Tables

Table 2-1
Summary of Remedial Investigation Results
Hookston Station
Pleasant Hill, California

Location	Media	Sample Results Compared to MCLs, RWQCB ESLs, and CalEPA CHHSLs									
		TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl Chloride	Non-Hookston VOCs	TPH	SVOCs	PCBs	Metals
Hookston Station Parcel	Shallow soil(≤9.8 ft)	above (6 of 117)	above (2 of 117)	below	nd	below	PCE (below)	above (14 of 47)	above (1 of 5)	below	above (10 of 18)
	Deep soil (>9.8 ft)	above (1 of 122)	below	below	below	nd	benzene and xylenes (above - 2 of 93); PCE (below)	below	ns	ns	ns
	Soil vapor*	above (1 of 2)	nd	nd	nd	nd	PCE, benzene, toluene, ethylbenzene, xylenes (below)	n/a	n/a	n/a	n/a
	Ground water	above (67 of 102)	above (33 of 102)	above (1 of 102)	above (33 of 102)	above (8 of 102)	PCE (15 of 102 above), benzene and MTBE(3 of 102 above)	above (5 of 8)	below	ns	above (8 of 17)
	Indoor air	above (2 of 5)	below	ns	nd	ns	ns	n/a	n/a	n/a	n/a
Outside the Hookston Station Parcel	Shallow soil(≤9.8 ft)	below	nd	nd	nd	nd	nd	nd	ns	ns	above (1 of 1)
	Deep soil (>9.8 ft)	below	nd	nd	nd	nd	nd	ns	ns	ns	ns
	Soil vapor*	above (8 of 23)	above (1 of 23)	below	below	above (3 of 23)	PCE (2 of 23 above), benzene and 1,1,1-TCA (1 of 23 above)	n/a	n/a	n/a	n/a
	Ground water	above (64 of 149)	above (28 of 149)	above (4 of 149)	above (41 of 149)	above (10 of 149)	PCE(10 of 149 above); benzene and MTBE(2 of 149 above)	above (2 of 8)	below	ns	above (18 of 23)
	Indoor air	above (9 of 47)	below	nd	below	above (1 of 42)	PCE (15 of 43 above), benzene (42 of 42 above), 1,2-DCA (8 of 42 above)	n/a	n/a	n/a	n/a
	Surface water	below	below	nd	nd	nd	MTBE (above); PCE and toluene (below)	ns	ns	ns	ns
	Sediment	nd	nd	nd	nd	nd	nd	ns	ns	ns	ns

Notes:
CalEPA CHHSL - CalEPA's California Human Health Screening Level (CalEPA DTSC 2005)
DCA = Dichloroethane
DCE = Dichloroethene
ft = feet
MCL = California Environmental Protection Agency (CalEPA) Maximum Contaminant Level for drinking water
MTBE = Methyl-tert-butyl ether
n/a - not applicable
nd - nondetect
ns - not sampled
PCB = Polychlorinated biphenyl
PCE = Tetrachloroethene
(6 of 100) - indicates frequency of detection above the MCL, ESL, or CHHSL
RWQCB ESL - San Francisco Bay Regional Water Quality Control Board Environmental Screening Level (RWQCB 2005)
SVOC = Semi-volatile organic compound
TCA = Trichloroethane
TCE = Trichloroethene
TPH = Total petroleum hydrocarbons
VOC = Volatile organic compounds
above - indicates compound was detected above the applicable MCL, RWQCB ESL, and/or CalEPA CHHSL
below - indicates compound was detected but at a concentration below the applicable MCL, RWQCB ESL, and/or CalEPA CHHSL
* Based on active soil vapor sampling results
Based on data collected during previous investigations, the remedial investigation, and quarterly monitoring events

Source	Exposure Medium	Pathway	Receptor	Pathway Complete?	Exceeds Carcinogenic Risk Management Level for the Parcel (1 in 100,000)?	Exceeds Noncarcinogenic Risk Management Level (1)?	Primary Constituent Contributing to Risk Exceedance	Notes	Pathway Addressed in FS?
Ground water	Ground water	Ingestion and dermal contact with ground water used for drinking water purposes	Commercial/industrial worker, construction worker	No	-	-	-	Ground water is not used as a potable water supply.	No
Ground water	Indoor air	Inhalation of VOCs released from ground water used for tap or shower water	Commercial/industrial worker, construction worker	No	-	-	-	Ground water is not used as a potable water supply.	No
		Inhalation of VOCs migrating from shallow ground water	Commercial/industrial worker	Yes	No	No	None	Only TCE; cis-1,2-DCE; and 1,1-DCE were evaluated.	No
		Inhalation of VOCs migrating from shallow ground water	Construction worker	No	-	-	-	Construction workers are not expected to spend significant amounts of time indoors.	No
Ground water	Outdoor Air	Inhalation of VOCs migrating from shallow ground water	Commercial/industrial worker, construction worker	Yes	-	-	-	Additional risk characterization was not conducted because exposure pathway is minor due to rapid dilution in outdoor air.	No
Soil	Indoor Air	Inhalation of VOCs migrating from shallow soil	Commercial/industrial worker	Yes	No	No	None	Only TCE; cis-1,2-DCE; and 1,1-DCE were evaluated.	No
	Soil	Ingestion		Yes	No	No	None	Risk characterization based on the highest VOC, SVOC, and TPH detections reported in soil from 0 to 10 feet bgs, and highest metals concentration reported in surface soils (subsurface metals samples were not collected prior to the finalization of the Baseline Risk Assessment). Additional metals soil sampling conducted in June 2006 did not confirm the presence of elevated arsenic concentrations in surface soil but found elevated arsenic conconcentrations in subsurface soil (2 feet bgs). Therefore, this exposure pathway will not be addressed in this FS because commercial/industrial workers are not expected to have dermal contact subsurface soils.	No
	Soil	Dermal Contact		Yes	Yes	No	Arsenic		No (see notes)
	Outdoor air	Inhalation of chemicals migrating from shallow soil		Yes	No	No	None		No
Soil	Indoor air	Inhalation of VOCs migrating from shallow soil	Construction worker	No	-	-	-	Construction workers are not expected to spend significant amounts of time indoors.	No
	Soil	Ingestion		Yes	Yes	No	Arsenic	Risk characterization based on the highest VOC, SVOC, and TPH detections reported in soil from 0 to 10 feet bgs, and highest metals concentration reported in surface soils (subsurface metals samples were not collected prior to the finalization of the Baseline Risk Assessment). Additional soil sampling conducted in June 2006 did not confirm the presence of elevated arsenic concentrations in surface soil but found elevated arsenic concentrations in subsurface soil (2 feet bgs). Therefore, this exposure pathway will be addressed in this FS because construction workers may be exposed to subsurface soils.	Yes
	Soil	Dermal Contact		Yes	No	No	None		No
	Outdoor air	Inhalation of chemicals migrating from shallow soil		Yes	No	No	None		No

Notes:
VOC = Volatile organic compound
TCE = Trichloroethene
PCE = Tetrachloroethene
FS = Feasibility Study
ERM = ERM-West, Inc.
DCE = Dichloroethene
SVOC = Semi-volatile organic compound
bgs = below ground surface
TPH = Total petroleum hydrocarbons

Table 2-3
Summary of Risk Characterization for the Downgradient Study Area
Hookston Station
Pleasant Hill, California

Source	Exposure Medium	Pathway	Receptor	Pathway Complete?	Exceeds Carcinogenic Risk Management Level for Downgradient Study Area (1 in 1,000,000)?	Exceeds Noncarcinogenic Risk Management Level (1)?	Primary Constituent Contributing to Risk Exceedance	Notes	Pathway Addressed in FS?
Impacted ground water	Indoor Air	Inhalation of VOCs released from ground water used for tap or shower water	Downgradient resident	No	-	-	-	Downgradient private wells are not used for potable water supply.	No
		Inhalation of VOCs migrating from shallow ground water	Downgradient resident	Yes	Yes	Yes	Benzene, PCE	Risk characterization based on all VOCs detected in indoor air. Benzene and PCE are not chemicals of concern originating from Hookston Sation, therefore, exposures to benzene and PCE will not be addressed in this FS.	No
				Yes	Yes	No	TCE	Risk characterization based only on chemicals of concern originating from the Hookston Station Parcel (TCE and degradation compounds) detected in indoor air. Risk characterization does not include potential risks posed by PCE and benzene.	Yes
		Inhalation of VOCs migrating from shallow ground water	Downgradient worker	Yes	-	-	-	Pathway addressed by downgradientresident (the most exposed off-site receptor).	Yes (resident)
Impacted ground water	Ground water	Ingestion and dermal contact with ground water used for drinking water purposes	Downgradient resident	No	-	-	-	Downgradient private wells are not used for potable water supply.	No
Impacted ground water	Indoor and Outdoor Air	Inhalation of VOCs released from ground water during irrigation	Downgradient resident	Yes	No	No	None	Based on data collected from backyard irrigation wells. This exposure pathway is addressed in this FS, based on risk calculations for MW-14A.	Yes
				No - hypothetical pathway	Yes	No	TCE, vinyl chloride	Based on data collected from monitoring well MW-14A, which is only used for ground water monitoring purposes.	
Impacted ground water	Ground water	Ingestion of VOCs in ground water used to fill a backyard swimming pool	Downgradient child resident	Yes	No	No	None	Based on data collected from backyard irrigation wells.	Yes
				No - hypothetical pathway	Yes	Yes	None	Based on data collected from monitoring well MW-14A, which is upgradient of the residential neighborhood and is only used for ground water monitoring purposes.	
Impacted ground water	Ground water	Dermal contact with VOCs in ground water used to fill a backyard swimming pool	Downgradient child resident	Yes	No	No	None	Based on data collected from backyard irrigation wells.	Yes
				No - hypothetical pathway	Yes	Yes	None	Based on data collected from monitoring well MW-14A, which is upgradient of the residential neighborhood and is only used for ground water monitoring purposes.	
Impacted ground water	Outdoor air	Inhalation of VOCs in ground water used to fill a backyard swimming pool	Downgradient child resident	Yes	No	No	None	Based on data collected from backyard irrigation wells.	No (pathway addressed by default due to dermal and inhalation pathways)
				No - hypothetical pathway	No	No	None	Based on data collected from monitoring well MW-14A, which is upgradient of the residential neighborhood and is only used for ground water monitoring purposes.	
Impacted ground water migrating to surface water	Indoor and Outdoor Air	Inhalation of VOCs volatilizing from Walnut Creek Canal	Downgradient resident	Yes	Yes	No	PCE	PCE is not a chemical originating from the Hookston Station Parcel.	No
	Fish	Consumption of fish caught from Walnut Creek Canal	Downgradient resident	Yes	-	-	-	Screening level risk evalaution was conducted in the Preliminary Risk Assessment (ERM 2002). Surface water sample results were less than the National AWQC and California Inland Surface Waters Criteria; these criteria are promulgated under the federal Clean Water Act and the CTR respectively, and are developed to ensure protection of aquatic organisms and of human health via ingestion of aquatic organisms. Additional risk characaterization was not warranted.	No

__Notes:__
VOC = Volatile organic compound
TCE = Trichloroethene
PCE = Tetrachloroethene
FS = Feasibility Study
ERM = ERM-West, Inc.
AWQC = Ambient Water Quality Criteria
CTR = California Toxics Rule
DCE = Dichloroethene
SVOC = Semi-volatile organic compound
bgs = below ground surface
TPH = Total petroleum hydrocarbons

Table 4-1
Chemical-Specific Applicable or Relevant and Appropriate Requirements
Hookston Station
Pleasant Hill, California

