SDMS DOCID# 1128589

EPA Superfund
Record of Decision Amendment

PACIFIC COAST PIPELINE
EPA ID: CAD980636781
FILLMORE, CA

September 2011

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List of Acronyms and Abbreviations

10^{-6}	0.000001
1,2-DCA	1,2-dichloroethane
$\mu g/m^3$	microgram per cubic meter
µg/dL	microgram per deciliter
µg/L	microgram per liter (equivalent to parts per billion, ppb)
^{12}C	carbon isotope with 12 neutrons
^{2}H	hydrogen isotope with two neutrons
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
CAMU	corrective action management unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CHHSL	California Human Health Screening Level
CNDDB	California Natural Diversity Database
COC	chemical of concern
COPC	chemical of potential concern
COPEC	chemical of potential ecological concern
CSM	conceptual site model
CURB	city urban restriction boundary
DTSC	Department of Toxic Substances Control
EPC	exposure point concentration
ESL	ecological screening levels
GW	groundwater
GWN	groundwater northern plume
GWS	groundwater southern plume
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IC	institutional control
IUR	inhalation unit risk
LNAPL	light non-aqueous phase liquid
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
NCP	National Contingency Plan
O&M	operation and maintenance
PAHs	polycyclic aromatic hydrocarbons
PCPL	Pacific Coast Pipeline
RAO	remedial action objective
RfC	reference concentration

RfD	reference dose
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
RSL	Regional Screening Level
RWQCB	Regional Water Quality Control Board
SLERA	screening level ecological risk assessment
SVE	soil vapor extraction
TPH	total petroleum hydrocarbons
UCL	upper confidence limit
VOC	volatile organic compound

PART I: THE DECLARATION

1.0 Site Name and Location

Pacific Coast Pipeline Superfund Site
67 East Telegraph Road
Fillmore, Ventura County, California
EPA ID No. CAD980636781

The Pacific Coast Pipeline (PCPL) Superfund Site is located just east of the City of Fillmore in Ventura County, California. It is at 67 East Telegraph Road, north of State Highway 126 and east of Pole Creek.

2.0 Statement of Basis and Purpose

The United States Environmental Protection Agency (EPA) is amending the March 31, 1992, Record of Decision (ROD) groundwater remedy that was selected for the Pacific Coast Pipeline Superfund Site (PCPL Site, the Site).

The 1992 ROD selected groundwater extraction and treatment as the remedy for the contaminated groundwater and soil vapor extraction for the contaminated vadose zone. The ROD did not address soil contamination. The original remedy was successful in reducing groundwater contaminant concentrations by 90%; however two plumes of volatile organic compounds (VOCs) remain above the cleanup level established in the 1992 ROD. This decision document presents the final remedy for addressing the remaining groundwater contamination and the shallow soil contamination at the Site.

This response action has been chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This ROD Amendment is based on the Administrative Record file for the PCPL Site. The State of California, acting through the Department of Toxic Substances Control (DTSC), concurs with the selected remedy.

3.0 Assessment of Site

The response actions selected in this ROD Amendment are necessary to protect the public health or welfare and the environment from actual or threatened releases of hazardous substances into the environment.

4.0 Description of Selected Remedy

This remedy is expected to be the final remedy for the PCPL Site. The remedial actions address both groundwater and soil contamination. The selected remedy is:

- Groundwater Southern Plume: Alternative GWS-5, Multiple Technologies
- Groundwater Northern Plume: Alternative GWN-2, Monitored Natural Attenuation

- Soil: Alternative S-3, Excavation and On-Site Disposal with Cap

The components of these alternatives are described in more detail in Section 9.0, Description of Alternatives and Section 12.0, Selected Remedy. Briefly, the major components of the groundwater southern plume remedy are air sparging, followed by enhanced bioremediation with sulfate, followed by monitored natural attenuation (MNA). The major component of the groundwater northern plume remedy is MNA. The major components of the soil remedy are excavation of contaminated soil, disposal in an on-site pit, and a cap. There will be institutional controls (ICs) to restrict future property use to commercial and/or recreational purposes, to limit actions that could interfere with the remedy (i.e., the cap), and to prevent groundwater use until the groundwater cleanup levels are achieved.

5.0 Statutory Determination

This remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. The remedial action for the southern plume groundwater satisfies the statutory preference for treatment as a principal element of the remedy. The light non-aqueous phase liquid (LNAPL) in the southern plume contains benzene and toluene and is considered to be a "principal threat waste", which is a waste that is 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 remedial actions for the northern plume groundwater and soil do not meet the statutory preference for treatment. The contaminants in the northern plume and the soil are not principal threat wastes, as they are not source material and are not highly toxic or mobile, and treatment of the contaminants in these two areas is impracticable.

Because this remedy will result in waste remaining on the PCPL property above levels that allow for unlimited use and unrestricted exposure, a review will be conducted every five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment. Land use and groundwater restrictions are necessary to prevent exposure to hazardous substances in soil and groundwater both during and after remedy implementation.

6.0 ROD Data Certification Checklist

The following information is included in the Decision Summary section of this ROD Amendment. Additional information can be found in the Administrative Record for this Site.

· Chemicals of concern and their respective concentrations - Groundwater, Section 5.4; Soil, Section 5.6

· Baseline risk represented by the chemicals of concern - Section 7

· Cleanup levels established for chemicals of concern and the bases for these levels - Section 8.2

· How source materials constituting principal threats are addressed - Section 11

· Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and this ROD Amendment - Section 6

· Potential land and groundwater use that will be available at the Site as a result of the Selected Remedy - Section 13.1

· Estimated capital, annual operation and maintenance, and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected - Table 9-1

· Key factors that led to selecting the remedy - Section 12.1

7.0 Authorizing Signature

This ROD Amendment documents the selected remedy for contamination at the PCPL Site. This remedy was selected by the EPA with the concurrence of the California Department of Toxic Substances Control. The Assistant Director of the Superfund Division, Region 9, has been delegated the authority to approve this ROD Amendment.

By: ______________________ Date: Sept. 29, 2011

Michael M. Montgomery
Assistant Director, Superfund Division

PART II: THE DECISION SUMMARY

This Decision Summary provides a description of the Site and the analyses that led to the selection of the remedy for the Site. It includes background information about the Site, the nature and extent of contamination found at the Site, the assessment of human health and environmental risks posed by the contaminants at the Site, and the identification and evaluation of remedial action alternatives for the Site.

1.0 Site Name, Location, and Description

The PCPL Site is located just east of the City of Fillmore, Ventura County, California. It is north of the Santa Clara River and Hwy 126 and east of Pole Creek (Figure 1-1). The area is a mix of residences, businesses, and agricultural land. The Site is approximately 55 acres and relatively flat, sloping downhill toward Hwy 126. Most of the property has been graded to bare soil and is largely devoid of vegetation. The east portion of the Site is a very steep upward sloping hill that has some native vegetation and shrub habitat. In the hills east of the Site is an avocado orchard, a satellite company, and open space. West of the Site is Pole Creek, a concrete, channelized creek that empties into the Santa Clara River. Further west is a residential area and San Cayetano Elementary School.

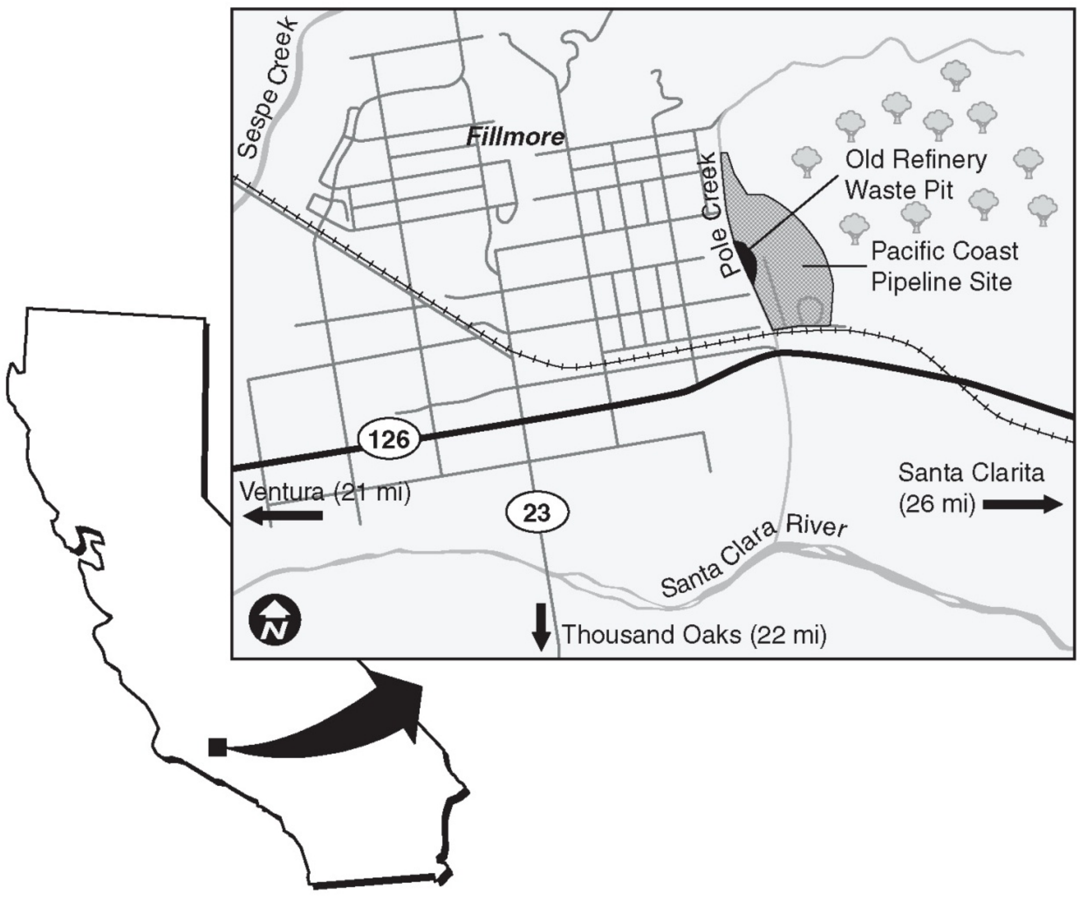
The property, previously owned by Texaco and currently owned by Chevron, was formerly an oil refinery and crude oil pumping station. All of the refinery structures have been removed and the property is empty except for a trailer that serves as an office for the cleanup work. Access to the Site is controlled by a chain-link fence and a locked gate.

The Chevron property contains contaminated soil and two groundwater plumes that extend to the west. Contaminated groundwater extends beyond the property under residential housing (Figure 1-2). The nearest residence is approximately 125 feet west of the property boundary.

2.0 Site History and Enforcement Activities

2.1 Site Operational History

A petroleum refinery operated at the Site from 1915 until 1950 (Figure 2-1). Texaco acquired the existing refinery in 1928 and continued to operate it until 1950, at which time it was dismantled, with only aboveground storage tanks remaining. The property was converted to a crude oil pumping station in 1952. Pumping station operations discontinued in 2002 and the remaining facilities were removed. The primary products of the refinery were gasoline, diesel, and fuel oil. Some of the process units were a hydrogen sulfide fractionator, various stills for refining petroleum, agitators, and a depropanizer. Refinery wastes were disposed of on-site in a large main waste pit located along the western boundary of the refinery property and in eight smaller unlined sumps and pits distributed throughout the property.



Pacific Coast Pipeline Superfund Site

Figure 1-1
Pacific Coast Pipeline Site Location

Figure 1-2
Benzene Plumes, 2011

Pacific Coast Pipeline Superfund Site

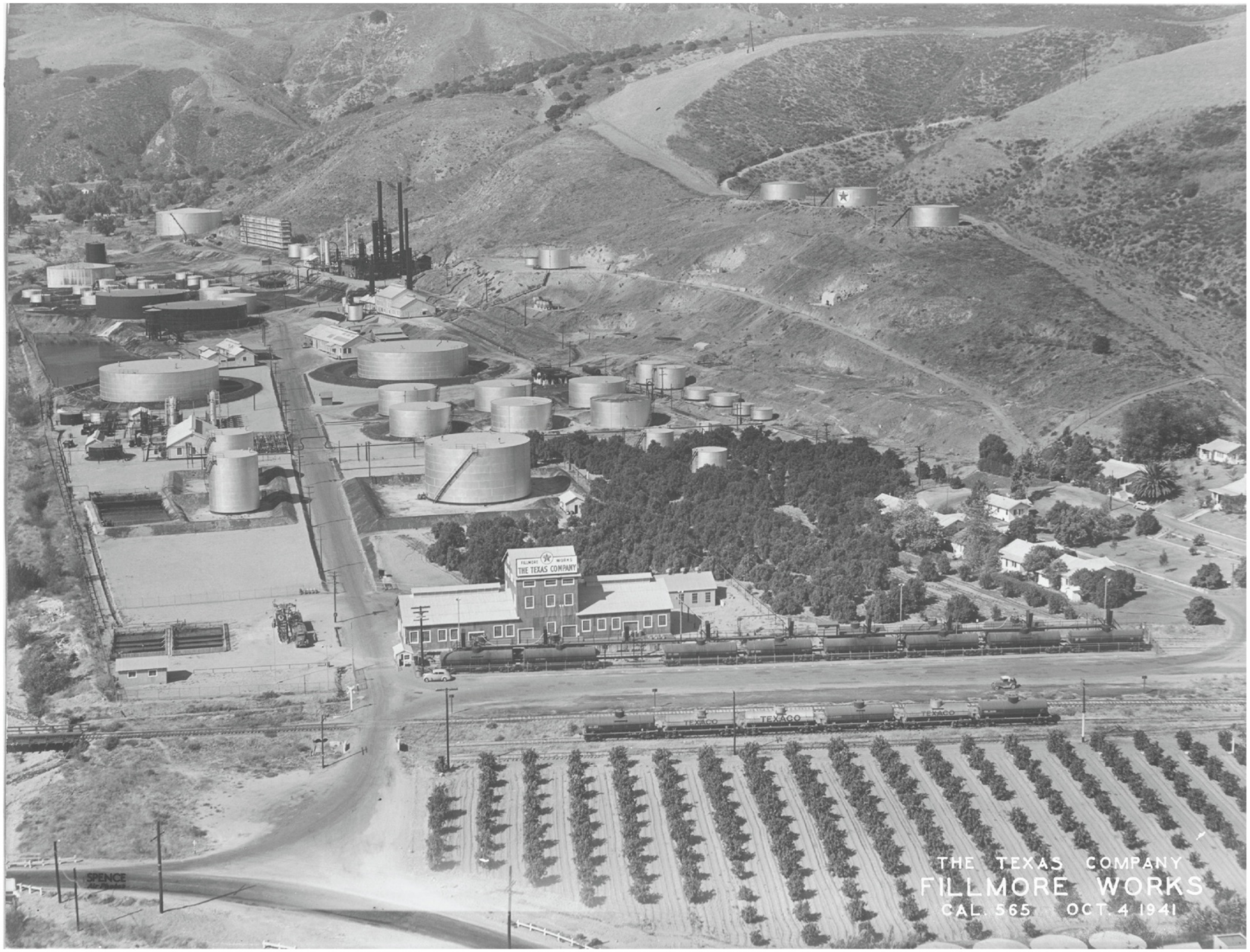


Figure 2-1
Historical Refinery Photo, 1941

2.2 Previous Remedial and Enforcement Activities

The first cleanup activities began at the PCPL Site in 1980. The Regional Water Quality Control Board (RWQCB), Los Angeles Region, directed Texaco to investigate the groundwater at the Site. More investigations followed, with oversight by both the California Department of Health Services (DHS) and EPA. Due to a suite of hazardous petroleum chemicals (benzene, toluene and ethylbenzene and xylenes, referred to as BTEX) in the groundwater, EPA placed the Site on the National Priorities List in 1989.

EPA issued a ROD in 1992 for the groundwater; the selected remedy was groundwater pump and treat and soil vapor extraction (SVE) for the two distinct plumes of contamination. The chemicals of concern (COCs) in groundwater, those chemicals that needed to be addressed by the cleanup action, were benzene, toluene, ethylbenzene, and 1,2-DCA. The cleanup levels for these contaminants were California drinking water standards, also referred to as maximum contaminant levels, or MCLs (Table 2-1, 1992 ROD Chemicals of Concern). The goal of the SVE system was to capture BTEX in the vadose zone before it made its way into the groundwater.

Table 2-1: 1992 ROD Chemicals of Concern

Chemical	Maximum Detected (1983)	Cleanup standard µg/L
benzene	5,600	1
toluene	560	100
ethylbenzene	650	680
1,2-DCA	9	0.5

The treatment systems reached the limits of their effectiveness in 2002 and were shut off. The only chemicals remaining in groundwater above their MCLs were benzene and toluene in the southern plume and benzene in the northern plume. Monitoring indicated no rebound in contaminant concentrations. Groundwater monitoring has continued to the present. The footprint of both plumes has remained stable, with concentrations in the northern plume continuing to decline and concentrations in the southern plume holding steady (Figure 2-2, Historical Benzene Concentrations). A summary of remedial and enforcement activities is presented in Table 2-2.

Table 2-2: Remedial and Enforcement Activities

Sponsor (Year)	Scope of Activity	Key Findings
LA RWQCB (1980)	Groundwater (GW) investigation	GW discovered to be contaminated with BTEX, PAHs
Texaco (1983-1989)	GW and soil investigation	Hazardous levels of lead, BTEX in waste pit; first monitoring well network installed
Texaco (1986)	Excavation and disposal of 33,000 cubic yards of waste and contaminated soil from main waste pit and other waste disposal areas	Removed primary sources of GW contamination; pit contaminants primarily lead, BTEX, TPH
EPA (1989)	Site placed on National Priorities List	
EPA, Texaco (1989)	Administrative Order on Consent for RI/FS	
EPA, Texaco (1990 - 1992)	Conducted RI/FS	Focus was on GW. Detected two plumes with significant levels of BTEX and TPH;

Sponsor (Year)	Scope of Activity	Key Findings
		up to 5,800 µg/L benzene. Also BTEX in vadose zone below former waste pits
EPA (1992)	ROD issued	Selected remedy is GW pump & treat and SVE
EPA, Texaco (1993)	Consent Decree for Remedial Design/Remedial Action	
Texaco (1993)	Installed GW pump & treat system	3 extraction wells at 5 to 20 gpm, clean water discharged to Pole Creek
Texaco (1994)	Installed Phase 1 SVE system	82,000 lbs. TPH and 520 lbs. benzene removed in first year of operation
Texaco (1995)	Installed Phase 2 SVE, GW system upgrade	Completion of treatment system, increased capacity of GW treatment system
EPA (1996)	Issued Preliminary Close-Out Report	Site achieved construction complete status
Texaco (1997-1998)	Upgrade of monitoring well network	Installation of two new wells in higher concentration area, abandonment of damaged wells
EPA (2001)	Conducted first five-year review	Treatment systems operating as designed, biodegradation occurring at edges of plumes
Texaco (2002)	SVE system and GWTS shut off	SVE monitoring, no rebound above shut-off criteria. Total of 2,191 pounds of benzene and 1,387,229 pounds of TPH removed. GW plume not spreading. Remaining COCs were benzene (510 µg/L) and toluene (180 µg/L)
Texaco (2002 - 2003)	Oxygen Release Compound pilot study	ORC injection not effective in reducing benzene in GW
EPA (2006)	Second five-year review report	Potential for soil vapor intrusion needs to be evaluated; ROD needs amending to address contaminated GW and future Site use
Chevron (2006 - 2009)	Phase 1, 2, and 3 soil sampling, shallow soil (0 to 10 ft bgs)	Widespread contamination of lead and PAHs, determined to be low level threat waste
Chevron (2007)	Soil vapor intrusion and natural attenuation study	Natural attenuation is occurring in GW and vadose zone directly above GW plumes; soil vapor intrusion does not present a health risk to residents
EPA, Texaco (2009)	Administrative Order for Focused RI/FS	
Chevron (2011)	Final Focused RI/ FS	Lead and PAHs in soil present risk to human health and environment; current ROD remedy will not clean up GW contamination in southern plume
EPA (2011)	Proposed Plan	Three remedial actions proposed for the Site: soil excavation and on-site disposal; multiple technologies for southern plume; MNA for northern plume

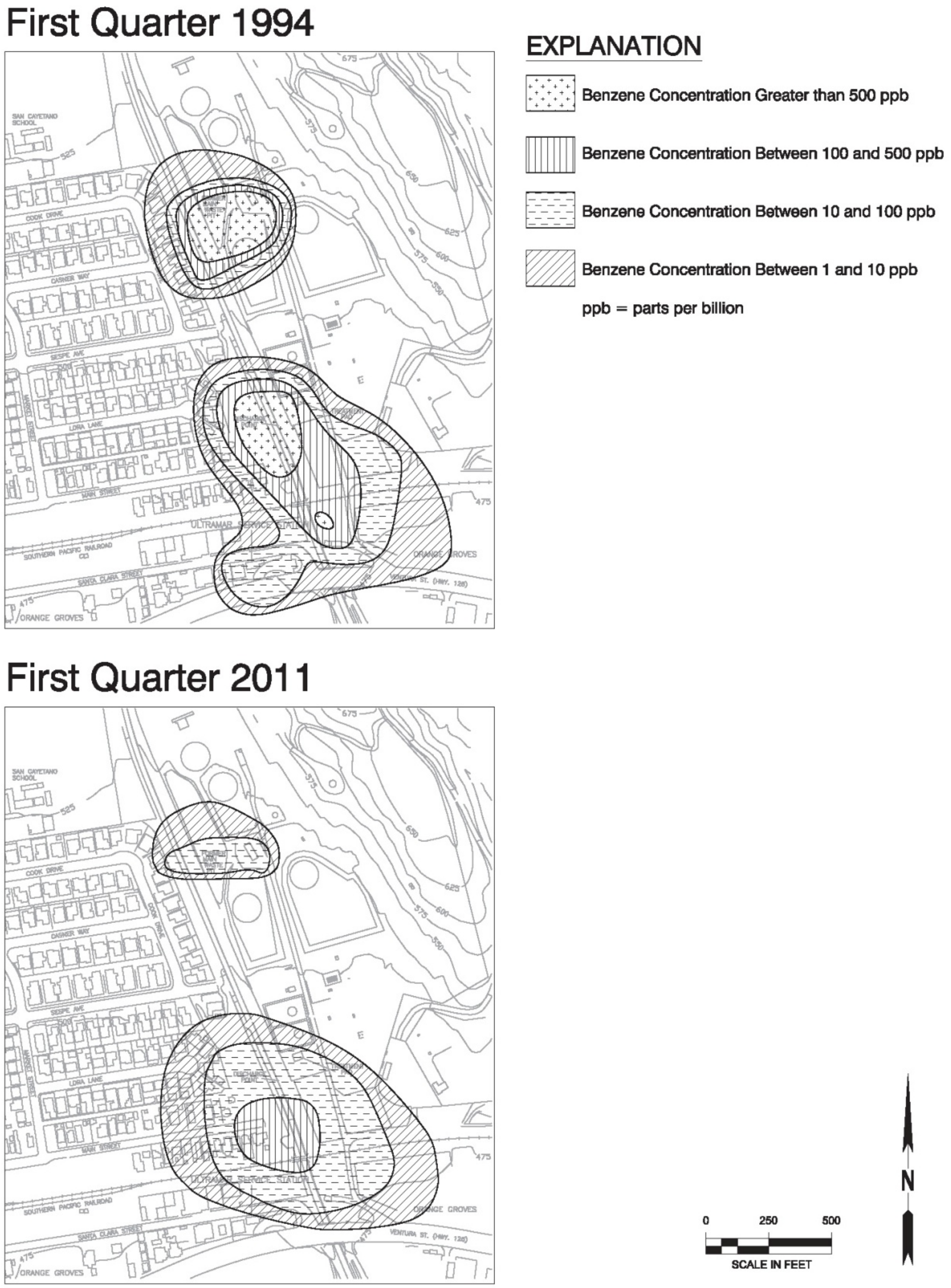


Figure 2-2
Historical Benzene Concentrations

Pacific Coast Pipeline Superfund Site

3.0 Community Participation

Public participation activities prior to the issuance of this ROD Amendment included community interviews in September 2009 for the preparation of a Community Involvement Plan, distribution of a fact sheet in November 2010, and meetings with community members in April 2011 to preview the alternatives to be presented in the Proposed Plan. The Proposed Plan was issued on June 1, 2011, and a public meeting was held in Fillmore on June 16, 2011. Notices of this meeting were published in the Ventura County Star and the LA Opinion and documents were made available both on EPA's website and at the Fillmore City Hall repository at 250 Central Avenue, Fillmore, California. The public comment period began on June 1, 2011, and closed on July 15, 2011.

