

Volume 1: RECORD OF DECISION

EPA Superfund CASMALIA RESOURCES SUPERFUND SITE SANTA BARBARA COUNTY, CALIFORNIA



U.S. Environmental Protection Agency
Region IX
San Francisco, California

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June 2018

RECORD OF DECISION

for

CASMALIA RESOURCES SUPERFUND SITE,
SANTA BARBARA COUNTY, CALIFORNIA

U.S. Environmental Protection Agency
Region IX
San Francisco, California



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Acronyms and Abbreviations

µg/L	microgram per liter
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirements
ASTM	ASTM International (formerly the American Society for Testing and Materials)
BAF	bioaccumulation factor
Basin Plan	2011 Water Quality Control Plan for the Central Coast Basin
BERA	baseline ecological risk assessment
BMP	best management practice
BO	biological opinion
BTA	Burial Trench Area
CA	cost analysis
CD	Consent Decree
CDA	Central Drainage Area
CDFW	California Department of Fish and Wildlife
CDI	chronic daily intake
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CNS	Casmalia Neutralization System
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CR	Casmalia Resources
CSC	Casmalia Steering Committee
CSM	conceptual Site model
CTAC	community technical assistance consultant

ACRONYMS AND ABBREVIATIONS

DCE	dichloroethene
DNAPL	dense nonaqueous phase liquid
DTSC	Department of Toxic Substances Control
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ERA	ecological risk assessment
ESA	Endangered Species Act
ESD	Explanation of Significant Differences
ET	evapotranspiration
FPP	Former Ponds and Pads Area
FR	Federal Register
FS	Feasibility Study
GAC	granular activated carbon
GCL	geosynthetic clay layer
HDPE	high-density polyethylene
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
HS	hotspot
HSU	hydrostratigraphic unit
IAC	Interagency Committee
IC	institutional control
LLTW	low-level threat waste
LNAPL	light nonaqueous phase liquid

LOAEL	lowest observed adverse effect level
LTE	long-term effectiveness
MCL	maximum contaminant level
MCPP	2-(2-chloro-4-methylphenoxy) propionic acid
mg/kg	milligram(s) per kilogram
MNA	monitored natural attenuation
MSA	Maintenance Shed Area
NAPL	nonaqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	no observed adverse effects level
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	operation and maintenance
OM&M	operations, maintenance, and monitoring
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
P/S	Pesticide/Solvent (Landfill)
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PCT	Perimeter Control Trench
POC	Point of Compliance
PRP	potentially responsible party
PSCT	Perimeter Source Control Trench
PTW	principal threat waste
RAO	remedial action objective
RCF	Runoff Control Facility (Pond)
RCRA	Resource Conservation and Recovery Act

ACRONYMS AND ABBREVIATIONS

RfC	reference concentration
RfD	reference dose
RI	Remedial Investigation
RL	remediation level
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board
SF	slope factor
Site	Casmalia Resources Superfund Site
SOW	Statement of Work
State	State of California
STE	short-term effectiveness
SVOC	semivolatile organic compound
TBD	to be determined criteria
TCE	trichloroethene
TDS	total dissolved solids
TI	Technical Impracticability
TIE	Technical Impracticability Evaluation
TRV	toxicity reference value
TSD	treatment, storage, and disposal
USC	United States Code
USDW	underground source of drinking water
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compound
WCSA	West Canyon Spray Area
WMA	Waste Management Area

PART 1: THE DECLARATION

1.1 Site Name and Location

Casmalia Resources Superfund Site (Site), Santa Barbara County, California, Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number **CAD020748125**.

The Site is an inactive, 252-acre, Class I hazardous waste management facility that lies in the northwestern corner of Santa Barbara County, California. The Site is situated 10 miles southwest of Santa Maria, 4 miles from the Pacific Coast, and 1.5 miles north of the unincorporated town of Casmalia. Nearby off-property land uses are primarily ranching and grazing, with some oil and natural gas development. Vandenberg Air Force Base lies 8 miles southeast of the Site.

The Site was owned and formerly operated by Casmalia Resources (CR). It accepted over 5.6 billion pounds of solid and liquid wastes from over 10,000 generators between 1972 and 1989. The facility stopped accepting wastes in 1989 after CR was unsuccessful in obtaining a Resource Conservation and Recovery Act (RCRA) Part B permit to treat, store, and dispose of hazardous wastes. The facility ceased operations in 1991.

Waste management operations were conducted within the 252-acre facility boundary, designated as Zone 1. Waste management units included numerous landfills, surface impoundments, evaporation pads, oil field waste spreading areas, treatment units, injection wells, and disposal trenches. The former waste disposal facility (Zone 1) is surrounded by adjacent properties, designated as Zone 2. The multiple Zone 2 parcels were all formerly owned by the owner/operator, CR, and are now owned by several different entities, including a land acquisition company formed by the Casmalia Steering Committee (CSC), the primary potentially responsible party (PRP) group, and several other local landowners. The CSC acquired several Zone 2 parcels and established institutional controls (ICs) to help create a partial buffer zone around Zone 1. This Record of Decision (ROD) addresses both Zone 1 and Zone 2.

1.2 Statement of Basis and Purpose

This decision document presents the U.S. Environmental Protection Agency's (EPA's) Selected Remedy for the Casmalia Resources Superfund Site, including both Zone 1 and Zone 2. The remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 United States Code (USC) Section 9601 *et seq.*, as amended, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 *Code of Federal Regulations* (CFR) Part 300. This decision is based on EPA's Administrative Record file for this Site. The Proposed Plan (EPA, 2017) and ROD address the community involvement requirements of CERCLA.

The Department of Toxic Substances Control (DTSC) is the lead support agency for the State of California (State), and has been the primary support agency during the Remedial Investigation

(RI) and Feasibility Study (FS) process for the Site. In addition, EPA has consulted with the U.S. Fish and Wildlife Service (USFWS), the Central Water Quality Control Board (RWQCB), and the California Department of Fish and Wildlife (CDFW) for many years during ongoing Site investigations and development of the Selected Remedy. In accordance with 40 CFR § 300.430, the State has actively participated in the decision-making process, and has provided EPA with invaluable input. DTSC, as the support agency, reviewed a pre-final version of this ROD and concurred with the Selected Remedy in a letter to EPA dated May 7, 2018.

1.3 Assessment of Site

Releases of hazardous substances have contaminated soil, sediment, soil vapor, surface water, and groundwater as a result of past hazardous waste treatment, storage, and disposal activities at the former Class I hazardous waste management facility. The response actions selected in this ROD are necessary to protect public health or the environment from actual or threatened releases of hazardous substances and contaminants into the environment.

1.4 Description of Selected Remedy

The Selected Remedy and the major components are summarized in this section. The Selected Remedy will provide the best approach for cost-effective risk reduction. It will protect human health and the environment by either removing hazardous substances and contaminants from the Site, thereby reducing any residual risk, or by limiting exposure to human receptors and/or ecological receptors by implementing the actions described later in this section.

The Selected Remedy will be the final remedy for the entire Site, comprised of Zones 1 and 2 (Figure 2-1). The remediation strategy incorporates actions for five different principal study areas (designated Areas 1 through 5) and multiple impacted media into a comprehensive remedy (Figures 2-14 and 2-15). Areas 1 through 4 include the primary source areas and associated soil, sediment, and surface water. Area 5 includes onsite (Zone 1) groundwater and is further divided into three subareas (Area 5 North, Area 5 South, and Area 5 West).

Consistent with EPA's presumptive remedy for municipal solid waste landfills and common practice at many large legacy hazardous waste landfill sites, the Selected Remedy is a combined containment and treatment remedy. The remedy will include engineering controls, institutional controls (ICs), contaminant source reduction and treatment, monitored natural attenuation (MNA), perimeter control, long-term operations and maintenance (O&M), long-term monitoring, and contingency measures.

Principal threat wastes (PTWs) for the Site are high-concentration waste materials that occur within the northeastern portion of the Site and underlying groundwater. The PTWs include waste materials within the five landfills and the adjacent disposal areas, and the highly contaminated free-phase nonaqueous phase liquid (NAPL) between and underlying these areas. The PTWs contain numerous organic and inorganic chemicals at high concentrations across multiple chemical classes (volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], herbicides, pesticides, dioxins/furans, metals, and cyanide). The Selected Remedy

addresses PTWs through NAPL source reduction, extraction and treatment of contaminated Site liquids, and containment of waste materials in landfills, soil, and groundwater.

The Selected Remedy includes many different components based on Site areas. The primary remedial actions for each of the five study areas are as follows:

- Area 1 (Capped Landfills Area, Burial Trench Area [BTA], and Central Drainage Area [CDA]): The Selected Remedy includes continued use of the existing RCRA Subtitle C capping systems for the landfills area, plus expansion of the caps in selected areas. These RCRA-compliant caps (RCRA caps) were constructed on four of the landfills (Pesticide/Solvent [P/S] Landfill, Heavy Metals Landfill, Caustics/Cyanide Landfill, and Acids Landfill) between 1999 and 2002. The capped area will be expanded to cover the uncapped polychlorinated biphenyl (PCB) Landfill, interstitial areas with former waste management units between the landfills, the BTA west of the landfills, and the CDA south of the landfills. Capping will contain waste materials and contaminated soil and minimize infiltration and potential migration of contamination to groundwater.
- Area 2 (RCRA Canyon and West Canyon Spray Area [WCSA]): The Selected Remedy includes installation of either an evapotranspiration (ET) cap or a RCRA hybrid cap. A RCRA cap meets Subtitle C performance standards, and selection of the cap configuration will be finalized during the remedial design phase and is subject to EPA approval.
- Area 3 (Former Ponds & Pads Area [FPP]): The Selected Remedy includes excavation of four soil hotspots (Hotspot-1 [HS-1] through Hotspot-4 [HS-4]), which are discrete areas with elevated concentrations of metals, VOCs, and other organic compounds. Excavated soil will be consolidated into the existing PCB Landfill prior to capping. Subject to EPA approval during remedial design, all or a portion of HS-1 in the Liquids Treatment Area alternatively may be covered with an asphalt cap, and Hotspot-3 (HS-3) in the FPP Area may be covered with the RCRA cap extended from Area 1. The final remedial approach for these hotspots will be selected during the remedial design phase. A fifth soil hotspot (Hotspot-10 [HS-10]), consisting of contaminated soil in the Maintenance Shed Area (MSA), will be covered with the RCRA cap extended from Area 1.
- Area 4 (Stormwater Ponds and Treated Liquid Impoundments): The Selected Remedy includes removal of all liquids, placement of clean soil, and installation of engineered caps over Pond 18, Pond A-5, Pond 13, A-Series Pond, and the Runoff Control Facility (RCF) Pond. Pond 18 will be closed, Ponds A-5 and 13 will be closed and converted into lined stormwater retention basins, and a lined stormwater channel will be constructed over the former footprint of the RCF Pond (after it is capped). Surface water systems for treated liquids and clean stormwater will continue to be managed separately. These improvements will allow for more offsite discharge of clean stormwater to the B-Drainage and Casmalia Creek. Finally, one or more new, lined, RCRA-compliant evaporation ponds will be constructed over the former footprint of the A Series Pond.

- Area 5 (Sitewide Groundwater). Area 5 includes three subareas:
 - Area 5 North: The Selected Remedy includes subsurface liquids extraction and treatment from existing and new facilities in the source areas (source reduction). Extraction will continue from the existing Gallery Well, Sump 9B, and the Perimeter Source Control Trench (PSCT) to contain and prevent groundwater from migrating vertically and laterally to the south. Approximately 16 new NAPL extraction wells will be installed in the P/S Landfill to capture as much pooled product as possible and reduce the driving head that may contribute to downward and lateral migration. The area that is circumscribed by the boundaries of the five hazardous waste landfills is designated as a Waste Management Area (WMA) because waste materials are being left in place and removal is not practicable. Groundwater cleanup levels do not apply within the WMA; and groundwater below the area circumscribing the five landfills will not be remediated pursuant to the NCP and EPA guidance on WMAs (EPA, 1993a; EPA, 1996; EPA, 2009a).
 - The Selected Remedy also includes a Technical Impracticability (TI) Zone designated pursuant to the NCP and EPA guidance (EPA, 1993c). A comprehensive Technical Impracticability Evaluation (TIE) evaluation was documented in the RI Report (CSC, 2011) and the FS Report (CSC, 2016), which examined: (1) hydrogeologic factors; (2) contaminant-related factors; and (3) technology constraints on remediation system design and implementation. The TIE concluded that full restoration of groundwater to MCLs within a limited portion of the Site, designated as Area 5 North, is technically impracticable from an engineering perspective [40 CFR 300.430(f)(1)(ii)(C)(3)]. A TI waiver is appropriate for Area 5 North because the presence of large volumes of light nonaqueous phase liquid (LNAPL), dense nonaqueous phase liquid (DNAPL), and dissolved-phase organic and inorganic contamination in low-permeability fractured bedrock, both within and south of the P/S Landfill, make it technically impracticable to meet drinking water standards in this area. The presence of LNAPL and/or DNAPL is observed up to 500 feet south of the P/S Landfill in the CDA; there is no expectation that groundwater within this area can be remediated for beneficial use.

The WMA is within the boundaries of the TI Zone. A Point of Compliance (POC) will encompass both the WMA and the TI Zone, and will be located at the Area 5 North boundary to ensure that groundwater quality is not further degraded outside this area. Because the TI Zone includes the WMA, and because the POC is the boundary of the TI Zone, this ROD may refer to the TI Zone to mean both the TI Zone and the WMA. Groundwater cleanup levels apply beyond the POC boundary circumscribing the TI Zone (Area 5 North). Approximately 12 new Lower Hydrostratigraphic Unit (HSU) monitoring wells will be installed to verify that dissolved-phase contaminants and NAPL are not migrating southward underneath the PSCT outside of Area 5 North. A rigorous compliance monitoring program will also be implemented.

Under the Selected Remedy, highly contaminated liquids and NAPL from the Gallery Well, Sump 9B, and new source area extraction wells in the P/S Landfill will be stored

onsite and then transported to an EPA-approved offsite treatment, storage, and disposal facility. Less-contaminated liquids from the PSCT and perimeter control trenches (PCT)-A, PCT-B, and PCT-C will be treated onsite using a treatment system upgraded pursuant to the ROD, and the treated effluent will be sent to one or more new onsite evaporation ponds.

- Area 5 South and Area 5 West: The Selected Remedy includes liquids extraction and onsite treatment from the existing PCT-A, PCT-B, and PCT-C to contain and prevent contaminated groundwater from migrating southward down the adjacent drainages. The Selected Remedy also includes MNA to both treat and help contain groundwater contamination onsite (within Zone 1). MNA is a passive, in situ method whereby contaminant concentrations are reduced in place through existing physical, chemical, or biological processes.
- Stormwater Discharge: Fresh sitewide stormwater, consisting of runoff generated from rain events, will be managed following remedy implementation using new, lined, stormwater retention basins, and discharged to the B-Drainage and Casmalia Creek under National Pollutant Discharge Elimination System (NPDES) permit substantive requirements.
- Institutional Controls (ICs): The ICs include environmental covenants that place restrictions on both land use and water use within the boundaries of the former waste disposal area (Zone 1) and surrounding land parcels (Zone 2). These restrictions include land or water disturbing activities such as excavation, construction, demolition, groundwater pumping, and any activity that affects habitat, open space, or wetlands, which cannot be implemented without EPA approval. ICs are already established for six parcels, in the form of legal covenants that provide for land and water use restrictions and allow access for CSC (and successor landowners) to perform response actions and long-term operations, maintenance, and monitoring activities. EPA is also included as a third-party beneficiary to these covenants, allowing it access to the Site and the ability under the law to enforce the terms of the covenants. As needed, additional ICs will be implemented as part of the remedial design and remedial action phases of work.
- Long-Term Operations and Maintenance (O&M): Long-term O&M will be conducted to ensure that all Site components and systems are functioning effectively throughout the duration of the remedial action. Long-term O&M will address multiple media and systems, including, but not limited to, capping systems, liquids collection, treatment, and disposal systems, surface water management, and all monitoring systems. Long-term O&M will incorporate modern, integrated, and upgradeable automated process control systems and instrumentation to ensure that all Site systems function safely, reliably, and effectively; these will include, but not be limited to, alarms, automatic shut-off systems, video surveillance systems, data recorders, and flow controllers. Long-term O&M will be performed based on optimization studies, and a long-term O&M plan that will be subject to EPA review and approval.

- **Long-term Monitoring:** Long-term performance and compliance monitoring will be conducted to ensure that remedial systems are functioning effectively and remain in compliance with performance standards. Long-term monitoring will include compliance monitoring of groundwater both laterally and vertically, surface water, soil vapor and ambient air, and performance monitoring of remedial systems. Long-term monitoring will also include ongoing evaluation of ICs. Long-term monitoring will incorporate modern, integrated, and upgradable automated data collection systems and instrumentation to ensure that Site monitoring systems function effectively, including, but not limited to, data loggers for new monitoring wells. Long-term groundwater monitoring will be performed based on optimization studies and subject to a long-term monitoring plan that will require EPA review and approval. EPA may require additional monitoring, if determined necessary based on the results of monitoring data, to ensure protection of human health and the environment.
- **Contingency Measures:** Contingency measures will be performed if groundwater monitoring data indicate that contamination is migrating beyond area boundaries, including the POC and the perimeter boundary of the former disposal facility (Zone 1). Contingency measures will be initiated if groundwater monitoring data show that migration is occurring at statistically representative concentrations that cause, or are likely to cause, exceedances of performance standards. These contingency measures will be performed to ensure adequate containment. Contingency measures may include any or all the following: (1) additional monitoring from existing wells; (2) installation of additional monitoring wells to further characterize potential migration; and (3) installation of a limited number of extraction wells within a localized area to maintain hydraulic containment. These extraction wells would supplement the area and perimeter containment provided by existing perimeter control trenches, extraction wells, and natural attenuation. Installation of additional extraction wells outside the POC or Zone 1 perimeter boundary as part of contingency measures may require an Explanation of Significant Differences (ESD).

1.5 Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with federal and State requirements that are applicable or relevant and appropriate to the remedial action (unless justified by a waiver), is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) to the maximum extent practicable. The Selected Remedy complies with the offsite disposal requirements of CERCLA and the NCP.

The Selected Remedy also satisfies the statutory preference for treatment as a principal element of the remedy (that is, reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment) for the contaminated media.

Because the Selected Remedy will result in hazardous substances, pollutants, or contaminants remaining onsite above levels that would allow for unlimited use and unrestricted exposure, a

statutory review will be conducted within 5 years after initiation of remedial action, and every 5 years thereafter, to ensure that the remedy is, or will be, protective of human health and the environment. If it is determined that components of the Selected Remedy are not protective, EPA will evaluate corrective actions and implement the preferred action to ensure continued protectiveness.

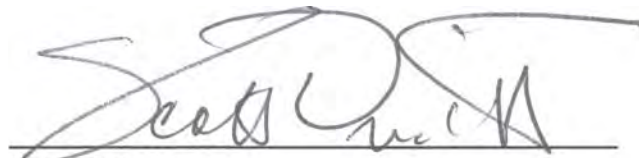
1.6 ROD Data Certification Checklist

Specific certification information is included in Part 2, the Decision Summary, of this ROD. Additional information can be found in the Administrative Record file for this Site. Part 2 information is organized in the following sections:

- Chemicals of concern (COCs) and their respective concentrations (Section 2.5.6)
- Baseline risk represented by the COCs (Section 2.7)
- Performance standards (cleanup or containment levels) established for the COCs and the basis for these levels (Section 2.8.7)
- How source materials constituting principal threats are addressed (Section 2.11)
- Current and reasonably anticipated future land use assumptions, and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (Section 2.6)
- Potential land and groundwater use that will be available at the Site as a result of the Selected Remedy (Section 2.6)
- Estimated capital, annual operations and maintenance (O&M), and total present value costs, discount rate, and the number of years over which the Selected Remedy cost estimates are projected (Section 2.12.15)
- Key factors that led to selecting the remedy (Section 2.13)

This ROD was prepared consistently with guidance published by EPA for preparation of RODs (EPA, 1999b).

1.7 Authorizing Signatures

A handwritten signature in black ink, appearing to read "Scott Pruitt", written over a horizontal line.

E. Scott Pruitt
Administrator
U.S. Environmental Protection Agency

6 / 29 / 20 18
Date

PART 2: THE DECISION SUMMARY

2.1 Site Name, Location, and Brief Description

Casmalia Resources Superfund Site (Site), Santa Barbara County, California, CERCLIS Identification Number **CAD020748125**.

The Site is an inactive Class I hazardous waste management facility located in the northwestern corner of Santa Barbara County, California (Figure 2-1). The Site lies in a rural setting, approximately 4 miles from the Pacific Ocean and about 10 miles southwest of the city of Santa Maria. The small, unincorporated town of Casmalia is located approximately 1.5 miles south-southeast of the Site and has a population of about 300. Nearby land uses surrounding the Site include agriculture, cattle grazing, and oil field development.

EPA is the lead agency for the Site, and has worked collaboratively with numerous public agency stakeholders throughout the history of the Site. DTSC, the Central Coast RWQCB, and CDFW have participated actively for many years in Site planning, oversight, and decision making. DTSC is the lead support agency for the State and provided formal concurrence of the Selected Remedy in a letter to EPA dated May 7, 2018. In addition, EPA has consulted with the USFWS.

The source of cleanup monies will be a fund established by EPA based on settlement funds received from PRPs, and work funded and performed by other PRPs (see Section 2.2.4). The former Class I hazardous waste management facility, owned and formerly operated by CR, accepted over 5.6 billion pounds of solid and liquid wastes between 1972 and 1989. More than 10,000 businesses and government entities sent waste to the Site. Wastes received at the Site included (in part): petroleum wastes, acids, bases, organic chemical solvents, petroleum solvents, paint sludge, pesticides, infectious wastes, septic tank pumpings, and sewage sludge. The facility stopped accepting wastes in 1989, after CR was unsuccessful in obtaining a permit under RCRA to treat, store, and dispose of hazardous wastes; it then closed in 1991.

Waste management operations were conducted within the 252-acre facility boundary, designated as Zone 1. Former waste management units included:

- 6 landfills
- 43 surface impoundments
- 15 evaporation pads
- 2 nonhazardous waste spreading areas
- 6 oil field waste spreading areas
- 11 shallow injection wells
- 7 disposal trenches
- 1 drum burial unit

The historical Site layout is shown in Figure 2-2. The former waste management facility (Zone 1) of the Site is secured by perimeter fencing and an access gate. Zone 2 extends outward from Zone 1 and encompasses adjacent properties, owned by the CSC and other local landowners. The CSC acquired several Zone 2 parcels to help create a partial buffer zone around Zone 1. This ROD addresses both Zone 1 and Zone 2.

2.2 Site History and Enforcement Activities

EPA has been engaged with the Site for many years, first in reviewing the application for a RCRA permit and then in an environmental response mode under the Superfund Program. CR was operated as a limited partnership. CR's general partner, Kenneth Hunter, Jr., later Hunter Resources Inc., operated the Site from 1972 to 1991 as a Class I hazardous waste disposal facility. CR coordinated with EPA and State regulators in the 1980s, implementing phased Site improvements and seeking to obtain a RCRA Part B permit. The facility ultimately experienced operational, regulatory, and financial challenges, however, that led to increased regulatory and community concerns. The Site stopped accepting wastes in 1989, after CR was unsuccessful in obtaining a RCRA permit; it ceased operations in 1991.

At that time, conditions at the Site presented imminent and substantial endangerment to human health and the environment. EPA temporarily began conducting critical Site stabilization activities in 1992 under Superfund emergency response authorities, and continued those activities through 1996. EPA and the CSC finalized a Consent Decree (CD) in 1997 that provided for the CSC to conduct Site characterization and response actions. Work under the CD is planned to continue through implementation of the Selected Remedy in this ROD.

The Site was placed on the National Priorities List (NPL) on September 13, 2001.

2.2.1 Casmalia Resources Operations (1972 – 1991)

The CR facility began operations in 1972 in accordance with California RWQCB Waste Discharge Permit No. 72-28, which allowed a 61-acre hazardous waste disposal facility, including 15 surface impoundments and one landfill area. The permit was amended twice (Permit No. 75-73; Permit No. 80-43) to gradually expand the Site to its ultimate size of 252 acres. The facility accepted a diverse array of solid and liquid hazardous waste materials during its lifespan, but stopped accepting liquids in July 1987 and solid wastes in November 1989.

During CR operations, the Site also had five waste treatment units: (1) an acid/alkaline neutralization facility, identified as the Casmalia Neutralization System (CNS); (2) a hydrogen peroxide treatment system; (3) a wet air oxidation unit; (4) a temporary pilot-scale powder-activated carbon treatment unit; and (5) oil recovery tanks. None of these waste treatment units are currently in place.

Federal, State, and local environmental and health agencies closely scrutinized the Site during the 1980s. Potential environmental concerns were showcased in the local media, and community complaints in the mid- to late-1980s noted odors emanating from the Site, and

alleged surface water and groundwater contamination. Despite some operational improvements implemented by CR, it became clear by 1988 that a RCRA Part B permit would not be forthcoming. The Site operator stopped accepting waste in 1989, substantially ramped down Site activities, and effectively abandoned the Site in 1991.

Various measures were taken to limit Site-related impacts. During early Site operations, subsurface clay barriers were installed in the B- and C-Drainages in 1972-1973 and in 1982. CR installed subsurface compacted clay barrier walls downgradient of the P/S Landfill and PCB Landfill in 1980. The P/S Landfill barrier includes a liquids extraction point called the “Gallery Well,” which also was installed in 1980. A subsurface barrier near Pond 20 was constructed in 1981-1982, and a subsurface barrier was installed at the base of RCRA Canyon in 1984. A relatively shallow liquid extraction point, Sump 9B, was constructed in response to evidence of contamination observed during closure of the former Pad 9B waste pad in 1988.

Groundwater extraction has been ongoing since 1980, when the Gallery Well began operating as a groundwater collection facility. CR installed several perimeter collection and extraction facilities, including three collection trenches and five extraction wells in 1989. These features, located along the A-, B-, and C-Drainages, were originally called plume capture and control trenches, but are now commonly referred to as the “perimeter control trenches” (PCT-A, PCT-B, and PCT-C). Extraction wells installed within these trenches are completed to depths of approximately 35 to 70 feet bgs.

CR installed the PSCT downgradient of the landfills in 1990 (see Figure 2-3). The PSCT is a 3-foot wide gravel-filled collection trench that extends over a linear distance of about 2,650 feet across most of the central portion of the Site, downgradient of the five landfills, the CDA, and the BTA (CSC, 2011). The PSCT extends to depths of between approximately 13 and 65 feet, depending on the depth at which unweathered claystone bedrock was encountered during construction. The PSCT is designed to intercept subsurface liquids migrating from north to south across the Site.

In 1998, the CSC installed an additional shallow liquid extraction point (Road Sump) south of Sump 9B to intercept groundwater potentially migrating downgradient from Sump 9B.

2.2.2 EPA Emergency Response Operations (1992-1996)

EPA invoked Superfund removal authority to conduct emergency response operations and stabilize the Site from 1992 through 1996. EPA maintained essential Site operations, including: collection, treatment, and disposal of contaminated liquids; management of surface water; groundwater monitoring; and stabilization of the landfills. EPA then entered into enforcement negotiations with the CSC that led to the Casmalia CD in 1997 and the CSC taking over stabilization and maintenance activities.

2.2.3 CSC Response Actions under Consent Decree (1997-Present)

Under the 1997 CD, the CSC is obligated to fund and perform specific Site cleanup activities. The CSC has been performing response actions under EPA oversight as required by the CD and CERCLA processes. These requirements define specific, phased elements of work that include Site operations, monitoring, RIs, and development of an FS. The CSC's work has included continued Site stabilization activities, including ongoing extraction, treatment, and disposal of contaminated subsurface liquids, monitoring, and routine maintenance.

Consistent with the CD, the CSC installed an engineered capping system for the P/S Landfill in 1999. The CSC also implemented non-time critical removal actions, including performing an Engineering Evaluation/Cost Analysis (EE/CA) that led to an EE/CA report in 2000, as well as capping of an area encompassing three landfills (Heavy Metals, Caustics/Cyanide, and Acids landfills) and areas between these landfills in 2001 and 2002. The CSC intentionally left the fifth landfill (PCB Landfill) uncapped, with the plan of placing future remediation soils there and then installing a RCRA cap. Figure 2-3 presents current Site conditions, which includes the former and current landfills, current extraction trenches and extraction wells, former ponds and evaporation pads, and configuration of the five ponds.

The CSC has continued to operate and maintain groundwater collection facilities (Gallery Well, Sump 9-B, PSCT, PCT-A, PCT B, and PCT-C) under EPA's oversight through the requirements of the CD. Table 2-1 presents a summary of the operations of these systems, including total volumes extracted through mid-2016. The CSC also initiated a routine groundwater and surface water monitoring program pursuant to the CD, which consists of semiannual collection of water level and water quality data.

The CSC conducted RI activities (planning, field work, and reporting) from 2002 through 2011 to characterize the nature and extent of contamination, fate and transport of contamination, and human health and ecological risk. The RI work included the installation and sampling of monitoring wells and piezometers in onsite and offsite areas, highly complex groundwater modeling and geophysical surveys, and extensive sampling of soil, sediment, soil vapor, surface water, and groundwater in accordance with the NCP and CERCLA RI/FS guidance. The CSC completed the final RI report in January 2011 (CSC, 2011) and final FS report in February 2016 (CSC, 2016).

Figure 2-4 presents aerial photographs showing the progression of Site conditions from 1970 (prior to landfill development), through various years of Site operations and stabilization activities, to current conditions (2016). Figure 2-5 presents a timeline of key operational, investigation, response, and enforcement activities since 1972 when Site operations began.

Key Accomplishments: To date, EPA oversight of CR and the CSC has resulted in completion of many significant projects to stabilize the Site, remove and contain contamination, control risks, conduct characterization, evaluate remedial alternatives, and set the stage for final Site remediation. Key enforcement and source stabilization and control activities have included the following.

- Completed negotiations that resulted in the Casmalia CD and NPL listing
- Proposed and then completed listing of the Site on the NPL in 2001
- Performed response actions at most former waste surface impoundments and evaporation pads in the southern area of the Site, and placed contaminated soils into the existing landfills (prior to capping)
- Removed the former RCRA Landfill waste and placed the contents into the existing landfills (prior to capping)
- Installed subsurface compacted clay barrier walls in the B- and C-Drainages, downgradient of the P/S and PCB landfills, at the base of RCRA Canyon, and near former Pond 20, to limit lateral subsurface fluid migration in these areas
- Capped four existing landfills (P/S, Heavy Metals, Caustics/Cyanide, and Acids)
- Installed the Gallery Well extraction system in the P/S Landfill, with extraction and treatment/disposal of approximately 11,000,000 gallons of liquid since operations began
- Constructed an onsite liquids treatment system for water from the PSCT
- Installed the PSCT at the foot of the P/S Landfill, with extraction and onsite treatment of approximately 87,000,000 gallons of liquid since operations began
- Installed the Sump 9B liquids extraction system between the P/S Landfill and the PSCT, with extraction and treatment/disposal of approximately 7,000,000 gallons of liquid since operations began
- Installed three PCTs (PCT-A, PCT-B, and PCT-C) near the southern Site boundary
- Installed approximately 400 monitoring wells and piezometers in onsite and offsite areas
- Constructed an improved stormwater collection and storage system, including three stormwater retention ponds (RCF Pond, A-Series Pond, and Pond 13) and two treated liquids evaporation ponds (Pond A-5 and Pond 18)
- Constructed an engineered wetland (B-Drainage wetland) to address habitat restoration for special-status amphibians
- Completed extensive Site investigations, an RI report, and an FS report
- Provided ongoing routine Site maintenance, including: collection, treatment, and disposal of contaminated liquids; landfill cap maintenance; routine water level, groundwater, surface water, and biological monitoring; reporting; and related activities

2.2.4 Summary of Enforcement Activities

EPA has entered into numerous CDs and Administrative Orders on Consent with PRPs in order to require these PRPs to implement and/or fund ongoing Site work. Under the 1997 CD, the CSC is required to fund and conduct the Phase I work (such as, fund and perform the RI and FS), and to conduct Site work funded from EPA settlements.

Through 2017, based upon EPA's initial cost estimate using Site records to develop a settlement formula, EPA settled with over 2,000 parties. Over 1,900 PRPs, referred to as *de minimis* contributors because they sent relatively small amounts of waste to the Site, resolved their liability and contributed over \$63 million for Site-related response actions. The remaining parties include the former owner and operator and customers referred to as "major" waste generators, who have collectively paid over \$56 million. Altogether, these settlements have recovered over \$119 million to help fund response actions at the Site. EPA continues to pursue additional PRP settlements and may take further enforcement action against non-settled PRPs in order to raise funds for Site-related response action and to reimburse EPA for Site-related costs.

2.2.5 Casmalia Consent Decree

The 1997 CD and Statement of Work (SOW) define discrete elements of work, sequencing and phasing of major work activities, and specific projects, activities, and deliverables. The CD further establishes a process for funding response actions through third-party recoveries. The work covered by the CD and SOW are described in terms of four phases, as follows:

Phase I: Phase I work includes: performance of early response actions (such as, Site stabilization, critical Site operations, and liquids management) and routine Site maintenance; design and capping of the P/S Landfill; cap design for the other landfills; Site characterization; and preparation of the RI report and FS report. Phase I work is funded directly by the CSC member companies.

Phase II: Phase II work includes: specified Site activities not covered under Phase I, including cap construction for the other landfills (except the PCB Landfill); ongoing, routine Site operations after 2000; ongoing, routine groundwater monitoring; community relations activities; collection, treatment, and disposal of Site liquids; stormwater management; and Site monitoring.

Phase II also includes design and construction of the Selected Remedy, along with the first 5 years of operations, maintenance, and monitoring (OM&M). Although the CSC is obligated to perform the Phase II work under the CD, the work must be funded by cashout settlements from other parties or other sources.

Phase III: Phase III work includes the first 30 years of long-term OM&M.

Phase IV: Phase IV work entails the post 30-year OM&M work after Phase III.

The CSC has completed Phase I work, is currently performing Phase II work, and is required to complete Phase II obligations, including design and construction of the Selected Remedy and the first 5 years of OM&M. The party or parties that will perform Phases III and IV, which may include the CSC, are to be determined.

2.3 Community Participation

EPA's outreach goal is to educate the community about work being done at the Site and collaborate with stakeholders to successfully engage the public. EPA relies on community input to understand local priorities and concerns during remedy decision making. The Site has historically been a focus of community concern during and since the time it was an active, Class I, hazardous waste management facility. EPA began holding community meetings at the town of Casmalia when it temporarily took over critical Site stabilization activities in 1992, under emergency response authorities. EPA continued to hold community meetings as it conducted emergency response operations from 1992 through 1996, and developed and finalized the CD in 1997. For the past two decades, EPA has hosted regular Interagency Committee (IAC) meetings with the DTSC, RWQCB, CDFW, and USFWS to coordinate work, solicit input, and communicate the status of ongoing activities with public stakeholders.

EPA has also helped support a Community Technical Assistance Consultant (CTAC) to review and provide community input on technical initiatives and Site response work. The CTAC role provides an opportunity for community members to learn about the Site and share community needs and concerns. The CTAC provides input and feedback to EPA and the State so that community perspectives can be considered in the remedy selection process. Particularly in the last few years, the CTAC has played an active role in the ongoing IAC meetings, representing the viewpoints of the local community.

The Proposed Plan for the Site was made available to the public on November 22, 2017. The Proposed Plan and other Site documents (including the RI report and FS report) can be found: on the EPA website, in the Administrative Record file of the information repositories maintained at the EPA Region IX Superfund Records Center at 95 Hawthorne Street in San Francisco, California; and at the Santa Maria Public Library, 2nd Floor, Reference Department, 421 S. McClelland Street, Santa Maria, California. The notice of the availability of the Proposed Plan, including the date and location for the public meeting and public comment period, was published the week prior to the start of the public comment period in the *Santa Maria Times* newspaper and sent to the Site mailing list. A public comment period was held from November 22, 2017, to January 22, 2018.

A public meeting was held December 6, 2017, to present the Proposed Plan to the community audience and accept public comments. The meeting was attended by about 60 people. EPA presented an overview of the Proposed Plan and formal public comments were accepted at the meeting. Transcripts of the public meeting are part of the Administrative Record file at the information repositories. EPA's response to comments received at the public meeting and

otherwise during the public comment period are included in the Responsiveness Summary, which is part of this ROD (see Section 3.0 and Appendix G).

2.4 Scope and Role of Operable Unit or Response Action

The Site is a large facility with many legacy waste management units and extensive soil, sediment, surface water, and groundwater contamination. Although the Site has been stabilized and there are no current risks of exposure to the public, remediation and long-term OM&M at the Site are necessary for long-term protection of human health and the environment. The Site has not been organized into multiple operable units (OUs). The Selected Remedy presents the final response action for the entire Site. The Selected Remedy addresses PTWs at the Site through the containment of waste within the landfills and removal of NAPL source material.

The remediation strategy incorporates actions for five different Site areas and multiple impacted media into a comprehensive remedy. The study areas are described in further detail in Section 2.5.3. Areas 1 through 4 include the primary source areas, soil, sediment, and surface water. Area 5 includes onsite groundwater. The five areas are defined within the former facility boundary (Zone 1) to facilitate cleanup evaluation and implementation, based on each area's unique hazardous waste operations during the operational era, ongoing response actions, physical characteristics, and Site-related contaminants. The Selected Remedy addresses PTWs at the Site through containment of the waste within the landfills, and the removal of NAPL source material in Area 1. Long-term monitoring, based on optimization studies, will be required to verify that contaminants are not migrating beyond the POC boundary in Area 5 North, or beyond the Zone 1 boundary.

2.5 Site Characteristics

The CSC conducted RI activities (planning, fieldwork, and reporting) from 2002 through 2011 to characterize the nature and extent of contamination, fate and transport of contamination, and human health and ecological risk. The RI work included the installation and sampling of monitoring wells and piezometers in Zone 1 and Zone 2 areas, highly complex groundwater modeling and geophysical surveys, and extensive sampling of soil, sediment, soil vapor, surface water, and groundwater. The FS was completed from 2011 to 2016 to evaluate a range of remedial alternatives to address soil, soil vapor, surface water, sediment, and groundwater contamination in accordance with the NCP and CERCLA RI/FS guidance. The CSC completed the final RI report in January 2011 (CSC, 2011) and the final FS report in February 2016 (CSC, 2016). Concurrent with the RI and FS work (2002 to 2016), important interim actions were also completed, including extraction and treatment and/or disposal of contaminated Site liquids (NAPL and groundwater). The Site conditions are documented in the RI report and FS report. Key features of the Site are described in Section 2.5.2.

2.5.1 Conceptual Site Model

The conceptual Site model (CSM) presents an understanding of the sources of chemicals released to the environment, how they were released and transported within and among media, and the exposure pathways and routes by which both human and ecological receptors may contact them. Receptors that may be potentially exposed to Site-related chemicals are identified, and the likelihood of their potential exposures is assessed through consideration of the current and the anticipated future use of the Site.

The former hazardous waste management facility accepted a full range of listed and characteristic RCRA wastes. As a result of these activities, contamination occurs pervasively throughout the Site. The primary contaminant sources include existing landfill areas, former waste disposal areas and facilities that have not previously undergone cleanup, and residual contamination from prior Site cleanup activities. Of these, the existing landfill areas and former disposal areas not addressed through prior interim response actions represent the most significant continuing sources of contamination.

Based on extensive Site characterization, chemicals of potential concern (COPCs) consist of numerous VOCs, SVOCs, polycyclic aromatic hydrocarbons, pesticides, herbicides, PCBs, dioxins, furans, and metals. Over 300 chemicals of interest, which are commingled and dispersed throughout various Site areas and multiple media, have been detected. The chemicals are adsorbed to soil and claystone, mixed within soil gas, dissolved in surface water and groundwater, and accumulated as free-phase and residual LNAPL and DNAPL.

Figure 2-6 presents a 3-dimensional CSM geological block diagram for the Site.

From a risk assessment perspective, there must be a complete exposure pathway from the source to receptors for chemical intake to occur. The CSM identifies potentially complete exposure pathways and potential receptors. The human health CSM diagrams for uncapped areas and surface water at the Site are presented in Figures 2-7 and 2-8. The ecological CSM diagrams for terrestrial uncapped areas, terrestrial capped areas, and freshwater habitat areas at the Site are in Figure 2-9, Figure 2-10, and Figure 2-11, respectively.

2.5.2 Site Features and Physiography

The 252-acre Site is in the northwestern corner of Santa Barbara County, California. The area near the Site is sparsely settled, and land uses consist primarily of agriculture, cattle grazing, and oil field development. The Site is located on the south-flanking slope of the gently rolling Casmalia Hills, and bounded by the North Ridge to the north; it generally slopes from north to south. Casmalia Creek flanks the Site on the west/southwest and merges with Shuman Creek approximately 2 miles south of the Site and approximately 1 mile west of the town of Casmalia. Shuman Creek empties into the Pacific Ocean, approximately 4 miles west of the confluence with Casmalia Creek. An ephemeral drainage is located to the north/northeast of the Site and is referred to as the "North Drainage." Three surface drainages exit the southern facility boundary and are identified, from east to west, as the A-Drainage (southeastern corner), B-Drainage

(south-central boundary), and C-Drainage (southwestern corner). The North Drainage and A-Drainage are tributaries to Shuman Creek, while the B-Drainage and C-Drainage are tributaries to the perennial Casmalia Creek immediately west of the Site (see Figure 2-1).

Surface elevations range from 835 feet above mean sea level (amsl) at the north to 375 feet amsl at the southern boundary. The A-, B-, and C-Drainages play crucial roles in EPA's remedial actions with respect to: (1) the management and controlled discharge of surface water; and (2) implementation of habitat restoration projects, including constructed wetlands for threatened and endangered species.

The CSC constructed the wetlands habitat in the B-Drainage in 2008 to serve as mitigation of potential harm to special-status species, primarily from the anticipated closure of surface water ponds, in accordance with a 2007 consultation with USFWS and subsequent USFWS Biological Opinion (BO). The wetlands are located immediately south of Zone 1 (Figure 2-1). The BO was issued to cover ongoing Site operations and anticipated future cleanup and closure of all five existing surface water ponds (RCF, A-Series Pond, Pond A-5, Pond 18, and Pond 13). Special-status species at the Site include the federally threatened California Red-legged Frog and the federally endangered California Tiger Salamander.

The Casmalia Hills form a topographic high location, separating two groundwater basins. The Santa Maria Valley groundwater basin is located to the north and east of the Site, and the San Antonio Valley Creek groundwater basin is located south of the Site (Figure 2-12). The Site lies in an upland area between these two basins, but drains to the Shuman Creek watershed; therefore, drainage is formally associated with the San Antonio Valley Creek basin. Although groundwater is present, the Site is not located within a California-designated groundwater basin. Groundwater beneath the Site does not serve as a source of drinking water for the town of Casmalia or other communities. The town of Casmalia receives its water supply via a pipeline connection from Casmite Well No. 1, located about 2.7 miles northeast of the Site in the separate Santa Maria Valley basin. Parcel ownership near the Site is depicted on Figure 2-13.

2.5.3 Study Areas and Sampling Strategy

The Site has been thoroughly studied, beginning with CR Site investigations and response actions in the 1980s, followed by EPA's Site stabilization and monitoring activities from 1992 through 1996. Since 1997, studies continued with the CD work that required the CSC to complete the RI/FS, conduct response actions, and perform ongoing O&M.

Numerous detailed study areas were identified during the RI to facilitate: assessing Site characteristics, nature and extent of contaminants, and fate and transport of contaminants; and conducting risk assessments. The media subject to characterization and monitoring have included soil, soil vapor, groundwater, surface water, and sediment.

The RI study areas were identified based on historical use and waste management and disposal practices, and included those listed as follows.

REMEDIAL INVESTIGATION STUDY AREAS	
Soil and Sediment Study Areas	Capped Landfills
	PCB Landfill
	RCRA Canyon Area
	West Canyon Spray Area
	Burial Trench Area (BTA)
	Central Drainage Area (CDA)
	Liquids Treatment Area
	Maintenance Shed Area
	Administration Building Area
	Roadways
	Remaining On-Site Area
	Former Ponds and Pads Areas (FPP)
	Stormwater Ponds
	Treated Liquids Impoundments
Offsite Area (areas outside the Site boundary, that is, Zone 2)	
Surface Water and Groundwater Study Areas	Stormwater Ponds
	Treated Liquids Impoundments
	Northern Groundwater Area
	Southern Groundwater Area
	Offsite Area (surface water and groundwater outside the Site boundary, that is, Zone 2)

Based on the RI results, the many detailed RI study areas were consolidated and five main study areas were designated for the purposes of conducting the FS. Four areas (Areas 1 through 4) include surface features and systems, and a fifth area (Area 5) includes all onsite groundwater. Area 5 is further divided into three subareas (Area 5 North, Area 5 South, and Area 5 West), based on topography, subsurface structure, groundwater flow patterns, and contaminant distribution. Area 5 addresses onsite groundwater because contamination that could contribute to exceedances of remediation levels has been contained within the Zone 1 boundary. The five FS study areas were established and evaluated based on geographical features, surface or subsurface structure, and/or similar impacted media.

The five study areas include:

- **Area 1** (Capped Landfills Area, BTA, and CDA)

- **Area 2** (RCRA Canyon and WCSA)
- **Area 3** (FPP Area)
- **Area 4** (Stormwater Ponds and Treated Liquid Impoundments)
- **Area 5** (Groundwater)
 - Area 5 North
 - Area 5 South
 - Area 5 West

Figure 2-14 shows the location of Areas 1 through 4, addressing surface features. Figure 2-15 shows the location of Area 5, addressing groundwater.

2.5.4 Onsite Sources and Features

A large number of sources of contamination, numerous engineering systems and components, and multiple impacted media are present at the Site. The historical waste management units and current Site features are summarized in the following subsections.

2.5.4.1 Waste Management Units and Facilities

The six landfill disposal areas were located along the northern portions of the Site. One of the landfills, the former RCRA landfill, was excavated and partially closed between 1989 and 1990. Surface impoundments (used for evaporation and treatment of liquid wastes or for storing stormwater) and evaporation pads (used to evaporate liquid wastes and Site stormwater runoff) primarily occupied the southern and central portions of the Site. Some surface impoundments and evaporation pads were also present in the northern portion of the Site, between the landfills (Figure 2-2).

Five Existing Inactive Landfills

CR operated the five existing landfills (P/S, Heavy Metals, Caustics/Cyanide, Acids, and PCB) in the 1970s and 1980s. In the late 1980s, CR graded the existing landfills (with the exception of the PCB Landfill) in accordance with closure plans prepared for each landfill. To achieve the desired grades, CR placed approximately 20 to 60 feet of stabilized soils excavated as part of the pond and pad closure activities. CR placed a minimal thickness of cover soil over the PCB Landfill because this landfill was never filled to capacity; it was to be left uncapped and reserved for future remediation soils.

Following negotiation of the CD in 1997, the CSC improved the P/S Landfill clay buttress in 1998 to provide additional stability and enhance containment, and constructed a RCRA cap in 1999. Following completion of the EE/CA report in 2000, CSC placed a RCRA cap over the Heavy Metals Landfill and the interstitial areas on either side of that landfill in 2001, and capped the remainder of the EE/CA Area (Caustics/Cyanides and Acids landfills, along with the interstitial areas) in 2002. The CSC constructed a buttress for the Caustics/Cyanides Landfill as part of the

EE/CA Area capping project. Except for the PCB Landfill, the five inactive Site landfills have now been capped.

Former RCRA Landfill, RCRA Canyon, and West Canyon Spray Area

The former RCRA Landfill is in a natural canyon (currently referred to as “RCRA Canyon,” and historically sometimes referred to as “West Canyon”) on the northwestern side of the Site. This area was at one time intended to be lined in preparation for receiving RCRA-regulated waste from the McColl Superfund Site. However, when it became apparent that McColl wastes would not be delivered to the Site, in 1989 to 1990, CR excavated the limited amount of RCRA Canyon wastes that had been placed in late 1983 to early 1984 and transferred the wastes to the P/S Landfill.

RCRA Canyon was also the location of the oil-field-waste spreading areas, referred to as “the WCSA.” The north and west slopes of this area received oil field wastes (primarily drilling mud), winery wastes, spray irrigation of leachate, and surface stormwater runoff collected from other portions of the Site. Dried wastes were reported to have been periodically removed and used as daily cover in the landfills.

Burial Trenches and Shallow Disposal Wells

Waste disposal in the BTA, also historically referred to as “the Burial Cells Unit,” began in the early 1970s with disposal in seven trenches directly south of the PCB Landfill and west of the P/S Landfill (Figure 2-2). The disposal trenches were constructed by excavating a series of cells 15 to 40 feet square and approximately 15 feet deep. Cells were constructed in seven rows and assigned numerical designations, with the individual cells in a given row assigned alphabetical designations.

Waste disposal in the BTA also included liquids disposal in 11 shallow wells constructed between December 1977 and September 1982. Available information indicates two of these wells (wells 10 and 11) were between trenches 4 and 5, and the remaining nine wells were between trenches 3 and 4.

Former Surface Impoundments and Spreading Areas

CR used a total of 43 ponds and 15 evaporation pads, collectively referred to as “surface impoundments.” Construction of the surface impoundments began in 1972, and new impoundments were added or enlarged through 1985. These facilities were used for the receipt, treatment, storage, and evaporative disposal of acid and alkaline wastes, oil field wastes, industrial wastewater, and Site stormwater runoff. Although contaminated liquids were eventually transferred to most Site ponds, only a few Site ponds directly received wastes. In addition to the hazardous waste ponds and pads, two waste ponds (Sludges 1 and 2) were used for disposal of non-hazardous wastes, such as sewage sludge, and six areas were used for spreading and drying oil field wastes and drilling mud. Disposal of liquids to the ponds ceased by 1988.

CR conducted surface impoundment closure activities from 1988 to 1991. The overall objective of the closure activities was to remove hazardous constituents to background or other cleanup levels approved by the RWQCB. Surface impoundment closure was undertaken in three stages: liquids removal, bottom sludge removal, and contaminated subgrade removal. Removed liquids and bottom sludges were either evaporated or solidified for disposal into the Site's landfill areas. Contaminated subgrade materials were also relocated to the Site's landfill areas for disposal.

Based on available information, it appears that 40 out of the 58 former surface impoundments were recommended for closure at the time. Four entire impoundments (Pad 9A, Pad 9B, Pond R, and Pond 23) and limited portions of two others (the western portion of Pond 6 and the southern berm area of Pond 19) were recommended for closure as landfills through capping. Impoundments recommended for closure as landfills are restricted to the area lying north of the PSCT, and either overlie or are near known existing contamination sources, including the BTA, CDA, and the toe area of the P/S Landfill. The closure status of the former surface impoundments is shown on Figure 2-16. Some of the former ponds and pads contain significant hotspots of contaminated soils because CR did not complete response actions.

Disposal of drums occurred on an experimental basis in the area of former Pond 19 (Figure 2-2). Wastes once deposited in this former Drum Burial Area were removed and redeposited into one of the existing inactive landfill areas, beginning in about December 1979 until early 1980.

Former Waste Treatment Units

The Site had five waste treatment units: (1) the acid/alkaline CNS; (2) a temporary pilot-scale PACT unit; a wet air oxidation unit; a hydrogen peroxide treatment system; and oil recovery and treatment tanks (Figure 2-2). These treatment units no longer exist, but the former treatment unit areas were evaluated during the RI/FS process.

2.5.4.2 Current Containment and Extraction Facilities

Several structures and facilities have been installed to limit contaminant migration and treat impacted or potentially impacted liquids.

Subsurface Barriers and Extraction Facilities

CR installed subsurface compacted clay barrier walls downgradient of the P/S Landfill in 1980, along with the Gallery Well located immediately upgradient of this barrier. Subsurface barriers were also installed at the base of the PCB Landfill in 1980, near Pond 20 in 1981 to 1982, and at the base of RCRA Canyon in 1984. As part of early Site operations, subsurface clay barriers with extraction facilities were also installed in the B- and C-Drainages in 1972 to 1973 and 1982, respectively (Figure 2-2).

The Gallery Well began operating in 1980 as a groundwater extraction facility. A relatively shallow liquid extraction point, Sump 9B, was constructed in the CDA in 1988, in response to evidence of contamination observed during the closure of the former Pad 9B waste pad.

CR installed several perimeter collection and extraction facilities, including three collection trenches and five extraction wells, in 1989. These features, located along the A-, B-, and C-Drainages, are referred to as the “perimeter control trenches” (PCTs, or PCT-A, PCT-B, and PCT-C). CR installed the PSCT downgradient of the landfills in 1990 (see Figure 2-3). In 1998, the CSC installed an additional shallow liquid extraction point (Road Sump) to intercept groundwater potentially migrating downgradient from Sump 9B.

Stormwater Runoff Collection Ponds and Treated Liquids Ponds

Five existing unlined ponds were created by CR as a result of excavating waste and contaminated soils from the former surface impoundments in the late 1980s. Three of these ponds are currently used for stormwater collection along the south-central Site boundary:

- RCF Pond. The RCF Pond is in the area once occupied by portions of former Ponds 3, 4, 9, 10, and 11. It currently receives untreated water from PCT-A for evaporation. Stormwater from the central and eastern part of the Site also flows to the RCF Pond.
- A-Series Pond. The A-Series Pond is in the area once occupied by portions of former Ponds A-1, A-2, A-3, and A-4. It currently receives untreated water from PCT-B and PCT-C for evaporation.
- Pond 13. Pond 13 is the most southerly (downgradient) of the original stormwater runoff containment ponds. It is still used for its original purpose of stormwater runoff control.

Two of these ponds have been used for treated liquids disposal, and are located near former ponds of the same designation in the southwestern portion of the Site. These are:

- Pond A-5. Pond A-5 previously received treated liquids extracted from Sump 9B and the Gallery Well; this pond does not currently receive any liquids.
- Pond 18. Pond 18 currently receives treated effluent from the PSCT granular activated carbon (GAC)-treatment system for evaporation.

The five existing ponds all contain total dissolved solids (TDS) concentrations that approach or exceed the concentration of seawater due to evaporation from the extracted groundwater. Pond water contains metals at concentrations that may present an increased risk to ecological receptors. Pond sediments contain concentrations of metals that may serve as an ongoing source of groundwater contamination. The ponds also have become “attractive nuisances” for several special-status species, including the California Red-legged Frog, the California Tiger Salamander, and the Western Spadefoot toad. For the purposes of the Superfund Program, an attractive nuisance refers to an area, habitat, or feature that is attractive to wildlife and has, or

has the potential to have, waste or contaminants left on site that are harmful to plants or animals after a completed remedial action (EPA, 2007). For the Site, the contaminants consist of elevated TDS levels that will be present in the new lined evaporation pond system, resulting from treated groundwater discharged to the ponds that evaporates over time.

The CSC constructed another small, unlined surface water runoff collection basin during 2003 in a portion of the CDA (Figure 2-3). Clean stormwater runoff from the P/S Landfill cap and EE/CA Area cap is directed via constructed drainage swales into this basin, and a pipeline from the basin allows stormwater to be directed into the RCF Pond or the upper reaches of the B-Drainage for discharge outside the Site's boundary, bypassing uncapped areas of the Site. This pipeline is equipped with valves and flow meters to control the location and rate of discharge. Discharges from this pond comply with the substantive provisions of the General NPDES permit.

Subsurface Site Liquids Management

The Gallery Well, Sump 9B, the PSCT, and the PCTs are currently used to control subsurface liquids migration under requirements of the 1997 CD. Liquids have been extracted from these features since they were each installed, although the method for treating and/or disposing of these liquids has changed over time. Liquids from the Gallery Well and Sump 9B, which also contain LNAPL and DNAPL, are temporarily stored in tanks at the liquids treatment area and then disposed at an offsite treatment, storage, and disposal (TSD) facility. Liquids from the PSCT are treated onsite using GAC and discharged to Pond 18 for evaporation. Liquids from the PCTs are discharged directly to the RCF and A-Series ponds for evaporation without treatment.

The groundwater collection facilities are operated to maintain water levels at or below specific criteria elevations. Criteria water level elevations are described by water level depths measured from a datum, such as top of the casing of the collection facility; they have been historically referred to as "action levels." Periodic liquid level measurements document compliance with the specific action levels established for each applicable extraction point. Routine Site maintenance, wetlands monitoring, and groundwater monitoring activities are also conducted. The CSC submits quarterly progress reports to EPA to document the significant work in the following main CD elements or components of work at the Site:

- Interim Collection/Treatment/Disposal of Contaminated Liquids Component of Work
- Routine Site Maintenance Element of Work, including Wetlands Operations/Monitoring
- Routine Groundwater Monitoring Element of Work

2.5.5 Geology and Hydrogeology

In the vicinity of the Site, the Todos Santos Claystone Member (claystone) of the Sisquoc Formation overlies the Monterey (Shale) Formation. The Monterey Formation is up to 5,000 feet thick and is composed of interbedded shale, chert, limestone, and diatomite.

The claystone underlying the Site is massive to faintly bedded, and has been informally divided into an upper weathered stratigraphic unit and a lower unweathered stratigraphic unit. The weathered claystone ranges in thickness from about 15 to 100 feet, and in most places is 30 to 60 feet thick (CSC, 2011). The unweathered claystone is below the weathered claystone, is up to 1,300 feet thick, and conformably overlies the Monterey Formation. The unweathered claystone is significantly less fractured than the overlying weathered claystone.

Two hydrostratigraphic units have been defined, identified as: the Upper Hydrostratigraphic Unit (Upper HSU), associated with the shallow weathered claystone; and the Lower Hydrostratigraphic Unit (Lower HSU) associated with the underlying deeper unweathered claystone. Groundwater flow at the Site is quite restricted in both the Upper HSU and Lower HSU. Most groundwater flow occurs in fractures in the Upper HSU, with a minor component of flow in the less fractured Lower HSU. Although groundwater flow occurs through fractures in the Upper and Lower HSUs, most groundwater is stored within the matrix porosity. Given the thickness of the unweathered claystone (>1,000 feet), the generally small aperture of fractures, and the lack of interconnectivity between fractures on a Site-wide scale, significant movement of dissolved-phase contaminants or NAPL to at any appreciable rate is unlikely. The overall decrease of fracture density with depth and apparent limited fracture connectivity suggest that the majority of fractures likely terminate at depth and act as areas of dead-zone storage (CSC, 2016).

Groundwater flow conditions have been evaluated through numerous field investigations and numerical groundwater flow modeling. Over 400 groundwater monitoring wells and piezometers have been installed across the Site. A natural groundwater flow divide occurs at the North Ridge. Groundwater north of this divide flows northward toward the North Drainage. Groundwater south of the ridge flows southward beneath the Site. Groundwater flow direction is controlled by topography, the geologic structure of the contact between the two HSUs, and the liquids extraction facilities operated to control the migration of landfill leachate and contaminated groundwater. The water table contour map on Figure 2-17 presents typical horizontal groundwater flow patterns and gradients at the Site. Appendix A presents a Site plan with the well locations and a table of well construction details.

Groundwater modeling specialists spent over 5 years developing and applying a simulation model to depict onsite groundwater flow patterns. The RI report provides a detailed discussion on the development, calibration, use, and results of the groundwater modeling work. The results of the groundwater elevation data and the numerical flow modeling showed the following:

- The North Ridge is a groundwater flow divide, and contaminants in groundwater are not present north of the divide. Contaminants dissolved in groundwater flow southward from this divide, beneath the primary source areas (landfills, CDA, and BTA) and toward the PSCT.
- The Gallery Well extracts liquids (aqueous phase, LNAPL, and DNAPL) from the P/S Landfill, which contributes to containment of these liquids within the landfill area. NAPL and dissolved-phase constituents are contained within the P/S Landfill area from the

combination of the underlying unweathered claystone, clay barrier, and extraction from the Gallery Well. DNAPL may not be completely contained at the actual base of the landfill; however, because the potential exists for it to migrate a short distance downward and laterally through fractures in the underlying claystone (based on the observed presence of DNAPL in downgradient wells including Sump 9B and RGPZ-7D). Nevertheless, as described above, significant movement of NAPL beyond this area at any appreciable rate is unlikely.

- Sump 9B extracts liquids between the P/S Landfill and the PSCT, which contributes to a localized capture zone of liquids and mitigation of a surface seep that historically formed during wet winters.
- The PSCT extracts and contains contaminated liquids moving southward beneath the primary source areas and through the Upper HSU. Liquids flowing through the Lower HSU are either captured by the PSCT or some may move beneath the PSCT as indicated by particle tracking. Based on the specific compounds detected and their concentrations relative to the wells within and upgradient of the PSCT, these compounds are believed to be related to previously existing ponds and pads and/or to contaminants present in these areas prior to construction of the PSCT (CSC, 2011).
- The lack of extensive continuity between fractures may limit the extent of potential fluid pathways on a Site-wide scale (CSC, 2011).

