]	High
Cesium-137	4,600	30,903	0.00005	441,466	Low
Potassium-40	15	102	0.014	1,454	Low
Strontium-90	35	236	0.181	3,373	Low
Tritium	0.0[7]	NA	NA	0 to 36[5]	High

Notes:

[1] Values obtained from Table C2 in the *Feasibility Study Data Gaps Work Plan* (Weiss, 2008)

[2] Mobility Category - Time to reach groundwater: less than 100 years = High; between 100 and 300 years = Intermediate; over 300 years = Low

[3] NUFT-modeled value when constituent reaches peak concentration in groundwater for applicable Site land disposal units; from Appendix A, Tables D-6 through D-11

[4] The NUFT model predicts that this COC should currently be above background and MCL values (Appendix A), but groundwater monitoring data indicate that all results are below the MCL.

[5] Range of NUFT-modeled values when constituent reaches peak concentration in groundwater for applicable Site land disposal units; from Appendix A, Tables D-6 through D-11

[6] Carbon-14 molecular form assumed as methanol, as noted in Appendix A, Table D-4.

[7] Tritium molecular form assumed as water, as noted in Appendix A, Table D-4.

Acronyms/Abbreviations:

cm^3/g - cubic centimeters per gram

COC - constituent of concern

K_d - soil/water partitioning coefficient

MCL - Maximum Contaminant Level

NA - not applicable

NUFT - Non-isothermal Unsaturated Flow and Transport

Adapted from Table 4.1 in:

Geomatrix, 2004. *Final UC Davis Remedial Investigation Report, LEHR/SCDS Environmental Restoration* , December.

Values Used in Calculations:

Porosity: n = 0.37, from Site data in Table D-2, Appendix A
Effective porosity: ne = 0.25, from the *Final UC Davis Remedial Investigation Report* (Geomatrix, 2004)

Infiltration Rate: 10.8 cm/year = 0.35 feet/year, from Appendix A

Average linear groundwater velocity: 1.4 feet/year

Depth to groundwater: 20 feet, from Appendix A

Reference:

Weiss, 2008, *Feasibility Study Data Gaps Work Plan* , LEHR/SCDS, August.

Table 3-1. List of Soil/Solid Waste Human Health and Ecological Constituents of Concern - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Human Health COCs[1]		Ecological COCs[3]
Land Disposal Unit	**0-10 feet bgs**	**10-20 feet bgs**	**0-10 feet bgs**
Eastern Trenches	Carbon-14 Tritium (Hydrogen-3)	Carbon-14	---
Landfill Unit No. 1	Arsenic Lead Carbon-14 Benzo(a)pyrene	Carbon-14	Arsenic Barium Cadmium Copper Lead Manganese Selenium Silver Thallium Zinc 4,4'-DDE
Landfill Unit No. 2	Lead Carbon-14 Cesium-137 Aroclor 1260 Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene	Lead Potassium-40 Carbon-14 Strontium-90	Antimony Cadmium Copper Lead Manganese Molybdenum Silver Thallium Zinc 4,4'-DDD 4,4'-DDE 4,4'-DDT
Landfill Unit No. 3	Lead Manganese Carbon-14 Cesium-137 Strontium-90 Aroclor 1260	Carbon-14	Antimony Barium Cadmium Copper Lead Manganese Molybdenum Selenium Silver Zinc Aroclor 1260
Southern Trenches	Carbon-14[2]	---	---
Waste Burial Holes	Carbon-14 Tritium (Hydrogen-3) Strontium-90 Cesium-137 Naphthalene	Carbon-14 Tritium (Hydrogen-3) Strontium-90	---

Notes:

[1] Human health COCs designated in Appendix C of the FS - Volume 1

[2] Carbon-14 is designated a COPC until it can be further evaluated

[3] PCGs were not developed for ecological COCs because of the uncertainty in the risk estimates (Section 3.3.1)

Acronyms/Abbreviations:

bgs - below ground surface

COC - constituent of concern

COPC - constituent of potential concern

FS - Volume 1 - *Final Feasibility Study for the University of California, Davis Areas Volume 1: Soil/Solid Waste and Soil Gas*

PCG - preliminary cleanup goal

Table 3-2. Preliminary Cleanup Goals, Soil/Solid Waste (0 to 10 Feet Below Ground Surface) - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Land Disposal Unit/Constituent	COC Type	GW Impact Designated Level [1] (mg/kg or pCi/g)	Human Health Screening Level [2] (mg/kg or pCi/g)	Soil Background [3] (mg/kg or pCi/g)	Preliminary Cleanup Goal [4] (mg/kg or pCi/g)
Eastern Trenches					
Carbon-14	GW, HH	< 0.13	0.48	**< 0.13**	**< 0.13**
Tritium (Hydrogen-3)	GW, HH	< 1.2	0.88	**< 1.2**	**< 1.2**
Landfill Unit No. 1					
Arsenic	HH	---	0.39	**9.6**	**9.6**
Benzo(a)pyrene	HH	---	**0.015**	0	**0.015**
Carbon-14	GW, HH	< 0.13	0.48	**< 0.13**	**< 0.13**
Copper	GW	44	---	**60**	**60**
Lead	HH	---	**80**	9.5	**80**
Selenium	GW	0.22	---	**1.2**	**1.2**
Landfill Unit No. 2					
Benzo(a)anthracene	HH	---	**0.15**	0	**0.15**
Benzo(a)pyrene	HH	---	**0.015**	0	**0.015**
Benzo(b)fluoranthene	HH	---	**0.15**	0	**0.15**
Cadmium	GW	0.29	---	**0.5**	**0.5**
Carbon-14	GW, HH	< 0.13	0.48	**< 0.13**	**< 0.13**
Cesium-137	HH	---	**0.062**	0.01	**0.062**
Lead	HH	---	**80**	9.5	**80**
Aroclor 1260	HH	---	**0.22**	0	**0.22**
Landfill Unit No. 3					
Barium	GW	35	---	**260**	**260**
Cadmium	GW	0.32	---	**0.5**	**0.5**
Carbon-14	GW, HH	< 0.13	0.48	**< 0.13**	**< 0.13**
Cesium-137	HH	---	**0.062**	0.01	**0.062**
Copper	GW	**138**	---	60	**138**
Lead	HH	---	**80**	9.5	**80**
Manganese	HH	---	**1,800**	750	**1,800**
Aroclor 1260	HH	---	**0.22**	0	**0.22**
Strontium-90	HH	---	**0.24**	0.056	**0.24**
Southern Trenches					
Carbon-14	HH	---	**0.48**	< 0.13	**0.48**
Waste Burial Holes					
Carbon-14	GW, HH	**0.32**	0.48	< 0.13	**0.32**
Cesium-137	HH	---	**0.062**	0.01	**0.062**
Naphthalene	HH	---	**3.6**	0	**3.6**
Strontium-90	HH	---	**0.24**	0.056	**0.24**
Tritium (Hydrogen-3)	GW, HH	3.2	0.88	**< 1.2**	**< 1.2**

Table 3-2. Preliminary Cleanup Goals, Soil/Solid Waste (0 to 10 Feet Below Ground Surface) - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Notes:

Bold indicates selected preliminary cleanup goal.

[1] Designated levels for groundwater impact at drinking water standards obtained from Appendix A.

[2] Screening values for non-radiologic constituents are the US EPA RSLs updated in November 2011 and accessed January 2012 (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table) except for lead, which is a CHHSL (http://oehha.ca.gov/risk/chhsltable.html) and was accessed July 2010. The screening values for radiologic constituents are US EPA PRGs updated in August 2010 and accessed January 2012 (http://epa-prgs.ornl.gov/radionuclides/download.shtml).

[3] Background values obtained from Weiss Associates, 1998. *Final Technical Report: Results of Western Dog Pens, Background, and Off-site Investigations* , Laboratory for Energy-Related Health Research, University of California, Davis, June. Background for organic constituents is assumed to be zero.

[4] Preliminary cleanup goal chosen by:

(1) selecting the lowest of RSLs (PRGs for radionuclides and CHHSL for lead) or groundwater designated level.

(2) comparing this value to constituent's background concentration.

(3) higher of two values designated as preliminary cleanup goal.

Acronyms/Abbreviations:

CHHSL - California Human Health Screening Level

COC - constituent of concern

GW - groundwater

HH - human health

mg/kg - milligrams per kilogram

pCi/g - picocuries per gram

PRG - Preliminary Remediation Goal

RSL - Regional Screening Level

US EPA - United States Environmental Protection Agency

--- - not applicable

Table 3-3. Preliminary Cleanup Goals, Soil/Solid Waste (10 Feet Below Ground Surface and Deeper) - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Land Disposal Unit/Constituent	COC Type	GW Impact Designated Level [1] (mg/kg or pCi/g)	Human Health Screening Level [2] (mg/kg or pCi/g)	Soil Background [3] (mg/kg or pCi/g)	Proposed Preliminary Cleanup Goal 10 to 20 feet bgs [4] (mg/kg or pCi/g)	Proposed Preliminary Cleanup Goal Beyond 20 feet bgs [5] (mg/kg or pCi/g)
Eastern Trenches						
Tritium (Hydrogen-3)	GW	<1.2	---	**< 1.2**	**< 1.2**	**< 1.2**
Carbon-14	GW, HH	<0.13	0.48	**<0.13**	**<0.13**	**<0.13**
Landfill Unit No. 1						
Selenium	GW	0.22	---	**1.2**	**1.2**	**1.2**
Carbon-14	GW, HH	<0.13	0.48	**<0.13**	**<0.13**	**<0.13**
Landfill Unit No. 2						
Cadmium	GW	0.29	---	**0.5**	**0.5**	**0.5**
Carbon-14	GW, HH	<0.13	0.48	**<0.13**	**<0.13**	**<0.13**
Lead	HH	---	**80**	9.5	**80**	---
Strontium-90	HH	---	**0.24**	0.056	**0.24**	---
Potassium-40	HH	---	0.12	**14**	**14**	---
Landfill Unit No. 3						
Barium	GW	35	---	**260**	**260**	**260**
Cadmium	GW	0.32	---	**0.5**	**0.5**	**0.5**
Carbon-14	GW, HH	<0.13	0.48	**<0.13**	**<0.13**	**<0.13**
Southern Trenches						
---	---	---	---	---	---	---
Waste Burial Holes						
Carbon-14	GW, HH	**0.32**	0.48	<0.13	**0.32**	**0.32**
Tritium (Hydrogen-3)	GW, HH	**3.2**	0.88	**< 1.2**	**< 1.2**	**3.2**
Strontium-90	HH	---	**0.24**	0.056	**0.24**	---

Notes:

Bold indicates selected preliminary cleanup goal.

[1] Designated levels for groundwater impact at drinking water standards obtained from Appendix A.

[2] Human health screening levels are applicable to a depth of 20 feet bgs; beyond 20 feet bgs, there is greater likelihood of groundwater impact versus human health risk. Screening values for non-radiologic constituents are the US EPA RSLs updated in November 2011 and accessed January 2012 (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table) except for lead, which is a CHHSL (http://oehha.ca.gov/risk/chhsltable.html) and was accessed July 2010. The screening values for radiologic constituents are US EPA PRGs updated in August 2010 and accessed January 2012 (http://epa-prgs.ornl.gov/radionuclides/download.shtml).

[3] Background values obtained from Weiss Associates, 1998. *Final Technical Report: Results of Western Dog Pens, Background, and Off-site Investigations* , Laboratory for Energy-Related Health Research, University of California, Davis, June. Background for organic constituents is assumed to be zero.

[4] Proposed preliminary cleanup goal chosen by:

(1) selecting the lowest of RSLs (PRGs for radionuclides and CHHSL for lead) or groundwater designated level.

(2) comparing this value to constituent's background concentration.

(3) higher of two values designated as preliminary cleanup goal.

[5] Soil cleanup goal for constituents below 20 feet bgs is the maximum of the soil background value and the groundwater impact designated level; human health cleanup goals are not considered at this depth.

Acronyms/Abbreviations:

bgs - below ground surface

CHHSL - California Human Health Screening Level

COC - constituent of concern

GW - groundwater

HH - human health

mg/kg - milligrams per kilogram

pCi/g - picocuries per gram

PRG - Preliminary Remediation Goal

RSL - Regional Screening Level

US EPA - United States Environmental Protection Agency

--- - not applicable

Table 3-4. Ratio of NOAEL to LOAEL Hazard Quotients, Landfill Units Nos. -1, -2 and -3 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Land Disposal Unit/ COPEC	Botta's Pocket Gopher			American Robin			Ornate Shrew			Horned Lark			Rock Dove			Redtail Hawk			Northern Harrier		
	NOAEL HQ	LOAEL HQ	Order of Magnitude Difference	NOAEL	LOAEL	Order of Magnitude Difference	NOAEL	LOAEL	Order of Magnitude Difference	NOAEL	LOAEL	Order of Magnitude Difference	NOAEL	LOAEL	Order of Magnitude Difference	NOAEL	LOAEL	Order of Magnitude Difference	NOAEL	LOAEL	Order of Magnitude Difference
Landfill Unit No. 1																					
Arsenic	---	---	---	---	---	---	2	0.15	1.2	---	---	---	---	---	---	---	---	---	---	---	---
Cadmium	2	0.043	1.6	27	0.21	2.1	48	1	1.6	37	0.28	2.1	---	---	---	---	---	---	---	---	---
Copper	2	0.007	2.4	7	0.32	1.4	3	0.012	2.4	7	0.29	1.4	---	---	---	---	---	---	---	---	---
Lead	4	0.018	2.4	3,700	6	2.8	43	0.18	2.4	4,100	7	2.8	2	0.003	2.8	3	0.005	2.8	1	0.002	2.8
Manganese	---	---	---	2	0.16	1.0	11	0.92	1.1	2	0.21	1.0	---	---	---	---	---	---	---	---	---
Selenium	7	0.31	1.4	3	0.64	0.6	13	0.53	1.4	3	0.79	0.6	---	---	---	---	---	---	---	---	---
Zinc	5	0.12	1.6	13	1	1.0	24	0.56	1.6	16	2	1.0	---	---	---	---	---	---	---	---	---
4,4'-DDE	---	---	---	1	0.019	1.8	---	---	---	2	0.019	2.0	---	---	---	---	---	---	---	---	---
Landfill Unit No. 2																					
Antimony	---	---	---	---	---	---	9	0.41	1.3	---	---	---	---	---	---	---	---	---	---	---	---
Cadmium	2	0.048	1.6	32	0.24	2.1	56	1	1.6	43	0.33	2.1	---	---	---	---	---	---	---	---	---
Copper	2	0.009	2.4	11	0.47	1.4	4	0.016	2.4	9	0.41	1.4	---	---	---	---	---	---	---	---	---
Lead	2	0.006	2.4	1,200	2	2.8	15	0.062	2.4	1,400	2	2.8	---	---	---	1	0.002	2.8	---	---	---
Manganese	---	---	---	2	0.18	1.0	12	1	1.1	2	0.23	1.0	---	---	---	---	---	---	---	---	---
Zinc	3	0.059	1.6	8	0.77	1.0	16	0.38	1.6	10	0.98	1.0	---	---	---	---	---	---	---	---	---
4,4'-DDE	---	---	---	7	0.10	1.8	---	---	---	9	0.13	1.8	---	---	---	---	---	---	---	---	---
4,4'-DDT	---	---	---	3	0.016	2.2	---	---	---	4	0.021	2.2	---	---	---	---	---	---	---	---	---
Landfill Unit No. 3																					
Antimony	1	0.051	1.3	---	---	---	50	2	1.3	---	---	---	---	---	---	---	---	---	---	---	---
Cadmium	3	0.072	1.6	56	0.43	2.1	98	2	1.6	57	0.44	2.1	---	---	---	---	---	---	---	---	---
Copper	2	0.006	2.4	7	0.29	1.4	3	0.012	2.4	5	0.20	1.4	---	---	---	---	---	---	---	---	---
Lead	11	0.046	2.4	10,000	16	2.8	110	0.44	2.4	8,000	13	2.8	3	0.005	2.8	5	0.008	2.8	1	0.002	2.8
Manganese	2	0.21	1.1	6	0.58	1.0	38	3	1.1	6	0.55	1.0	---	---	---	---	---	---	---	---	---
Selenium	4	0.16	1.4	2	0.40	0.6	8	0.34	1.4	2	0.37	0.6	---	---	---	---	---	---	---	---	---
Zinc	4	0.081	1.6	10	0.97	1.0	19	0.45	1.6	9	0.91	1.0	---	---	---	---	---	---	---	---	---
Aroclor 1260	---	---	---	1	0.077	1.2	---	---	---	1	0.077	1.2	---	---	---	---	---	---	---	---	---

Acronyms/Abbreviations:

COPEC - constituent of potential ecological concern

LOAEL - lowest observed adverse effect level

NOAEL - no observed adverse effect level

--- - COPEC is not listed for specified receptor

Table 3-5. Soil Vapor Constituents of Concern and Preliminary Cleanup Goals - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Land Disposal Unit	Soil Vapor COCs	Soil Vapor Intrusion Risk Assessment COCs Risk-Based Concentration[1] [µg/m^3]			Groundwater Impact COCs Soil Vapor Designated Levels[2] [µg/m^3]			Preliminary Cleanup Goal [µg/m^3]		
		5 feet bgs	15 feet bgs	25 feet bgs	5 feet bgs[3]	15 feet bgs	25 feet bgs	5 feet bgs	15 feet bgs	25 feet bgs
Eastern Trenches	1,2-Dichloroethane	---	173.7	---	---	**11.0**	**11.0**	---	**11.0**	**11.0**
	1,2-Dichloropropane	---	**593.8**	---	---	---	---	---	**593.8**	---
	1,3-Butadiene	**7.7**	---	---	---	---	---	**7.7**	---	---
	Chloroform[3]	**87.5**	**203.1**	**322.7**	---	8,859	8,859	**87.5**	**203.1**	**322.7**
Landfill Unit No. 1	1,3-Butadiene	---	**14.2**	---	---	---	---	---	**14.2**	---
Landfill Unit No. 2	1,2-Dichloropropane	**178.4**	---	---	---	---	---	**178.4**	---	---
	Chloroform	**68.6**	**133.3**	**317.2**	---	9,856	8,462	**68.6**	**133.3**	**317.2**
	Tetrachloroethene	**313.3**	**714.3**	---	---	---	---	**313.3**	**714.3**	---

Notes:

Bold indicates selected PCG.

[1] Preliminary cleanup goals established for constituents with cancer risk exceeding 1 x 10^{-6} at a given depth (Appendix B). Non-cancer hazard quotients were considered; however, no constituent had a hazard quotient exceeding one.

[2] Designated levels for groundwater impact at drinking water standards obtained from Appendix A and converted to soil vapor concentrations. Soil vapor designated levels are not applied at 5 feet bgs because soil vapor at this depth is above the high water table; human health risk from vapor intrusion is more likely at this depth.

[3] Designated level end point is the MCLG (for chloroform).

Acronyms/Abbreviations:

bgs - below ground surface

COC - constituent of concern

MCLG - maximum contaminant level goal

PCG - preliminary cleanup goal

µg/m^3 - micrograms per cubic meter

--- - not applicable

Table 3-6. Protectiveness of Cleanup Goals for Human Health Cancer Risk - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Land Disposal Unit/ Constituent	Preliminary Cleanup Goal [1] [mg/kg or pCi/g]	Screening Value[2] [mg/kg or pCi/g]	Risk[3]	% of Total Risk 0-10 feet bgs	% of Total Risk 10-20 feet bgs	% of Total Risk 0-20 feet bgs
Eastern Trenches						
0-10 feet bgs						
Tritium (Hydrogen-3)	1.2	0.88	1.4E-06	83.3%	---	71.4%
Carbon-14	0.13	0.48	2.7E-07	16.7%	---	14.3%
Total Risk			**1.6E-06**			
10-20 feet bgs						
Carbon-14	0.13	0.48	2.7E-07	---	100.0%	14.3%
Total Risk			**2.7E-07**			
Total Risk 0-20 feet bgs			**1.9E-06**			
Landfill Unit No, 1						
0-10 feet bgs						
Arsenic	9.6	0.39	2.5E-05	95.1%	---	94.1%
Carbon-14	0.13	0.48	2.7E-07	1.1%	---	1.0%
Benzo(a)pyrene	0.015	0.015	1.0E-06	3.9%	---	3.8%
Total Risk			**2.6E-05**			
10-20 feet bgs						
Carbon-14	0.13	0.48	2.7E-07	---	100%	1.0%
Total Risk			**2.7E-07**			
Total Risk 0-20 feet bgs			**2.6E-05**			
Landfill Unit No. 2						
0-10 feet bgs						
Carbon-14	0.13	0.48	2.7E-07	5.2%	---	0.2%
Cesium-137	0.062	0.062	1.0E-06	19.0%	---	0.8%
Aroclor 1260	0.22	0.22	1.0E-06	19.0%	---	0.8%
Benzo(a)anthracene	0.15	0.15	1.0E-06	19.0%	---	0.8%
Benzo(a)pyrene	0.015	0.015	1.0E-06	19.0%	---	0.8%
Benzo(b)fluoranthene	0.15	0.15	1.0E-06	19.0%	---	0.8%
Total Risk			**5.3E-06**			
10-20 feet bgs						
Potassium-40	14	0.12	1.2E-04	---	99.0%	94.9%
Carbon-14	0.13	0.48	2.7E-07	---	0.2%	0.2%
Strontium-90	0.24	0.24	1.0E-06	---	0.8%	0.8%
Total Risk			**1.2E-04**			
Total Risk 0-20 feet bgs			**1.3E-04**			
Landfill Unit No. 3						
0-10 feet bgs						
Carbon-14	0.13	0.48	2.7E-07	8.3%	---	7.7%
Cesium-137	0.062	0.062	1.0E-06	30.6%	---	28.2%
Strontium-90	0.24	0.24	1.0E-06	30.6%	---	28.2%
Aroclor 1260	0.22	0.22	1.0E-06	30.6%	---	28.2%
Total Risk			**3.3E-06**			
10-20 feet bgs						
Carbon-14	0.13	0.48	2.7E-07	---	100%	7.7%
Total Risk			**2.7E-07**			
Total Risk 0-20 feet bgs			**3.5E-06**			
Southern Trenches						
0-10 feet bgs						
Carbon-14	0.48	0.48	1.0E-06	100%	---	100%
Total Risk			**1.0E-06**			
Total Risk 0-20 feet bgs			**1.0E-06**			

Table 3-6. Protectiveness of Cleanup Goals for Human Health Cancer Risk - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Land Disposal Unit/ Constituent	Preliminary Cleanup Goal [1] [mg/kg or pCi/g]	Screening Value[2] [mg/kg or pCi/g]	Risk[3]	% of Total Risk 0-10 feet bgs	% of Total Risk 10-20 feet bgs	% of Total Risk 0-20 feet bgs
Waste Burial Holes						
0-10 feet bgs						
Carbon-14	0.32	0.48	6.7E-07	13.4%	---	8.3%
Tritium (Hydrogen-3)	1.2	0.88	1.4E-06	27.0%	---	16.9%
Strontium-90	0.24	0.24	1.0E-06	19.9%	---	12.4%
Cesium-137	0.062	0.062	1.0E-06	19.9%	---	12.4%
Naphthalene	3.6	3.6	1.0E-06	19.9%	---	12.4%
Total Risk			**5.0E-06**			
10-20 feet bgs						
Carbon-14	0.32	0.48	6.7E-07	---	22.2%	8.33%
Tritium (Hydrogen-3)	1.2	0.88	1.4E-06	---	44.9%	16.9%
Strontium-90	0.24	0.24	1.0E-06	---	33.0%	12.4%
Total Risk			**3.0E-06**			
Total Risk 0-20 feet bgs			**8.1E-06**			

Notes:

Lead is not included on this table as toxicity is measured by blood-lead levels rather than cancer risk.

[1] FS - Volume 1 preliminary cleanup goal

[2] Screening values for non-radiologic constituents are the US EPA RSLs updated in November 2011, accessed January 2012 (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table). The screening values for radiologic constituents are US EPA PRGs updated in August 2010, accessed January 2012 (http://epa-prgs.ornl.gov/radionuclides/download.shtml).

[3] Estimated risk posed by FS - Volume 1 preliminary cleanup goals

Acronyms/Abbreviations:

bgs - below ground surface

FS - Volume 1 - *Final Feasibility Study for the University of California, Davis Areas Volume 1: Soil/Solid Waste and Soil Gas*

mg/kg - milligrams per kilogram

pCi/g - picocuries per gram

PRG - Preliminary Remediation Goal

RSL - Regional Screening Level

US EPA - United States Environmental Protection Agency

Table 3-7. Protectiveness of Cleanup Goals for Human Health Non-Cancer Hazards - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Land Disposal Unit/ Constituent	Cleanup Goal [1] [mg/kg]	Screening Value[2] [mg/kg]	Hazard Quotient[3]	% of Total Hazard 0-10 feet bgs	% of Total Hazard 10-20 feet bgs	% of Total Hazard 0-20 feet bgs
Eastern Trenches						
	---	---	---	---	---	---
Landfill Unit No. 1						
	---	---	---	---	---	---
Landfill Unit No. 2						
	---	---	---	---	---	---
Landfill Unit No. 3						
0-10 feet bgs						
Manganese	1,800	1,800	1.0	100%	---	100%
Total Hazard			1.0			
Southern Trenches						
	---	---	---	---	---	---
Waste Burial Holes						
	---	---	---	---	---	---

Notes:

Lead is not included on this table as toxicity is measured by blood-lead levels rather than non-cancer hazard.

[1] FS - Volume 1 preliminary cleanup goal

[2] Screening values for non-radiologic constituents are the US EPA RSLs updated in November 2011, accessed January 2012 (http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table).

[3] Estimated hazard posed by FS - Volume 1 preliminary cleanup goal

Acronyms/Abbreviations:

bgs - below ground surface

FS - Volume 1 - *Final Feasibility Study for the University of California, Davis Areas Volume 1: Soil/Solid Waste and Soil Gas*

mg/kg - milligrams per kilogram

pCi/g - picocuries per gram

RSL - Regional Screening Level

US EPA - United States Environmental Protection Agency

--- - not applicable

Table 4-1. Initial Screening of Remedial Technologies and Process Options for Soil/Solid Waste or Soil Gas - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

General Response Action	Remedial Technology	Process Options	Description	Screening Comments
No Action/No Further Action	No Action/No Further Action	No Action/No Further Action	No further action	Required for consideration by NCP and may be applicable for areas where removal actions have been completed
Institutional Controls	Land Use Controls	Land Use Restrictions	Land use restriction placed in deed/land use covenant	Potentially Applicable
		Fencing	Fence erected and maintained around contaminated soil	Potentially Applicable
		Subsurface Hazard Notification	Signage posted to notify workers of subsurface hazards and removal restrictions	Potentially Applicable
	Monitoring	Groundwater Monitoring	Groundwater wells sampled regularly to monitor constituent concentrations	Potentially Applicable
		Storm Water Monitoring	Storm water discharge sampled regularly to monitor constituent concentrations	Potentially Applicable
Containment	Drainage Control	Storm Water Runoff Diversion/Collection	Storm water runoff diverted by use of a ditch, berm, swale, or surface grading to prevent infiltration	Potentially Applicable
		Subsurface Drains	Water collected or conveyed by conduit just below surface	Potentially Applicable
		Infiltration Pond	Storm water runoff is collected, temporarily stored, and infiltrated in a basin	Potentially Applicable
		Extended Detention Basin	Storm water runoff is collected over large surface area where it can be efficiently evaporated in the presence of sunlight and ambient temperatures	Potentially Applicable
		Storm Water Lift Station	Stormwater collected and pumped to different location for discharge	Potentially Applicable
	Landfill Cap	Evapotranspiration Cap	Plants cultivated to aid evapotranspiration of water and prevent infiltration	Potentially Applicable
		Clay Cover, Single Layer	Compacted clay covered with soil on top of soil contamination	Potentially Applicable
		Asphalt/Concrete Cap, Single Layer	Asphalt or concrete layered over soil contamination	Potentially Applicable
		Multiple-Layer Cap	Cap consisting of an upper top soil layer, drainage layer, low-permeability synthetic liner, and compacted clay	Potentially Applicable
	Horizontal Physical Barrier	Grout Injection	Grout injected at a prescribed depth through drilled holes to create a floor for contaminant plume	Potentially Applicable
		Geomembrane Liner	Plastic or similar low-permeability sheet placed under contamination to create a floor for the contaminant plume	Potentially Applicable
		Clay Liner	Clay deposited under contamination to create a floor for the contaminant plume	Potentially Applicable
		Geosynthetic Clay Liner	Composite liner with one or two layers of geotextile embedded with bentonite and one layer of compacted soil placed under contamination to create a floor for the contaminant plume	Potentially Applicable
	Leachate Control System	Leachate Collection and Removal System	Natural or synthetic drainage layer below the waste and above the bottom liner drains liquids leaching from the waste to a sump where the leachate collects for pumping and treatment	Potentially Applicable
In Situ Physical/ Chemical Treatment	Flushing	Water Only	Water is applied to soil to leach contaminants from vadose zone into groundwater for capture	Not Applicable – low hydraulic conductivity and difficulty of removing groundwater
		Surfactant-Enhanced Solution	Surfactant-enhanced aqueous solution is applied to soil to leach contaminants from vadose zone into groundwater for capture	Not Applicable – low hydraulic conductivity and difficulty of removing groundwater
	Solidification/ Stabilization	Solidifying/ Stabilizing Additive	*Solidification*: Contaminants physically bound to or encapsulated by a stable mass (e.g., pozzolanic agents) *Stabilization*: Chemical reactions occur between stable media and contaminants to decrease contaminant mobility (e.g., lime-neutralizing products, biosolids, combustion byproducts)	Potentially Applicable
In Situ Thermal Enhancements	Heating	Vitrification	Heat is applied to soil in vadose zone to produce high temperatures that melt soil particles and encapsulate contaminants in glass or crystalline products	Potentially Applicable
Removal	Excavation	Excavate Using Conventional Heavy Equipment	Contaminated soil is removed with excavators and loaders	Potentially Applicable

Table 4-1. Initial Screening of Remedial Technologies and Process Options for Soil/Solid Waste or Soil Gas - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

General Response Action	Remedial Technology	Process Options	Description	Screening Comments
Removal (continued)	Excavation (continued)	Excavate Using Oversized Auger	Contaminated soil is removed with large-diameter (greater than three-foot) auger	Potentially Applicable
	Source Material Removal	PTW Removal	Known source material is segregated from other waste and removed	Potentially Applicable
Ex Situ Physical/ Chemical Treatment	Soil Washing	Chemical Extraction	Solution is used to scrub soil and dissolve or suspend contaminants for extraction	Not Applicable – no chemical solution is available that is effective against the range of COCs present
		Particle Size Separation	Fine and coarse soils are separated so that the contaminants are concentrated into a smaller volume	Not Applicable – COCs are not sufficiently correlated with any particle size
		Gravity Separation	Particles with different specific gravities are separated	Not Applicable – COCs are not sufficiently unique in specific gravity
		Attrition Scrubbing	Films containing contaminants are washed from the outside of the coarse particles of soil	Not Applicable for fine-grained soil
	Solidification/Stabilization	Solidifying/Stabilizing Additive	*Solidification*: Contaminants are physically bound to or encapsulated by a stable mass *Stabilization*: Chemical reactions occur between stable media and contaminants to decrease contaminant mobility	Potentially Applicable
	Chemical Reduction/ Oxidation	Ozone	Oxidizing agents are added to a solution of contaminated soil and cause contaminants to degrade and some metals to become immobile	Not Applicable – could create chromium (VI) from naturally occurring chromium (III)
		Hydrogen Peroxide		Not Applicable – could create chromium (VI) from naturally occurring chromium (III)
		Chlorine		Not Applicable – could create chromium (VI) from naturally occurring chromium (III)
		Hypochlorites		Not Applicable – could create chromium (VI) from naturally occurring chromium (III)
		Chlorine Dioxide		Not Applicable – could create chromium (VI) from naturally occurring chromium (III)
	Dehalogenation	Base-Catalyzed Decomposition	Sodium bicarbonate is added to screened, crushed, contaminated soil and then heated to dehalogenize and volatize contaminants	Not Applicable for large applications
		Glycolate	An alkaline polyethylene glycol is added to contaminated soil and then heated in a reactor. The halogen atom in the contaminant is replaced by the glycol molecule, making it less hazardous	Not Applicable for large applications
	Separation	Dewatering: Belt Filter Press	Water is removed from soil in three stages to reduce quantity of solid needing further treatment or disposal	Not Applicable – soil water content is currently low enough that a decrease will not reduce solids volume
		Dewatering: Drying Bed	Solid material is inserted into bed with drainage basins and allowed to settle and evaporate	Not Applicable – soil water content is currently low enough that a decrease will not reduce solids volume
		Solids Separation	Contaminants in soil are removed from their media and remaining contaminated particles are concentrated separately from clean soil using gravity (settling), magnetic, or sieving techniques (see "Particle Size Separation" and "Gravity Separation" in "Soil Washing" process option above)	Not Applicable – the COCs are not amenable to gravity, magnetic, or sieving separation techniques
		Supercritical Fluid Extraction	Supercritical fluid is combined with contaminated soil and the volatile contaminants separate into the supercritical phase for extraction	Not Applicable – not effective for metals and radionuclides, and extremely costly for VOCs compared to other process options
Ex Situ Thermal Treatment	Thermal Desorption	Direct-Fired	Fire is applied directly to contaminated soil to desorb contaminants from soil	Potentially Applicable
		Indirect-Fired	Heated air stream is applied directly to contaminated soil to desorb water and contaminants	Potentially Applicable
		Indirect-Heated	Externally-fired rotary dryer volatizes water and contaminants from soil into inert gas stream	Potentially Applicable
		Hot Gas Desorption	Contaminated soil is heated to at least 260ºC and effluent gas is burned in order to separate volatile contaminants	Potentially Applicable
	Incineration	Circulating Bed Combustor	High-velocity air entrains soil to create highly turbulent atmosphere for uniform and well-mixed combustion, which can be operated at lower temperature than other incinerators	Potentially Applicable
		Fluidized Bed	High-velocity air suspends contaminants in combustion loop	Potentially Applicable
		Infrared Combustion	Mobile unit uses electrically-powered silicon carbide rods to deliver infrared radiant heat to combust contaminants	Potentially Applicable
		Rotary Kiln	Slightly inclined, rotating, cylindrical combustion chamber with refractory lining burns contaminants	Potentially Applicable

Table 4-1. Initial Screening of Remedial Technologies and Process Options for Soil/Solid Waste or Soil Gas - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

General Response Action	Remedial Technology	Process Options	Description	Screening Comments
Ex Situ Thermal Treatment (continued)	Open Burn/Detonation	Self-sustained Combustion	Combustion is initiated by external ignition such as flame, heat, or detonation of an energetic charge without emission control	Not Applicable for COCs Present
	Pyrolysis	Rotary Kiln & Fluidized Bed Furnace	Thermal treatment using less heat/oxygen than combustion	Potentially Applicable
		Molten Salt Destruction	Contaminants are heated and scrubbed by a molten salt such as sodium carbonate	Potentially Applicable
	Heating	Vitrification	Heat is applied to excavated soil to produce high temperatures that melt soil particles and encapsulate contaminants in glass or crystalline products	Potentially Applicable
Ex Situ Biological Treatment	Soil Mixing	Biopiles	Soil is mixed with amendments and contained by an impermeable liner within an aerated area that includes a leachate collection system	Not Applicable – not effective for metals and radionuclides
		Composting	Appropriate amendments are chosen to encourage microbial activity under thermophilic conditions	Not Applicable – not effective for metals and radionuclides
		Landfarming	Excavated material is inserted into lined beds and tilled to aerate the contaminated soil	Not Applicable – not effective for metals and radionuclides
	Slurry-Phase	Bioreactor	Contaminated soil is suspended in water to encourage microbial activity	Not Applicable – not effective for metals and radionuclides
Disposal	Soil Reuse/Disposal	On-Site Reuse	Consolidated waste material reused	Potentially Applicable
		On-Site Disposal	Consolidated waste material disposed of on-Site	Potentially Applicable
		Off-Site Reuse	Material reused off-Site (e.g., asphalt batching)	Not Applicable to Solid Waste – material too heterogeneous
		Off-Site Disposal	Consolidated waste material disposed of at an appropriately permitted facility	Potentially Applicable
Vapor-Phase Treatment	Monitoring	Air Monitoring	Long-term air monitoring program	Potentially Applicable
	Containment	Soil Vapor Intrusion Barrier	Plastic, foil, or spray-on elastomer liner placed below foundation for new construction	Potentially Applicable
	Soil Gas Extraction	Sub-Slab Depressurization	Used to intercept soil vapors before they enter buildings	Potentially Applicable
		Soil Vapor Extraction	Vacuum used to induce vapor migration toward extraction wells	Potentially Applicable
	Landfill Gas Extraction	Passive Venting	Landfill gas diverted to atmosphere or treatment system through extraction wells, using natural pressure changes within landfill as the driving force of extraction	Not Applicable – on-Site land disposal units do not generate measurable amounts of gas
		Active Gas Collection Systems	A pump or vacuum system removes landfill gas through extraction wells, diverts to atmosphere or treatment system	Not Applicable – on-Site land disposal units do not generate measurable amounts of gas
	Flaring	Gas Stream Combustion	Landfill off-gas burned to produce water, heat, and carbon dioxide	Potentially Applicable
	Biofiltration	Biofilm Reactor	Contaminated vapor is pumped into soil bed where contaminants adsorb to the surface of the soil and are degraded by the microorganisms within the soil	Potentially Applicable
	High Energy Destruction	High Energy Corona	High-voltage electricity destroys volatile contaminants at room temperature	Potentially Applicable
		Tunable Hybrid Plasma Reactor	Moderate-energy electron beam is injected into air on-Site where the contaminants are destroyed or converted into a less toxic substance	Potentially Applicable
	Membrane Separation	Non-porous Gas Separation Membrane	Separation occurs because organic vapor contaminants travel through the membrane, air does not	Potentially Applicable
	Oxidation	Catalytic Oxidation	Contaminants in air are destroyed in a high-temperature combustor in the presence of a catalyst (e.g., metal oxides or noble metals)	Potentially Applicable
		Internal Combustion Engine Oxidation	Contaminants in air are used as fuel and are destroyed in a high-temperature combustor	Not Applicable – COC concentrations too low to support combustion
		Thermal Oxidation	Contaminants in air are destroyed in a high-temperature combustor	Potentially Applicable
		UV Oxidation	Contaminated air is exposed to UV light, which breaks the chemical bonds of the contaminants	Potentially Applicable
	Scrubbers	Wet	Washes air to separate gases from soluble or particulate contaminants in one of the following configurations: orifice, venturi, fiber-bed, mechanical, impingement-plate, spray, or condensation	Not Applicable for COCs Present
		Dry	Dry spray configuration washes air to separate gases from soluble or particulate contaminants	Not Applicable for COCs Present

Table 4-1. Initial Screening of Remedial Technologies and Process Options for Soil/Solid Waste or Soil Gas - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

General Response Action	Remedial Technology	Process Options	Description	Screening Comments
Vapor-Phase Treatment (continued)	Vapor-Phase Carbon Adsorption	Granular Activated Carbon (GAC)	Contaminated vapor extracted into a series of containers filled with activated carbon to allow contaminants to be adsorbed onto carbon media	Not Applicable – risk of radionuclide concentration in the GAC

Acronyms/Abbreviations:
COC - constituent of concern
DOE - United States Department of Energy
GAC - granular activated carbon
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
PTW - principal threat waste
UV - ultraviolet
VOC - volatile organic compound
ºC – degrees Celsius

Sources:
Julie Van Deuren, Teressa Lloyd, Shobha Chhetry, Raycharn Liou, James Peck, 2002. *Remediation Technologies Screening Matrix and Reference Guide*, 4th Edition, document prepared for the U.S. Department of Defense (DoD) and other Federal Agencies participating in the Federal Remediation Technology Roundtable (FRTR), January.
United States Environmental Protection Agency Technology Innovation Program, Contaminated Site Clean-up Information, Technologies, http://www.cluin.org/remediation.
Weiss Associates, 2008. *Final DOE Areas Feasibility Study*, prepared document for SM Stoller Corporation and the Laboratory for Energy-Related Health Research (LEHR) at University of California, Davis (Figures 3-1 and 3-2), March.
Eastern Research Group, 2001. *Landfill Gas Primer – An Overview for Environmental Health Professionals*, prepared document for the Agency for Toxic Substances and Disease Registry, November.
United States Environmental Protection Agency, 2000a. *Engineered Approaches to In Situ Bioremediation of Chlorinated Hydrocarbons: Fundamentals and Field Applications,* EPA542/R-00/008, Office of Solid Waste and Emergency Response, Washington, DC, http://clu-in.org/download/remed/engappinsitbio.pdf, July.

