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LOCKHEED MARTIN

March 22, 2012

Mr. Daniel Zogaib
Southern California Cleanup Operations
Department of Toxic Substances Control
5796 Corporate Avenue
Cypress, CA 90630

Subject: Submittal of Technical Memorandum entitled *Preliminary Remedial Action Objectives, ARARs, GRAs, and Remedial Technology Screening Tables, Laborde Canyon (Beaumont Site 2)*

Dear Mr. Zogaib:

Please find enclosed one hard copy and two compact disks of the Technical Memorandum entitled *Preliminary Remedial Action Objectives, ARARs, GRAs, and Remedial Technology Screening Tables, Laborde Canyon (Beaumont Site 2)* for your review and approval or comment.

In the meantime, if you have any questions regarding this submittal, please contact me at 818-847-9901 or brian.thorne@lmco.com.

Sincerely,

Gene Matsushita for Brian

Brian Thorne, Project Lead

Enclosure: Technical Memorandum entitled *Preliminary Remedial Action Objectives, ARARs, GRAs, and Remedial Technology Screening Tables, Laborde Canyon (Beaumont Site 2)*

Copy: Gene Matsushita, LMC (electronic and hard copy)
Sally Drinkard, CDM (electronic copy)
Tom Villeneuve, Tetra Tech (electronic copy)
Hans Kernkamp, Riverside County Waste Management (electronic copy)
Alan Bick, Gibson Dunn (electronic copy)

BUR071 DTSC Submittal-Tech Memo PRAO

MARCH 21, 2012

TECHNICAL MEMORANDUM
LOCKHEED MARTIN CORPORATION

SUBJECT: Preliminary Remedial Action Objectives, ARARs, GRAs, and Remedial Technology Screening Tables, Laborde Canyon (Beaumont Site 2)

The following technical memorandum presents the initial steps in the feasibility study (FS) process for the Lockheed Martin Corporation (LMC) Laborde Canyon site (Beaumont Site 2), located in Beaumont, California. The purpose of this technical memorandum is to present the results of the initial FS tasks to the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) for review and approval prior to commencing the development and screening of Site remedial alternatives and preparation of the FS report. This work is being completed in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) in 40 C.F.R. Part 300.

1.0 INTRODUCTION

This technical memorandum includes the following tasks: preliminary evaluation of risk drivers in each area of concern at the Site; development of remedial action objectives (RAOs); identification of applicable or relevant and appropriate requirements (ARARs) and additional standards and guidance to be considered (TBCs); development of general response actions (GRAs) for each medium; and the identification and screening of remedial technologies and process options for each GRA. The information included in this memorandum will provide the foundation upon which numerical remediation goals, cleanup levels, and remediation alternatives can be developed. Estimates of human health and ecological risks, together with federal, state, and local regulatory requirements, were used as the basis for defining the RAOs for the Site. A brief summary of the risks has been included below. A detailed summary of human health and ecological risk assessment results, along with the conceptual site model addressing the nature and extent of contamination, will be included in the FS prior to the presentation of RAOs and GRAs. For purposes of this memorandum, the phrase ‘protective levels’ has been used in the discussion of individual RAOs in lieu of the more detailed remedial cleanup goals that will be available following completion of the revised risk assessments.

1.1 SUMMARY OF SITE RISKS

Remedial investigations for the Site have been completed and the human health and ecological risk assessments are being finalized. Based on the preliminary results of the risk assessments, the following areas were identified as showing cancer risks exceeding 1×10^{-6} or non-cancer hazard indices greater than 1 for human receptors, or hazard indices greater than 1 for ecological receptors based on a reproductive endpoint (Tetra Tech, 2011b):

Human Receptors

- Waste Discharge Area (WDA) – Cancer risks of 2×10^{-6} were identified for adult trespassers (reasonable maximum exposure scenario only) in the WDA. Risk is driven by elevated cadmium concentrations in soil sample POND3-0.5', collected at a depth of 0.5 foot below ground surface (bgs).
- Groundwater – Perchlorate, 1,4-dioxane, trichloroethene (TCE), 1,2-dichloroethane (1,2-DCA), 1,1-dichloroethene (1,1-DCE), methylene chloride, and 1,3,5-trinitrohexahydro-1,3,5-triazine (RDX) concentrations exceeded drinking water criteria in one or more groundwater samples.

Ecological Receptors

- Southern Test Bay Canyon (Area K) – Hazard indices greater than 1 were identified for small herbivorous mammals (Stephens' kangaroo rat [SKR]), herbivorous birds, and insectivorous birds in Southern Test Bay Canyon. Risk is driven by elevated perchlorate concentrations in shallow (0.5-1.5 feet bgs) soil.
- Waste Discharge Area – Hazard indices greater than 1 were identified for SKR, plants, and soil invertebrates in the WDA. Risk was driven by elevated lead and zinc concentrations at depths of 0.5 and 5 feet bgs in soil boring POND3-0.5.

2.0 DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES

The development of RAOs is the first step in the development and screening of remedial alternatives. RAOs are general cleanup objectives that consider the site contaminants of concern, contaminated media, potential exposure routes, receptors, and chemical/media-specific cleanup goals. The following sections present the proposed soil and groundwater RAOs developed for Laborde Canyon.

2.1 SOIL REMEDIAL ACTION OBJECTIVES

RAO S1 - Protect human receptors from exposure to Site chemicals of concern (COCs) in soil through ingestion, inhalation, and dermal contact at concentrations exceeding protective levels.

The Human Health and Ecological Risk Assessment (HHERA) found human health risks driven by cadmium concentrations in one shallow soil sample (Pond3-0.5') collected in the WDA. RAO S1 addresses potential exposures to cadmium in this area of the Site.

RAO S2 - Protect ecological receptors from exposure to Site COCs in soil through ingestion and food consumption (for mammals and birds) and direct uptake (for plants) at concentrations exceeding protective levels.

The results of the HHERA identified perchlorate in Southern Test Bay Canyon and lead and zinc in the WDA as the primary risk drivers for ecological receptors, including small mammals (SKR), herbivorous birds, insectivorous birds, soil invertebrates, and plants. RAO S2 addresses potential exposures to perchlorate in Southern Test Bay Canyon, and potential exposures to lead and zinc in the WDA.

2.2 GROUNDWATER REMEDIAL ACTION OBJECTIVES

RAO GW1 - Protect human receptors from exposure to Site COCs in groundwater by ingestion, dermal contact, and inhalation at concentrations exceeding protective levels.

The HHERA evaluated potential human health risks associated with the use of groundwater at the Site by comparing COC concentrations in groundwater to potentially applicable drinking water criteria. Seven COCs in groundwater have been detected at concentrations exceeding potential drinking water criteria: perchlorate, 1,4-dioxane, TCE, 1,2-DCA, 1,1-DCE, methylene chloride, and RDX. This RAO addresses potential exposures to these COCs in onsite and offsite groundwater.

RAO GW2 - Protect groundwater resources outside the current groundwater plume by limiting the offsite migration of site COCs at concentrations exceeding levels that are protective of designated beneficial uses.

The Site is not located within a groundwater basin designated in the Basin Plan. However, it is located in an area which is tributary to the San Jacinto Upper groundwater management zone of the San Jacinto Groundwater Basin (RWQCB, 1995). Per the Basin Plan, groundwaters that are not specifically listed have the same beneficial uses as the groundwater basins or sub-basins to which they are tributary or overlie. Designated beneficial uses of groundwater in the San Jacinto Upper groundwater management zone include municipal and domestic supply (MUN), agricultural supply (AGR), industrial service supply (IND), and industrial process supply (PROC). Numeric water quality objectives for the San Jacinto Upper groundwater management zone are summarized in Table 2-1.

Table 2-1
Numeric Water Quality Objectives for the
San Jacinto Upper Groundwater Management Zone

Constituent	Water Quality Objective (mg/L)
Total Dissolved Solids[1]	320
Sodium[2]	SAR[3] < 9 units
Chloride[2]	500
Total Inorganic Nitrogen[1]	1.4
Sulfate[2]	500
pH[2]	6 – 9 units
Arsenic[2]	0.05
Lead[2]	0.05
Boron[2]	0.75

Notes
1.Water quality objective of the San Jacinto Upper groundwater management zone from Table 4.1 of Basin Plan
2. Basin Plan water quality objective for groundwater.
3. SAR – sodium absorption ratio
mg/L – milligrams per liter

The Basin Plan narrative indicates that AGR beneficial uses may be impaired by excessive boron, chloride, sodium, and total dissolved solids (TDS) concentrations. Similarly, IND and PROC beneficial uses may be impaired by hardness and pH, which can cause pipe scaling. None of these constituents was released as a direct result of Site activities. Therefore, agricultural and industrial water supply beneficial uses are unlikely to be impaired as a direct result of releases of COCs at the Site.

Although the Basin Plan indicates that MUN is a potential beneficial use of Site groundwater due to the tributary location of the Site with respect to the San Jacinto Upper groundwater management zone, State Water Resources Control Board Resolution No. 88-63 ("Sources of Drinking Water Policy") states that there are several exceptions to the MUN designation. One of the exceptions is for water sources which do not provide sufficient water to supply a single well capable of producing an average sustained yield of 200 gallons per day (gpd). Hydraulic testing (Tetra Tech, 2010; Tetra Tech, 2011a) has found that hydraulic conductivity values at Laborde Canyon are quite low, suggesting that well yields may not be sufficient to supply at least 200 gpd to a single well. The available hydraulic testing data were therefore used to estimate potential well yields, using the specific capacity method outlined in Appendix 16.D. of Driscoll (1986). The results of this analysis (Attachment A) indicate that potential average well yields at Laborde Canyon are less than the 200 gpd threshold promulgated in Resolution No. 88-63. Groundwater at the Site is therefore an exception to the MUN beneficial use designation.

Federal and state maximum contaminant levels (MCLs) are enforceable standards that are protective of the MUN beneficial use of groundwater. As previously noted, onsite perchlorate, 1,4-dioxane, TCE, 1,2-DCA, 1,1-DCE, and RDX concentrations have exceeded drinking water criteria, but because Site groundwater is not a source of drinking water, the presence of these COCs does not impair beneficial uses. Furthermore, because existing land use controls at the Site prevent the future use of groundwater, the presence of COCs in onsite groundwater does not pose a threat to human health. However, perchlorate has migrated offsite at concentrations exceeding the MCL, and continued expansion of the groundwater plume at concentrations exceeding MCLs could be considered a potential threat to the MUN beneficial use of groundwater in the San Jacinto Upper groundwater management zone. RAO GW2 addresses the potential for impairments to beneficial uses of groundwater in the San Jacinto Groundwater Basin due to offsite migration of contaminants.

3.0 IDENTIFICATION AND COMPILATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND ADDITIONAL STANDARDS AND GUIDANCE TO BE CONSIDERED (TBC)

Section 121(d) of CERCLA requires that remedial actions implemented at CERCLA sites attain any federal or more stringent state environmental standards, criteria, or limitations that are determined to be either applicable or relevant and appropriate, unless a waiver is granted. Applicable requirements are those cleanup standards, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site. A requirement is applicable if the jurisdictional prerequisites of the environmental standard show a direct correspondence when objectively compared with the conditions at the site.

Relevant and appropriate requirements are those cleanup standards, control standards, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that, while not applicable, address problems or situations sufficiently similar to the circumstances of the proposed response action and are well suited to the conditions of the site. The criteria for determining relevance and appropriateness are listed in Title 40 of the Code of Federal Regulations (CFR) Section 300.400(g)(2).