In summary, there are two water-bearing units (Upper HSU and Lower HSU) beneath the Site area where NAPL is present. There has been extensive monitoring of these two water bearing units, and groundwater contaminants are limited in horizontal and vertical extent (as described further in Section 2.5.6.5). These water-bearing units have discontinuous fractures and low hydraulic conductivity which limit contaminant migration. Perimeter groundwater extraction systems are installed downgradient of the primary source areas (i.e., landfills, CDA, BTA) to capture contaminant migration in the Upper HSU. In addition, groundwater monitoring data show that contaminant concentrations in the Lower HSU are at or below MCLs at the Zone 1 boundary. There are no current drinking water aquifers that could be impacted by the dissolved-phase constituents or NAPL. The Lower HSU is up to 1,300 feet thick and is underlain by the Monterey Formation which is up to 5,000 feet thick, and these impede contaminant migration. Horizontal and vertical contaminant migration from the discontinuous fractures in the water bearing zones is very slow and is also limited by diffusion into the claystone matrix. The capping and extraction systems which are part of the Selected Remedy will reduce the hydraulic driving force and further limit contaminant migration into the fractures.

2.5.6 Nature and Extent of Contamination

The nature and extent of contamination at the Site includes VOCs, SVOCs, and metals in soils, surface water and sediment, and groundwater (with VOCs present to a limited degree in soil vapor). Over 300 COPCs have been detected, many of which exceed human health and ecological risk-based levels. These chemicals are also commingled and dispersed within the various media across the Site. The nature and extent of contamination by media for each area

are summarized in the following subsections. Figure 2-18 presents a plan view summary of the chemical detections and exceedances for each media. Table 2-2 presents the COPCs in each media based on the RI results. Table 2-3 presents the constituents detected above risk-based concentrations in each media. Appendix B contains selected figures that depict the nature and extent of key constituents in the various media.

2.5.6.1 Soils

Soil contamination occurs pervasively throughout Areas 1 and 2, and variably within Area 3. Contamination includes many COPCs (metals, VOCs, SVOCs, and other organic compounds), as follows:

- In Area 1, surface and subsurface soils represent the most contaminated soils at the Site. Soils north of the PSCT in the CDA and BTA are primarily contaminated with metals and organic compounds, many of which increase in concentration with depth and serve as groundwater contamination sources via infiltration.
- In Area 2, COPCs were identified in RCRA Canyon/WCSA and included elevated concentrations of metals (copper, chromium, and zinc) that remain from areawide spraying of oil field and other wastes during disposal operations. The elevated concentrations of these metals occur in the top several feet of soil and diminish with depth.
- In Area 3, several discrete soil hotspot areas contain elevated concentrations of metals, VOCs, and other organic compounds. These hotspot areas include the following (see Figure 2-19):
 - **Hotspot 1 (HS-1)** – shallow soil contamination in the Liquid Treatment Area (metals, organics)
 - **Hotspot 2 (HS-2)** – shallow soil contamination in the former MSA (metals, organics)
 - **Hotspot 3 (HS-3)** – shallow and deeper soil contamination from former Ponds A and B (organics)
 - **Hotspot 4 (HS-4)** – shallow soil contamination south of PSCT-1 (metals, organics)
 - **Hotspot 5 (HS-5)** – shallow soil contamination north of RCF Pond (metals, organics)
 - **Hotspot 6 (HS-6)** – shallow soil contamination northwest of RCF Pond (organics)
 - **Hotspot 7 (HS-7)** – shallow soil contamination due east of Pond 18 (metals)
 - **Hotspot 8 (HS-8)** – shallow soil contamination further east of Pond 18 (metals)
 - **Hotspot 9 (HS-9)** – shallow soil contamination between Pond 18 and RCF Pond (metals, organics)

- **Hotspot 10 (HS-10)** – deeper soil contamination southwest of RCF Pond, from a former waste pond discovered while drilling soil boring RISBON-59 (organics)

The maximum depth of soil impacts was encountered in the BTA where former deep waste disposal operations resulted in elevated inorganic concentrations at depths of up to 44.75 feet bgs, and elevated organic concentrations at depths of up to 77.5 feet bgs.

For VOCs, the constituent found in soils at the highest concentration was tetrachloroethene (PCE) at 46 milligrams per kilogram (mg/kg) in the FPP Area (Area 3). This concentration is approximately 4 times the preliminary remediation goal of 11 mg/kg (CSC, 2011).

Soil sampling indicates that soil contamination only occurs onsite within the historical facility boundary (Zone 1). Soils in Zone 2 did not show evidence of impacts from former facility operations.

2.5.6.2 Soil Vapor

Soil vapor containing VOCs and limited amounts of methane has been found in various sampling locations across the Site. Although many COPCs have been detected at low concentrations, some high concentrations have been found in relatively discrete areas, such as the former waste disposal areas that serve as sources of soil vapor.

A total of 43 individual VOCs was detected at the various soil vapor sampling locations around the perimeter of the landfills, the CDA, and the BTA, and represent COPCs in soil vapor. The VOCs that exceeded risk-based concentrations were PCE, trichloroethene (TCE), and 1,3-butadiene. The highest soil vapor concentrations occur primarily in association with the most extensive buried waste materials in Area 1. These VOCs are likely the result of contamination from the landfills and residual contamination in the BTA and CDA. Concentrations tend to decrease away from the source areas, to below risk-based cleanup levels at the Site's boundaries.

Localized soil vapor concentrations in the North Drainage are subject to continued study and are being monitored by a cluster of three soil gas probes along the North Ridge. Results from monitoring during the period between 2009 and 2014 show that soil vapor concentrations in the North Drainage probes are relatively low (below risk-based concentrations), and are consistent or decreasing over time.

The generation of landfill gas as methane is relatively insignificant because organic rich municipal solid waste was not disposed of in the landfills. Gas flux testing of the interim soil caps was conducted in 1997, and results indicated there was no substantial movement of methane and other VOCs through these interim soil caps and into ambient air. Based on these findings, it was concluded that the landfill cap, as constructed over the P/S Landfill in 1999, would effectively eliminate the very low gas fluxes observed, and installation of a gas mitigation system was not needed. The construction materials selected for the final caps included fine-

grained soils and high-density polyethylene (HDPE) geomembranes to restrict transport of soil vapor.

2.5.6.3 Surface Water and Sediment

Until remedial action is implemented, the five surface water storage ponds in Zone 1 play a critical, but temporary, role in collecting, storing, and evaporating stormwater and treated liquids to prevent uncontrolled discharges. The TDS and metals concentrations in the five ponds have been generally increasing over time due to a high concentration of salts and metals from both surface water and extracted groundwater discharged to the ponds and subject to evaporation. Low levels of organic compounds also are occasionally detected in some ponds. The TDS and metals exceed ecological risk screening levels, including those for the California red-legged Frog, a special-status species that formerly inhabited the ponds in the 1990s and early 2000s until the ponds became too salty. The underlying pond sediments also contain elevated levels of metals, VOCs, and other organic compounds, and serve as potential sources of contamination to shallow groundwater.

Surface water and sediment in Zone 2 (along Casmalia Creek, North Drainage, and the A-, B-, and C-Drainages) did not show evidence of impacts from former Site operations.

2.5.6.4 Surface Seeps

Based on extensive studies, surface seeps have been identified in two main areas within Zone 1, as follows:

- **RCRA Canyon Seep.** This seep forms seasonally at the southern end of RCRA Canyon in the winter. The seep forms in response to a shallow water table and upward groundwater gradients at the canyon bottom that are greater in the winter, in response to rainfall infiltrating over the canyon. The seep is elevated in TDS and metals, which could result in risks to amphibians if water is allowed to pond. The seep reveals the shallow depth of groundwater in this area, and points to a need to install low-permeability capping systems to contain and lower groundwater levels.
- **Sump 9B Seep.** This seep periodically forms between the P/S Landfill and the PSCT due to a shallow water table that will intersect the ground surface in response to rainfall infiltrating over the area. This seep will not form if the water table is pumped down by Sump 9B. When it forms, however, the seep is highly contaminated and has an LNAPL sheen. This seep also points to the need to install low-permeability capping systems to contain and lower groundwater levels.

2.5.6.5 Groundwater

Groundwater has been impacted by a wide range of organic and inorganic contaminants, including LNAPL and DNAPL. Figures 2-20 and 2-21 show the lateral distribution of total VOCs and metals (along with LNAPL and DNAPL), respectively, for the Upper HSU. Figures 2-22 and 2-

23 show the lateral distribution of total VOCs and metals (along with DNAPL) in the Lower HSU. Other classes of organic contaminants (such as, SVOCs, herbicides, pesticides, and PCBs) are distributed within the aerial extent covered by the total VOCs. Appendix B provides figures that show the lateral distribution of key metals (arsenic, nickel, cadmium, and selenium) in the Upper HSU and Lower HSU. The lateral extent of exceedances of maximum contaminant levels (MCLs) has been contained within the Site's geographic boundaries (Zone 1) by a combination of engineered containment systems (such as, barrier trenches, sumps, and liquids extraction systems) and MNA. The lateral extent of measurable LNAPL and DNAPL in both the Upper HSU and Lower HSU is limited to Area 5 North. The PSCT, completed to the base of the Upper HSU to a maximum depth of 65 feet, was designed to capture Upper HSU groundwater migrating to the south.

The vertical extent of dissolved-phase constituents and DNAPL is greatest in the area south of the P/S Landfill. The highest concentrations of dissolved-phase constituents and the greatest DNAPL thickness are generally found in Upper HSU monitoring wells in this area, completed at depths of up to about 100 feet bgs. At monitoring wells near the toe of the P/S Landfill, such as RIPZ-13 and RGPZ-5D, DNAPL was found to accumulate near the contact between the more permeable Upper HSU and the less permeable Lower HSU. However, based on drilling and sampling of several wells (including RGPZ-6D, RGPZ-7C, and RGPS-7D) about 500 feet south of the Gallery Well, dissolved-phase constituents above MCLs, and observable DNAPL, are present within the Lower HSU at depths of up to about 150 feet bgs.

The VOCs detected in groundwater in the greatest number of wells and at relatively high concentrations compared to other constituents include PCE, TCE, cis-1,2-dichloroethene (DCE), vinyl chloride, and benzene. The maximum concentration detected in groundwater for PCE (140,000 micrograms per liter [$\mu\text{g}/\text{L}$]) is 24,000 times greater than the MCL of 5 $\mu\text{g}/\text{L}$. Similarly, the maximum concentration detected in groundwater for TCE (120,000 $\mu\text{g}/\text{L}$) is 22,000 times greater than the MCL of 5 $\mu\text{g}/\text{L}$.

Area 5 North

Area 5 North presents obstacles to full remediation because of the presence of multiple source areas and complex hydrogeology. Area 5 North encompasses the major landfills and burial areas. The P/S Landfill was a disposal Site for many drums and containers of liquid wastes. Shallow groundwater generally flows horizontally through preferential pathways in the heterogeneous and fractured Upper HSU. Groundwater flows at slower rates in the less fractured Lower HSU. Contamination resides both in fractures and as residual contamination in the matrix of the claystone, which is characterized by very low permeability and high porosity, preventing effective long-term removal or treatment.

As described, DNAPL has been detected in Lower HSU piezometers (RGPZ-7C and RGPZ-7D) in the CDA, approximately 500 feet south of the P/S Landfill and north of the PSCT, indicating a potential for density-driven mobile DNAPL to flow through Lower HSU fractures. Geologic cross-sections prepared during construction of the P/S Landfill indicate the presence of a "low spot" at the base of the landfill where DNAPL could accumulate. As part of the RI, the CSC conducted

geophysical surveys to further delineate the base of the landfill. The geophysical surveys provided images of the base of the landfill, and support the presence of the low area. The CSC later installed four piezometers directly into the landfill, one of which (RIPZ-13) documented a DNAPL thickness of 14 feet.

Based on laboratory analysis, the DNAPL contains over 100 constituents, including VOCs, SVOCs, and a host of other compounds. Some key constituents include TCE, PCE, 1,2-dichlorobenzene, 1,2,3-trimethylbenzene, ethylbenzene, xylenes, pentane, toluene, and diphenyl ether, among many others.

Area 5 North includes a designated WMA where the former landfills are located. Area 5 North also includes many technical complexities that warranted an evaluation of TI for groundwater restoration in the area surrounding the WMA. EPA guidance was followed in preparing a TIE report, which was included in the RI report and summarized in the FS report. The evaluation assessed the potential to achieve full restoration of groundwater to MCLs in all three groundwater study areas (Area 5 North, Area 5 South, and Area 5 West). The evaluation identified several factors that supported TI with respect to groundwater restoration for Area 5 North, including:

- Ongoing sources of contaminants that are encapsulated within capped landfills, such as solvents and pesticides within the P/S Landfill
- High volumes of NAPL, including up to 100,000 gallons of LNAPL, and up to 100,000 gallons of pooled DNAPL that have accumulated at the base of the P/S Landfill and serve as an ongoing source of contamination
- Migration of NAPL and dissolved-phase groundwater constituents into low-permeability fractured bedrock that are difficult to access and treat
- Numerous chemical constituents (such as, hydrocarbons, solvents, metals, and PCBs) that are difficult or impossible to treat by in situ and/or ex situ technologies

The TIE concluded that full restoration of groundwater to MCLs in Area 5 North, within a reasonable timeframe, was not technically practicable from an engineering perspective. Specifically, groundwater modeling showed that it would take several thousand years to restore groundwater to MCLs, even with aggressive pump-and-treat technologies and after removal of NAPL source material. In situ technologies, such as bioremediation or chemical oxidation, would also have very limited effectiveness because of the difficulty in achieving widespread contact between the injected remedial amendments and the contaminants. Area 5 North is characterized by conditions that contribute to TI, including large volumes of residual wastes, large volumes of pooled DNAPL, fractured and low-permeability claystone, and the occurrence of matrix diffusion.

Area 5 South

South of the PSCT in Area 5 South, groundwater moves generally southward at a relatively slow rate. The flow rate and direction are controlled primarily by Site topography, hydraulic conductivity of the Upper and Lower HSUs, and unpredictable fracture patterns. The presence of ponds influences the shallow groundwater flow paths. The concentrations of dissolved-phase contamination are much lower than in Area 5 North, and no NAPL has been detected. The PSCT captures groundwater and contaminants in the Upper HSU and restricts contaminant migration from Area 5 North to Area 5 South. VOC and metals concentrations are near or below MCLs in the Lower HSU beneath the PSCT (based on monitoring wells completed at depths of up to about 200 feet; see Figures 2-22 and 2-23). MNA processes slow contaminant mass migration in Area 5 South (south of the PSCT), as described in Section 2.5.8. PCT-A and PCT-B intercept groundwater in the Upper HSU at the southern perimeter of the Site and prevent it from moving offsite down these drainages.

Area 5 West

Groundwater contamination in Area 5 West is influenced by shallow wastes that were buried or sprayed in the RCRA Canyon area and WCSA. Shallow contaminated soils are present in RCRA Canyon, and represent a source of contaminants to groundwater. Groundwater flow in the Upper HSU in RCRA Canyon is largely influenced by topography and surface water elevations in the ponds. MNA processes help slow contaminant mass migration in Area 5 West, as described in Section 2.5.8. PCT-C intercepts groundwater in the Upper HSU at the southern perimeter of the Site and restricts it from moving offsite down this drainage. Similar to Area 5 South, VOC and metals concentrations are near or below MCLs in the Lower HSU across Area 5 West (based on monitoring wells completed at depths of up to about 200 feet; see Figures 2-22 and 2-23).

A prominent seasonal surface seep forms at the southern end of RCRA Canyon in the winter. The seep forms in response to a shallow water table and upward groundwater gradients at the canyon bottom that are greater in the winter in response to rainfall infiltration. Based on laboratory sampling, this seep has elevated metals and TDS concentrations, and may represent a potential risk to wildlife if allowed to accumulate.

2.5.7 Distribution of Nonaqueous Phase Liquid

The presence of detectable NAPL is limited to the area underlying Area 1 and within Area 5 North. The P/S Landfill and CDA are the only areas of the Site where both free-phase (mobile) LNAPL and DNAPL in the Upper HSU were observed during drilling, gauged in routine liquid level monitoring, or implied based on dissolved chemistry results. Results of extensive Site investigations document the presence of substantial volumes of NAPL in and south of the P/S Landfill within Area 5 North. Up to 100,000 gallons of pooled DNAPL has accumulated at the base of the P/S Landfill, and a similar amount of pooled LNAPL also occurs on top of the

aqueous phase liquids. In addition, free-phase DNAPL is known to exist at the following locations:

- DNAPL pool overlying Lower HSU fractured claystone within the southern area of the P/S Landfill. Measurable thicknesses are present in the Gallery Well, RIPZ-27 immediately north of the Gallery Well, and RIPZ-13 approximately 150 feet north of the Gallery Well.
- Within fractures of the Lower HSU claystone in the CDA between the P/S Landfill and the PSCT. Measurable thicknesses are present within Lower HSU piezometers RGPZ-7C and RGPZ-7D, approximately 500 feet south of the clay barrier and 150 feet north of the PSCT.

The distribution of LNAPL and/or DNAPL within the Upper and Lower HSUs, as observed in monitoring locations or interpreted from groundwater concentrations, is depicted on Figures 2-20 through 2-23.

Within the P/S Landfill, approximately 3,000 to 4,000 gallons of DNAPL (and minor volumes of LNAPL) were historically extracted and continue to be extracted from the Gallery Well annually. The annual rate of DNAPL extraction has been relatively stable for over 10 years, indicating a significant volume of free-phase DNAPL occurs in the P/S Landfill. Where present, DNAPL thicknesses range from approximately 5 to 14 feet in piezometers within the southern end of the P/S Landfill.

The CDA (located downgradient of the P/S Landfill and upgradient of the PSCT) is the only other area of the Site where DNAPL was gauged in routine monitoring, and implied based on dissolved chemistry within Lower HSU monitoring wells. Former Pads 9A and 9B in the CDA were used for landfill runoff and leachate control, and may also be sources of DNAPL because of observed DNAPL in this area.

The BTA was also investigated for the presence of NAPL because of the significant extent of groundwater contamination in this area. Although dissolved VOC concentrations are relatively high in this area, no wells or piezometers in the BTA were observed to contain NAPL during liquid level monitoring.

2.5.8 Monitored Natural Attenuation

Natural attenuation refers to naturally occurring processes that reduce contamination in soil or groundwater without human intervention. These processes can reduce the mass, toxicity, mobility, volume, or concentration of contaminants. The reduction of contamination can happen as a result of a variety of biological, chemical, and physical processes, such as biodegradation, volatilization, dispersion, dilution, and sorption. Biodegradation and volatilization can result in significant reductions of total contaminant mass from soil and groundwater. The other natural attenuation processes can result in a reduction of concentration, but not an actual reduction of contaminant mass, because the contamination is either spread over a larger area (dispersion, dilution) or removed from the aqueous phase (sorption). MNA refers to the ongoing evaluation and verification of natural attenuation

processes. While MNA is a passive remediation approach, it does not preclude the use of active remediation, and is often used in combination with active remedies.

The MNA processes play a critical role at the Site, effectively contributing to the reduction in contaminant concentrations and limiting the nature and extent of groundwater contamination. Groundwater data demonstrate the occurrence of significant natural attenuation processes in all three groundwater areas (Area 5 North, Area 5 South, and Area 5 West). Natural attenuation helps to contain and prevent offsite migration of contaminants in the Upper HSU, and to generally contain contaminants in the Lower HSU within Area 5 North.

Extensive groundwater monitoring data, collected between 1998 and 2008, provide strong evidence that natural attenuation processes reduce contaminant concentrations and contribute to the effective containment of groundwater contamination within the boundaries of Zone 1. The RI and FS reports include detailed MNA evaluations that address organic and inorganic chemicals in groundwater in a manner consistent with EPA policy and guidance. The natural attenuation evaluation specifically considered EPA's guidance on the use of MNA as a remedy component at Superfund sites (EPA, 1999a). The CSC collected and analyzed data along three lines of evidence to demonstrate the occurrence of MNA processes, consistent with the Office of Solid Waste and Emergency Response (OSWER) directive (EPA, 1999a) and further described as follows:

- (1) Groundwater Concentrations over Time. Concentrations of organic and inorganic constituents are declining in Area 5 South and Area 5 West, as shown in an extensive set of time series concentration charts. Concentrations of organic and inorganic constituents are also declining in some wells in Area 5 North. Biodegradation is one of the most important natural attenuation processes observed at the Site, particularly for chlorinated solvent compounds, which are the most widespread dissolved-phase constituents in groundwater. For inorganic compounds, sorption to aquifer solids provides the primary means for attenuation of the groundwater plume. Dilution (rainfall recharge) and dispersion are also important attenuation processes for both organic and inorganic constituents.
- (2) Geochemical Data. The biodegradation of solvent-class, fuel-derived hydrocarbons was evaluated using geochemical data focused on the following four lines of evidence:
 - Concentrations of dissolved-phase organic contaminants (for example, PCE and TCE) decrease along flow paths from high concentrations at source areas, to low concentrations or nondetectable levels in downgradient portions of plumes. Corresponding increases in degradation products (such as cis-1,2-DCE, ethene and ethane) relative to PCE and TCE were also observed. Cis-1,2-DCE represents 80 to 100 percent of the total DCE, further suggesting reductive dechlorination. Evaluation of benzene concentrations over time and along flow paths similarly reveals biodegradation into its breakdown products.

- Dissolved hydrogen concentrations, in conjunction with other indicators, suggest metabolic breakdown of organic constituents consistent with reductive dechlorination processes.
- The spatial distribution and concentrations of electron donors and acceptors (dissolved oxygen, nitrate, iron, manganese, sulfate, and sulfide) were evaluated; changes in concentrations spatially and temporally within contaminated groundwater are consistent with degradation processes.
- Metabolic end products (for example, methane) were evaluated as indicators of biodegradation. Increasing concentrations of dissolved methane and ethane in downgradient, contaminated areas are consistent with reductive dechlorination processes. The redox potential, alkalinity, and chloride concentrations also indicate reductive dechlorination processes.

(3) Microcosm Studies. Dehalococoides bacteria, a known degrader of chlorinated solvents, were detected in groundwater samples. The presence of Dehalococoides is consistent with the biodegradation of chlorinated solvent compounds.

2.6 Current and Potential Future Site and Resource Uses

2.6.1 Land Use

The County of Santa Barbara has applied agricultural land use zoning in the area that includes and surrounds the Site. Local land use generally entails agricultural and grazing activities. Parcel ownership near the Site is depicted on Figure 2-13. The Site is located within a group of land parcels comprising approximately 4,500 acres that, during the time the facility operated, were all owned by Kenneth Hunter, Jr., or CR. The 252-acre facility (Zone 1) is located within portions of three land parcels that are still owned by CR:

- Parcel 113-260-002 (397.82 acres)
- Parcel 113-260-003 (158.67 acres)
- Parcel 113-260-004 (38.21 acres)

Based on the CD, Zone 2 is the area that encompasses the extent of Site-related contamination or potential contamination outside the CR facility boundary (Zone 1); the Zone 2 outer boundary remains undetermined (unbounded) at this time. The CSC formed a real estate holding company, the Casmalia Resources Acquisition Property Company, which acquired three additional parcels immediately north of Zone 1:

- Parcel 113-260-001 (91.94 acres)
- Parcel 113-220-012 (118.32 acres)
- Parcel 113-220-010 (442.29 acres) immediately north of Zone 1

The CSC's control over these six parcels (total of 1,247.25 acres) allows it to manage access and provide a substantial buffer zone around the facility. In 2011, ICs were established for the six parcels previously listed, in the form of legal covenants that provide for land and water use restrictions, and allow access for CSC to perform response actions and long-term OM&M activities. The covenants run with the land pursuant to California Civil Code Section 1471, and successive owners of the property are bound to such restrictions. EPA is also included as a third-party beneficiary to these covenants, allowing it access to the Site and the ability under the law to enforce the terms of the covenants.

EPA anticipates that Site remediation and OM&M activities will continue throughout the long-term future. For Zone 1, other land uses such as cattle grazing are restricted by perimeter fencing and ICs. Stakeholders expect the land use for the adjacent parcels in Zone 2, outside the former waste management facility boundary, to continue, consistent with agricultural zoning, including oil and gas development.

2.6.2 Groundwater and Surface Water Use

The Site is underlain by low-permeability rocks that are generally considered to be non-water-bearing compared to the unconsolidated sediments found within the nearby alluvial valleys and basins. Although groundwater is present, the Site is not located within a California-designated groundwater basin, and groundwater beneath the Site does not serve as a source of drinking water for the town of Casmalia or other communities. The town of Casmalia receives its water supply via a pipeline connection from Casmite Well No. 1, located approximately 2.7 miles northeast of the Site in the separate Santa Maria Valley basin. There is an extensive groundwater monitoring network along the southern boundary of the former facility. After many years of investigations, there has been no indication that Site-related contaminants above screening levels have migrated in groundwater past the southern perimeter containment trenches at the southern Zone 1 boundary toward the town of Casmalia (see Figure 2-18 and figures in Appendix B).

Groundwater within Zone 1 is not extracted for beneficial use. Groundwater surrounding Zone 1 is used to support ranching, livestock, and similar nonpotable use activities. Nearby groundwater has not been developed for drinking water purposes because of the high concentrations of TDS. Four shallow water supply wells are located along Casmalia Creek, just west of Zone 1; only one of these wells is used. The active well (WS-2) is situated on CSC-controlled property, and is used on a limited basis for nonpotable purposes related to Site operations and environmental response activities.

Based on federal groundwater classification, groundwater at the Site qualifies as an underground source of drinking water (USDW). A USDW is defined as an aquifer or portion of an aquifer that: (1) is currently used as a drinking water source or may be used as a drinking water source in the future; (2) contains TDS levels below 10,000 milligrams per liter; (3) meets the sufficient yield criterion of 150 gallons per day, and (4) is not an exempted aquifer (40 CFR 144.3). In addition, groundwater at the Site is classified as a potential source of drinking water (Subclass IIB; EPA, 1986).

Beneficial uses for groundwater and surface water are defined in the *Water Quality Control Plan for the Central Coast Basin* (Basin Plan, RWQCB, 2017). The Central Coast RWQCB develops and periodically updates the Basin Plan to outline how water quality should be managed to provide the highest water quality reasonably available. The Basin Plan identifies several beneficial uses for the surface water and groundwater of the Shuman and Casmalia Creek watersheds in the San Antonio hydrologic unit.

Surface water beneficial uses for the Casmalia Canyon Creek subunit within the Shuman Canyon Creek watershed (the nearest to the Site) include municipal or domestic water supply, agricultural supply, recreational, wildlife and warm water aquatic habitats, spawning, reproduction, and/or early development of fish, and commercial sport fishing. Beneficial uses for groundwater throughout the Central Coastal Basin are considered suitable for agricultural water supply, municipal and domestic water supply, and industrial use.

The ICs established in 2011 for the six parcels listed in Section 2.6.1 are legal covenants that provide for land and water use restrictions. As noted above, EPA anticipates that Site remediation and long-term OM&M activities will continue throughout the future, and there will be no beneficial use of groundwater and surface water within Zone 1 of the Site.

2.7 Summary of Site Risks

In risk management decision-making for the Site, EPA considered the following factors when assessing the need for remediation:

- There are multiple COCs present at the Site. In the event of uncontrolled exposure(s), some COCs pose carcinogenic risks and/or noncancer hazards for various human populations, while some pose risks to various plant and animal populations.
- Multiple contaminants are present at the Site at concentrations that exceed established ARARs. For example, 81 constituents found in groundwater exceed MCLs (see Table 2-7).
- There are multiple former waste management units and contaminated media at the Site. Contamination is present in soils, sediments, surface water, groundwater, and subsurface soil gas, all potentially creating uncontrolled exposures to various current and future human populations, as well as to various plant and animal populations.
- There are multiple exposure pathways by which various human, plant, and/or animal populations may experience current or future uncontrolled exposures to contamination at the Site. Potential human exposure pathways include direct ingestion, dermal contact, and inhalation.
- Remediation to ARARs, as required by the NCP, will leave potential residual human cancer risks on the order of 1×10^{-5} for some potentially exposed current and future populations via some uncontrolled pathways. For example, attainment of MCLs for TCE and PCE will achieve protectiveness to approximately 1×10^{-5} in the event groundwater becomes a

source of domestic tap water (a long-term eventuality recognized by the State of California, per State water policy).

- There is general agreement among major stakeholders (e.g., representatives of State agencies, potentially responsible parties, and community representatives) on the need for Site remediation.

A comprehensive risk assessment was conducted as part of the RI/FS process to identify and estimate potential risk to people and the environment from contaminated soil, soil vapor, sediment, and surface water. The risk assessment is detailed in the RI report (CSC, 2011) and summarized in the FS report (CSC, 2016). Consistent with EPA guidance and policy, the risk assessment included a human health risk assessment (HHRA) and an ecological risk assessment (ERA). The HHRA included a baseline risk assessment that evaluated cancer and noncancer risks for existing Site conditions, and current land and water uses; it also included an evaluation of risk for reasonably anticipated future land use scenarios. The ERA included a quantitative evaluation of Site risks to a wide range of plant and wildlife species, for current and future use scenarios.

Together, the HHRA and ERA are used to identify an initial list of COPCs, followed by a shorter list of chemicals of concern (COCs), or those chemicals that exceed risk-based concentrations and must be addressed by the Selected Remedy.

The HHRA and ERA also accounted for prior completion of several interim environmental response actions. The P/S Landfill and EE/CA Area (Heavy Metals, Caustics/Cyanides and Acids landfills, and the areas between these landfills) have already been capped. In the HHRA and ERA, it was presumed that the PCB Landfill would be capped in the future, and that the CDA and BTA areas would also be capped. It was also presumed that the two treated liquids impoundments (Pond A-5 and Pond 18) and three stormwater ponds (RCF, A-Series, and Pond 13) would be drained of contents and capped prior to reconfiguration in support of long-term operations.

The study areas for exposure calculations included the following:

- Areas 1 to 3: The terrestrial, uncapped Areas in Areas 1 to 3, including the CDA, BTA, Liquids Treatment Area, RCRA Canyon, WCSA, MSA, Administration Building Area, Roadway Areas, Remaining Onsite Areas, and FPP Area south of the PSCT
- Area 4 (Stormwater Ponds and Treated Liquids Impoundments): A-Series Pond, RCF Pond, Pond A-5, Pond 13, and Pond 18
- Offsite Drainages: North Drainage, A-Drainage, B-Drainage, and C-Drainage

2.7.1 Background Concentration Evaluation

The HHRA and ERA both included a background analysis of naturally occurring constituents, selection of COPCs, and calculations of exposure point concentrations (EPCs). A statistical analysis was performed on the chemical concentration data to calculate upper-bound concentration estimates of metals and dioxins in background soils. COPCs were selected for each environmental medium (soil, sediment, surface water, and soil vapor). Chemicals were identified as a COPC on a per-medium basis if: the frequency of detection was greater than 5 percent, the chemical was not considered an essential nutrient (calcium, magnesium, potassium, iron, and sodium), and was greater than background.

2.7.2 Human Health Risk Assessment

The baseline risk assessment estimates what risks the Site poses if no actions were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this Site.

For purposes of the HHRA, the Site included both Zones 1 and 2. Zone 1 includes the inactive hazardous waste management facility and comprises approximately 252 acres. Zone 2 includes the area encompassing the extent of Site-related contamination or potential contamination outside the Zone 1 boundary.

Consistent with EPA guidance, the HHRA process included: (1) data review and evaluation; (2) exposure assessment; (3) toxicity assessment; (4) risk characterization; and (5) uncertainty analysis. The key steps are described in the following subsections, along with a description of the COCs identified from the HHRA.

2.7.2.1 Data Review and Evaluation

A thorough data evaluation was conducted to develop a risk assessment dataset, identify media-specific COPCs, and calculate EPCs for evaluation in the HHRA. The risk assessment prepared as part of the RI (CSC, 2011, Appendix T), along with summaries in Section 8 of the RI Report, include extensive detail concerning cancer and non-cancer health risks for individual Site areas and features, receptors, and exposure scenarios. Condensed, summary level tables provide a general indication of health risks, receptors, and exposure pathways associated with different Site areas and features. These tables did not intend to provide quantitative risk data for small scale portions of the Site or every individual Site feature.

EPA guidance discusses Site-specific considerations that can affect risk-based selection of remedial actions. Although EPA may consider 1×10^{-4} as an upper bound in terms of cancer risk, EPA also uses a discretionary range of risk of 1×10^{-6} to 1×10^{-4} as a basis for remedial actions, particularly in combination with other risks and Site-specific factors. EPA also evaluates chemical-specific ARARs (e.g., exceedances of MCLs for groundwater), non-cancer risk (e.g., $HQ > 1$), ecological risks, and Site management and remedy implementability considerations to

develop a basis for action. The RI Report followed EPA guidance in terms of calculating human and ecological risks. Moreover, some summary level health risk tables used 10^{-5} as a mid-range proxy to indicate general Site areas and major features where cumulative cancer risks were calculated between the 1×10^{-6} and 1×10^{-4} range.

2.7.2.2 Exposure Assessment for HHRA

The objectives of the exposure assessment were to identify potential receptors (populations) that may be exposed to chemicals in impacted media, the exposure pathways, and the route of potential intake. The end product of the exposure assessment is a measure of chemical intake as an average daily dose that integrates the exposure parameters for the receptors of concern (such as, contact rates, exposure frequency, and duration) with the EPC for the media of concern. These average daily doses are then used with chemical-specific toxicity values (such as, reference doses and cancer slope factors), to arrive at an estimate of potential health risks for the potential receptors of concern.

The CSM identifies potential chemical sources, release mechanisms, transport media, routes of chemical migration through the environment, exposure media, and potential receptors. Receptors that may be potentially exposed to Site-related chemicals are identified and the likelihood of their potential exposures assessed through consideration of the current and the anticipated future use of the Site. Figures 2-7 and 2-8 provide the HHRA-related CSMs for the terrestrial (uncapped) and surface water areas, respectively.

The following receptors may be potentially exposed to Site-related chemicals within Zone 1:

- Site commercial/industrial workers maintaining the liquids treatment area, surface impoundments, and landfill covers and drainage structures
- Trespassers
- Ranchers using NTU Road to access their lands

The following receptors were also evaluated in the HHRA because they may be potentially exposed to Site-related chemicals within Zone 2:

- Ranchers working the fields along the southwestern border of Zone 1
- Consumers of beef raised in the fields near Zone 1
- Recreational users of the drainage areas
- Hypothetical residents living near the Site

EPCs are the concentrations of chemicals in environmental media to which receptors may be exposed through defined exposure pathways. EPCs were estimated for each environmental media associated with complete and potentially complete pathways identified in the CSM. These media and pathways include the following:

- Surface (0 to 6 inches bgs) and shallow (0 to 5.5 feet bgs) soil considered for incidental ingestion, dermal contact, and inhalation of fugitive dust and vapor pathways, as well as ingestion of beef
- Surface (0 to 6 inches bgs) and shallow sediment (0 to approximately 5 feet bgs) considered for incidental ingestion, dermal contact, and inhalation of fugitive dust and vapor pathways
- Soil vapor considered for the vapor inhalation pathway
- Surface water considered for incidental ingestion, dermal contact, and inhalation pathways

EPCs were derived using the same statistical methodology for soil, sediment, and surface water. EPCs for the outdoor and indoor air exposure pathways in the HHRA were further developed using fate-and-transport modeling, as described in Appendix T of the final RI report (CSC, 2011). The EPC tables for each medium are presented in Appendix C. The medium-specific EPCs for each COC are presented in Table 2-8.

Finally, the exposure assessment quantified the magnitude, frequency, and duration of chemical intake (daily intake) by the potential receptor populations.

2.7.2.3 Toxicity Assessment for HHRA

The toxicity assessment characterized the relationship between the magnitude of exposure to a COPC and the nature and magnitude of adverse health effects that may result from such exposure. Adverse health effects are classified into two broad categories: noncarcinogenic and carcinogenic. Toxicity criteria are generally developed based on a threshold approach for noncancer effects and a non-threshold approach for cancer effects.

Potential effects resulting from human exposure to noncarcinogens were estimated quantitatively using chronic reference doses (RfDs) for ingestion or dermal contact with chemicals and reference concentrations (RfCs) for inhaled chemicals. The RfD is an estimate of the maximum human exposure level that can be present without an appreciable risk of deleterious effects during a designated time. The RfC is an estimate of the maximum air concentration that can be present without an appreciable risk of deleterious effects. In addition, CalEPA (2000, 2003) has developed chronic reference exposure levels for the Air Toxics Hot Spots program, which were used if they were more conservative than the RfCs.

Potential cancer effects resulting from human exposure to carcinogens are generally estimated quantitatively using oral cancer slope factors or inhalation unit risk factors.

2.7.2.4 Risk Characterization and Identification of COCs for HHRA

Risk characterization integrates the results of the exposure assessment and toxicity assessment to estimate potential cancer risks and adverse noncancer health effects associated with exposure to chemicals detected at the Site. This integration provides quantitative estimates of cancer risk and noncancer hazard that are then compared to regulatory risk thresholds. The risk

characterization led to the identification of COCs, which are those COPCs exceeding a risk threshold. For groundwater, COCs include chemicals which exceed, or may be reasonably expected to exceed, MCLs.

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

$$\text{Risk} = \text{CDI} \times \text{SF}$$

where:

Risk = a unitless probability (such as, 2×10^{-5}) of an individual developing cancer
CDI = chronic daily intake, averaged over 70 years (mg/kg per day)
SF = slope factor, expressed as (mg/kg per day)⁻¹

These risks are probabilities that usually are expressed in scientific notation (such as, 1×10^{-6}). An excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of Site-related exposure. This is referred to as an “excess lifetime cancer risk” because the risk would be in addition to the risks of cancer individuals face from other causes, such as smoking or excessive sun exposure. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA’s discretionary risk management range for Site-related exposures is 1×10^{-6} to 1×10^{-4} .

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

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI}/\text{RfD}$$

where:

CDI = chronic daily intake
RfD = reference dose

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

For the purposes of the HHRA, a cumulative cancer risk of 1×10^{-5} (mid-range proxy to indicate where cumulative cancer risks were calculated between the 1×10^{-6} to 1×10^{-4} range) and noncancer HI of 1 were used to compare Site commercial/industrial worker risk estimates. For all other potential exposures, a cancer risk level of 1×10^{-6} and noncancer HI of 1 were used. These risk levels are used to provide context to the risk results and support the following discussion, which focuses on those pathways and chemicals that contribute the majority to the risk estimates. Additional considerations, such as technical feasibility, economic, social, political, and legal factors, may be part of the final risk management decision.

The risk results are summarized in Tables 2-9 through 2-15 for onsite soil, offsite soil and sediment, onsite sediment, onsite surface water, outdoor air, indoor air, and potential exposures to various media by a hypothetical offsite resident. The results show the following:

- For potential exposures to Site soils and sediments via direct contact (ingestion and dermal contact) and outdoor inhalation, only the FPP Area and Liquid Treatment Study Areas exhibited elevated risk for Site commercial/industrial worker exposures, with a cumulative risk of 5×10^{-5} and a noncancer HI of 2, respectively. PCE in shallow soil was the primary risk driver for the FPP Study Area and MCPP was the primary risk driver for both surface and shallow soils at the Liquid Treatment Study Area. In addition, risk estimates for trespasser exposures to FPP soils were slightly elevated (2×10^{-6}) because of the presence of PCE in subsurface soils. The sample locations that contributed the majority to these risk estimates were RISBON-37, RISBON-41, and RISBON-63 in the FPP Study Area just south of the PSCT and RISBLT-02 in the Liquid Treatment Study Area.
- For soils/sediments outside the Site's boundary, cancer risk and noncancer hazard estimates for recreational and rancher exposures were below a cancer risk level of 1×10^{-6} and a noncancer HI of 1.
- For Site surface water, Ponds A-Series, Pond 13, and RCF Pond cancer risk estimates were elevated for Site commercial/industrial worker exposures (maximum cumulative risk of 8×10^{-5}) and trespassers (maximum cumulative risk of 3×10^{-6}), with arsenic as the primary risk driver. All noncancer HIs were below 1.
- For the hypothetical resident living near the Site, the BTA, CDA, and FPP Study Areas exhibited elevated risk resulting from exposures from transport of Site vapors to locations outside the Site's boundary, with a maximum cumulative BTA risk estimate of 1×10^{-5} . The primary risk drivers were PCE and TCE. The sample locations that contributed the majority to these risk estimates were RISBON-37, RISBON-41, and RISBON-63 in the FPP Study Area just south of the PSCT; RISBCD-07 in the CDA; and RISSBC-05 in the BTA. It should be noted that the hypothetical resident evaluation is overly conservative in that modeling assumes the resident is located adjacent to the study area being evaluated. In reality, the resident

would be located some distance from the study area boundary, which would result in lower estimates of exposure.

- For the hypothetical residential exposures, only the vapor intrusion pathway resulted in a marginally elevated risk estimate, with a cumulative risk estimate of 2×10^{-6} . The primary risk driver for this pathway was 1,3-butadiene. When considering more recent soil vapor data, this risk estimate would be even lower and similar to the target risk level of 1×10^{-6} .

In summary, the HHRA results indicated that several COPCs are primary risk drivers and are, therefore, identified as COCs. Several COCs were identified for the Site, based on those that exceeded the 10^{-5} cancer risk (or midway within the EPA risk management range of 1×10^{-6} to 1×10^{-4}) or had a noncancer hazard quotient greater than 1 (HQ>1). EPA selected 1×10^{-5} as the basis for identification of risk drivers to ensure protectiveness above the minimum level of 1×10^{-4} .

- Soils (CDA, BTA, Liquids Treatments Area, FPP Area):
 - 2-(2-chloro-4-methylphenoxy) propionic acid (MCP)
 - PCE
 - TCE

These areas exhibited elevated risk from dermal contact, incidental ingestion, and outdoor inhalation for Site commercial/industrial worker exposures (cumulative risk estimate of 5×10^{-5} and a noncancer hazard index [HI] of 2), with PCE and MCP as the primary risk drivers. The CDA and BTA exhibited elevated risk from outdoor inhalation for a hypothetical resident assumed to be living adjacent to the Site's boundary (maximum cumulative risk estimate of 1×10^{-5}), with PCE, TCE, and benzene as the primary risk drivers. The hypothetical resident evaluation is conservative, in that the modeling assumes the resident is located adjacent to the study area being evaluated. In reality, the resident would be located some distance from the study area, thereby resulting in lower estimates of exposure.

- Surface Water (Ponds):
 - Arsenic

The A-Series Pond, RCF Pond, and Pond 13 surface water exhibited elevated risk (within EPA's discretionary risk range of 1×10^{-6} to 1×10^{-4}) for commercial/industrial worker exposures (maximum cumulative risk of 8×10^{-5}) and trespasser exposures (maximum cumulative risk of 3×10^{-6}), with arsenic as the primary risk driver. All noncancer HIs were below 1. The HHRA identified no COCs for sediment. Tables 2-4, 2-5, 2-9, and 2-12 present the HHRA-related COCs in surface soil, shallow soil, and sediment, respectively. As described in the summary of the ecological risks in Section 2.7.3, EPA has determined that it is appropriate to close all the existing ponds to prevent exposure of special status species to contaminated pond water and to prevent attractive nuisances.

- Site Groundwater:
 - Dissolved chemicals in groundwater that exceed MCLs (81 chemicals; see Table 2-7 for the full list)

The State of California classifies essentially all groundwater within the State as a potential source of drinking water. Thus, even though at present there are no known complete exposure pathways for groundwater, and no current or reasonably anticipated future reuse scenarios that include exposure pathways or receptor populations for groundwater within Zone 1, remedial action is being chosen based on the presence of multiple COCs at concentrations above MCLs.

The HHRA did not include detailed risk calculations of cancer and non-cancer risk for groundwater because there are no reasonably anticipated future uses that include residential or commercial reuse of groundwater within the footprint of the former waste disposal Site. The HHRA identified and evaluated future use scenarios that include only onsite workers and unauthorized trespassers as potential receptors. All remedial alternatives include ICs to prohibit residential and commercial reuse. However, the Selected Remedy addresses remediation of groundwater, except in the designated WMA and TI Zone, based on the presence of multiple COCs that exceed MCLs.

- Soil Vapor:
 - 1,3-butadiene
 - PCE
 - TCE

For the hypothetical residential exposure, the vapor intrusion pathway for indoor air resulted in a marginally elevated risk estimate (cumulative risk estimate of 2×10^{-6}), with 1,3-butadiene as the primary risk driver. In addition, PCE and TCE are COCs based on potential outdoor inhalation exposure by a hypothetical resident assumed to be living near the Site's boundary (see Table 2-3).

Table 2-8 presents the COCs and associated medium-specific EPCs.

2.7.2.5 Uncertainty Analysis

The methodology used in the HHRA is consistent with EPA and State risk assessment guidance. However, the procedures used in any quantitative HHRA are conditional estimates, given the many assumptions that must be made about exposure and toxicity. Major sources of uncertainty in risk assessment include: (1) natural variability (such as, differences in body weight or sensitivity in a group of people); (2) incomplete knowledge of basic physical, chemical, and biological processes (such as, the affinity of a chemical for soil, degradation rates); (3) model assumptions used to estimate key inputs (such as, exposure, dose response models, and fate-and-transport models); and (4) measurement error, primarily with respect to sampling and laboratory analysis.

Site-specific factors, which the HHRA incorporated, decrease uncertainty, although uncertainty may persist in even the most Site-specific HHRA because of the inherent uncertainty in the process. However, because the assumptions used tend to be protective of health and conservative in nature, the estimated risks are likely to exceed the most probable risk posed to potential receptors at the Site, and actual risks would be much lower.

2.7.3 Ecological Risk Assessment

The objective of the ERA was to conduct a sitewide assessment using a tiered approach that would provide information for the RI/FS. To achieve this objective, the ERA assessed whether Site-related chemicals in Site media have adversely affected resident flora (plants) and resident fauna (animals).

The ERA was conducted in an iterative (or tiered) manner, with greater detail and refinement included in each successive tier. In the screening-level ERA, chemicals of potential ecological concern (COPECs), defined as chemicals that are potentially Site related, were identified. In the Tier 1 ERA, risks were estimated for all the COPECs. Finally, the Tier 2 ERA used Site-specific biota uptake values and ecological benchmarks to identify COCs (COCs are those COPECs that exceed a risk threshold).

The ERA considered potential exposure pathways for the terrestrial uncapped areas and freshwater aquatic areas. The capped landfills and interstitial areas were not included in the ERA. The surface seeps were not evaluated beyond Tier 1 because they are currently dry, facilities (for example, Sump 9B) are in place to control the seeps, and they were not expected to be sources of exposure to amphibians, aquatic life, or aquatic plants. Multiple exposure pathways were evaluated, including direct contact and uptake by plants and invertebrates, as well as inhalation and ingestion by animals.

EPA has determined that it is necessary and appropriate to close all the surface water ponds to prevent: exposures of special-status species (threatened and endangered amphibians) to contaminated pond water, and attractive nuisances. In terms of ecological risk, all five ponds contain very high concentrations of TDS and metals that exceed Tier 1 ecological screening levels ($HQ > 1$) for multiple constituents in both pond water and pond sediments. The TDS concentrations in the ponds approach the levels found in seawater (20,000 – 40,000 ppm). Consistent with EPA guidance, the ecological risk assessment examined risks to aquatic plants, sediment invertebrates, amphibians, and other aquatic wildlife from exposure to pond sediments. Tier 1 exceedences were identified for pond sediment, primarily for metals such as cadmium, chromium, manganese, mercury, molybdenum, selenium, vanadium, and zinc (see Table 2-6). A Tier 2 ERA was not conducted on the ponds, because it had already been determined appropriate to close the ponds based on the results of the Tier 1 evaluation. Therefore, the Tier 2 ERA focused on the remaining exposure areas and risk-driving COPECs from the Tier 1 ERA, which included:

- Administration Building Area
- RCRA Canyon

- WCSA
- Roadway areas
- Remaining Site areas
- FPP Area south of the PSCT

Consistent with EPA guidance, the ERA process included: (1) data review and evaluation; (2) exposure assessment; (3) toxicity assessment; (4) risk characterization; and (5) uncertainty analysis. These process components, including identification of ecological COCs, are described in the following subsections.

2.7.3.1 Data Review and Evaluation and Identification of COPECs

A thorough data evaluation was conducted to develop a risk assessment dataset and identify chemicals of potential ecological concern (COPECs). In the ERA, COPECs were selected following appropriate guidance, as described in the RI Report (2011). COPECs were selected for sitewide areas as well as individual study areas. Data for each medium were used in the COPEC selection process. Briefly, the steps included:

- Evaluation of frequency of detection, where chemicals were selected as sitewide COPECs if the chemical was positively detected in 5 percent or more of the samples)
- Identification of essential nutrients
- Comparison of Site data with background data (for metals in soil and sediment only), where the maximum detected concentration of metals was compared to the 95 percent UTL, as described in the RI Report (2011)

For estimating exposures to ecological receptors at the Site, the following Site media data were evaluated:

- Surface soil (0 to 6 inches bgs)
- Shallow soil (0 to 5.5 feet bgs)
- Deep soil (0 to 10 feet bgs; only for the deep burrowing receptor)
- Sediment (0 to 6 inches bgs)
- Surface water (from ponds and runoff)
- Soil vapor

2.7.3.2 Exposure Assessment for the ERA

The objectives of the exposure assessment were to identify potential receptors (populations) that may be exposed to chemicals in impacted media, the exposure pathways, and the route of potential intake. For the ERA, the CSMs were developed on the basis of existing information regarding the nature and extent of chemical contamination, habitat types, and flora and fauna at the Site. The exposure media evaluated included soils, sediment, surface water, and soil gas. The ecological receptors evaluated included terrestrial ecological communities (plants and soil

invertebrates), freshwater ecological communities (sediment-dwelling invertebrates, aquatic life, and aquatic plants), terrestrial wildlife (reptiles, amphibians, mammals, birds, and deep burrowing mammals), and freshwater wildlife (amphibians, mammals, and birds). Figures 2-9, 2-10, and 2-11 provide the CSMs for terrestrial uncapped, terrestrial capped, and aquatic areas, respectively.

Identification of Ecological Receptors and Indicator Species

General classes of ecological receptors were identified to represent different trophic levels to characterize potential ecological risks associated with the Site. Representative species were used, as appropriate, to represent a wide range of receptors within each functional group, as follows.

- Terrestrial Ecological Communities:
 - Terrestrial plants: general category (not species specific)
 - Soil invertebrates: general category (not species specific)
- Terrestrial Wildlife:
 - Amphibians: general category (not species specific)
 - Reptiles: western fence lizard (*Sceloporus occidentalis*)
 - Mammals:
 - Herbivorous small mammals: California vole (*Microtus californicus*)
 - Invertivorous small mammals: ornate shrew (*Sorex ornatus*)
 - Carnivorous mammals: striped skunk (*Mephitis mephitis*)
- Birds:
 - Invertivorous ground-feeding birds: western meadowlark (*Sturnella neglecta*) (breeding)
 - Herbivorous ground-feeding birds: western meadowlark (*Sturnella neglecta*) (non-breeding)
 - Carnivorous birds (raptors): American kestrel (*Falco sparverius*)
 - Deep-burrowing Mammals: represented by the American badger (*Taxidea taxus*)
- Freshwater Aquatic Ecological Communities:
 - Sediment-dwelling Invertebrates: general (not species specific)
 - Aquatic life: general (not species specific)
 - Aquatic plants: general (not species specific)
- Freshwater Aquatic Wildlife:
 - Amphibians: general (not species specific)
 - Mammals:

- Omnivorous/invertivorous small mammals: raccoon (*Procyon lotor*)
- Birds:
 - Invertivorous wading birds: killdeer (*Charadrius vociferous*)
 - Invertivorous (breeding) diving birds (ducks): mallard duck (*Anas platyrhynchos*)

The Site also contains several listed special-status species, including the California red-legged frog (federally listed as threatened, and a State species of special concern), the California tiger salamander (federally listed as endangered, and State listed as threatened), and the western spadefoot toad (State species of special concern). As described elsewhere in the ROD, EPA continues to work with the USFWS and CDFW through the Site's interagency committee to address habitat mitigation and protection of these species.

The exposure scenarios evaluated for the ecological receptors include the following:

- The terrestrial uncapped areas evaluated included the following exposure units: RCRA Canyon, Liquid Treatment Area, WCSA, Burial Trench Area, Maintenance Shed Area, Central Drainage Area, Administration Building Area, Roadway Areas, Remaining Site Areas, FPP Area, A-Series Pond, RCF Ponds, Pond A-5, Pond 13, and Pond 18. The treated liquid impoundments (Pond A-5 and Pond 18) and the stormwater ponds (A-Series Pond, RCF Pond, and Pond 13) are anticipated to be closed as part of the Selected Remedy. Therefore, the treated liquid impoundments and the stormwater ponds were evaluated similarly to terrestrial areas. For terrestrial receptors, exposures were estimated for each of these units, and also for the two following sitewide scenarios: (1) sitewide (that is, all terrestrial uncapped units) with Pond A-5 and Pond 18; and (2) sitewide without ponds (that is, all terrestrial uncapped units only).
- The freshwater aquatic areas evaluated included the following exposure units: Site freshwater aquatic areas (A-Series Pond, RCF Pond, Pond A-5, Pond 13, and Pond 18), freshwater aquatic areas outside the Site's boundaries (North Drainage, A-Drainage, B-Drainage, upper C-Drainage, lower C-Drainage), runoff in RCRA Canyon, Site freshwater seeps (qualitatively only; A-series seep Caustic/Cyanide and Acid Landfill seep, Caustic Landfill seep, Seep 9B). For Site freshwater aquatic receptors, exposures were estimated for each of the units listed, and also for the following two sitewide scenarios: pondwide (that is, all Site ponds) and stormwater impoundments (A-Series pond, RCF Pond, and Pond 13).

Ecological community exposures are expressed in terms of Site media concentrations, whereas wildlife exposures are expressed in terms of daily doses. For wildlife receptors, numerous exposure assumptions, such as food and water ingestion rates, body weights, and absorption factors, are defined in the ERA for estimation of the exposure doses for each wildlife receptor. These exposure parameters were obtained from literature sources and used in all tiers of the ERA. In contrast, bioaccumulation factors (BAFs) for the screening-level and Tier 1 ERA were primarily obtained from guidance documents or other commonly used literature sources, but were developed from Site-specific uptake data for the Tier 2 ERA.

2.7.3.3 Ecological Effects Assessment for the ERA

The effects assessment includes the identification and development of toxicity values for ecological receptors. Following California Environmental Protection Agency guidance (Cal-EPA 1996), toxicity values were based on “no-effect” levels. The no-effect level is the concentration or dose at, or below which, no adverse effects on the test organism are observed. However, to evaluate a range of risk estimates for ecological receptors in all the tiers of the baseline ecological risk assessment “lowest observable effects” data or other alternate “upper bound” toxicity values were also developed.

For ecological communities and amphibians, effects are assessed using toxicity values referred to as “screening values.” Screening values are threshold concentrations expressed in mg/kg or milligrams per liter /L that are effect levels or benchmarks for organisms inhabiting/exposed to that matrix (soil, sediment, surface water). For terrestrial plants, soil invertebrate ecological communities and amphibians, single screening values were developed; for sediment-dwelling invertebrates and aquatic life, low and high screening values were developed; and for aquatic plant ecological communities and amphibians, single screening values were developed.

For wildlife (mammals and birds), effects are assessed using toxicity values referred to as “toxicity reference values” (TRVs). A TRV is defined as a daily dose of a chemical expressed in milligrams of chemical per kilogram of body weight per day and represents a dose associated with no-effect, lowest-effect, or mid-range-effects for ecologically relevant endpoints. For wildlife, a range of low and high TRVs were developed. Low TRVs were based on no observed adverse effects levels (NOAELs) and high TRVs were based on the lowest observed adverse effect level (LOAEL) or mid-range effect levels. TRVs could not be developed for reptiles because of limited toxicity data. Both NOAELs and LOAELs represent doses affecting receptors at the individual level. If risks (that is, HQs over 1) are predicted at this level (that is, when the estimated exposure dose exceeds the LOAEL), effects may be evident at the population level. Because there is a higher level of concern, NOAEL-based TRVs are considered when making risk management decisions for protected (threatened and endangered) species.

2.7.3.4 Ecological Risk Characterization and Ecological COCs

The Tier 2 ERA was conducted to further evaluate pathways, receptors, and risk-driving COPECs from the Tier 1 ERA. The Tier 2 ERA included additional studies and evaluations designed to make the ecological risk assessment more Site-specific and less generic.

The Tier 2 ERA included the following additional efforts to further refine the ecological risks at the Site:

- Tissue sampling (plants, soil invertebrates, and/or small mammals)
- Refinement of ecological benchmarks, including developing tissue TRVs to use as additional weight-of-evidence in the risk characterization

The ERA anticipated that all the remedial alternatives being considered will include closure of all the ponds and remediation to prevent known exposures from surface impoundments (pond water and sediment), as well as the CDA, BTA, MSA, and Liquids Treatment Area. Therefore, the Tier 2 ERA focused on the remaining exposure areas and risk-driving COPECs from the Tier 1 ERA, which included the following: Administration Building Area; RCRA Canyon; WCSA; Roadway Areas; remaining Site areas; and FPP Area south of the PSCT.

The Tier 2 ERA identified that ecological risks at the Site are driven mainly by the following COCs for terrestrial birds (Table 2-4):

- Chromium, copper, and zinc in the RCRA Canyon Area
- Chromium, copper, and zinc in the WCSA
- Chromium and copper in the Roadway area

The invertivorous bird (based on the invertivorous meadowlark) is predicted to be the most sensitive terrestrial bird to potential adverse effects from exposure to these chemicals in surface soil (0 to 0.5 foot bgs).

For terrestrial mammals, a comparison of Site-specific tissue data to tissue-based TRVs developed for kidney and liver tissue indicates that cadmium, chromium, copper, lead, and zinc are not expected to accumulate in target tissues at levels that would result in potential adverse risks. Tier 2 risks to terrestrial mammals at the Site are driven mainly by barium in RCRA Canyon. However, historical activities indicated that drilling mud containing barium sulfate was spread in RCRA Canyon and the WCSA. Barium toxicity to ecological receptors (wildlife) results from free barium ions, which can be absorbed into lungs and intestines. Barium sulfate, which is insoluble, does not cause significant toxicity because free barium ions are not released. The toxicity values used in the baseline ecological risk assessment were all based on soluble forms of barium, and therefore the calculated ecological risk from exposure to barium reported in the RI was overestimated. Considering that barium at RCRA Canyon and the WCSA is barium sulfate and, therefore, not toxic to ecological receptors, barium was excluded as an ecological COC.

Figures 2-24 and 2-25 depict the co-located risks to ecological communities and wildlife receptors, respectively, assuming that barium is not toxic.

2.7.3.5 Uncertainty Analysis

The methodology used in the ERA is consistent with EPA and State risk assessment guidance. However, the procedures used in any quantitative ERA are conditional estimates, given the many assumptions that must be made about exposure and toxicity.

Site-specific factors, which the ERA incorporated, decrease uncertainty, although uncertainty may persist in even the most Site-specific ERAs due to the inherent uncertainty in the process. However, because the assumptions used tend to be protective of the environment and conservative in nature, the estimated risks are likely to exceed the most probable risk posed to potential ecological receptors at the Site, and actual risks would be much lower.

2.7.4 Risk Assessment Conclusions

The Selected Remedy in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants into the environment.

2.7.5 Basis for Action

The basis for action considers the nature and extent of contamination in waste materials and impacted media, risk assessments, Site-specific conditions and characteristics, and remediation technologies. The Site contains many different waste materials, along with multiple impacted media. Waste materials and impacted media include: (1) surface and shallow waste materials and contaminated soil, (2) contaminated surface water, (3) extracted contaminated subsurface liquids, (4) contaminated pond sediments, (5) soil vapor, (6) large-volume sources of NAPL (DNAPL and LNAPL), and (7) contaminated groundwater with multiple commingled constituents, many of which exceed MCLs.