Chemical-Specific ARAR	Agency	Reference	Description	Comment
Safe Drinking Water Act - MCLs	USEPA	40 CFR 141.11 - 141.16; 141.60 - 141.62	National Primary Drinking Water Standards - enforceable standards for specified contaminants in drinking water.	Relevant and appropriate for setting water quality objectives for ground water. Lists water quality criteria for chemicals where an MCL is not established.
California Safe Drinking Water Act - MCLs	DHS	22 CCR 64444; 64473	California drinking water standards; primary and secondary MCLs for specified contaminants in drinking water.	Relevant and appropriate for setting water quality objectives for ground water, to the extent that state MCLs are more stringent than federal MCLs. Lists water quality criteria for chemicals where an MCL is not established.
Hazardous Waste - Identification	USEPA/DTSC	40 CFR 261/ 22 CCR 66261	Sets standards for classification of hazardous wastes. Establishes constituent levels for characteristic wastes and lists of wastes considered to be hazardous wastes.	All wastes generated during site activities must be evaluated to determine if they are hazardous.
Hazardous Waste - LDR	USEPA/DTSC	40 CFR 268/ 22 CCR 66268	Sets LDR constituent concentrations and treatment standards.	Hazardous wastes generated during site activities must meet LDR standards prior to land disposal.
San Francisco Bay Basin Water Quality Objectives	SFBRWQCB	Water Quality Control Plan for the San Francisco Bay Basin	Establishes water quality objectives, including narrative and numerical standards that protect the beneficial uses and water quality objectives of surface and ground water in the region.	Applicable portions of the basin plan include the beneficial uses of affected water bodies and water quality objectives to protect those uses. Any activity, including, but not limited to, the discharge of contaminated waters, must not result in actual water quality exceeding water quality objectives.
Safe Drinking Water and Toxics Enforcement Act (Proposition 65)	Health and Welfare Agency	22 CCR 12000 et seq.	Warning requirements/prohibition of discharge or release of any chemical listed by the state as a carcinogen or reproductive hazard to water or land, where the chemical will probably pass through a source of drinking water.	Several VOCs, including TCE, are on the list of chemicals. Relevant and appropriate for discharges that may impact a source of drinking water.

Notes:

ARAR = Applicable or relevant and appropriate requirement
CCR = California Code of Regulations
CFR = Code of Federal Regulations
DHS = Department of Health Services
DTSC = Department of Toxic Substances Control
LDR = Land Disposal Restriction
MCL = Maximum Contaminant Level
SFBRWQCB = San Francisco Bay Regional Water Quality Control Board
TCE = Trichloroethene
USEPA = United States Environmental Protection Agency
VOC = Volatile organic compound

Table 4-2
Action-Specific Applicable or Relevant and Appropriate Requirements
Hookston Station
Pleasant Hill, California

Action-Specific ARAR	Agency	Reference	Description	Comment
Air Resources Act	California Air Resources Board/ BAAQMD	Health & Safety Code, Div. 26, Sec. 39000 et seq.	Regulates both vehicular and nonvehicular sources of air contaminants in California. Defines relationship of California Air Resources Board and local or regional air pollution control districts. Establishes ambient air quality standards and permit procedures.	Applicable to air emission sources. The SMAQMD is the enforcement agency.
Air - Permits; exemptions	BAAQMD	Regulation 2, Rule 1	Specifies emissions units that are not required to obtain an Authority to Construct or a Permit to Operate.	Sources with emissions of any air contaminant that does not exceed 2 pounds in any 24-hour period are not required to obtain an authority to construct or permit to operate. Must maintain records to verify exemption.
Air - New Source Review of Toxic Air Contaminants	BAAQMD	Regulation 2, Rule 5	Requires review of new and modified sources of toxic air contaminant emissions in order to evaluate potential public exposure and health risk, to mitigate potentially significant health risks resulting from these exposures, and to provide net health risk benefits by improving the level of control when existing sources are modified or replaced.	Applicable to new or modified sources of toxic air contaminants that is required to have an authority to construct or permit to operate persuant to Regulation 2, Rule 1.
Air - Organic Compounds - Air Stripping and Soil Vapor Extraction Operations	BAAQMD	Regulation 8, Rule 47	Limits emissions of organic compounds from contaminated ground water and soil.	Applicable to new and modified air sripping and soil vapor extraction equipmentused for the treatemnt of ground water or soil contaminated with organic compounds.
Air - Opacity	BAAQMD	Regulation 6, Rule 301	Sets limits for opacity of emissions (Number 1 on the Ringelmann chart).	Applicable to emissions of visible air contaminants. Associated with dust-producing actions.
Air - Nuisance	BAAQMD	Regulation 6, Rule 305	Prohibits discharge of air contaminants in quantities that cause injury, detriment, or nuisance.	Applicable to emissions of air contaminants that may cause injury, detriment, nuisance or annoyance to any considerable number of persons or the public, or that endanger the comfort, health, or safety of any such persons or the public, or which cause or have natural tendency to cause injury or damage to business or property.
Air - Organic Compounds - Aeration of contaminated soil	BAAQMD	Regulation 8, Rule 40	Limits emissions of organic compounds from soil that has been contaminated by organic chemicals and specifies acceptable procedures for controlling emissions.	Applicable to excavation of soil impacted with organic compounds.
OSHA Hazardous Waste Operations and Emergency Response	Cal-OSHA	29 CFR 1910.120/8 CCR 5192	Worker training and health and safety plan requirements for site cleanup operations.	Applicable to on-site workers engaged in site cleanup operations.
OSHA Excavation Standards	Cal-OSHA	29 CFR 1926/8 CCR 1540 and 341	Includes requirements for benching, sloping, or shoring of excavations to prevent cave-ins; entry into any excavation deeper than 5 feet requires a permit.	Applicable to excavation activities.
OSHA Heavy Equipment Operation Standards	Cal-OSHA	29 CFR 1926/8 CCR 1590 and 3649	Requirements for safe operation of haulage, earthmoving, industrial trucks, and tractors.	Applicable to activities involving the use of heavy equipment.
OSHA Head, Eye, Face, and Hearing Protection Standards	Cal-OSHA	29 CFR 1926 Subpart E/8 CCR 3381, 3382, 5162, and 5097.	Specific details regarding PPE and noise levels for hearing protection for workers.	Applicable to activities where employees may encounter hazards requiring the use of PPE or hearing protection.
OSHA Worker Protection Programs	Cal-OSHA	29 CFR 1910.1200/ 8 CCR 5194 and 3203	Written program requirements include hazard communication, illness, and injury prevention plan.	Employees who may be exposed to hazardous substances must be informed of those hazards in accordance with hazard communication requirements. All employers must develop illness and injury prevention plan for providing information on safe and healthy work practices.
OSHA Worker Vinyl Chloride Exposure Standard	Cal-OSHA	29 CFR 1910.1017/8 CCR 5210	Specific standard for occupational exposure to vinyl chloride; includes requirements for monitoring, protective equipment, and decontamination. The PEL for vinyl chloride is currently 1 part per million for an 8-hour TWA.	If concentrations of vinyl chloride in air exceed the PEL, control measures will be required. This applies to actions that may encourage offgassing of volatile organic compounds.
OSHA Permissible Exposure Limits	Cal-OSHA	29 CFR 1910.1001/8 CCR 5155	Requirements for controlling employee exposure to airborne contamination during work operations; sets PELs for specified contaminants and workplace monitoring requirements.	If concentrations of any specified contaminant in air exceed the PEL, control measures (administrative or engineering controls, or personal protective equipment) will be required. This applies to dust-producing actions or actions that may encourage offgassing of volatile organic compounds.
Clean Water Act/Porter Cologne Water Quality Control Act - NPDES/Pretreatment Requirements	USEPA/ RWQCB	40 CFR 122 and 403; California Water Code 13370	Establishes permit and potential treatment requirements for any wastewater stream discharged to surface water. Standards may differ depending on whether water is discharged to a Publicly Owned Treatment Works or directly to a surface water body under an NPDES permit.	Applicable to discharge of any wastewater stream generated as part of an alternative.
Hazardous Waste	DTSC	27 CCR 66260	Provides definitions of terms used in the hazardous waste regulations under Title 22 of the CCR.	Applicable to activities generating wastes; wastes must be classified using generator knowledge or waste analysis.
Hazardous Waste Identification	USEPA/DTSC	40 CFR 261 / 22 CCR 66261	Sets standards for classification of RCRA hazardous wastes and California hazardous wastes and requirements for recycling and reclamation of RCRA and California hazardous wastes.	Wastes generated during site activities (including residues from treatment operations) must be evaluated to determine if hazardous.
Hazardous Waste Generator Standards	USEPA/DTSC	40 CFR 262 / 22 CCR 66262	Requirements for generation, on-site management, and off-site transportation of RCRA and non-RCRA hazardous waste.	Waste generated during site activities must be managed in accordance with these standards if determined to be a hazardous waste.
Hazardous Waste	USEPA/DTSC	40 CFR 265, 264 / 22 CCR 66265, 66264	Requirements for management/storage of hazardous waste in containers.	Applicable to any hazardous wastes accumulated or stored in containers.
Hazardous Waste	USEPA/DTSC	40 CFR 264, 265 Subpart B / 22 CCR 66264 and 66265	General facility standards for on-site treatment, storage, or disposal of hazardous waste.	Applicable to alternatives involving the TSD of hazardous waste.
Hazardous Waste	USEPA/DTSC	40 CFR 264, 265 Subpart C / 22 CCR 66264 and 66265	Preparedness and prevention requirements applicable to on-site TSD of hazardous waste. Applies to generators and TSDs.	Applicable to alternatives involving the TSD of hazardous waste.
Hazardous Waste	USEPA/DTSC	40 CFR 264, 265 Subpart D / 22 CCR 66264 and 66265	Contingency Plan requirements applicable to on-site TSD of hazardous waste. Applies to generators and TSDs.	Applicable to alternatives involving the TSD of hazardous waste.