TBC criteria do not meet the definition of an ARAR, but still may be useful in determining whether to take action at a site, or to what degree action is necessary, particularly when there are no ARARs for a site, action, or contaminant. TBC criteria are non-promulgated advisories or guidance issued by federal or state government that are not legally binding, but may provide useful information or recommended procedures for remedial action. Although TBCs do not have the status of ARARs, they are typically considered together with ARARs to establish the required level of cleanup for protection of health or the environment. The critical difference between a TBC and an ARAR is that an entity is not required to comply with or meet a TBC when implementing a remedial action. TBCs are defined in 40 CFR §300.400(g)(3).

ARARs and TBCs are generally classified as chemical-specific, location-specific, or action-specific. These categories were developed to help define ARARs; however, some ARARs do not fall precisely within one group. The categories of ARARs are defined below.

- Chemical-specific ARARs include those laws and requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics or containing specified chemical compounds. These requirements generally set numerical health- or risk-based concentration limits or discharge limitations for specific hazardous substances. If, in a specific situation, a chemical is subject to more than one discharge or exposure limit, the most stringent of the requirements should generally be applied. An example of a chemical-specific ARAR is a groundwater standard.

- Location-specific ARARs are those requirements that relate to the geographical or physical position of the site, rather than the nature of the contaminants or the proposed remedial actions. These requirements may limit the placement of a remedial action, or impose additional constraints on a remedial action. Location-specific ARARs may refer to activities near endangered species habitat, wetlands, or areas of historical significance.

- Action-specific ARARs are requirements that apply to specific actions associated with site remediation. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy, and often define acceptable handling, treatment, and disposal procedures for hazardous substances. Examples of action-specific ARARs include requirements applicable to landfill closure, wastewater discharge, hazardous waste disposal, and air emissions.

Preliminary lists of potential chemical-specific, location-specific, and action-specific ARARs and TBCs are included in Tables B-1, B-2, and B-3, respectively, in Attachment B. The identification of ARARs for remedial actions at the site is an ongoing iterative process, and the lists will be updated as appropriate during remedial action planning and implementation.

4.0 DEVELOPMENT OF GENERAL RESPONSE ACTIONS (GRAS) AND IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES AND PROCESS OPTIONS

General Response Actions (GRAs) for each medium are actions that may be taken to satisfy the RAOs. GRAs considered for Laborde Canyon include the following:

- No action
- Monitoring (groundwater only)
- Institutional and engineering controls
- Containment
- Treatment
- Removal (soil only)
- Extraction (groundwater only)
- Disposal

The list of GRAs was then expanded to include general remedial technology types. As an example, the treatment GRA was expanded to include both *in situ* and *ex situ* physical, biological, chemical, and thermal treatment technologies. The list of technology types was then screened to eliminate technologies that cannot be technically implemented at the Site. None of the technology types was eliminated at this stage of the screening process.

Each technology type was then populated with representative process options for further screening. Process options were obtained from several sources, including in-house experience with a variety of remedial technologies, and a search of readily-available literature. The literature search included technology reviews and case studies prepared by the United States Environmental Protection Agency (USEPA), the Federal Remedial Technologies Roundtable (FRTR), the Interstate Technology & Regulatory Council (ITRC), and the Environmental Security Technology Certification Program (ESTCP).

4.1 TECHNOLOGY SCREENING

The complete list of process options for each medium was screened based on the CERCLA criteria of effectiveness, implementability, and cost (USEPA, 1988). The screening for effectiveness considered three elements: the potential effectiveness of the process option in handling the estimated areas or volumes of impacted media and meeting the RAOs; potential impacts to human health and the environment during construction and implementation; and whether the process is proven and reliable with respect to the contaminants and conditions at the Site. The implementability evaluation considered technical as well as institutional aspects of implementability, such as permitting issues and the availability of services, equipment, and/or workers. The cost evaluation was limited to evaluation of relative costs (low, moderate, or high) within a given technology type. Process options were screened out on the basis of cost only if alternate process options could be implemented at a lower cost.

The technology screening is conducted to reduce the number of viable technology types, not just the number of individual process options. During the screening process, entire technology types were eliminated from consideration only if all of the process options representing the technology type were screened out. The results of the technology screening are presented in Tables C-1 (soil) and C-2 (groundwater) in Attachment C.

Based on the screening results, technologies that will be used to develop site-wide remedial alternatives for Laborde Canyon include the following:

Soil Technologies

- Land use controls
- Community awareness
- Erosion control
- Capping
- Excavation and transportation
- *In situ* biological and physical treatment
- *Ex situ* biological treatment
- Onsite and offsite disposal

Groundwater

- Sampling and analysis
- Monitored natural attenuation
- Land use controls

- Community awareness
- Hydraulic containment
- Permeable reactive barrier
- *In situ* biological treatment
- *Ex situ* chemical, biological and physical treatment
- Extraction
- Onsite and offsite disposal

5.0 REFERENCES

1. Environmental Security Technology Certification Program (ESTCP) Website at http://www.serdp-estcp.org/.
2. FRTR (Federal Remediation Technologies Roundtable) Website at http://www.frtr.gov/.
3. ITRC (Interstate Technology & Regulatory Council) Website at http://www.itrcweb.org/.
4. Regional Water Quality Control Board, Santa Ana Region. 1995. Water Quality Control Plan, Santa Ana River Basin, January 1995.
5. Tetra Tech, Inc. 2010. Additional Offsite Well Installation and Aquifer Testing Report, Lockheed Martin Corporation, Beaumont Site 2, Beaumont, California, October 2010.
6. Tetra Tech, Inc. 2011a. Contaminant Flow and Transport Modeling Report, Beaumont Site 2, Lockheed Martin Corporation, Beaumont, California, July 2011.
7. Tetra Tech, Inc. 2011b. Human Health and Ecological Risk Assessment (HHERA) Report, Laborde Canyon (Lockheed Martin Corporation Beaumont Site 2), Beaumont, California, September 2011.
8. United States Environmental Protection Agency (U.S. EPA), 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA, Interim Final, October 1988.

6.0 ATTACHMENTS

Attachment A Groundwater Well Yield Analysis

Attachment B ARARs and TBC Criteria

Table B-1 Potential Chemical-Specific ARARs and TBC Criteria
Table B-2 Potential Location-Specific ARARs and TBC Criteria
Table B-3 Potential Action-Specific ARARs and TBC Criteria

Attachment C General Response Actions and Remedial Technology Screening

Table C-1 Soil Remedial Technology Screening
Table C-2 Groundwater Remedial Technology Screening

7.0 ACRONYMS AND ABBREVIATIONS

AGR	agricultural water supply beneficial use
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COCs	chemicals of concern
1,2-DCA	1,1-dichloroethane
1,1-DCE	1,1-dichloroethene
DTSC	California Environmental Protection Agency, Department of Toxic Substances Control
ESTCP	Environmental Security Technology Certification Program
FRTR	Federal Remedial Technologies Roundtable
FS	feasibility study
gpd	gallons per day
GRAs	general response actions
HHERA	Human Health and Ecological Risk Assessment
IND	industrial service supply
ITRC	Interstate Technology & Regulatory Council
LMC	Lockheed Martin Corporation
LPC	Lockheed Propulsion Company
MCL	maximum contaminant level
MW	monitoring well
MUN	municipal and domestic supply
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
PERA	predictive ecological risk assessment
PCE	tetrachloroethene
PROC	industrial process supply

RAOs	remedial action objectives
RDX	1,3,5-trinitrohexahydro-1,3,5-triazine
SAR	sodium absorption ratio
SARA	Superfund Amendments and Reauthorization Act
SKR	Stephens' kangaroo rat
TBC	to be considered
TCE	trichloroethene
TDS	total dissolved solids
USEPA	United States Environmental Protection Agency
VOCs	volatile organic compounds

ATTACHMENT A

GROUNDWATER WELL YIELD ANALYSIS

APPENDIX A
GROUNDWATER WELL YIELD ANALYSIS

Driscoll (1986, Appendix 16.D.) developed two empirical equations for estimating the specific capacity and transmissivity of a well. These equations are based on the Cooper and Jacob (1946) approximation of the Theis equation for small values of W(u):

$$s = \frac{264\,Q}{T} log \frac{0.3\,Tt}{r^2 S}$$

where

s = drawdown in well (feet)
Q = yield of the well (gallons per minute [gpm])
T = transmissivity of the well (gallons per day per foot [gpd/ft])
t = time of pumping (days)
r = radius of the well (feet)
S = storage coefficient of the aquifer.

The Cooper-Jacob equation can be rearranged in terms of specific capacity (Q/s):

$$\frac{Q}{s} = \frac{T}{264\,log \frac{0.3\,Tt}{r^2 S}}$$

Driscoll (1986) noted that typical values can be assumed for the variables in the denominator of Equation 2, with only minimal effect on the estimate of specific capacity. In his derivation, Driscoll (1986) assumed values of t = 1 day, r = 0.5 feet, T = 30,000 gpd/ft, and S = 1×10^{-3} for a confined aquifer and S = 7.5×10^{-2} for an unconfined aquifer to obtain the following equations:

$$\frac{Q}{s} = \frac{T}{2000}$$

for a confined aquifer, and

$$\frac{Q}{s} = \frac{T}{1500}$$

for an unconfined aquifer.

Although the values used for the variables by Driscoll (1986) are typical of water supply aquifers, the constants above have also been shown to be applicable to low transmissivity aquifers (e.g., Weink, 2001).

To estimate well yields, the above equations were rearranged to give (for example):

$$Q = \frac{Ts}{2000}$$

and then solved for Q by substituting appropriate values for transmissivity and drawdown.

Transmissivity estimates were obtained from hydraulic testing data (both slug tests and constant-rate tests) presented in Tetra Tech (2010) and Tetra Tech (2011). These data are summarized in Table A-1.

For the slug test data, transmissivity was estimated by multiplying the hydraulic conductivity values by the saturated thicknesses (B) used in the slug test interpretations. Transmissivity estimates were also obtained directly from constant rate aquifer test interpretations. Drawdown values were assumed to be equal to the saturated thicknesses for water table wells, or equal to the saturated thickness plus the water column height above the well screen for wells with submerged screens. These assumptions maximize the calculated well yield, and are therefore considered to be conservative. Well yields were then calculated using the equation for unconfined or confined aquifers, depending on whether the well is screened across the water table or within a confined zone.

The resulting well yield estimates are summarized in Table A-2. Estimated yields range from 0.12 gpd for well TT-MW2-28 to 4,097 gpd for well TT-MW2-36A, with a geometric mean of 72 gpd. It should be noted that the highest yields were calculated for wells which are completed in thin, discontinuous sand lenses. It is likely that the estimated yields for these wells could not be sustained over long time periods.

Based on the results summarized above, the average well yield at Laborde Canyon is estimated to be approximately 72 gpd, well below the State Water Resources Control Board Resolution 88-63 threshold of 200 gpd for an aquifer to be considered a potential source of drinking water supply.

References

Cooper, H.H. Jr. and Jacob, C.E. (1946) *A generalized graphical method for evaluating formation constants and summarizing well field history.* Transactions, American Geophysical Union, Vol 27, No. 4.

Driscoll (1986) *Groundwater and Wells, 2nd Edition.* U.S. Filter/Johnson Screens, Saint Paul, Minnesota,1089 pp.