Many factors were considered in developing and evaluating remedial alternatives for the Site. The alternatives are evaluated against both human health cancer/noncancer risk-based screening levels and ecological risk screening levels. Additional considerations included:

- Consistency with EPA and State policies, including CERCLA's preference for treatment and NAPL source reduction
- EPA's presumptive remedy for municipal solid waste landfills and common practice for large legacy hazardous waste landfills
- The State's policies directed toward achieving the highest water quality consistent with the maximum benefits to the people of the State (e.g., groundwater considered suitable for agricultural water supply, municipal and domestic water supply, and industrial use) (RWQCB, 2017)
- The State's anti-degradation policies for groundwater
- Overall constructability
- Compatibility and integration with other Site systems
- Reduction of infiltration in areas where waste remains in place
- Control of hydraulic gradients to prevent surface outflow and seeps

The basis for action for different Site media is summarized as follows:

- Waste Materials and Contaminated Soil: The Site contains large volumes of waste materials (and PTW) and contaminated soils that pose risks to receptor populations through direct

physical contact and outdoor inhalation of vapors in some portions of the specified Site areas. The waste materials are primarily within Area 1 (PCB Landfill, CDA, and BTA), while contaminated soils are located within Areas 1, 2, and 3. The receptor population primarily includes Site workers, trespassers, and ecological receptors. Waste materials and contaminated soils also serve as contamination sources for Site groundwater.

- **Large-Volume Sources of NAPL:** Despite the Gallery Well and Sump 9B providing ongoing NAPL removal for many years, large volumes of NAPL (including LNAPL and DNAPL) are present in Area 5 North. Monitoring has documented the presence of an estimated 100,000 gallons of pooled DNAPL at the base of the P/S Landfill; a similar amount of pooled LNAPL also occurs at the water table surface in the P/S Landfill area. In addition, DNAPL has been detected in fractured bedrock underlying the P/S Landfill and CDA. The NAPL is a PTW and a major source of contamination of groundwater. Per the NCP, EPA expects to use treatment to address PTW (EPA, 1991), including the reduction of NAPL to limit the spread of groundwater contamination.
- **Contaminated Groundwater:** Groundwater underlying the Site would pose an unacceptable risk, if it were to be used for domestic purposes, because it contains a large number of dissolved constituents at concentrations that exceed MCLs. Although there is no reasonable anticipation that Site groundwater would be used for domestic purposes, EPA has determined that MCLs apply as applicable or relevant and appropriate requirements (ARARs) for Site groundwater (unless a waiver is applied). This approach aligns with State of California policies directed toward achieving the highest water quality consistent with the maximum benefits to the people of the State.
- **Contaminated Surface Water and Pond Sediment:** The Site contains five ponds (Area 4) that were designed and constructed as temporary surface water storage facilities. All five ponds contain very high levels of TDS that approach or exceed the concentration of seawater. Remedial action to address the ponds is necessary for a combination of reasons, including: (1) pond water contains actionable human health risk levels and exceeds Tier 1 ecological risk screening levels; (2) underlying TDS-contaminated pond sediments are present; (3) pond water and pond sediments are sources of groundwater contamination; and (4) the five ponds are attractive nuisances that can create risks to threatened and endangered species at the Site. The temporary need for the ponds will likely be eliminated during implementation of the Selected Remedy that includes other new stormwater and liquids management systems.

2.8 Remedial Action Objectives

Remedial action objectives (RAOs) describe, in general terms, what a remedial action should accomplish to be protective of human health and the environment. RAOs are statements that specify the environmental media of concern, contaminant type, potential exposure pathways to be addressed by remedial actions, receptors to be protected, and remediation goals or cleanup levels (40 CFR Section 300.430[e][2][i]).

Section 300.430 of the NCP (40 CFR 300.430) directs EPA to focus on an excess upper-bound lifetime cancer risk to an individual of between 1×10^{-4} and 1×10^{-6} when deciding on remedial action objectives to be protective for known or suspected carcinogens. The NCP further notes that the 1×10^{-6} risk level should be considered as a point of departure for such decisions, and that RAOs be consistent with existing ARARs. At the Site, RAOs are a mix of ARARs, chiefly MCLs, and risk-based cleanup levels (CLs). The RAOs identified in the ROD are intended to meet ARARs and/or be protective of human health at a 1×10^{-5} excess cancer risk or noncancer risk hazard quotient of 1.0. These health protective goals were chosen to be consistent with the threshold criteria set forth in 40 CFR § 300.430 (protection of human health and compliance with ARARs). They are also consistent with the primary balancing criteria (long-term effectiveness, reduction of toxicity, mobility or volume of contamination, short term effectiveness, implementability, and cost-effectiveness) and modifying criteria (state and community acceptance) in 40 CFR § 300.400.

For known or suspected carcinogens that do not have established MCLs (for example, soils), risk-based CLs were chosen to be protective of human health as 1×10^{-5} excess cancer risk. The remediation of 1×10^{-5} was chosen to be consistent with the threshold criteria set forth in 40 CFR § 300.430 and to be consistent with the protectiveness achieved by attainment of MCLs for those contaminants for which MCLs have been established.

The RAOs are summarized in Sections 2.8.1 through 2.8.6.

2.8.1 Soil (Areas 1, 2, and 3)

The RAOs for soil are as follows:

- Prevent direct physical human exposure (e.g., dermal exposure and incidental ingestion) to risk-driving chemicals in soil and waste materials, such that total carcinogenic risks are below the risk level of 1×10^{-5} , and noncancer HIs are less than or equal to 1 (see human health CLs for soil in Table 2-16).
- Provide containment and minimize infiltration and vertical and lateral migration of contamination into groundwater.
- Prevent ecological exposure to risk-driving chemicals in soil, such that risks are below the acceptable target levels (LOAEL, HQ less than or equal to 1) (see ecological CLs for soil in Table 2-16).
- Reduce sources of contamination in soil to minimize the vertical downward migration of contaminants to groundwater, such that infiltration does not contribute to additional exceedances of MCLs in groundwater.

2.8.2 Pond Sediments (Area 4)

The RAOs for pond sediments are as follows:

- Prevent direct physical contact (that is, dermal exposure and incidental ingestion) to pond sediments, such that total carcinogenic risks are below the risk level of 1×10^{-5} , and noncancer HIs are less than or equal to 1.
- Prevent ecological exposure to risk-driving chemicals in pond sediments, such that risks are below the acceptable target levels (LOAEL, HQ less than or equal to 1).

2.8.3 Surface Water (Areas 1 through 4, and Adjacent Wetlands)

The RAOs for surface water are as follows:

- Prevent human exposures (that is, dermal exposure or incidental ingestion) to risk-driving chemicals (primarily metals) in surface water, such that total carcinogenic risks are below the risk level of 1×10^{-5} , and noncancer HIs are less than or equal to 1.
- Prevent off-property discharges of surface water with concentrations of contaminants in excess of appropriate permit limits and discharge requirements that are protective of public health and the environment.
- Prevent ecological exposures to risk-driving chemicals in surface water, such that exposures are below acceptable target levels (HQs less than or equal to 1).
- Achieve target treatment standards, to be defined during the remedial design phase, for effluent from the new groundwater treatment system prior to discharge to the onsite lined evaporation pond(s).

2.8.4 NAPL (Areas 1 and 5)

The RAOs for NAPL are as follows:

- Reduce DNAPL sources of groundwater contamination that contribute to exceedances of MCLs by removing DNAPL source material from the base of the P/S Landfill in Area 1 and other areas where present, to the extent practicable.
- Reduce LNAPL sources of groundwater contamination that contribute to exceedances of MCLs by removing LNAPL source material, to the extent practicable, from the P/S Landfill in Area 1 and other areas where present.
- Contain NAPL within the Zone 1 subarea (Area 5 North) to prevent further groundwater impacts beyond this area.

2.8.5 Groundwater (Area 5)

The RAOs for groundwater are as follows:

- Where technically practicable (Area 5 South and Area 5 West), restore the beneficial use of groundwater by achieving MCLs, or other applicable cleanup goals for chemicals without MCLs.
- Contain groundwater contamination within the Zone 1 subarea (Area 5 North) where groundwater restoration to applicable standards is not technically practicable.
- Prevent potential off-property migration of groundwater contamination beyond the Zone 1 perimeter boundary.

2.8.6 Wetland Habitat for Threatened and Endangered Species (Areas 1 through 4, and Adjacent Wetland)

As described previously, the Site contains contaminated surface water and sediment that exceed Tier 1 ecological risk levels and which pose unacceptable risks to federal threatened and endangered species that have been documented at the Site. Surface water at the Site, such as the ponds, can also create an attractive nuisance.

The RAOs for wetland habitats for threatened and endangered species in Areas 1 through 4, and the adjacent wetlands, are as follows:

- Maintain or provide soil, sediment, vegetation, and water quality capable of supporting a functioning ecosystem for the aquatic and terrestrial plant and animal populations at the Site.
- Maintain or provide soil, sediment, vegetation, and water quality supportive of individuals of special-status species, which are protected under the Endangered Species Act (ESA).

2.8.7 Cleanup Levels

The CLs, also referred to as “remediation levels” or “remediation standards” in various EPA documents, apply to the remediation and containment within the various impacted media. The preliminary remediation goals identified in the Proposed Plan are established as CLs in the ROD. The CLs apply to the RAOs presented in Sections 2.8.1 through 2.8.6.

The CLs have been identified for the Site based on the results of the HHRA and ERA. Table 2-16 presents soil CLs for the human health COCs (MCP, TCE, and PCE) and the ecological COCs (chromium, copper, and zinc).

For groundwater, concentrations of dissolved-phase constituents will be required to meet MCLs in Area 5 South and Area 5 West, which are beyond the designated TI Zone of Area 5 North (see Table 2-7). There is no expectation that groundwater impacted by the high volumes of

heterogeneous waste materials within the TI Zone will be cleaned up to MCLs, in the area within the TI Zone. EPA is not establishing alternative groundwater cleanup levels due to: (1) the technical challenges of designating an appropriate alternative level based on the large number of COCs; and (2) the TI of achieving MCLs, let alone potentially more stringent alternative cleanup levels. However, EPA will continue to evaluate groundwater remediation during long-term groundwater monitoring and the five-year review process.

Existing pond surface water will be removed during implementation of the Selected Remedy. The existing surface water will be removed, and the pond bottoms will be capped, thereby eliminating unacceptable risk to ecological receptors. Therefore, CLs are not required for these media.

In summary, the media-specific CLs are as follows:

- Soil (including hotspots): Risk-based concentrations (Table 2-16)
- Groundwater: MCLs (Table 2-7), except in the designated TI Zone in Area 5 North
- Pond Surface Water and Sediment: None (the Selected Remedy will eliminate exposure to existing pond surface water and sediment)
- Soil Vapor: None (the Selected Remedy will provide for capping of the CDA and BTA in Area 1, and excavation and/or capping of soil hotspots in the FPP Area in Area 3)
- Seep Surface Water: None (The Selected Remedy will provide for capping and will eliminate seeps)
- Surface Water Discharge: The applicable, substantive, NPDES permit limits and discharge requirements will apply to offsite surface water discharge.

2.9 Description of Alternatives

The six sitewide remedial alternatives were developed and presented in the FS report, and are summarized in this section.

The FS process began with an evaluation of General Response Actions, based on the various environmental media and contaminant types, to address RAOs and potential ARARs. General Response Actions considered included containment, in situ treatment, removal, ex situ treatment, disposal, reuse, and ICs. Several cap types were also considered. A wide range of remedial technologies was then reviewed, with the goal of selecting a set of potentially effective technologies as components in the remedial alternatives. The technologies considered inappropriate were screened out in the initial evaluation. The next step was to combine the technologies retained from the screening evaluation, along with results of the TIE for groundwater in Area 5 North, to develop a range of remedial alternatives for each study area. A second screening evaluation of those remedial alternatives was then conducted, based on the

three screening criteria from CERCLA guidance (effectiveness, implementability, and cost). This evaluation screened out remedial alternatives that did not rate well on these criteria, resulting in a list of compiled, sitewide, remedial alternatives that are subject to detailed evaluation described in this section.

Six sitewide remedial alternatives were developed following technology screening and evaluation of alternatives for individual areas. Each alternative is a combination of the remedial components from the area-specific detailed evaluation. The alternatives range from least aggressive (no further action), to more aggressive (P/S Landfill dewatering), to most aggressive (P/S Landfill dewatering and groundwater extraction and treatment). The six alternatives have several common components, as well as distinguishing features.

2.9.1 Common Elements

The following are common elements for each remedial alternative (except Alternative 1):

- Engineered RCRA Capping Systems: Each alternative includes engineered capping systems. The engineering designs of the various capping configurations vary spatially throughout the Site and between different alternatives. The various types of caps evaluated during the development of remedial alternatives are illustrated on Figure 2-26.
- ICs: Each alternative includes ICs, which are administrative and legal controls to help minimize the potential for human exposure to contamination and/or protect the integrity of the response action. Land use covenants have been established for six parcels, including and surrounding the Zone 1 portion of the Site.
- Soil Hotspot Remediation: Each alternative includes remediation of the soil hotspots in Area 3 to reduce the residual human health and ecological risks to acceptable levels. The hotspots would be addressed by excavation (with disposal of soils in the PCB Landfill prior to capping of that landfill) and/or capping.
- Liquids Extraction and Onsite/Offsite treatment: Each alternative includes continued extraction of liquids from the Gallery Well and Sump 9B, with disposal at an approved, offsite facility. Each alternative also includes continued liquids extraction from the PSCT and PCT-A, PCT-B, and PCT-C, with the treatment and effluent disposal requirements differing among the various alternatives.
- Habitat Mitigation: Each alternative includes habitat mitigation, which may include improvement of existing habitat and/or potential construction of additional habitat. The scope of habitat mitigation will be based on coordination with the USFWS during the remedial design phase.
- A WMA and TI Zone Encompassed by a POC: Each alternative includes both a WMA and TI Zone encompassed by a POC. The POC is located at the TI Zone (Area 5 North) boundary to ensure that groundwater quality is not further degraded outside this area (see Figure 2-27).

- MNA: Each alternative includes MNA that contributes to the reduction in contaminant concentrations, and limits the nature and extent of groundwater contaminant migration at the Site.
- Long-term OM&M with Optimization of Monitoring, Extraction, and Treatment Components: Each alternative includes a long-term OM&M program to monitor treatment system performance, contain groundwater impacts, and ensure compliance with performance standards at the POC.

2.9.2 Distinguishing Features

Several features and technologies, such as the size and type of lined evaporation ponds and extraction systems, clearly differentiate the alternatives.

The distinguishing feature of Alternative 1 (No Further Action) is that no additional remedial action would take place. There is no cost estimate associated with this alternative.

The distinguishing feature of Alternative 2 (Capping, Liquids Extraction, Large Evaporation Pond) is the use of a larger evaporation pond system (about 11 acres) for treatment of extracted liquids and a portion of stormwater runoff from the uncapped eastern slope of RCRA Canyon.

The distinguishing feature of Alternative 3 (Capping, Liquids Extraction, Small Evaporation Pond), the Selected Remedy, is the use of a smaller evaporation pond system (about 6 acres) for treated extracted liquids, while all of RCRA Canyon will be capped. Stormwater from the entire RCRA Canyon area will have acceptable ecological risks (HQ less than 1) and allow offsite discharge to the B-Drainage.

The distinguishing feature of Alternative 4 (Capping, Liquids Extraction, Offsite Discharge) is the elimination of evaporation ponds by adding a treatment plant at the Site for PSCT and PCT liquids that treat constituents to meet NPDES permit requirements. The treated liquids would be discharged offsite to Casmalia Creek, rather than managed in an evaporation pond.

The distinguishing feature of Alternative 5 (Capping, Liquids Extraction, P/S Landfill Dewatering, Small Evaporation Pond) is aggressive dewatering of the P/S Landfill by constructing approximately five horizontal wells drilled underneath and into the landfill using horizontal directional drilling (HDD).

The distinguishing features of Alternative 6 (Capping, Liquids Extraction, P/S Landfill Dewatering, Groundwater Extraction, Offsite Discharge) are P/S Landfill dewatering (as in Alternative 5), combined with construction and operation of approximately 80 new groundwater extraction wells in Area 5 South and Area 5 West. The extracted liquids would be treated to meet NPDES requirements and discharged offsite to the C-Drainage, rather than managed in an evaporation pond.

2.9.3 Remedial Alternatives

Table 2-17 summarizes the components for the six alternatives.

2.9.3.1 *Alternative 1 – No Further Action*

Alternative 1 is included for completeness and assumes that no additional remediation will take place, other than the response actions that were already completed (that is, the installation of RCRA caps on the P/S Landfill and the EE/CA area) and are ongoing (that is, groundwater extraction and treatment/management from the existing Gallery Well, Sump 9B, PSCT, and PCT features). Liquids from the Gallery Well and Sump 9B are disposed at an approved, offsite facility. The PSCT liquids are treated onsite using GAC and discharged to Pond 18. The PCT liquids are discharged to the RCF and A-Series Pond. Stormwater is retained in onsite ponds for evaporation, except for fresh stormwater from the capped landfill area that is discharged offsite to the B-Drainage and Casmalia Creek. This alternative neither protects human health and the environment nor achieves ARARs because of contaminants that are either not contained or result in unacceptable exposure. Therefore, it does not meet CERCLA's threshold criteria for remedy selection.

2.9.3.2 *Alternative 2 – Capping, Liquids Extraction, Large Evaporation Pond*

Alternative 2 would use a large evaporation pond (11 acres) for treated extracted liquids and a portion of stormwater from RCRA Canyon (see Figure 2-28). Among other objectives, this alternative remediates RCRA Canyon (Area 2) to meet all RAOs that do not by themselves require that all of the RCRA Canyon area be covered with some sort of cap. In doing so, this alternative assumes that some stormwater runoff from RCRA Canyon would be directed to the new evaporation pond to be constructed in the footprint of the existing A-Series Pond. Further remediation details for each area are described as follows:

- Area 1 – PCB Landfill, BTA, and CDA: Area 1 would be covered with a RCRA cap over approximately 28.8 acres. The cap will be similar in design to the existing P/S Landfill cap and the EE/CA Area cap and will tie into these caps. The RCRA cap would also extend to cover the maintenance shed area. Stormwater from Area 1 would be discharged offsite to the B-Drainage and Casmalia Creek under a General Permit.
- Area 2 – RCRA Canyon and WCSA: Area 2 would be remediated by constructing a RCRA ET cap that is approximately 5 feet thick over the western portion of RCRA Canyon (about 8.4 acres), excavating the relatively shallow contaminated soils of the WCSA, and then backfilling the excavations with clean soil (about 5.5 acres). The ET cap would serve to reduce surface water infiltration in this area of the Site, thereby lowering the level of the water table and eliminating the surface seeps at the southern end of RCRA Canyon. Stormwater from the capped western slope would be discharged offsite down the B-Drainage and Casmalia Creek under a General Permit. Stormwater best management practices (BMPs) will be used over the eastern slope of the RCRA Canyon (about 19.3 acres). Stormwater from the uncapped eastern slope of RCRA Canyon will not be discharged offsite

because of low-level (HQ less than 1) residual soil contamination. Instead, this stormwater would be retained in the new 11-acre, lined, evaporation pond that would be constructed in the footprint of the closed A-Series Pond and/or RCF Pond.

- Area 3 – FPP Area, Remaining Onsite Areas: Area 3 would be remediated by addressing the five soil hotspot locations, which would reduce the residual human health and ecological risks to acceptable levels. The hotspots would be addressed as follows:
 - HS-1: The shallow soil hotspot in the Liquids Treatment Area would be excavated to CLs for soil (Table 2-16) and placed under the RCRA cap of the PCB Landfill, and/or covered with an asphalt cap as shown on Figure 2-26.
 - HS-2: The shallow soil hotspot(s) in the MSA would be covered with the RCRA cap extended from Area 1.
 - HS-3: The shallow and deep soil hotspot in the former Ponds A/B area would either be: (1) excavated to CLs for soil and placed under the RCRA cap of the PCB Landfill; or (2) covered with the RCRA cap extended from Area 1 (based on an implementability and engineering evaluation during remedial design).
 - HS-4: The shallow soil hotspot south of PSCT-1 would be excavated to CLs for soil and placed under the RCRA cap of the PCB Landfill.
 - HS-10: Because there are no unacceptable human health or ecological risks for the deep soil hotspot at RISBON-59, the proposed action is long-term groundwater monitoring. Two additional downgradient monitoring wells will be installed to verify that there are no unacceptable impacts to groundwater. Stormwater from Area 3 would be discharged to the B-Drainage and Casmalia Creek under a General Permit.
- Area 4 – Stormwater Ponds and Treated Liquid Impoundments: Area 4 would be remediated as follows:
 - Pond 18 – Remove all liquids, place clean soil within the pond footprint to regrade it to match adjacent Site topography, and install a RCRA cap to close the pond.
 - Pond A-5 – Remove all liquids, place excavated soil from the WCSA within the pond footprint to raise the bottom of the former pond, and install a lined cap retention basin. The basin will be constructed with a double liner consisting of an HDPE layer and a geosynthetic clay later (GCL) (HDPE/GCL liner) liner, and converted into a new retention basin used as part of the RCRA Canyon stormwater management system.
 - Pond 13 – Remove all liquids, place a clean soil cover over the pond, construct an HDPE/GCL liner as an engineered cap for the contaminated sediments in the pond, and convert into a new retention basin.

- A-Series Pond – Remove all liquids, regrade the northeastern corner of the pond to increase the pond size to approximately 11 acres, add soil fill to raise the pond bottom above the water table, and construct a double-lined (such as, dual HDPE liner) RCRA evaporation pond system. The double-lined system would include leak detection, and a leachate collection and removal system. The new evaporation pond would also receive any liquids remaining prior to remedial construction at the other existing ponds, and future treated PSCT and PCT liquids. The design configuration and total number of individual evaporation ponds would be finalized during the remedial design phase, but the total area would remain at approximately 11 acres. The evaporation pond system would be designed with biological controls (such as, netting, fencing, screening, and hazing) and biological monitoring to minimize adverse impacts to special-status species based on coordination with USFWS. Habitat mitigation would be performed as necessary based on coordination with USFWS during the remedial design phase.
- RCF Pond – Remove all liquids, place clean soil throughout the bottom of the pond to raise the pond bottom to prevent groundwater intrusion, construct a soil cap (or “eco-cap”), and construct a new lined stormwater channel through the middle of former pond footprint to the B-Drainage to convey stormwater runoff from the CDA and other capped portions of the Site.
- Area 5 North: Area 5 North would be addressed through liquids extraction from existing and new facilities to control and contain contaminant sources within the designated TI Zone. However, Area 5 North would not be remediated to meet MCLs because the presence of LNAPL, DNAPL, residual NAPL, and dissolved-phase organic and inorganic contamination in low-permeability fractured bedrock generally makes it technically impracticable to remediate the groundwater to meet MCLs in this area. Extraction would continue from the existing Gallery Well and from approximately 16 “NAPL-only” (LNAPL and DNAPL) extraction wells to be installed in the southern portion of the P/S Landfill. Increased extraction from the P/S Landfill should reduce the driving head of the DNAPL that is likely causing it to spread into the Lower HSU beneath the P/S Landfill and CDA.

Within the Upper HSU, extraction would continue from the PSCT to prohibit groundwater from migrating southward outside of the designated TI Zone. Extraction will also be performed from Sump 9B if the water table remains unacceptably high after capping in Area 1.

Finally, approximately 12 new Lower HSU monitoring wells would be installed and monitored upgradient of PSCT-1 and PSCT-4 (three at each location with each location monitoring two depths) to verify that dissolved-phase contaminants and NAPL are not migrating southward underneath the PSCT and outside the TI Zone.

The liquids extracted from the Gallery Well and approximately 16 new NAPL-only wells in the P/S Landfill would be stored and shipped for treatment and disposal at an approved facility. The extracted liquids from the PSCT would be treated at the Site using an upgraded treatment system that would likely include, but not be limited to, solids removal and

activated carbon; the treated effluent would then be transferred to the new 11-acre evaporation pond. The treatment system design details will be determined during remedial design.

- Area 5 South: Within the Upper HSU, extraction would continue from the PCT-A and PCT-B facilities to contain and prevent contaminated groundwater from migrating through the A- and B-Drainages. The current concentrations of dissolved-phase organic and inorganic contaminants within the Upper HSU exceed MCLs. These concentrations are expected to decrease over many decades as a result of naturally occurring conditions, including dilution and flushing from infiltrating rainfall and natural degradation of organic compounds. The flushed contaminants would be extracted at the PCT-A and PCT-B facilities as long as contaminants exceed MCLs. This approach is referred to as “MNA with perimeter containment.” The Lower HSU does not require remediation because the concentrations of organic and inorganic compounds in groundwater are below MCLs in this area.

The liquids extracted from the PCT-A and PCT-B facilities would be treated at the Site, using an upgraded liquids treatment system that would likely include, but not be limited to, solids removal and activated carbon; the treated effluent would then be transferred to the new 11-acre evaporation pond. The treatment system selected will be determined during remedial design.

- Area 5 West: Within the Upper HSU, extraction would continue from the PCT-C facility to contain and prevent contaminated groundwater from migrating through RCRA Canyon and the C-Drainage. Concentrations of the dissolved-phase inorganic contaminants within the Upper HSU currently exceed MCLs. A significant source of this contamination is likely from the metals in the overlying soils in RCRA Canyon and the WCSA, and infiltration of surface water high in metals from Pond A-5 and the A-Series Pond. Once these sources are eliminated, the metals concentrations in Area 5 West will decrease over many decades as a result of naturally occurring conditions, including dilution and flushing from infiltrating rainfall. The flushed contaminants would be extracted at the PCT-C facility as long as contaminant levels exceed MCLs (MNA with perimeter containment).

The Lower HSU of Area 5 West does not require remediation because the concentrations of organic and inorganic compounds in groundwater are below MCLs in this area.

The liquids extracted from PCT-C would be treated at the Site using an upgraded liquids treatment system that would likely include, but not be limited to, solids removal and activated carbon. The treated effluent would then be transferred to the new 11-acre evaporation pond.

The time to construct for Alternative 2 is estimated to be 5 years. The estimated remediation timeframes for groundwater in Area 5 South to reach remediation goals (MCLs) would range from 80 years (nickel) to 260 years (arsenic) after complete source removal. Based on model simulations, the estimated remediation timeframes for groundwater in Area 5 West to reach MCLs would range from 90 years (nickel) to 220 years (arsenic) after

complete source removal. There is uncertainty in the actual timeframes to achieve cleanup standards, and the actual timeframe may range from several decades to centuries.

- **Long-Term O&M:** Long-term O&M will be conducted to ensure that all Site components and systems are functioning effectively throughout the duration of the remedial action. Long-term O&M will address multiple media and systems, including, but not limited to, capping systems, liquids collection, treatment, and disposal systems, surface water management, and all monitoring systems. Long-term O&M will be performed based on optimization studies, and a long-term O&M plan that will be subject to EPA review and approval.
- **Long-term Monitoring:** Long-term performance and compliance monitoring will be conducted to ensure that remedial systems are functioning effectively and remain in compliance with performance standards. Long-term monitoring will include compliance monitoring of groundwater both laterally and vertically, surface water, soil vapor, and ambient air, and performance monitoring of remedial systems. Long-term monitoring will also include ongoing evaluation of ICs. Long-term groundwater monitoring will be performed based on optimization studies and subject to a long-term monitoring plan that will require EPA review and approval. EPA may require additional monitoring, if determined necessary based on the results of monitoring data, to ensure protection of human health and the environment.
- **Contingency Measures:** Contingency measures will be performed if groundwater monitoring data indicate that contamination is migrating beyond area boundaries, including the POC and the perimeter boundary of the former disposal facility (Zone 1). Contingency measures will be initiated if groundwater monitoring data show that migration is occurring at statistically representative concentrations that cause, or are likely to cause, exceedances of performance standards. These contingency measures will be performed to ensure adequate containment. Contingency measures may include any or all of the following: (1) additional monitoring from existing wells; (2) installation of additional monitoring wells to further characterize potential migration; and (3) installation of a limited number of extraction wells within a localized area to maintain hydraulic containment. These extraction wells would supplement the area and perimeter containment provided by existing perimeter control trenches, extraction wells, and natural attenuation.

2.9.3.3 Alternative 3 – Capping, Liquids Extraction, Small Evaporation Pond (Selected Remedy)

Alternative 3 is a variation of Alternative 2 and is the Selected Remedy in this ROD. Alternative 3 will use landfill capping, liquids extraction, and a smaller (approximately 6 acres) evaporation pond(s) instead of the larger (11 acres) pond (see Figure 2-29). The primary difference in this alternative is additional capping in Area 2 to ensure that all stormwater runoff from the RCRA Canyon area can be discharged to the B-Drainage and Casmalia Creek via the General Permit, rather than managed in the evaporation pond.

The remediation details for each area are described as follows:

- Area 1 – PCB Landfill, BTA, and CDA: Area 1 remediation would be the same as described for Alternative 2.
- Area 2 – RCRA Canyon and WCSA: Area 2 would be capped with either an ET cap or a RCRA-equivalent hybrid cap that covers the western and eastern slopes of RCRA Canyon and the WCSA. As shown on Figure 2-26, an ET cap will include a foundation later and a vegetative layer approximately 4 feet in thickness; the hybrid cap will include a foundation layer, HDPE liner, geotextile drainage later, biotic barrier, and a vegetative layer about 2 feet in thickness. The cap type for the different subareas would be selected during remedial design. With this capping, stormwater from the entire area will have acceptable ecological risks (that is, HQ less than 1) and allow discharge to the B-Drainage and Casmalia Creek. In addition, the larger cap will significantly reduce surface water infiltration in this area, further lowering the level of the water table and helping to eliminate the contaminated surface seep at the southern end of the RCRA Canyon.
- Area 3 – FPP Area, Remaining Onsite Areas: Area 3 remediation would be the same as described for Alternative 2.
- Area 4 – Stormwater Ponds and Treated Liquid Impoundments: Area 4 remediation would be the same as for Alternative 2, except that this alternative would use a smaller (approximately 6 acres) evaporation pond(s) within the former footprint of the A-Series Pond and/or RCF Pond, instead of the larger 11-acre pond because no stormwater from RCRA Canyon would be discharged into it. The design configuration and total number of individual evaporation ponds will be finalized during the remedial design phase, but the total area will remain at about 6 acres. The evaporation ponds will be designed with biological controls (such as, netting and fencing) and biological monitoring to minimize adverse impacts to special-status species. Habitat mitigation will be performed as necessary based on coordination with USFWS and CDFW during the remedial design phase.

The remainder of the A-Series Pond area would be capped with an eco-cap.

- Area 5 North, Area 5 South, and Area 5 West – Groundwater: Area 5 remediation would be the same as described for Alternative 2, except that treated water would be directed to a smaller (approximately 6 acres) evaporation pond(s), instead of the larger (11 acres) pond.

The time to construct for Alternative 3 is estimated to be 5 years. Based on model simulations, the estimated remediation timeframes for groundwater in Area 5 South to reach MCLs are similar to those presented for Alternative 2. The estimated remediation timeframes for groundwater in Area 5 West to reach MCLs would be faster than those presented for Alternative 2, because the source of metals over the entire RCRA Canyon area would be capped under Alternative 3 compared to a partial cap under Alternative 2. However, the predicted difference in timeframes between Alternatives 2 and 3 is likely within the range of accuracy of the analysis; therefore, it is not quantified.

2.9.3.4 Alternative 4 – Capping, Liquids Extraction, Offsite Discharge

Alternative 4 is a variation of Alternative 3 that would include landfill capping, liquids extraction, and offsite discharge without an evaporation pond (see Figure 2-30). The pond would be eliminated by adding a treatment plant at the Site for PSCT and PCT liquids that treats both organic and inorganic constituents to meet substantive NPDES permit requirements. The treated liquids would then be discharged offsite to Casmalia Creek, rather than managed in an evaporation pond. This alternative may also involve a process to obtain approval from the RWQCB to allow for offsite discharge of treated liquids to Casmalia Creek, which is located within the Antonio Creek Valley Creek basin.

The remediation details for each area are described as follows:

- Area 1 – PCB Landfill, BTA, and CDA: Area 1 remediation would be the same as described for Alternative 2.
- Area 2 – RCRA Canyon and Western Canyon Spray Area: Area 2 remediation would be the same as described for Alternative 3.
- Area 3 – FPP Area, Remaining Onsite Areas: Area 3 remediation would be the same as described for Alternative 2.
- Area 4 – Stormwater Ponds and Treated Liquid Impoundments: Area 4 remediation would be the same as described for Alternative 3, except that no RCRA evaporation pond would be constructed for management of stormwater or extracted liquids. All stormwater would be discharged to the B-Drainage and Casmalia Creek. Additional treatment would be added to treat PSCT and PCT liquids to meet NPDES substantive permit requirements prior to discharge to the C-Drainage west of the Site. The bottom of the A-Series Pond would be partially filled to raise the pond bottom above anticipated groundwater levels; it would then be capped with an eco-cap similar to the cap proposed for the RCF Pond.
- Area 5 (Groundwater) – Area 5 North, Area 5 South, and Area 5 West: Area 5 remediation would be similar to Alternative 2, except liquids extracted from the PSCT and PCTs would be treated to meet NPDES substantive requirements prior to discharge to the C-Drainage west of the Site.

The time to construct for Alternative 4 is estimated to be 5 years. The estimated remediation timeframes for groundwater in Area 5 South and Area 5 West to reach MCLs would be similar to those presented for Alternative 2, given the range of accuracy of the analysis.

2.9.3.5 Alternative 5 – Capping, Liquids Extraction, P/S Landfill Dewatering, Small Evaporation Pond

Alternative 5 is a variation of Alternative 3 that would include landfill capping, liquids extraction, and aggressive dewatering of the P/S Landfill using horizontal extraction wells at the

base of the landfill (see Figure 2-31). Alternative 5 would use horizontal wells to drain up to 10 million gallons of contaminated liquids, including up to 100,000 gallons of pooled DNAPL, from the base of the P/S Landfill over a period of several years. The wells would be installed along the base of the landfill using horizontal direction drilling (HDD) technology. As with Alternative 3, the treated PSCT and PCT liquids would be discharged to a new, 6-acre evaporation pond constructed in the footprint of the A-Series Pond, and all stormwater would be discharged to the B-Drainage and Casmalia Creek.

The remediation details for each area are described as follows:

- Area 1 – PCB Landfill, BTA, and CDA: Area 1 remediation would be the same as described for Alternative 2.
- Area 2 – RCRA Canyon and WCSA: Area 2 remediation would be the same as described for Alternative 3.
- Area 3 – FPP Area, Remaining Onsite Areas: Area 3 remediation would be the same as described for Alternative 2, with one exception: The RISBON-59 hotspot (HS-10) would be excavated and the contaminated soil would be moved to the PCB Landfill prior to capping of that landfill.
- Area 4 – Stormwater Ponds and Treated Liquid Impoundments: Area 4 remediation would be the same as described for Alternative 3.
- Area 5 (Groundwater) – Area North, Area 5 South, and Area 5 West: Area 5 remediation would be the same as described for Alternative 2 for Area 5 South and Area 5 West. However, for Area 5 North, aggressive dewatering of the P/S Landfill would be conducted by constructing approximately five horizontal wells drilled underneath and into the landfill using HDD. Alternative 5 also includes the conversion of four existing CDA monitoring wells into LNAPL skimming wells. The Gallery Well would remain in operation, but this alternative does not include the 16 “NAPL only” wells in the P/S Landfill. The Gallery Well liquids, NAPL, and other aqueous phase liquids drained from the P/S Landfill would be sent offsite to a permitted facility for disposal.

The time to construct for Alternative 5 is estimated to be 5 years. The estimated remediation timeframes for groundwater in Area 5 South and Area 5 West to reach MCLs would be similar to those presented for Alternative 2, given the range of accuracy of the analysis.

2.9.3.6 Alternative 6 – Capping, Liquids Extraction, P/S Landfill Dewatering, Groundwater Extraction, Offsite Discharge

Alternative 6 is a variation of Alternative 5 that also includes landfill capping, liquids extraction, P/S Landfill dewatering, and construction and operation of approximately 80 new groundwater extraction wells in Area 5 South and Area 5 West to help decrease the timeframe to achieve MCLs (see Figure 2-32). In addition, Alternative 6 proposes that extracted liquids would be

treated sufficiently and discharged to the C-Drainage west of the Site, in accordance with NPDES substantive permit requirements, such that no evaporation pond would be needed.

The remediation details for each area are described as follows:

- Area 1 – PCB Landfill, BTA, and CDA: Area 1 remediation would be the same as described for Alternative 2.
- Area 2 – RCRA Canyon and WCSA: Area 2 remediation would be the same as described for Alternative 3.
- Area 3 – FPP Area, Remaining Onsite Areas: Area 3 remediation would be the same as described for Alternative 5.
- Area 4 – Stormwater Ponds and Treated Liquid Impoundments: Area 4 remediation would be the same as described for Alternative 4.
- Area 5 Groundwater (Area 5 North): Area 5 North remediation would be the same as described for Alternative 5, with the following additions:
 - Approximately a dozen new LNAPL skimming wells would be installed in the CDA. The extracted LNAPL would be stored and shipped to a permitted facility for disposal.
 - Extraction would occur immediately from 4 of the 12 new monitoring wells that would be installed and monitored within the Lower HSU upgradient of PSCT-1 and PSCT-4 to ensure that dissolved-phase contaminants and NAPL are not migrating southward underneath the PSCT outside of the designated TI Zone. These liquids would be combined with the liquids extracted from the PSCT and PCTs for treatment and disposal.
 - Liquids extracted from the PSCT and PCTs would be treated to meet NPDES substantive permit requirements and discharged to the C-Drainage west of the Site rather than being managed in an evaporation pond. The Gallery Well liquids, NAPL, and other aqueous phase liquids drained from the P/S Landfill would be sent offsite to a permitted facility for disposal.
- Area 5 Groundwater (Area 5 South and Area 5 West): Area 5 South and Area 5 West remediation would be the same as described for Alternative 2, except that approximately 80 new groundwater extraction wells would be located throughout the two areas to decrease the timeframe to achieve MCLs. The liquids from the PCTs and the 80 new extraction wells would be treated to meet NPDES substantive permit requirements, and then discharged to the C-Drainage west of the Site, rather than being managed in an evaporation pond.

The time to construct for Alternative 6 is estimated to be 5 years. The estimated remediation timeframes for groundwater in Area 5 South and Area 5 West to reach MCLs

would be faster than those for Alternative 3 because of the aggressive extraction from the 80 new wells. However, there is uncertainty in the timeframes to achieve cleanup standards; and the estimated time to achieve CLs is still expected to be several decades and potentially over a century.

2.10 Comparative Analysis of Alternatives

The alternatives were evaluated based on the CERCLA criteria identified in the NCP. The nine CERCLA criteria include the following:

- Threshold Criteria:
 1. Overall Protection of Human Health and the Environment
 2. Compliance with ARARs
- Balancing Criteria:
 1. Long-Term Effectiveness (LTE)
 2. Reduction of Toxicity, Mobility, or Volume through Treatment
 3. Short-Term Effectiveness (STE)
 4. Implementability
 5. Cost
- Modifying Criteria:
 1. State Agency Acceptance
 2. Community Acceptance

Table 2-18 presents a graphical summary of the comparative evaluation of the sitewide alternatives against the CERCLA 9-point criteria. The following narrative provides a detailed comparison of the sitewide alternatives. For additional comparison, Table 2-19 provides a summary of the estimated groundwater cleanup times for Area 5 North, South, and West, along with projected capital and O&M costs for each alternative.

1. Overall Protection of Human Health and the Environment

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

With the exception of the No Further Action alternative (Alternative 1), all remedial alternatives achieve the RAOs and are protective of human health and the environment.

2. Compliance with ARARs

Section 121(d) of CERCLA and NCP Section 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain standards legally referred to as “ARARs,” unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or State environmental, or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA Site. State standards that a state identifies in a timely manner and that are more stringent than federal requirements may be applicable. *Relevant and appropriate requirements* are those cleanup standards, standards of control, and other substantive requirements that, while not “applicable” to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA Site, address problems or situations sufficiently similar to those encountered at a CERCLA Site that their use is well-suited to the particular Site. Only those State standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate. The ARARs for the Site are presented in Appendix D.

Compliance with ARARs addresses whether a remedy will meet all of the ARARs of other federal and State environmental statutes or provides a basis for invoking a waiver.

With the exception of the No Further Action alternative (Alternative 1), all alternatives comply with the proposed ARARs. For example, chemical-specific ARARs include MCLs, which would apply across the Site, except for the TI Zone in Area 5 North. EPA’s approach to groundwater at the Site is to apply the selected groundwater cleanup ARARs (MCLs) throughout the plume, except for the designated TI Zone within Area 5 North where it is not technically practicable to meet ARARs. The Selected Remedy (Alternative 3) incorporates a waiver of the groundwater cleanup ARARs within the designated TI Zone (including the WMA) within Area 5 North. This approach complies with CERCLA Section 121(d)(4), is consistent with EPA’s presumptive remedy approach to groundwater at landfill sites, and is protective of human health and the environment.

3. Long-Term Effectiveness

LTE refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

Overall, Alternatives 3 through 6 are reasonably comparable in achieving LTE, although Alternatives 4 through 6 more aggressively address Site liquids and could potentially provide improved LTE. Alternatives 2-3 make use of similar remedial components, but differ in scale, such as the size of evaporation ponds and liquids treatment systems. Alternative 4 uses additional liquids treatment and excludes evaporation ponds. Alternatives 5 and 6 are more aggressive, utilizing P/S Landfill dewatering with horizontal wells for Alternative 5 and

aggressive liquids extraction. Alternative 6 includes aggressive pump-and-treat extraction to accelerate cleanup times for on-property (Zone 1) groundwater in Area 5 South and Area 5 West. However, both Alternatives 5 and 6 involve additional project complexity, risk, and cost. Alternative 5 involves significant project risk, which is described below under implementability.

Alternative 3 is ranked above Alternative 2 because it provides more widespread and effective capping systems, more effective treatment systems, and less reliance on evaporation ponds. The Alternative 3 capping system would cover the entire RCRA Canyon/WCSA area, better limit infiltration, and increase the potential to meet NPDES substantive permit requirements. Alternative 3 would also eliminate a seep at the southern part of the RCRA Canyon that contains elevated TDS and metals. Alternative 3 uses a smaller 6-acre evaporation pond, which would provide less artificial habitat and, therefore, better protection of ecological species, as well as easier dredging and maintenance, compared to the larger 11-acre pond for Alternative 2.

Alternative 4 does not include an evaporation pond and, therefore, provides better protection of ecological species compared to those alternatives with ponds. Also, Alternative 4 provides more aggressive liquids treatment prior to discharge to Casmalia Creek, but increases project risk and technical complexity. Alternatives 5 and 6 provide even more aggressive liquids extraction and treatment through horizontal wells (Alternative 5) and vertical wells (Alternative 6), but are also more vulnerable to increased project risk and technical complexity. The risks and complexities associated with Alternative 5 include challenges in installing horizontal wells in heterogeneous materials, and at the proper depths and spacing to capture sufficient DNAPL. Both Alternatives 5 and 6 include risks and complexities with long-term handling and offsite shipment and disposal of large volumes of hazardous liquids.

The FS report includes a thorough evaluation of the benefits and weaknesses (project risks) associated with the use of HDD and horizontal wells in the context of this specific Site application. For Alternative 5, these risks include the possibility of uncontrolled releases of large volumes of contaminated liquids. The FS concludes that there are difficult technical challenges and unacceptable project risks associated with the use of horizontal wells. Moreover, the use of horizontal wells to dewater the P/S Landfill would merely serve to accelerate a dewatering process that has been occurring gradually over time since the installation of the landfill caps in 1999 through 2002. The FS included groundwater modeling (MODFLOW) that estimated the horizontal wells, used in Alternatives 5 and 6, would take roughly 4 or 9 years, respectively; whereas dewatering without horizontal wells would take on the order of 10 or 11 years, respectively, following construction of the remedial action. The FS concluded that the technical challenges, risks, and costs associated with the use of horizontal wells outweigh any potential incremental benefits.

Reviews at least every 5 years, as required, would be necessary to evaluate the effectiveness of any of these alternatives because hazardous substances would remain onsite in concentrations above health-based levels.

4. Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternatives 2 through 4 are generally equivalent in achieving reduction of toxicity, mobility, or volume through treatment. These three alternatives include source reduction to extract pooled NAPL from the P/S Landfill, and liquids extraction from the PSCT and three PCTs for containment. Alternative 4 includes additional treatment of liquids to allow for discharge to Casmalia Creek instead of evaporation in ponds. Alternatives 5 and 6 provide even more aggressive liquids extraction and treatment through horizontal wells (Alternative 5) and vertical wells (Alternative 6), but are also more vulnerable to increased project safety risk and technical complexity from long-term operations and offsite waste transportation and disposal. In addition, Alternatives 5 and 6 would limit the potential for further migration of contaminants, but would not substantially increase protectiveness compared to Alternative 3, despite the considerably greater cost. Groundwater is effectively contained within Site boundaries, and EPA has no reason to believe that future property use will rely on onsite groundwater.

All alternatives, except for the No Further Action alternative (Alternative 1), are equivalent in terms of using containment to address PTWs in Area 1, where the former landfills and burial areas are located.

5. Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy, until cleanup levels are achieved.

Alternative 3 is top ranked in achieving STE because it provides remedial effectiveness in the short term, with less project risk (complexity and uncertainty) associated with horizontal well drilling (Alternative 5) or more aggressive pump-and-treat systems (Alternative 6). Alternative 3 is ranked higher than Alternative 2 because the smaller evaporation ponds would provide better protection of ecological species. Although Alternative 4 has the advantage of not including an evaporation pond, Alternative 3 is ranked higher because Alternative 4 is vulnerable to additional project risk and technical complexity associated with construction of a more robust treatment plant to meet offsite discharge requirements.

6. Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors, such as availability of services and materials, administrative feasibility, and coordination with other governmental entities, are also considered.

Alternative 3 is the top-ranked alternative in achieving implementability, because it is readily implementable and would not face the same risk and technical challenges associated with meeting NPDES discharge requirements (Alternative 4), horizontal wells (Alternative 5), or vertical wells with more aggressive pump-and-treat systems (Alternative 6). Alternative 5 is

ranked lower than Alternative 3 for implementability because of challenges in installing horizontal wells in heterogeneous materials and at the proper depths and spacing to capture sufficient DNAPL, challenges in maintaining wells and collection equipment in effective working order over an extended OM&M period, and increased potential for unintended releases. Alternative 6 is ranked lowest for implementability because of technical complexity associated with the aggressive pump-and-treat systems, including installation, optimization, and monitoring of an 80-well extraction system, construction of additional liquids treatment systems, and long-term transport of large volumes of hazardous liquids. Alternative 3 is ranked above Alternative 2 because of reduced OM&M requirements for a smaller lined evaporation pond system.

7. Cost

Table 2-19 summarizes the estimated capital, annual O&M, total present value costs, discount rate, and the number of years over which the Selected Remedy would occur. A breakdown of the costs, by area, for the Selected Remedy is provided in Table 2-20. The detailed costs associated with the Selected Remedy are presented in Appendix E. For the Selected Remedy, capital costs are estimated at \$60 million, and annual O&M costs are estimated at \$4 million.

Present value cost estimates were developed for each alternative using a 3 percent and 7 percent net discount rate. EPA guidance (EPA, 2000) and Office of Management and Budget Circular A-94 require use of a 7 percent discount rate for the evaluation of alternatives for federal projects. Present value costs were also calculated using a 3 percent discount rate. The estimates also included both a commonly used 30-year O&M period, consistent with EPA guidance, and an extended 100-year O&M period. The extended 100-year O&M period provides a more realistic, long-term, cost estimate because long-term O&M is anticipated to extend substantially past an initial 30-year O&M period, essentially in perpetuity.

Costs generally increase from Alternatives 2 through 6 corresponding to an increase in technical complexity (see Table 2-19). Significant cost drivers include liquids treatment, horizontal drilling (Alternative 5), vertical drilling at up to 80 locations (Alternative 6), and the collection, treatment, and disposal of hazardous liquids over extended durations. For Alternative 5, costs associated with the extraction and offsite treatment of roughly 10 million gallons of contaminated liquids over several (e.g., 3 to 5) years would be substantial, nearly doubling the annual O&M costs. Alternative 6 provides more aggressive liquids extraction and treatment compared to Alternative 3 along with accelerated on-property groundwater cleanup times in Area 5 South and Area 5 West, although at much higher cost. Construction costs for Alternative 6 are about 1.5 times the construction costs for Alternative 3. More significantly, annual O&M costs for Alternative 6 are nearly four times higher than those for Alternative 3 due to high costs associated with liquids extraction, treatment, and disposal.

8. State Agency Acceptance

The State has been actively involved at the Site with EPA through the IAC. During the public hearing for the Proposed Plan, State agencies submitted comment letters supporting the RI/FS process and the Proposed Plan for Site remediation. DTSC, in its role as lead State support

agency for the Site, has expressed its support for, and formally concurred on, the Selected Remedy based on a review of the pre-final ROD as described in a May 7, 2018, letter to EPA.

9. Community Acceptance

The key Site documents (including the RI report, FS report, and Proposed Plan) were made available by EPA for public review, and can be found on the EPA website and in the Administrative Record file (see Appendix F for the Administrative Record index).

During the public comment period held from November 22, 2017, through January 22, 2018, the community generally expressed its support for the Preferred Alternative (Alternative 3). Comments received during the public comment period are addressed in the Responsiveness Summary (Section 3.0 and Appendix G).

Green Remediation

In the Superfund program, green remediation is the practice of considering all environmental effects of remedy implementation and incorporating options to minimize the environmental footprint of cleanup actions. Although not one of the nine formal CERCLA/NCP criteria, the green remediation aspects of the remedial alternatives were evaluated in the FS report. These aspects provide useful information regarding the incorporation of sustainability concepts and practices into remedy implementation. The green remediation aspects evaluated included electricity, fuel usage, water usage, and air emissions for: (1) remedial construction activities; (2) materials manufacturing and transport; and (3) OM&M activities, including treatment and offsite disposal of liquids.

As summarized in Table 2-18, Alternative 3 is rated as having lower adverse impacts and costs (that is, rated as better) than Alternatives 4 and 6 because they involve operation of a larger liquids treatment plant to treat inorganic constituents prior to offsite discharge. Alternative 3 is rated higher than Alternatives 5 and 6 because of the greater risks and potential impacts from horizontal well installation, and the transport and offsite disposal of large volumes of hazardous liquids. Overall, Alternatives 4 through 6 rank lower than Alternative 3 because they include significantly more remedial construction and long-term OM&M, which would increase electricity, fuel usage, water usage, and air emissions. Alternative 3 is rated nearly the same as Alternative 2 because the additional impacts of the ET cap construction across the entire RCRA Canyon/WCSA are balanced by the lower impacts from construction of a smaller evaporation pond.

2.11 Principal Threat Wastes

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a Site wherever practicable (NCP Section 300.430(a)(1)(iii)(A)). The PTW concept is applied to the characterization of “source materials” at a Superfund Site. A source material is material that includes or contains hazardous substances, pollutants, or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or air, or act as a

source for direct exposure. As an example, NAPL in groundwater may be viewed as source material. PTWs are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur.

The PTWs at the Site are the high-concentration waste materials within the five landfills. PTWs within Area 5 North include drummed waste and NAPL within the P/S Landfill, and NAPL within the CDA. The PTWs contain numerous organic and inorganic chemicals at high concentrations across multiple chemical classes (VOCs, SVOCs, herbicides, pesticides, PCBs, dioxins/furans, metals, and cyanide).

Low-level threat wastes (LLTWs) are present within contaminated soil in Areas 2, 3, and 4. LLTWs are those source materials that generally can be reliably contained and present lower potential risk than PTWs. They include source materials that exhibit low toxicity, have low mobility in the environment, or are near health-based levels.

The PTWs and LLTWs at the Site have been addressed by various response actions over time, including excavations, pond closures, reconsolidation of pond bottoms and other materials into the existing five landfills, capping of four landfills and interstitial areas between these landfills, and extraction of NAPL and highly impacted groundwater for disposal at an offsite permitted facility.

The Selected Remedy considers how PTWs and LLTWs can be managed in a manner that is protective of human health and the environment, complies with CERCLA, and is consistent with the NCP. According to the NCP and EPA guidance, EPA expects to use treatment to address principal threats posed by a Site wherever practicable, and engineering controls, such as containment, for waste that poses a relatively low long-term threat.

Based on an extensive technical evaluation conducted during the RI/FS process, EPA has determined that it is not technically practicable to treat PTWs in landfills (Area 1), and in groundwater within a portion of the Site (Area 5 North) where NAPL is present. Therefore, the Selected Remedy includes designation of a WMA (for Area 1) and TI Zone (for Area 5 North), along with containment and source reduction through liquids extraction and treatment.

2.12 Selected Remedy

After careful study of the remedial alternatives developed for the Site, EPA has identified Alternative 3 as the Selected Remedy. The Selected Remedy is a combined containment and treatment remedy that includes NAPL source reduction, extraction, and treatment of contaminated Site liquids, and containment of waste materials in landfills, soils, and groundwater.

The Selected Remedy meets statutory requirements for protecting human health and the environment, achieves ARARs (while incorporating a waiver for MCLs within the designated TI

Zone for Area 5 North), adopts permanent solutions, uses treatment where technically practicable, and is cost-effective.

The Selected Remedy will achieve containment of both solids and liquids through use of engineering controls, ICs, and MNA. The Selected Remedy will include NAPL source reduction and treatment through existing and new extraction wells to provide focused DNAPL removal, thereby reducing sources that contribute to groundwater contamination. Extracted NAPL will be pre-treated (for example, subject to oil-water phase separation) prior to transport to an approved, permitted facility for further treatment and disposal. The Selected Remedy will also expand the current use of groundwater extraction systems (containment trenches, extraction wells, and extraction sumps) to remove contaminated liquids, which are then treated and sent to the lined evaporation ponds.

2.12.1 Key Components of Selected Remedy

The Selected Remedy includes the following key components:

- Area 1 (Capped Landfills Area, BTA, and CDA): The Selected Remedy includes continued use of the existing RCRA capping systems for the landfills area, plus expansion of the caps in selected areas. These RCRA caps were constructed on four of the landfills (P/S Landfill, Heavy Metals Landfill, Caustics/Cyanide Landfill, and Acids Landfill) between 1999 and 2002. The capped area will be increased to cover the uncapped PCB Landfill, interstitial areas with former waste management units between the landfills, the BTA, and the CDA. The Area 1 cap will also be extended to cover soil hotspot HS-1 in the MSA, and may be extended to cover HS-3 in the FPP Area based on an implementability and engineering evaluation during remedial design.
- Area 2 (RCRA Canyon and WCSA): The Selected Remedy includes installation of either an ET cap or RCRA hybrid cap (a RCRA cap meets RCRA Subtitle C performance standards; the cap type will be selected based on an implementability and engineering evaluation during the remedial design phase, subject to EPA review and approval).
- Area 3 (FPP Area): The Selected Remedy includes excavation and/or capping of four soil “hotspots” (HS-1 through HS-4, discrete areas with elevated concentrations of metals, VOCs, and other organic compounds) and consolidation of excavated soils into the existing PCB Landfill prior to capping. The final remedial approach for these hotspots will be selected during the remedial design phase. The extent of excavation and/or capping will be based on confirmatory soil sampling to verify that cleanup to CLs for soil is achieved. In summary, the hotspots will be addressed as follows:
 - HS-1: The shallow soil hotspot in the Liquids Treatment Area will be excavated to CLs for soil (Table 2-16) and placed under the RCRA cap of the PCB Landfill, and/or covered with an asphalt cap, as shown on Figure 2-26.

- HS-2: The shallow soil hotspot(s) in the MSA will be covered with the RCRA cap extended from Area 1.
- HS-3: The shallow and deep soil hotspot in the former Ponds A/B area will either be: (1) excavated to CLs for soil and placed under the RCRA cap of the PCB Landfill, or (2) covered with the RCRA cap extended from Area 1.
- HS-4: The shallow soil hotspot south of PSCT-1 will be excavated to CLs for soil and placed under the RCRA cap of the PCB Landfill.
- HS-10: Because there are no unacceptable human health or ecological risks for the deep soil hotspot at RISBON-59, the selected action is long-term groundwater monitoring. Two additional, downgradient monitoring wells will be installed to verify that there are no unacceptable impacts to groundwater. Stormwater from Area 3 would be discharged to the B-Drainage and Casmalia Creek under the substantive requirements of the General Permit.
- Area 4 (Stormwater Ponds and Treated Liquids Impoundment): The Selected Remedy includes removal of all liquids (with TDS concentrations that approach or exceed the concentration of seawater), placement of clean soil, and installation of engineered caps over Pond 18, Pond A-5, Pond 13, A-Series Pond, and RCF Pond. Pond 18 will be closed; Ponds A-5 and 13 will be closed and converted into lined stormwater retention basins; and a lined stormwater channel will be constructed over the former footprint of the RCF Pond (after it is capped). Finally, one or more new, lined evaporation ponds will be constructed over the former footprint of the A Series Pond.
- Area 5 (Sitewide Groundwater), which includes three subareas:
 - Area 5 North: The Selected Remedy includes subsurface liquids extraction and treatment from existing and new facilities in the source areas (source reduction). Extraction will continue from the existing Gallery Well, Sump 9B, and the PSCT to contain and prevent groundwater from migrating southward. Approximately 16 new extraction wells will be installed in the P/S Landfill to capture as much pooled NAPL as possible. The area that is circumscribed by the boundaries of the five hazardous waste landfills is designated as a WMA because waste materials are being left in place. A TI waiver is necessary for Area 5 North because the presence of LNAPL, DNAPL, and dissolved-phase organic and inorganic contamination in low-permeability fractured bedrock that make it technically impracticable to remediate and meet drinking water standards in this area. The POC will encompass the TI Zone; it will be located at the Area 5 North boundary to ensure that groundwater quality is not further degraded outside this area. Also, approximately 12 new Lower HSU monitoring wells will be installed to verify that dissolved-phase contaminants and NAPL are not migrating southward, underneath the PSCT outside of Area 5 North. Rigorous performance and compliance monitoring programs will also be implemented.

Under the Selected Remedy, highly contaminated liquids and NAPL from the Gallery Well, Sump 9B, and new source area extraction wells in the P/S Landfill will be stored onsite and transported to an EPA-approved offsite TSD facility for treatment. Liquids from the PSCT and PCTs will be treated onsite in a new treatment system, and treated effluent will be sent to one or more new onsite evaporation ponds.

- Area 5 South and Area 5 West: The Selected Remedy includes liquids extraction and onsite treatment from the existing PCT-A, PCT-B, and PCT-C to contain and prevent contaminated groundwater from migrating southward down the adjacent drainages. The Selected Remedy also includes MNA, a passive, in situ method whereby contaminant concentrations are reduced in place through physical, chemical, or biological processes.
- Collection/Treatment & Disposal of Liquids (Sitewide): Contaminated liquids and NAPL from the Gallery Well and NAPL source reduction extraction wells completed in the P/S Landfill would be stored onsite and then transported to an offsite TSD facility for treatment. Liquids from the PSCT would be treated onsite using an upgraded treatment system, and treated liquids would be sent to the evaporation ponds for volume reduction. Liquids from the PCTs would be treated using an upgraded liquids treatment system and sent to the evaporation ponds for volume reduction. Figure 2-33 presents preliminary process flow diagrams for these systems; final design details will be confirmed during the remedial design phase.
- Stormwater Discharge: Fresh sitewide stormwater will be managed following remedy implementation using new, lined, stormwater retention basins and discharged to the B-Drainage and Casmalia Creek under NPDES substantive requirements.
- WMA, TI Zone, and POC: A WMA is designated as circumscribing the surface footprints of the five former landfills within Area 1 North. A TI Zone is designated throughout Area 5 North. A POC is designated along the boundary of the TI Zone (Area 5 North boundary).
- Institutional Controls: ICs, in the form of land use covenants and related restrictions, will provide controls on land and water use to help prevent exposures to contamination. The goal of ICs is to help ensure long-term protectiveness of the Selected Remedy because waste materials will remain in place.
- Interim OM&M: Operations, maintenance, and monitoring will continue on an interim basis, under work plans approved by EPA, throughout the construction of the Selected Remedy.
- Long-Term Operations & Maintenance (O&M): Long-term O&M will be conducted to ensure that all Site components and systems are functioning effectively throughout the remedial action. Long-term O&M will address multiple media and systems, including, but not limited to, capping systems; liquids collection, treatment, and disposal systems; surface water management; and all monitoring systems (including air, surface water, groundwater, biological). Long-term O&M will incorporate modern, integrated, and upgradable automated process control systems and instrumentation to ensure that all Site systems

function safely, reliably, and effectively; these will include, but not be limited to, alarms, automatic shut-off systems, video surveillance systems, data recorders, and flow controllers. Long-term O&M will be performed based on optimization studies and a long-term O&M plan that will be subject to EPA review and approval.