Action-Specific ARAR	**Agency**	**Reference**	**Description**	**Comment**
Hazardous Waste	USEPA/DTSC	40 CFR 264, 265 Subpart E / 22 CCR 66264 and 66265	Manifesting, record keeping, and reporting requirements applicable to TSD facilities.	Applicable to alternatives involving the TSD of hazardous waste.
Hazardous Waste	USEPA/DTSC	40 CFR 264, 265 Subpart F / 22 CCR 66264 and 66265	Establishes monitoring requirements for facilities that treat, store, or dispose of hazardous waste.	Applicable to alternatives involving theTSD of hazardous waste.
Hazardous Waste	USEPA/DTSC	40 CFR 264, 265 Subpart G / 22 CCR 66264 and 66265	Closure and post-closure requirements for hazardous waste TSD in new on-site units.	Applicable to alternatives involving creation of new TSD units.
Hazardous Waste	USEPA/ DTSC	40 CFR 264, 265 Subpart K/ 22 CCR 66264 and 66265	Requirements for surface impoundment (waste pile) liner to prevent any migration of wastes out of the impoundment to the adjacent subsurface soil or ground water.	Applicable to alternatives involving hazardous waste piles.
Hazardous Waste	USEPA/DTSC	40 CFR 264, 265 Subpart L / 22 CCR 66264 and 66265	Requirements for storage of hazardous waste in a waste pile for greater than 90 days.	Applicable to alternatives in which hazardous waste is stored in a waste pile for greater than 90 days.
Hazardous Waste	USEPA/DTSC	40 CFR 264, 265 Subpart N / 22 CCR 66264 and 66265	Requirements for hazardous waste landfills.	Applicable to alternatives involving land disposal of hazardous waste.
Hazardous Waste	USEPA/DTSC	40 CFR 264 Subpart X / 22 CCR 66264	Requirements for treatment in miscellaneous units.	Applicable to alternatives involving treatment in units classified as miscellaneous units.
Hazardous Waste	DTSC	Health and Safety Code 25200 et. seq	Establishes tiered permitting system for facilities involved in the treatment of certain non-RCRA hazardous wastes. Sets requirements applicable to facilities subject to tiered permitting.	Alternatives treating non-RCRA hazardous waste that meet specified waste stream and quantity limitations may be subject to tiered permitting.
Hazardous Waste	DTSC	Health and Safety Code 25123.3	Remediation waste staging requirements allowing the temporary accumulation of non-RCRA contaminated soil provided that certain conditions are met.	Applicable to activities that involve temporary accumulation of non-RCRA contaminated soil. Requires an impermeable surface, controls to prevent dispersion or runoff, inspections, and certification.
Hazardous Waste - Corrective Action Management Units and Temporary Units	USEPA	40 CFR 264 Subpart S	Requirements for the establishment of specialized units under the corrective action program that are applicable to site remediation activities.	Applicable to activities using corrective action management units or temporary units.
Hazardous Waste - LDR	USEPA/DTSC	40 CFR 268 / 22 CCR 66268	Establishes land disposal restrictions and treatment standards for hazardous wastes applicable to generators.	Any hazardous wastes generated as a result of on-site activities or by treatment systems must meet LDR requirements.
Hazardous Material/Hazardous Waste Transportation Requirements	USEPA / DOT / DTSC	40 CFR 262 / 49 CFR 172 / 22 CCR 66262	Requirements for packaging, labeling, placarding, and transporting hazardous waste.	Any hazardous wastes shipped off site for disposal must meet the requirements for hazardous waste shipping and transportation.
Discharge of Waste to Land	RWQCB	23 CCR Chapter 15 Division 3	Waste and site classifications of waste landfills, including allowable soluble constituent concentrations.	Applicable to on-site land disposal of wastes.
Land Use Controls	DTSC	CCC Section 1471	Allows an owner of land to make a covenant to restrict use of land for the benefit of a covenantee. The covenant runs with the land to bind successive owners.	In the event a remedy is selected that does not result in unrestricted use, a LUC between the City of Pleasant Hill and DTSC will be signed and recorded with Contra Costa County prior to DTSC certification that the removal action has been completed.
Land Use Controls	DTSC	CHSC 25222.1 and 25355.5	Authorizes DTSC to enter into an agreement with a land owner to restrict the present and future use of land.	
Land Use Controls	DTSC	CHSC 25233	Provides a process and criteria for requesting a variance from a land use restriction.	
Land Use Controls	DTSC	CHSC 25234	Provides a process and criteria for requesting the removal or termination of land use restrictions.	
Land Use Controls	DTSC	22 CCR 67391.1	Provides the requirements for land use covenants when contaminants will remain on land at levels that are not suitable for unrestricted use of land.	
Porter-Cologne Water Quality Control Act	RWQCB	California Water Code Sec. 13243	RWQCB may specify certain conditions or areas where the discharge of waste, or certain types of waste, will not be permitted.	Applicable to discharges that may affect water quality.
Porter-Cologne Water Quality Control Act	RWQCB	California Water Code Sec. 13263	RWQCB may issue waste discharge requirements to regulate discharges to protect ground and surface water quality.	Applicable to discharges that may affect water quality, including injection wells (e.g., in situ ground water treatment).
Porter-Cologne Water Quality Control Act	RWQCB	California Water Code Sec. 13267(b)	RWQCB may require any person suspected of discharging, or who proposes to discharge, waste to furnish technical or monitoring program reports.	Applicable to discharges that may affect water quality.
Porter-Cologne Water Quality Control Act	RWQCB	California Water Code Sec. 13304(a)	RWQCB may require any person who causes or permits any waste to be deposited or discharged where it is, or probably will be, discharged to waters of the state and create a condition of pollution or nuisance to clean up the waste or abate the effects of the waste.	Applicable to discharges that may affect water quality.
Porter-Cologne Water Quality Control Act/San Francisco Bay Basin Water Quality Objectives	RWQCB	RWQCB-Water Quality Control Plan for the San Francisco Bay Basin	Establishes water quality objectives that protect the beneficial uses and water quality objectives of surface and ground waters in the region. Describes implementation plans and other control measures designed to ensure compliance with statewide plans and policies and provide comprehensive water quality planning.	Applicable portions of the basin plan include the beneficial uses of affected water bodies and water quality objectives to protect those uses. Any activity, including, but not limited to, the discharge of contaminated waters must not result in actual water quality exceeding water quality objectives.
Porter-Cologne Water Quality Control Act	RWQCB	State Water Resources Control Board Resolution No. 92-49 (As amended October 2, 1996)	Establishes requirement for investigation and cleanup and abatement of discharges. Among other requirements, discharges must clean up and abate the effects of discharges in a manner that promotes the attainment of either background water quality, or the best water quality that is reasonable if background water quality cannot be restored. Requires the application of 23 CCR Division 3, Chapter 15 requirements to cleanups.	Applicable to all cleanups of discharges that may affect water quality.

Table 4-2
Action-Specific Applicable or Relevant and Appropriate Requirements
Hookston Station
Pleasant Hill, California

Action-Specific ARAR	Agency	Reference	Description	Comment
Porter-Cologne Water Quality Control Act	RWQCB	23 CCR 2511(d)	Specifies that wastes removed from the immediate place of release must be discharged in accordance with the classification and siting requirements of Chapter 15. Waste contained or left in place must comply with Chapter 15 to the extent feasible.	Applies to actions taken by or at the direction of public agencies to clean up unintentional or unauthorized discharges of waste to the environment.
Porter-Cologne Water Quality Control Act	RWQCB	23 CCR 2550.4	Cleanup levels must be set at background concentration levels, or, if background levels are not technologically and economically feasible, then at the lowest levels that are economically and technologically achievable. Specific factors must be considered in setting cleanup levels above background levels. Cleanup levels above background levels shall be evaluated every 5 years. If the actual concentration of a constituent is lower than its associated cleanup level, the cleanup level shall be lowered to reflect existing water quality.	Applies in setting cleanup levels for ground water, surface water, and the unsaturated zone for all discharges of waste to land.
Porter-Cologne Water Quality Control Act	RWQCB	23 CCR 2550.6	Establishes compliance period for monitoring for waste management unit. Requires monitoring for compliance with remedial action objectives for 3 years from the date of achieving cleanup levels.	Applies to water quality monitoring for new waste management units and for corrective action activities.
Porter-Cologne Water Quality Control Act	RWQCB	23 CCR 2550.7	Requires general soil, surface water, and ground water monitoring.	Applies to all areas at which waste has been discharged to land.
Porter-Cologne Water Quality Control Act	RWQCB	23 CCR 2550.9	Requires an assessment of the nature and extent of the release, including a determination of the spatial distribution and concentration of each constituent.	Applies to areas at which monitoring results show statistically significant evidence of a release.
Porter-Cologne Water Quality Control Act	RWQCB	23 CCR 2550.10	Requires implementation of corrective action measures that ensure that cleanup levels are achieved throughout the zone affected by the release by removing the waste constituents or treating them in place. Source control may be required. Also requires monitoring to determine the effectiveness of the corrective actions.	Applies to cleanup activities in order to protect ground water.
Porter-Cologne Water Quality Control Act	RWQCB	23 CCR Chapter 15, 2550.2, 2550.3, 2550.4, 2550.5, 2550.6	Establishes water quality protection standards consisting of contaminants of concern, concentration limits, point of compliance and monitoring points.	SWRCB Resolution 92-49 requires actions to cleanup discharge of waste to comply with Chapter 15.
Safe Drinking Water and Toxic Enforcement Act (Prop. 65)	Health and Welfare Agency	California Health and Safety Code, Division 20	Warning requirements/discharge prohibitions of any chemical listed by state as carcinogen or reproductive hazard to water or land, where chemical will pass through a source of drinking water.	Chemicals and applicable regulatory levels are listed in Title 22, CCR 12000, et seq.
Clean Water Act - Storm Water	USEPA/RWQCB	40 CFR 122; California General Permit	Requires permits for storm water discharges associated with industrial activity. Construction activities on less than 5 acres are exempt.	Applicable to storm water discharges from activities involving material handling; hazardous waste treatment, storage, or disposal; or construction activities on 5 acres or more.
State Water Resources Control Board Non-Degradation Policy	SWRCB	Resolution 68-16 (as contained in the RWQCB's Water Quality Control Plan)	State Board Policy requiring maintenance of existing water quality unless demonstrated that the change is beneficial, will not unreasonably affect present or potential uses, and will not result in water quality less than what is prescribed by other state policies.	Applicable to discharges of waste to waters, including discharges that may affect surface or ground waters.
National Environmental Policy Act	United States Army Corps of Engineers	42 U.S.C. 4321-4370c	Requirements for preparation of an Environmental Impact Statement.	Applicable to major federal actions significantly affecting the environment.
CEQA	CalEPA	Public Resources Code 21000 et. seq.	Requires an analysis to determine whether a project will have a "significant" impact and proposed mitigation measures. Projects with potential significant impacts require an environmental impact evaluation.	CEQA requirements are conducted as part of the Remedial Action Plan process.

Notes:

ARAR = Applicable or relevant and appropriate requirement
BAAQMD = Bay Area Air Quality Management District
CalEPA = California Environmental Protection Agency
CCR = California Code of Regulations
CEQA = California Environmental Quality Act
CFR = Code of Federal Regulations
CHSC = California Health and Safety Code
NPDES = National Pollutant Discharge Elimination System
OSHA = Occupational Safety and Health Administration
PEL = Permissible exposure limit
PPE = Personal protective equipment
RCRA = Resource Conservation and Recovery Act
RWQCB = Regional Water Quality Control Board
SWRCB = State Water Resources Control Board

Table 4-3
Location-Specific Applicable or Relevant and Appropriate Requirements
Hookston Station
Pleasant Hill, California

Location-Specific ARAR	Agency	Reference	Description	Comment
Location Standards for Hazardous Waste Facilities - Floodplains	DTSC	27 CCR 66264.18	Requires that a facility located within a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any hazardous waste unless it can be demonstrated that the wastes can be removed safely before floodwaters can reach the facility.	Applicable to treatment, storage, or disposal facilities within a 100-year floodplain.
Location Standards for Hazardous Waste Facilities - Seismic Considerations	DTSC	27 CCR 66264.18	Specifies that portions of new facilities where transfer, treatment, storage, or disposal of hazardous waste will be conducted shall not be located within 200 feet (61 meters) of a fault that has had displacement in Holocene period.	Applicable to construction of any new treatment, storage, or disposal facilities.
Seismic Construction Standards	International Conference of Building Officials/ City of Pleasant Hill Community Development Department	California Uniform Building Code Part V, Chapter 23, Part III	Specifies requirements for earthquake-resistant design.	Any construction must be designed in accordance with these requirements.
Discharges of Waste to Land	RWQCB	23 CCR, Chapter 15	Waste management unit classification and siting and construction standards.	