4.0 Scope and Role of Response Action

The goal of the 1992 ROD was to reduce groundwater contaminant levels below federal and state drinking water standards. The pump & treat and SVE remedy addressed only groundwater and vadose zone contamination. While successful in reducing the contaminant mass in the groundwater and in the vadose zone directly above the contaminant plumes, the selected technology was not successful in achieving the goal of reducing groundwater contaminant levels below drinking water standards. In order to achieve this goal, the 1992 ROD needs to be amended.

Our knowledge about the toxicity of the soil contaminants addressed in this ROD has evolved. Today we recognize that lead and PAHs pose a greater risk than we understood back in 1992 and as a result we are cleaning up those contaminants in order to be protective of human health and the environment at the Site.

In this Amendment the PCPL Site is being addressed as one operable unit. Chevron conducted a focused remedial investigation (RI) to determine the nature and extent of the soil contamination, to evaluate the potential for soil vapor intrusion, and to continue with the groundwater cleanup. The goals of the response actions selected in this ROD Amendment are to clean up the soil so the property can be used for commercial and recreational purposes, to clean up soil to support the existing on-site Southern California scrub habitat for native plants and animals, and to clean up the groundwater to drinking water standards. Specific remedial action objectives (RAOs) and cleanup levels are presented in Section 8.0.

The work will be implemented under the oversight of EPA.

5.0 Site Characteristics

This section provides information about the physical characteristics of the Site, including the meteorology, geology, soil, groundwater, ecology, and the nature and extent of contamination.

5.1 Local Climate, Geology, Hydrogeology, and Surface Water

Climate: The climate in Fillmore, California, is semi-arid Mediterranean. The average annual rainfall is approximately 18 inches. The majority of rain occurs during a four month period in the winter when the daily high temperature is in the mid-60s. The daily high temperature in the summer is in the mid-80s. The prevailing wind direction is westerly from the Pacific Ocean.

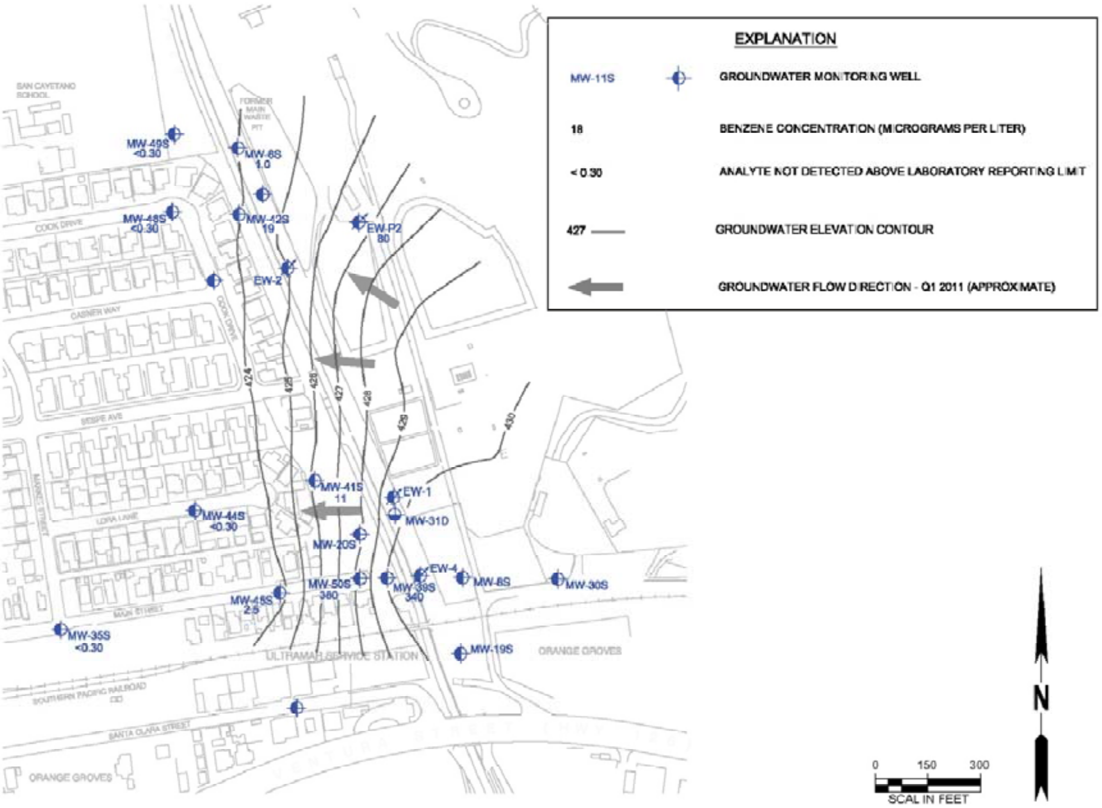
Geology: The Site lies at the northern edge of a sediment-filled basin, the Santa Clara Trough. The deposits in this basin are over 40,000 feet thick. The San Cayetano Fault passes beneath the Site along the eastern boundary, where the flat terrain of Fillmore abuts the adjoining hills. The fault trace has been buried by alluvial and colluvial material and is not visible near the Site. The area is in a petroleum producing region, the Ventura Basin, and there are numerous oilfields in the vicinity. The fractured sandstone and shale of the Monterey Formation are a source of crude oil and tar seeps, which are common features in the vicinity.

The Site geology consists of laterally discontinuous interlayers of unconsolidated, fine- to coarse-grained detritus deposited in paleo stream channels, alluvial fans, and depositional environments associated with nearby landslides. The subsurface strata is extremely heterogeneous sedimentary rock (see *Phase 2 Design Report, 1994,* and *Report of Natural Attenuation, 2007*).

Hydrogeology: The Site is located within the eastern portion of the Fillmore Groundwater Basin. The alluvial deposits and the underlying San Pedro Formation are the major water-bearing units, with groundwater flow direction toward the west (Figure 5-1) and the confluence of Sespe Creek and the Santa Clara River. The extreme variability of the local subsurface geology (discontinuous layers of material with highly variable hydraulic properties) creates a complex hydrogeologic environment. There are two main water bearing zones: Aquifer I, an unconfined to semi-confined shallow aquifer, and Aquifer II, a partially confined to confined aquifer below Aquifer I. Aquifer I, which goes to a depth of 100 feet below ground surface (bgs), is the only one with contaminants. The sand grains gradually get finer at depth, with the grains in Aquifer II finer than those in Aquifer I. Due to discontinuous layering, the two water bearing zones are locally interconnected and semi-confined. However, during long-term groundwater elevation monitoring, Aquifer I in some locations appears to function as a confined system.

Groundwater levels have fluctuated significantly over the past decades. Currently the depth to the southern groundwater plume is 55 feet bgs and the depth to the northern groundwater plume is 85 feet bgs. This difference is due to the sloping topography. The southern plume groundwater flow rate averages 219 feet per year; the northern plume groundwater flow rate averages 142 feet per year. The difference is due to the steeper gradient in the southern plume.

Surface Water: The Santa Clara River is approximately half a mile south of the Site. The river flows west to the Pacific Ocean (approx. 23 miles). Two perennial streams in Fillmore flow into the Santa Clara River, Pole Creek which is on the west edge of the Site and Sespe Creek which is 1.5 miles west of the Site. The portion of Pole Creek that is adjacent to the Site was channelized with concrete in 1973. Pole Creek has very little flow most of the year, with high debris flows during and after winter storms. Historic on-site berms constructed during refinery operations contain storm water run-off, which then evaporates. In the past, storm water was collected and discharged to Pole Creek.



Pacific Coast Pipeline Superfund Site

Figure 5-1
Groundwater Flow Direction, Fillmore

Site Soil: Most of the soil is disturbed, having been graded or mixed in with gravel or other material for service roads. Nearby, undisturbed soil is classified by the U.S. Department of Agriculture as Mocho series loam (evenly mixed sand, silt and clay) that consists of very deep, well drained soils that formed in alluvium derived mostly from sandstone and shale rock sources. The undisturbed soil in the hillside area has Mocho series properties.

5.2 Site Ecology

The majority of the Site is graded and devoid of vegetation and habitat. The only areas where ecological habitat may exist are the eastern hillside and the northernmost portion of the Site.

The hillside is approximately 12 acres and is generally very steep, sloping upward to the east. The vegetation is mostly intact, with a few dirt service roads, and disturbed by the presence of non-native weeds in a few areas. The vegetation consists primarily of Venturan Coastal Sage Scrub, which is characterized as low, mostly soft-woody shrubs less than six feet in height, with a mostly closed canopy. Species of this community include California sagebrush, California buckwheat, purple sage, coyote brush, and desert candle.

The northern portion covers approximately 7 acres and is mostly flat with several remnant constructed depressions. This area is much more disturbed than the hillside habitat. Large portions are devoid of vegetation. The remainder of the area contains some native scrub and sparse wooded areas with both native and non-native trees. Of the vegetated portion, roughly 30% is Venturan Coastal Sage Scrub, 40% is ruderal habitat (weedy plants that grow in highly disturbed areas), and about 30% is wooded. The wooded areas are patchy and populated primarily by non-native Peruvian pepper and eucalyptus trees. Thus, the northern portion of the Site, when compared with both the adjacent hillside and habitat outside the Site boundary, is of insignificant value as habitat in light of its degraded and disturbed condition.

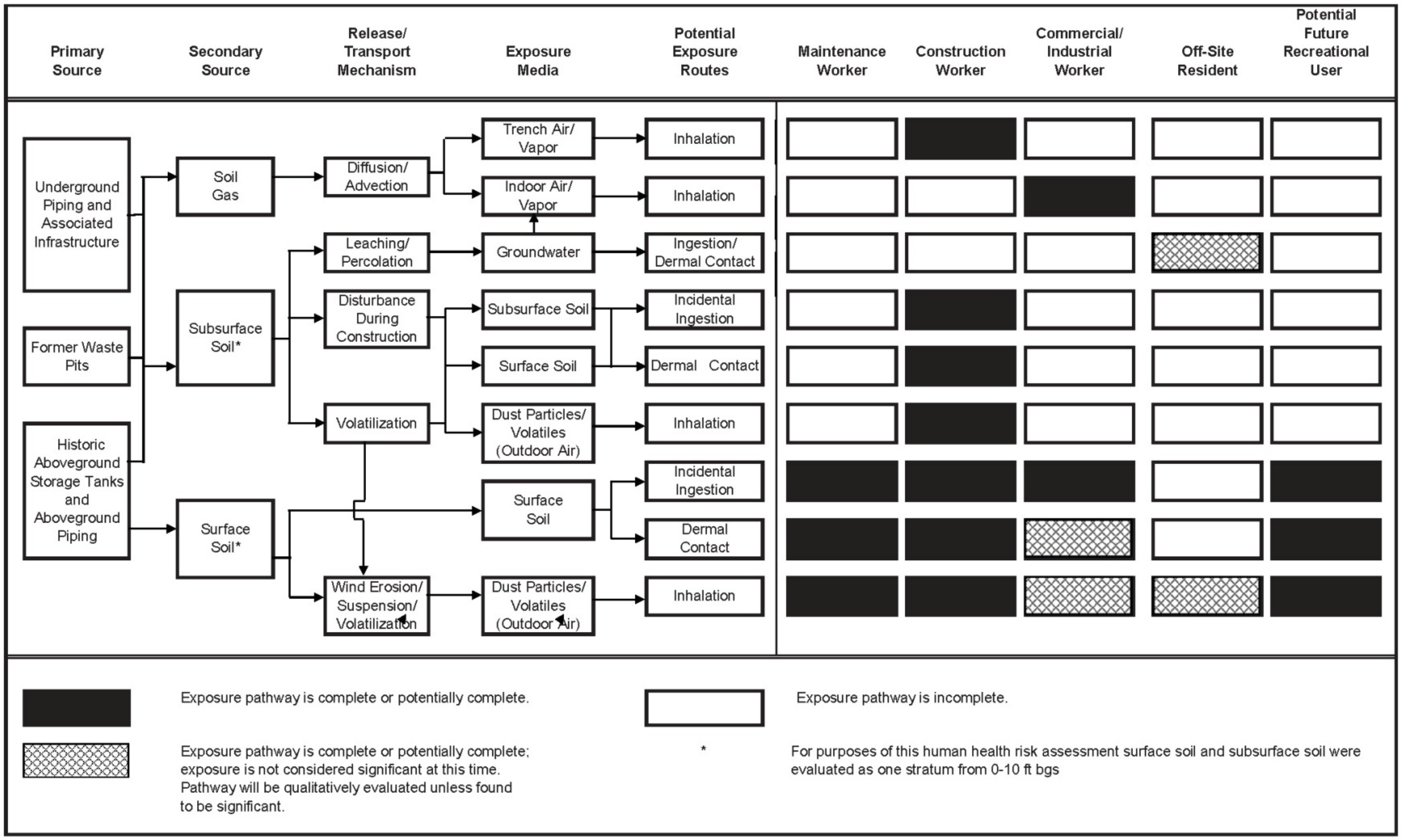
The animals present are those that are expected in this habitat and are discussed in the Ecological Risk Assessment, Section 7.2

5.3 Conceptual Site Models

A conceptual site model (CSM) identifies potential contaminant sources, affected media, release mechanisms, the routes of migration, and potential receptors that could be exposed to contamination. The primary sources of contamination were the refinery facilities, pipes, structures, and waste pits. These sources have been removed. The secondary sources are surface soil, subsurface soil and soil gas. The Human CSM for the chemicals of potential concern (COPCs) at the PCPL Site is presented as a chart in Figure 5-2 and as a diagram in Figure 5-3. The Ecological CSM is presented as a chart in Figure 5-4.

For groundwater, the primary source of contamination was former unlined waste pits. Leaking of liquid waste in these pits led to contamination of the subsurface soil, which became a secondary source of contamination due to leaching and percolation, ultimately resulting in groundwater contamination. The potential exposure routes for contaminated groundwater are ingestion, dermal contact, and inhalation (due to volatilization when heated). Potential receptors are workers and residents who would use this groundwater. Currently the exposure pathways are incomplete because there are no supply wells in the contaminated groundwater. There are no potential ecological receptors for the contaminated groundwater, as there are no direct or indirect exposure pathways.

There are no sources of contamination to surface water due to berms along the western edge of the Site.



Pacific Coast Pipeline Superfund Site

Figure 5-2
Human Exposure Conceptual Site model, COPCs

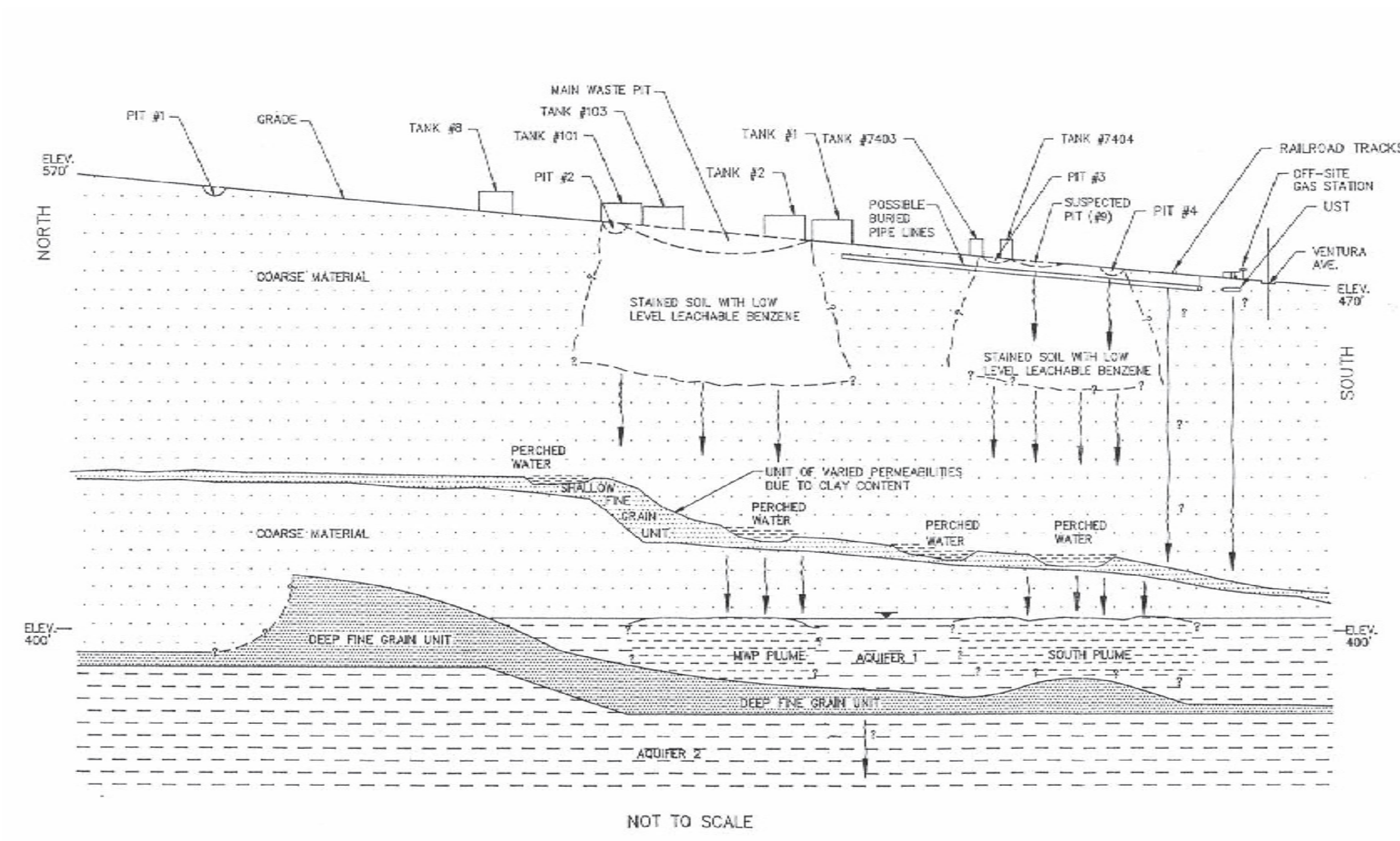
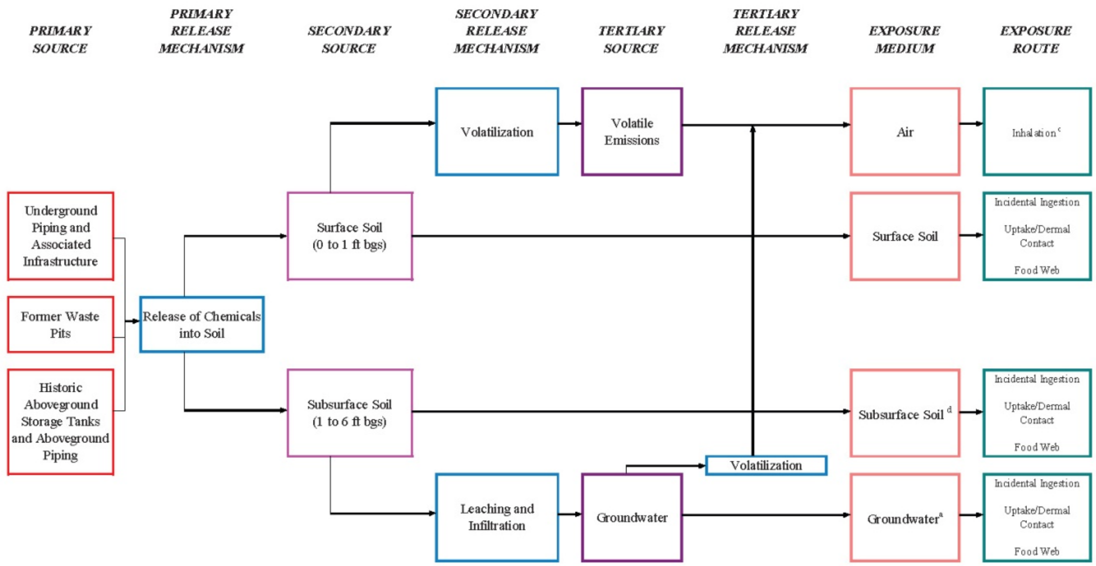


Figure 5-3
Conceptual Site Model Diagram



Exposure Medium	Exposure Route	Terrestrial Plants	Soil Invertebrates	Herbivorous Birds and Mammals	Insectivorous/Carnivorous Birds and Rodents	Omnivorous Birds and Mammals	Top-Level Predators	Aquatic Biota
Air	Inhalation[c]	NA	NA	●	●	●	○	IC
Surface Soil	Incidental Ingestion	NA	●	●	●	●	●	IC
	Uptake/Dermal Contact	●	●	○	○	○	○	IC
	Food Web	NA	NA	●	●	●	●	IC
Subsurface Soil[d]	Incidental Ingestion	NA	○	●	●	●	●	IC
	Uptake/Dermal Contact	○	○	○	○	○	○	IC
	Food Web	NA	NA	○	○	○	○	IC
Groundwater[a]	Incidental Ingestion	IC	IC	IC	IC	IC	IC	IC
	Uptake/Dermal Contact	IC	IC	IC	IC	IC	IC	IC
	Food Web	IC	IC	IC	IC	IC	IC	IC

Legend:
● Potentially complete pathway
○ Minor or insignificant pathway
IC Incomplete pathway
NA Not an applicable pathway for this receptor.
[a] No surface water bodies are present at the site. Therefore, groundwater is not a medium of concern for ecological receptors (no discharge to surface water pathway and below ecological exposure depths - 0 to 6 feet bgs).
[b] Aquatic biota defined as plants, invertebrates, and fish.
[c] Inhalation exposure potentially complete for burrowing animals only.
[d] Potentially complete and significant exposure pathways for subsurface soils assumed for burrowing mammals only (no burrowing birds at the site).