Table 4-2. Evaluation of Remedial Technologies and Process Options for Soil/Solid Waste or Soil Gas - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

General Response Action	Remedial Technology	Process Options	Effectiveness	COCs Affected	Implementability	Relative Costs	Included in Final Alternatives[1]
No Action/No Further Action	No Action/No Further Action	No Action/No Further Action	Not effective	None	Does not comply with ARARs	None	Retained for Baseline Comparison
Institutional Controls	Land Use Controls	Land Use Restrictions	Effective	None	May require legal authority	Low capital, low O&M	Retained
		Fencing	May be effective in protecting against exposure to surface soil contaminants	None	Implementable	Low/medium capital, low O&M	Not Retained – no surface contamination to protect against; other institutional controls provide protection against subsurface contaminants at lower cost
		Subsurface Hazard Notification	Effectiveness dependent upon maintenance	None	Implementable	Low capital, low O&M	Retained
	Monitoring	Groundwater Monitoring	Not effective at reducing risk but provides data necessary to evaluate and control risk using other process options	None	Implementable, already implemented on-Site	Low capital, low O&M	Retained
		Storm Water Monitoring	Not effective at reducing risk but provides data necessary to evaluate and control risk using other process options	None	Implementable, already implemented on-Site	Low capital, low O&M	Retained
Containment	Drainage Control	Storm Water Runoff Diversion/Collection	Effective at minimizing storm water infiltration and contact with contaminated waste	All	Implementable	Low capital, medium O&M	Retained
		Subsurface Drains		All	Implementable	Medium capital, low O&M	Not Retained – surface diversion/collection is easier to install and more effective in the areas where drainage is needed
		Infiltration Pond	Effective at controlling runoff and minimizing contact with contaminated waste, but any surface contamination will have a transportation pathway to groundwater	All	Implementable	High capital, medium O&M	Not Retained – extended detention basin will provide same protectiveness without threat of groundwater contamination
		Extended Detention Basin	Effective at controlling runoff and minimizing contact with contaminated waste	All	Implementable	High capital, medium O&M	Retained
		Storm Water Lift Station	Effective at minimizing storm water infiltration and contact with contaminated waste	All	Implementable	High capital, low O&M	Retained
	Landfill Cap	Evapotranspiration Cap	Effective at minimizing storm water contact with contaminated waste	All	Implementable	High capital, medium O&M	Retained
		Clay Cover, Single Layer	Effective at minimizing storm water contact with contaminated waste	All	Implementable	High capital, medium O&M	Retained
		Asphalt/Concrete Cap, Single Layer	Effectively contains waste, reduces leaching from soil	All	Implementable	High capital, medium O&M	Retained
		Multiple-Layer Cap	Effectively contains waste, reduces leaching from soil	All	Implementable	High capital, medium O&M	Retained

Table 4-2. Evaluation of Remedial Technologies and Process Options for Soil/Solid Waste or Soil Gas - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

General Response Action	Remedial Technology	Process Options	Effectiveness	COCs Affected	Implementability	Relative Costs	Included in Final Alternatives[1]
Containment (continued)	Horizontal Physical Barrier	Grout Injection	Effectively eliminates migration of waste material/leachate into deeper soil/groundwater	All	Implementable	High capital, medium O&M	Not Retained – more difficult to verify effectiveness than other horizontal barrier process options
		Geomembrane Liner		All	Implementable	High capital, medium O&M	Retained
		Clay Liner	Effectively eliminates migration of waste material/leachate into deeper soil/groundwater	All	Implementable	High capital, medium O&M	Not Retained – more difficult to maintain than other horizontal barrier process options
		Geosynthetic Clay Liner		All	Implementable	High capital, medium O&M	Retained
	Leachate Control System	Leachate Collection and Removal System	Effectively eliminates waste leachate migration into groundwater	All	Implementable	High capital, medium O&M	Retained
In Situ Physical/ Chemical Treatment	Solidification/ Stabilization	Solidifying/Stabilizing Additive	Less effective for organic contaminants	Inorganics, Radionuclides	Implementable	Very high capital, medium O&M	Not Retained – other process options are more effective
In Situ Thermal Treatment Enhancements	Heating	Vitrification	Effective for immobilizing inorganics, less effective for destroying organics; COCs not treated may be emitted to environment	Inorganics, Radionuclides	Implementable	Very high capital, medium O&M	Not Retained – lower-cost process options with equal or greater effectiveness/protectiveness are available
Removal	Excavation	Excavate Using Conventional Heavy Equipment	Effectively removes contaminated material, allows sorting and separation of materials with different degrees of contamination	All	Implementable; excavation worker protection may be necessary to limit exposure	Volume-dependent capital cost, low O&M	Retained
		Excavate Using Oversized Auger					Not Retained – conventional excavation is equally or more effective and has lower cost
	Source Material Removal	PTW Removal					Retained
Ex Situ Physical/ Chemical Treatment	Solidification/ Stabilization	Solidifying/Stabilizing Additive	Effectively immobilizes contamination	Inorganics, Radionuclides	Implementable	High capital, medium O&M	Retained
Ex Situ Thermal Treatment	Thermal Desorption	Direct-Fired	Not effective for most metals, not effective for radionuclides (these contaminants may be present in off-gas)	VOCs	Implementable	High capital, high O&M	Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs
		Indirect-Fired	Not effective for most metals, not effective for radionuclides (these contaminants may be present in off-gas)	VOCs	Implementable	High capital, high O&M	Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs
		Indirect-Heated					Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs

Table 4-2. Evaluation of Remedial Technologies and Process Options for Soil/Solid Waste or Soil Gas - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

General Response Action	Remedial Technology	Process Options	Effectiveness	COCs Affected	Implementability	Relative Costs	Included in Final Alternatives[1]
Ex Situ Thermal Treatment (continued)	Thermal Desorption (continued)	Hot Gas Desorption	Not effective for most metals, not effective for radionuclides (these contaminants may be present in off-gas)	VOCs	Implementable	High capital, high O&M	Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs
	Incineration	Circulating Bed Combustor	Not effective for metals or radionuclides (these contaminants may be present in off-gas)	VOCs	Off-Site incinerator would need to be used for PCB contaminated media; gas treatment system would be needed for volatile heavy metals	High capital, high O&M	Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs
		Fluidized Bed					Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs
		Infrared Combustion					Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs
		Rotary Kiln			Off-Site incinerator would need to be used for PCB contaminated media		Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs
	Pyrolysis	Rotary Kiln & Fluidized Bed Furnace	Not effective for metals or radionuclides, unknown effectiveness for PCBs	VOCs	Implementable	High capital, high O&M	Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs
		Molten Salt Destruction					Not Retained – not effective for metals and radionuclides; lower-cost process options with equal or greater effectiveness/protectiveness are available for VOCs
	Heating	Vitrification	Effective for immobilizing inorganics, less effective for destroying organics; COCs not treated may be emitted to environment	Metals, Radionuclides	Implementable	High capital, medium O&M	Not Retained – risk of VOC emissions; lower-cost process options with equal or greater effectiveness/protectiveness are available for metals and radionuclides
Disposal	Soil Reuse/Disposal	On-Site Reuse	Effectively contains waste and prevents leaching	All	Implementable only for uncontaminated soil	Low capital, medium O&M	Retained for uncontaminated soil only, with reuse limited to fill beneath on-Site disposal unit caps
		On-Site Disposal		All	Implementable	Low capital, medium O&M	Retained
		Off-Site Disposal	Effectively removes material from site	All	Issues with land disposal restrictions and possible CERCLA liability off-Site	Proportional to volume for disposal, low O&M	Retained
Vapor-phase Treatment	Monitoring	Air Monitoring	Not effective at reducing risk, but provides data necessary to evaluate and control risk using other process options	None	Implementable	Medium capital, low O&M	Not Retained – anticipated concentrations are low or negligible, and no monitoring point is available with consistent or reproducible conditions to provide meaningful data
	Containment	Soil Vapor Intrusion Barrier	Effective when used in conjunction with sub-slab depressurization	VOCs	Implementable if it includes a passive venting layer	Low capital, medium O&M	Retained – potentially applies to new building construction; however, this process option is not carried through the FS – Volume 1 as plans for any new construction are unknown at this time
	Soil Gas Extraction	Sub-slab Depressurization	Effective	VOCs	Implementable for new construction, possible for existing structures with additional resources	Low capital, high O&M	Retained – potentially applies to new building construction; however, this process option is not carried through the FS – Volume 1 as plans for any new construction are unknown at this time

Table 4-2. Evaluation of Remedial Technologies and Process Options for Soil/Solid Waste or Soil Gas - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

General Response Action	Remedial Technology	Process Options	Effectiveness	COCs Affected	Implementability	Relative Costs	Included in Final Alternatives[1]
Vapor-phase Treatment (continued)	Soil Gas Extraction (continued)	Soil Vapor Extraction	Effective	VOCs	Implementable	Medium capital, high O&M	Not Retained – Results from an SVE Pilot Test for chloroform concluded that pervasive low-permeability soil in HSU-1 would limit the effectiveness of SVE, and that the resulting low VOC concentrations at the blower inlet would not justify an active treatment such as SVE (Brown and Caldwell, 2002). Excavation is more effective/protective for source removal and has comparable cost.
	Flaring	Gas Stream Combustion	Not effective for radionuclides, metals, or halogenated compounds	VOCs	Implementable	High capital, high O&M	Not Retained – no other retained process options produce a vapor-phase waste stream requiring treatment
	Biofiltration	Biofilm Reactor	Effective	VOCs	Implementable	Low capital, low O&M	Not Retained – no other retained process options produce a vapor-phase waste stream requiring treatment
	High-Energy Destruction	High-Energy Corona	Effective	VOCs, Inorganics	Implementable – scrubber needed for chlorinated compounds	High capital, high O&M	Not Retained – no other retained process options produce a vapor-phase waste stream requiring treatment
		Tunable Hybrid Plasma Reactor	Effectiveness unknown	VOCs	Not implementable at this time – still in testing phase	High capital, high O&M	Not Retained – still in testing phase
	Membrane Separation	Non-porous Gas Separation Membrane	Effective for consistent concentrations of VOCs	VOCs	Implementable, secondary treatment may be needed to polish effluent	High capital, high O&M	Not Retained – no other retained process options produce a vapor-phase waste stream requiring treatment
	Oxidation	Catalytic Oxidation	Effective	VOCs	Implementable – special catalyst and scrubber needed for halogenated compounds	Low capital, low O&M	Not Retained – no other retained process options produce a vapor-phase waste stream requiring treatment
		Thermal Oxidation	Effective	VOCs	Implementable – special catalyst and scrubber needed for halogenated compounds	Low capital, low O&M	Not Retained – no other retained process options produce a vapor-phase waste stream requiring treatment
		UV Oxidation	Effective	VOCs	Implementable – special catalyst and scrubber needed for halogenated compounds	Low capital, low O&M	Not Retained – no other retained process options produce a vapor-phase waste stream requiring treatment

Note:
[1]Process options were eliminated if, on the basis of professional judgment, they were not considered applicable, or if at least one other process option was deemed more effective or more easily implemented, and/or if at least one other process option exhibited a lower estimated cost but was as effective, implementable, and protective as other options.

Acronyms/Abbreviations:
ARAR - applicable or relevant and appropriate requirement
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
COC - constituent of concern
DOE - United States Department of Energy
FS - Feasibility Study
HSU - hydrostratigraphic unit
O&M - operations and maintenance
PCB - polychlorinated biphenyl
PTW - principal threat waste
SVE - soil vapor extraction
US EPA - United States Environmental Protection Agency
UV - ultraviolet

Table 4-2. Evaluation of Remedial Technologies and Process Options for Soil/Solid Waste or Soil Gas - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Acronyms/Abbreviations (continued):
VOC - volatile organic compound

Reference:
Brown and Caldwell, 2002. *Soil Vapor Extraction Technology Assessment, LEHR/SCDS Environmental Restoration, Davis, California*. December.

Sources:
Julie Van Deuren, Teressa Lloyd, Shobha Chhetry, Raycharn Liou, James Peck, 2002. *Remediation Technologies Screening Matrix and Reference Guide, 4th Edition*, document prepared for the U.S. Department of Defense (DoD) and other Federal Agencies participating in the Federal Remediation Technology Roundtable (FRTR), January.
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Cost Sources:
Costs are roughly based on Table 3-2, Treatment Technologies Screening Matrix from Federal Remediation Technologies Roundtable, as well as professional judgment and consultation of the following resources:
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Ralph S. Baker, 2006. In Situ *Thermal Remediation of Soil Contaminated with Organic Chemicals*, TerraTherm, Inc., June.
Harry L. Allen, Dr. Sally Brown, Dr. Rufus Chaney, Dr. W. Lee Daniels, Dr. Charles L. Henry, Dennis R. Neuman, Dr. Ellen Rubin, Jim Ryan, William Toffey, 2007. *The Use of Soil Amendments for Remediation, Revitalization, and Reuse*, document prepared for US Environmental Protection Agency, December.
Parsons Brinckerhoff, 2001. *Highway Stormwater Pump Station Design*, prepared for the Federal Highway Administration, February.
Modeled in Figure 4-5 of *CERCLA Guidance for Conducting Remedial Investigations and Feasibility Studies.*
Obtained cost evaluation from EarthTech. *Landfill Gas Collection System Design* (http://www.epa.gov/reg5rcra/wptdiv/solidwaste/slides/PART2LF_Gas_Mgmt_Section6.pdf).
Obtained cost evaluation from US EPA Air and Radiation, 1996. *Turning a Liability into an Asset*. (http://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=600008CZ.txt) September.
The Interstate Technology & Regulatory Council Vapor Intrusion Team, 2007. *Vapor Intrusion Pathway: A Practical Guideline*, January.

Table 4-3. Selected Process Options - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

General Response Action	Selected Process Option[1]
No Action/No Further Action	No Action/No Further Action
Institutional Controls	Land Use Restrictions
	Subsurface Hazard Notification
	Groundwater Monitoring
	Storm Water Monitoring
Containment	Storm Water Runoff Diversion/Collection
	Extended Detention Basin
	Storm Water Lift Station
	Evapotranspiration Cap
	Clay Cover, Single Layer
	Asphalt/Concrete Cap, Single Layer
	Multiple-Layer Cap
	Geomembrane Liner
	Geosynthetic Clay Liner
	Leachate Collection and Removal System
Removal	Excavation Using Conventional Heavy Equipment
	Principal Threat Waste Removal
Ex Situ Physical/Chemical Treatment	Solidifying/Stabilizing Additive
Disposal	On-Site Reuse
	On-Site Disposal
	Off-Site Disposal

Note:

[1]Process options were eliminated if, on the basis of professional judgment, they were not considered applicable, or if at least one other process option was deemed more effective or more easily implemented, and/or if at least one other process option exhibited a lower estimated cost but was as effective, implementable, and protective as other options.

Table 5-1. Description and Applicability of Remedial Action Alternative Components for Soil/Solid Waste - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Remedial Action Components (Specific details included in the descriptions are subject to refinement and modification in post-FS remediation documents. Detailed assumptions for costing are in Appendix F.)	**Applicability to Solid Waste Alternative**								
	SW-2 Institutional Controls and Groundwater Monitoring	**SW-3 VOC "Hot Spot" Removal, Three On-Site CAMUs with Graded Covers, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-4 VOC "Hot Spot" Removal, Three On-Site CAMUs with Evapotranspi-ration Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-5 VOC "Hot Spot" Removal, Three On-Site CAMUs with Asphalt Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-6 VOC "Hot Spot" Removal, Three On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-7 VOC "Hot Spot" Removal, Two On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-8 VOC "Hot Spot" Removal, One On-Site Lined CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-9 Excavate and Dispose of Waste Off-Site, Waste Burial Holes CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-10 Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**
Planning/Oversight/General									
Work Planning – Work planning includes preparation of construction specifications and bid documents, a quality assurance/quality control (QA/QC) plan, a sampling and analysis plan, and a health and safety (H&S) plan.	●	●	●	●	●	●	●	●	●
Health and Safety – Adherence to H&S requirements is necessary at both the project and task level. Project H&S requirements would include, but are not limited to, development of a project H&S plan; establishment of a medical surveillance program; project and tailgate H&S meetings; record keeping; and establishment of emergency procedures. Task-specific H&S requirements would vary but would likely include hazard assessment; hazard control, including potential exposure to radioactive compounds (RAD); personal protective equipment (PPE); and training. It is assumed that level C PPE would be required for work in volatile organic compound (VOC)-impacted areas, and radiological contamination control procedures would be required in RAD-impacted areas.	●	●	●	●	●	●	●	●	●
Construction Quality Assurance/Quality Control Program – QA/QC inspections would be performed to verify that work is completed in accordance with technical specifications. The QA/QC program would include definition of standards and specifications, QA/QC scheduling, and materials and work elements verification. Procedures for correcting defects would be determined in advance, and written procedures would be developed specifying contractor performance and project quality.	●	●	●	●	●	●	●	●	●

Table 5-1. Description and Applicability of Remedial Action Alternative Components for Soil/Solid Waste - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Remedial Action Components (Specific details included in the descriptions are subject to refinement and modification in post-FS remediation documents. Detailed assumptions for costing are in Appendix F.)	**Applicability to Solid Waste Alternative**								
	SW-2 Institutional Controls and Groundwater Monitoring	**SW-3 VOC "Hot Spot" Removal, Three On-Site CAMUs with Graded Covers, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-4 VOC "Hot Spot" Removal, Three On-Site CAMUs with Evapotranspi-ration Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-5 VOC "Hot Spot" Removal, Three On-Site CAMUs with Asphalt Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-6 VOC "Hot Spot" Removal, Three On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-7 VOC "Hot Spot" Removal, Two On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-8 VOC "Hot Spot" Removal, One On-Site Lined CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-9 Excavate and Dispose of Waste Off-Site, Waste Burial Holes CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-10 Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**
Construction Site Environmental Controls – Environmental controls would be established during demolition, excavation, filling, grading, and capping activities. The environmental controls would include best management practices (BMPs) for dust and sediment control, Site access fencing, trash disposal, sanitary facilities, fuels and chemicals management, concrete washouts, and proper vehicle maintenance. Environmental controls would also include re-establishment of vegetation and surface covers following the completion of Site activities.		●	●	●	●	●	●	●	●
Materials Management Plan – The Materials Management Plan (MMP) would describe procedures for the sorting and screening of excavated materials, stockpiling, sampling and analysis (i.e., waste characterization), potential treatment, and disposal. The MMP would also cover procedures for the excavation, sorting, and off-Site disposal of principal threat waste (PTW). Materials sent off-Site for disposal would meet the acceptance criteria for the licensed facility. Descriptions of the processes and standards for the *ex situ* solidification/stabilization of fractions of the hazardous and mixed waste streams, including threshold criteria for its implementation, would be included.		●	●	●	●	●	●	●	●

Table 5-1. Description and Applicability of Remedial Action Alternative Components for Soil/Solid Waste - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Remedial Action Components (Specific details included in the descriptions are subject to refinement and modification in post-FS remediation documents. Detailed assumptions for costing are in Appendix F.)	**Applicability to Solid Waste Alternative**								
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Pre-Remediation									
Land Surveying – Surveying would be completed under the direction of a California Licensed Land Surveyor to: 1) develop a legal description of the impacted areas; and 2) establish baseline conditions in areas subject to modification. Horizontal locations would be determined to the nearest 0.01 foot and referenced to the North American Datum of 1983, California State Plane, Zone II. Elevations would be determined to the nearest 0.01 foot and referenced to the North American Vertical Datum of 1988.	●	●	●	●	●	●	●	●	●
Decontamination Facilities – Prior to any remediation or characterization activity, suitable decontamination stations would be constructed for equipment and personnel performing excavation, sampling, and capping activities, or any other activity with potential for contact with contaminated soil or waste. These would include a wash, rinse, and containment station for vehicles and equipment and a personnel decontamination station for donning and doffing PPE. Decontamination solutions, rinse water, and wastes would be contained, sampled, and characterized for proper disposal.	●	●	●	●	●	●	●	●	●

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Pre-Construction Biological Survey – Prior to the initiation of Site work, a biological survey would be completed to: 1) characterize the existing habitat conditions and biological resources at and immediately adjacent to the proposed work areas; and 2) identify the potential biological impacts that may be associated with the proposed project. Biological surveys would assess select plant, insect, migratory bird, and other animal species abundance, biotic diversity, and endangered/critical species' habitat, including elderberry shrub clusters.		●	●	●	●	●	●	●	●
Elderberry Shrub Cluster Relocation – Elderberry shrub clusters located within areas potentially impacted by remediation would be relocated to the Russell Ranch Mitigation Area, as specified in the *UC Davis Long Range Development Plan Environmental Impact Report* (UC Davis, 2003) Mitigation Measure 4.4-6(b).		●	●	●	●	●	●	●	●
Data Gap Investigation – A data gap investigation would be completed for the Southern Trenches (ST) and the presumed Hopland Field Station Disposal Area (HFSDA). For both locations, the investigation would include excavation of exploratory trenches and sampling. Samples would be analyzed for radium-226, radium-228, strontium-90, cesium-137, isotopic uranium, tritium, and carbon-14. Beyond 12 feet below ground surface (bgs), carbon-14 and tritium would be analyzed. Upon completion of field activities, the outline of each trench would be surveyed. The results of the study would indicate whether further remedial action is needed in these areas.	●	●	●	●	●				

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<u>Building Decommissioning and Demolition; Replacement or Relocation</u> – Building decommissioning and demolition would consist of a utility survey and deconstruction and segregation of materials. A utility survey would be completed to identify electrical, sewer, water, fiber optic, gas, storm water, and other utilities that may be present within the area to be excavated. Identified utilities would be marked and incorporated into the deconstruction activities scope of work. For deconstruction, segregation, and disposal, it is assumed that five percent of building materials would be characterized as non-Resource Conservation and Recovery Act (RCRA)/non-Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous waste and would be sent off-Site for disposal. RADs are known to have been used in Geriatrics Bldgs. Nos. 1 and 2 (H-292 and H-293). This waste would be identified as decommissioning waste and would not be sent to a Class III landfill but may be placed in the corrective action management units (CAMU) under Alternatives SW-4, SW-5, SW-6, SW-7, and SW-8, or to a Class I landfill under Alternatives SW-3, SW-9, and SW-10. Similarly, non-hazardous building demolition waste may be recycled or placed in on-Site CAMUs, except for Alternatives SW-3, SW-9	Buildings: Cobalt-60 Annex		●							

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and SW-10, under which it would be sent off-Site for disposal or recycling. A radiological survey and characterization sampling would be conducted prior to building demolition. Other buildings at the Site have been assumed not to contain RADs. The State Historic Preservation Officer has indicated that there are no known historical or cultural resources identified within or adjacent to the Site (UC Davis, 1996). Historical evaluations of the buildings to be removed would not be performed. Buildings may be replaced based on future University needs. Replaced buildings would be based on the total square footage of those demolished and designed as warehouse style.	Buildings: Animal Housing Buildings X-1 through X-5, Geriatrics Bldg. No.1 (H-292), Geriatrics Bldg. No. 2 (H-293), the Storage Building W-3, and the Cobalt-60 Annex			●	●	●	●	●	●	●

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Decommissioning of Groundwater Monitoring Wells – Table 5-3 lists Site wells that would be decommissioned under each alternative. Wells would be decommissioned by over-drilling the existing well and filling the boreholes with cement grout.			●	●	●	●	●	●	●
Remediation – Excavation, Waste Segregation and Disposal, Backfill									
Area Excavation – Excavation activities would include clearing, grubbing, and excavating waste and contact soil from the waste areas. Contact soil is soil surrounding and in contact with waste and is assumed to have an average thickness of two feet. Waste would be removed cautiously to minimize the risk of breaking or puncturing containers potentially containing PTW. PTW, which consists of highly toxic or mobile materials, would be segregated and characterized. Air quality parameters would be monitored during excavation activities. Removed wastes and other excavated materials would be monitored with appropriate radiological instruments for radioactivity and a photoionization detector (PID) for VOCs. Backfilled soil would be compacted to at least 90 percent. Surveying would occur both before and after the excavation has been backfilled.		●	●	●	●	●	●	●	●

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<u>PTW Excavation</u> – PTW previously identified during historical exploratory trench investigations in Landfill Unit (LFU) No. 1, LFU-2, and the Eastern Trenches (ET) would be removed, segregated, and sent off-Site for disposal at a licensed facility. The locations of the exploratory trenches with previously identified PTW were estimated based on geophysical anomalies identified in previous geophysical surveys. However, the locations of these trenches were not surveyed. To confirm the locations of these original exploratory trenches, new spatially-referenced geophysical surveys would be conducted. The results of these surveys would be compared to previous survey results to re-establish the locations of the original exploratory trenches and the potential location of PTW. Initial trenching would be conducted in a grid pattern over the identified geophysical anomalies using a small backhoe bucket to locate solid waste cells before full trench excavation begins. The remaining non-PTW waste and impacted soil would be replaced within the excavated trenches on-Site or sent off-Site for disposal (SW-9 and SW-10). Excavation would continue in these trenches until no further PTW is encountered. Under Alternatives SW-8, SW-9, and SW-10, the land disposal units would be targeted in their entirety and would not require an initial geophysical survey. PTW identified would be removed, segregated, and sent off-Site for disposal.		●	●	●	●	●	●	●	●

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Additional Exploratory Trenches – In areas where geophysical anomalies were observed, or where there is suspicion of the presence of waste based on review of historical photographs and documents, and where no previous exploratory trench investigations have been conducted, additional exploratory trenches would be excavated. PTW encountered in these trenches would be segregated and sent off-Site for disposal at a licensed facility, and non-PTW waste and impacted soil would be replaced within the trenches. Excavation would continue in these trenches until no further PTW is encountered.	Trenches excavated in ET		●	●	●					
	Trenches excavated in LFU-1 and LFU-2		●	●	●	●	●			
	Trenches excavated in LFU-3		●	●	●	●				

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<u>Volatile Organic Compound "Hot Spot" Removal</u> – Two VOC soil gas "hot spots," one located south of Geriatrics Building No. 2 (H-293) and one at the Cobalt-60 Annex, would be excavated to 20 feet bgs. The excavation depth of 20 feet bgs is five feet deeper than the measured maximum VOC concentration at 15 feet bgs. The excavated soil would be characterized and hazardous material would be sent off-Site for disposal at a licensed facility.	Non-hazardous material backfilled on-Site, except for the eastern half of the ET VOC "hot spot," which would be backfilled with clean fill		●	●	●	●	●	●		
	Non-hazardous material sent off-Site for disposal, VOC "hot spots" backfilled with clean fill								●	●

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Confirmation Sampling – In excavations that would be backfilled with clean fill, the sides and floor of each excavation would be confirmation-sampled in accordance with the confirmation sampling protocol outlined in the Remedial Design/Remedial Action (RD/RA) Work Plan. Analytical results would be statistically evaluated to determine if they exceed a preliminary cleanup goal (PCG). Excavation would continue until confirmation samples are within levels identified in the work plan and as defined in the Record of Decision (ROD).		●	●	●	●	●	●	●	●
Segregation, Stockpiling, and Characterization of Excavated Material – During excavation activities, newly exposed surfaces and excavated material would be monitored with appropriate radiological instruments for radioactivity and a PID for VOCs; excavated material would also be visually screened for the presence or indications of PTW. If present, these materials would be removed, as appropriate, and placed in the PTW storage area for further characterization. If soils and waste (including PTW) remain commingled after initial segregation, they would be stockpiled before undergoing additional screening and sorting. If designated for off-Site disposal, the remaining non-PTW soil and solid waste would be classified and segregated as non-hazardous, RCRA-hazardous, non-RCRA hazardous, mixed, or low-level radioactive waste (LLRW), depending on a combination of the excavation monitoring results and sampling of the stockpiles. Segregation, stockpiling, and characterization activities would be conducted in accordance with the protocol developed in the MMP.		●	●	●	●	●	●	●	●

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***Ex situ* Treatment** – Hazardous and mixed wastes which exceed the threshold criteria specified in the MMP would undergo on-Site *ex situ* treatment prior to off-Site disposal at a licensed facility. The actual amount of waste to be treated would depend on the results of the waste characterization test (Toxicity Characteristic Leaching Procedure; see Appendix E). Treatment would involve the solidification/stabilization of COC-impacted soil and solid waste, rendering the COCs less mobile.		●	●	●	●	●	●	●	●
On-Site Disposal – For designated land disposal units, soil and solid waste not classified as PTW would be returned to an on-Site CAMU. After consolidation within the CAMU, the CAMU would receive a cap designed to reduce infiltration.		●	●	●	●	●	●	●	
Off-Site Disposal – Waste would be sent for disposal only at facilities authorized by the United States Environmental Protection Agency to receive CERCLA waste. Non-hazardous remediation waste and non-decommissioning demolition waste would be transported for disposal at a local Class II landfill. RCRA and Non-RCRA hazardous waste would be sent to a Class I landfill for disposal. Biological, LLRW, and mixed waste would be disposed of at facilities licensed to treat and accept such waste. Off-Site disposal activities would be conducted in accordance with the MMP.		●	●	●	●	●	●	●	●
Backfill – Clean fill material to backfill excavations would be tested for physical and chemical compatibility with each designated location. Costs for this testing are included in the backfill unit costs. Backfilling activities would be performed in accordance with the MMP.		●	●	●	●	●	●	●	●

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Remediation – Capping									
Establish Graded Cover – This cover would be constructed on a foundation layer of clean, low-permeability fill and graded to establish a minimum 1.5 percent slope in order to facilitate drainage (maximum thicknesses estimated between 2 and 3.25 feet). A topsoil cover would overlie the foundation layer and would be planted with vegetation. The CAMU perimeters would be re-graded to promote drainage from the covers into a surface water drainage system (see below). During construction, baseline, intermediate, and final surveys would be completed to document and verify that design specifications have been met.		●							
Consolidate Waste and Evapotranspiration Cap – This cap would be constructed on a foundation layer of clean, low-permeability fill and graded to establish a minimum 1.5 percent slope in order to facilitate drainage (maximum estimated thickness 4.5 feet). A clay loam layer and topsoil cover would overlie the foundation layer. The topsoil cover would be planted with vegetation to promote evapotranspiration. The CAMU perimeters would be re-graded to promote drainage from the evapotranspiration caps into a surface water drainage system (see below). During construction, baseline, intermediate, and final surveys would be completed to document and verify that design specifications have been met.			●						

Table 5-1. Description and Applicability of Remedial Action Alternative Components for Soil/Solid Waste - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Remedial Action Components (Specific details included in the descriptions are subject to refinement and modification in post-FS remediation documents. Detailed assumptions for costing are in Appendix F.)	**Applicability to Solid Waste Alternative**								
	SW-2 Institutional Controls and Groundwater Monitoring	**SW-3 VOC "Hot Spot" Removal, Three On-Site CAMUs with Graded Covers, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-4 VOC "Hot Spot" Removal, Three On-Site CAMUs with Evapotranspi-ration Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-5 VOC "Hot Spot" Removal, Three On-Site CAMUs with Asphalt Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-6 VOC "Hot Spot" Removal, Three On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-7 VOC "Hot Spot" Removal, Two On-Site CAMUs with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-8 VOC "Hot Spot" Removal, One On-Site Lined CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-9 Excavate and Dispose of Waste Off-Site, Waste Burial Holes CAMU with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**SW-10 Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**
<u>Consolidate Waste and Asphalt Cap</u> – This cap would be constructed on a foundation layer of clean, low-permeability fill and base rock, graded, and compacted to permit future light-duty parking or other similar uses. A 40-mil welded high-density polyethylene liner (HDPE) and drainage mat or equivalent would be installed over the graded surface and topped with an asphalt pavement layer. The CAMU perimeters would be regraded to promote drainage from the asphalt into a surface water drainage system (see below). During construction, baseline, intermediate, and final surveys would be completed to document and verify that design specifications have been met.				●				
<u>Consolidate Waste and Multiple-Layer Cap</u> – This cap would consist of an upper vegetated (topsoil) layer, a bio-barrier and protection layer, a drainage layer, and a low-permeability layer comprising a geomembrane and compacted clay or geosynthetic clay, and a foundation layer. The CAMU perimeters would be graded to promote drainage to a surface water drainage system (see below). During construction, baseline, intermediate, and final surveys would be completed to document and verify that design specifications have been met.					●	●	●	●	

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Levee Easement Setback – In order to comply with the relevant applicable or relevant and appropriate requirements related to levee setback easements (as described in Appendix D), any CAMU boundary within 10 feet of the Putah Creek levee toe would be designed to allow access for inspection and maintenance but would not be compromised in its function to limit water infiltration. The cap would be designed and constructed at current grade. This easement would apply to the ST, Waste Burial Holes (WBH), and LFU-1.		●	●	●	●	●	●	●	
Landfill Liner – A bottom liner would be installed over native soil and beneath the consolidated waste in the on-Site CAMU. The bottom liner would consist of a leachate detection layer and a leachate collection layer. Both layers would be composed of a permeable geofabric, an HDPE geomembrane, and a geosynthetic clay liner (or equivalent).							●		

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Drainage Controls										
LFU-3 Concrete-Lined Drainage Channel Sealed – The concrete-lined drainage channel would be sealed to prevent infiltration through cracks and maintained annually.			●							
LFU-3 Concrete-Lined Drainage Channel Demolition/ Reconstruction – The waste underlying the drainage channel would be removed.	Portion of concrete-lined drainage channel demolished, concrete re-established after excavation.			●	●	●				
	Entire concrete-lined drainage channel demolished, replaced with a vegetated drainage channel after excavation. Erosion controls would be installed as appropriate, and may include geotextiles and/or rip-rap.						●	●	●	●
LFU-3 East-West-Trending Drainage Ditch Relocation – The east-west-trending drainage ditch that currently crosses LFU-3 would be diverted to the south. Erosion controls would be installed as appropriate, and may include geotextiles and/or rip-rap.			●	●	●	●	●	●	●	●
LFU-1 Concrete-Lined Drainage Channel – A concrete-lined drainage channel would be constructed along the eastern side of LFU-1 that links into the existing culvert at LF-01; waste encountered during construction of the drainage channel would be consolidated in the LFU-1 CAMU or disposed of off-Site.			●							

Table 5-1. Description and Applicability of Remedial Action Alternative Components for Soil/Solid Waste - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

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LFU-1 Drainage/Vegetated Swale – Waste would be excavated along the eastern side of LFU-1 to allow for gravity drainage in an unlined vegetated swale. The vegetated swale would be constructed in accordance with BMP TC-30 in the California *Stormwater Best Management Practice Handbook, New Development and Redevelopment* (CASQA, 2003). The swale would be designed to treat flow that is not evapotranspired. Erosion controls would be installed as appropriate, and may include geotextiles and/or rip-rap.			●	●	●	●	●	●	●	●
Storm Water Collection and Conveyance System – Small drainage depressions would be installed across the landfill surface to direct water to a perimeter collection system, which would consist of a series of drop inlets and an underground storm drain pipe. The pipe would permit water to gravity flow to a storm water lift station located away from the land disposal unit areas where water would be pumped to an extended detention basin for treatment (see below). Erosion controls would be installed through the entire drainage system, as needed.			●	●	●	●	●	●		
Storm Water Lift Station – Two storm water lift stations would be established outside the LFU-2/WBH/ET area, and one would be established outside of the LFU-3 area. The lift stations would feed a new extended detention basin to the north of the LFU-2/WBH/ET area and one north of LFU-3.	Lift stations at LFU-2 /ET/WBH		●	●	●	●	●	●		
	Lift stations at LFU-3		●	●	●	●				

Table 5-1. Description and Applicability of Remedial Action Alternative Components for Soil/Solid Waste - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

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Extended Detention Basin – An extended detention basin would be constructed in accordance with BMP TC-22 in the California *Stormwater Best Management Practice Handbook, New Development and Redevelopment* (CASQA, 2003). The required basin volume would be determined using the 85th percentile, 24-hour runoff event. The basin would include a HDPE liner beneath three to five feet of soil to prevent infiltration.		●	●	●	●	●	●		
Post-Remediation									
Cover/Cap Monitoring and Maintenance – The condition of each cover/cap would be visually inspected annually, and maintenance would be conducted as needed. Covers/caps would be surveyed annually to assess the degree of settlement.		●	●	●	●	●	●	●	
Drainage Enhancements Monitoring and Maintenance – Storm water monitoring would be conducted annually during the rainy season at one or more locations where the cap runoff enters storm water channels. Maintenance of storm water drainage infrastructure would be conducted as needed.		●	●	●	●	●	●	●	●

Table 5-1. Description and Applicability of Remedial Action Alternative Components for Soil/Solid Waste - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

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<u>Groundwater Monitoring Well Installation</u> – New hydrostratigraphic unit (HSU) 1 groundwater monitoring wells would be installed downgradient of the VOC "hot spots," LFU-2/WBH/ET, LFU-1, and LFU-3. The wells would be completed just below the bottom of the depth range of seasonal water table fluctuation. In addition, designated, decommissioned monitoring wells would be replaced by a new well downgradient of the land disposal unit and consistent with prior and future monitoring goals. In addition to HSU-1 wells, some HSU-2 wells may need to be replaced if decommissioned during remediation (Table 5-3). Each newly installed well would be surveyed.	●	●	●	●	●	●	●	●	●

Table 5-1. Description and Applicability of Remedial Action Alternative Components for Soil/Solid Waste - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

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Groundwater and Storm Water Monitoring – Groundwater samples would be collected from designated monitoring wells located downgradient of the excavated/capped areas to evaluate the effectiveness of the remedial alternative. Quarterly sampling would be conducted during the first year and annual sampling would be completed for subsequent years. Monitoring results would be reported in the University of California, Davis annual groundwater monitoring reports and evaluated in five-year reviews. Groundwater sampling parameters would likely consist of VOCs, semi-volatile organic compounds, California Administrative Manual (CAM) 17 metals[1], total dissolved solids, tritium, and carbon-14. Storm water samples would be collected during two significant storm events per year, and sample parameters would include hardness, CAM 17 metals, low-level mercury, nitrate, nitrite, oil and grease, total organic carbon, total suspended solids, and field parameters (pH, electrical conductivity, and temperature). Specific analytical methods, parameters, and monitoring wells to be sampled would be identified in the RD/RA work plan. Groundwater and storm water monitoring activities were assumed to include data validation, electronic data import, data management, and monitoring reports for cost estimating purposes. In addition, for cost estimating purposes, monitoring was assumed to be conducted for 100 years; actual monitoring would be conducted until cleanup goals are achieved. Table 5-3 indicates which wells would be monitored under each alternative.	●	●	●	●	●	●	●	●	●

[1] The following metals are included in CAM 17 (California Administrative Manual, presently known as California Code of Regulations): antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc.