- **Long Term Monitoring:** Long-term performance and compliance monitoring will be conducted to ensure that remedial systems are functioning effectively and remain in compliance with performance standards. Long-term monitoring will include compliance monitoring of groundwater both laterally and vertically, surface water, soil vapor and ambient air, and performance monitoring of remedial systems. Long-term monitoring will also include ongoing evaluation of ICs. Long-term monitoring will incorporate modern, integrated, and upgradable automated data collection systems and instrumentation to ensure that Site monitoring systems function effectively; these will include, but not be limited to, data loggers for new monitoring wells. Long-term groundwater monitoring will be performed based on optimization studies and subject to a long-term monitoring plan that will require EPA review and approval. EPA may require additional monitoring, if determined necessary based on the results of monitoring data, to ensure protection of human health and the environment.
- **Contingency Measures:** Contingency measures will be performed if groundwater monitoring data indicate that contamination is migrating beyond area boundaries, including the POC and the perimeter boundary of the former disposal facility (Zone 1). Contingency measures will be initiated if groundwater monitoring data show that migration is occurring at statistically representative concentrations that cause, or are likely to cause, exceedances of performance standards. These contingency measures will be performed to ensure adequate containment. Contingency measures may include any or all the following: (1) additional monitoring from existing wells; (2) installation of additional monitoring wells to further characterize potential migration; and (3) installation of a limited number of extraction wells within a localized area to maintain hydraulic containment. These extraction wells would supplement the area and perimeter containment provided by existing perimeter control trenches, extraction wells, and natural attenuation. Installation of additional extraction wells outside the POC or Zone 1 perimeter boundary, as part of contingency measures, could require an ESD.
- **Five-Year Reviews:** Because waste will remain at the Site, EPA will conduct statutory reviews every 5 years to continue to evaluate and ensure the long-term protectiveness of the Selected Remedy. The five-year reviews include evaluations of overall remedy protectiveness, including the effectiveness of NAPL removal and the effectiveness of ICs. If it is determined that components of the Selected Remedy are not protective, EPA will evaluate corrective actions and implement the preferred action to ensure continued protectiveness.

The following graphic summarizes the key components of the Selected Remedy.

Summary of Key Components of the Selected Remedy

- **RCRA Engineered Capping Systems:** Use of RCRA capping to contain contaminated soil and waste materials, including existing and new layered engineered capping systems (soils and geosynthetics) and RCRA ET covers, for Areas 1 and 2, and limited portions of Area 3.
- **Soil Hotspot Removal and/or Capping:** Focused excavation and reconsolidation of contaminated soil and waste materials in isolated portions of Area 3 into the existing PCB Landfill, which will later be capped and closed, and/or capping of the hotspots.
- **Stormwater and Treated Groundwater Removal/Existing Pond Closure:** Removal of existing stormwater and treated groundwater from the five existing ponds, which will be closed.
- **Long-Term Stormwater Management:** Construction of two lined stormwater retention basins, with conveyance systems (for example, V-ditches and channels) for off-property discharge to the B-Drainage.
- **Lined Evaporation Ponds for Treated Groundwater:** Construction of a new evaporation pond system (approximately 6 acres), with liners and security fencing.
- **NAPL Source Reduction:** Removal of an estimated 100,000 gallons each of pooled DNAPL and LNAPL sources from the P/S Landfill, using existing extraction wells and about 16 new vertical NAPL-only extraction wells.
- **Off-Property NAPL Treatment and Disposal:** Transportation, treatment, and offsite disposal of NAPL at an EPA-approved facility.
- **Perimeter Containment of Groundwater Contamination with Collection Trenches and MNA:** Perimeter containment of shallow (Upper HSU) and deep (Lower HSU) groundwater contamination within the former facility boundaries (Zone 1), using several existing containment trenches, extraction wells, and MNA.
- **Groundwater Collection, Treatment, and Disposal/Optimization of Site Systems:** Collection of groundwater from existing containment trenches, on-property treatment, and transfer of treated effluent to the new 6-acre, lined, evaporation pond system. A pre-design evaluation during remedial design/remedial action to help select optimized extraction rates and improve OM&M. The improvements will likely include automation, instrumentation, and integration, including installation and use of meters, sensors, transducers, continuous recording data loggers, leak detection and notification systems, telemetry, and centralized control systems.
- **ICs:** Land use controls and/or government controls to restrict access and establish controls on land and water use, to limit or prevent exposures to contamination (extensive ICs for six parcels are already in place).
- **Designation of WMA and TI Zone (within Area 5 North) with POC:** The footprint of the former landfills within Area 5 North is designated as a WMA because waste materials are being left in place and there is no expectation that groundwater in this area can be remediated for beneficial use. The area within the Area 5 North boundary is designated as a TI Zone for groundwater. This area contains multiple, closely spaced, waste management units, and large volumes of LNAPL and DNAPL, which have accumulated at the base of the P/S Landfill and are observed up to 500 feet south of the landfill in the CDA. A detailed TIE concluded that full restoration of groundwater to MCLs within Area 5 North was not technically practicable from an engineering perspective. Designation of a POC that corresponds to, or is located just outside of, the Area 5 North boundary to demonstrate groundwater quality is not further degraded outside the TI Zone.
- **Long-term O&M/Long-Term Monitoring:** Long-term O&M, including monitoring for overall performance and regulatory compliance (for example, long-term compliance monitoring for groundwater at the Area 5 North boundary and corresponding POC, and the Site [Zone 1] boundary).
- **Contingency Measures** Contingency measures, such as additional monitoring and focused extraction in localized areas, will be conducted if deemed necessary by EPA.
- **Ecological Habitat Mitigation:** Mitigation of selected ecological habitat areas to address adverse impacts to threatened or endangered species covered by the federal ESA.
- **Five-Year Reviews:** Superfund law requires EPA to conduct a detailed review every 5 years when waste is left in place, to confirm the Selected Remedy remains fully protective and meets intended goals. EPA will conduct five-year reviews to assess ongoing protectiveness. If the remedy is found to be deficient or no longer protective, EPA will begin work to evaluate and implement necessary corrective actions and improvements.

2.12.2 Waste Management Area

The Selected Remedy includes a WMA coincident with the outer boundary of the five former landfills in Area 1.

Consistent with the NCP preamble and with EPA guidance documents, EPA is designating the footprint of the former landfills (P/S, Heavy Metals, Caustics/Cyanide, Acids, and PCB landfills) within Area 5 North as a WMA for the Selected Remedy. In general, the term “waste left in place” is used in the NCP to refer to landfill wastes that, at the completion of the remedy, will be contained or otherwise controlled within a WMA (EPA, 1996). The NCP preamble sets forth EPA’s regulatory approach for groundwater as follows, “remediation levels generally should be attained throughout the contaminated plume, or at and beyond the edge of the waste management area when waste is left in place” (EPA, 2009a). Under this EPA regulatory approach, CLs for groundwater do not apply within the WMA.

Where several, closely spaced, waste management units exist, EPA guidance (1993a) provides for designation of a single WMA. EPA is designating the footprint of the five former landfills within Area 5 North as a single WMA because waste materials are being left in place and there is no expectation that groundwater under and between the landfills can be remediated for beneficial use.

Area 5 North also contains large volumes of NAPL (both LNAPL and DNAPL), which have accumulated at the base of the P/S Landfill and are observed up to 500 feet south of the landfill in the CDA. Consistent with EPA guidance (EPA, 1996), NAPL is not included within the WMA and EPA generally does not consider NAPL as “waste left in place.” This is because the full extent of NAPL contamination is often not known, and NAPL can continue to migrate in the subsurface. Also, NAPL is considered a PTW and is, therefore, treated separately from groundwater as a source of contamination. The Selected Remedy includes components to reduce the NAPL sources of contamination in Area 5 North using NAPL extraction.

Although Area 5 North contains hazardous waste landfills rather than municipal waste landfills, the use of a WMA is also generally consistent with EPA’s guidance entitled, *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA, 1993b). The presumptive remedy guidance states that, “... consistent with the [NCP], EPA’s expectation was that containment technologies generally would be appropriate for municipal landfill waste because the volume and heterogeneity of waste generally make treatment impracticable.” The guidance further states that waste in landfills generally occurs in large volumes and is often co-disposed with industrial and hazardous wastes; therefore, containment is generally an appropriate response action, including capping, source area groundwater control, liquids collection and treatment, gas collection (if appropriate), and ICs. The WMA within Area 5 North contains the five former landfills, where waste materials will be left in place and treatment is not technically practicable.

Figure 2-27 presents the plan view layout of the WMA, located within a portion of Area 5 North that coincides with the outer boundary of the five former landfills. Groundwater in this area underlies the most highly contaminated parts of the Site, including the capped landfills and the

PCB Landfill. A WMA is appropriate for both the Upper and Lower HSUs within this area for both organic and inorganic compounds.

2.12.3 Technical Impracticability Zone

The Selected Remedy includes a TI Zone coincident with the outer boundary of Area 5 North. EPA conducted a TIE as part of the RI/FS process. The TIE concluded that it is technically impracticable to clean up groundwater throughout Area 5 North to cleanup standards, namely MCLs. According to the NCP, a TI waiver may be appropriate, when compliance with an ARAR “is technically impracticable from an engineering perspective” (40 CFR 300.430[f][1][ii][C][3]). CERCLA Section 121(d)(4) provides that ARARs may be waived in certain limited circumstances, as long as the remediation also ensures protection of human health and the environment.

The RI and FS reports contain a comprehensive TIE section, including an assessment of the potential to achieve full restoration of groundwater to MCLs in all three areas (Area 5 North, Area 5 South, and Area 5 West). The TIE closely follows the *Guidance for Evaluating Technical Impracticability of Ground-Water Restoration* (EPA, 1993c). Consistent with the guidance, the TIE examined: (1) hydrogeologic factors; (2) contaminant-related factors; and (3) technology constraints on remediation system design and implementation. The TIE concluded that full restoration of groundwater to MCLs within a limited portion of the Site, designated as Area 5 North, is technically impracticable from an engineering perspective. Groundwater restoration in the other two areas (Area 5 South and Area 5 West), while not strictly technically impracticable, will require long-term remediation with MNA, on the order of decades to over 200 years, depending on the contaminant. Although remediation costs are not a primary factor in a TI determination, the estimated cost for complete restoration of the capped landfills area (including landfill removal) is in the tens of billions of dollars, based on the TIE.

Restoration to MCLs within Area 5 North is technically impracticable because: (1) large volumes of pooled DNAPL have accumulated at the base of the P/S Landfill and extend south into the CDA; (2) residual waste will be capped in place (but not removed) representing an ongoing source of contamination; (3) DNAPL will be removed through additional extraction measures, but residual DNAPL will remain as an ongoing source of contamination; (4) low-permeability, fractured claystone with high matrix porosity is present resulting in significant matrix diffusion and storage of contaminant mass; and (5) remediation technologies are ineffective in removing contaminant mass in these types of environments. Further, groundwater contamination will be effectively contained within the Area 5 North boundary through a combination of engineering controls and MNA.

No in situ technology is capable of treating the diverse array of chemicals found in the TI Zone of Area 5 North. In addition to NAPL and organic constituents, this area contains many inorganic constituents (for example, metals such as arsenic, cadmium, nickel, and selenium) that significantly exceed MCLs in both the Upper and Lower HSUs. EPA also examined the feasibility of pump-and-treat remediation in groundwater within this area; it concluded that such actions would not be effective. Groundwater flow and contaminant transport modeling demonstrated that, even after several thousands of years of operation, pump-and-treat

remediation would not restore contaminated groundwater to MCLs. Buried waste within Area 5 North will continue to provide ongoing sources for groundwater contamination within the TI Zone. Furthermore, substantial contamination is contained within the matrix of the low-permeability claystone (through matrix diffusion), and back diffusion processes would contribute to long-term contaminant migration from the matrix into groundwater. Consequently, pump-and-treat remediation could remove large volumes of contaminated liquids from fractures, yet remain largely ineffective in addressing contaminants within the claystone matrix, which would serve as a continuing source of groundwater contamination.

Figure 2-27 presents the plan view layout of the TI Zone. The base of the TI Zone is 200 feet amsl. This elevation is about 100 feet below the deepest monitoring well where DNAPL was found (RGPZ-7D, which has a total depth of 148.3 feet bgs and is screened between approximately 328 and 315 feet amsl). The base of the TI Zone at 200 feet amsl (or about 265 feet bgs at the RGPZ-7D well location) will fully encompass any known DNAPL impacts to groundwater within Area 5 North.

The effects of both designations (the WMA and TI Zone) are similar because there is no expectation that waste materials will be removed or that groundwater throughout all of Area 5 North can be cleaned up to ARARs. The TI Zone (including the WMA) will be subject to ICs and rigorous performance and compliance monitoring programs.

EPA has established one POC that is coincident with the Area 5 North boundary. During the remedial design phase, a rigorous groundwater monitoring program will be established to demonstrate compliance with the designated TI Zone. The groundwater monitoring program is expected to consist of two key phases: (1) interim monitoring during remedial construction; and (2) long-term monitoring following construction completion. Monitoring wells will be installed at strategic locations, based on optimization studies, to provide advance indication and detect potential migration of contamination exceeding remediation levels beyond the POC. Monitoring will be performed during construction and throughout the long-term OM&M period based on a monitoring plan approved by EPA. Compliance at the POC will also be evaluated as part of overall remedy protectiveness during regular five-year reviews.

2.12.4 Short-Term and Long-Term O&M

The O&M program is expected to consist of two key phases: (1) ongoing OM&M that will continue to be performed on an interim basis, under work plans approved by EPA, throughout the construction of the Selected Remedy; and (2) long-term O&M following construction completion.

Interim O&M: Interim (short-term) O&M will continue throughout the construction of the remedy to ensure that site systems function safely, effectively, and reliably. O&M will continue under EPA-approved O&M plans that may be subject to modification to accommodate construction activities.

Long-Term O&M: Long-term O&M will be conducted to ensure that all Site components and systems are functioning effectively throughout the duration of the remedial action. Long-term O&M will address multiple media and systems, including, but not limited to, capping systems; liquids collection, treatment, and disposal systems; surface water management; and all monitoring systems (including air, surface water, groundwater, biological). Long-term O&M will incorporate modern, integrated, and upgradeable automated process control systems and instrumentation to ensure that all Site systems function safely, reliably, and effectively; these will include but not be limited to alarms, automatic shut-off systems, video surveillance systems, data recorders, and flow controllers. Long-term O&M will be performed based on optimization studies and a long-term O&M plan that will be subject to EPA review and approval.

Other key components of the long-term O&M activities will include: (1) evaluation of the nature and extent of NAPL and dissolved-phase groundwater COCs; (2) evaluation of overall plume stability through trend analysis; (3) evaluation of individual well concentration trends over time for target COCs; (4) development of sampling locations and frequency recommendations based on statistical analysis; (5) evaluation of individual well analytical data for statistical sufficiency and identify locations that have achieved RLs; (6) establishment of procedures to improve NAPL extraction; (7) establishment and tracking of influent and effluent concentrations at the upgraded groundwater treatment plant; (8) tracking of the rates and volumes of NAPL and groundwater extraction; (9) evaluation of the estimated capture zone of the various containment systems (such as wells and trenches); and (10) any additional activities as requested by EPA. Section 2.12.11 presents additional details regarding NAPL extraction activities.

2.12.5 Interim and Long-Term Monitoring

Interim monitoring will continue during construction of the Selected Remedy, followed by long-term performance and compliance monitoring throughout the duration of the remedial action, to ensure safe and effective operation of Site systems and compliance with performance standards. Long-term monitoring will be based on optimization studies and will incorporate integrated and upgradeable automated data collection systems and instrumentation to ensure reliable and accurate data collection.

Interim Monitoring: Interim monitoring for appropriate Site media will continue during construction of the Selected Remedy under monitoring plans that are subject to EPA review and approval. Interim monitoring will be replaced by long-long term monitoring upon approval of long-term monitoring plans.

Long-Term Performance Monitoring: Performance monitoring will be conducted based on monitoring plans that are subject to EPA review and approval. Performance monitoring will be conducted for multiple media and Site facilities and systems to ensure that the Selected Remedy is functioning effectively. Performance monitoring will include appropriate Site media, such as groundwater, soil vapor, ambient air, surface water, and NAPL. Performance monitoring will be conducted to ensure that Site facilities and systems are functioning in a safe, reliable, and effective manner in conformance with design goals and parameters.

Long-Term Compliance Monitoring: The compliance monitoring will be conducted based on monitoring plans that are subject to EPA review and approval. Compliance monitoring will be conducted for Site media, such as groundwater and surface water, to ensure that the Selected Remedy is functioning in conformance with performance standards. Monitoring wells will be designated to monitor containment for (1) the POC which is being designated for the TI Zone and (2) for the Zone 1 perimeter boundary. Surface water will be monitored to ensure compliance with performance standards.

2.12.6 Capping and Pond Lining Technologies

The Selected Remedy includes several engineered cap and pond-lining technologies. The capping configurations for the various Site areas will be confirmed during the remedial design phase (subject to EPA review and approval), and include those listed as follows:

- RCRA Cap (Area 1 – PCB Landfill, CDA, BTA, Maintenance Shed Area; Area 4 – Pond 18):
 - 2 feet of vegetative layer
 - Biotic barrier, geocomposite drainage layer, geomembrane, geosynthetic clay liner
 - Foundation layer (variable thickness), to 90 percent compaction
- ET Cap (Area 2 – RCRA Canyon/WCSA)¹:
 - 4 feet of vegetative layer
 - 1 foot of foundation layer, to 90 percent compaction
- RCRA-Equivalent Hybrid Cap (Area 2 – RCRA Canyon/WCSA)¹:
 - 2 feet of vegetative layer
 - Biotic barrier, geotextile drainage layer, and HDPE liner
 - Foundation layer (variable thickness), to 90 percent compaction
- Ecological Cap (Area 4 – RCF Pond):
 - 2 feet of vegetative layer
 - Foundation layer (variable thickness), to 90 percent compaction
- Asphalt Cap (Area 3 – HS-1, Liquids Treatment Area):
 - 4 inches of asphalt
 - 4 inches of aggregate base
- Lined Cap Retention Basin (Area 4 – Pond A-5, Pond 13 [clean stormwater]):
 - 1 foot of soil cover
 - Geonet geotextile, geocomposite liner, and HDPE liner
 - 2 feet of foundation layer, to 90 percent compaction
- RCRA Evaporation Pond (Area 4 – A-Series Pond [treated groundwater]):

¹ The Selected Remedy includes an ET cap and/or RCRA-Equivalent hybrid cap for Area 2 (RCRA Canyon/WCSA), and the specific design details will be developed during the remedial design phase.

- 1 foot of soil cover
- Primary HDPE geomembrane, geonet drainage layer, secondary HDPE geomembrane
- Leachate collection and removal system (connected to geonet drainage layer, sump)
- Vadose zone monitoring beneath secondary HDPE geomembrane
- 2 feet of foundation layer, to 90 percent compaction

2.12.7 Construction Water

The Selected Remedy will require a sufficient quantity of water that is of adequate quality for construction purposes, including, but not limited to, soil conditioning, dust control, and irrigation. Because of the potential for serious drought conditions in California, adequate supplies of suitable quality water must be made available for construction. Potential water sources to be considered may include potable or reclaimed water, to be delivered by pipeline or truck, or onsite wells or ponds, subject to adequate supply and potentially requiring onsite treatment.

EPA will set limits on TDS concentrations for construction water that will be used at the Site. The TDS concentrations must be sufficiently low to promote vegetative growth, prevent degradation to vegetation and the soil column, and reduce adverse impacts from stormwater runoff to the nearby B-Drainage and Casmalia Creek. TDS limits will be established for the entire soil thickness above caps containing geomembranes (such as, RCRA cap), and throughout the entire thickness of caps without geomembranes (such as, ET cap). Construction water with higher TDS levels can be used below the geomembrane layer only for caps constructed with geomembranes.

2.12.8 Monitoring During Remedial Construction

An appropriate level of monitoring of construction activities will be conducted during remedial construction. The monitoring protocol will be identified during the remedial design and remedial action phases. Such monitoring will likely include air monitoring in active work areas, along the Site's perimeter as determined necessary by EPA, soil erosion and sediment control, third-party construction quality assurance (using current national standards that are acceptable to EPA) for the engineered caps and other components of the Selected Remedy, construction completion verification, and other related protocol.

2.12.9 Habitat Mitigation

The Selected Remedy includes habitat mitigation, which will be conducted based on coordination with the USFWS and CDFW during the remedial design phase. For example, the lined evaporation pond system will be designed with biological controls (such as, netting, fencing, screening, and hazing) and biological monitoring to minimize adverse impacts to special-status species based on coordination with USFWS. Habitat mitigation may also include establishing appropriate nearby suitable habitat for ecological species of concern, and/or other appropriate measures.

2.12.10 Institutional Controls

EPA considers ICs to include “*non-engineered instruments, such as administrative and legal controls, that help to minimize the potential for human exposure to contamination and/or protect the integrity of the response action*” (EPA, 2011). ICs typically limit land or resource use, or by providing information that helps modify or guide human behavior at a Site. Common examples of ICs include zoning restrictions, building or excavation permits, well drilling prohibitions, easements, and covenants. ICs are used to ensure that unacceptable exposure from various Site media containing COCs does not occur.

The Selected Remedy will make use of ICs by including existing and future land use covenants as part of the remedy. The goal is to help ensure protectiveness since waste materials will remain in place. Covenants have been established for six parcels (Property), which include a total of 1,247.25 acres in all of Zone 1 and portions of Zone 2 located to the north and south of the Site (see Figure 2-13). These covenants include:

- On May 31, 2011, a Covenant to Restrict Use of Property/Environmental Restrictions was issued for the following parcels, which comprise all but the southeastern portion of Zone 1 and portions of adjacent land:
 - Parcel 113-260-002 (Parcel 2)
 - Parcel 113-260-003 (Parcel 3)
- On June 1, 2011, a Covenant to Restrict Use of Property and Easement/Environmental Restrictions was issued for the following parcels:
 - Parcel 113-260-004 (Parcel 4), which includes the southeastern portion of Zone 1 and portions of adjacent land
 - Parcels 113-260-001 (Parcel 1), 113-220-010 (Parcel 10), and 113-220-012 (Parcel 12), which are located adjacent to and north/northeast of Parcels 2 and 3

The covenants establish various provisions, restrictions, and conditions (collectively referred to as "Environmental Restrictions"), to which the Property is subject, including how the Property is used, occupied, leased, sold, and/or conveyed. The Environmental Restrictions run with the land pursuant to California Civil Code Section 1471, and successive owners of the Property are bound to such restrictions. The objectives of the Environmental Restrictions are to:

- Prevent residential construction, and maintain control over any commercial, industrial, agricultural or ranching, construction, or other activity that may interfere with response actions taken or approved by EPA.
- Provide space for potential construction of remedial systems and monitoring systems at the Site.

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- Protect any measures taken or approved by EPA to protect wildlife habitat, open space, and wetlands, including, but not limited to, habitat for endangered or threatened species.
- Mitigate risks that might be associated with unanticipated release of hazardous materials from the Site.

The covenants require that the Property owner(s) grant access to those performing response actions under regulatory oversight by EPA and/or the State, including their agents and contractors. The covenants also require that the Property owner(s) not undertake any "land or water disturbing activity" on the property that is not approved in writing by EPA. Land or water disturbing activities include excavation, construction, demolition, groundwater pumping, and any activity that affects habitat, open space, or wetlands. EPA is also included as a third-party beneficiary to these covenants, allowing it full access to the Site and the ability under the law to enforce the terms of the covenants.

Current and future landowners will give written notice of Site contamination to each buyer, lessee, renter, and mortgagee of any of these lands. Also, every lease, deed, mortgage, or instrument conveying any part of these lands will expressly provide that it is subject to these Environmental Restrictions.

The long-term OM&M activities will include monitoring of the effectiveness and enforcement of ICs. The ICs will also be evaluated as part of the five-year review process. Additional ICs for other land parcels may be implemented if deemed necessary by EPA.

2.12.11 NAPL Extraction and Monitoring

The Selected Remedy includes the installation of approximately 16 NAPL extraction wells in the southern portion of the P/S Landfill to provide additional source reduction.

As described in the FS report, the liquids in the P/S Landfill result in a "driving force" (head) that facilitates: (1) downward migration of contaminated liquids and pooled DNAPL through source areas and fractured bedrock; and (2) horizontal migration into weathered and unweathered bedrock. This head contributes to the horizontal gradient that causes groundwater (and contaminants dissolved in groundwater) to move southward through the Lower HSU and potentially underneath the PSCT.

The objectives of the NAPL extraction wells are to reduce the overall volume of mobile NAPL and decrease the thickness of pooled NAPL, which will also reduce the hydraulic head that creates a driving force that can push NAPL (and dissolved constituents) into fractured bedrock.

The network of extraction wells (estimated to be 16, but potentially ranging from 15 to 20) will be installed to a depth at or near the base of the P/S Landfill to extract as much NAPL, including mobile pooled DNAPL and LNAPL, as technically practicable. The objective is to pump from a large number of wells at low pumping rates to maximize extraction over the long-term and avoid destabilization of the capture area due to over-pumping. The network of extraction wells

will be installed in the early stages of remedy construction. The extraction goals, specific performance standards, and operating protocol will be established during the remedial design phase, and will consider the total estimated volume of 100,000 gallons of DNAPL, and a similar volume of LNAPL. Companion monitoring wells will also be installed near the extraction wells to provide long-term monitoring of NAPL thickness. The extraction and monitoring wells will be located in the low area of the P/S Landfill toe, where substantial thicknesses of pooled NAPL has been observed in existing wells. The new wells will be installed with the goal of directly intercepting the DNAPL pool and overcoming the barriers to DNAPL flow that would likely leave DNAPL behind using only the Gallery Well. Various investigative approaches, such as membrane interface probe, cone penetrometer testing, and/or ultraviolet optical screening tool, will be considered to map the bottom of the landfill and evaluate NAPL distribution, so that the optimal well locations are selected for the likely presence of recoverable LNAPL and DNAPL. The scope of these investigation activities will be determined during the remedial design phase.

The new extraction and monitoring wells will be installed in a manner that recovers as much NAPL volume as possible, using either: (1) a single screen across the entire saturated zone (LNAPL, aqueous phase, and DNAPL) (the preferred approach); or (2) two screens across both the upper LNAPL zone and lower DNAPL zone. EPA-approved well materials will be used. One or more pumps will be placed in each extraction well where both measurable LNAPL and DNAPL are present. The bottom pump will be placed at the top of the DNAPL zone and pumped slowly (pulsed pumping only several times per day) to recover DNAPL that comes into the well by up coning. The top pump will be placed within the LNAPL and pumped slowly to skim LNAPL that comes into the well. The extraction rates of groundwater will be minimized so that the LNAPL and DNAPL saturations and flow paths around each well are maintained at the maximum possible level to increase LNAPL and DNAPL recovery. Some groundwater would be extracted, as appropriate, to slightly enhance the inward gradients towards the extraction wells.

The extraction wells will be designed and operated based on optimization studies to maximize the volume of extracted pooled LNAPL and DNAPL. The well operations will be detailed in the O&M monitoring plan (as described in Section 2.12.4). Wells will be monitored for key operating parameters, such as volume, extraction rates, DNAPL and LNAPL thickness, key indicator constituents, and others, throughout the long-term OM&M period. If EPA determines that NAPL extraction is negligible and does not continue to contribute to improved protectiveness under those operating conditions, EPA may approve temporary discontinuation of extraction in one or more extraction wells, pending further evaluation. Extraction may be temporarily discontinued if, for example, EPA determines that continued extraction of liquids is not resulting in substantial, or measurable, removal of NAPL constituents. In such a case, extraction in one of more wells may be paused, for several months or even years, to allow for additional evaluation and consideration of revised extraction procedures. The NAPL presence will continue to be monitored throughout the OM&M period, and extraction will resume when, and if, EPA determines that continued extraction will enhance protectiveness.

2.12.12 Point of Compliance and Compliance Monitoring Programs

Consistent with the NCP and EPA guidance, the POC for attaining CLs in groundwater is established on a Site-specific basis. Final cleanup levels for contaminated groundwater generally should be attained throughout the entire contaminant plume, except when remedies involve areas where waste materials will be managed in place. In the latter case, cleanup levels should be achieved "at and beyond the edge of the waste management area when waste is left in place" (1990 NCP preamble at 55 FR 8713). Pursuant to the NCP (including NCP preamble), a POC generally would be established at, or just outside of, the WMA.

However, based on the TIE, ARARs are not expected to be attained in groundwater within the TI Zone, which encompasses all of Area 5 North and includes the WMA. For this reason, EPA is designating the POC to correspond to the Area 5 North boundary. Compliance monitoring at the POC will be used to demonstrate that groundwater quality is not further degraded outside the TI Zone.

The Selected Remedy will incorporate a long-term groundwater performance and compliance monitoring program to monitor system performance, containment of groundwater impacts, and compliance with performance standards both at the POC (corresponding with the Area 5 North boundary) and at the Zone 1 property boundary. The long-term O&M and monitoring program will include identification of groundwater and NAPL extraction protocol (including optimization studies), groundwater monitoring networks, monitoring standards, and a formalized POC. The Site already has a significant water monitoring network in place, which will need to be supplemented to appropriately monitor the Selected Remedy following implementation.

2.12.13 Contingency Measures

Contingency measures will be performed if groundwater monitoring data indicate that contamination is migrating beyond area boundaries, including the POC and the perimeter boundary of the former disposal facility (Zone 1). Contingency measures will be initiated if groundwater monitoring data show that migration is occurring at statistically representative concentrations that cause, or are likely to cause, exceedances of performance standards. These contingency measures will be performed to ensure adequate containment. Contingency measures may include any or all the following:

1. Additional monitoring from existing wells
2. Installation of additional monitoring wells to further characterize potential migration
3. Installation of a limited number of extraction wells within a localized area to maintain hydraulic containment

These extraction wells would supplement the area and perimeter containment provided by existing perimeter control trenches, extraction wells, and natural attenuation. Installation of

additional extraction wells outside the POC or Zone 1 perimeter boundary, as part of contingency measures, could require an ESD.

The objectives of such extraction would be to provide improved hydraulic containment and limit further migration beyond area boundaries. The Selected Remedy includes perimeter control, using containment trenches and perimeter extraction wells, which have already been in operation for many years. Installation of additional extraction wells in a localized area, therefore, would provide incremental improvements to the existing perimeter control systems. Further evaluation would be conducted to determine if additional measures are necessary.

Details of the compliance monitoring program and contingency measures for additional monitoring and/or extraction in the vicinity of the TI Zone within Area 5 North (and corresponding POC) and the Site's boundary will be developed during the remedial design phase. Design and operation of the monitoring program will be based on the results of optimization studies.

2.12.14 Greener Cleanups Considerations

Consistent with EPA Region IX's Greener Cleanups Policy (EPA, 2009c), the Selected Remedy will incorporate greener cleanup practices. The Selected Remedy's remedial design phase will evaluate a range of practices, strategies, and technologies to support the implementation of greener cleanups. The greener cleanups approach should reflect the following core elements:

- Reduce total energy use and apply renewable energy sources.
- Reduce air pollutants and greenhouse gas emissions.
- Reduce water use and impacts to water resources.
- Reduce, reuse, and recycle materials and waste.
- Protect and restore land and ecosystems.

As part of the greener cleanups approach, a greener cleanups assessment will be submitted for approval as part of the remedial design phase. This assessment will evaluate opportunities to apply greener cleanup BMPs and reduce the environmental footprint throughout remedial actions. The greener cleanups assessment will consider and outline, at a minimum, the following touchstone practices:

- Renewable energy to power the cleanup remedy
- Clean diesel fuels and technologies for onsite equipment and transport
- Reuse or recycling of demolition debris
- Water from recycled sources and recycling of treated water

The assessment will use resources, such as EPA's *Principles for Greener Cleanups* (EPA, 2009b), EPA's *Green Remediation Strategy* (EPA, 2010), the *ASTM Greener Cleanups Standard Guide* (ASTM, 2013), the *Greener Cleanups Policy – EPA Region 9* (EPA, 2009c), and resources on cluin.org (EPA, 2018), in considering these practices and identifying any additional greener cleanup BMPs at the Site.

The implementation of these practices, or any additional greener cleanup BMPs, does not change cleanup goals, or how and why cleanup decisions are made. Instead, such practices call for more environmentally friendly methods of implementing the cleanup. The cleanup at the Site must meet all statutory and regulatory requirements.

2.12.15 Sequencing of Work

The Selected Remedy sequencing of work will be finalized during the remedial design phase, subject to EPA review and approval. In general, the Selected Remedy will be constructed over a period of about 5 years. The preliminary construction sequence is summarized as follows:

- After the ROD has been approved, expeditiously begin the remedial design field investigations in the southern portion of the P/S Landfill to locate, design, construct, and begin extraction from the NAPL-only wells. The network of approximately 16 (e.g., 15-20) NAPL extraction wells will be installed in the early stages of the remedy construction process. Expedient recovery of NAPL, a principal threat waste, in the early stages of remedial action is important in minimizing further migration of NAPL.
- Complete the Selected Remedy for RCRA Canyon and WCSA (Area 2), which would include an ET cap and/or RCRA hybrid cap over the entire area. During that same timeframe, the liquids from Pond A-5 would be transferred to the RCF Pond; the A-5 pond would be backfilled with the WCSA excavated soils; and the new, lined, retention basin in the footprint of the A-5 pond would be constructed. The proposed pipeline that conveys stormwater runoff from the capped RCRA Canyon area would be built and put into service. The stormwater runoff from the southern portion of RCRA Canyon would sheet flow to the A-Series Pond and be monitored for a period of time (to be identified during remedial design) to determine whether the stormwater meets the NPDES substantive requirements and can be discharged.
- Complete the Selected Remedy for the CDA, PCB Landfill, BTA (Area 1), and the MSA and FPP Area (Area 3), which will consist of a RCRA cap. The proposed concrete drainage channel to convey clean stormwater runoff from the northern part of the Site through or around the B-Drainage wetlands would be built and put into service at this time.
- Complete the pond closures of the A-Series Pond, Pond 18, and Pond 13 (Area 4). The A-Series Pond will be emptied and the new lined evaporation pond system will be constructed in the footprint of the A-Series Pond.
- Complete the Selected Remedy for the RCF Pond (Area 4), which involves adding an eco-cap to the raised pond bottoms, and conduct grading and BMPs in the area south of the PSCT (Area 3).
- Complete the recommended groundwater remedy (Area 5) by completing design and construction of the upgraded groundwater treatment system.

2.12.16 Cost Estimate for the Selected Remedy

The estimated capital, annual O&M, total present value costs, discount rate, and the number of years over which the Selected Remedy occurs are summarized in Table 2-19. A breakdown of the costs by area for the Selected Remedy is provided in Table 2-20. The detailed costs associated with the Selected Remedy are presented in Appendix E.

For the Selected Remedy, the estimated capital costs, annual O&M, total present worth capital, and O&M costs are summarized as follows:

Capital Costs (2014 \$):	\$59,967,000
Annual O&M Costs (2014 \$):	\$4,064,000
Total present worth capital and O&M costs, 7 percent discount rate ¹ , 30-year timeframe	\$89,499,000
Total present worth capital and O&M costs, 7 percent discount rate ¹ , 100-year timeframe	\$96,218,000

¹ The 7% discount rate is included per EPA guidance and OMB Circular A-94. Table 2-20 presents additional cost details.

2.12.17 Expected Outcomes of Selected Remedy

The expected outcome of the Selected Remedy is to achieve RAOs through the removal, treatment, and/or containment of soil, groundwater, and surface water contamination to CLs, and the protection of human and ecological receptors from unacceptable exposure, including onsite (Zone 1) containment of impacted groundwater. The Selected Remedy will control and monitor remaining onsite contamination. The Selected Remedy will be subject to ongoing OM&M activities and five-year reviews to help verify protectiveness of human health and the environment.

2.13 Statutory Determinations

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and use permanent solutions and treatment or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element, and includes a bias against offsite disposal of untreated wastes. The following sections discuss how the Selected Remedy meets these statutory requirements and explain the 5-year review requirements for the Selected Remedy.

2.13.1 Protection of Human Health and the Environment

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. The Selected Remedy includes ICs, containment and engineering operation controls, and source removal/reduction, to reduce or eliminate unacceptable human and ecological exposure to contamination remaining onsite. If no action is taken, potential exposure would result in unacceptable risk to human health and the environment.

2.13.2 Compliance with Applicable or Relevant and Appropriate Requirements and Justification of a Waiver

Remedial actions selected under CERCLA must comply with all ARARs under federal environmental laws or, where more stringent than the federal requirements, State environmental or facility siting laws. Where a state has delegated authority to enforce a federal statute, such as RCRA, the delegated portions of the statute are considered to be a federal ARAR unless the state law is broader in scope than the federal law. ARARs are identified on a Site-specific basis, from information about Site-specific chemicals, specific actions that are being considered, and specific features of the Site's location. There are three categories of ARARs:

- Chemical-specific ARARs are health- or risk-based numerical cleanup or containment values or methodologies, which, when applied to Site-specific conditions, result in the establishment of numerical values for COCs at the Site. These values establish the acceptable amount or concentration of a COC that may be found in or discharged to the ambient environment.
- Location-specific ARARs are restrictions placed on concentrations of hazardous substances or the conduct of activities because of special locations, which have important geographical, biological, or cultural features. Examples of special locations include wetlands, flood plains, sensitive ecosystems, and seismic areas. Location-specific ARARs for the Site include substantive requirements that address federally threatened and endangered species, and migratory birds that have been found at the Site. Location-specific ARARs include the substantive requirements of the ESA and Migratory Bird Treaty Act among other requirements, based on the presence of species that may be exposed to Site-related risks.
- Action-specific ARARs are technology-based or activity-based requirements, or limitations on actions, to be taken in handling hazardous wastes. They are triggered by the particular remedial activities selected to accomplish a remedy. Action-specific ARARs for the Site generally include requirements to address selection, design, operation, monitoring, and closure of remedy systems and components.

Where no ARARs exist for a given chemical, action, or location, EPA may consider non-promulgated federal or State advisories and guidance as "to be considered" criteria (TBC).

Although consideration of a TBC is not required, if standards are selected based on TBC, those standards are legally enforceable as performance standards.

EPA's approach to groundwater at the Site is to apply the selected groundwater cleanup ARARs (MCLs) throughout the plume, except for the designated TI Zone within Area 5 North where it is not technically practicable to meet ARARs. The Selected Remedy incorporates a WMA where ARARs do not apply, and a waiver of the groundwater cleanup ARARs within the designated TI Zone in Area 5 North. This approach complies with CERCLA Section 121(d)(4), is consistent with EPA's presumptive remedy approach to groundwater at municipal waste landfill sites and common practice for large hazardous waste landfill sites, and is protective of human health and the environment. A TI waiver is necessary for groundwater in Area 5 North because the presence of LNAPL, DNAPL, residual NAPL, and dissolved-phase organic and inorganic contamination in low-permeability fractured bedrock make it technically impracticable to remediate and meet the drinking water standards in this area. The Selected Remedy complies with all other ARARs.

Appendix D provides a complete list of ARARs for the Site.

2.13.3 Cost-Effectiveness

CERCLA requires EPA to consider the cost-effectiveness of the Selected Remedy. The NCP defines a cost-effective remedy as one where "costs are proportional to its overall effectiveness." More than one remedial alternative can be cost-effective, and EPA is not required to select the most cost-effective alternative. Overall, effectiveness is determined by evaluating three of the balancing criteria: long-term effectiveness; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness.

The costs associated with the Selected Remedy and the other sitewide alternatives are summarized in Table 2-19. A breakdown of the costs by area for the Selected Remedy is provided in Table 2-20. The detailed costs associated with the Selected Remedy are presented in Appendix E.

EPA judges the No Action Alternative (Alternative 1) as neither protective of human health nor cost-effective.

2.13.4 Utilization of Permanent Solutions and Treatment or Recovery to the Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner. Of those alternatives that are protective of human health and the environment, and comply with ARARs, EPA has determined that the Selected Remedy provides the best balance in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element, in addition to state and community acceptance.

The Selected Remedy will maximize the extent to which permanent solutions and treatment or recovery technologies can be used in a practicable manner. It consists of the following:

- **Area 5 North – Source Removal:** Removing LNAPL and DNAPL will reduce the volume of source material that is acting as a source of contamination to groundwater and reduce the potential for LNAPL and DNAPL to further migrate. Transport of extracted source area liquids (NAPL) to an offsite TSD facility will allow for treatment of this material.
- **Area 5 North – Containment:** Extracting liquids from the PSCT, treating the liquids, and discharging them to the new lined evaporation pond system (footprint of A-Series Pond and/or RCF Pond) will reduce the volume of highly contaminated groundwater and prevent it from migrating toward Area 5 South. MNA processes will supplement these actions to further reduce contaminant concentrations.
- **Areas 5 South and Area 5 West – Restoration and Containment:** Extracting liquids from the three PCTs, treating the liquids, and discharging them to the new evaporation pond (footprint of A-Series Pond and/or RCF Pond) will reduce the volume of moderately contaminated groundwater and prevent it from migrating to the A-, B-, and C-Drainages. MNA processes will supplement these actions to further reduce contaminant concentrations.

2.13.5 Preference for Treatment as a Principal Element

Removing NAPL, a PTW, will reduce the volume of source material that is acting as a source of contamination to groundwater and reduce the potential for NAPL to further migrate. Transport of extracted source area liquids (NAPL) to an offsite TSD facility will allow for treatment of this material.

Although not considered a PTW, extracting liquids from the PSCT and the PCTs (PCT-A, PCT-B, and PCT-C), treating the liquids, and discharging them to the new lined evaporation pond system (footprint of A-Series Pond and/or RCF Pond) will reduce the volume of contaminated groundwater and prevent it from migrating. MNA processes will supplement these actions to further reduce contaminant concentrations.

2.13.6 Five-Year Review Requirements

The NCP at 40 CFR Section 300.430 (f)(4)(ii) requires a five-year review if the remedial action results in hazardous substances, pollutants, or contaminants remaining onsite above levels that allow for unlimited use and unrestricted exposure. This review evaluates whether a remedy currently is, or will be, protective of human health and the environment.

Because the Selected Remedy will result in hazardous substance, pollutants, or contaminants to remain onsite above levels that allow for unrestricted use and unrestricted exposure, a statutory five-year review will be required. A five-year review will be conducted within 5 years after initiation of the remedial action, and every 5 years thereafter, to ensure that the remedy is, or will be, protective of human health and the environment. The five-year review will also include evaluation of the effectiveness of NAPL extraction, ICs, and other pertinent requirements.

2.13.7 Documentation of Significant Changes from Preferred Alternative of Proposed Plan

The Proposed Plan for the Casmalia Resources Superfund Site was released for public comment on November 22, 2018, and the 60-day public comment period closed on January 22, 2018. The Proposed Plan identified Alternative 3 (Capping, Liquids Extraction, Small Evaporation Pond) as the Preferred Alternative for remediation. EPA reviewed all written and oral comments submitted during the public comment period. It was determined that no significant changes to the Selected Remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

PART 3: RESPONSIVENESS SUMMARY

3.1 Stakeholder Comments and EPA Responses

There was significant community response received at the public meeting and provided in writing during the comment period. The comments and EPA responses are included in the Responsiveness Summary as Appendix G of this document.

3.2 Technical and Legal Issues

The Selected Remedy includes many complex technical requirements that will be addressed during the remedial design phase, subject to EPA review and approval.

The five-year review will reevaluate overall cleanup goals (including RLs) to ensure that the Selected Remedy is protective of human health and the environment.

There are no outstanding legal issues.

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Table 2-1. Contaminated Liquids, Extraction, Treatment, and Disposal

Entity	Year	Gallery Well				Sump 9B				PSCT				PCTs			
		Const	Ext	Tmt	Disposal	Const	Ext	Tmt	Disposal	Const	Ext	Tmt	Disposal	Const	Ext	Tmt	Disposal
O/O	1980	X	X	None	P/S LF	-	-	-	-	-	-	-	-	-	-	-	-
O/O	1981	-	X	None	P/S LF	-	-	-	-	-	-	-	-	-	-	-	-
O/O	1982	-	X	None	P/S LF	-	-	-	-	-	-	-	-	-	-	-	-
O/O	1983	-	X	None	P/S LF	-	-	-	-	-	-	-	-	-	-	-	-
O/O	1984	-	X	None	P/S LF	-	-	-	-	-	-	-	-	-	-	-	-
O/O	1985	-	X	None	P/S LF	-	-	-	-	-	-	-	-	-	-	-	-
O/O	1986	-	X	None	P/S LF	-	-	-	-	-	-	-	-	-	-	-	-
O/O	1987	-	X	None	P/S LF	-	-	-	-	-	-	-	-	-	-	-	-
O/O	1988	-	X	None	P/S LF	-	-	-	-	-	-	-	-	-	-	-	-
O/O	1989	-	-	-	-	X	X	Solidification	P/S LF	-	-	-	-	X	X	None	RCF, A-Series
O/O	1990	-	X	None	Offsite TSD, TX	-	X	Solidification	P/S LF	X	-	-	-	-	X	None	RCF, A-Series
O/O	1991	-	X	None	Offsite TSD, TX	-	-	-	-	-	-	-	-	-	X	None	RCF, A-Series
EPA ^{a,b}	1992	-	X	None	Offsite TSD, NJ	-	-	-	-	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
EPA ^a	1993	-	X	None	Offsite TSD, NJ	-	-	-	-	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
EPA ^a	1994	-	X	None	Offsite TSD, NJ	-	X	None	Offsite TSD, NJ	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
EPA ^a	1995	-	X	None	Offsite TSD, NJ	-	X	None	Offsite TSD, NJ	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
EPA ^a	1996	-	X	Bio/PACT	Pond A-5	-	X	Bio/PACT	Pond A-5	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC ^c	1997	-	X	Bio/PACT	Pond A-5	-	X	Bio/PACT	Pond A-5	-	X	GAC	Pond 18/A5	-	X	None	RCF, A-Series
CSC	1998	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18/A5	-	X	None	RCF, A-Series
CSC	1999	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2000	-	X	None	Offsite TSD, CA	-	X	ATS/GAC	Pond 18	-	X	ATS/GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2001	-	X	None	Offsite TSD, CA	-	X	ATS/GAC	Pond 18	-	X	ATS/GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2002	-	X	None	Offsite TSD, CA	-	X	ATS/GAC	Pond 18	-	X	ATS/GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2003	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2004	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2005	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2006	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series

Table 2-1. Contaminated Liquids, Extraction, Treatment, and Disposal

Entity	Year	Gallery Well				Sump 9B				PSCT				PCTs			
		Const	Ext	Tmt	Disposal	Const	Ext	Tmt	Disposal	Const	Ext	Tmt	Disposal	Const	Ext	Tmt	Disposal
CSC	2007	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2008	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2009	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2010	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2011	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2012	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2013	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2014	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2015	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
CSC	2016	-	X	None	Offsite TSD, CA	-	X	None	Offsite TSD, CA	-	X	GAC	Pond 18	-	X	None	RCF, A-Series
Total Volume Extracted (gallons) ^d		Gallery Well: 11,295,940				Sump 9B: 6,876,008				PSCT: 87,704,476				PCTs: 187,115,084			

Notes:

Source: Modified from Table 2-4, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

^a The Owner/Operator controlled PCT extraction from 1992 through 1996

^b EPA Emergency Response Section began operations at the site in August 1992

^c The CSC took over site operations from EPA on September 17, 1997

^d Total volumes are based on site records, but should be considered estimated values, and are through the end of September 2016.

– = did not occur or not applicable

ATS = Ameripure treatment system

Bio/PACT = biologically-activated/powdered-activated carbon treatment

Const = constructed

CSC = Casmalia Steering Committee

EPA = U.S. Environmental Protection Agency

Ext = extraction

GAC = granular activated carbon

O/O = Owner/Operator

P/S LF = pesticide/solvent landfill

PCT = perimeter control trench

PSCT = perimeter source control trench

RCF = runoff containment facility (pond)

Tmt = treatment

X = implies the date that something occurred

TSD = treatment, storage, and disposal (CA – California; NJ – New Jersey; TX – Texas)

Table 2-2. Chemicals of Potential Concern in Soil, Sediment, Surface Water, and Soil Vapor

Parameter Class	CAS_RN	Parameter	Sitewide Soil Matrix COPC	Study Area- Specific Soil Matrix COPC for HHRA	Study Area- Specific Soil Matrix COPC for ERA	Sediment COPC	Surface Water COPC	Onsite Soil Vapor COPC	Offsite Soil Vapor COPC
CYANIDE	A57-12-5	Amenable Cyanide	-	-	-	-	-	-	-
CYANIDE	57-12-5	Total Cyanide	X	-	-	-	-	-	-
DIOXIN	35822-46-9	1,2,3,4,6,7,8-HpCDD	-	-	-	-	-	-	-
DIOXIN	67562-39-4	1,2,3,4,6,7,8-HpCDF	-	-	-	-	-	-	-
DIOXIN	39227-28-6	1,2,3,4,7,8-HxCDD	-	-	-	-	-	-	-
DIOXIN	57653-85-7	1,2,3,6,7,8-HxCDD	-	-	-	-	-	-	-
DIOXIN	57117-44-9	1,2,3,6,7,8-HxCDF	-	-	-	-	-	-	-
DIOXIN	19408-74-3	1,2,3,7,8,9-HxCDD	-	-	-	-	-	-	-
DIOXIN	72918-21-9	1,2,3,7,8,9-HxCDF	-	-	-	-	-	-	-
DIOXIN	3268-87-9	OCDD	-	-	-	-	-	-	-
DIOXIN	39001-02-0	OCDF	-	-	-	-	-	-	-
DIOXIN	URS-TEQ-04	Total Avian Dioxin TEQ	X	-	-	X	X	-	-
DIOXIN	URS-TEQ-06	Total Fish Dioxin TEQ	X	-	-	X	X	-	-
DIOXIN	URS-TEQ-02	Total TEQ	X	-	-	X	X	-	-
HERB	93-72-1	2,4,5-TP (Silvex)	-	-	X	-	-	-	-
HERB	94-82-6	2,4-Dichlorophenoxybutyric acid (2,4-DB)	X	-	-	X	-	-	-
HERB	88-85-7	2-sec-Butyl-4,6-dinitrophenol (Dinoseb)	-	-	X	-	-	-	-
HERB	75-99-0	Dalapon	X	-	-	-	-	-	-
HERB	120-36-5	Dichlorprop	-	-	-	X	-	-	-
HERB	94-74-6	MCPA	X	-	-	-	-	-	-
HERB	93-65-2	MCPP	X	-	-	X	-	-	-

Table 2-2. Chemicals of Potential Concern in Soil, Sediment, Surface Water, and Soil Vapor

Parameter Class	CAS_RN	Parameter	Sitewide Soil Matrix COPC	Study Area- Specific Soil Matrix COPC for HHRA	Study Area- Specific Soil Matrix COPC for ERA	Sediment COPC	Surface Water COPC	Onsite Soil Vapor COPC	Offsite Soil Vapor COPC
Metals	7429-90-5	Aluminum	*	-	-	-	-	-	-
Metals	7429-90-5	Aluminum (Dissolved)	-	-	-	-	-	-	-
Metals	7440-36-0	Antimony	-	-	-	-	X	-	-
Metals	7440-36-0	Antimony (Dissolved)	-	-	-	-	X	-	-
Metals	7440-38-2	Arsenic	-	-	-	-	X	-	-
Metals	7440-38-2	Arsenic (Dissolved)	-	-	-	-	X	-	-
Metals	7440-39-3	Barium	X	-	-	X	X	-	-
Metals	7440-39-3	Barium (Dissolved)	-	-	-	-	X	-	-
Metals	7440-41-7	Beryllium	X	-	-	-	X	-	-
Metals	7440-41-7	Beryllium (Dissolved)	-	-	-	-	X	-	-
Metals	7440-43-9	Cadmium	X	-	-	X	X	-	-
Metals	7440-43-9	Cadmium (Dissolved)	-	-	-	-	X	-	-
Metals	7440-70-2	Calcium	-	-	-	-	**	-	-
Metals	7440-70-2	Calcium (Dissolved)	-	-	-	-	**	-	-
Metals	7440-47-3	Chromium	X	-	-	X	X	-	-
Metals	7440-47-3	Chromium (Dissolved)	-	-	-	-	X	-	-
Metals	7440-48-4	Cobalt	X	-	-	-	X	-	-
Metals	7440-48-4	Cobalt (Dissolved)	-	-	-	-	X	-	-
Metals	7440-50-8	Copper	X	-	-	X	X	-	-
Metals	7440-50-8	Copper (Dissolved)	-	-	-	-	X	-	-
Metals	7439-89-6	Iron	-	-	-	-	**	-	-
Metals	7439-89-6	Iron (Dissolved)	-	-	-	-	**	-	-
Metals	7439-92-1	Lead	X	-	-	X	X	-	-

Table 2-2. Chemicals of Potential Concern in Soil, Sediment, Surface Water, and Soil Vapor

Parameter Class	CAS_RN	Parameter	Sitewide Soil Matrix COPC	Study Area- Specific Soil Matrix COPC for HHRA	Study Area- Specific Soil Matrix COPC for ERA	Sediment COPC	Surface Water COPC	Onsite Soil Vapor COPC	Offsite Soil Vapor COPC
Metals	7439-92-1	Lead (Dissolved)	-	-	-	-	X	-	-
Metals	7439-95-4	Magnesium	-	-	-	-	**	-	-
Metals	7439-95-4	Magnesium (Dissolved)	-	-	-	-	**	-	-
Metals	7439-96-5	Manganese	X	-	-	X	X	-	-
Metals	7439-96-5	Manganese (Dissolved)	-	-	-	-	X	-	-
Metals	7439-97-6	Mercury	X	-	-	X	X	-	-
Metals	7439-97-6	Mercury (Dissolved)	-	-	-	-	X	-	-
Metals	7439-98-7	Molybdenum	X	-	-	X	X	-	-
Metals	7439-98-7	Molybdenum (Dissolved)	-	-	-	-	X	-	-
Metals	7440-02-0	Nickel	X	-	-	X	X	-	-
Metals	7440-02-0	Nickel (Dissolved)	-	-	-	-	X	-	-
Metals	7440-09-7	Potassium	-	-	-	-	**	-	-
Metals	7440-09-7	Potassium (Dissolved)	-	-	-	-	**	-	-
Metals	7782-49-2	Selenium	X	-	-	X	X	-	-
Metals	7782-49-2	Selenium (Dissolved)	-	-	-	-	X	-	-
Metals	7440-22-4	Silver	-	-	-	-	X	-	-
Metals	7440-22-4	Silver (Dissolved)	-	-	-	-	X	-	-
Metals	7440-23-5	Sodium	-	-	-	-	**	-	-
Metals	7440-23-5	Sodium (Dissolved)	-	-	-	-	**	-	-
Metals	7440-28-0	Thallium	X	-	-	X	X	-	-
Metals	7440-28-0	Thallium (Dissolved)	-	-	-	-	X	-	-
Metals	7440-31-5	Tin	X	-	-	X	X	-	-
Metals	7440-62-2	Vanadium	X	-	-	-	X	-	-

Table 2-2. Chemicals of Potential Concern in Soil, Sediment, Surface Water, and Soil Vapor

Parameter Class	CAS_RN	Parameter	Sitewide Soil Matrix COPC	Study Area- Specific Soil Matrix COPC for HHRA	Study Area- Specific Soil Matrix COPC for ERA	Sediment COPC	Surface Water COPC	Onsite Soil Vapor COPC	Offsite Soil Vapor COPC
Metals	7440-62-2	Vanadium (Dissolved)	-	-	-	-	X	-	-
Metals	7440-66-6	Zinc	X	-	-	X	X	-	-
Metals	7440-66-6	Zinc (Dissolved)	-	-	-	-	X	-	-
PAH	91-57-6	2-Methylnaphthalene	-	-	-	X	-	-	-
PAH	83-32-9	Acenaphthene	X	-	-	-	-	-	-
PAH	208-96-8	Acenaphthylene	-	-	X	-	-	-	-
PAH	120-12-7	Anthracene	X	-	-	-	-	-	-
PAH	56-55-3	Benzo(a)anthracene	X	-	-	X	X	-	-
PAH	50-32-8	Benzo(a)pyrene	X	-	-	X	X	-	-
PAH	205-99-2	Benzo(b)fluoranthene	X	-	-	X	X	-	-
PAH	191-24-2	Benzo(g,h,i)perylene	X	-	-	X	X	-	-
PAH	207-08-9	Benzo(k)fluoranthene	X	-	-	-	-	-	-
PAH	218-01-9	Chrysene	X	-	-	X	-	-	-
PAH	53-70-3	Dibenzo(a,h)anthracene	-	-	-	-	X	-	-
PAH	206-44-0	Fluoranthene	X	-	-	X	-	-	-
PAH	86-73-7	Fluorene	X	-	-	X	-	-	-
PAH	193-39-5	Indeno(1,2,3-c,d)pyrene	X	-	-	X	-	-	-
PAH	91-20-3	Naphthalene	X	-	-	X	X	-	-
PAH	85-01-8	Phenanthrene	-	-	-	X	-	-	-
PAH	129-00-0	Pyrene	X	-	-	X	-	-	-
PCB	11096-82-5	Aroclor 1260	X	-	-	X	-	-	-
PCBConger	SUM-PCBC	Sum of PCB Congeners	X	-	-	X	-	-	-
PCBConger	SUM-PCBC	PCBConger-PCBC TEQ	X	-	-	X	-	-	-

Table 2-2. Chemicals of Potential Concern in Soil, Sediment, Surface Water, and Soil Vapor

Parameter Class	CAS_RN	Parameter	Sitewide Soil Matrix COPC	Study Area- Specific Soil Matrix COPC for HHRA	Study Area- Specific Soil Matrix COPC for ERA	Sediment COPC	Surface Water COPC	Onsite Soil Vapor COPC	Offsite Soil Vapor COPC
PCBConger	SUM-PCBC	PCBConger-Total Avian PCBC TEQ	X	-	-	X	-	-	-
PCBConger	35065-29-3	2,2',3,4,4',5,5'-HpCB-180	X	-	-	X	-	-	-
PCBConger	35065-30-6	2,2'3,3'4,4',5-HpCB-170	X	-	-	X	-	-	-
PCBConger	39635-31-9	2,3,3',4,4',5,5'-HpCB-189	X	-	-	X	-	-	-
PCBConger	38380-08-4	2,3,3',4,4',5-HxCB-156	X	-	-	X	-	-	-
PCBConger	69782-90-7	2,3,3',4,4',5'-HxCB-157	X	-	-	X	-	-	-
PCBConger	32598-14-4	2,3,3',4,4'-PeCB-105	X	-	-	X	-	-	-
PCBConger	52663-72-6	2,3',4,4',5,5'-HxCB-167	X	-	-	X	-	-	-
PCBConger	74472-37-0	2,3,4,4',5-PeCB-114	X	-	-	X	-	-	-
PCBConger	31508-00-6	2,3',4,4',5-PeCB-118	X	-	-	X	-	-	-
PCBConger	65510-44-3	2',3,4,4',5-PeCB-123	X	-	-	X	-	-	-
PCBConger	32774-16-6	3,3',4,4',5,5'-HxCB-169	X	-	-	X	-	-	-
PCBConger	57465-28-8	3,3',4,4',5-PeCB-126	X	-	-	X	-	-	-
PCBConger	32598-13-3	3,3',4,4'-TeCB-77	X	-	-	X	-	-	-
PCBConger	70362-50-4	3,4,4',5-TeCB-81	X	-	-	X	-	-	-
PEST	72-54-8	4,4'-DDD	-	-	X	X	-	-	-
PEST	72-55-9	4,4'-DDE	X	-	-	X	-	-	-
PEST	50-29-3	4,4'-DDT	X	-	-	X	-	-	-
PEST	309-00-2	Aldrin	-	-	X	-	-	-	-
PEST	319-84-6	alpha-BHC	-	-	X	-	-	-	-
PEST	5103-71-9	Chlordane, alpha	-	-	-	X	-	-	-
PEST	12789-03-6	Chlordane, gamma	-	-	X	-	-	-	-

Table 2-2. Chemicals of Potential Concern in Soil, Sediment, Surface Water, and Soil Vapor

Parameter Class	CAS_RN	Parameter	Sitewide Soil Matrix COPC	Study Area- Specific Soil Matrix COPC for HHRA	Study Area- Specific Soil Matrix COPC for ERA	Sediment COPC	Surface Water COPC	Onsite Soil Vapor COPC	Offsite Soil Vapor COPC
PEST	319-86-8	delta-BHC	-	-	X	-	-	-	-
PEST	60-57-1	Dieldrin	-	-	X	-	-	-	-
PEST	959-98-8	Endosulfan I	-	-	X	X	-	-	-
PEST	33213-65-9	Endosulfan II	-	-	-	X	-	-	-
PEST	1031-07-8	Endosulfan sulfate	-	-	-	X	-	-	-
PEST	72-20-8	Endrin	-	-	X	X	-	-	-
PEST	76-44-8	Heptachlor	-	-	-	X	-	-	-
PEST	1024-57-3	Heptachlor epoxide	-	X	X	-	-	-	-
PEST	118-74-1	Hexachlorobenzene	X	-	-	X	-	-	-
PEST	143-50-0	Kepone	-	-	-	X	-	-	-
PEST	72-43-5	Methoxychlor	X	-	-	-	-	-	-
PEST	2385-85-5	Mirex	-	X	X	-	-	-	-
SVOC	65-85-0	Benzoic acid	-	-	X	-	-	-	-
SVOC	111-44-4	Bis(2-chloroethyl)ether	-	-	-	-	X	-	-
SVOC	117-81-7	Bis(2-ethylhexyl)phthalate	X	-	-	-	X	-	-
SVOC	84-66-2	Diethylphthalate	X	-	-	-	-	-	-
SVOC	84-74-2	Di-n-butylphthalate	-	-	X	-	-	-	-
SVOC	107-21-1	Ethylene glycol	-	-	-	-	∅	-	-
SVOC	62-75-9	N-Nitrosodimethylamine	-	X	X	-	-	-	-
SVOC	55-18-5	N-Nitrosodiethylamine	-	-	-	-	X	-	-
SVOC	621-64-7	N-Nitrosodipropylamine	-	-	X	-	X	-	-
SVOC	10595-95-6	N-Nitrosomethylethylamine	-	-	X	-	-	-	-
SVOC	930-55-2	N-Nitrosopyrrolidine	-	X	X	-	X	-	-

Table 2-2. Chemicals of Potential Concern in Soil, Sediment, Surface Water, and Soil Vapor

Parameter Class	CAS_RN	Parameter	Sitewide Soil Matrix COPC	Study Area- Specific Soil Matrix COPC for HHRA	Study Area- Specific Soil Matrix COPC for ERA	Sediment COPC	Surface Water COPC	Onsite Soil Vapor COPC	Offsite Soil Vapor COPC
VOC	71-55-6	1,1,1-Trichloroethane	X	-	-	-	-	X	-
VOC	79-00-5	1,1,2-Trichloroethane	-	-	-	-	-	X	-
VOC	75-34-3	1,1-Dichloroethane	X	-	-	X	X	X	-
VOC	75-35-4	1,1-Dichloroethylene	X	-	-	-	-	X	-
VOC	87-61-6	1,2,3-Trichlorobenzene	-	-	-	-	-	-	-
VOC	95-63-6	1,2,4-Trimethylbenzene	-	-	-	-	-	X	X
VOC	106-93-4	1,2-Dibromoethane (EDB)	-	-	-	-	X	-	-
VOC	95-50-1	1,2-Dichlorobenzene	-	-	-	-	-	-	-
VOC	107-06-2	1,2-Dichloroethane	-	-	-	-	-	-	-
VOC	540-59-0	1,2-Dichloroethene	X	-	-	X	-	-	-
VOC	78-87-5	1,2-Dichloropropane	-	-	-	-	-	X	-
VOC	108-67-8	1,3,5-Trimethylbenzene	-	-	-	-	-	X	X
VOC	106-99-0	1,3-Butadiene	-	-	-	-	-	X	X
VOC	541-73-1	1,3-Dichlorobenzene	-	-	-	-	-	-	-
VOC	106-46-7	1,4-Dichlorobenzene	-	-	-	-	-	X	-
VOC	123-91-1	1,4-Dioxane	-	-	-	-	-	-	X
VOC	591-78-6	2-Hexanone	-	-	-	-	-	X	X
VOC	622-96-8	4-Ethyltoluene	-	-	-	-	-	X	-
VOC	67-64-1	Acetone	X	-	-	X	X	X	X
VOC	75-05-8	Acetonitrile	X	-	-	-	X	-	-
VOC	107-02-8	Acrolein	X	-	-	-	-	-	-
VOC	71-43-2	Benzene	X	-	-	X	-	X	X
VOC	75-25-2	Bromoform	-	-	-	-	-	-	-

Table 2-2. Chemicals of Potential Concern in Soil, Sediment, Surface Water, and Soil Vapor

Parameter Class	CAS_RN	Parameter	Sitewide Soil Matrix COPC	Study Area- Specific Soil Matrix COPC for HHRA	Study Area- Specific Soil Matrix COPC for ERA	Sediment COPC	Surface Water COPC	Onsite Soil Vapor COPC	Offsite Soil Vapor COPC
VOC	74-83-9	Bromomethane	-	-	-	-	-	X	-
VOC	75-15-0	Carbon disulfide	X	-	-	X	X	X	X
VOC	56-23-5	Carbon tetrachloride	-	-	-	-	-	X	-
VOC	75-00-3	Chloroethane	-	-	-	-	-	X	-
VOC	67-66-3	Chloroform	-	X	-	-	-	X	X
VOC	74-87-3	Chloromethane	-	-	-	-	-	X	X
VOC	79-38-9	Chlorotrifluoroethene	-	-	-	-	-	-	-
VOC	156-59-2	cis-1,2-Dichloroethene	-	-	-	-	-	X	-
VOC	110-82-7	Cyclohexane	-	-	-	-	-	X	-
VOC	60-29-7	Diethyl ether	-	-	-	-	-	-	-
VOC	108-20-3	Diisopropyl ether	-	-	-	X	-	-	-
VOC	64-17-5	Ethanol	-	-	-	-	-	X	X
VOC	100-41-4	Ethylbenzene	-	-	-	X	-	X	X
VOC	75-69-4	Freon 11 (Trichlorofluoromethane)	-	-	-	-	-	X	-
VOC	76-12-0	Freon 112	-	-	-	-	-	-	-
VOC	76-13-1	Freon 113 (1,1,2-trichloro-1,2,2-trifluo)	X	-	-	X	-	X	-
VOC	75-71-8	Freon 12 (Dichlorodifluoromethane)	-	-	-	-	-	-	-
VOC	142-82-5	Heptane	-	-	-	-	-	X	X
VOC	110-54-3	Hexane	-	-	-	-	-	X	X
VOC	67-63-0	Isopropanol	X	-	-	-	-	X	X
VOC	78-93-3	Methyl ethyl ketone	X	-	-	X	-	X	X

Table 2-2. Chemicals of Potential Concern in Soil, Sediment, Surface Water, and Soil Vapor

Parameter Class	CAS_RN	Parameter	Sitewide Soil Matrix COPC	Study Area- Specific Soil Matrix COPC for HHRA	Study Area- Specific Soil Matrix COPC for ERA	Sediment COPC	Surface Water COPC	Onsite Soil Vapor COPC	Offsite Soil Vapor COPC
VOC	108-10-1	Methyl isobutyl ketone (MIBK)	-	-	-	X	X	X	-
VOC	96-37-7	Methylcyclopentane	-	-	-	X	-	-	-
VOC	75-09-2	Methylene chloride	X	-	-	X	X	X	X
VOC	124-19-6	Nonanal	-	-	-	-	∅	-	-
VOC	123-38-6	Propanal	X	-	-	X	X	-	-
VOC	100-42-5	Styrene	-	-	-	-	-	X	X
VOC	75-65-0	Tert-butyl alcohol (TBA)	X	-	-	-	-	-	-
VOC	127-18-4	Tetrachloroethylene	X	-	-	-	-	X	X
VOC	109-99-9	Tetrahydrofuran	X	-	-	X	-	X	-
VOC	108-88-3	Toluene	X	-	-	-	-	X	X
VOC	1330-20-7	Total xylenes	-	-	-	-	-	X	X
VOC	156-60-5	trans-1,2-Dichloroethylene	-	-	-	-	-	-	-
VOC	79-01-6	Trichloroethylene	X	-	-	X	X	X	X
VOC	75-01-4	Vinyl chloride	-	X	-	-	-	X	-

Notes:

X = compound was selected as a COPC for that medium

- = not applicable

* = not selected as a COPC because site soil pH > 5.5 (EPA, 2003: Ecological Soil Screening Level for Aluminum. OSWER Directive 9285.7.60).