Figure 5-4
Ecological Conceptual Site Model

5.4 Nature and Extent of Groundwater Contamination

Groundwater data for the Site dates back to the 1980s. Data was collected during the first remedial investigation and feasibility study (RI/FS), during treatment system operations, and has continued to be collected since the treatment systems stopped operating. Currently 34 wells are monitored; 14 are monitored every three months and 20 are monitored semi-annually.

Contaminants found are typical of petroleum industry operations. The 1992 ROD identified as the source of groundwater contamination nine unlined waste pits that were used to store liquid waste generated during refining operations. The waste in these pits was removed during the 1986 removal, thus eliminating the primary source of contamination.

The majority of the current groundwater contamination resulted from a 30 foot rise in the groundwater level since the early 1990s and a subsequent drop. A smear zone was created, with petroleum hydrocarbons getting carried up into the vadose zone and submerged in the saturated zone. A few monitoring wells in the center of the southern plume sometimes detect petroleum floating at the top of the groundwater. This petroleum, referred to as light non-aqueous phase liquid, or LNAPL (i.e., not dissolved in water), contains benzene and toluene and is the principal threat to groundwater. LNAPL has not been detected in the northern plume and the continuing drop in contaminant concentrations indicates there is none.

Benzene is the primary COC exceeding its cleanup level of 1 µg/L. Concentrations in the southern plume are holding steady while concentrations in the northern plume are continuing to decline. The highest concentration is 380 µg/L in the southern plume and 80 µg/L in the northern plume. The benzene plumes are stable and contamination is not spreading (Figure 2-2). Toluene, which was the only other COC above its ROD cleanup level when the treatment systems were shut down, is now above the current drinking water standard in only one well in the southern plume at a concentration of 190 µg/L and is below the ROD cleanup level of 100 µg/L (California MCL) in the northern plume. In 1994 California raised the drinking water standard for toluene from 100 µg/L to its current 150 µg/L.

The other COCs in the 1992 ROD are ethylbenzene and 1,2-DCA. Ethylbenzene was never above the 1992 cleanup level of 680 µg/L. In 1997 it was 650 µg/L; currently the highest concentration is 32 µg/L. In 2003 California lowered the MCL to 300 µg/L and concentrations are well below that. 1,2-DCA reached its cleanup level of 0.5 µg/L in 1991 and remains below that level. Because both of these chemicals are below drinking water standards they are no longer COCs.

5.5 Natural Attenuation of Groundwater

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

At the PCPL Site a key indicator that natural attenuation is occurring in groundwater is that the two plumes of contaminated groundwater are stable. Since the groundwater pump and treat system was turned off in 2002, the contamination has not spread with the flow of groundwater. Long-term monitoring shows that benzene concentrations are dropping in the northern plume and remaining steady in the southern plume. Toluene has continued to decrease in both plumes and is now below the state MCL in the northern plume.

Determining the mechanisms of attenuation requires extensive sampling and analysis. Water quality parameters such as pH, alkalinity, and concentrations of sulfate, nitrate and dissolved oxygen are measured. At the PCPL Site, analysis of the data indicates that both aerobic and anaerobic biodegradation are the primary attenuation mechanisms destroying the volatile organic compounds (VOCs) in groundwater. Isotope fractionation studies demonstrated that microbial degradation of benzene is taking place. Along with plume stability and decreasing concentrations of benzene and toluene, other evidence is:

> 1) oxygen-rich groundwater upgradient, downgradient, and at-depth below the contaminant plume but oxygen-depleted groundwater in the plume (aerobic biodegradation);
>
> 2) sulfate-rich groundwater upgradient, downgradient, and at-depth below the contaminant plume but sulfate-depleted groundwater in the plume (anaerobic biodegradation, Figure 5-5);
>
> 3) isotope analysis of hydrogen in benzene: Bacteria preferentially consume lighter (lower numbered) isotopes. Comparing the $^{1}H/^{2}H$ ratio in benzene in upgradient groundwater to downgradient groundwater reveals that there is less ^{1}H than ^{2}H in the benzene in downgradient groundwater. This indicates that bacteria in the benzene plume have consumed the ^{1}H.
>
> 4) isotope analysis of carbon in benzene: there is less ^{12}C in benzene in downgradient groundwater than ^{13}C, indicating that bacteria have consumed the ^{12}C.

See RI/FS Appendix E, *Groundwater MNA Multiple Lines of Evidence, Chevron, September 11, 2009*, for a complete discussion of the natural attenuation characteristics of the Site groundwater.

Part of the above-referenced study included a soil vapor intrusion investigation to determine if the benzene in groundwater could volatilize and migrate up into nearby residences. Results indicate that soil vapor intrusion is not occurring and does not present a health risk to residents. The same natural attenuation processes that are destroying VOCs in groundwater are also destroying it in the vadose zone above the groundwater plumes.

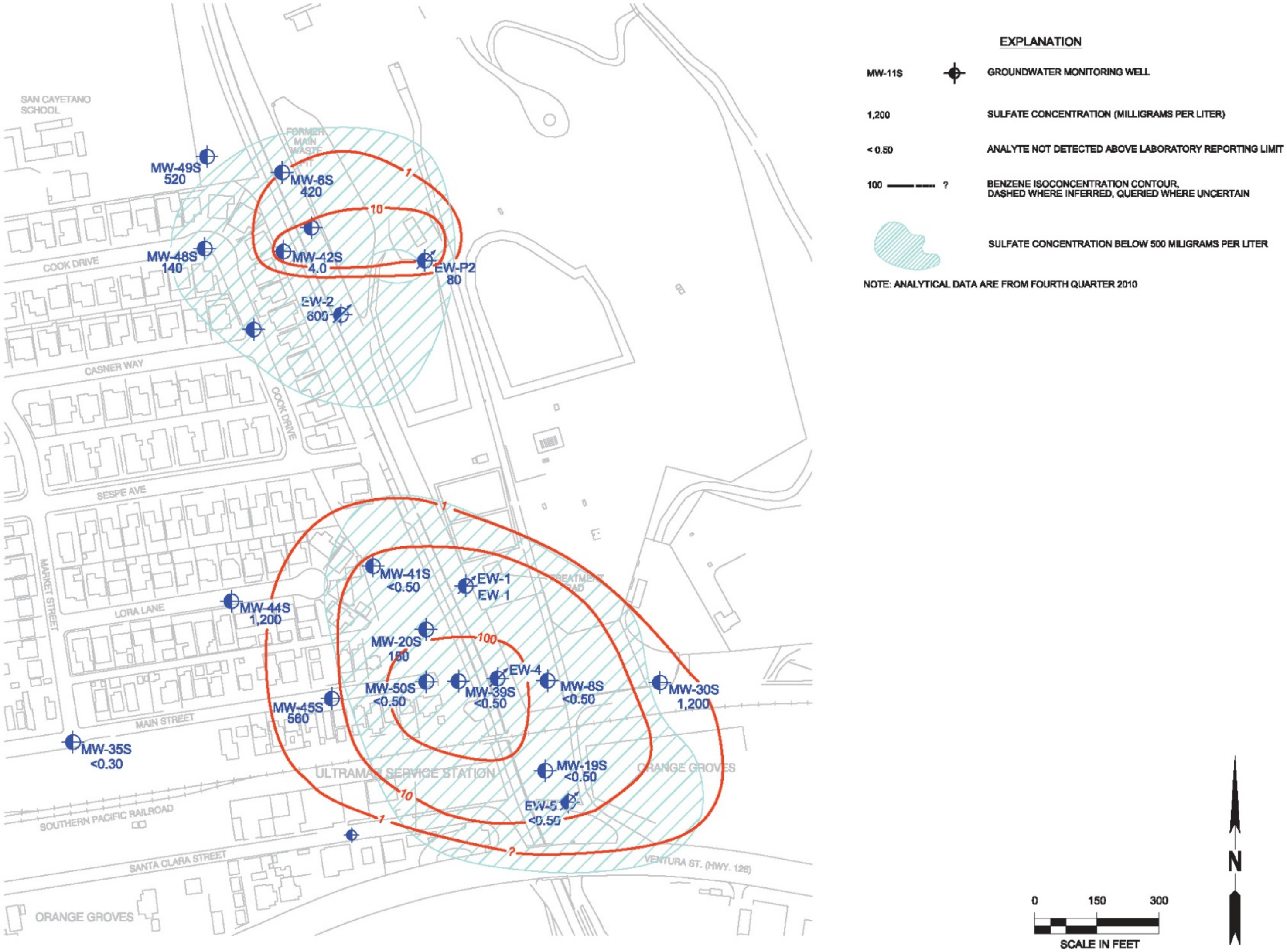


Figure 5-5
Sulfate Distribution in Groundwater

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5.6 Nature and Extent of Soil Contamination

Historic refinery operations were the source of soil contamination at the Site. With the removal of refinery wastes in the numerous waste pits, the remaining contamination is present across the Site, predominantly in shallow soils, and is associated with historical operations, incidental releases, and former waste management practices.

Sampling Strategy: Investigations before the 1992 ROD determined that the shallow soil (0 to 10 feet bgs) is no longer a source of contamination to groundwater. None of the contaminants currently in the soil are in the groundwater except for naphthalene, which is not a groundwater COC as it is only intermittently detected at concentrations below California action levels. Because the current contaminants in soil are not migrating to groundwater, EPA limited its investigation for this ROD Amendment to the shallow soil. There are no exposure pathways for contaminants below 10 feet bgs, as no on-site workers, recreational users, residents, or ecological receptors would be exposed to contaminants below 10 feet.

For the focused RI/FS, the soil was investigated in three phases, with each phase building upon data gathered in the previous phase. A total of 1,089 soil samples were collected across the Site. Soil gas samples were also collected; they are discussed later in this Section. Soil impacts were generally limited to medium to heavy molecular weight hydrocarbons and inorganics. Contaminant concentrations were compared to two residential screening levels. California Human Health Screening Levels (CHHSSLs) were used when available, otherwise EPA Regional Screening Levels (RSLs) were used. These screening levels are specific concentrations of chemicals that are considered by EPA to be very protective of human health and are discussed further in Section 7.1.1, Chemicals of Potential Concern.

Polycyclic Aromatic Hydrocarbons: Polycyclic aromatic hydrocarbons (PAHs) are a group of chemicals found in crude oil and which are also formed during the incomplete burning of oil, wood, and other organic matter. They generally occur as complex mixtures, not as single compounds. Twenty-one different PAHs were detected in samples. Table 5-1 shows the eight PAHs that were detected above residential RSLs.

Table 5-1: PAHs Above RSLs

PAH Compound	Max Detected Concentration (mg/kg)	RSL (mg/kg)	Number of locations above RSL	Feet bgs
Benzo(a)anthracene	53	0.15	31	1 to 10
Benzo(a)pyrene	80	0.015	51	1 to 10
Benzo(b)fluoranthene	52	0.15	36	1 to 10
Benzo(k)fluoranthene	25	1.5	2	1
Chrysene	79	15	6	1 to 10
Dibenz(a,h)anthracene	5.8	0.015	17	1 to 5
Indeno(1,2,3-cd)pyrene	21,000	0.15	13	1
Naphthalene	40	3.6	40	1 to 10

Metals: Soil samples were analyzed for California Assessment Manual metals, a specific list of 17 metals regulated in soil in California. Several metals were detected (Table 8, RI/FS), but only arsenic and lead exceeded the RSL. The arsenic concentrations were consistent with Site background levels.

Hexavalent Chromium: Hexavalent chromium was present at very low detections in two soil samples. The concentrations did not exceed the RSL. The maximum concentration was 0.0003 mg/kg.

Lead: Lead was detected in 163 locations across the Site. The majority of detections were at one foot bgs, 14 were at five feet bgs, and 7 were at ten feet bgs. The CHHSL is 80 mg/kg; the maximum concentration detected (one location) was 34,000 mg/kg.

Polychlorinated Biphenyls: Out of 233 soil samples analyzed, aroclor 1248 was the only PCB detected in one sample at one foot bgs at a concentration of 0.031 mg/kg, which is below the screening level of 0.22 mg/kg.

Soil Gas Results: 60 soil gas samples were analyzed from 27 borings. 22 VOCs were detected, three exceeded the CHHSLs (Table 5-2).

Table 5-2: Soil Gas Chemicals Above CHHSLs

Compound	Max Concentration (μg/m^3)	CHHSL (mg/kg)	Number of Locations above CHHSL	Feet bgs
1,2-Dichloroethane	440	0.05	1	10
Benzene	8,400	0.036	14	5 to 10
Naphthalene	3,100	0.032	14	5 to 10

Site Construction Materials, Berms

During the Site investigations it was noted that miscellaneous construction material, primarily asphalt and concrete associated with foundations, were present throughout the property. This debris was sampled and did not have contamination above screening levels. There are several earthen berms that were used as containment dikes for the former aboveground storage tanks and these were also sampled. Sampling results indicated that some of the berms have some areas with lead above the industrial screening criteria.

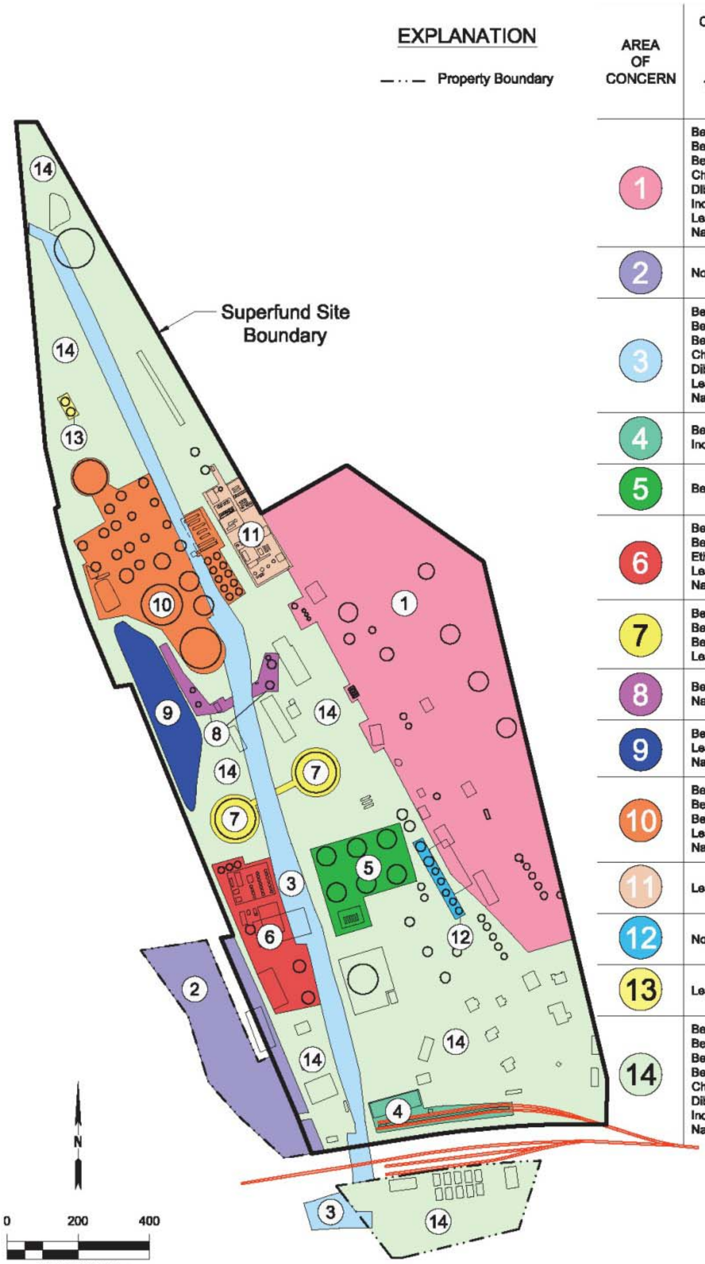
5.7 Summary of Soil Contamination

For evaluation purposes the Site was divided into 14 Areas of Concern (AOCs) (Figure 5-6). These areas were defined based on historical uses, chemical releases, geography, and terrain. All but two of the AOCs have some soil contamination, with lead and PAHs scattered across 12 of the 14 AOCs. The greatest number of detections were in the top one foot of soil, with fewer detections at five feet and even fewer at ten feet.

Soil: The main contaminants, lead and PAHs, are relatively stable, non-migrating chemicals. Their presence in the shallow soils, and lack of presence in the groundwater, is consistent with the fate and transport expected of these chemicals. Contaminant migration was modeled using

SESOIL, a model that simulates long-term pollutant fate and migration in the unsaturated soil zone, and the results indicate that the contaminants in the soil will not migrate down into the groundwater.

Soil vapor: Based on a soil vapor intrusion study, the contaminants in soil gas are biodegrading and not migrating down to groundwater. 1,1-DCA has not been detected in groundwater since 1991 and ethylbenzene is at 12 µg/L in the groundwater, well below the MCL of 680 µg/L. The primary sources for these chemicals were Waste Pit 3, the naphtha treating plant, and the gas separation plant.



AREA OF CONCERN	CHEMICALS OF CONCERN EXCEEDING RISK BASED CRITERIA 10^{-6} Cancer Risk Threshold (Not Applied to Lead*)	CHEMICALS OF CONCERN EXCEEDING RISK BASED CRITERIA 10^{-5} Cancer Risk Threshold (Not Applied to Lead*)
1	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Chrysene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Lead Naphthalene	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Dibenz(a,h)anthracene Lead
2	None	None
3	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Chrysene Dibenz(a,h)anthracene Lead Naphthalene	Lead
4	Benzo(a)pyrene Indeno(1,2,3-cd)pyrene	None
5	Benzo(a)anthracene	None
6	Benzene Benzo(a)pyrene Ethylbenzene Lead Naphthalene	Benzene Lead
7	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Lead	Lead
8	Benzo(a)pyrene Naphthalene	None
9	Benzo(a)pyrene Lead Naphthalene	Lead
10	Benzo(a)anthracene Benzo(a)pyrene Benzo(k)fluoranthene Lead Naphthalene	Benzo(a)anthracene Benzo(a)pyrene Benzo(k)fluoranthene Lead
11	Lead	Lead
12	None	None
13	Lead	Lead
14	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene Naphthalene	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Dibenz(a,h)anthracene Indeno(1,2,3-cd)pyrene

* Lead is a noncancer health hazard and, therefore, unaffected by cancer risk threshold.

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Figure 5-6
Areas of Concern

6.0 Current and Potential Future Land and Water Uses

The former refinery property is approximately 56 acres and has had no activity since it ceased operating as a crude oil pumping station in 2002. It is located in Ventura County just east of the City of Fillmore. The parcel was zoned OS-160 (Open Space, 160 acre minimum lot size) in 1985 by Ventura County. Because this parcel was created before the zoning was put into place, the minimum lot size does not apply.

The City of Fillmore expects this property will be developed for commercial and recreational uses in the future. The City has planned for this area through the Fillmore General Plan. The Fillmore General Plan Update (Revised July 2005) includes the property in both the Fillmore Sphere of Influence, which is the area outside the City limits that may one day be annexed into the City, and the City Urban Restriction Boundary (CURB), which defines the future urban development boundary for the City of Fillmore. The General Plan states that this area would be redesignated for a future regional park site with a campground that could accommodate RVs. The City no longer endorses the plan for an RV campground and now considers the property's potential use to include commercial and other recreational activities. In the future, after the City approves a General Plan Amendment for new land use outside the City Limits and within its Sphere, the County Local Agency Formation Commission must approve the plan and annexation of the property to the City. When interviewed in 2011 for the third five-year review, Kevin McSweeney, Fillmore Community Development Director, stated that after the property is annexed to the City of Fillmore it will not be zoned residential.

The LA RWQCB designates beneficial uses of water resources within its jurisdiction. The groundwater in the Fillmore area is designated as "existing municipal use"(drinking water). The City obtains all of its drinking water from groundwater in the Sespe Creek sub-basin and does not use groundwater from the Pole Creek area. The Sespe sub-basin provides enough water for the City's needs and it is unlikely that groundwater in the Pole Creek area would be used as a drinking water supply. Once the groundwater at the Site reaches California drinking water standards it could be used for drinking water. There is a deep on-site agriculture well, supplying the avocado orchard east of the Site. This well draws from the deeper Aquifer II, yielding up to 125 gallons per minute during the arid summer months. Before the Site soil cleanup begins, this well will be taken out of service permanently, as Chevron does not intend to use this groundwater in the future.

Pole Creek is an ephemeral tributary to the Santa Clara River that runs along the west side of the PCPL Site. The LA RWQCB does not list Pole Creek in its Water Quality Control Plan but the beneficial uses of the Santa Clara River apply through the Tributary Rule. The current designated beneficial uses are existing agricultural, industrial, recreational, groundwater and surface water recharge, and ecological uses. Its beneficial use is also designated "potential municipal use" (*Water Quality Control Plan, Los Angeles Region, June 13, 1994*). No change to these designations is expected. It is highly unlikely the RWQCB would determine that Pole Creek has an existing municipal use due to its low flow for much of the year.

7.0 Summary of Site Risks in Soil

EPA evaluated the risks to both human health and the environment that the contaminants in Site soil might pose. A human health risk assessment (HHRA) and a screening level ecological risk assessment (SLERA) were conducted to determine whether or not contaminants present in soil and soil gas present a threat to human health or the environment. These assessments estimate the current and possible future risks if no action were taken to clean up the Site. Not all chemicals at a Superfund site automatically present a risk. The risk depends on the chemical and the way people, plants, and animals are exposed to it. After identifying the potential risks, these risks were then evaluated to determine if cleanup actions are necessary. The risk assessment process does not estimate actual disease outcomes but is merely a standard measure of the potential for harm. It incorporates several health protective assumptions into the evaluation process and can be used to compare different locations and contaminant distributions for further evaluation.

A risk assessment was not conducted for groundwater for this ROD Amendment because one was prepared for the 1992 ROD, the contaminants have not changed, and the cleanup is driven by federal and state drinking water standards.