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Land Use/Institutional Controls (ICs) – Land use controls/ICs are designed to prevent future Site development or activities incompatible with the designated land use. Land use controls would, as appropriate: 1) allow access to monitoring wells; 2) restrict drilling (or other subsurface penetration) and access to groundwater; 3) restrict surface changes affecting drainage, infiltration, and potential constituent of concern mobilization; and 4) require assessment and mitigation of potential vapor intrusion hazards to buildings. A requirement for a soil management plan would also be recorded for implementation during post-remediation earthwork and construction activities. Land-use restrictions would consist of implementing a codified land use restriction in coordination with the UC Davis Office of the President, Real Estate Services Group, and the UC Davis Office of Administrative and Resource Management. A land use covenant would be recorded with Solano County that prohibits residential land use, and restricts non-residential use of the approximately 6.4 acres of disposal areas, including LFU-1, LFU-2, LFU-3, the ET, ST, WBH, and any co-located areas (such as the HFSDA). Signage would be posted to notify workers of potential subsurface hazards both during remedial action phases and post-construction activities while ICs remain in place. Subsurface hazard notification would consist of metal signs on posts.	●	●	●	●	●	●	●	●	●

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Five-Year Reviews – For each five-year period, documents associated with compliance, performance, and land use controls would be reviewed. This would include updating and correcting remedial program manuals, specifications, and record documents. The conclusions from each five-year review would be compiled in a summary report. The five-year reviews would be conducted until cleanup goals in the ROD are achieved.	●	●	●	●	●	●	●	●	●

● = Component of remedial alternative.

Acronyms/Abbreviations:
bgs - below ground surface
BMP - best management practice
CAM - California Administrative Manual, as defined in California Code of Regulations Title 22
CAMU - corrective action management unit
CASQA - California Stormwater Quality Association
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
ET - Eastern Trenches
FS - Feasibility Study
HDPE - high-density polyethylene
HFSDA - Hopland Field Station Disposal Area
HSU - hydrostratigraphic unit
H&S - health and safety
IC - institutional control
LFU - landfill unit
LLRW - low-level radioactive waste
mil - 1/1,000th of an inch
MMP - Materials Management Plan
PCG - preliminary cleanup goal
PID - photoionization detector
PPE - personal protective equipment
PTW - principal threat waste
QA/QC - quality assurance/quality control
RAD - radioactive compounds
RCRA - Resource Conservation and Recovery Act
RD/RA - remedial design/remedial action
ROD - Record of Decision
ST - Southern Trenches

Table 5-1. Description and Applicability of Remedial Action Alternative Components for Soil/Solid Waste - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Acronyms/Abbreviations (continued):
UC Davis - University of California, Davis
VOC - volatile organic compound
WBH - Waste Burial Holes

References:
California Stormwater Quality Association (CASQA), 2003. *Stormwater Best Management Practice Handbook, New Development and Redevelopment*, January.
University of California, Davis (UC Davis), 1996. *Draft Environmental Impact Report Waste Water Treatment Plant Replacement Project*, October.
UC Davis, 2003. *UC Davis Long Range Development Plan Environmental Impact Report, Volume 1*, October.

Table 5-2. Elements Included in Soil/Solid Waste Alternatives - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Element Number	Elements	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10
1	Planning and oversight (includes documentation for H&S, QA/QC, construction site environmental controls); pre-remediation activities (includes land survey, decontamination facilities, pre-construction biological survey, and elderberry shrub cluster relocation)	X	X	X	X	X	X	X	X	X
2	Data gap trench investigations and sampling at the ST and the HFSDA	X	X	X	X	X				
3	Institutional controls (ICs), including land use covenants and subsurface hazard notification	X	X	X	X	X	X	X	X	X
4	Install new groundwater monitoring wells	X	X	X	X	X	X	X	X	X
5	Post-remediation activities: storm water monitoring, groundwater monitoring, five-year reviews	X	X	X	X	X	X	X	X	X
6	Demolish one on-Site building; off-Site disposal or recycling		X							
7	Materials Management Plan (MMP) development and implementation		X	X	X	X	X	X	X	X
8	Confirmation sampling and backfill with clean fill		X	X	X	X	X	X	X	X
9	Dispose of known PTW off-Site from trenches in the ET, LFU-1, and LFU-2; backfill remaining non-PTW and impacted soil within trenches		X	X	X	X[a]	X[a]			
10	Excavate additional exploratory trenches in the ET, LFU-1, LFU-2, and LFU-3; segregate and dispose of PTW off-Site; backfill remaining non-PTW and impacted soil within trenches		X	X	X	X[a]	X[a,b]			
11	Excavate VOC "hot spots"; dispose of hazardous material off-Site, backfill non-hazardous material; in the eastern half of the ET VOC "hot spot" area, backfill with clean fill		X[c]	X[c]	X[c]	X[c]	X[c]	X[c]	X[d]	X[d]
12	*Ex situ* treatment of a fraction of the mixed waste and hazardous waste sent for off-Site disposal		X	X	X	X	X	X	X	X
13	Establish proper grades with low-permeability fill; plant vegetative cover; extend monitoring well casings to graded surface		X							
14	Surface water drainage enhancements across LFU-1, LFU-2, ET, and WBH; installation of extended detention basin		X	X	X	X	X	X		
15	Installation of concrete-lined drainage channel along eastern edge of LFU-1 to 3 feet bgs; segregate and dispose of PTW off-Site, use remaining soil to grade and cover LFU-1		X							
16	Concrete-lined drainage channel along the eastern edge of LFU-3 sealed and maintained annually to limit infiltration through cracks		X							
17	Redirect drainage ditch south along perimeter of LFU-3		X	X	X	X	X	X	X	X
18	Surface water drainage enhancements across LFU-3; installation of extended drainage basin		X	X	X	X				
19	Perform annual O&M on storm water infrastructure and caps; routine maintenance of drainage channels		X	X	X	X	X	X	X	X[e]
20	Well decommissioning; installation of replacement wells			X	X	X	X	X	X	X
21	Demolish nine on-Site buildings; off-Site disposal of hazardous waste and recycling or on-Site disposal of non-hazardous waste in CAMUs			X	X	X	X	X	X[f]	X[f]
22	LFU-3: Excavate waste and contact soil below concrete-lined channel; segregate and dispose of PTW off-Site; place remaining waste under cap; replace concrete liner			X	X	X				
23	Grade and cover CAMUs with clean, low-permeability fill; install evapotranspiration caps			X						
24	Installation of vegetated swale along eastern edge of LFU-1; excavation to 10 feet bgs, segregate and dispose of PTW off-Site, place remaining waste under LFU-1 cap			X	X	X	X	X[g]	X[h]	X[h]
25	Grade and cover CAMUs with clean, low-permeability fill; install HDPE liner and asphalt caps				X					
26	ET: Excavate soil/solid waste and contact soil, segregate and dispose of PTW off-Site, return non-PTW soil/solid waste to excavation or beneath CAMU cap; ET North backfilled with clean fill					X	X			
27	Grade and cover CAMUs with clean, low-permeability fill; install multiple-layer caps					X	X	X	X	
28	LFU-3: Excavate soil/solid waste and contact soil; segregate and dispose of PTW off-Site; place non-PTW in CAMU; backfill with clean fill						X	X		
29	LFU-3: Demolish concrete-lined drainage channel; replace with vegetated drainage channel						X	X	X	X
30	ST and HFSDA: Excavate soil/solid waste and contact soil; segregate and dispose of PTW off-Site; place non-PTW in CAMU; backfill with clean fill						X	X		
31	Excavate soil/solid waste and contact soil from LFU-1, LFU-2, LFU-3, the ET, ST, and HFSDA and place in one lined CAMU at LFU-1/LFU-2/ET; WBH CAMU not lined; segregate and dispose of PTW off-Site							X		
32	Use clean soil from CAMU excavation as backfill							X		
33	Excavate ST and HFSDA; segregate and dispose of PTW off-Site; non-PTW waste placed in WBH CAMU; backfill with clean fill								X	
34	Excavate soil/solid waste and contact soil from LFU-1, LFU-2 waste cells, LFU-3 waste cells, the ET, and the VOC "hot spots" and dispose of off-Site								X	X
35	Excavate soil/solid waste and contact soil from the WBH, the ST, and the HFSDA, and dispose of off-Site									X

Notes:

[a] Does not include the known trenches with PTW or proposed trenches in the ET; under Alternatives SW-6 and SW-7, these trenches would be included when the entire ET is excavated (ET excavation is included in elements 26, 31, and 34).

[b] Does not include the proposed trenches in LFU-3; under Alternative SW-7, these trenches would be included when the LFU-3 waste cells are excavated (LFU-3 excavation is included in elements 28, 31, and 34).

[c] The eastern half of the ET VOC "hot spot" would be backfilled with clean fill since it would not be covered by the graded covers or caps.

[d] Non-hazardous material would be sent off-Site for disposal at a licensed facility as no capped CAMU will be present in the VOC "hot spot" areas; the VOC "hot spots" would be backfilled with clean, imported fill.

[e] Annual O&M performed on vegetated swales only.

[f] Non-hazardous demolition waste would be sent off-Site for recycling or disposal.

[g] Excavation to 20 feet bgs along eastern edge of LFU-1.

[h] Non-PTW waste would be sent off-Site for disposal at a licensed facility as no capped CAMU will be present at LFU-1.

Acronyms/Abbreviations:

bgs - below ground surface

CAMU - corrective action management unit

ET - Eastern Trenches

HDPE - high-density polyethylene

HFSDA - Hopland Field Station Disposal Area

H&S - health and safety

IC - institutional control

LFU - landfill unit

MMP - Materials Management Plan

O&M - operations and maintenance

PTW - principal threat waste

QA/QC - quality assurance/quality control

ST - Southern Trenches

VOC - volatile organic compound

WBH - Waste Burial Holes

Table 5-3. Groundwater Monitoring Well Decommissioning, Replacement, and Monitoring - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

LEHR Groundwater Monitoring Well Name	Alternative SW-1	Alternative SW-2	Alternative SW-3	Alternative SW-4	Alternative SW-5	Alternative SW-6	Alternative SW-7	Alternative SW-8	Alternative SW-9	Alternative SW-10
DDC-1	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
DDC-2	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
DDC-3	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
DDC-4	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
DDC-5	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
DDC-6	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
TP-1A	nc	nc	nc	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]
TP-1B	nc	nc	nc	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]
TP-1C	nc	nc	nc	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]
TP-2A	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
TP-2B	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
TP-2C	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
TP-3A	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
TP-3B	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
TP-3C	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
TP-4A	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
TP-4B	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
TP-4C	nc	nc	nc	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]	R[1]
TP-5A	nc	nc	nc	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]
TP-5B	nc	nc	nc	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]
TP-5C	nc	nc	nc	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]	D[2]
UCD1-002	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
UCD1-008	nc	M	M[3]	D	D	D	D	D	D	D
UCD1-009	nc	nc	nc	D[4]	D[4]	D[4]	D[4]	D[4]	D[4]	D[4]
UCD1-010	nc	M	M	M	M	M	M	M	M	M
UCD1-011	nc	M	M	M	M	M	M	M	M	M
UCD1-012	nc	nc	nc	D[4]	D[4]	D[4]	D[4]	D[4]	D[4]	D[4]
UCD1-013	nc	M	M[3]	D	D	D	D	D	D	D
UCD1-024	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
UCD1-034	nc	M	M	M	M	M	M	M	M	M
UCD1-049	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
UCD1-050	nc	nc	nc	D[4]	D[4]	D[4]	D[4]	D[4]	D[4]	D[4]
UCD1-051	nc	M	M	D[4]	D[4]	D[4]	D[4]	D[4]	D[4]	D[4]
UCD1-062	nc	M	M	M	M	M	M	M	M	M
UCD1-064	nc	M	M	M	M	M	M	M	M	M
UCD1-065	nc	M	M	M	M	M	M	D	M	M
UCD1-066	nc	M	M	M	M	M	M	M	M	M
UCD1-070	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
UCD2-014	nc	nc	nc[3]	R	R	R	R	R	R	R
UCD2-039	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
UCD2-048	nc	nc	nc	nc	nc	nc	nc	nc	nc	nc
Wells to be installed										
1 - ET North downgradient well	---	N	N	N	N	N	N	N	N	N
2 - ET VOC "Hot Spot" downgradient well	---	N	N	N	N	N	N	N	N	N
3 - LFU-1 downgradient well	---	N	N	N	N	N	N	N	N	N
4 - LFU-1 downgradient well	---	N	N	N	N	N	N	N	N	N
5 - LFU-1 upgradient well	---	N	N	N	N	N	N	N	N	N
6 - LFU-2 downgradient well	---	N	N	N	N	N	N	---	N	N
7 - LFU-3 downgradient well	---	N	N	N	N	N	N	N	N	N
8 - LFU-3 upgradient well	---	N	N	N	N	N	N	N	N	N
9 - WBH downgradient well	---	N	N	N	N	N	N	---	N	N
10 - LFU-2/WBH downgradient well	---	---	---	---	---	---	---	N	---	---

Notes:

UCD1 indicates a monitoring well screened in HSU-1; UCD2 indicates a monitoring well screened in HSU-2; DDC indicates a density-driven convection pilot test well; TP indicates a temporary piezometer.

[1] Future configuration of the DDC system is subject to change. For comparison and costing purposes in the FS - Volume 1, it is assumed that the indicated well would be decommissioned and replaced. Actual fate of the well will be decided after publication of the FS - Volume 1.

[2] Future configuration of the DDC system is subject to change. For comparison and costing purposes in the FS - Volume 1, it is assumed that the indicated well would be decommissioned. Actual fate of the well will be decided after publication of the FS - Volume 1.

[3] Monitoring well casing would be extended so it is accessible at the newly established ground surface.

[4] Under the remedial alternative, decommissioning of the indicated well may be required. As a conservative measure, it is assumed in the FS that the indicated well would be decommissioned. A new well downgradient of ET North (1) would serve as a replacement for the well.

Acronyms/Abbreviations:

D - well decommissioned
DDC - density-driven convection
ET - Eastern Trenches
FS - Feasibility Study
HSU - hydrostratigraphic unit
LEHR - Laboratory for Energy-related Health Research
LFU - landfill unit
M - well designated for monitoring
N - new well to be installed and designated for monitoring
nc - no change; well not included in post-solid waste remediation land disposal unit monitoring
R - well decommissioned and relocated/replaced
VOC - volatile organic compound
WBH - Waste Burial Holes
--- - not applicable

Table 5-4. Assumed Subarea Depths, Areas, and Volumes - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Subarea Name	Area [square feet]	Depth of Excavation [feet bgs]	Depth to Top of Waste [feet bgs]	Depth to Bottom of Waste [feet bgs]	Thickness of Waste [feet]	Total Excavated Volume [BCY]	Total Excavated Volume [LCY]	Soil/Solid Waste [LCY]	Soil [LCY]	Alternative SW-1	Alternative SW-2	Alternative SW-3	Alternative SW-4	Alternative SW-5	Alternative SW-6	Alternative SW-7	Alternative SW-8	Alternative SW-9	Alternative SW-10
Eastern Trenches																			
ET North	3,952	8.0	2.5	8	5.5	1,171	1,639	1,127	512	-	-	-	-	-	X	X	X	X	X
ET South	16,196	8.0	2.5	8	5.5	4,799	6,718	4,619	2,099	-	-	-	-	-	X	X	-	X	X
ET South (SW-8)	16,196	20.0	2.5	8	5.5	11,997	16,796	4,619	12,177	-	-	-	-	-	-	-	X	-	-
ET VOC "Hot Spot" East	962	20.0	-	-	0	713	998	0	998	-	-	X	X	X	X	X	X	X	X
ET VOC "Hot Spot" West	664	20.0	2.5	8	5.5	492	689	189	499	-	-	X	X	X	X	X	X	X	X
ET Exploratory Trenches	[a]	[a]	[a]	[a]	[a]	231	324	212	112	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]	-[b]
ET Trench 24	75	7.5	2.5	7.5	5	21	29	19	10	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]	-[b]
ET Trench 26	48	7.0	2.5	7.0	4.5	12	17	11	6	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]	-[b]
ET TRL-45	219	7.5	2.5	7.5	5	61	85	57	28	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]	-[b]
ET TRL-48	163	9.5	2.5	9.5	7	57	80	59	21	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]	-[b]
ET-T1	79	6	2.5	6.0	3.5	18	25	14	10	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]	-[b]
ET-T2	93	6	2.5	6.0	3.5	21	29	17	12	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]	-[b]
ET-T3	93	6	2.5	6.0	3.5	21	29	17	12	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]	-[b]
ET-T4	93	6	2.5	6.0	3.5	21	29	17	12	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]	-[b]
ET TEV Total (LCY)										0	0	2,010	2,010	2,010	10,044	10,044	20,121	10,044	10,044
Landfill Unit No. 1																			
LFU-1 Non-Drainage Area	69,158	10.0	3	10	7	25,614	35,860	25,102	10,758	-	-	-	-	-	-	-	-	X	X
LFU-1 Drainage Area	19,479	10.0	3	10	7	7,215	10,100	7,070	3,030	-	-	-	X	X	X	X	-	X	X
LFU-1 (SW-8)	88,637	20.0	3	10	7	65,657	91,920	32,172	59,748	-	-	-	-	-	-	-	X	-	-
LFU-1 Exploratory Trenches	[c]	[c]	[c]	[c]	[c]	598	838	504	334	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU-1 TRL-35	528	7.0	3	7.0	4	137	192	110	82	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU-1 TRL-36	248	6.0	3	6.0	3	55	77	39	39	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU1-T1	128	8	3	8.0	5.0	38	53	33	20	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU1-T2	133	8	3	8.0	5.0	40	55	35	21	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU1-T3	137	8	3	8.0	5.0	41	57	35	21	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU1-T4	191	8	3	8.0	5.0	57	79	50	30	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU1-T5	233	8	3	8.0	5.0	69	97	60	36	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU1-T6	280	8	3	8.0	5.0	83	116	73	44	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU1-T7	269	8	3	8.0	5.0	80	112	70	42	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU-1 TEV Total (LCY)										0	0	838	10,938	10,938	10,938	10,938	91,920	45,960	45,960
Landfill Unit No. 2																			
LFU-2 Waste Cells	63,405	13.0	2.5	13	10.5	30,528	42,740	34,521	8,219	-	-	-	-	-	-	-	-	X	X
LFU-2 (SW-8)	94,328	20.0	2.5	13	10.5	69,873	97,822	35,410	62,412	-	-	-	-	-	-	-	X	-	-
LFU-2 VOC "Hot Spot"	1,633	20.0	2.5	13	10.5	1,210	1,693	889	804	-	-	X	X	X	X	X	-[d]	X	X
LFU-2 Exploratory Trenches	[e]	[e]	[e]	[e]	[e]	681	953	736	218	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU-2 TRL-12	37	7.75	2.5	7.75	5.25	11	15	10	5	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU-2 TRL-20	55	5.5	2.5	5.5	3	11	16	9	7	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU-2 TRL-22	86	15.0	2.5	15.0	12.5	48	67	56	11	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU2-T1	427	11	2.5	11.0	8.5	174	244	188	55	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU2-T2	427	11	2.5	11.0	8.5	174	244	188	55	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU2-T3	323	11	2.5	11.0	8.5	132	184	142	42	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU2-T4	323	11	2.5	11.0	8.5	132	184	142	42	-	-	X	X	X	X	X	-[b]	-[b]	-[b]
LFU-2 TEV Total (LCY)										0	0	2,647	2,647	2,647	2,647	2,647	97,822	44,433	44,433
Landfill Unit No. 3																			
LFU-3 Waste Cells	26,785	10.0	2.5	10	7.5	9,920	13,889	10,416	3,472	-	-	-	-	-	-	X	X	X	X
LFU-3 Drainage Area	7,403	10.0	2.5	10	7.5	2,742	3,839	1,853	1,985	-	-	-	X	X	X	-[b]	-[b]	-[b]	-[b]
LFU-3 Exploratory Trenches	[f]	[f]	[f]	[f]	[f]	84	117	81	37	-	-	X	X	X	X	-[b]	-[b]	-[b]	-[b]
LFU3-T1	134	8	2.5	8.0	5.5	40	56	38	17	-	-	X	X	X	X	-[b]	-[b]	-[b]	-[b]
LFU3-T2	149	8	2.5	8.0	5.5	44	62	42	19	-	-	X	X	X	X	-[b]	-[b]	-[b]	-[b]
LFU-3 TEV Total (LCY)										0	0	117	3,956	3,956	3,956	13,889	13,889	13,889	13,889

Table 5-4. Assumed Subarea Depths, Areas, and Volumes - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Subarea Name	Area [square feet]	Depth of Excavation [feet bgs]	Depth to Top of Waste [feet bgs]	Depth to Bottom of Waste [feet bgs]	Thickness of Waste [feet]	Total Excavated Volume [BCY]	Total Excavated Volume [LCY]	Soil/Solid Waste [LCY]	Soil [LCY]	Alternative SW-1	Alternative SW-2	Alternative SW-3	Alternative SW-4	Alternative SW-5	Alternative SW-6	Alternative SW-7	Alternative SW-8	Alternative SW-9	Alternative SW-10
Southern Trenches and Hopland Field Station Disposal Area																			
ST	7,027	6.0	1	6	5	1,562	2,186	1,822	364	-	-	-	-	-	-	X	X	X	X
ST Exploratory Trenches	[g]	[g]	[g]	[g]	[g]	195	273	227	45	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
ST-T1	76	6.0	1	6.0	5.0	17	24	20	4	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
ST-T2	76	6.0	1	6.0	5.0	17	24	20	4	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
ST-T3	76	6.0	1	6.0	5.0	17	24	20	4	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
ST-T4	76	6.0	1	6.0	5.0	17	24	20	4	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
ST-T5	570	6.0	1	6.0	5.0	127	177	148	30	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
HFSDA	2,076	6.0	2	6	4	461	646	431	215	-	-	-	-	-	-	X	X	X	X
HFSDA Exploratory Trenches	[h]	[h]	[h]	[h]	[h]	42	59	39	20	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
HFSDA-T1	63	6.0	2	6.0	4.0	14	20	13	7	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
HFSDA-T2	63	6.0	2	6.0	4.0	14	20	13	7	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
HFSDA-T3	63	6.0	2	6.0	4.0	14	20	13	7	-	X	X	X	X	X	-[b]	-[b]	-[b]	-[b]
ST and HFSDA TEV Total (LCY)										0	332	332	332	332	332	2,832	2,832	2,832	2,832
Waste Burial Holes																			
WBH Shallow	9,604	10.0	0	0	0	3,557	4,980	0	4,980	-	-	-	-	-	-	-	-	-	X
WBH Intermediate[i]	3,615	5.0	0	0	0	669	937	0	937	-	-	-	-	-	-	-	-	-	X
WBH Deep[j]	1,033	5.0	0	0	0	191	268	0	268	-	-	-	-	-	-	-	-	-	X
WBH Deep (south)[k]	42	20.0	0	0	0	31	44	0	44	-	-	-	-	-	-	-	-	-	X
WBH TEV Total (LCY)										0	0	0	0	0	0	0	0	0	6,228
Other Areas																			
Non-Impacted Area	46,402	20.0	0	0	0	34,372	48,121	0	48,121	-	-	-	-	-	-	-	X	-	-
Non-Impacted Area TEV Total (LCY)										0	0	0	0	0	0	0	48,121	0	0
Total Excavated Volume by Alternative [LCY]										0	332	5,943	19,882	19,882	27,916	40,349	274,704	117,158	123,386

Notes:

Bulk factor of 1.4 used to convert BCY to LCY.

[a] Refer to trenches with known PTW (ET Trench 24, ET Trench 26, TRL-45, TRL-48) and proposed exploratory trenches (ET-T1, ET-T2, ET-T3, and ET-T4).

[b] Subarea will be excavated as part of larger land disposal unit excavation for ET, LFU-1, LFU-2, LFU-3, ST, or HFSDA.

[c] Refer to trenches with known PTW (TRL-35, TRL-36) and proposed exploratory trenches (LFU1-T1, LFU1-T2, LFU1-T3, LFU1-T4, LFU1-T5, LFU1-T6, and LFU1-T7).

[d] Under Alternative SW-8, the LFU-2 VOC "Hot Spot" is included in the LFU-2 (SW-8) subarea.

[e] Refer to trenches with known PTW (TRL-12, TRL-20, TRL-22) and proposed exploratory trenches (LFU2-T1, LFU2-T2, LFU2-T3, and LFU2-T4).

[f] Refer to proposed exploratory trenches LFU3-T1 and LFU3-T2.

[g] Refer to proposed exploratory trenches ST-T1, ST-T2, ST-T3, ST-T4, and ST-T5.

[h] Refer to proposed exploratory trenches HFSDA-T1, HFSDA-T2, and HFSDA-T3.

[i] WBH Intermediate subarea is excavated to 15 feet bgs; because the WBH Shallow subarea is excavated to 10 feet bgs, the additional depth of excavation is 5 feet bgs.

[j] WBH Deep subarea is excavated to 20 feet bgs; because the WBH Intermediate subarea is excavated to 15 feet bgs, the additional depth of excavation is 5 feet bgs.

[k] WBH Deep (south) subarea is excavated to 20 feet bgs; because the WBH Deep (south) subarea lies outside the WBH boundary, it is listed separately and has a depth of excavation listed as 20 feet bgs.

Acronyms/Abbreviations:

BCY - bank cubic yards

bgs - below ground surface

ET - Eastern Trenches

HFSDA - Hopland Field Station Disposal Area

LCY - loose cubic yards

LFU - landfill unit

PTW - principal threat waste

ST - Southern Trenches

TEV - total excavated volume

VOC - volatile organic compound

WBH - Waste Burial Holes

X - excavate

Table 6-1. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternatives SW-1 and SW-2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m^3)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Eastern Trenches	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	7.7	87.5	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			10-20	- -	- -	- -	- -	- -	- -	- -	11.0	593.8	- -	203.1	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			>20	- -	- -	- -	- -	- -	- -	- -	11.0	- -	- -	322.7	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
	SBL-436	5/7/2002	0.5																		1.2 J				
	SBL-437	5/7/2002	0.5																						15.5
	SBL0031	5/25/1995	2.5																						13
	SBL0031	5/25/1995	5																						333
	ET-1	9/10/2008	5										17 J	1,400											
	SBL0031	5/25/1995	10																		1.8 J				
	SBL0030	5/25/1995	15																		6.7 J				1.3
	ET-1	9/10/2008	15								330	1,900		13,000											
	SBL0031	5/25/1995	25																						3.37
	ET-1	9/10/2008	25								43			710											
	SBL0030	5/25/1995	30																						1.49
	SBL0030	5/25/1995	40																		8.3 J				
Landfill Unit No. 1	**Applicable PCGs[a]**		0-10	9.6	- -	- -	60	80	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	0.015	- -	- -	0.13	- -	- -	- -	- -
			10-20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	14.2	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
			>20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0025	5/22/1995	0															0.02							
	SBL-416	5/6/2002	0.5							1.3															
	SBL-417	5/6/2002	0.5					3,640													4.7				
	SBL0025	5/22/1995	2.5																		1.8				
	SBL0047	9/27/1996	2.5	140			470	1,300		12															
	SBL0050	9/27/1996	4	27			570	2,100		13															
	TRL0036	8/15/1996	4.5	19.4			2,690	1,300																	
	TRL0038	8/16/1996	4.5	43.1			477	1,340		10.4															
	SBL0048	9/27/1996	5.5	66			160	330		12															
	TRL0036	8/16/1996	5.5							3.3															
	TRL0043	8/20/1996	7	23.7			317	810		5.1															
	TRL0038	8/16/1996	8.5							3.5															
	SBL0047	9/27/1996	10							3.2															
	SBL0050	9/27/1996	15							3.1															
	LF1-1	9/17/2008	15										74												
	LF1-2	9/15/2008	15.5																		1.0 J				
	SBL0025	5/23/1995	20																		2.5				
	SBL0048	9/27/1996	20							2.7															
	SBL0027	5/23/1995	25																		2.6				
Landfill Unit No. 2	**Applicable PCGs[a]**		0-10	- -	- -	0.51	- -	80	- -	- -	- -	178.4	- -	68.6	313.3	0.15	0.15	0.015	- -	0.22	0.13	0.06	- -	- -	- -
			10-20	- -	- -	0.51	- -	80	- -	- -	- -	- -	- -	133.3	714.3	- -	- -	- -	- -	- -	0.13	- -	14	0.24	- -
			>20	- -	- -	0.51	- -	- -	- -	- -	- -	- -	- -	317.2	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0028	5/24/1995	0																			0.062			
	SBL0033	5/26/1995	0.3																		4.2 J				
	SBL-423	5/7/2002	0.5			1.2																			
	SBL-424	5/7/2002	0.5			0.6		129																	
	SBL0029	5/24/1995	2.5			6.1		613												0.3					
	SBL0033	5/26/1995	2.5			6.7		729													2.1 J	0.16			
	SBL0045	9/26/1996	2.5					320													3.0	0.09			
	SBL0046	9/26/1996	2.5													0.7	0.5	0.5				0.12			
	TRL0016	7/28/1996	4			1.9		215														0.25			
	SBL0033	5/26/1995	5															0.04							
	TRL0013	7/25/1996	5			3.4		402														0.19			
	LF2-1	9/11/2008	5									910		9,600	2,600										
	SBL0028	5/24/1995	7.5																		1.8				
	SBL0044	9/25/1996	8.5			1.6		340														0.08			
	SBL0029	5/24/1995	9																			0.15			
	TRL0023	8/1/1996	9.5			2.7		455														0.22			
	TRL0022	8/1/1996	12.3			1.4		938																0.3	
	SBL0033	5/26/1995	12.5																				14.6		
	LF2-4	9/17/2008	12.5			1.5															1.2 J				
	SBL0028	5/24/1995	15																				14.1		
	SBL0029	5/24/1995	15																		2.4		15.5		
	SBL0046	9/26/1996	15																				18.6		
	LF2-1	9/11/2008	15											16,000	1,500										
	LF2-1	9/18/2008	15											380											
	LF2-4	9/17/2008	20			1.3																			
	LF2-1	9/11/2008	25											920											
	LF2-4	9/17/2008	25			1.4																			
	SBL0028	5/24/1995	30																		1.07				
	LF2-4	9/17/2008	32.5			1.1																			
Landfill Unit No. 3	**Applicable PCGs[a]**		0-10	- -	260	0.51	138	80	1,800	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.22	0.13	0.06	- -	0.24	- -
			10-20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -	- -
			>20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0020	3/2/1995	0																		1.25	0.2			
	SBL0021	3/3/1995	0																		0.45				
	SBL0022	3/6/1995	0																		3.77				
	SBL0024	3/7/1995	0																			0.065		0.88	
	TRL0102	6/5/1995	0.25																		1.2 J	0.073			
	TRL0501	6/5/1995	0.3			0.9		316																	
	TRL0101	6/5/1995	1.3			1.5		155	4,300													1.3			
	TRL0801	6/6/1995	1.5		968	4.5	684	2,540												1.6	0.9 J	0.3			
	TRL0031	8/12/1996	4		475	2.2		185														1.7		5.07	
	TRL0028	8/8/1996	5.5			20	165	216														0.3		1.5	
	SBL0021	3/3/1995	5.8																		0.6				
	SBL0036	9/19/1996	6.5		400	1.7	640	270														0.3			
	TRL0030	8/9/1996	7		262	3.1	433	164														0.2		1.8	
	SBL0022	3/6/1995	7.5			4	509	394														0.3		0.9	
	SBL0035	9/19/1996	8.5		500	12	1,700	1,800														0.7			
	TRL0029	8/9/1996	10			2.4		1,080														0.2		1.1	
	LF3-2	9/18/2008	12.5			1.5																			

Table 6-1. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternatives SW-1 and SW-2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m^3)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Landfill Unit No. 3 (continued)	SBL0022	3/6/1995	14																		1.3				
	SBL0022	3/6/1995	20		342																				
	LF3-2	9/18/2008	20			0.9																			
	SBL0036	9/20/1996	25		410																				
	LF3-2	9/18/2008	27.5			1.6																			
	LF3-2	9/18/2008	32.5		380	1.3															0.9 J				
Waste Burial Holes	**Applicable PCGs[a]**		0-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.6	--	0.3	0.06	--	0.24	1.2
			10-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	0.24	1.2
			>20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	--	3.2
	SSSP0009/0007/0	10/20/1999	0.5																		0.344				
	SSSP0010/0011/0	10/25/1999	0.5																		0.446				6.5
	SSSP0014/0015/0	10/25/1999	0.5																						1.91
	SSWB0018	9/3/1996	2																					0.53	
	LLRS0004	3/29/2000	2.5																		3.3				26
	LLRS0002	12/8/1999	3																		17.3				76.2
	LLRS0003	12/8/1999	3																		9.87				13.5
	LLRS0005	3/29/2000	3																		4.44				25.5
	SBL-446	5/8/2002	3																		3.85				26.1
	SBL-448	5/8/2002	3																		6.31				22.1
	PMWS0001	12/8/1999	3.2																						111
	PMWS0002	12/8/1999	3.2																		2.85				128
	LLRS0006	3/29/2000	3.3																		2.37				19.7
	TRL0050	8/27/1996	3.5																					0.59	
	SBL-449	5/8/2002	3.5																		6.82				62.9
	LLRS0001	12/9/1999	4																		7.42				21.7
	SBL-371	3/29/2001	4																		7.17				27.3 J
	SBL-372	3/29/2001	4																		6.56				41 J
	SBL-373	3/29/2001	4																		3.57				35 J
	SBL-374	3/29/2001	4																		0.494 J				
	SBL-375	3/29/2001	4																		7.86				212 J
	SBL-376	3/29/2001	4																						17.4 J
	SBL-450	5/8/2002	4.5																		15.1				165
	TRL0049	8/27/1996	5																					0.91	
	TRL0050	8/27/1996	5.25																					0.44	
	SBL-447	5/8/2002	6.5																		7.48				289
	SBL-451	5/8/2002	6.5																		12				261
	TRL0049	8/27/1996	7																					0.69	
	TRL0054	9/3/1996	7																92		1,442	4,610		1.06	2.71
	SSWB0102	11/4/1999	7																						1.94 J
	SSWB0103	11/4/1999	7																		0.346				
	WBH-3	9/16/2008	7.5																						56.5
	SSWB0088	10/20/1999	8																		1.57				5.15
	SSWB0089	10/20/1999	8																						6.23
	SSWB0091	10/20/1999	8																						4.34
	SSWB0105	11/4/1999	8.5																						3.8
	SSWB0079	10/14/1999	9																						902
	SSWB0075	10/18/1999	9																						22.5
	SSWB0093	10/21/1999	9																		1.12				28.7
	SSWB0104	11/4/1999	9																						2.43 J
	SSWB0083	10/18/1999	9.5																						1.7
	TRL0051	8/29/1996	10																						3,530
	SSWB0067	10/8/1999	10																		2.17				
	SSWB0071	10/9/1999	10																		0.629 J				
	SSWB0072	10/9/1999	10																		0.866				
	SSWB0080	10/15/1999	10																						9.36
	SSWB0082	10/16/1999	10																						14.9
	SSWB0084	10/18/1999	10																						43.8
	SSWB0087	10/19/1999	10																						2.11
	SSWB0090	10/20/1999	10																		2.06				14.6
	SSWB0085	10/18/1999	10.7																		0.487				
	SSWB0094	10/21/1999	11																		0.751				
	SSWB0095	10/21/1999	11																						162
	SSWB0097	10/25/1999	11																						1.31 J
	SSWB0099	10/26/1999	11																						30.9
	SSWB0078	10/12/1999	11.5																		0.48 J				2.45 J
	TRL0052	8/30/1996	12																		15.7				4.78
	TRL0054	9/3/1996	12																					25.5	
	SSWB0068	10/8/1999	12																		0.837				
	SSWB0073	10/9/1999	12																		2.27				4.03
	SSWB0074	10/9/1999	12																		6.21				4.51
	SSWB0086	10/18/1999	12.7																		0.772				
	SSWB0096	10/25/1999	13																						42.3
	SSWB0098	10/25/1999	13																		7.78				
	SBL0032	5/26/1995	15																						3,930
	WBH-2	9/16/2008	15																						19.7
	SBL-393	3/26/2001	15.5																		0.424 J				
	SBL-395	3/26/2001	15.5																		0.402 J				
	SBL-396	3/26/2001	15.5																		0.668				66.5
	SBL-391	3/27/2001	15.5																						34.8
	SBL-398	3/27/2001	15.5																		1.14				
	SBL-399	3/27/2001	15.5																		0.461 J				
	SBL-392	3/28/2001	15.5																						3.89 J
	SBL-393	3/26/2001	17.5																		0.564 J				
	SBL-395	3/26/2001	17.5																		0.657 J				
	SBL-396	3/26/2001	17.5																		0.44 J				133
	SBL-391	3/27/2001	17.5																						32.8
	SBL-398	3/27/2001	17.5																		0.415 J				
	SBL-392	3/28/2001	17.5																		0.422 J				6.74
	SBL-397	3/28/2001	17.5																		0.474 J				
	SBL-393	3/26/2001	19																		0.323 J				455

Table 6-1. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternatives SW-1 and SW-2 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m^3)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Waste Burial Holes (continued)	SBL-395	3/26/2001	19																		0.645				
	SBL-396	3/26/2001	19																		0.479 J				11 J
	SBL-391	3/27/2001	19																						37.9
	SBL-398	3/27/2001	19																		0.637 J				
	SBL-394	3/28/2001	19																		0.383 J				
	SBL-397	3/28/2001	19																		0.661				
	WBH-2	9/16/2008	20																						38.1
	SBL0032	5/26/1995	35																		1.9 J				147
Southern Trenches	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.48	- -	- -	- -	- -
			10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
	TRL0024	8/2/1996	2.7																		15.1				

Note:

[a] PCGs provided on Tables 3-2, 3-3, and 3-5.

