Casmalia Resources Superfund Site

Santa Barbara County, California

Proposed Plan

Casmalia Resources Superfund Site
EPA ID: CAD 020748125

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Acronyms and Abbreviations

µg/L	microgram(s) per liter
amsl	above mean sea level
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BHHRA	baseline human health risk assessment
BTA	Burial Trench Area
Cal-EPA	California Environmental Protection Agency
CD	Consent Decree
CDA	Central Drainage Area
CDFW	California Department of Fish and Wildlife
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
cm/sec	centimeter(s) per second
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CR	Casmalia Resources
CSC	Casmalia Steering Committee
CTAC	community technical assistance consultant
DCE	dichloroethene
Dhc	Dehaloccocoides
DNAPL	dense non-aqueous 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
ET	evapotranspiration

FR	Federal Register
FS	feasibility study
ft/day	foot (feet) per day
GAC	granular activated carbon
GCL	geosynthetic clay layer
GRA	General Response Action
HDPE	high-density polyethylene
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
HSU	hydrostratigraphic unit
IAC	Interagency Committee
IC	institutional control
LLTW	low-level threat waste
LNAPL	light non-aqueous phase liquid
LOAEL	lowest observed adverse effect level
LTE	long-term effectiveness
LUC	land use control
MCL	maximum contaminant level
MCPP	2-(2-chloro-4-methylphenoxyl) propionic acid
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
MNA	monitored natural attenuation
MSA	Maintenance Shed Area
NAPL	non-aqueous phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
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

PAH	polycyclic aromatic hydrocarbon
P/S	pesticide/solvent (landfill)
PCB	polychlorinated biphenyl
PCT	Perimeter Control Trench
PCE	tetrachloroethene
Plan	Proposed Plan
POC	point of compliance
PRG	preliminary remediation goal
PRP	potentially responsible party
PSCT	Perimeter Source Control Trench
PTW	principal threat waste
RAO	remedial action objective
RCF	Runoff Control Facility
RCRA	Resource Conservation and Recovery Act
RfD	reference dose
RI	remedial investigation
ROD	Record of Decision
RWQCB	Regional Water Quality Control Board, Central Coast Region
Site	Casmalia Resources Superfund Site
STE	short-term effectiveness
SVOC	semivolatile organic compound
SWR	sitewide remedial alternative
TCE	trichloroethene
TDS	total dissolved solids
TEQ	toxicity equivalent
TI	Technical Impracticability
TIE	Technical Impracticability Evaluation
U.S.	United States
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

1. Introduction

The United States Environmental Protection Agency (EPA) is issuing this **Proposed Plan** (Plan) to present EPA's **Preferred Alternative** for the Casmalia Resources Superfund Site (Site), located in Santa Barbara County, California (see *Figure 1*). This Plan also describes EPA's Site cleanup objectives and other cleanup alternatives that EPA considered. A glossary defining key terms is provided in Appendix A at the end of this document; the key terms appear in bold the first time they are presented.

The Site was owned and operated by Casmalia Resources (CR) as a **hazardous waste management facility** from the early 1970s until 1991. Former waste management operations at the Site were conducted within an area approximately 252 acres in size, designated as Zone 1, which included multiple waste management units such as landfills, storage and evaporation ponds, evaporation pads, oil field waste spreading areas, treatment units, and disposal wells and trenches. The main facility (Zone 1) is surrounded by adjacent properties, designated as Zone 2, which help create a partial buffer around Zone 1 (as shown on *Figure* 1 and described in Section 3.1). EPA expects the Preferred Alternative described in this Plan to be the final action for the entire Site, including Zones 1 and 2.

EPA is the lead agency for the Site, and has worked collaboratively with numerous public agency stakeholders throughout the history of the Site. The State of California Environmental Protection Agency (Cal-EPA), represented by the Department of Toxic Substances Control (DTSC) and the Central Coast Regional Water Quality Control Board (RWQCB) (collectively, the "State"), has been the primary supporting agency. In addition, EPA has consulted with the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW) for many years during ongoing Site investigations and development of the Preferred Alternative.

EPA is issuing this Plan as part of its public participation requirements under Section 117 of the **Comprehensive Environmental Response, Compensation, and Liability Act of 1980** (CERCLA) as amended, 42 United States Code Section 9617, commonly known as **Superfund**; and the **National Oil and Hazardous Substances Pollution Contingency Plan (NCP)**, as set forth in 40 Code of Federal Regulations (CFR) Section 300.430(f)(2). This Plan summarizes information that can be found in greater detail in the **Remedial Investigation** (RI) and **Feasibility Study** (FS) reports, as well as other documents contained in the **Administrative Record** for the Site. EPA and the State encourage the public to review these documents to gain a more comprehensive understanding of the Site and the Superfund activities that have been conducted.

To ensure the community's concerns are being addressed, a public **Comment Period** lasting 60 calendar days will be held. During this time, the public is encouraged to submit comments to EPA on this Proposed Plan. EPA will also hold a public meeting at the Orcutt Academy Charter School (formerly Winifred Wollam Elementary School) in Casmalia, California. Please see Section 9 for additional details on community participation.

The Preferred Alternative incorporates actions for five study areas (Areas 1 through 5; see Section 3.7 and *Figures 11 and 12*) and multiple impacted media into a comprehensive remedy. Areas 1 through 4 include the primary source areas and associated soil, soil vapor, sediment, and surface water. Area 5 includes 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 many legacy landfill sites, the Preferred Alternative 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, and long-term operations, maintenance, and monitoring (OM&M). The following primary systems and components are included for each study area (see *Figure 19*):

- Area 1 (Capped Landfills Area, Burial Trench Area [BTA], and Central Drainage Area [CDA]): The Preferred Alternative includes continued use of the existing **Resource Conservation and Recovery Act** (RCRA) Subtitle C capping systems for the landfills area, plus expansion of the caps in selected areas. These RCRA prescriptive 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 with the intent of being incorporated into the final remedy. The capped area will be increased to cover the uncapped Polychlorinated Biphenyl (PCB) Landfill, interstitial areas with former waste management units between the landfills, the BTA, and the CDA.
- Area 2 (RCRA Canyon and West Canyon Spray Area [WCSA]): The Preferred Alternative includes installation of either an evapotranspiration (ET) cap or RCRA-equivalent hybrid cap (a "RCRA-equivalent" cap meets RCRA Subtitle C performance standards, and the cap type will be selected during **remedial design**).
- Area 3 (Former Ponds and Pads Area): The Preferred Alternative includes excavation of four soil "hotspots" (discrete areas with elevated concentrations of metals, volatile organic compounds [VOCs], and other organic compounds) and consolidation of the soils into the existing PCB Landfill prior to capping. A fifth soil hotspot, consisting of contaminated soil in the Maintenance Shed Area (MSA), would be covered with the RCRA cap extended from Area 1.
- Area 4 (Stormwater Ponds and Treated Liquid Impoundments): The Preferred Alternative 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 Runoff

Control Facility (RCF) Pond. Pond 18 will be closed, Ponds A-5 and 13 will be closed and converted into lined retention basins for stormwater, 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 RCRA evaporation ponds will be constructed over the former footprint of the A-Series Pond. The sizes and numbers of evaporation ponds will vary for several remedial alternatives.

- Area 5 (Sitewide Groundwater), which includes three subareas:
  - Area 5 North: The Preferred Alternative includes liquids extraction and treatment from existing and new facilities in the source areas (source reduction). Extraction will continue from the existing Gallery Well and Perimeter Source Control Trench (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 **non-aqueous phase liquid** (NAPL) as possible. EPA is designating all of Area 5 North as a **Technical Impracticability** (TI) Zone except the area that is circumscribed by the boundaries of the five hazardous waste landfills, which is being designated as a **waste management area** (WMA). Therefore, EPA is designating all of Area 5 North as a combined WMA (where former landfills are located) and TI Zone (surrounding the WMA) because waste materials are being left in place, treatment is not practicable, and there is no expectation that groundwater within the area can be remediated for beneficial use. Area 5 North contains five closely spaced former landfills where designation of a single WMA is appropriate (EPA, 1993a). Several other waste management units, including the BTA and CDA, are located adjacent to the WMA. Specifically, the CDA contains closely spaced former ponds and pads, which were used to manage landfill runoff, control leachate, and receive bulk liquid wastes. Area 5 North also contains large volumes of **light non-aqueous phase liquids** (LNAPL) and **dense non-aqueous phase liquids** (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. The **point of compliance** (POC) will encompass both the WMA and interconnected TI Zone, and will be located at the Area 5 North boundary to ensure that groundwater quality is not further degraded outside this area. The NCP preamble sets forth EPA policy 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*" (55 Federal Register [FR] 8713; EPA, 2009).
  - Area 5 South and Area 5 West: The Preferred Alternative includes liquids extraction and treatment from the existing Perimeter Control Trench (PCT)-A, PCT-B, and PCT-C to contain and prevent contaminated groundwater from migrating southward down the adjacent drainages. The remedy in this study area also includes MNA, which is a passive, in situ method whereby

contaminant concentrations are reduced in place through physical, chemical, or biological processes.

Under the Preferred Alternative, highly contaminated liquids and NAPL from the Gallery Well and new source area extraction wells in the P/S Landfill would be transported to an EPA-approved offsite treatment, storage, and disposal facility. Less-contaminated liquids from the PSCT and PCTs would be treated onsite in a new treatment system, and treated effluent would be sent to one or more new onsite evaporation ponds. Rigorous performance and compliance monitoring programs also will be implemented.

If determined necessary by EPA, **contingency measures**, such as additional monitoring and focused extraction, will be implemented in localized areas, such as along or just beyond the area perimeters, if routine monitoring indicates that groundwater contamination is migrating beyond area boundaries. Such measures would include:

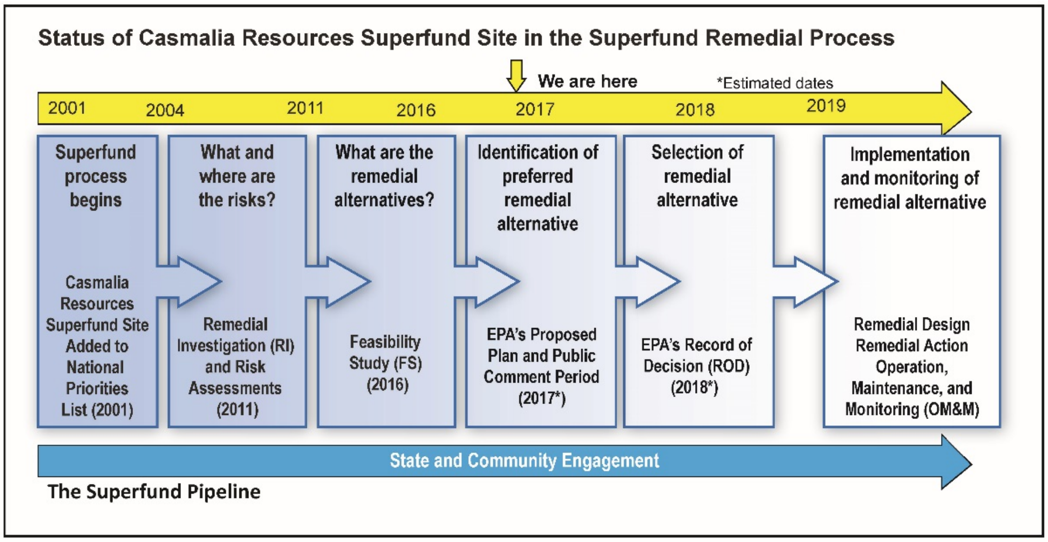
1. Additional confirmatory sampling over several (for example, three or four) sampling events to confirm the existence of statistically significant exceedances of trigger levels (maximum contaminant levels [MCLs]);
2. Installation of additional monitoring wells to further characterize the nature and extent of contamination in the immediate vicinity of the exceedance; and/or
3. Installation of a limited number of extraction wells, with treatment of extracted liquids in onsite treatment systems.

The objective of such extraction would be to provide hydraulic containment and limit further migration beyond area boundaries. The Preferred Alternative 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 system. Further evaluation would be conducted to determine if additional measures are necessary.

Because waste will remain at the Site, EPA will conduct statutory Five-Year Reviews to continue to evaluate and ensure the long-term protectiveness of the final remedy. The Five-Year Reviews include evaluations of remedy protectiveness. If it is determined that components of the remedy are not protective, EPA will evaluate corrective actions and implement the preferred action to ensure continued protectiveness. ICs have already been established, and are included in the remedial alternatives, that run with the land to restrict future land and water use.

Implementation of the Preferred Alternative, or another cleanup alternative described in this Plan, is considered necessary to protect human health and the environment from actual or threatened releases of hazardous substances. The State agencies have expressed support for the Preferred Alternative. EPA is seeking public comments on this Plan, including the Preferred Alternative and the other alternatives for the Site. EPA, in consultation with the State, will select a final remedy after the public Comment Period has ended and the comments received during the Comment Period have been reviewed and considered. Based on new information and/or comments received on the Preferred Alternative, the final Selected Remedy may be different from the Preferred Alternative presented in this Plan.

The public's comments will be considered and discussed in the **Responsiveness Summary** of the **Record of Decision** (ROD), which will document EPA's Selected Remedy for the Site. After the ROD is issued, the remedial design, remedial construction, and long-term OM&M phases will be conducted.



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2. Site Background

2.1 Overview

The CR Site is an inactive Class I hazardous waste management facility located in the northwestern corner of Santa Barbara County, California. The Site was owned and operated by CR, which accepted wastes from 1972 to 1989, and ceased operations in 1991. During its operational history, the Site accepted over 5.6 billion pounds of waste from over 10,000 generators. Former waste management operations conducted within Zone 1 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

Landfill Panorama (with RCF Pond in Foreground)

The Site also had five waste treatment units: an acid/alkaline neutralization facility identified as the Casmalia Neutralization System; a hydrogen peroxide treatment system; a wet air oxidation unit; a temporary pilot-scale powder-activated carbon treatment unit; and oil recovery tanks. *Figure 2* presents the historical Site layout, which depicts the closely spaced former waste management operations. None of these waste management units are currently in use.

Contamination at the Site has been characterized through many years of investigation, and includes VOCs, semivolatile organic compounds (SVOCs), and metals in soils, surface water, groundwater, and, to a limited degree, in soil vapor. Over 300 chemicals of interest, which are commingled and dispersed throughout various Site areas and multiple media, and which required extensive monitoring, have been detected. The principal contaminant sources include the existing landfill areas, the former waste disposal areas and facilities that have not previously undergone cleanup, and residual contamination from prior Site cleanup activities.

The Site lies in a rural setting approximately 4 miles from the Pacific Ocean and approximately 10 miles southwest of the city of Santa Maria. The nearest population center is the unincorporated community of Casmalia, located approximately 1.5 miles south-southeast of the Site. Land use surrounding the Site includes agriculture, cattle grazing, and oil field development. Vandenberg Air Force Base lies 8 miles southeast of the Site.

2.2 Site History

EPA has been engaged with the Site for many years, first in a RCRA permitting role 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. 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, which led to community concerns. The facility stopped accepting wastes in 1989 and ceased operations in 1991.

When operations ceased, Site conditions presented imminent and substantial endangerment to human health and the environment. EPA temporarily took over critical site stabilization activities in 1992 under Superfund emergency response authorities, and continued those activities through 1996. EPA and the Casmalia Steering Committee (CSC), the primary **potentially responsible party** (PRP) group, then finalized a **Consent Decree** (CD) in 1997 that provided for the CSC to conduct site characterization and response actions. The CSC began work in 1997 and will implement the Preferred Alternative described in this Plan.

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

2.2.1 Casmalia Resources Operation (1972 to 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 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, including (in part): petroleum wastes, acids, bases, organic chemical solvents, petroleum solvents, paint sludge, pesticides, infectious wastes, septic tank pumpings, and sewage sludge.

Federal, State, and local environmental and health agencies closely scrutinized the Site during the 1980s. Community members, local officials, the media, and environmental activists all highlighted potential environmental issues associated with ongoing Site operations. 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. Site operators stopped accepting waste in 1989, dramatically 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 1982, respectively. CR installed subsurface compacted clay barrier walls downgradient of the P/S Landfill and PCB Landfill in 1980 (see *Figure 2*). The P/S Landfill barrier includes a liquids extraction point called the Gallery Well, which 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 the 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 commonly referred to today as the "perimeter control trenches" (PCT-A, PCT-B, and PCT-C).

CR installed the PSCT downgradient of the landfills in 1990 (see *Figure 5*). 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 to 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 started enforcement negotiations with the CSC that led to the Casmalia CD in 1997.

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

Under the 1997 CD, the CSC is obligated to perform and finance 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 consisting of landfill capping; ongoing extraction, treatment, and disposal of contaminated subsurface liquids; monitoring; and routine Site maintenance.

Consistent with the CD, the CSC installed an engineered capping system for the P/S Landfill in 1999. The CSC also implemented a non-time-critical removal action, including 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, and then installing a final RCRA cap similar to the other four landfills. Contaminated soils were also removed from the area of several ponds and pads, and the five current ponds (RCF Pond, A-Series Pond, Pond A-5, Pond 13, and Pond 18 [*Figure 5*]) were created during removal of the contaminated soils to temporarily support stormwater management.

Heavy Metals Landfill (Installation of Geosynthetic Liner)

Acids Landfill (following Installation of RCRA Cap including Geosynthetic Liner and Vegetative Cap)

The CSC has continued to operate and maintain groundwater collection facilities (Gallery Well, PSCT, PCT-A, PCT B, and PCT-C) under EPA's oversight through the requirements of the CD. *Table 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, 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 onsite and offsite 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, and groundwater contamination in accordance with the NCP and CERCLA RI/FS guidance. The CSC completed the Final RI Report in January 2011 and the Final FS Report in February 2016. Together, these documents provide EPA with key information necessary to issue this Plan for the Site.

Figure 3 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 recent conditions in 2016.

2.3 Key Accomplishments

To date, EPA, CR, and the CSC have completed 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.
- 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 Landfill and PCB Landfill, 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.

Figure 4 presents a timeline of key operational, investigation, response, and enforcement activities since 1972 when operations began.

Currently, Zone 1 of the Site is secured by perimeter fencing and an access gate. Zone 2 extends outward from the limits of Zone 1, encompasses adjacent surrounding lands owned by the CSC and other local landowners, and serves as a partial buffer around Zone 1. Onsite staff, retained by the CSC and stationed in a field trailer within Zone 1, conduct the ongoing routine Site maintenance activities.

Figure 5 presents the current Site layout.

2.4 Community Engagement

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 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, developed and finalized the CD in 1997 that requires the CSC to conduct Site response actions, and provided oversight of the RI, FS, and ongoing Site maintenance activities.

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 many of the ongoing IAC meetings, representing the viewpoints of the local community.

3. Site Characteristics

3.1 Land Use and Physiography

The area near the Site is sparsely settled, and land use consists primarily of agriculture, cattle grazing, and oil field development. The nearest residence to the Site is located about 1 mile to the northeast along Black Road. The small unincorporated town of Casmalia is located approximately 1.5 miles south-southeast of the Site and has a population of about 300. Larger population centers in proximity to the Site include the City of Santa Maria, located approximately 10 miles northeast of the Site; the City of Guadalupe, located approximately 8 miles north of the Site; and the City of Lompoc, located approximately 16 miles southeast of the Site.

The Site is located on the south-facing flank of the Casmalia Hills and 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 (southeast corner), B-Drainage (south-central boundary), and C-Drainage (southwest corner). The North Drainage and A-Drainage are tributaries to Shuman Creek, while the B-Drainage and C-Drainage are tributaries to Casmalia Creek (see *Figure 1*).

Figure 6 depicts parcel ownership near the Site. 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 or CR. The 252-acre facility (Zone 1) is located within portions of three land parcels (113-260-002 [397.82 acres], 113-260-003 [158.67 acres], and 113-260-004 [38.21 acres]), which are still owned by CR. 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 at this time. The CSC formed a real estate holding company, the Casmalia Resources Acquisition Property Company, which acquired three additional parcels (113-260-001 [91.94 acres], 113-220-012 [118.32 acres], and 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 listed above, 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. 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. The other Zone 2 parcels surrounding the CR property are primarily used by private landowners for ranching, grazing, and oil and gas development. EPA anticipates that Site remediation and long-term OM&M activities will continue throughout the long-term future. Stakeholders expect the land use for the adjacent parcels in Zone 2 to continue, consistent with agricultural zoning, including oil and gas development.

3.2 Ecology

The Site contains two general ecological habitat types: upland (terrestrial) habitat, and aquatic habitat. Terrestrial portions of the 252-acre Site are sparsely vegetated and annually grazed grassland. Upland habitat occurs primarily in the northern portion of the Site. The majority of aquatic habitat is located in the southern portion of the Site and consists of large impoundments created for the collection of surface water runoff (RCF Pond, A-Series Pond, and Ponds A-5, 13, and 18). In addition, a series of six interconnected artificial wetland pools was constructed in 2008 just south of Pond 13, in the upper reaches of the B-Drainage, and is referred to as the B-Drainage wetlands (see *Figure 1*). Freshwater areas include riparian areas associated with Casmalia Creek and Shuman Creek.

B-Drainage Wetland Pools

The site contains several special-status species, including (1) California Red-legged Frog (Federally listed as threatened, and State species of special concern); (2) California Tiger Salamander (Federally listed as endangered, and State listed as threatened; and (3) Western Spadefoot toad (State species of special concern).

3.3 Regional and Nearby Water Use

The Site is located in the Casmalia Hills, a topographic high 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 (see *Figure 7*). 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.

The northern boundary of the Site is approximately 2.5 miles from the San Antonio Valley Creek basin. The Site is underlain by low-permeability rocks generally considered 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 (RWQCB, 2016); 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 14*).

Groundwater surrounding Zone 1 is used to support ranching, livestock, and similar nonpotable use activities. 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 (see *Figure 9*), 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 total dissolved solids (TDS) levels below 10,000 milligrams per liter (mg/L); and (3) 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).

3.4 Geology

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. *Figure 8* presents a generalized geologic cross section depicting formations underlying the Site.

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 is exposed across about 90 percent of the Site, and ranges in thickness from 15 to 65 feet. The thicker sections of weathered claystone occur in areas of topographic highs, particularly in the northern portions of the Site, and gradually thin to the south. The weathered claystone is yellowish gray to pale olive to olive-gray in color.

The unweathered claystone is exposed across less than 10 percent of the Site, and typically lies at depths of 15 to almost 100 feet below ground surface (bgs). The unweathered claystone is medium bluish gray (dry) to olive-black to gray olive-green (wet) in color. The unweathered 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.

Alluvium and colluvium locally occur atop the claystone and within present and former drainages. Engineered fill is present throughout the Site as dikes, berms, environmental barriers, and solid waste disposal units. Fill material was also placed in association with landfill capping activities, and as buttresses at the toe of some landfills. Fill was generally derived from excavation of Site soils and consists of silty clay and claystone.

3.5 Hydrogeology and Groundwater Flow

Overlying the weathered claystone are discontinuous surficial clayey soils, colluvium, alluvium, and fill. Perched water is present in the vadose zone, is laterally discontinuous, and results in local seeps in some areas (particularly in RCRA Canyon).

The claystone is laterally and vertically extensive across the Site. Based on the degree of weathering, two hydrostratigraphic units (HSUs), an Upper and Lower HSU, have been defined for the Site. The Upper HSU consists of the weathered and transition zone claystone, while the Lower HSU consists of unweathered claystone. Most groundwater flow at the Site occurs in fractures in the Upper HSU that are present at a density of several fractures per foot. A minor component of groundwater flow occurs within fractures of the Lower HSU, which are present at a frequency of every several feet to tens of feet. Although groundwater flow occurs through fractures in the Upper and Lower HSUs, most groundwater in this unit is stored within the matrix porosity. The Upper HSU is poorly transmissive with a geometric mean hydraulic conductivity of 6.8×10^{-5} centimeters per second (cm/sec) (0.19 foot per day [ft/day]). The Lower HSU is less transmissive compared to the Upper HSU, with a mean hydraulic conductivity of 1.3×10^{-6} cm/sec (3.7×10^{-3} ft/day).

The saturated zone within the claystone consists of a “dual-porosity” groundwater system, in which the effective porosity of the matrix (provided by interconnected pores) is relatively large (mean values of 44 and 48 percent in the Lower and Upper HSUs, respectively) compared to the bulk fracture porosity (less than 1 percent). The dual porosity (matrix and fracture) nature of the claystone creates a distinct groundwater flow system. Groundwater storage occurs primarily within the claystone matrix, which comprises most of the total porosity, and groundwater flow occurs primarily through fractures despite their small contribution to total porosity.

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 (see *Figure 9*). Groundwater flow is controlled by topography, the geologic structure of the contact between the Upper and Lower HSUs, and liquids extraction facilities operated to control migration of contaminated groundwater.

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. Contaminated dissolved-phase liquids, LNAPL, and DNAPL within the P/S Landfill are extracted by the Gallery Well at the southern perimeter of the landfill. The Gallery Well is located immediately upgradient of a clay barrier at the southern limit of the P/S Landfill that provides additional containment of these liquids. Groundwater in the Upper HSU flows southward and is intercepted by Sump 9B and the PSCT. Groundwater south of the PSCT is influenced by surface water elevations in the ponds and is intercepted by the PCTs. Groundwater in the Lower HSU flows southward and underneath the PSCT. However, groundwater flow in the Lower HSU is much less significant than flow in the Upper HSU because of the lower permeability and less extensive fracturing.

The water table contour map on *Figure 10* presents typical horizontal groundwater flow patterns and gradients at the Site.

3.6 Groundwater Flow Model

Groundwater modeling specialists from EPA and the CSC spent over 5 years developing and applying a simulation model to depict onsite groundwater flow patterns. A finite difference model (U.S. Geological Survey, MODFLOW-2000) with particle tracking (MODPATH) was created to simulate 3-D flow. The 7-layer, steady-state model was constructed and carefully calibrated to examine groundwater flow paths around specific geologic and engineering features under a variety of scenarios. When used in conjunction with water level data from the monitoring well network, the model provides valuable information on the direction and rate of groundwater flow.

The RI Report provides a detailed discussion on the development, calibration, use, and results of the 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 fully contained at the actual base of the landfill as there is the potential for it to migrate a short distance downward through fractures in the underlying claystone.
- 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 may be partially captured by the PSCT or may move beneath the PSCT as indicated by particle tracking.

- The PCTs extract and contain liquids moving southward toward the A-, B-, and C-Drainages.

3.7 Five Study Areas

The RI Report identified several soil, sediment, groundwater, and surface water study areas based on an understanding of the historical uses of these areas. Based on the RI results, the FS Report divided the Site into five study areas, including four surface areas (Areas 1 through 4) and a fifth area that includes all onsite groundwater (Area 5). The FS study areas were established and evaluated based on geographical proximity and/or similar impacted media, and are described below. *Figure 11* shows the location of Areas 1 through 4. *Figure 12* shows the location of Area 5.

3.7.1 Area 1 (Capped Landfills Area, BTA, and CDA)

The northern part of the Site contains the five existing landfills (P/S, Heavy Metals, Caustics/Cyanide, Acids, and PCB) and numerous, closely spaced waste management units. The CSC constructed engineered RCRA Subtitle C capping systems on four of the landfills (P/S, Heavy Metals, Caustics/Cyanide, and Acids) between 1999 and 2002. Final capping of the PCB Landfill is deferred, reserving the landfill for reconsolidation of waste materials generated as part of the final remedy.

Waste disposal in the BTA began in the early 1970s with disposal in seven trenches directly south of the PCB Landfill and west of the P/S Landfill. Waste disposal in the BTA also included liquids disposal in 11 shallow wells constructed in the mid to late 1970s and early 1980s.

Area 1 includes the Drum Burial Area, which consisted of disposal of drums on an experimental basis near former Pond 19. Wastes in the former Drum Burial Area were removed and redeposited in one of the existing inactive landfill areas in 1979-1980.

As shown on *Figure 5*, Area 1 contains several other waste management units associated with former operation of the adjacent landfills (CSC, 2011), including the following:

- Former Pads 9A and 9B in the CDA were used for landfill runoff and leachate control, and may be sources of DNAPL (in addition to the P/S Landfill) because of observed DNAPL in this area.
- Former Ponds 6 and 19, also in the CDA, were used for landfill runoff and leachate control, although DNAPL has not been observed in this area.
- Former Ponds 10A, 10B, 10C, 10E, 10F, and 10G, generally located between adjacent landfills, were “landfill runoff / leachate control” ponds.
- Former Pond R, located just south of the P/S Landfill in the CDA, received acidic and caustic wastes in 1978, as well as runoff from the P/S Landfill and MSA.
- Former Pond 23, located south of the PCB Landfill in the BTA, was constructed to provide localized runoff control, but may have received bulk liquid waste material.

The CSC also constructed other stormwater runoff control systems to convey clean stormwater from these capped landfill areas through the CDA and offsite to the B-Drainage and Casmalia Creek. The Gallery Well, Sump 9B, and PSCT were constructed by CR and the CSC to actively control and contain contaminated liquids (NAPL and groundwater) within this study area.

3.7.2 Area 2 (RCRA Canyon and WCSA)

The former RCRA landfill is located in a natural canyon (referred to as RCRA Canyon, and historically sometimes referred to as West Canyon) on the northwest 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, CR excavated the limited amount of RCRA Canyon wastes in 1989-1990 that had been placed in late 1983 to early 1984.

RCRA Canyon (with Pond A-5 and A-Series Ponds in Distance)

RCRA Canyon was also the location of the oil field waste spreading areas, referred to as the *West Canyon Spray Area* (WCSA). The north and west slopes of this area received oil field wastes (primarily drilling mud), winery wastes, and 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.

3.7.3 Area 3 (Former Ponds and Pads Area)

CR utilized a total of 43 ponds and 15 evaporation pads, collectively referred to as surface impoundments, many of which are located in Area 3. Construction of these 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 nonhazardous wastes such as sewage sludge, and six areas were used for spreading and drying of oil field wastes and drilling mud. Disposal of liquids to the ponds ceased by 1988.

Surface impoundment closure activities were completed from 1988 to 1990. 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 landfill areas. Contaminated subgrade materials were also relocated to the Site landfill areas for disposal.

Area 3 also includes “remaining site areas,” consisting of various portions of land in the north, south, east, and west of the Site where various soil hotspots are located.

3.7.4 Area 4 (Stormwater Ponds and Treated Liquid Impoundments)

Five existing ponds were created 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 (see *Figure 5*), and currently receives untreated water from PCT-A.
- A-Series Pond. The A-Series Pond lies in the area once occupied by portions of former Ponds A-1, A-2, A-3, and A-4, and currently receives untreated water from PCT-B and PCT-C.
- Pond 13. Pond 13 is the most southerly (downgradient) of the original stormwater runoff containment ponds, and 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:

- Pond A-5. Pond A-5 once received treated liquids extracted from Sump 9B and the Gallery Well, although 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.

3.7.5 Area 5 (Sitewide Groundwater)

Area 5 includes Sitewide groundwater, and was further divided into Area 5 North, Area 5 South, and Area 5 West as shown on *Figure 12*.

- Area 5 North. Area 5 North includes all groundwater north of the PSCT.
- Area 5 South. Area 5 South includes all groundwater south of the PSCT.
- Area 5 West. Area 5 West includes all groundwater in, north, and south of the RCRA Canyon area.

3.8 Contaminant Sources, Affected Media, and Chemicals of Potential Concern

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 untreated former disposal areas represent the most significant continuing sources of contamination.