Notes:
ARAR = Applicable or relevant and applicable requirement
CCR = California Code of Regulations
DTSC = Department of Toxic Substances Control
RWQCB = Regional Water Quality Control Board

Table 4-4
Chemical-Specific Requirements to be Considered
Hookston Station
Pleasant Hill, California

Chemical-Specific TBC	Agency	Reference	Description	Comment
PRGs	USEPA	PRG Table – October 2004	Sets a PRG for potential industrial and residential uses for a variety of compounds.	May be used for general risk screening purposes or to set initial cleanup goals.
Vapor Intrusion to Indoor Air from Soil and Ground Water	OSWER	Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Ground Water and Soils	Provides a tool for a screening level evaluation as to whether or not the vapor intrusion pathway is complete and whether it poses an unacceptable risk to human health.	May be used to evaluate indoor air quality.
Vapor Intrusion to Indoor Air from Soil and Ground Water	DTSC	Interim Final Guidance for the Evaluation and Mitigation of Subsurface Vapor Intrusion to Indoor Air	Recommends an approach for evaluating vapor intrusion into buildings and its subsequent impact to indoor air quality.	May be used to evaluate indoor air quality.
Calderon-Sher Safe Drinking Water Act	OEHHA	PHG Tables – 6 March 2006	Requires OEHHA to adopt PHGs for drinking water based on health risk assessments using the most current scientific methods for the approximately 85 chemicals for which state MCLs are presently available.	May be used for general risk screening purposes.
ESLs	SFRWQCB	Screening For Environmental Concerns at Sites With Contaminated Soil and Groundwater, Interim Final, February 2005	Presents lookup tables of conservative ESLs for over 100 chemicals commonly found at sites with contaminated soil and ground water.	May be used for general risk screening purposes.
CHHSLs	Cal EPA	California Land Environmental Restoration and Reuse Act	CalEPA has developed "screening values" for 54 hazardous substances that are typically found at brownfields sites. These values serve as reference numbers to help developers and local governments estimate the costs and extent of cleanup of contaminated sites, providing valuable information in their development decisions.	May be used for general risk screening purposes.
Proposed Corrective Action Rule (40 CFR 264 Subpart S) Action Levels	USEPA	55 CFR 30798	Sets action levels for certain chemicals in soil; exceeding action levels may trigger requirements for additional investigation or remediation.	May be used in determining whether contamination poses potential threat to human health or the environment.
A Compilation of Water Quality Goals	RWQCB	CVRWQCB, August 2003 with updates through 25 May 2004	Defines a procedure for selection of appropriate concentrations of chemical constituents and water quality parameters used to determine compliance with the narrative water quality objectives contained in the Basin Plan.	

Table 4-4
Chemical-Specific Requirements to be Considered
Hookston Station
Pleasant Hill, California

Chemical-Specific TBC	Agency	Reference	Description	Comment
Health Advisories and Water Quality Advisories	USEPA	USEPA Office of Water	Short-term, long-term, and lifetime exposure health advisories for noncarcinogens and possible human carcinogens.	Incremental cancer risk estimates for known and probable human carcinogens are also included.
National Ambient Water Quality Criteria	USEPA/Clean Water Act	Quality Criteria for Water, 1986	Protects human health and welfare.	
Water Quality for Agriculture	Food and Agriculture Organization of the United Nations	Water Quality for Agriculture, 1985	Contains criteria protective of agricultural uses of water.	
Water Quality Criteria	SWRCB, 1963 and 1978	Water Quality Criteria, McKee and Wolf, 1963 and 1978	Contains criteria for human health and welfare, agricultural use, and industrial use.	

Notes:

CalEPA = California Environmental Protection Agency
CFR = Code of Federal Regulations
CHHSL = California Human Health Screening Level
DTSC = Department of Toxic Substances Control
ESL = Environmental Screening Level
MCLs = Maximum contaminant levels
OEHHA = Office of Environmental Health Hazard Assessment
OSWER = Office of Solid Waste and Emergency Response
PHGs = Public health goals
PRG = Preliminary Remediation Goals
RWQCB = Regional Water Quality Control Board
SFRWQCB = San Francisco Regional Water Quality Control Board
SWRCB = State Water Resources Control Board
TBC = To be considered
USEPA = United States Environmental Protection Agency

Table 4-5
Risk-Based Cleanup Goals
Hookston Station
Pleasant Hill, California

	Receptor	Exposure Scenario	Reference	TCE		cis-1,2-DCE		trans-1,2-DCE		1,1-DCE		Vinyl Chloride		Arsenic	
				Risk-Based Concentration for Selected Risk Management Threshold for Theoretical Lifetime Excess Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Non-Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Theoretical Lifetime Excess Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Non-Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Theoretical Lifetime Excess Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Non-Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Theoretical Lifetime Excess Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Non-Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Theoretical Lifetime Excess Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Non-Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Theoretical Lifetime Excess Cancer Risk	Risk-Based Concentration for Selected Risk Management Threshold for Non-Cancer Risk
Soil	Construction Worker	Direct contact with on-site subsurface soil	Appendix H of the FS	n/a		n/a		n/a		n/a		n/a		31.0 mg/kg	912 mg/kg
Ground Water	Residents	Inhalation of chemicals released from ground water during irrigation	Appendix H of the FS	1,890 µg/L	33,900 µg/L	nc	30,800 µg/L	nc	61,700 µg/L	nc	176,000 µg/L	49.2 µg/L	89,300 µg/L	n/a	
Ground Water	Residents	Swimming contact with ground water used to fill a backyard pool	Appendix H of the FS	1,105 µg/L	815 µg/L	nc	42,700 µg/L	nc	85,500 µg/L	nc	155,000 µg/L	121 µg/L	19,600 µg/L	n/a	
Indoor Air	Residents	Inhalation of off-site residential indoor air	Appendix H of the FS	0.96 µg/m^3	69 µg/m^3	nc	63 µg/m^3	nc	125 µg/m^3	nc	357 µg/m^3	0.025 µg/m^3	181 µg/m^3	n/a	

California Maximum Contaminant Levels

	Receptor	Exposure Scenario	Reference	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl Chloride	Arsenic
Ground Water	Human	Drinking Water	California MCLs for drinking water	5 µg/L	6 µg/L	10 µg/L	6 µg/L	0.5 µg/L	n/a

Final Cleanup Goals

	TCE	cis-1,2-DCE	trans-1,2-DCE	1,1-DCE	Vinyl Chloride	Arsenic
Soil	n/a	n/a	n/a	n/a	n/a	31 mg/kg
Ground Water	5 µg/L*	6 µg/L*	10 µg/L*	6 µg/L*	0.5 µg/L*	n/a
Indoor Air	0.96 µg/m^3	63 µg/m^3	125 µg/m^3	357 µg/m^3	0.025 µg/m^3	n/a

Notes:
µg/L - microgram per liter
µg/m^3 - microgram per cubic meter
DCE = Dichloroethene
MCL - Maximum Contaminant Level
mg/kg - milligram per kilogram
n/a - not applicable - compound was nondetect or the detected concentrations represented risk levels below the Risk Management Thresholds (Section 2.3.3 of the FS); therefore risk-based cleanup goals were not calculated
nc - noncarcinogenic
TCE = Trichloroethene
* MCLs have been selected as the final ground water cleanup goals. However, background ground water concentrations exceed the MCLs. Until background ground water is remediated to the MCLs by the appropriate Responsible Party(ies), background ground water concentrations will be utilized as the interim ground water cleanup goals for the downgradient study area.

Table 5-1
Soil Remedial Technologies and Process Options
Hookston Station
Pleasant Hill, California

General Response Action	Remedial Technology	Process Option	Description	Effectiveness	Implementability	Cost	Summary of Screening
No Action	No Action	None	No institutional controls or treatment.	Not effective for protecting human health and environment.	Implementable but not acceptable to the general public or government agencies.	None	Required as a baseline for comparison by the National Contingency Plan. Retained.
Institutional Controls / Limited Action	Institutional Control	Deed Notification /Restriction	Implement deed notification to inform future owners of the presence of potentially hazardous substances at the Hookston Station Parcel and /or implement deed restriction to restrict future use of Hookston Station Parcel.	Effectiveness for protection of human health would depend on enforcement of and compliance with deed restrictions.	Technically implementable. Specific legal requirements and authority would need to be met.	Low capital	Potentially applicable in combination with other technologies. Retained.
	Access Control	Fencing /warning signage	Construct or maintain existing Hookston Station Parcel fencing and signage to control Hookston Station Parcel access by the general public thereby reducing potential exposure to contaminants.	Effective for reducing exposure risk to the general public provided fencing and signage is maintained in the long term.	Technically implementable but not consistent with current and future land use.	Low capital.	Not consistent with current and future land use. Not retained.
Containment	Capping	Surface Cap	Installation of surface cap over contaminated soil areas to prevent or reduce contaminant migration and to prevent exposure. Multiple-component cap may include asphalt or concrete paving, synthetic membranes, low permeability soil caps in landscaped areas, and existing or new buildings or structures.	Effective for preventing direct contact exposure (i.e. dermal contact or ingestion). Limits infiltration and leachate formation, but less effective than source removal options for protection of ground water.	Technically implementable. The selected capping technology must be consistent with proposed future land use.	Low capital. Negligible O&M.	Not applicable as arsenic-impacted soil requiring remediation is limited to the subsurface. Not retained.
In Situ Soil Treatment	Biological Treatment	Natural Attenuation	Natural processes such as volatilization, biodegradation, adsorption, and chemical reactions with soil materials can reduce contaminant concentrations to acceptable levels.	Generally not effective for reducing risk to human health. Not effective for metals.	Technically implementable. Generally not perceived as an acceptable response by the general public or government agencies.	Negligible capital. Low O&M. Low cost relative to other in situ options.	Not applicable for metals. Not Retained.
		Phytoremediation	Process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil.	Still in the demonstration phase. Potentially effective for metals, solvents, and petroleum hydrocarbons.	Technically implementable, but inconsistent with land use.	Low capital and O&M. Low cost relative to other in situ options.	Inconsistent with current and future land use. Not retained.
In Situ Soil Treatment	Physical/Chemical Treatment	Soil Flushing	The extraction of contaminants from soil with passage of aqueous solution through in-place soils using an injection or infiltration process. Extraction fluids must be recovered from underlying aquifer. Applicable for more soluble contaminants.	Applicable for VOCs and soluble inorganic chemicals. Presence of fine grained soils limits effectiveness.	Technically implementable. However, there has been little commercial application. Regulatory concerns over potential to wash contaminants beyond fluid capture zones and introduction of surfactants in to the subsurface make permitting difficult.	High capital and O&M. High cost relative to other in situ options.	Not effective for arsenic in soil. Not retained.
		Soil Vapor Extraction	Vacuum is applied through extraction pipes to create a pressure/concentration gradient in impacted areas, which induces gas-phase volatiles to diffuse through soil to extraction wells. The process includes a system for treating off-gas. Air flow also induces aerobic bioremediation of some contaminants. Generally applied to highly volatile contaminants.	Not effective for metals. Effective for VOCs, less effective for SVOCs.	Technically implementable, but not typically applied for metals-contaminated soil.	High capital. Moderate O&M.	Not effective for arsenic in soil. Not retained.
		In Situ Solidification/ Stabilization	Contaminants are stabilized or solidified in situ, resulting in decreased mobility of the contaminant or the chemical conversion of the contaminant to a more stable form. Stabilization uses chemical processes to convert the contaminant, such as arsenic, to a more stable form or chemically fix the contaminant, resulting in a stable, low mobility form.	Stabilization would be effective for arsenic in vadose zone soil, provided the contaminant can be reached by injected stabilization chemicals.	Technically implementable. Would require significant infrastructure to address small volume of impacted soil.	High capital. Low O&M. High capital cost relative to level of risk.	Cost prohibitive relative to benefit. Extensive injection network required to achieve distribution. Not retained.
		In Situ Vitrification	Uses an electric current to melt soil at extremely high temperatures and thereby immobilize most inorganics and destroy organic pollutants by pyrolysis.	Effective for SVOCs and inorganic chemicals. Less effective for VOCs, and not effective for fuels.	Technically implementable. Resulting fused material in subsurface could interfere with land use. Would require significant infrastructure to address small volume of impacted soil.	Very high capital. Low O&M. High cost relative to other in situ options.	High cost relative to other in situ treatment options. Not retained.