7.1.0 Summary of Human Health Risk Assessment

The steps in the HHRA are:

- identification of chemicals of potential concern (COPCs);
- exposure assessment, a determination of how people are exposed, the amount they are exposed to and the length of time they are exposed;
- toxicity assessment, a determination of the health effects associated with exposure to the COPCs; and
- risk characterization, a determination of the potential for adverse health effects due to exposure to Site COPCs.

Each of these steps is explained in the following sections. To a certain extent, the HHRA applies information that errs to be health protective. The HHRA can be found in the PCPL Remedial Investigation.

7.1.1 Chemicals of Potential Concern

Two screening evaluations were done for contaminants present in the soil and soil gas at the Site. Initially, the highest concentration of each contaminant was compared to either its corresponding residential Regional Screening Level value (RSL: EPA 2010) or the residential California Human Health Screening Level (CHHSL; Cal/EPA 2005). Those contaminants with concentrations above residential screening levels were carried forward as COPCs. Contaminants that did not have a screening level were also carried forward as COPCs.

Those contaminants that were not screened out in the initial evaluation were classified as COPCs and were evaluated further in the HHRA. Contaminants are classified as a "potential" concern at the beginning of the HHRA because they may or may not present a risk or cause adverse effects. The HHRA concludes with the identification of those chemicals that are an actual concern for which action is warranted in order to limit exposure. Those contaminants are referred to as chemicals of concern (COCs).

Residential screening levels were used because they are the most health protective. If the contaminant concentration was acceptable for a residential setting, which assumes long exposure times in its risk calculation, then the contaminant concentration would be acceptable for an industrial setting, which assumes shorter exposure times. Both EPA and Cal/EPA screening levels were used because neither list includes all contaminants. CHHSLs were selected to evaluate soil gas concentrations because the RSLs do not have soil gas screening values. For evaluation of soil contaminants, the more health protective of the values between the CHHSLs and RSLs were selected.

RSLs and CHHSLs are the levels of concern for both cancer-causing and non-cancer health effects, whichever is applicable. For cancer-causing contaminants, concentrations are calculated based on the likelihood of one additional person out of one million getting cancer if exposed to the contaminant. Therefore, the screening-level risk estimate is the ratio of the highest concentration of a COPC to its RSL or CHHSL multiplied by 1×10^{-6}. For COPCs that do not cause cancer but can cause other health effects (e.g., developmental, neurological), similar exposure assumptions are made but the level of concern is expressed as a ratio of the average daily dose to the reference dose, a dose below which no adverse effects would be expected. This ratio is called the hazard index (HI) and is the sum of all individual hazard quotients, which are calculated by chemical and by pathway. If the HI is calculated to be equal to or less than 1.0, then no adverse health effect is expected. A contaminant with an HI greater than 1.0 or a cancer risk estimated to be greater than 1×10^{-6} does not mean that there is a cancer or health risk of concern to exposed individuals. This merely means that additional evaluation is required in a quantitative HHRA.

Lead is evaluated differently from other COPCs. Rather than a dose-response relationship, lead health effects are based on predicting blood-lead concentrations in people exposed to lead in the environment. In California, the health protective target is a site exposure that could result in an increase in blood-lead concentration of no more than 1 microgram per deciliter (µg/dL). The residential lead CHHSL of 80 mg/kg is based on this target concentration.

The screening evaluation showed that contaminant concentrations in soil in AOCs 1, 6, and 10 greatly exceed both the residential and industrial screening levels, indicating that action in these AOCs would be required. These AOCs were not quantitatively evaluated further in the HHRA.

The quantitative HHRA included only COPCs with screening-level risk estimates above 1×10^{-6} or screening level HIs above 1. Lead was also included in the quantitative HHRA because of lead concentrations greater than the CHHSL of 80 mg/kg. Inorganic COPCs in soil were compared to their respective background or naturally occurring concentrations. If the highest concentration was less than background, then that COPC (e.g., arsenic) was eliminated from further evaluation in the quantitative HHRA.

By comparing contaminants to their screening levels and background levels, COPCs were identified for further evaluation in the quantitative risk assessment (Table 7-1):

Table 7-1: COPCs Evaluated in the HHRA

Metals in Soil	Chromium VI, and Lead
PAHs in Soil	Acenaphthylene, Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)Fluoranthene, Benzo(g,h,i)perylene, Benzo(k)fluoranthene, Chrysene, Dibenz(a,h)anthracene, Indeno(1,2,3-cd)pyrene, Naphthalene, and Phenanthrene
Volatile Organic Compounds in Soil	1,3-Dichlorobenzene, Ethylbenzene, Bromochloromethane, 1,2,3-Trichlorobenzene, 1,2-Dibromo-3-chloropropane, 1,2-Dibromoethane (EDB), Naphthalene, n-Butylbenzene, n-Propylbenzene, p-Isopropyltoluene, sec-Butylbenzene, and tert-Butylbenzene
Volatile Organic Compounds in Soil Gas	1,2-Dichloroethane, 2-Butanone (MEK), 2-Hexanone, 4-Methyl-2-pentanone (MIBK), Acetone, Benzene, Bromomethane, Carbon disulfide, Chloromethane, Ethylbenzene, Freon 113, Isopropanol, Naphthalene, Styrene, Trichlorofluoromethane, and Vinyl Acetate

7.1.2 Exposure Assessment

The exposure assessment describes how humans could get exposed to the COPCs. In contrast to the screening process, which was based on a residential land use, the quantitative HHRA assumed the agreed-upon commercial/industrial land use of the Site. The assumed exposed population is the future workers at the property. Industrial use of the property assumes the absence of sensitive or more susceptible groups such as children, elderly, or sick people.

The conceptual site model (CSM) in Section 5.3 shows how workers could come in contact with the COPCs. Depending on the physical nature of a chemical, workers could be exposed through pathways that include ingestion, skin contact, inhalation of COPCs that adhere to airborne particulates, and inhalation of vapors from volatile COPCs. Site conditions typically determine whether people could be exposed through some or all of these exposure pathways or not be exposed at all. To be health-protective, the HHRA assumed that workers could come in contact with COPCs in soil and soil gas through all these pathways.

The chemical exposure of workers depends on how often and for how long the workers come into contact with COPCs in soil or soil gas at a site. The workers are assumed to be exposed under reasonable maximum exposure (RME) conditions. The RME, which is defined as the highest exposure that could reasonably be expected to occur for a given exposure pathway, is intended to account for the uncertainty in the contaminant concentration and the variability in exposure conditions. Under these RME conditions, workers are assumed to come in contact with the average COPC concentration, rather than the highest concentration, in each AOC. To account for the uncertainty in estimating the true average concentration of a chemical at each AOC, a health protective 95 percent upper confidence limit (UCL) of the arithmetic mean concentration is used (meaning the concentration evaluated is a value that will be greater than the true mean with 95 percent confidence). The 95% UCL provides reasonable confidence that the true average concentration will not be underestimated (EPA, 1992).

7.1.2.1 Groundwater

Chemicals in groundwater that require cleanup are benzene and toluene, as they are above federal and state MCLs. Health risks associated with exposures to groundwater were not evaluated; instead, concentrations of COPCs in groundwater were compared to federal and state MCLs to determine if remedial action is necessary to meet drinking water standards.

7.1.2.2 Surface Water

There is no exposure to surface water because Pole Creek is in a fenced, concrete flood control channel and is not used for drinking water; therefore, there is no health risk associated with surface water.

7.1.2.3 Soil

The Site worker is assumed to come in contact with soil in each AOC through incidental ingestion, skin contact, and inhalation of both airborne particulates and vapor at a frequency of five days a week for 50 weeks a year because the worker is assumed to take a two-week vacation each year. The job tenure of Site workers is also assumed to be 25 years. The worker is assumed to ingest soil through incidental hand-to-mouth transfer at a rate of 100 milligrams a day (mg/day). With the temperate climate in California, the industrial worker is assumed to be wearing a short-sleeved shirt, shorts, and shoes. The skin surface that could be exposed to a COPC is, therefore, limited to the head, hands, forearms, and lower legs. Other chemical-specific factors, such as absorption factors through the skin and the gastrointestinal tract, are also incorporated into the estimate of the average daily chemical intake of an industrial worker through these different routes of exposure. Another factor in estimating the exposure of workers is body weight. The default body weight for a worker is 70 kilograms or 154 pounds. For cancer-causing COPCs, the incidence of cancer is assumed to manifest itself within a 70-year lifetime of an exposed industrial worker. For non-cancer-causing COPCs, health effects are expected to be manifested during the 25-year period of employment at the Site.

7.1.2.4 Soil Gas and Soil Vapor Intrusion

In some instances, vapors from volatile COPCs in soil gas can move upward from the deep soils and groundwater and if there is a building above a contaminated area, vapors can eventually enter the interior spaces through cracks in the slab or openings between the walls and floor. One factor that influences the extent to which vapors enter and accumulate inside a building is the difference between air pressures inside a building and in the outside environment. Other factors that influence vapor intrusion are the volatility of the chemical, physical and chemical properties of the soil, the surface area and height of the building, temperature, and air exchange rate. To evaluate the possibility that future workers inside future buildings could be exposed to unacceptable levels of COPCs in indoor air, soil gas measurements were collected at the Site. The measured soil gas values were then modeled to determine the potential indoor air concentrations and were found to be above screening levels in AOC 6.

7.1.3 Toxicity Assessment

The toxicity assessment provides information regarding the potential of a chemical to cause cancer and other adverse health effects. Toxic chemical effects are separated into carcinogenic effects and noncarcinogenic effects due to the currently held scientific opinion that the mechanisms of action for cancer-causing and non-cancer-causing chemicals differ. For carcinogens, it is assumed that any level of exposure has a finite possibility of causing cancer; therefore, there is no threshold dose for carcinogenic effects. That is, a single exposure to a carcinogenic chemical at any level may result in an increased probability that an individual will develop cancer. The increased probability may be so small (i.e., less than 1×10^{-6}, or one in a million) that it is considered insignificant, or it may be greater and require further evaluation.

For noncarcinogens, it is believed that humans have protective mechanisms that must be overcome before the adverse effect results; therefore, there is a threshold dose for these effects. This threshold concept of noncarcinogenic effects holds that a range of exposures up to some defined threshold can be tolerated by humans without appreciable risk of harm.

Tables 7-2A and 7-2B present the toxicity information on the COPCs at the Site. Oral and dermal slope factors are toxicity values for evaluating the probability of an individual developing cancer from oral or dermal exposure to contaminant levels over a lifetime. The weight of evidence classification describes the type of evidence (whether human or animal) and amount of confidence in the information on cancer outcomes. Oral and dermal slope factors are expressed in units of $(mg/kg\text{-}day)^{-1}$ or a milligram of contaminant per kilogram of body weight per day. The inhalation unit risk (IUR) is defined as the excess lifetime cancer risk estimated to result from continuous exposure to an agent at a concentration of 1 µg/m3 in air. IUR toxicity values are expressed in units of $(\mu g/m3)^{-1}$.

For noncarcinogens, the chronic oral reference dose (RfD) is an estimate of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of harmful effects during a lifetime. The inhalation reference concentration (RfC) is an estimate of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of harmful effects during a lifetime. Toxicity information for COPCs identified at the Site is published by EPA and Cal/EPA, and may be updated based on new information. As an example, ethylbenzene was previously classified as a noncarcinogen, but recent studies indicate that exposures to ethylbenzene could cause cancer. Therefore, an oral slope factor and inhalation unit risks were developed in addition to the oral reference dose and inhalation reference concentration.

Table 7-2A: Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal						
Chemical of Potential Concern	**Oral Cancer Slope Factor**	**Dermal Cancer Slope Factor**	**Slope Factor Units**	**Weight of Evidence**	**Source**	**Date**
Chromium VI	0.5[a]	20[a]	(mg/kg)/day	D	IRIS	1996
Lead	0.0085[b]	0.0085[b]	(mg/kg)/day	B2	IRIS	1993
Benzo(a)anthracene	1.2[b]	1.2[b]	(mg/kg)/day	B2	IRIS	1994
Benzo(a)pyrene	12[b]	12[b]	(mg/kg)/day	B2	IRIS	1994
Benzo(b)fluoranthene	1.2[b]	1.2[b]	(mg/kg)/day	B2	IRIS	1994
Chemical of Potential Concern	**Oral Cancer Slope Factor**	**Dermal Cancer Slope Factor**	**Slope Factor Units**	**Weight of Evidence**	**Source**	**Date**
Benzo(k)fluoranthene	1.2[b]	1.2[b]	(mg/kg)/day	B2	IRIS	1994
Dibenz(a,h)anthracene	4.1[b]	4.1[b]	(mg/kg)/day	B2	IRIS	1994
Indeno(1,2,3-cd)pyrene	1.2[b]	1.2[b]	(mg/kg)/day	B2	IRIS	1994
Naphthalene	--	--	(mg/kg)/day	C	IRIS	1998
Benzene	0.1[b]	0.1[b]	(mg/kg)/day	A	IRIS	2000
Ethylbenzene	0.011[a,b]	0.011[a,b]	(mg/kg)/day	B2	NTP	2007

Pathway: Inhalation						
Chemical of Potential Concern	**Inhalation Unit Risk**		**Units**	**Weight of Evidence**	**Source**	**Date**
Chromium VI	0.15 [b]		per $\mu g/m^3$	A	IRIS	1986
Lead	0.000012 [b]		per $\mu g/m^3$	--		
Benzo(a)anthracene	0.00011[a,b]		per $\mu g/m^3$	B2	IRIS	1994
Benzo(a)pyrene	0.0011 [a,b]		per $\mu g/m^3$	B2	IRIS	1994
Benzo(b)fluoranthene	0.00011 [a,b]		per $\mu g/m^3$	B2	IRIS	1994
Benzo(k)fluoranthene	0.00011 [a,b]		per $\mu g/m^3$	B2	IRIS	1994
Dibenz(a,h)anthracene	0.0012 [a,b]		per $\mu g/m^3$	B2	IRIS	1994
Indeno(1,2,3-cd)pyrene	0.00011 [a,b]		per $\mu g/m^3$	B2	IRIS	1994
Naphthalene	0.000034 [a,b]		per $\mu g/m^3$	C	IRIS	1998
Benzene	0.000029 [b]		per $\mu g/m^3$	A	IRIS	2000
Ethylbenzene	0.0000025 [a,b]		per $\mu g/m^3$	B2	NTP	2007

Notes:
a – EPA toxicity criterion
b- Cal/EPA toxicity criterion
NTP – National Toxicology Program
IRIS – Integrated Risk Information System
Weight of Evidence: A – known human carcinogen; B2 – probable human carcinogen, animal data; C – possible human carcinogen; D – not classified, lack of evidence

Table 7-2B: Non-Cancer Toxicity Data Summary

Pathway: Ingestion, Dermal						
Chemical of Potential Concern	**Oral RfD**	**Dermal RfD**	**Units**	**Target Organ**	**Source**	**Date**
Chromium VI	0.003[a]	0.000075[a]	mg/kg-day	Immune system, Respiratory system	ATSDR	2008
Benzene	0.0004[a]	0.0004[a]	mg/kg-day	Nervous system	ATSDR	2007
Ethylbenzene	0.1[a]	0.1[a]	mg/kg-day	Nervous system	ATSDR	2010
Naphthalene	0.02[a]	0.02[a]	mg/kg-day	Blood, liver	ATSDR	2005

Pathway: Inhalation						
Chemical of Potential Concern	**Inhalation RfC**			**Target Organ**	**Source**	**Date**
Benzene	0.03		mg/m^3	Nervous system	ATSDR	2007
Ethylbenzene	1.0		mg/m^3	Nervous system	ATSDR	2010
Naphthalene	0.003[a]		mg/m^3	Respiratory system	ATSDR	2005

Notes:
ATSDR – Agency for Toxic Substances and Disease Registry
a – EPA toxicity criterion

7.1.4 Chemicals of Concern

After determining the risks associated with the COPCs, EPA selected as COCs those contaminants in shallow soil and soil gas that present to on-site workers a carcinogenic risk greater than 1×10^{-6} or a predicted blood-lead level greater than 1 µg/dL. No contaminants had a noncarcinogenic HI greater than 1. The COCs in groundwater are the contaminants with concentrations above California MCLs.

Eight PAHs in soil and three VOCs in soil gas have a cancer risk greater than 1 x 10^{-6}. Concentrations of lead at eight of the fourteen AOCs would result in a blood-lead level greater than 1 µg/dL (RI/FS Section 6.7). Therefore, the COCs in soil are PAHs and lead. COCs in soil gas are benzene, ethylbenzene, and naphthalene. The two COCs in groundwater are benzene and toluene.

As previously mentioned, due to multiple contaminants in soil and soil gas with concentrations greater than screening levels, AOCs 1, 6, and 10 were identified for mitigation without a quantitative health risk assessment. The COCs in shallow soil and soil gas are identified by AOC in Table 7-3 and in Figure 5-6. Concentrations are presented in Section 5.6.

Table 7-3: Chemicals of Concern

AOC	Soil	Soil Gas
1	Lead, PAHs	None
3	Lead, PAHs	None
4	PAHs	None
5	PAHs	None
6	Lead, PAHs	Benzene, ethylbenzene, naphthalene
7	Lead, PAHs	None
8	PAHs	None
9	Lead, PAHs	None
10	Lead, PAHs	None
11	Lead	None
13	Lead	None
14	PAHs	None

Table 7-4 presents COCs in soil by exposure route and their minimum and maximum concentrations detected. It also shows the exposure point concentrations (EPCs) which are the concentrations at the point of contact between the COC and the human receptor. Although lead is a COC, it is evaluated using blood-lead modeling and not dose-response relationships, so it is not included in Table 7-4. The three COCs in soil gas are also not included in this table because the few areas requiring soil gas remediation are co-located with lead and would be cleaned up at the same time; therefore, EPCs were not calculated for the soil gas COCs.

Table 7-4: COC Exposure Point Concentrations, Human Health Risk Evaluation

Scenario Timeframe: Future
Medium: Soil
Exposure Medium: Soil

Exposure Point	Chemical of Concern	Concentrations Detected		Units	Frequency of Detection	Exposure Point Concentration	Exposure Point Concentration Units	Statistical Measure
		Min	Max					
Soil On-site - Direct Contact	Benzo(a)anthracene	0.0022	52	mg/kg	4.3%	1.9	mg/kg	95% UCL
	Benzo(a)pyrene	0.0021	32	mg/kg	4.8%	1.2	mg/kg	95% UCL
	Benzo(b)fluoranthene	0.0031	52	mg/kg	9.5%	1.8	mg/kg	95% UCL
Soil On-site - Inhalation of Soil Particulates (Dust)	Benzo(a)anthracene	0.0022	52	mg/kg	4.3%	1.9	mg/kg	95% UCL
	Benzo(a)pyrene	0.0021	32	mg/kg	4.8%	1.2	mg/kg	95% UCL
	Benzo(b)fluoranthene	0.0031	52	mg/kg	9.5%	1.8	mg/kg	95% UCL

Key
mg/kg: Milligrams per kilogram
UCL: 95% Upper Confidence Limit of the Mean Concentration

This table presents the chemicals of concern (COCs) detected in soil and the exposure point concentration (EPC) for each of the COCs (i.e., the concentration that will be used to estimate the exposure and risk from each COC in the soil). Because the site was divided into 14 Areas of Concern (AOCs) and the data were also divided accordingly, the statistics presented in this table represent those associated with the AOC data set with the maximum EPC for each COC. This table includes the range of concentrations detected for each COC, as well as the frequency of detection, the maximum EPC, and the statistical measure used to derive the EPC.

7.1.5 Risk Characterization

Risk estimates represent the incremental probability that an individual exposed to carcinogens will develop cancer over a 70-year lifetime. Risk estimates due to exposures to carcinogens through ingestion and skin contact are calculated as follows:

Risk = ADD x SF

where:

Risk = unitless

ADD = average daily dose through ingestion or dermal contact

SF = oral or dermal slope factor, expressed as $\frac{1}{mg/kg\text{-}day}$

Quantitative estimates of risk due to inhalation are evaluated using the IUR. Using the same equation shown above, dose is replaced by the exposure level based on the COPC concentration in air and the length of exposure. The exposure level is multiplied by the inhalation unit risk (IUR) instead of the SF. An excess lifetime cancer risk of 1 x 10^{-6} indicates that exposures to Site COPCs could result in a one in a million increased chance of developing cancer in addition to the current measured cancer rate in the U.S. population of 1 in 3.

Health effects due to exposures to noncarcinogens are estimated using the hazard quotient (HQ) approach. The ratio of the average daily dose due to exposures to a noncarcinogen to the dose that would not result in health effects is the hazard quotient:

$$Hazard\ Quotient_i = \frac{ADD_i}{RfD_i}$$

where: ADD_i = Average daily dose for chemical i (mg/kg-day)

RfD_i = Reference dose for chemical i (mg/kg-day)

As in risk estimates due to inhalation of carcinogens, the hazard quotient due to inhalation of a noncarcinogen is calculated by replacing the dose with the exposure level based on the COPC concentration in air and the length of exposure. The RfD is replaced by the RfC. A hazard quotient less than or equal to 1 indicates that the predicted exposure to that chemical should not result in adverse health effects. Hazard quotients due to different exposure routes are summed to estimate a hazard index. A hazard index of less than or equal to 1 indicates acceptable levels of exposure to chemicals having an additive effect. Tables 7-5A and 7-5B present a summary of the risk characterization for carcinogenic COCs for commercial workers and construction workers, respectively. The carcinogenic COC with the greatest risk is benzo(a)pyrene. Risk characterization summaries are not provided for noncarcinogens because the HIs were less than 1.

Table 7-5A: Risk Characterization Summary – Carcinogens, Commercial Worker

Scenario Timeframe: Current
Receptor Population: Commercial Worker
Receptor Age: t Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	On-site - Direct Contact	Benzo(a)anthracene	8.0×10^{-7}	NA	7.9×10^{-7}	1.6×10^{-6}
			Benzo(a)pyrene	5.0×10^{-6}	NA	5.0×10^{-6}	1.0×10^{-5}
			Benzo(b)fluoranthene	7.5×10^{-7}	NA	7.5×10^{-7}	1.5×10^{-6}
	Dust	On-site - Inhalation of Soil as Dust	Benzo(a)anthracene	NA	1.3×10^{-11}	NA	1.3×10^{-11}
			Benzo(a)pyrene	NA	7.9×10^{-11}	NA	7.9×10^{-11}
			Benzo(b)fluoranthene	NA	1.2×10^{-11}	NA	1.2×10^{-11}

Key
NA : Route of exposure is not applicable to this medium.

This table provides the maximum risk estimates for the significant routes of soil exposures for the COCs. These risk estimates are based on a reasonable maximum exposure for 25 years and were developed by taking into account various conservative assumptions about the frequency and duration of a future adult commercial worker's exposure to soil, as well as the toxicity of the COCs.