Over 300 chemicals of interest, which are commingled and dispersed throughout various Site areas and multiple media, have been detected. Site-related contaminants occur within the following media:

- Soil (surface and subsurface)
- Soil vapor
- Sediment
- Surface water
- Groundwater

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. Organic **chemicals of potential concern** (COPCs) are derived from the following constituent groups:

- VOCs
- SVOCs
- Polycyclic aromatic hydrocarbons (PAHs)
- Pesticides
- Herbicides
- PCBs
- Dioxins and furans

Inorganic COPCs primarily include metals and salts. Water in the five ponds and groundwater also exhibit elevated TDS concentrations.

Figure 13 presents a conceptual site model block diagram for the Site.

3.9 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, groundwater, and, to a limited degree, soil vapor. Over 300 chemicals of interest 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 below. *Figure 14* presents a plan view summary of the chemical detections and exceedances for each media. *Table 2* presents the constituents detected above risk-based concentrations in each media.

3.9.1 Soils

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

Surface and subsurface soils in Area 1 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:

- Hotspot 1 – shallow soil contamination in the Liquids Treatment Area (metals, organics)
- Hotspot 2 – shallow soil contamination in the former MSA (metals, organics)
- Hotspot 3 – shallow and deeper soil contamination from former Ponds A and B that was not sufficiently cleaned up by CR (organics)
- Hotspot 4 – shallow soil contamination south of PSCT-1 (metals, organics)
- Hotspot 5 – shallow soil contamination north of RCF Pond (metals, organics)
- Hotspot 6 – shallow soil contamination northwest of RCF Pond (organics)
- Hotspot 7 – shallow soil contamination due east of Pond 18 (metals)
- Hotspot 8 – shallow soil contamination further east of Pond 18 (metals)
- Hotspot 9 – shallow soil contamination between Pond 18 and RCF Pond (metals, organics)
- Hotspot 10 – deeper soil contamination southwest of RCF Pond from a former waste pond not cleaned up by CR, and 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 former ponds and pads area (Area 3); this concentration is approximately 4 times the **preliminary remediation goal** (PRG) 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.

3.9.2 Soil Vapor

Soil vapor containing VOCs and limited amounts of methane has been found in various sampling locations across the Site. Although many constituents of interest have been detected, the highest concentrations were found in relatively discrete areas, such as the waste disposal areas, which serve as sources of soil vapor. Concentrations tend to decrease away from the source areas to below risk-based cleanup levels at the Site boundaries.

A total of 43 individual VOCs were 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.

Diffusion causes the VOCs to migrate outside these source areas, including south of the PSCT and north into the North Drainage. Localized soil vapor concentrations in the North Drainage (northern property boundary) 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 (Geosyntec, 2014).

The generation of landfill gas as methane is relatively insignificant because organic rich municipal solid waste was not disposed 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 (CSC, 2016).

3.9.3 Surface Water and Sediment

The five surface water storage ponds in Zone 1 play a critical, but temporary, role (until **remedial action** is implemented) in collecting and storing 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 concentrations of the ponds were relatively low after 32 inches of rain fell during the 1997-1998 El Niño winter and fresh stormwater filled the ponds. Since that time, the TDS has steadily increased and now exceeds the salinity of seawater (generally greater than 25,000 mg/L; CSC, 2016). The elevated 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 for contamination of shallow groundwater via infiltration.

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.

3.9.4 Surface Seeps

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

- The RCRA Canyon Seep forms seasonally at the south 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 risk to amphibians if the 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.
- Another surface seep (Sump 9B 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.

Well Installation (RIMW-7D, near Burial Trench Area)

3.9.5 Groundwater

The distribution of groundwater contamination is predominantly located within the Zone 1 boundary, with little to no contamination in Zone 2, including north of the North Ridge. Groundwater contamination consists of dissolved-phase constituents and NAPL (both LNAPL and DNAPL). NAPL is present within Zone 1 as a mobile (free) phase and immobile (residual) phase. LNAPL is lighter than water and floats on the water table, whereas DNAPL is heavier than water and is found primarily at the base of the P/S Landfill and to depths of over 100 feet below the water table in the CDA. The clay-rich nature of the claystone and lack of extensive interconnected fractures limit the vertical extent of DNAPL migration. Constituents identified in dissolved-phase contamination in groundwater include VOCs, SVOCs, pesticides, herbicides, PCBs, dioxins, and metals. The distribution of NAPL and dissolved-phase contaminants in groundwater is controlled by the physical characteristics of the groundwater flow system, contaminant source areas, contaminant properties, and ongoing liquids extraction from several extraction facilities.

The VOCs detected in groundwater in the greatest number of wells and at relatively high concentrations 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 [µg/L]) is 24,000 times greater than the MCL of 5 µg/L. Similarly, the maximum concentration detected in groundwater for TCE (120,000 µg/L) is 22,000 times greater than the MCL of 5 µg/L.

3.9.5.1 Area 5 North

Area 5 North presents obstacles to full remediation due to 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. Fractures occur every several inches (or less) in the Upper HSU and every several feet to tens of feet (or more) in the Lower HSU. Contamination resides both in fractures and as residual contamination in the matrix of the claystone – characterized by very low permeability and high porosity – preventing effective long-term removal or treatment.

Shallow groundwater in the Upper HSU flows southward through the principal source areas (landfills, BTA, and CDA) and is intercepted by the Gallery Well, Sump 9B, and the PSCT. Deeper groundwater in the Lower HSU flows slowly southward beneath the PSCT. Although groundwater flows beneath the PSCT, contamination has been effectively contained onsite through a combination of the low claystone permeability and natural processes that attenuate contaminant migration (further discussed in Section 3.11).

The Gallery Well extracts contaminated dissolved-phase liquids, LNAPL, and DNAPL from near the base of the P/S Landfill, and is located immediately upgradient of a clay barrier at the southern limit of the landfill that provides additional liquids containment. Sump 9B extracts contaminated liquids from the shallow water table and when maintained properly prevents a seep from forming immediately south of the P/S Landfill.

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 documented a DNAPL thickness of 14 feet (RIPZ-13).

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 proposed 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 adjacent to the WMA. EPA guidance (EPA, 1993b) was followed in preparing a Technical Impracticability Evaluation (TIE) report, which was included in the RI Report (CSC, 2011) and summarized in the FS Report (CSC, 2016). 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 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 (hydrocarbons, solvents, metals, PCBs, etc.) 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 within 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. 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**.

3.9.5.2 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 concentrations are near or below MCLs in the Lower HSU beneath the PSCT. Natural attenuation mechanisms slow contaminant mass migration under the PSCT. 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.

3.9.5.3 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. PCT-C intercepts groundwater in the Upper HSU at the southern perimeter of the Site and restricts it from moving offsite down this drainage.

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.

3.10 Distribution of Non-aqueous Phase Liquid

The presence of detectable NAPL is limited to the area underlying 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 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 15 and 16*, respectively.

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 on an annual basis. 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 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.

3.11 Natural Attenuation

Natural attenuation 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 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 and as further described below.

What is Monitored Natural Attenuation (MNA)?

Natural attenuation is a passive in situ groundwater treatment through various physical, chemical, or biological processes. MNA can be an important component of a final remedy. It includes routine monitoring of the natural attenuation processes to verify reduction in groundwater constituent concentrations to help achieve site-specific remediation objectives. While MNA is a passive remediation approach, it does not preclude the use of active remediation. In fact, MNA is often included along with active remediation as a final remedy.

Process	Mechanism
Physical	**Dilution Dispersion Volatilization**
Chemical	**Adsorption Absorption Chemical transformation**
Biological	**Microbial metabolism (aerobic, anaerobic, and fermentative pathways)**

(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 (CSC, 2011). Concentrations of organic and inorganic constituents are also declining in some wells for Area 5 North. Biodegradation is one of the most important natural attenuation mechanisms 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 mechanisms for both organic and inorganic constituents.

(2) Geochemical Data. The biodegradation of solvent-class, fuel-derived hydrocarbons was evaluated using geochemical data. This part of the MNA evaluation examined 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 nondetect levels in downgradient portions of plumes. Corresponding increases in degradation products relative to PCE and TCE were also observed (PCE → TCE → cis-1,2-DCE and trans-1,2-DCE → vinyl chloride → ethene → ethane). 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. Dehaloccocoides (Dhc) bacteria, a known degrader of chlorinated solvents, was detected in groundwater samples. The presence of Dhc is consistent with the biodegradation of chlorinated solvent compounds.

3.12 Principal Threat Wastes and Low-Level Threat Wastes

Principal threat wastes (PTWs) are highly toxic or highly mobile materials that may present a significant risk to human health or the environment if exposure were to occur. They include liquids and other materials having high concentrations of toxic compounds (for example, solvents). The PTWs at the Site are considered to be the high-concentration waste materials within the five landfills, CDA, and BTA, and the highly contaminated free-phase NAPL between and underlying these areas. 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 considered to be 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 Preferred Alternative 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 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 Preferred Alternative includes containment and designation of a WMA and interconnected TI Zone (for Area 1 and Area 5 North), along with source reduction and liquids extraction and treatment (see inset below).

Principal Threat Wastes (PTWs)

The NCP establishes an expectation that EPA will: (1) use treatment to address the principal threats posed by a site wherever practicable – NCP Section 300.430(a)(1)(iii)(A); (2) use engineering controls for waste that poses a relatively low long-term threat or where treatment is impracticable; (3) use ICs; or (4) use a combination of methods to achieve protection of human health and the environment and/or to prevent or limit exposure to PTWs. 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 table below lists the PTWs for the Casmalia Resources Superfund Site.

Area	Location	Media	Contaminant(s)	Approach	Comments
1	Landfills (5), BTA, and CDA	Soil	Pesticides, Solvents, Caustics, Cyanides, PCBs, Metals, Acids	Containment	Excavation and treatment of wastes from waste management units is not practicable or cost-effective (would cost tens of billions of dollars), and would pose considerable worker exposure and waste transportation and disposal risks.
5 North	LNAPL and DNAPL below landfills and in the CDA	Ground-water	VOCs, SVOCs, PCBs, Metals	Containment (within WMA located within Area 5), with NAPL source reduction, extraction, and offsite treatment, along with long-term OM&M	Full restoration of groundwater to MCLs is technically impracticable, warranting designation of a WMA (within the footprint of former landfills) and interconnected TI Zone for Area 5 North.

4. Scope and Role of Response Action

This Proposed Plan presents information necessary to inform the public about the environmental concerns resulting from former waste management operations at the Site. Risks to both human health and the environment were identified and calculated, and a variety of potential cleanup alternatives were evaluated prior to developing this Plan. The Preferred Alternative presented in this Plan addresses the entire Site and is considered to be the final action for the Site.

The Preferred Alternative will be a combined containment and treatment remedy, consistent with EPA's approach at most legacy landfill sites, including EPA's *Presumptive Remedy for CERCLA Municipal Landfill Sites* (EPA, 1993a). Although the Site was a hazardous waste landfill and not a municipal landfill, it contains former waste management units, including former landfills, which cannot be practically removed or treated and therefore will be contained onsite within a designated WMA. The remedy will also include a TI Zone that surrounds the WMA and extends to the Area 5 North boundary. The WMA and TI Zone designations will be combined with considerable collection, removal, and treatment of landfill contaminants through various liquids control systems, which will inhibit further migration of contaminants to groundwater. The Preferred Alternative will also include engineering controls, ICs, MNA, and long-term OM&M.

Consistent with the NCP preference for treatment "to the maximum extent practicable," the Preferred Alternative will include NAPL source reduction and extraction, and treatment of contaminated Site liquids. The liquids control systems will also address the principal threats posed by landfill contaminants. DNAPL source reduction will be addressed through the installation of extraction wells focused on removal of DNAPL that contributes to onsite groundwater contamination. Extracted DNAPL will receive pretreatment onsite and be transported offsite for further treatment and disposal. The Preferred Alternative also will expand the current use of extraction systems (containment trenches, extraction wells, and extraction sumps) to remove and provide treatment of contaminated liquids.

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5. Summary of Site Risks

Site investigation activities have detected over 300 chemicals of interest that are commingled and dispersed throughout the various Site areas and multiple media; this situation contributes to risk and poses considerable challenges to site cleanup. A comprehensive risk assessment was conducted as part of the RI/FS process. 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. The HHRA also includes 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 during development of remedial alternatives.

Table 2 presents a summary of HHRA and ERA risk-based concentration exceedances by media, location, and constituent.

5.1 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 media (soil, sediment, surface water, and soil vapor). Chemicals were identified as a COPC on a per-matrix basis if the frequency of detection was greater than 5 percent, it was not considered an essential nutrient (calcium, magnesium, potassium, iron, and sodium), and it was greater than background.

5.2 Human Health Risk Assessment

5.2.1 Baseline Risk Assessment

Consistent with EPA guidance, the risk assessment process included (1) data review and evaluation; (2) exposure assessment; (3) toxicity assessment; (4) risk characterization; and (5) uncertainty analysis (see inset at the end of this section for details on each step).

The baseline human health risk assessment (BHHRA) evaluated risks for each area of the Site under current conditions, sources of contamination in various media, exposure pathways, and potentially impacted populations, or “receptors.” Sources of contamination include contaminated media such as buried solid and liquid wastes, soil, groundwater, NAPL, and soil vapor. Individual Site features, such as former waste management units (landfills, pits, ponds, lagoons, disposal wells, and trenches), were also considered in the BHHRA.

The BHHRA then developed appropriate quantitative risk calculations for exposure pathways, such as direct physical contact, ingestion, inhalation, and movement of contamination through air, soil, fractured rock, surface water, and groundwater. The following specific exposure pathways were considered potentially complete for human receptors at the Site:

- Incidental ingestion of COPCs in soil, sediment, or surface water
- Dermal contact with soil, sediment, or surface water
- Inhalation of COPCs in windborne dust generated from soil or sediment
- Inhalation of vapors emanating from soil, sediment, or surface water into outdoor air
- Inhalation of vapors emanating from soil vapor into outdoor air and indoor air
- Inhalation of vapors emanating from soil vapor outside the Site boundaries into indoor air
- Ingestion of beef from cattle that have grazed near the Site

There are 92 chemicals in groundwater that exceed MCLs (see *Table 3* for specific constituents). The risk assessment evaluated groundwater, but did not calculate risks for groundwater due to the lack of complete exposure pathways and receptor populations. Instead, EPA considers MCLs to be relevant and appropriate in decision making for groundwater response actions. Similarly, the BHHRA did not include detailed risk calculations for Site features with incomplete exposure pathways, such as the landfills that have already been capped.

Current potentially exposed populations in Zone 1 include Site workers, occasional trespassers, recreational users, and local ranchers using the NTU Road to access their lands. The potentially exposed populations in Zone 2 include local ranchers, recreational users of the drainage areas, hypothetical residents living near the Site, and consumers of beef from cattle raised in the fields near Zone 2. There are no completed exposure pathways to residents in the town of Casmalia.

For determining whether remedial actions are necessary at a Superfund site, EPA has established a generally acceptable excess lifetime cancer risk range for site-related exposure of 10^{-4} to 10^{-6}. Noncancer concerns are evaluated as a **hazard quotient** (HQ) of less than or equal to 1 (HQ<1).

5.2.2 Anticipated Future Use Scenarios

The HHRA evaluated risks associated with Site workers and trespassers, and for ranchers, recreational users, and hypothetical future residents outside the historical Site boundaries. The HHRA did not include quantitative risk calculations for residential exposure to contaminated groundwater within the historical Site boundaries due to a lack of exposure pathways and future receptors for groundwater. EPA has no reasonable anticipation that the Site will have future residential or commercial activities that would rely on local groundwater. Groundwater modeling has shown that it will take many generations, even centuries in some portions of the Site, to achieve MCLs as groundwater cleanup goals. Moreover, large volumes of waste materials will remain onsite over the long term, which can serve as ongoing sources of groundwater contamination. ICs in the form of deed restrictions have been established on and surrounding the former facility property that prohibit future residential reuse, some forms of commercial reuse, and reuse of groundwater. In light of the remaining on-property waste and existing deed restrictions, an HHRA is not warranted for this scenario.

As described in Section 3.3, 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. However, groundwater at the Site still qualifies as a USDW (and Class IIB) under federal groundwater classification policy, and is therefore subject to MCLs.

5.2.3 Chemicals of Concern – Human Health

EPA has identified several COCs based on the results of the HHRA, and has documented the presence of many (92) chemicals in groundwater that exceed MCLs. The results of the HHRA identified the following COCs for the Site, based on those that exceeded the 10^{-5} cancer risk (or midway within the EPA risk management range of 10^{-4} and 10^{-6}) or had a noncancer HQ>1.

Soils (CDA, BTA, and Selected Soil Hotspots 1 through 4 and 10):

- 2-(2-chloro-4-methylphenoxyl) propionic acid (MCPP)
- PCE
- TCE

These areas exhibited elevated risk from dermal contact, incidental ingestion, and outdoor inhalation for commercial/industrial worker exposures (cumulative risk estimate of 5×10^{-5} and a noncancer **hazard index** [HI] of 2), with PCE and MCPP 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 boundary (maximum cumulative risk estimate of 1×10^{-5}), with PCE and TCE 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 for commercial/industrial worker exposures (maximum cumulative risk of 8 x 10^{-5}) and trespasser exposures (maximum cumulative risk of 3 x 10^{-6}), with arsenic as the primary risk driver. All noncancer HIs were below 1.

Site Groundwater (Area 5):

- Dissolved chemicals in groundwater that exceed MCLs (92 chemicals; see *Table 3* for the full list)

Soil Vapor (CDA, BTA, former Ponds and Pads):

- 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 x 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 boundary, as described above.

What is Human Health Risk and How is it Calculated?

Human health risk assessment (HHRA) is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these releases under current and future land uses. A five-step process is used for assessing site-related human health risks for reasonable maximum exposure scenarios.

- **Data Review and Evaluation:** In this step, available data are reviewed to characterize the site and identify data gaps, to define nature and extent of environmental contamination at the site, and to identify COPCs. COPCs are selected for each environmental media (soil, sediment, surface water, groundwater, and soil vapor) for inclusion in the risk assessment. COPCs are defined as potentially hazardous chemicals clearly associated with the site and are present at concentrations higher than background levels.
- **Exposure Assessment:** In this step, the magnitude, frequency, duration, and routes of potential human exposure to site-related COPCs are assessed. The exposure assessment considers both current and likely future site uses and is based on complete exposure pathways to actual or probable human receptors (that is, general groups that could come in contact with site-related COPCs). The exposure scenarios are summarized in the conceptual site model, which includes the sources, affected media, release mechanisms, and exposure pathways for each identified receptor population.
- **Toxicity Assessment:** In this step, for each COPC, available information identifying the nature and degree of toxicity is presented and the dose-response relationship (the relationship between the magnitude of exposure and magnitude of potential adverse health effects on each receptor) is characterized. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other noncancer health hazards, such as changes in the normal functions of organs within the body (for example, changes in the effectiveness of the immune system). Some contaminants are capable of causing both cancer and noncancer health hazards.
- **Risk Characterization:** This step integrates the results of the exposure and toxicity assessment to yield quantitative estimates for potential cancer risks and noncancer hazards to defined receptor populations. The process of risk assessment is an iterative process where available site, receptor, and chemical-specific data are used. When site-specific data are not available, conservative (health protective) assumptions are used. The use of repeated, conservative assumptions can lead to overly conservative estimations of actual risk, which, in turn, reflects an upper-bound estimate of the most probable risk. Exposure and toxicity are evaluated based on the potential risk of developing cancer and the potential for noncancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "*one in ten thousand excess cancer risk*"; or one additional cancer case may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the exposure assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10^{-4} to 10^{-6}, corresponding to an excess cancer risk of 1 in 10,000 to 1 in 1,000,000. For noncancer health effects, an HQ is calculated for a single substance based on the ratio of an exposure over a specified timeframe period to a *reference dose* (RfD). An HI is calculated as the sum of more than one HQ for multiple substances and/or exposure pathways. The key concept for a noncancer HI is that exposures less than a specific RfD (measured as an HI less than or equal to 1) are not expected to result in adverse health effects. The goal of protection is 10^{-6} for cancer risk and an HI of 1 for a noncancer health hazard. However, the HI is not a statistical probability. A ratio of 0.001 does not mean that there is a 1 in 1,000 chance of the effect occurring. Further, it is important to emphasize that the level of concern does not increase linearly as an HI of 1 is approached or exceeded, because RfDs do not have equal accuracy or precision and are not based on the same severity of toxic effects. Contaminants that exceed a 10^{-4} cancer risk or an HI of 1 are typically those that will require remedial action at a site and are referred to as COCs.
- **Uncertainty Analysis:** The procedures used in a risk assessment are conditional estimates given that many assumptions must be made about exposure and toxicity. Uncertainties in risk assessment include natural variability (differences in body weight, sensitivity in a group of people, etc.); incomplete knowledge of basic physical, chemical, and biological processes (for example, the affinity of a chemical for soil, degradation rates); model assumptions used to estimate key inputs (exposure, dose-response models, fate and transport models); and measurement error primarily with respect to sampling and laboratory analysis. Even with the incorporation of site-specific factors, which do result in a decrease in uncertainty, uncertainty may still persist due to the inherent uncertainty in the risk assessment process. However, 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.

5.3 Ecological Risk Assessment

The objective of the ERA was to assess whether Site-related chemicals in Site media have adversely affected resident flora (plants) and migratory or resident fauna (animals). The ERA process consisted of five main phases: (1) Problem Formulation; (2) Data Evaluation/Risk Characterization; (3) Exposure Assessment; (4) Ecological Effects Assessment; and (5) Uncertainty Analysis (see inset at the end of this section for details on each step).

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.

The onsite ponds were evaluated during the Tier 1 ERA, but not in the Tier 2 ERA because all ponds are subject to closure under all remedial alternatives. The Tier 2 ERA therefore 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
- Former pond and pad areas south of the PSCT

The results of the Tier 1 and Tier 2 ERA process identified the following ecological COCs for the Site:

<u>Terrestrial Areas</u>:

- RCRA Canyon Area – chromium, copper, and zinc
- WCSA – chromium, copper, and zinc
- Roadway Area – chromium and copper

These COCs result in elevated terrestrial risks (HQ>1) to selected birds and mammals.

Aquatic Areas (including Sediment):

No COCs were identified in the Tier 2 ERA, because all ponds will be closed under the various remedial alternatives, essentially eliminating the exposure route for aquatic receptors. The ecological COCs (including Tier 1 COPECs) for surface soil, shallow soil, and sediment are presented in *Tables 4, 5, and 6*, respectively.

The Site also contains several listed special-status species, including the California Red-legged Frog (Federally listed as threatened and 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). EPA has been working with the USFWS and CDFW to address habitat mitigation and protection of these species.

What is Ecological Risk and How is it Calculated?

Ecological risk assessment (ERA) is a tiered approach that assesses whether site-related chemicals in site media have adversely affected resident flora (plants) and migratory or resident fauna (animals). The process used for assessing site-related ecological risks includes the following, with each successive step being more refined and containing greater detail:

- **Problem Formulation:** In this step, environmental setting, exposure areas, conceptual site model that includes identification of exposure pathways and ecological and indicator receptors, and selected COPECs are discussed.
- **Data Evaluation/Risk Characterization:** In this step, the results of the previous step are used to estimate the risk posed to ecological receptors through evaluation of site data from surface, shallow, and deep soil; sediment; surface water; and soil gas. Data from groundwater are not considered relevant for the purposes of this ERA because there are expected to be no complete pathways between the Site receptors and groundwater.
- **Exposure Assessment**: In this step, EPCs (representative concentrations of a COPEC in an environmental medium that is potentially contacted by the receptor), exposure scenarios, and 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; bioaccumulation factors are generated and considered.
- **Ecological Effects Assessment**: In this step, toxicity values are identified and developed for ecological receptors. Literature (containing field studies or toxicity tests) that discusses the relationship between chemical contaminant concentrations and their effects on ecological receptors (on a media-, receptor-, and chemical-specific basis) is reviewed.
- **Risk Characterization:** In this step, risk characterization is completed in two steps: (1) risk estimation (the quantitative evaluation that integrates the exposure and effects data to evaluate the potential for adverse ecological effects in terms of HQs), and (2) risk description (an interpretation of the risk estimates including other non-quantitative lines of evidence such as habitat quality and area, as well as a spatial evaluation of potential risk drivers). Contaminants that exceed an HQ of 1 are typically those that will require remedial action at a site and are referred to as COCs.
- **Uncertainty Analysis:** In this step, uncertainties are identified and steps are taken to minimize the effects of uncertainties. Uncertainties may result both from the use of assumptions or models in lieu of actual data, and from the error inherent in the estimation of exposure parameters. These uncertainties may result in the potential overestimation or underestimation of risks; however, because direct measurements are not available for many of the components upon which the risk estimates depend, conservative assumptions and methodologies were employed to minimize the possibility of underestimating risk.

5.4 Basis for Action

The basis for action during development of remedial alternatives considers the nature and extent of contamination in waste materials and impacted media, risk assessments, **remedial action objectives** (RAOs), site-specific conditions and characteristics, and remediation technologies. The waste materials and impacted media addressed in the remedial alternatives development included the following:

- Waste Materials and Contaminated Soil: The Site contains large volumes of waste materials and contaminated soils that pose risks to receptor populations through direct physical contact and inhalation of vapors. The waste materials are primarily within Area 1 (PCB Landfill, CDA, and BTA); contaminated soils are located within Areas 1, 2, and 3. The receptor population includes ecological receptors, Site workers, and trespassers. Waste materials and contaminated soils also serve as contamination sources for Site groundwater.
- 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 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 ecological risk screening levels; (2) underlying TDS-contaminated pond sediments are present; (3) pond water and contaminated pond sediments are sources of TDS groundwater contamination; and (4) the five ponds are **attractive nuisances** under the federal Endangered Species Act (ESA), which can create risks to threatened and endangered species at the Site. The temporary need for the ponds will likely be eliminated during implementation of a comprehensive Site remedy that includes other new stormwater and liquids management systems.
- Large-Volume Sources of NAPL (DNAPL and LNAPL): Despite the Gallery Well providing ongoing NAPL removal for many years, large volumes of NAPL (including LNAPL and DNAPL) are present in Area 5 North underlying Area 1. Monitoring has documented the presence of up to 100,000 gallons of pooled DNAPL at the base of the P/S Landfill; a similar amount of pooled LNAPL also occurs on top of the aqueous phase liquids in the P/S Landfill. In addition, DNAPL has been detected in fractured rock underlying the P/S Landfill and CDA. This NAPL is a major source of contamination (and PTW) that should be reduced as much as possible to meet regulatory requirements and limit the spread of groundwater contamination.
- Contaminated Groundwater: Groundwater underlying the Site would pose an unacceptable risk, if it were to be used, because it contains a large number of dissolved constituents at elevated 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.

Many factors have been 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 include:

- Consistency with EPA and State policies, including CERCLA's preference for treatment and NAPL source reduction
- The State's anti-degradation policies for groundwater
- Overall constructability
- Compatibility and integration with other Site systems
- Reduction of infiltration
- Control of hydraulic gradients to prevent surface outflow and seeps

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6. Remedial Action Objectives and Preliminary Remediation Goals

6.1 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]). The RAOs section of the Proposed Plan should clearly present the intended results of the remedial action (EPA, 1999b). The RAOs are summarized below.

6.1.1 Soil (Areas 1, 2, and 3)

The RAOs for soil are as follows:

- Prevent direct physical human exposure (i.e., dermal exposure and incidental ingestion) to risk-driving chemicals in soil, such that total carcinogenic risks are within the NCP risk range of 10^{-4} to 10^{-6}, and noncancer HIs are less than 1.
- Prevent ecological exposure to risk-driving chemicals in soil, such that risks are below the acceptable target levels (lowest-observed adverse effect level [LOAEL], HQ less than 1).
- Remove "hotspot" areas in soils that serve as sources that can contribute to exceedances of MCLs in groundwater.
- Minimize the vertical downward migration of contaminants in soil to groundwater, such that infiltration does not contribute to additional exceedances of MCLs in groundwater.

6.1.2 Pond Sediments (Area 4)

The RAOs for pond sediments are as follows:

- Prevent direct physical contact (i.e., dermal exposure and incidental ingestion) to pond sediments, such that total carcinogenic risks are within the NCP risk range of 10^{-4} to 10^{-6}, and noncancer HIs are less than 1.
- Prevent ecological exposure to risk-driving chemicals in pond sediments, such that risks are below the acceptable target levels (LOAEL, HQ less than 1).

6.1.3 Soil Vapor (Areas 1 through 4)

The RAOs for soil vapor are as follows:

- Control potential future migration of soil vapor from soil or shallow groundwater to prevent inhalation exposures, such that total carcinogenic risks remain within the NCP risk range of 10^{-4} to 10^{-6}, and noncancer HIs are less than 1.

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

The RAOs for surface water are as follows:

- Prevent human exposures (i.e., dermal exposure or incidental ingestion) to risk-driving chemicals (primarily metals) in surface water, such that total carcinogenic risks are within the NCP risk range of 10^{-4} to 10^{-6}, and noncancer HIs are less than 1.
- Prevent off-property discharges of surface water in excess of appropriate permit limits and discharge requirements 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 1).

6.1.5 NAPL (Areas 1 and 5)

The RAOs for NAPL are as follows:

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

6.1.6 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.

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

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, as mitigation for Site-related adverse impacts determined necessary by EPA.

- Maintain or provide soil, sediment, vegetation, and water quality supportive of individuals of special-status species, which are protected under the ESA, as mitigation for Site-related adverse impacts determined necessary by EPA, in consultation with USFWS and CDFW.

6.2 Preliminary Remediation Goals

PRGs have been identified for the Site based on the results of the HHRA and ERA. *Table 7* presents soil PRGs for the ecological COCs (chromium, copper, and zinc) and human health COCs (MCPP, TCE, and PCE).

Although groundwater was not considered a risk to human health or ecological receptors because there was not a complete pathway, concentrations of dissolved-phase constituents will be required to meet MCLs in the area beyond the designated WMA and interconnected TI Zone of Area 5 North. There is no expectation that groundwater impacted by the high volumes of heterogeneous waste materials will be cleaned up to MCLs in the WMA and TI Zone. EPA is not planning to establish alternative groundwater cleanup levels based on: (1) the technical challenges of designating an appropriate alternative level based on so many COCs; and (2) the TI of even achieving MCLs let alone potentially more stringent 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 and pond sediment will be removed during implementation of the Preferred Alternative. The existing surface water will be removed, and the pond bottoms will be either excavated or capped, thereby eliminating unacceptable risk to ecological receptors. Therefore, PRGs are not required for these media. However, the substantive provisions of the 1999 National Pollutant Discharge Elimination System (NPDES) permit standards (revised 2004) are used as PRGs (or treatment standards) for potential discharge of treated stormwater, treated pond water, or treated groundwater to the B-Drainage and Casmalia Creek.

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

- Soil (including hotspots) – Risk-based concentrations (*Table 7*)
- Groundwater – MCLs (*Table 3*), except in the designated WMA and interconnected TI Zone of Area 5 North
- Pond Surface Water and Sediment – None (remedial action will eliminate existing pond surface water and sediment)
- Soil Vapor – None (remedial action will provide for capping of the CDA and BTA in Area 1, and excavation of soil hotspots in the former ponds and pads in Area 3)
- Seep Surface Water – None (remedial action will provide for capping and will eliminate seeps)

Another important consideration for the remedial action will be treatment goals for the offsite discharge of treated stormwater (if needed for Alternatives 4 and 6), treated pond water, or treated groundwater; these proposed PRGs (or treatment standards) are presented in *Table 8*.