Acronyms/Abbreviations:
bgs - below ground surface
DCA - dichloroethane
J - concentration is an estimated value
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethylene
PCG - preliminary cleanup goal
pCi/g - picocuries per gram
VOC - volatile organic compound
µg/m^3 - micrograms per cubic meter

Table 6-2. Summary of Excavation Volumes by Alternative - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Excavation Summary			Waste Stream Volumes [LCY]				Assumed Waste Characterization Type Volumes (Off-Site Disposal Only) [LCY]					Building Demolition Volumes [LCY]			Disposal Summary (Including Building Demolition Waste)		
Alternative	**Excavation Depth Range [feet]**	**Total Excavated Volume [BCY]**	**Total Excavated Volume[a] [LCY]**	**Soil**	**LTW**	**PTW**	**Biological Waste**	**LLRW**	**Mixed Waste**	**RCRA Hazardous**	**Non-RCRA Hazardous**	**Non-Hazardous**	**Building Demolition Total Waste**	**Building Demolition Hazardous Waste**	**Building Demolition Non-Hazardous Waste**	**On-Site Disposal**	**Off-Site Disposal**	**Estimated *Ex Situ* Treatment Volume [LCY] [b]**
Alternative SW-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative SW-2	6	237	332	65	259	3	5	0	0	3	0	0	0	0	0	329	3	0
Alternative SW-3	6-20	4,245	5,943	3,067	2,823	38	15	1,322	69	692	276	0	35	2	33	3,584	2,394	76
Alternative SW-4	6-20	14,201	19,882	8,082	11,613	150	38	1,339	75	781	276	0	883	45	838	18,249	2,516	86
Alternative SW-5	6-20	14,201	19,882	8,082	11,613	150	38	1,339	75	781	276	0	883	45	838	18,249	2,516	86
Alternative SW-6	6-20	19,940	27,916	10,582	16,967	261	107	1,356	80	870	276	0	883	45	838	26,173	2,626	95
Alternative SW-7	6-20	28,821	40,349	12,547	27,250	387	166	1,374	87	970	276	1,798	883	45	838	36,683	4,550	106
Alternative SW-8	6-20	196,217	274,704	188,518	84,757	1,116	312	1,484	123	1,554	276	17,989	883	45	838	254,116	21,471	168
Alternative SW-9	6-20	83,684	117,158	30,972	84,757	1,116	312	40,187	2,142	49,124	7,336	15,558	883	45	838	2,809	115,231	5,127
Alternative SW-10	6-20	88,133	123,386	37,200	84,757	1,116	312	44,829	2,164	49,124	7,843	19,426	883	45	838	0	124,269	5,129

Notes:

Table adapted from Table E-14 (Appendix E)

[a] Bulk factor of 1.4 applied to bank volume

[b] Volume of waste to be treated by solidification/ stabilization is assumed to be 10 percent of the mixed and RCRA hazardous waste volumes

Acronyms/Abbreviations:

BCY - bank cubic yards

LCY - loose cubic yards

LLRW - low-level radioactive waste

LTW - low threat waste

PTW - principal threat waste

RCRA - Resource Conservation and Recovery Act

Table 6-3. Estimated Number of Truck Trips and Mileage for Off-Site Disposal and Fill Import per Alternative - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Total Off-Site Disposal Volume	Truck Trips[a]											Total Miles Traveled for Disposal[d]	Total Miles Traveled for Import Fill[e]	Total Miles Traveled for Cap Material[f]	Total Miles Traveled
		Bulk Soil/Solid Waste						Drummed Waste	Building Demolition Waste		Fill[b]	Caps[c]	Total Truck Trips			
	(loose cubic yards)	LLRW	Mixed	RCRA	Non-RCRA	Non-Hazardous	Biological		Hazardous	Non-Hazardous						
Alternative SW-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alternative SW-2	3	0	0	1	0	0	0	0	0	0	0	0	1	454	0	0	454
Alternative SW-3	2,394	67	4	35	14	0	0	1	1	2	51	594	769	108,608	2,550	29,700	140,858
Alternative SW-4	2,516	67	4	40	14	0	0	1	3	0	737	3,150	4,016	111,414	36,850	157,500	305,764
Alternative SW-5	2,516	67	4	40	14	0	0	1	3	0	737	980	1,846	111,414	36,850	49,000	197,264
Alternative SW-6	2,626	68	5	44	14	0	0	1	3	0	819	2,227	3,181	115,606	40,950	111,350	267,906
Alternative SW-7	4,550	69	5	49	14	90	0	2	3	0	1,463	1,968	3,663	136,992	73,150	98,400	308,542
Alternative SW-8	21,471	75	7	78	14	900	0	4	3	0	0 [j]	2,428	3,509	312,698	0	121,400	434,098
Alternative SW-9	115,231	2,010	108	2,457	367	778	16	4	3	42	5,848	209	11,842	4,034,770	292,400	10,450	4,337,620
Alternative SW-10	124,269	2,242	109	2,457	393	972	16	4	3	42	6,160	0	12,398	4,359,462	308,000	0	4,667,462

Notes:

[a] Waste facilities/mileage subject to change in final remedy implementation; waste disposal truck trip estimates are based on RACER software results which assume 20 cubic yard capacity of disposal trucks.

[b] Assumes volume of imported material for backfill equal to volume of waste disposed of off-Site less available on-Site backfill material, and 20 cubic yard capacity for truck. Assumed fill material available within 25-mile radius (50 miles roundtrip).

[c] Assumes cap foundation layer material imported locally (within 25-mile radius, 50 miles roundtrip), and 20 cubic yard capacity of truck. The number of trucks needed for transport of liners (geomembranes, geosynthetic clay liners, geotextiles, etc.) is not included in this estimate; the number of trucks needed for liner transport is minimal in comparison with those needed for transport of soil/fill for the caps. For Alternative SW-5, the number of trucks includes those for the delivery of asphalt mix from a source within 25 miles.

[d] Based on 186 miles roundtrip to Class II landfill for non-hazardous waste, 454 miles roundtrip to Class I landfill for RCRA hazardous and non-RCRA hazardous waste, 1,188 miles roundtrip to facility accepting LLRW and mixed waste, and 4,866 miles roundtrip to biological LLRW incineration facility. For this analysis, it is assumed the drummed waste is sent to the LLRW facility.

[e] Assumes material for excavation backfill obtained from local source within 25-mile radius (50 miles roundtrip).

[f] Assumes cap fill material (and asphalt under Alternative SW-5) imported locally within 25-mile radius (50 miles roundtrip).

Acronyms/Abbreviations:

LLRW - low-level radioactive waste

RACER - Remedial Action Cost Engineering and Requirements

RCRA - Resource Conservation and Recovery Act

Table 6-4. Site Environmental Footprint per Alternative - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Remedial Alternatives	GHG Emissions[a]	Total Energy Used	Diesel Fuel Equivalent[b]	NO_x Emissions	SO_x Emissions	PM_{10} Emissions	Water Consumption	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Accident Fatality Risk[c]	Transportation Emissions Fatality Risk[d]	Total Fatality Risk
	Metric Tons	MMBTUs	Gallons	Metric Tons	Metric Tons	Metric Tons	Gallons	Tons	Tons			
SW-1	0	0	0	0.0	0.0	0.0	0	0	0	0.E+00	0.E+00	0.E+00
SW-2	42	550	3,958	0.2	0.1	0.02	414,250	0	4	2.E-04	6.E-05	2.E-04
SW-3	1,415	22,408	161,205	1.8	0.8	0.6	1,243,750	33	2,361	2.E-03	2.E-02	2.E-02
SW-4	4,002	69,151	497,488	2.8	1.0	0.7	3,724,930	0	2,516	4.E-03	4.E-02	5.E-02
SW-5	3,029	42,343	304,626	2.8	1.0	0.7	3,724,930	0	2,516	3.E-03	3.E-02	3.E-02
SW-6	3,582	60,507	435,302	3.2	1.1	0.7	3,724,930	0	2,626	3.E-03	4.E-02	4.E-02
SW-7	3,945	66,589	479,061	3.7	1.2	1.1	3,724,930	1,798	2,752	4.E-03	4.E-02	5.E-02
SW-8	5,236	86,356	621,266	8.8	3.1	4.5	7,046,610	17,989	3,481	6.E-03	6.E-02	7.E-02
SW-9	14,414	221,962	1,596,852	17.3	7.2	23.3	7,046,610	16,396	98,835	4.E-02	6.E-01	6.E-01
SW-10	15,187	232,758	1,674,518	18.2	7.6	25.1	7,046,610	20,264	104,005	4.E-02	6.E-01	7.E-01

Notes:

Results from SiteWise™ Version 2 (Battelle, 2011), see Appendix I, Attachment I-2

[a] Greenhouse gas emissions include contributions from carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O)

[b] MMBTUs converted to gallons of diesel fuel, using the conversion factor in Exhibit 3.13 in US EPA (2011)

[c] The accident fatality risk estimated in SiteWise™ includes the risk from both on-Site workers during remedial construction and from traffic accidents of off-Site transportation of personnel, equipment, materials, and waste

[d] Based on 9.7 x 10^{-9} latent fatalities per rural mile traveled for large trucks, 9.7 x 10^{-7} latent fatalities per suburban mile, and 1.6 x 10^{-6} latent fatalities per urban mile, and assumed 90:5:5 trip ratio through rural, suburban, and urban areas, respectively (Biwer and Butler, 1999). This results in an overall average risk of 1.4 x 10-7 latent fatalities per mile traveled. Total miles traveled for each alternative obtained from Table 6-3.

Acronyms/Abbreviations:

GHG - greenhouse gas

NO_x - nitrogen oxides

SO_x - sulfur oxides

PM_{10} - particulate matter with diameter less than 10 micrometers

MMBTUs - million British thermal units

US EPA - United States Environmental Protection Agency

References:

Battelle Memorial Institute (Battelle), 2011. *SiteWise™ Version 2 User Guide,* June.

Biwer, Bruce M., and James P. Butler, 1999. *Vehicle Emission Unit Risk Factors for Transportation Risk Assessments* , Risk Analysis 19.6: 1157-171. Wiley Online Library. Web. 4 Nov. 2010.

United States Environmental Protection Agency, 2011. *Methodology for Understanding and Reducing a Project's Environmental Footprint: Draft for Public Input,* September.

Table 6-5. Alternative SW-2 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Institutional Controls and Groundwater Monitoring

	COST COMPONENT	TOTAL
CAPITAL COSTS:	Data Gap Investigation	$157,394
	Decontamination Facilities[a]	$37,879
	Install New Groundwater Wells[b]	$115,168
	Off-Site Transportation and Disposal	$8,339
	TOTAL CAPITAL COST	**$318,780**
O&M COSTS:	Institutional Controls	$1,144,900
	Groundwater and Storm Water Monitoring[b]	$4,873,320
	TOTAL O&M COST	**$6,018,220**
PERIODIC COSTS:	Five-Year Reviews	$173,297
	TOTAL PERIODIC COST	**$173,297**
TOTAL PRESENT VALUE OF ALTERNATIVE[c]		**$6,510,297**

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Decontamination Facilities include temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative.

[c] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

Acronyms/Abbreviations:

O&M - operations and maintenance

Table 6-6. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-3 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Eastern Trenches																								
Applicable PCGs[a]		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	7.7	87.5	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
		10-20	- -	- -	- -	- -	- -	- -	- -	11.0	593.8	- -	203.1	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
		>20	- -	- -	- -	- -	- -	- -	- -	11.0	- -	- -	322.7	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
SBL-436	5/7/2002	0.5																		1.2 J				
SBL-437	5/7/2002	0.5																						15.5
SBL0031	5/25/1995	2.5																						13
SBL0031	5/25/1995	5																						333
SBL0031	5/25/1995	10																		1.8 J				
SBL0030	5/25/1995	15																		6.7 J				1.3
SBL0031	5/25/1995	25																						3.37
ET-1	9/10/2008	25								43			710											
SBL0030	5/25/1995	30																						1.49
SBL0030	5/25/1995	40																		8.3 J				
Landfill Unit No. 1																								
Applicable PCGs[a]		0-10	9.6	- -	- -	60	80	- -	1.2	- -	- -	- -	- -	- -	- -	- -	0.015	- -	- -	0.13	- -	- -	- -	- -
		10-20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	14.2	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
		>20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
SBL0025	5/22/1995	0															0.02							
SBL-416	5/6/2002	0.5							1.3															
SBL-417	5/6/2002	0.5					3,640													4.7				
SBL0025	5/22/1995	2.5																		1.8				
SBL0047	9/27/1996	2.5	140			470	1,300		12															
SBL0050	9/27/1996	4	27			570	2,100		13															
TRL0036	8/15/1996	4.5	19.4			2,690	1,300																	
TRL0038	8/16/1996	4.5	43.1			477	1,340		10.4															
SBL0048	9/27/1996	5.5	66			160	330		12															
TRL0036	8/16/1996	5.5							3.3															
TRL0043	8/20/1996	7	23.7			317	810		5.1															
TRL0038	8/16/1996	8.5							3.5															
SBL0047	9/27/1996	10							3.2															
SBL0050	9/27/1996	15							3.1															
LF1-1	9/17/2008	15										74												
LF1-2	9/15/2008	15.5																		1.0 J				
SBL0025	5/23/1995	20																		2.5				
SBL0048	9/27/1996	20							2.7															
SBL0027	5/23/1995	25																		2.6				
Landfill Unit No. 2																								
Applicable PCGs[a]		0-10	- -	- -	0.51	- -	80	- -	- -	- -	178.4	- -	68.6	313.3	0.15	0.15	0.015	- -	0.22	0.13	0.06	- -	- -	- -
		10-20	- -	- -	0.51	- -	80	- -	- -	- -	- -	- -	133.3	714.3	- -	- -	- -	- -	- -	0.13	- -	14	0.24	- -
		>20	- -	- -	0.51	- -	- -	- -	- -	- -	- -	- -	317.2	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
SBL0028	5/24/1995	0																			0.062			
SBL0033	5/26/1995	0.3																		4.2 J				
SBL-423	5/7/2002	0.5			1.2																			
SBL-424	5/7/2002	0.5			0.6		129																	
SBL0029	5/24/1995	2.5			6.1		613												0.3					
SBL0033	5/26/1995	2.5			6.7		729													2.1 J	0.16			
SBL0045	9/26/1996	2.5					320													3.0	0.09			
SBL0046	9/26/1996	2.5													0.7	0.5	0.5				0.12			
TRL0016	7/28/1996	4			1.9		215														0.25			
SBL0033	5/26/1995	5															0.04							
TRL0013	7/25/1996	5			3.4		402														0.19			
SBL0028	5/24/1995	7.5																		1.8				
SBL0044	9/25/1996	8.5			1.6		340														0.08			
SBL0029	5/24/1995	9																			0.15			
TRL0023	8/1/1996	9.5			2.7		455														0.22			
TRL0022	8/1/1996	12.3			1.4		938																0.3	
SBL0033	5/26/1995	12.5																				14.6		
LF2-4	9/17/2008	12.5			1.5															1.2 J				
SBL0028	5/24/1995	15																				14.1		
SBL0029	5/24/1995	15																		2.4		15.5		
SBL0046	9/26/1996	15																				18.6		
LF2-4	9/17/2008	20			1.3																			
LF2-1	9/11/2008	25											920											
LF2-4	9/17/2008	25			1.4																			
SBL0028	5/24/1995	30																		1.07				
LF2-4	9/17/2008	32.5			1.1																			
Landfill Unit No. 3																								
Applicable PCGs[a]		0-10	- -	260	0.51	138	80	1,800	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.22	0.13	0.06	- -	0.24	- -
		10-20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
		>20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
SBL0020	3/2/1995	0																		1.25	0.2			
SBL0021	3/3/1995	0																		0.45				
SBL0022	3/6/1995	0																		3.77				
SBL0024	3/7/1995	0																			0.065		0.88	
TRL0102	6/5/1995	0.25																		1.2 J	0.073			
TRL0501	6/5/1995	0.3			0.9		316																	
TRL0101	6/5/1995	1.3			1.5		155	4,300													1.3			
TRL0801	6/6/1995	1.5		968	4.5	684	2,540												1.6	0.9 J	0.3			
TRL0031	8/12/1996	4		475	2.2		185														1.7		5.07	
TRL0028	8/8/1996	5.5			20	165	216														0.3		1.5	
SBL0021	3/3/1995	5.8																		0.6				
SBL0036	9/19/1996	6.5		400	1.7	640	270														0.3			
TRL0030	8/9/1996	7		262	3.1	433	164														0.2		1.8	
SBL0022	3/6/1995	7.5			4	509	394														0.3		0.9	
SBL0035	9/19/1996	8.5		500	12	1,700	1,800														0.7			
TRL0029	8/9/1996	10			2.4		1,080														0.2		1.1	
LF3-2	9/18/2008	12.5			1.5																			
SBL0022	3/6/1995	14																		1.3				
SBL0022	3/6/1995	20		342																				
LF3-2	9/18/2008	20			0.9																			
SBL0036	9/20/1996	25		410																				
LF3-2	9/18/2008	27.5			1.6																			

Table 6-6. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-3 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Landfill Unit No. 3 (continued)	LF3-2	9/18/2008	32.5		380	1.3															0.9 J				
Waste Burial Holes	**Applicable PCGs[a]**		0-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	3.6	--	0.3	0.06	--	0.24	1.2
			10-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	0.24	1.2
			>20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.3	--	--	--	3.2
	SSSP0009/0007/0	10/20/1999	0.5																		0.344				
	SSSP0010/0011/0	10/25/1999	0.5																		0.446				6.5
	SSSP0014/0015/0	10/25/1999	0.5																						1.91
	SSWB0018	9/3/1996	2																					0.53	
	LLRS0004	3/29/2000	2.5																		3.3				26
	LLRS0002	12/8/1999	3																		17.3				76.2
	LLRS0003	12/8/1999	3																		9.87				13.5
	LLRS0005	3/29/2000	3																		4.44				25.5
	SBL-446	5/8/2002	3																		3.85				26.1
	SBL-448	5/8/2002	3																		6.31				22.1
	PMWS0001	12/8/1999	3.2																						111
	PMWS0002	12/8/1999	3.2																		2.85				128
	LLRS0006	3/29/2000	3.3																		2.37				19.7
	TRL0050	8/27/1996	3.5																					0.59	
	SBL-449	5/8/2002	3.5																		6.82				62.9
	LLRS0001	12/9/1999	4																		7.42				21.7
	SBL-371	3/29/2001	4																		7.17				27.3 J
	SBL-372	3/29/2001	4																		6.56				41 J
	SBL-373	3/29/2001	4																		3.57				35 J
	SBL-374	3/29/2001	4																		0.494 J				
	SBL-375	3/29/2001	4																		7.86				212 J
	SBL-376	3/29/2001	4																						17.4 J
	SBL-450	5/8/2002	4.5																		15.1				165
	TRL0049	8/27/1996	5																					0.91	
	TRL0050	8/27/1996	5.25																					0.44	
	SBL-447	5/8/2002	6.5																		7.48				289
	SBL-451	5/8/2002	6.5																		12				261
	TRL0049	8/27/1996	7																					0.69	
	TRL0054	9/3/1996	7																92		1,442	4,610		1.06	2.71
	SSWB0102	11/4/1999	7																						1.94 J
	SSWB0103	11/4/1999	7																		0.346				
	WBH-3	9/16/2008	7.5																						56.5
	SSWB0088	10/20/1999	8																		1.57				5.15
	SSWB0089	10/20/1999	8																						6.23
	SSWB0091	10/20/1999	8																						4.34
	SSWB0105	11/4/1999	8.5																						3.8
	SSWB0079	10/14/1999	9																						902
	SSWB0075	10/18/1999	9																						22.5
	SSWB0093	10/21/1999	9																		1.12				28.7
	SSWB0104	11/4/1999	9																						2.43 J
	SSWB0083	10/18/1999	9.5																						1.7
	TRL0051	8/29/1996	10																						3,530
	SSWB0067	10/8/1999	10																		2.17				
	SSWB0071	10/9/1999	10																		0.629 J				
	SSWB0072	10/9/1999	10																		0.866				
	SSWB0080	10/15/1999	10																						9.36
	SSWB0082	10/16/1999	10																						14.9
	SSWB0084	10/18/1999	10																						43.8
	SSWB0087	10/19/1999	10																						2.11
	SSWB0090	10/20/1999	10																		2.06				14.6
	SSWB0085	10/18/1999	10.7																		0.487				
	SSWB0094	10/21/1999	11																		0.751				
	SSWB0095	10/21/1999	11																						162
	SSWB0097	10/25/1999	11																						1.31 J
	SSWB0099	10/26/1999	11																						30.9
	SSWB0078	10/12/1999	11.5																		0.48 J				2.45 J
	TRL0052	8/30/1996	12																		15.7				4.78
	TRL0054	9/3/1996	12																					25.5	
	SSWB0068	10/8/1999	12																		0.837				
	SSWB0073	10/9/1999	12																		2.27				4.03
	SSWB0074	10/9/1999	12																		6.21				4.51
	SSWB0086	10/18/1999	12.7																		0.772				
	SSWB0096	10/25/1999	13																						42.3
	SSWB0098	10/25/1999	13																		7.78				
	SBL0032	5/26/1995	15																						3,930
	WBH-2	9/16/2008	15																						19.7
	SBL-393	3/26/2001	15.5																		0.424 J				
	SBL-395	3/26/2001	15.5																		0.402 J				
	SBL-396	3/26/2001	15.5																		0.668				66.5
	SBL-391	3/27/2001	15.5																						34.8
	SBL-398	3/27/2001	15.5																		1.14				
	SBL-399	3/27/2001	15.5																		0.461 J				
	SBL-392	3/28/2001	15.5																						3.89 J
	SBL-393	3/26/2001	17.5																		0.564 J				
	SBL-395	3/26/2001	17.5																		0.657 J				
	SBL-396	3/26/2001	17.5																		0.44 J				133
	SBL-391	3/27/2001	17.5																						32.8
	SBL-398	3/27/2001	17.5																		0.415 J				
	SBL-392	3/28/2001	17.5																		0.422 J				6.74
	SBL-397	3/28/2001	17.5																		0.474 J				
	SBL-393	3/26/2001	19																		0.323 J				455
	SBL-395	3/26/2001	19																		0.645				
	SBL-396	3/26/2001	19																		0.479 J				11 J
	SBL-391	3/27/2001	19																						37.9
	SBL-398	3/27/2001	19																		0.637 J				
	SBL-394	3/28/2001	19																		0.383 J				

Table 6-6. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-3 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Waste Burial Holes (continued)	SBL-397	3/28/2001	19																		0.661				
	WBH-2	9/16/2008	20																						38.1
	SBL0032	5/26/1995	35																		1.9 J				147
Southern Trenches	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.48	- -	- -	- -	- -
			10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
	TRL0024	8/2/1996	2.7																		15.1				

Note:

[a] PCGs provided on Tables 3-2, 3-3, and 3-5.

Acronyms/Abbreviations:
bgs - below ground surface
DCA - dichloroethane
J - concentration is an estimated value
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethylene
PCG - preliminary cleanup goal
pCi/g - picocuries per gram
VOC - volatile organic compound
µg/m³ - micrograms per cubic meter

Table 6-7. Alternative SW-3 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Graded Covers, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring

	COST COMPONENT	TOTAL
CAPITAL COSTS:		
Pre-Remediation	Biological Survey	$86,304
	Elderberry Mitigation	$270,000
	Data Gap Investigation	$157,394
	Decontamination Facilities[a]	$195,984
	Building D&D (including disposal)	$94,688
	Clearing and Grubbing	$52,025
Excavation and Backfill	ET PTW and Exploratory Trench Excavation[b]	$125,480
	LFU-1 PTW and Exploratory Trench Excavation[b]	$285,662
	LFU-2 PTW and Exploratory Trench Excavation[b]	$310,177
	LFU-3 PTW and Exploratory Trench Excavation[b]	$72,889
	ET VOC "Hot Spot" Excavation	$234,122
	LFU-2 VOC "Hot Spot" Excavation	$196,258
Materials Management and Disposal	Materials Management[c]	$472,652
	Off-Site Transportation and Disposal	$2,291,553
CAMU Construction	LFU-1 Graded Cover	$256,367
	LFU-2/ET/WBH Graded Cover	$383,333
	LFU-3 Graded Cover	$88,118
Post-Remediation	Install New Groundwater Wells[d]	$118,168
	Storm Drainage[e]	$691,009
	LFU-1 Drainage Channel	$29,823
	LFU-3 Drainage Channels	$51,820
	TOTAL CAPITAL COST	**$6,463,826**
O&M COSTS:	Institutional Controls	$1,144,900
	Groundwater and Storm Water Monitoring[d]	$4,873,320
	O&M Drainage System[f]	$200,901
	O&M of Graded Covers	$702,560
	TOTAL O&M COST	**$6,921,681**
PERIODIC COSTS:	Periodic Storm Water Lift Station Repair	$12,225
	Five-Year Reviews	$173,297
	TOTAL PERIODIC COST	**$185,523**
TOTAL PRESENT VALUE OF ALTERNATIVE[g]		**$13,571,030**
ST and HFSDA Graded Cover Contingency		$44,059
TOTAL PRESENT VALUE OF ALTERNATIVE with contingency		**$13,615,089**

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Decontamination Facilities include temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] PTW and Exploratory Trench Excavation includes the cost of a geophysical survey to be performed prior to excavation.

[c] Materials Management includes the cost of stockpiling and management of excavated materials, waste characterization sampling, and sifting/sorting waste streams.

[d] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative.

[e] Storm drainage includes costs of storm water detention basins and infrastructure for storm water conveyance from graded cover areas to the detention basins and final discharge.

[f] O&M Drainage System includes O&M costs for storm water detention basins and associated infrastructure, in addition to storm water drainage channels/swales.

[g] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

Table 6-7. Alternative SW-3 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Acronyms/Abbreviations:
CAMU - corrective action management unit
D&D - decommissioning and demolition
ET - Eastern Trenches
HFSDA - Hopland Field Station Disposal Area
LFU - landfill unit
O&M - operations and maintenance
PTW - principal threat waste
ST - Southern Trenches
VOC - volatile organic compound
WBH - Waste Burial Holes

Table 6-8. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-4 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Eastern Trenches	**Applicable PCGs[a]**	0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	7.7	87.5	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
		10-20	- -	- -	- -	- -	- -	- -	- -	11.0	593.8	- -	203.1	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
		>20	- -	- -	- -	- -	- -	- -	- -	11.0	- -	- -	322.7	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
	SBL-436	5/7/2002	0.5																	1.2 J				
	SBL-437	5/7/2002	0.5																					15.5
	SBL0031	5/25/1995	2.5																					13
	SBL0031	5/25/1995	5																					333
	SBL0031	5/25/1995	10																	1.8 J				
	SBL0030	5/25/1995	15																	6.7 J				1.3
	SBL0031	5/25/1995	25																					3.37
	ET-1	9/10/2008	25							43			710											
	SBL0030	5/25/1995	30																					1.49
	SBL0030	5/25/1995	40																	8.3 J				
Landfill Unit No. 1	**Applicable PCGs[a]**	0-10	9.6	- -	- -	60	80	- -	1.2	- -	- -	- -	- -	- -	- -	- -	0.015	- -	- -	0.13	- -	- -	- -	- -
		10-20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	14.2	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
		>20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0025	5/22/1995	0														0.02							
	SBL-416	5/6/2002	0.5						1.3															
	SBL-417	5/6/2002	0.5				3,640													4.7				
	SBL0025	5/22/1995	2.5																	1.8				
	SBL0047	9/27/1996	2.5	140		470	1,300		12															
	SBL0050	9/27/1996	4	27		570	2,100		13															
	TRL0036	8/15/1996	4.5	19.4		2,690	1,300																	
	TRL0038	8/16/1996	4.5	43.1		477	1,340		10.4															
	SBL0048	9/27/1996	5.5	66		160	330		12															
	TRL0036	8/16/1996	5.5						3.3															
	TRL0038	8/16/1996	8.5						3.5															
	SBL0047	9/27/1996	10						3.2															
	SBL0050	9/27/1996	15						3.1															
	LF1-1	9/17/2008	15									74												
	LF1-2	9/15/2008	15.5																	1.0 J				
	SBL0025	5/23/1995	20																	2.5				
	SBL0048	9/27/1996	20						2.7															
	SBL0027	5/23/1995	25																	2.6				
Landfill Unit No. 2	**Applicable PCGs[a]**	0-10	- -	- -	0.51	- -	80	- -	- -	- -	178.4	- -	68.6	313.3	0.15	0.15	0.015	- -	0.22	0.13	0.06	- -	- -	- -
		10-20	- -	- -	0.51	- -	80	- -	- -	- -	- -	- -	133.3	714.3	- -	- -	- -	- -	- -	0.13	- -	14	0.24	- -
		>20	- -	- -	0.51	- -	- -	- -	- -	- -	- -	- -	317.2	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0028	5/24/1995	0																		0.062			
	SBL0033	5/26/1995	0.3																	4.2 J				
	SBL-423	5/7/2002	0.5		1.2																			
	SBL-424	5/7/2002	0.5		0.6		129																	
	SBL0029	5/24/1995	2.5		6.1		613												0.3					
	SBL0033	5/26/1995	2.5		6.7		729													2.1 J	0.164			
	SBL0045	9/26/1996	2.5				320													2.95	0.086			
	SBL0046	9/26/1996	2.5												0.7	0.5	0.5				0.116			
	TRL0016	7/28/1996	4		1.9		215														0.252			
	SBL0033	5/26/1995	5														0.04							
	TRL0013	7/25/1996	5		3.4		402														0.185			
	SBL0028	5/24/1995	7.5																	1.8				
	SBL0044	9/25/1996	8.5		1.6		340														0.078			
	SBL0029	5/24/1995	9																		0.15			
	TRL0023	8/1/1996	9.5		2.7		455														0.224			
	TRL0022	8/1/1996	12.3		1.4		938																0.3	
	SBL0033	5/26/1995	12.5																			14.6		
	LF2-4	9/17/2008	12.5		1.5															1.17 J				
	SBL0028	5/24/1995	15																			14.1		
	SBL0029	5/24/1995	15																	2.4		15.5		
	SBL0046	9/26/1996	15																			18.6		
	LF2-4	9/17/2008	20		1.3																			
	LF2-1	9/11/2008	25										920											
	LF2-4	9/17/2008	25		1.4																			
	SBL0028	5/24/1995	30																	1.07				
	LF2-4	9/17/2008	32.5		1.1																			
Landfill Unit No. 3	**Applicable PCGs[a]**	0-10	- -	260	0.51	138	80	1,800	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.22	0.13	0.06	- -	0.24	- -
		10-20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
		>20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0020	3/2/1995	0																	1.25	0.2			
	SBL0021	3/3/1995	0																	0.45				
	SBL0022	3/6/1995	0																	3.77				
	SBL0024	3/7/1995	0																		0.065		0.88	
	TRL0031	8/12/1996	4	475	2.2		185														1.67		5.07	
	TRL0028	8/8/1996	5.5		20	165	216														0.302		1.48	
	SBL0021	3/3/1995	5.8																	0.58				
	SBL0036	9/19/1996	6.5	400	1.7	640	270														0.313			
	TRL0030	8/9/1996	7	262	3.1	433	164														0.204		1.8	
	SBL0022	3/6/1995	7.5		4	509	394														0.282		0.93	
	SBL0035	9/19/1996	8.5	500	12	1,700	1,800														0.67			
	TRL0029	8/9/1996	10		2.4		1,080														0.217		1.07	
	LF3-2	9/18/2008	12.5		1.5																			
	SBL0022	3/6/1995	14																	1.29				
	SBL0022	3/6/1995	20	342																				
	LF3-2	9/18/2008	20		0.89																			
	SBL0036	9/20/1996	25	410																				
	LF3-2	9/18/2008	27.5		1.6																			
	LF3-2	9/18/2008	32.5	380	1.3															0.87 J				
Waste Burial Holes	**Applicable PCGs[a]**	0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.6	- -	0.3	0.06	- -	0.24	1.2
		10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	0.24	1.2
		>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	- -	3.2
	SSSP0009/0007/0	10/20/1999	0.5																	0.344				
	SSSP0010/0011/0	10/25/1999	0.5																	0.446				6.5
	SSSP0014/0015/0	10/25/1999	0.5																					1.91
	SSWB0018	9/3/1996	2																				0.53	
	LLRS0004	3/29/2000	2.5																	3.3				26
	LLRS0002	12/8/1999	3																	17.3				76.2
	LLRS0003	12/8/1999	3																	9.87				13.5
	LLRS0005	3/29/2000	3																	4.44				25.5
	SBL-446	5/8/2002	3																	3.85				26.1
	SBL-448	5/8/2002	3																	6.31				22.1
	PMWS0001	12/8/1999	3.2																					111
	PMWS0002	12/8/1999	3.2																	2.85				128
	LLRS0006	3/29/2000	3.3																	2.37				19.7
	TRL0050	8/27/1996	3.5																				0.59	

Table 6-8. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-4 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Waste Burial Holes (continued)	SBL-449	5/8/2002	3.5																		6.82				62.9
	LLRS0001	12/9/1999	4																		7.42				21.7
	SBL-371	3/29/2001	4																		7.17				27.3 J
	SBL-372	3/29/2001	4																		6.56				41 J
	SBL-373	3/29/2001	4																		3.57				35 J
	SBL-374	3/29/2001	4																		0.494 J				
	SBL-375	3/29/2001	4																		7.86				212 J
	SBL-376	3/29/2001	4																						17.4 J
	SBL-450	5/8/2002	4.5																		15.1				165
	TRL0049	8/27/1996	5																					0.91	
	TRL0050	8/27/1996	5.25																					0.44	
	SBL-447	5/8/2002	6.5																		7.48				289
	SBL-451	5/8/2002	6.5																		12				261
	TRL0049	8/27/1996	7																					0.69	
	TRL0054	9/3/1996	7																92		1,442	4,610		1.06	2.71
	SSWB0102	11/4/1999	7																						1.94 J
	SSWB0103	11/4/1999	7																		0.346				
	WBH-3	9/16/2008	7.5																						56.5
	SSWB0088	10/20/1999	8																		1.57				5.15
	SSWB0089	10/20/1999	8																						6.23
	SSWB0091	10/20/1999	8																						4.34
	SSWB0105	11/4/1999	8.5																						3.8
	SSWB0079	10/14/1999	9																						902
	SSWB0075	10/18/1999	9																						22.5
	SSWB0093	10/21/1999	9																		1.12				28.7
	SSWB0104	11/4/1999	9																						2.43 J
	SSWB0083	10/18/1999	9.5																						1.7
	TRL0051	8/29/1996	10																						3,530
	SSWB0067	10/8/1999	10																		2.17				
	SSWB0071	10/9/1999	10																		0.629 J				
	SSWB0072	10/9/1999	10																		0.866				
	SSWB0080	10/15/1999	10																						9.36
	SSWB0082	10/16/1999	10																						14.9
	SSWB0084	10/18/1999	10																						43.8
	SSWB0087	10/19/1999	10																						2.11
	SSWB0090	10/20/1999	10																		2.06				14.6
	SSWB0085	10/18/1999	10.7																		0.487				
	SSWB0094	10/21/1999	11																		0.751				
	SSWB0095	10/21/1999	11																						162
	SSWB0097	10/25/1999	11																						1.31 J
	SSWB0099	10/26/1999	11																						30.9
	SSWB0078	10/12/1999	11.5																		0.48 J				2.45 J
	TRL0052	8/30/1996	12																		15.7				4.78
	TRL0054	9/3/1996	12																					25.5	
	SSWB0068	10/8/1999	12																		0.837				
	SSWB0073	10/9/1999	12																		2.27				4.03
	SSWB0074	10/9/1999	12																		6.21				4.51
	SSWB0086	10/18/1999	12.7																		0.772				
	SSWB0096	10/25/1999	13																						42.3
	SSWB0098	10/25/1999	13																		7.78				
	SBL0032	5/26/1995	15																						3,930
	WBH-2	9/16/2008	15																						19.7
	SBL-393	3/26/2001	15.5																		0.424 J				
	SBL-395	3/26/2001	15.5																		0.402 J				
	SBL-396	3/26/2001	15.5																		0.668				66.5
	SBL-391	3/27/2001	15.5																						34.8
	SBL-398	3/27/2001	15.5																		1.14				
	SBL-399	3/27/2001	15.5																		0.461 J				
	SBL-392	3/28/2001	15.5																						3.89 J
	SBL-393	3/26/2001	17.5																		0.564 J				
	SBL-395	3/26/2001	17.5																		0.657 J				
	SBL-396	3/26/2001	17.5																		0.44 J				133
	SBL-391	3/27/2001	17.5																						32.8
	SBL-398	3/27/2001	17.5																		0.415 J				
	SBL-392	3/28/2001	17.5																		0.422 J				6.74
	SBL-397	3/28/2001	17.5																		0.474 J				
	SBL-393	3/26/2001	19																		0.323 J				455
	SBL-395	3/26/2001	19																		0.645				
	SBL-396	3/26/2001	19																		0.479 J				11 J
	SBL-391	3/27/2001	19																						37.9
	SBL-398	3/27/2001	19																		0.637 J				
	SBL-394	3/28/2001	19																		0.383 J				
	SBL-397	3/28/2001	19																		0.661				
	WBH-2	9/16/2008	20																						38.1
	SBL0032	5/26/1995	35																		1.9 J				147
Southern Trenches	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.48	- -	- -	- -	- -
			10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
			>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
	TRL0024	8/2/1996	2.7																		15.1				

Note:
[a] PCGs provided on Tables 3-2, 3-3, and 3-5.