Tetra Tech (2010) *Additional Offsite Well Installation and Aquifer Testing Report, Lockheed Martin Corporation, Beaumont Site 2, Beaumont, California.* October 2010.

Tetra Tech (2011) *Contaminant Flow and Transport Modeling Report, Beaumont Site 2, Lockheed Martin Corporation, Beaumont, California.* July 2011.

Weink, B.M. (2001) *Correlating Hydraulic Conductivity and Specific Capacity to Map the Spatial Distribution of Hydraulic Conductivity in a Heterogeneous Aquifer System, Perris Basin, Southern California.* Unpublished MS thesis, University of California at Riverside.

Table A-1
Aquifer Test Data and Groundwater Well Yield Estimates
Laborde Canyon, Beaumont, California

Well ID	Hydraulic Conductivity[1] (feet per day)			Saturated Thickness[2] (feet)	Transmiss-ivity[3] (gpd/ft)	Water Column Height[4] (ft)	Assumed Drawdown[5] (ft)	Estimated Yield[6] (gpd)	
	Falling Head	Rising Head	Mean					Confined	Unconfined
Slug Test Data (Tetra Tech, 2010; 2011a)									
TT-MW2-7	0.042	0.038	0.04	6	1.8	WT	6	-	10
TT-MW2-7D	0.090	0.079	0.085	10	6.3	43	53	241	-
TT-MW2-8	0.50	0.49	0.50	5	19	WT	5	-	89
TT-MW2-9	0.19	0.19	0.19	9	13	WT	9	-	110
TT-MW2-9D	0.32	0.29	0.31	5	11	25	30	248	-
TT-MW2-10	0.65	0.91	0.78	3	18	WT	3	-	50
TT-MW2-11	0.011	0.014	0.012	7	0.64	WT	7	-	4.3
TT-MW2-13	0.16	0.17	0.17	7	8.7	WT	7	-	59
TT-MW2-14	0.12	0.11	0.11	5	4.2	WT	5	-	20
TT-MW2-17D	1.3	1.3	1.3	5	50	26	31	1107	-
TT-MW2-17S	0.051	0.048	0.050	8	3.0	WT	8	-	23
TT-MW2-19D	5.9E-04	-	5.9E-04	25	0.11	123	148	11.7	-
TT-MW2-19S	1.2E-03	-	1.2E-03	7	0.062	WT	7	-	0.42
TT-MW2-24	0.16	0.16	0.16	20	24	WT	20	-	459
TT-MW2-28	7.3E-04	6.4E-04	6.8E-04	5	0.026	WT	5	-	0.12
TT-MW2-30A	0.77	0.71	0.74	10	56	46	56	2241	-
TT-MW2-30B	0.053	0.045	0.049	10	3.7	71	81	215	-
TT-MW2-30C	0.011	0.010	0.011	5	0.40	150	155	44.7	-
TT-MW2-36A	2.7	2.2	2.5	10	184	21	31	4097	-
TT-MW2-37A	0.019	0.015	0.017	5	0.64	52	57	26.3	-
TT-MW2-37B	8.0E-03	6.7E-03	7.3E-03	5	0.27	112	117	23.2	-
TT-MW2-38A	0.65	0.15	0.40	20	60	WT	20	-	1155
TT-MW2-38B	0.086	0.073	0.080	5	3.0	94	99	212	-
TT-MW2-38C	0.026	0.040	0.033	10	2.5	131	141	252	-
TT-MW2-39	4.9	2.1	3.5	5	130	WT	5	-	624
TT-MW2-40A	3.1	2.7	2.9	5	109	31	36	2815	-
TT-MW2-41A	5.1E-04	4.0E-03	2.3E-03	10	0.17	WT	10	-	1.6
TT-MW2-42A	0.065	0.043	0.054	5	2.0	WT	5	-	10

Table A-1
Aquifer Test Data and Groundwater Well Yield Estimates
Laborde Canyon, Beaumont, California

Well ID	Hydraulic Conductivity[1] (feet per day)			Saturated Thickness[2] (feet)	Transmiss-ivity[3] (gpd/ft)	Water Column Height[4] (ft)	Assumed Drawdown[5] (ft)	Estimated Yield[6] (gpd)	
	Falling Head	Rising Head	Mean					Confined	Unconfined
Constant Rate Aquifer Test Data (Tetra Tech, 2010)									
TT-EW2-1	-	-	-	-	5.2	WT	10	-	50
TT-PZ2-2	-	-	-	-	10	WT	10	-	101
TT-MW2-8	-	-	-	-	69	WT	10	-	661
Geometric Mean:	**-**	**-**	**0.073**	**-**	**4.5**		**-**	**72**	

Notes:
1) Slug tests interpreted using method of Bouwer et al.
2) Saturated thickness estimates are those used in slug test interpretations.
3) Transmissivity for slug test data calculated as hydraulic conductivity (k) × saturated thickness (B)
4) Approximate height of water column above top of well screen. WT indicates water table well.
5) Maximum drawdown assumed to be the saturated thickness for water table wells; water column height plus saturated thickness for non-water table wells.
6) Estimated using empirical equations from Driscoll (1986), Appendix 16.D.

0.33264	14.8032

0.041967	0.036357

ATTACHMENT B

ARARS AND TBC CRITERIA

Table B-1
Potential Chemical-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Federal ARARs and TBCs				
Safe Drinking Water Act (42 USC §300 et seq.)				
National Primary Drinking Water Standards (MCLs)	40 CFR §141.61 – 141.62	Enforceable, chemical-specific drinking water standards	Relevant and appropriate	Applicable at the tap for drinking water supply systems; potentially relevant and appropriate for groundwater that has the potential to be used as drinking water.
Maximum Contaminant Level Goals (MCLGs)	40 CFR §141.50 – 141.51	Chemical-specific drinking water criteria pertaining to known or anticipated health effects	To be considered	To be considered for groundwater with multiple chemicals of concern that has the potential to be used as drinking water. MCLGs that are equal to zero are not considered ARARs or TBCs.
National Secondary Drinking Water Standards (Secondary MCLs)	40 CFR §143.3	Chemical-specific standards for consumer acceptance of drinking water	To be considered	Secondary MCLs are based on aesthetic criteria, and are therefore not risk-based.
Clean Water Act (33 USC §1251 et seq.)				
National Recommended Water Quality Criteria	Clean Water Act, Section 304(a)	Chemical-specific surface water quality criteria for the protection of aquatic life and human health	To be considered	Recommended criteria for discharges to surface water
California Toxics Rule	40 CFR §131.38	Chemical-specific water quality standards for the protection of aquatic life and human health in the enclosed bays and estuaries and inland surface waters of California	Applicable	Applicable for discharges to surface water
USEPA Superfund Guidance				
USEPA Region 9 Regional Screening Levels (RSLs)	USEPA Region 9	RSLs include numeric human health-based criteria for soil and tap water. The RSLs assume either residential or commercial/industrial worker receptors. For certain chemicals, DTSC recommends the use of California Human Health Screening Levels (CHHSLs) or the 2004 USEPA Region 9 California-modified Preliminary Remediation Goals (PRGs) in place of RSLs.	To be considered	RSLs are advisory only. A quantitative human health risk assessment has been performed and will be used to evaluate site-specific risks.
USEPA Health Advisories	USEPA	Health advisories are non-enforceable human health-based criteria for unregulated chemicals.	To be considered	Health advisories are advisory only.
Toxic Substances Control Act (15 USC §2601 et seq)				
Regulations pertaining to PCB-contaminated materials	40 C.F.R. §761.61(a)(4), (b), and (c)	Regulates storage and disposal of materials contaminated with PCBs at concentrations greater than 50 ppm.	Potentially applicable	PCB concentrations at the site are well below 50 ppm. However, these requirements are applicable if PCB concentrations greater than 50 ppm are discovered during remedial actions.

Table B-1
Potential Chemical-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
State ARARs and TBCs				
California Safe Drinking Water Act (HSC §116270 et seq.)				
California Primary Drinking Water Standards (California MCLs)	22 CCR §64421 - 64444	Enforceable, chemical-specific drinking water standards. California MCLs that are more stringent than federal MCLs, or which apply to chemicals not addressed by federal MCLs, are considered to be potential ARARs.	Relevant and appropriate	Applicable at the tap for drinking water supply systems; relevant and appropriate for groundwater that has the potential to be used as drinking water.
California Secondary Drinking Water Standards (California Secondary MCLs)	22 CCR §64449	Chemical-specific standards for consumer acceptance of drinking water. Secondary MCLs are based on aesthetic criteria, and are therefore not risk-based.	To be considered	Secondary MCLs are based on aesthetic criteria, and are therefore not risk-based.
California Public Health Goals (PHGs)	HSC §116365	PHGs are drinking water contaminant levels developed by the California Environmental Protection Agency, Office of Environmental Health Hazard Assessment (OEHHA), which are protective of human health over a lifetime of exposure.	To be considered	PHGs are advisory only; public water systems are not required to comply with PHGs.
California Drinking Water Notification Levels (DWNLs) and Response Levels	HSC §116455	DWNLs are health-based advisory levels established by the CDPH for contaminants in drinking water for which MCLs have not been established. Response levels are levels at which CDPH recommends removal of a drinking water source from service. Response levels are chemical-dependent, and range from 10 to 100 times the DWNL; the response level for 1,4-dioxane is currently 35 times the DWNL. DWNLs are established as precautionary measures for contaminants that may be considered candidates for establishment of MCLs, but have not yet undergone or completed the regulatory standard-setting process prescribed for the development of MCLs.	To be considered	DWNLs and Response Levels are non-regulatory and are not drinking water standards.

Table B-1
Potential Chemical-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Porter-Cologne Water Quality Control Act (CWC §13000 et seq.)				
Water Quality Control Plan for the Santa Ana River Basin (Basin Plan)	CWC §13240 et seq.	Describes the water resources of the Santa Ana River Basin, including both surface water and groundwater. Establishes beneficial uses of surface water and groundwater within the region. Establishes water quality objectives, including narrative and numerical standards, to protect the beneficial uses of surface water and groundwater. Describes implementation plans and other control measures designed to ensure compliance with state-wide plans and policies.	Applicable	The site is not located within a groundwater basin designated in the Basin Plan, but is tributary to the San Jacinto Upper Pressure groundwater management zone of the San Jacinto Groundwater Basin. Specific waters which are not listed in the Basin Plan have the same beneficial uses as the groundwater basins or subbasins to which they are tributary or overlie. Designated beneficial uses of groundwater in the San Jacinto Upper Pressure groundwater management zone include MUN (municipal and domestic supply), AGR (agricultural supply), IND (industrial service supply) and PROC (industrial process supply).Designated beneficial uses of surface water in Potrero Creek include MUN, AGR, groundwater recharge (GWR), contact recreation (REC1), non-contact recreation (REC2), warmwater habitat (WARM), and wildlife habitat (WILD)
Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304	SWRCB Resolution 92-49, as amended on April 21, 1994 and October 2, 1996	Requires that dischargers "clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored."	Applicable	Applicable narrative standards for establishing groundwater cleanup levels
Sources of Drinking Water Policy	SWRCB Resolution. 88-63, as revised by SWRCB Resolution No. 2006-0008	Designates all surface water and groundwater in the state as suitable or potentially suitable for municipal or domestic use. Specific exceptions include 1) waters where total dissolved solids exceed 3,000 mg/L or electrical conductivity exceeds 5,000 µS/cm; 2) waters with contamination, unrelated to the specific pollution incident, that cannot reasonably be treated for domestic use; 3) water sources which do not provide sufficient water to supply a single well capable of producing an average, sustained yield of 200 gallons per day (0.14 gallons per minute); 4) waters regulated as a geothermal resource or exempted for the purpose of injection of fluids for production of geothermal energy or hydrocarbons; or 5) waters located in certain treatment systems or a system designed to convey or store agricultural drainage.	Applicable	Applicable narrative criteria for establishing the beneficial uses of surface water and groundwater

Table B-1
Potential Chemical-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Cal/EPA Brownfields Guidance				
Cal/EPA California Human Health Screening Levels (CHHSLs)	"Use of California Human Health Screening Levels (CHHSLs) in Evaluation of Contaminated Properties," dated January 2005.	CHHSLs are numeric human health-based criteria for soil, soil gas, and ambient air. The CHHSLs assume either residential or commercial/industrial worker receptors.	To be considered	CHSSLs are advisory only. A quantitative site-specific risk assessment has been performed; these results will be used to evaluate human health risk.