Table 7-5B: Risk Characterization Summary - Carcinogens, Construction Worker

Scenario Timeframe: Current
Receptor Population: Construction/Excavation Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Concern	Carcinogenic Risk			
				Ingestion	Inhalation	Dermal	Exposure Routes Total
Soil	Soil	On-site - Direct Contact	Benzo(a)pyrene	6.6×10^{-7}	NA	3.0×10^{-7}	9.6×10^{-7}
	Dust	On-site - Inhalation of Soil as Dust	Benzo(a)pyrene	NA	4.3×10^{-9}	NA	4.3×10^{-9}

Key
NA : Route of exposure is not applicable to this medium.

This table provides the maximum risk estimates for the significant routes of soil exposures for the COCs. These risk estimates are based on a reasonable maximum exposure for 25 years and were developed by taking into account various conservative assumptions about the frequency and duration of a future construction/excavation worker's exposure to soil, as well as the toxicity of the COCs.

Lead is also a COC that was evaluated but is not included in Tables 7-5A and 7-5B because it is evaluated based on predicting lead concentrations in the bloodstream rather than exposure concentrations or doses. The California Adult Blood-Lead Model (California OEHHA, 2009) was used to estimate blood lead levels in adults from exposures to site soils and compared to the target of 1 µg/dL. The predicted concentrations for adult workers ranged from a low of 0.02 µg/dL in AOC 2 to a high of 7.1 µg/dL in AOC 13 (RI/FS Appendix F-4). The risk in AOCs 1, 6, and 10 is probably higher, but because the concentrations in these AOCs exceeded industrial screening levels and remediation is required, these AOCs were not evaluated in the HHRA.

7.1.6 Cleanup Levels

Cleanup levels were developed for the identified COCs in order to protect future workers from unacceptable exposures. Risk-based cleanup levels for each COC were developed based on the range of risks considered acceptable by EPA, that is, one-in-one-million (1×10^{-6}) to one-in-ten-thousand (1×10^{-4}). For lead, the Adult Blood-Lead Model was used to develop a concentration of inorganic lead in soil that would result in a blood-lead concentration equal to 1 µg/dL in exposed workers. Specific cleanup levels and associated risks are presented in Section 8.2.

7.1.7 Uncertainty Analysis, Human Health Risk Assessment

Each step in the quantitative HHRA has uncertainties due to assumptions that could increase or decrease the likelihood of an actual threat to human health. Sources of uncertainty include, but may not be limited to:

- Data collection: Sampling was biased toward areas of suspected elevated chemical concentrations. This would tend to overestimate the risk.

- Exposure Assessment. Assumptions are based on default conditions recommended by EPA and DTSC. The frequency and duration of Site workers' contacts with COPCs in soil and air would tend to be less than the default assumptions. Furthermore, COPC concentrations in soil and soil gas could decrease over time. Despite this possibility, the exposure assessment assumes that Site workers come in contact with the same chemical concentrations for the entire period of exposure. Therefore, the health risks are more likely to be overestimated.

  Job tenure of the workers was assumed to be 25 years. Risk would be overestimated for workers who remain employed at the Site for shorter periods of time and would have lower exposures and, consequently, less likelihood of increased incidence of cancer and other health effects. Risk could be underestimated for someone who works at the Site for longer than 25 years and more than 8 hours per day regularly.

- Toxicity Assessment. Toxicity information is based largely on animal studies that are adjusted to extrapolate effects on humans. Uncertainty factors applied to the toxicity data obtained from animal studies contribute a layer of conservatism that could lower the concentration from what would actually cause a health effect. Thus, the risk estimates would tend to be overestimated rather than underestimated.

  Toxicity assessments may be based on data from animal studies. To account for the extrapolation from effects in animals to effects in humans, the concentration that resulted in a no-observed-adverse effect in animals are reduced 10-fold to 1000-fold to convert to a "safe" value for human intake, depending on the amount and quality of the information available. These are uncertainty factors and, while efforts are made to overestimate the risk, it is possible that the risk could be underestimated.

7.2.0 Summary of Ecological Risk Assessment

A phased approach was used to assess the potential for risk to ecological receptors. As there is no exposure of ecological receptors to contaminated groundwater (Section 5.3, Conceptual Site Models), no ecological risk assessment was conducted for this media. So far as soil and soil gas contaminants are concerned, EPA determined that the hillside area, designated as AOC 1, is the only area that warranted a screening level ecological risk assessment (SLERA). All other parts of the property are graded to bare soil or are largely devoid of vegetation or any other features constituting habitat (Section 5.2, Site Ecology). At the conclusion of the SLERA for AOC 1, EPA concluded that lead in soil was the only contaminant that generated unacceptable ecological risk and that evaluation of remedial options for this contaminant could be forwarded directly to the Feasibility Study without further risk assessment.

7.2.1 Identification of Chemicals of Concern

In order to select ecological chemicals of concern (COCs), soil-related exposure pathways associated with the following terrestrial receptor groups were evaluated in the SLERA: terrestrial plants, soil invertebrates, and terrestrial birds and mammals. Chemicals of potential ecological concern (COPECs) were identified in soil exposure pathways as being those chemicals with a 5% or greater detection frequency and, for inorganics, exceeding the site-specific background concentrations. COPECs identified for the 0 to 1 foot and 0 to 6 foot sample depths were copper, lead, PCBs, PAHs, and VOCs. In addition to VOCs in soil, exposure to these COPECs in soil gas by burrowing animals via inhalation was quantitatively evaluated in the SLERA. All receptor groups were assumed to be exposed to surface soil (0 to 1 ft bgs) but only mammals (burrowers) were assumed to be exposed to the combination of surface and subsurface soil (0 to 6 ft bgs) as well as soil vapors in their burrow. The following list presents the hierarchy of sources of ecological screening levels (ESLs) for soil that were used for this SLERA:

- EPA's *Interim Ecological Soil Screening Levels* (EcoSSLs) (USEPA, 2005c);
- Oregon Department of Environmental Quality's (ODEQ's) *Level II Screening Level Values* (SLVs) (DEQ, 2001);
- Toxicity reference values (TRVs) in EPA's *Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities* (USEPA, 1999b); and
- Primary literature documents for PAHs and soil invertebrates (Sverdrup, Nielsen, and Krogh, 2002).

The COPECs were compared to ecotoxicity screening levels (ESLs) as detailed in the SLERA. For COPECs in soil, the exposure point concentration was the lower of the maximum detected concentration in AOC 1 or the 95% upper confidence limit on the mean. Of all the COPECs identified in soil 0 to 1 feet bgs, only lead, pyrene, phenanthrene, and 1,2,4-trimethylbenzene had exposure point concentrations that exceeded ESLs. Of all the COPECs identified in soil 1 to 6 feet bgs, only copper and lead had exposure point concentrations exceeding ESLs. These five contaminants became final COPECs, which were then evaluated further.

7.2.1.1 Soil – Inorganics

A total of 20 locations had total lead concentrations above the ESLs (26 mg/kg for 0 to 1 ft bgs samples and 56 mg/kg for 1 to 6 ft bgs samples). Maximum concentrations of lead were 18,000 mg/kg in surface soil and 20,000 mg/kg in subsurface soil. Based on the 95% UCL, the hazard quotients for lead were 150 for surface soil and 49 for subsurface soil (mammals only). (Lead ecological risk is calculated as an HQ, not a blood-lead concentration as for humans). As such, lead was determined to be a COC.

One location exhibited copper above the mammalian ESL, and this was in the subsurface sample at 5 ft bgs. It is unlikely that burrowing mammals would be exposed to the copper concentration at this one location over a chronic exposure period, and the concentration is moderately elevated (approximately ten times the ESL). Based on the level of conservatism reflected in the exposure assumptions for burrowing mammals (i.e., continuous contact), adverse effects to this receptor group from copper in subsurface soils are expected to be negligible and copper is not a COC.

7.2.1.2 Soil – Organics

The final COPECs were two PAHs and one VOC in 0 to 1 feet bgs. Of these organic COPECs, the hazard quotients were 1.04 for phenanthrene, 1.8 for pyrene, and 2.1 for 1,2,4-trimethylbenzene. These low hazard quotients viewed in conjunction with the conservative assumptions used in the SLERA indicate that organics are not COCs in AOC 1.

7.2.1.3 Soil Gas

Of the 12 VOCs detected in the soil gas sample collected from 5 ft bgs at Pit #7, two were reported at concentrations slightly above the lower screening levels protective of burrowing mammals as described in the SLERA. Given the minimal amount by which the soil gas measurements exceeded screening levels and the highly conservative assumptions factored into the inhalation pathway evaluation, there was no further assessment of this pathway.

7.2.1.4 Summary of Chemicals of Concern

Thus lead is the only final COPEC that was identified as a COC. COCs for ecological receptors are typically identified from the roster of final COPECs only after the more rigorous baseline ecological risk assessment is conducted. However, with only one final COC, a baseline ecological risk assessment was not deemed necessary for this project. EPA was able to determine that lead is a COC in soil based on its concentrations above ecological screening levels (Table 7-6).

Table 7-6: Chemicals of Concern, SLERA

Receptor	COPEC of Concern	Min Conc[1] (ppm)	Max Conc[1] (ppm)	Mean Conc (ppm)	95% UCL of the Mean[2] (ppm)	Background Conc (ppm)	Screening Tox Value (ppm)	Screening Tox Value Source[3]	HQ Value[4]	COC Flag (Y or N)
Exposure Medium: Soil (0 – 1 ft bgs)										
Plants	Lead	1.8	18,000	470	2700	26	120	EcoSSL – Plants	150	Y
Insects	Lead	1.8	18,000	470	2730	26	1700	EcoSSL – Soil Invertebrates	11	Y
Birds[5]	Lead	1.8	18,000	470	2730	26	26	Background[5]	110	Y
Mammals	Lead	1.8	18,000	470	2730	26	56	EcoSSL – Mammals	49	Y
Exposure Medium: Soil (0 – 6 ft bgs)[6]										
Mammals	Lead	2	20,000	700	2400	26	56	EcoSSL – Mammals	43	Y

Notes
[1] Minimum/maximum detected concentration above the method reporting limit (MRL).
[2] The 95% Upper Confidence Limit (UCL).
[3] EcoSSL: USEPA March 2005. Ecological Soil Screening Levels for Lead Interim Final. U.S. Environmental Protection Agency Office of Solid Waste and Emergency Response.
[4] Hazard Quotient (HQ) is defined for Plant and Soil Invertebrate as the Maximum detected concentration divided by the Screening Toxicity Value. HQ is defined for Birds and Mammals as the lower of the Maximum detected concentration and 95% UCL divided by the Screening Toxicity Value.
[5] The site-specific background concentration of lead was used as the default Screening Toxicity Value for Birds because the EcoSSL for Birds is below background.
[6] Only burrowing mammals were assumed to be exposed to the 0 to 6-feet bgs depth interval.

7.2.2 Exposure Assessment

The ecological setting of the Site is described in Section 5.2, Site Ecology. A search of the California Department of Fish and Game's California Natural Diversity Database (CNDDB) indicate that three of the 16 special status species observed within the Fillmore 7.5' United States Geologic Survey Quadrangle have been noted within a 1-mile radius of the Site: pallid bat (*Antrozous pallidus*), hoary bat (*Lasiurus cinereus*), and two-striped garter snake (*Thamnophis hammondii*) (Figure 24 of the Phase 3 Report in Appendix B). No special status species were noted during the one-day biological survey that was performed in February 4, 2009. No special status birds were reported in the CNDDB as observed within a 1-mile radius of the Site. However, the potential for special status birds reported within the Fillmore Quad to be present at the Site was considered because avian species often have significantly larger home ranges than ground-dwelling animals. Although three protected species of birds have been identified within the Fillmore Quad, more attractive habitats nearby would likely result in transient exposure, if any. The Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) and Least Bell's vireo (*Vireo bellii pusillus*) prefer riparian habitats, and the California condor (*Gymnogyps californianus*) requires vast expanses of open grasslands. No riparian habitat is present within the study areas, and the open vegetated areas (mainly at AOC 1) would be of limited value to a condor in comparison to the surrounding habitats, primarily to the east and north of the Site.

The special status species reported by the CNDDB are either not expected to be present due to inadequate habitat conditions at AOC 1 (mainly the lack of permanent water bodies and roosting environments) or would likely be present on an intermittent or transitory basis only. Although the bats could forage in the vicinity of the Site, the duration spent there would likely be short due to the lack of species-suitable habitat, and their main source of food (airborne insects) have little contact with soil-bound contaminants which limits the potential for exposure through food items. Therefore, exposure to bats from site-related contamination would probably be very low, if at all. There is very little toxicological data available for assessing risk to reptiles, such as the two-striped garter snake, and it is believed that the risks assessed here, and any actions taken to protect other species, should be protective of reptiles.

The findings of the SLERA indicated that lead is the primary risk driver in soil at AOC 1, with ecological screening levels that are exceeded for all receptor groups at the surface and for burrowing mammals in subsurface soils. An ecological conceptual site model (Figure 5-4) reflects the findings of the SLERA and shows the ecological receptors and exposure pathways. The following exposure pathways are presented as complete and potentially significant:

- Direct contact (uptake or dermal contact) with surface soil by terrestrial plants and soil invertebrates;
- Incidental ingestion and food web exposures originating from surface soil by terrestrial birds and mammals; and
- Incidental ingestion of subsurface soil by burrowing mammals.

7.2.3 Ecological Effects Assessment

The assessment endpoints for the terrestrial ecological receptors are:

- Protection of the terrestrial plant community and soil invertebrate populations that may be exposed to COPECs in surface soil to maintain species diversity, abundance, and nutrient cycling.
- Protection of resident small birds and mammals, with no unacceptable effects on reproduction or development at a population level due to COPECs in soil and food items (e.g., terrestrial plants, invertebrates, and small mammals).
- Protection of resident burrowing mammals, with no unacceptable effects on reproduction or development at a population level due to COPECs in soil vapors confined in burrow air.
- Protection of top-level predatory birds and mammals, with no unacceptable effects on reproduction or development at a population level due to COPECs in soil and food items (e.g., small mammals and birds).

The measurement endpoints, as is commonly the case for a SLERA, involved comparing COPEC concentrations from the Site to appropriate ESLs. This information is summarized in Table 7-7.

Table 7-7: Ecological Exposure Pathways of Concern

Exposure Medium	Sensitive Environment Flag (Y or N)	Receptor	Endangered/ Threatened Species Flag (Y or N)	Exposure Routes	Assessment Endpoints	Measurement Endpoints
Surface Soil (0-1ft bgs)	N	Terrestrial Plants	N	Uptake/ Dermal Contact	Maintain species diversity, abundance, and nutrient cycling	Toxicity due to soil concentrations in exceedance of screening toxicity value related to maintenance of the terrestrial plant community
		Soil Invertebrates	N	Dermal Contact	Maintain species diversity, abundance, and nutrient cycling	Toxicity due to soil concentrations in exceedance of screening toxicity value related to maintenance of the terrestrial soil invertebrate community
				Incidental Ingestion		
		Resident Small Birds and Mammals	N	Incidental Ingestion	No unacceptable effects on reproduction or development at a population level	Toxicity due to soil concentrations in exceedance of screening toxicity value related to survival, growth, and reproduction of resident populations of birds and mammals
				Food Web		
		Top-Level Predatory Birds and Mammals	N	Incidental Ingestion	No unacceptable effects on reproduction or development at a population level	Toxicity due to soil concentrations in exceedance of screening toxicity value related to survival, growth, and reproduction of resident populations of birds and mammals
				Food Web		
Surface and Subsurface Soil (0-6 ft bgs)	N	Burrowing Mammals	N	Incidental Ingestion	No unacceptable effects on reproduction or development at a population level	Toxicity due to soil concentrations in exceedance of screening toxicity value related to survival, growth, and reproduction of resident populations of mammals
				Food Web		

7.2.4 Ecological Risk Characterization and Cleanup Levels

A total of 19 locations have lead concentrations above the lead screening level; seven of these locations coincide with levels above human health screening levels. Lead at the surface poses the greatest risk to ecological receptors, even though lead concentrations are higher in subsurface samples. Ecological receptors that do not burrow are most likely to come into direct contact with only the first few inches of soil.

In summary, existing conditions are not protective of ecological receptors in some parts of AOC 1. For surface soil, the selected lead cleanup level is the site-specific background level of 26 mg/kg, and for subsurface soil it is EPA's interim ecological soil screening level for mammals of 56 mg/kg (Table 7-8). There are 19 areas in AOC 1 that need to be cleaned up in order to reduce ecological risk to acceptable levels.

Table 7-8: COC Concentrations, Ecological Receptors

Habitat Type/ Name	Exposure Medium	COC	Protective Level	Units	Basis[1]	Assessment Endpoint
Terrestrial/AOC1	Soil – 0 to 1 foot bgs	Lead	26	mg/kg	Site-specific background	Protection of small birds and mammals with no unacceptable effects on reproduction or development
	Soil – 1 to 6 feet bgs	Lead	56	mg/kg	EPA EcoSSL -- Mammals	Protection of burrowing mammals with no unacceptable effects on reproduction or development

Notes
[1]The site-specific background concentration of lead was used as the default Screening Toxicity Value for birds because the EcoSSL for birds is below background. Therefore, to be protective of all terrestrial receptors, including birds, the background concentration is presented in this table.

7.2.5 Uncertainty Analysis, Screening Level Ecological Risk Assessment

The ecological risks are more likely to be overestimated than underestimated. Risks were estimated from the maximum contaminant concentrations found on site or from the 95% UCL on the mean of site concentrations. This intentionally over-predicts risk, especially for mobile receptors. In addition, the ESLs used in the risk estimation were also intentionally conservative. Balanced against this conservatism were two potential factors that underestimate risk. The first of these was there were some combinations of receptors and COPECs that lacked an ESL. The second was the occurrence of analytical detection limits that were greater than some ESLs. As described in the RI/FS, there were only limited instances of these factors which potentially underestimate risk. Taking all sources of uncertainty into account, it is likely there is a small overestimation of ecological risk for all COPECs.

7.3.0 Basis for Remedial Action

The response actions selected in this ROD Amendment are necessary to protect human health and the environment from actual releases of hazardous substances into the environment. The response actions are warranted because:

- Groundwater contains contaminants above acceptable risk levels, i.e., drinking water standards;
- Concentrations of lead, PAHs, and soil gas in the shallow soil exceed the levels necessary to protect on-site workers, recreational users, and ecological receptors;
- The Site will not be cleaned up to allow for unrestricted use, so institutional controls (ICs) are needed to ensure that the future use of the property is limited to commercial and recreational uses and the integrity of the Site cap is maintained; and
- ICs are needed to ensure no one uses the contaminated groundwater before groundwater cleanup levels are attained.

8.0 Remedial Action Objectives

The RAOs provide a general description of what the cleanup will accomplish at the Site. These goals serve as the design basis for the remedial alternatives which are presented in Section 9.

The RAOs of the 1992 ROD were to reduce groundwater contamination levels below drinking water standards and to reduce migration of contamination in the vadose zone. The remedy succeeded in achieving the latter but not the former. In addition to cleaning up water to drinking water standards, this ROD Amendment includes other RAOs to ensure that the remedy is protective of human health and the environment.

8.1 Remedial Action Objectives

- Prevent human exposure through direct dermal contact, ingestion, and inhalation of shallow soil and soil vapor contaminated above threshold levels for commercial land use, construction activities, and recreational activities.

  Basis: This objective was established in order to allow for the reasonably anticipated future use of the property for commercial and recreational purposes and to protect property users from potential exposure to contaminants in the shallow soil that exceed established risk-based threshold levels.

  Addressing risk: Removing contaminated soil will reduce the amount of contamination to an acceptable exposure level for a commercial or recreational user.

- Prevent use of contaminated groundwater and restore the aquifer to the most beneficial use, i.e., drinking water, within a reasonable time frame.

  Basis: This objective was established in order to prevent potential exposure to groundwater with contamination above regulatory limits and to restore the aquifer to its most beneficial use.

  Addressing risk: Preventing use of contaminated groundwater will reduce to acceptable levels the risk associated with exposure to water with chemicals above drinking water standards.

- Prevent contaminants in waste pit (lead, PAHs) from migrating into underlying groundwater.

  Basis: This objective is to protect groundwater from potential future contamination.

  Addressing risk: This will eliminate the risk associated with using water contaminated with lead and PAHs.

- Reduce contamination in soil below toxicity threshold levels so it is not toxic to the plants and animals of the existing scrub habitat.

Basis: This objective is to protect the on-site scrub habitat and the ecological receptors.

Addressing risk: This will reduce the risk posed by lead to all ecological receptors in the Site habitat.

8.2 Cleanup Levels

Table 8-1 presents the cleanup levels for all of the COCs, for both human and ecological receptors at the Site. Cleaning the contaminants in soil and groundwater to these levels will control the risks posed by them. The cleanup levels for groundwater are California MCLs, which are more protective than federal drinking water standards. For carcinogens, a cleanup level risk of 10^{-6} was selected because it will be more protective in the long-term. This is discussed further in Section 12.3.3, Description of Selected Remedy, Soil. For lead the cleanup level is 320 mg/kg, based on a risk of 1 µg/dL. There are two soil cleanup levels for ecological receptors in AOC 1; the deeper soil cleanup level is to protect burrowing mammals.

Table 8-1: Cleanup Levels

Chemical of Concern	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
HUMAN RECEPTORS			
GROUNDWATER	**µg/L**		
Benzene	1	California MCL	cancer, 2.4 x 10^{-6}
Toluene	150	California MCL	non-cancer, Hazard Index < 1
SOIL	**mg/kg**		
Metals			
Lead	320	Risk Assessment	Blood-lead = 1 µg/dL
Polycyclic Aromatic Hydrocarbons			
Benzo(a)anthracene	1.2	Risk Assessment	Cancer, 1 x 10^{-6}
Benzo(a)pyrene	0.12	Risk Assessment	
Benzo(b)fluoranthene	1.2	Risk Assessment	
Benzo(k)fluoranthene	1.2	Risk Assessment	
Chrysene	12	Risk Assessment	
Dibenz(a,h)anthracene	0.35	Risk Assessment	
Indeno(1,2,3-cd)pyrene	1.2	Risk Assessment	
Naphthalene	13	Risk Assessment	
SOIL GAS	**µg/L**		
Benzene	0.62	CHHSL	Cancer, 1 x 10^{-6}
Ethylbenzene	7.8	CHHSL	
Naphthalene	0.65	CHHSL	
ECOLOGICAL RECEPTORS - SOIL	**mg/kg**		
Lead in surface soil, top 6 inches	26	SLERA	acceptable
Lead in subsurface soil, down to 6 feet	56	SLERA	acceptable

9.0 Description of Remedial Alternatives

The 1992 ROD targeted only the two plumes of contaminated groundwater and the overlying vadose zone. The selected remedy was groundwater pump and treat and soil vapor extraction. The contamination in the extracted groundwater and soil vapor was to be removed by carbon adsorption. EPA anticipated that this remedy would clean up the groundwater to drinking water standards in 30 years. However, these two technologies were not successful in cleaning up the groundwater to drinking water standards and so different remedial alternatives have been evaluated.