Acronyms/Abbreviations:
bgs - below ground surface
DCA - dichloroethane
J - concentration is an estimated value
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethylene
PCG - preliminary cleanup goal
pCi/g - picocuries per gram
VOC - volatile organic compound
µg/m³ - micrograms per cubic meter

Table 6-9. Alternative SW-4 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Evapotranspiration Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring

	COST COMPONENT	TOTAL
CAPITAL COSTS:		
Pre-Remediation	Biological Survey	$86,304
	Elderberry Mitigation	$270,000
	Data Gap Investigation	$157,394
	Decontamination Facilities[a]	$582,436
	Building D&D (including disposal)	$314,966
	Decommission Groundwater Wells[b]	$624,402
	Clearing and Grubbing	$52,025
	Demolish LFU-3 N-S Drainage Channel	$5,026
Excavation and Backfill	ET PTW and Exploratory Trench Excavation[c]	$118,150
	LFU-1 PTW and Exploratory Trench Excavation[c]	$278,207
	LFU-2 PTW and Exploratory Trench Excavation[c]	$300,782
	LFU-3 PTW and Exploratory Trench Excavation[c]	$71,311
	ET VOC "Hot Spot" Excavation	$181,700
	LFU-1 Drainage Area Excavation	$609,893
	LFU-2 VOC "Hot Spot" Excavation	$47,289
	LFU-3 Drainage Area Excavation	$269,681
Materials Management and Disposal	Materials Management[d]	$1,078,201
	Excavated Material Consolidation[e]	$45,243
	Off-Site Transportation and Disposal	$2,386,533
CAMU Construction	LFU-1 Cap	$775,270
	LFU-2/ET/WBH Cap	$1,323,777
	LFU-3 Cap	$298,888
Post-Remediation	Install New Groundwater Wells[b]	$297,551
	Storm Drainage[f]	$687,484
	LFU-1 Drainage Swale	$18,841
	LFU-3 Drainage Channels	$116,775
	Building Reconstruction[g]	$423,616
	TOTAL CAPITAL COST	**$11,421,744**
O&M COSTS:	Institutional Controls	$1,144,900
	Groundwater and Storm Water Monitoring[b]	$4,383,323
	O&M Drainage System[h]	$200,901
	O&M of Caps	$1,164,386
	TOTAL O&M COST	**$6,893,510**
PERIODIC COSTS:	Periodic Storm Water Lift Station Repair	$12,225
	Five-Year Reviews	$173,297
	TOTAL PERIODIC COST	**$185,523**
TOTAL PRESENT VALUE OF ALTERNATIVE[i]		**$18,500,777**
ST and HFSDA Evapotranspiration Cap Contingency		$149,444
TOTAL PRESENT VALUE OF ALTERNATIVE with contingency		**$18,650,222**

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Decontamination Facilities include temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative.

[c] PTW and Exploratory Trench Excavation includes the cost of a geophysical survey to be performed prior to excavation.

Table 6-9. Alternative SW-4 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Notes (continued):

[d] Materials Management includes the cost of stockpiling and management of excavated materials, waste characterization sampling, and sifting/sorting waste streams.

[e] Excavated Material Consolidation includes the cost of consolidating non-PTW excavated material from on-Site excavations within the footprints of on-Site CAMUs and beneath the final caps.

[f] Storm drainage includes costs of storm water detention basins and infrastructure for storm water conveyance from capped areas to the detention basins and final discharge.

[g] Building Reconstruction cost includes the cost of constructing three warehouse type buildings at the Site, intended to replace the Geriatrics buildings (H-292 and H-293) and buildings H-253 and H-290.

[h] O&M Drainage System includes O&M costs for storm water detention basins and associated infrastructure, in addition to storm water drainage channels/swales.

[i] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

Acronyms/Abbreviations:

CAMU - corrective action management unit
D&D - decommissioning and demolition
ET - Eastern Trenches
HFSDA - Hopland Field Station Disposal Area
LFU - landfill unit
N-S - north-south
O&M - operations and maintenance
PTW - principal threat waste
ST - Southern Trenches
VOC - volatile organic compound
WBH - Waste Burial Holes

Table 6-10. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-5 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Eastern Trenches	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	7.7	87.5	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			10-20	- -	- -	- -	- -	- -	- -	- -	11.0	593.8	- -	203.1	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			>20	- -	- -	- -	- -	- -	- -	- -	11.0	- -	- -	322.7	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
	SBL-436	5/7/2002	0.5																		1.2 J				
	SBL-437	5/7/2002	0.5																						15.5
	SBL0031	5/25/1995	2.5																						13
	SBL0031	5/25/1995	5																						333
	SBL0031	5/25/1995	10																		1.8 J				
	SBL0030	5/25/1995	15																		6.7 J				1.3
	SBL0031	5/25/1995	25																						3.37
	ET-1	9/10/2008	25								43			710											
	SBL0030	5/25/1995	30																						1.49
	SBL0030	5/25/1995	40																		8.3 J				
Landfill Unit No. 1	**Applicable PCGs[a]**		0-10	9.6	- -	- -	60	80	- -	1.2	- -	- -	- -	- -	- -	- -	- -	0.015	- -	- -	0.13	- -	- -	- -	- -
			10-20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	14.2	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
			>20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0025	5/22/1995	0															0.02							
	SBL-416	5/6/2002	0.5							1.3															
	SBL-417	5/6/2002	0.5					3,640													4.7				
	SBL0025	5/22/1995	2.5																		1.8				
	SBL0047	9/27/1996	2.5	140			470	1,300		12															
	SBL0050	9/27/1996	4	27			570	2,100		13															
	TRL0036	8/15/1996	4.5	19.4			2,690	1,300																	
	TRL0038	8/16/1996	4.5	43.1			477	1,340		10.4															
	SBL0048	9/27/1996	5.5	66			160	330		12															
	TRL0036	8/16/1996	5.5							3.3															
	TRL0038	8/16/1996	8.5							3.5															
	SBL0047	9/27/1996	10							3.2															
	SBL0050	9/27/1996	15							3.1															
	LF1-1	9/17/2008	15										74												
	LF1-2	9/15/2008	15.5																		1.0 J				
	SBL0025	5/23/1995	20																		2.5				
	SBL0048	9/27/1996	20							2.7															
	SBL0027	5/23/1995	25																		2.6				
Landfill Unit No. 2	**Applicable PCGs[a]**		0-10	- -	- -	0.51	- -	80	- -	- -	- -	178.4	- -	68.6	313.3	0.15	0.15	0.015	- -	0.22	0.13	0.06	- -	- -	- -
			10-20	- -	- -	0.51	- -	80	- -	- -	- -	- -	- -	133.3	714.3	- -	- -	- -	- -	- -	0.13	- -	14	0.24	- -
			>20	- -	- -	0.51	- -	- -	- -	- -	- -	- -	- -	317.2	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0028	5/24/1995	0																			0.062			
	SBL0033	5/26/1995	0.3																		4.2 J				
	SBL-423	5/7/2002	0.5			1.16																			
	SBL-424	5/7/2002	0.5			0.648		129																	
	SBL0029	5/24/1995	2.5			6.1		613												0.31					
	SBL0033	5/26/1995	2.5			6.7		729													2.1 J	0.164			
	SBL0045	9/26/1996	2.5					320													2.95	0.086			
	SBL0046	9/26/1996	2.5													0.68	0.47	0.49				0.116			
	TRL0016	7/28/1996	4			1.9		215														0.252			
	SBL0033	5/26/1995	5															0.036							
	TRL0013	7/25/1996	5			3.4		402														0.185			
	SBL0028	5/24/1995	7.5																		1.8				
	SBL0044	9/25/1996	8.5			1.6		340														0.078			
	SBL0029	5/24/1995	9																			0.15			
	TRL0023	8/1/1996	9.5			2.7		455														0.224			
	TRL0022	8/1/1996	12.3			1.4		938																0.34	
	SBL0033	5/26/1995	12.5																				14.6		
	LF2-4	9/17/2008	12.5			1.5															1.17 J				
	SBL0028	5/24/1995	15																				14.1		
	SBL0029	5/24/1995	15																		2.4		15.5		
	SBL0046	9/26/1996	15																				18.6		
	LF2-4	9/17/2008	20			1.3																			
	LF2-1	9/11/2008	25											920											
	LF2-4	9/17/2008	25			1.4																			
	SBL0028	5/24/1995	30																		1.07				
	LF2-4	9/17/2008	32.5			1.1																			
Landfill Unit No. 3	**Applicable PCGs[a]**		0-10	- -	260	0.51	138	80	1,800	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.22	0.13	0.06	- -	0.24	- -
			10-20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -	- -
			>20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -	- -
	SBL0020	3/2/1995	0																		1.25	0.213			
	SBL0021	3/3/1995	0																		0.45				
	SBL0022	3/6/1995	0																		3.77				
	SBL0024	3/7/1995	0																			0.065		0.88	
	TRL0031	8/12/1996	4		475	2.2		185														1.67		5.07	
	TRL0028	8/8/1996	5.5			20	165	216														0.302		1.48	
	SBL0021	3/3/1995	5.8																		0.58				
	SBL0036	9/19/1996	6.5		400	1.7	640	270														0.313			
	TRL0030	8/9/1996	7		262	3.1	433	164														0.204		1.8	
	SBL0022	3/6/1995	7.5			4	509	394														0.282		0.93	
	SBL0035	9/19/1996	8.5		500	12	1,700	1,800														0.67			
	TRL0029	8/9/1996	10			2.4		1,080														0.217		1.07	
	LF3-2	9/18/2008	12.5			1.5																			
	SBL0022	3/6/1995	14																		1.29				
	SBL0022	3/6/1995	20		342																				
	LF3-2	9/18/2008	20			0.89																			
	SBL0036	9/20/1996	25		410																				
	LF3-2	9/18/2008	27.5			1.6																			
	LF3-2	9/18/2008	32.5		380	1.3															0.87 J				
Waste Burial Holes	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.6	- -	0.3	0.06	- -	0.24	1.2
			10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	0.24	1.2
			>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	- -	3.2
	SSSP0009/0007/0	10/20/1999	0.5																		0.344				
	SSSP0010/0011/0	10/25/1999	0.5																		0.446				6.5
	SSSP0014/0015/0	10/25/1999	0.5																						1.91
	SSWB0018	9/3/1996	2																					0.53	
	LLRS0004	3/29/2000	2.5																		3.3				26
	LLRS0002	12/8/1999	3																		17.3				76.2
	LLRS0003	12/8/1999	3																		9.87				13.5
	LLRS0005	3/29/2000	3																		4.44				25.5
	SBL-446	5/8/2002	3																		3.85				26.1
	SBL-448	5/8/2002	3																		6.31				22.1
	PMWS0001	12/8/1999	3.2																						111
	PMWS0002	12/8/1999	3.2																		2.85				128
	LLRS0006	3/29/2000	3.3																		2.37				19.7
	TRL0050	8/27/1996	3.5																					0.59	
	SBL-449	5/8/2002	3.5																		6.82				62.9

Table 6-10. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-5 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Waste Burial Holes (continued)	LLRS0001	12/9/1999	4																		7.42				21.7
	SBL-371	3/29/2001	4																		7.17				27.3 J
	SBL-372	3/29/2001	4																		6.56				41 J
	SBL-373	3/29/2001	4																		3.57				35 J
	SBL-374	3/29/2001	4																		0.494 J				
	SBL-375	3/29/2001	4																		7.86				212 J
	SBL-376	3/29/2001	4																						17.4 J
	SBL-450	5/8/2002	4.5																		15.1				165
	TRL0049	8/27/1996	5																					0.91	
	TRL0050	8/27/1996	5.25																					0.44	
	SBL-447	5/8/2002	6.5																		7.48				289
	SBL-451	5/8/2002	6.5																		12				261
	TRL0049	8/27/1996	7																					0.69	
	TRL0054	9/3/1996	7																92		1.442	4,610		1.06	2.71
	SSWB0102	11/4/1999	7																						1.94 J
	SSWB0103	11/4/1999	7																		0.346				
	WBH-3	9/16/2008	7.5																						56.5
	SSWB0088	10/20/1999	8																		1.57				5.15
	SSWB0089	10/20/1999	8																						6.23
	SSWB0091	10/20/1999	8																						4.34
	SSWB0105	11/4/1999	8.5																						3.8
	SSWB0079	10/14/1999	9																						902
	SSWB0075	10/18/1999	9																						22.5
	SSWB0093	10/21/1999	9																		1.12				28.7
	SSWB0104	11/4/1999	9																						2.43 J
	SSWB0083	10/18/1999	9.5																						1.7
	TRL0051	8/29/1996	10																						3,530
	SSWB0067	10/8/1999	10																		2.17				
	SSWB0071	10/9/1999	10																		0.629 J				
	SSWB0072	10/9/1999	10																		0.866				
	SSWB0080	10/15/1999	10																						9.36
	SSWB0082	10/16/1999	10																						14.9
	SSWB0084	10/18/1999	10																						43.8
	SSWB0087	10/19/1999	10																						2.11
	SSWB0090	10/20/1999	10																		2.06				14.6
	SSWB0085	10/18/1999	10.7																		0.487				
	SSWB0094	10/21/1999	11																		0.751				
	SSWB0095	10/21/1999	11																						162
	SSWB0097	10/25/1999	11																						1.31 J
	SSWB0099	10/26/1999	11																						30.9
	SSWB0078	10/12/1999	11.5																		0.48 J				2.45 J
	TRL0052	8/30/1996	12																		15.7				4.78
	TRL0054	9/3/1996	12																					25.5	
	SSWB0068	10/8/1999	12																		0.837				
	SSWB0073	10/9/1999	12																		2.27				4.03
	SSWB0074	10/9/1999	12																		6.21				4.51
	SSWB0086	10/18/1999	12.7																		0.772				
	SSWB0096	10/25/1999	13																						42.3
	SSWB0098	10/25/1999	13																		7.78				
	SBL0032	5/26/1995	15																						3,930
	WBH-2	9/16/2008	15																						19.7
	SBL-393	3/26/2001	15.5																		0.424 J				
	SBL-395	3/26/2001	15.5																		0.402 J				
	SBL-396	3/26/2001	15.5																		0.668				66.5
	SBL-391	3/27/2001	15.5																						34.8
	SBL-398	3/27/2001	15.5																		1.14				
	SBL-399	3/27/2001	15.5																		0.461 J				
	SBL-392	3/28/2001	15.5																						3.89 J
	SBL-393	3/26/2001	17.5																		0.564 J				
	SBL-395	3/26/2001	17.5																		0.657 J				
	SBL-396	3/26/2001	17.5																		0.44 J				133
	SBL-391	3/27/2001	17.5																						32.8
	SBL-398	3/27/2001	17.5																		0.415 J				
	SBL-392	3/28/2001	17.5																		0.422 J				6.74
	SBL-397	3/28/2001	17.5																		0.474 J				
	SBL-393	3/26/2001	19																		0.323 J				455
	SBL-395	3/26/2001	19																		0.645				
	SBL-396	3/26/2001	19																		0.479 J				11 J
	SBL-391	3/27/2001	19																						37.9
	SBL-398	3/27/2001	19																		0.637 J				
	SBL-394	3/28/2001	19																		0.383 J				
	SBL-397	3/28/2001	19																		0.661				
	WBH-2	9/16/2008	20																						38.1
	SBL0032	5/26/1995	35																		1.9 J				147
Southern Trenches	**Applicable PCGs[a]**		0-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.48	--	--	--	--
			10-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			>20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TRL0024	8/2/1996	2.7																		15.1				

Note:

[a] PCGs provided on Tables 3-2, 3-3, and 3-5.

Acronyms/Abbreviations:

bgs - below ground surface
DCA - dichloroethane
J - concentration is an estimated value
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethylene
PCG - preliminary cleanup goal
pCi/g - picocuries per gram
VOC - volatile organic compound
µg/m³ - micrograms per cubic meter

Table 6-11. Alternative SW-5 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Asphalt Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring

	COST COMPONENT	TOTAL
CAPITAL COSTS:		
Pre-Remediation	Biological Survey	$86,304
	Elderberry Mitigation	$270,000
	Data Gap Investigation	$157,394
	Decontamination Facilities[a]	$582,436
	Building D&D (including disposal)	$314,966
	Decommission Groundwater Wells[b]	$624,402
	Clearing and Grubbing	$52,025
	Demolish LFU-3 N-S Drainage Channel	$5,026
Excavation and Backfill	ET PTW and Exploratory Trench Excavation[c]	$118,150
	LFU-1 PTW and Exploratory Trench Excavation[c]	$278,207
	LFU-2 PTW and Exploratory Trench Excavation[c]	$300,782
	LFU-3 PTW and Exploratory Trench Excavation[c]	$71,311
	ET VOC "Hot Spot" Excavation	$181,700
	LFU-1 Drainage Area Excavation	$609,893
	LFU-2 VOC "Hot Spot" Excavation	$47,289
	LFU-3 Drainage Area Excavation	$269,681
Materials Management and Disposal	Materials Management[d]	$1,078,201
	Excavated Material Consolidation[e]	$45,243
	Off-Site Transportation and Disposal	$2,386,533
CAMU Construction	LFU-1 Cap	$1,250,719
	LFU-2/ET/WBH Cap	$2,183,121
	LFU-3 Cap	$466,033
Post-Remediation	Install New Groundwater Wells[b]	$297,551
	Storm Drainage[f]	$707,262
	LFU-1 Drainage Swale	$18,841
	LFU-3 Drainage Channels	$116,775
	Building Reconstruction[g]	$423,616
	TOTAL CAPITAL COST	**$12,943,460**
O&M COSTS:	Institutional Controls	$1,144,900
	Groundwater and Storm Water Monitoring[b]	$4,383,323
	O&M Drainage System[h]	$200,901
	O&M of Caps	$2,035,744
	TOTAL O&M COST	**$7,764,868**
PERIODIC COSTS:	Periodic Storm Water Lift Station Repair	$12,225
	Five-Year Reviews	$173,297
	TOTAL PERIODIC COST	**$185,523**
TOTAL PRESENT VALUE OF ALTERNATIVE[i]		**$20,893,851**
ST and HFSDA Asphalt Cap Contingency		$233,016
TOTAL PRESENT VALUE OF ALTERNATIVE with contingency		**$21,126,868**

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Decontamination Facilities include temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative.

[c] PTW and Exploratory Trench Excavation includes the cost of a geophysical survey to be performed prior to excavation.

[d] Materials Management includes the cost of stockpiling and management of excavated materials, waste characterization sampling, and sifting/sorting waste streams.

Table 6-11. Alternative SW-5 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Notes (continued):

[e] Excavated Material Consolidation includes the cost of consolidating non-PTW excavated material from on-Site excavations within the footprints of on-Site CAMUs and beneath the final caps.

[f] Storm drainage includes costs of storm water detention basins and infrastructure for storm water conveyance from capped areas to the detention basins and final discharge.

[g] Building Reconstruction cost includes the cost of constructing three warehouse type buildings at the Site, intended to replace the Geriatrics buildings (H-292 and H-293) and buildings H-253 and H-290.

[h] O&M Drainage System includes O&M costs for storm water detention basins and associated infrastructure, in addition to storm water drainage channels/swales.

[i] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

Acronyms/Abbreviations:

CAMU - corrective action management unit
D&D - decommissioning and demolition
ET - Eastern Trenches
HFSDA - Hopland Field Station Disposal Area
LFU - landfill unit
N-S - north-south
O&M - operations and maintenance
PTW - principal threat waste
ST - Southern Trenches
VOC - volatile organic compound
WBH - Waste Burial Holes

Table 6-12. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-6 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Sample Location	Sample Date	Sample Depth (feet bgs)	Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
				Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Eastern Trenches	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	7.7	87.5	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			10-20	- -	- -	- -	- -	- -	- -	- -	11.0	593.8	- -	203.1	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			>20	- -	- -	- -	- -	- -	- -	- -	11.0	- -	- -	322.7	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
	SBL0031	5/25/1995	10																		1.8 J				
	SBL0030	5/25/1995	15																		6.7 J				1.3
	SBL0031	5/25/1995	25																						3.37
	ET-1	9/10/2008	25								43			710											
	SBL0030	5/25/1995	30																						1.49
	SBL0030	5/25/1995	40																		8.3 J				
Landfill Unit No. 1	**Applicable PCGs[a]**		0-10	9.6	- -	- -	60	80	- -	1.2	- -	- -	- -	- -	- -	- -	- -	0.015	- -	- -	0.13	- -	- -	- -	- -
			10-20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	14.2	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
			>20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0025	5/22/1995	0															0.02							
	SBL-416	5/6/2002	0.5							1.3															
	SBL-417	5/6/2002	0.5					3,640													4.7				
	SBL0025	5/22/1995	2.5																		1.8				
	SBL0047	9/27/1996	2.5	140			470	1,300		12															
	SBL0050	9/27/1996	4	27			570	2,100		13															
	TRL0036	8/15/1996	4.5	19.4			2,690	1,300																	
	TRL0038	8/16/1996	4.5	43.1			477	1,340		10.4															
	SBL0048	9/27/1996	5.5	66			160	330		12															
	TRL0036	8/16/1996	5.5							3.3															
	TRL0038	8/16/1996	8.5							3.5															
	SBL0047	9/27/1996	10							3.2															
	SBL0050	9/27/1996	15							3.1															
	LF1-1	9/17/2008	15										74												
	LF1-2	9/15/2008	15.5																		1.0 J				
	SBL0025	5/23/1995	20																		2.5				
	SBL0048	9/27/1996	20							2.7															
	SBL0027	5/23/1995	25																		2.6				
Landfill Unit No. 2	**Applicable PCGs[a]**		0-10	- -	- -	0.51	- -	80	- -	- -	- -	178.4	- -	68.6	313.3	0.15	0.15	0.015	- -	0.22	0.13	0.06	- -	- -	- -
			10-20	- -	- -	0.51	- -	80	- -	- -	- -	- -	- -	133.3	714.3	- -	- -	- -	- -	- -	0.13	- -	14	0.24	- -
			>20	- -	- -	0.51	- -	- -	- -	- -	- -	- -	- -	317.2	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0028	5/24/1995	0																			0.062			
	SBL0033	5/26/1995	0.3																		4.2 J				
	SBL-423	5/7/2002	0.5			1.2																			
	SBL-424	5/7/2002	0.5			0.6		129																	
	SBL0029	5/24/1995	2.5			6.1		613												0.3					
	SBL0033	5/26/1995	2.5			6.7		729													2.1 J	0.164			
	SBL0045	9/26/1996	2.5					320													3.0	0.086			
	SBL0046	9/26/1996	2.5													0.7	0.5	0.5				0.116			
	TRL0016	7/28/1996	4			1.9		215														0.252			
	SBL0033	5/26/1995	5															0.04							
	TRL0013	7/25/1996	5			3.4		402														0.185			
	SBL0028	5/24/1995	7.5																		1.8				
	SBL0044	9/25/1996	8.5			1.6		340														0.078			
	SBL0029	5/24/1995	9																			0.15			
	TRL0023	8/1/1996	9.5			2.7		455														0.224			
	TRL0022	8/1/1996	12.3			1.4		938																0.3	
	SBL0033	5/26/1995	12.5																				14.6		
	LF2-4	9/17/2008	12.5			1.5															1.2 J				
	SBL0028	5/24/1995	15																				14.1		
	SBL0029	5/24/1995	15																		2.4		15.5		
	SBL0046	9/26/1996	15																				18.6		
	LF2-4	9/17/2008	20			1.3																			
	LF2-1	9/11/2008	25											920											
	LF2-4	9/17/2008	25			1.4																			
	SBL0028	5/24/1995	30																		1.07				
	LF2-4	9/17/2008	32.5			1.1																			
Landfill Unit No. 3	**Applicable PCGs[a]**		0-10	- -	260	0.51	138	80	1,800	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.22	0.13	0.06	- -	0.24	- -
			10-20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
			>20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0020	3/2/1995	0																		1.25	0.213			
	SBL0021	3/3/1995	0																		0.45				
	SBL0022	3/6/1995	0																		3.77				
	SBL0024	3/7/1995	0																			0.065		0.88	
	TRL0031	8/12/1996	4		475	2.2		185														1.67		5.07	
	TRL0028	8/8/1996	5.5			20	165	216														0.302		1.48	
	SBL0021	3/3/1995	5.8																		0.58				
	SBL0036	9/19/1996	6.5		400	1.7	640	270														0.313			
	TRL0030	8/9/1996	7		262	3.1	433	164														0.204		1.8	
	SBL0022	3/6/1995	7.5			4	509	394														0.282		0.93	
	SBL0035	9/19/1996	8.5		500	12	1,700	1,800														0.67			
	TRL0029	8/9/1996	10			2.4		1,080														0.217		1.07	
	LF3-2	9/18/2008	12.5			1.5																			
	SBL0022	3/6/1995	14																		1.29				
	SBL0022	3/6/1995	20		342																				
	LF3-2	9/18/2008	20			0.89																			
	SBL0036	9/20/1996	25		410																				
	LF3-2	9/18/2008	27.5			1.6																			
	LF3-2	9/18/2008	32.5		380	1.3															0.87 J				
Waste Burial Holes	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.6	- -	0.3	0.06	- -	0.24	1.2
			10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	0.24	1.2
			>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	- -	3.2
	SSSP0009/0007/0	10/20/1999	0.5																		0.344				
	SSSP0010/0011/0	10/25/1999	0.5																		0.446				6.5
	SSSP0014/0015/0	10/25/1999	0.5																						1.91
	SSWB0018	9/3/1996	2																					0.53	
	LLRS0004	3/29/2000	2.5																		3.3				26
	LLRS0002	12/8/1999	3																		17.3				76.2
	LLRS0003	12/8/1999	3																		9.87				13.5
	LLRS0005	3/29/2000	3																		4.44				25.5
	SBL-446	5/8/2002	3																		3.85				26.1
	SBL-448	5/8/2002	3																		6.31				22.1
	PMWS0001	12/8/1999	3.2																						111
	PMWS0002	12/8/1999	3.2																		2.85				128
	LLRS0006	3/29/2000	3.3																		2.37				19.7
	TRL0050	8/27/1996	3.5																					0.59	
	SBL-449	5/8/2002	3.5																		6.82				62.9
	LLRS0001	12/9/1999	4																		7.42				21.7
	SBL-371	3/29/2001	4																		7.17				27.3 J
	SBL-372	3/29/2001	4																		6.56				41 J
	SBL-373	3/29/2001	4																		3.57				35 J

Table 6-12. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-6 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Waste Burial Holes (continued)	SBL-374	3/29/2001	4																		0.494 J				
	SBL-375	3/29/2001	4																		7.86				212 J
	SBL-376	3/29/2001	4																						17.4 J
	SBL-450	5/8/2002	4.5																		15.1				165
	TRL0049	8/27/1996	5																					0.91	
	TRL0050	8/27/1996	5.25																					0.44	
	SBL-447	5/8/2002	6.5																		7.48				289
	SBL-451	5/8/2002	6.5																		12				261
	TRL0049	8/27/1996	7																					0.69	
	TRL0054	9/3/1996	7																92		1,442	4,610		1.06	2.71
	SSWB0102	11/4/1999	7																						1.94 J
	SSWB0103	11/4/1999	7																		0.346				
	WBH-3	9/16/2008	7.5																						56.5
	SSWB0088	10/20/1999	8																		1.57				5.15
	SSWB0089	10/20/1999	8																						6.23
	SSWB0091	10/20/1999	8																						4.34
	SSWB0105	11/4/1999	8.5																						3.8
	SSWB0079	10/14/1999	9																						902
	SSWB0075	10/18/1999	9																						22.5
	SSWB0093	10/21/1999	9																		1.12				28.7
	SSWB0104	11/4/1999	9																						2.43 J
	SSWB0083	10/18/1999	9.5																						1.7
	TRL0051	8/29/1996	10																						3,530
	SSWB0067	10/8/1999	10																		2.17				
	SSWB0071	10/9/1999	10																		0.629 J				
	SSWB0072	10/9/1999	10																		0.866				
	SSWB0080	10/15/1999	10																						9.36
	SSWB0082	10/16/1999	10																						14.9
	SSWB0084	10/18/1999	10																						43.8
	SSWB0087	10/19/1999	10																						2.11
	SSWB0090	10/20/1999	10																		2.06				14.6
	SSWB0085	10/18/1999	10.7																		0.487				
	SSWB0094	10/21/1999	11																		0.751				
	SSWB0095	10/21/1999	11																						162
	SSWB0097	10/25/1999	11																						1.31 J
	SSWB0099	10/26/1999	11																						30.9
	SSWB0078	10/12/1999	11.5																		0.48 J				2.45 J
	TRL0052	8/30/1996	12																		15.7				4.78
	TRL0054	9/3/1996	12																					25.5	
	SSWB0068	10/8/1999	12																		0.837				
	SSWB0073	10/9/1999	12																		2.27				4.03
	SSWB0074	10/9/1999	12																		6.21				4.51
	SSWB0086	10/18/1999	12.7																		0.772				
	SSWB0096	10/25/1999	13																						42.3
	SSWB0098	10/25/1999	13																		7.78				
	SBL0032	5/26/1995	15																						3,930
	WBH-2	9/16/2008	15																						19.7
	SBL-393	3/26/2001	15.5																		0.424 J				
	SBL-395	3/26/2001	15.5																		0.402 J				
	SBL-396	3/26/2001	15.5																		0.668				66.5
	SBL-391	3/27/2001	15.5																						34.8
	SBL-398	3/27/2001	15.5																		1.14				
	SBL-399	3/27/2001	15.5																		0.461 J				
	SBL-392	3/28/2001	15.5																						3.89 J
	SBL-393	3/26/2001	17.5																		0.564 J				
	SBL-395	3/26/2001	17.5																		0.657 J				
	SBL-396	3/26/2001	17.5																		0.44 J				133
	SBL-391	3/27/2001	17.5																						32.8
	SBL-398	3/27/2001	17.5																		0.415 J				
	SBL-392	3/28/2001	17.5																		0.422 J				6.74
	SBL-397	3/28/2001	17.5																		0.474 J				
	SBL-393	3/26/2001	19																		0.323 J				455
	SBL-395	3/26/2001	19																		0.645				
	SBL-396	3/26/2001	19																		0.479 J				11 J
	SBL-391	3/27/2001	19																						37.9
	SBL-398	3/27/2001	19																		0.637 J				
	SBL-394	3/28/2001	19																		0.383 J				
	SBL-397	3/28/2001	19																		0.661				
	WBH-2	9/16/2008	20																						38.1
	SBL0032	5/26/1995	35																		1.9 J				147
Southern Trenches	**Applicable PCGs[a]**		0-10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	0.48	--	--	--	--
			10-20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
			>20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
	TRL0024	8/2/1996	2.7																		15.1				

Note:

[a] PCGs provided on Tables 3-2, 3-3, and 3-5.

Acronyms/Abbreviations:

bgs - below ground surface
DCA - dichloroethane
J - concentration is an estimated value
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethylene
PCG - preliminary cleanup goal
pCi/g - picocuries per gram
VOC - volatile organic compound
µg/m³ - micrograms per cubic meter

Table 6-13. Alternative SW-6 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring

	COST COMPONENT	TOTAL
CAPITAL COSTS:		
Pre-Remediation	Biological Survey	$86,304
	Elderberry Mitigation	$270,000
	Data Gap Investigation	$157,394
	Decontamination Facilities[a]	$582,436
	Building D&D (including disposal)	$314,966
	Decommission Groundwater Wells[b]	$624,402
	Clearing and Grubbing	$52,025
	Demolish LFU-3 N-S Drainage Channel	$5,026
Excavation and Backfill	LFU-1 PTW and Exploratory Trench Excavation[c]	$278,207
	LFU-2 PTW and Exploratory Trench Excavation[c]	$300,782
	LFU-3 PTW and Exploratory Trench Excavation[c]	$71,311
	ET Excavation[d]	$273,170
	ET VOC "Hot Spot" Excavation	$181,700
	LFU-1 Drainage Area Excavation	$609,893
	LFU-2 VOC "Hot Spot" Excavation	$47,289
	LFU-3 Drainage Area Excavation	$269,681
Materials Management and Disposal	Materials Management[e]	$1,548,268
	Excavated Material Consolidation[f]	$50,438
	Off-Site Transportation and Disposal	$2,425,318
CAMU Construction	LFU-1 Cap	$1,113,709
	LFU-2/ET/WBH Cap	$1,861,724
	LFU-3 Cap	$408,092
Post-Remediation	Install New Groundwater Wells[b]	$297,551
	Storm Drainage[g]	$687,484
	LFU-1 Drainage Swale	$18,841
	LFU-3 Drainage Channels	$116,775
	Building Reconstruction[h]	$423,616
	TOTAL CAPITAL COST	**$13,076,401**
O&M COSTS:	Institutional Controls	$1,144,900
	Groundwater and Storm Water Monitoring[b]	$4,383,323
	O&M Drainage System[i]	$200,901
	O&M of Caps	$1,300,501
	TOTAL O&M COST	**$7,029,624**
PERIODIC COSTS:	Periodic Storm Water Lift Station Repair	$12,225
	Five-Year Reviews	$173,297
	TOTAL PERIODIC COST	**$185,523**
TOTAL PRESENT VALUE OF ALTERNATIVE[j]		**$20,291,548**
ST and HFSDA Multiple-Layer Cap Contingency		$204,046
TOTAL PRESENT VALUE OF ALTERNATIVE with contingency		**$20,495,595**

Table 6-13. Alternative SW-6 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Decontamination Facilities include temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative.

[c] PTW and Exploratory Trench Excavation includes the cost of a geophysical survey to be performed prior to excavation.

[d] The ET PTW and Exploratory Trenches will be excavated as part of the ET excavation.