6.3 Applicable or Relevant and Appropriate Requirements

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. ARARs are identified on a site-specific basis from information about site-specific chemicals, features of the site location, and specific actions being considered. There are three categories of ARARs:

- Chemical-specific ARARs: Chemical-specific ARARs are treatment standards and action levels for various media such as soil, groundwater, and soil vapor. Chemical-specific ARARs include MCLs, which EPA considers relevant and appropriate standards for groundwater quality. ARARs would not apply within the WMA located within Area 5 North. Moreover, the TIE demonstrated that it is technically impracticable to restore groundwater to MCLs throughout Area 5 North. The Preferred Alternative, therefore, includes a list of COCs for which MCLs would be waived for the designated TI Zone that surrounds the WMA in Area 5 North, since cleanup technologies could not restore groundwater to MCLs within this area.
- Location-specific ARARs: Location-specific ARARs address requirements for specific geographic areas. Examples include California Basin Plans, waste discharge requirements for surface water, and requirements to protect certain types of wildlife. The federal ESA, for example, is an important location-specific ARAR that sets requirements for threatened and endangered species within designated areas. In addition, certain regulations from the California Fish and Game Code establish protections or place restrictions on activities that could adversely impact plant and animal habitats.
- Action-specific ARARs: Action-specific ARARs include requirements for the identification and management of hazardous materials. Many of these requirements address design, construction, operation, and monitoring of the remedial alternatives. These standards also address design of treatment, storage, containment, and monitoring systems such as caps, wells, trenches, tanks, drainage, and treatment systems. These ARARs include State requirements such as Title 22, Title 23, and Title 27 regulations, for the design, construction, post-closure care, and monitoring of landfill-like closure systems. Such requirements address engineered capping systems (for example, seismic design), surface water management, and development of monitoring systems.

Table 14, which is based on Appendix B of the FS Report (CSC, 2016) provides a complete list of ARARs for the Site.

7. Summary of Remedial Alternatives

The FS Report describes the process for developing the remedial alternatives, which are summarized in this section. The FS process began with an evaluation of General Response Actions (GRAs), based on the various environmental media and contaminant types, to address RAOs and potential ARARs. GRAs 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 subject to the detailed evaluation described in this section.

Six sitewide remedial alternatives (SWRs) were developed following technology screening and evaluation of alternatives for individual areas. Each SWR is a combination of the remedial components from the area-specific detailed evaluation. The remedial alternatives range from least aggressive (No Further Action) to most aggressive. Common components include engineered RCRA-equivalent capping systems, ICs (even if they are already in place), soil hotspot removal (with disposal of soils in the PCB Landfill prior to capping), liquids extraction, various programs for habitat mitigation, a WMA and TI Zone designation, MNA, and long-term OM&M with optimization of monitoring, extraction, and treatment components. Other components, such as the size and type of evaporation ponds and extraction systems, clearly differentiate some of the alternatives. The various types of caps evaluated during the development of remedial alternatives are illustrated on *Figure 17*.

<u>Capping and Pond Lining Technologies</u>

Capping technologies represent common components that play significant roles in the alternatives evaluation for Study Areas 1 through 4. The capping technologies vary between the alternatives, and include those listed below:

- **RCRA Cap (Area 1 – PCB Landfill, CDA, BTA, MSA; Area 4 – Pond 18):**
    - 2 feet of vegetative layer
    - Biotic barrier, geocomposite drainage layer, geomembrane, and geosynthetic clay liner
    - Foundation layer (variable thickness) to 90 percent compaction

- **ET Cap (Area 2 – RCRA Canyon/WCSA, Other Areas):**
  - 4 feet of vegetative layer
  - 1 foot of foundation layer to 90 percent compaction
- **RCRA–Equivalent Hybrid Cap (Area 2 – RCRA Canyon/WCSA):**
  - 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 – 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 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

All SWRs include long-term groundwater monitoring to evaluate system performance and compliance with performance standards. Compliance monitoring includes identification of groundwater monitoring networks, monitoring protocol, and a POC. At this stage, EPA expects one POC will generally correspond to, or be located just outside of, the designated WMA and TI Zone, to demonstrate that groundwater is not further degraded outside the Area 5 North boundary. A rigorous monitoring program will also be established at the boundary for Area 5 North, to demonstrate compliance with the designated WMA and TI Zone. All alternatives (except the No Further Action alternative) include NAPL extraction from Area 5 North as part of long-term source control. However, each alternative incorporates a waiver of the groundwater cleanup ARARs (MCLs) within the designated TI Zone within Area 5 North, because cleanup of groundwater in this area is technically impracticable and would likely require several thousand years.

All SWRs will require a sufficient quantity of water of adequate quality for construction purposes, including but not limited to soil conditioning, dust control, and irrigation. Due to the recent California drought, EPA and participating entities recognize the importance of having adequate supplies of construction water. EPA is working with State agencies and PRPs to identify one or more appropriate construction water source. Potential water sources include potable or reclaimed water (delivered by pipeline or truck), or onsite wells or ponds (which may require onsite treatment).

EPA will set limits on TDS concentrations in mg/L 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 (e.g., RCRA cap), and throughout the entire thickness of caps without geomembranes (e.g., ET cap). Construction water with higher TDS levels can be used below the geomembrane layer only for caps constructed with geomembranes.

The six SWRs are described below, followed by a comparative analysis of each in relation to CERCLA evaluation criteria.

Table 9 presents a comparison matrix of the components for each of the six SWRs. *Table 10* presents the cost estimates for SWR 2 through SWR 6, including net present worth capital costs and OM&M costs.

7.1 Alternative 1 – No Further Action

This alternative, which CERCLA requires as a basis for comparison with other remedial alternatives, provides no additional remediation, but takes into account the response actions that have already been completed (such as the caps on the P/S Landfill and the EE/CA area [Heavy Metals, Caustics/Cyanide, and Acids Landfills]), or actions that are ongoing (such as groundwater extraction from the existing Gallery Well, Sump 9B, PSCT, and the PCTs). Currently, liquids from the Gallery Well and Sump 9B are disposed at a permitted disposal facility. The PSCT liquids are treated at the Site using GAC and discharged to Pond 18. PCT liquids are discharged (without treatment) to the RCF Pond and A-Series Pond. Stormwater is retained in Site ponds for evaporation, except stormwater from the capped landfills area that is discharged to the B-Drainage and Casmalia Creek.

7.2 Alternative 2 – Capping, Liquids Extraction, Large Evaporation Pond

SWR 2 would utilize landfill capping, liquids extraction, and a large evaporation pond (approximately 11 acres) for evaporation of treated extracted liquids and a portion of the stormwater runoff from RCRA Canyon. This alternative remediates RCRA Canyon (Area 2), and assumes that some stormwater runoff from RCRA Canyon would be directed to the new evaporation pond that would be constructed in the footprint of the existing A-Series Pond.

Figure 18 presents the configuration of SWR 2. Further remediation details for each area are described below.

- Area 1 – PCB Landfill, BTA, and CDA. Area 1 would be covered with a RCRA cap over approximately 28.8 acres. The cap would 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 MSA in Area 3. Stormwater from Area 1 would be discharged to the B-Drainage and Casmalia Creek.
- Area 2 – RCRA Canyon (North and West) and WCSA. Area 2 would be remediated by constructing an ET cap that is approximately 5 feet thick over the western portion of RCRA Canyon (8.4 acres), excavating the relatively shallow contaminated soils of the WCSA, and then backfilling the excavations with clean soil (5.5 acres). The ET cap would serve to reduce surface water infiltration in this area of the Site, thus 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 down the B-Drainage and into Casmalia Creek. Stormwater from the uncapped eastern slope of RCRA Canyon would be directed into a new 11-acre lined RCRA evaporation pond that would be constructed in the former footprint of the A-Series Pond.
- Area 3 – Former Ponds and Pads, Remaining Onsite Areas. Area 3 would be remediated by addressing the five soil hotspot locations, which would reduce the residual ecological risks to acceptable levels. The hotspots in the former Ponds A/B, the area south of PSCT-1, and the Liquids Treatment Area would be excavated and placed under the RCRA cap of the PCB Landfill; the contaminated soil hotspots in the MSA would be covered with the RCRA cap (extended from Area 1). Because there are no unacceptable human health or ecological risks for RISBON-59 (Hotspot 10), 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 and Treated Liquids 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 lined cap retention basin will be constructed with a double liner consisting of an HDPE layer and a geosynthetic clay layer (GCL) (HDPE/GCL liner), and will be 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 lined cap retention basin.

- o *A-Series Pond:* remove all liquids, regrade the northeast corner of the pond to increase the pond size to approximately 11 acres, add fill to raise the pond bottom above the water table, and construct a double-lined (for example, 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.
- o *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 the 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 WMA and interconnected 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 as many as 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 contain contaminated groundwater from migrating southward outside of the designated WMA and interconnected TI Zone. Extraction also will 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 upgradient of PSCT-1 and PSCT-4 to verify that dissolved-phase contaminants and NAPL are not migrating southward underneath the PSCT outside of the TI Zone. As a contingency measure, one or more of the new monitoring wells would be converted into an extraction well and liquids would be extracted if contaminants (VOCs or SVOCs) are detected above MCLs. If determined necessary by EPA, additional monitoring and focused extraction will be implemented in localized areas, such as along or just beyond the area perimeters, if routine monitoring indicates that groundwater contamination is migrating beyond area boundaries. Such measures would include:

  - o Additional confirmatory sampling over several (three to four) sampling events to confirm the existence of statistically representative exceedances of trigger levels (MCLs);

- o Installation of additional monitoring wells to further characterize the nature and extent of contamination in the immediate vicinity of the exceedance; and/or
- o Installation of extraction wells with treatment of extracted liquids in onsite treatment systems.

The objective of such extraction would be to provide hydraulic containment and limit further migration beyond area boundaries. Groundwater extracted from the Lower HSU would be treated and discharged together with the PSCT liquids to the new 11-acre RCRA evaporation pond.

The liquids extracted from the Gallery Well and 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 will likely include activated carbon and solids removal; the treated effluent would then be transferred to the new evaporation pond.

- 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 contamination within the Upper HSU exceed MCLs (primarily arsenic, nickel, cadmium, and selenium). These concentrations are expected to decrease over many decades due to 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 contaminant levels 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 will likely include activated carbon and solids removal; the treated effluent would then be transferred to the new 11-acre double-lined evaporation pond.

- 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 contamination within the Upper HSU currently exceed MCLs (primarily arsenic, nickel, cadmium, and selenium). A significant source of this contamination is likely from 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 due to 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 will likely include activated carbon and solids removal; the treated effluent would then be transferred to the new 11-acre double-lined evaporation pond.

The time to construct for SWR 2 is estimated to be 5 years. The estimated remediation timeframes for groundwater in Area 5 South to reach 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 remediation goals (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.

7.3 Alternative 3 – Capping, Liquids Extraction, Small Evaporation Pond (Preferred Alternative)

SWR 3 is a variation of SWR 2, and would utilize landfill capping, liquids extraction, and a smaller (6-acre) evaporation pond(s) instead of the larger (11-acre) pond. 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 rather than managed in the evaporation pond.

Figure 19 presents the configuration of SWR 3. Further details of remediation for each area are presented below.

- Area 1 – PCB Landfill, BTA, and CDA. Area 1 remediation would be the same as described for SWR 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. The cap type for the different subareas would be selected during remedial design (subject to EPA review and approval). With this capping, stormwater from the entire area will have acceptable ecological risks (HQ<1) and allow discharge to the B-Drainage. In addition, the larger cap will significantly reduce surface water infiltration in this area, further lowering the water table and helping to eliminate the contaminated surface seep at the southern end of RCRA Canyon.
- Area 3 – Former Ponds and Pads, Remaining Site Areas. Area 3 remediation would be the same as described for SWR 2.
- Area 4 – Stormwater Ponds and Treated Liquid Impoundments. Area 4 remediation would be the same as described for SWR 2, except that this alternative would utilize

a smaller 6-acre evaporation pond system within the former footprint of the A-Series Pond (instead of the larger 11-acre pond), because no stormwater from RCRA Canyon would be discharged into it. The remainder of the A-Series Pond area would be capped with an eco-cap.

- Area 5 (Groundwater) – Area 5 North, Area 5 South, and Area 5 West. Area 5 remediation would be the same as described for SWR 2.

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

7.4 Alternative 4 – Capping, Liquids Extraction, Offsite Discharge

SWR 4 is a variation of SWR 3 that would include landfill capping, liquids extraction, and offsite discharge without an evaporation pond. 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 (as shown in *Table 8*). The treated liquids would then be discharged offsite to Casmalia Creek, rather than managed in an evaporation pond. This alternative, however, would require an "Exception" to the RWQCB Basin Plan to address the requirement that prohibits waste discharge to surface waters within the San Antonio Valley Creek basin.

Figure 20 presents the configuration of SWR 4. The proposed remediation for each area is described below.

- Area 1 – PCB Landfill, BTA, and CDA. Area 1 remediation would be the same as described for SWR 2.
- Area 2 – RCRA Canyon and WCSA. Area 2 remediation would be the same as described for SWR 3.
- Area 3 – Former Ponds and Pads, Remaining Site Areas. Area 3 remediation would be the same as described for SWR 2.
- Area 4 – Stormwater Ponds and Treated Liquid Impoundments. Area 4 remediation would be the same as described for SWR 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 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 one 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 SWR 2 except liquids extracted from the PSCT and PCTs would be treated to meet NPDES requirements prior to discharge to the C-Drainage west of the Site.

The time to construct for SWR 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 SWR 2, given the range of accuracy of the analysis.

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

SWR 5 is a variation of SWR 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. As with SWR 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.

Figure 21 presents the configuration of SWR 5. The proposed remediation details for each area are described below.

- Area 1 – PCB Landfill, BTA, and CDA. Area 1 remediation would be the same as described for SWR 2.
- Area 2 – RCRA Canyon and WCSA. Area 2 remediation would be the same as described for SWR 3.
- Area 3 – Former Ponds and Pads, Remaining Site Areas. Area 3 remediation would be the same as described for SWR 2 with one exception: the RISBON-59 hotspot (Hotspot 10) would be excavated and the contaminated soils 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 SWR 3.
- Area 5 (Groundwater) – Area 5 North, Area 5 South, and Area 5 West. Area 5 remediation would be the same as described for SWR 2 for Area 5 South and Area 5 West. However, for Area 5 North, SWR 5 would include aggressive dewatering of the P/S Landfill by constructing approximately five wells drilled horizontally underneath and into the landfill. 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, NAPLs, and other aqueous phase liquids drained from the P/S Landfill would be sent offsite to a permitted facility for disposal. SWR 5 also includes the conversion of four existing CDA monitoring wells into LNAPL skimming wells. Extracted LNAPL would be stored and shipped to a permitted facility for disposal.

The time to construct for SWR 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 SWR 2, given the range of accuracy of the analysis.

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

SWR 6 is a variation of SWR 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. In addition, SWR 6 proposes that extracted liquids would be treated sufficiently and discharged to the C-Drainage west of the Site in accordance with NPDES permit requirements, such that no evaporation pond would be needed. This would require an "Exception" to the RWQCB Basin Plan to address the requirement that restricts waste discharge to surface waters within the San Antonio Valley Creek basin.

Figure 22 presents the configuration of SWR 5. The proposed remediation details for each area are described below.

- Area 1 – PCB Landfill, BTA, and CDA. Area 1 remediation would be the same as described for SWR 2.
- Area 2 – RCRA Canyon and WCSA. Area 2 remediation would be the same as described for SWR 3.
- Area 3 – Former Ponds and Pads, Remaining Site Areas. Area 3 remediation would be the same as described for SWR 5.
- Area 4 – Stormwater Ponds and Treated Liquid Impoundments. Area 4 remediation would be the same as described for SWR 4.
- Area 5 (Groundwater) – Area 5 North. Area 5 North remediation would be the same as described for SWR 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 offsite 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 WMA and interconnected 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 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 continue to 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 SWR 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 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 SWR 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 SWR 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 remediation goals is still expected to be several decades and potentially over a century.

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8. Evaluation of Alternatives and Top-Ranked Alternative

The SWRs were evaluated based on the CERCLA criteria identified in the NCP. The nine CERCLA criteria include the following (see inset below for further description of each):

Threshold Criteria:

1. Overall Protection of Human Health and the Environment
2. Compliance with ARARs

Balancing Criteria:

3. Long-Term Effectiveness (LTE)
4. Reduction of Toxicity, Mobility, or Volume through Treatment
5. Short-Term Effectiveness (STE)
6. Implementability
7. Cost

Modifying Criteria:

8. State Agency Acceptance
9. Community Acceptance

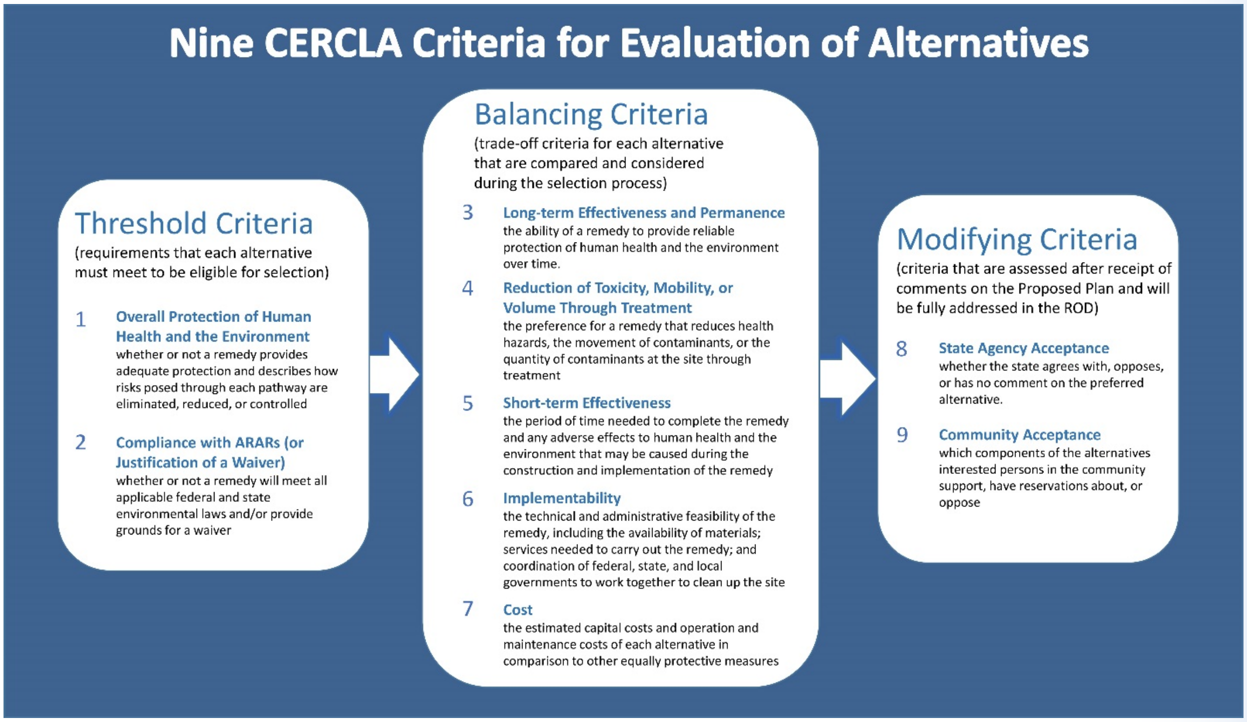

Table 11 provides a summary of the SWRs based on the two threshold criteria and five balancing criteria. The modifying criteria (i.e., State agency and community acceptance of the Preferred Alternative) will be evaluated after the public Comment Period for this Plan ends, and will be described in the Responsiveness Summary contained in the ROD.

For additional comparison, *Table 12* provides a summary of the estimated groundwater cleanup times for Area 5 North, South, and West, along with projected capital and operation and maintenance (O&M) costs for each alternative.

8.1 Overall Protection of Human Health and the Environment

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

8.2 Compliance with ARARs

The list of potential ARARs (see *Table 14*, based on Appendix B of the FS Report [CSC, 2016]) contains chemical-specific, action-specific, and location-specific ARARs developed in consultation with State and federal agencies consistent with EPA guidelines and practice. With the exception of the No Further Action alternative (SWR 1), all alternatives comply with the proposed ARARs. For example, chemical-specific ARARs include MCLs, which would apply across the Site except for the combined WMA and TI Zone, which includes all of 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 WMA and interconnected TI Zone within Area 5 North where it is not technically practicable to meet ARARs. The Preferred Alternative (SWR 3) incorporates a WMA where ARARs do not apply, and a waiver of the groundwater cleanup ARARs within the designated TI Zone 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 (EPA, 1993a), and is protective of human health and the environment.

All alternatives (except SWR 1) would satisfy location-specific ARARs, including the federal ESA requirements for threatened and endangered species within designated areas. Finally, all alternatives (except SWR 1) would satisfy action-specific ARARs including State requirements such as Title 22, 23, and 27 regulations, which apply to the design, construction, and monitoring of landfill-like closure systems.

8.3 Long-Term Effectiveness

SWRs 3 through 6 are reasonably comparable in achieving LTE, although SWRs 4 through 6 more aggressively address Site liquids and could potentially provide improved LTE (a reduction in remediation timeframes to meet RAOs was not quantified due to uncertainties in these estimates). SWR 3 is ranked above SWR 2 because it provides more widespread and effective capping systems, more effective treatment systems, and less reliance on evaporation ponds. The SWR 3 capping system would cover the entire RCRA Canyon/WCSA area, better limit infiltration, and increase the potential to meet

NPDES permit requirements. SWR 3 would also eliminate a seep at the southern part of the RCRA Canyon that contains elevated TDS and metals. SWR 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 SWR 2.

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

8.4 Reduction of Toxicity, Mobility, or Volume through Treatment

SWR 2 through SWR 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. SWR 4 includes additional treatment of liquids to allow for discharge to Casmalia Creek instead of evaporation in ponds. SWR 5 and SWR 6 provide even more aggressive liquids extraction and treatment through horizontal wells (SWR 5) and vertical wells (SWR 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, SWR 5 and SWR 6 would limit the potential for further migration of contaminants, but would not substantially increase protectiveness compared to SWR 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 (SWR 1), are equivalent in terms of using containment to address PTWs in Area 1, where the former landfills and burial areas are located.

8.5 Short-Term Effectiveness

SWR 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 (SWR 5) or more aggressive pump-and-treat systems (SWR 6). SWR 3 is ranked higher than SWR 2 because the smaller evaporation ponds would provide better protection of ecological species. Although SWR 4 has the advantage of not including an evaporation pond, SWR 3 is ranked higher because SWR 4 is vulnerable to additional project risk and technical complexity associated with construction of a more robust treatment plant to meet offsite discharge requirements. SWR 4 also requires a regulatory "exception" from the RWQCB's Basin Plan to allow for offsite discharge of treated liquids to Casmalia Creek, which could be a lengthy and time-consuming process.

8.6 Implementability

SWR 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 (SWR 4), horizontal wells (SWR 5), or vertical wells with more aggressive pump-and-treat systems (SWR 6). SWR 5 is ranked lower than SWR 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. SWR 6 is ranked lowest for implementability due to 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. SWR 3 is ranked above SWR 2 because of reduced OM&M requirements for a smaller RCRA evaporation pond system.

8.7 Cost

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, which more closely reflects current economic conditions. The estimates also included both a commonly used 30-year O&M period, and an extended 100-year O&M period, which is more appropriate for the Site to represent post-30-year long-term O&M requirements. Costs generally increase from Alternatives SWR 2 through SWR 6 as the SWRs increase in technical complexity (see *Table 10*). Significant cost drivers include liquids treatment, horizontal drilling (SWR 5), vertical drilling at up to 80 locations (SWR 6), and the collection, treatment, and disposal of hazardous liquids over extended durations. Although SWR 6 provides more aggressive liquids extraction and treatment compared to SWR 3, the reduction in timeframe to achieve RAOs cannot be quantified because of uncertainties in these estimates, and the cost is more than twice that of SWR 3.

For the Preferred Alternative (SWR 3), the estimated capital costs, annual O&M, and total present worth capital and O&M costs are 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, 30-year timeframe:	**$89,499,000**
Total present worth capital and O&M costs, 7 percent discount rate, 100-year timeframe:	**$96,218,000**

8.8 Evaluation of Combined Threshold and Balancing Criteria

SWR 3 is identified as the top-ranked or Preferred Alternative based on assessment of the CERCLA criteria. SWR 3 is fully protective, meets RAOs, and complies with ARARs (while incorporating a designated WMA and interconnected TI Zone in Area 5 North). SWR 3 is less costly than SWR 4, SWR 5, and SWR 6 while providing similar overall protection of human health and the environment. SWR 3 also provides a higher level of protection for ecological species compared to lower-cost SWR 2.

Overall, SWR 3 provides the greatest efficiency in meeting project objectives while reducing project risks, unnecessary technical challenges, and potential unintended releases.

8.9 Green Remediation (Informal Criterion)

Although not one of the formal CERCLA/NCP criteria, the green remediation aspects of the remedial alternatives were evaluated in the FS Report, and 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 depicted in *Table 11*, SWR 3 is rated lower (better) than SWR 4 and SWR 6 because they involve operation of a larger liquids treatment plant to treat inorganic constituents prior to offsite discharge. SWR 3 is rated higher than SWR 5 and SWR 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. SWR 3 is rated about the same as SWR 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.

8.10 Preferred Alternative – Overview and Further Considerations

8.10.1 Overview of Preferred Alternative

After careful study of the remedial alternatives developed for the Site, EPA proposes SWR 3 as the Preferred Alternative. The Preferred Alternative 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 inset at the end of Section 8 provides an overview of the various components of this alternative.

The Preferred Alternative meets statutory requirements for protecting human health and the environment, achieves ARARs (while incorporating a designated WMA and interconnected TI Zone for Area 5 North), adopts permanent solutions, uses treatment where technically practicable, and is cost-effective. *Table 13* presents a cost summary for the various components of the Preferred Alternative.

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

The Preferred Alternative will include rigorous long-term OM&M programs. Long-term monitoring will include both performance and compliance monitoring at and near the designated WMA and TI Zone, the POC around the Area 5 North boundary, and across the Site.

If determined necessary by EPA, contingency measures such as additional monitoring and focused extraction will be implemented in localized areas (for example, along or just beyond area boundaries) if routine monitoring indicates that groundwater contamination is migrating beyond area boundaries. Such measures would include: (1) additional sampling over several (for example, three to four) events to confirm the existence of statistically significant exceedances of trigger levels (MCLs); (2) installation of additional monitoring wells to further characterize the nature and extent of contamination in the immediate vicinity of the exceedance; and/or (3) installation of a limited number of extraction wells with treatment of extracted liquids in onsite treatment systems. The objective of such extraction would be to provide hydraulic containment and limit further migration beyond area boundaries. The Preferred Alternative includes perimeter control, using containment trenches and perimeter extraction wells that 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 system. Further evaluation will be conducted to determine if additional measures are necessary.

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 remedy. The Five-Year Reviews include evaluations of remedy protectiveness. If it is determined that components of the remedy are not protective, EPA will evaluate corrective actions and implement the preferred action to ensure continued protectiveness.

8.10.2 Institutional Controls

The Preferred Alternative (as well as the other alternatives) 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. The following covenants have been established for six parcels (Property) that comprise 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 6*):

- On May 31, 2011, a “Covenant to Restrict Use of Property/Environmental Restrictions” was issued for Parcels 113-260-002 (Parcel 2) and 113-260-003 (Parcel 3), which comprise all but the southeast portion of Zone 1 and portions of adjacent land.
- On June 1, 2011, a “Covenant to Restrict Use of Property and Easement/ Environmental Restrictions” was issued for Parcel 113-260-004 (Parcel 4), which includes the southeast portion of Zone 1 and portions of adjacent land; and 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.
- 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 the CSC and others 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. The “land or water disturbing activity” includes 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.

8.10.3 Waste Management Area (WMA)

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. This delineation applies to all Sitewide alternatives (SWRs 2 through 6) except for SWR 1 (the No Further Action alternative). 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 uses various mechanisms in determining where groundwater cleanup levels are to be achieved. The NCP preamble sets forth EPA policy that for groundwater, “*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, 2009).

What are Institutional Controls (ICs)?

ICs are legal and administrative controls, in the form of Land Use Controls (LUCs), applied to properties to restrict access and establish controls on land and water use. LUCs are intended to prevent exposures to contamination or to protect the remedy in place. LUCs generally include the following components:

Land Use Covenant
Environmental covenants are currently in place for several CSC-owned parcels adjacent to the Site. Additional land use and/or environmental covenants will be considered during remedial design.

Limitations on Land and Groundwater Use
ICs will control access and place restrictions on residential/commercial land use and on the extraction of groundwater to ensure that there are no exposure pathways between the waste materials and potential receptors.

Long-Term Monitoring
Enforcement of ICs is monitored and evaluated every 5 years during implementation of the chosen remedy to ensure protectiveness of human health, the environment, and the remedial action.

The NCP preamble states:

> *In such cases, the most feasible and effective ground-water cleanup strategy may be to address the problem as a whole rather than source-by-source, and to draw a point of compliance to encompass the sources of the release. In determining where to draw the point of compliance in such situations, the lead agency will consider factors such as the proximity of the sources, the technical practicability of groundwater remediation at that specific site, the vulnerability of the groundwater and its possible uses, exposure and likelihood of exposure and similar considerations* (55 FR 8754, March 8, 1990).

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 WMA because waste materials are being left in place and there is no expectation that groundwater within the area can be remediated for beneficial use. EPA is not designating WMAs in Area 5 South and Area 5 West, even if waste is being left in place, because there has not been a demonstration of TI for these areas and natural attenuation processes are considered to be practicable for groundwater quality improvement.

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. As described in Section 3.12, NAPL is considered a PTW and is therefore treated separately from groundwater as a source of contamination. The remedial alternatives, including the Preferred Alternative, include 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, 1993a). 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; hence, containment is generally an appropriate response action, including capping, source area groundwater control, liquids collection and treatment, gas collection (if appropriate), and ICs. The proposed WMA within Area 5 North contains the five former landfills, where waste materials will be left in place and where treatment is not technically practicable.

As stated above, the NCP preamble and EPA guidance (1993a) indicate that designation of a WMA is an appropriate regulatory mechanism for waste that will be left in place in association with multiple closely spaced sources. *Figure 23* presents the plan view layout of the proposed WMA, located within a portion of Area 5 North. 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.

The WMA, where heterogeneous waste will be capped and remain in place, will be subject to ICs as described in Section 8.10.2. A rigorous compliance monitoring program, as described in Section 8.10.5, will also be developed.

8.10.4 Technical Impracticability Evaluation and TI Zone Designation

EPA conducted a TIE as part of the remedial investigations. The TIE concluded that it is technically impracticable to clean up groundwater in Area 5 North to the 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][2][ii][C][3]). CERCLA Section 121(d)(4) provides that ARARs may be waived in certain limited circumstances, as long as the cleanup 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*

What is Technical Impracticability (TI)?

EPA recognizes that it may not be possible to clean up some waste materials to regulatory performance standards (MCLs, ARARs, etc.) in any reasonable timeframe. An ARAR waiver should be invoked for those portions of the contaminated soil or groundwater where it has been demonstrated that attainment of one or more ARARs is technically impracticable from an engineering perspective. When regulatory performance standards are waived at a Superfund site due to TI, the EPA's general guidance is that the site must consider source control and containment, and source removal alternatives to the extent practicable to prevent further migration of the contaminated groundwater plume and prevent exposure to the contaminated groundwater.