General Response Action	Remedial Technology	Process Option	Description	Effectiveness	Implementability	Cost	Summary of Screening
Removal	Removal/Off-Site Disposal	Excavation	Excavation of impacted material with disposal at an off-site location.	Effective for complete range of contaminant groups.	Implementable for areas of arsenic-impacted soils. Lack of lateral and vertical delineation results in difficult implementation for scale of contamination	High capital relative to risk associated with arsenic in soil. Negligible O&M.	Excavation too costly relative to risks associated with arsenic in soil. Not retained.
Off-site management	Land disposal	Landfill	Disposal of impacted soil at a permitted, off-site landfill	Effective for complete range of contaminant groups.	Technically implementable. Impacted soil must be profiled and meet land disposal restrictions. Pre-treatment may be required if material does not meet certain restrictions.	Moderate to high capital depending on types of waste present. Negligible O&M	Not applicable without use of excavation. Not retained.
Ex Situ Soil Treatment	Biological Treatment	Biopiles	Excavated soils are mixed with soil amendments and placed in an area that includes leachate collection systems and some form of aeration.	Solid-phase (soil) process is most effective for non-halogenated VOCs and fuel hydrocarbons. Not effective for some halogenated VOCs and SVOCs, and for metals.	Difficult to implement. May require complete enclosure. Addition of amendment material results in volumetric increase in treated material. Leachate and off-gas may require treatment.	Moderate capital and O&M. Moderate cost relative to other ex situ biological options.	Limited effectiveness for metals and difficult to implement. Not retained.
	Physical/Chemical Treatment	Chemical Reduction / Oxidation	Oxidizing/reducing agents are added to soils to convert hazardous contaminants to compounds that are less toxic, more stable, or inert.	Most effective for some inorganics. Less effective for arsenic and non-halogenated organic chemicals.	Technically implementable but difficult achieve sufficient distribution of oxidizing/reducing agents in heterogeneous soils.	High capital. Low O&M. High cost relative to other ex situ physical/chemical options.	Limited effectiveness for arsenic. Not retained.
		Soil Washing	Wash soil with water-based surfactants, detergents, acids, etc., to remove chemicals from soil particles. Treat or dispose of high chemical concentration residual fluids.	Most effective for inorganic chemicals, SVOCs and fuels. Less effective for VOCs. Removal of organics adsorbed to clay-sized particles may be difficult.	Difficult to implement for complex waste mixtures. Difficult to distribute washing fluids in heterogeneous soils. Residuals may be difficult to extract from matrix and may require additional treatment/disposal.	High capital and O&M. High cost relative to other ex situ physical/chemical options.	Difficult to implement. Difficult to formulate washing fluids for complex waste mixtures. Soils may remain toxic due to difficulty extracting residual fluids. Not retained.
		Solidification / Stabilization	Contaminants are physically bound or enclosed within a stabilized mass or chemical reactions are induced between stabilizing agent and contaminants to reduce their mobility.	Low temperature or cement stabilization effective for reducing the leachability of inorganic chemicals.	Technically implementable. However most processes result in significant increase in volume.	Moderate capital. Low O&M. Moderate cost relative to other ex situ physical/chemical options.	Not applicable without use of excavation. Not retained.
		Ex situ SVE	Excavated soils are placed in lined piles and vapor is extracted through vertical or horizontal wells/vents. Requires treatment to abate extracted vapors prior to release to atmosphere.	Effective for VOCs but not effective for metals.	Technically implementable but not applicable for metals.	Moderate capital and O&M. Moderate cost relative to other ex situ physical/chemical technologies, but high cost relative to competing in situ technologies (i.e. SVE).	Not applicable for metals. Not retained.

Notes:

Shading indicates Process Option not retained
O&M = operation and maintenance
SVE = Soil Vapor Extraction
SVOC = semivolatile organic compound
VOC = volatile organic compound

Table 5-2
Ground Water Remedial Technologies and Process Options
Hookston Station
Pleasant Hill, California

General Response Action	Remediation Technology	Process Option	Description	Effectiveness	Implementability	Cost	Summary of Screening
No Action	No Action	None	No institutional controls or treatment.	Not effective for protecting human health and environment.	Implementable but generally not acceptable to the general public or government agencies.	None.	Required as a baseline for comparison by the National Contingency Plan. Retained.
Institutional Controls/Limited Action	Institutional Control	Deed/Water Use Restriction or Notification	Implement deed restriction to restrict installation of new wells at the Hookston Station Parcel. Water use restrictions would be used to remove existing supply wells and prevent the installation of new supply wells within the downgradient study area.	Effectiveness for preventing exposure to impacted ground water would depend on enforcement of and compliance with deed restrictions and conditions of well permits.	Technically implementable. Specific legal requirements and authority would need to be met.	Low capital. Negligible O&M.	Potentially applicable in combination with other technologies. Retained.
	Long Term Monitoring	Ground Water Monitoring	Long term monitoring of the monitoring well network to assess plume stability and contaminant concentration trends over time.	Effective for tracking VOC distribution over time.	Technically implementable. Monitoring well network already established.	Negligible capital. Moderate O&M.	Potentially applicable in combination with other technologies. Retained.
	Engineering Controls	Irrigation Well Closure	Abandon existing irrigation wells within the downgradient study area and connect disconnected systems to existing public water supply.	Effective for removing risk pathway associated with extraction and use of contaminated groundwater in residential area.	Technically implementable. May require legal action to achieve cooperation with land owners. Would be implemented with water use restrictions to prevent installation of future wells.	Moderate capital. Low O&M.	Easily implemented method of eliminating risks associated with exposure ground water exposure pathways in the downgradient study area. Retained.
Containment	Physical Ground Water Barrier	Low Permeability Wall	Construction of a low-permeability vertical barrier to restrict ground water flow and contaminant migration in the downgradient direction. Long-term monitoring of containment structure required.	Effective for containing impacted ground water or providing a barrier for ground water treatment systems. Would need to be implemented in association with additional active treatment technologies to reduce contaminant mass.	Technically implementable in accessible areas.	High capital. Negligible O&M.	Narrow plume width. Not retained.
	Hydraulic Ground Water Barrier	Ground Water Pumping	Ground water pumping or injection to establish capture zone and restrict ground water flow and contaminant migration in the downgradient direction.	Effective for containing impacted ground water. Low-permeability soil within the A-Zone would require use of extensive well network to ensure adequate capture or maintenance of areas of concern. Will not achieve cleanup goals in area downgradient of barrier.	Technically implementable. Treatment of extracted ground water may be required depending on influent contaminant concentrations. Implementation in the downgradient study area would be difficult due to number of wells required. Maintenance of a hydraulic barrier requires extensive injection and extraction well network connected with significant conveyance piping.	High capital and O&M.	Not effective at reducing VOC concentrations downgradient from the extraction barrier. Not retained.
	Vapor Intrusion Barrier	Vapor Intrusion Prevention Systems	Systems using a combination of vapor barrier and/or vapor extraction prevents exposure to VOCs in soil and/or groundwater by blocking the migration pathway of VOCs into building basements/foundations. An impermeable barrier is installed either on the ground surface or underside of the floor under a crawlspace construction building. Can be combined with a vapor extraction system placed between the ground surface and the barrier that draws a low flow of vapor from the ground surface, providiing additional mitigation.	Effective for preventing migration of VOCs into indoor air. Does not reduce VOC concentrations in primary medium, groundwater. Effectiveness compromised if not inspected and maintained regularly.	Relatively easily implementable for standard residential construction methods. Consistent with preservation of structures and currrent residential land use.	Low capital. Low O&M	Applicable for implementation at residences in the downgradient study area. Provides highly cost-effective reduction of risk associated with indoor air impacts from ground water. Retained.

General Response Action	Remediation Technology	Process Option	Description	Effectiveness	Implementability	Cost	Summary of Screening
		Soil Vapor Extraction	Vacuum is applied through extraction pipes to create a pressure/concentration gradient in impacted areas, which induces gas phase volatiles to diffuse through soil to extraction wells. The process includes a system for treating off-gas.	Effective in high permeability soils for extracting VOCs in soil and/or ground water. Less effective for removal of VOCs and hydrocarbons in low permeability soils where SVE is diffusion limited. Pilot testing has indicated insufficient radius of influence for effective application of vertical SVE wells within residential area.	Technically implementable. Would require placement of more expensive and difficult to install horizontal or angled SVE wells under residences to provide effective removal of VOCs in soil vapor prior to reaching indoor air. Location within the downgradient study area will require extensive infrastructure to convey vapors to central treatment system.	High capital. Moderate O&M. High capital cost due to use of horizontal and angled well systems and extensive infrastructure in the downgradient study area.	Cost prohibitive relative to benefit. Intrusive construction of systems near residences. Not retained.
In Situ Ground Water Treatment	Monitored Natural Attenuation	Intrinsic Bioremediation	Reduction of dissolved concentrations through naturally occurring processes such as dilution, volatilization, biodegradation, or adsorption. Sampling and analysis of ground water samples for indicators of natural attenuation is generally included.	Effective for VOCs, including TCE. Effectiveness evaluated through periodic monitoring of contaminant concentrations as well as indicators of attenuation byproducts. Reductive dechlorination of TCE has the potential to result in recalcitrant concentrations of dichloroethenes and vinyl chloride.	Technically implementable. Would require installation of more extensive network of monitoring wells to provide adequate performance monitoring.	Low capital. Moderate O&M. Low overall cost relative to active remediation options.	Potentially applicable to downgradient or post-treatment concentrations of VOCs in groundwater. Retained.
	Thermal Treatment	Steam Heating	Involves the installation of a series of steam injection wells. Steam is generated in a boiler that would be located at the Hookston Station Parcel and injected at the wells, which gradually raises the temperature of the ground water and soil, thereby enhancing the mobility and volatility of contaminants. This technology commonly uses an SVE system to control buildup of volatilized contaminants and non-condensable gases, as well as ground water extraction.	Typically effective for fuels and SVOCs and VOCs under correct conditions. The stratified nature and low permeability of A-Zone soil will likely inhibit proper flow and distribution of steam, reducing the effectiveness of this technology.	Technically implementable. SVE would be required to capture steam and vaporized contaminants. Consistant steam flow may be difficult to achieve in the low permeability and stratified A-Zone soils. High temperatures will require replacing existing ground water vapor and monitoring wells with heat resistant well materials. Presence of extensive subsurface utilities will require relocation of utilities.	High capital and O&M. High cost relative to other in situ options.	Costly alternative. Less effective for low permeability soils than electrically induced heating. Not retained.
		Electrically Induced Heating	Electrical current is generated between electrodes installed in the subsurface, which gradually raises the temperature of ground water, thereby enhancing the mobility and volatility of contaminants. This technology also requires an SVE system to control buildup of volatilized contaminants and non-condensable gases.	Effective for VOCs. More effective than steam heating in tight soils. Effective capture of VOCs requires implementation of SVE. Requires closely spaced wells to effectively capture soil vapor in low permeability soils.	Technically implementable, but difficult to implement in areas with surface features because closely space electrodes are required to implement this option. SVE would be required to capture steam and vaporized contaminants. High temperatures will require destruction of existing ground water vapor and monitoring wells and installation of heat resistant wells. Presence of extensive subsurface utilities will require relocation of utilities.	High capital and O&M. High cost relative to other in situ options.	Costly alternative. Not expected to be implementable in the downgradient study area. Not retained.
	Physical Treatment	In-Well Air Stripping	In-well aerators perform air stripping of ground water within the well. Ground water is not removed from the well, but is circulated between an upper and lower screen in the well. Volatile compounds enter the vapor phase and are recovered and treated by a vapor extraction system.	Effective for VOCs, SVOCs and fuels. Cost effective in areas with deep water tables because impacted ground water does not have to be pumped to surface. Relies on adequate groundwater flow within an induced recirculation cell, which may be prohibited by low permeability and layered nature of A-Zone soils.	Low permeability and layered nature of soils would significantly reduce radius of influence of this technology, increasing the number of recirculation wells required.	High capital. Moderate O&M.	Low effectiveness due to low permeability soil. Not retained.