** = the compound was not selected as a COPC because it is an essential nutrient

∅ = compound was detected only in offsite surface water (not in any onsite media); therefore, it was not selected as a COPC

CAS_RN = Chemical Abstracts Service Registry Number

COPC = chemical of potential concern

DDE = dichlorodiphenyldichloroethane

ERA = Ecological Risk Assessment

HHRA = Human Health Risk Assessment

MCPA = 2-methyl-4-chlorophenoxyacetic acid

MCPP = 2-(2-chloro-4-methylphenoxy) propionic acid

OCDD = octachlorodibenzodioxin

OCDF = octachlorodibenzofuran

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PAH = polycyclic aromatic hydrocarbon

PCB = polychlorinated biphenyl

PEST = pesticide

RA = risk assessment

SVOC = semivolatile organic compound

TEQ = toxicity equivalent

VOC = volatile organic compound

Table 2-3. Summary of Risk-Based Concentration Exceedances by Media, Location, and Constituent

Media	Study Area	Constituent(s)	Exceedances
Soil	Capped Landfills Area	None	No unacceptable exposures
	RCRA Canyon	Chromium, Copper, Zinc	Eco RBC exceedance
	West Canyon Spray Area	Chromium, Copper, Zinc	Eco RBC exceedance
	Burial Trench Area	Total DDT, Dioxin TEQ, TCE, Copper	Eco RBC exceedance
	Central Drainage Area	Dioxin TEQ	HH RBC exceedance (one location)
		Total DDT, TCE, Dioxin TEQ, Chromium	Eco RBC exceedance
	Liquids Treatment Area (Hotspot 1)	MCCP	HH RBC exceedance (one Location)
		Total DDT, MCCP, Chromium, Copper, Zinc	Eco RBC exceedance
		Dioxin TEQ	HH RBC exceedance (one location)
	Maintenance Shed Area (Hotspot 2)	Total DDT, Dioxin TEQ, Chromium, Copper, Zinc	Eco RBC exceedance
		Administration Building Area	None
	Roadways Area	Total DDT, PCB Congeners, Chromium, Copper, Zinc	Eco RBC exceedance
	Former Ponds and Pads and Remaining Onsite Areas (Hotspots 3, 4, and 10)	PCE	HH RBC exceedance (one location)
		Total DDT, PCE, TCE, Total PCB congeners, Chromium, Copper	Eco RBC exceedance
Offsite Soils		None	No unacceptable exposures
Sediment	Stormwater Ponds	MCCP	Eco RBC exceedance
	Treated Liquids Impoundments	MCCP	Eco RBC exceedance
	Offsite Sediments	None	No unacceptable exposures
Soil Vapor	Central Drainage Area	PCE	No unacceptable exposures ^a
	Former Ponds and Pads	PCE, TCE	No unacceptable exposures
	Burial Trench Area	TCE	No unacceptable exposures ^a
	North Drainage	1,3-Butadiene	HHRA exceedance – offsite resident (hypothetical)

Table 2-3. Summary of Risk-Based Concentration Exceedances by Media, Location, and Constituent

Media	Study Area	Constituent(s)	Exceedances
Surface Water (Onsite Ponds)	Stormwater Ponds	Arsenic	HHRA exceedance – industrial workers
		Arsenic, Barium, Nickel, Selenium	Eco Exceedance – aquatic plants, aquatic life
	Treated Liquids Impoundments	None	No unacceptable exposures
Surface Water (Onsite drainages)	Onsite	None	No unacceptable exposures
Surface Water (Offsite drainages)	Offsite	None	No unacceptable exposures
Groundwater	On/Offsite	None	No unacceptable exposures ^b

Notes:

Source: Modified from Table 5-3, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

^a PCE and TCE were also identified as COCs for offsite exposures due to potential volatilization into outdoor air (per Table 7-2 from *Final Feasibility Study Report, Casmalia Resources Superfund Site* [CSC, 2016]).

^b Groundwater was evaluated during the risk assessment, but risks were not calculated for groundwater due to the lack of complete exposure pathways and receptor populations. Although EPA has no reason to believe that future property use will rely on onsite groundwater, MCLs will apply as the cleanup goals for the chemicals found in groundwater outside of Area 5 North. The results of the HHRA showed that PCE, TCE, and 90 other chemicals exceed drinking water standards (i.e., MCLs).

Eco RBC Exceedance = listed constituents exceed site-specific ecological risk-based concentration

HH RBC Exceedance = listed constituents exceed site-specific human health risk-based concentrations

HHRA Exceedance = chemical was identified as a risk-driver in the HHRA

Eco Exceedance = chemical was identified as a risk-driver in the ERA

Please note that while there may be a few individual samples in a Study Area that exceed an RBC, the Study Area as a whole may not pose a significant risk due to the use of the 95UCL concentration in the ERA and HHRA. The 95UCL concentration better represents the concentration to which a receptor may be exposed regularly. The sample-specific comparison to the RBCs presented in this section is to only provide context to the discussion of nature and extent of constituents across the Site. See Sections 5.2.3 and 5.3 for human health and ecological chemicals of concern based on the outcome of the risk assessment.

95UCL = 95 percent upper confidence limit

COC = chemical of concern

DDT = dichlorodiphenyltrichloroethane

Eco = ecological

HH = human health

MCL = maximum contaminant level

PCE = tetrachloroethylene/tetrachloroethene

RBC = risk-based concentration

RCRA = Resource Conservation and Recovery Act

TCE = trichloroethylene/trichloroethene

Table 2-4. Chemicals of Concern^a in Surface Soil - Terrestrial Birds, Soil Invertebrates, and Plants

Exposure Area	Tier 1 ERA	Tier 2 ERA ^b	Human Health ^c
RCRA Canyon Area	Risk-driving COPECs identified for further evaluation in the Tier 2 ERA: Cadmium, Chromium, Lead, and Zinc	Chromium, Copper, and Zinc	None
West Canyon Spray Area	Risk-driving COPECs identified for further evaluation in the Tier 2 ERA: Cadmium, Chromium, Copper, and Zinc	Chromium, Copper, and Zinc	None
Administration Building Area	None	None	None
Roadway Area	Risk-driving COPEC identified for further evaluation in the Tier 2 ERA: Chromium	Chromium and Copper	None
Remaining Onsite Area	None	None	None
Former Ponds and Pads Areas	None	None	None
Liquids Treatment Area ^d	Cadmium, Chromium, Vanadium, MCPP, DDT, Total DDT, and Hexachlorobenzene	--	MCPP
Burial Trench Area ^d	Chromium, Vanadium, and TCE	--	None
Maintenance Shed Area ^d	Cadmium, Chromium, Lead, Vanadium, and DDE, and Total DDT	--	None
Central Drainage Area ^d	Chromium, Vanadium, Dioxin TEQ, Total TEQ, Bis (2-ethylhexyl)phthalate, and Endrin ^c	--	None
A-Series Pond ^d	Cadmium and Selenium	--	None
RCF Pond ^d	Chromium	--	None
Pond A-5 ^d	Cadmium, Chromium, and Selenium	--	None
Pond 13 ^d	Cadmium and Selenium	--	None
Pond 18 ^d	Cadmium, Chromium, and Selenium	--	None

Notes:

Source: Modified from Table 7-1, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

^a COCs are those chemicals of potential concern that have been identified in the quantitative risk assessment as exceeding a risk threshold and, therefore, warrant further evaluation in the feasibility study. For areas with planned presumptive remedies, COCs are based on the results of the Tier 1 ERA. For areas with no planned presumptive remedies, COCs are based on the results of the Tier 2 ERA and the HHRA. This applies to surface soil (0 to 6 inches below ground surface).

^b COCs are based on terrestrial birds only.

^c COCs are based on commercial/industrial worker exposures and target risk of $> 1 \times 10^{-5}$ and hazard quotient of > 1 .

^d The exposure area has an assumed presumptive remedy in place and was not evaluated in the Tier 2 ERA.

-- = Exposure area was not evaluated in Tier 2 ERA.

COPEC = chemical of potential ecological concern

Table 2-5. Chemicals of Concern^a in Shallow Soil - Terrestrial Mammals, Soil Invertebrates, and Plants

Exposure Area	Tier 1 ERA	Tier 2 ERA ^b	Human Health ^c
RCRA Canyon Area	Risk-driving COPECs identified for further evaluation in the Tier 2 ERA: Cadmium, Chromium, Copper, and Zinc	None	None
West Canyon Spray Area	Risk-driving COPECs identified for further evaluation in the Tier 2 ERA: Cadmium, Chromium, Copper, and Zinc	None	None
Administration Building Area	None	None	None
Roadway Area	Risk-driving COPEC identified for further evaluation in the Tier 2 ERA: Chromium and Zinc	None	None
Remaining Onsite Area	None	None	None
Former Ponds and Pads Areas	Risk-driving COPEC identified for further evaluation in the Tier 2 ERA: Zinc	None	PCE
Liquids Treatment Area ^d	Cadmium, Molybdenum, Selenium, Zinc, DDT, Total DDT, MCP, Hexachlorobenzene, and Mirex	--	MCP
Burial Trench Area ^d	Molybdenum, Selenium, and Zinc	--	TCE
Maintenance Shed Area ^d	Cadmium, Chromium, Lead, Lead, Zinc, Dioxin TEQ, and Total TEQ	--	None
Central Drainage Area ^d	Molybdenum, Zinc, Dioxin TEQ, and Total TEQ	--	PCE
A-Series Pond ^d	Cadmium, Molybdenum, Selenium, and Zinc	--	None
RCF Pond ^d	Molybdenum, Selenium, and Zinc	--	None
Pond A-5 ^d	Barium, Cadmium, Molybdenum, Selenium, and Zinc	--	None
Pond 13 ^d	Cadmium, Selenium, and Zinc	--	None
Pond 18 ^d	Cadmium, Molybdenum, Selenium, and Zinc	--	None

Notes:

Source: Modified from Table 7-2, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

^a COCs are those chemicals of potential concern that have been identified in the quantitative risk assessment as exceeding a risk threshold and, therefore, warranting further evaluation in the Feasibility Study. For areas with planned presumptive remedies, COCs are based on the results of the Tier 1 ERA. For areas with no planned presumptive remedies, COCs are based on the results of the Tier 2 ERA and the HHRA. This applies to shallow soils (0 to 5.5 feet bgs).

^b COCs based on terrestrial mammals only.

^c COCs based on commercial/industrial worker exposures and target risk of $> 1 \times 10^{-5}$ and hazard quotient of > 1 .

^d Exposure area has a presumptive remedy in place and was not evaluated in the Tier 2 ERA.

-- = Exposure area not evaluated in Tier 2 ERA

bgs = below ground surface

Table 2-6. Chemicals of Concern* in Sediment Based on Aquatic Wildlife and Sediment Invertebrates

Exposure Area	Tier 1 ERA	Tier 2 ERA	Human Health
A-Series Pond	Arsenic, Chromium, Manganese, Mercury, Molybdenum, Selenium, Vanadium, and Zinc	--	None
RCF Pond	Chromium, Avian PCB TEQ, Total TEQ, and MCPP	--	None
Pond A-5	Cadmium, Chromium, Selenium, and MCPP	--	None
Pond 13	None	--	None
Pond 18	Chromium, Selenium, and MCPP	--	None

Notes:

Source: Modified from Table 7-3, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

* No COCs were identified for sediment in the Tier 2 ERA because all of the ponds will have assumed presumptive remedies in place as part of the EPA-approved closure plan for the site, and will be backfilled/graded to prevent accumulation of water; they will be unavailable as a pathway for aquatic receptors, essentially eliminating the potential for adverse effects to aquatic receptors.

-- = Exposure area not evaluated in Tier 2 ERA

Table 2-7. Dissolved Chemicals in Groundwater that Exceed Maximum Contaminant Levels

Chemical	MCL (µg/L)	Maximum Detected Concentration (µg/L)	Location	Date
1,1,1-Trichloroethane	200	410,000	Gallery Well	9/30/1997
1,1,2,2-Tetrachloroethane	1	1,700	PSCT-1	5/23/2002
1,1,2-Trichloroethane	5	2,700	PSCT-1	5/23/2002
1,1-Dichloroethane	5	170,000	PSCT-1	5/23/2002
1,1-Dichloroethylene	6	38,000	PSCT-1	5/23/2002
1,2-Dichloroethane	0.5	110,000	PSCT-1	5/23/2002
1,2-Dichloropropane	5	4,400	PSCT-1	5/23/2002
1,4-dioxane	1 ^e	1,000	RIMW-7	4/22/2008
1,2,3,4,6,7,8-HpCDD	0.00003	8.71	RIPZ-8	10/19/2006
1,2,3,4,6,7,8-HpCDF	0.00003	2.43	RIPZ-8	10/19/2006
1,2,3,4,7,8,9-HpCDF	0.00003	0.343	RIPZ-8	10/19/2006
1,2,3,4,7,8-HxCDD	0.00003	0.0162	RIPZ-8	10/19/2006
1,2,3,4,7,8-HxCDF	0.00003	1.01	RIPZ-8	10/19/2006
1,2,3,6,7,8-HxCDD	0.00003	0.491	RIPZ-8	10/19/2006
1,2,3,6,7,8-HxCDF	0.00003	0.401	RIPZ-8	10/19/2006
1,2,3,7,8,9-HxCDD	0.00003	0.0716	RIPZ-8	10/19/2006
1,2,3,7,8,9-HxCDF	0.00003	0.345	Gallery Well	11/15/2004
1,2,3,7,8-PeCDD	0.00003	0.0287	RIPZ-8	10/19/2006
1,2,3,7,8-PeCDF	0.00003	0.856	RIPZ-8	10/19/2006
2,3,4,6,7,8-HxCDF	0.00003	0.27	RIPZ-8	10/19/2006
2,3,4,7,8-PeCDF	0.00003	0.772	RIPZ-8	10/19/2006
2,3,7,8-TCDD	0.00003	0.000737	Sump 9B	4/14/2005
2,3,7,8-TCDF	0.00003	0.461	RIPZ-8	10/19/2006
Acenaphthylene	0.2 ^{a, f}	58	Gallery Well	12/15/2004
Aluminum-Dissolved	1,000	1,400	RGPZ-6D	4/6/2005
Aluminum-Total	1,000	150,000	RGPZ-6B	3/2/2005
Antimony-Dissolved	6	14	WP-3D	6/5/1998
Antimony-Total	6	25	RGPZ-12D	5/4/2006
Arsenic-Dissolved	50	710	Pond 13	10/28/2004
Arsenic-Total	50	330	Pond A-5	11/3/2004
Barium-Total	1,000	1,300	RG-8B	4/6/2004
Benzene	1	39,000	PSCT-1	5/23/2002
Benzo(a)anthracene	0.2 ^{a, f}	130	Gallery Well	12/15/2004
Benzo(a)Pyrene	0.2 ^{a, f}	34	SW-17	4/15/2005
Benzo(b)fluoranthene	0.2 ^{a, f}	33	Gallery Well	12/15/2004
Benzo(ghi)perylene	0.2 ^{a, f}	43	RGPZ-6B	3/2/2005
Benzo(k)fluoranthene	0.2 ^{a, f}	35	SW-17	4/15/2005

Table 2-7. Dissolved Chemicals in Groundwater that Exceed Maximum Contaminant Levels

Chemical	MCL (µg/L)	Maximum Detected Concentration (µg/L)	Location	Date
Beryllium-Dissolved	4	8	RP-98C	9/26/1997
Beryllium-Total	4	80	WS-4	5/3/2006
Bis(2-ethylhexyl) phthalate	4	19,000	Gallery Well	4/13/2005
Bromodichloromethane	100 ^b	5,400	Gallery Well	11/22/1999
Bromoform	100 ^b	15	Gallery Well	2/11/1998
Cadmium-Dissolved	5	150	MW-18C	4/14/2005
Cadmium-Total	5	422	B-5	12/31/1997
Carbon tetrachloride	0.5	19,000	Gallery Well	9/30/1997
Chlorobenzene	70	400	Gallery Well	11/17/2005
Chloroform	80 ^{b, f}	180,000	PSCT-1	5/23/2002
Chromium-Dissolved	50	110	RIMW-9	5/1/2006
Chromium-Total	50	8,960	B-5	12/31/1997
Chrysene	0.2 ^{a, f}	150	Gallery Well	12/15/2004
cis-1,2-Dichloroethene	6	200,000	PSCT-1	5/23/2002
cis-1,3-Dichloropropene	0.5 ^c	7.1	RAP-3A	4/26/1999
Copper-Dissolved	1,000	3,330	B3B	10/29/1998
Copper-Total	1,000	5,010	B-5	12/31/1997
Dibenz(a,h)anthracene	0.2 ^{a, f}	15	SW-17	4/15/2005
Endrin	2	4,000	Gallery Well	7/18/2000
Ethylbenzene	300	34,000	PSCT-1	10/22/2003
Fluoranthene	0.2 ^{a, f}	210	Gallery Well	12/15/2004
Fluorene	0.2 ^{a, f}	430	Gallery Well	12/15/2004
Freon 11 (Trichlorofluoromethane)	150	20,000	Gallery Well	9/30/1997
Freon 113	1,200	52,000	Gallery Well	9/30/1997
Heptachlor	0.01	0.33	RG-7B	10/16/2003
Heptachlor epoxide	0.01	0.33	WP-3S	5/10/2001
Hexachlorobenzene	1	640	Gallery Well	11/22/1999
Lead-Dissolved	15	218	B3B	1/2/1998
Lead-Total	15	584	B-5	12/31/1997
Lindane (gamma-BHC)	0.2	0.83	RIMW-8	5/10/2006
Manganese-Dissolved	50 ^f	44,000	Gallery Well	11/15/2004
Manganese-Total	50 ^f	44,000	Gallery Well	4/13/2005
MTBE	13	7,000	Gallery Well	7/18/2000
Methylene Chloride	5	1,700,000	PSCT-1	5/23/2002
Naphthalene	0.2 ^{a, f}	150,000	SW-17	4/15/2005
Nickel-Dissolved	100	3,830	Gallery Well	11/5/1998
Nickel-Total	100	26,100	Gallery Well	11/22/1999

Table 2-7. Dissolved Chemicals in Groundwater that Exceed Maximum Contaminant Levels

Chemical	MCL (µg/L)	Maximum Detected Concentration (µg/L)	Location	Date
OCDD	0.00003	112	RIPZ-8	10/19/2006
OCDF	0.00003	16	RIPZ-8	10/19/2006
o-Xylene	1,750 ^d	29,000	PSCT-1	10/22/2003
PCBs	0.5	3,000	Gallery Well	4/13/2005
PCP	1	81	RGPZ-6B	4/18/2005
Pyrene	0.2 ^{a, f}	290	Gallery Well	12/15/2004
Selenium-Dissolved	50	2,900	Pond 13	10/28/2004
Selenium-Total	50	1,600	Pond 13	10/28/2004
Styrene	100	1,100	Rd Sump	7/20/2000
Tetrachloroethylene	5	140,000	Gallery Well	9/30/1997
Thallium-Dissolved	2	22	A2B	9/12/1997
Thallium-Total	2	86	A2B	9/12/1997
Toluene	150	98,000	Gallery Well	9/30/1997
trans-1,2-Dichloroethene	10	2,300	PSCT-1	5/23/2002
Trichloroethylene	5	120,000	PSCT-1	5/23/2002
Vinyl Chloride	0.5	20,000	SW-17	4/15/2005
Xylene (total)	1,750	160,000	PSCT-1	10/22/2003
Zinc-Dissolved	5,000	7,810	Gallery Well	11/5/1998
Zinc-Total	5,000	6,900	Gallery Well	9/30/1997

Notes:

Source: Modified from Appendix A, Table A-3, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

California MCLs are listed above, unless otherwise noted.

^a The federal MCL for PAH compounds is based on benzo(a)pyrene.

^b MCL based on trihalomethane.

^c MCL based on total 1,2-dichloropropene.

^d MCL based on total xylenes.

^e A California/federal MCL is not established; the California Notification Level is listed.

^f California MCL is not established; the federal MCL is listed.

µg/L = microgram per liter (parts per billion)

HpCDD = heptachlorodibenzo-p-dioxin

HpCDF = heptachlorodibenzofuran

HxCDD = hexachlorodibenzo-p-dioxin

HxCDF = hexachlorodibenzofuran

MTBE = methyl tert-butyl ether

PCP = pentachlorophenol

PeCDD = pentachlorodibenzo-p-dioxin

PeCDF = pentachlorodibenzofuran

TCDD = tetrachlorodibenzo-p-dioxin

TCDF = tetrachlorodibenzofuran

Table 2-8. Sitewide Medium-Specific EPCs for Each COC

Media	COC	EPC – Concentration	Units	Basis – Location/Depth	Basis – Data
Soils (HHRA) ^a	MCPD	118	mg/kg	Sitewide Surface Soils: 0-0.5 foot bgs	UCL
		49.2	Mg/kg	Sitewide Shallow Soils: 0-5 feet bgs	UCL
		--	mg/kg	Offsite B-Drainage Soils: 0-5 feet bgs	ND
	PCE	0.1590	mg/kg	Sitewide Surface Soils: 0-0.5 feet bgs	UCL
		11.28	mg/kg	Sitewide Shallow Soils: 0-5 feet bgs	UCL
		--	mg/kg	Offsite B Drainage Soils: 0-5 feet bgs	ND
	TCE	1.03	mg/kg	Sitewide Surface Soils: 0-0.5 feet bgs	UCL
		1.22	mg/kg	Sitewide Shallow Soils: 0-5 feet bgs	UCL
		--	mg/kg	Offsite B Drainage Soils: 0-5 feet bgs	ND
Soils (ERA) ^b	Chromium	66.0	mg/kg	Sitewide Surface Soils: 0-0.5 feet bgs	UCL
		49.9	mg/kg	Sitewide Shallow Soils: 0-5 feet bgs	UCL
	Copper	42.3	mg/kg	Sitewide Surface Soils: 0-0.5 feet bgs	UCL
		25.1	mg/kg	Sitewide Shallow Soils: 0-5 feet bgs	UCL
	Zinc	103	mg/kg	Sitewide Surface Soils: 0-0.5 feet bgs	UCL
		71.4	mg/kg	Sitewide Shallow Soils: 0-5 feet bgs	UCL
Surface Water ^c	Arsenic (total)	220	µg/L	Pondwide surface water	UCL
	Arsenic (dissolved)	390	µg/L	Pondwide surface water	UCL
Soil Vapor ^d	PCE - for HHRA	55,000	ppbv	Onsite soil vapor	Max
	PCE - for ERA	16,478	ppbv	Onsite soil vapor	UCL
	PCE – for HHRA/ERA	1.1	ppbv	Offsite soil vapor	Max
	TCE - for HHRA	150,000	ppbv	Onsite soil vapor	Max
	TCE - for ERA	48,434	ppbv	Onsite soil vapor	UCL
	TCE – for HHRA/ERA	0.69	ppbv	Offsite soil vapor	Max
	1,3-Butadiene - for HHRA	54	ppbv	Onsite soil vapor	Max
	1,3-Butadiene – for ERA	15	ppbv	Onsite soil vapor	UCL
1,3-Butadiene - for HHRA/ERA	8.3	ppbv	Offsite soil vapor	Max	

Notes:

^a Based on Table 7-2c (Summary of EPCs for Onsite Soil Sitewide Without Ponds) and Table 7-3 (Summary of EPCs for Offsite Soil); CSC, 2011.

^b Based on Table 7-2c (Summary of EPCs for Onsite Soil Sitewide Without Ponds); CSC, 2011.

^c Based on Table 7-6 (Summary of EPCs for Onsite Surface Water); CSC, 2011.

^d Based on Table 7-8 (Summary of EPCs for Soil Vapor) and Table 7-9 (Summary of EPCs for Offsite Soil Vapor); CSC, 2011.

EPC = exposure point concentration

Max = maximum (concentration)

mg/kg = milligram per kilogram

ND = not detected

ppbv = part per billion by volume

UCL = upper confidence limit

Table 2-9. Cumulative Risk and Hazard, Potential Exposures to Onsite Soil

Study Area	Commercial/Industrial Worker						Trespasser				Rancher			
	Surface Soil (0 - 0.5 feet bgs)			Shallow Soil (0 to 5 feet bgs)			Surface Soil (0 to 0.5 feet bgs)		Shallow Soil (0 to 5 feet bgs)		Surface Soil (0 to 0.5 foot bgs)		Shallow Soil (0 to 5 feet bgs)	
	Noncancer Hazard	Cancer Risk	Risk/Hazard Drivers	Noncancer Hazard	Cancer Risk	Risk/Hazard Drivers	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk
Administration Building	5E-02	2E-07		5E-02	2E-07		4E-03	5E-09	4E-03	5E-09	--	--	--	--
Burial Trench	4E-01	6E-06		4E-01	7E-06		4E-02	2E-07	4E-02	2E-07	--	--	--	--
Central Drainage	3E-01	9E-06		3E-01	1E-05		2E-02	2E-07	2E-02	2E-07	--	--	--	--
Former Ponds and Pads	9E-02	8E-06		5E-01	5E-05	Tetrachloro-ethylene	7E-03	2E-07	6E-02	2E-06	--	--	--	--
Liquid Treatment	2E+00	7E-06	MCCP	2E+00	6E-06	MCCP	1E-01	1E-07	1E-01	1E-07	--	--	--	--
Maintenance Shed	1E-01	3E-06		1E-01	3E-06		7E-03	5E-08	7E-03	5E-08	--	--	--	--
RCRA Canyon	1E-01	5E-07		9E-02	4E-07		8E-03	1E-08	6E-03	8E-09	--	--	--	--
Roadways	2E-01	5E-06		2E-01	5E-06		1E-02	1E-07	1E-02	1E-07	3E-02	9E-07	3E-02	8E-07
Remaining Onsite	1E-01	5E-06		1E-01	4E-06		9E-03	1E-07	1E-02	9E-08	--	--	--	--
West Canyon Spray	8E-02	5E-07		7E-02	6E-07		5E-03	1E-08	4E-03	1E-08	--	--	--	--

Notes:

Source: Modified from Table 8-1, *Final Remedial Investigation Report, Casmalia Resources Superfund Site* (CSC, 2011).

surface soil = soil between 0 and 0.5 feet bgs

shallow soil = soil between 0 and 5 feet bgs

-- = not applicable

Table 2-10. Cumulative Risk and Hazard, Potential Exposures to Offsite Soil and Offsite Sediment

Study Area	Recreator				Rancher			
	Surface (0 to 0.5 foot bgs)		Shallow (0 to 5 feet bgs)		Surface (0 to 0.5 foot bgs)		Shallow (0 to 5 feet bgs)	
	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk
Offsite Soil ^a	3E-03	7E-09	3E-03	7E-09	1E-02	3E-08	1E-02	3E-08
Offsite Sediment ^b	7E-04	7E-09	--	--	3E-03	3E-08	--	--

Notes:

Source: Modified from Table 8-2, *Final Remedial Investigation Report, Casmalia Resources Superfund Site* (CSC, 2011).

^a Potential exposures to offsite soils are evaluated based on data collected from the B Drainage.

^b Potential exposures to offsite sediment are evaluated based on data collected from North Drainage, A Drainage, and Lower and Upper C Drainages. Exposure pathways evaluated for offsite soil/sediment include: incidental ingestion, dermal contact, and outdoor inhalation.

In addition to the above pathways, ingestion of beef is also evaluated for a rancher.

-- = not applicable

Table 2-11. Cumulative Risk and Hazard, Potential Exposures to Onsite Sediment

Study Area	Commercial/Industrial Worker				Trespasser			
	Surface Sediment (0 to 0.5 foot bgs)		Shallow Sediment (0 to 5 feet bgs)		Surface Sediment (0 to 0.5 foot bgs)		Shallow Sediment (0 to 5 feet bgs)	
	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk	Noncancer Hazard	Cancer Risk
Pond 18	4E-02	2E-07	3E-02	2E-07	2E-03	3E-09	2E-03	3E-09
Pond A-5	7E-02	2E-07	7E-02	1E-07	5E-03	5E-09	4E-03	5E-09

Notes:

Source: Modified from Table 8-3, *Final Remedial Investigation Report, Casmalia Resources Superfund Site* (CSC, 2011). CSC and EPA agreed that two treated liquids impoundments, Pond A-5 and Pond 18, will be drained as part of site remediation. Therefore, potential exposure to pond waters from these two areas were not considered in the HHRA. However, pond sediments were evaluated as exposed surface soils because the ponds will be drained.

Table 2-12. Cumulative Risk and Hazard, Potential Exposures to Onsite Surface Water

Study Area	Commercial/Industrial Worker			Trespasser	
	Noncancer Hazard	Cancer Risk	Risk/Hazard Drivers	Noncancer Hazard	Cancer Risk
A-Series Pond	7E-02	5E-05	Arsenic	8E-03	2E-06
Pond 13	1E-01	8E-05	Arsenic	1E-02	3E-06
RCF Pond	7E-02	5E-05	Arsenic	8E-03	2E-06

Notes:

Source: Modified from Table 8-4, *Final Remedial Investigation Report, Casmalia Resources Superfund Site* (CSC, 2011). CSC and EPA agreed that two treated liquids impoundments, Pond A-5 and Pond 18, will be drained as part of site remediation. Therefore, potential exposure to pond waters from these two areas were not considered in the HHRA. However, pond sediments were evaluated as exposed surface soils because the ponds will be drained.
-- = not applicable

Table 2-13. Cumulative Risk and Hazard, Potential Outdoor Air Exposures to Onsite Soil Vapor (Commercial/Worker)

COPC	Noncancer Hazard	Cancer Risk
1,1,1-Trichloroethane	4E-04	--
1,1,2-Trichloroethane	2E-06	2E-10
1,1-Dichloroethane	4E-04	1E-07
1,1-Dichloroethylene	3E-03	--
1,2,4-Trimethylbenzene	7E-06	--
1,2-Dichloropropane	1E-04	2E-09
1,3,5-Trimethylbenzene	1E-06	--
1,3-Butadiene	8E-05	9E-09
1,4-Dichlorobenzene	2E-08	6E-11
2-Hexanone	1E-07	--
4-Ethyltoluene	2E-07	--
Acetone	1E-06	--
Benzene	1E-06	5E-10
Bromomethane	8E-07	--
Carbon disulfide	2E-08	--
Carbon tetrachloride	2E-03	1E-06
Chloroethane	7E-10	2E-12
Chloroform	6E-04	6E-08
Chloromethane	4E-07	--
cis-1,2-Dichloroethene	1E-03	--
Cyclohexane	2E-08	--
Ethanol	2E-07	--
Ethylbenzene	5E-08	--
Freon 11 (Trichlorofluoromethane)	2E-04	--
Freon 113 (1,1,2-trichloro-1,2,2-trifluoroethane)	1E-04	--
Heptane	6E-08	--
Hexane	3E-06	--
Isopropanol	4E-07	--
Methyl ethyl ketone	1E-06	--
Methyl isobutyl ketone (MIBK)	9E-09	--

Table 2-13. Cumulative Risk and Hazard, Potential Outdoor Air Exposures to Onsite Soil Vapor (Commercial/Worker)

COPC	Noncancer Hazard	Cancer Risk
Methylene chloride	1E-05	2E-09
Styrene	8E-10	--
Tetrachloroethylene	4E-03	3E-07
Tetrahydrofuran	3E-06	7E-10
Toluene	3E-07	--
Total Xylenes	2E-06	--
Trichloroethylene	9E-03	2E-07
Vinyl chloride	7E-05	2E-07
Cumulative Risk	2E-02	2E-06

Notes:

Source: Modified from Table 8-5, *Final Remedial Investigation Report, Casmalia Resources Superfund Site* (CSC, 2011).

The soil vapor-to-outdoor air pathway was evaluated using onsite soil vapor data.

-- = not applicable

Table 2-14. Cumulative Risk and Hazard, Administration Building – Potential Indoor Air Exposures to Vapors Emanating from Soil (Commercial/Industrial Worker)

COPC	Noncancer Hazard	Cancer Risk
1,2,3-Trichlorobenzene	2E-03	--
1,2-Dichlorobenzene	2E-04	--
1,2-Dichloroethene	3E-03	--
1-Butanol	2E-04	--
Acenaphthene	2E-06	--
Acetone	5E-05	--
Anthracene	2E-07	--
Benzene	3E-02	8E-06
Carbon disulfide	8E-03	--
Ethylbenzene	1E-04	--
Fluorene	8E-07	--
Methyl ethyl ketone	9E-06	--
Naphthalene	2E-03	7E-08
Pyrene	5E-08	--
Tert-Butyl Alcohol	1E-04	--
Tetrachloroethylene	2E-02	1E-06
Tetrahydrofuran	5E-05	1E-08
Toluene	6E-04	--
p-Xylene	5E-03	--
Cumulative Risk	6E-02	9E-06

Notes:

Source: Modified from Table 8-6, *Final Remedial Investigation Report, Casmalia Resources Superfund Site* (CSC, 2011).

The soil-to-indoor air pathway was evaluated using Administration Building soil data.

-- = not applicable

Table 2-15. Cumulative Risk and Hazard, Potential Exposures to Onsite Soil, Offsite Sediment, and Offsite Soil Vapor, Hypothetical Offsite Resident

	Surface Soil (0 to 0.5 foot bgs)			Shallow Soil (0 to 5 foot bgs)			Offsite Soil Vapor		
	Noncancer Hazard	Cancer Risk	Risk/Hazard Drivers	Noncancer Hazard	Cancer Risk	Risk/Hazard Drivers	Noncancer Hazard	Cancer Risk	Risk/Hazard Drivers
Administration Building	3E-03	3E-08	--	2E-03	3E-08	--	--	--	--
Burial Trench	7E-01	1E-05	Trichloro-ethylene	7E-01	1E-05	Trichloroethylene	--	--	--
Central Drainage	5E-02	1E-06	--	1E-01	4E-06	Benzene; Tetrachloroethylene	--	--	--
Former Ponds and Pads	4E-02	1E-07	--	1E+00	7E-05	Tetrachloroethylene; Trichloroethylene	--	--	--
Liquids Treatment	1E-02	8E-08	--	1E-02	6E-08	--	--	--	--
Maintenance Shed	1E-03	8E-08	--	2E-03	8E-08	--	--	--	--
RCRA Canyon	5E-03	7E-08	--	4E-03	5E-08	--	--	--	--
Roadways	3E-02	7E-07	--	3E-02	6E-07	--	--	--	--
Remaining Onsite	1E-03	3E-08	--	1E-02	2E-07	--	--	--	--
West Canyon Spray	2E-03	2E-07	--	4E-03	2E-07	--	--	--	--
Offsite Sediment ^{a, b}	2E-01	8E-07	--	4E-03	2E-07	--	--	--	--
Offsite Soil ^{a, c}	7E-01	5E-07	--	7E-01	5E-07	--	--	--	--
Offsite Soil Vapor ^d	7E-01	8E-07	--	7E-01	8E-07	--	3E-02	2E-06	1,3-Butadiene

Notes:

Source: Modified from Table 8-7, *Final Remedial Investigation Report, Casmalia Resources Superfund Site* (CSC, 2011).

Only the outdoor air pathway was evaluated for adjacent residents, assuming they are located next to the site.

^aExposure pathways evaluated for offsite soil and sediment include: incidental ingestion, dermal contact, and outdoor inhalation.

^bPotential exposures to offsite sediment are evaluated based on data collected from North Drainage, A Drainage, and Lower and Upper C Drainages.

^cPotential exposures to offsite soils are evaluated based on data collected from the B Drainage.

^dSoil vapor results collected offsite were used to evaluate the indoor air pathway.

-- = not applicable

Table 2-16. Cleanup Levels for Chemicals of Concern in Soil

Chemicals of Concern	Ecological RBC		Human Health RBC (mg/kg)	Background ^c (mg/kg)	Cleanup Levels	
	Surface Soil ^a (mg/kg)	Subsurface Soil ^b (mg/kg)			Surface Soil ^a (mg/kg)	Subsurface Soil ^b (mg/kg)
Ecological						
Chromium	74	204	--	47	74	204
Copper	25	14	--	19	25	19
Zinc	191	353	--	104	191	353
Human Health						
MCP	--	--	770 ^d	NA	770	770
TCE	--	--	50 ^e	NA	50	50
PCE	--	--	11 ^e	NA	11	11

Notes:

Source: Modified from Table 8-6c, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

^a Selected surface soil ecological risk-based concentration (based on the 95% upper confidence limit on the mean) for 0 to 0.5 foot bgs.

^b Selected surface and shallow soil ecological risk-based concentration (based on the 95% upper confidence limit on the mean) for surface (0 to 0.5 foot bgs) and subsurface (0.5 to 5.5 feet bgs)

^c Background is based on the upper threshold limit using site-specific data (CSC, 2011)

^d Target hazard quotient = 1

^e Target risk = 1×10^{-5}

-- = not applicable (not a chemical of concern for these receptors)

NA = not available

Table 2-17. Sitewide Remedial Alternatives Components

Feasibility Study Area	Alternative 1 No Further Action	Alternative 2 Capping, Liquids Extraction, Large Evaporation Pond	Alternative 3 Capping, Liquids Extraction, Small Evaporation Pond SELECTED REMEDY	Alternative 4 Capping, Liquids Extraction, Offsite Discharge	Alternative 5 Capping, Liquids Extraction, P/S Landfill Dewatering, Small Evaporation Pond	Alternative 6 Capping, Liquids Extraction, P/S Landfill Dewatering, Groundwater Extraction, Offsite Discharge
Area 1 - Capped Landfills, PCB Landfill, BTA, and CDA						
Capped Landfills (P/S, Heavy Metals, Caustics/Cyanide, Acids)	RCRA Cap (existing)	RCRA Cap (existing)	RCRA Cap (existing)	RCRA Cap (existing)	RCRA Cap (existing)	RCRA Cap (existing)
PCB Landfill	-	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap
BTA	-	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap
CDA	-	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap
Area 2 - RCRA Canyon/WCSA*						
8.4-acre RCRA Canyon	-	ET Cap	ET Cap and/or RCRA-Equivalent Hybrid Cap	ET Cap and/or RCRA-Equivalent Hybrid Cap	ET Cap and/or RCRA-Equivalent Hybrid Cap	ET Cap and/or RCRA-Equivalent Hybrid Cap
5.5-acre WCSA	-	Excavate/Backfill	ET Cap and/or RCRA-Equivalent Hybrid Cap	ET Cap and/or RCRA-Equivalent Hybrid Cap	ET Cap and/or RCRA-Equivalent Hybrid Cap	ET Cap and/or RCRA-Equivalent Hybrid Cap
19.3-acre other areas	-	Stormwater BMPs	ET Cap	ET Cap	ET Cap	ET Cap
Area 3 - Former Ponds/Pads, Roadways, Remaining Onsite Areas, MSA, LTA						
MSA (Location 2)	-	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap
LTA (Location 1)	-	Excavate/Asphalt cap	Excavate/Asphalt cap	Excavate/Asphalt cap	Excavate/Asphalt cap	Excavate/Asphalt cap
Ponds A/B (Location 3)	-	Excavate/PCB LF disposal	Excavate/PCB LF disposal	Excavate/PCB LF disposal	Excavate/PCB LF disposal	Excavate/PCB LF disposal
South of PSCT-1 (Location 4)	-	Excavate/PCB LF disposal	Excavate/PCB LF disposal	Excavate/PCB LF disposal	Excavate/PCB LF disposal	Excavate/PCB LF disposal
RISBON-59 (Location 10)	-	Groundwater Monitoring	Groundwater Monitoring	Groundwater Monitoring	Excavate/PCB LF disposal	Excavate/PCB LF disposal
Area 4 - Ponds						
Pond 18	-	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap	RCRA Cap
Pond A-5	-	Lined Cap Retention Basin	Lined Cap Retention Basin	Lined Cap Retention Basin	Lined Cap Retention Basin	Lined Cap Retention Basin
Pond 13	-	Lined Cap Retention Basin	Lined Cap Retention Basin	Lined Cap Retention Basin	Lined Cap Retention Basin	Lined Cap Retention Basin
A-Series	-	RCRA Evaporation Pond	Eco-Cap/RCRA Evaporation Pond	Eco-Cap	Eco-Cap/RCRA Evaporation Pond	Eco-Cap
RCF	-	Eco-Cap	Eco-Cap	Eco-Cap	Eco-Cap	Eco-Cap
Area 5N - Groundwater - North						
WMA and TI Waiver	-	WMA and TI Waiver	WMA and TI Waiver	WMA and TI Waiver	WMA and TI Waiver	WMA and TI Waiver
P/S Landfill						
- Gallery Well	Gallery Well	Gallery Well	Gallery Well	Gallery Well	Gallery Well	Gallery Well
- DNAPL/LNAPL Ext Wells (w/ min. water)	-	DNAPL/LNAPL Extraction	DNAPL/LNAPL Extraction	DNAPL/LNAPL Extraction	-	-
- Landfill dewatering	-	-	-	-	P/S LF de-watering	P/S LF de-watering
Central Drainage Area						
- Sump 9B (contingency measure)	Sump 9B	Sump 9B	Sump 9B	Sump 9B	Sump 9B	Sump 9B
- LNAPL Extraction Wells (skimming)	-	-	-	-	Convert 4 existing monitoring wells to LNAPL extraction wells	Add 12 new LNAPL skimmer wells
Perimeter Containment						
- Upper HSU	PSCT Ext	PSCT Ext	PSCT Ext	PSCT Ext (Offsite discharge)	PSCT Ext	PSCT Ext (Offsite discharge)
- Lower HSU	-	Monitor 12 new LHSU wells	Monitor 12 new LHSU wells	Monitor 12 new LHSU wells	Monitor 12 new LHSU wells	Extraction from 4 new LHSU wells Monitor 8 new LHSU wells
Monitored Natural Attenuation	-	MNA	MNA	MNA	MNA	MNA

Table 2-17. Sitewide Remedial Alternatives Components

Feasibility Study Area	Alternative 1 No Further Action	Alternative 2 Capping, Liquids Extraction, Large Evaporation Pond	Alternative 3 Capping, Liquids Extraction, Small Evaporation Pond SELECTED REMEDY	Alternative 4 Capping, Liquids Extraction, Offsite Discharge	Alternative 5 Capping, Liquids Extraction, P/S Landfill Dewatering, Small Evaporation Pond	Alternative 6 Capping, Liquids Extraction, P/S Landfill Dewatering, Groundwater Extraction, Offsite Discharge
Area 5S - Groundwater - South						
Aggressive extraction	-	-	-	-	-	40 Ext wells
Perimeter Containment	PCT-A/B Extraction	PCT-A/B Extraction	PCT-A/B Extraction	PCT-A/B Extraction (Offsite discharge)	PCT-A/B Extraction	PCT-A/B Extraction (Offsite Discharge)
Monitored Natural Attenuation	-	MNA	MNA	MNA	MNA	MNA
Area 5W - Groundwater - West						
Aggressive extraction	-	-	-	-	-	40 Ext wells (Offsite discharge)
Perimeter Containment	PCT-C Extraction	PCT-C Extraction	PCT-C Extraction	PCT-C Extraction (Offsite discharge)	PCT-C Extraction	PCT-C Extraction (Offsite discharge)
Monitored Natural Attenuation	-	MNA	MNA	MNA	MNA	MNA
Onsite Disposal to Evaporation Pond						
Location	RCF, A-Series, A-5, 18, 13	A-Series (reconstructed, 11 acres)	A-Series and/or RCF (reconstructed, 6 acres)	None	A-Series (reconstructed, 6 ac)	None
Groundwater	PSCT/PCT	PSCT/PCT	PSCT/PCT (after treatment)	-	PSCT/PCT	-
Stormwater	Sitewide, except capped landfill area	Partial RCRA Canyon/WCSA	-	-	-	-
Offsite Disposal to TSDF						
Groundwater/NAPL liquids	-	DNAPL/LNAPL, Gallery Well liquids	DNAPL/LNAPL, Gallery Well Liquids	DNAPL/LNAPL, Gallery Well liquids	P/S LF liquids, Gallery Well liquids	P/S LF liquids, Gallery Well liquids
Offsite Disposal to Casmalia Creek						
Groundwater (treated)	-	-	-	PSCT, PCT (treated)	-	PSCT/PCT, P/S LF, 80 (+/-) wells (treated)
Stormwater	Capped Landfills	Entire site, except partial RCRA Canyon/WCSA	Entire site	Entire site	Entire site	Entire site

Notes:
 Source: Modified from Table 12-1, *Final Feasibility Study Report, Casmalia Resources Superfund Site (CSC, 2016)*.
 * For Area 2, Alternatives 3 through 6, the final cap may be an ET cap or RCRA-equivalent hybrid cap. The cap type and design for the three sub-areas in Area 2 will be determined during remedial design. The bold font is applied for the Selected Remedy.
 BTA = Burial Trench Area
 BMP = best management practice
 CDA = Central Drainage Area
 DNAPL = dense nonaqueous phase liquid
 ET = evapotranspiration
 HSU = hydrostratigraphic unit
 LF = landfill
 LHSU = lower hydrostratigraphic unit
 LNAPL = light nonaqueous phase liquid
 LTA = Liquids Treatment Area
 MNA = monitored natural attenuation
 MSA = maintenance shed area
 NAPL = nonaqueous phase liquid
 P/S = pesticides/solvent
 TI = technical impracticability
 TSDF = treatment, storage, and disposal facility
 WCSA = West Canyon Spray Area
 WMA = Waste Management Area

Table 2-18. Summary of Sitewide Remedial Alternatives Evaluation

Evaluation Criteria	Alternative 1 No Further Action	Alternative 2 Capping, Liquids Extraction, Large Evaporation Pond	Alternative 3 Capping, Liquids Extraction, Small Evaporation Pond SELECTED REMEDY	Alternative 4 Capping, Liquids Extraction, Offsite Discharge	Alternative 5 Capping, Liquids Extraction, P/S Landfill Dewatering, Small Evaporation Pond	Alternative 6 Capping, Liquids Extraction, P/S Landfill Dewatering, Groundwater Extraction, Offsite Discharge
1 Overall Protection of Human Health and the Environment	No	Yes	Yes	Yes	Yes	Yes
2 Compliance with ARARs	No	Yes	Yes	Yes	Yes	Yes
3 Long-term Effectiveness	N/A	●	●	●	●	●
4 Reduction of Toxicity, Mobility or Volume through Treatment	N/A	●	●	●	●	●
5 Short-term Effectiveness	N/A	●	●	●	●	○
6 Implementability	N/A	●	●	●	●	○
7 Cost	N/A	●	●	○	○	○
8 State Acceptance	State agencies (with DTSC as the lead state agency) have expressed support for the Preferred Alternative)					
9 Community Acceptance	Pending review after 60-day public comment period					
Green Impacts Assessment	N/A	●	●	●	●	●
Capital Costs (2014 \$)	\$0	\$53,987,000	\$59,967,000	\$65,737,000	\$69,411,000	\$93,245,000
Annual O&M Costs (2014 \$)	\$2,724,000	\$3,997,000	\$4,065,000	\$7,772,000	\$8,464,000	\$14,849,000
NPV: Capital + O&M, 30-year, 3%	\$53,400,000	\$115,445,000	\$120,224,000	\$195,733,000	\$147,035,000	\$291,069,000
NPV: Capital + O&M, 30-year, 7%	\$33,807,000	\$85,195,000	\$89,499,000	\$138,550,000	\$113,814,000	\$209,924,000

Table 2-18. Summary of Sitewide Remedial Alternatives Evaluation

Evaluation Criteria	Alternative 1 No Further Action	Alternative 2 Capping, Liquids Extraction, Large Evaporation Pond	Alternative 3 Capping, Liquids Extraction, Small Evaporation Pond SELECTED REMEDY	Alternative 4 Capping, Liquids Extraction, Offsite Discharge	Alternative 5 Capping, Liquids Extraction, P/S Landfill Dewatering, Small Evaporation Pond	Alternative 6 Capping, Liquids Extraction, P/S Landfill Dewatering, Groundwater Extraction, Offsite Discharge
NPV: Capital + O&M, 100-year, 3%	\$86,089,000	\$159,052,000	\$163,561,000	\$282,661,000	\$191,734,000	\$412,474,000
NPV: Capital + O&M, 100-year, 7%	\$38,875,000	\$91,956,000	\$96,218,000	\$152,025,000	\$120,744,000	\$228,744,000
Balancing Criteria (Criteria Nos. 3 - 6)		Cost and Green Impacts Assessment				
○ Poor	○ Low	○ Low to Moderate	○ Moderate	○ Moderate to High	○ High	
◐ Poor to Moderate	◐ Low to Moderate	◐ Moderate	◐ Moderate to High	◐ High		
◑ Moderate	◑ Moderate	◑ Moderate to High	◑ High			
◒ Moderate to good	◒ Moderate to High	◒ High				
◓ Good	◓ High					

Notes:

Source: Modified from Table 12-5, *Final Feasibility Study Report*, Casmalia Resources Superfund Site (CSC, 2016).

Green impacts assessment is not one of the nine CERCLA criteria for evaluation of alternatives; however, it is included as a consideration for selection of a remedial alternative.

NPV = net present value

O&M = operations and maintenance

Table 2-19. Estimated Groundwater Cleanup Times and Costs for Sitewide Alternatives 1 through 6

Area	Alternative 1 No Further Action	Alternative 2 Capping, Liquids Extraction, Large Evaporation Pond	Alternative 3 Capping, Liquids Extraction, Small Evaporation Pond SELECTED REMEDY	Alternative 4 Capping, Liquids Extraction, Offsite Discharge	Alternative 5 Capping, Liquids Extraction, P/S Landfill Dewatering, Small Evaporation Pond	Alternative 6 Capping, Liquids Extraction, P/S Landfill Dewatering, Groundwater Extraction, Offsite Discharge
Estimated Groundwater Cleanup Times (years) ^a						
Area 5 North ^b	N/A	>6,300	>6,300	>6,300	>6,300	>6,300
Area 5 South ^c	N/A	>260	>260	>260	>260	>100
Area 5 West ^c	N/A	>220	>220	>220	>220	>100
Estimated Sitewide Alternative Cleanup Costs ^d						
Capital Costs	\$0	\$54.0M	\$60.0M	\$65.7M	\$69.4M	\$93.2M
O&M Costs (per year)	\$2.7M	\$4.0M	\$4.1M	\$7.8M	\$8.5M	\$15.0M
NPV (30 years, 7%)	\$33.8M	\$85.2M	\$89.5M	\$138.6M	\$113.8M	\$209.9M
NPV (30 years, 3%)	\$53.4M	\$115.5M	\$120.2M	\$195.7M	\$147.0M	\$291.1M
NPV (100 years, 7%)	\$38.9M	\$92.0M	\$96.2M	\$152.0M	\$120.7M	\$228.7M
NPV (100 years, 3%)	\$86.1M	\$159.1M	\$163.6M	\$282.7M	\$191.7M	\$412.5M

Notes:

^a Estimated cleanup times are from *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016), including Appendix A – Technical Impracticability Evaluation. The timeframes are based on various analytical models and have considerable uncertainty.

^b The estimated cleanup time for Area 5 North is the time for PCE to diffuse out of the bedrock matrix and reach the groundwater cleanup level of 5 µg/L. This timeframe is after all DNAPL is removed from the fractures and assumes fractures are continually flushed with clean water. Given that the DNAPL is unlikely to completely diffuse from the fractures, and the residual DNAPL cannot be completely removed by remediation, the groundwater concentrations at the site will remain above MCLs for an indeterminate length of time. These prolonged timeframes form a primary basis for EPA's proposed TI Zone and waiver of cleanup levels (i.e., MCLs) for groundwater in Area 5 North.

^c The estimated cleanup times for Area 5 South and Area 5 West are timeframes after sources are removed, so actual timeframes will likely be longer.

^d Estimated costs are from *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

Alternative 3 is EPA's Selected Remedy and is highlighted in **bold**.

M = million

N/A = not applicable (EPA will not be selecting Alternative 1, so cleanup times under this alternative are not provided).