Some situations where EPA may determine that it is technically impracticable to remediate wastes are:

- Unsuitable geology: for example, fractured geology, very low-permeability rocks.
- Chemical constraints: for example, many different COCs, DNAPL in fractured bedrock, elevated concentrations of TDS.
- Technology limitations: for example, extraction is ineffective in low-permeability zones, or a single technology may not be able to treat a diverse array of COCs.
- Complete removal of a large volume of contamination source (a landfill, for example) requires a large-scale removal action, such that increased risks to human health and the environment would outweigh the potential benefits to water quality.
- Because a contamination source cannot be completely removed due to risk to human health and the environment, the source would continuously recontaminate the media.
- Even if an aggressive technology was able to remove significant amounts of contamination out of an aquifer, due to the diffusion of residual contamination from the bedrock matrix into the aquifer, aquifer restoration would still take up to thousands of years.

Impracticability of Ground-Water Restoration (EPA, 1993b). 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 (CSC, 2016).

EPA's Preferred Alternative (Alternative 3, also referred to as SWR 3) includes a TI Zone within the area located between the WMA and the Area 5 North boundary, as shown on *Figure 23*. Restoration to MCLs within the TI Zone of 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. The area located between the WMA and the Area 5 North boundary serves as a reasonable choice for designating a small TI Zone within the much larger Site boundary.

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 (e.g., 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 and concluded 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 the WMA 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 siltstone matrix, which would serve as a continuing source for groundwater contamination.

The base of the TI Zone (and adjacent WMA) is proposed to be 200 feet above mean sea level (amsl). This elevation is 100 feet below the deepest monitoring well where DNAPL was found (RGPZ-7D, which is screened between approximately 328 and 315 feet amsl). The proposed base of the TI Zone at 200 feet amsl 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 or groundwater throughout all of Area 5 North can be cleaned up to ARARs. The TI Zone (and adjacent WMA) will be subject to ICs as described in Section 8.10.2, and a rigorous compliance monitoring program as described in Section 8.10.5.

8.10.5 Point of Compliance and Compliance Monitoring Program

The POC for attaining remediation levels 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). Because ARARs are not expected to be attained in groundwater within the WMA and interconnected TI Zone described in Sections 8.10.3 and 8.10.4 for Area 5 North, the POC should be established at or beyond these areas. EPA expects the POC will generally correspond to, or be located just outside of, the Area 5 North boundary to demonstrate that groundwater quality is not further degraded outside the WMA and TI Zone. Based on the NCP (including NCP preamble), a POC generally would be established at, or just outside of, the WMA. In this case, however, the POC is located along the boundary of the TI Zone (same as the boundary of Area 5 North), which is interconnected with the WMA (see *Figure 23*).

The Preferred Alternative will incorporate a long-term groundwater 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 facility property boundary. The 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 quality monitoring network in place, which will likely need to be supplemented to appropriately monitor the selected remedy following implementation.

The performance and compliance monitoring program would be established within and outside the interconnected WMA and TI Zone. EPA may require contingency measures such as additional interior “guard” wells within the TI Zone, or downgradient “compliance” monitoring wells outside the Area 5 North boundary, to evaluate if NAPL is migrating beyond the Area 5 North boundary. A performance and compliance monitoring program would also be established at the Site boundary to verify that migration of contaminated groundwater does not cause exceedances of MCLs beyond the Site boundary.

Details of the monitoring network and contingency measures for additional monitoring and/or extraction in the vicinity of the WMA and TI Zone within Area 5 North (and corresponding POC) and the Site boundary will be developed during the remedial design.

8.10.6 Summary of the Preferred Alternative

The Preferred Alternative is Alternative 3 (also referred to as SWR 3) – Capping, Liquids Extraction, Small Evaporation Pond. The Preferred Alternative addresses Site-related contaminants in two distinct areas:

- Within the designated WMA and TI Zone coincident with Area 5 North
- Beyond the Area 5 North boundary and across the remainder of the Site

In accordance with 40 CFR 265.91(b)(2), because the Site includes *"…more than one surface impoundment, landfill, or land treatment area, the waste management area is described by an imaginary boundary line which circumscribes the several waste management components."* Additionally, a TI Zone and waiver may be appropriate when compliance with an ARAR *"is technically impracticable from an engineering perspective"* (40 CFR 300.430[f][2][ii][C][3]).

The following inset summarizes the key components of the Preferred Alternative.

Key Components of the Preferred Alternative (Alternative 3, also referred to as SWR 3)

- **RCRA-Equivalent Engineered Capping Systems:** Use of RCRA-equivalent capping to contain contaminated soil and waste materials, including existing and new layered engineered capping systems (soils and geosynthetics) and RCRA-equivalent ET covers, for Area 1, Area 2, and limited portions of Area 3.
- **Soil Hotspot Removal:** 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.
- **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 up to 100,000 gallons of pooled DNAPL and LNAPL sources from the P/S Landfill, using 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 (1) several existing containment trenches, and (2) MNA.
- **Groundwater Collection, Treatment, and Disposal:** Collection, on-property treatment, and transfer of contaminated groundwater (from existing containment trenches) to the new 6-acre lined evaporation pond system.
- **Optimization of Site Systems:** 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:** LUCs 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):** 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 between the WMA and the Area 5 North boundary is designated as a TI Zone. 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.
- **POC:** Designation of a compliance point that generally corresponds to, or is located just outside of, the Area 5 North boundary to demonstrate groundwater quality is not further degraded outside the WMA and interconnected TI Zone.
- **Long-term OM&M/Contingency Measures:** Long-term OM&M, including monitoring for both 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 boundary). Additional contingency measures, such as additional monitoring and focused extraction in localized areas, will be conducted if determined 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 very 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.

9. Community Participation

EPA relies on public input so that the remedy selected for each Superfund site meets the needs and concerns of the local community. To ensure that the community's concerns are being addressed, a public Comment Period lasting sixty (60) calendar days will be held.

During this time, the public is encouraged to submit comments to EPA on this Proposed Plan. In addition, EPA will hold a public meeting at the Orcutt Academy Charter School (formerly Winifred Wollam Elementary School) in Casmalia, California.

EPA will announce the details of the public Comment Period and public meeting by posting them on our website **(**http://www.epa.gov/superfund/casmalia), issuing a public notice and fact sheet, and placing ads in local newspapers. You can find links to the Proposed Plan and supporting documents in the Administrative Record on our website. In addition, documents are available for viewing at the following **Information Repository** locations:

Santa Maria Public Library
Reference Department
421 S. McClelland Street
Santa Maria, CA 93454
(805) 925-0994

EPA Superfund Records Center
Third Floor
75 Hawthorne Street
San Francisco, CA 94105
(415) 947-8717

Comments can be directed to:

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It is important to note that although EPA has proposed a Preferred Alternative, the final remedy for the Site has not been selected. All comments received will be considered and addressed by EPA before a final remedy is selected for the Site.

Detailed information on the material discussed herein may be found in the Administrative Record for the Site, which contains the RI Report, FS Report, and other information used by EPA in the decision making process. EPA encourages the public to review the Administrative Record to gain a more comprehensive understanding of the Site and Superfund activities that have been conducted. Copies of the Administrative Record are available for review through the EPA website at: http://www.epa.gov/superfund/casmalia.

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Tables

TABLE 1.
Contaminated Liquids, Extraction, Treatment, and Disposal

		Gallery Well				Sump 9B				PSCT				PCTs			
Entity	**Year**	**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
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

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	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]		11,295,940				6,876,008				87,704,476				187,115,084			

Notes:

[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] The total volumes are based on Site records but should be considered estimated values, and are through the end of September 2016.

ATS Ameripure treatment system
Bio/PACT biologically-activated/powdered-activated carbon treatment
CA California
Const constructed
CSC Casmalia Steering Committee
EPA U.S. Environmental Protection Agency
Ext extraction
GAC granular activated carbon
NJ New Jersey
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
TSD Treatment, Storage, and Disposal
TX Texas

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

TABLE 2.
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)	MCPP	HH RBC Exceedance (One Location)
		Total DDT, MCPP, Chromium, Copper, Zinc	Eco RBC Exceedance
	Maintenance Shed Area (Hotspot 2)	Dioxin TEQ	HH RBC Exceedance (One location)
		Total DDT, Dioxin TEQ, Chromium, Copper, Zinc	Eco RBC Exceedance
	Administration Building Area	None	No unacceptable exposures
	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	MCPP	Eco RBC Exceedance
	Treated Liquids Impoundments	MCPP	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)

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:

[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, maximum contaminant levels (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.

It should be noted 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 a receptor may be exposed to on a regular basis. 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
DDT	dichlorodiphenyltrichloroethane
Eco	ecological
ERA	Ecological Risk Assessment
HH	human health
HHRA	Human Health Risk Assessment
MCPP	2-(2-chloro-4-methylphenoxyl) propionic acid
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene/tetrachloroethene
RBC	risk-based concentration
RCRA	Resource Conservation and Recovery Act
TCE	trichloroethylene/trichloroethene
TEQ	toxicity equivalent

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

TABLE 3.
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
Beryllium-Dissolved	4	8	RP-98C	9/26/1997

Chemical	MCL (µg/L)	Maximum Detected Concentration (µg/L)	Location	Date
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
OCDD	0.00003	112	RIPZ-8	10/19/2006
OCDF	0.00003	16	RIPZ-8	10/19/2006

Chemical	MCL (µg/L)	Maximum Detected Concentration (µg/L)	Location	Date
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:

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 micrograms per liter (parts per billion)
HpCDD heptachlorodibenzo-p-dioxin
HpCDF heptachlorodibenzofuran
HxCDD hexachlorodibenzo-p-dioxin
HxCDF hexachlorodibenzofuran
MCL maximum contaminant level
MTBE methyl tert-butyl ether
OCDD octachlorodibenzodioxin
OCDF octachlorodibenzofuran
PCB polychlorinated biphenyl
PCP pentachlorophenol
PeCDD pentachlorodibenzo-p-dioxin
PeCDF pentachlorodibenzofuran
TCDD tetrachlorodibenzo-p-dioxin
TCDF tetrachlorodibenzofuran

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

TABLE 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:

[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.

[b] COCs based on terrestrial birds only.

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

[d] Exposure area has an assumed presumptive remedy in place and was not evaluated in the Tier 2 ERA.

-- Exposure area not evaluated in Tier 2 ERA
COC chemical of concern
COPEC chemical of potential ecological concern
DDE dichlorodiphenyldichloroethane
DDT dichlorodiphenyltrichloroethane
ERA Ecological Risk Assessment
HHRA Human Health Risk Assessment
MCPP 2-(2-chloro-4-methylphenoxyl) propionic acid
RCF Runoff Containment Facility
RCRA Resource Conservation and Recovery Act
TCE trichloroethene
TEQ Toxicity Equivalent

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

TABLE 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, MCPP, Hexachlorobenzene, and Mirex	--	MCPP
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:

[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.

[b] COCs based on terrestrial mammals only.

[c] COCs based on commercial/industrial worker exposures and target risk of > 1×10^{-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
COC chemical of concern
COPEC chemical of potential ecological concern
DDT dichlorodiphenyltrichloroethane
ERA Ecological Risk Assessment
HHRA Human Health Risk Assessment
MCPP 2-(2-chloro-4-methylphenoxyl) propionic acid
PCE tetrachloroethene
RCF Runoff Containment Facility
RCRA Resource Conservation and Recovery Act
TCE trichloroethene
TEQ Toxicity Equivalent

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

TABLE 6.
Chemicals of Concern[a] 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:

[a] No COCs were identified for sediment in the Tier 2 ERA as 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
COC chemical of concern
ERA Ecological Risk Assessment
MCPP 2-(2-chloro-4-methylphenoxyl) propionic acid
PCB polychlorinated biphenyl
RCF Runoff Containment Facility
TEQ Toxicity Equivalent

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

TABLE 7.
Preliminary Remediation Goals for Chemicals of Concern in Soil

Chemicals of Concern	Ecological RBC		Human Health RBC (mg/kg)	Background[c] (mg/kg)	Preliminary Remediation Goals	
	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						
MCPP	--	--	770[d]	NA	770	770
TCE	--	--	50[e]	NA	50	50
PCE	--	--	11[e]	NA	11	11

Notes:

[a] Selected surface soil ecological risk-based concentration for 0 to 0.5 foot bgs

[b] Selected surface and shallow soil ecological risk-based concentration for 0 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)
bgs below ground surface
MCPP 2-(2-chloro-4-methylphenoxyl) propionic acid
mg/kg milligrams per kilogram
NA not available
PCE tetrachloroethylene/tetrachloroethene
RBC risk-based concentration
TCE trichloroethylene/trichloroethene

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

TABLE 8.
Proposed NPDES Standards for Offsite Discharge of Treated Stormwater, Pond Water, or Treated Groundwater

Parameter Name	1999 NPDES Standards (Revised 2004)	Casmalia Creek Surface Water (March 1998)[a]	A-Drainage Surface Water (RI data set)[a]	B-Drainage Wetlands Stormwater Discharge (2008-2012)[a]	C-Drainage Surface Water (RI data set)[a]	Ecological-Risk Level, HQ<1[b], Based On Aquatic Life[c] (Effect Level)	Source	Ecological-Risk Level, HQ<1[b], Based On Amphibians[d] (No-Effect Level)	Source	Proposed Standards
Aluminum, Total	1.0 mg/L	-	4.1 mg/L	-	100 mg/L	--	--	--	--	1.0 mg/L
Ammonia as N	0.25 mg/L	0.15 mg/L	-	-	-	--	--	--	--	0.25 mg/L
Antimony, Total	0.006 mg/L	ND	ND	-	0.044 mg/L	0.03 mg/L	Suter and Tsao, 1996; CVRWQCB, 2007	0.003 mg/L	Pauli et al., 2000[e]	0.006 mg/L
Arsenic, Total	0.050 mg/L	0.011 mg/L	0.0023 mg/L	-	0.019 mg/L	0.15 mg/L	EPA, 2006a; EPA, 2006b	0.0004 mg/L	Pauli et al., 2000[e]	0.050 mg/L
Barium	1.0 mg/L	0.070 mg/L	0.035 mg/L	0.6 mg/L	0.64 mg/L	0.004 mg/L	Suter and Tsao, 1996	0.0023 mg/L	Sparling et al., 2000[f]	1.0 mg/L
Beryllium, Total	0.004 mg/L	0.00033 mg/L	0.0001 mg/L	0.0036 mg/L	0.0047 mg/L	0.00066 mg/L	Suter and Tsao, 1996	0.000032 mg/L	Pauli et al., 2000[e]	0.004 mg/L
Boron	0.75 mg/L	-	-	-	-	--	--	--	--	0.75 mg/L
Cadmium, Total	0.003 mg/L	0.001 mg/L	0.00023 mg/L	0.0031 mg/L	0.0061 mg/L	0.003 mg/L	EPA, 2006a	0.0000158 mg/L	Pauli et al., 2000[e]	0.003 mg/L
Chromium III	0.050 mg/L	-	-	-	-	0.250 mg/L	EPA, 2006a	0.0003 mg/L	EPA, 2007	0.050 mg/l
Chromium VI	0.0114 mg/L	-	-	-	-	--	--	--		0.0114 mg/L
Chromium, Total	0.050 mg/L	0.01800 mg/L	ND	0.150 mg/L	0.24 mg/L	0.250 mg/L	EPA, 2006a	0.0003 mg/L	EPA, 2007	0.050 mg/L
Cobalt, Total	0.050 mg/L	ND	ND	0.020 mg/L	0.013 mg/L	0.023 mg/L	Suter and Tsao, 1996	0.0005 mg/L	Pauli et al., 2000[e]	0.050 mg/L
Copper, Total	0.030 mg/L	ND	0.032 mg/L	0.056 mg/L	0.11 mg/L	0.013 mg/L	EPA, 2006a	0.00001 mg/L	Sparling et al., 2000[f]	0.030 mg/L
Fluoride	1.0 mg/L	-	-	-	-	--	--	--	--	1.0 mg/L
Iron, Total	0.300 mg/L	6.41 mg/L	4.0 mg/L	-	130 mg/L	--	--	--	--	0.300 mg/L
Lead, Total	0.015 mg/L	0.0075 mg/L	0.00086 mg/L	-	0.034 mg/L	0.0039 mg/L	EPA, 2006a; EPA, 2006b	0.0004 mg/L	EPA, 2007	0.015 mg/L
Lithium	2.5 mg/L	-	-	-	-	--		--	--	2.5 mg/L
Manganese, Total	0.050 mg/L	0.441 mg/L	0.031 mg/L	-	0.71 mg/L	0.12 mg/L	Suter and Tsao, 1996	0.0005 mg/L	Sparling et al., 2000[f]	0.050 mg/L
MBAS	0.200 mg/L	0.08 mg/L	-	-	-	--	--	--	--	0.200 mg/L
Mercury, Total	0.00005 mg/L	ND	ND	0.0001 mg/L	0.00012 mg/L	0.00077 mg/L	EPA, 2006b	0.00001 mg/L	EPA, 2007	0.00005 mg/L
Molybdenum, Total	0.010 mg/L	0.05400 mg/L	ND	0.032 mg/L	0.027 mg/L	0.370 mg/L	Suter and Tsao, 1996	0.0004 mg/L	Sparling et al., 2000[f]	0.010 mg/L
Nickel, Total	0.100 mg/L	0.028 mg/L	0.013 mg/L	0.180 mg/L	0.23 mg/L	0.073 mg/L	EPA, 2006a; EPA, 2006b	0.00002 mg/L	Pauli et al., 2000[e]	0.100 mg/L
Nitrate (as NO_3)	45 mg/L	-	-	-	-	--	--	--	--	45 mg/L
Nitrate + Nitrite (as N)	10 mg/L	-	-	-	-	--	--	--	--	10 mg/L
Nitrite (as N)	1.0 mg/L	-	-	-	-	--	--	--	--	1 mg/L
Selenium, Total recoverable	0.005 mg/L	0.019 mg/L	-	0.044 mg/L	-	0.005 mg/L	EPA, 2006a; EPA, 2006b	0.0009 mg/L	EPA, 2007	0.005 mg/L
Silver, Total	0.100 mg/L	ND	ND	-	0.00053 mg/L	0.00036 mg/L	Suter and Tsao, 1996	0.000041 mg/L	Pauli et al., 2000[e]	0.100 mg/L
Sulfate	250 mg/L	-	-	-	-	--	--	--	--	250 mg/L
Thallium, Total	0.002 mg/L	ND	ND	-	0.0016 mg/L	0.012 mg/L	Suter and Tsao, 1996	0.0001 mg/L	Sparling et al., 2000[f]	0.002 mg/L
Vanadium, Total	0.100 mg/L	0.05700 mg/L	ND	-	0.23 mg/L	0.020 mg/L	Suter and Tsao, 1996	0.00003 mg/L	Sparling et al., 2000[f]	0.100 mg/L

Parameter Name	1999 NPDES Standards (Revised 2004)	Casmalia Creek Surface Water (March 1998)[a]	A-Drainage Surface Water (RI data set)[a]	B-Drainage Wetlands Stormwater Discharge (2008-2012)[a]	C-Drainage Surface Water (RI data set)[a]	Ecological-Risk Level, HQ<1[b], Based On Aquatic Life[c] (Effect Level)	Source	Ecological-Risk Level, HQ<1[b], Based On Amphibians[d] (No-Effect Level)	Source	Proposed Standards
Zinc, Total	0.200 mg/L	0.026 mg/L	0.01 mg/L	0.230 mg/L	0.28 mg/L	0.17 mg/L	EPA, 2006a; EPA, 2006b	0.000047 mg/L	Pauli et al., 2000[e]	0.200 mg/L
BOD	-	-	-	44 mg/L O_2	-	--	--	--	--	--
COD	-	-	-	190 mg/L O_2	-	--	--	--	--	--
TSS	-	226 mg/L	-	3,100 mg/L	-	--	--	--	--	--
TSD	1,000 mg/L	2,200 mg/L	-	3,200 mg/L	-	--	--	--	--	--
Hardness (as $CaCO_3$)	-	808 mg/L	-	-	-	--	--	--	--	--
Odor	3 threshold units	45.00	-	-	-	--	--	--	--	3 threshold units
Oil and Grease	-	-	-	-	-	--	--	--	--	--
pH	-	8.42 s.u.	-	7.69 s.u.	-	--	--	--	--	--

Notes:

The selected standards are preliminary and subject to RWQCB review and approval.

The proposed standards reflect the 1999 NPDES Standard (revised 2004) while the background concentrations measured in the A-, B-, and C-Drainages and the ecological-risk levels are provided for comparison purposes.

[a] Analyte concentrations represent maximum values reported for each of the indicated surface water sampling efforts.

[b] Ecological-Risk Level based on the surface water screening levels presented in Table U-24 of the Final RI Report (CSC, 2011).

[c] Preference in selecting surface water screening levels was given to promulgated numeric water quality criteria for priority toxic pollutants and other standards for water quality in the State of California. Chronic effects values were selected, where available, from the following hierarchy of sources:

- EPA Federal Register Title 40 CFR Part 131 Water Quality Standards Section 38 - Established Numeric Criteria for Priority Toxic Pollutants for the State of California (EPA, 2006a)
- EPA National Ambient Water Quality Criteria (EPA, 2006b)
- Oak Ridge National Laboratory: Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter and Tsao, 1996)
- EPA Supplemental Guidance to Risk Assessment Guidance: Region 4 Bulletins, Ecological Risk Assessment (EPA, 2001)
- SFRWQCB Ecological Screening Levels (ESLs): Freshwater Aquatic Habitat Goals (SFRWQCB, 2005)
- CVRWQCB Recommended Numerical Limits to Translate Water Quality Objectives (CVRWQCB, 2007)
- Water Management Policies Guidelines Provincial Water Quality Objectives of the Ontario Ministry of Environment and Energy (MOEE, 1999)

[d] Selected based on the lowest no-effect value (protective of sensitive species) of the empirical data cited in: Ecotoxicology of Amphibians and Reptiles (Sparling et al., 2000); empirical data from the Database of Reptile and Amphibian Toxicology Literature (RATL) (Pauli et al., 2000), and empirical data from the ECOTOX database (EPA, 2007). Uncertainty factors were used to extrapolate to no-effect levels, when only effect-levels were available.

[e] Lethal concentration with 50 percent mortality (LC_{50}) value from Pauli et al. (2000) / Uncertainty Factor of 100.

[f] Lethal concentration with 10 percent mortality (LC_{10}) value from Sparling et al. (2000) / Uncertainty Factor of 10.

-	not available or not analyzed
--	parameter was not evaluated in the risk assessment
BOD	biochemical oxygen demand
$CaCO_3$	calcium carbonate
CFR	Code of Federal Regulations
COD	chemical oxygen demand
CSC	Casmalia Steering Committee
CVRWQCB	Central Valley Regional Water Quality Control Board
EPA	U.S. Environmental Protection Agency
HQ	hazard quotient
MBAS	methylene blue active substances (surfactants)
mg/L O_2	milligrams of oxygen consumed per liter
mg/L	milligrams per liter
N	nitrogen
ND	not detected
NO_3	nitrate
NPDES	National Pollutant Discharge Elimination System
RI	Remedial Investigation
RWQCB	Regional Water Quality Control Board
TDS	total dissolved solids
TSS	total suspended solids
SFRWQCB	San Francisco Regional Water Quality Control Board
s.u.	standard pH units

Source: Modified from Table 8-5, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

TABLE 9.
Sitewide Remedial Alternatives Components

FS Area	Alternative 1 No Further Action	Alternative 2 Capping, Liquids Extraction, Large Evaporation Pond	Alternative 3 Capping, Liquids Extraction, Small Evaporation Pond *PREFERRED ALTERNATIVE*	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[a]						
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 - DNAPL/LNAPL Ext Wells (w/ min. water) - Landfill dewatering	 Gallery Well - -	 Gallery Well DNAPL/LNAPL Extraction -	 **Gallery Well** **DNAPL/LNAPL Extraction** **-**	 Gallery Well DNAPL/LNAPL Extraction -	 Gallery Well - P/S LF de-watering	 Gallery Well - P/S LF de-watering
Central Drainage Area - Sump 9B (contingency measure) - LNAPL Extraction Wells (skimming)	 Sump 9B -	 Sump 9B -	 **Sump 9B** **-**	 Sump 9B -	Sump 9B Convert 4 existing monitoring wells to LNAPL extraction wells	 Sump 9B Add 12 new LNAPL skimmer wells
Perimeter Containment - Upper HSU - Lower HSU	 PSCT Ext -	 PSCT Ext Monitor 12 new LHSU wells	 **PSCT Ext** **Monitor 12 new LHSU wells**	 PSCT Ext (Offsite discharge) Monitor 12 new LHSU wells	 PSCT Ext Monitor 12 new LHSU wells	PSCT Ext (Offsite discharge) Extraction from 4 new LHSU wells Monitor 8 new LHSU wells
Monitored Natural Attenuation	-	MNA	**MNA**	MNA	MNA	MNA

FS Area	Alternative 1 No Further Action	Alternative 2 Capping, Liquids Extraction, Large Evaporation Pond	Alternative 3 Capping, Liquids Extraction, Small Evaporation Pond *PREFERRED ALTERNATIVE*	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 ac)	**A-Series (reconstructed, 6 ac)**	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:

[a] 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 3 subareas in Area 2 will be determined during remedial design. The **bold** font is applied for the Preferred Alternatives

ac acres
BTA Burial Trench Area
BMP best management practice
CDA Central Drainage Area
DNAPL dense non-aqueous phase liquid
ET evapotranspiration
HSU hydrostratigraphic unit
LF landfill
LHSU lower hydrostratigraphic unit
LNAPL light non-aqueous phase liquid
LTA Liquids Treatment Area
MNA monitored natural attenuation
MSA maintenance shed area
NAPL non-aqueous phase liquid
P/S pesticides/solvent
PCB polychlorinated biphenyl
PCT Perimeter Control Trench
PSCT Perimeter Source Control Trench
RCF Runoff Containment Facility
RCRA Resource Conservation and Recovery Act
TI Technical Impracticability
TSDF Treatment, storage, and disposal facility
WCSA West Canyon Spray Area
WMA Waste Management Area

Source: Modified from Table 12-1, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

TABLE 10.
Cost Estimate for Sitewide Remedial Alternatives

Alternative No.	Sitewide Remedial Alternative[a]	Capital Cost (2014 $)	Annual O&M Cost (2014 $)	Timeframe	Present Worth Capital + O&M 3% Discount Rate (2014 $)	Present Worth Capital + O&M 7% Discount Rate (2014 $)
1	**No Further Action**	–	–	–	–	–
2	**Capping, Liquids Extraction, Large Evaporation Pond** FS Area 1 Alt 4 + FS Area 2 Alt 3[b] + FS Area 3 Alt 3 + FS Area 4 Alt 4 + FS Area 5N Alt 3 + FS Area 5S Alt 2 + FS Area 5W Alt 2	$53,987,000	$3,997,000	30-year	$115,445,000	$85,195,000
				100-year	$159,052,000	$91,956,000
3	**Capping, Liquids Extraction, Small Evaporation Pond – *PREFERRED ALTERNATIVE*** FS Area 1 Alt 4 + FS Area 2 Alt 9 + FS Area 3 Alt 3 + FS Area 4 Alt 5 + FS Area 5N Alt 3 + FS Area 5S Alt 2 + FS Area 5W Alt 2	$59,967,000	$4,065,000	30-year	$120,224,000	$89,499,000
				100-year	$163,561,000	$96,218,000
4	**Capping, Liquids Extraction, Offsite Discharge** FS Area 1 Alt 4 + FS Area 2 Alt 9 + FS Area 3 Alt 3 + FS Area 4 Alt 6 + FS Area 5N Alt 4 + FS Area 5S Alt 3 + FS Area 5W Alt 3	$65,737,000	$7,772,000	30-year	$195,733,000	$138,550,000
				100-year	$282,661,000	$152,025,000
5	**Capping, Liquids Extraction, P/S Landfill Dewatering, Small Evaporation Pond** FS Area 1 Alt 4 + FS Area 2 Alt 9 + FS Area 3 Alt 4 + FS Area 4 Alt 5 + FS Area 5N Alt 6 + FS Area 5S Alt 2 + FS Area 5W Alt 2	$69,411,000	$8,464,000	30-year	$147,035,000	$113,814,000
				100-year	$191,734,000	$120,744,000
6	**Capping, Liquids Extraction, P/S Landfill Dewatering, Groundwater Extraction, Offsite Discharge** FS Area 1 Alt 4 + FS Area 2 Alt 9 + FS Area 3 Alt 4 + FS Area 4 Alt 6 + FS Area 5N Alt 7 + FS Area 5S Alt 5 + FS Area 5W Alt 5	$93,245,000	$14,849,000	30-year	$291,069,000	$209,924,000
				100-year	$412,474,000	$228,744,000

Notes:

Present Worth Capital Costs are shown for a 3 percent and 7 percent net discount rate based on an average capital expenditure (remedy construction) for each year of the 5-year construction period.

Total Present Worth Capital + O&M Cost is shown for a 3 percent and 7 percent net discount rate and a 30-year and a 100-year timeframe and includes contingency on capital and O&M costs.

FS Remedy construction will take 5 years (projected to occur from 2016 to 2020). Annual O&M Costs post-construction begin in 2021. Please note prior to and during construction the Site will continue to incur O&M and EPA oversight costs.

Total Present Worth Cost (Capital + O&M) is assumed to be the sum of the present worth cost for individual alternative components from each FS Area that composes the Sitewide remedial alternative.

[a] Refer to Table 10-1 in *Final Feasibility Study Report* (CSC, 2016) for additional details.

[b] For SWR Alternative 2, Area 2 is remediated by constructing an evapotranspiration (ET) cap over the western slopes of the RCRA Canyon, instead of a RCRA mono soil cap originally specified in Area 2 Alternative 3. The original Alternative 3 cost sheet was modified to incorporate the ET cap.

Alt	alternative	P/S	pesticide/solvent
FS	Feasibility Study	RCRA	Resource Conservation and Recovery Act
O&M	operation and maintenance	SWR	Sitewide Remedial Alternative

Source: Modified from Table 12-4, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

TABLE 11.
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 *PREFERRED ALTERNATIVE*	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 have expressed support for the Preferred Alternative (3)					
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
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

Evaluation Criteria	Alternative 1 No Further Action	Alternative 2 Capping, Liquids Extraction, Large Evaporation Pond	Alternative 3 Capping, Liquids Extraction, Small Evaporation Pond ***PREFERRED ALTERNATIVE***	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

Balancing Criteria (Criteria Nos. 3 - 6)		**Cost and Green Impacts Assessment**	
○	Poor	○	Low
◔	Poor to Moderate	◔	Low to Moderate
◑	Moderate	◑	Moderate
◕	Moderate to good	◕	Moderate to High
●	Good	●	High

Notes:

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.

ARAR	applicable or relevant and appropriate requirement
N/A	not applicable
NPV	net present value
O&M	operation and maintenance
P/S	pesticide/solvent

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

TABLE 12.
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 *PREFERRED ALTERNATIVE*	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 (yrs)[a]						
Area 5 North[b]	NA	>6,300	**>6,300**	>6,300	>6,300	>6,300
Area 5 South[c]	NA	>260	**>260**	>260	>260	>100
Area 5 West[c]	NA	>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 yr)	$2.7M	$4.0M	**$4.1M**	$7.8M	$8.5M	$15.0M
NPV (30 yrs, 7%)	$33.8M	$85.2M	**$89.5M**	$138.6M	$113.8M	$209.9M
NPV (30 yrs, 3%)	$53.4M	$115.5M	**$120.2M**	$195.7M	$147.0M	$291.1M
NPV (100 yrs, 7%)	$38.9M	$92.0M	**$96.2M**	$152.0M	$120.7M	$228.7M
NPV (100 yrs, 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 the fact 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] 1 Estimated costs are from *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016).