The 1992 ROD also called for fencing and restricted site access. Based on current standards, these controls are not sufficient to protect human health and the environment in the long term, therefore new institutional controls have been selected.

The alternatives presented in this Amendment will address both the contamination remaining in groundwater and the contamination in the shallow soil. The reasonably anticipated future land use is commercial and recreational.

There are three main Site zones that require remediation: the southern groundwater plume (GWS), the northern groundwater plume (GWN), and shallow soil on the former refinery property down to 10 ft bgs. The remedial technologies and evaluations are divided into two media: groundwater and soil. In the RI//FS numerous remedial technologies to clean up groundwater and soil were evaluated. Based on the results of the preliminary review, some were eliminated and the remainder were evaluated further. The groundwater technologies presented here for the southern and northern plumes are identical, but there are differences in the number of wells, the length of estimated treatment times, and costs between the two plumes.

Alternatives were screened out if they were not protective of human health and the environment and did not comply with applicable or relevant and appropriate requirements (ARARs). In the RI/FS, two alternatives that were not screened out and were included in the detailed analysis of alternatives were later determined to not be protective of human health and the environment. These alternatives were composting with organic manure and solidification with a phosphate-based stabilizer. Further review of these alternatives showed that the composting would not remediate lead and the solidification with phosphate would not remediate PAHs, so these alternatives were screened out.

The alternatives that met the first two of the nine criteria used to evaluate alternatives, overall protection of human health and the environment and compliance with ARARs, are described in detail below. For groundwater, a No Change to Current Remedy alternative was included as a baseline for comparative analysis purposes. For soil, a No Action alternative was included. Even though these baseline alternatives were determined to not be protective of human health and the environment and do not comply with ARARs, they were retained as Alternative 1 for each area of remediation.

The groundwater remedial alternatives are:

- GW-1: No Change to Current Remedy

- GWS-2 and GWN-2: Monitored Natural Attenuation (MNA), ICs
- GWS-3 and GWN-3: Air Sparging and MNA, ICs
- GWS-4 and GWN-4: Enhanced Bioremediation with Sulfate and MNA, ICs
- GWS-5 and GWN-5: Multiple Technologies, ICs

The soil remedial alternatives are:

- S-1: No Action
- S-2: Soil Excavation, Off-Site Disposal, ICs
- S-3: Soil Excavation, On-Site Disposal, Capping, ICs
- S-5a: Soil Excavation, On-Site Solidification and Disposal, ICs

9.1 Groundwater Alternatives, Common Elements: ICs, MNA, ARARs

All of the alternatives, with the exception of Alternative GW-1 (No Change to Current Remedy) include the following common elements:

Institutional Controls: All groundwater alternatives include institutional controls (ICs). ICs are non-engineered controls applied to property to minimize the potential for exposure to contamination left on a property, to minimize the potential for exposure during a long-term treatment before cleanup levels are reached, and/or to protect the remedy after it is completed. Each groundwater alternative relies on both continued enforcement of the City of Fillmore restriction on drilling wells in areas of contaminated groundwater until the cleanup levels are reached and a restrictive covenant for property use. ICs include the following components:

- Types of control: For groundwater under Chevron property, deed restrictions and a restrictive covenant between the State and property owner; for groundwater under City of Fillmore, notices of contamination, and restriction on extraction and use of groundwater;
- Relationship of control to remedy: To protect people from drinking contaminated water;
- Objectives obtained by ICs: Prevent exposure to contaminants in groundwater;
- Performance standards: Prohibit well drilling to prevent use of contaminated groundwater;
- Monitoring: Groundwater monitoring to verify the plume is not spreading and monitoring to ensure the ICs are implemented and enforced until cleanup levels are reached; and
- Responsible entities: For site-wide groundwater monitoring, Chevron. For use restrictions for groundwater under Chevron property, deed restrictions by Chevron when property is conveyed, and a restrictive covenant to be signed by Chevron, California DTSC, and EPA, and filed at the Ventura County Recorder's office. For groundwater use restrictions within Fillmore city limits, the City is responsible for enforcement. Chevron will provide notices of contamination to property owners whose property overlies the plumes of contaminated groundwater.

Monitored Natural Attenuation: Each alternative includes Monitored Natural Attenuation (MNA). MNA is a term that refers to the use of natural attenuation processes as part of site remediation. At the PCPL Site it involves letting naturally-occurring biological processes, both aerobic and anaerobic, reduce the amount of contaminants in groundwater. In order to select MNA as a remedy, there must be evidence that natural attenuation is occurring in the Site groundwater and that cleanup levels can be reached in a reasonable time frame. Evidence of natural attenuation at the Site is presented in Section 5.5 of this ROD Amendment and in the RI/FS, Appendix E. MNA includes long-term monitoring to verify that the groundwater plumes are not spreading and that progress is being made towards attainment of cleanup levels. There will be an adequate monitoring network to allow EPA to assess this progress.

Key Groundwater ARARs: The key ARAR for the groundwater alternatives is California drinking water standards.

9.2 Description of Groundwater Alternatives

<u>SOUTHERN PLUME</u>

This section presents each of the groundwater alternatives and describes the features that are unique to each remedial option. In the southern plume there are two COCs, benzene and toluene. For each alternative the key components, O&M activities, monitoring requirements, length of time, and present value costs are included. The estimated costs are presented in Table 9-1 (pg. 60).

Alternative GW-1: No Change to Current Remedy

- 1992 ROD (pump and treat, SVE) would remain in place;
- Operation & Maintenance (O&M) would remain the same;
- Current monitoring would continue;
- No ICs.

Cleanup levels would not be reached in the estimated timeframe of 30 years (the year 2022, based on 1992 ROD). The present value cost of this alternative is an estimated $7 million.

Alternative GWS-2: Monitored Natural Attenuation (MNA)

- MNA;
- ICs to prevent use of groundwater until cleanup levels achieved;
- Standard O&M for monitoring wells;
- Monitoring network of fourteen wells.

Cleanup levels to be reached in an estimated 100 years. Present value cost of this alternative is an estimated $590,000.

Alternative GWS-3: Air Sparging with Vapor Monitoring & MNA

- Air sparging with up to 51 sparge wells (Figure 9-1);
- If needed, 1 SVE well;
- O&M for sparging wells, monitoring wells and probes;
- Monitoring: 10 groundwater monitoring wells, 15 piezometers, 15 vapor monitors;
- MNA;
- ICs.

Sparge wells would be used to inject air into the groundwater. The primary target of air sparging would be the LNAPL. If sparging results in soil gas reaching health-based concentrations (122 µg/m^3, based on CHHSL) at five feet below the ground, an SVE system using granular activated carbon would be installed. The system would operate for an estimated 20 years, followed by MNA for 10 years. Cleanup levels to be reached in an estimated 30 years. Present value cost of this alternative is an estimated $5.7 million.

Alternative GWS-4: Enhanced Bioremediation With Sulfate & MNA

- Groundwater circulation with up to 20 circulation wells;
- O&M for circulation wells and groundwater monitoring wells;
- Monitoring: 10 groundwater monitoring wells, 9 performance monitoring wells;
- MNA;
- ICs.

Groundwater circulation is an innovative technology that takes advantage of the naturally occurring sulfate-rich groundwater below the contaminant plume. Wells would pull deeper groundwater from below the benzene plume up into the benzene plume. This deeper water has more sulfate than the water that has been exposed to benzene. Sulfate is highly soluble in water and when sulfate-rich groundwater is introduced into the benzene plume, the sulfate is available to the sulfate-consuming bacteria, which can then readily destroy the benzene. Enhanced bioremediation would operate for an estimated 50 years, followed by MNA for 10 years. Cleanup levels to be met in an estimated 60 years. The present value cost of this alternative is an estimated $4.67 million.

Alternative GWS-5: Multiple Technologies; *<u>Selected Alternative</u>*

- Air sparging with up to 51 sparge wells;
- If needed, 1 SVE well;
- Enhanced bioremediation with up to 20 groundwater circulation wells;
- O&M to maintain equipment, take measurements, and collect data for sparge wells, vapor probes, circulation wells and groundwater monitoring wells;
- Monitoring: 14 groundwater monitoring wells, 15 piezometers, 15 vapor monitors, 9 air sparge performance monitoring wells;
- MNA;
- ICs.

This alternative is a phased approach to cleaning up the groundwater. A combination of southern plume Alternatives 2, 3, and 4 would be used to clean up groundwater at the Site. The number of treatment and monitoring wells would remain the same but the length of time for each treatment phase would be reduced. First to be implemented would be air sparging to target the LNAPL, operating until the system is no longer effective, estimated to be no more than six years. Next would be groundwater circulation to enhance bioremediation in order to target the dissolved benzene and toluene, estimated to take up to nine years. This technology would be used until benzene reaches 100 µg/L. Then MNA would be implemented to eliminate the remaining contamination in groundwater. Cleanup levels to be reached in an estimated 25 years. The present value cost of this alternative is an estimated $6.4 million.

NORTHERN PLUME

In the northern plume benzene is now the only COC above its cleanup level. Toluene concentrations have been below the California drinking water standard of 150 µg/L for two years. For each alternative the key components, O&M activities, monitoring requirements, length of time, and present value costs are included. The estimated costs are presented in Table 9-1 (pg. 60).

Alternative GW-1: No Change to Current Remedy

- 1992 ROD (pump and treat, SVE) would remain in place;
- O&M would remain the same;
- Current monitoring would continue;
- No ICs.

Cleanup level would not be reached in the estimated timeframe of 30 years (the year 2022, based on 1992 ROD). The present value cost of this alternative is an estimated $7 million.

Alternative GWN-2: Monitored Natural Attenuation (MNA); *Selected Alternative*

- MNA;
- ICs to prevent use of groundwater until cleanup level achieved;
- Standard O&M for monitoring wells;
- Monitoring network of five existing wells and two additional wells.

Cleanup level to be reached in an estimated 50 years. Present value cost of this alternative is an estimated $598,000.

Alternative GWN-3: Air Sparging with Vapor Monitoring & MNA

- Air sparging with up to 3 sparge wells;
- If needed, 1 SVE well;
- O&M for sparging wells, monitoring wells and vapor probes;
- Monitoring: 7 groundwater monitoring wells, 4 piezometers, 4 vapor monitors;
- MNA;
- ICs.

If sparging results in soil gas reaching health-based concentrations (122 $\mu g/m^3$, based on CHHSL) at five feet below the ground, an SVE system using granular activated carbon would be installed. Air sparging would operate for an estimated 15 years, followed by MNA for 10 years. Cleanup level to be reached in an estimated 25 years. Present value cost of this alternative is an estimated $2.7 million.

Alternative GWN-4: Enhanced Bioremediation With Sulfate & MNA

- Groundwater circulation with up to 4 circulation wells;
- O&M for circulation wells and groundwater monitoring wells;
- Monitoring: 7 groundwater monitoring wells, 3 performance monitoring wells;
- MNA;
- ICs.

See Alternative GWS-4 for description. Up to four circulation wells would operate for an estimated 30 years, followed by MNA for 10 years. Cleanup level to be reached in an estimated 40 years. The present value cost of this alternative is an estimated $2.7 million.

Alternative GWN-5: Multiple Technologies

- Air sparging with up to 3 sparge wells;
- If needed, 1 SVE well;
- Enhanced bioremediation with up to 4 groundwater circulation wells;
- O&M to maintain equipment, take measurements, and collect date for sparge wells, vapor probes, circulation wells and groundwater monitoring wells;
- Monitoring: 7 groundwater monitoring wells, 4 piezometers, 4 vapor monitors, 3 air sparge performance monitoring wells;
- MNA;
- ICs.

See Alternative GWS-5 for a description. Air sparging would be done for up to four years, followed by enhanced bioremediation for up to six years, followed by MNA for up to ten years. Cleanup level to be reached in an estimated 20 years. The present value cost of this alternative is an estimated $2.94 million.

Expected Outcomes

The expected outcome for the 1992 ROD was meeting drinking water standards in 30 years. This outcome could not be met by the selected remedy, thus the shut-down of the groundwater extraction system. The expected outcomes of the new groundwater alternatives are:

- Alternative GW-1: cleanup goals would not be achieved because drinking water standards would not be met in the southern and northern plumes by 2022.
- All other alternatives: drinking water standards would be met. The range for cleanup times in the southern plume is 25 to 100 years. The range for the northern plume is 20 to 50 years.

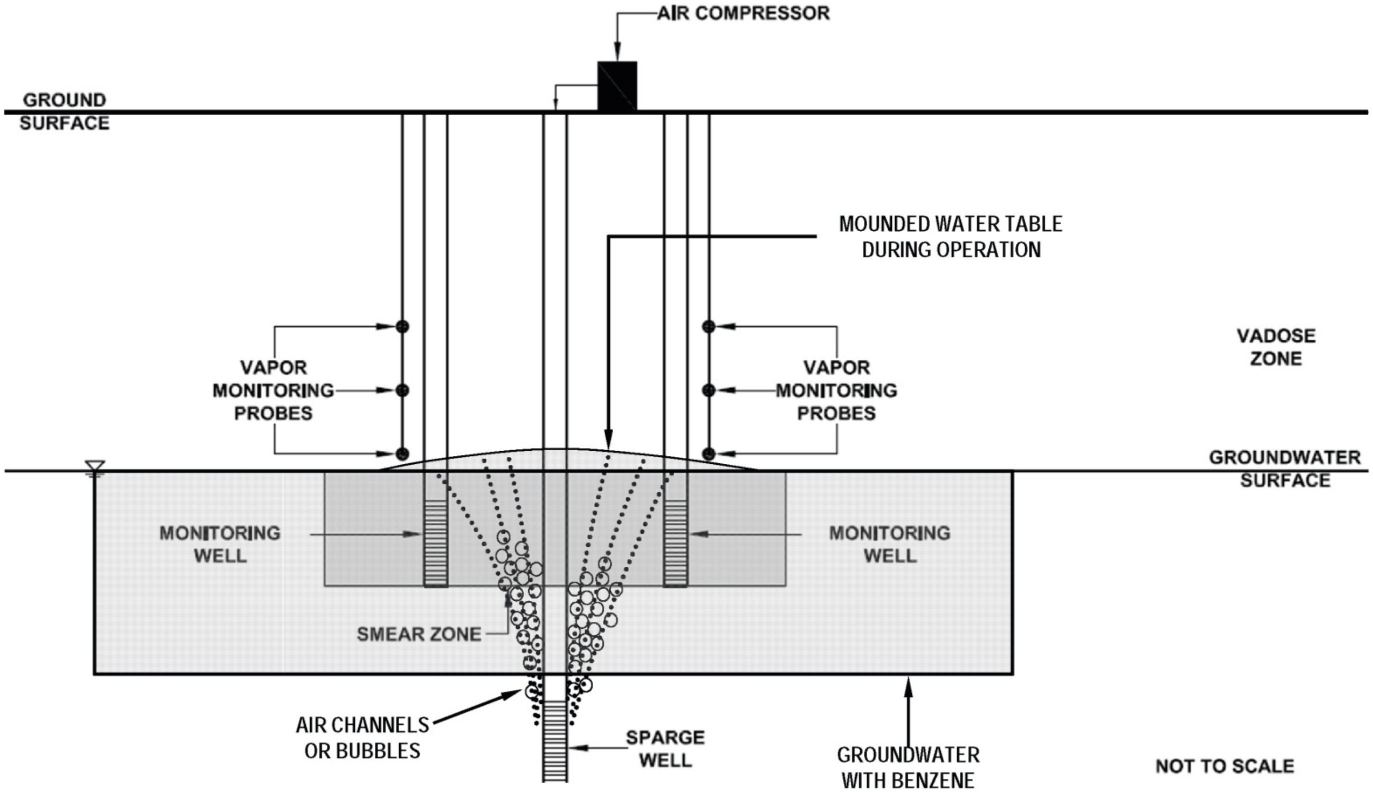

Figure 9-1
Air Sparging Schematic

SOIL

9.3 Soil Alternatives, Common Elements: ICs, ARARs

Except for Alternative S-1, No Action, each alternative:

- Addresses the top ten feet of soil;
- Includes cleanup of soil to a cancer risk of 10^{-6} and a blood-lead risk of 1 µg/dL;
- Involves excavation of 20,000 cubic yards of soil;
- Includes dust monitoring and dust suppression; and
- Reduces contamination to allow for future commercial and recreational uses only.

Alternatives S-3 and S-5a both include consolidation in the on-site former main waste pit.

Institutional Controls: Except for Alternative S-1, all soil alternatives include institutional controls with the following components:

- Types of control: Deed restrictions, a land use covenant between the State and property owner, and City zoning requirements;
- Relationship of control to remedy: To protect site users from long-term exposure to contaminated soil; to protect the remedy (waste pit cap) from construction activities;
- Objectives obtained by ICs: Prevent long-term exposure to contaminants in soil; prevent migration of contaminants in soil;
- Performance standards: Prohibit residential and other sensitive uses of the former refinery property;
- Monitoring: To ensure the ICs are implemented and enforced; and
- Responsible entities: Deed restrictions included by Chevron when property is conveyed; a restrictive covenant to be signed by Chevron, California DTSC, and EPA and filed at the Ventura County Recorder's office; zoning by the City of Fillmore.

ARARs: All of the soil alternatives comply with ARARs. The key ARARs are RCRA CAMU regulations and the California land use covenant requirements.

9.4 Description of Soil Alternatives

This section presents each of the soil alternatives and describes the key components, O&M, length of time, and present value costs. The estimated costs are presented in Table 9-1 (pg. 60).

Alternative S-1: No Action
EPA is required to consider a no action alternative. Under this alternative no soil would be cleaned up and no use restrictions would be placed on the property.

Alternative S-2: Soil Excavation, Off-Site Disposal, & ICs

- Off-site disposal of excavated soil;
- Approximately 1,000 truckloads of soil transported to a licensed facility;
- No O&M required;
- ICs.

This alternative has an estimated timeframe of 10 weeks and a present value cost of approximately $3.4 million.

Alternative S-3: Soil Excavation, On-Site Disposal, Capping, & ICs; *Selected Alternative*

- Consolidation of excavated soil in former on-site waste pit;
- Engineered cap to prevent leaching of contaminants into groundwater;
- Maintenance of cap required;
- ICs.

This alternative includes an additional IC to ensure cap integrity would be maintained. This alternative has an estimated time frame of 13 weeks and a present value cost of approximately $1.6 million.

Alternative S-5a: Soil Excavation, On-Site Solidification & Disposal, & ICs

- Ex-situ treatment, solidification with Portland cement;
- Consolidation of treated soil in former on-site waste pit;
- No O&M required;
- ICs.

Because the cement amendment would bind up the lead and PAHs and render them immobile, leaching of these contaminants would not occur and a cap would not be needed to protect groundwater. This alternative has an estimated timeframe of 14 weeks and a present value cost of approximately $1.7 million.

Expected Outcomes

For Alternative S-1 (No Action), RAOs would not be met. For the others, RAOs would be met and contamination in soil would be reduced to levels that allow for commercial and recreational use of the property after the remedial action is completed.

Table 9-1: Remedial Alternatives Cost Summary

Remedial Alternative	Description	Period (Years)	Capital Cost ($)	O&M Cost ($)	Periodic Cost ($)	Total Cost ($)	Present Value
Process Options for Shallow Soils - Risk Criteria of 1 x 10^{-6}							
# 1	No Action - Monitoring Only	0	$0	$0	$0	$0	$0
# 2a	Excavation: Off-Site Disposal at Landfill (commercial standards)	1	$3,325,954	$0	$47,500	$3,373,454	$3,370,346
# 2b	Excavation: Off-Site Disposal at Landfill (residential standards)	1	$25,201,530	$0	$47,500	$25,249,030	$25,245,923
# 3	Excavation: On-Site Consolidation and CAP	1	$1,549,325	$2,500	$47,500	$1,596,825	$1,593,718
# 5a	Excavation: Ex-situ Treatment by Solidification/Stabilization (using Cement) in Main Waste Pit	1	$1,617,050	$0	$47,500	$1,664,550	$1,661,443
Process Options for Shallow Soils - Risk Criteria of 1 x 10^{-5}							
# 3	Excavation: On-Site Consolidation and CAP	1	$1,292,710	$2,500	$47,500	$1,340,210	$1,337,103
# 5a	Excavation: Ex-situ Treatment by Solidification/Stabilization (using Cement) in Main Waste Pit	1	$1,229,710	$0	$47,500	$1,277,210	$1,274,103
Alternatives for Southern Groundwater Plume							
# 1	No Action - Monitoring Only	0	$0	$0	$0	$0	$0
# 2	Monitored Natural Attenuation	100	$174,197	$2,456,875	$330,000	$2,961,072	$587,938
# 3	Air Sparging with Vapor Monitoring (MNA for 10yrs)	30	$2,202,730	$6,035,113	$853,750	$9,091,592	$5,676,422
# 4	Groundwater Circulation: Enhanced Bioremediation using Sulfate (MNA for 10yrs)	60	$1,704,715	$9,421,344	$707,500	$11,833,558	$4,675,285
# 5	Multiple Technology - Air Sparge (6yrs), Circulation (9yrs), and MNA (10yrs)	25	$3,414,133	$4,133,291	$1,132,500	$8,679,924	$6,436,062
Alternatives for Northern Groundwater Plume							
# 1	No Action - Monitoring Only	0	$0	$0	$0	$0	$0
# 2	Monitored Natural Attenuation	50	$222,908	$1,120,625	$190,000	$1,533,533	$598,235
# 3	Air Sparging with Vapor Monitoring (MNA for 10yrs)	25	$669,892	$3,283,944	$276,250	$4,230,086	$2,726,268
# 4	Groundwater Circulation: Enhanced Bioremediation using Sulfate (MNA for 10yrs)	40	$740,689	$4,760,356	$323,125	$5,824,170	$2,773,778
# 5	Multiple Technology - Air Sparge (4yrs), Circulation (6yrs), and MNA (10yrs)	20	$1,173,152	$2,288,106	$340,000	$3,801,258	$2,939,441

Notes:
- EPA guidance document "A Guide to Developing and Documenting Cost Estimates During the Feasibility Study" dated July 2000.
- EPA guidance on present value calculations (current discount rate of 7%) obtained from "Revisions to OMB Circular A-94 on Guidelines and Discount Rates for Benefit-Cost Analysis" dated June 25, 1993.
- Institutional control costing is provided in each process option since it's an integral part of each alternative.
- The periodic cost for the shallow soil alternatives represents the construction completion report.

10.0 Comparative Analysis of Alternatives

To determine which remedial alternatives to select, EPA evaluated and compared them using nine evaluation criteria (40 C.F.R. § 300.430(e)(9)(iii)).