Table 2-20. Description and Cost Estimate Summary for the Selected Remedy

Feasibility Study Area	Description	Selected Remedy Component	Capital Costs 2014 \$	Annual O&M Costs 2014 \$	Present Worth Capital + O&M Costs (2014 \$)		
					O&M Timeframe	Discount Rate	
						3%	7%
1	PCB Landfill, BTA, CDA, Capped Landfills Area – P/S Landfill, EE/CA Landfill Area	RCRA Cap (PCB Landfill, BTA, CDA) + Stormwater Controls + ICs + Monitoring	\$14,018,000	\$318,000	30-Year	\$18,793,000	\$14,749,000
					100-Year	\$23,806,000	\$15,526,000
2	RCRA Canyon, WCSA	ET Cap (entire RCRA Canyon, WCSA) + Stormwater Controls + ICs + Monitoring	\$15,655,000	\$473,000	30-Year	\$23,301,000	\$17,936,000
					100-Year	\$30,322,000	\$19,024,000
3	Former Ponds and Pads, Remaining Onsite Areas, Roadways, Liquids Treatment Area, Maintenance Shed Area	RCRA Cap (Location 2) + Excavate ([Location 3] [20']; [Location 4] [5']) + Excavate/New Asphalt Cap (Location 1) (5') + Groundwater Monitoring (Location 10) + Grading/BMPs (Uncapped Areas) + Stormwater Controls + ICs + Monitoring	\$6,681,000	\$196,000	30-Year	\$9,888,000	\$7,619,000
					100-Year	\$12,814,000	\$8,072,000
4	Stormwater Ponds and Treated Liquid Impoundments – A-Series Pond, RCF Pond, Pond A-5, Pond 13, Pond 18	Eco-Cap (RCF Pond, portion of A-Series Pond) + Construct 6-acre Lined Evaporation Pond (A-Series Pond) + RCRA Cap (Pond 18) + Lined Retention Basin (Ponds A-5, 13) + Stormwater Controls + ICs + Monitoring	\$13,131,000	\$386,000	30-Year	\$21,621,000	\$16,287,000
					100-Year	\$30,318,000	\$17,636,000
5N	Groundwater, Area 5 North	Extraction (PSCT, Gallery Well) + Extraction (NAPL-only in P/S Landfill) + Extraction (NAPL-only in CDA, 4 wells) + Monitoring (12 new LHSU wells) + Treat and Discharge PSCT Groundwater to Onsite Evaporation Pond + ICs + Monitoring (combined with TI Waiver)	\$6,068,000	\$2,128,000	30-Year	\$31,445,000	\$22,402,000
					100-Year	\$43,294,000	\$24,240,000
5S	Groundwater, Area 5 South	Extraction (PCT-A, PCT-B) + Treat/Discharge to Onsite Evaporation Pond + MNA + ICs + Monitoring	\$1,781,000	\$305,000	30-Year	\$7,667,000	\$5,216,000
					100-Year	\$11,863,000	\$5,867,000
5W	Groundwater, Area 5 West	Extraction (PCT-C) + Treat and Discharge to Onsite Evaporation Pond + MNA + ICs + Monitoring	\$2,633,000	\$258,000	30-Year	\$7,509,000	\$5,290,000
					100-Year	\$11,144,000	\$5,853,000
Total Present Worth Cost Estimate			\$59,967,000	\$4,064,000	30-Year	\$120,224,000	\$89,499,000
					100-Year	\$163,561,000	\$96,218,000

Notes:

Source: Modified from Table 12-6, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

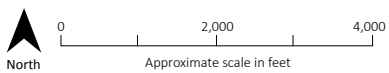
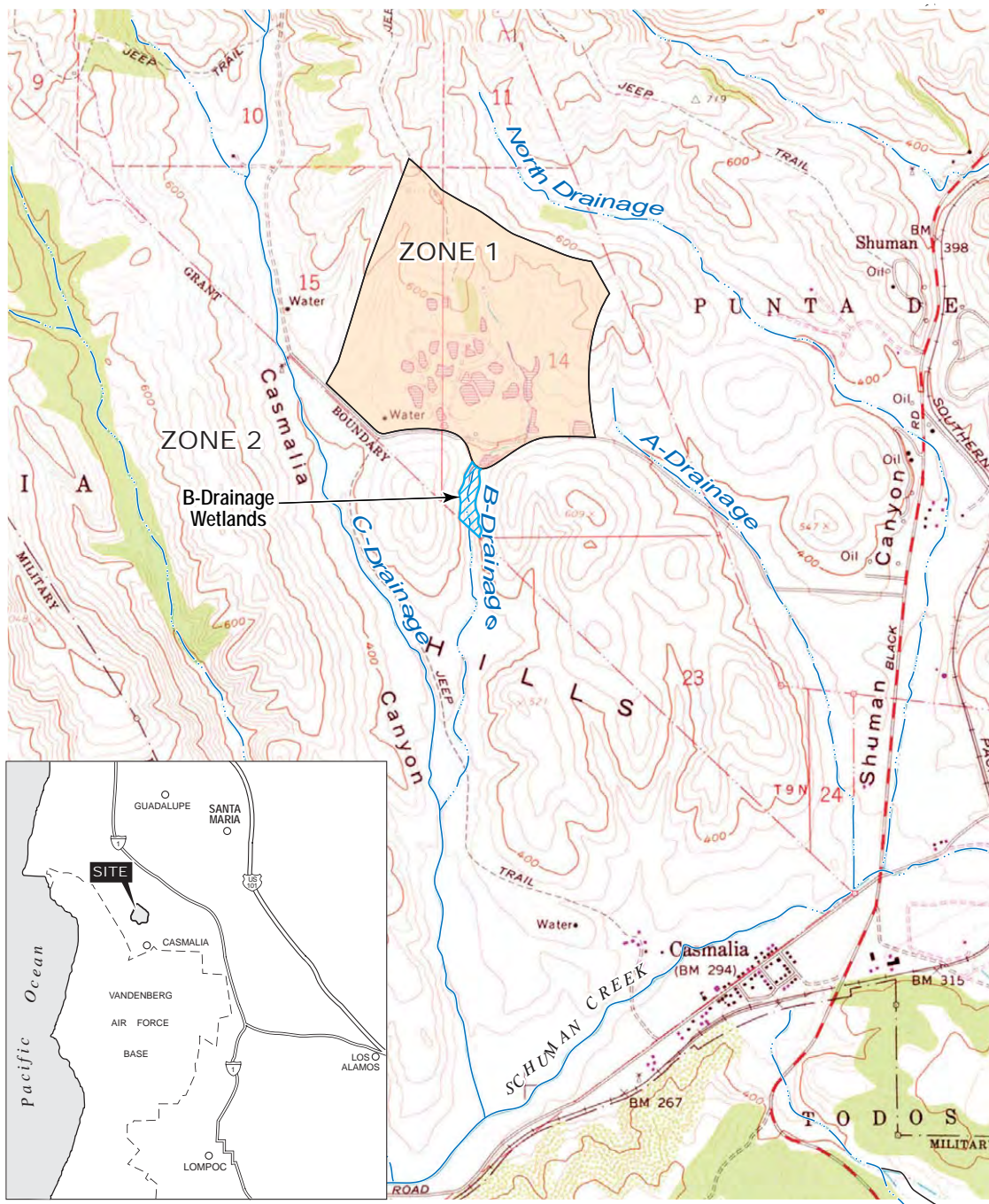
Present worth of capital costs are 2014 dollars, based on an average capital expenditure for each year of 5-year construction period using net discount rate of 3% and 7%. Total present worth of capital + O&M costs are 2014 dollars, based on 30- and 100-year timeframes and include 35% to 50% contingencies.

Costs are presented using net discount rates of 3% and 7%, as suggested in EPA guidance; these are consistent with current expected inflation and return on investments. For FS Area 2, the Selected Remedy would use either an evapotranspiration or hybrid cap but cost estimate assumes an evapotranspiration cap.

EE/CA = engineering evaluation/cost analysis

IC = institutional control

LHSU = lower hydrostratigraphic unit



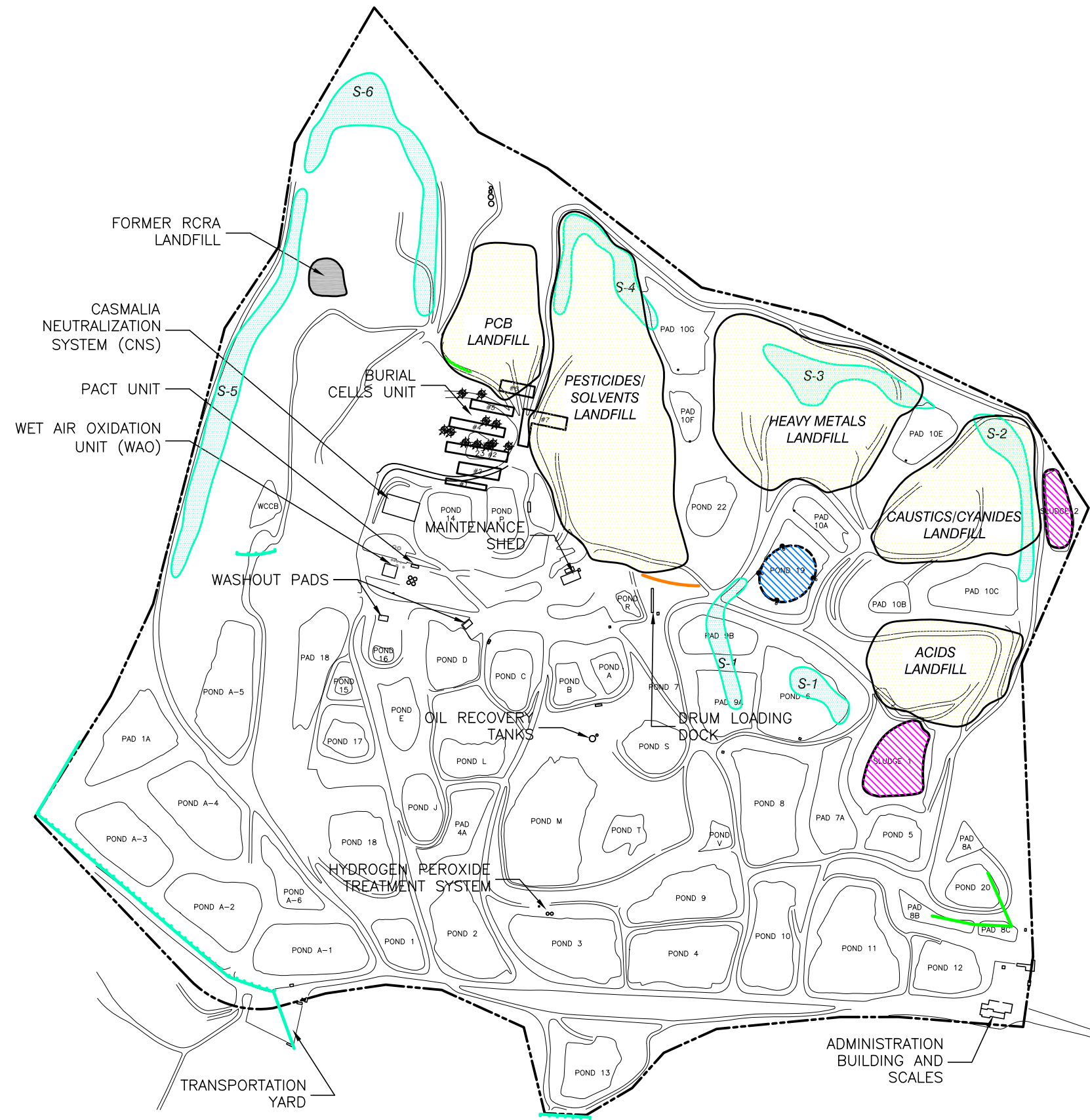
Base Map: USGS 7.5' Topographic Quadrangles:
 Casmalia, CA 1959 (Photorevised 1982);
 Guadalupe, CA 1959 (Photorevised 1982)



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FIGURE 2-1
 Site Location Map
 Record of Decision

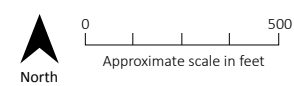
Source: Modified from Figure 1-1, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)




- Burial Trenches, Taken From Figure A21-1-1 (Woodward-Clyde, 1988)
- Injection Well Location, Taken From Figure A21-1-1 (Woodward-Clyde, 1988)
- Former Pond or Pad
- Landfills
- Oil Field Waste Spreading Area
- Non-RCRA Sludge Disposal Area
- Former Drum Burial Area
- Subsurface Clay Barrier
- Clay Barrier/Extraction Trench (Woodward-Clyde, 1988)
- P/S Landfill Clay Barrier (1981 Photograph)

Notes

1. Waste disposal unit locations taken from Figure A21-1-1 (Woodward-Clyde, 1988).
2. Subsurface barriers and trenches taken from Figure 21-1 (Woodward-Clyde, 1988).

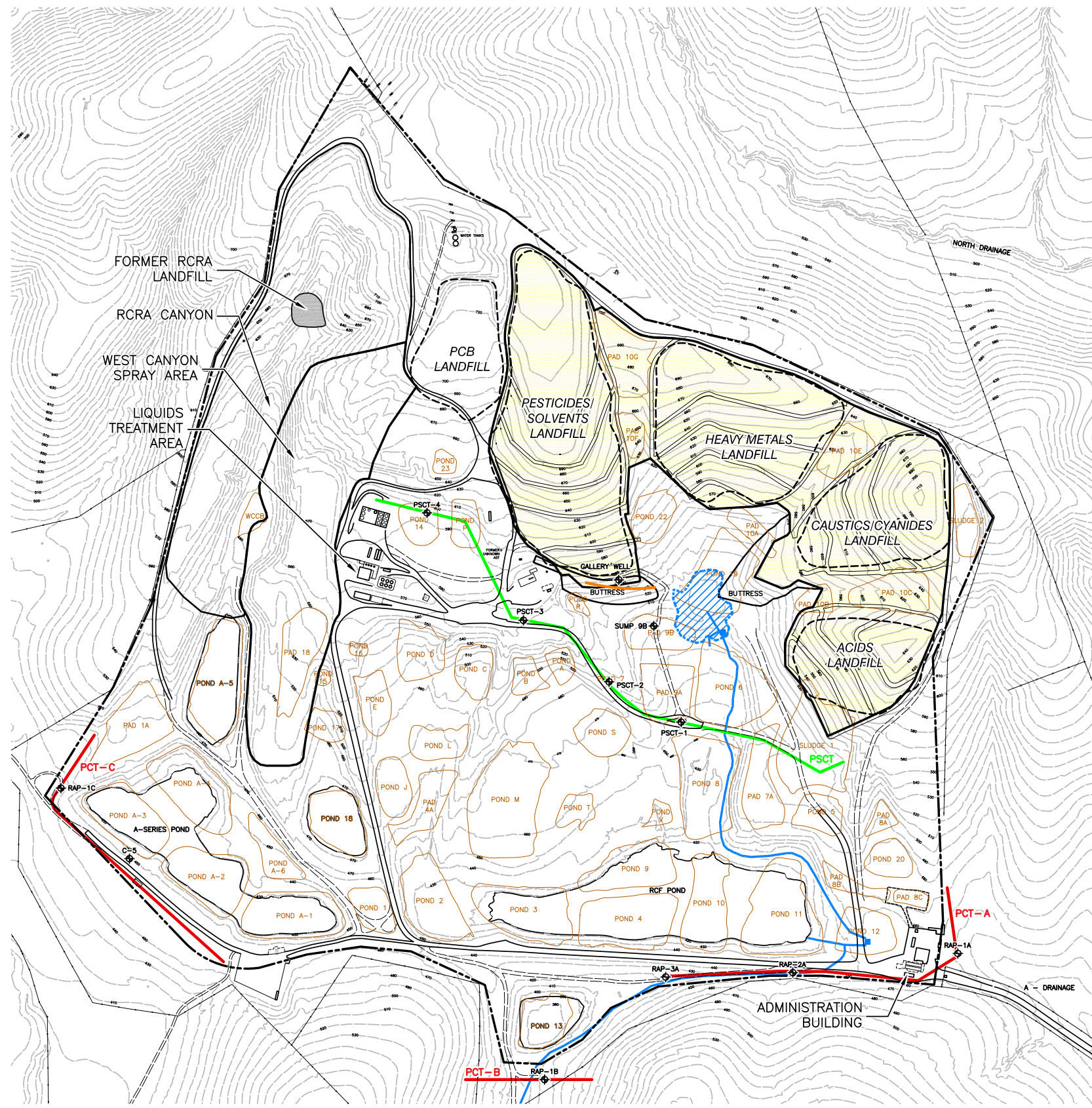




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FIGURE 2-2
Historical Site Layout
Record of Decision

Source: Modified from Figure 2-2, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



LEGEND

- Existing Pond
- Former Ponds and Pads
- Landfill Limits
- Capped Landfills
- Liquids Extraction Location
- Road Location, Dashed Where Unpaved
- Central Drainage Area Collection Basin
- Pipelines
- Perimeter Source Control Trench (Brierly & Lyman, 1989a)
- Perimeter Control Trench (Brierly & Lyman, 1989b)
- P/S Landfill Clay Barrier (1981 Photograph)

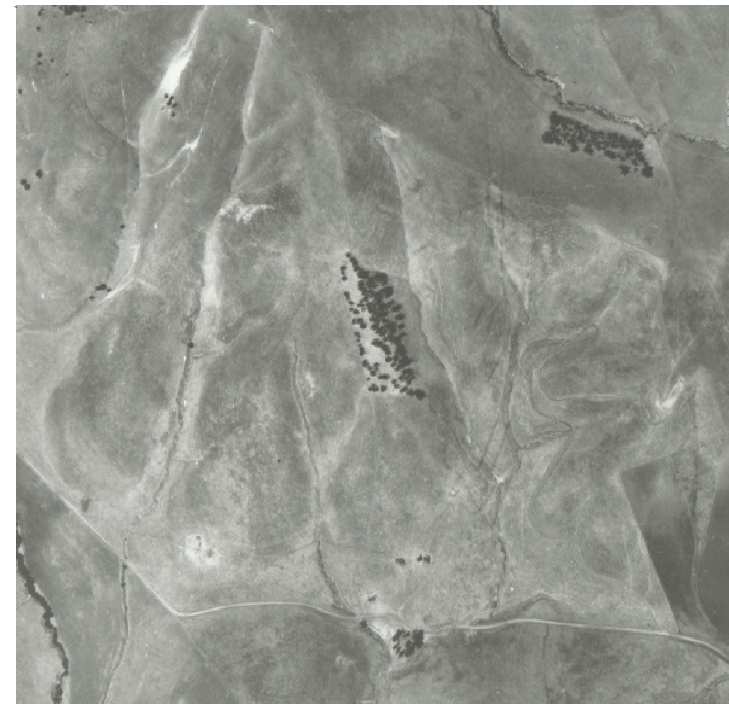
North 0 500
Approximate scale in feet

Topographic Source: Pacific Engineer Associates, July 8 1998

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**FIGURE 2-3
Current Site Layout
Record of Decision**

Source: Modified from Figure 2-1, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



18 JUNE 1970



1974



25 AUGUST 1981



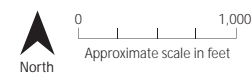
1985-1986



12 FEBRUARY 2002



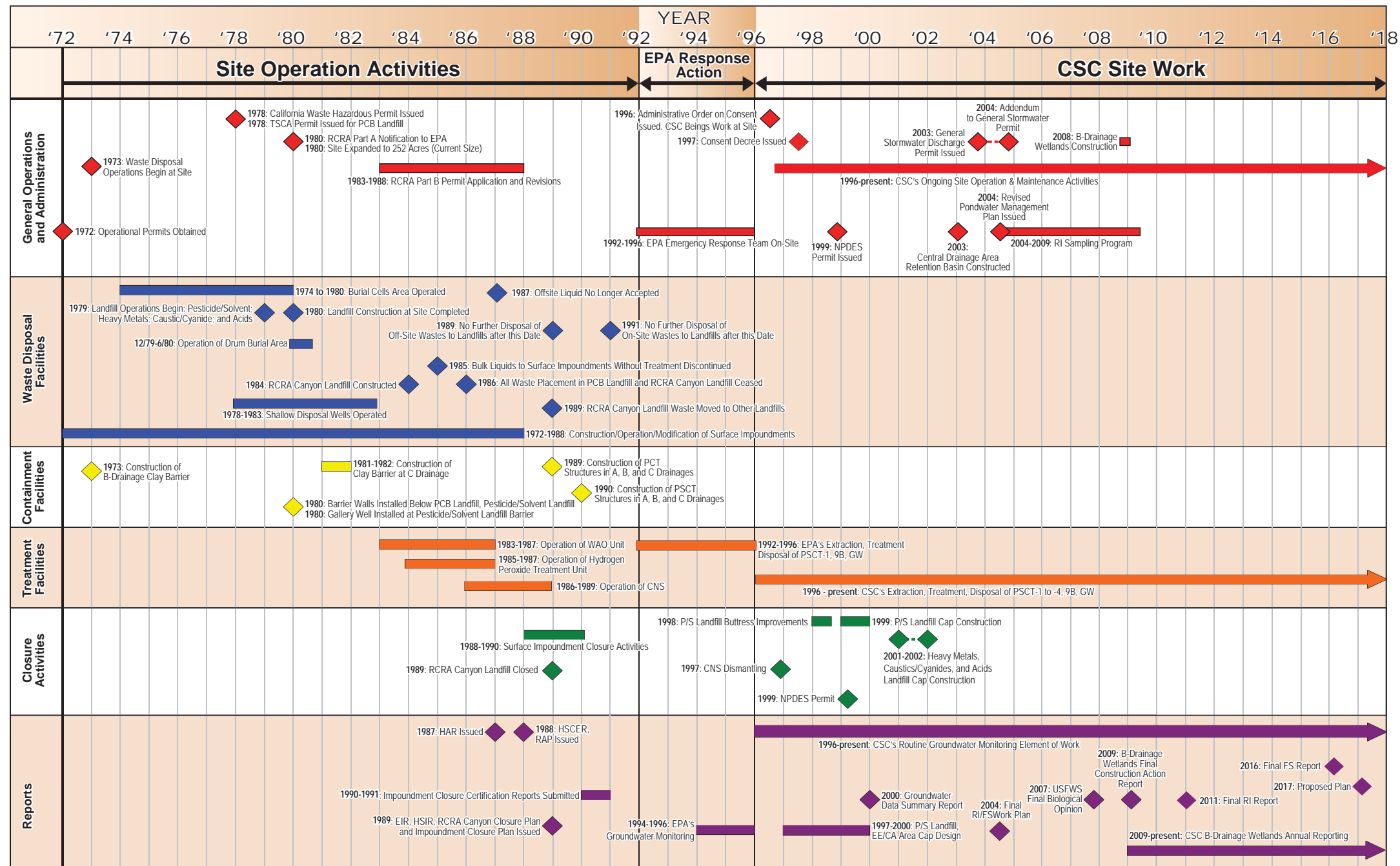
Aerial image © Google Earth, 2016. Annotation by CH2M HILL, 2016.



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FIGURE 2-4
Selected Site Aerial Photographs (1970-2016)
Record of Decision

Source: Modified from Figure 2-6, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



Acronyms

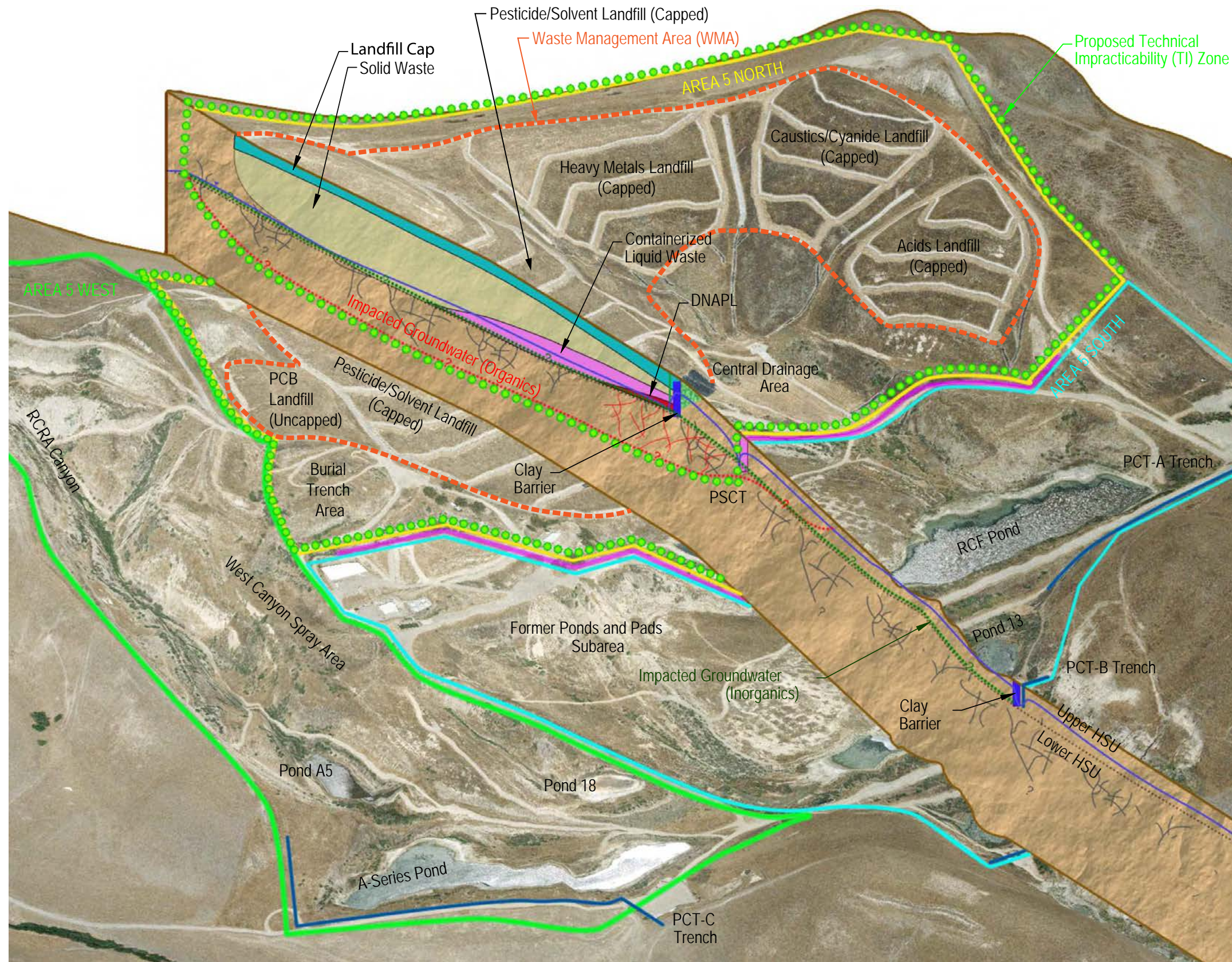
CNS	Casmalia Neutralization System	HSCER	Hydrogeologic Site Characterization and Evaluation Report	RAP	Remedial Action Plan
CSC	Casmalia Steering Committee	HSIR	Hydrogeologic Site Investigation Report	RCRA	Resource Conservation and Recovery Act
EE/CA	Engineering Evaluation/Cost Analysis	NPDES	National Pollution Discharge Elimination System	RI	Remedial Investigation
EIR	Environmental Impact Report	P/S	pesticide/solvent	TSCA	Toxic Substances Control Act
EPA	U.S. Environmental Protection Agency	PCB	Polychlorinated biphenyl	USFWS	U.S. Fish and Wildlife Service
FS	Feasibility Study	PCT	Perimeter Control Trench	WAO	Wet Air Oxidation
HAR	Hydrogeologic Assessment Report	PSCT	Perimeter Source Control Trench		

Source: Modified from Figure 2-3, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



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FIGURE 2-5
Site Chronology and Milestones
Record of Decision



LEGEND

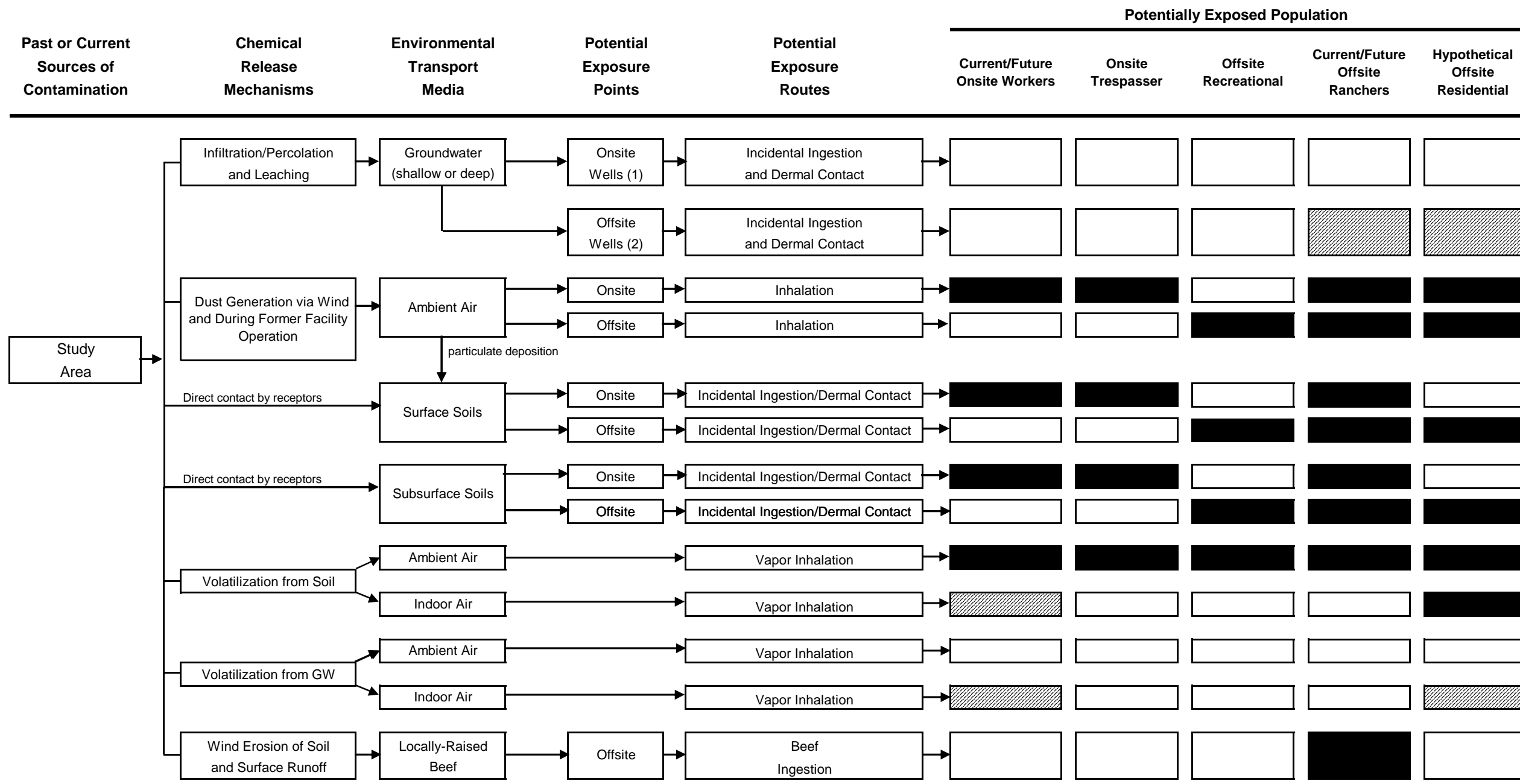
- Fractures
- DNAPL-Filled Fractures
- Proposed Technical Impracticability (TI) Zone
- Waste Management Area (WMA)
- Landfill Cap
- Solid Waste
- Containerized Liquid Waste
- DNAPL
- Extent of Dissolved Phase Organics or DNAPL in Fractures is Uncertain
- Extent of Dissolved Phase Metals is Uncertain
- Upper/Lower HSU Contact (Approximate)
- PSCT
- PCT
- Groundwater Level
- Area 5 North
- Area 5 South
- Area 5 West

Note: Oblique graphic, not to scale, vertical exaggeration is approximately 2 times.

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FIGURE 2-6
Conceptual Site Model Block Diagram
Record of Decision

Source: Modified from Figure 4-24, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



GW: groundwater

(1) Onsite wells not used for Potable Water

(2) Sample results collected from offsite monitoring wells do not indicate a significant impact


■ Potentially complete pathway will be quantitatively evaluated

▨ Insignificant pathway: an exposure estimated to be 2 or more orders of magnitude less than by other pathways (for the same receptor), or if the likelihood of exposure by that pathway is very small (USEPA, 1989)

□ Incomplete Pathway

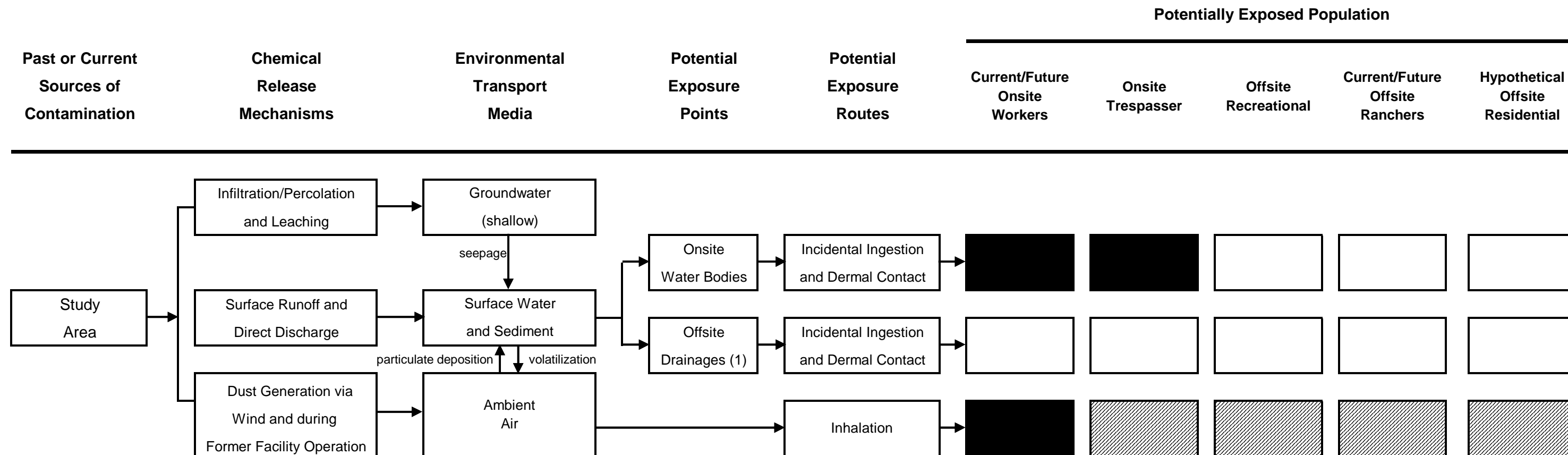
* Including Pond 18 and Pond A-5 Sediments assuming liquids are drained

Section 8



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FIGURE 2-7
Conceptual Site Model, Baseline Human Health Risk
Assessment, Uncapped Areas
Record of Decision



(1) The Site is currently a zero discharge facility

■ Potentially complete pathway will be quantitatively evaluated

▨ Insignificant pathway: an exposure estimated to be 2 or more orders of magnitude less than by other pathways (for the same receptor), or if the likelihood of exposure by that pathway is very small (USEPA, 1989)

□ Incomplete Pathway



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FIGURE 2-8
Conceptual Site Model, Baseline Human Health Risk
Assessment, Surface Water
Record of Decision

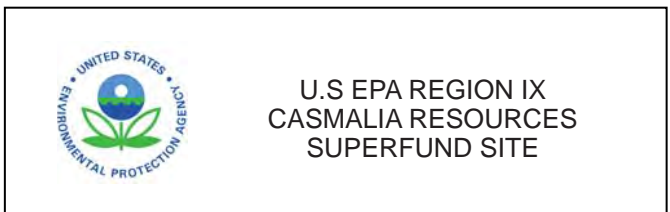
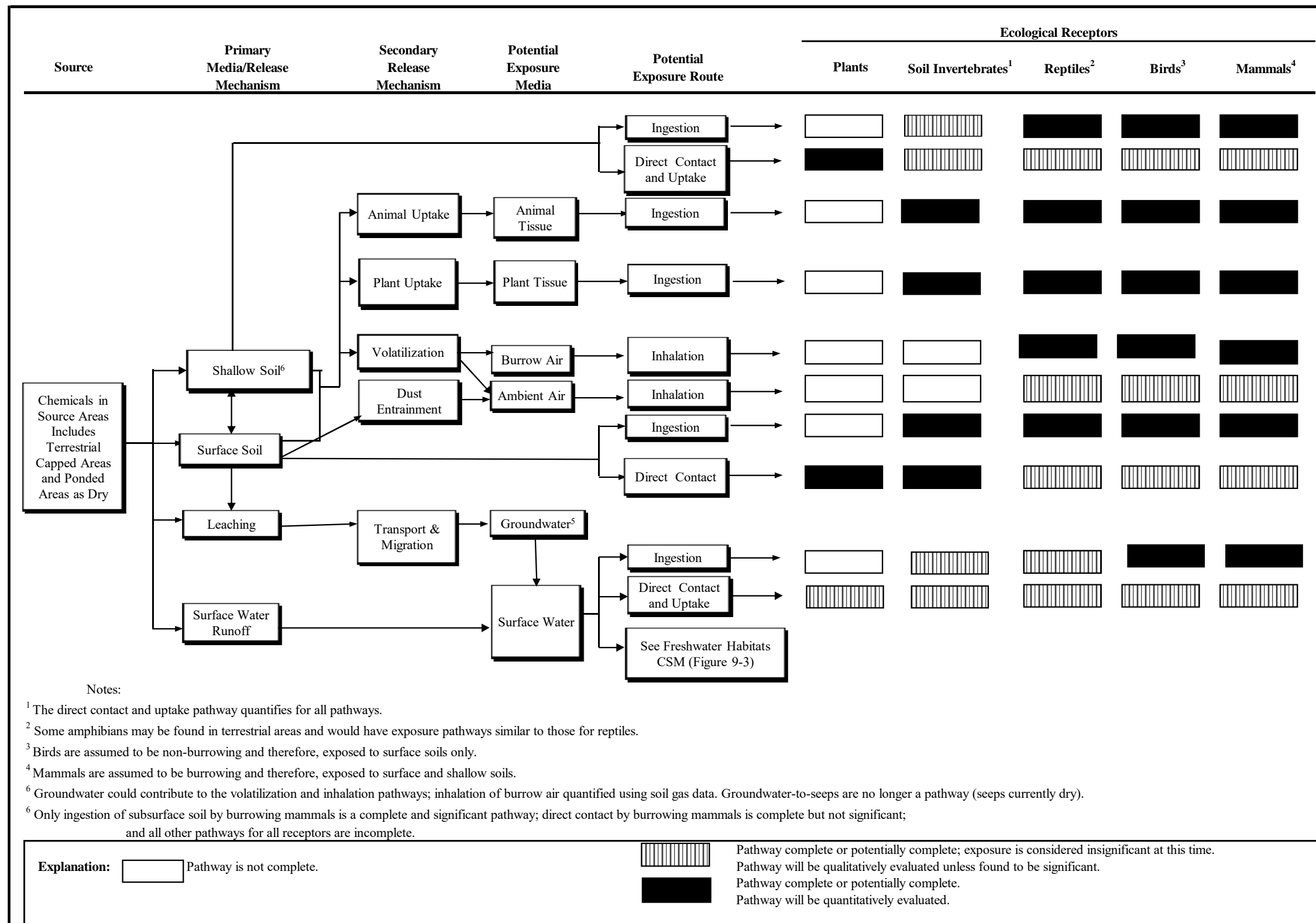
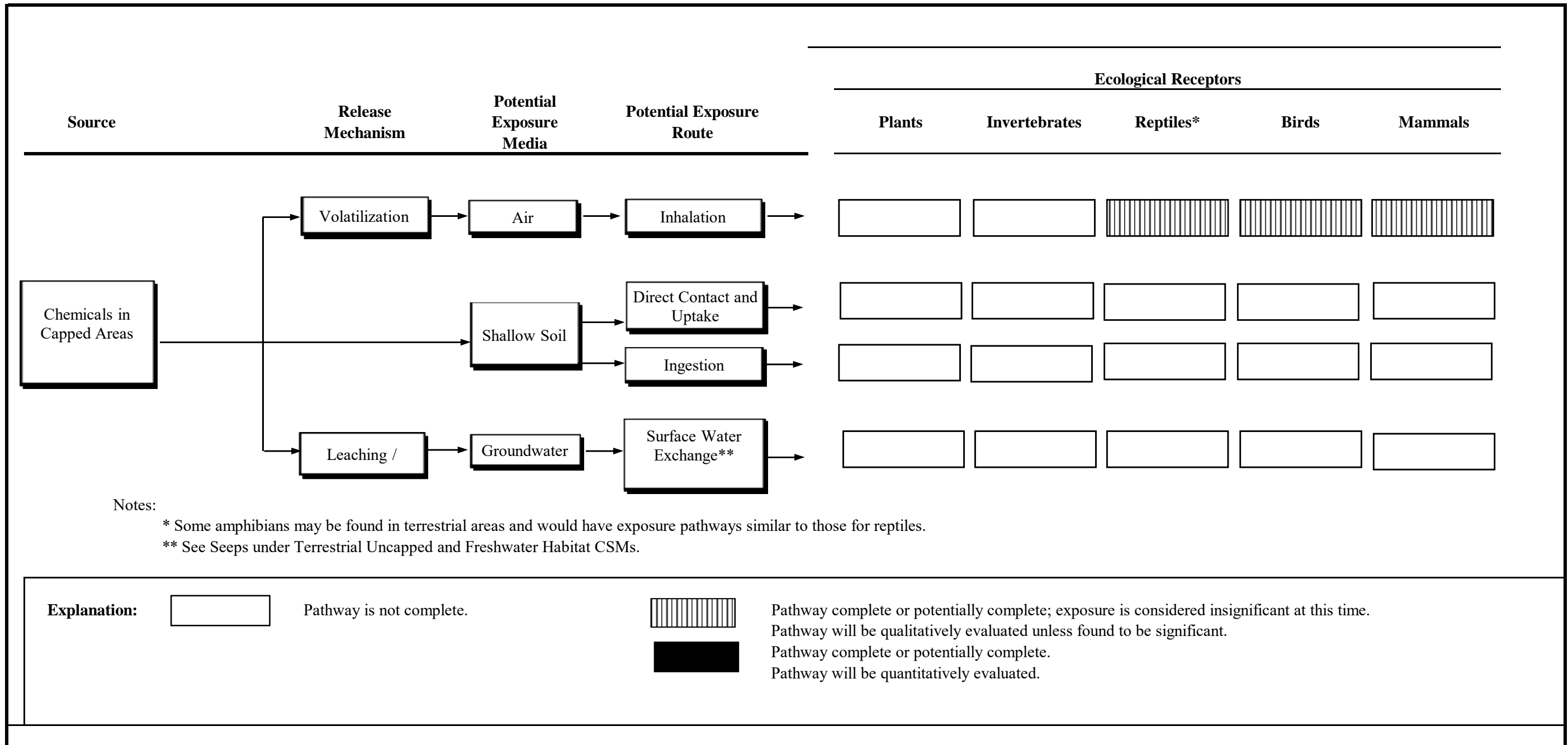

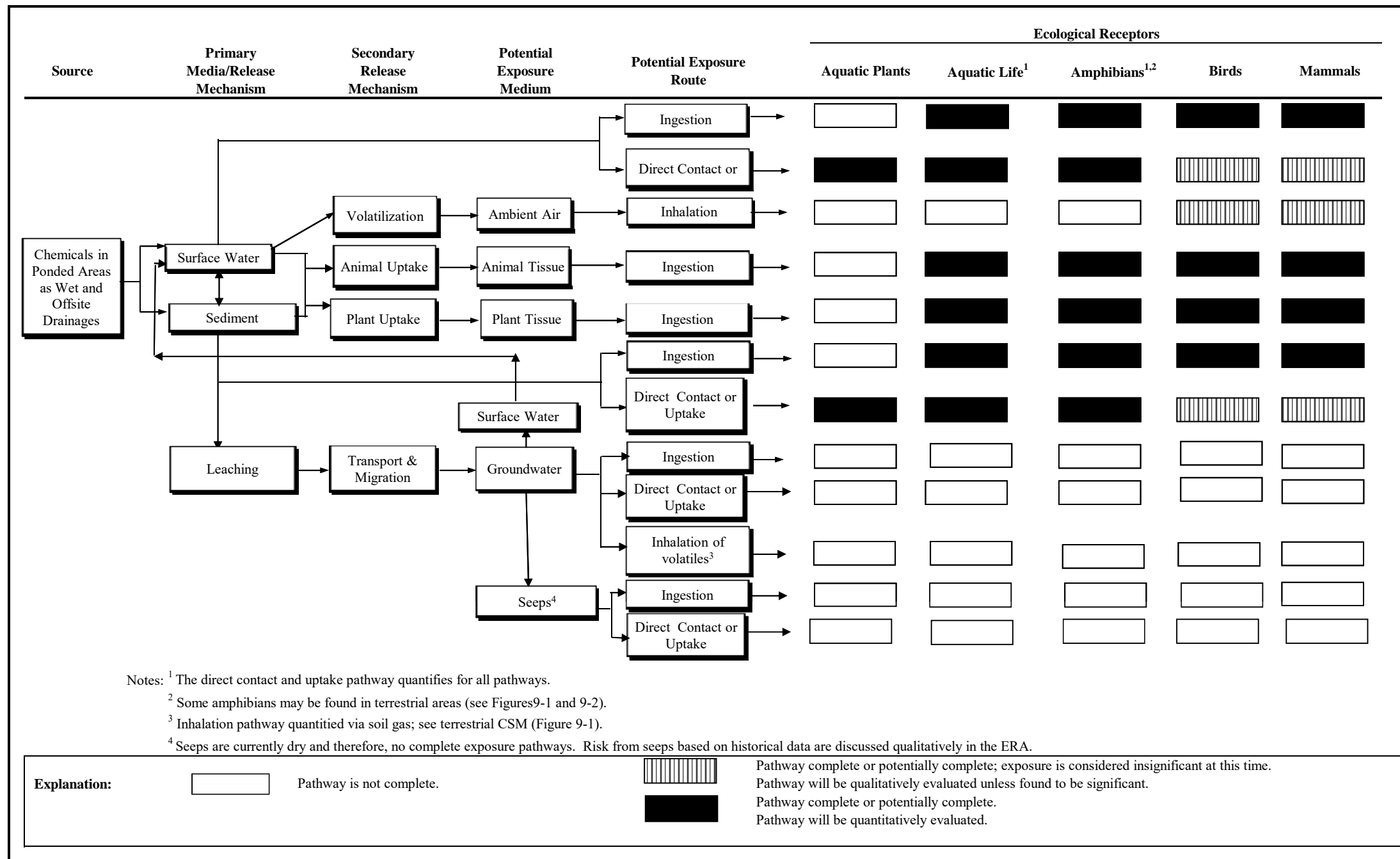



FIGURE 2-9
 Conceptual Site Model, Ecological Risk Assessment,
 Terrestrial Uncapped Areas
Record of Decision

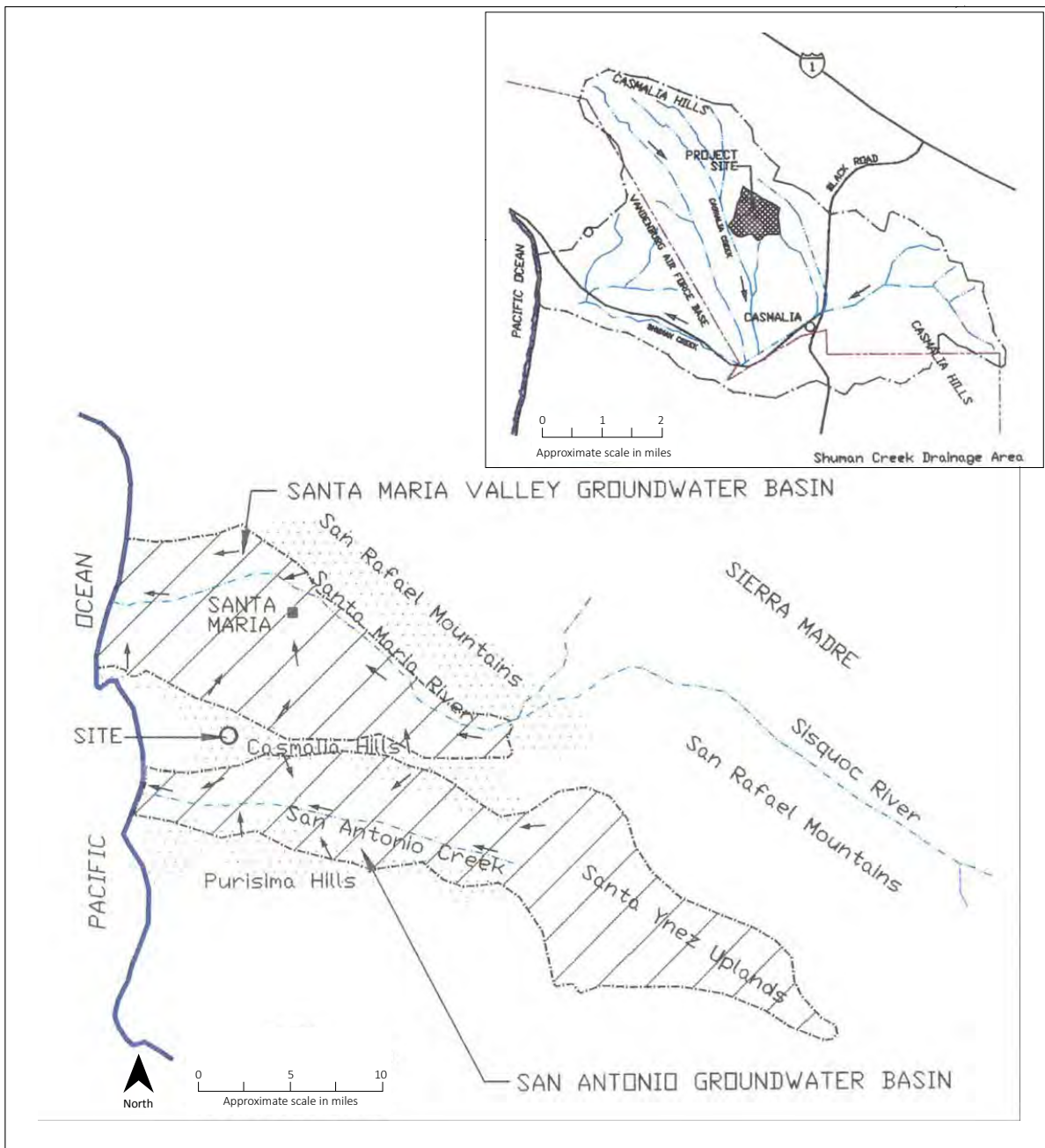
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FIGURE 2-10
 Conceptual Site Model, Ecological Risk Assessment,
 Terrestrial Capped Areas
Record of Decision

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FIGURE 2-11
 Conceptual Site Model, Ecological Risk Assessment,
 Freshwater Habitat Areas
Record of Decision



Source: Topographic base map provided by Pacific Engineering, Inc. from aerial survey dated March 4, 2004.

Explanation

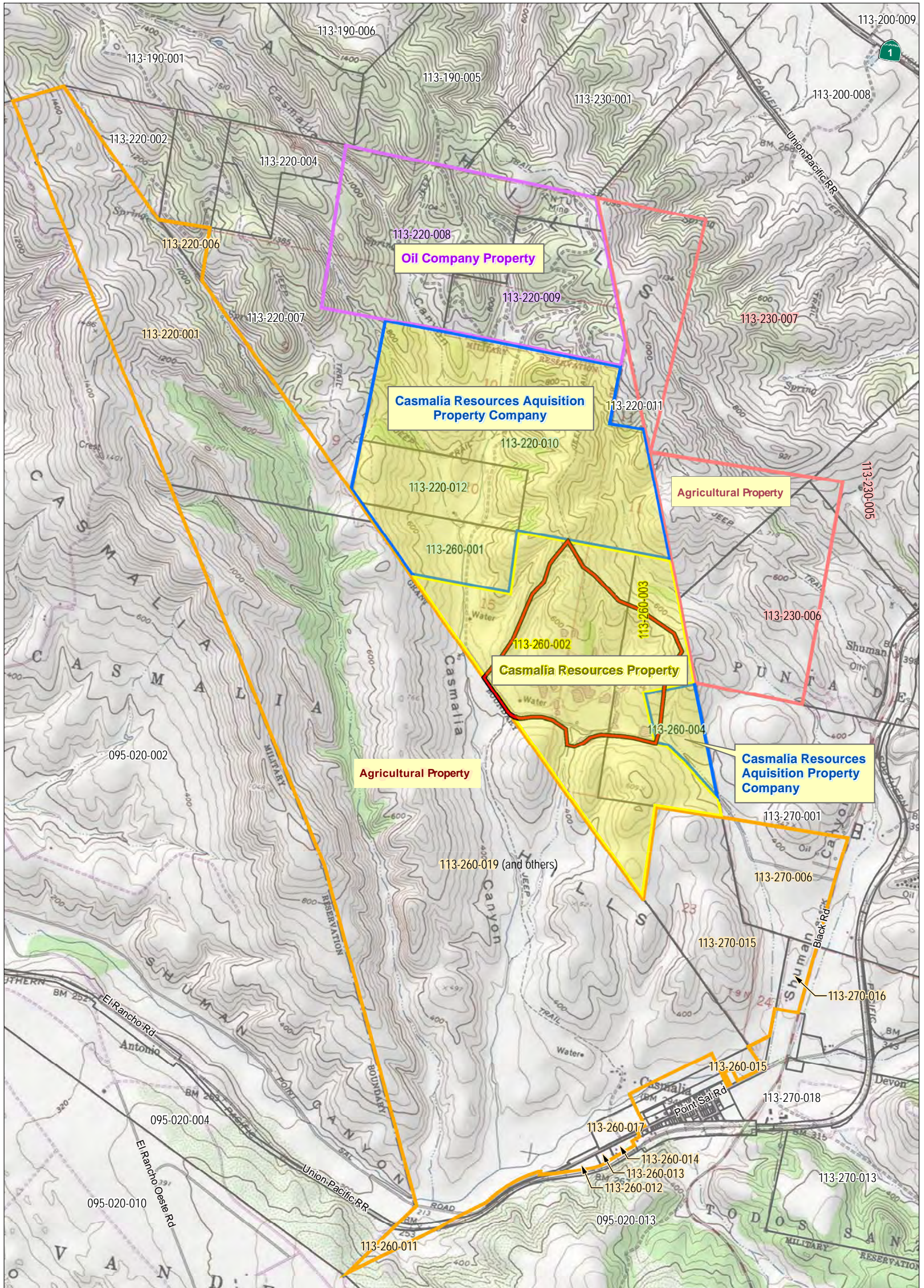
- Approximate Boundary of Groundwater Basin
- Casmalia Resources Facility
- Hills
- River/Creek
- Roads
- Pacific Coast
- Vandenberg Air Force Base Boundary
- Groundwater Flow Direction



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FIGURE 2-12
Local Groundwater Basins
Record of Decision

Source: Modified from Figure 4-6, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



Legend

- Casmalia Disposal Site
- Casmalia Resources Property
- Casmalia Resources Acquisition Property Company
- Oil Company Property
- Agricultural-Zoned Property (west/south of Site)
- Agricultural-Zoned Property (east of Site)
- Highlighted parcels with existing institutional controls (land use covenants)

County Assessor's Parcel Boundaries



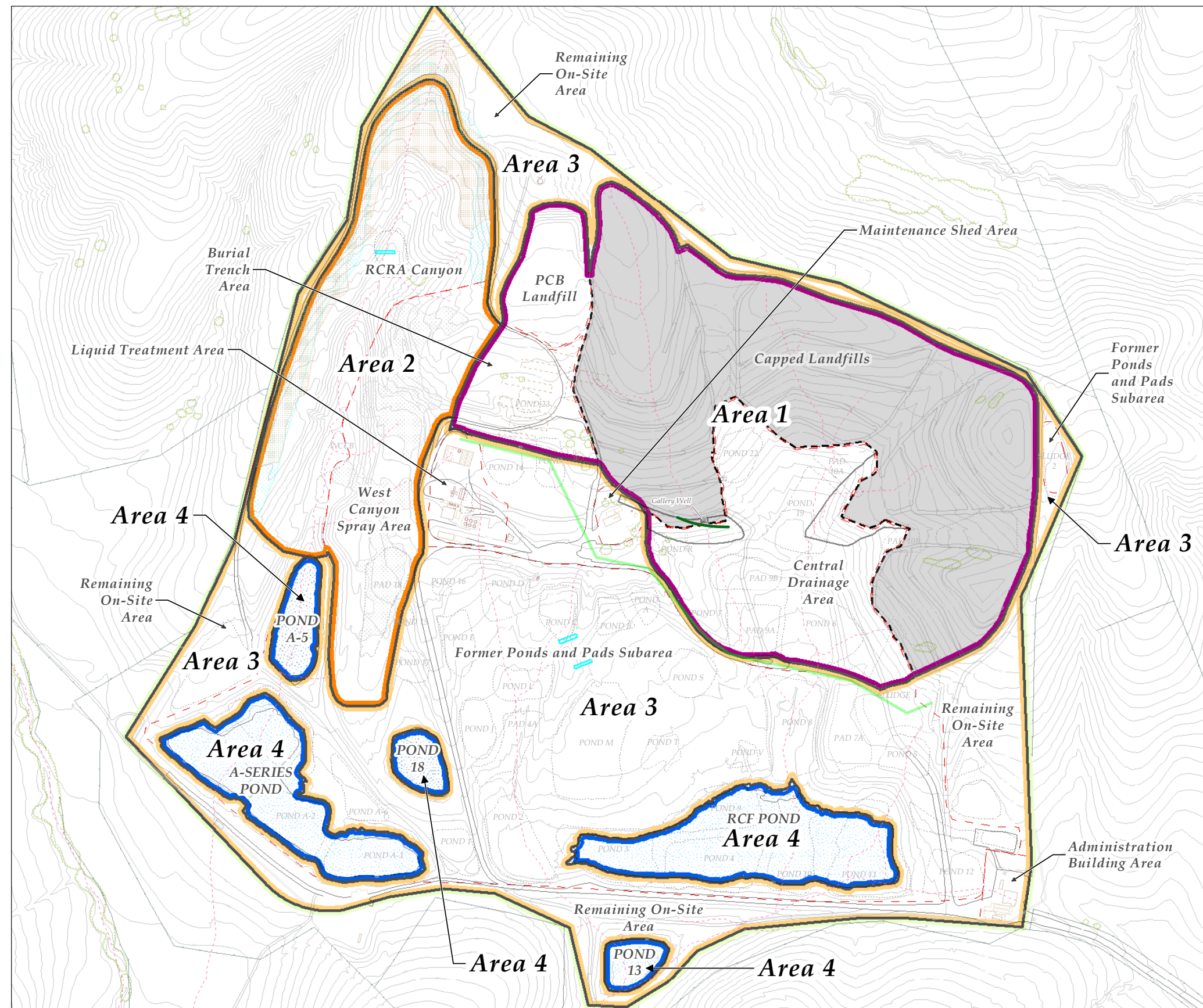
0 2,400 4,800
Approximate scale in feet



**U.S EPA REGION IX
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FIGURE 2-13
Parcel Ownership in Site Vicinity
Record of Decision

Source: Modified from Figure 7-3, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



Explanation

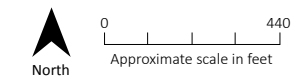

FS Study Area Boundary

- Area 1
- Area 2
- Area 3
- Area 4

Other Site Features

- Casmalia Site Boundary
- RI Study Area
- Existing Extent of Capped Landfills
- P/S Landfill Clay Barrier (1981 Photograph)
- Perimeter Source Control Trench (Brierly & Lyman, 1989a)
- Perimeter Control Trench (Brierly & Lyman, 1989b)
- Buttress
- Burial Trench Location (Figure A21-1-1 Woodward-Clyde, 1988)
- Historical Natural Drainage (Based on 1956 Photo, 1974 Topographic Maps, and Figures 21-2 and 21-3 Woodward-Clyde, 1988)
- Historical Feature
- Former Waste Burial Area
- Fence
- Oil Field Waste Spreading Area (Based on 1983, 1985/86 Photos)
- Oil Field Waste Spreading Area (Figure A21-1-1 Woodward-Clyde, 1988)
- 1983 Spray Area
- Stormwater Pond
- Treated Liquid Impoundment

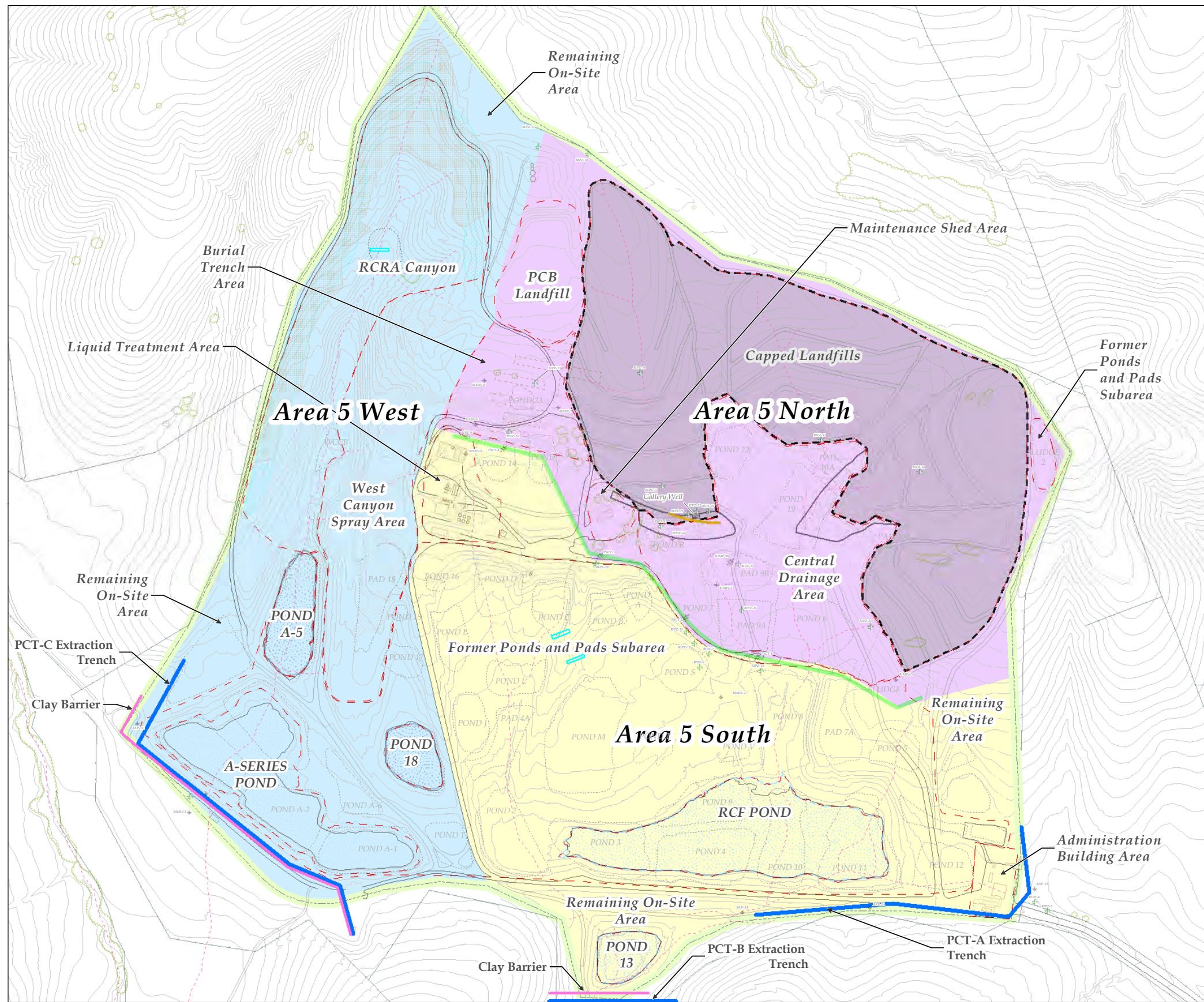
Source: Topographic base map provided by Pacific Engineering, Inc. from aerial survey dated March 4, 2004.