General Response Action	Remediation Technology	Process Option	Description	Effectiveness	Implementability	Cost	Summary of Screening
		Air Sparging	Air is injected into the saturated zone to induce mechanical stripping and volatilization of contaminants. Introduction of oxygen also enhances aerobic biodegradation. SVE is required to capture vapor phase contaminants.	Effective for VOCs and fuels. Effective removal dependant on ability to sparge adequate air and to remove resultant vapor through SVE. Pilot testing would be required to determine effectiveness. Requires closely spaced SVE wells to effectively capture vapor phase contaminants. Biodegradation of TCE would not be enhanced, and could be hindered, by increase in oxygen concentration.	Technically implementable. Low permeability soils of the A-Zone would require close spacing of numerous sparge wells and associated SVE wells.	High capital. Low O&M. High cost relative to other in situ treatment options due to required number of wells, extent of equipment, and depth of impacts.	Not expected to be cost effective relative to other technologies. Not retained.
	Chemical Treatment	Chemical Oxidation	Injection of a dilute solution of an oxidant such as potassium permanganate, sodium persulfate, or Fenton's Reagent, into the contaminated zone to directly oxidize VOCs.	Chemical oxidation is expected to be an effective method for mass reduction of contaminants of concern. Bench testing has indicated that oxidant demand is low in B-Zone soils and moderate in A-Zone soils. The low permeability, stratified soils within the A-Zone will limit effectiveness due to the low volume of solution capable of injection, and could inhibit distribution of oxidant to contaminants. However, the higher permeability and low soil oxidant demand of the B-Zone are conducive to effective oxidation.	Low permeability of A-Zone soil will impact ability to inject adequate volume of oxidant. However, B-Zone soil has a relatively higher permeability and a low oxidant demand (reducing the rate at which the oxidant is reacted), which help to reduce the treatment volume.	Moderate capital. Low O&M. Low cost relative to other in situ treatment options.	Low oxidant demand and relatively high permeability of B-Zone soil are conducive to chemical oxidation. Retained.
		Ozone Sparging	Sparging of gas-phase ozone to oxidize VOCs in situ. Implemented similarly to air sparging with the addition of ozone to the sparged air. Typically combined with soil vapor extraction. Typically most applicable for high concentration and recalcitrant contaminants.	Ozone can be effective at oxidizing VOCs in groundwater. Delivery of ozone may be prohibitive due to low-permeability of A-Zone soil. Short-lived ozone requires good distribution for adequate effectiveness.	Technology is implemented in a similar manner as air sparging, and has similar implementation issues. Pilot testing will be necessary to determine spacing of sparge wells and operation parameters. Low permeability soils of the A-Zone may require tight spacing of numerous sparge wells.	High capital. High O&M. High cost relative to other in situ treatment options due to required number of wells and extent of equipment.	Not expected to be cost effective relative to other technologies. Not retained.
		Zero-Valent Iron Permeable Reactive Barrier	Placement of zero-valent iron into the contaminated zone to destroy VOCs through chemically-mediated reductive dechlorination. The zero-valent iron is placed in the form of a reactive barrier wall perpendicular to ground water flow direction. Placement of the zero-valent iron may be performed using dug trenches or through high-pressure slurry injection.	Effective for complete destruction of halogenated VOCs.	Most commonly implemented as a reactive barrier wall, treating contaminants passing through wall. Trenching in the downgradient study area could present difficulties. Depth of the excavation would require shoring support or innovative trenching techniques. As a result, slurry injection could be more implementable.	Moderate to high capital. Negligible O&M. Moderate cost relative to some in situ treatment options.	Can be difficult and expensive to implement, but reliable treatment as a barrier. May be an effective barrier to prevent further migration of contaminants into the downgradient study area. Retained.
	Biological Treatment	Enhanced Anaerobic Bioremediation	Injection of a carbon source (electron donor) material into the contaminated zone to stimulate degradation of polychlorinated VOCs through reductive dechlorination. Typical injectates include acetate, lactate, and food-grade oils. Can be supplemented with addition of specific degrading microbes to enhance overall effectiveness.	Effective for polychlorinated VOCs. However, daughter compounds such as dichloroethene and vinyl chloride are much more difficult to dechlorinate, which could be overcome with bioaugmentation.	Technically implementable. Most case studies indicate application requires a dense injection grid. Consequently, difficult to implement in developed portions of the downgradient study area. Bench testing would be required to evaluate biodegradation conditions.	Moderate capital. Low O&M. Moderate cost relative to other in situ treatment options.	May effectively completely dechlorinate TCE. Implementation can be relatively simple. Retained.

General Response Action	Remediation Technology	Process Option	Description	Effectiveness	Implementability	Cost	Summary of Screening
		Enhanced Aerobic Bioremediation	Injection of oxygen or oxygen-releasing material into or upgradient of the contaminated zone to enhance degradation of organic compounds through aerobic respiration.	Effective for non-halogenated VOCs, SVOCs, and fuels. More effective for dichloroethene and vinyl chloride.	Technically implementable. Most case studies indicate application requires a dense injection grid. Consequently, difficult to implement in developed portions of the downgradient study area. Bench testing would be required to evaluate biodegradation conditions.	Moderate capital. Low O&M. High cost relative to other in situ treatment options	Not effective for primary contaminant, TCE. Not retained.
Collection/Ex Situ Treatment	Ground Water Pumping	Extraction Wells or Trenches	Ground water pumping using extraction wells or trenches. Objectives of ground water extraction include removal of dissolved contaminants from the subsurface and containment of contaminated ground water to prevent migration. Most applicable for contaminants which cannot be reliably treated in situ or where immediate containment is required.	Effective for plume containment and source area migration control. Can be implemented in combination with in situ technologies to increase influence of the in situ technology by creating regions of recirculation. Low permeability of A-Zone soil may limit effectiveness of extraction.	Technically implementable. Biological or iron fouling of extraction wells, conveyance piping and treatment systems is a common problem and severely limits system performance. Low permeability of A-Zone soils and large plume size will require extensive extraction network. Placement of extraction wells in the downgradient study area will require extensive infrastructure to develop conveyance and treatment system.	High capital. Moderate O&M.	Potentially applicable for contaminant mass removal in source areas and as an enhancement of other in situ technologies. Retained.
	Chemical/Physical Treatment	Air Stripping	Extracted water is passed downward against a stream of rising air. The countercurrent stream of air strips VOCs from the water. The resulting VOC-laden air is treated following removal from the vessel, if required.	Effective for removal of VOCs from extracted ground water.	Technically implementable. Treatment of off-gas may be required. Biological or iron fouling can severely limit system performance. Well established ex-situ technology readily provided by vendors.	Moderate capital. Moderate O&M. Moderate cost relative to other ex situ treatment options.	Applicable for treatment of VOCs dissolved in ground water. Retained.
		Liquid or Gas-Phase Carbon Adsorption	Extracted water or vapor is passed through vessels containing granular activated carbon. Organic compounds with an affinity for carbon are transferred from the aqueous or vapor phase to the solid phase by sorption to the carbon.	Most effective for hydrocarbons and SVOCs. Less effective for lower chlorinated VOCs.	Difficult to implement. Streams with high suspended solids (> 50 milligrams per liter) cause fouling and require frequent carbon change-out. Can be easily implemented as a point-of-use treatment for private irrigation wells.	Moderate capital. High O&M. High cost relative to other ex situ treatment options	Higher cost relative to other ex situ treatment options. Most effective for point-of-use applications in the downgradient study area. Retained.
		UV Oxidation /Reduction.	UV light and/or oxidizing chemicals (e.g., hydrogen peroxide) can be used to destroy organic constituents.	Effective for most organic compounds including petroleum hydrocarbons and halogenated VOCs. Chloroethanes may be stripped rather than destroyed requiring off-gas treatment with catalytic oxidation or carbon. Incomplete destruction is possible with some compounds.	Technically implementable. However, iron fouling is likely to affect UV units in the same manner as air strippers. O&M to address potential iron fouling is expected to be time consuming and costly for the UV units.	High capital and O&M.	Higher cost and O&M issues than other ex situ physical/chemical technologies. Not retained.

General Response Action	Remediation Technology	Process Option	Description	Effectiveness	Implementability	Cost	Summary of Screening
	Biological Treatment	Bioreactor Contact Beds	Water is passed through a reactor vessel that contains a fixed bacterial film. Contaminants are aerobically degraded by the bacteria as the water passes through the reactor vessel.	Effective for fuel hydrocarbons and SVOCs. Treatment of halogenated compounds may require addition of specially adapted cometabolite organisms.	Technically implementable. However, sustaining microbial populations can be difficult. Iron fouling is likely to affect bioreactors in the same manner as air strippers.	High capital and moderate O&M. Moderate cost relative to other ex situ treatment options	May be difficult to implement due to iron fouling. Higher cost than other ex situ technologies. Not retained.
Disposal	Off-site Disposal	Discharge to Publicly-Owned Treatment Works (POTW)	Discharge of extracted ground water to the sanitary sewer for conveyance to a local POTW for treatment and discharge.	Effective for disposal of extracted ground water.	Technically implementable. Requires sampling to ensure compliance with permit discharge standards. Pre-treatment may be required prior to discharge.	Low capital. Low O&M.	Potentially applicable for disposal of extracted ground water. Retained.
	Disposal at the Hookston Station Parcel	Injection Wells	Discharge of extracted ground water back into aquifer using injection wells	Effective for disposal of extracted ground water. May be used in cooperation with other in situ technologies to increase influence, such as in situ oxidation or enhanced bioremediation	Technically implementable. Permits can be difficult to obtain. Low permeability soils may require extensive injection network. Biofouling would be expected as a result of reinjecting extracted ground water.	Moderate capital. Moderate O&M.	More costly than POTW discharge, with low implementability. Not retained.

Notes:
Shading indicates Process Option not retained
DTSC = Department of Toxic Substances Control
IRM = Interim Remedial Measure
MCL = maximum contaminant level
NPDES = National Pollution Discharge and Elimination System
O&M = operation and maintenance
POTW = Publically owned treatment works
SVE = Soil Vapor Extraction
SVOC = semivolatile organic compound
UV = ultra violet
VOC = volatile organic compound

Table 5-3
Summary of Screening - Retained Remedial Technologies
Hookston Station
Pleasant Hill, California

General Response Action	Remedial Technology	Process Option	Description
Soil Technologies			
No Action	No Action	None	No institutional controls or treatment.
Institutional Controls/Limited Action	Institutional Control	Deed Notification/ Restriction	Implement deed notification to inform future owners of the presence of potentially hazardous substances at the Hookston Station Parcel and /or implement deed restriction to restrict future use of the Hookston Station Parcel.
Ground Water Technologies			
No Action	No Action	None	No institutional controls or treatment.
Institutional Controls/Limited Action	Institutional Control	Deed/Water Use Restriction or Notification	Implement deed restriction to restrict installation of wells and water usage on the Hookston Station Parcel. Implement water use restrictions to abandon existing wells and prevent installation of new wells within the downgradient study area.
	Long Term Monitoring	Ground Water Monitoring	Long term gauging and sampling of monitoring well network to assess plume stability and contaminant concentration trends over time.
	Engineering Controls	Irrigation Well Closure	Abandon existing extraction wells within the downgradient study area and reconnect systems to existing public water supply.
Containment	Vapor Intrusion Barrier	Vapor Intrusion Prevention Systems	Use of impermeable barrier installed below building floor to prevent crawl space or basement floor of residential buildings. Potentially combined with localized extraction of vapor under the barrier to enhance removal.
In Situ Ground Water Treatment	Monitored Natural Attenuation	Intrinsic Bioremediation	Reduction of dissolved concentrations through naturally occurring processes such as dilution, volatilization, biodegradation, or adsorption. Sampling and analysis of ground water sample for indicators of natural attenuation is generally included.
	Chemical Treatment	Chemical Oxidation	Injection of a dilute solution of an oxidant such as potassium permanganate, sodium persulfate, or Fenton's Reagent into the contaminated zone to directly oxidize VOCs.