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

µg/L	micrograms per liter
DNAPL	dense non-aqueous phase liquid
LNAPL	light non-aqueous phase liquid
M	million
MCL	maximum contaminant level
NA	not applicable (EPA will not be selecting Alternative 1, so cleanup times under this alternative are not provided).
NPV	net present value
O&M	operations and maintenance
PCE	tetrachloroethene
TI	Technical Impracticability
yrs	year(s)

TABLE 13.
Description and Cost Estimate Summary of Top-Ranked Remedial Alternative 3

FS Area	Description	Remedial Alternative Component	Capital Costs 2014 $	Annual O&M Costs 2014 $	Present Worth Capital + O&M Costs (2014 $) O&M Timeframe	Discount Rate 3%	Discount Rate 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:

Present Worth of Capital Costs are 2014 $ 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 $ based on 30-year and 100-year timeframes and include 35% to 50% contingency. Costs are presented using net discount rate of 3% and 7% as suggested in EPA guidance and are consistent with current expected inflation and return on investments. For FS Area 2, the selected remedy would use either an Evapotranspiration (ET) or Hybrid cap but cost estimate assumes ET cap.

BMP best management practice
BTA Burial Trench Area
CDA Central Drainage Area
EE/CA Engineering Evaluation/Cost Analysis
ET evapotranspiration
FS feasibility study
IC institutional control
LHSU lower hydrostratigraphic unit
MNA monitored natural attenuation
NAPL non-aqueous phase liquid
O&M operation and maintenance
P/S pesticide/solvent
PCB polychlorinated biphenyl
PCT Perimeter Control Trench
RCF Runoff Containment Facility
PSCT Perimeter Source Control Trench
RCRA Resource Conservation and Recovery Act
TI Technical Impracticability
WCSA West Canyon Spray Area

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

TABLE 14.
List of Potential ARARs

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
CHEMICAL-SPECIFIC ARARs					
Air Quality					
Santa Barbara APCD Rules:					
Visible Emissions	Rule 302	Air / Onsite Construction	Establishes limits on visible emissions of air contaminants into the atmosphere.	Applicable	
Nuisance	Rule 303	Air / Onsite Construction	Prohibits discharges of air contaminants or other material in violation of Health and Safety Code § 41700 in quantities that cause injury, detriment, nuisance, or annoyance to any considerable number of persons or to the public; or that endanger the comfort, repose, health or safety of such persons or the public; or that cause or have a natural tendency to cause injury or damage to business or property.	Applicable	
Particulate Matter	Rule 304	Air / Onsite Construction	Prohibits discharges into the atmosphere of particulate matter in excess of 0.3 grain per cubic foot.	Applicable	
New Source Review	Regulation VIII, Rule 803	Air / Onsite Construction	This regulation includes requirements that new sources of air emissions must meet.	Relevant and Appropriate	Substantive standards only.
Water Quality					
Federal Clean Water Act / California Water Code / SWRCB Regulations / RWQCB					
Maximum Contaminant Levels (MCLs)	42 U.S.C. § 300f et seq.; 40 CFR §§ 141.50-141.52; EPA Region 9 Drinking Water Standards and Health Advisory Table, February 2000	Groundwater	National primary drinking water standards.	Relevant and Appropriate	Relevant and appropriate for in situ groundwater, except for the combined Technical Impracticability (TI) Zone/Waste Management Area (WMA), as described below. TI Zone: These standards are waived for designated chemicals in groundwater (see Table 3 in the Proposed Plan) within Area 5 North, based on a TI waiver.

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
					Waste Management Area (WMA): In addition, these standards do not apply for groundwater under the WMA, which circumscribes the five landfills located in Area 5 North. The standards apply beyond the Point of Compliance (POC), outside the combined TI Zone/WMA area in Area 5 North. See Section 8.10 and Figure 23 of the Proposed Plan.
Soils, Waste Delineation and Management					
Toxic Substances Control Act (TSCA), 15 U.S.C. §§ 2601-2692; 40 CFR §§ 761.50-761.79	Establishes means for storage and disposal of material contaminated with polychlorinated biphenyls (PCBs) of concentrations of 50 ppm or greater.	Disposal of PCBs / Onsite reconsolidation (e.g., PCB landfill)	Applicable to storage and disposal of waste materials containing >50 ppm.	Applicable	Substantive requirements only.
Other Federal Criteria, Advisories, and Guidance to be Considered (TBC)					
EPA Groundwater Classification System; Office of Groundwater Protection			Three classifications for groundwater based on ecological importance, replaceability, and vulnerability. Considered a statement of EPA policy for setting remediation goals.	To Be Considered (TBC)	
EPA Secondary MCLs and Proposed MCLs		Groundwater	Secondary drinking water standards; proposed MCLs. Proposed MCLs considered for groundwater in the absence of a federal or state MCL.	To Be Considered (TBC)	
Applied Action Levels		Groundwater	Air and water guidelines used to evaluate the risk a site poses to certain biologic receptors. Considered for groundwater.	To Be Considered (TBC)	

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
ACTION-SPECIFIC ARARs					
Waste Management/Landfill Closure					
California Hazardous Waste Control Act / DTSC Regulations					Final selection of ARAR will depend on determination of whether the federal or state standard is more stringent. The state standard is an ARAR only if it is more stringent than the federal requirement.
Hazardous Waste Identification	40 CFR §§ 261.10, 22 CCR 261.10	Multi-media	Criteria for identifying hazardous waste. Applicable if hazardous waste is encountered during implementation of response actions at the Site.	Applicable	
Hazardous Waste Generation	40 CFR 262.10, 22 CCR §§ 66262.10 - 11	Multi-media	Provides standards applicable to generators of hazardous waste. 262.10 determines which standards apply to generators. May be applicable if hazardous waste is generated during implementation of response actions at the Site. Particular provisions are described below.	Applicable	Substantive standards only.
Hazardous Waste Determination	40 CFR 262.11, 22 CCR § 66262.11	Multi-media	Provides method of determining whether a waste is a hazardous waste.	Applicable	
Waste Manifesting	40 CFR 262.23, 22 CCR § 66262.23	Multi-media	Provides requirements for use of a hazardous waste manifest. Applicable if hazardous waste will be transported off-Site.	Applicable	
Pre-Transport Requirements	40 CFR 262.30-34; 22 CCR 66262.30 - 66262.34	Multi-media	Provides requirements for packaging, labeling, marking, placarding, and permissible accumulation time before transporting hazardous waste off-Site.	Applicable	
Applicability of General Facility Standards	40 CFR 265.10; 22 CCR § 66265.10	Multi-media	Provides that the regulations in Subpart B (40 CFR 265.10-19; Article 2 (General Facility Standards, §§ 66265.10 - 66265.25) apply to owners and operators of hazardous waste facilities.	Applicable	
General Waste Analysis	40 CFR 262.13; 22 CCR § 66265.13	Multi-media	Provides standards for obtaining analyses of hazardous waste before transferring, treating, storing or disposing of such waste.	Applicable	

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
Security	40 CFR 262.14; 22 CCR § 66265.14	Multi-media	Provides standards for prevention of unknowing entry or unauthorized entry of persons or livestock.	Applicable	
Ignitable, Reactive and Incompatible Wastes	40 CFR 265.17; 22 CCR § 66265.17	Multi-media	Provides standards to prevent accidental ignition or reaction of ignitable, reactive or incompatible wastes. Applicable if such wastes are encountered during implementation of response actions at the Site.	Applicable	
Construction Quality Assurance	40 CFR 265.19; 22 CCR § 66265.19	Multi-media	Provides standards for Construction Quality Assurance Programs.	Applicable	Substantive requirements only.
Seismic and Precipitation Design Standards	22 CCR § 66265.25	Multi-media	Provides that all cover systems required by Chapter 15 (*i.e.*, § 66265.1 et seq.) and all containment and control features that will remain after closure must be designed, constructed and maintained to withstand the maximum credible earthquake without any decrease in the level of public health and environmental protection afforded by the original design.	Applicable	
General Closure Standard	40 CFR 265.110; 22 CCR § 66265.110	Multi-media	Provides that Sections 66265.111-.115 (closure) and Sections 66265.116-.120 (post-closure) apply to owners and operators of all hazardous waste facilities. (Sections identified as potential ARARs below.)	Relevant and Appropriate	Substantive requirements only.
Landfill Closure Construction	40 CFR 265.111; 22 CCR § 66265.111	Multi-media	Provides that the owner or operator must close the facility in a manner that: · Minimizes the need for further maintenance, and · Controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated rainfall or run-off, or waste decomposition products to the ground or surface water or to the atmosphere.	Relevant and Appropriate	Substantive requirements only.

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
Disposal/ Decontamination	40 CFR 265.114; 22 CCR § 66265.114	Multi-media	Provides that during the partial and final closure periods, all contaminated equipment, structures and soil must be properly disposed of or decontaminated by removing all hazardous waste and residues, except as otherwise specified. Applicable if implementation of response actions at the Site involves hazardous waste-contaminated equipment, structures or soil.	Relevant and Appropriate	
Landfill Closure Construction	40 CFR 265. 310 (a), (b); 22 CCR §§ 66265.310(a), (c) and (d)	Multi-media	Provides performance standards for design and construction of landfill final covers.	Relevant and Appropriate	Applies to owner/operators.
Landfill Post-Closure Care	22 CCR §§ 66265.310(b) and (e)	Multi-media	Provides requirements for post-closure care of landfills.	Relevant and Appropriate	Applies to owner/operators.
California Hazardous Waste Control Act / DTSC Regulations					
Surface Impoundment Closure and Post-Closure Care Standard	40 CFR 265.228; 22 CCR § 66265.228	Soils, contaminated soils, waste materials	(a) At closure, the owner or operator shall: (1) remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and manage them as hazardous waste unless Section 66261.3(d) applies, or (2) close the impoundment and provide post-closure care as specified. (b) Sets forth requirements for maintaining and protecting the final cover and maintaining and monitoring groundwater monitoring systems and leak detection systems when wastes, waste materials or contaminated material will remain after closure.	Relevant and Appropriate	

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
Waste Pile Closure and Post-Closure Care Standard	40 CFR 265.258; 22 CCR § 66265.258	Soils, contaminated soils, waste materials	(a) At closure, the owner or operator shall remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated subsoils, and structures and equipment contaminated with waste and leachate, and manage them as hazardous waste unless Section 66261.3(d) applies, or (b) if after reasonable efforts to remove and decontaminate not all subsoils can be practicably removed or decontaminated, close facility and perform post-closure care as specified.	Relevant and Appropriate	
Tank System Closure and Post-Closure Care Standard	40 CFR 265.197; 22 CCR § 66265.197		(a) At closure of a tank system, the owner or operator shall remove or decontaminate all waste residues, contaminated containment system components (liners, etc.), contaminated soils, and structures and equipment contaminated with waste and leachate, and manage them as hazardous waste unless Section 66261.3(d) applies, or (b) if not all contaminated soils can be practicably removed or decontaminated, close the tank system and perform post-closure care as specified.	Relevant and Appropriate	Substantive requirements only.
Corrective Action Waste Management Units (CAMU)	40 CFR 264.552, 553; 22 CCR, 66264.552, 66264.553	Soils, contaminated soils, waste materials	Establishes that consolidation and placement into a corrective action management unit of remediation wastes generated as part of a corrective action do not constitute placement or land disposal of hazardous waste. Prohibits creation of an unacceptable risk to humans and the environment resulting from exposure. Establishes closure and other requirements for temporary tank and container storage.	Relevant and Appropriate	Substantive requirements only.

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
Standards for Tanks Not Regulated under Hazardous Waste Facility Permit or Interim Status	40 CFR 265.190-201; 22 CCR § 67383.1 -.5	Tank Systems	Provides minimum standards for the management of all underground and aboveground tank systems that held hazardous waste or hazardous materials, and are to be disposed, reclaimed or closed in place, except as provided in 22 CCR Section 67383.1 (b), (c) and (d). These standards do not apply to tank systems regulated under a hazardous waste facility permit, other than a permit by rule, or to tank systems regulated under a grant of interim status.	Relevant and Appropriate	Substantive requirements only.
Underground Storage of Hazardous Substances	40 CFR 265.190-201; H&S Code §§ 25280-25299.6 and regulations specified below				See below.
Permanent Closure Requirements for Underground Storage Tanks (USTs)	40 CFR 265.190-201; 23 CCR § 2672(b), (c)		Owners or operators of USTs for storage of hazardous waste shall comply with applicable provisions of Hazardous Waste Control Act (H&S Code § 25100 et seq.) and requirements listed in § 2672(b). Where tanks are approved to be closed in place, must also comply with applicable provisions of UST law (H&S Code § 25280 et seq.) and requirements listed in § 2672(c).	Relevant and Appropriate	Substantive requirements only.
Santa Barbara County Standards for Destruction or Inactivation of Wells	Santa Barbara County Code Chap. 34A, Section 34A-1, 2, 11, 12, 13, and Cal. Dept. of Water Resources (DWR) Bulletin Nos. 74-81 and 74-90		Section 34A-5 provides that the standards for destruction or inactivation of wells (including injection wells and monitoring wells) are set forth in DWR Bulletin No. 74-81 (Water Well Standards), as supplemented by Bulletin No. 74-90.	Applicable	Substantive requirements only.

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
Waste Management Units - General Closure Requirements	23 CCR §§ 2580(a), (b) and (d)		Section 2580 provides that waste management units must be closed according to an approved closure and post-closure maintenance plan that provides for continued compliance with applicable standards for waste containment and precipitation and drainage controls in Article 4 and the monitoring program requirements in Article 5.	Relevant and Appropriate	Substantive requirements only.
Final Cover – Vegetation Requirements	23 CCR § 2580(e)		Subsection (e) of Section 2580 provides that vegetation must not impair the integrity of the final cover.	Relevant and Appropriate	Substantive requirements only.
Water Quality					
Compliance with Clean Water Act	Federal Water Pollution Control Act, 33 U.S.C. 1251, et seq.; Cal. Water Code § 13370 et seq.		Federal law requires compliance with the federal Clean Water Act requirements for point source surface water discharges. State law also requires compliance.	Applicable	Federal law is ARAR where state law is not more stringent. Substantive requirements only.
Safe Drinking Water Act; MCLs	Safety of Public Water Systems, 42 U.S.C. 300f-g, h; 22 CCR Sections 64431, 64439, and 64444		Establishes maximum contaminant levels for public water supply systems. Relevant and appropriate for aquifers that are current or potential public or private supply sources.	Relevant and Appropriate	Federal law is ARAR unless specific California MCLs are more stringent than federal MCLs.
State Water Resources Control Board (SWRCB) “Statement of Policy with Respect to Maintaining High Quality of Waters in California” (Anti-Degradation Policy)	SWRCB Resolution No. 68-16, set forth at Central Coast Regional Water Quality Control Board (RWQCB) Water Quality Control Plan (Basin Plan), Appendix A-2		Policy requiring maintenance of existing water quality unless demonstrated that the change is consistent with maximum benefit to the people of the State, will not unreasonably affect present or anticipated beneficial uses, and will not result in water quality less than what is prescribed by other state policies.	Applicable	Applies if any action would degrade water quality.
SWRCB “Sources of Drinking Water” Policy	SWRCB Resolution No. 88-63, set forth at Central Coast RWQCB Basin Plan, Appendix A-9		Statement of policy that surface waters and ground waters of the State are considered to be suitable, or potentially suitable, for municipal or domestic water supply except under specified circumstances.	Applicable	

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
SWRCB "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304	SWRCB Resolution No. 92-49	Statewide Policy, adopted by SWRCB under California Water Code Sections 13140 and 13307, approved by Office of Administrative Law	Statement of Policies and Procedures for investigation and cleanup of groundwater	The Central Coast Water Board has identified SWRCB Resolution No. 92-49 as an ARAR for the remedial action being selected at the Casmalia site in this document. EPA disagrees with the Central Coast Water Board about whether Resolution No. 92-49 is an ARAR for the remedial actions being proposed in this plan, namely adoption of Alternative 3. There is, however, no substantive dispute as to the selected remedies and cleanup levels for this cleanup action, and the Central Coast Water Board believes the selected remedies and cleanup levels set forth in the proposed plan substantively comply with Resolution No. 92-49. The Central Coast Water Board reserves any and all rights to assert Resolution No. 92-49 as an ARAR in the ROD and without prejudice to its position, the Central Coast Water	

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
				Board agrees to concur with this proposed plan. Should Alternative 3 be substantially modified, or another Alternative be selected, then the Central Coast Water Board reserves the right to assert the applicability of 92-49 as an ARAR to EPA's proposed modified final remedy.	
Porter-Cologne Water Quality Act	Water Code §§ 13260-13269		Establishes that nearly all groundwater and surface water are considered suitable, or potentially suitable, for municipal or domestic water supply.	Applicable	
Water Quality Monitoring and Response Programs for Waste Management Units	23 CCR Div. 3, Ch. 15 as specified below				See below.
Precipitation and Drainage Controls	23 CCR § 2546		Provides performance standards related to precipitation and drainage controls for design and construction of containment structures and cover materials.	Relevant and Appropriate	Substantive Requirements Only.
Seismic Design Standards	23 CCR § 2547		Provides that Class I waste management units (*e.g.*, including landfills) must be designed to withstand the maximum credible earthquake without damage to the foundation or structures, which control leachate, surface drainage, erosion or gas.	Relevant and Appropriate	Substantive Requirements Only.
Water Quality Monitoring and Response Programs for Waste Management Units – Corrective Action	23 CCR §§ 2550.10(a), (b), (d), and (g)(1)			Relevant and Appropriate	Substantive Requirements only.

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
Central Coast RWQCB Water Quality Control Plan (September 1994, as amended April 1995) (Basin Plan)			General WQOs for groundwater: Shall not contain taste or odor producing substances in concentrations that adversely affect beneficial uses.	Relevant and Appropriate	
			Municipal and domestic supply groundwater: Shall not contain organic chemicals in excess of the limiting concentrations in 22 CCR § 64444 [as renumbered] and listed in Table 3.1 of Basin Plan, and shall not contain concentrations of chemical constituents in excess of limits in 22 CCR § 64431 [as renumbered] (MCLs).	Relevant and Appropriate	
			Agricultural supply groundwater: Shall not contain constituents "in amounts that adversely affect such beneficial uses." Table 3.3 identifies adverse effects guidelines. No "controllable water quality factor" shall degrade the quality of any groundwater resource or adversely affect long-term soil productivity.	Relevant and appropriate	
			Groundwater Management Principle: "Wastewaters percolated into groundwater shall be of such quality at the point where they enter the ground so as to assure the continued usability of all groundwaters of the basin."	Relevant and Appropriate	
			Discharge Prohibitions: Wastes discharged to ground waters shall be free of toxic substances in excess of accepted drinking water standards; taste, odor, or color producing substances; and specified nitrogen compounds.	Applicable	

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
			Beneficial Uses of Surface Water in the San Antonio Hydrologic Unit , Table 2-1, Sec. 11-12: Defines beneficial uses for surface waters at the Casmalia Canyon and Shuman Canyon Creeks as: municipal/ domestic supply; agricultural supply; water contact recreation; non-contact water recreation; wildlife habitat; warm fresh water habitat; spawning, reproduction, and/or early development; and commercial and sport fishing.	Relevant and Appropriate	
General Permit for Stormwater Discharges Associated with Construction Activity	SWRCB Order No. 99-08-DWQ		Sets forth NPDES requirements for stormwater runoff from certain construction activities that disturb land equal to one (1) acre or more. Includes substantive requirements for developing and implementing a stormwater pollution prevention plan and performing monitoring of stormwater discharges.	Relevant and Appropriate	Substantive requirements only.
LOCATION-SPECIFIC ARARs					
Endangered Species and Migratory Birds					
U.S. Fish and Wildlife Service					
Federal Endangered Species Act (ESA)	16 U.S.C. §§ 1531-1544	Sitewide	Federal requirements governing endangered and threatened species. Section 1538 (Prohibited Acts) will be considered as a potential ARAR during the FS if any of the remedial alternatives being evaluated may be expected to adversely affect threatened or endangered species. Pursuant to 50 CFR § 402.14(b), EPA need not initiate formal consultation if, as a result of informal consultation or preparing a biological assessment, EPA determines (with the written concurrence of the U.S. Fish and Wildlife Service) that the response action is not likely to adversely affect listed species.	Applicable	

Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
California Fish and Game Code (F&G Code)					
Diversion of / Changes to Streams	F&G Code § 1603	Surface water	Prohibits the substantial diversion or obstruction of the natural flow or substantial changes to the bed, channel, or bank of any river, stream or lake designated by the Department of Fish and Game, or the use of any material from the streambeds, without first notifying the Department and otherwise complying with the statute.	Applicable	Substantive only.
Rare/Endangered Native Plants	F&G Code § 1908	Sitewide	Prohibits the taking of a rare or endangered native plants.	Relevant and Appropriate	Substantive provisions only.
Migratory Bird Treaty Act	16 U.S.C. § 703-712	Onsite Ponds	Establishes protections for migratory birds at the site.	Applicable	Substantive provisions only.
Bald and Golden Eagle Act	16 U.S.C. § 668(a)	Sitewide	Establishes protections for bald and golden eagles.	Applicable	Substantive provisions only.
	14 CCR § 472 and § 475		Describes the exceptions to the prohibition on the take of nongame birds and mammals, and exceptions to the manner in which nongame birds and mammals may be taken.	Relevant and Appropriate	Substantive provisions only.
Endangered or Threatened Species	F&G Code 2080	Onsite Ponds	Prohibits import, export, take, possession, purchase or sale of any endangered or threatened species.	Relevant and Appropriate for "take" provision only	Substantive provisions only.
Fully Protected Animals	F&G Code 4700	Sitewide	Prohibits the take of any fully protected animal, including the ring-tailed cat.	Relevant and Appropriate for "take" provision only	Substantive provisions only.
Mountain Lions	F&G Code 4800	Sitewide	Prohibits the take, injury, possession, transport, import or sale of any mountain lion.	Relevant and appropriate for "take" and "injure" provisions only	Substantive provisions only.

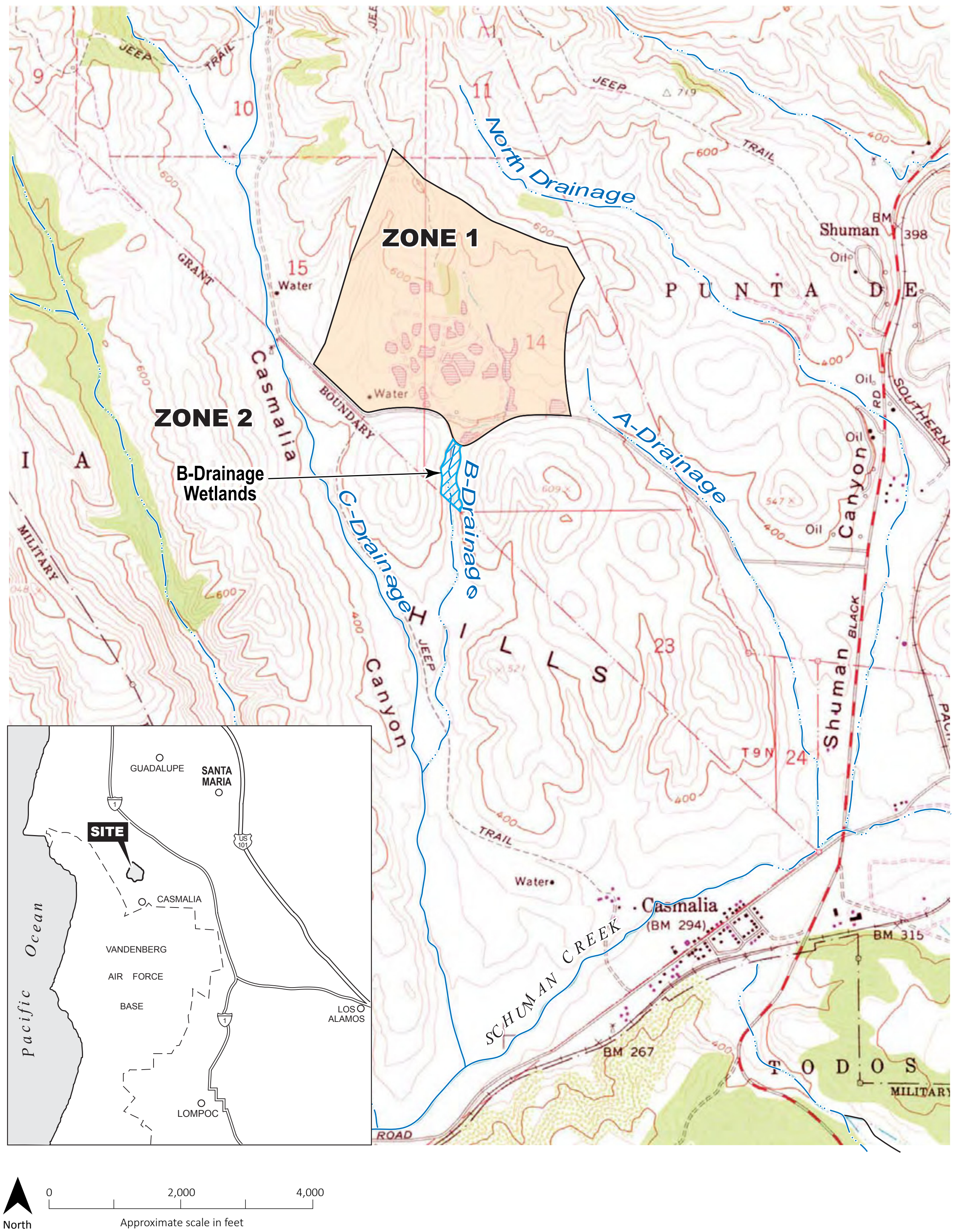
Standard / Requirement	Citation	Action / Media	Description	Status / Preliminary Determination	Comments
Institutional Controls*					
DTSC Requirements for Land Use Covenants	22 CCR §67391.1	Sitewide, Land Use Covenants	Provides standards for implementation of land use covenants where hazardous materials will remain onsite.	Relevant and appropriate	Substantive provisions only, specifically sub-sections (a)(2), (d), (e), (f) and (i) * <u>Note</u>: California Civil Code Section 1471 is California's implementing statute for the recording of land use covenants that run with the land.

Notes:

ARAR	applicable or relevant and appropriate requirement
CCR	California Code of Regulations
CFR	Code of Federal Regulations
DTSC	Department of Toxic Substances Control
F&G	Fish and Game (Code)
FS	feasibility study
MCL	maximum contaminant level
NPDES	National Pollutant Discharge Elimination System
RWQCB	Regional Water Quality Control Board
SWRCB	State Water Resources Control Board
TI	Technical Impracticability
U.S.C.	United States Code
UST	underground storage tank
WMA	waste management area
WQO	water quality objective

Source: Modified from Appendix B, *Final Feasibility Study Report, Casmalia Resources Superfund Site* (CSC, 2016)

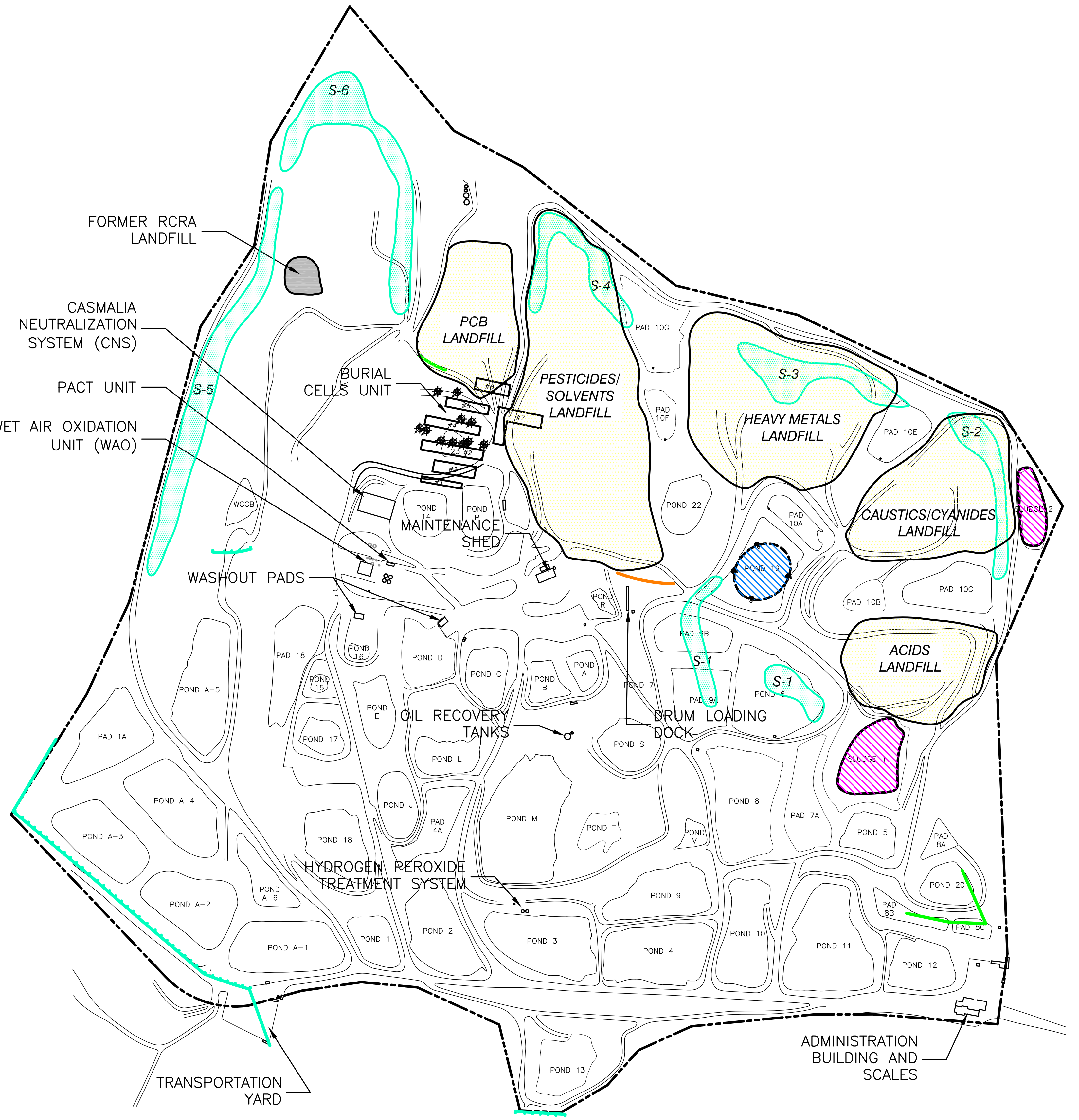
Figures



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

Figure 1
Site Location Map
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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).