Acronyms and Abbreviations:
Cal/EPA: California Environmental Protection Agency
CCR: California Code of Regulations
CDPH: California Department of Public Health
CFR: Code of Federal Regulations
CHHSLs: California Human Health Screening Levels
CWC: California Water Code
DWNLs: California Drinking Water Notification Levels
HSC: California Health and Safety Code
MCL: Maximum Contaminant Level
MCLGs: Maximum Contaminant Level Goals
OEHHA: California Environmental Protection Agency, Office of Environmental Health Hazard Assessment
PHGs: Public Health Goals
PGRs: Preliminary Remediation Goals
RSLs: Regional Screening Levels
SWRCB: State Water Resources Control Board
USEPA: United States Environmental Protection Agency
USC: United States Code

Table B-2
Potential Location-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Federal ARARs and TBCs				
National Archaeological and Historical Preservation Act (16 USC §469)				
Protection of archeological resources	36 CFR Part 65	Requires actions to recover and preserve artifacts if activities threaten significant scientific, prehistoric, historic, or archaeological resources.	Potentially applicable	Previous surveys have not identified archeological resources in areas where actions are proposed. Additional surveys may need to be conducted prior to construction in areas that have not been surveyed.
National Historic Preservation Act (16 USC §470)				
Protection of historic resources	36 CFR Part 800	Requires actions to minimize harm to historic properties listed on or eligible for listing on the National Register of Historic Places.	Potentially applicable	The site has structures greater than 50 years old, and the former LPC facilities are greater than 50 years old and may have Cold War era significance. Applicable if these or other resources are listed or eligible for listing on the National Register of Historic Places, and actions could potentially cause damage.
Clean Water Act Section 404 (33 USC §1344)				
Water pollution prevention and control	33 USC §1344	Requires permits for discharge of dredged or fill material into waters of the United States. Applies to navigable waters and tributaries.	Potentially applicable	Applicable if actions involve construction (dredge and fill) within the stream channel.
Executive Order No. 11990, Protection of Wetlands				
Protection of wetlands	40 CFR §6.302(a)	Requires actions to minimize the destruction, loss, or degradation of wetlands.	Potentially applicable	Applicable if actions involve construction in wetlands areas, or which may impact groundwater elevations or quality in riparian areas.
Endangered Species Act (16 USC §1531 et seq.)				
Protection of federally-listed threatened and endangered species and their critical habitat	50 CFR Parts 200 and 402	Requires actions to conserve listed species and their habitat. Includes requirements for consultation with the USFWS.	Applicable	The site is habitat for the federally-endangered Stephens' kangaroo rat (SKR), as well as other threatened or endangered animals and plants. A Habitat Conservation Plan and Incidental Take Permit for SKR will be required by the USFWS for remediation activities in critical habitat.
Fish and Wildlife Coordination Act (16 USC §661 et seq.)				
Protection and conservation of wildlife	40 CFR §302	Restricts diversion, channeling, or other activity that modifies a stream or river and affects fish and wildlife.	Potentially applicable	Applicable if actions involve construction within the stream channel or which may impact groundwater elevations or quality in riparian areas.

Table B-2
Potential Location-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Migratory Bird Treaty Act (16 USC §703 et seq.)				
Protection of native birds	50 CFR Parts 10 and 20	Protects almost all species of native migratory birds in the U.S. from unregulated "take," which can include poisoning at hazardous waste sites.	Potentially applicable	Applicable if actions affect native migratory birds.
State ARARs and TBCs				
California Register of Historical Resources (PRC §5020 et seq.)				
Protection of California historic resources	14 CCR §4850 et seq.	Requires actions to minimize harm to historic properties listed on or eligible for listing on the California Register of Historical Resources.	Potentially applicable	Sites eligible for the National Register of Historic Places are automatically eligible for the California Register of Historical Resources.
California Endangered Species Act (FGC §2050 et seq.)				
Protection of California-listed threatened and endangered species and their critical habitat	FGC §2080 and 3005	Requires actions to conserve listed species and their habitat. Includes requirements for coordination with the CDFG for species that are both federally and state-listed.	Applicable	The site is habitat for the federally-endangered Stephens' kangaroo rat (SKR), as well as other threatened or endangered animals and plants. Endangered species-related permitting will require coordination between the USFWS and CDFG.
Native Plant Protection Act (FGC §1900 et seq.)				
Protection of endangered and rare native plants	FGC §1900 et seq.	Requires actions to conserve endangered and rare native plants.	Potentially applicable	Applicable if actions affect endangered or rare native plant species.
California Fish and Game Code § 5650				
Protection of aquatic habitat and species in California	CFGC §5650	Prohibits the deposition into state waters of petroleum products, factory refuse, and any substance deleterious to fish, plants, or birds.	Potentially applicable	Applicable if actions involve construction within the stream channel.
California Streambed Alteration Program (FGC §1600-1616)				
California Streambed Alteration Agreement	CFGC §1600-1616	Requires notification of any physical impacts to rivers, streams, or lakes.	Potentially applicable	Applicable if actions involve construction (dredge and fill) within the stream channel.
Fish and Game Commission Wetlands Policy (adopted 1987) included in Fish and Game Code Addenda				
Protection of wetland habitat in California	Fish and Game Commission Wetlands Policy included in FGC Addenda	Requires actions to assure that there is no net loss of wetlands acreage or habitat value. Action must be taken to preserve, protect, and enhance California's wetland acreage and habitat value.	Potentially Applicable	Applicable if actions impact groundwater elevations or quality in riparian areas.

Acronyms and Abbreviations:
ARAR: Applicable or Relevant and Appropriate criteria
CDFG: California Department of Fish and Game
CFR: Code of Federal Regulations
FGC: California Fish and Game Code
LPC: Lockheed Propulsion Company
PRC: Public Resources Code
SKR: Stephens' kangaroo rat
TBC: To be considered criteria
USC: United States Code
USFWS: United States Fish and Wildlife Service

Table B-3
Potential Action-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Federal ARARs and TBCs				
Safe Drinking Water Act (42 USC §300 et seq.)				
Underground Injection Control Program	40 CFR §144	Prohibits injection wells from causing a violation of primary MCLs in the receiving waters and adversely affecting the health of persons.	Potentially applicable	Applicable to actions that include reinjection of treated groundwater into an aquifer
Clean Water Act (33 USC §1251 et seq.)				
National Pollution Discharge Elimination System (NPDES) Discharge Permit	40 CFR $122 et seq.	Criteria for discharge of pollutants to surface water, including NPDES permit requirements	Potentially applicable	Applicable to actions which involve the discharge of treated groundwater to surface water
NPDES Stormwater Permit	40 CFR §122 et seq;	Criteria for stormwater discharges, including NPDES Stormwater Permit requirements	Potentially applicable	Applicable to actions which involve the disturbance of more than 1 acre of land
Resource Conservation and Recovery Act (42 USC §6901 et seq.)				
Definition of RCRA hazardous waste	22 CCR §66261 40 CFR §261	Defines RCRA hazardous wastes.	Potentially applicable	Potentially applicable to excavated contaminated soil, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.
Hazardous waste generator requirements	22 CCR §66262 40 CFR §262	Standards for generators of hazardous waste, including accumulation, storage, manifesting, recordkeeping, and reporting requirements. Applies to both RCRA and non-RCRA hazardous wastes.	Potentially applicable	Potentially applicable to excavated contaminated soil, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.
Hazardous waste transporter requirements	22 CCR §66263 40 CFR §263	Standards for transporters of hazardous waste, including manifesting and recordkeeping requirements. Applies to both RCRA and non-RCRA hazardous wastes.	Potentially applicable	Potentially applicable to excavated contaminated soil, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.
Hazardous waste treatment, storage, and disposal requirements	22 CCR §66264 et seq 40 CFR §264 et seq.	Includes standards for disposal of hazardous wastes, including land disposal restrictions, treatment standards, and technology requirements. Applies to both RCRA and non-RCRA hazardous wastes.	Potentially applicable	Potentially applicable to excavated contaminated soil, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.
Hazardous Material Transportation Act (49 USC §5101 et seq.)				
Hazardous material transportation requirements	40 CFR §171 et seq.	Standards for transportation of hazardous materials	Potentially applicable	Applicable to actions which involve off-site treatment or disposal of excavated contaminated soil, extracted groundwater, or treatment residuals.

Table B-3
Potential Action-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Clean Air Act (42 USC §7600 et seq.)				
National Emission Standards for Hazardous Air Pollutants (NESHAPs)	40 CFR §61	Establishes emissions standards for designated hazardous air pollutants and sources, and sets emissions standards for fugitive emissions due to equipment leaks.	Potentially relevant and appropriate	NESHAPs have not been established for specific activities associated with potential actions at the site, but are potentially relevant and appropriate for emissions of designated pollutants. In general, toxic air pollutants are reviewed by SCAQMD as part of its permitting process.
National Ambient Air Quality Standards (NAAQS)	40 CFR §50	Primary and secondary standards for six criteria pollutants	Potentially applicable	The NAAQS for particulates is applicable to actions involving soil excavation.
New Source Performance Standards (NSPS)	40 CFR §60	Establishes emissions standards for new stationary sources of air pollutants.	Potentially applicable	The NSPS are applicable to actions that involve the treatment of soil and/or groundwater.
Occupational Safety and Health Act (29 USC §651 et seq.)				
Worker safety requirements	29 CFR Part 1910	Establishes Occupational Safety and Health Administration (OSHA) standards for worker safety. Includes 29 CFR §1910.120 (Hazardous Waste Operations and Emergency Response) regulations.	Applicable	Relevant portions of OSHA regulations, including 29 CFR §1910.120, are applicable to all actions at the site.
State ARARs and TBCs				
Porter-Cologne Water Quality Control Act (CWC §13000 et seq.)				
Statement of Policy With Respect to Maintaining High Quality of Waters in California (“Anti-Degradation Policy”)	SWRCB Resolution 68-16	Establishes requirements for activities involving the discharge of contamination directly into surface water and groundwater. Specifically, “Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.”	Potentially applicable	Applicable to actions which include the injection or discharge of treated effluent to groundwater or surface water, or injection of amendments into the subsurface.