The nine evaluation criteria are:
- Overall protection of human health and the environment;
- Compliance with applicable or relevant and appropriate requirements (ARARs);
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability;
- Cost;
- State acceptance; and
- Community acceptance

The first two criteria, overall protection and compliance with ARARs, are defined under CERCLA as “threshold criteria.” If an alternative does not meet these two criteria, it is not eligible for selection. The next five criteria are defined as “balancing criteria.” These criteria are used to weigh major trade-offs among alternatives. The last two criteria, state and community acceptance, are defined as “modifying criteria.” In the final comparison of alternatives, modifying criteria and balancing criteria are of equal importance.

10.1 Threshold Criteria

10.1.1 Overall Protection of Human Health and the Environment

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

For groundwater, keeping the 1992 ROD remedy (Alternative GW-1) will not reduce groundwater to drinking water standards and will not provide for restrictions on the extraction and use of contaminated groundwater. For soil, no action (S-1) will not prevent exposure to soil with contamination above human and ecological risk-based levels. Because these two alternatives do not provide adequate protection of human health and the environment, they do not meet this criterion and are not discussed further in the nine criteria analysis.

SOUTHERN GROUNDWATER PLUME: All alternatives would achieve RAOs and provide overall protection of human health and the environment. Groundwater would be cleaned up to drinking water standards and ICs would be used to prevent groundwater extraction and use until the cleanup levels are achieved. The multiple technologies alternative (GWS-5) would take the shortest amount of time to reach the cleanup levels (approx. 25 years), followed by air sparging (30 years for GWS-3), enhanced bioremediation (60 years for GWS-4) and MNA (100 years for GWS-2).

NORTHERN GROUNDWATER PLUME: The overall protection achieved by the northern plume alternatives is identical to that for the southern plume, with GWN-5 taking 20 years, GWN-3 taking 25 years, GWN-4 taking 30 years, and GWN-2 taking 50 years to reach the cleanup level.

SOIL: All alternatives would achieve RAOs and provide overall protection of human health and the environment. The removal and disposal of contaminated soil would provide protection from exposure to contaminants due to direct contact, ingestion, and inhalation. ICs would be used to restrict the future use of the property to commercial and recreational uses only and to maintain remedy integrity.

10.1.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations, which are collectively referred to as "ARARs".

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

This criterion addresses whether a remedy will meet all of the relevant and appropriate requirements of federal and state environmental statutes or provides a basis for invoking a waiver. See Appendix A for a complete list of all ARARs.

GROUNDWATER: The chemical specific ARARs for both the southern and northern plumes are the California drinking water standards and, if SVE is required, Ventura County air monitoring standards. All of the alternatives that meet Criterion 1, Overall Protection of Human Health and the Environment, will achieve compliance with ARARs. The length of time for drinking water to meet ARARs depends upon the alternative. If SVE is required during air sparging, it would comply with regulations for the handling and disposal of hazardous wastes generated.

SOIL: Soil cleanup levels are health-based rather than standards-based so there are no ARARs that determine the cleanup level. ARARs do cover the excavation and on-site disposal of contaminated soil. All of the alternatives that meet Criterion 1 comply with requirements for handling and disposal of contaminated soil.

10.2 Balancing Criteria

10.2.1 Long-Term Effectiveness and Permanence

This criterion considers residual risk and the ability of an alternative to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.

GROUNDWATER: For both plumes, each of the four alternatives would result in a permanent reduction of risk after the cleanup level for benzene has been reached. Once cleanup levels are reached, ICs would not be needed and the use of the water would not be restricted.
For the southern plume, air sparging (GWS-3) and multiple technologies (GWS-5) would be most effective in the long-term because the air sparging would remove the most contaminant mass that acts as a continuing source of pollution to the groundwater. For the northern plume, the four alternatives would be equally effective at maintaining protection of human health and the environment.

SOIL: Each of the alternatives would provide an adequate level of protectiveness in the long-term. Off- disposal (Alternative S-2) moves the contaminated soil to a licensed facility, permanently removing the risk from the Fillmore area. On-site disposal (Alternative S-3) requires perpetual cap maintenance and monitoring to ensure exposure does not occur and contaminants do not leach down to the groundwater. On-site solidification (Alternative S-5a) provides the greatest long-term protection because the solidification of the contaminants would make them immobile, thus eliminating future potential exposure to human or environmental receptors.

10.2.2 Reduction of Toxicity, Mobility, or Volume Through Treatment

This criterion evaluates an alternative's use of treatment to 1) reduce the harmful effects of contaminants; 2) reduce the ability of contaminants to move in the environment; or 3) reduce the amount of contamination present.

GROUNDWATER: The MNA alternatives (GWS-2 and GWN-2) do not include treatment as a component of the remedy. However, through natural attenuation both alternatives would achieve a reduction of toxicity and volume of benzene and toluene in order to reach cleanup levels. The toxicity reduction would occur as the bacteria break down the contaminants into less toxic organic molecules, and the volume reduction would occur as the mass is reduced.

The remaining groundwater alternatives would reduce the volume of benzene through treatment: Alternatives GWS-3 and GWN-3 through air sparging, GWS-4 and GWN-4 through bioremediation, and GWS-5 and GWN-5 through both types of treatment. GWS-5 is likely to provide the most reduction of volume as it will target both the benzene LNAPL and the dissolved benzene in groundwater. There is no LNAPL in the northern plume and benzene concentrations are so low that the active treatment alternatives would not be as effective as in the southern plume.

SOIL: Neither off-site nor on-site disposal (Alternatives S-2 and S-3) uses treatment to reduce toxicity, mobility, or volume of the contaminants. Alternative S-2 would reduce mobility by sequestering the contaminants in a licensed facility and Alternative S-3 would reduce mobility by sequestering and capping the contaminants on-site. Treating the contaminated soil with a cement additive (Alternative S-5a) is the only alternative that uses an active, engineered treatment process that would reduce the mobility of contaminants by solidifying them with cement.

10.2.3 Short-term Effectiveness

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

GROUNDWATER: Implementation of the MNA alternatives (GWS-2 and GWN-2) can be achieved with the least additional risk to workers, the community, and the environment, as they require only the drilling of additional monitoring wells. These alternatives take the longest to achieve the cleanup levels, but ICs would effectively protect human health by preventing the extraction and use of the groundwater until cleanup levels are met.

The remaining alternatives involve more construction work and field sampling, but any adverse impacts would be controlled by existing worker safety programs. Because none of these treatment alternatives involve bringing groundwater to the surface, potential short-term impacts caused by exposure to contamination would be minimal. If an SVE system is required during air sparging, any emissions from the treatment process would be addressed by engineering controls to ensure that there are no harmful releases to air. No exposure to benzene would occur in the community during the installation and operation of either the groundwater, or if necessary, the soil vapor treatment systems.

For the southern plume, Alternatives GWS-3, GWS-4, and GWS-5 are relatively equivalent in risk posed to workers as they all require installation of treatment and monitoring wells. The multiple technologies alternative (GWS-5) requires the most construction work, which is offset by the fact that the remedy would operate for the shortest amount of time in order to achieve cleanup levels. For the northern plume, the alternatives are equally effective in the short-term, with the longer timeframe for GWN-2 balanced by the increased field work required for the other three alternatives.

For impacts to the environment, various factors such as greenhouse gas emissions, nitrogen oxide (NOx) emissions, electricity usage, and water usage were compared for the remedial alternatives (RI/FS Section 13). Using these factors, the MNA alternatives (GWS-2 and GWN-2) would have the least impact. Of the treatment alternatives, the multiple technologies (GWS-5 and GWN-5) would have the least impact to the environment. The greenhouse gas emissions and electricity usage would be lowest because the treatment systems would operate for the shortest amount of time. The air sparging alternatives (GWS-3 and GWN-3) would require the most vehicle usage due to the increased number of site visits for O&M. The enhanced bioremediation alternatives (GWS-4 and GWN-4) would use the most electricity due to the length of time the systems would have to operate.

SOIL: All of the alternatives would be completed in less than four months and involve excavation of 20,000 cubic yards of soil, presenting the same risk to workers during excavation. On-site disposal (S-3) would present the least potential risk as it involves the least handling of contaminated soil. The risk during cap construction would be minimal. Soil solidification (S-5a) would present more potential risk to workers as it requires more handling of the soil when it is treated with cement in shallow mixing cells. Off-site disposal (S-2) would require approximately 1,000 truckloads of excavated soil to be transported from the PCPL Site, presenting potential physical and chemical exposure risks to the community and workers during the loading, transport, and off-loading of contaminated soil.

For impacts to the environment, on-site disposal (S-3) would have the lowest greenhouse gas emissions, lowest water usage, and lowest fuel usage. Off-site disposal (S-2) would have the highest fuel usage and soil solidification (S-5a) would have the highest greenhouse gas emissions from the manufacturing of Portland cement.

10.2.4 Implementability

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

GROUNDWATER: All of the alternatives are implementable and the materials and services required are readily available. The treatment alternatives would require more work to construct and operate than the MNA alternative. The implementability of the air sparging would be more technically challenging than the other alternatives because of the need to more precisely target the LNAPL zone. However, this is a proven technology with an excellent success rate.
All of the alternatives would require the same amount of coordination with other agencies in order to implement the ICs.

SOIL: All of the alternatives are implementable and the materials and services required are readily available. Implementation of off-site disposal (S-2) would require the least coordination and materials but it would require that a licensed facility be available to accept the waste. On-site disposal and cap placement (S-3) is readily implementable and does not present any technical challenges. On-site solidification (S-5a) would require the most work to implement, with the need for a supply of Portland cement, mixing equipment, and a field pilot study to determine the correct amount of cement required to stabilize the contaminants.

10.2.5 Cost

A cost summary for all three zones of remediation is in Table 9-1 (pg. 60). It includes the capital, O&M, and total present value costs, and the number of years over which the remedy cost estimate is projected. The present value costs are calculated using a 7% discount rate.

SOUTHERN PLUME: The estimated present worth costs for the alternatives range from $588,000 for Alternative GWS-2 to $6.4 million for GWS-5. The cost of each alternative increases as the degree of treatment increases.

NORTHERN PLUME: The estimated present worth costs for the alternatives range from $598,000 for Alternative GWN-2 to $2.9 million for GWN-5. The cost of each alternative increases as the degree of treatment increases.

SOIL: The estimated present worth costs for the alternatives range from $1.6 million for Alternative S-3 to $3.4 million for Alternative S-2. The cost increase is due to transportation and disposal costs.

10.3 Modifying Criteria

10.3.1 State Acceptance

The State of California Department of Toxic Substances Control supports EPA's selection of Alternative GWS-5 for the southern plume, Alternative GWN-2 for the northern plume, and Alternative S-3 for soil.

10.3.2 Community Acceptance

During the public comment period the community expressed its support for the Site cleanup. EPA received 13 written comments during the 45-day comment period and received eight oral comments at the Proposed Plan public meeting. The majority of commenters did not comment specifically on the remedial alternatives or state a preference but rather expressed concern about potential health risks from the Site. Of those comments regarding the alternatives, all supported GWS-5 for the southern plume, one preferred GWN-5 for the northern plume, and two preferred that the contaminated soil be shipped off-site. One commenter proposed that the waste pit be relocated elsewhere on the property and another commenter proposed that contaminated soil be left in place and capped instead of being excavated.

EPA has addressed the comments in the Responsiveness Summary section of this ROD Amendment. EPA does not believe that any of the issues raised in the comments warrant selection of a different remedy to address the contamination at the PCPL Site.

10.4 Summary of Comparative Analysis of Alternatives

GROUNDWATER: Based on the comparative analyses, Alternatives GWS-5, Multiple Technologies, and GWN-2, MNA, are the best alternatives for the PCPL groundwater. GWS-5 provides treatment for the benzene and, of the treatment alternatives, is the most effective in the short-term and will achieve the remedial action objectives the soonest. GWN-2 is the most effective in the short term, is the most cost-effective, and the most practicable alternative for the lower contaminant concentrations in the northern plume.

SOIL: Based on the comparative analyses, Alternative S-3, Excavation, On-Site Disposal & Capping, & ICs is the best alternative for the PCPL soil. While S-5a reduces the mobility, S-3 is the most effective in the short-term, is the most cost-effective, and is easy to implement.

11.0 Principal Threat Waste

Principal threat wastes 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 NCP establishes an expectation that EPA will use treatment to address principal threat wastes if such wastes exist at a site. Low level threat wastes are those source materials that can be reliably contained and that would present only a low risk in the event of exposure.

The LNAPL in the southern plume groundwater is considered to be a principal threat waste, as it contains benzene and toluene, cannot be contained, and continues to be a source of contamination to groundwater. The air sparging and groundwater circulation components of the selected remedy, GWS-5, satisfy the statutory preference for treatment. The northern plume does not have a principal threat waste, as there is no LNAPL in that plume and contaminated groundwater is not considered to be a source material.

The soil contains only low level threat wastes, as the lead, PAHs, and VOCs in soil are not mobile and are not in concentrations significantly above health-based levels. The expectation for treatment does not apply to these wastes.

12.0 Selected Remedy

The remedy for the Site includes three remedial actions: GWS-5, Multiple Technologies (air sparging, groundwater circulation to enhance bioremediation, and MNA) for the southern groundwater plume; GWN-2, MNA for the northern groundwater plume; and S-3, excavation, on-site disposal, and a cap for the soil. All actions addressing groundwater contamination include ICs to prevent the extraction and use of groundwater until cleanup levels are achieved. The action for soil contamination includes ICs to ensure the integrity of the cap and to limit uses of the PCPL property to commercial and/or recreational uses. These three remedial alternatives are discussed in greater detail below.

12.1 Summary of the Rationale for the Selected Remedy

The three alternatives were selected because they each provide the best approach for meeting the remedial action objectives at the Site.

Southern plume: Alternative GWS-5, the three-phase multiple technologies, is as effective as the other alternatives in the long-term, but is the most effective alternative in the short-term. The air sparging component will provide the greatest reduction in toxicity and volume through treatment and is the best way to clean up benzene in the smear zone. Groundwater circulation to enhance bioremediation is an innovative, energy-efficient technology for reducing benzene in the groundwater and, when following air sparging, will result in the fastest cleanup. After those two technologies have reached their effective limits, MNA will ultimately reach the cleanup level of 1 µg/L. Each remediation technology is implementable. Even though the selected remedy requires more design, construction and operational work than the others, this is balanced by the shorter period of time during which system O&M will be required. The cost is higher but the benefit of achieving the cleanup levels sooner outweighs this.

Northern Plume: In the northern plume, because the benzene is not mobile and natural attenuation is both containing the plume and continuing to lower the concentration (toluene has already reached the California drinking water standard), treatment of this plume is impracticable. The other alternatives are not more protective in the short- or long-term, require more effort to implement, and are significantly more expensive. Alternative GWN-2, MNA, will take the longest amount of time to reach the cleanup level (50 years), but this is a reasonable remedial time for this site because there is no anticipated need for the groundwater within this period of time.

Soil: Alternative S-3 was selected over the other alternatives because it provides equal long-term risk reduction but with better short-term effectiveness, i.e., less handling of contaminated soil and fewer environmental impacts, and is the easiest to implement. It does not meet the preference for treatment but the soil contains low-level threat wastes that can be readily contained. This remedy is also the most cost effective.

12.2 Description of Selected Remedy

12.2.1 Southern Plume: Multiple Technologies, GWS-5

Each phase of the selected remedy will address both benzene and toluene. Because the drinking water standard for benzene is lower than the standard for toluene, the performance of the remedy is dominated by the treatment of benzene.

The first phase of the selected remedy is air sparging. The goal is to introduce air into the groundwater and provide the naturally occurring bacteria with oxygen, which will allow them to thrive and destroy the benzene, particularly the LNAPL. A pilot test will be run prior to full implementation of the sparging system in order to optimize the system. The full design will include installation of up to 51 sparge wells, 15 wells to monitor water levels, and 15 probes to monitor vapor in the vadose zone. If soil vapor concentrations of benzene rise above 122 µg/cubic meter at five feet below the ground surface (based on residential CHHLS), an SVE well would be installed to remove the soil vapor. Granular activated carbon canisters would trap the soil vapor and the canisters would be sent to a recycling facility. The sparge system will operate until it is no longer effective, estimated to be no more than six years.

The next phase is groundwater circulation to enhance bioremediation with sulfate. This treatment involves introducing sulfate-rich groundwater from deeper in the aquifer to the shallower benzene-contaminated groundwater to enhance biodegradation. Sulfate is very soluble in water, so when sulfate-rich water is introduced into the benzene plume, the sulfate is immediately available to sulfate-consuming bacteria, which can then readily destroy the benzene. This water would be released into the benzene plume at a very slow rate. Surrounding monitoring wells would detect any change in the benzene plume. Following a pilot test, the full design of this remedy will include installation of up to 20 groundwater circulation wells and 9 monitoring wells. This system will operate until benzene concentrations are 100 µg/L. At that point it will be most cost-effective to switch to MNA.

MNA is expected to reduce the remaining benzene to the California drinking water standard of 1 µg/L. Natural attenuation is occurring at the Site, both aerobically and anaerobically. The multiple lines of evidence for natural attenuation are presented in Section 5.5 of this ROD Amendment. MNA includes long-term groundwater monitoring to verify that the plumes are not spreading and to verify the progress toward the cleanup levels. The monitoring network will consist of 10 groundwater monitoring wells. Because this phase will be implemented 15 years after the initial remedial action (air sparging) and benzene concentrations will be significantly reduced, the monitoring will be conducted annually, a frequency adequate to meet the goals of the monitoring program.

ICs, which will be monitored, will ensure that the groundwater is not extracted and used until drinking water standards have been reached. See Section 9.1 for IC details.

The actual number of treatment and monitoring wells to be sampled and the locations and specifications (depths, screened intervals, and well construction materials) will be determined during the remedial design for each phase and documented in each operation and monitoring plan. These plans will also provide details on sampling procedures, target analytes, analytical methods, field and laboratory quality assurance/quality control, and reporting requirements. During the pilot testing and the start of full implementation of the treatment systems, monitoring will be conducted daily, then weekly, then monthly. When the treatment systems are operating as intended, groundwater monitoring will be conducted semi-annually for the first ten years, then annually until cleanup levels are reached. This remedy is expected to achieve the cleanup levels in a total of 25 years.

O&M for this remedial action will consist of operation of the treatment and monitoring equipment and its maintenance. Some treatment system operations will include adjusting the rate of air injection for the sparging wells, adjusting the rate of pumping in the circulation wells, operating the SVE system if needed, and operating the various monitoring systems.

12.2.2 Northern Plume: Monitored Natural Attenuation, GWN-2

The remedy for the northern plume is MNA, which is expected to reduce the benzene in the northern plume to the California drinking water standard of 1 µg/L. Concentrations of all other COCs identified in the 1992 ROD are below drinking water standards. Since the treatment systems were shut down in 2002, concentrations of all COCs, including benzene, have continued to decline. This remedy includes a monitoring network of seven monitoring wells. Monitoring will be conducted annually until the cleanup level for benzene has been reached, an estimated 50 years. ICs will ensure that the groundwater is not extracted and used until drinking water standards have been reached. See Section 9.1 for IC details. O&M for this remedial action will be limited to those actions required to run and maintain the groundwater monitoring well network.

12.2.3 Soil: Excavation and On-Site Disposal, S-3

The soil remedy involves the excavation of 20,000 cubic yards of soil and consolidation of the soil in the on-site former main waste pit (Table 12-1 and Figure 12-1). An engineered cap will cover the soil disposed in the waste pit and the excavated areas will be backfilled with clean soil. Dust monitoring and dust suppression will be conducted during implementation of this remedy. The cleanup will reduce the lead risk to a blood-lead concentration of 1 µg/dL and will reduce the PAH cancer risk to 1×10^{-6}. EPA also evaluated a PAH cleanup to a 1×10^{-5} cancer risk; this option costs $257,000 less but would leave more PAHs in the soil. EPA decided that the additional cost for a cleanup to a 1×10^{-6} risk was justified by the increased overall protection to human health and the environment it will provide. The soil cleanup is estimated to take 13 weeks. ICs will ensure that the future property use is limited to commercial and recreational uses only and will protect the cap integrity. See Section 9.3 for IC details. The only O&M for this remedial action is the inspection and maintenance of the cap. Inspections will be conducted bi-annually.