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FIGURE 2-14
Feasibility Study Areas 1 through 4
Record of Decision

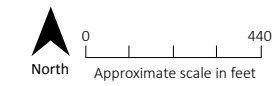
Source: Modified from Figure 8-1A, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)




Explanation

- Area 5 North
- Area 5 West
- Area 5 South
- Other Site Features**
- Casmalia Site Boundary
- RI Study Area
- Existing Extent of Capped Landfills
- Piezometer
- Monitoring Well
- Liquids Extraction Well
- P/S Landfill Clay Barrier (1981 Photograph)
- Perimeter Source Control Trench (Brierly & Lyman, 1989)
- PCT Extraction Trench
- Clay Barrier
- Buttress
- Burial Trench Location (Figure A21-1-1 Woodward-Clyde, 1988)
- Historical Natural Drainage (Based on 1956 Photo, 1974 Topographic Maps, and Figures 21-2 and 21-3 Woodward-Clyde, 1988)
- Historical Feature
- Former Waste Burial Area
- Fence
- Oil Field Waste Spreading Area (Based on 1983, 1985/86 Photos)
- Oil Field Waste Spreading Area (Figure A21-1-1 Woodward-Clyde, 1988)
- 1983 Spray Area
- Stormwater Pond
- Treated Liquid Impoundment

Source: Topographic base map provided by Pacific Engineering, Inc. from aerial survey dated March 4, 2004.





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FIGURE 2-15
Feasibility Study Area 5
Record of Decision

Source: Modified from Figure 8-1B, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)

LEGEND

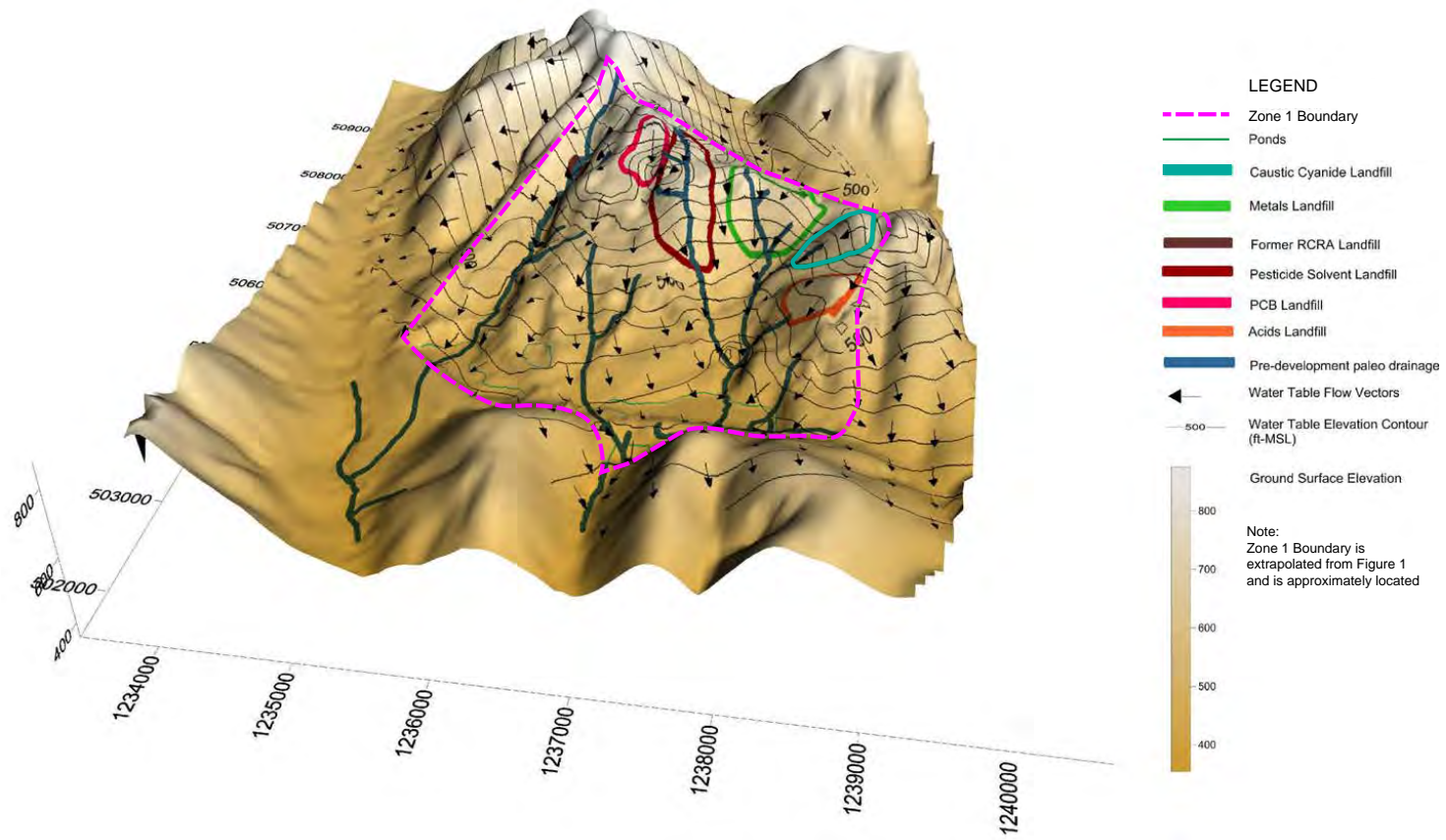
- Recommended for Closure
- Closure Process Incomplete: Constituents in Excess of Target Cleanup Levels (TCLs) Locally Left in Place
- Recommended for Closure as Landfill by Capping as Part of Selected Remedy



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FIGURE 2-16
Closure Status of Former Surface Impoundments
Record of Decision

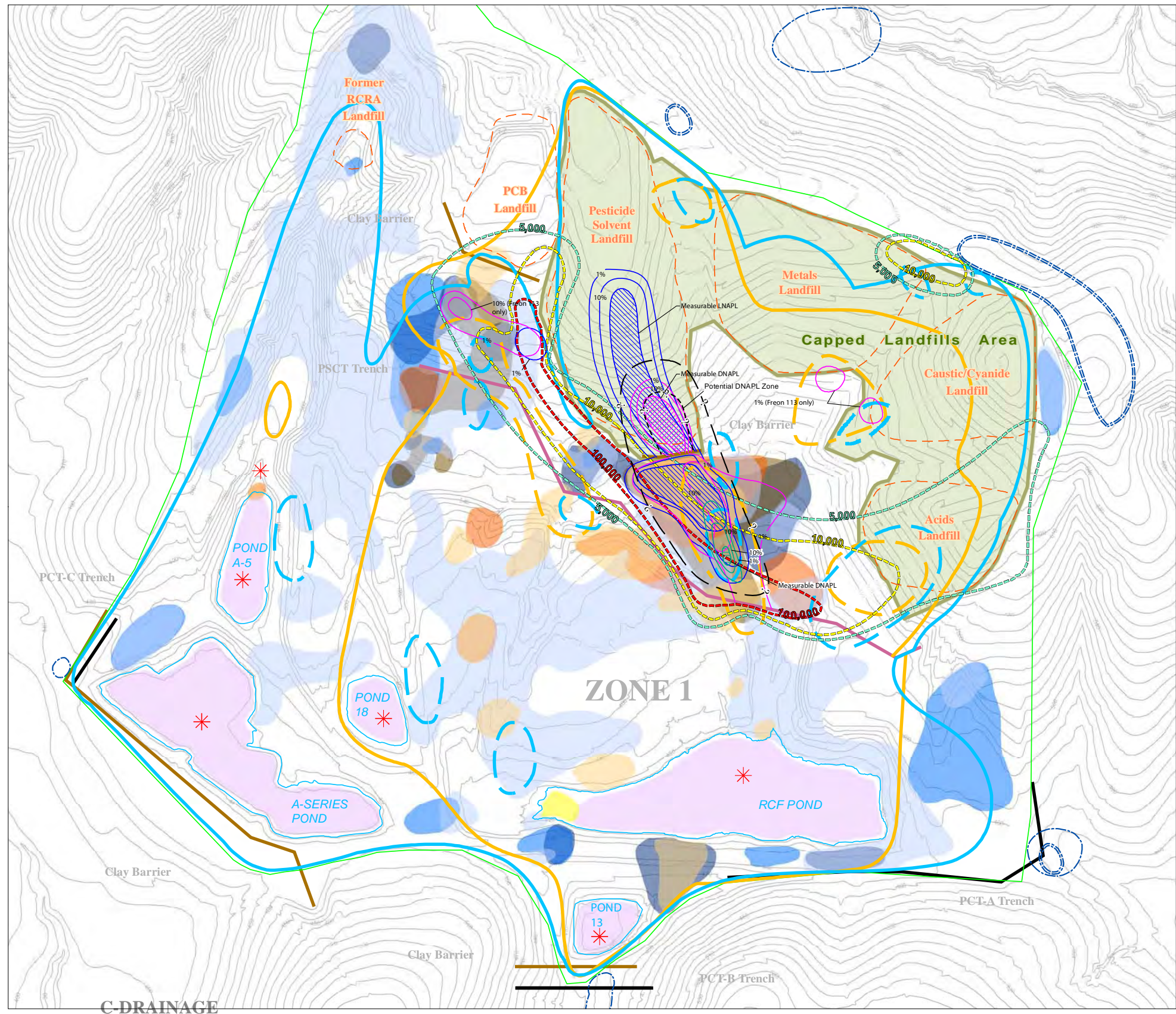
Sources:
Brierley & Lyman, Pond Closure Certification Report and
Casmalia Resources and RWQCB Status Reports



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FIGURE Figure 2-17
Water Table Potentiometric Surface, December 2015
Record of Decision

Source: Modified from Figure 2-1, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)
PR06021714025CO ROD_Figure 2-17 Water Table Potentiometric Surface, December 2015.ai 2/18



- Legend**
- Capped Landfills Area
 - Landfill Boundaries
 - Facility and Zone 1 Boundary
 - Pond Outline
 - Perimeter Source Control Trench
 - Perimeter Control Trench
 - Clay Barrier
- Estimated Total VOCs Soil Vapor Isoconcentration Contours (ppbv)**
- 5,000
 - 10,000
 - 100,000
- Extent of Groundwater Exceedances (Natural & Anthropogenic)**
- Total VOCs - Upper HSU
 - Total VOCs - Lower HSU
 - Anthropogenic Metals - Upper HSU
 - Anthropogenic Metals - Lower HSU
 - Background Metals - Upper HSU
 - Background Metals - Lower HSU
- Extent of organics in sediment in excess of RBCs**
- 0-5.3 feet
- Extent of organics in soil in excess of RBCs**
- 0-5.3 feet
 - >5.3 - 10.0 feet
 - >10 feet
- Extent of metals in sediment in excess of RBCs**
- 0-5.3 feet
 - >5.3 - 10.0 feet
 - >10 feet
- Extent of metals in soil in excess of RBCs**
- 0-5.3 feet
 - >5.3 - 10.0 feet
 - >10 feet
- * Indicates Elevated TDS in Existing Pond Water and RCRA Canyon Storm Water Runoff

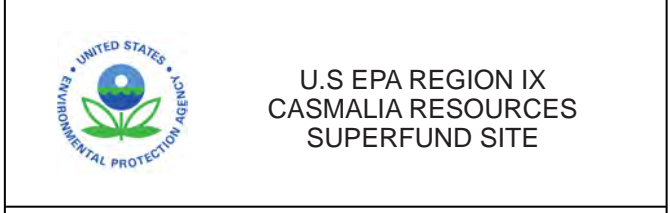
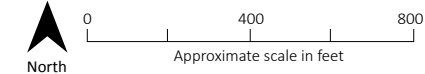
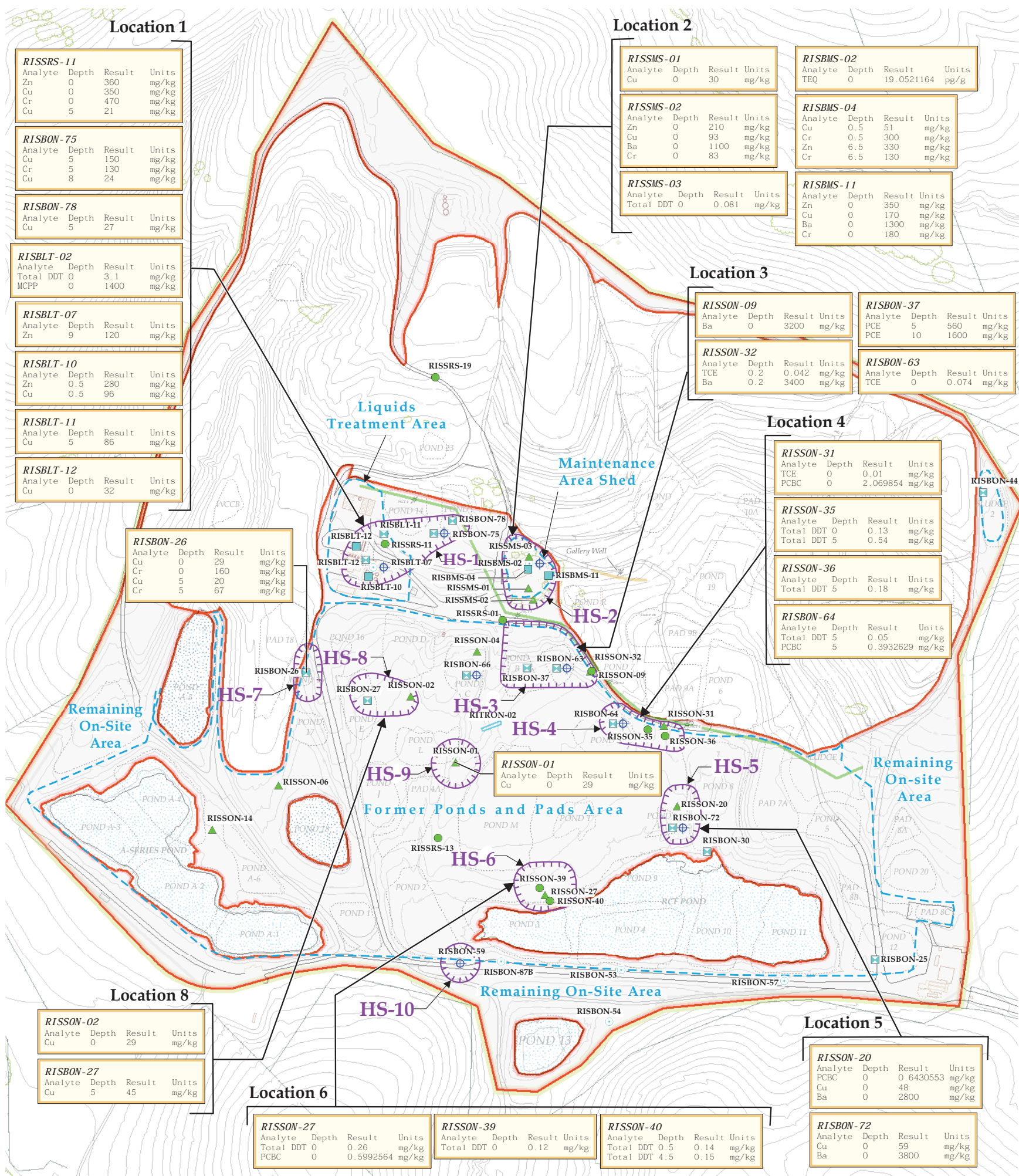


FIGURE 2-18
Summary of Chemical Detections and Exceedances - All Media
Record of Decision

Source: Modified from Figure 5-1, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)





Explanation

Soil Sample Locations

- ▲ Surface Soil (Type 2)
- Surface to Shallow Soil (Type 3)
- Surface to Medium Soil (Type 4)
- Surface to Deep Soil (Type 5)
- Surface to Deep Soil - Groundwater and/or Contact if Encountered (Type 6)
- ⊕ NAPL (Type 7)

Other Site Features

- HS Approximate Hotspot Location ¹
- Casmlia Site Boundary
- FS Study Area Boundary
- RI Study Area Limits
- Liquids Extraction Well
- P/S Landfill Clay Barrier (1981 Photograph)
- Perimeter Source Control Trench (Brierly & Lyman, 1989)
- Perimeter Control Trench (Brierly & Lyman, 1989)

- Historical Feature
- Former Waste Burial Area
- Fence
- Stormwater Pond
- Treated Liquid Impoundment

Source: Topographic base map provided by Pacific Engineering, Inc. from aerial survey dated March 4, 2004.

Note:

¹Posted data grouped and labeled by hotspot location

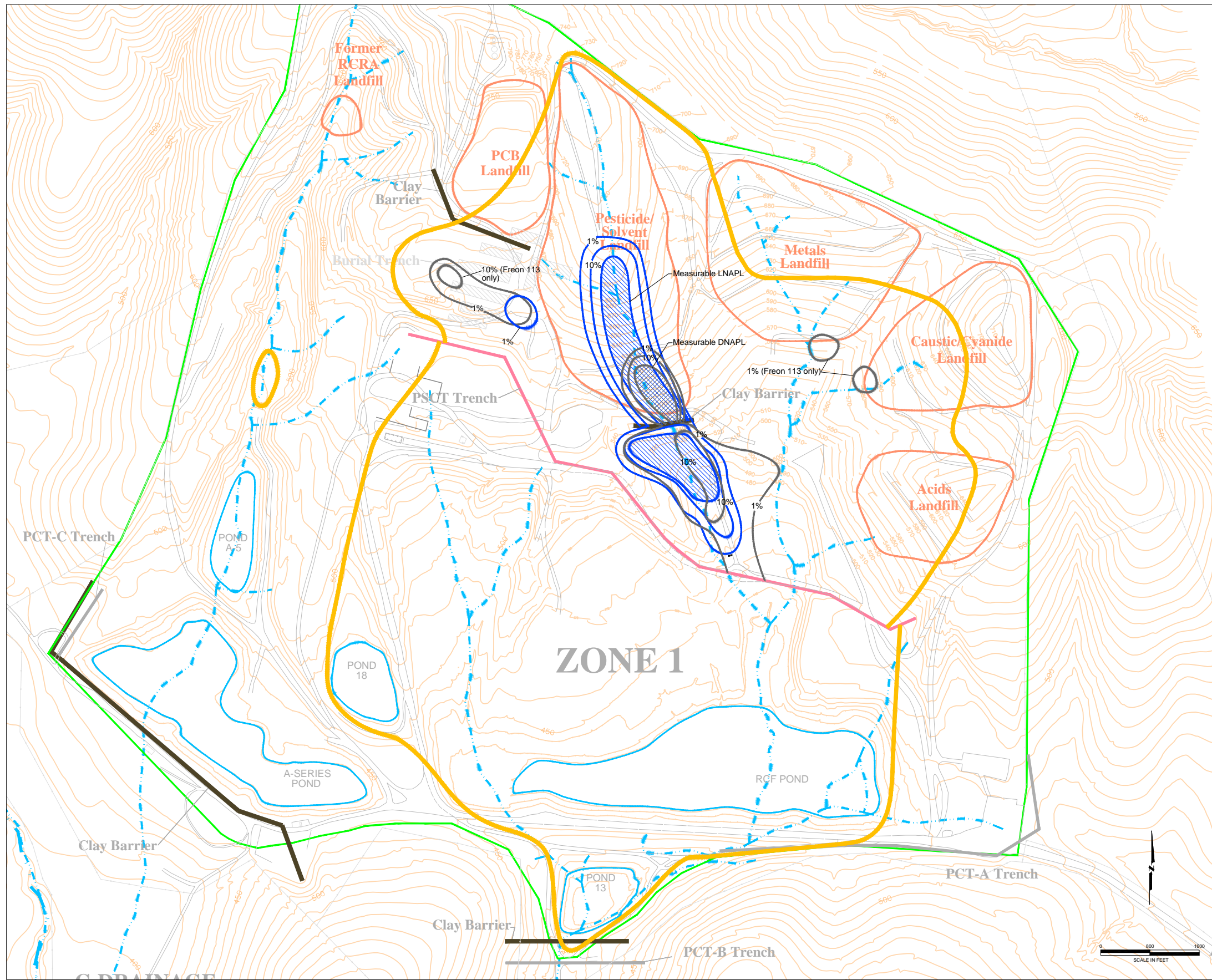


0 420
Scale in Feet (1 inch = 420 feet)



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FIGURE 2-19
Soil Hotspot Locations with Exceedences
Record of Decision



LEGEND

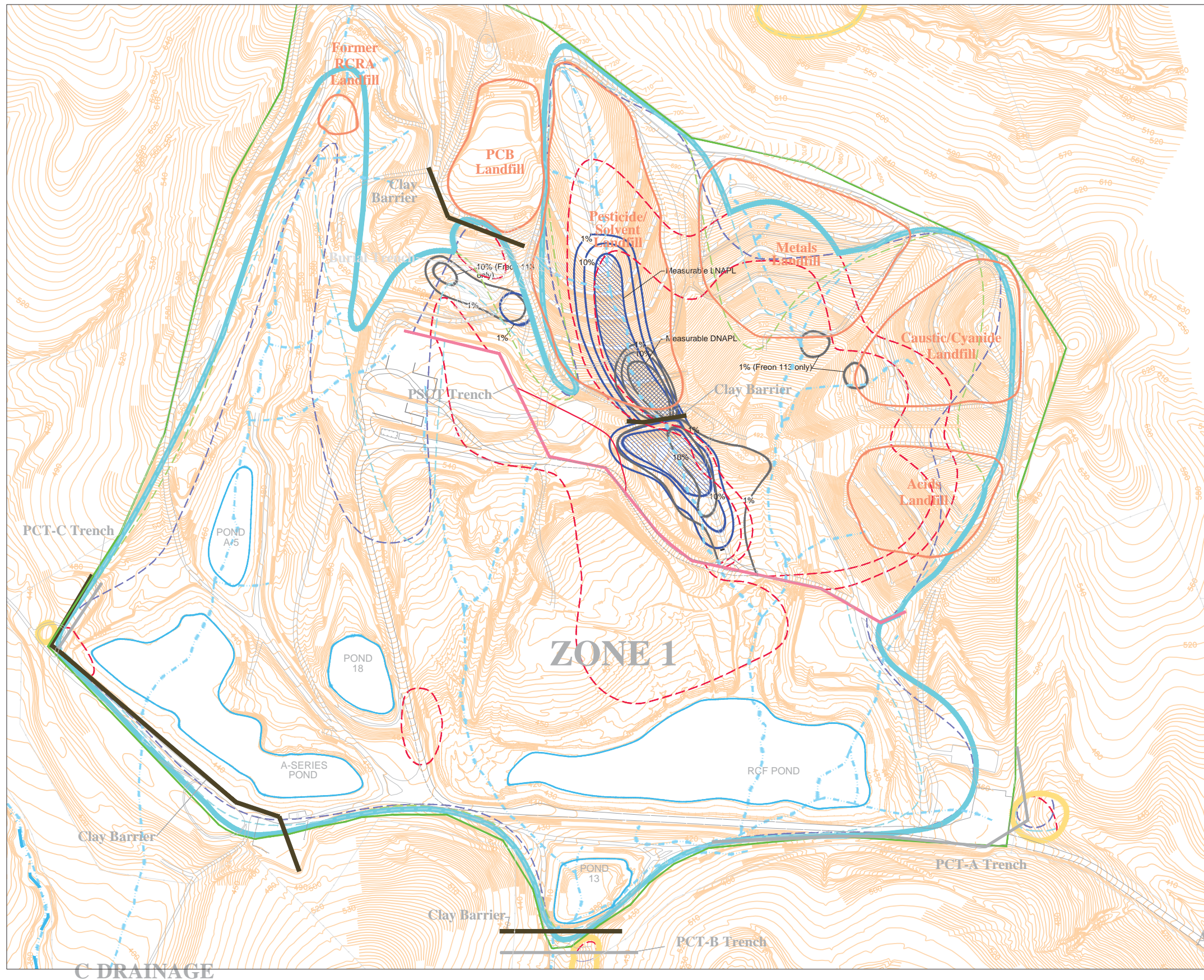
- Burial Trench
- Landfill Boundaries
- Facility and Zone 1 Boundary
- Perimeter Source Control Trench (PSCT)
- Perimeter Control Trench (PCT)
- Clay Barrier
- Creek
- Pond Outline

- Total VOCs
- Dissolved Concentration Contour of LNAPL Constituents greater than 1%, 10% of aqueous solubility
- Measurable LNAPL (Free Phase)
- Dissolved Concentration Contour of DNAPL Constituents greater than 1%, 10% of aqueous solubility
- Measurable DNAPL (Free Phase)
- Historical Natural Drainage

Note: Dissolved concentrations of DNAPL inferred surrounding areas of measurable DNAPL.

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FIGURE 2-20
LNAPL, DNAPL, and Total VOCs in Upper HSU
Record of Decision



LEGEND

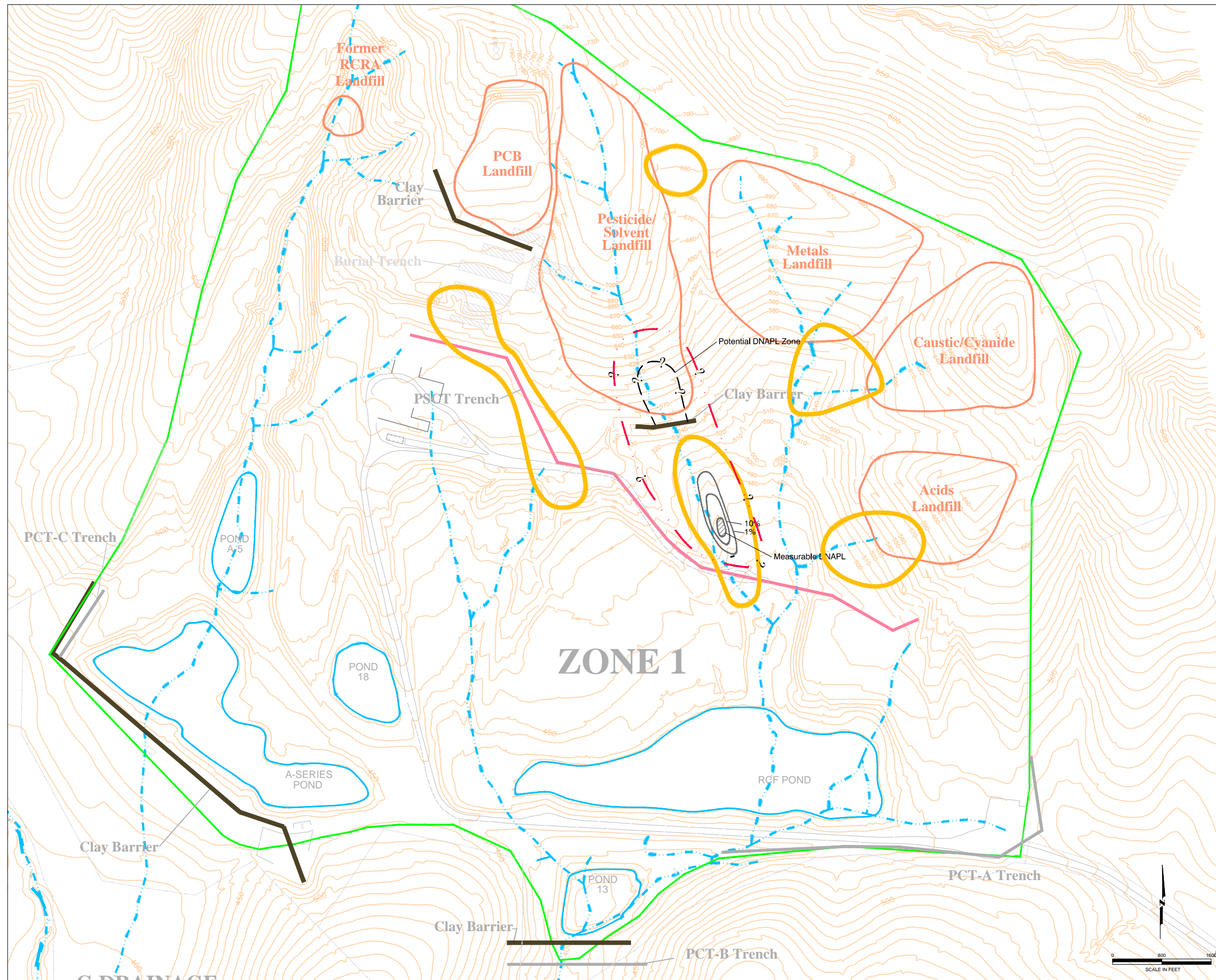
- Burial Trench
- Landfill Boundaries
- Facility and Zone 1 Boundary
- Perimeter Source Control Trench (PSCT)
- Perimeter Control Trench (PCT)
- Clay Barrier
- Creek
- Pond Outline
- Anthropogenic Metals
- Background Metals
- Arsenic
- Cadmium
- Nickel
- Selenium
- Dissolved Concentration Contour of LNAPL Constituents greater than 1%, 10% of aqueous solubility
- Measurable LNAPL (Free Phase)
- Dissolved Concentration Contour of DNAPL Constituents greater than 1%, 10% of aqueous solubility
- Measurable DNAPL (Free Phase)
- Historical Natural Drainage

Note: Dissolved concentrations of DNAPL inferred surrounding areas of measurable DNAPL.











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FIGURE 2-21
LNAPL, DNAPL, and Metals in Upper HSU
Record of Decision



LEGEND

-  Burial Trench
-  Landfill Boundaries
-  Facility and Zone 1 Boundary
-  Perimeter Source Control Trench (PSCT)
-  Perimeter Control Trench (PCT)
-  Clay Barrier
-  Creek
-  Pond Outline




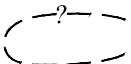
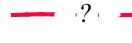

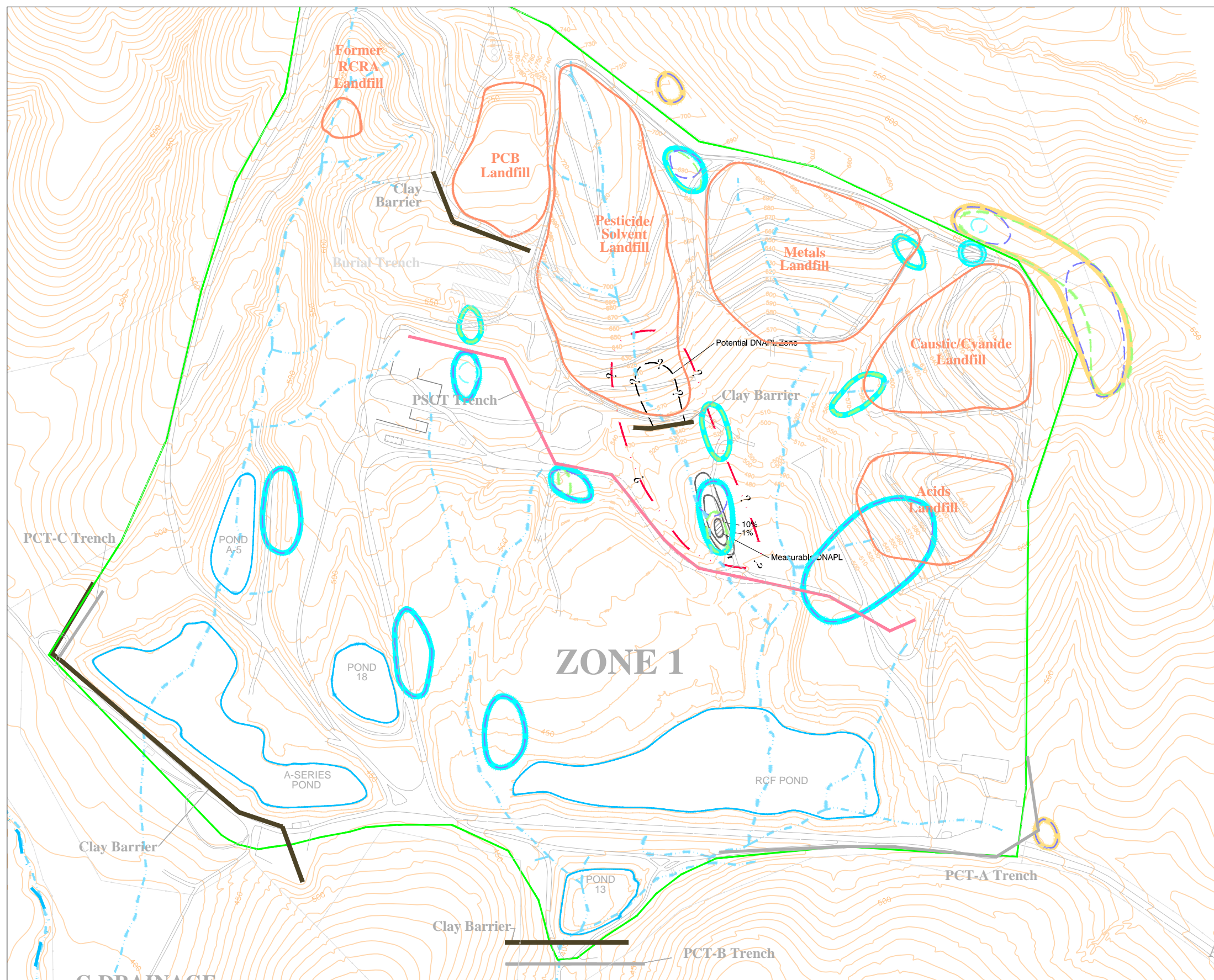








-  Total VOCs
-  Dissolved Concentration Contour of DNAPL Constituents greater than 1%, 10% of aqueous solubility
-  Measurable DNAPL (Free Phase)
-  Presence of DNAPL inferred by DNAPL at Landfill/Lower HSU contact
-  Potential DNAPL Zone. Horizontal and Vertical extent uncertain.
-  Historical Natural Drainage











FIGURE 2-22
 DNAPL and Total VOCs in Lower HSU
Record of Decision

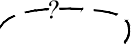
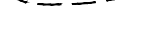



LEGEND


-  Burial Trench
-  Landfill Boundaries
-  Facility and Zone 1 Boundary
-  Perimeter Source Control Trench (PSCT)
-  Perimeter Control Trench (PCT)
-  Clay Barrier
-  Creek
-  Pond Outline

-  Anthropogenic Metals
-  Background Metals
-  Arsenic
-  Cadmium not detected above criteria
-  Nickel
-  Selenium

-  Dissolved Concentration Contour of DNAPL
Constituents greater than 1%, 10% of
aqueous solubility
-  Measurable DNAPL (Free Phase)

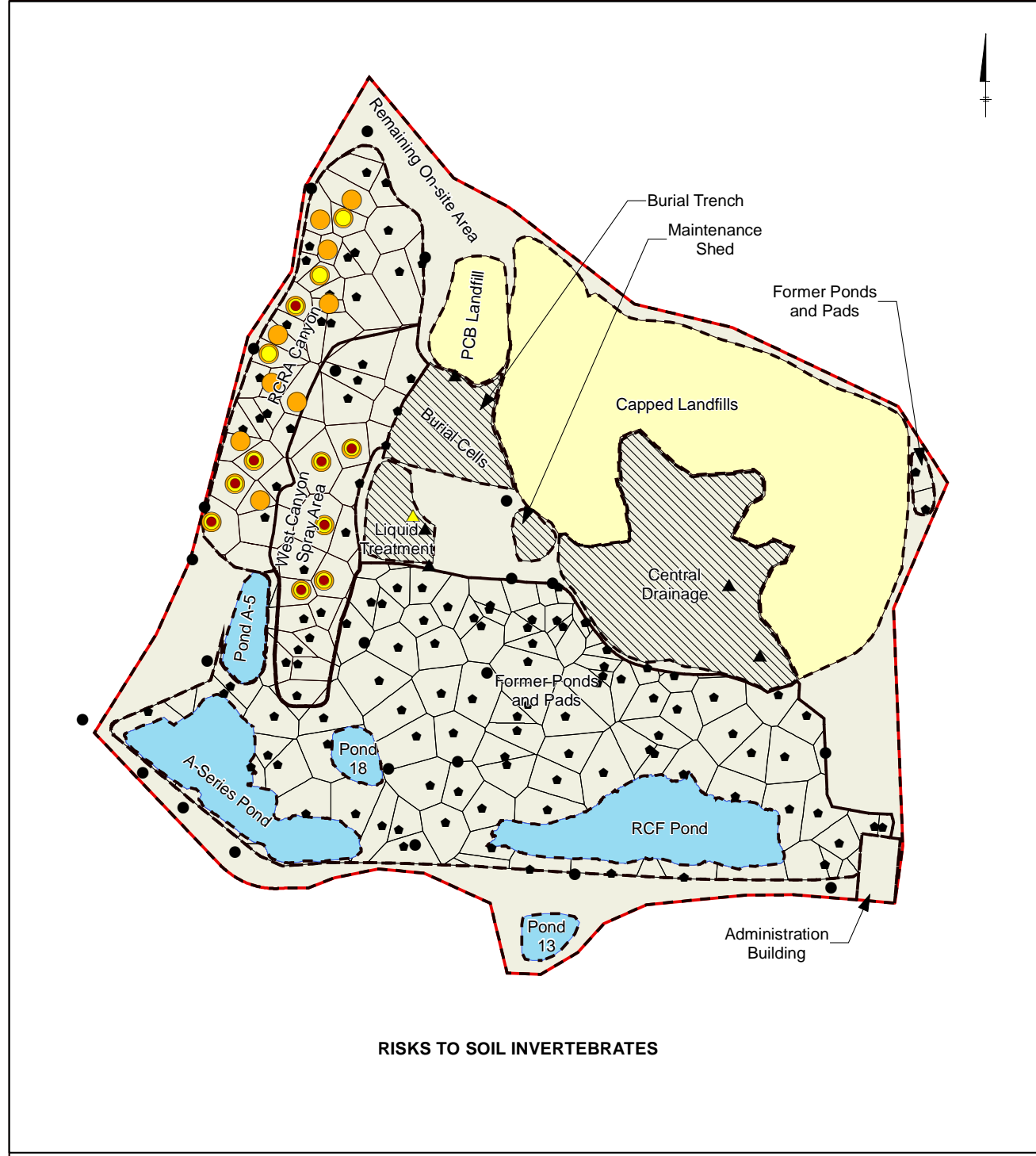
-  Presence of DNAPL inferred by DNAPL at
Landfill/Lower HSU contact
-  Potential DNAPL Zone. Horizontal and Vertical
extent uncertain.

-  Historical Natural Drainage

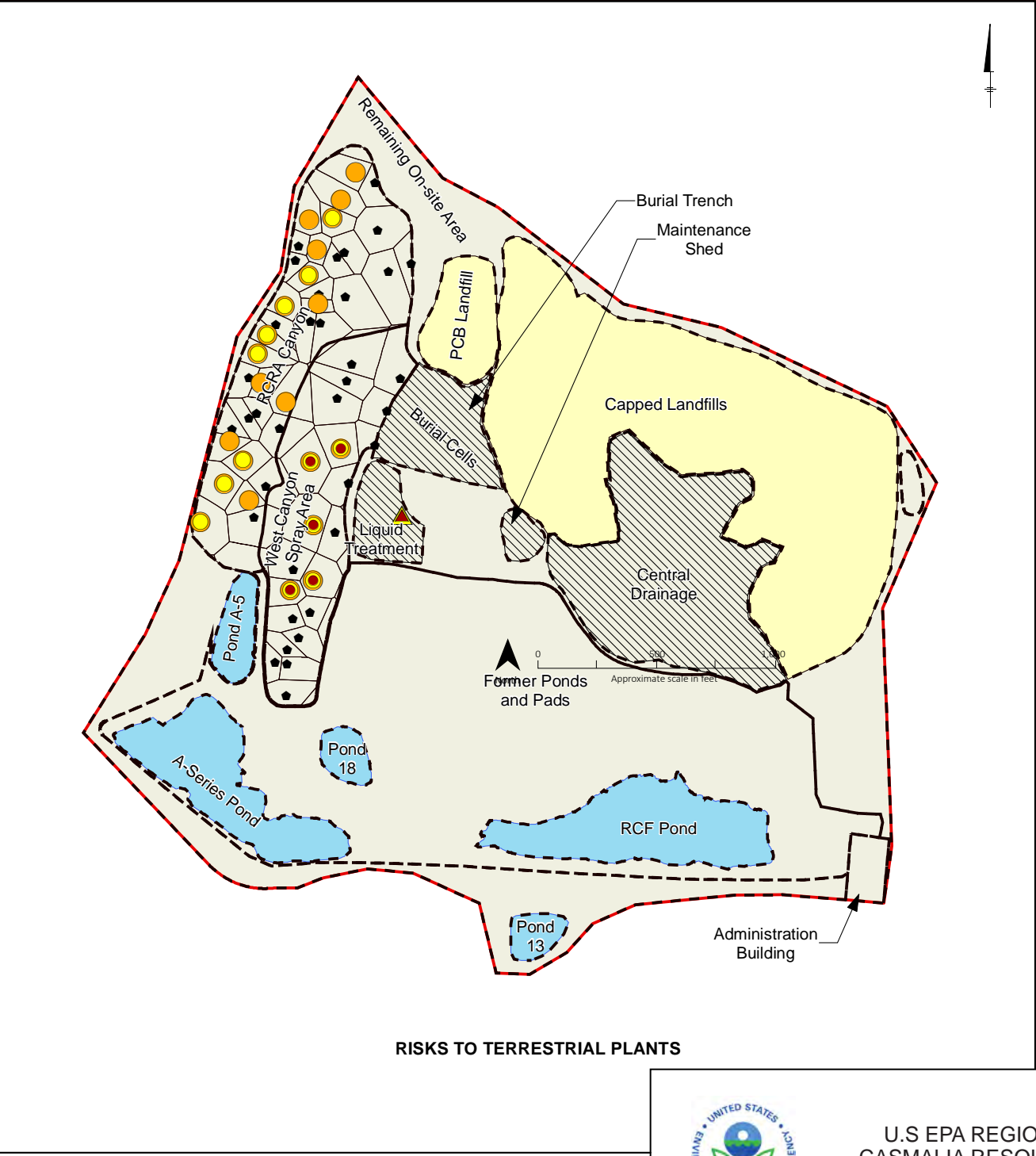


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FIGURE 2-23
DNAPL and Metals in Lower HSU
Record of Decision



RISKS TO SOIL INVERTEBRATES



RISKS TO TERRESTRIAL PLANTS

LEGEND

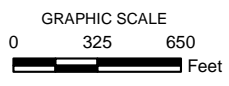
- Landfills
- Ponds
- Other Features
- Presumptive Remedy Areas
- Property Boundary
- Roadway Samples Outside Presumptive Remedy Area
- Roadway Samples Inside Presumptive Remedy Area


RISKS ASSOCIATED WITH SOIL INVERTEBRATES OR TERRESTRIAL PLANTS

- SOIL CONCENTRATION <= UTL OR HQ_{LOWEST-EFFECT LEVEL} < 1
- COPPER HQ_{LOWEST-EFFECT LEVEL} >= 1
- CHROMIUM HQ_{LOWEST-EFFECT LEVEL} >= 1
- ZINC HQ_{LOWEST-EFFECT LEVEL} >= 1

NOTES

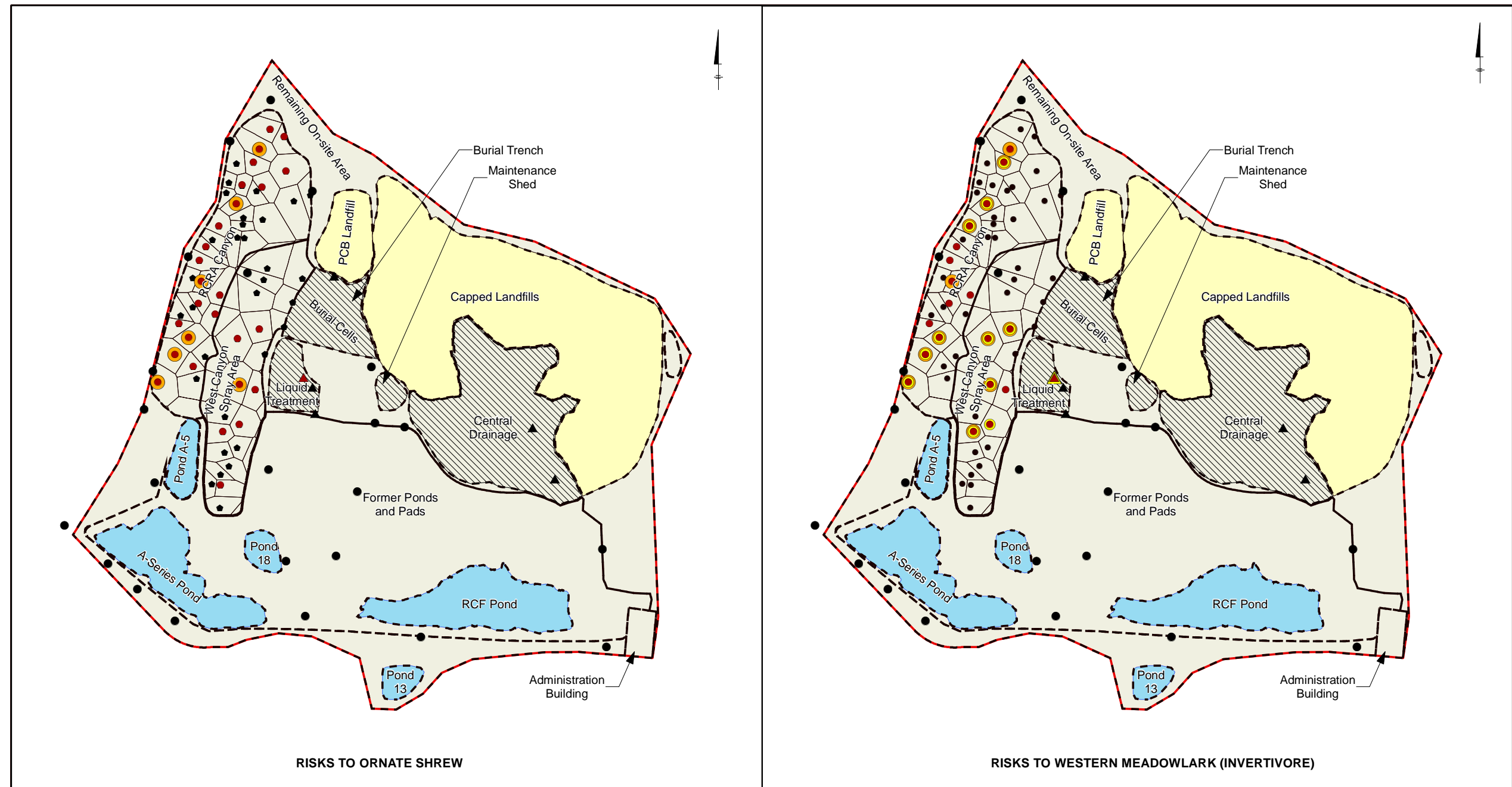
BASE IMAGERY FROM STATE OF CALIFORNIA, UNIVERSAL TRANSVERSE MERCATOR PROJECTION (UTM) ON THE NORTH AMERICAN DATUM OF 1983. SOURCE IMAGE DATE IS 1994.





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FIGURE 2-24
Co-Located Risks to Ecological Communities
Assuming Barium is Not Toxic
Record of Decision



RISKS TO ORNATE SHREW

RISKS TO WESTERN MEADOWLARK (INVERTIVORE)

- LEGEND**
- Landfills
 - Ponds
 - Other Features
 - Presumptive Remedy Areas
 - Property Boundary

- Roadway Samples Outside Presumptive Remedy Area
- Roadway Samples Inside Presumptive Remedy Area

- RISKS ASSOCIATED WITH ORNATE SHREW OR WESTERN MEADOWLARK (INVERTIVORE)**
- SOIL CONCENTRATION \leq UTL OR $HQ_{LOWEST-EFFECT LEVEL} < 1$
 - COPPER $HQ_{LOWEST-EFFECT LEVEL} \geq 1$
 - CHROMIUM $HQ_{LOWEST-EFFECT LEVEL} \geq 1$
 - ZINC $HQ_{LOWEST-EFFECT LEVEL} \geq 1$

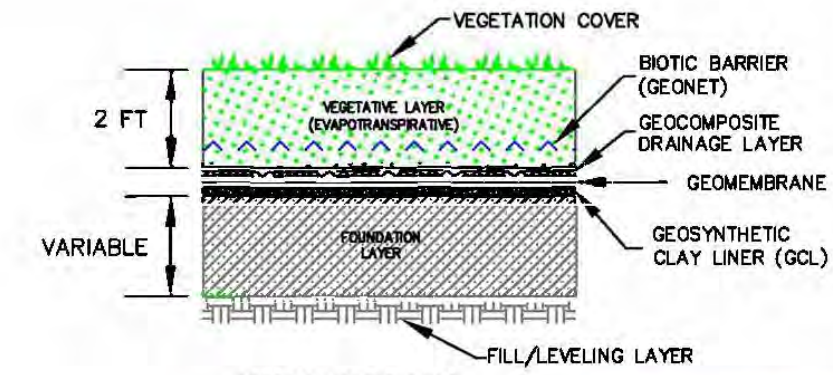
GRAPHIC SCALE
0 325 650
Feet

NOTES
BASE IMAGERY FROM STATE OF CALIFORNIA, UNIVERSAL TRANSVERSE MERCATOR PROJECTION (UTM) ON THE NORTH AMERICAN DATUM OF 1983. SOURCE IMAGE DATE IS 1994.

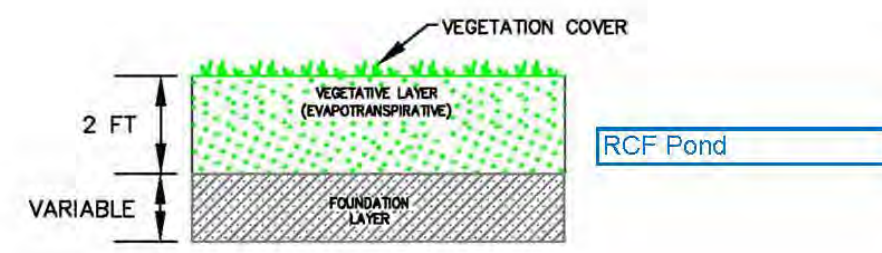


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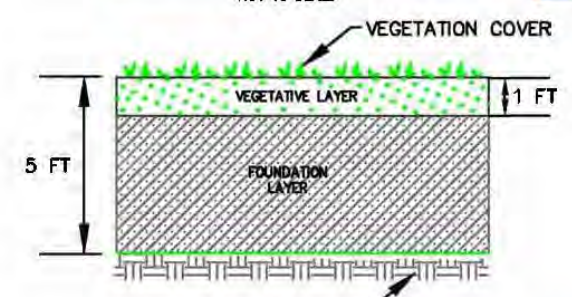
FIGURE 2-25
Co-Located Risks to Wildlife Receptors
Assuming Barium is Not Toxic
Record of Decision



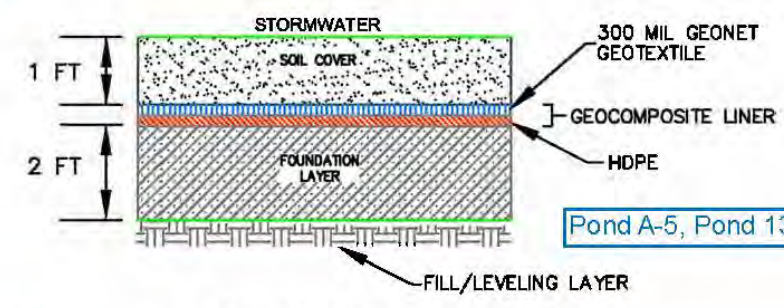
DETAIL A - TYPICAL RCRA CAP SECTION NOT TO SCALE
PCB Landfill CDA, BTA, MSA



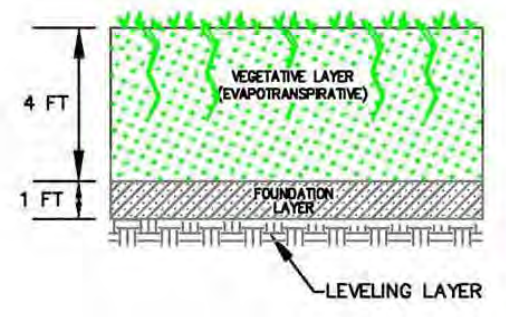
DETAIL E - TYPICAL ECO-CAP - SOIL CAP NOT TO SCALE
RCF Pond



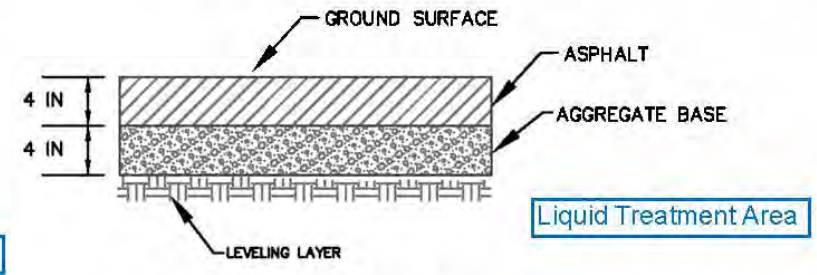
DETAIL B - TYPICAL 5' RCRA-EQUIVALENT MONO SOIL CAP SECTION NOT TO SCALE
RCRA Canyon/WCSA (Optional)



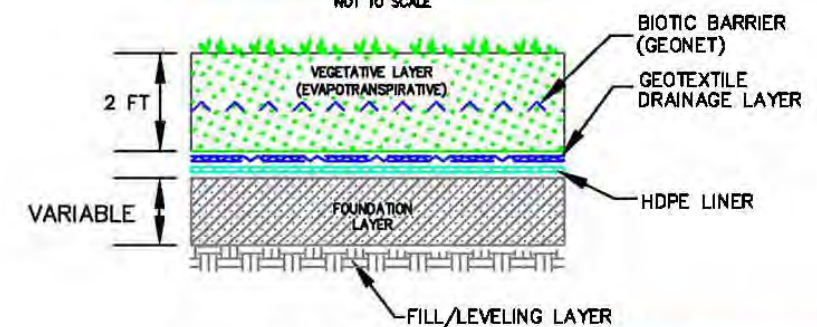
DETAIL F - LINED CAP RETENTION BASIN NOT TO SCALE
Pond A-5, Pond 13



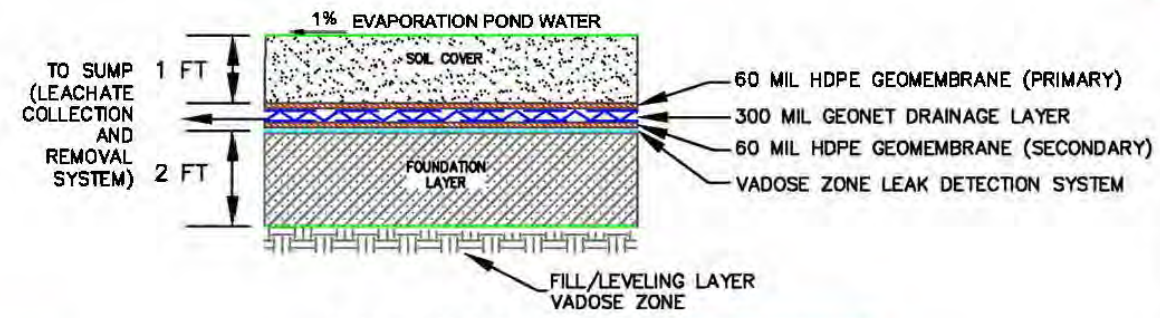
DETAIL C - TYPICAL EVAPOTRANSPIRATIVE CAP SECTION NOT TO SCALE
RCRA Canyon/WCSA (Optional)



DETAIL G - TYPICAL ASPHALT CAP CROSS SECTION NOT TO SCALE
Liquid Treatment Area

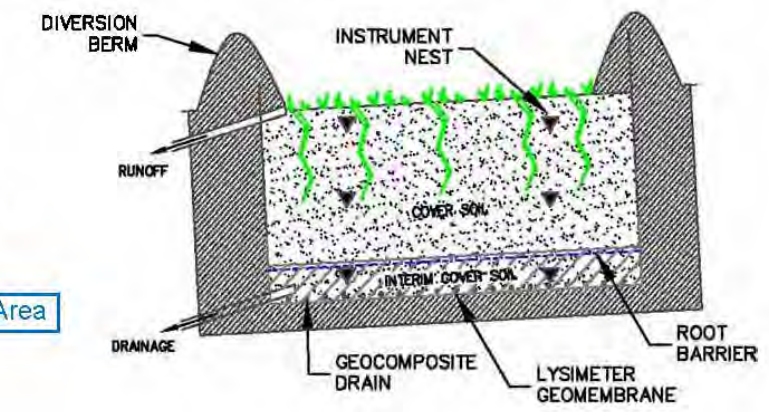


DETAIL D - TYPICAL RCRA-EQUIVALENT HYBRID CAP SECTION NOT TO SCALE
RCRA Canyon (Optional)



DETAIL H - TYPICAL RCRA EVAPORATION POND SECTION NOT TO SCALE
A-Series Pond

- NOTES:
1. CAPS A, B, C, AND D ARE USED IN APPLICATIONS THAT PREVENT OR MINIMIZE RAINWATER INFILTRATION.
 2. CAP E IS USED TO PREVENT POTENTIAL EXPOSURE TO ECOLOGICAL RECEPTORS.
 3. CAP F IS USED TO LINE THE STORMWATER RETENTION BASINS.
 4. CAP G IS ONLY CONSIDERED IN THE LIQUID TREATMENT AREA.
 5. CAP H IS USED TO LINE THE EVAPORATION POND AND INCLUDES A LEACHATE COLLECTION AND RECOVERY SYSTEM (LCRS) COMPOSED OF A 300 MIL GEONET DRAINAGE LAYER THAT DRAINS TO A SUMP. THE POND BOTTOM IS SLOPED AT 1% TO COLLECT ANY LEACHATE THAT PENETRATES THE PRIMARY LINER.
 6. USE OF OFFSITE BORROW SOIL IS PROPOSED FOR THE VEGETATIVE AND FOUNDATION LAYERS (SEE FIGURE 10-2) BORROW SOIL IS A CLAYSTONE MATERIAL AND WILL NEED SOME PRE-PROCESSING SUCH AS SCREENING AND PULVERIZING TO REDUCE PARTICLE SIZE.
 7. FOUNDATION LAYERS WILL BE COMPACTED TO 90% RELATIVE COMPACTION WHILE VEGETATIVE LAYERS WILL BE TREATED WITH SOIL AMENDMENTS (E.G. BIOSOLIDS) AND LIGHTLY COMPACTED (85% RELATIVE COMPACTION).