Figure 2
Historical Site Layout
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

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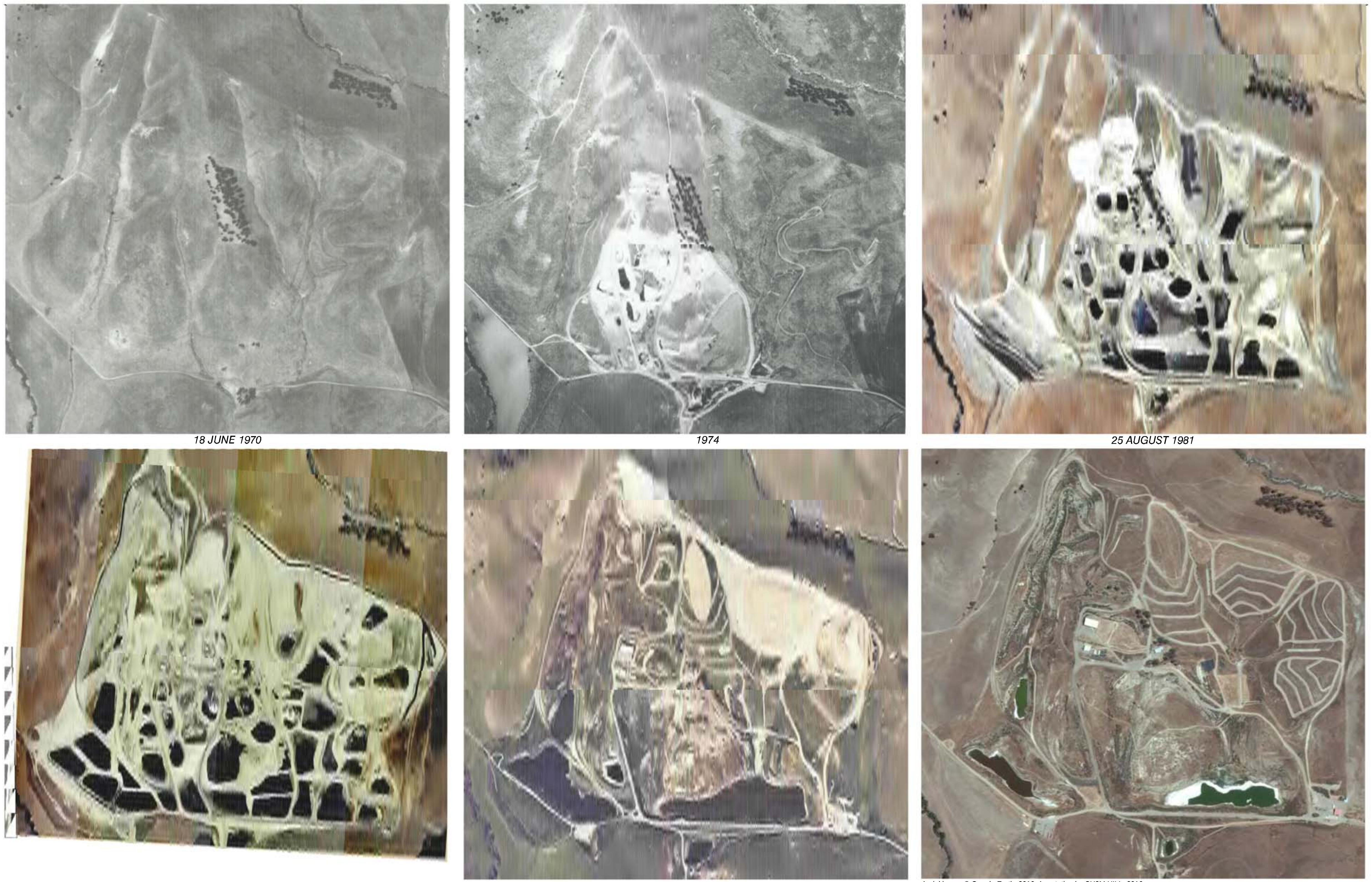


18 JUNE 1970

1974

25 AUGUST 1981

1985-1986

12 FEBRUARY 2002

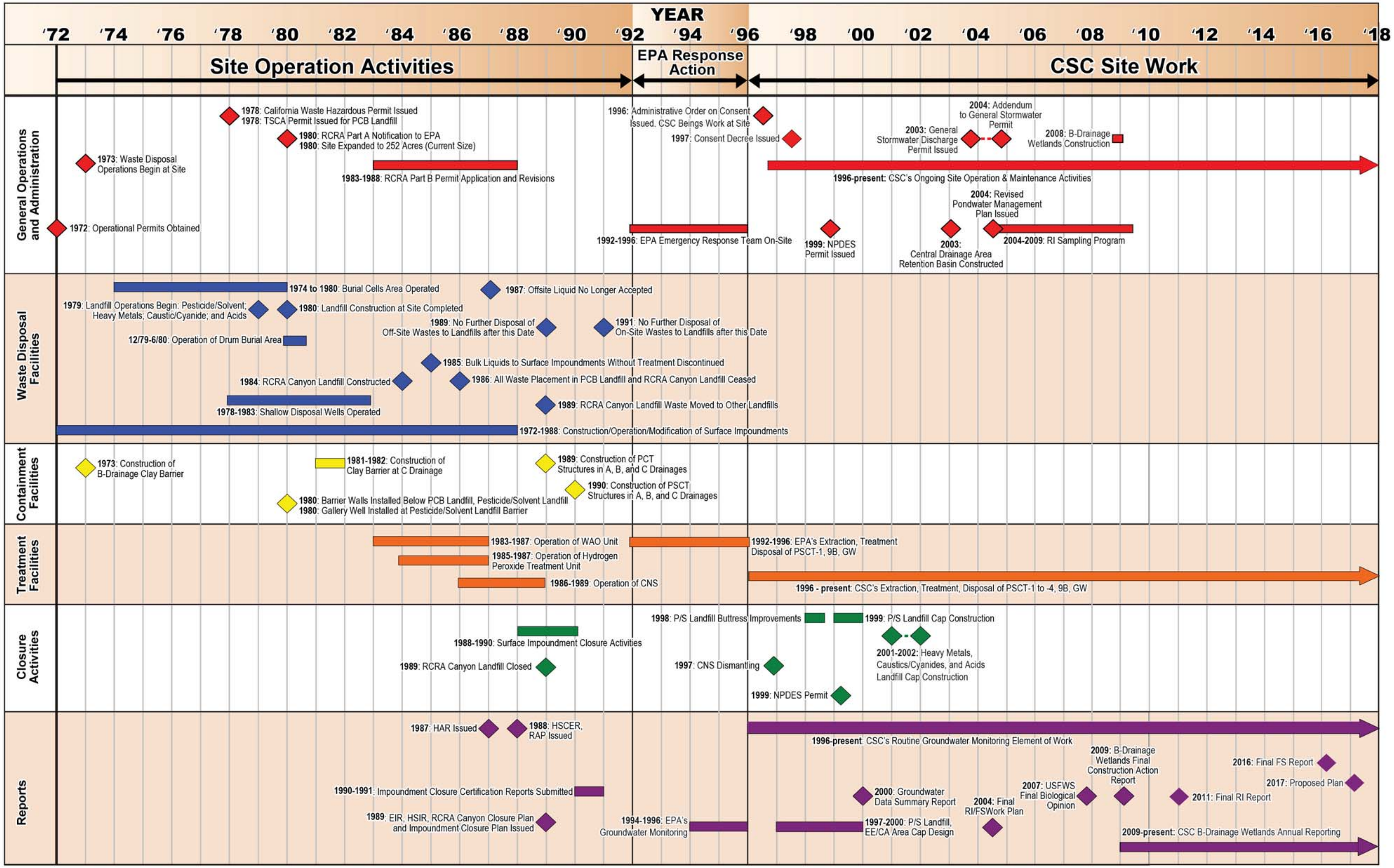
Aerial image © Google Earth, 2016. Annotation by CH2M HILL, 2016.

North

0 1,000
Approximate scale in feet

Figure 3
Selected Site Photographs (1970-2016)
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

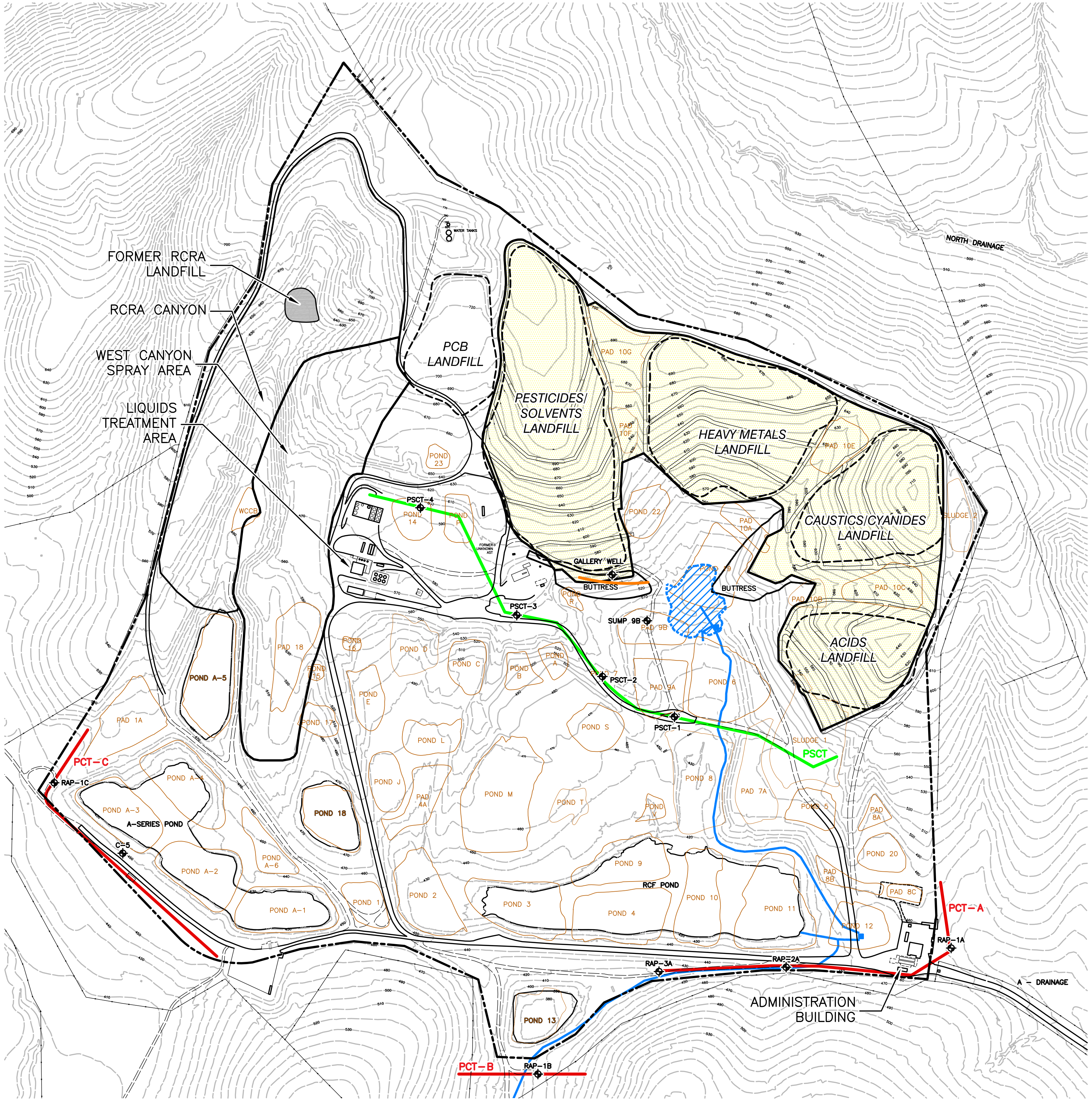


Acronyms

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		

Figure 4
Site Chronology and Milestones
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

Source: Modified from Figure 2-3, *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

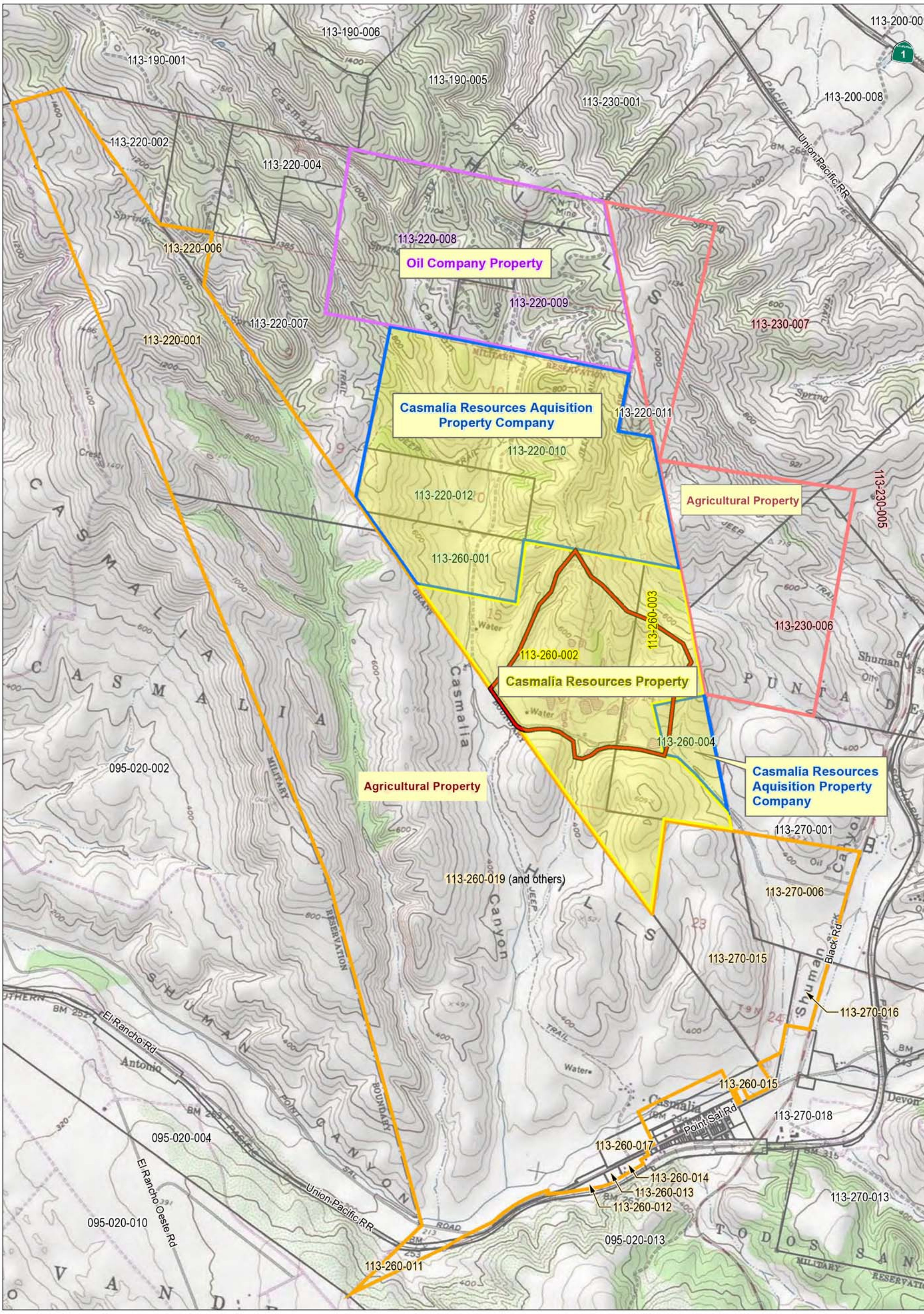
0 500

Approximate scale in feet

Topographic Source: Pacific Engineer Associates, July 8 1998

Figure 5
Current Site Layout
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

Source: Modified from Figure 2-1, *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

North

0 — 2,400 — 4,800
Approximate scale in feet

Figure 6
Parcel Ownership in Site Vicinity
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

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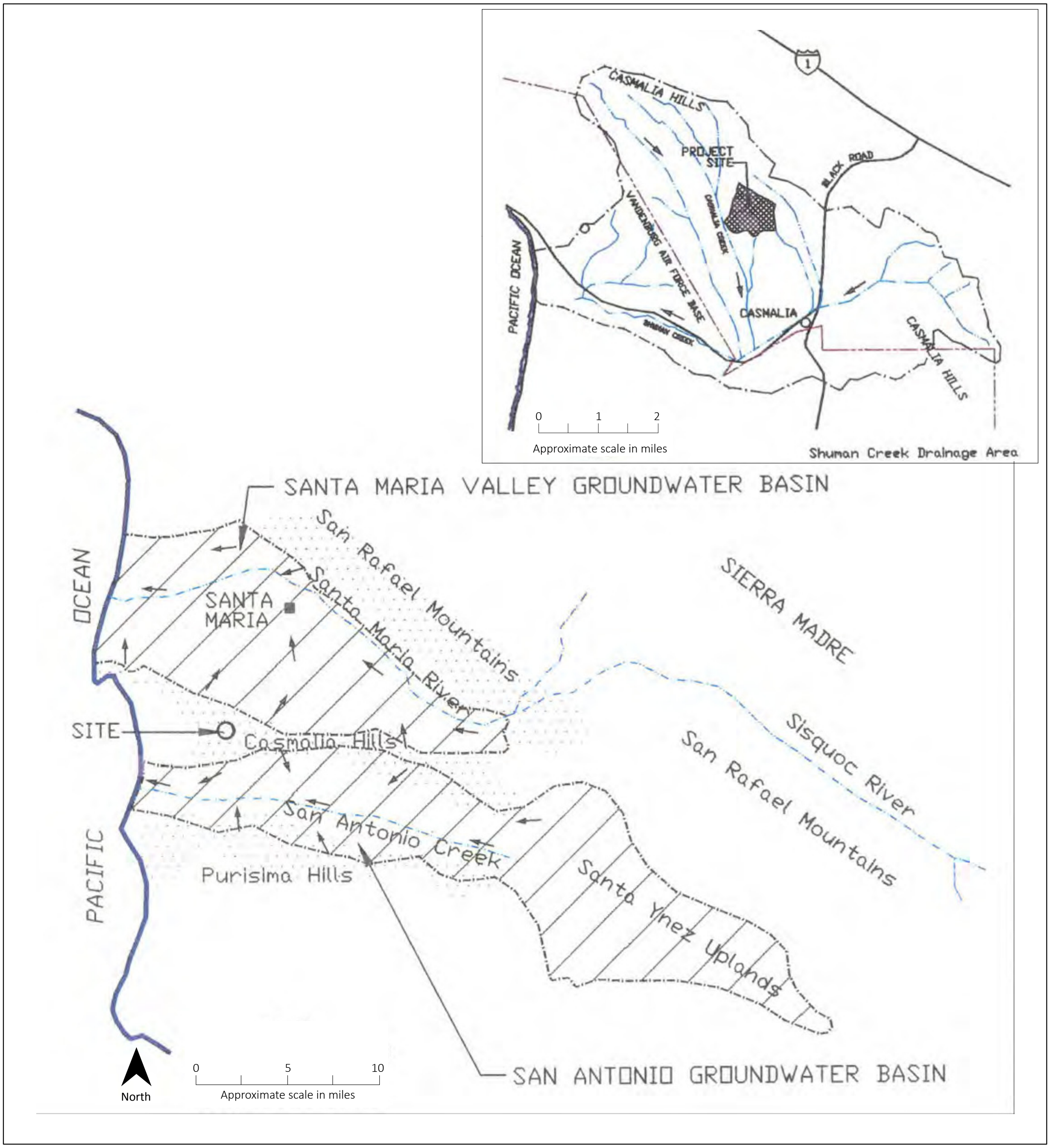


Source: Topographic base map provided by Pacific Engineering, Inc. from aerial survey dated March 4, 2004.

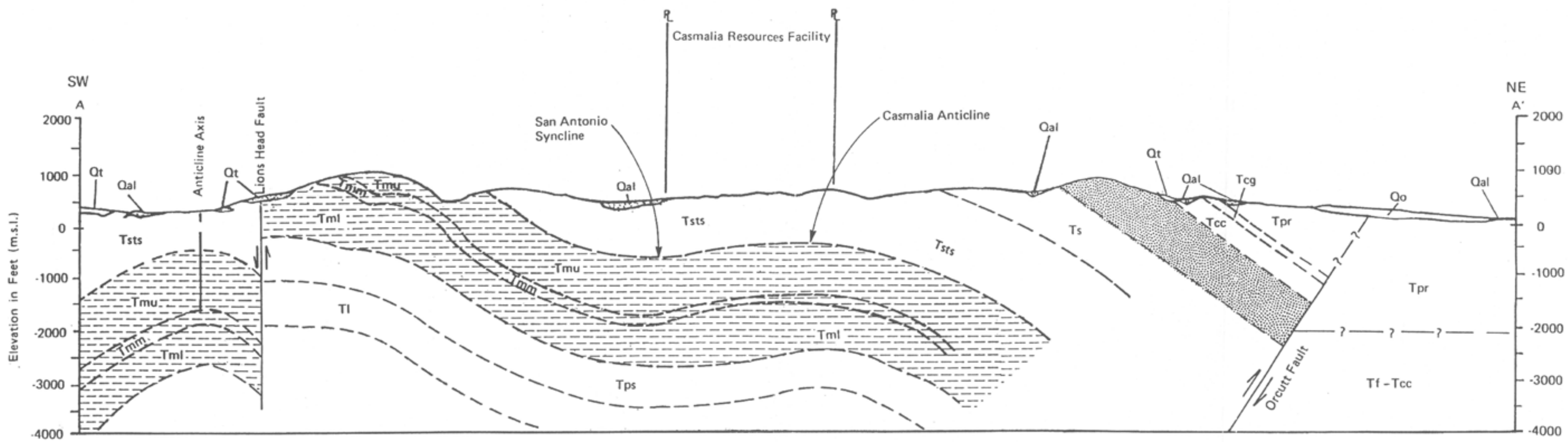
Explanation

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

Figure 7
Local Groundwater Basins
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

Modified from Woodward-Clyde, 1988



Explanation

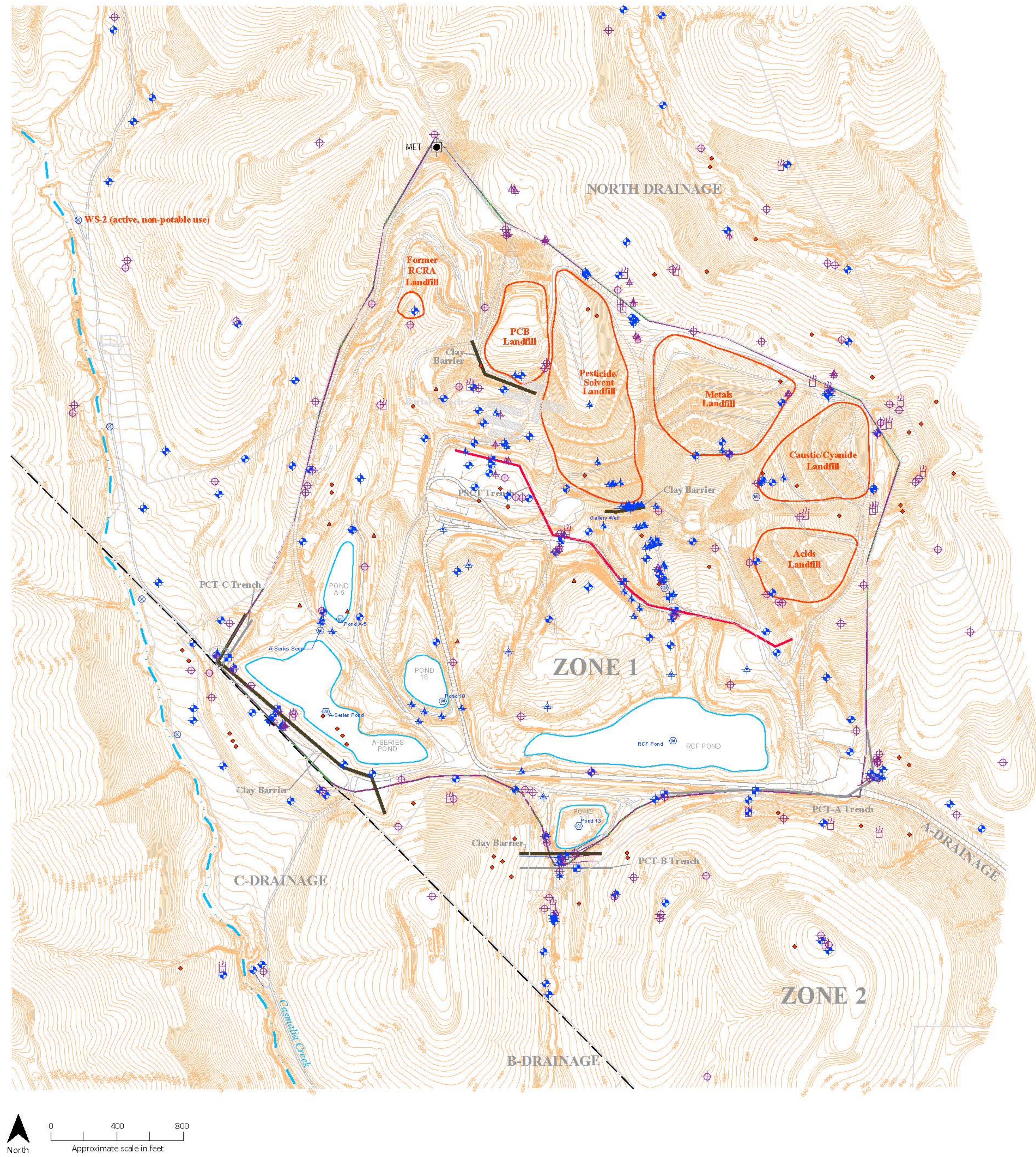
Qal Alluvium	Tcg Graciosa Member	Tsts Todos Santos Claystone Member	Tps Point Sal Formation
Qt Terrace Deposits	Tcc Cebada Member	Tmu Monterey Shale Upper Member	Tl Undifferentiated Lospe Formation
Qo Orcutt Sand	Tf Foxen Mudstone	Tmm Monterey Shale Middle Member	
Tpr Paso Robles Formation	Ts Sisquoc Formation	Tml Monterey Shale Lower Member	

0 3,000 6,000
Approximate scale in feet

Note:
All faults are schematic and are not to scale.

Source: Modified from Figure 4-5, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)

Figure 8
Regional Geologic Cross-Section
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California



Legend

- Burial Trench
- Landfill Boundaries
- Facility and Zone 1 Boundary
- Perimeter Source Control Trench
- Perimeter Control Trench
- Clay Barrier
- Creek
- Pond Outline
- Approximate Bognuda Ranch Property Boundary (no well access)
- Upper HSU Monitoring Well
- Upper HSU Piezometer
- Upper HSU Extraction Point
- POND18 Upper HSU Surface Water Sample
- Upper HSU Other Sampling Point
- Upper HSU Hydropunch
- Lower HSU Piezometer
- Lower HSU Monitoring Well
- MET Meteorological Station
- Water Supply Well (Non-Potable)

Notes:

Topo map revised 1998, 2000, 2004. Topo with P/S landfill and borrow area revised 2000.
Zone 1 boundary (green) is approximate and includes the area within the facility boundary.

Map does not include historical wells.

Source: Modified from Figure 4-7, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)

Figure 9
Well Location Map
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

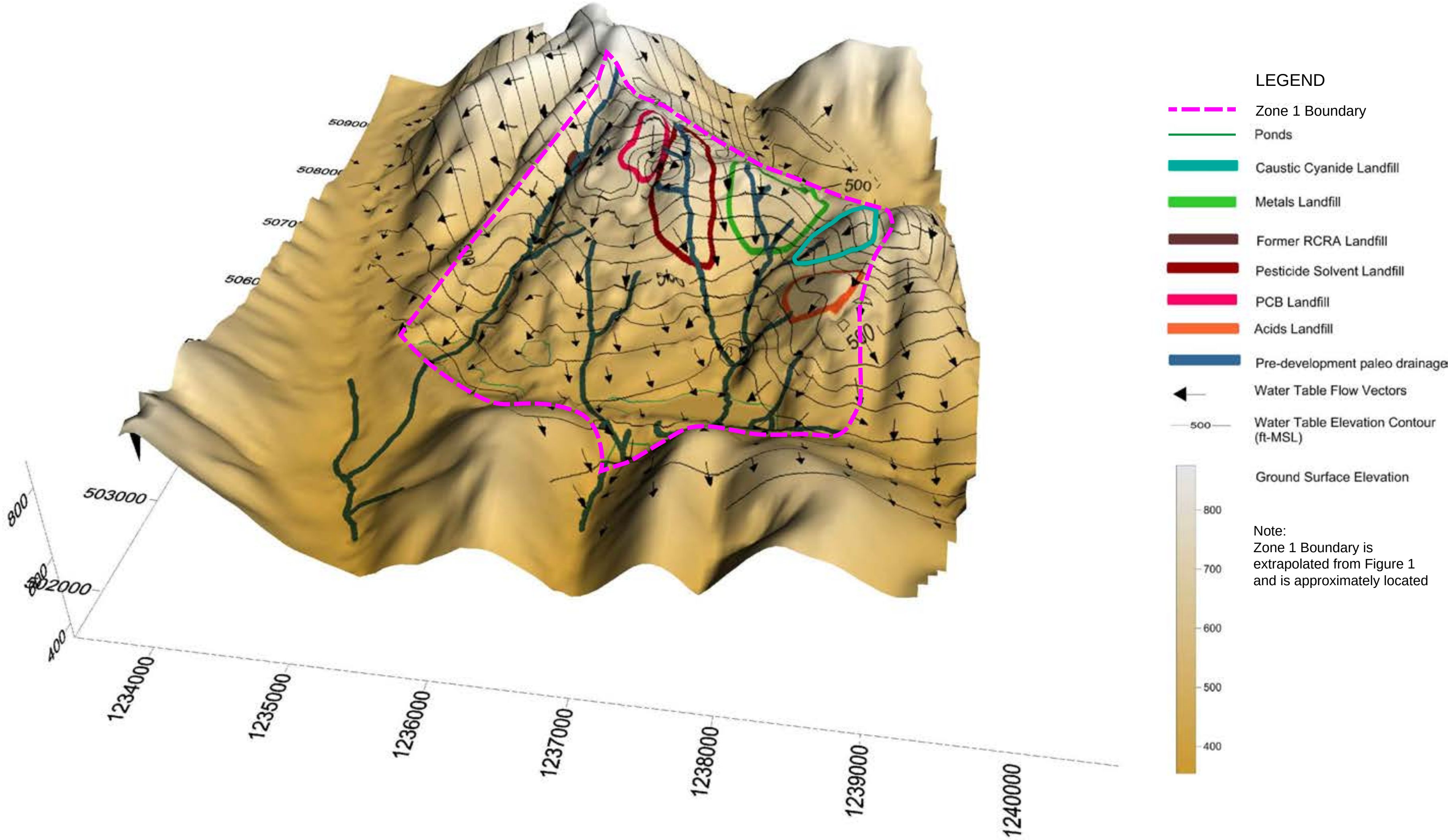


Figure 10
Water Table Potentiometric Surface, December 2015
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