Table B-3
Potential Action-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304	SWRCB Resolution 92-49, as amended on April 21, 1994, and October 2, 1996	Establishes criteria for "containment zones," which are specific portions of a water bearing unit where it is unreasonable to remediate to the level that achieves water quality objectives. Dischargers are required to take all actions necessary to prevent the migration of pollutants beyond the boundaries of the containment zone in concentrations which exceed water quality objectives, and must verify containment with an approved monitoring program and must provide reasonable mitigation measures to compensate for any significant adverse environmental impacts attributable to the discharge.	Potentially relevant and appropriate	Relevant and appropriate for actions that include groundwater containment.
Hazardous Waste Control Act (HSC §25100 et seq)				
Definition of non-RCRA (California) hazardous waste	22 CCR §66261.101	Defines non-RCRA(California) hazardous wastes. Generator, transporter, and treatment, storage, and disposal requirements are discussed (above in this table) under RCRA.	Potentially applicable	Potentially applicable to excavated contaminated soil, extracted groundwater, and treatment residuals, if these are determined to be hazardous wastes.
Consolidated Regulations for Treatment, Storage, Processing or Disposal of Solid Waste (PRC §40000 et seq. and CWC §13000 et seq.)				
SWRCB general landfill construction and containment criteria	27 CCR §20310 and 20320	SWRCB criteria for the design and construction of landfills and landfill containment structures	Potentially relevant and appropriate	Applicable for actions that include onsite disposal of non-hazardous waste; relevant and appropriate for actions that include landfill capping.
SWRCB general standards for closure of landfills	27 CCR §20950	SWRCB general standards for closure of solid waste management units, including performance goals	Potentially applicable	Applicable for actions that include landfill capping or onsite disposal of non-hazardous waste.
SWRCB landfill closure and post-closure maintenance requirements	27 CCR §21090 and 21132	SWRCB requirements for closure and post-closure maintenance, including final cover design and maintenance, grading, and post-closure maintenance requirements, as well as emergency response plan review requirements. Also includes requirements for clean closure of landfills.	Potentially applicable	Applicable for actions that include landfill capping, clean closure, or onsite disposal of non-hazardous waste.
SWRCB landfill closure and post-closure maintenance plan requirements	27 CCR §21769	SWRCB requirements for Closure and Post-closure Maintenance Plans, including preliminary and final plans.	Potentially applicable	Applicable for actions that include landfill capping or onsite disposal of non-hazardous waste.
CIWMB landfill closure and post-closure maintenance requirements	27 CCR §21100 et seq.	CIWMB requirements for closure and post-closure maintenance, including post-closure emergency response plan, final cover, final grading, slope stability, drainage and erosion control, landfill gas control, post-closure maintenance, and post-closure land use requirements.	Potentially applicable	Applicable for actions that include landfill capping or onsite disposal of non-hazardous waste.

Table B-3
Potential Action-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
CIWMB landfill gas monitoring requirements	27 CCR §20920 et seq.	CIWMB requirements for landfill gas monitoring and control	Potentially applicable	Applicable for actions that include landfill capping or onsite disposal of non-hazardous waste.
CIWMB landfill closure plan requirements	27 CCR §21790 and 21800	CIWMB requirements for preliminary and final closure plans	Potentially applicable	Applicable for actions that include landfill capping or onsite disposal of non-hazardous waste.
CIWMB landfill post-closure maintenance plan requirements	27 CCR §21825 and 21830	CIWMB requirements for preliminary and final post-closure maintenance plans.	Potentially applicable	Applicable for actions that include landfill capping or onsite disposal of non-hazardous waste.
South Coast Air Quality Management District Regulations				
Rule 401 (Visible Emissions)	SCAQMD Regulation IV (Prohibitions)	Limits visible emissions from any single source	Potentially applicable	Applicable to actions involving soil excavation
Rule 402 (Nuisance)	SCAQMD Regulation IV (Prohibitions)	Prohibits discharge of any material, including odorous compounds, that causes injury, detriment, nuisance, or annoyance to the public; endangers human health, comfort, repose, or safety; or has a natural tendency to cause injury or damage to business or property.	Potentially applicable	Applicable to actions involving soil excavation
Rule 403 (Fugitive Dust)	SCAQMD Regulation IV (Prohibitions)	Limits site activities or man-made conditions so that the concentrations of fugitive dust beyond the property line shall not be visible and the downwind particulate concentration shall not be more than 50 mg/m3 above upwind concentrations.	Potentially applicable	Applicable to actions involving soil excavation
Rule 404 (Particulate Matter)	SCAQMD Regulation IV (Prohibitions)	Limits particulate matter for volumetric gas flow.	Potentially applicable	Potentially applicable to actions involving certain onsite soil or groundwater treatment
Rule 466 (Pumps and Compressors)	SCAQMD Regulation IV (Prohibitions)	Limits liquid and gas leakage from pumps and compressors handling reactive organic compounds.	Potentially applicable	Potentially applicable to actions involving certain onsite soil or groundwater treatment
Rule 466.1 (Valves and Flanges)	SCAQMD Regulation IV (Prohibitions)	Limits liquid and gas leakage from valves and flanges.	Potentially applicable	Potentially applicable to actions involving certain onsite soil or groundwater treatment
Rule 467 (Pressure Relief Devices)	SCAQMD Regulation IV (Prohibitions)	Requires pressure relief valves to be vented to a vapor recovery or disposal system, or subject to inspection and maintenance requirements.	Potentially applicable	Potentially applicable to actions involving certain onsite soil or groundwater treatment
Rule 1150 (Excavation of Landfill)	SCAQMD Regulation XI (Source Specific Standards)	Requires preparation and implementation of an Excavation Management Plan, which shall include measures for mitigating public nuisance conditions.	Potentially applicable	Applicable to actions involving excavation or capping of the landfill

Table B-3
Potential Action-Specific ARARs and To Be Considered Criteria

Requirement, Standard, or Criterion	Citation	Description	ARAR or TBC Determination	Comments
Rule 1166 (Volatile Organic Compound Emissions from Decontamination of Soil)	SCAQMD Regulation XI (Source Specific Standards)	Requires control of VOC emissions from VOC-contaminated soils.	Potentially applicable	Applicable to actions involving soil excavation in areas with VOC contamination
Rule 1401 (New Source Review of Toxic Air Contaminants)	SCAQMD Regulation XIV (Toxics and other Non-Criteria Pollutants)	Establishes risk standards for permitting stationary sources.	Potentially applicable	Potentially applicable to actions involving certain onsite soil or groundwater treatment
California Occupational Safety and Health Act (CLC §6300 et seq.)				
Worker safety requirements	8 CCR Division 1, Chapter 4	Establishes Cal/OSHA standards for worker safety in California.	Applicable	Relevant portions of Cal/OSHA regulations are applicable to all actions at the site.
California Civil Code §1457 et seq. (Transfer of Obligations)				
Land use controls	California Civil Code §1471	Establishes conditions under which land use controls will apply to successive owners of land.	Potentially applicable	Applicable to actions that include land use controls.
Riverside County Ordinances				
Well Permits	Riverside County	Requires permits for installation of groundwater wells.	Potentially applicable	Applicable to actions that include installation of groundwater extraction or monitoring wells.
Grading Permits	Riverside County	Requires grading permits for excavations exceeding 25 cubic yards.	Potentially applicable	Applicable to actions that include excavation.
Building Permits	Riverside County	Requires permits for certain construction activities, such as electrical and plumbing systems.	Potentially applicable	Potentially applicable to actions involving certain onsite soil or groundwater treatment

Acronyms and Abbreviations:
ARAR: Applicable or Relevant and Appropriate criteria
Cal/OSHA: California Occupational Safety and Health Administration
CCR: California Code of Regulations
CFR: Code of Federal Regulations
CIWMB: California Integrated Waste Management Board
CLC: California Labor Code
CWC: California Water Code
MCL: Maximum Contaminant Level
NAAQS: National Ambient Air Quality Standards
NESHAPs: National Emission Standards for Hazardous Air Pollutants
NPDES: National Pollution Discharge Elimination System
USC: United States Code
VOC: Volatile organic compounds
NSPS: New Source Performance Standards
OSHA: Occupational Safety and Health Administration
PRC: California Public Resources Code
RCRA: Resource Conservation and Recovery Act
SCAQMD: South Coast Air Quality Management District
SWRCB: State Water Resources Control Board
TBC: To be considered criteria

ATTACHMENT C

GENERAL RESPONSE ACTIONS AND REMEDIAL TECHNOLOGY SCREENING

Table C-1
Soil Remedial Technology Screening
Laborde Canyon, Beaumont, California

General Response Action	Technology Type	Process Option	Description	Effectiveness (Primary): Effectiveness in Handling Volume of Impacted Media	Effectiveness (Primary): Impacts During Implementation	Effectiveness (Primary): Reliability	Implement-ability	Relative Cost	Retain or Reject	Screening Comments
No Action	N/A	N/A	No action is taken for site contamination.	Low	Low	Low	High	Low	Retain	Baseline for comparison with other technologies.
Institutional and Engineering Controls	Land Use Controls	Land Use Covenants	Land use covenants are recorded with the County Assessor to restrict future land use.	High	Low	Medium	High	Low	Retain	Restrictions on onsite land use have already been recorded with County Assessor; may not be implementable for downgradient properties.
		Governmental Controls	Zoning, permitting, or other governmental restrictions are placed on a property to control future land use.	High	Low	Medium	Low	Low	Reject	Implementation dependent on current property owner.
		Property Owner Controls	Restrictions on land use are imposed by the property owner.	High	Low	Medium	Low	Low	Reject	Implementation dependent on current property owner.
	Community Awareness	Warning Signs	Warning signs are posted in areas of concern to reduce exposure to human receptors	High	Low	Low	High	Low	Retain	Signage is not effective for ecological receptors.
		Public Notices	Notices of environmental contamination are distributed to the local community to enhance awareness of potential hazards and remedies.	High	Low	Low	Low	Low	Reject	Notices cannot be readily targeted to primary exposed population (trespassers) and will need to be coordinated through the property owner (RCWMD) and DTSC.
		Information and Education Programs	Comprehensive community information and educational programs are undertaken to enhance awareness of potential hazards and remedies.	High	Low	Low	Low	Low	Reject	Information and programs cannot be readily targeted to primary exposed population (trespassers) and will need to be coordinated through the property owner (RCWMD) and DTSC.
	Access Restrictions	Exclusion Fencing	Areas of concern are enclosed by fencing to reduce exposure to human and/or ecological receptors.	High	Low	Low	Low	Low	Reject	High potential for vandalism reduces effectiveness and implementability of fencing.
		Surveillance/ Security	Areas of concern are patrolled by a security service to control access by human receptors.	Low	Medium	Medium	Low	High	Reject	Nighttime patrols not implementable due to size of site and presence of nocturnal endangered species.
Containment	Erosion Control	Inspection	Periodic visual inspections are conducted in areas where near-surface contaminants are present in areas subject to erosion.	High	Low	Low	High	Low	Retain	Must be combined with other process options if indications of potential exposure are found.
		Vegetative Cover	Vegetation is planted and maintained to reduce erosion.	Medium	Low	Medium	High	Low	Rettain	Retained as a measure to reduce erosion in areas disturbed by other actions. As a standalone remedy, effectiveness is limited by plant uptake of contaminants.
		Grading/Terracing	The ground surface is recontoured by removal or addition of material to alter drainage patterns; may include alteration of drainage channel.	Medium	Medium	Medium	High	Low	Retain	Retained as a measure to reduce erosion in areas disturbed by other actions. May require Clean Water Act Section 404/401 permits and CDFG Streambed Alteration Agreement, dependent on location.
		Armoring	Areas subject to erosion, such as drainage channels, are lined with gabions, riprap, or concrete to reduce erosion.	Medium	High	Medium	Medium	Moderate	Reject	Likely to severely impact stream hydraulics due to narrow width of drainage channel; may require Clean Water Act Section 404/401 permits and CDFG Streambed Alteration Agreement, depending on location.
	Dust Control	Wind breaks	Tress, soil berms or fencing are installed to reduce ground-level wind speeds and minimize both wind erosion and the migration of surficial contaminants.	Low	Low	Low	Medium	Low	Reject	Dust control (other than during construction activities) is not anticipated to be necessary for protection of human and ecological receptors.