DETAIL I - TYPICAL ACAP TYPE LYSIMETER SECTION NOT TO SCALE

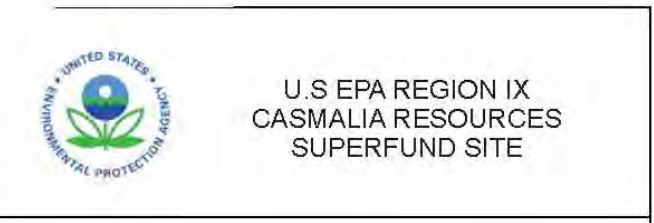
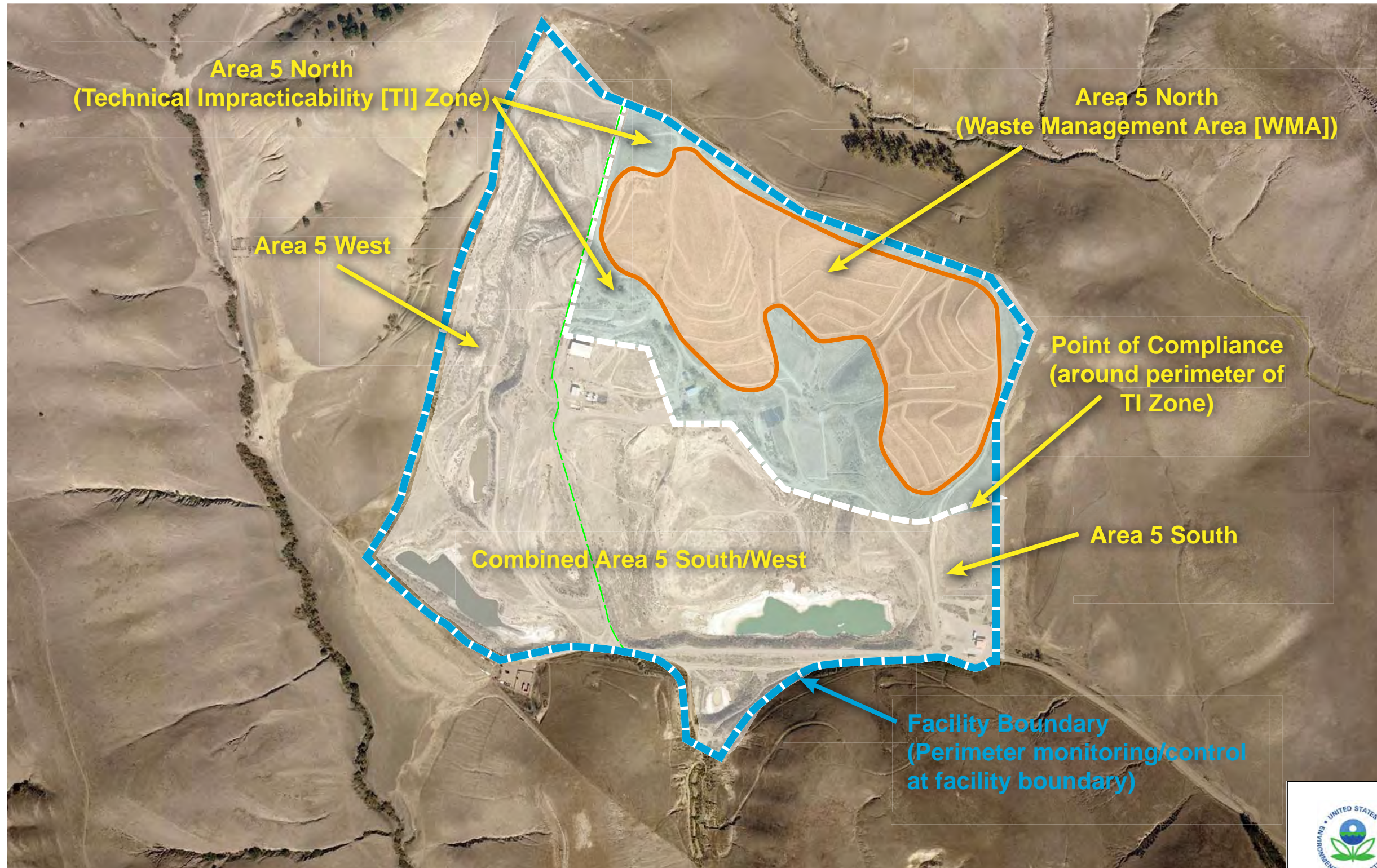
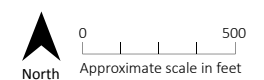


FIGURE 2-26 Caps Considered in Remedial Alternatives Record of Decision

Source: Modified from Figure 10-1A, Final Feasibility Study Report, Casmalia Resources Superfund Site, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



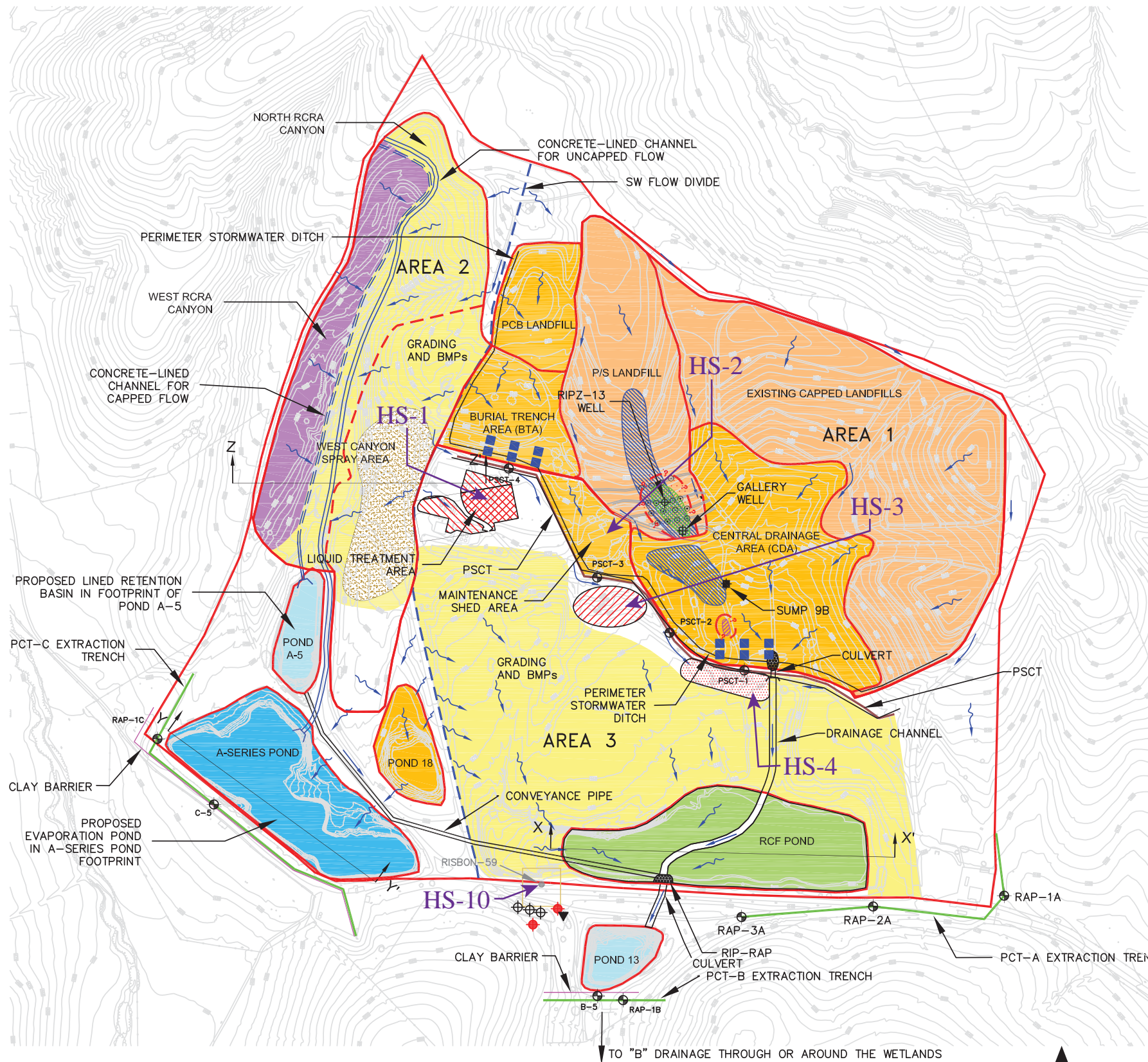
Total Acreage of Area 5 North
= 92.90 acres



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FIGURE 2-27
Location of Waste Management Area, Technical
Impracticability Zone, and Point of Compliance
Record of Decision

Aerial image © Central Coast Aerial Mapping. Annotation by CH2M HILL, 2017.




LEGEND:

- | | | | |
|--|--|--|------------------------------------|
| | LIMITS OF STUDY AREA (AREAS 1-4) | | EXISTING MONITORING WELL |
| | PSCT TRENCH | | EXISTING EXTRACTION WELL |
| | PCT EXTRACTION TRENCH | | PCT AND PSCT EXTRACTION WELLS |
| | CLAY BARRIER | | NAPL-ONLY EXTRACTION WELL |
| | EXISTING RCRA CAP | | EXISTING PIEZOMETER |
| | PROPOSED RCRA CAP | | PROPOSED UPPER HSU MONITORING WELL |
| | EVAPOTRANSPIRATIVE (ET) CAP | | LHSU MONITORING WELL |
| | ECO CAP - SOIL CAP (RCF POND) | | RIP RAP |
| | LINED EVAPORATION POND (A-SERIES POND) | | CHANNELED STORMWATER FLOW |
| | LINED RETENTION BASIN (POND A-5, POND 13) | | NATURAL STORMWATER FLOW |
| | EXCAVATION (5') AND BACKFILL | | HS-11 SOIL HOTSPOT 1 |
| | EXCAVATION (20') AND BACKFILL OR COVER WITH CAP EXTENDED FROM AREA 1 | | |
| | EXCAVATION (5'), BACKFILL, AND ASPHALT COVER | | |
| | PROPOSED ASPHALT COVER | | |
| | 5' EXCAVATION AND BACKFILL TO GRADE | | |
| | UNCAPPED AREA INCLUDING GRADING AND BMPs | | |
| | LNAPL IN UPPER HSU | | |
| | DNAPL IN UPPER HSU | | |
| | DNAPL IN LOWER HSU | | |
| | POTENTIAL EXTENT OF DNAPL IN LOWER HSU | | |

NOTES:

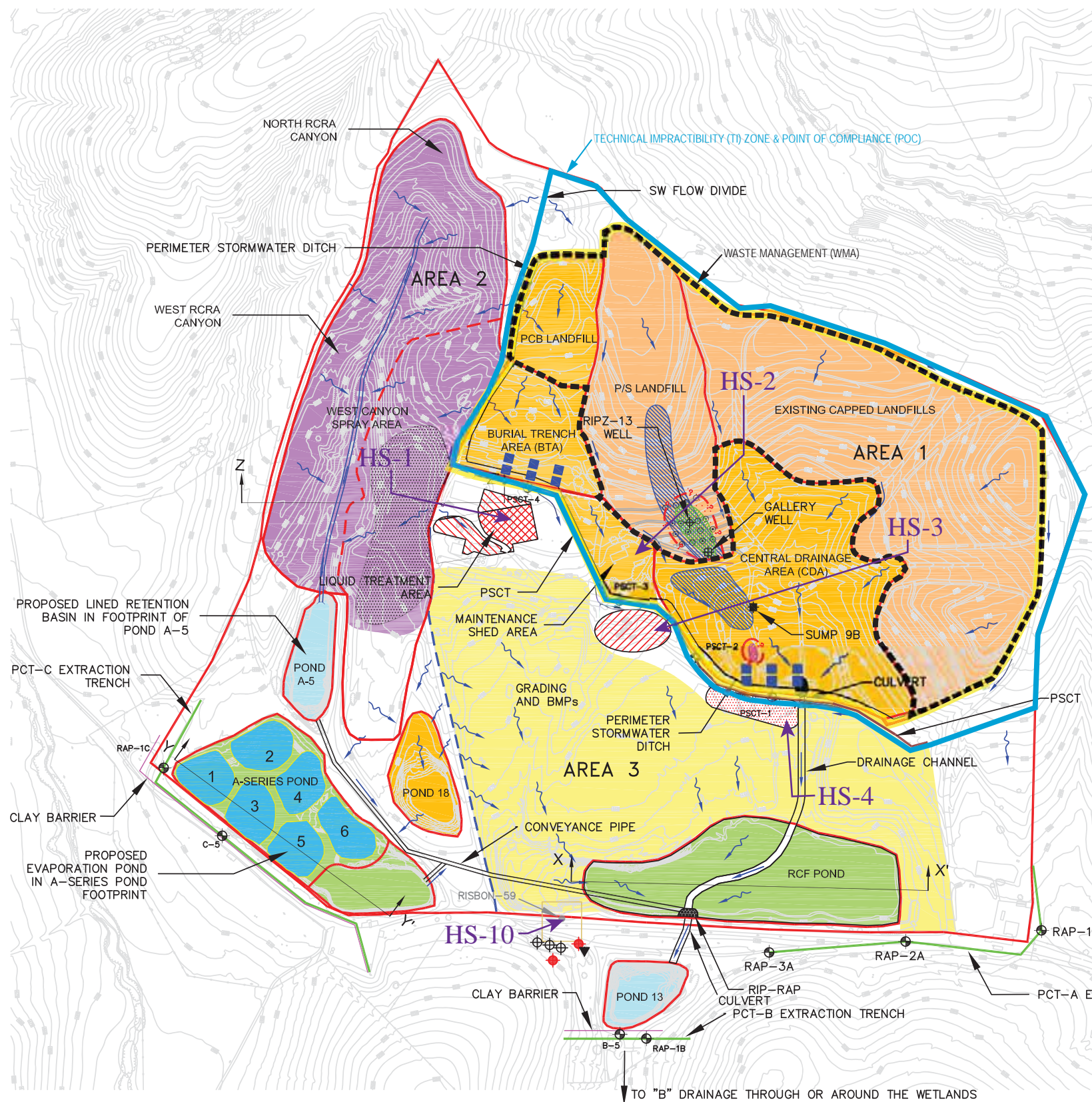
1. THE REMEDIAL ALTERNATIVE INCLUDES RCRA CAPS IN FS AREAS 1 AND 3, AN ET CAP IN FS AREA 2, EXCAVATION IN FS AREA 3 AND AN ECO CAP IN AREA 4. THE EXCAVATED SOIL IN FS AREA 3 IS DISPOSED OF IN THE PCB LANDFILL PRIOR TO CAP CONSTRUCTION.
2. A NEW 11-ACRE LINED EVAPORATION POND IS PROPOSED IN THE FOOTPRINT OF THE A-SERIES POND.
3. THE TREATED PSCT AND EXTRACTED PCT GROUNDWATER IS SENT TO THE EVAPORATION POND IN THE FOOTPRINT OF A-SERIES POND.
4. RCF POND WILL BE BACKFILLED TO RAISE THE MINIMUM BOTTOM ELEVATION TO APPROXIMATELY 415 FT MSL AND ENSURE IT IS ABOVE THE GROUNDWATER LEVEL.
5. THIS REMEDIAL ALTERNATIVE FOR FS AREA 5 INCLUDES OPERATING THE EXISTING PSCT, GALLERY WELL AND PCT EXTRACTION SYSTEMS AND DNAPL/LNAPL-ONLY EXTRACTION FROM 16 WELLS IN THE SOUTHERN PART OF THE P/S LANDFILL.
6. CAPPED AREA STORMWATER FLOW IS DIRECTED THROUGH POND 13, DISCHARGED THROUGH OR AROUND WETLANDS AND ONTO THE OFFSITE B-DRAINAGE. UNCAPPED AREAS IN FS AREA 3 SOUTH OF THE PSCT AND EAST OF LTP ROAD WILL INCLUDE GRADING AND BMPs TO MINIMIZE EROSION.



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FIGURE 2-28
 Sitewide Remedial Alternative 2 - Capping, Liquids
 Extraction, Large Evaporation Pond
Record of Decision

Source: Modified from Figure 12-1A, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)
 PR0602171402SCO ROD_Figure 2-28 Sitewide Remedial Alternative 2 - Capping, Liquids Extraction, Large Evaporation Pond.ai 2/18

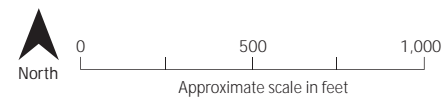


LEGEND:

- WASTE MANAGEMENT AREA
- LIMITS OF STUDY AREA (AREAS 1-4)
- PSCT TRENCH
- PCT EXTRACTION TRENCH
- CLAY BARRIER
- EXISTING RCRA CAP
- PROPOSED RCRA CAP
- EVAPOTRANSPIRATIVE (ET) CAP AND/OR HYBRID CAP
- ECO CAP - SOIL CAP (RCF POND)
- LINED EVAPORATION POND (A-SERIES POND)
- LINED RETENTION BASIN (POND A-5, POND 13)
- 5' EXCAVATION WITH ET CAP
- EXCAVATION (5') AND BACKFILL
- EXCAVATION (20') AND BACKFILL OR COVER WITH CAP EXTENDED FROM AREA 1
- EXCAVATION (5'), BACKFILL, AND ASPHALT COVER
- PROPOSED ASPHALT COVER
- UNCAPPED AREA INCLUDING GRADING AND BMPs
- LNAPL IN UPPER HSU
- DNAPL IN UPPER HSU
- DNAPL IN LOWER HSU
- POTENTIAL EXTENT OF DNAPL IN LOWER HSU
- WASTE MANAGEMENT AREA (WMA)
- TECHNICAL IMPRACTICABILITY (TI) ZONE & POINT OF COMPLIANCE (POC)
- EXISTING MONITORING WELL
- EXISTING EXTRACTION WELL
- PCT AND PSCT EXTRACTION WELLS
- NAPL-ONLY EXTRACTION WELL
- EXISTING PIEZOMETER
- PROPOSED UPPER HSU MONITORING WELL
- LHSU MONITORING WELL
- RIP RAP
- CHANNELED STORMWATER FLOW
- NATURAL STORMWATER FLOW
- HS-11 SOIL HOTSPOT 1

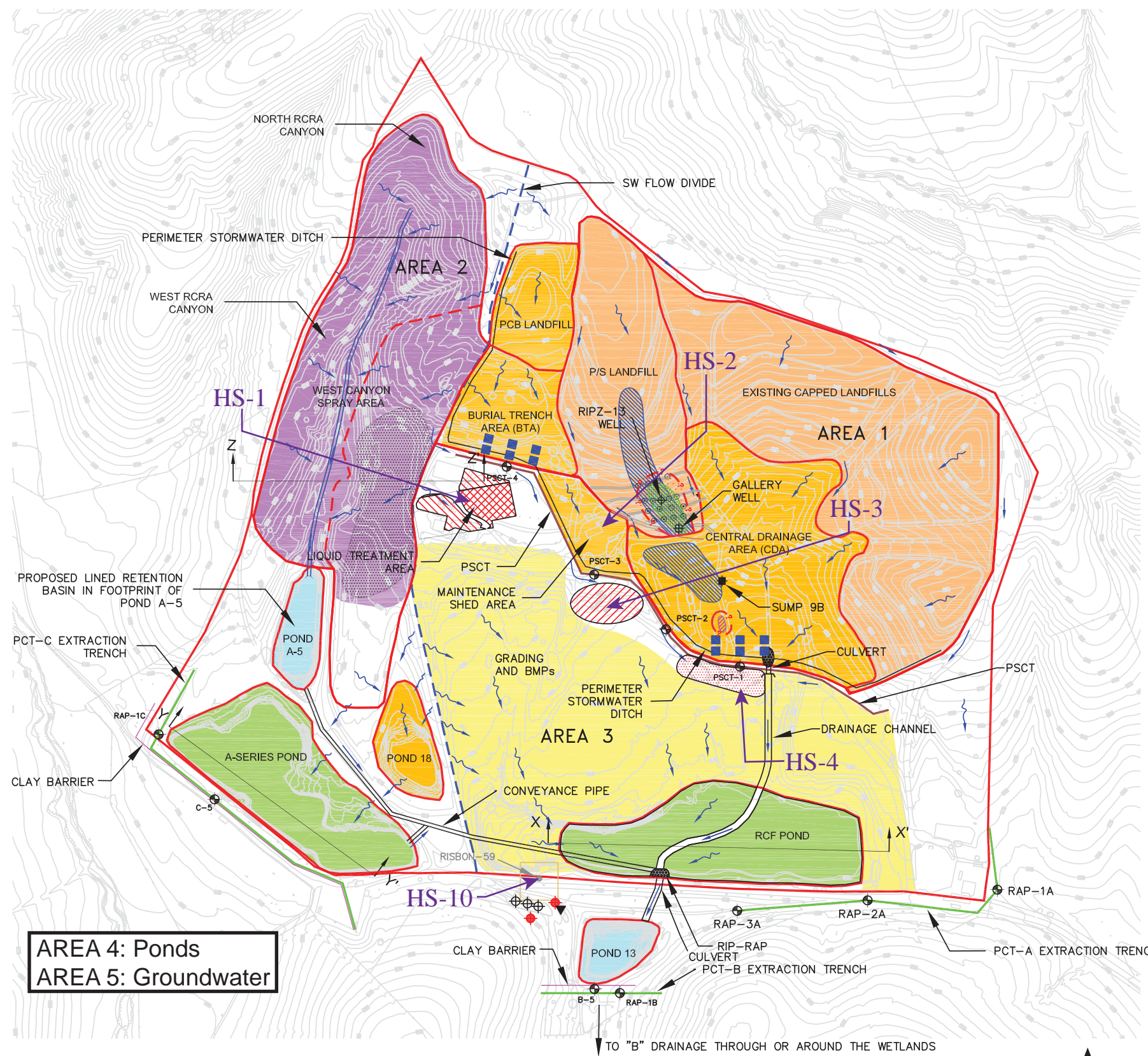
NOTES:

1. THE REMEDIAL ALTERNATIVE ASSUMES AN ET CAP FOR FS AREA 2, BUT THE ACTUAL CAP TYPE AND DETAILS WILL BE DETERMINED DURING REMEDIAL DESIGN. THIS REMEDIAL ALTERNATIVE ALSO INCLUDES RCRA CAPS IN FS AREAS 1 AND 3, AND AN ECO CAP AND LINED PONDS IN FS AREA 4. THE EXCAVATED SOIL IN FS AREA 3 IS DISPOSED OF IN THE PCB LANDFILL PRIOR TO CAP CONSTRUCTION.
2. A NEW 6-ACRE EVAPORATION POND IS PROPOSED AS SIX 1-ACRE PONDS IN THE FOOTPRINT OF THE A-SERIES POND.
3. THE TREATED PSCT AND EXTRACTED PCT GROUNDWATER IS SENT TO THE EVAPORATION POND IN THE FOOTPRINT OF A-SERIES POND.
4. RCF POND WILL BE BACKFILLED TO RAISE THE MINIMUM BOTTOM ELEVATION TO APPROXIMATELY 415 FT MSL AND ENSURE IT IS ABOVE THE GROUNDWATER LEVEL.
5. THIS REMEDIAL ALTERNATIVE FOR FS AREA 5 INCLUDES OPERATING THE EXISTING PSCT, GALLERY WELL AND PCT EXTRACTION SYSTEMS AND DNAPL/LNAPL-ONLY EXTRACTION FROM 16 WELLS IN THE SOUTHERN PART OF THE P/S LANDFILL.
6. CAPPED AREA STORMWATER FLOW IS DIRECTED THROUGH POND 13, DISCHARGED THROUGH OR AROUND THE WETLANDS AND ONTO THE OFFSITE B-DRAINAGE. UNCAPPED AREAS IN FS AREA 3 SOUTH OF THE PSCT AND EAST OF LTP ROAD WILL INCLUDE GRADING AND BMPs TO MINIMIZE EROSION.
7. THE UNSHADED AREAS ("WHITE SPACE") BETWEEN SHADED AREAS REPRESENTS LAND WHERE SOIL/SOIL GAS DO NOT EXCEED RISK-BASED LEVELS, AND WHERE SURFACE OR NEAR SURFACE REMEDIATION IS NOT REQUIRED BASED ON CURRENTLY AVAILABLE INFORMATION. THIS IS SUBJECT TO CHANGE BASED ON FORTHCOMING REMEDIAL DESIGN PLANNING ACTIVITIES.



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FIGURE 2-29
Sitewide Remedial Alternative 3 (Selected Remedy) –
Capping, Liquids Extraction, Small Evaporation Pond
Record of Decision



LEGEND:

—	LIMITS OF STUDY AREA (AREAS 1-4)	⊕	EXISTING MONITORING WELL
—	PSCT TRENCH	⊕	EXISTING EXTRACTION WELL
—	PCT EXTRACTION TRENCH	⊕	PCT AND PSCT EXTRACTION WELLS
—	CLAY BARRIER	⊕	NAPL-ONLY EXTRACTION WELL
■	EXISTING RCRA CAP	⊕	EXISTING PIEZOMETER
■	PROPOSED RCRA CAP	⊕	PROPOSED UPPER HSU MONITORING WELL
■	EVAPOTRANSPIRATIVE (ET) CAP AND/OR HYBRID CAP	⊕	LHSU MONITORING WELL
■	ECO CAP - SOIL CAP (A-SERIES, RCF POND)	⊕	RIP RAP
■	LINED RETENTION BASIN (POND A-5, POND 13)	⊕	CHANNELED STORMWATER FLOW
■	5' EXCAVATION WITH ET CAP	⊕	NATURAL STORMWATER FLOW
■	EXCAVATION (5') AND BACKFILL	⊕	HS-11 SOIL HOTSPOT 1
■	EXCAVATION (20') AND BACKFILL OR COVER WITH CAP EXTENDED FROM AREA 1		
■	EXCAVATION (5'), BACKFILL, AND ASPHALT COVER		
■	PROPOSED ASPHALT COVER		
■	UNCAPPED AREA INCLUDING GRADING AND BMPs		
■	LNAPL IN UPPER HSU		
■	DNAPL IN UPPER HSU		
■	DNAPL IN LOWER HSU		
- - -	POTENTIAL EXTENT OF DNAPL IN LOWER HSU		

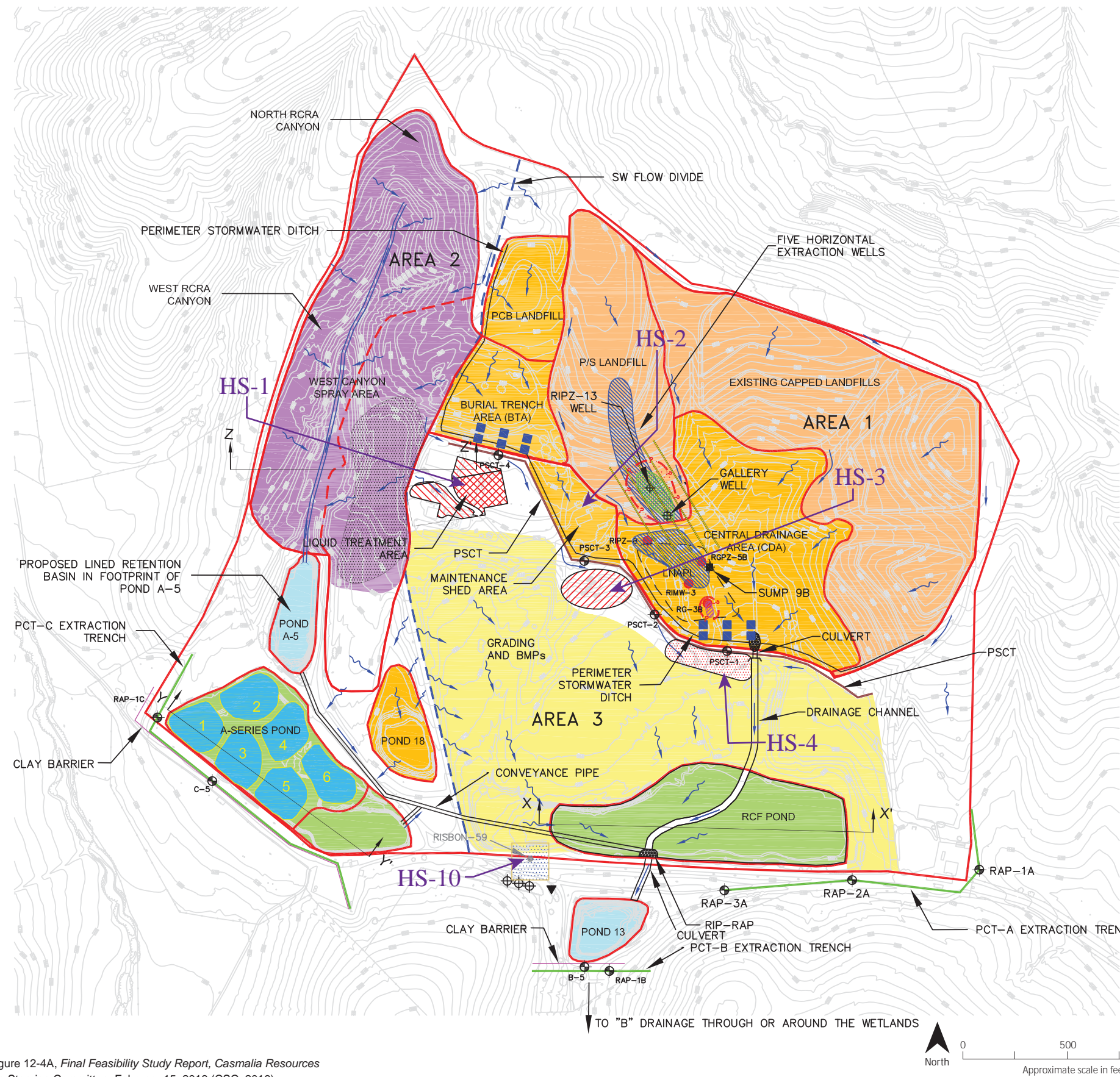
- NOTES:**
1. THE REMEDIAL ALTERNATIVE ASSUMES AN ET CAP FOR FS AREA 2, BUT THE ACTUAL CAP TYPE AND DETAILS WILL BE DETERMINED DURING REMEDIAL DESIGN. THIS REMEDIAL ALTERNATIVE ALSO INCLUDES RCRA CAPS IN FS AREAS 1 AND 3, AND AN ECO CAP IN FS AREA 4. THE EXCAVATED SOIL IN FS AREA 3 IS DISPOSED OF IN THE PCB LANDFILL PRIOR TO CAP CONSTRUCTION.
 2. THE PSCT AND PCT GROUNDWATER IS TREATED FOR VOCs AND INORGANICS IN AN ONSITE LIQUIDS TREATMENT PLANT AND DISCHARGED OFFSITE TO CASMALIA CREEK UNDER A SITE-SPECIFIC NPDES PERMIT.
 3. RCF POND WILL BE BACKFILLED TO RAISE THE MINIMUM BOTTOM ELEVATION TO APPROXIMATELY 415 FT MSL AND ENSURE IT IS ABOVE THE GROUNDWATER LEVEL.
 4. THIS REMEDIAL ALTERNATIVE FOR FS AREA 5 INCLUDES OPERATING THE EXISTING PSCT, GALLERY WELL AND PCT EXTRACTION SYSTEMS AND DNAPL/LNAPL-ONLY EXTRACTION FROM 16 WELLS IN THE SOUTHERN PART OF THE P/S LANDFILL.
 5. CAPPED AREA STORMWATER FLOW IS DIRECTED THROUGH POND 13, TO DISCHARGED THROUGH OR AROUND THE WETLANDS AND ONTO THE OFFSITE B-DRAINAGE. UNCAPPED AREAS IN FS AREA 3 SOUTH OF THE PSCT AND EAST OF LTP ROAD WILL INCLUDE GRADING AND BMPs TO MINIMIZE EROSION.



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FIGURE 2-30
 Sitewide Remedial Alternative 4 - Capping,
 Liquids Extraction, Offsite Discharge
 Record of Decision

Source: Modified from Figure 12-3A, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)
 PR0602171402SCO ROD_Figure 2-30 Sitewide Remedial Alternative 4 - Capping, Liquids Extraction, Offsite Discharge.ai 2/18



LEGEND:

- LIMITS OF STUDY AREA (AREAS 1-4)
- PSCT TRENCH
- PCT EXTRACTION TRENCH
- CLAY BARRIER
- HORIZONTAL WELL
- EXISTING RCRA CAP
- PROPOSED RCRA CAP
- EVAPOTRANSPIRATIVE (ET) CAP AND/OR HYBRID CAP
- ECO CAP – SOIL CAP (A-SERIES, RCF POND)
- LINED RETENTION BASIN (POND A-5, POND 13)
- 5' EXCAVATION WITH ET CAP
- EXCAVATION (5') AND BACKFILL
- EXCAVATION (20') AND BACKFILL OR COVER WITH CAP EXTENDED FROM AREA 1
- EXCAVATION (5'), BACKFILL, AND ASPHALT COVER
- PROPOSED ASPHALT COVER
- UNCAPPED AREA INCLUDING GRADING AND BMPs
- EXCAVATION (50') AND BACKFILL
- LNAPL IN UPPER HSU
- DNAPL IN UPPER HSU
- DNAPL IN LOWER HSU
- EXISTING MONITORING WELL FOR LNAPL SKIMMER
- ⊕ EXISTING MONITORING WELL
- ⊕ EXISTING EXTRACTION WELL
- ⊕ PCT AND PSCT EXTRACTION WELLS
- ▼ EXISTING PIEZOMETER
- LHSU MONITORING WELL
- RIP RAP
- CHANNELED STORMWATER FLOW
- ~ NATURAL STORMWATER FLOW
- - - POTENTIAL EXTENT OF DNAPL IN LOWER HSU
- HS-11 SOIL HOTSPOT 1

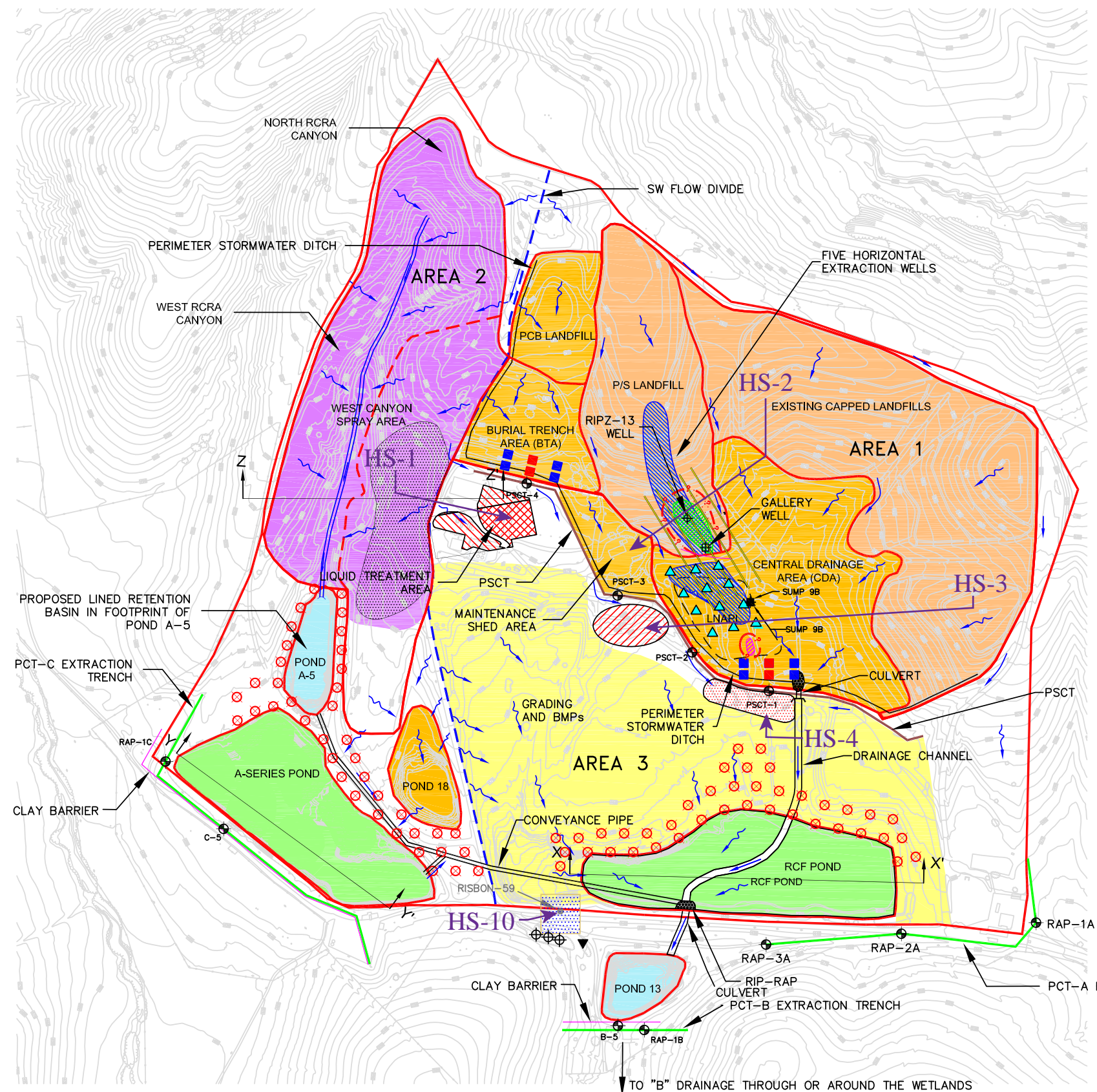
NOTES:

1. THE REMEDIAL ALTERNATIVE ASSUMES AN ET CAP FOR FS AREA 2, BUT THE ACTUAL CAP TYPE AND DETAILS WILL BE DETERMINED DURING REMEDIAL DESIGN. THIS REMEDIAL ALTERNATIVE ALSO INCLUDES RCRA CAPS IN FS AREAS 1 AND 3, AND AN ECO CAP AND LINED PONDS IN FS AREA 4. THE EXCAVATED SOIL IN FS AREA 3 IS DISPOSED OF IN THE PCB LANDFILL PRIOR TO CAP CONSTRUCTION.
2. A NEW 6-ACRE EVAPORATION POND IS PROPOSED AS SIX 1-ACRE PONDS IN THE FOOTPRINT OF THE A-SERIES POND.
3. THE TREATED PSCT AND EXTRACTED PCT GROUNDWATER IS SENT TO THE EVAPORATION POND IN THE FOOTPRINT OF A-SERIES POND.
4. RCF POND WILL BE BACKFILLED TO RAISE THE MINIMUM BOTTOM ELEVATION TO APPROXIMATELY 415 FT MSL AND ENSURE IT IS ABOVE THE GROUNDWATER LEVEL.
5. THIS REMEDIAL ALTERNATIVE FOR FS AREA 5 INCLUDES OPERATING THE EXISTING PSCT, GALLERY WELL AND PCT EXTRACTION SYSTEMS AND P/S LANDFILL DE-WATERING WITH HORIZONTAL WELLS IN THE SOUTHERN PART OF THE LANDFILL. LIQUIDS FROM DE-WATERING P/S LANDFILL ARE SENT OFFSITE FOR DISPOSAL.
6. CAPPED AREA STORMWATER FLOW IS DIRECTED THROUGH POND 13, DISCHARGED THROUGH OR AROUND THE WETLANDS AND ONTO THE OFFSITE B-DRAINAGE. UNCAPPED AREAS IN FS AREA 3 SOUTH OF THE PSCT AND EAST OF LTP ROAD WILL INCLUDE GRADING AND BMPs TO MINIMIZE EROSION.



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FIGURE 2-31
Sitewide Remedial Alternative 5 – Capping, Liquids
Extraction, P/S Landfill Dewatering, Small Evaporation Pond
Record of Decision

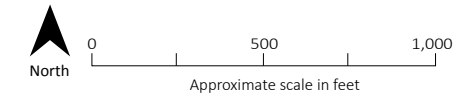


LEGEND:

- LIMITS OF STUDY AREA (AREAS 1-4)
- PSCT TRENCH
- PCT EXTRACTION TRENCH
- CLAY BARRIER
- HORIZONTAL WELL
- EXISTING RCRA CAP
- PROPOSED RCRA CAP
- EVAPOTRANSPIRATIVE (ET) CAP AND/OR HYBRID CAP
- ECO CAP – SOIL CAP (A-SERIES, RCF POND)
- LINED RETENTION BASIN (POND A-5, POND 13)
- 5' EXCAVATION WITH ET CAP
- EXCAVATION (5') AND BACKFILL
- EXCAVATION (20') AND BACKFILL OR COVER WITH CAP EXTENDED FROM AREA 1
- EXCAVATION (50') AND BACKFILL
- EXCAVATION (5'), BACKFILL, AND ASPHALT COVER
- PROPOSED ASPHALT COVER
- UNCAPPED AREA INCLUDING GRADING AND BMPs
- LNAPL IN UPPER HSU
- DNAPL IN UPPER HSU
- DNAPL IN LOWER HSU
- ? - ? - POTENTIAL EXTENT OF DNAPL IN LOWER HSU
- ▲ NEW LNAPL SKIMMER WELL
- ⊕ EXISTING MONITORING WELL
- ⊕ EXISTING EXTRACTION WELL
- ⊕ PCT-A AND PSCT EXTRACTION WELLS
- ⊗ AGGRESSIVE EXTRACTION WELL
- ▼ EXISTING PIEZOMETER
- LHSU MONITORING WELL
- LHSU EXTRACTION WELL
- RIP RAP
- CHanneled STORMWATER FLOW
- NATURAL STORMWATER FLOW
- HS-11 SOIL HOTSPOT 1

NOTES:

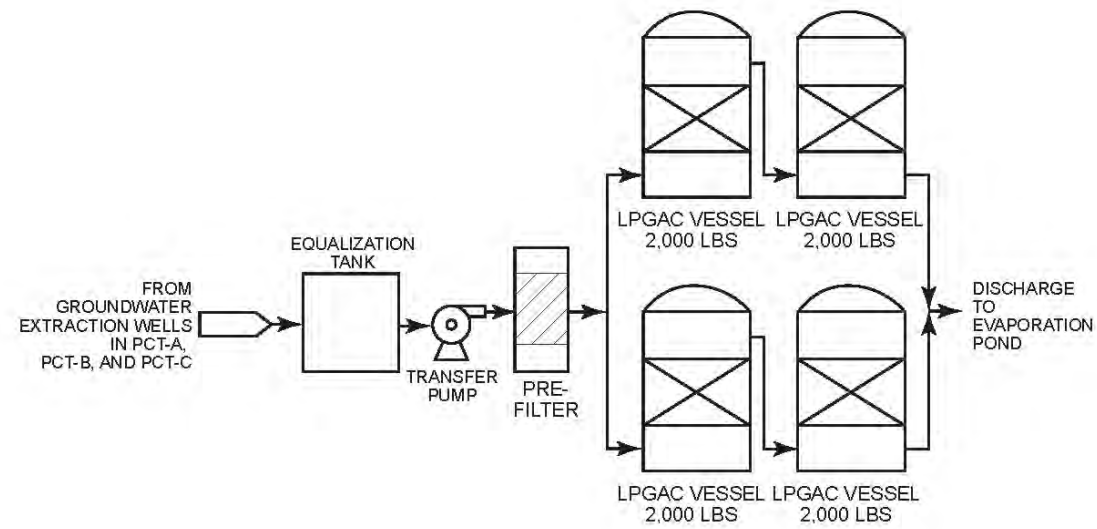
1. THE REMEDIAL ALTERNATIVE ASSUMES AN ET CAP FOR FS AREA 2, BUT THE ACTUAL CAP TYPE AND DETAILS WILL BE DETERMINED DURING REMEDIAL DESIGN. THIS REMEDIAL ALTERNATIVE ALSO INCLUDES RCRA CAPS IN FS AREAS 1 AND 3, AND AN ECO CAP IN FS AREA 4. THE EXCAVATED SOIL IN FS AREA 3 IS DISPOSED OF IN THE PCB LANDFILL PRIOR TO CAP CONSTRUCTION.
2. THE AGGRESSIVE EXTRACTION FROM AREA 5 SOUTH AND 5 WEST AND THE PSCT AND PCT GROUNDWATER IS TREATED FOR VOC's AND INORGANICS IN AN ONSITE LIQUIDS TREATMENT PLANT AND DISCHARGED OFFSITE TO CASMALIA CREEK UNDER A SITE-SPECIFIC NPDES PERMIT.
3. RCF POND WILL BE BACKFILLED TO RAISE THE MINIMUM BOTTOM ELEVATION TO APPROXIMATELY 415 FT MSL AND ENSURE IT IS ABOVE THE GROUNDWATER LEVEL.
4. THIS REMEDIAL ALTERNATIVE FOR FS AREA 5 INCLUDES OPERATING THE EXISTING PSCT, GALLERY WELL AND PCT EXTRACTION SYSTEMS AND P/S LANDFILL DE-WATERING WITH HORIZONTAL WELLS IN THE SOUTHERN PART OF THE LANDFILL. LIQUIDS FROM DE-WATERING P/S LANDFILL ARE SENT OFFSITE FOR DISPOSAL.
5. CAPPED AND UNCAPPED AREA STORMWATER FLOW IS DIRECTED THROUGH POND 13, DISCHARGED THROUGH OR AROUND WETLANDS AND INTO THE OFFSITE B-DRAINAGE. UNCAPPED AREAS IN FS AREA 3 SOUTH OF THE PSCT AND EAST OF LTP ROAD WILL INCLUDE GRADING AND BMPs TO MINIMIZE EROSION.



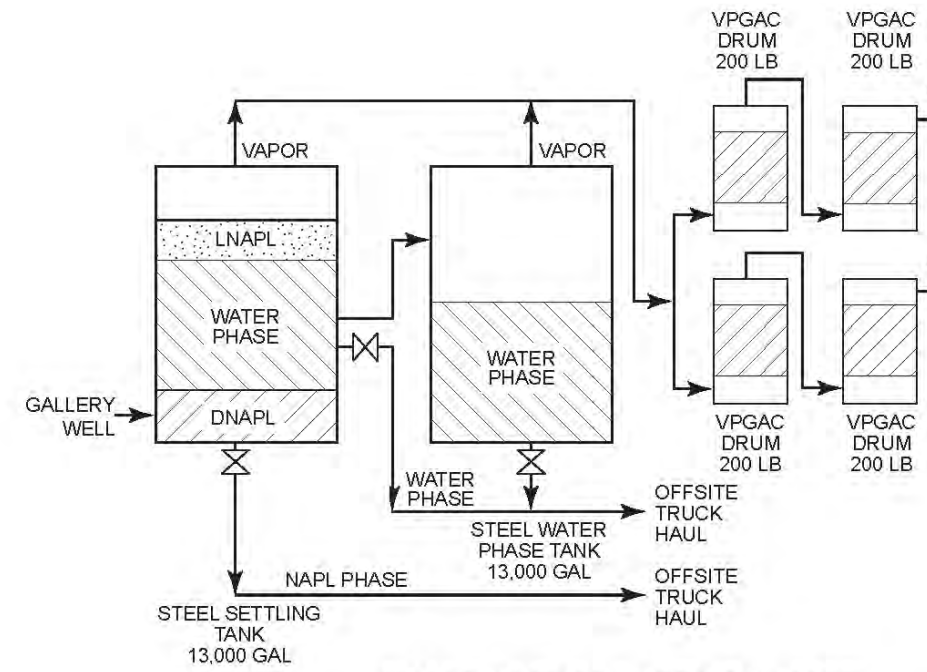
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FIGURE 2-32
 Sitewide Remedial Alternative 6 – Capping, Liquids
 Extraction, P/S Landfill Dewatering, Groundwater Extraction,
 Offsite Discharge
Record of Decision

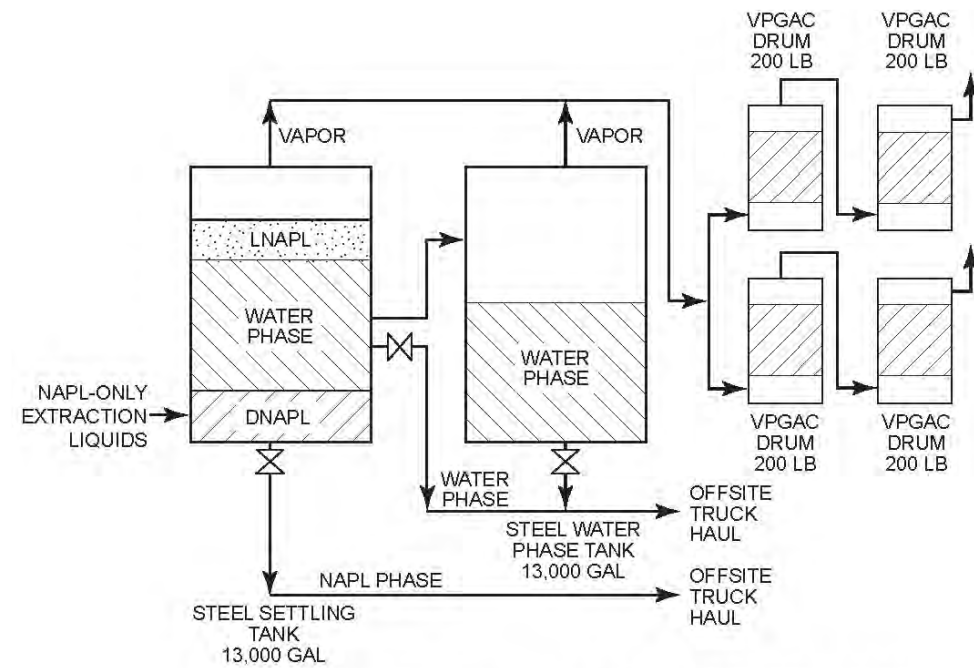
Source: Modified from Figure 12-6A, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



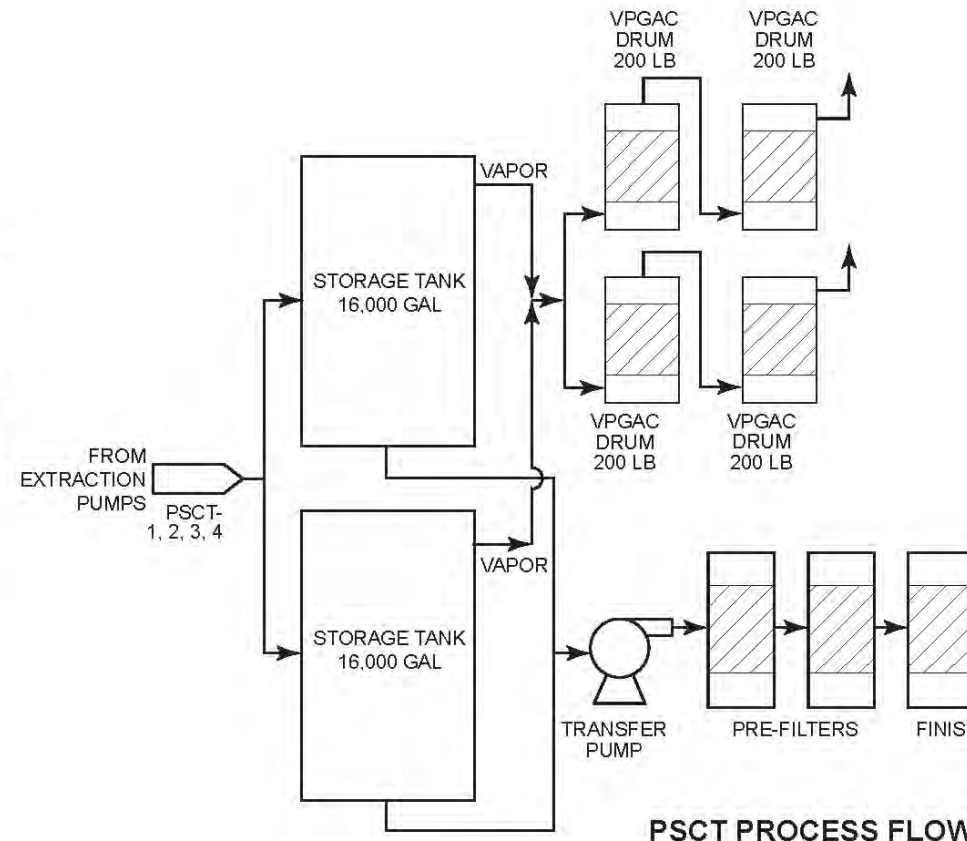
PCT-A, PCT-B, AND PCT-C PROCESS FLOW



GALLERY WELL PROCESS FLOW



NAPL-ONLY EXTRACTION PROCESS FLOW







PSCT PROCESS FLOW

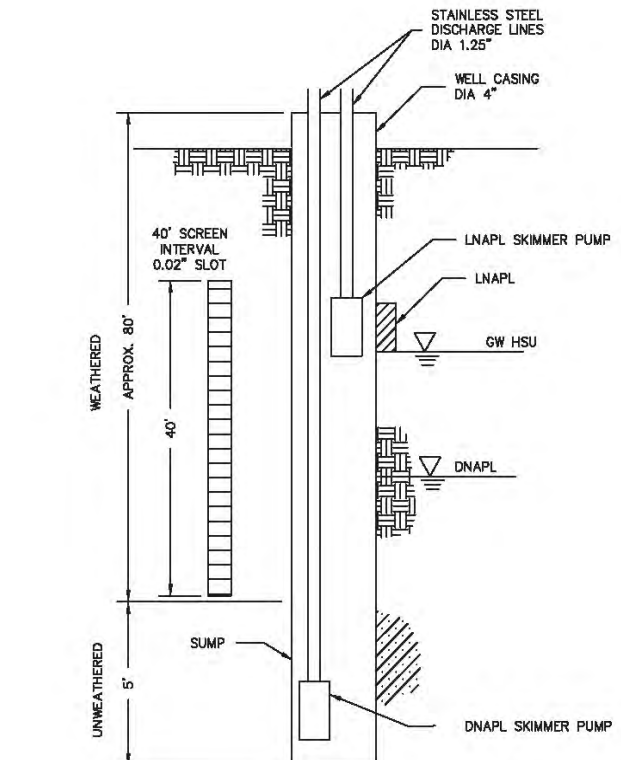
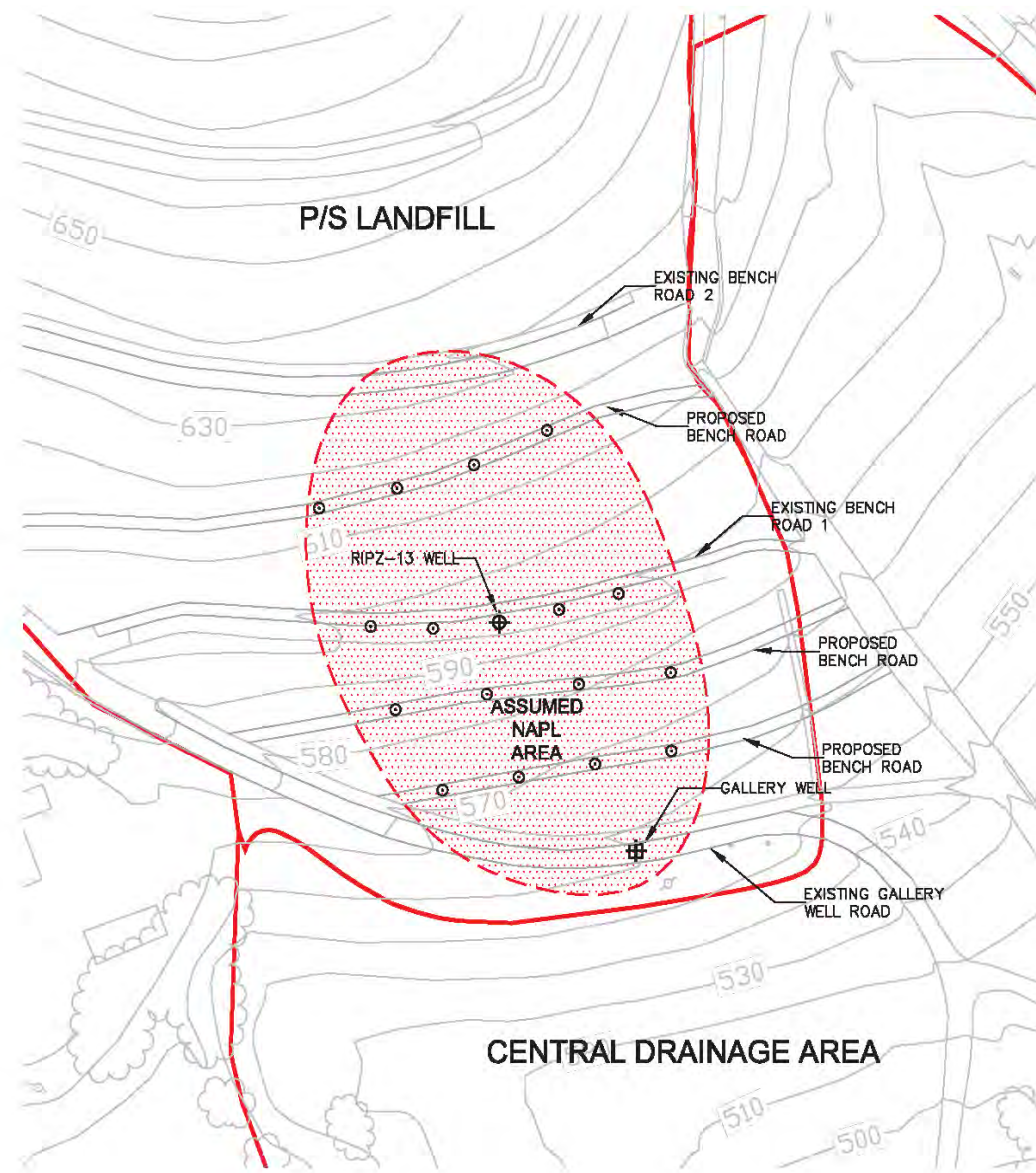


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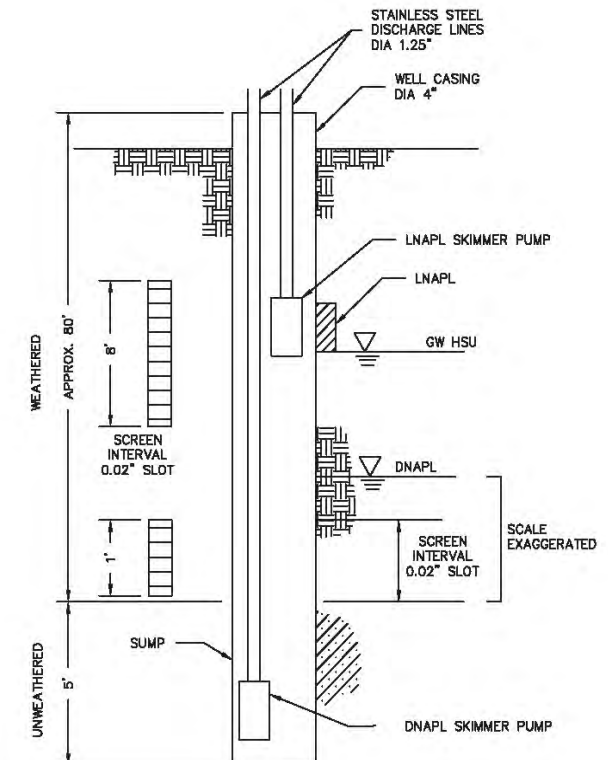
FIGURE 2-33
Selected Remedy – Process Flow Diagram for NAPL and Groundwater
Record of Decision

LEGEND:

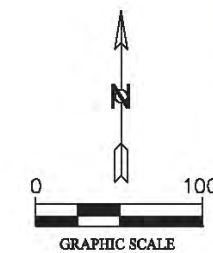
-  NAPL EXTRACTION AREA
-  EXISTING EXTRACTION WELL
-  NAPL-ONLY EXTRACTION WELL (16 WELLS)
-  BENCH ROAD



**NAPL-ONLY EXTRACTION WELL
IN UPPER HSU - CONTINUOUS SCREEN**
NOT TO SCALE



**NAPL-ONLY EXTRACTION WELL
IN UPPER HSU - TWO DISCRETE SCREENS**
NOT TO SCALE



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FIGURE 2-34
Selected Remedy – Preliminary Design Details for
NAPL-Only Extraction Wells
Record of Decision