Table 5-3
Summary of Screening - Retained Remedial Technologies
Hookston Station
Pleasant Hill, California

General Response Action	Remedial Technology	Process Option	Description
		Zero-Valent Iron Permeable Reactive Barrier	Placement of zero-valent iron into the contaminated zone to destroy VOCs through chemically-mediated reductive dechlorination.
	Biological Treatment	Enhanced Anaerobic Bioremediation	Injection of a carbon source (electron donor) material into the contaminated zone to stimulate degradation of polychlorinated VOCs through reductive dechlorination.
Collection/Ex Situ Treatment	Ground Water Pumping	Extraction Wells or Trenches	Ground water pumping using extraction wells or trenches. Objectives of ground water extraction include removal of dissolved contaminants from the subsurface and containment of contaminated ground water to prevent migration.
	Chemical/Physical Treatment	Air Stripping	Extracted water is passed downward against a stream of rising air. The countercurrent stream of air strips VOCs from the water. The resulting VOC laden air is treated following removal from the vessel, if required.
	Chemical/Physical Treatment	Liquid or Gas-Phase Carbon Adsorption	Extracted water or vapor is passed through vessels containing granular activated carbon. Organic compounds with an affinity for carbon are transferred from the aqueous or vapor phase to the solid phase by sorption to the carbon.
Disposal	Off-Site Disposal	Discharge to Publicly-Owned Treatment Works (POTW)	Discharge of extracted ground water to the sanitary sewer for conveyance to a local POTW for treatment and discharge.

Notes:

POTW = Publically owned treatment works
SVE = Soil Vapor Extraction
VOC = volatile organic compound

Table 6-1
Remedial Alternative Summary
Hookston Station
Pleasant Hill, California

Target Area	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Shallow Soil	No Action	Institutional Controls (soil management plan)	Institutional Controls (soil management plan)	Institutional Controls (soil management plan)	Institutional Controls (soil management plan)	Institutional Controls (soil management plan)
Residential Indoor Air	No Action	Indoor air vapor intrusion prevention systems	Indoor air vapor intrusion prevention systems	Indoor air vapor intrusion prevention systems	Indoor air vapor intrusion prevention systems	Indoor air vapor intrusion prevention systems
A-Zone Ground Water	No Action	Monitored natural attenuation, Private well removal	In situ enhanced anaerobic bioremediation, Private well removal	Zero-valent iron permeable reactive barrier, Private well removal	Zero-valent iron permeable reactive barrier, Private well removal	Ground water extraction with ex situ physical treatment, Private well removal
B-Zone Ground Water	No Action	Monitored natural attenuation, Private well removal	In situ chemical oxidation, Private well removal	In situ chemical oxidation, Private well removal	Zero-valent iron permeable reactive barrier, Private well removal	Ground water extraction with ex situ physical treatment, Private well removal

Remedial Alternative	Description	O&M Duration	Direct and Indirect Capital Costs	Total O&M Costs (Undiscounted)	NPW of Total O&M Costs	Estimated Total Cost (NPV)
Alternative 1	No Action	NA	$0	$0	$0	**$0**
Alternative 2	Monitored Natural Attenuation - A-Zone and B-Zone Ground Water;	30 Years or greater	$314,010	$4,584,460	$2,260,597	**$2,575,000**
	Residential Vapor Intrusion Prevention Systems;	30 Years or greater				
	Private Well Removal.	NA				
Alternative 3	Enhanced Anaerobic Bioremediation - A-Zone Ground Water;	30 Years (10 years on Parcel)	$3,013,987	$3,000,155	$1,915,610	**$4,930,000**
	In Situ Chemical Oxidation - B-Zone Ground Water;	30 Years				
	Residential Vapor Intrusion Prevention Systems;	6 Years				
	Private Well Removal.	NA				
Alternative 4	Zero-Valent Iron Permeable Reactive Barrier - A-Zone Ground Water;	30 Years	$3,213,835	$3,483,641	$1,979,886	**$5,194,000**
	In Situ Chemical Oxidation - B-Zone Ground Water;	30 Years				
	Residential Vapor Intrusion Prevention Systems;	4 Years				
	Private Well Removal.	NA				
Alternative 5	Zero-Valent Iron Permeable Reactive Barrier - A-Zone and B-Zone Ground Water;	30 Years	$7,067,510	$2,884,073	$1,670,940	**$8,739,000**
	Residential Vapor Intrusion Prevention Systems;	4 Years				
	Private Well Removal.	NA				
Alternative 6	Ground Water Extraction, Treatment, and Disposal - A-Zone and B-Zone Ground Water;	30 Years	$1,900,257	$26,184,172	$10,905,844	**$12,807,000**
	Residential Vapor Intrusion Prevention Systems;	3 Years				
	Private Well Removal.	NA				

Notes: O&M = Operation and Maintenance
NPV = Net Present Value, based on 7% discount rate
NA = Technology does not have an O&M component

Table 7-2
Summary of Detailed Analysis - Remedial Alternative 1
Hookston Station
Pleasant Hill, California

Evaluation Criteria	Detailed Analysis Summary	Score
Threshold Criteria		
Overall protection of human health and the environment	No actions are taken. Provides no protection of human health and the environment.	No
Compliance with applicable or relevant and appropriate requirements (ARARs)	Will not satisfy ARARs.	No
Balancing Criteria		
Long-term effectiveness and permanence	No actions are taken. Provides no long-term effectiveness or permanence.	0
Reduction of toxicity, mobility, or volume (TMV) through treatment	Provides no reduction in TMV through treatment.	0
Short-term effectiveness	As no actions are taken, there would be no short-term risk to workers. However protection from site risks would not be attained.	2
Implementability	As no actions are taken, this alternative is highly implementable.	5
Cost	No cost.	5
Balancing Criteria Score		12
Modifying Criteria		
State and community acceptance	State and community acceptance will be evaluated following public review of the FS	TBD

Each alternative's performance against the criteria is initially ranked on a scale of 0 to 5. The ranking scores are not intended to be quantitative, but rather are only summary indicators of the alternative's performance against the CERCLA evaluation criteria. The rankings equate to the following qualifiers:

NR = Not ranked
0 = No/none
1 = Low
2 = Low-moderate
3 = Moderate
4 = Moderate-high
5 = High

Table 7-3
Summary of Detailed Analysis - Remedial Alternative 2
Hookston Station
Pleasant Hill, California

Evaluation Criteria	Detailed Analysis Summary	Score
Threshold Criteria		
Overall protection of human health and the environment	Immediate risks due to VOCs in ground water addressed through vapor mitigation and private well removal. MNA will be relied on to reduce overall concentrations of VOCs.	No
Compliance with applicable or relevant and appropriate requirements (ARARs)	While MNA may eventually be able to reduce VOCs from the Hookston Station to below ARARs in localized areas where conditions are favorable, this alternative is not expected to be able to reliably reach ARARs over the extent of the Hookston Station ground water plume in a reasonable period of time	No
Balancing Criteria		
Long-term effectiveness and permanence	In areas that are not conducive to biodegradation, intrinsic biodegradation may occur at very slow rates. Monitoring would ensure that geochemical conditions remain conducive to biodegradation throughout the attenuation period, and would be used to determined residual concentrations and/or the need to implement further treatment.	1
Reduction of toxicity, mobility, or volume (TMV) through treatment	No reduction in TMV of chemicals in soil and ground water through treatment. Vapor intrusion mitigation achieves a level of reduced toxicity, but slow ground water treatment may result in increased volume of impacted ground water	1
Short-term effectiveness	This alternative poses little risk to local receptors during implementation, and requires no additional implementation. However, MNA is a long-term process and therefore has only moderate short-term effectiveness.	3
Implementability	Materials and services needed to implement containment measures are readily available, and technologies are reliable and proven.	4
Cost	$2,575,000	4
Balancing Criteria Score		13
Modifying Criteria		
State and community acceptance	State and community acceptance will be evaluated following public review of the FS	TBD

Each alternative's performance against the criteria is initially ranked on a scale of 0 to 5. The ranking scores are not intended to be quantitative, but rather are only summary indicators of the alternative's performance against the CERCLA evaluation criteria. The rankings equate to the following qualifiers:

TBD = To be determined
NR = Not ranked
0 = No/none
1 = Low
2 = Low-moderate
3 = Moderate
4 = Moderate-high
5 = High

Table 7-4
Summary of Detailed Analysis - Remedial Alternative 3
Hookston Station
Pleasant Hill, California

Evaluation Criteria	Detailed Analysis Summary	Score
Threshold Criteria		
Overall protection of human health and the environment	Immediate risks due to VOCs in ground water addressed through vapor mitigation and private well removal. Protective of human health and the environment, despite uncertainty of effectiveness of enhanced bioremediation.	Yes
Compliance with applicable or relevant and appropriate requirements (ARARs)	May be able to satisfy chemical, action, and location specific ARARs. B-Zone VOCs are expected to be treated to chemical-specific ARARs through source area treatment by oxidation.	Yes
Balancing Criteria		
Long-term effectiveness and permanence	Nearly immediate and permanent reduction of the most highly concentrated VOCs in A-Zone and B-Zone ground water is possible with this alternative. Complete effectiveness of bioremediation of VOCs in A-Zone is uncertain without completion of pilot-scale testing of this technology to ensure that residual concentrations of recalcitrant 1,2-DCE and/or vinyl chloride do not remain following treatment. Incomplete biodegradation could result in significant residual risk.	3
Reduction of toxicity, mobility, or volume (TMV) through treatment	Reduction of TMV of VOC-impacted ground water may be achieved through treatment by enhanced bioremediation (A-Zone) and chemical oxidation (B-Zone). The completeness of A-Zone bioremediation is uncertain, particularly within the downgradient study area, with potential for localized untreated areas as well as temporary or permanent residual concentrations of vinyl chloride as a result of incomplete reductive dechlorination.	2
Short-term effectiveness	This alternative presents minimal risk to the community. Workers performing the chemical oxidation injections will be in contact with potassium permanganate in solid and dissolved form. Immediate contaminant risks will be reduced through vapor mitigation systems and removal of private supply wells. However, the expected increased duration of bioremediation within the downgradient study area, due to the limited area over which this can be implemented, results in reduced short-term effectiveness.	3
Implementability	Materials and services needed for remedial action are readily available, and technologies are reliable and proven, with the exception of enhanced bioremediation for which reliability must be proven on a site-specific basis.	3
Cost	$4,930,000	3
Balancing Criteria Score		14
Modifying Criteria		
State and community acceptance	State and community acceptance will be evaluated following public review of the FS	TBD

Each alternative's performance against the criteria is initially ranked on a scale of 0 to 5. The ranking scores are not intended to be quantitative, but rather are only summary indicators of the alternative's performance against the CERCLA evaluation criteria. The rankings equate to the following qualifiers:

TBD = To be determined
NR = Not ranked
0 = No/none
1 = Low
2 = Low-moderate
3 = Moderate
4 = Moderate-high
5 = High

Table 7-5
Summary of Detailed Analysis - Remedial Alternative 4
Hookston Station
Pleasant Hill, California