Table C-1
Soil Remedial Technology Screening
Laborde Canyon, Beaumont, California

General Response Action	Technology Type	Process Option	Description	Effectiveness (Primary): Effectiveness in Handling Volume of Impacted Media	Effectiveness (Primary): Impacts During Implementation	Effectiveness (Primary): Reliability	Implementability	Relative Cost	Retain or Reject	Screening Comments
Containment	Vapor Control	Vapor Barrier	An impermeable membrane, with or without a venting system, is placed below the ground surface to reduce upward migration of volatiles.	Medium	Medium	Medium	Medium	Low	Reject	Vapor control not anticipated to be necessary for protection of human and ecological receptors.
	Capping	Geomembrane Cap	A geomembrane is placed over impacted area or landfill to reduce leaching of contaminants by infiltrating water and prevent contact with contaminated soil or landfill waste.	High	Medium	High	High	Low	Retain	Implementablilty score assumes no permitting required by CIWMB or RWQCB.
		Earthen Cap	A clean compacted soil layer is placed over impacted area or landfill to prevent direct contact with contaminated soil or landfill waste.	High	Medium	High	High	Low	Retain	Implementablilty score assumes no permitting required by CIWMB or RWQCB.
		Landfill Cap	An engineered landfill cap is constructed over impacted area or landfill to reduce leaching of contaminants by infiltrating water and prevent contact with contaminated soil or landfill waste.	High	Medium	High	High	Low	Retain	Implementablilty score assumes no permitting required by CIWMB or RWQCB.
		Evapotranspiration Cap	An engineered evapotranspiration cap is constructed over impacted area or landfill to reduce leaching of contaminants by infiltrating water and prevent contact with contaminated soil or landfill waste.	High	Medium	High	High	Low	Retain	Implementablilty score assumes no permitting required by CIWMB or RWQCB.
	Grouting	Source Area Grouting	Conventional grout or chemical grout is injected into vadose zone and/or saturated zone source areas to reduce leaching of contaminants.	Low	Medium	Low	Low	High	Reject	Difficult to implement due to heterogeneous bedrock geology.
Removal	Excavation	Shallow Conventional Excavation	Shallow soils are retrieved to the surface with conventional construction equipment from unsloped, sloped or shored excavations.	High	Medium	High	High	Low	Retain	Must be combined with transportation/*ex situ* treatment/disposal options. T&E species issues may impact schedule.
		Deep Conventional Excavation	Deep soils are retrieved to the surface with conventional construction equipment from unsloped, sloped or shored excavations.	High	High	High	Low	Moderate	Reject	Deep excavations are not implementable due to location of source areas in narrow side canyons with steep slopes; must be combined with transportation/ex situ treatment/disposal options.
		Large-Diameter Auger Borings	Contaminated soils are retrieved to surface using overlapping large-diameter soil borings; borings are backfilled with slurry to allow for overlap.	Low	Medium	Medium	Low	High	Reject	Not implementable due to difficult drilling conditions; must be combined with transportation/*ex situ* treatment/disposal options.
	Transportation	Trucking	Excavated soil is moved onsite or offsite by means of construction equipment or trucks.	High	Medium	High	High	Low	Retain	Must be combined with excavation, *ex situ* treatment, and disposal options.
Treatment	*In Situ* Biological Treatment	Enhanced Bioremediation	Electron donor, electron acceptors, and/or nutrients are introduced into the subsurface using wells or infiltration galleries to stimulate or increase the rate of contaminant degradation by microorganisms.	High	Low	Medium	High	Low	Retain	Contaminants may be flushed to groundwater, where they will require treatment or recovery.
		Enhanced Bio. (Gaseous Electron Donor)	A gaseous electron donor (e.g. hydrogen, propane, etc.) is delivered to contaminated soils to stimulate anaerobic biodegradation.	Medium	Low	Medium	Medium	Moderate	Reject	Low moisture content of soils is likely to impact implementability.
		Bioventing	Atmospheric air is delivered to contaminated unsaturated soils by forced air movement to increase oxygen concentrations and stimulate aerobic biodegradation.	Low	Low	Low	Medium	Low	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions; heterogeneous bedrock geology limits implementability.
		Phytoremediation	Plants are used to remove, transfer, stabilize, and/or destroy contaminants in soil and sediment.	Low	Medium	Low	Medium	Low	Reject	Difficult to implement due to dry season water requirements for plants; ecological risks may result from plant uptake.

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Treatment	*In Situ* Physical Treatment	Water Flushing	Water is introduced into the vadose zone to transport soluble contaminants to the groundwater for treatment or recovery. This technology excludes flushing with electron donor solutions (see Enhanced Bioremediation).	High	Low	Medium	High	Low	Retain	Contaminants flushed to groundwater will require treatment or recovery.
		Surfactant Flushing	An aqueous surfactant solution is infiltrated or injected into the vadose zone to mobilize contaminants to the saturated zone for treatment or recovery.	High	Low	Low	Medium	Moderate	Reject	Not effective for site contaminants, which do not include free-phase petroleum or chlorinated solvents.
		Soil Vapor Extraction	A vacuum is applied to induce a controlled flow of air to remove volatile and some semivolatile contaminants from soil. Enhancement technologies include steam or hot air injection, radio frequency or electrical heating, etc.	Medium	Low	Low	Medium	Low	Reject	Not effective for perchlorate or 1,4-dioxane; heterogeneous bedrock geology limits implementability.
		Solidification	Contaminants are physically bound in a solid matrix by in-situ mixing of soil with a binding agent, such as portland or pozzolanic cement.	Medium	High	Low	Medium	Moderate	Reject	Not effective for site contaminants.
		Stabilization	Stabilizing agents are introduced into soil to reduce the mobility of contaminants.	Medium	Medium	Low	Medium	Moderate	Reject	Not effective for site contaminants.
	In Situ Chemical Treatment	Chemical Oxidation (liquid oxidants)	Strong oxidizing agents are introduced or injected into the subsurface to convert contaminants to less toxic or non-toxic compounds. Oxidants may include permanganate, persulfate, Fenton's reagent, etc.	Low	Medium	Low	Low	High	Reject	Not effective for perchlorate; very difficult to implement due to heterogeneous bedrock geology and need for contact with reagents.
		Chemical Oxidation (gaseous oxidants)	Ozone is injected into the subsurface to convert contaminants to less toxic or non-toxic compounds.	Low	Medium	Low	Low	High	Reject	Not effective for perchlorate; very difficult to implement due to heterogeneous bedrock geology and need for contact with reagents.
		Chemical Reduction	Reducing agents are injected into the subsurface to convert contaminants to less toxic or non-toxic compounds. This technology excludes injection of electron donor.	Low	Medium	Low	Medium	Moderate	Reject	Not effective for site contaminants (reagents for perchlorate reduction are currently being researched); very difficult to implement due to heterogeneous bedrock geology and need for contact with reagents.
	In Situ Thermal Treatment	Vitrification	Soils are brought to their melting point, typically with an electrical current, to form a glass. Contaminants are driven off, decomposed, or immobilized by this process.	Low	High	Medium	Low	High	Reject	Very high energy and equipment costs; not cost-effective for site contaminants.
	Ex Situ Physical Treatment	Separation	Contaminants or foreign materials (such as trash) are separated from soil using a variety of methods, including gravity, magnetic, or size separation (screening); also includes retrieval by hand-picking.	Medium	Low	Medium	Medium	Moderate	Reject	Not effective for site contaminants.
		Soil Washing	Contaminants are separated from excavated soil by washing in an aqueous solution, which may be amended with leaching agents, surfactants, or chelating agents. This option also includes washing with unamended water.	Low	Medium	Medium	Medium	Moderate	Reject	Implementability limited by consumptive water use.
		Solidification	Contaminants are physically bound by mixing excavated soil with a binding agent, such as asphalt or portland cement, to reduce mobility.	Low	Low	Low	Medium	Low	Reject	Not effective for site contaminants.
		Stabilization	Stabilizing agents are added to soil to reduce the mobility of contaminants.	Medium	Low	Low	Medium	Low	Reject	Not effective for site contaminants.

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Treatment	*Ex Situ* Chemical Treatment	Chemical Oxidation	Strong oxidizing agents are mixed with excavated soil to convert contaminants to less toxic or non-toxic compounds. Oxidants include permanganate, persulfate, Fenton's reagent, etc.	Low	High	Low	Low	Moderate	Reject	Not effective for perchlorate; difficult to implement due to health and safety issues associated with reagents.
		Chemical Reduction	Reducing agents are mixed with excavated soil to convert contaminants to less toxic or non-toxic compounds. This technology excludes addition of electron donor (discussed under Ex Situ Biological Treatment).	Low	High	Low	Low	Moderate	Reject	Not effective for perchlorate; difficult to implement due to health and safety issues associated with reagents.
		Dehalogenation	Excavated soil is heated with a reagent (sodium bicarbonate or polyethylene glycolate) to decompose or dehalogenate chlorinated organic compounds to reduce toxicity.	Low	Medium	Low	Medium	High	Reject	Not effective for site contaminants.
		Chemical Extraction	Contaminants are separated from excavated soil by a chemical extraction process, typically using acids or solvents. (Extraction using water as solvent is discussed under Soil Washing).	Low	Medium	Medium	Medium	Moderate	Reject	Not effective for site contaminants; difficult to implement due to health and safety issues associated with reagents.
	Ex Situ Biological Treatment	Ex Situ Bioremediation	Excavated contaminated soil is mixed with electron donor, bulking agents, and/or other amendments to promote aerobic or anaerobic biologic activity.	Medium	Low	Medium	High	Low	Retain	Must be combined with excavation and transportation options.
		Phytoremediation	Plants are used to remove, transfer, stabilize, and/or destroy contaminants in excavated soil or sediment.	Low	Medium	Low	Low	Low	Reject	Difficult to implement due to dry season water requirements for plants; ecological risks may result from plant uptake.
		Landfarming	Excavated contaminated soil is placed in beds and periodically turned to aerate and promote biologic activity.	Medium	Low	Low	Medium	Low	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions.
		Biopiles	Excavated contaminated soil is mixed with amendments and actively aerated to promote biologic activity.	Medium	Low	Low	Medium	Moderate	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions.
		Slurry Phase Biological Treatment	A slurry is formed using excavated contaminated soil, water and amendments and then mixed to promote biologic activity.	Low	Low	Low	Medium	High	Reject	Implementability limited by consumptive water use.
	Ex Situ Thermal Treatment	Thermal Desorption	Contaminated soil is heated to moderate temperatures to volatilize water and contaminants. The contaminants are captured in an air stream for treatment.	Medium	Medium	Low	Medium	Moderate	Reject	Not effective for perchlorate.
		Incineration	Excavated soil is heated to high temperatures (>1,000 °F) to volatilize and combust organic compounds.	Medium	Medium	High	Low	High	Reject	Difficult to implement because no incineration facilities are located near site; effective for site contaminants, but most applicable to PCBs, SVOCs, dioxins, and explosives.
		Pyrolysis	Excavated soil is heated to moderate temperatures (~800 °F) in the absence of oxygen to decompose organic compounds.	Medium	Medium	High	Medium	High	Reject	Difficult to implement because no facilities are located near site. Effective for site contaminants, but most applicable to SVOCs and pesticides.
Disposal	Onsite Disposal	Reuse of Treated Soil	Treated soil is reused onsite as excavation backfill or fill material.	High	Low	Medium	Medium	Low	Retain	Requires WDR permit from RWQCB; must be combined with excavation, transportation, and ex situ treatment options.
		Onsite Landfill	Treated or untreated soil is disposed in an authorized onsite repository or landfill.	High	Medium	High	Low	Low	Reject	Property owner (RCWMD) is unlikely to approve construction of a landfill at the site; extensive permitting requirements; must be combined with excavation and transportation options.