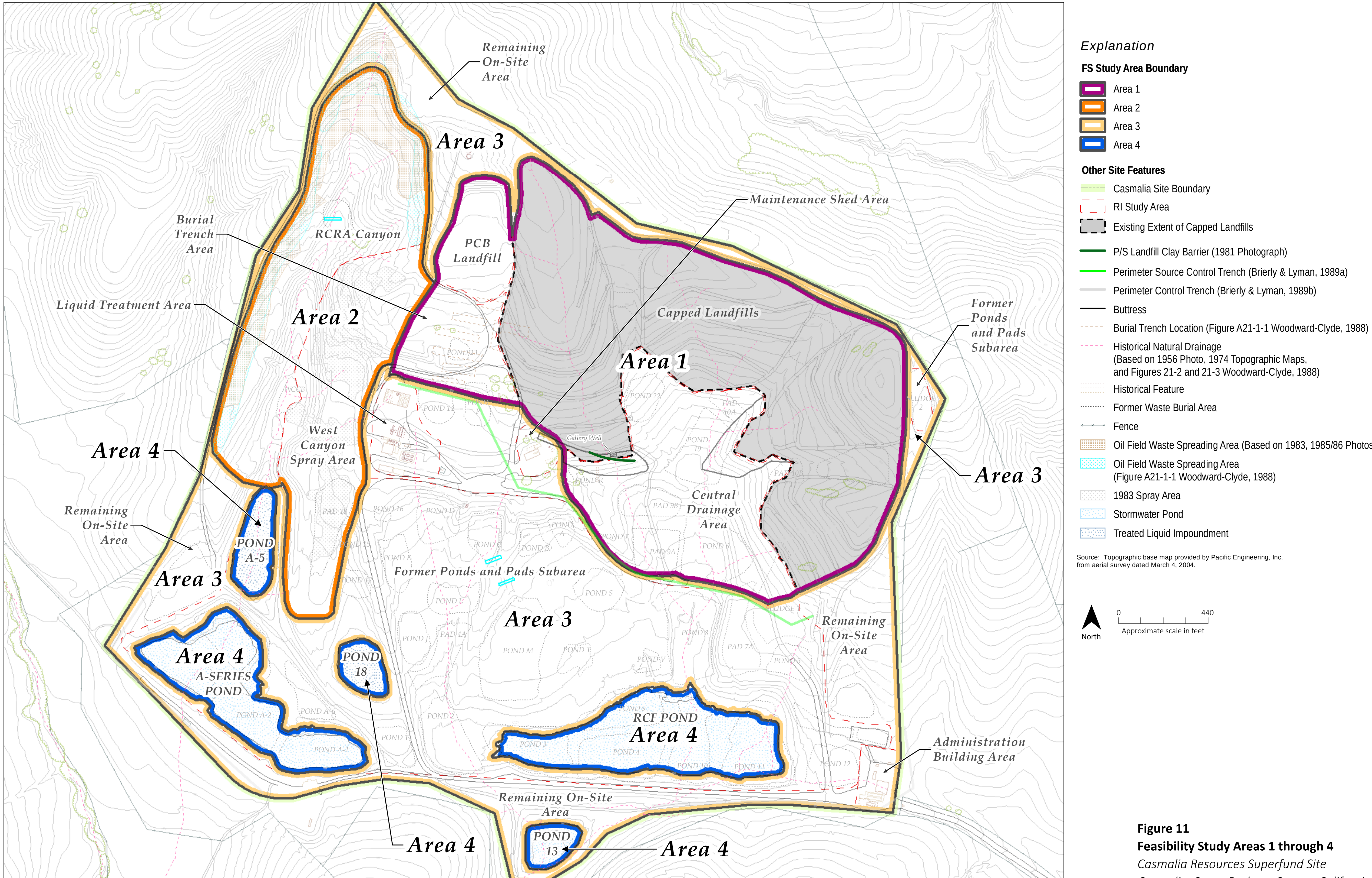


Figure 11
Feasibility Study Areas 1 through 4
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

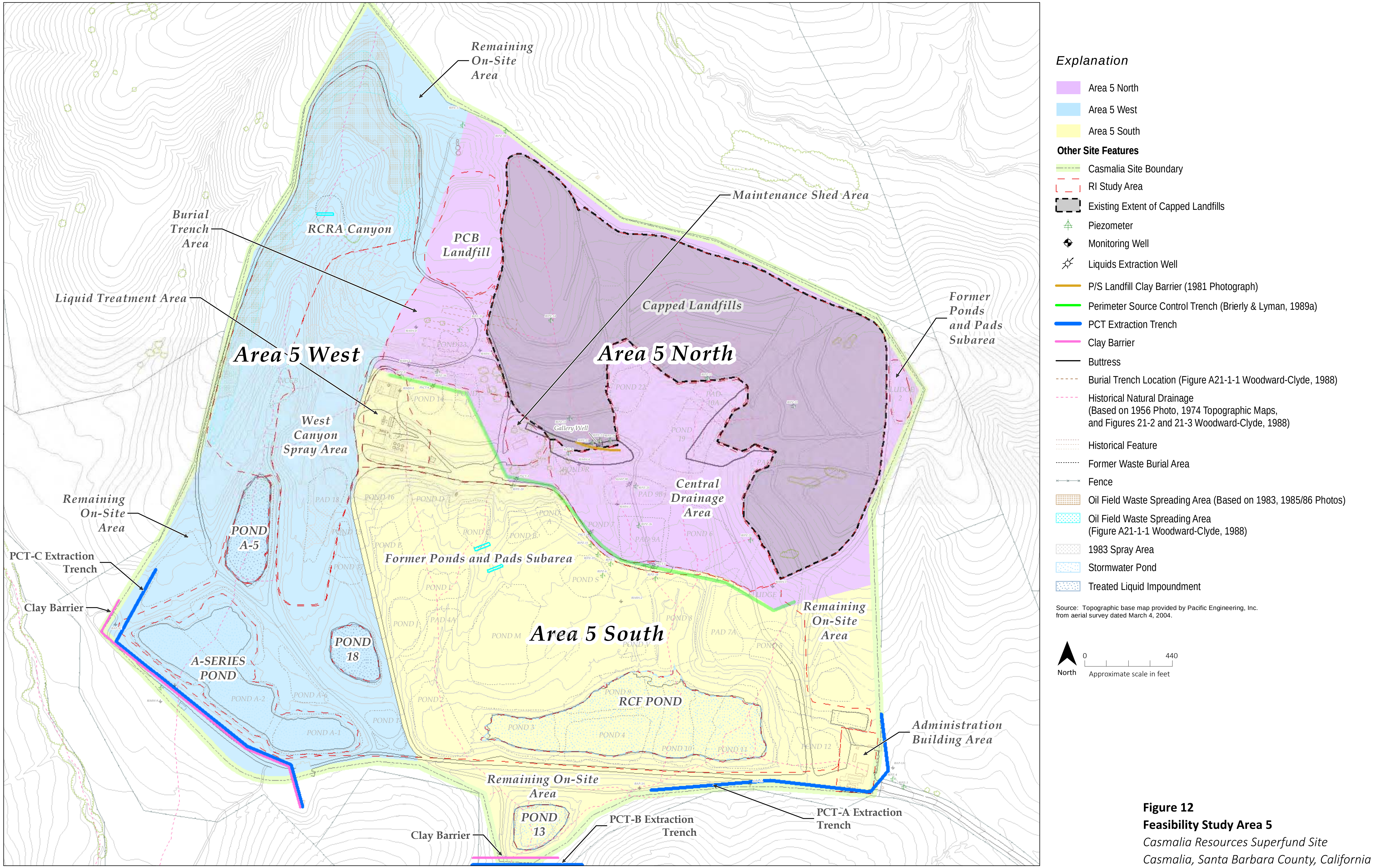


Figure 12
Feasibility Study Area 5
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

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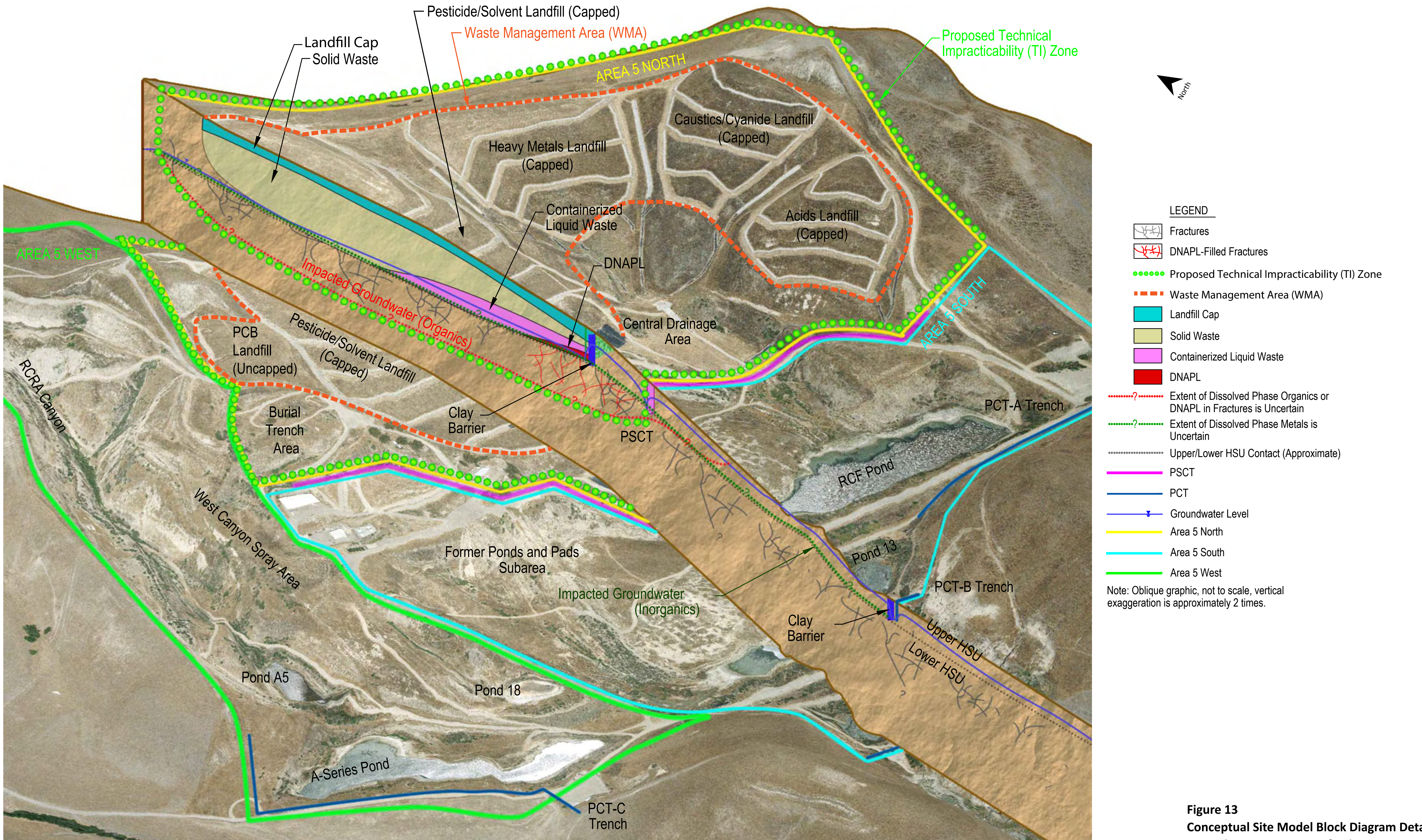


Figure 13
Conceptual Site Model Block Diagram Detail
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

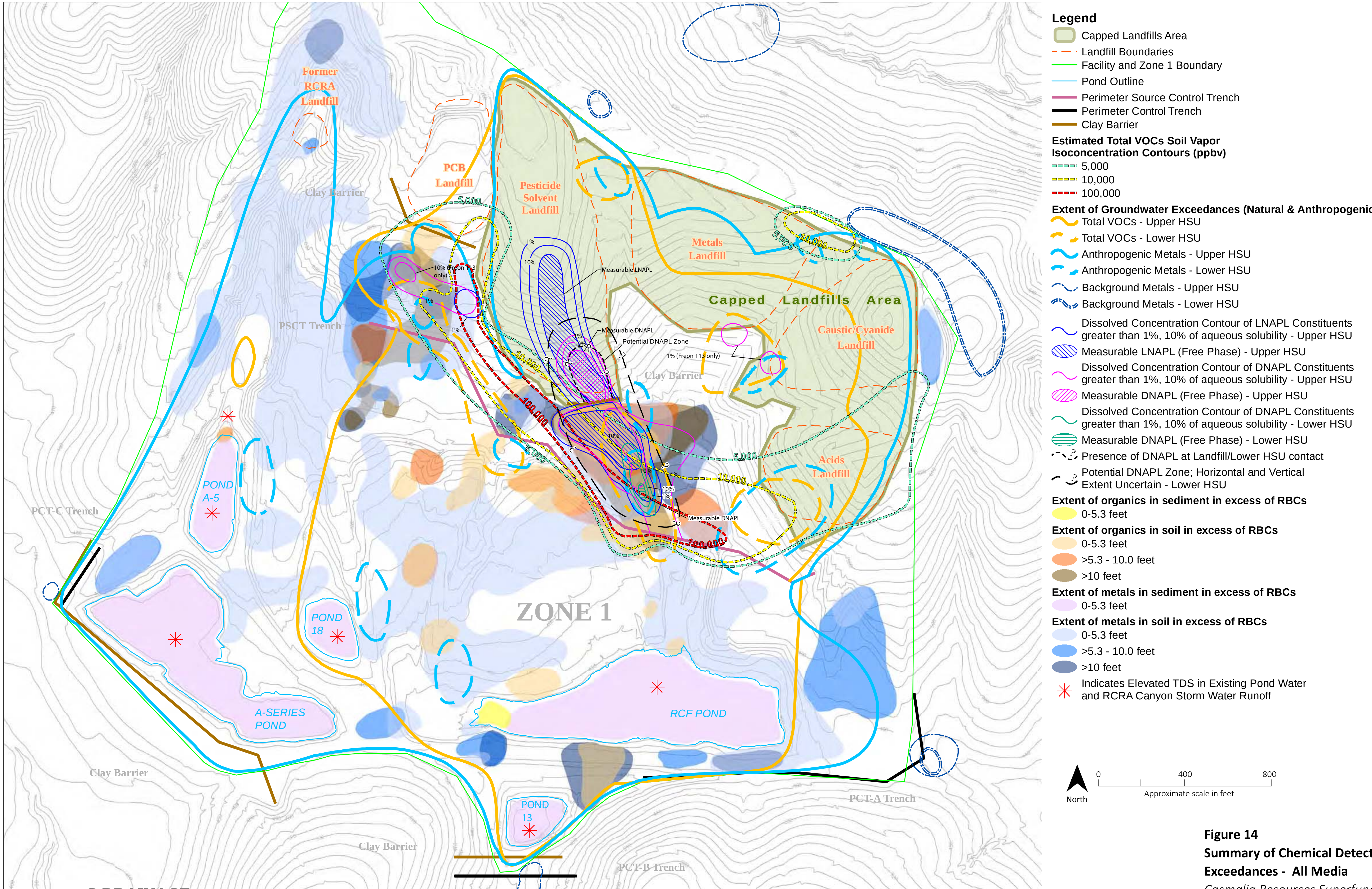


Figure 14
Summary of Chemical Detections and Exceedances - All Media
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

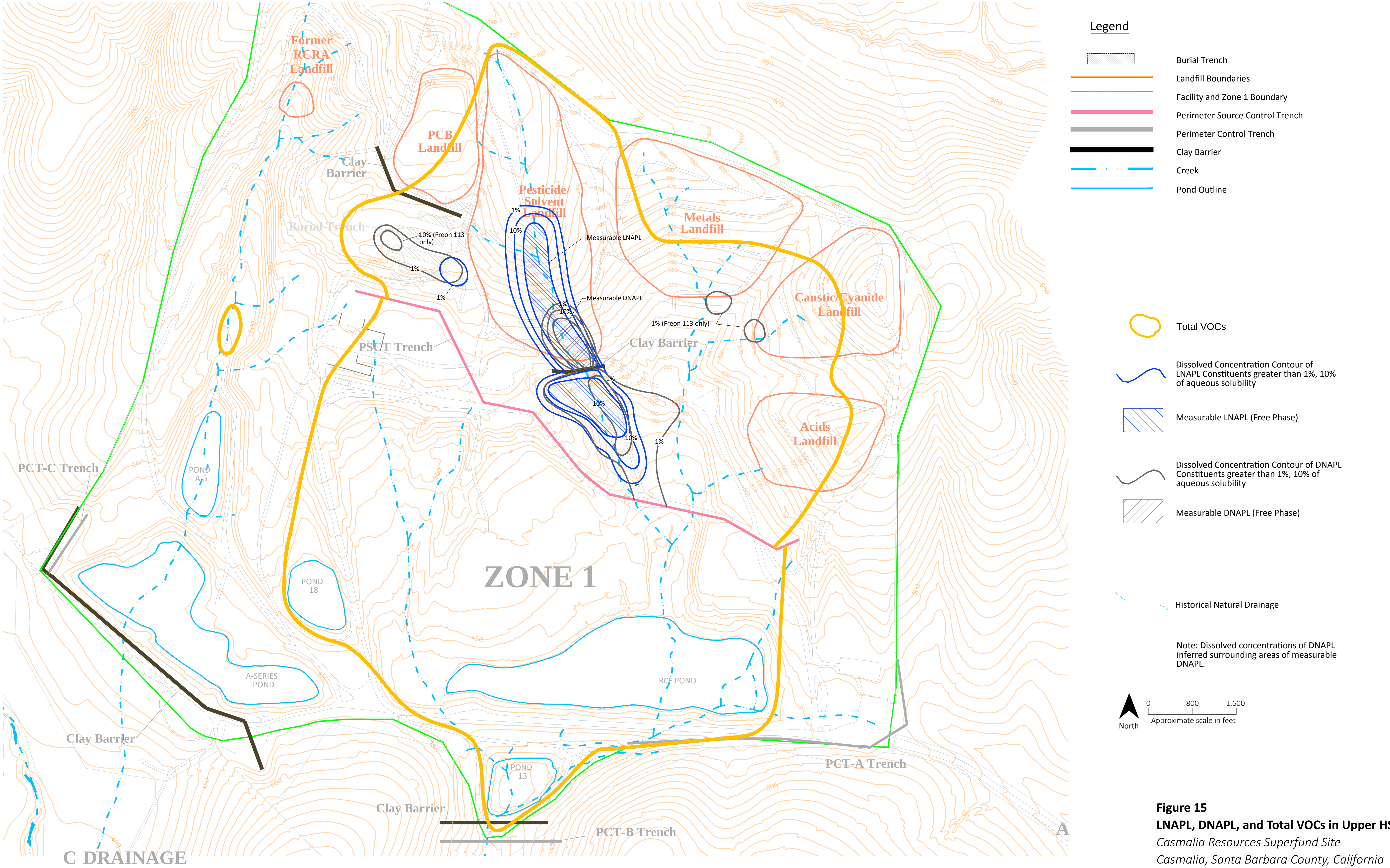


Figure 15
LNAPL, DNAPL, and Total VOCs in Upper HSU
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

EN1013161114SCO Figure_14_LNAPL_DNAPL_Total VOCs_Upper_HSU.ai

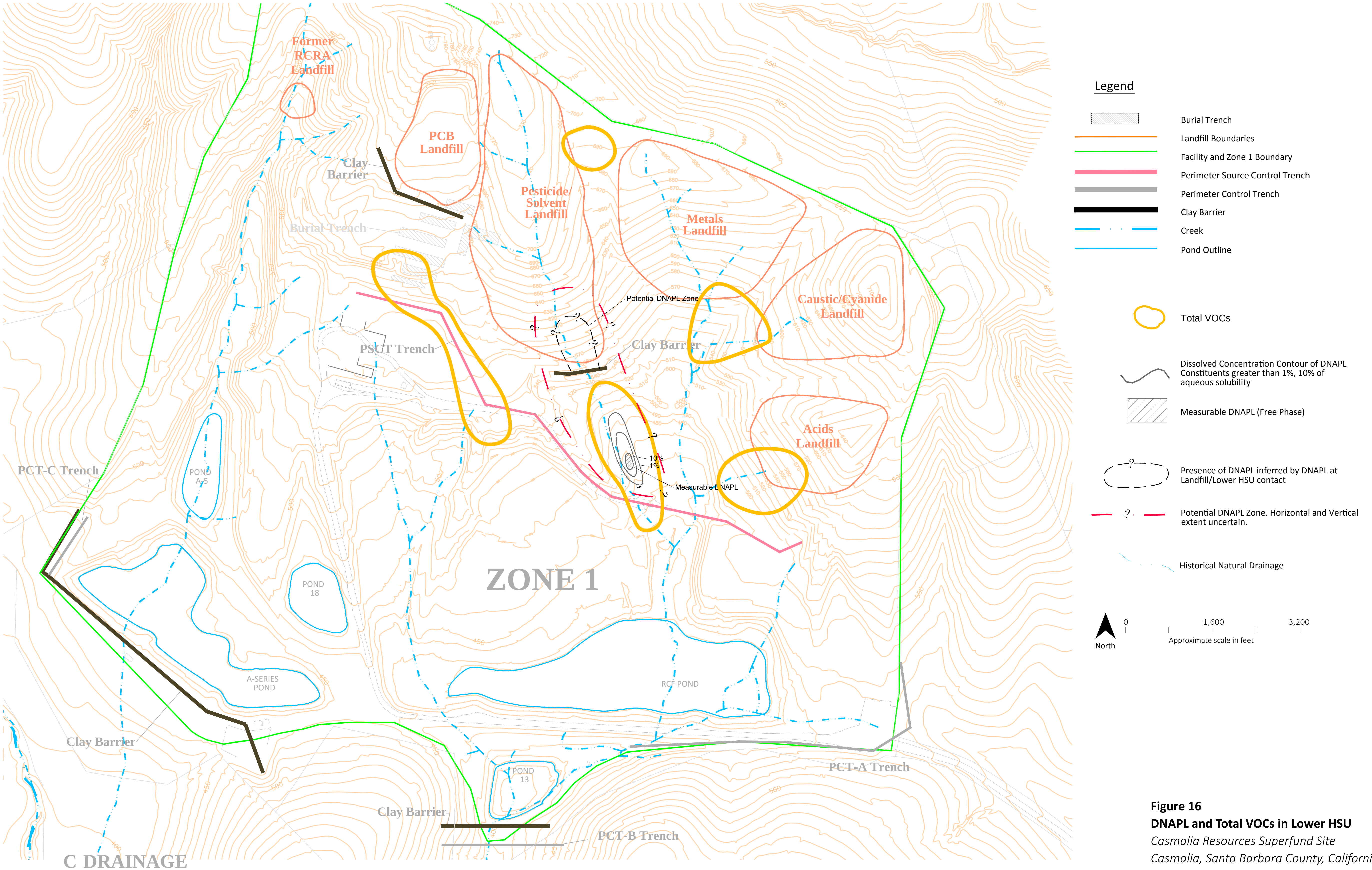
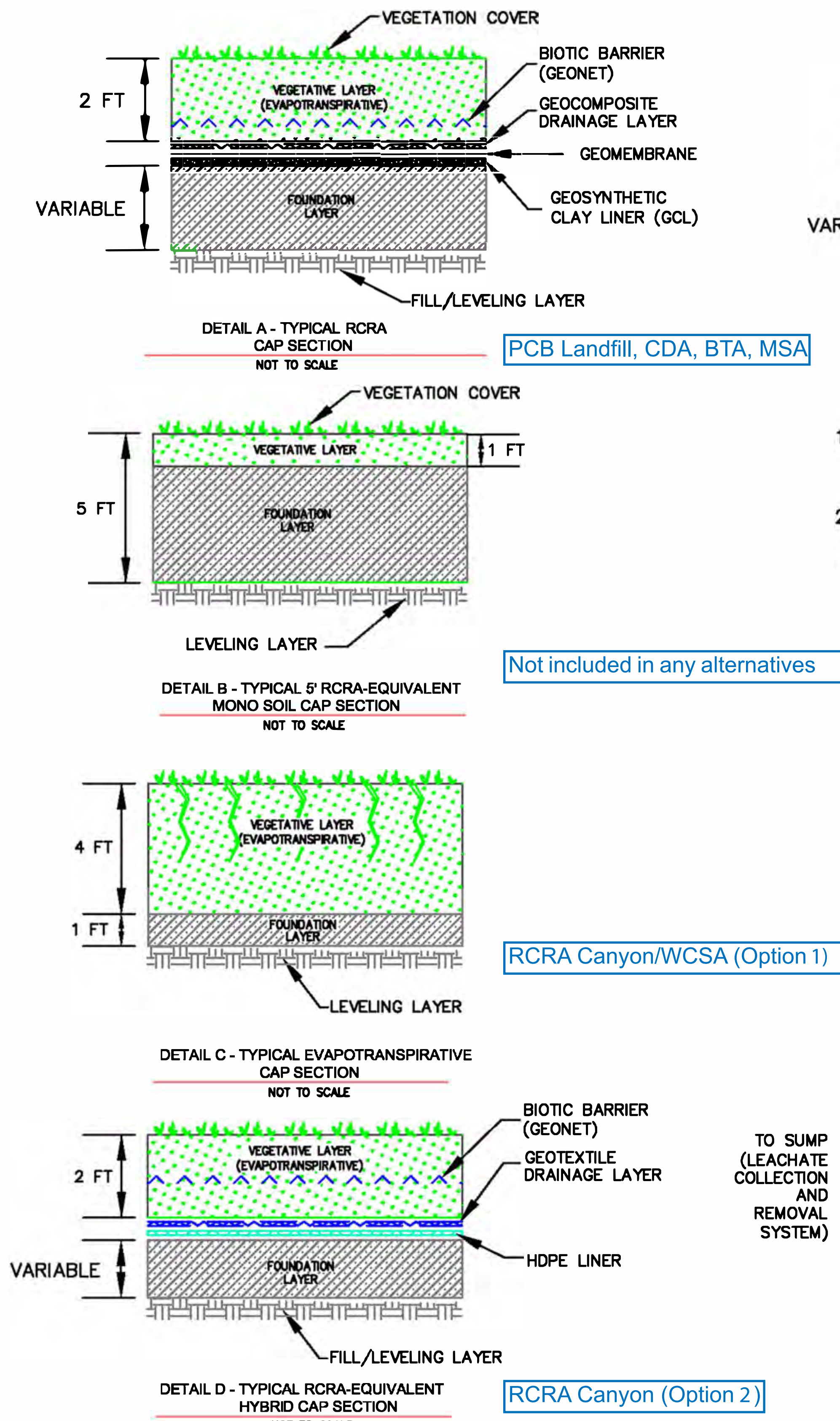
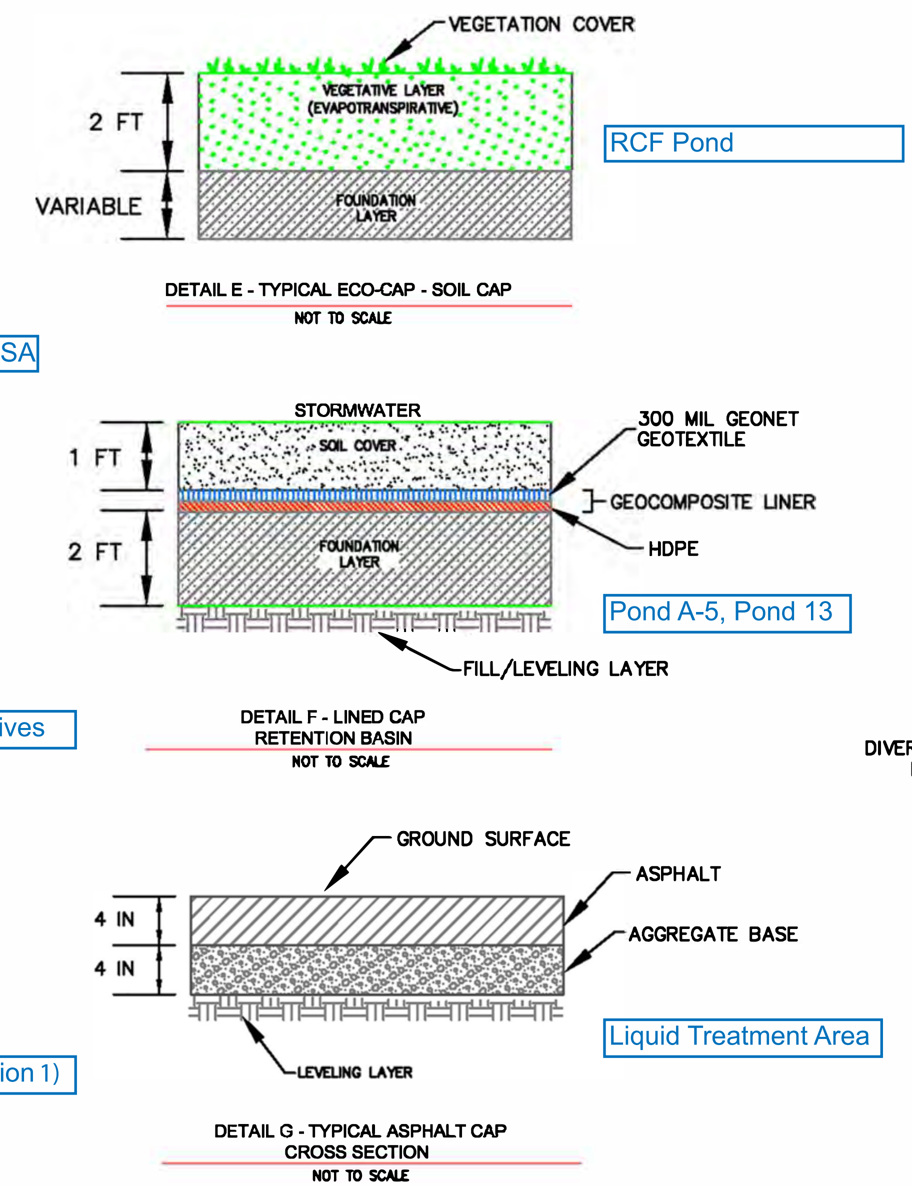


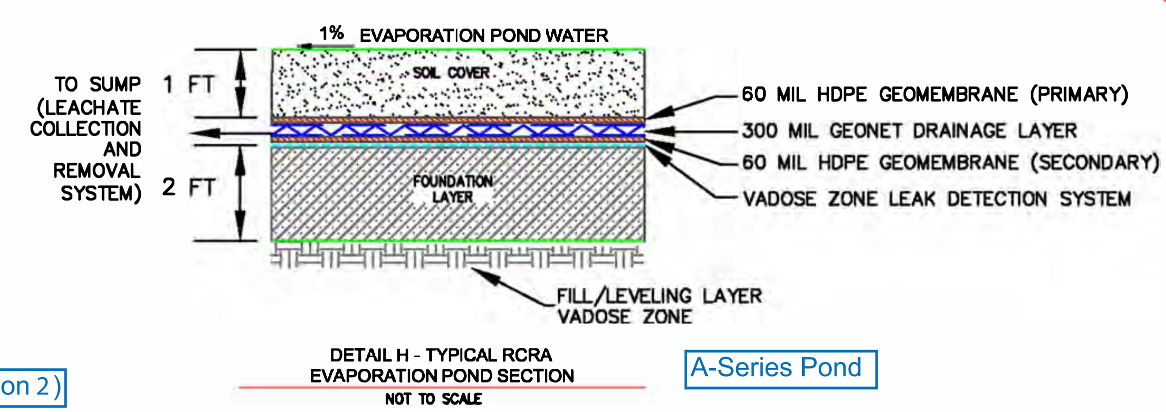
Figure 16
DNAPL and Total VOCs in Lower HSU
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

Source: Modified from Figure 5-8, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)

EN1013161114SCO Figure_15_DNAPL_and_Total_VOCs_in_Lower_HSU.ai 11/16







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).