[e] Materials Management includes the cost of stockpiling and management of excavated materials, waste characterization sampling, and sifting/sorting waste streams.

[f] Excavated Material Consolidation includes the cost of consolidating non-PTW excavated material from on-Site excavations within the footprints of on-Site CAMUs and beneath the final caps.

[g] Storm drainage includes costs of storm water detention basins and infrastructure for storm water conveyance from capped areas to the detention basins and final discharge.

[h] Building Reconstruction cost includes the cost of constructing three warehouse type buildings at the Site, intended to replace the Geriatrics buildings (H-292 and H-293) and buildings H-253 and H-290.

[i] O&M Drainage System includes O&M costs for storm water detention basins and associated infrastructure, in addition to storm water drainage channels/swales.

[j] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

Acronyms/Abbreviations:

CAMU - corrective action management unit
D&D - decommissioning and demolition
ET - Eastern Trenches
HFSDA - Hopland Field Station Disposal Area
LFU - landfill unit
N-S - north-south
O&M - operations and maintenance
PTW - principal threat waste
ST - Southern Trenches
VOC - volatile organic compound
WBH - Waste Burial Holes

Table 6-14. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-7 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

			Sample Depth	Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
Sample Location		Sample Date	(feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Eastern Trenches	Applicable PCGs[a]		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	7.7	87.5	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			10-20	- -	- -	- -	- -	- -	- -	- -	11.0	593.8	- -	203.1	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			>20	- -	- -	- -	- -	- -	- -	- -	11.0	- -	- -	322.7	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
	SBL0031	5/25/1995	10																		1.8 J				
	SBL0030	5/25/1995	15																		6.7 J				1.3
	SBL0031	5/25/1995	25																						3.37
	ET-1	9/10/2008	25								43			710											
	SBL0030	5/25/1995	30																						1.49
	SBL0030	5/25/1995	40																		8.3 J				
Landfill Unit No. 1	Applicable PCGs[a]		0-10	9.6	- -	- -	60	80	- -	1.2	- -	- -	- -	- -	- -	- -	- -	0.015	- -	- -	0.13	- -	- -	- -	- -
			10-20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	14.2	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
			>20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0025	5/22/1995	0															0.02							
	SBL-416	5/6/2002	0.5							1.3															
	SBL-417	5/6/2002	0.5					3,640													4.7				
	SBL0025	5/22/1995	2.5																		1.8				
	SBL0047	9/27/1996	2.5	140			470	1,300		12															
	SBL0050	9/27/1996	4	27			570	2,100		13															
	TRL0036	8/15/1996	4.5	19.4			2,690	1,300																	
	TRL0038	8/16/1996	4.5	43.1			477	1,340		10.4															
	SBL0048	9/27/1996	5.5	66			160	330		12															
	TRL0036	8/16/1996	5.5							3.3															
	TRL0038	8/16/1996	8.5							3.5															
	SBL0047	9/27/1996	10							3.2															
	SBL0050	9/27/1996	15							3.1															
	LF1-1	9/17/2008	15										74												
	LF1-2	9/15/2008	15.5																		1.0 J				
	SBL0025	5/23/1995	20																		2.5				
	SBL0048	9/27/1996	20							2.7															
	SBL0027	5/23/1995	25																		2.6				
Landfill Unit No. 2	Applicable PCGs[a]		0-10	- -	- -	0.51	- -	80	- -	- -	- -	178.4	- -	68.6	313.3	0.15	0.15	0.015	- -	0.22	0.13	0.06	- -	- -	- -
			10-20	- -	- -	0.51	- -	80	- -	- -	- -	- -	- -	133.3	714.3	- -	- -	- -	- -	- -	0.13	- -	14	0.24	- -
			>20	- -	- -	0.51	- -	- -	- -	- -	- -	- -	- -	317.2	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0028	5/24/1995	0																			0.062			
	SBL0033	5/26/1995	0.3																		4.2 J				
	SBL-423	5/7/2002	0.5			1.2																			
	SBL-424	5/7/2002	0.5			0.6		129																	
	SBL0029	5/24/1995	2.5			6.1		613												0.3					
	SBL0033	5/26/1995	2.5			6.7		729													2.1 J	0.164			
	SBL0045	9/26/1996	2.5					320													3.0	0.086			
	SBL0046	9/26/1996	2.5													0.7	0.5	0.5				0.116			
	TRL0016	7/28/1996	4			1.9		215														0.252			
	SBL0033	5/26/1995	5															0.04							
	TRL0013	7/25/1996	5			3.4		402														0.185			
	SBL0028	5/24/1995	7.5																		1.8				
	SBL0044	9/25/1996	8.5			1.6		340														0.078			
	SBL0029	5/24/1995	9																			0.15			
	TRL0023	8/1/1996	9.5			2.7		455														0.224			
	TRL0022	8/1/1996	12.3			1.4		938																0.3	
	SBL0033	5/26/1995	12.5																				14.6		
	LF2-4	9/17/2008	12.5			1.5															1.2 J				
	SBL0028	5/24/1995	15																				14.1		
	SBL0029	5/24/1995	15																		2.4		15.5		
	SBL0046	9/26/1996	15																				18.6		
	LF2-4	9/17/2008	20			1.3																			
	LF2-1	9/11/2008	25											920											
	LF2-4	9/17/2008	25			1.4																			
	SBL0028	5/24/1995	30																		1.07				
	LF2-4	9/17/2008	32.5			1.1																			
Landfill Unit No. 3	Applicable PCGs[a]		0-10	- -	260	0.51	138	80	1,800	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.22	0.13	0.06	- -	0.24	- -
			10-20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
			>20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	LF3-2	9/18/2008	12.5			1.5																			
	SBL0022	3/6/1995	14																		1.29				
	SBL0022	3/6/1995	20		342																				
	LF3-2	9/18/2008	20			0.89																			
	SBL0036	9/20/1996	25		410																				
	LF3-2	9/18/2008	27.5			1.6																			
	LF3-2	9/18/2008	32.5		380	1.3															0.87 J				
Waste Burial Holes	Applicable PCGs[a]		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.6	- -	0.3	0.06	- -	0.24	1.2
			10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	0.24	1.2
			>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	- -	3.2
	SSSP0009/0007/0	10/20/1999	0.5																		0.344				
	SSSP0010/0011/0	10/25/1999	0.5																		0.446				6.5
	SSSP0014/0015/0	10/25/1999	0.5																						1.91
	SSWB0018	9/3/1996	2																					0.53	
	LLRS0004	3/29/2000	2.5																		3.3				26
	LLRS0002	12/8/1999	3																		17.3				76.2
	LLRS0003	12/8/1999	3																		9.87				13.5
	LLRS0005	3/29/2000	3																		4.44				25.5
	SBL-446	5/8/2002	3																		3.85				26.1
	SBL-448	5/8/2002	3																		6.31				22.1
	PMWS0001	12/8/1999	3.2																						111
	PMWS0002	12/8/1999	3.2																		2.85				128
	LLRS0006	3/29/2000	3.3																		2.37				19.7
	TRL0050	8/27/1996	3.5																					0.59	
	SBL-449	5/8/2002	3.5																		6.82				62.9
	LLRS0001	12/9/1999	4																		7.42				21.7
	SBL-371	3/29/2001	4																		7.17				27.3 J
	SBL-372	3/29/2001	4																		6.56				41 J
	SBL-373	3/29/2001	4																		3.57				35 J
	SBL-374	3/29/2001	4																		0.494 J				
	SBL-375	3/29/2001	4																		7.86				212 J
	SBL-376	3/29/2001	4																						17.4 J

Table 6-14. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-7 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

			Metals (mg/kg)							VOCs (µg/m^3)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Waste Burial Holes (continued)																								
SBL-450	5/8/2002	4.5																		15.1				165
TRL0049	8/27/1996	5																					0.91	
TRL0050	8/27/1996	5.25																					0.44	
SBL-447	5/8/2002	6.5																		7.48				289
SBL-451	5/8/2002	6.5																		12				261
TRL0049	8/27/1996	7																					0.69	
TRL0054	9/3/1996	7																92		1,442	4,610		1.06	2.71
SSWB0102	11/4/1999	7																						1.94 J
SSWB0103	11/4/1999	7																		0.346				
WBH-3	9/16/2008	7.5																						56.5
SSWB0088	10/20/1999	8																		1.57				5.15
SSWB0089	10/20/1999	8																						6.23
SSWB0091	10/20/1999	8																						4.34
SSWB0105	11/4/1999	8.5																						3.8
SSWB0079	10/14/1999	9																						902
SSWB0075	10/18/1999	9																						22.5
SSWB0093	10/21/1999	9																		1.12				28.7
SSWB0104	11/4/1999	9																						2.43 J
SSWB0083	10/18/1999	9.5																						1.7
TRL0051	8/29/1996	10																						3,530
SSWB0067	10/8/1999	10																		2.17				
SSWB0071	10/9/1999	10																		0.629 J				
SSWB0072	10/9/1999	10																		0.866				
SSWB0080	10/15/1999	10																						9.36
SSWB0082	10/16/1999	10																						14.9
SSWB0084	10/18/1999	10																						43.8
SSWB0087	10/19/1999	10																						2.11
SSWB0090	10/20/1999	10																		2.06				14.6
SSWB0085	10/18/1999	10.7																		0.487				
SSWB0094	10/21/1999	11																		0.751				
SSWB0095	10/21/1999	11																						162
SSWB0097	10/25/1999	11																						1.31 J
SSWB0099	10/26/1999	11																						30.9
SSWB0078	10/12/1999	11.5																		0.48 J				2.45 J
TRL0052	8/30/1996	12																		15.7				4.78
TRL0054	9/3/1996	12																					25.5	
SSWB0068	10/8/1999	12																		0.837				
SSWB0073	10/9/1999	12																		2.27				4.03
SSWB0074	10/9/1999	12																		6.21				4.51
SSWB0086	10/18/1999	12.7																		0.772				
SSWB0096	10/25/1999	13																						42.3
SSWB0098	10/25/1999	13																		7.78				
SBL0032	5/26/1995	15																						3,930
WBH-2	9/16/2008	15																						19.7
SBL-393	3/26/2001	15.5																		0.424 J				
SBL-395	3/26/2001	15.5																		0.402 J				
SBL-396	3/26/2001	15.5																		0.668				66.5
SBL-391	3/27/2001	15.5																						34.8
SBL-398	3/27/2001	15.5																		1.14				
SBL-399	3/27/2001	15.5																		0.461 J				
SBL-392	3/28/2001	15.5																						3.89 J
SBL-393	3/26/2001	17.5																		0.564 J				
SBL-395	3/26/2001	17.5																		0.657 J				
SBL-396	3/26/2001	17.5																		0.44 J				133
SBL-391	3/27/2001	17.5																						32.8
SBL-398	3/27/2001	17.5																		0.415 J				
SBL-392	3/28/2001	17.5																		0.422 J				6.74
SBL-397	3/28/2001	17.5																		0.474 J				
SBL-393	3/26/2001	19																		0.323 J				455
SBL-395	3/26/2001	19																		0.645				
SBL-396	3/26/2001	19																		0.479 J				11 J
SBL-391	3/27/2001	19																						37.9
SBL-398	3/27/2001	19																		0.637 J				
SBL-394	3/28/2001	19																		0.383 J				
SBL-397	3/28/2001	19																		0.661				
WBH-2	9/16/2008	20																						38.1
SBL0032	5/26/1995	35																		1.9 J				147

Note:

[a] PCGs provided on Tables 3-2, 3-3, and 3-5.

Acronyms/Abbreviations:

bgs - below ground surface
DCA - dichloroethane
J - concentration is an estimated value
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethylene
PCG - preliminary cleanup goal
pCi/g - picocuries per gram
VOC - volatile organic compound
µg/m^3 - micrograms per cubic meter

Table 6-15. Alternative SW-7 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

VOC "Hot Spot" Removal, Two On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring

	COST COMPONENT	TOTAL
CAPITAL COSTS:		
Pre-Remediation	Biological Survey	$86,304
	Elderberry Mitigation	$270,000
	Decontamination Facilities[a]	$582,436
	Building D&D (including disposal)	$314,966
	Decommission Groundwater Wells[b]	$624,402
	Clearing and Grubbing	$54,151
	Demolish LFU-3 N-S Drainage Channel	$10,264
Excavation and Backfill	LFU-1 PTW and Exploratory Trench Excavation[c]	$278,207
	LFU-2 PTW and Exploratory Trench Excavation[c]	$300,782
	ET Excavation[d]	$273,170
	ET VOC "Hot Spot" Excavation	$181,700
	LFU-1 Drainage Area Excavation	$609,893
	LFU-2 VOC "Hot Spot" Excavation	$47,289
	LFU-3 Excavation[e]	$893,073
	ST and HFSDA Excavation	$206,155
Materials Management and Disposal	Materials Management[f]	$2,143,896
	Excavated Material Consolidation[g]	$87,682
	Off-Site Transportation and Disposal	$2,590,911
CAMU Construction	LFU-1 Cap	$1,113,709
	LFU-2/ET/WBH Cap	$1,861,724
Post-Remediation	Install New Groundwater Wells[b]	$297,551
	Storm Drainage[h]	$474,347
	LFU-1 Drainage Swale	$18,841
	LFU-3 Drainage Channels	$91,540
	Building Reconstruction[i]	$423,616
	TOTAL CAPITAL COST	**$13,836,609**
O&M COSTS:	Institutional Controls	$1,144,900
	Groundwater and Storm Water Monitoring[b]	$4,383,323
	O&M Drainage System[j]	$133,934
	O&M of Caps	$1,180,095
	TOTAL O&M COST	**$6,842,252**
PERIODIC COSTS:	Periodic Storm Water Lift Station Repair	$8,150
	Five-Year Reviews	$173,297
	TOTAL PERIODIC COST	**$181,448**
TOTAL PRESENT VALUE OF ALTERNATIVE[k]		**$20,860,309**

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Decontamination Facilities include temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative.

[c] PTW and Exploratory Trench Excavation includes the cost of a geophysical survey to be performed prior to excavation.

Table 6-15. Alternative SW-7 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Notes (continued):

[d] The ET PTW and Exploratory Trenches will be excavated as part of the ET excavation.

[e] The LFU-3 Drainage Area is included in the LFU-3 Excavation cost component.

[f] Materials Management includes the cost of stockpiling and management of excavated materials, waste characterization sampling, and sifting/sorting waste streams.

[g] Excavated Material Consolidation includes the cost of consolidating non-PTW excavated material from on-Site excavations within the footprints of on-Site CAMUs and beneath the final caps.

[h] Storm drainage includes costs of storm water detention basins and infrastructure for storm water conveyance from capped areas to the detention basins and final discharge.

[i] Building Reconstruction cost includes the cost of constructing three warehouse type buildings at the Site, intended to replace the Geriatrics buildings (H-292 and H-293) and buildings H-253 and H-290.

[j] O&M Drainage System includes O&M costs for storm water detention basins and associated infrastructure, in addition to storm water drainage channels/swales.

[k] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

Acronyms/Abbreviations:

CAMU - corrective action management unit

D&D - decommissioning and demolition

ET - Eastern Trenches

HFSDA - Hopland Field Station Disposal Area

LFU - landfill unit

N-S - north-south

O&M - operations and maintenance

PTW - principal threat waste

ST - Southern Trenches

VOC - volatile organic compound

WBH - Waste Burial Holes

Table 6-16. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternatives SW-8 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
Sample Location	**Sample Date**	**Sample Depth (feet bgs)**	**Arsenic**	**Barium**	**Cadmium**	**Copper**	**Lead**	**Manganese**	**Selenium**	**1,2-DCA**	**1,2-Dichloropropane**	**1,3-Butadiene**	**Chloroform**	**PCE**	**Benzo(a) anthracene**	**Benzo(b) fluoranthene**	**Benzo(a) pyrene**	**Naphthalene**	**Aroclor 1260**	**Carbon-14**	**Cesium-137**	**Potassium-40**	**Strontium-90**	**Tritium**
Eastern Trenches	**Applicable PCGs[a]**	0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	7.7	87.5	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
		10-20	- -	- -	- -	- -	- -	- -	- -	11.0	593.8	- -	203.1	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
		>20	- -	- -	- -	- -	- -	- -	- -	11.0	- -	- -	322.7	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
	SBL0031	5/25/1995	25																					3.37
	ET-1	9/10/2008	25							43			710											
	SBL0030	5/25/1995	30																					1.49
	SBL0030	5/25/1995	40																	8.3 J				
Landfill Unit No. 1	**Applicable PCGs[a]**	0-10	9.6	- -	- -	60	80	- -	1.2	- -	- -	- -	- -	- -	- -	- -	0.015	- -	- -	0.13	- -	- -	- -	- -
		10-20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	14.2	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
		>20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0027	5/23/1995	25																	2.6				
Landfill Unit No. 2	**Applicable PCGs[a]**	0-10	- -	- -	0.51	- -	80	- -	- -	- -	178.4	- -	68.6	313.3	0.15	0.15	0.015	- -	0.22	0.13	0.06	- -	- -	- -
		10-20	- -	- -	0.51	- -	80	- -	- -	- -	- -	- -	133.3	714.3	- -	- -	- -	- -	- -	0.13	- -	14	0.24	- -
		>20	- -	- -	0.51	- -	- -	- -	- -	- -	- -	- -	317.2	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	LF2-1	9/11/2008	25										920											
	LF2-4	9/17/2008	25		1.4																			
	SBL0028	5/24/1995	30																	1.07				
	LF2-4	9/17/2008	32.5		1.1																			
Landfill Unit No. 3	**Applicable PCGs[a]**	0-10	- -	260	0.51	138	80	1,800	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.22	0.13	0.06	- -	0.24	- -
		10-20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
		>20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	LF3-2	9/18/2008	12.5		1.5																			
	SBL0022	3/6/1995	14																	1.29				
	SBL0022	3/6/1995	20	342																				
	LF3-2	9/18/2008	20		0.89																			
	SBL0036	9/20/1996	25	410																				
	LF3-2	9/18/2008	27.5		1.6																			
	LF3-2	9/18/2008	32.5	380	1.3															0.87 J				
Waste Burial Holes	**Applicable PCGs[a]**	0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.6	- -	0.3	0.06	- -	0.24	1.2
		10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	0.24	1.2
		>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	- -	3.2
	SSSP0009/0007/0	10/20/1999	0.5																	0.344				
	SSSP0010/0011/0	10/25/1999	0.5																	0.446				6.5
	SSSP0014/0015/0	10/25/1999	0.5																					1.91
	SSWB0018	9/3/1996	2																				0.53	
	LLRS0004	3/29/2000	2.5																	3.3				26
	LLRS0002	12/8/1999	3																	17.3				76.2
	LLRS0003	12/8/1999	3																	9.87				13.5
	LLRS0005	3/29/2000	3																	4.44				25.5
	SBL-446	5/8/2002	3																	3.85				26.1
	SBL-448	5/8/2002	3																	6.31				22.1
	PMWS0001	12/8/1999	3.2																					111
	PMWS0002	12/8/1999	3.2																	2.85				128
	LLRS0006	3/29/2000	3.3																	2.37				19.7
	TRL0050	8/27/1996	3.5																				0.59	
	SBL-449	5/8/2002	3.5																	6.82				62.9
	LLRS0001	12/9/1999	4																	7.42				21.7
	SBL-371	3/29/2001	4																	7.17				27.3 J
	SBL-372	3/29/2001	4																	6.56				41 J
	SBL-373	3/29/2001	4																	3.57				35 J
	SBL-374	3/29/2001	4																	0.494 J				
	SBL-375	3/29/2001	4																	7.86				212 J
	SBL-376	3/29/2001	4																					17.4 J
	SBL-450	5/8/2002	4.5																	15.1				165
	TRL0049	8/27/1996	5																				0.91	
	TRL0050	8/27/1996	5.25																				0.44	
	SBL-447	5/8/2002	6.5																	7.48				289
	SBL-451	5/8/2002	6.5																	12				261
	TRL0049	8/27/1996	7																				0.69	
	TRL0054	9/3/1996	7															92		1,442	4,610		1.06	2.71
	SSWB0102	11/4/1999	7																					1.94 J
	SSWB0103	11/4/1999	7																	0.346				
	WBH-3	9/16/2008	7.5																					56.5
	SSWB0088	10/20/1999	8																	1.57				5.15
	SSWB0089	10/20/1999	8																					6.23
	SSWB0091	10/20/1999	8																					4.34
	SSWB0105	11/4/1999	8.5																					3.8
	SSWB0079	10/14/1999	9																					902
	SSWB0075	10/18/1999	9																					22.5
	SSWB0093	10/21/1999	9																	1.12				28.7
	SSWB0104	11/4/1999	9																					2.43 J
	SSWB0083	10/18/1999	9.5																					1.7
	TRL0051	8/29/1996	10																					3,530
	SSWB0067	10/8/1999	10																	2.17				
	SSWB0071	10/9/1999	10																	0.629 J				
	SSWB0072	10/9/1999	10																	0.866				
	SSWB0080	10/15/1999	10																					9.36
	SSWB0082	10/16/1999	10																					14.9
	SSWB0084	10/18/1999	10																					43.8
	SSWB0087	10/19/1999	10																					2.11
	SSWB0090	10/20/1999	10																	2.06				14.6
	SSWB0085	10/18/1999	10.7																	0.487				
	SSWB0094	10/21/1999	11																	0.751				
	SSWB0095	10/21/1999	11																					162
	SSWB0097	10/25/1999	11																					1.31 J
	SSWB0099	10/26/1999	11																					30.9
	SSWB0078	10/12/1999	11.5																	0.48 J				2.45 J
	TRL0052	8/30/1996	12																	15.7				4.78
	TRL0054	9/3/1996	12																				25.5	

Table 6-16. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternatives SW-8 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

			Metals (mg/kg)							VOCs (µg/m^3)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Waste Burial Holes (continued)																								
SSWB0068	10/8/1999	12																		0.837				
SSWB0073	10/9/1999	12																		2.27				4.03
SSWB0074	10/9/1999	12																		6.21				4.51
SSWB0086	10/18/1999	12.7																		0.772				
SSWB0096	10/25/1999	13																						42.3
SSWB0098	10/25/1999	13																		7.78				
SBL0032	5/26/1995	15																						3,930
WBH-2	9/16/2008	15																						19.7
SBL-393	3/26/2001	15.5																		0.424 J				
SBL-395	3/26/2001	15.5																		0.402 J				
SBL-396	3/26/2001	15.5																		0.668				66.5
SBL-391	3/27/2001	15.5																						34.8
SBL-398	3/27/2001	15.5																		1.14				
SBL-399	3/27/2001	15.5																		0.461 J				
SBL-392	3/28/2001	15.5																						3.89 J
SBL-393	3/26/2001	17.5																		0.564 J				
SBL-395	3/26/2001	17.5																		0.657 J				
SBL-396	3/26/2001	17.5																		0.44 J				133
SBL-391	3/27/2001	17.5																						32.8
SBL-398	3/27/2001	17.5																		0.415 J				
SBL-392	3/28/2001	17.5																		0.422 J				6.74
SBL-397	3/28/2001	17.5																		0.474 J				
SBL-393	3/26/2001	19																		0.323 J				455
SBL-395	3/26/2001	19																		0.645				
SBL-396	3/26/2001	19																		0.479 J				11 J
SBL-391	3/27/2001	19																						37.9
SBL-398	3/27/2001	19																		0.637 J				
SBL-394	3/28/2001	19																		0.383 J				
SBL-397	3/28/2001	19																		0.661				
WBH-2	9/16/2008	20																						38.1
SBL0032	5/26/1995	35																		1.9 J				147

Note:

[a] PCGs provided on Tables 3-2, 3-3, and 3-5.

Acronyms/Abbreviations:
bgs - below ground surface
DCA - dichloroethane
J - concentration is an estimated value
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethylene
PCG - preliminary cleanup goal
pCi/g - picocuries per gram
VOC - volatile organic compound
µg/m^3 - micrograms per cubic meter

Table 6-17. Alternative SW-8 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

VOC "Hot Spot" Removal, One On-Site Lined Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring

	COST COMPONENT	TOTAL
CAPITAL COSTS:		
Pre-Remediation	Biological Survey	$86,304
	Elderberry Mitigation	$270,000
	Decontamination Facilities[a]	$1,157,352
	Building D&D (including disposal)	$314,966
	Decommission Groundwater Wells[b]	$631,623
	Clearing and Grubbing	$60,339
	Demolish LFU-3 N-S Drainage Channel	$10,264
Excavation and Backfill[c]	ET Excavation[d]	$301,634
	ET VOC "Hot Spot" Excavation	$174,189
	LFU-1 Excavation[e]	$952,602
	LFU-2 Excavation[f]	$1,010,770
	LFU-3 Excavation[g]	$230,423
	ST and HFSDA Excavation	$78,337
	Non-Impacted Area Excavation	$568,546
Materials Management and Disposal	Materials Management[h]	$7,157,613
	Excavated Material Consolidation[i]	$700,300
	Off-Site Transportation and Disposal	$3,778,710
CAMU Construction	Multiple-Layer Cap With Liner and LCRS	$7,455,403
Post-Remediation	Install New Groundwater Wells[b]	$288,862
	Storm Drainage[j]	$476,807
	LFU-1 Drainage Swale	$18,841
	LFU-3 Drainage Channels	$91,540
	Building Reconstruction[k]	$423,616
	TOTAL CAPITAL COST	**$26,239,041**
O&M COSTS:	Institutional Controls	$1,144,900
	Groundwater and Storm Water Monitoring[b]	$4,040,774
	O&M Drainage System[l]	$133,934
	O&M of Caps	$1,379,232
	O&M of Leachate Collection and Recovery System	$249,432
	TOTAL O&M COST	**$6,948,273**
PERIODIC COSTS:	Periodic Storm Water Lift Station Repair	$8,150
	Five-Year Reviews	$173,297
	TOTAL PERIODIC COST	**$181,448**
TOTAL PRESENT VALUE OF ALTERNATIVE[m]		**$33,368,762**
Non-Impacted Area Disposal and Import Fill Contingency[n]		$6,992,711
TOTAL PRESENT VALUE OF ALTERNATIVE with contingency		**$40,361,473**

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Decontamination Facilities include temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative.

[c] Under Alternative SW-8, excavation and backfill costs are calculated differently from those in other alternatives. For excavations occurring within the footprint of the liner and cap, backfilling of excavated material into the lined CAMU is costed separately under "Excavated Material Consolidation," whereas in areas outside the cap footprint and in other alternatives, the cost of backfilling is included in the excavation cost component. For areas outside the footprint of the liner and cap, the excavated areas are assumed to receive clean backfill from an on-Site source (non-impacted area), thus lowering the cost in comparison to other alternatives.

[d] The ET PTW and Exploratory Trenches will be excavated as part of the ET excavation.

Table 6-17. Alternative SW-8 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Notes (continued):

[e] The LFU-1 PTW and Exploratory Trenches and the LFU-1 Drainage Area will be excavated as part of the LFU-1 excavation.

[f] The LFU-2 PTW and Exploratory Trenches and LFU-2 VOC "Hot Spot" will be excavated as part of the LFU-2 excavation.

[g] The LFU-3 PTW and Exploratory Trenches and LFU-3 Drainage Area will be excavated as part of the LFU-3 excavation.

[h] Materials Management includes the cost of stockpiling and management of excavated materials, waste characterization sampling, and sifting/sorting waste streams.

[i] Excavated Material Consolidation includes the cost of consolidating non-PTW excavated material from on-Site excavations within the footprint of the on-Site CAMU and beneath the final cap.

[j] Storm drainage includes costs of storm water detention basins and infrastructure for storm water conveyance from capped areas to the detention basins and final discharge.

[k] Building Reconstruction cost includes the cost of constructing three warehouse type buildings at the Site, intended to replace the Geriatrics buildings (H-292 and H-293) and buildings H-253 and H-290.

[l] O&M Drainage System includes O&M costs for storm water detention basins and associated infrastructure, in addition to storm water drainage channels/swales.

[m] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

[n] The contingent action cost for Alternative SW-8 includes the disposal of the material from the Non-Impacted Area as Non-RCRA hazardous waste, and import of clean fill sufficient for backfill of on-Site excavated areas.

Acronyms/Abbreviations:

CAMU - corrective action management unit

D&D - decommissioning and demolition

ET - Eastern Trenches

HFSDA - Hopland Field Station Disposal Area

LCRS - leachate collection and recovery system

LFU - landfill unit

N-S - north-south

O&M - operations and maintenance

PTW - principal threat waste

RCRA - Resource Conservation and Recovery Act

ST - Southern Trenches

VOC - volatile organic compound

Table 6-18. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-9 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
	Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Eastern Trenches	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	7.7	87.5	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			10-20	- -	- -	- -	- -	- -	- -	- -	11.0	593.8	- -	203.1	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
			>20	- -	- -	- -	- -	- -	- -	- -	11.0	- -	- -	322.7	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
	SBL0031	5/25/1995	10																		1.8 J				
	SBL0030	5/25/1995	15																		6.7 J				1.3
	SBL0031	5/25/1995	25																						3.37
	ET-1	9/10/2008	25								43			710											
	SBL0030	5/25/1995	30																						1.49
	SBL0030	5/25/1995	40																		8.3 J				
Landfill Unit No. 1	**Applicable PCGs[a]**		0-10	9.6	- -	- -	60	80	- -	1.2	- -	- -	- -	- -	- -	- -	- -	0.015	- -	- -	0.13	- -	- -	- -	- -
			10-20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	14.2	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
			>20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0050	9/27/1996	15							3.1															
	LF1-1	9/17/2008	15										74												
	LF1-2	9/15/2008	15.5																		1.0 J				
	SBL0025	5/23/1995	20																		2.5				
	SBL0048	9/27/1996	20							2.7															
	SBL0027	5/23/1995	25																		2.6				
Landfill Unit No. 2	**Applicable PCGs[a]**		0-10	- -	- -	0.51	- -	80	- -	- -	- -	178.4	- -	68.6	313.3	0.15	0.15	0.015	- -	0.22	0.13	0.06	- -	- -	- -
			10-20	- -	- -	0.51	- -	80	- -	- -	- -	- -	- -	133.3	714.3	- -	- -	- -	- -	- -	0.13	- -	14	0.24	- -
			>20	- -	- -	0.51	- -	- -	- -	- -	- -	- -	- -	317.2	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0028	5/24/1995	0																			0.062			
	SBL0028	5/24/1995	7.5																		1.8				
	SBL0028	5/24/1995	15																				14.1		
	SBL0029	5/24/1995	15																		2.4		15.5		
	SBL0046	9/26/1996	15																				18.6		
	LF2-4	9/17/2008	20			1.3																			
	LF2-1	9/11/2008	25											920											
	LF2-4	9/17/2008	25			1.4																			
	SBL0028	5/24/1995	30																		1.07				
	LF2-4	9/17/2008	32.5			1.1																			
Landfill Unit No. 3	**Applicable PCGs[a]**		0-10	- -	260	0.51	138	80	1,800	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.22	0.13	0.06	- -	0.24	- -
			10-20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
			>20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	LF3-2	9/18/2008	12.5			1.5																			
	SBL0022	3/6/1995	14																		1.29				
	SBL0022	3/6/1995	20		342																				
	LF3-2	9/18/2008	20			0.89																			
	SBL0036	9/20/1996	25		410																				
	LF3-2	9/18/2008	27.5			1.6																			
	LF3-2	9/18/2008	32.5		380	1.3															0.87 J				
Waste Burial Holes	**Applicable PCGs[a]**		0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.6	- -	0.3	0.06	- -	0.24	1.2
			10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	0.24	1.2
			>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	- -	3.2
	SSSP0009/0007/0	10/20/1999	0.5																		0.344				
	SSSP0010/0011/0	10/25/1999	0.5																		0.446				6.5
	SSSP0014/0015/0	10/25/1999	0.5																						1.91
	SSWB0018	9/3/1996	2																					0.53	
	LLRS0004	3/29/2000	2.5																		3.3				26
	LLRS0002	12/8/1999	3																		17.3				76.2
	LLRS0003	12/8/1999	3																		9.87				13.5
	LLRS0005	3/29/2000	3																		4.44				25.5
	SBL-446	5/8/2002	3																		3.85				26.1
	SBL-448	5/8/2002	3																		6.31				22.1
	PMWS0001	12/8/1999	3.2																						111
	PMWS0002	12/8/1999	3.2																		2.85				128
	LLRS0006	3/29/2000	3.3																		2.37				19.7
	TRL0050	8/27/1996	3.5																					0.59	
	SBL-449	5/8/2002	3.5																		6.82				62.9
	LLRS0001	12/9/1999	4																		7.42				21.7
	SBL-371	3/29/2001	4																		7.17				27.3 J
	SBL-372	3/29/2001	4																		6.56				41 J
	SBL-373	3/29/2001	4																		3.57				35 J
	SBL-374	3/29/2001	4																		0.494 J				
	SBL-375	3/29/2001	4																		7.86				212 J
	SBL-376	3/29/2001	4																						17.4 J
	SBL-450	5/8/2002	4.5																		15.1				165
	TRL0049	8/27/1996	5																					0.91	
	TRL0050	8/27/1996	5.25																					0.44	
	SBL-447	5/8/2002	6.5																		7.48				289
	SBL-451	5/8/2002	6.5																		12				261
	TRL0049	8/27/1996	7																					0.69	
	TRL0054	9/3/1996	7																	92	1,442	4,610		1.06	2.71
	SSWB0102	11/4/1999	7																						1.94 J
	SSWB0103	11/4/1999	7																		0.346				
	WBH-3	9/16/2008	7.5																						56.5
	SSWB0088	10/20/1999	8																		1.57				5.15
	SSWB0089	10/20/1999	8																						6.23
	SSWB0091	10/20/1999	8																						4.34
	SSWB0105	11/4/1999	8.5																						3.8
	SSWB0079	10/14/1999	9																						902
	SSWB0075	10/18/1999	9																						22.5
	SSWB0093	10/21/1999	9																		1.12				28.7
	SSWB0104	11/4/1999	9																						2.43 J
	SSWB0083	10/18/1999	9.5																						1.7
	TRL0051	8/29/1996	10																						3,530

Table 6-18. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-9 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

			Metals (mg/kg)							VOCs (µg/m³)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Waste Burial Holes (continued)																								
SSWB0067	10/8/1999	10																		2.17				
SSWB0071	10/9/1999	10																		0.629 J				
SSWB0072	10/9/1999	10																		0.866				
SSWB0080	10/15/1999	10																						9.36
SSWB0082	10/16/1999	10																						14.9
SSWB0084	10/18/1999	10																						43.8
SSWB0087	10/19/1999	10																						2.11
SSWB0090	10/20/1999	10																		2.06				14.6
SSWB0085	10/18/1999	10.7																		0.487				
SSWB0094	10/21/1999	11																		0.751				
SSWB0095	10/21/1999	11																						162
SSWB0097	10/25/1999	11																						1.31 J
SSWB0099	10/26/1999	11																						30.9
SSWB0078	10/12/1999	11.5																		0.48 J				2.45 J
TRL0052	8/30/1996	12																		15.7				4.78
TRL0054	9/3/1996	12																					25.5	
SSWB0068	10/8/1999	12																		0.837				
SSWB0073	10/9/1999	12																		2.27				4.03
SSWB0074	10/9/1999	12																		6.21				4.51
SSWB0086	10/18/1999	12.7																		0.772				
SSWB0096	10/25/1999	13																						42.3
SSWB0098	10/25/1999	13																		7.78				
SBL0032	5/26/1995	15																						3,930
WBH-2	9/16/2008	15																						19.7
SBL-393	3/26/2001	15.5																		0.424 J				
SBL-395	3/26/2001	15.5																		0.402 J				
SBL-396	3/26/2001	15.5																		0.668				66.5
SBL-391	3/27/2001	15.5																						34.8
SBL-398	3/27/2001	15.5																		1.14				
SBL-399	3/27/2001	15.5																		0.461 J				
SBL-392	3/28/2001	15.5																						3.89 J
SBL-393	3/26/2001	17.5																		0.564 J				
SBL-395	3/26/2001	17.5																		0.657 J				
SBL-396	3/26/2001	17.5																		0.44 J				133
SBL-391	3/27/2001	17.5																						32.8
SBL-398	3/27/2001	17.5																		0.415 J				
SBL-392	3/28/2001	17.5																		0.422 J				6.74
SBL-397	3/28/2001	17.5																		0.474 J				
SBL-393	3/26/2001	19																		0.323 J				455
SBL-395	3/26/2001	19																		0.645				
SBL-396	3/26/2001	19																		0.479 J				11 J
SBL-391	3/27/2001	19																						37.9
SBL-398	3/27/2001	19																		0.637 J				
SBL-394	3/28/2001	19																		0.383 J				
SBL-397	3/28/2001	19																		0.661				
WBH-2	9/16/2008	20																						38.1
SBL0032	5/26/1995	35																		1.9 J				147

Note:

[a] PCGs provided on Tables 3-2, 3-3, and 3-5.