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General Response Action	Technology Type	Process Option	Description	Effectiveness (Primary)			Implement-ability	Relative Cost	Retain or Reject	Screening Comments
				Effectiveness in Handling Volume of Impacted Media	Impacts During Implemen-tation	Reliability				
Disposal	Offsite Disposal	Landfill	Excavated soil is transported offsite for treatment and/or disposal at an authorized facility.	High	Low	High	High	High	Retain	Permanently removes contaminants from site. Must be combined with excavation and transportation options.

Notes:
Shading indicates process option or technology screened out.

Scoring Notes (scores are listed in order from best to worst):

Effectiveness in handling volumes of impacted media
- High: Process option can readily handle both anticipated volumes of media and anticipated contaminant concentrations.
- Medium: Process option can readily handle either anticipated volumes of media or anticipated contaminant concentrations.
- Low: Process option can readily handle neither anticipated volumes of media nor anticipated contaminant concentrations.

Impacts during implementation
- Low: Implementation expected to have few temporary impacts.
- Medium: Implementation expected to have moderate temporary impacts.
- High: Implementation expected to have large temporary impacts or unmitigatable impacts.

Reliability
- High: Process option is reliable and permanent for all contaminants.
- Medium: Process option is reliable and permanent for perchlorate, but not for 1,4-dioxane and/or VOCs.
- Low: Process option is not reliable for perchlorate/ not reliable for any site contaminants.

Implementability
- High: Simple and straightforward to construct; administrative approvals readily obtained.
- Medium: Construction feasible, but complicated by site-specific geology/hydrogeology; administrative approval moderately difficult to obtain.
- Low: Implementation severely impacted by site-specific geology/hydrogeology; administrative approvals difficult to obtain.

Cost
- Low: Cost low relative to other process options.
- Moderate: Cost moderate relative to other process options.
- High: Cost high relative to other process options.

Table C-2
Groundwater Remedial Technology Screening
Laborde Canyon, Beaumont, California

General Response Action	Remedial Technology Type	Process Option	Process Option Description	Effectiveness (Primary)			Implement-ability	Relative Cost	Retain or Reject	Screening Comments
				Effectiveness in Handling Volumes of Impacted Media	Impacts During Implement-ation	Reliability				
No Action	N/A	N/A	No action is taken for site contamination.	Low	Low	Low	High	Low	Retain	Baseline for comparison with other technologies
Monitoring	Sampling and Analysis	Groundwater Monitoring	Samples are collected and analyzed to monitor contamination.	High	Low	High	High	Low	Retain	Likely to be required as a component of any groundwater remedy.
Monitoring	Monitored Natural Attenuation	Natural Attenuation Monitoring	Samples are collected and analyzed to monitor contaminant attenuation.	High	Low	Medium	High	Low	Retain	Potential component of groundwater remedy; not effective for 1,4-dioxane.
Institutional and Engineering Controls	Land Use Controls	Land Use Controls	Land use covenants are recorded with the County Assessor to restrict future groundwater use.	High	Low	Medium	High	Low	Retain	Restrictions on onsite groundwater use have already been recorded with County Assessor; may not be implementable for downgradient properties.
Institutional and Engineering Controls	Land Use Controls	Governmental Controls	Zoning, permitting, or other governmental restrictions are placed on a property to control future groundwater use.	High	Low	Medium	Low	Low	Reject	Implementation dependent on current property owner.
Institutional and Engineering Controls	Land Use Controls	Property Owner Restrictions	Restrictions on groundwater use are imposed by the property owner.	High	Low	Medium	Low	Low	Reject	Implementation dependent on current property owner.
Institutional and Engineering Controls	Community Awareness	Warning Signs	Warning signs are posted in areas of concern to reduce exposure to human receptors	High	Low	Low	High	Low	Retain	Effective for humans but not ecological receptors; human exposure to groundwater is unlikely.
Institutional and Engineering Controls	Community Awareness	Public Notices	Notices of environmental contamination are used to enhance awareness of potential hazards and remedies within the local community.	High	Low	Low	Low	Low	Reject	Exposure to groundwater is unlikely; cannot be readily targeted to primary exposed population (trespassers); will need to be coordinated through the property owner (RCWMD) and DTSC.
Institutional and Engineering Controls	Community Awareness	Information and Education Programs	Comprehensive community information and educational programs are undertaken to enhance awareness of potential hazards and remedies.	High	Low	Low	Low	Low	Reject	Exposure to groundwater is unlikely; cannot be readily targeted to primary exposed population (trespassers); will need to be coordinated through property owner (RCWMD) and DTSC..
Containment	Physical Barriers	Slurry Wall	A trench is excavated into the saturated zone and filled with a bentonite slurry to retard or divert groundwater flow.	Medium	Medium	Medium	Low	High	Reject	Depth to groundwater limits implementability over most of site; groundwater extraction may be needed to minimize undesired hydraulic effects.
Containment	Physical Barriers	Grout Curtain	Conventional or chemical grout is injected into the saturated zone through closely-spaced injection points to form a continuous low-permeability vertical curtain which retards or diverts groundwater flow.	Medium	Medium	Medium	Low	High	Reject	Depth to groundwater and heterogeneous bedrock geology limits implementability over most of site; groundwater extraction may be needed to minimize undesired hydraulic effects.
Containment	Physical Barriers	Driven Pile Wall	Interlocking sheet pile is driven into the saturated zone to retard or divert groundwater flow.	Medium	Medium	Medium	Low	High	Reject	Depth to groundwater limits implementability over most of site; groundwater extraction may be needed to minimize undesired hydraulic effects.
Containment	Hydraulic Containment	Groundwater Extraction	Groundwater is extracted to create a groundwater depression which prevents contaminated groundwater from flowing in an undesired direction. Groundwater extraction and treatment technologies are described elsewhere.	High	Low	High	High	Moderate	Retain	Must be combined with *ex situ* treatment and disposal options.
Containment	Hydraulic Containment	Injection Barrier	Water in injected to create a groundwater divide which prevents contaminated groundwater from flowing in an undesired direction.	Medium	Low	High	Low	Low	Reject	Difficult to implement in narrow canyon setting; must be combined with groundwater extraction and *ex situ* treatment process options or an alternate water source.

Table C-2
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General Response Action	Remedial Technology Type	Process Option	Process Option Description	Effectiveness (Primary)			Implement-ability	Relative Cost	Retain or Reject	Screening Comments
				Effectiveness in Handling Volumes of Impacted Media	Impacts During Implement-ation	Reliability				
Containment	Permeable Reactive Barrier	Biobarrier	Groundwater passively flows through a permeable barrier where electron donors, electron acceptors, and/or nutrients are added to promote biologic activity. Various configurations possible (trenches, funnel-and-gate, injection, etc.).	High	Low	Medium	High	Low	Retain	Effective for perchlorate and chlorinated solvents; not effective for 1,4-dioxane.
		Zero-Valent Iron Barrier	Groundwater passively flows through a permeable barrier containing ZVI, which promotes destruction of chlorinated compounds. Various configurations possible (trenches, funnel-and-gate, etc.).	High	Medium	Low	Medium	Moderate	Reject	Effective for chlorinated solvents, not effective for perchlorate or 1,4-dioxane; trench implementation not straightforward.
		Metal-Enhanced Reduction Barrier	Groundwater passively flows through a permeable barrier containing basic oxygen furnace slag. Various configurations possible (trenches, funnel-and-gate, etc.).	High	Medium	Low	Medium	Moderate	Reject	Not effective for site contaminants; trench implementation not straightforward..
		pH Control Barrier	Groundwater passively flows through a permeable barrier containing limestone to adjust pH. Various configurations possible (trenches, funnel-and-gate, etc.).	High	Medium	Low	Medium	Moderate	Reject	Not effective for site contaminants; trench implementation not straightforward..
		Redox Barrier	Groundwater passively flows through a permeable barrier containing calcium polysulfide, sodium dithionite, or other reducing agents. Various configurations possible (trenches, funnel-and-gate, injection, etc.).	High	Low	Low	Medium	Moderate	Reject	Effective for chlorinated solvents; not effective for perchlorate or 1,4-dioxane.
		Sorptive Barrier	Groundwater passively flows through a permeable barrier containing sorptive material (GAC, zeolite, ion exchange resin, apatite, etc.) to remove contaminants. Various configurations possible (trenches, funnel-and-gate, injection, etc.).	High	Medium	Low	Medium	High	Reject	Not effective for site contaminants; trench implementation not straightforward..
	Immobilization	Source Area Grouting	Grout or chemical grout is injected into the saturated zone through closely-spaced injection points to reduce groundwater flux through a submerged source area.	Medium	Medium	Medium	Low	High	Reject	Not implementable due to heterogeneous bedrock geology.
		Chemical Fixation	Chemical reagents are introduced to the subsurface to change the valance state or solubility of contaminants to reduce their mobility	Medium	Medium	Low	Medium	High	Reject	Not effective for site contaminants.
Treatment	*In Situ* Biological Treatment	Enhanced Bioremediation	Amendments (electron donor, nutrients, etc) are injected into the saturated zone to promote biologic activity.	High	Low	Medium	High	Low	Retain	Effective for perchlorate and chlorinated solvents; not effective for 1,4-dioxane.
		Thermally-Enhanced Bioremediation	Portions of the subsurface are heated to moderate temperatures to enhance biodegradation rates.	Medium	Low	Medium	Medium	High	Reject	No advantage over enhanced bioremediation for site climate.
		Biosparging	Atmospheric air is injected into the saturated zone at a low rate to promote aerobic biologic activity.	High	Low	Low	Low	Low	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions; difficult to implement due to heterogeneous bedrock geology.
		Phytoremediation	Phreatophyte plants are used to remove, transfer, stabilize, and/or destroy contaminants in the saturated zone.	Medium	Low	Medium	Low	Low	Reject	Not implementable because depth to groundwater is >10-15 feet throughout site.
	In Situ Physical Treatment	Air Sparging	Atmospheric air is injected into the saturated zone to volatilize contaminants, which are collected or treated in the vadose zone.	Medium	Low	Low	Low	Low	Reject	Difficult to implement due to heterogeneous bedrock geology; not effective for perchlorate or 1,4-dioxane.
		Bioslurping	Contaminants in the saturated zone are treated through a combination of bioventing and vacuum-enhanced free product recovery.	Medium	Low	Low	Medium	Low	Reject	Not effective for site contaminants, which biodegrade under anaerobic conditions.