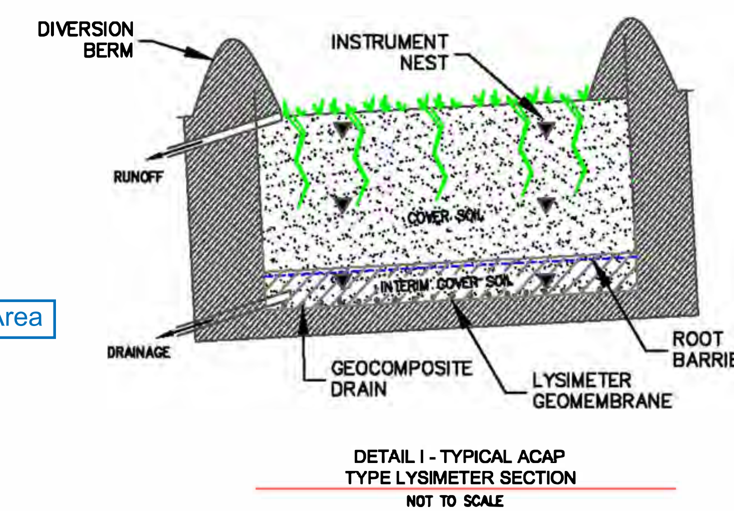


Figure 17
Caps Considered in Feasibility Study Alternatives
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

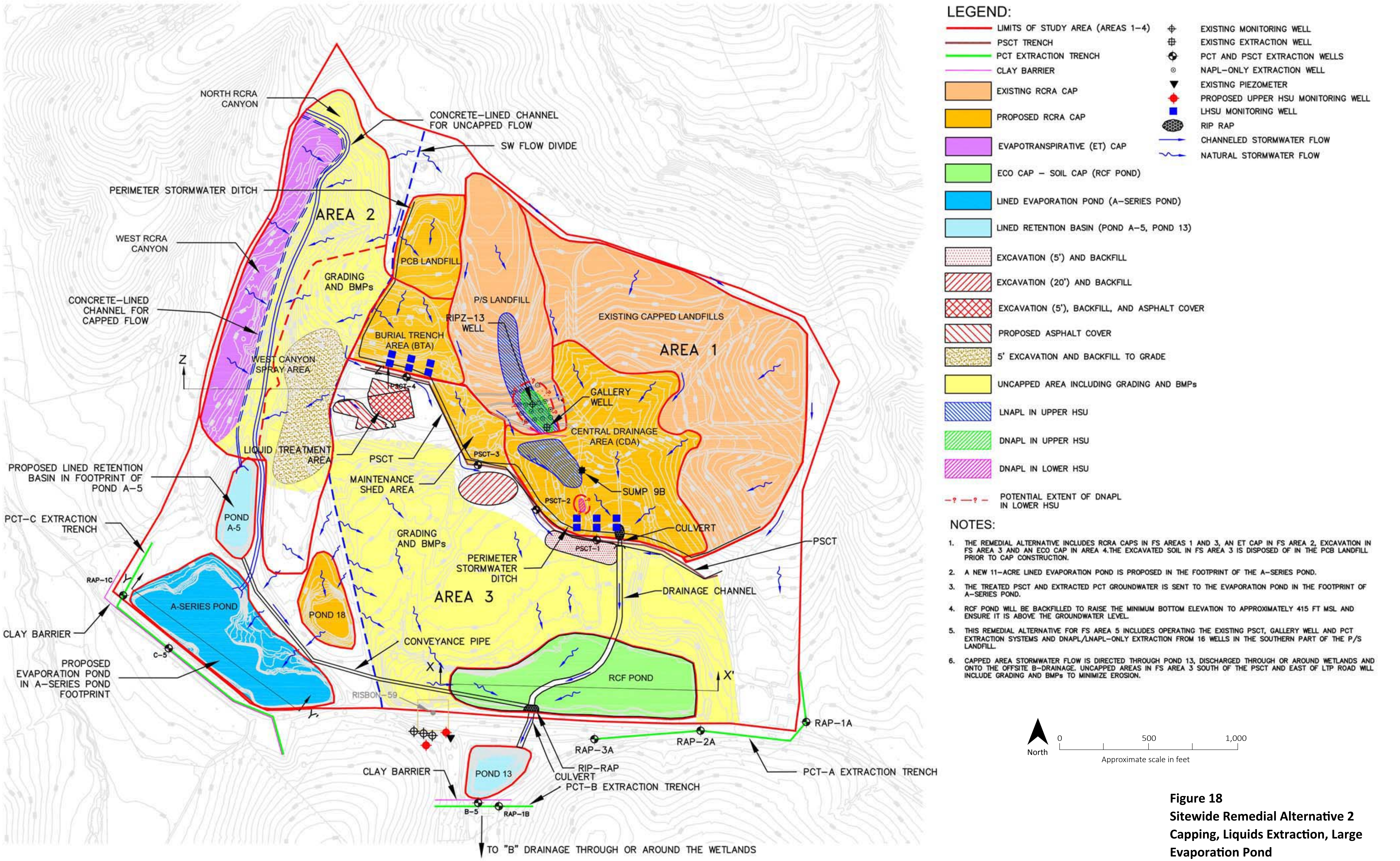
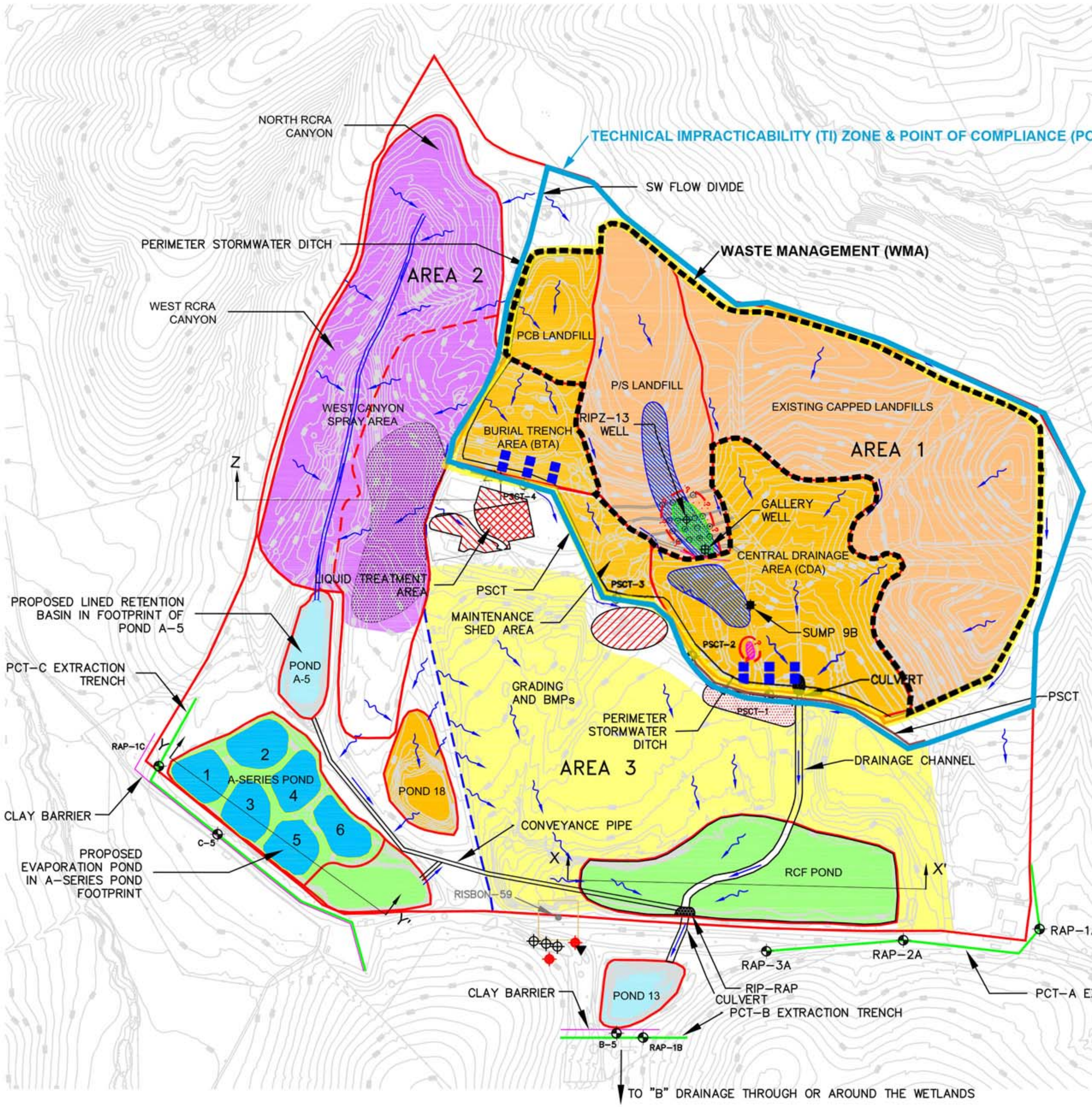


Figure 18
Sitewide Remedial Alternative 2
Capping, Liquids Extraction, Large Evaporation Pond
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

Source: Modified from Figure 12-1A, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



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
- 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

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.

Figure 19
Sitewide Remedial Alternative 3 (Preferred Alternative), Capping, Liquids Extraction, Small Evaporation Pond
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

Source: Modified from Figure 12-2A, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)

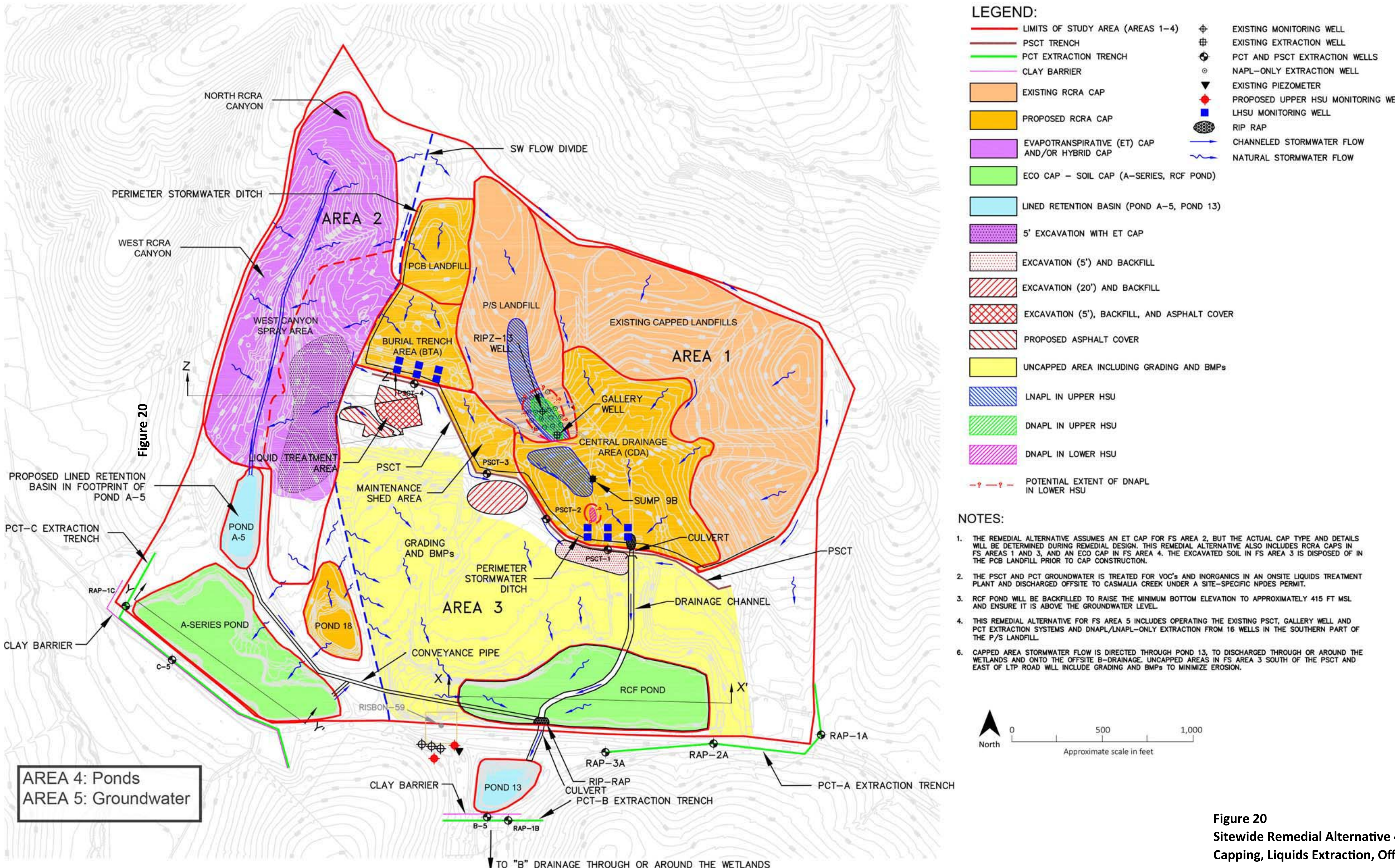
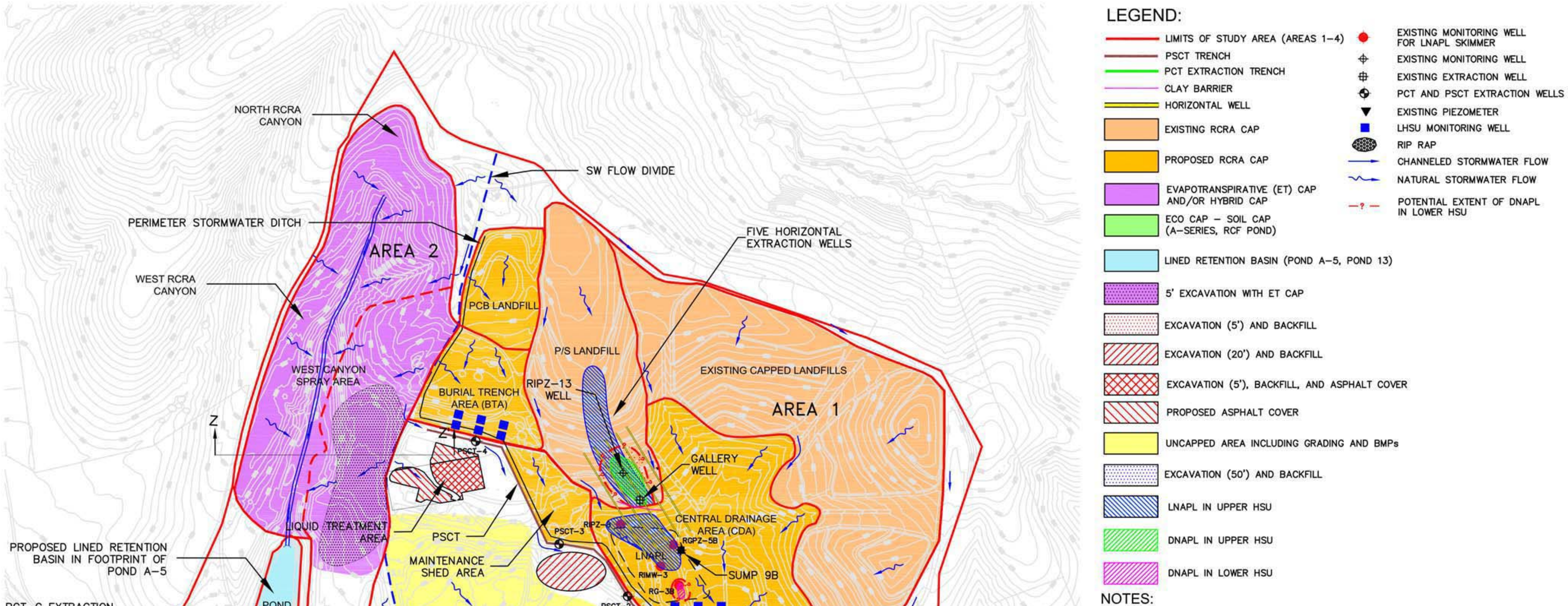


Figure 20
Sitewide Remedial Alternative 4
Capping, Liquids Extraction, Offsite Discharge
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

Source: Modified from Figure 12-3A, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



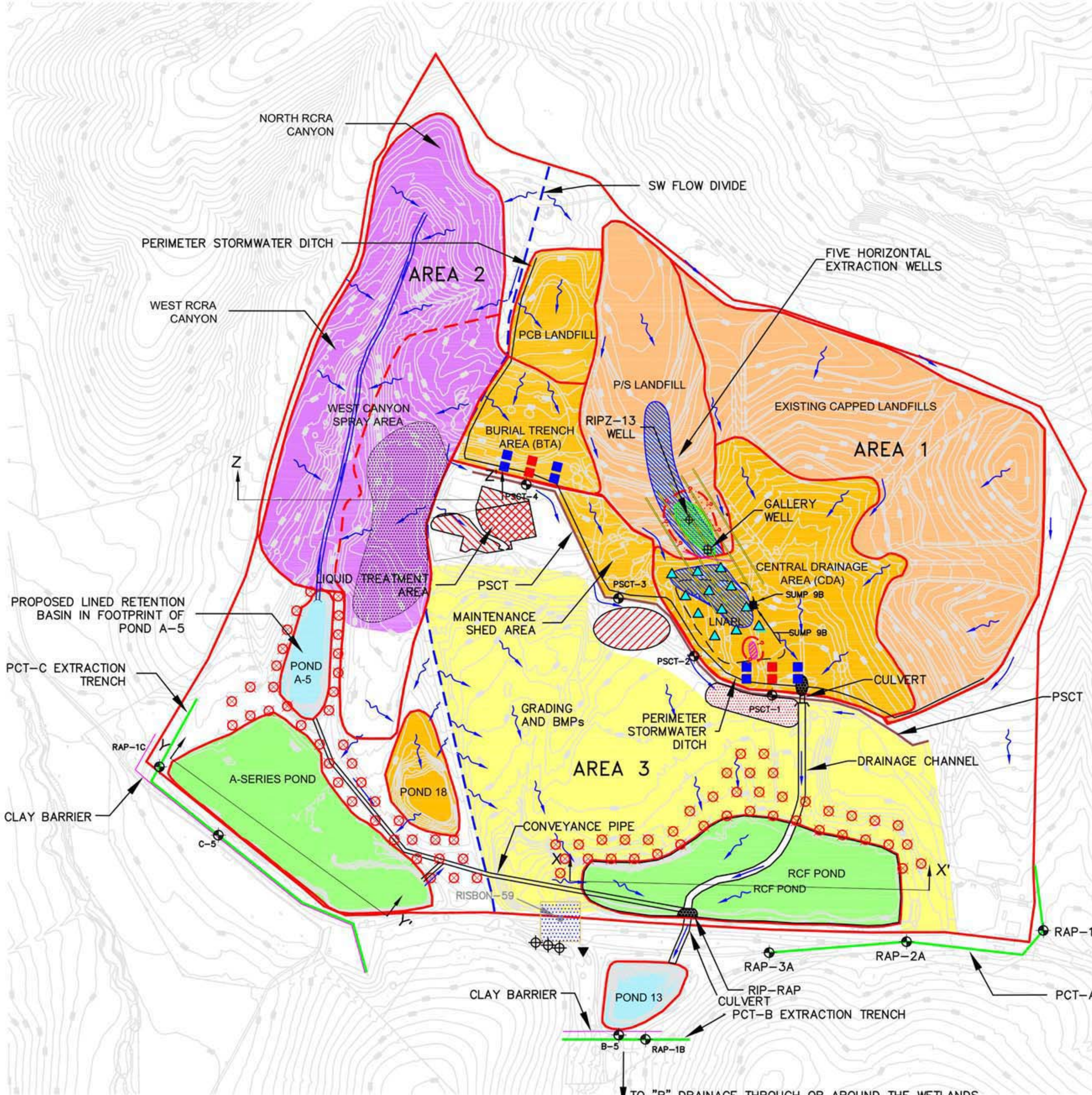
NOTES:

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 THOUGH 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.

North
0 500 1,000
Approximate scale in feet

Figure 21
Sitewide Remedial Alternative 5
Capping, Liquids Extraction, P/S Landfill Dewatering, Small Evaporation Pond
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

Source: Modified from Figure 12-4A, *Final Feasibility Study Report, Casmalia Resources Superfund Site*, Casmalia Steering Committee, February 15, 2016 (CSC, 2016)



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
- 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

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.

North

0 500 1,000

Approximate scale in feet

Figure 22
Sitewide Remedial Alternative 6
Capping, Liquids Extraction, P/S Landfill Dewatering, Groundwater Extraction, Offsite Discharge
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

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

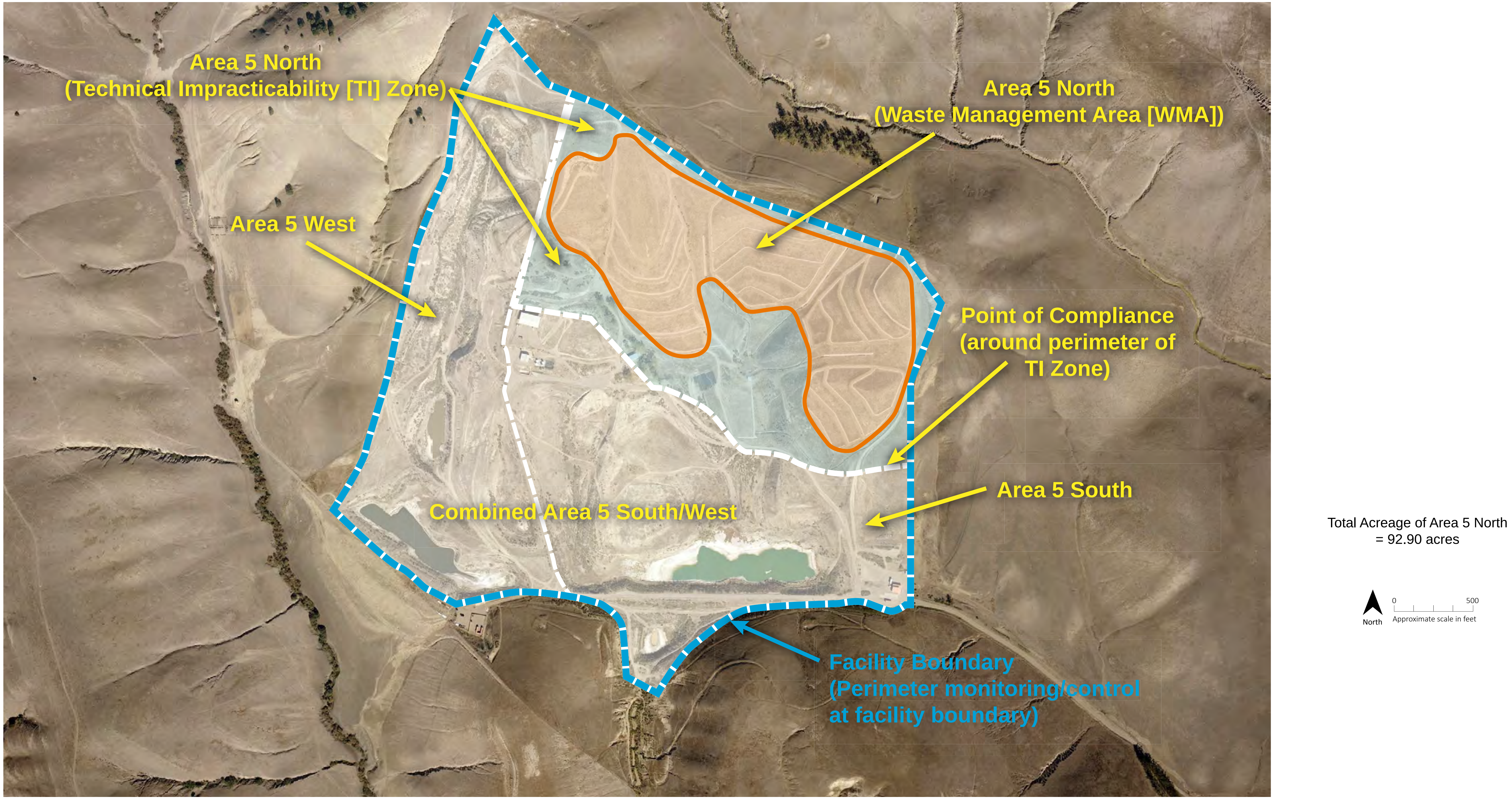


Figure 23
Location of Waste Management Area and Technical Impracticability Zone
Casmalia Resources Superfund Site
Casmalia, Santa Barbara County, California

Appendix A
Glossary

Appendix A – Glossary

Administrative Record: A file that is maintained and concerns all information used by the lead agency to make its decision on the selection of a response action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Applicable or Relevant and Appropriate Requirements (ARARs): ARARs are any promulgated standards, requirements, criteria, or limitations under federal environmental laws, or any promulgated standards, requirements, criteria, or limitations under state environmental or siting laws that are more stringent than federal requirements, that are either legally "applicable or relevant and appropriate" under the circumstances. Under CERCLA Section 121(d), a remedial action must comply with (or justify a waiver for) ARARs.

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 onsite that are harmful to plants or animals.

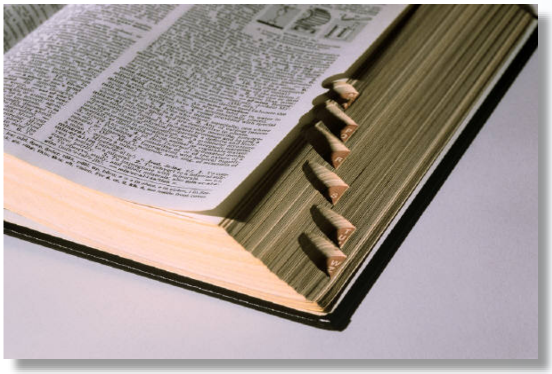
Chemical of Concern (COC): A hazardous substance or group of substances that pose unacceptable risk to human health or the environment at a site.

Chemical of Potential Concern (COPC): A hazardous substance or group of substances that are potentially site-related and were evaluated quantitatively in the risk assessment.

Hazardous Waste Management Facility: A waste management facility or landfill that received Resource Conservation and Recovery Act (RCRA) hazardous wastes.

Comment Period: A period during which the public can review and comment on various documents and U.S. Environmental Protection Agency (EPA) actions.

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA): A federal law, modified in 1986 by the Superfund Amendments and Reauthorization Act (SARA), and also known as "Superfund," which authorizes response actions to reduce the dangers associated with releases or threats of releases of hazardous substances that may endanger public health or the environment.



Consent Decree (CD): A legal document submitted by the Department of Justice on behalf of the EPA for approval by a federal judge to settle a case. A CD can be used to formalize an agreement reached between EPA and potentially responsible parties (PRPs) for cleanup at a Superfund site.

Contingency Measures. Contingency measures are additional actions, such as monitoring and focused extraction, that would be implemented if determined necessary by EPA in localized areas; for example, along or beyond area boundaries.

Dense Non-aqueous Phase Liquid (DNAPL): An immiscible phase hydrocarbon (non-aqueous phase liquid [NAPL]) with a density greater than water.

Engineering Controls: Engineering measures (caps, treatment systems, etc.) designed to minimize the potential for human or ecological exposure to contamination by either limiting direct contact with contaminated areas or controlling migration of contaminants through environmental media.

Feasibility Study (FS): A study of the applicability or practicability of a proposed action conducted after the remedial investigation (RI) to determine what alternatives or technologies could be applicable to clean up the site-specific chemicals of concern (COCs).

Hazard Index (HI): The sum of more than one hazard quotient (HQ) for multiple substances and/or multiple exposure pathways. The HI is calculated separately for chronic, subchronic, and shorter-duration exposures. An HI may be used to evaluate the risk for multiple non-carcinogenic hazardous substances with similar modes of toxic action.

Hazard Quotient (HQ): A method to summarize the relative level of risk for a single non-carcinogenic hazardous substance that is based on the ratio of an exposure over a specified time period to a reference dose.

Information Repository: A physical location where the public can go to view current information, technical reports, and reference documents regarding CERCLA sites.

Institutional Controls (ICs): Non-engineered measures that may be selected as remedial or response actions either by themselves or in combination with engineered remedies, such as administrative and legal controls that minimize the potential for exposure to contamination by limiting land or resource use.

Light Non-aqueous Phase Liquid (LNAPL): An immiscible phase hydrocarbon (NAPL) with a density less than water.

Low-level threat wastes (LLTWs): Waste materials that generally can be reliably contained and present lower potential risk than Principal Threat Wastes (PTWs). They include source materials that exhibit low toxicity, have low mobility in the environment, or are near health-based levels.

Matrix Diffusion: The movement of solutes in groundwater from the main fracture conduits into the rock matrix due to a concentration gradient.

Monitored Natural Attenuation (MNA): A passive in situ groundwater treatment through physical, chemical, or biological processes. MNA relies on natural attenuation processes to reduce contaminant concentrations. 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.

National Oil and Hazardous Substances Pollution Contingency Plan (NCP): The federal regulation that guides the CERCLA program.

National Priorities List (NPL): EPA's list of the most serious hazardous waste sites identified for possible long-term remedial response.

Non-aqueous Phase Liquid (NAPL): Hydrocarbons that exist as a separate, immiscible phase when in contact with water and/or air.

Point of Compliance (POC). The POC is the point at which both the groundwater protection standard must be met and monitoring must be conducted. The POC is defined as a vertical surface located at the hydraulically downgradient limit of the designated area that extends into the aquifer underlying the designated area.

Potentially Responsible Party (PRP): A current or former owner or operator of a facility at a time when hazardous substances were disposed.

Preferred Alternative: The remedial alternative selected by EPA following completion of the remedial investigation/feasibility study (RI/FS) process. The Preferred Alternative is described in the Proposed Plan along with other remedial alternatives under consideration.

Preliminary Remediation Goal (PRG): Contaminant concentrations that are developed during an RI/FS. They are based on ARARs and other information whenever ARARs are not adequately protective of all receptors at a site, such as concentrations associated with the 1 in 1,000,000 cancer risk or a hazard quotient (HQ) equal to 1 for non-carcinogens calculated from EPA toxicity information.

Principal Threat Waste (PTW): A source of hazardous substances that is highly toxic or highly mobile, such as pools of NAPL, and that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur.

Proposed Plan: A Superfund public participation document and/or fact sheet that summarizes the preferred cleanup strategy for a Superfund Site.

Record of Decision (ROD): A legal, technical, and public document that identifies the selected remedy at a Superfund site.

Remedial Action: The actual construction or implementation phase that follows the remedial design of the selected cleanup alternative at a site on the NPL.

Remedial Action Objective (RAO): An objective that describes what the proposed cleanup is expected to accomplish to protect human health and the environment.

Remedial Design: An engineering phase that follows the ROD when technical drawings and specifications are developed for the subsequent remedial action at a site on the NPL.

Resource Conservation and Recovery Act (RCRA): A federal law that established a regulatory system to track hazardous substances from the time of generation to disposal. RCRA also provides rules for the proper handling, storage, transportation, treatment, and disposal of hazardous wastes.

Responsiveness Summary: A summary of oral and written public comments received during a Comment Period on key EPA documents, and responses to those comments. The responsiveness summary is a key part of the ROD, highlighting community concerns for EPA decision makers.

Superfund: The common name used for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Technical Impracticability (TI). TI refers to an ARAR waiver authorized under CERCLA. The TI waiver is used when an ARAR specified in a ROD cannot be met because achieving the ARAR is technically impracticable from an engineering perspective. The TI waiver can be used to waive meeting groundwater restoration ARARs such as maximum contaminant levels (MCLs) and non-zero MCL goals. Use of the term "engineering perspective" implies that a TI determination should primarily focus on the technical capability of achieving the cleanup level, with cost playing a subordinate role. In accordance with EPA guidance (*Guidance for Evaluating Technical Impracticability of Ground-Water Restoration,* September 1993), a TI waiver is based on a detailed evaluation of site-specific conditions, and applies solely to a region of groundwater defined as the Tl Zone.

Toxicity Equivalent (TEQ): A single value used to express the joint toxicity of a mixture of compounds with a similar toxic action.

Waste Management Area (WMA). For facilities that contain more than one regulated hazardous waste management unit, the WMA is described by an imaginary line circumscribing all of the regulated units (40 Code of Federal Regulations, Section 264.95[b][2]).