Acronyms/Abbreviations:

bgs - below ground surface
DCA - dichloroethane
J - concentration is an estimated value
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethylene
PCG - preliminary cleanup goal
pCi/g - picocuries per gram
VOC - volatile organic compound
µg/m³ - micrograms per cubic meter

Table 6-19. Alternative SW-9 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Excavate and Dispose of Waste Off-Site, Waste Burial Holes Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring

	COST COMPONENT	TOTAL
CAPITAL COSTS:		
Pre-Remediation	Biological Survey	$86,304
	Elderberry Mitigation	$270,000
	Decontamination Facilities[a]	$1,157,352
	Building D&D (including disposal)	$511,850
	Decommission Groundwater Wells[b]	$624,402
	Clearing and Grubbing	$54,151
	Demolish LFU-3 N-S Drainage Channel	$10,264
Excavation and Backfill	ET Excavation[c]	$690,687
	ET VOC "Hot Spot" Excavation	$252,758
	LFU-1 Excavation[d]	$2,775,120
	LFU-2 Excavation[e]	$2,619,614
	LFU-2 VOC "Hot Spot" Excavation	$253,312
	LFU-3 Excavation[f]	$893,073
	ST and HFSDA Excavation	$206,155
Materials Management and	Materials Management[g]	$7,259,526
Disposal	Excavated Material Consolidation[h]	$9,549
	Off-Site Transportation and Disposal	$77,135,180
CAMU Construction	WBH Cap	$338,380
Post-Remediation	Install New Groundwater Wells[b]	$297,551
	LFU-1 Drainage Swale	$18,841
	LFU-3 Drainage Channels	$91,540
	Building Reconstruction[i]	$423,616
	TOTAL CAPITAL COST	**$95,979,224**
O&M COSTS:	Institutional Controls	$1,144,900
	Groundwater and Storm Water Monitoring[b]	$4,383,323
	O&M Drainage System[j]	$33,483
	O&M of Caps	$428,598
	TOTAL O&M COST	**$5,990,304**
PERIODIC COSTS:	Five-Year Reviews	$173,297
	TOTAL PERIODIC COST	**$173,297**
TOTAL PRESENT VALUE OF ALTERNATIVE[k]		**$102,142,825**

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Decontamination Facilities include temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative.

[c] The ET PTW and Exploratory Trenches will be excavated as part of the ET excavation.

[d] The LFU-1 PTW and Exploratory Trenches and the LFU-1 Drainage Area will be excavated as part of the LFU-1 excavation.

[e] The LFU-2 PTW and Exploratory Trenches will be excavated as part of the LFU-2 excavation.

Table 6-19. Alternative SW-9 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Notes (continued):

[f] The LFU-3 PTW and Exploratory Trenches and LFU-3 Drainage Area will be excavated as part of the LFU-3 excavation.

[g] Materials Management includes the cost of stockpiling and management of excavated materials, waste characterization sampling, and sifting/sorting waste streams.

[h] Excavated Material Consolidation includes the cost of consolidating non-PTW excavated material from on-Site excavations within the footprint of the on-Site CAMU and beneath the final cap.

[i] Building Reconstruction cost includes the cost of constructing three warehouse type buildings at the Site, intended to replace the Geriatrics buildings (H-292 and H-293) and buildings H-253 and H-290.

[j] O&M Drainage System includes O&M costs for storm water detention basins and associated infrastructure, in addition to storm water drainage channels/swales.

[k] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

Acronyms/Abbreviations:

CAMU - corrective action management unit
D&D - decommissioning and demolition
ET - Eastern Trenches
HFSDA - Hopland Field Station Disposal Area
LFU - landfill unit
N-S - north-south
O&M - operations and maintenance
PTW - principal threat waste
ST - Southern Trenches
VOC - volatile organic compound
WBH - Waste Burial Holes

Table 6-20. Concentrations of Constituents of Concern Remaining in Soil and Soil Gas Above Preliminary Cleanup Goals, Alternative SW-10 - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

				Metals (mg/kg)							VOCs (µg/m^3)					PAHs (mg/kg)				PCBs (mg/kg)	Radioactive Elements (pCi/g)				
Sample Location	Sample Date	Sample Depth (feet bgs)	Arsenic	Barium	Cadmium	Copper	Lead	Manganese	Selenium	1,2-DCA	1,2-Dichloropropane	1,3-Butadiene	Chloroform	PCE	Benzo(a) anthracene	Benzo(b) fluoranthene	Benzo(a) pyrene	Naphthalene	Aroclor 1260	Carbon-14	Cesium-137	Potassium-40	Strontium-90	Tritium
Eastern Trenches	**Applicable PCGs[a]**	0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	7.7	87.5	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
		10-20	- -	- -	- -	- -	- -	- -	- -	11.0	593.8	- -	203.1	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
		>20	- -	- -	- -	- -	- -	- -	- -	11.0	- -	- -	322.7	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	1.2
	SBL0031	5/25/1995	10																	1.8 J				
	SBL0030	5/25/1995	15																	6.7 J				1.3
	SBL0031	5/25/1995	25																					3.37
	ET-1	9/10/2008	25							43			710											
	SBL0030	5/25/1995	30																					1.49
	SBL0030	5/25/1995	40																	8.3 J				
Landfill Unit No. 1	**Applicable PCGs[a]**	0-10	9.6	- -	- -	60	80	- -	1.2	- -	- -	- -	- -	- -	- -	- -	0.015	- -	- -	0.13	- -	- -	- -	- -
		10-20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	14.2	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
		>20	- -	- -	- -	- -	- -	- -	1.2	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0050	9/27/1996	15						3.1															
	LF1-1	9/17/2008	15									74												
	LF1-2	9/15/2008	15.5																	1.0 J				
	SBL0025	5/23/1995	20																	2.5				
	SBL0048	9/27/1996	20						2.7															
	SBL0027	5/23/1995	25																	2.6				
Landfill Unit No. 2	**Applicable PCGs[a]**	0-10	- -	- -	0.51	- -	80	- -	- -	- -	178.4	- -	68.6	313.3	0.15	0.15	0.015	- -	0.22	0.13	0.06	- -	- -	- -
		10-20	- -	- -	0.51	- -	80	- -	- -	- -	- -	- -	133.3	714.3	- -	- -	- -	- -	- -	0.13	- -	14	0.24	- -
		>20	- -	- -	0.51	- -	- -	- -	- -	- -	- -	- -	317.2	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	SBL0028	5/24/1995	0																		0.062			
	SBL0028	5/24/1995	7.5																	1.8				
	SBL0028	5/24/1995	15																			14.1		
	SBL0029	5/24/1995	15																	2.4		15.5		
	SBL0046	9/26/1996	15																			18.6		
	LF2-4	9/17/2008	20			1.3																		
	LF2-1	9/11/2008	25										920											
	LF2-4	9/17/2008	25			1.4																		
	SBL0028	5/24/1995	30																	1.07				
	LF2-4	9/17/2008	32.5			1.1																		
Landfill Unit No. 3	**Applicable PCGs[a]**	0-10	- -	260	0.51	138	80	1,800	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.22	0.13	0.06	- -	0.24	- -
		10-20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
		>20	- -	260	0.51	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.13	- -	- -	- -	- -
	LF3-2	9/18/2008	12.5		1.5																			
	SBL0022	3/6/1995	14																	1.29				
	SBL0022	3/6/1995	20		342																			
	LF3-2	9/18/2008	20		0.89																			
	SBL0036	9/20/1996	25		410																			
	LF3-2	9/18/2008	27.5		1.6																			
	LF3-2	9/18/2008	32.5		380	1.3														0.87 J				
Waste Burial Holes	**Applicable PCGs[a]**	0-10	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	3.6	- -	0.3	0.06	- -	0.24	1.2
		10-20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	0.24	1.2
		>20	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	0.3	- -	- -	- -	3.2
	TRL0054	9/3/1996	12																				25.5	
	SSWB0068	10/8/1999	12																	0.837				
	SBL-395	3/26/2001	15.5																	0.402 J				
	SBL-398	3/27/2001	15.5																	1.14				
	SBL-399	3/27/2001	15.5																	0.461 J				
	SBL-395	3/26/2001	17.5																	0.657 J				
	SBL-398	3/27/2001	17.5																	0.415 J				
	SBL-397	3/28/2001	17.5																	0.474 J				
	SBL-395	3/26/2001	19																	0.645				
	SBL-398	3/27/2001	19																	0.637 J				
	SBL-394	3/28/2001	19																	0.383 J				
	SBL-397	3/28/2001	19																	0.661				
	SBL0032	5/26/1995	35																	1.9 J				147

Note:

[a] PCGs provided on Tables 3-2, 3-3, and 3-5.

Acronyms/Abbreviations:

bgs - below ground surface
DCA - dichloroethane
J - concentration is an estimated value
mg/kg - milligrams per kilogram
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethylene
PCG - preliminary cleanup goal
pCi/g - picocuries per gram
VOC - volatile organic compound
µg/m^3 - micrograms per cubic meter

Table 6-21. Alternative SW-10 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring

	COST COMPONENT	TOTAL
CAPITAL COSTS:		
Pre-Remediation	Biological Survey	$86,304
	Elderberry Mitigation	$270,000
	Decontamination Facilities[a]	$1,157,352
	Building D&D (including disposal)	$511,850
	Decommission Groundwater Wells[b]	$624,402
	Clearing and Grubbing	$54,151
	Demolish LFU-3 N-S Drainage Channel	$10,264
Excavation and Backfill	ET Excavation[c]	$690,687
	ET VOC "Hot Spot" Excavation	$252,758
	LFU-1 Excavation[d]	$2,775,120
	LFU-2 Excavation[e]	$2,619,614
	LFU-2 VOC "Hot Spot" Excavation	$253,312
	LFU-3 Excavation[f]	$893,073
	ST and HFSDA Excavation	$206,155
	WBH Excavation	$478,752
Materials Management and Disposal	Materials Management[g]	$7,366,984
	Off-Site Transportation and Disposal	$83,868,657
Post-Remediation	Install New Groundwater Wells[a]	$297,551
	LFU-1 Drainage Swale	$18,841
	LFU-3 Drainage Channels	$91,540
	Building Reconstruction[h]	$423,616
	TOTAL CAPITAL COST	**$102,950,982**
O&M COSTS:	Institutional Controls	$1,144,900
	Groundwater and Storm Water Monitoring[b]	$4,383,323
	O&M Drainage System[i]	$33,483
	TOTAL O&M COST	**$5,561,706**
PERIODIC COSTS:	Five-Year Reviews	$173,297
	TOTAL PERIODIC COST	**$173,297**
TOTAL PRESENT VALUE OF ALTERNATIVE[j]		**$108,685,985**

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Decontamination Facilities include temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative.

[c] The ET PTW and Exploratory Trenches will be excavated as part of the ET excavation.

[d] The LFU-1 PTW and Exploratory Trenches and the LFU-1 Drainage Area will be excavated as part of the LFU-1 excavation.

[e] The LFU-2 PTW and Exploratory Trenches will be excavated as part of the LFU-2 excavation.

[f] The LFU-3 PTW and Exploratory Trenches and LFU-3 Drainage Area will be excavated as part of the LFU-3 excavation.

Table 6-21. Alternative SW-10 Cost Estimate Summary - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Notes (continued):

[g] Materials Management includes the cost of stockpiling and management of excavated materials, waste characterization sampling, and sifting/sorting waste streams.

[h] Building Reconstruction cost includes the cost of constructing three warehouse type buildings at the Site, intended to replace the Geriatrics buildings (H-292 and H-293) and buildings H-253 and H-290.

[i] O&M Drainage System includes O&M costs for storm water detention basins and associated infrastructure, in addition to storm water drainage channels/swales.

[j] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

Acronyms/Abbreviations:
D&D - decommissioning and demolition
ET - Eastern Trenches
HFSDA - Hopland Field Station Disposal Area
LFU - landfill unit
N-S - north-south
O&M - operations and maintenance
PTW - principal threat waste
ST - Southern Trenches
VOC - volatile organic compound
WBH - Waste Burial Holes

Table 7-1. Relative Comparison of Alternatives - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Summary of Alternative	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-term Effectiveness	Implementability	Cost (Total Present Value)	Total Score[1]
SW-1	No Action/No Further Action	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). No monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative does not meet RAOs.		No remedial actions are proposed. Although this alternative may be effective in the long-term, no monitoring would be conducted to confirm long-term protection of human health and the environment.	No soil/solid waste would be treated, and thus there would be no reduction of toxicity, mobility, or volume.	There are no short-term risks to the community or workers since no remedial actions would be implemented.	Implementable since there are no technical or administrative components.	No costs associated with the No Action/No Further Action alternative.	
		NOT PROTECTIVE	**DOES NOT COMPLY**	**0**	**0**	**5**	**5**	**5**	**0.0**
SW-2	Institutional Controls and Groundwater Monitoring	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). ICs would prohibit residential development and restrict non-residential development. Monitoring would confirm long-term protection of human health and the environment. This alternative meets each RAO.		Sampling in the ST and HFSDA would better characterize risk in these disposal areas. Monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative is considered effective in the long-term.	No soil/solid waste would be treated, and thus there would be no reduction of toxicity, mobility, or volume.	There are minimal risks to the community, workers, and the environment due to well installation. 42 metric tons of GHGs, 0.2 metric tons of NO_x emissions, 0.1 metric tons of SO_x emissions, and 0.02 metric tons of PM_{10} emissions are estimated to be released. 550 MMBTU of energy are estimated to be used, equivalent to approximately 3,960 gallons of diesel. The estimated total fatality risk is 2E-04. This alternative would take one year to implement.	There are minimal technical and administrative components associated with well installation, monitoring, and sampling at the ST/HFSDA.	$6,510,297	
		PROTECTIVE	**COMPLIES**	**1**	**0**	**4**	**5**	**4**	**2.8**
SW-3	VOC “Hot Spot” Removal, Three On-Site Corrective Action Management Units with Graded Covers, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). ICs would prohibit residential development and restrict non-residential development. Monitoring would confirm long-term protection of human health and the environment. Additional protectiveness would be achieved through removal of 38 LCY of PTW, removal of 2,394 LCY of hazardous material (including the two VOC "hot spot" areas) and the reduction of infiltration via graded covers and storm water drainage enhancements. This alternative meets each RAO.		Hazardous material would be consolidated within three covered CAMUs. Sampling in the ST and HFSDA would better characterize risk in these disposal areas. The VOC "hot spot" areas would be excavated and hazardous material taken off-Site for disposal. PTW from historical and proposed trenches would be removed. Graded covers and storm water drainage enhancements would be installed to reduce infiltration. Monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative is considered effective in the long-term.	A fraction of hazardous waste may be treated via *ex situ* solidification/stabilization prior to off-Site disposal; the actual amounts would depend on the hazardous characteristics of the waste. 76 LCY of material are assumed to be treated.[2]	Risks are associated with construction site hazards, air emissions, fugitive dust emissions, and vehicular traffic. 1,400 metric tons of GHGs, 1.8 metric tons of NO_x emissions, 0.8 metric tons of SO_x emissions, and 0.6 metric tons of PM_{10} emissions are estimated to be released. 22,400 MMBTU of energy are estimated to be used, equivalent to approximately 161,200 gallons of diesel. The estimated total fatality risk is 2E-02. This alternative would take one year to implement.	Technically and administratively feasible to implement in one year. The excavation, segregation, and disposal of soil/solid waste would be moderately complex to coordinate and implement. The installation of graded covers would be straightforward. Required equipment and contractors are available. Additional land for storm water drainage enhancements is readily available and would not pose a burden to the University's mission.	$13,571,030	
		PROTECTIVE	**COMPLIES**	**2**	**3**	**3**	**4**	**3.5**	**3.1**
SW-4	VOC “Hot Spot” Removal, Three On-Site Corrective Action Management Units with Evapotranspiration Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). ICs would prohibit residential development and restrict non-residential development. Monitoring would confirm long-term protection of human health and the environment. Additional protectiveness would be achieved through removal of 150 LCY of PTW, removal of 2,516 LCY of hazardous material (including the two VOC "hot spot" areas) and the reduction of infiltration via evapotranspiration caps and storm water drainage enhancements. This alternative meets each RAO.		Hazardous material would be consolidated within three CAMUs. Sampling in the ST and HFSDA would better characterize risk in these disposal areas. The VOC "hot spot" areas would be excavated and hazardous material taken off-Site for disposal. PTW from historical and proposed trenches would be removed. Evapotranspiration caps and storm water drainage enhancements would be installed to reduce infiltration; heavy precipitation may overwhelm the evapotranspiration barrier and result in infiltration. Periodic evapotranspiration cap maintenance would be required to limit infiltration. Monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative is considered effective in the long-term.	A fraction of hazardous waste may be treated via *ex situ* solidification/stabilization prior to off-Site disposal; the actual amounts would depend on the hazardous characteristics of the waste. 86 LCY of material are assumed to be treated.[2]	Risks are associated with construction site hazards, air emissions, fugitive dust emissions, and vehicular traffic. 4,000 metric tons of GHGs, 2.8 metric tons of NO_x emissions, 1.0 metric tons of SO_x emissions, and 0.7 metric tons of PM_{10} emissions are estimated to be released. 69,200 MMBTU of energy are estimated to be used, equivalent to approximately 497,500 gallons of diesel. The estimated total fatality risk is 5E-02. This alternative would take one year to implement.	Technically and administratively feasible to implement in one year. The excavation, segregation, and disposal of soil/solid waste would be moderately complex to coordinate and implement. The installation of evapotranspiration caps would be more complex than the graded covers. Required equipment and contractors are available. Additional land for storm water drainage enhancements is readily available and would not pose a burden to the University's mission.	$18,500,777	
		PROTECTIVE	**COMPLIES**	**2**	**3**	**3**	**3**	**3**	**2.8**
SW-5	VOC “Hot Spot” Removal, Three On-Site Corrective Action Management Units with Asphalt Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). ICs would prohibit residential development and restrict non-residential development. Monitoring would confirm long-term protection of human health and the environment. Additional protectiveness would be achieved through removal of 150 LCY of PTW, removal of 2,516 LCY of hazardous material (including the two VOC "hot spot" areas) and the reduction of infiltration via asphalt caps and storm water drainage enhancements. This alternative meets each RAO.		Hazardous material would be consolidated within three CAMUs. Sampling in the ST and HFSDA would better characterize risk in these disposal areas. The VOC "hot spot" areas would be excavated and hazardous material taken off-Site for disposal. PTW from historical and proposed trenches would be removed. Asphalt caps and storm water drainage enhancements would be installed to reduce infiltration. Periodic asphalt cap maintenance would be required to limit infiltration. Monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative is considered effective in the long-term.	A fraction of hazardous waste may be treated via *ex situ* solidification/stabilization prior to off-Site disposal; the actual amounts would depend on the hazardous characteristics of the waste. 86 LCY of material are assumed to be treated.[2]	Risks are associated with construction site hazards, air emissions, fugitive dust emissions, and vehicular traffic. 3,000 metric tons of GHGs, 2.8 metric tons of NO_x emissions, 1.0 metric tons of SO_x emissions, and 0.7 metric tons of PM_{10} emissions are estimated to be released. 42,300 MMBTU of energy are estimated to be used, equivalent to approximately 304,600 gallons of diesel. The estimated total fatality risk is 3E-02. This alternative would take one year to implement.	Technically and administratively feasible to implement in one year. The excavation, segregation, and disposal of soil/solid waste would be moderately complex to coordinate and implement. The installation of asphalt caps would only be slightly more complex than the graded covers as the asphalt would be placed on top of a graded cover. Required equipment and contractors are available. Additional land for storm water drainage enhancements is readily available and would not pose a burden to the University's mission.	$20,893,851	
		PROTECTIVE	**COMPLIES**	**3**	**3**	**3**	**3**	**3**	**3.0**

Table 7-1. Relative Comparison of Alternatives - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Summary of Alternative	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-term Effectiveness	Implementability	Cost (Total Present Value)	Total Score[1]
SW-6	VOC “Hot Spot” Removal, Three On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). ICs would prohibit residential development and restrict non-residential development. Monitoring would confirm long-term protection of human health and the environment. Additional protectiveness would be achieved through removal of 261 LCY of PTW, removal of 2,626 LCY of hazardous material (including the two VOC "hot spot" areas) and the reduction of infiltration via multiple-layer caps and storm water drainage enhancements. This alternative meets each RAO.		Hazardous material would be consolidated within three CAMUs. Sampling in the ST and HFSDA would better characterize risk in these disposal areas. The VOC "hot spot" areas would be excavated and hazardous material taken off-Site for disposal. PTW from historical and proposed trenches would be removed. The ET would be excavated and PTW sent off-Site for disposal; soil/solid waste would be completely removed from the ET North and consolidated within the CAMUs. Multiple-layer caps and storm water drainage enhancements would be installed to reduce infiltration; multiple-layer caps are more effective in the long-term than graded covers or evapotranspiration caps. Multiple-layer cap maintenance would be required to limit infiltration. Monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative is considered effective in the long-term.	A fraction of hazardous waste may be treated via *ex situ* solidification/stabilization prior to off-Site disposal; the actual amounts would depend on the hazardous characteristics of the waste. 95 LCY of material are assumed to be treated.[2]	Risks are associated with construction site hazards, air emissions, fugitive dust emissions, and vehicular traffic. 3,600 metric tons of GHGs, 3.2 metric tons of NO_x emissions, 1.1 metric tons of SO_x emissions, and 0.7 metric tons of PM_{10} emissions are estimated to be released. 60,500 MMBTU of energy are estimated to be used, equivalent to approximately 435,300 gallons of diesel. The estimated total fatality risk is 4E-02. This alternative would take one year to implement.	Technically and administratively feasible to implement in one year. The excavation, segregation, and disposal of soil/solid waste would be moderately complex to coordinate and implement. The installation of multiple-layer caps would be more complex than the other cover/cap options. Required equipment and contractors are available. Additional land for storm water drainage enhancements is readily available and would not pose a burden to the University's mission.	$20,291,548	
		PROTECTIVE	**COMPLIES**	**3**	**3**	**3**	**3**	**3**	**3.0**
SW-7	VOC “Hot Spot” Removal, Two On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). ICs would prohibit residential development and restrict non-residential development. Monitoring would confirm long-term protection of human health and the environment. Additional protectiveness would be achieved through removal of 387 LCY of PTW, removal of 4,550 LCY of hazardous and non-hazardous material (including the two VOC "hot spot" areas) and the reduction of infiltration via multiple-layer caps and storm water drainage enhancements. This alternative meets each RAO.		Hazardous material would be consolidated within two CAMUs. The VOC "hot spot" areas would be excavated and hazardous material taken off-Site for disposal. PTW from historical and proposed trenches would be removed. The ET, ST, HFSDA, and LFU-3 waste cells would be excavated and PTW sent off-Site for disposal. Non-PTW soil/solid waste from the ET North, LFU-3 waste cells, the ST, and HFSDA would be consolidated within the CAMUs, thereby permanently removing soil/solid waste from these areas. Multiple-layer caps and storm water drainage enhancements would be installed to reduce infiltration; multiple-layer caps are more effective in the long-term than graded covers or evapotranspiration caps. Multiple-layer cap maintenance would be required to limit infiltration. Monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative is considered effective in the long-term.	A fraction of hazardous waste may be treated via *ex situ* solidification/stabilization prior to off-Site disposal; the actual amounts would depend on the hazardous characteristics of the waste. 106 LCY of material are assumed to be treated.[2]	Risks are associated with construction site hazards, air emissions, fugitive dust emissions, and vehicular traffic. 3,900 metric tons of GHGs, 3.7 metric tons of NO_x emissions, 1.2 metric tons of SO_x emissions, and 1.1 metric tons of PM_{10} emissions are estimated to be released. 66,600 MMBTU of energy are estimated to be used, equivalent to approximately 479,100 gallons of diesel. The estimated total fatality risk is 5E-02. This alternative would take one year to implement.	Technically and administratively feasible to implement in one year. The excavation, segregation, and disposal of soil/solid waste would be moderately complex to coordinate and implement. The installation of multiple-layer caps would be more complex than the other cover/cap options. Required equipment and contractors are available. Additional land for storm water drainage enhancements is readily available and would not pose a burden to the University's mission.	$20,860,309	
		PROTECTIVE	**COMPLIES**	**3**	**3**	**3**	**3**	**3**	**3.0**
SW-8	VOC “Hot Spot” Removal, One On-Site Lined Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). ICs would prohibit residential development and restrict non-residential development. Monitoring would confirm long-term protection of human health and the environment. Additional protectiveness would be achieved through removal of 1,116 LCY of PTW, removal of 21,471 LCY of hazardous and non-hazardous material (including the two VOC "hot spot" areas) and the reduction of infiltration via multiple-layer caps and storm water drainage enhancements. This alternative meets each RAO.		Hazardous material would be consolidated within one lined and capped CAMU. The VOC "hot spot" areas would be excavated and hazardous material taken off-Site for disposal. The ET, ST, HFSDA, LFU-1, LFU-2, and the LFU-3 waste cells would be excavated and segregated, and PTW would be sent off-Site for disposal. Non-PTW from the ET North, ST, HFSDA, and LFU-3 waste cells would be consolidated within the CAMU, thereby permanently removing soil/solid waste from these areas. A multiple-layer cap and storm water drainage enhancements would be installed to reduce infiltration; multiple-layer caps are more effective in the long-term than graded covers or evapotranspiration caps. Multiple-layer cap maintenance would be required to limit infiltration. Additional protection of groundwater would be achieved via the installation of a bottom liner and LCRS. Monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative is considered effective in the long-term.	A fraction of hazardous waste may be treated via *ex situ* solidification/stabilization prior to off-Site disposal; the actual amounts would depend on the hazardous characteristics of the waste. 168 LCY of material are assumed to be treated.[2]	Risks are associated with construction site hazards, air emissions, fugitive dust emissions, and vehicular traffic. 5,200 metric tons of GHGs, 8.8 metric tons of NO_x emissions, 3.1 metric tons of SO_x emissions, and 4.5 metric tons of PM_{10} emissions are estimated to be released. 86,400 MMBTU of energy are estimated to be used, equivalent to approximately 621,300 gallons of diesel. The estimated total fatality risk is 7E-02. This alternative would take two years to implement.	Technically and administratively feasible to implement in two years. The excavation, segregation, and disposal of soil/solid waste would be moderately complex to coordinate and implement. The installation of a bottom liner, LCRS, and multiple-layer cap would be substantially more complex than the other alternatives. Required equipment and contractors are available. Additional land for storm water drainage enhancements and for the installation of the bottom liner and LCRS between LFU-1 and LFU-2/ET/WBH is readily available and would not pose a burden to the University's mission.	$33,368,762	
		PROTECTIVE	**COMPLIES**	**4**	**3**	**2**	**1**	**2**	**2.4**
SW-9	Excavate and Dispose of Waste Off-Site, Waste Burial Holes Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). ICs would prohibit residential development and restrict non-residential development. Monitoring would confirm long-term protection of human health and the environment. Additional protectiveness would be achieved through removal of 1,116 LCY of PTW, removal of 115,231 LCY of hazardous and non-hazardous material (including the two VOC "hot spot" areas) and the reduction of infiltration via storm water drainage enhancements and a multiple-layer cap over the WBH. This alternative meets each RAO.		The VOC "hot spot" areas, ET, LFU-1, LFU-2 waste cells, and LFU-3 waste cells would be excavated and material sent off-Site for disposal, thereby permanently removing soil/solid waste from these areas. PTW from the ST and HFSDA would be sent off-Site for disposal, and non-PTW hazardous material would be consolidated within the WBH CAMU. A multiple-layer cap over the WBH and storm water drainage enhancements would be installed to reduce infiltration; multiple-layer caps are more effective in the long-term than graded covers or evapotranspiration caps. Multiple-layer cap maintenance would be required to limit infiltration. Monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative is considered effective in the long-term.	A fraction of hazardous waste may be treated via *ex situ* solidification/stabilization prior to off-Site disposal; the actual amounts would depend on the hazardous characteristics of the waste. 5,127 LCY of material are assumed to be treated.[2]	Risks are associated with construction site hazards, air emissions, fugitive dust emissions, and vehicular traffic. 14,400 metric tons of GHGs, 17 metric tons of NO_x emissions, 7.2 metric tons of SO_x emissions, and 23 metric tons of PM_{10} emissions are estimated to be released. 222,000 MMBTU of energy are estimated to be used, equivalent to approximately 1,596,900 gallons of diesel. The estimated total fatality risk is 6E-01. This alternative would take two years to implement.	Technically and administratively feasible to implement in two years. The excavation, segregation, and disposal of hazardous material and multiple-layer cap installation over the WBH would be moderately easy to coordinate and implement. Required equipment and contractors are available. Additional land for storm water drainage enhancements is readily available and would not pose a burden to the University's mission.	$102,142,825	
		PROTECTIVE	**COMPLIES**	**5**	**5**	**1**	**4**	**1**	**3.2**

Table 7-1. Relative Comparison of Alternatives - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Summary of Alternative	Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-term effectiveness and permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-term Effectiveness	Implementability	Cost (Total Present Value)	Total Score[1]
SW-10	Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	Currently, estimated cancer risks for residents are within or near the NCP's designated cancer risk range of 10^{-4} to 10^{-6} and near the hazard index of 1.0 (except for the WBH). ICs would prohibit residential development and restrict non-residential development. Monitoring would confirm long-term protection of human health and the environment. Additional protectiveness would be achieved through removal of 1,116 LCY of PTW, removal of 124,269 LCY of hazardous and non-hazardous material (including the two VOC "hot spot" areas) and the reduction of infiltration via storm water drainage enhancements. This alternative meets each RAO.		The VOC "hot spot" areas, ET, ST, HFSDA, WBH, LFU-1, LFU-2 waste cells, and LFU-3 waste cells would be excavated and material sent off-Site for disposal, thereby permanently removing soil/solid waste from these areas. Storm water drainage enhancements would be installed to reduce infiltration. Monitoring would be conducted to confirm long-term protection of human health and the environment. This alternative is considered effective in the long-term.	A fraction of hazardous waste may be treated via *ex situ* solidification/stabilization prior to off-Site disposal; the actual amounts would depend on the hazardous characteristics of the waste. 5,129 LCY[3] of material are assumed to be treated.[2]	Risks are associated with construction site hazards, air emissions, fugitive dust emissions, and vehicular traffic. 15,200 metric tons of GHGs, 18 metric tons of NO_x emissions, 7.6 metric tons of SO_x emissions, and 25 metric tons of PM_{10} emissions are estimated to be released. 232,800 MMBTU of energy are estimated to be used, equivalent to approximately 1,674,500 gallons of diesel. The estimated total fatality risk is 7E-01. This alternative would take two years to implement.	Technically and administratively feasible to implement in two years. The excavation, segregation, and disposal of hazardous material would be moderately easy to coordinate and implement. Required equipment and contractors are available. Additional land for storm water drainage enhancements is readily available and would not pose a burden to the University's mission.	$108,685,985	
		PROTECTIVE	**COMPLIES**	**5**	**5**	**1**	**4**	**1**	**3.2**

Notes:

Relative comparison: the rankings reflect the relative differences between the alternatives and are ranked on a scale of 0-5, where a higher ranking reflects a more favorable outcome for that category

Long-term effectiveness and permanence: a low ranking reflects lower long-term effectiveness/permanence relative to other alternatives

Reduction of toxicity, mobility, or volume by treatment: a lower ranking reflects a smaller volume treated and a higher ranking reflects a larger treated volume

Short-term effectiveness: a lower ranking reflects greater risks to the community than a higher ranking

Implementability: a lower ranking reflects greater technical and administrative challenges than a higher ranking, which would be easier to implement

Cost: ranking of high for cost refers to Alternatives that have low costs and thus perform well for this category; high total costs would have a lower ranking in this category

The Community Acceptance section will be completed upon receipt of community comments on the Proposed Plan.

The State Acceptance section will be completed upon receipt of regulatory agency comments on the FS Report and Proposed Plan.

[1] The total score is an average of the five numerical rankings. A score of zero (0) is applied if the alternative is not protective or does not comply with ARARs.

[2] The estimated volume of waste treated *ex situ* is ten percent of the mixed and RCRA hazardous waste characterization volumes.

[3] The estimated *ex situ* treatment volume for Alternative SW-10 is similar to Alternative SW-9 because the majority of waste in the WBH, ST, and HFSDA sent off-Site for disposal under SW-10 is categorized as LLRW, not mixed or RCRA hazardous waste.

Acronyms/Abbreviations:

ARAR - applicable or relevant and appropriate requirement
CAMU - corrective action management unit
ET - Eastern Trenches
FS - Feasibility Study
GHG - greenhouse gas
HFSDA - Hopland Field Station Disposal Area
IC - institutional control
LCRS - lea
LCY - loose cubic yards
LFU - landfill unit
LLRW - low-level radioactive waste
MMBTU - million British thermal units
NCP - National Oil and Hazardous Substances Pollution Contingency Plan
NO_x - nitrogen oxides
PM_{10} - particulate matter with a diameter less than 10 micrometers
PTW - principal threat waste
RAO - remedial action objective
RCRA - Resource Conservation and Recovery Act
SO_x - sulfur oxides
ST - Southern Trenches
VOC - volatile organic compound
WBH - Waste Burial Holes

Table 7-2. Comparison of Soil/Solid Waste and Vapor Intrusion Risks with Risks at Preliminary Cleanup Goal Concentrations - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Land Disposal Unit	**Soil/Solid Waste and Vapor Intrusion Risk[1]** 0-20 feet bgs	**Soil/Solid Waste and Vapor Intrusion Risk at PCG[2]** 0-20 feet bgs
Eastern Trenches	1×10^{-4}	4×10^{-6}
Landfill Unit No. 1	1×10^{-4}	3×10^{-5}
Landfill Unit No. 2[3]	3×10^{-4}	1×10^{-4}
Landfill Unit No. 3	2×10^{-5}	4×10^{-6}
Southern Trenches	1×10^{-5}	1×10^{-6}
Waste Burial Holes	2×10^{-2}	8×10^{-6}

Notes:

[1]Summarized from Table 2-11 and Table B-8 (5 foot depth)

[2]Summarized from total risk at 0-20 feet bgs (Table 3-6) plus the vapor intrusion risk at 5 feet bgs

[3]Risk at PCG due to background concentration of potassium-40; the baseline risk would be 3×10^{-5} when potassium-40 is excluded