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Laborde Canyon, Beaumont, California

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Treatment	*In Situ* Physical Treatment	In-Well Air Stripping	Air is injected into a dual-screen well, causing water to be drawn in through the lower screen and forced out of the upper screen. VOCs are removed from the water by air stripping action in well.	Low	Low	Low	Low	Moderate	Reject	Difficult to implement due to heterogeneous bedrock geology; not effective for perchlorate or 1,4-dioxane.
	In Situ Thermal Treatment	Steam Injection	Steam is injected into the saturated zone to heat and increase the volatility of contaminants in the saturated zone. Contaminants are recovered with recovery wells or from the vadose zone by vapor extraction.	Low	Medium	Low	Medium	High	Reject	Not effective for site contaminants at concentrations found at site.
		Radio Frequency Heating	Radio frequency electromagnetic energy is used to heat and increase the volatility of contaminants in the saturated zone to facilitate extraction with recovery wells or from the vadose zone by vapor extraction.	Low	Medium	Low	Medium	High	Reject	Not effective for site contaminants at concentrations found at site.
		Electrical Resistance Heating	An electrical current is used to heat and increase the volatility of contaminants in the saturated zone to facility extraction with recovery wells or from the vadose zone by vapor extraction.	Low	Medium	Low	Medium	High	Reject	Not effective for site contaminants at concentrations found at site.
	In Situ Chemical Treatment	Chemical Oxidation (liquid injection)	Strong oxidizing agents are injected into the saturated zone to convert contaminants to less toxic or non-toxic compounds. Oxidants may include permanganate, persulfate, Fenton's reagent, etc.	High	Medium	Low	Low	Moderate	Reject	Difficult to implement due to heterogeneous bedrock geology; not effective for perchlorate.
		Ozone Sparging	Ozone is injected into the saturated zone to oxidize contaminants to less toxic or non-toxic compounds	High	Medium	Low	Low	Moderate	Reject	Difficult to implement due to heterogeneous bedrock geology; not effective for perchlorate.
		Chemical Reduction	Reducing agents are injected into the saturated zone to convert contaminants to less toxic or non-toxic compounds.	High	Medium	Low	Low	Moderate	Reject	Difficult to implement due to heterogeneous bedrock geology; effective for VOCs; not effective for 1,4-dioxane; reagents for perchlorate reduction are currently being researched.
	Ex Situ Chemical Treatment	Adsorption	Dissolved contaminants are concentrated at the surface of an adsorption agent (other than granular organic carbon), reducing concentrations in the bulk solution.	High	Low	Low	High	High	Reject	Not effective for site contaminants.
		GAC	Groundwater pumped through a series of canisters containing granular organic carbon, which adsorbs organic contaminants.	High	Low	High	High	Moderate	Retain	Effective for VOCs; must be combined with other *ex situ* treatment process options to treat all contaminants.
		TGAC	Groundwater pumped through a series of canisters containing tailored granular organic carbon (GAC with an additional surface coating), which adsorbs contaminants, including perchlorate.	Medium	Low	Medium	High	High	Reject	Less effective than ion exchange for perchlorate treatment; must be combined with other *ex situ* treatment process options to treat all contaminants.
		Advanced Oxidation	Contaminants in water are oxidized using a combination of UV radiation, ozone, and/or hydrogen peroxide.	High	Low	High	High	Moderate	Retain	Effective for 1,4-dioxane; must be combined with other *ex situ* treatment process options to treat all contaminants.
		Ion Exchange	Groundwater pumped through a series of canisters containing an ion exchange resin, which removes inorganic contaminants.	High	Low	High	High	Moderate	Retain	Effective for perchlorate; must be combined with other *ex situ* treatment process options to treat all contaminants.
		Precipitation	Dissolved contaminants are removed from water by pH adjustment or addition of a precipitating agent.	High	Low	Low	Low	Moderate	Reject	Not effective for site contaminants.
		Batch Chemical Reduction	Groundwater is batch treated in storate tanks by addition of strong reducing agents which convert contaminants to less toxic or non-toxic compounds	Low	Medium	Low	Medium	Moderate	Reject	Effective for chlorinated solvents; not effective for 1,4-dioxane; reagents for perchlorate reduction are currently being researched.

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Treatment	Ex Situ Chemical Treatment	Batch Chemical Oxidation	Groundwater is batch treated in storage tanks by addition of strong oxidants which convert contaminants to less toxic or non-toxic compounds.	Medium	Medium	Medium	Medium	Moderate	Reject	Applicable for treatment of liquid residuals; however, no treatment options that produce liquid residuals are retained.
	Ex Situ Biological Treatment	Bioreactor	Contaminated water is brought into contact with an attached or suspended biological system to destroy contaminants.	High	Low	Medium	High	Low	Retain	Effective for perchlorate and chlorinated solvents; must be combined with other *ex situ* treatment process options to treat all contaminants.
		Batch Biotreatment	Groundwater is batch treated in storage tanks by addition of amendments (electron donor, nutrients, etc) to promote biologic activity.	Medium	Medium	Medium	Medium	Moderate	Reject	Applicable for treatment of liquid residuals; however, no treatment options that produce liquid residuals are retained.
		Constructed Wetlands	Contaminants are treated using natural biologic and geochemical processes in an artificial wetland ecosystem.	High	Low	Medium	Low	Moderate	Reject	Surface application of impacted water may attract ecological receptors and create new ecological exposure pathways; may require permitting from several State and Federal agencies; may require large effort to properly maintain.
	Ex Situ Physical Treatment	Air Stripping/ Air Diffusing	Volatile organics are removed from groundwater by increasing the surface area exposed to air.	High	Low	High	High	Low	Retain	Effective for VOCs; must be combined with other process options to treat all contaminants.
		Distillation	Contaminants are removed from groundwater by distillation.	Low	Medium	Low	Medium	High	Reject	Not effective for mixture of organic and inorganic contaminants found at site; not implementable for low concentrations of organic contaminants.
		Reverse Osmosis	Contaminants are removed from groundwater by reverse osmosis.	Medium	Medium	Medium	Medium	High	Reject	Very high equipment and energy costs; waste stream containing concentrated contaminants still requires treatment or disposal.
		Membrane Pervaporation	Extracted groundwater is heated, and contaminants are removed by diffusion through a membrane, where they are collected and condensed as a liquid.	Low	Medium	Low	Medium	High	Reject	Not effective for mixture of organic and inorganic contaminants found at site; not implementable for low concentrations of organic contaminants.
		Evaporation	Volume of extracted groundwater or treatment residual is reduced by evaporation.	Medium	Low	High	Low	Low	Reject	Effective for reducing volume of liquid treatment residuals; however, no treatment options that produce liquid residuals are retained.
Extraction	Extraction	Extraction	Groundwater is extracted from vertical wells, horizontal wells, or extraction trenches.	High	Low	High	High	Moderate	Retain	Must be combined with *ex situ* treatment and disposal process options.
		Dual-Phase Extraction (dual pump)	Groundwater and air are simultaneously extracted from wells using separate pump systems. The application of vacuum increases the rate of groundwater extraction.	High	Low	Medium	Medium	Moderate	Reject	Most effective for VOCs and LNAPL; advantages are limited for 1,4-dioxane and perchlorate in low hydraulic conductivity conditions. Requires *ex situ* treatment and disposal of extracted groundwater.
		Multi-Phase Extraction (total fluids)	Groundwater and air are simultaneously extracted by applying a vacuum to a dip tube set below the water table.	High	Low	Medium	Medium	Moderate	Reject	Most effective for VOCs and LNAPL; advantages are limited for 1,4-dioxane and perchlorate in low hydraulic conductivity conditions. Requires *ex situ* treatment and disposal of extracted groundwater.
		French Drains	Drains are installed to redirect groundwater away from building foundations or low areas.	Low	Low	Medium	Low	Low	Reject	Not implementable due to depth to groundwater.
		Pumped Excavations	Groundwater is extracted from an existing open excavation using sump pumps.	Low	Low	High	Low	Low	Reject	Deep excavations are not implementable at site due to narrow canyons with steep slopes.

Table C-2
Groundwater Remedial Technology Screening
Laborde Canyon, Beaumont, California

General Response Action	Remedial Technology Type	Process Option	Process Option Description	Effectiveness (Primary): Effectiveness in Handling Volumes of Impacted Media	Effectiveness (Primary): Impacts During Implement-ation	Effectiveness (Primary): Reliability	Implement-ability	Relative Cost	Retain or Reject	Screening Comments
Disposal	Onsite Disposal	Reinjection	Treated groundwater is disposed onsite by reinjection into contaminated aquifer.	High	Low	High	Medium	Low	Retain	Will require UIC and WDR permits.
		Deep Well Injection	Treated or untreated groundwater is disposed onsite by deep well injection.	Low	Medium	High	Low	High	Reject	Not implementable due to low hydraulic conductivity of deep San Timoteo formation.
		Sewer Discharge	Treated or untreated groundwater is disposed to the sanitary sewer.	Medium	Low	High	Low	High	Reject	No sewer connection at or in vicinity of site.
		Surface Discharge	Treated groundwater is disposed to the surface water drainage channel.	High	Low	High	Medium	Low	Retain	Will require NPDES permit.
		Infiltration	Treated groundwater is disposed by infiltration outside of the drainage channel.	High	Low	High	Medium	Low	Retain	Will require UIC and WDR permits.
	Offsite Disposal	Offsite Treatment	Extracted groundwater or treatment residual is transported offsite to an authorized facility for treatment.	Low	Low	High	Low	High	Reject	Effective for treatment of liquid residuals that are difficult to treat onsite; however, no treatment options that produce liquid residuals are retained.
		Offsite Disposal	Extracted groundwater or treatment residual is transported offsite to an authorized facility for disposal.	High	Low	High	High	High	Retain	Effective for disposal of wastes generated from treatment processes (e.g., activated carbon).

Notes:
Shading indicates process option or technology screened out.

Scoring Notes (scores are listed in order from best to worst):

Effectiveness in handling volumes of impacted media
- High: Process option can readily handle both anticipated volumes of media and anticipated contaminant concentrations.
- Medium: Process option can readily handle either anticipated volumes of media or anticipated contaminant concentrations.
- Low: Process option can readily handle neither anticipated volumes of media nor anticipated contaminant concentrations.

Impacts during implementation
- Low: Implementation expected to have few temporary impacts.
- Medium: Implementation expected to have moderate temporary impacts.
- High: Implementation expected to have large temporary impacts or unmitigatable impacts.

Reliability
- High: Process option is reliable and permanent for all contaminants.
- Medium: Process option is reliable and permanent for perchlorate, but not for 1,4-dioxane and/or VOCs.
- Low: Process option is not reliable for perchlorate/ not reliable for any site contaminants.

Implementability
- High: Simple and straightforward to construct; administrative approvals readily obtained.
- Medium: Construction feasible, but complicated by site-specific geology/hydrogeology; administrative approval moderately difficult to obtain.
- Low: Implementation severely impacted by site-specific geology/hydrogeology; administrative approvals difficult to obtain.

Cost
- Low: Cost low relative to other process options.
- Moderate: Cost moderate relative to other process options.
- High: Cost high relative to other process options.