Evaluation Criteria	Detailed Analysis Summary	Score
Threshold Criteria		
Overall protection of human health and the environment	This alternative provides a high level of short-term and long-term effectiveness and is expected to meet risk-based RAOs and therefore is considered protective of human health and the environment.	Yes
Compliance with applicable or relevant and appropriate requirements (ARARs)	This alternative is expected to be able to satisfy chemical, action, and location specific ARARs.	Yes
Balancing Criteria		
Long-term effectiveness and permanence	This alternative will be effective in the long-term for A-Zone ground water by providing immediate and permanent destruction of VOCs as ground water flows through the PRB. Nearly immediate and permanent reduction of the most highly concentrated VOCs in B-Zone ground water is expected with this alternative by chemical oxidation, providing for more complete downgradient reduction of VOCs natural processes.	5
Reduction of toxicity, mobility, or volume (TMV) through treatment	Significant reduction of TMV of VOC-impacted ground water is expected within the area and water-bearing zone with the greatest risk to receptors, A-Zone groundwater within the downgradient study area. The PRB is expected to immediately reduce the toxicity of A-Zone ground water as it passes through the PRB. Source area treatment of B-Zone groundwater by chemical	4
Short-term effectiveness	The expected time frame to achieve treatment to the level at which indoor air risks are reduced is expected to be short, while achieving the ultimate cleanup goal of the MCL for ground water will take significantly longer, without posing immediate risks.	4
Implementability	Materials and services needed for remedial action are readily available, and technologies are reliable and proven. Installation of the PRB in the downgradient study area will require both innovative techniques and proper coordination with residences and city agencies. This would be true of either a trenched or injected PRB, with the trenched PRB presenting greater installation difficulties, due to potential presence of subsurface utilities. Installation of vapor intrusion mitigation systems and decommissioning of private wells will require cooperation with residents.	3
Cost	$5,194,000	3
Balancing Criteria Score		19
Modifying Criteria		
State and community acceptance	State and community acceptance will be evaluated following public review of the FS	TBD

Each alternative's performance against the criteria is initially ranked on a scale of 0 to 5. The ranking scores are not intended to be quantitative, but rather are only summary indicators of the alternative's performance against the CERCLA evaluation criteria. The rankings equate to the following qualifiers:

TBD = To be determined
NR = Not ranked
0 = No/none
1 = Low
2 = Low-moderate
3 = Moderate
4 = Moderate-high
5 = High

Table 7-6
Summary of Detailed Analysis - Remedial Alternative 5
Hookston Station
Pleasant Hill, California

Evaluation Criteria	Detailed Analysis Summary	Score
Threshold Criteria		
Overall protection of human health and the environment	This alternative provides a moderately high level of short-term and long-term effectiveness and is expected to meet risk-based RAOs and therefore is considered protective of human health and the environment.	Yes
Compliance with applicable or relevant and appropriate requirements (ARARs)	This alternative is expected to satisfy chemical, action, and location specific ARARs within a reasonable time frame, as ground water is treated as it passes through the A-Zone and B-Zone PRBs. However, ground water within the Hookston Station Parcel will take a significantly longer duration to reach ARARs, while not posing an immediate risk to receptors.	Yes
Balancing Criteria		
Long-term effectiveness and permanence	This alternative will be effective in the long-term for A-Zone and B-Zone ground water by providing immediate and permanent destruction of VOCs as ground water flows past the PRB. Ground water within the Hookston Station Parcel is expected to reduce in the long-term through natural degradation processes, but this may result in residual contamination due to the high concentrations of VOCs present in the source area, particularly in B-Zone ground water.	4
Reduction of toxicity, mobility, or volume (TMV) through treatment	Significant reduction of TMV of VOC-impacted ground water is expected within the area and water-bearing zone with the greatest risk to receptors, A-Zone groundwater within the downgradient study area. The PRB is expected to immediately reduce the toxicity of ground water. The TMV of ground water within the Hookston Station Parcel is expected to eventually reduce as a result of natural degradation processes, but this is expected to take a significant amount of time.	3
Short-term effectiveness	The expected time frame to achieve treatment to the level at which indoor air risks are reduced is expected to be short, while achieving the ultimate cleanup goal of the MCL for ground water will take significantly longer without posing immediate risks. The duration to achieve MCLs in the B-Zone is expected to take a significant time frame.	4
Implementability	Materials and services needed for remedial action are readily available, and technologies are reliable and proven. Installation of the PRB in the downgradieng study area will be difficult and require both innovative techniques and proper coordination with residences and city agencies. The deeper A-Zone and B-Zone placement of the PRB will require a greater time frame and the use of innovative injected PRB methods. Installation of vapor intrusion mitigation systems and decommissioning of private wells will require cooperation with residents.	3
Cost	$8,739,000	2
Balancing Criteria Score		16
Modifying Criteria		
State and community acceptance	State and community acceptance will be evaluated following public review of the FS	TBD

Each alternative's performance against the criteria is initially ranked on a scale of 0 to 5. The ranking scores are not intended to be quantitative, but rather are only summary indicators of the alternative's performance against the CERCLA evaluation criteria. The rankings equate to the following qualifiers:

TBD = To be determined
NR = Not ranked
0 = No/none
1 = Low
2 = Low-moderate
3 = Moderate
4 = Moderate-high
5 = High

Evaluation Criteria	Detailed Analysis Summary	Score
Threshold Criteria		
Overall protection of human health and the environment	This alternative provides a moderately high level of short-term and long-term effectiveness and is expected to meet risk-based RAOs and therefore is considered protective of human health and the environment.	Yes
Compliance with applicable or relevant and appropriate requirements (ARARs)	This alternative is expected to satisfy chemical- specific ARARs for ground water, but over a significantly longer time frame than with alternatives consisting of more aggressive in situ technologies.	Yes
Balancing Criteria		
Long-term effectiveness and permanence	Plume-wide ground water extraction is expected to provide effective and relatively fast reduction of A-Zone TCE to concentrations reducing associated risks associated with migration to indoor air. However, this alternative relies on long-term operation and maintenance of an extraction and treatment system to achieve MCLs in A-Zone and B-Zone ground water, which may be unreliable.	4
Reduction of toxicity, mobility, or volume (TMV) through treatment	Reduction of TMV is expected with this alternative, through extraction of TCE-impacted ground water. However, the contaminants are simply removed from ground water, rather than being destroyed in situ. Contaminants are transferred between media at several stages of the treatment process. In addition, the low reliability of extraction to be able to capture all impacted ground water may result in localized untreated zones and higher residual TMV.	3
Short-term effectiveness	This alternative will require significant infrastructure associated with the treatment. The long duration of system operation and maintenance for this alternative reduces the level of short-term effectiveness. The expected time frame to achieve treatment to the level at which indoor air risks are reduced is expected to be short, while achieving the ultimate cleanup goal of the MCL for ground water will take significantly longer without posing immediate risks.	4
Implementability	This alternative requires construction, operation, and maintenance of significant infrastructure to implement P&T. However, the construction methods and equipment are readily available.	2
Cost	$12,807,000	1
Balancing Criteria Score		14
Modifying Criteria		
State and community acceptance	State and community acceptance will be evaluated following public review of the FS	TBD

Each alternative's performance against the criteria is initially ranked on a scale of 0 to 5. The ranking scores are not intended to be quantitative, but rather are only summary indicators of the alternative's performance against the CERCLA evaluation criteria. The rankings equate to the following qualifiers:

TBD = To be determined
NR = Not ranked
0 = No/none
1 = Low
2 = Low-moderate
3 = Moderate
4 = Moderate-high
5 = High

Table 7-8
Summary of Comparative Analysis of Alternatives
Hookston Station
Pleasant Hill, California

Remedial Alternative	Threshold Criteria (Yes/No)		Balancing Criteria (Ranked 1-5)						Total Score [1]	Modifying Criteria (Yes/No) [2]	RANK [3]
	Protection of Human Health and the Environment	Compliance with ARARs	Long Term Effectiveness	Reduction of Toxicity, Mobility, and Volume	Short-Term Effectiveness	Implementability	Cost (including ranking)			State and Community Acceptance	
Alternative 1	N	N	0	0	2	5	$0	5	12	TBD	6
Alternative 2	N	N	1	1	3	4	$2,575,000	4	13	TBD	5
Alternative 3	Y	Y	3	2	3	3	$4,930,000	3	14	TBD	4
Alternative 4	Y	Y	5	4	4	3	$5,194,000	3	19	TBD	1
Alternative 5	Y	Y	4	3	4	3	$8,739,000	2	16	TBD	2
Alternative 6	Y	Y	4	3	4	2	$12,807,000	1	14	TBD	3

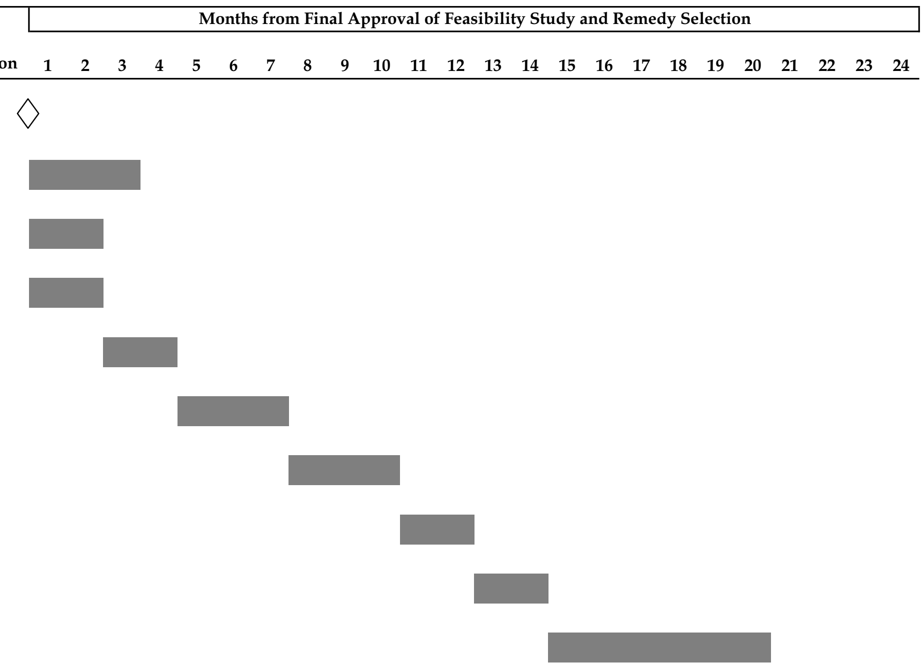
Notes:
1 = Total Score is sum of ranking for Balancing Criteria
2 = State and Community Acceptance is typically evaluated following review and comment and is expected to be more completely evaluated in later versions of this FS.
3 = Rank of Alternatives in order of preference, based on evaluation criteria. This evaluation includes the total score of the Balancing Criteria, as well as whether the threshold criteria are met.
TBD = To be determined. The modifying criteria of State and Community Acceptance will be evaluated following review of the FS.

Each alternative's performance against the criteria is initially ranked on a scale of 0 to 5. The ranking scores are not intended to be quantitative, but rather are only summary indicators of the alternative's performance against the CERCLA evaluation criteria. The rankings equate to the following qualifiers:

NR = Not Ranked
0 = No/None
1= Low
2 = Low-Moderate
3 = Moderate
4 = Moderate-High
5 = High

Table 8-1
Preliminary Implementation Schedule
Hookston Station
Pleasant Hill, California

Task #	Task Description	Anticipated Duration
1	Final RWQCB Approval of Feasibility Study and Implementation Plan	Milestone
2	Implementation of Vapor Intrusion Prevention Systems and Well Abandonments	90 days
3	SMP Development and Submittal	60 days
4	Pre-Design Investigation Work Plan Development and Submittal	60 days
5	Pre-Design Investigation Work Plan RWQCB Review and Approval	60 days
6	Pre-Design Investigation Implementation and Reporting	90 days
7	Remedial Design	90 days
8	RWQCB Review and Final Approval of Remedial Design	60 days
9	Permitting, Utility Clearance, Procurement	60 days
10	Remedy Implementation	180 days



Notes:
Anticipated Durations are estimates shown in calendar days.

Tasks 5 and 8 estimate a 60-day period for RWQCB review and final approval of the submittals under Tasks 4 and 7, respectively. If the period required for RWQCB approval of those submittals exceeds 60 days, the schedule for commencement of subsequent tasks dependent upoon those approvals will be delayed.