Acronyms/Abbreviations:

bgs - below ground surface

PCG - preliminary cleanup goal

Table 7-3. Summary Comparison of Concentrations of Constituents of Concern Remaining in Soil Above Preliminary Cleanup Goals for Each Remedial Alternative - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Description:		SW-1 No Action/No Further Action				SW-2 Institutional Controls and Groundwater Monitoring				SW-3 VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Graded Covers, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring			
		Number of Samples Remaining Above PCGs[1]	Depth Range of Samples Remaining Above PCGs (feet bgs)	Min Concentration Remaining (Depth [feet bgs])	Max Concentration Remaining (Depth [feet bgs])	Number of Samples Remaining Above PCGs[1]	Depth Range of Samples Remaining Above PCGs (feet bgs)	Min Concentration Remaining (Depth [feet bgs])	Max Concentration Remaining (Depth [feet bgs])	Number of Samples Remaining Above PCGs[1]	Depth Range of Samples Remaining Above PCGs (feet bgs)	Min Concentration Remaining (Depth [feet bgs])	Max Concentration Remaining (Depth [feet bgs])
Disposal Unit	**Units**												
Eastern Trenches													
Carbon-14	pCi/g	4	0.5-40	1.15 J[2] (0.5)	8.3 J (40)	4	0.5-40	1.15 (0.5)	8.3 J (40)	4	0.5-40	1.15 (0.5)	8.3 J (40)
Tritium (Hydrogen-3)	pCi/g	6	0.5-30	1.3 (15)	333 (5)	6	0.5-30	1.3 (15)	333 (5)	6	0.5-30	1.3 (15)	333 (5)
1,2-Dichloroethane	µg/m^3	2	15-25	43 (25)	330 (15)	2	15-25	43 (25)	330 (15)	1	25	---	43 (25)
1,2-Dichloropropane	µg/m^3	1	15	---	1,900 (15)	1	15	---	1,900 (15)	0	---	---	---
1,3-Butadiene	µg/m^3	1	5	---	17 J (5)	1	5	---	17 J (5)	0	---	---	---
Chloroform	µg/m^3	3	5-25	710 (25)	13,000 (15)	3	5-25	710 (25)	13,000 (15)	1	25	---	710 (25)
Landfill Unit No. 1													
Arsenic	mg/kg	6	2.5-7	19.4 (4.5)	140 (2.5)	6	2.5-7	19.4 (4.5)	140 (2.5)	6	2.5-7	19.4 (4.5)	140 (2.5)
Benzo(a)pyrene	mg/kg	1	0	---	0.022 (0)	1	0	---	0.022 (0)	1	0	---	0.022 (0)
Carbon-14	pCi/g	5	0.5-25	1.02 J (15.5)	4.74 (0.5)	5	0.5-25	1.02 J (15.5)	4.74 (0.5)	5	0.5-25	1.02 J (15.5)	4.74 (0.5)
Copper	mg/kg	6	2.5-7	160 (5.5)	2,690 (4.5)	6	2.5-7	160 (5.5)	2,690 (4.5)	6	2.5-7	160 (5.5)	2,690 (4.5)
Lead	mg/kg	7	0.5-7	330 (5.5)	3,640 (0.5)	7	0.5-7	330 (5.5)	3,640 (0.5)	7	0.5-7	330 (5.5)	3,640 (0.5)
Selenium	mg/kg	11	0.5-20	1.32 (0.5)	13 (4)	11	0.5-20	1.32 (0.5)	13 (4)	11	0.5-20	1.32 (0.5)	13 (4)
1,3-Butadiene	µg/m^3	1	15	---	74 (15)	1	15	---	74 (15)	1	15	---	74 (15)
Landfill Unit No. 2													
Benzo(a)anthracene	mg/kg	1	2.5	---	0.68 (2.5)	1	2.5	---	0.68 (2.5)	1	2.5	---	0.68 (2.5)
Benzo(a)pyrene	mg/kg	2	2.5-5	0.036 (5)	0.49 (2.5)	2	2.5-5	0.036 (5)	0.49 (2.5)	2	2.5-5	0.036 (5)	0.49 (2.5)
Benzo(b)fluoranthene	mg/kg	1	2.5	---	0.47 (2.5)	1	2.5	---	0.47 (2.5)	1	2.5	---	0.47 (2.5)
Cadmium	mg/kg	13	0.5-32.5	0.65 (0.5)	6.7 (2.5)	13	0.5-32.5	0.65 (0.5)	6.7 (2.5)	13	0.5-32.5	0.65 (0.5)	6.7 (2.5)
Carbon-14	pCi/g	7	0.3-30	1.07 (30)	4.2 J (0.3)	7	0.3-30	1.07 (30)	4.2 J (0.3)	7	0.3-30	1.07 (30)	4.2 J (0.3)
Cesium-137	pCi/g	9	0-9.5	0.062 (0)	0.252 (4)	9	0-9.5	0.062 (0)	0.252 (4)	9	0-9.5	0.062 (0)	0.252 (4)
Lead	mg/kg	9	0.5-12.3	129 (0.5)	938 (12.3)	9	0.5-12.3	129 (0.5)	938 (12.3)	9	0.5-12.3	129 (0.5)	938 (12.3)
Potassium-40	pCi/g	4	12.5-15	14.1 (15)	18.6 (15)	4	12.5-15	14.1 (15)	18.6 (15)	4	12.5-15	14.1 (15)	18.6 (15)
Strontium-90	pCi/g	2	5-12.3	0.34 (12.3)	0.42 (5)	2	5-12.3	0.34 (12.3)	0.42 (5)	2	5-12.3	0.34 (12.3)	0.42 (5)
Aroclor 1260	mg/kg	1	2.5	---	0.31 (2.5)	1	2.5	---	0.31 (2.5)	1	2.5	---	0.31 (2.5)
1,2-Dichloropropane	µg/m^3	1	5	---	910 (5)	1	5	---	910 (5)	0	---	---	---
Chloroform	µg/m^3	4	5-25	380 (15)	16,000 (15)	4	5-25	380 (15)	16,000 (15)	1	25	---	920 (25)
Tetrachloroethene	µg/m^3	2	5-15	1,500 (15)	2,600 (5)	2	5-15	1,500 (15)	2,600 (5)	0	---	---	---
Landfill Unit No. 3													
Barium	mg/kg	8	1.5-32.5	262 (7)	968 (1.5)	8	1.5-32.5	262 (7)	968 (1.5)	8	1.5-32.5	262 (7)	968 (1.5)
Cadmium	mg/kg	14	0.3-32.5	0.86 (0.3)	20 (5.5)	14	0.3-32.5	0.86 (0.3)	20 (5.5)	14	0.3-32.5	0.86 (0.3)	20 (5.5)
Carbon-14	pCi/g	8	0-32.5	0.45 (0)	3.77 (0)	8	0-32.5	0.45 (0)	3.77 (0)	8	0-32.5	0.45 (0)	3.77 (0)
Cesium-137	pCi/g	12	0-10	0.065 (0)	1.67 (4)	12	0-10	0.065 (0)	1.67 (4)	12	0-10	0.065 (0)	1.67 (4)
Copper	mg/kg	6	1.5-8.5	165 (5.5)	1,700 (8.5)	6	1.5-8.5	165 (5.5)	1,700 (8.5)	6	1.5-8.5	165 (5.5)	1,700 (8.5)
Lead	mg/kg	10	0.3-10	155 (1.3)	2,540 (1.5)	10	0.3-10	155 (1.3)	2,540 (1.5)	10	0.3-10	155 (1.3)	2,540 (1.5)
Manganese	mg/kg	1	1.3	---	4,300 (1.3)	1	1.3	---	4,300 (1.3)	1	1.3	---	4,300 (1.3)
Aroclor 1260	mg/kg	1	1.5	---	1.6 (1.5)	1	1.5	---	1.6 (1.5)	1	1.5	---	1.6 (1.5)
Strontium-90	pCi/g	6	0-10	0.88 (0)	5.07 (4)	6	0-10	0.88 (0)	5.07 (4)	6	0-10	0.88 (0)	5.07 (4)
Southern Trenches													
Carbon-14	pCi/g	1	2.7	---	15.1 (2.7)	1	2.7	---	15.1 (2.7)	1	2.7	---	15.1 (2.7)
Waste Burial Holes													
Carbon-14	pCi/g	55	0.5-35	0.323 J (19)	1,442 (7)	55	0.5-35	0.323 J (19)	1,442 (7)	55	0.5-35	0.323 J (19)	1,442 (7)
Cesium-137	pCi/g	1	7	---	4,610 (7)	1	7	---	4,610 (7)	1	7	---	4,610 (7)
Naphthalene	mg/kg	1	7	---	92 (7)	1	7	---	92 (7)	1	7	---	92 (7)
Strontium-90	pCi/g	7	2-12	0.44 (5.25)	25.5 (12)	7	2-12	0.44 (5.25)	25.5 (12)	7	2-12	0.44 (5.25)	25.5 (12)
Tritium (Hydrogen-3)	pCi/g	60	0.5-35	1.31 J (11)	3,930 (15)	60	0.5-35	1.31 J (11)	3,930 (15)	60	0.5-35	1.31 J (11)	3,930 (15)

Table 7-3. Summary Comparison of Concentrations of Constituents of Concern Remaining in Soil Above Preliminary Cleanup Goals for Each Remedial Alternative - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

Description:		SW-4				SW-5				SW-6			
		VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Evapotranspiration Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring				VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Asphalt Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring				VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring			
		Number of Samples Remaining Above PCGs[1]	Depth Range of Samples Remaining Above PCGs (feet bgs)	Min Concentration Remaining (Depth [feet bgs])	Max Concentration Remaining (Depth [feet bgs])	Number of Samples Remaining Above PCGs[1]	Depth Range of Samples Remaining Above PCGs (feet bgs)	Min Concentration Remaining (Depth [feet bgs])	Max Concentration Remaining (Depth [feet bgs])	Number of Samples Remaining Above PCGs[1]	Depth Range of Samples Remaining Above PCGs (feet bgs)	Min Concentration Remaining (Depth [feet bgs])	Max Concentration Remaining (Depth [feet bgs])
Disposal Unit	**Units**												
Eastern Trenches													
Carbon-14	pCi/g	4	0.5-40	1.15 (0.5)	8.3 J (40)	4	0.5-40	1.15 (0.5)	8.3 J (40)	3	10-40	1.8 J (10)	8.3 J (40)
Tritium (Hydrogen-3)	pCi/g	6	0.5-30	1.3 (15)	333 (5)	6	0.5-30	1.3 (15)	333 (5)	3	15-30	1.3 (15)	3.37 (25)
1,2-Dichloroethane	µg/m^3	1	25	---	43 (25)	1	25	---	43 (25)	1	25	---	43 (25)
1,2-Dichloropropane	µg/m^3	0	---	---	---	0	---	---	---	0	---	---	---
1,3-Butadiene	µg/m^3	0	---	---	---	0	---	---	---	0	---	---	---
Chloroform	µg/m^3	1	25	---	710 (25)	1	25	---	710 (25)	1	25	---	710 (25)
Landfill Unit No. 1													
Arsenic	mg/kg	6	2.5-7	19.4 (4.5)	140 (2.5)	6	2.5-7	19.4 (4.5)	140 (2.5)	6	2.5-7	19.4 (4.5)	140 (2.5)
Benzo(a)pyrene	mg/kg	1	0	---	0.022 (0)	1	0	---	0.022 (0)	1	0	---	0.022 (0)
Carbon-14	pCi/g	5	0.5-25	1.02 J (15.5)	4.74 (0.5)	5	0.5-25	1.02 J (15.5)	4.74 (0.5)	5	0.5-25	1.02 J (15.5)	4.74 (0.5)
Copper	mg/kg	6	2.5-7	160 (5.5)	2,690 (4.5)	6	2.5-7	160 (5.5)	2,690 (4.5)	6	2.5-7	160 (5.5)	2,690 (4.5)
Lead	mg/kg	7	0.5-7	330 (5.5)	3,640 (0.5)	7	0.5-7	330 (5.5)	3,640 (0.5)	7	0.5-7	330 (5.5)	3,640 (0.5)
Selenium	mg/kg	11	0.5-20	1.32 (0.5)	13 (4)	11	0.5-20	1.32 (0.5)	13 (4)	11	0.5-20	1.32 (0.5)	13 (4)
1,3-Butadiene	µg/m^3	1	15	---	74 (15)	1	15	---	74 (15)	1	15	---	74 (15)
Landfill Unit No. 2													
Benzo(a)anthracene	mg/kg	1	2.5	---	0.68 (2.5)	1	2.5	---	0.68 (2.5)	1	2.5	---	0.68 (2.5)
Benzo(a)pyrene	mg/kg	2	2.5-5	0.036 (5)	0.49 (2.5)	2	2.5-5	0.036 (5)	0.49 (2.5)	2	2.5-5	0.036 (5)	0.49 (2.5)
Benzo(b)fluoranthene	mg/kg	1	2.5	---	0.47 (2.5)	1	2.5	---	0.47 (2.5)	1	2.5	---	0.47 (2.5)
Cadmium	mg/kg	13	0.5-32.5	0.65 (0.5)	6.7 (2.5)	13	0.5-32.5	0.65 (0.5)	6.7 (2.5)	13	0.5-32.5	0.65 (0.5)	6.7 (2.5)
Carbon-14	pCi/g	7	0.3-30	1.07 (30)	4.2 J (0.3)	7	0.3-30	1.07 (30)	4.2 J (0.3)	7	0.3-30	1.07 (30)	4.2 J (0.3)
Cesium-137	pCi/g	9	0-9.5	0.062 (0)	0.252 (4)	9	0-9.5	0.062 (0)	0.252 (4)	9	0-9.5	0.062 (0)	0.252 (4)
Lead	mg/kg	9	0.5-12.3	129 (0.5)	938 (12.3)	9	0.5-12.3	129 (0.5)	938 (12.3)	9	0.5-12.3	129 (0.5)	938 (12.3)
Potassium-40	pCi/g	4	12.5-15	14.1 (15)	18.6 (15)	4	12.5-15	14.1 (15)	18.6 (15)	4	12.5-15	14.1 (15)	18.6 (15)
Strontium-90	pCi/g	2	5-12.3	0.34 (12.3)	0.42 (5)	2	5-12.3	0.34 (12.3)	0.42 (5)	2	5-12.3	0.34 (12.3)	0.42 (5)
Aroclor 1260	mg/kg	1	2.5	---	0.31 (2.5)	1	2.5	---	0.31 (2.5)	1	2.5	---	0.31 (2.5)
1,2-Dichloropropane	µg/m^3	0	---	---	---	0	---	---	---	0	---	---	---
Chloroform	µg/m^3	1	25	---	920 (25)	1	25	---	920 (25)	1	25	---	920 (25)
Tetrachloroethene	µg/m^3	0	---	---	---	0	---	---	---	0	---	---	---
Landfill Unit No. 3													
Barium	mg/kg	8	1.5-32.5	262 (7)	968 (1.5)	7	4-32.5	262 (7)	500 (8.5)	7	4-32.5	262 (7)	500 (8.5)
Cadmium	mg/kg	14	0.3-32.5	0.86 (0.3)	20 (5.5)	11	4-32.5	0.89 (20)	20 (5.5)	11	4-32.5	0.89 (20)	20 (5.5)
Carbon-14	pCi/g	8	0-32.5	0.45 (0)	3.77 (0)	6	0-32.5	0.45 (0)	3.77 (0)	6	0-32.5	0.45 (0)	3.77 (0)
Cesium-137	pCi/g	12	0-10	0.065 (0)	1.67 (4)	9	0-10	0.065 (0)	1.67 (4)	9	0-10	0.065 (0)	1.67 (4)
Copper	mg/kg	6	1.5-8.5	165 (5.5)	1,700 (8.5)	5	5.5-8.5	165 (5.5)	1,700 (8.5)	5	5.5-8.5	165 (5.5)	1,700 (8.5)
Lead	mg/kg	10	0.3-10	155 (1.3)	2,540 (1.5)	7	4-10	164 (7)	1,800 (8.5)	7	4-10	164 (7)	1,800 (8.5)
Manganese	mg/kg	1	1.3	---	4,300 (1.3)	0	---	---	---	0	---	---	---
Aroclor 1260	mg/kg	1	1.5	---	1.6 (1.5)	0	---	---	---	0	---	---	---
Strontium-90	pCi/g	6	0-10	0.88 (0)	5.07 (4)	6	0-10	0.88 (0)	5.07 (4)	6	0-10	0.88 (0)	5.07 (4)
Southern Trenches													
Carbon-14	pCi/g	1	2.7	---	15.1 (2.7)	1	2.7	---	15.1 (2.7)	1	2.7	---	15.1 (2.7)
Waste Burial Holes													
Carbon-14	pCi/g	55	0.5-35	0.323 J (19)	1,442 (7)	55	0.5-35	0.323 J (19)	1,442 (7)	55	0.5-35	0.323 J (19)	1,442 (7)
Cesium-137	pCi/g	1	7	---	4,610 (7)	1	7	---	4,610 (7)	1	7	---	4,610 (7)
Naphthalene	mg/kg	1	7	---	92 (7)	1	7	---	92 (7)	1	7	---	92 (7)
Strontium-90	pCi/g	7	2-12	0.44 (5.25)	25.5 (12)	7	2-12	0.44 (5.25)	25.5 (12)	7	2-12	0.44 (5.25)	25.5 (12)
Tritium (Hydrogen-3)	pCi/g	60	0.5-35	1.31 J (11)	3,930 (15)	60	0.5-35	1.31 J (11)	3,930 (15)	60	0.5-35	1.31 J (11)	3,930 (15)

Table 7-3. Summary Comparison of Concentrations of Constituents of Concern Remaining in Soil Above Preliminary Cleanup Goals for Each Remedial Alternative - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

		SW-7				SW-8				SW-9				SW-10			
Description:		**VOC "Hot Spot" Removal, Two On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**				**VOC "Hot Spot" Removal, One On-Site Lined Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**				**Excavate and Dispose of Waste Off-Site, Waste Burial Holes Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**				**Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**			
		Number of Samples Remaining Above PCGs[1]	**Depth Range of Samples Remaining Above PCGs (feet bgs)**	**Min Concentration Remaining (Depth [feet bgs])**	**Max Concentration Remaining (Depth [feet bgs])**	**Number of Samples Remaining Above PCGs[1]**	**Depth Range of Samples Remaining Above PCGs (feet bgs)**	**Min Concentration Remaining (Depth [feet bgs])**	**Max Concentration Remaining (Depth [feet bgs])**	**Number of Samples Remaining Above PCGs[1]**	**Depth Range of Samples Remaining Above PCGs (feet bgs)**	**Min Concentration Remaining (Depth [feet bgs])**	**Max Concentration Remaining (Depth [feet bgs])**	**Number of Samples Remaining Above PCGs[1]**	**Depth Range of Samples Remaining Above PCGs (feet bgs)**	**Min Concentration Remaining (Depth [feet bgs])**	**Max Concentration Remaining (Depth [feet bgs])**
Disposal Unit	**Units**																
Eastern Trenches																	
Carbon-14	pCi/g	3	10-40	1.8 J (10)	8.3 J (40)	1	40	---	8.3 J (40)	3	10-40	1.8 J (10)	8.3 J (40)	3	10-40	1.8 J (10)	8.3 J (40)
Tritium (Hydrogen-3)	pCi/g	3	15-30	1.3 (15)	3.37 (25)	2	25-30	1.49 (30)	3.37 (25)	3	15-30	1.3 (15)	3.37 (25)	3	15-30	1.3 (15)	3.37 (25)
1,2-Dichloroethane	$\mu g/m^3$	1	25	---	43 (25)	1	25	---	43 (25)	1	25	---	43 (25)	1	25	---	43 (25)
1,2-Dichloropropane	$\mu g/m^3$	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
1,3-Butadiene	$\mu g/m^3$	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Chloroform	$\mu g/m^3$	1	25	---	710 (25)	1	25	---	710 (25)	1	25	---	710 (25)	1	25	---	710 (25)
Landfill Unit No. 1																	
Arsenic	mg/kg	6	2.5-7	19.4 (4.5)	140 (2.5)	0	---	---	---	0	---	---	---	0	---	---	---
Benzo(a)pyrene	mg/kg	1	0	---	0.022 (0)	0	---	---	---	0	---	---	---	0	---	---	---
Carbon-14	pCi/g	5	0.5-25	1.02 J (15.5)	4.74 (0.5)	1	25	---	2.6 (25)	3	15.5-25	1.02 J (15.5)	2.6 (25)	3	15.5-25	1.02 J (15.5)	2.6 (25)
Copper	mg/kg	6	2.5-7	160 (5.5)	2,690 (4.5)	0	---	---	---	0	---	---	---	0	---	---	---
Lead	mg/kg	7	0.5-7	330 (5.5)	3,640 (0.5)	0	---	---	---	0	---	---	---	0	---	---	---
Selenium	mg/kg	11	0.5-20	1.32 (0.5)	13 (4)	0	---	---	---	2	15-20	2.7 (20)	3.1 (15)	2	15-20	2.7 (20)	3.1 (15)
1,3-Butadiene	$\mu g/m^3$	1	15	---	74 (15)	0	---	---	---	1	15	---	74 (15)	1	15	---	74 (15)
Landfill Unit No. 2																	
Benzo(a)anthracene	mg/kg	1	2.5	---	0.68 (2.5)	0	---	---	---	0	---	---	---	0	---	---	---
Benzo(a)pyrene	mg/kg	2	2.5-5	0.036 (5)	0.49 (2.5)	0	---	---	---	0	---	---	---	0	---	---	---
Benzo(b)fluoranthene	mg/kg	1	2.5	---	0.47 (2.5)	0	---	---	---	0	---	---	---	0	---	---	---
Cadmium	mg/kg	13	0.5-32.5	0.65 (0.5)	6.7 (2.5)	2	25-32.5	1.1 (32.5)	1.4 (25)	3	20-32.5	1.1 (32.5)	1.4 (25)	3	20-32.5	1.1 (32.5)	1.4 (25)
Carbon-14	pCi/g	7	0.3-30	1.07 (30)	4.2 J (0.3)	1	30	---	1.07 (30)	3	7.5-30	1.07 (30)	2.4 (15)	3	7.5-30	1.07 (30)	2.4 (15)
Cesium-137	pCi/g	9	0-9.5	0.062 (0)	0.252 (4)	0	---	---	---	1	0	---	0.062 (0)	1	0		0.062 (0)
Lead	mg/kg	9	0.5-12.3	129 (0.5)	938 (12.3)	0	---	---	---	0	---	---	---	0	---	---	---
Potassium-40	pCi/g	4	12.5-15	14.1 (15)	18.6 (15)	0	---	---	---	3	15	14.1 (15)	18.6 (15)	3	15	14.1 (15)	18.6 (15)
Strontium-90	pCi/g	2	5-12.3	0.34 (12.3)	0.42 (5)	0	---	---	---	0	---	---	---	0	---	---	---
Aroclor 1260	mg/kg	1	2.5	---	0.31 (2.5)	0	---	---	---	0	---	---	---	0	---	---	---
1,2-Dichloropropane	$\mu g/m^3$	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Chloroform	$\mu g/m^3$	1	25	---	920 (25)	1	25	---	920 (25)	1	25	---	920 (25)	1	25	---	920 (25)
Tetrachloroethene	$\mu g/m^3$	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Landfill Unit No. 3																	
Barium	mg/kg	3	20-32.5	342 (20)	410 (25)	3	20-32.5	342 (20)	410 (25)	3	20-32.5	342 (20)	410 (25)	3	20-32.5	342 (20)	410 (25)
Cadmium	mg/kg	4	12.5-32.5	0.89 (20)	1.6 (27.5)	4	12.5-32.5	0.89 (20)	1.6 (27.5)	4	12.5-32.5	0.89 (20)	1.6 (27.5)	4	12.5-32.5	0.89 (20)	1.6 (27.5)
Carbon-14	pCi/g	2	14-32.5	0.87 J (32.5)	1.29 (14)	2	14-32.5	0.87 J (32.5)	1.29 (14)	2	14-32.5	0.87 J (32.5)	1.29 (14)	2	14-32.5	0.87 J (32.5)	1.29 (14)
Cesium-137	pCi/g	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Copper	mg/kg	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Lead	mg/kg	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Manganese	mg/kg	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Aroclor 1260	mg/kg	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Strontium-90	pCi/g	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Southern Trenches																	
Carbon-14	pCi/g	0	---	---	---	0	---	---	---	0	---	---	---	0	---	---	---
Waste Burial Holes																	
Carbon-14	pCi/g	55	0.5-35	0.323 J (19)	1,442 (7)	55	0.5-35	0.323 J (19)	1,442 (7)	55	0.5-35	0.323 J (19)	1,442 (7)	12	12-35	0.383 J (19)	1.9 J (35)
Cesium-137	pCi/g	1	7	---	4,610 (7)	1	7	---	4,610 (7)	1	7	---	4,610 (7)	0	---	---	---
Naphthalene	mg/kg	1	7	---	92 (7)	1	7	---	92 (7)	1	7	---	92 (7)	0	---	---	---
Strontium-90	pCi/g	7	2-12	0.44 (5.25)	25.5 (12)	7	2-12	0.44 (5.25)	25.5 (12)	7	2-12	0.44 (5.25)	25.5 (12)	1	12	---	25.5 (12)
Tritium (Hydrogen-3)	pCi/g	60	0.5-35	1.31 J (11)	3,930 (15)	60	0.5-35	1.31 J (11)	3,930 (15)	60	0.5-35	1.31 J (11)	3,930 (15)	1	35	---	147 (35)

Notes:

[1] PCGs are shown on Table 3-2 for soil/solid waste COCs in the 0-10 feet bgs depth interval, on Table 3-3 for soil/solid waste COCs in the 10-20 feet bgs and greater than 20 feet bgs depth intervals, and on Table 3-5 for soil vapor COCs in each depth interval.

[2] J - concentration is an estimated value

Acronyms/Abbreviations:

bgs - below ground surface

mg/kg - milligrams per kilogram

PCG - preliminary cleanup goal

pCi/g - picocuries per gram

VOC - volatile organic compound

$\mu g/m^3$ - micrograms per cubic meter

References:

Biwer, Bruce M., and James P. Butler, 1999. *Vehicle Emission Unit Risk Factors for Transportation Risk Assessments**. Risk Analysis 19.6: 1157-171. *Wiley Online Library*. Web. 4 Nov. 2010.

United States Department of Transportation (US DOT), 2008, *Traffic Safety Facts*, National Highway Traffic Safety Administration.

Table 7-4. Comparison of Remedial Alternative Costs - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

	Alternative Components	SW-1 No Action/No Further Action	SW-2 Institutional Controls and Groundwater Monitoring	SW-3 VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Graded Covers, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	SW-4 VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Evapotranspiration Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	SW-5 VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Asphalt Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	SW-6 VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	SW-7 VOC "Hot Spot" Removal, Two On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	SW-8 VOC "Hot Spot" Removal, One On-Site Lined Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	SW-9 Excavate and Dispose of Waste Off-Site, Waste Burial Holes Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring	SW-10 Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring
Pre-Remediation Capital Costs	Biological Survey	---	---	$86,304	$86,304	$86,304	$86,304	$86,304	$86,304	$86,304	$86,304
	Elderberry Mitigation	---	---	$270,000	$270,000	$270,000	$270,000	$270,000	$270,000	$270,000	$270,000
	Data Gap Investigation	---	$157,394	$157,394	$157,394	$157,394	$157,394	---	---	---	---
	Decontamination Facilities[a]	---	$37,879	$195,984	$582,436	$582,436	$582,436	$582,436	$1,157,352	$1,157,352	$1,157,352
	Building D&D (including disposal)	---	---	$94,688	$314,966	$314,966	$314,966	$314,966	$314,966	$511,850	$511,850
	Decommission Groundwater Wells[b]	---	---	---	$624,402	$624,402	$624,402	$624,402	$631,623	$624,402	$624,402
	Clearing and Grubbing[c]	---	---	$52,025	$52,025	$52,025	$52,025	$54,151	$60,339	$54,151	$54,151
	Demolish LFU-3 N-S Drainage Channel	---	---	---	$5,026	$5,026	$5,026	$10,264	$10,264	$10,264	$10,264
Excavation and Backfill Capital Costs	ET PTW and Exploratory Trench Excavation and Backfill[d]	---	---	$125,480	$118,150	$118,150	---[e]	---[e]	---[e]	---[e]	---[e]
	LFU-1 PTW and Exploratory Trench Excavation and Backfill[d]	---	---	$285,662	$278,207	$278,207	$278,207	$278,207	---[f]	---[f]	---[f]
	LFU-2 PTW and Exploratory Trench Excavation and Backfill[d]	---	---	$310,177	$300,782	$300,782	$300,782	$300,782	---[g]	---[g]	---[g]
	LFU-3 PTW and Exploratory Trench Excavation and Backfill[d]	---	---	$72,889	$71,311	$71,311	$71,311	---[h]	---[h]	---[h]	---[h]
	ET Excavation and Backfill	---	---	---	---	---	$273,170	$273,170	$301,634 [i]	$690,687	$690,687
	ET VOC "Hot Spot" Excavation and Backfill	---	---	$234,122	$181,700	$181,700	$181,700	$181,700	$174,189 [i]	$252,758	$252,758
	LFU-1 Drainage Area Excavation and Backfill	---	---	---	$609,893	$609,893	$609,893	$609,893	---[j]	---[j]	---[j]
	LFU-1 Excavation and Backfill	---	---	---	---	---	---	---	$952,602 [i]	$2,775,120	$2,775,120
	LFU-2 Excavation and Backfill	---	---	---	---	---	---	---	$1,010,770 [i]	$2,619,614	$2,619,614
	LFU-2 VOC "Hot Spot" Excavation and Backfill	---	---	$196,258	$47,289	$47,289	$47,289	$47,289	---[k]	$253,312	$253,312
	LFU-3 Drainage Area Excavation and Backfill	---	---	---	$269,681	$269,681	$269,681	---[l]	---[l]	---[l]	---[l]
	LFU-3 Excavation and Backfill	---	---	---	---	---	---	$893,073	$230,423 [i]	$893,073	$893,073
	ST and HFSDA Excavation and Backfill	---	---	---	---	---	---	$206,155	$78,337 [i]	$206,155	$206,155
	WBH Excavation and Backfill	---	---	---	---	---	---	---	---	---	$478,752
	Non-Impacted Area Excavation and Backfill	---	---	---	---	---	---	---	$568,546 [i]	---	---
Materials Management and Disposal Capital Costs	Materials Management[m]	---	---	$472,652	$1,078,201	$1,078,201	$1,548,268	$2,143,896	$7,157,613	$7,259,526	$7,366,984
	Excavated Material Consolidation[n]	---	---	---	$45,243	$45,243	$50,438	$87,682	$700,300	$9,549	---
	Off-Site Transportation and Disposal	---	$8,339	$2,291,553	$2,386,533	$2,386,533	$2,425,318	$2,590,911	$3,778,710	$77,135,180	$83,868,657
CAMU Construction Capital Costs	LFU-1 Graded Cover/Cap	---	---	$256,367	$775,270	$1,250,719	$1,113,709	$1,113,709	---	---	---
	LFU-2/ET/WBH Graded Cover/Cap	---	---	$383,333	$1,323,777	$2,183,121	$1,861,724	$1,861,724	---	---	---
	LFU-3 Graded Cover/Cap	---	---	$88,118	$298,888	$466,033	$408,092	---	---	---	---
	WBH Cap	---	---	---	---	---	---	---	---	$338,380	---
	Multiple-Layer Cap With Liner and LCRS	---	---	---	---	---	---	---	$7,455,403	---	---
Post-Remediation Capital Costs	Install New Groundwater Wells[b]	---	$115,168	$118,168	$297,551	$297,551	$297,551	$297,551	$288,862	$297,551	$297,551
	Storm Drainage[o]	---	---	$691,009	$687,484	$707,262	$687,484	$474,347	$476,807	---	---
	LFU-1 Drainage Channel/Swale	---	---	$29,823	$18,841	$18,841	$18,841	$18,841	$18,841	$18,841	$18,841
	LFU-3 Drainage Channels	---	---	$51,820	$116,775	$116,775	$116,775	$91,540	$91,540	$91,540	$91,540
	Building Reconstruction[p]	---	---	---	$423,616	$423,616	$423,616	$423,616	$423,616	$423,616	$423,616
	Total Capital Costs	**$0**	**$318,780**	**$6,463,826**	**$11,421,744**	**$12,943,460**	**$13,076,401**	**$13,836,609**	**$26,239,041**	**$95,979,224**	**$102,950,982**
Operations and Maintenance Costs	Institutional Controls	---	$1,144,900	$1,144,900	$1,144,900	$1,144,900	$1,144,900	$1,144,900	$1,144,900	$1,144,900	$1,144,900
	Groundwater and Storm Water Monitoring[b]	---	$4,873,320	$4,873,320	$4,383,323	$4,383,323	$4,383,323	$4,383,323	$4,040,774	$4,383,323	$4,383,323
	O&M Drainage System[q]	---	---	$200,901	$200,901	$200,901	$200,901	$133,934	$133,934	$33,483	$33,483
	O&M of Caps	---	---	$702,560	$1,164,386	$2,035,744	$1,300,501	$1,180,095	$1,379,232	$428,598	---
	O&M of Leachate Collection and Recovery System	---	---	---	---	---	---	---	$249,432	---	---
	Total O&M Costs	**$0**	**$6,018,220**	**$6,921,681**	**$6,893,510**	**$7,764,868**	**$7,029,624**	**$6,842,252**	**$6,948,273**	**$5,990,304**	**$5,561,706**

Table 7-4. Comparison of Remedial Alternative Costs - Laboratory for Energy-related Health Research/Old Campus Landfill, University of California, Davis

		SW-1	SW-2	SW-3	SW-4	SW-5	SW-6	SW-7	SW-8	SW-9	SW-10
	Alternative Components	**No Action/No Further Action**	**Institutional Controls and Groundwater Monitoring**	**VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Graded Covers, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Evapotranspiration Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Asphalt Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**VOC "Hot Spot" Removal, Three On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**VOC "Hot Spot" Removal, Two On-Site Corrective Action Management Units with Multiple-Layer Caps, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**VOC "Hot Spot" Removal, One On-Site Lined Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**Excavate and Dispose of Waste Off-Site, Waste Burial Holes Corrective Action Management Unit with Multiple-Layer Cap, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**	**Excavate and Dispose of Waste Off-Site, Institutional Controls, Drainage Enhancements, and Groundwater Monitoring**
Periodic Costs	Periodic Storm Water Lift Station Repair	---	---	$12,225	$12,225	$12,225	$12,225	$8,150	$8,150	---	---
Periodic Costs	Five-Year Reviews	---	$173,297	$173,297	$173,297	$173,297	$173,297	$173,297	$173,297	$173,297	$173,297
	Total Periodic Costs	**$0**	**$173,297**	**$185,523**	**$185,523**	**$185,523**	**$185,523**	**$181,448**	**$181,448**	**$173,297**	**$173,297**
Cost Summary	Total Project Duration (Years)	0	100	100	100	100	100	100	100	100	100
	Total Capital Cost	$0	$318,780	$6,463,826	$11,421,744	$12,943,460	$13,076,401	$13,836,609	$26,239,041	$95,979,224	$102,950,982
	Total O&M Cost	$0	$6,018,220	$6,921,681	$6,893,510	$7,764,868	$7,029,624	$6,842,252	$6,948,273	$5,990,304	$5,561,706
	Total Periodic Cost	$0	$173,297	$185,523	$185,523	$185,523	$185,523	$181,448	$181,448	$173,297	$173,297
	Total Present Value of Alternative[r]	**$0**	**$6,510,297**	**$13,571,030**	**$18,500,777**	**$20,893,851**	**$20,291,548**	**$20,860,309**	**$33,368,762**	**$102,142,825**	**$108,685,985**
	Contingent Action[s]	---	---	$44,059	$149,444	$233,016	$204,046	---	$6,992,711	---	---
	Total Present Value of Alternative Plus Contingent Action Costs	***$0***	***$6,510,297***	***$13,615,089***	***$18,650,222***	***$21,126,868***	***$20,495,595***	***$20,860,309***	***$40,361,473***	***$102,142,825***	***$108,685,985***

Notes:

Totaled values are rounded up to the nearest whole dollar.

[a] Includes temporary facilities for decontamination of personnel and equipment; cost is proportional to the duration of the remedial action (one construction season or less in Alternatives SW-2 through SW-7 and two construction seasons in Alternatives SW-8, SW-9, and SW-10).

[b] Table 5-3 lists Site wells to be decommissioned, monitored, and constructed for each alternative. Note for Alternative SW-3, the same number of new groundwater monitoring wells are installed as in Alternative SW-2, but additional cost is included for extension of well casings for three existing wells so they are accessible from the newly established ground surface.

[c] Costs are related to the area to be cleared prior to remedial excavation or installation of a cap. Alternatives SW-3 through SW-6 do not include the ST and HFSDA, whereas Alternatives SW-7 through SW-10 do. Alternative SW-8 also includes the non-impacted area between the ET and LFU-1.

[d] PTW and Exploratory Trench Excavation includes the cost of a geophysical survey to be performed prior to excavation.

[e] The ET PTW and Exploratory Trenches will be excavated as part of the ET excavation under the Alternative indicated.

[f] The LFU-1 PTW and Exploratory Trenches will be excavated as part of the LFU-1 excavation under the Alternative indicated.

[g] The LFU-2 PTW and Exploratory Trenches will be excavated as part of the LFU-2 excavation under the Alternative indicated.

[h] The LFU-3 PTW and Exploratory Trenches will be excavated as part of the LFU-3 excavation under the Alternative indicated.

[i] Under Alternative SW-8, excavation and backfill costs are calculated differently from those in other alternatives. For excavations occurring within the footprint of the liner and cap, backfilling of excavated material into the lined CAMU is costed separately under "Excavated Material Consolidation," whereas in areas outside the cap footprint and in other alternatives, the cost of backfilling is included in the excavation cost component. Outside the footprint of the liner and cap, the excavated areas are assumed to receive clean backfill from an on-Site source (non-impacted area) thus lowering the cost in comparison to other alternatives.

[j] Under Alternatives SW-8, SW-9, and SW-10, the LFU-1 Drainage Area is included in the LFU-1 Excavation cost component.

[k] Cost of LFU-2 VOC "Hot Spot" excavation is included under LFU-2 excavation in Alternative SW-8.

[l] Under Alternatives SW-7, SW-8, SW-9, and SW-10, the LFU-3 Drainage Area is included in the LFU-3 Excavation cost component.

[m] Includes the cost of stockpiling and management of excavated materials, waste characterization sampling, and sifting/sorting waste streams.

[n] Includes the cost of consolidating non-PTW excavated material from on-Site excavations within the footprints of on-Site CAMUs and beneath the final caps.

[o] Includes costs of storm water detention basins and infrastructure for storm water conveyance from capped areas to the detention basins and final discharge.

[p] Includes the cost of constructing three warehouse type buildings at the Site, intended to replace the Geriatrics buildings, H-292 and H-293, and buildings H-253 and H-290.

[q] Includes O&M costs for storm water detention basins and associated infrastructure, in addition to storm water drainage channels/swales.

[r] Discount factor for present value analysis is 2.7%; the period of analysis is 100 years.

[s] Contingent Actions are as follows: For Alternative SW-3, the contingent action cost includes grading the ST and HFSDA, whereas in SW-4, SW-5, and SW-6, the contingent action costs include the installation of an evapotranspiration cap, asphalt cap, and multiple-layer cap, respectively, at the ST and HFSDA. For Alternative SW-8, the contingent action cost includes the disposal of the material from the non-impacted area between LFU-1 and the ET as non-RCRA hazardous waste, and the import of clean fill sufficient for backfill of on-Site excavated areas.

Acronyms/Abbreviations:

D&D - decommissioning and demolition
CAMU - corrective action management unit
ET - Eastern Trenches
HFSDA - Hopland Field Station Disposal Area
LCRS - leachate collection and removal system
LFU - landfill unit
N-S - north-south
O&M - operations and maintenance
PTW - principal threat waste
RCRA - Resource Conservation and Recovery Act
ST - Southern Trenches
VOC - volatile organic compound
WBH - Waste Burial Holes

Table 7-5. Green Remediation Best Management Practices for Site Remedial Alternatives - Laboratory for Energy-related Health Research, University of California, Davis

Energy
Use energy-efficient equipment
Proper use and maintenance of vehicles and equipment to improve engine efficiency
Small photovoltaic systems to power auxiliary equipment
Purchase clean energy from off-Site resources
Air and Atmosphere
Use alternative fuels: biodiesel, ultra-low sulfur diesel, fuel additives
Consolidate on-Site and off-Site vehicular trips to reduce fuel consumption
Select appropriately-sized equipment and vehicles
Reduce or eliminate engine idling
Identify local fill sources to reduce transportation impact
Select disposal facility as close as possible to reduce transportation impact
Use high-quality equipment lubricants made of biodegradable ingredients
Water
Use closed-loop graywater washing systems for equipment and vehicles
Land and Ecosystems
Construction best management practices, including straw wattles
Quick-growth seeding and geotextile placements to stabilize excavated material in staging areas
Cover excavated areas with biodegradable fabric
Prompt revegetation of excavated areas after backfill
Use of native rather than imported vegetation
Maximize opportunities for mixed-use and smart-growth land reuse
Materials and Waste
Implement recycling and reuse program for demolition debris, with a focus on on-Site reuse
Salvage woody debris for on-Site landscaping use or sale
Reclaim and stockpile uncontaminated soil to use as fill
Purchase green business supplies, personal protective equipment, etc.
Utilize local workforce
Utilize on-Site *ex situ* treatment to reduce trips to hazardous waste facilities
Reuse investigation-derived waste, if feasible
Locally source soil from campus and other nearby projects

Adapted from:

United States Environmental Protection Agency, 2011, *Introduction to Green Remediation Quick Reference Fact Sheet* , May.