Table 12-1: Soil Excavation Locations

Boring Identification	AOC	Depth (ft bgs)	Constituents Exceeding Risk-Based Criteria
FH-URS01	#1	3	Lead
FH-URS02	#1	10	Lead
P10-URS01	#1	3	Benzo(a)anthracene,Benzo(a)pyrene,Benzo(b)fluoranthene, Lead
P11-URS01	#1	10	Benzo(a)anthracene,Benzo(a)pyrene,Benzo(b)fluoranthene,Chrysene
P11-URS02	#1	7	Benzo(a)pyrene,Benzo(b)fluoranthene, Lead
P7-BH-2	#1	7	Lead
P7-URS01	#1	10	Benzo(a)pyrene,Lead
P7-URS02	#1	10	Lead
P8-URS01	#1	3	Lead
P8-URS02	#1	**3**	Lead
TK3-URS01	#1	7	Lead
TK5028-URS01	#1	3	Lead
UPA3-URS01	#1	10	Lead
UPA3-URS02	#1	10	Lead
UT11-URS01	#1	7	Benzo(a)pyrene, Lead
UT12-URS01	#1	3	Lead
UT17-URS01	#1	7	Lead
UT17-URS02	#1	3	Lead
UT18-URS01	#1	10	Benzo(a)anthracene,Benzo(a)pyrene,Benzo(b)fluoranthene,Chrysene, Dibenz(a,h)anthracene,Indeno(1,2,3-cd)pyrene,Naphthalene
UT29-URS01	#1	3	Lead
UT38-URS01	#1	3	Lead
MPC-URS02	#3	7	Dibenz(a,h)anthracene
MPC-URS24	#3	3	Lead (though not unacceptable health threat AOC-wide, this is a hot spot with 2400 mg/kg)
MPC-URS26	#3	3	Benzo(a)anthracene,Benzo(a)pyrene,Benzo(b)fluoranthene,Chrysene, Naphthalene
MPC-URS28	#3	7	Benzo(a)anthracene,Benzo(a)pyrene,Benzo(b)fluoranthene,Chrysene
CLR-URS01 / CLR-URS01-R	#4	7	Indeno(1,2,3-cd)pyrene, Benzo(a)pyrene
TK156-URS01	#5	3	Benzo(a)anthracene
GSP-URS01	#6	7	Naphthalene
GSP-URS03 / GSP-URS03-SV	#6	12	Lead,Naphthalene in Soil (10 ft bgs) Soil vapor detected benzene, ethylbenzene, naphthalene (10 ft bgs)
MPH-URS01	#6	3	Lead
NP-URS01	#6	3	Lead
NP-URS02 / NP-URS02-SV	#6	12	Naphthalene in Soil (1 ft bgs) Soil vapor detected benzene, ethylbenzene (10 ft bgs)
NP-URS03-SV	#6	12	Soil vapor detected ethylbenzene (10 ft bgs)
NP-URS04	#6	7	Benzo(a)pyrene
NP-URS05 / NP-URS05-SV	#6	12	Lead in Soil (1 ft bgs) Soil vapor detected benzene, ethylbenzene (10 ft bgs)
NP-URS06	#6	3	Benzo(a)pyrene
P3-BH-2-SV	#6	12	Soil vapor detected benzene, ethylbenzene, naphthalene (10 ft bgs)
P3-BH-3	#6	7	Lead
P3-BH-1	#6	12	Lead
P3-URS02	#6	12	Naphthalene
TK172-URS01	#6	3	Lead

Boring Identification	AOC	Depth (ft bgs)	Constituents Exceeding Risk-Based Criteria
TK174-URS01	#6	7	Benzo(a)pyrene,Lead
TK7404-F1	#6	12	Lead
TK1-F1	#7	3	Lead
TK2-0/TK2-02	#7	3	Benzo(a)anthracene,Benzo(b)fluoranthene
TK2-F1	#7	7	Benzo(a)pyrene
TK2-F2	#7	12	Benzo(a)anthracene,Benzo(a)pyrene,Benzo(b)fluoranthene
SB-3	#8	3	Naphthalene
TK351-URS01	#8	3	Benzo(a)pyrene
UT15-URS01	#8	7	Benzo(a)pyrene
MWP-URS01	#9	12	Naphthalene
MWP-URS02	#9	3	Lead
MWP-URS04	#9	7	Benzo(a)pyrene, Lead
N-1	#9	7	Lead
HTA-URS05-R	#10	12	Benzo(a)pyrene
P2-URS03	#10	7	Lead
TK101-WD	#10	3	Benzo(a)anthracene,Benzo(a)pyrene,Benzo(k)fluoranthene,Naphthalene
TK62-URS01	#10	3	Lead
TK66-URS01	#10	3	Lead
TK68-URS01	#10	7	Lead
TK71-URS01	#10	3	Lead
TK75-URS01	#10	3	Lead
TK79-URS01	#10	3	Lead
ASU-URS02	#11	3	Lead
RW-URS01	#11	7	Lead
SSP-URS01	#11	3	Lead
TK3321-URS01	#13	12	Lead
BH-URS02	#14	3	Benzo(a)anthracene,Benzo(a)pyrene,Benzo(b)fluoranthene,Benzo(k)fluoranthene, Chrysene,Dibenz(a,h)anthracene,Indeno(1,2,3-cd)pyrene
SB-1	#14	3	Naphthalene
TK35001-URS02	#14	12	Benzo(a)pyrene
Tank 1	Tank Berm	---	Lead
Tank 3	Tank Berm	---	Lead
Tank 8	Tank Berm	---	Lead
Tanks 101 / 103	Tank Berm	---	Lead
Tanks 7403 / 7404	Tank Berm	---	Lead

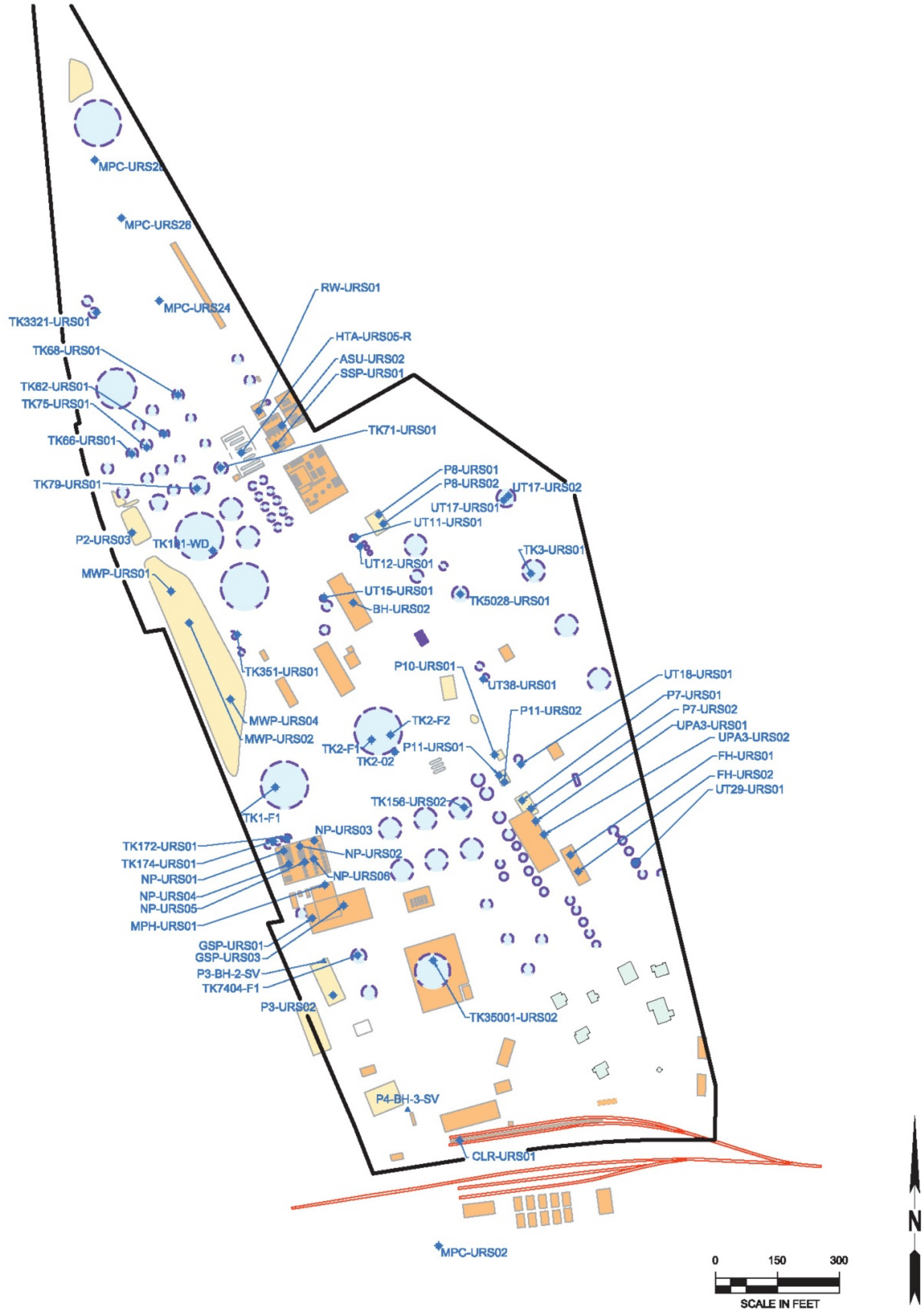

Figure 12-1
Soil Excavation Locations

Pacific Coast Pipeline Superfund Site

12.2.4 Groundwater System Performance Monitoring

Performance monitoring will be used to optimize operation of the air sparging and groundwater circulation systems. Monitoring will verify containment of the COCs in groundwater zones and demonstrate successful operation of the treatment systems. Remedy performance monitoring data will be documented in periodic groundwater monitoring reports. After shutdown of the sparge system, the results of the remedial action will be reported in an effectiveness monitoring report that will include analytical data from confirmatory samples. Reduction in COC concentrations will be determined with confirmatory samples. Monitoring will include water-level measurements as well as the collection and analysis of samples from wells located within and outside the plume areas. A summary of the anticipated performance monitoring for the selected groundwater remedial actions is presented in Table 12-2.

Table 12-2: Performance Monitoring

Type of Monitoring Data	Monitoring Location	Purpose/Use of Data
Water levels	Monitoring wells throughout and around the COC plumes	• Prepare potentiometric surface maps and hydrographs. • Determine horizontal and vertical hydraulic gradients. • Confirm capture zones (containment of plumes).
Groundwater contaminant concentrations	Monitoring wells throughout and around the COC plumes	• Delineate areal and vertical extent of contamination. • Confirm reduction in COC concentrations.
Flow rates	Air injection and groundwater circulation wells	• Confirm that sparging and circulation wells are operating to specifications.
Other operational parameters	Air injection and groundwater circulation wells	• Use as needed to assess proper operation or failure of pumps.

The actual number of monitoring wells to be sampled and the locations and specifications (depths, screened intervals, and well construction materials) for the various monitoring wells will be determined during remedial design and documented in the OMP. Groundwater monitoring will continue until the RAOs are met. The monitoring well network is depicted in Figure 12-2.

Pacific Coast Pipeline Superfund Site

Figure 12-2
Groundwater Monitoring Well Network

12.2.5 Operation and Monitoring Plans

Operation and Monitoring Plans (OMPs) for the southern plume will be developed during each remedial design phase. The OMP for air sparging will be written first. Upon completion of air sparging, the OMP for the enhanced bioremediation will be written. Following the enhanced bioremediation, the OMP for MNA will be written. For the northern plume, the OMP will be written during the MNA remedial design. These plans will establish the exact number and location of additional monitoring wells for the air sparging and enhanced bioremediation groundwater circulation systems. The plans will also provide details on sampling procedures, sampling frequency, target analytes, analytical methods, field and laboratory quality assurance/quality control, and reporting requirements. The criteria for assessing the effectiveness of the remedial actions, for identifying when to shut off the treatment systems, and for fine-tuning the air injection and groundwater circulation systems will be developed during the remedial design phases and will be incorporated into the OMPs.

12.3 Summary of the Estimated Remedy Costs

Appendix B has three cost tables, one for each remedial action component, that provide line item costs used in the cost estimate. The cost estimate is expected to be within +50% and -30% of the actual costs of the remedy. The southern plume groundwater remedy is expected to cost $6.4 million, the northern plume groundwater remedy is expected to cost $598,000, and the soil remedy is expected to cost $1.6 million. The total estimated remedy net present cost is $8.6 million.

12.4 Expected Outcomes of the Selected Remedy

The expected outcomes of the selected remedy will meet all of the remedial action objectives set forth in Section 8.1. The expected outcomes are:

- restoration of groundwater to its designated beneficial use (drinking water) within 25 years for the southern plume and 50 years for the northern plume;
- reduction of soil contaminant levels, resulting in availability of property for commercial and recreational uses;
- prevention of migration of contaminants in soil disposed in waste pit; and
- improved on-site habitat for plants and animals through reduced soil toxicity.

The groundwater cleanup will reduce the existing contamination concentrations to California drinking water standards. The soil cleanup will reduce contaminant concentrations to a cancer risk of 1×10^{-6} and a blood-lead risk of 1 µg/dL. Table 8-1 summarizes the cleanup levels for soil and groundwater contaminants and the associated risks.

13.0 Statutory Determinations

This section provides a brief description of how the selected remedy satisfies the CERCLA statutory requirements. Under CERCLA Section 121 and the NCP Section 300.430(f)(5)(ii), the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances, pollutants, or contaminants as a principal element, and a bias against off-site disposal of untreated wastes.

13.1 Protection of Human Health and Environment

The selected remedy will be protective of human health by reducing the potential for direct and indirect (vapor) contact to COCs in groundwater and soil. Reduction of the COC concentrations in groundwater to California drinking water standards through treatment and MNA will return the groundwater to its designated beneficial use, drinking water. The excavation, on-site disposal, and capping of contaminated soil will allow the property to be developed for commercial and recreational uses, as well as prevent the migration of soil contaminants to groundwater. Institutional controls will be implemented to prevent exposure to contaminated soil and groundwater and to maintain integrity of the remedy.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The NCP Sections 300.430(f)(5)(ii)(B) and (C) require that a ROD describe the federal and state ARARs that the selected remedy will attain and any ARARs the remedy will not meet, the waiver invoked, and the justification for any waivers. All federal and state ARARs will be met upon completion of the selected remedy and no ARARs are being waived.

Section 121 (e) of CERCLA, U.S.C. 9621 (e), states that no federal, state, or local permit is required for remedial actions conducted entirely on-site. Therefore, actions conducted entirely on-site must meet only the substantive, not the administrative, requirements of the ARARs. Any action conducted off-site is subject to the full requirements of federal, state, and local regulations.

The most significant ARARs are discussed below. For the complete list of ARARS for the selected remedy, see Appendix A.

13.2.1 Chemical-Specific ARARs

Chemical-specific ARARs are health- or risk-based concentration limits or values for various environmental media (for example, groundwater, surface water, air, and soil) that are established for specific chemicals in a specific media at a Superfund site, or that maybe discharged to the site during remedial activities. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants in the environment.

There are three chemical-specific ARARs for the selected remedy at the PCPL Site, each related to the groundwater cleanup. Both California and federal drinking water standards are potentially relevant and appropriate to the groundwater cleanup because the groundwater is a potential source of drinking water, and the groundwater therefore must be cleaned up to the more stringent of the state and federal standards. In this case, the cleanup will be to state standards, as they are more stringent than the federal standards for benzene and toluene. The LA RWQCB Basin Plan contains aquifer cleanup levels (MCLs), which will be achieved through the cleanup. There are no chemical specific ARARs for the Site soil.

13.2.2 Location-Specific ARARs

Location-specific ARARs are restrictions placed on the concentration of chemicals or conduct of operations based on the location of a site. Only one location-specific ARAR was identified for the Site: Executive Order 11988, Floodplain Management (5/24/1977)("EO 11988"). EO 11988, in relevant part, requires federal agencies to determine whether a proposed action as defined therein will occur within a floodplain; if so, to consider alternatives to the proposed action in the floodplain; and if the proposed action is the "only practicable alternative," to minimize potential harm to the floodplain. In this case, the only remedial actions occurring in the Pole Creek floodplain are excavation, well drilling, and well O&M. These activities will not adversely affect the floodplain because, in the case of the excavation, the areas to be excavated currently have no vegetation and, after excavation, will be backfilled with clean soil, compacted, and graded to resemble pre-excavation contours. The excavation will have beneficial effects in that hazardous wastes will be removed and consolidated outside the flood plain and so no longer will be exposed to, or easily transported by, flood waters. As for well drilling and well O&M, the affects of such activities on the flood plain are inconsequential.

13.2.3 Action-Specific ARARs

The federal and state action-specific ARARs generally set performance, design, or other similar action-specific controls or restrictions on certain activities related to the management of hazardous substances or the discharge of water and airborne pollutants. Action-specific ARARs of particular significance to the selected remedy are discussed in more detail below (see also Appendix A, "ARARs").

The primary action-specific ARARS for the soil remedy are:

RCRA Hazardous Waste Determination. A waste is considered a RCRA hazardous waste if it exhibits any of the characteristics of ignitability, corrosivity, reactivity, or toxicity or if it is listed as a hazardous waste. Waste generated during construction, monitoring, or remediation must be characterized and managed in accordance with RCRA requirements if it is intended for off-site disposal. Waste water may be generated in the construction of new groundwater wells. If sampling indicates the waste is hazardous, it will be managed according to these standards.

Ventura County Air Pollution Control District (VCAPCD) Regulation IV for Fugitive Dust. Emissions of fugitive dust shall not remain visible in the atmosphere beyond the property line of the emission source. To prevent such emissions, the best available control technologies must be used to minimize dust emissions associated with the soil remedy.

VCAPCD Regulations for Particulate Matter by Concentration and Weight. Particulate matter in excess of the established standards shall not be discharged to the atmosphere. Monitoring will be conducted during earth moving activities and generation of particulate matter will be controlled.

State of California requirements for state land use covenants. These requirements specify that a land use covenant imposing appropriate limitations on land use shall be executed and recorded when hazardous substances will remain at the property at levels which are not suitable for unrestricted use of the land. The selected alternative will require a land use covenant to restrict land use.

The primary action-specific ARARS for the groundwater are:

SWRCB Resolution 92-49; this resolution requires cleanup to either background water quality or the best water quality that is reasonable if background water quality cannot be restored. Compliance with ARARs will be achieved because the groundwater at the Site will be cleaned up to MCLs.

SWRCB Resolution 68-16 is the state's anti-degradation policy, which requires that high quality surface and groundwater be maintained to the maximum extent possible. The groundwater remedy at the Site will restore groundwater to its highest beneficial use, i.e., drinking water.

13.3 Cost Effectiveness

A cost-effective remedy is defined as one in which "costs are proportional to its overall effectiveness" (NCP §300.430(f)(1)(ii)(D). Assessing cost-effectiveness involves comparing costs to overall effectiveness, which is determined by evaluating the following three of the five balancing criteria: 1) longer-term effectiveness and permanence; 2) reduction in toxicity, mobility and volume through treatment; and 3) short-term effectiveness.

The selected remedy is cost-effective. While Alternative GWS-5 is the highest cost alternative for the southern plume, it will achieve the required cleanup levels in the shortest amount of time (25 years). Alternative GWN-2 is the least costly of the northern plume alternatives and is just as effective in the short- and long-term. It will not achieve the cleanup level for benzene through treatment, but the toxicity and volume of benzene will be reduced through natural attenuation. Alternative S-3 does not provide contaminant treatment but it does provide equal long-term effectiveness with better short-term effectiveness at no increase in cost. The total cost for implementing all three components of the remedy is estimated to be $8,628,015.

13.4 Utilization of Permanent Solutions and Alternative Treatment Technologies

EPA has determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a practicable manner at the PCPL Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA has determined that the selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element, bias against off-site treatment and disposal, and considering state and community acceptance. All of the PCPL remediation will take place on-site (if SVE is required the GAC canisters will be recycled off-site). The selected remedy treats the groundwater contaminants in-situ and will result in a permanent cleanup of groundwater. The bioremediation component of Alternative GWS-5 is an innovative treatment alternative that will clean up the groundwater in an energy efficient manner. The groundwater will be treated in-situ, thereby avoiding the water chemistry issues and complications that arise when groundwater is extracted and treated. The contaminated soil will not be treated due to impracticability but will be contained on-site and long-term effectiveness will be achieved through monitored engineering controls. The short-term effectiveness of the soil remedy led EPA to determine that Alternative S-3 was the most appropriate remedy for soil.

13.5 Preference for Treatment as a Principal Element

EPA has determined that the selected remedy for the southern plume meets the statutory preference for treatment as a principal element. Neither the northern plume nor the soil contain source material constituting a principal threat; the contamination is not highly toxic or mobile and treating it would be impracticable.

13.6 Five-Year Review Requirements

The NCP §300.430(f)(4)(ii) requires a five-year review if a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure. Because this remedy will result in contaminants remaining on-site and the future property use will be limited, EPA will conduct the required statutory five-year reviews to ensure that the remedy is, and will continue to be, protective of human health and the environment. Thus far, EPA has conducted three five-year reviews on the original ROD for this Site.

14.0 Documentation of Significant Change

The Proposed Plan for amending the PCPL ROD was released for public comment in June 2011. The Proposed Plan identified Alternatives GWS-5 (multiple technologies), GWN-2 (MNA), and S-3 (excavation, on-site disposal, capping, and ICs) as the preferred alternatives for groundwater and soil remediation. EPA reviewed all written and verbal comments submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

PART III: RESPONSIVENESS SUMMARY

This Responsiveness Summary provides EPA's response to written and oral comments received from the public and governmental agencies on EPA's June 2011 Proposed Plan for the Pacific Coast Pipeline Superfund Site ROD Amendment.

On June 1, 2011, the Proposed Plan was mailed to the persons and organizations on the PCPL mailing list, including local residents. The Proposed Plan summarized EPA's proposed amended remedy for the Site and invited citizens to attend a June 16, 2011, public meeting in Fillmore at which EPA presented the proposed amended remedy and received eight oral public comments. In addition to the public meeting, there was a 45-day comment period on the proposed amended remedy from June 1 to July 15, 2011. During the public comment period EPA received 12 written comments from individual members of the public and one from the Ventura County Watershed Protection District. A transcript of the public meeting and copies of the written comments are included in the Administrative Record for this ROD Amendment.

The comments received during the public comment period show that the public supports efforts to clean up groundwater and soil at the Site. At the same time, however, there is concern about the potential health effects from the contaminants at the Site. The comments can be divided into four broad categories: comments about the preferred alternatives, comments about technical issues, comments about health risks related to the Site, and other comments.

COMMENTS ON EPA'S PREFERRED ALTERNATIVES

1. **Comment:** Two commenters suggested that the contaminated soil should be removed from the Site and disposed in a certified disposal center (Alternative S-2). One of these two commenters suggested using rail to ship the contaminated soil off-site for disposal.

EPA Response: Disposing of the contaminated soil in an on-site pit and placing a cap on it will be protective of human health and the environment. EPA used seven criteria to compare shipping the contaminated soil off-site to disposing of it on-site and placing a cap on top. Disposing of it on-site rated higher in terms of short-term protectiveness (less handling of soil is required) and cost. The two options are equal in terms of overall protectiveness, meeting all ARARs (legal requirements), long-term protectiveness, and implementability. Neither option reduces the toxicity, mobility, or volume of contamination.

2. **Comment:** One commenter proposed that instead of digging up the contaminated soil, it should all be capped.

EPA Response: Lead is in soil across most of the Site, so the proposed approach would require capping more or less the entire property. Capping that much land would be difficult to implement and maintenance on a cap that large would require extensive maintenance. In addition, Site-wide capping would severely limit the potential future uses of the property.

3. **Comment:** One commenter urged that Alternative GWN-5 should be selected for the northern plume rather than GWN-2, which is estimated to take twice as long--50 years--to reach cleanup levels. (The commenter supported EPA's preferred alternatives for the southern groundwater plume (Alternative GWS-5) and soil (Alternative S-3)).

EPA Response: Natural attenuation is effectively cleaning up the contaminants in the northern groundwater plume. At the time the groundwater treatment system was shut down, the maximum concentration of toluene was 180 µg/L and the maximum concentration of benzene was 430 µg/L. Now, toluene in the northern groundwater plume is below the clean up level, and benzene concentrations continue to decrease so they currently are approximately only 20% of the concentration level in the southern plume. Given the effectiveness of natural attenuation in reducing contaminant concentrations and plume size, and the fact that the groundwater is not needed for drinking water at this time, EPA does not believe the nearly five times additional cost of Alternative GWN-5 ($2.94 million versus $598,000) is warranted even though it would reduce the estimated period of time required to achieve the cleanup goals.

4. **Comment:** One commenter requested that EPA either select Alternative S-2 or relocate the proposed on-site soil consolidation and disposal area further to the east of the former Main Waste Pit proposed for this use because the Main Waste Pit is located within the 100- and 500-year flood plain of Pole Creek. The commenter also disagreed with EPA's evaluation of Alternatives S-3 and S-5a in terms of two of the balancing criteria -- long term protectiveness and permanence, and reduction in toxicity, mobility, and volume -- due to potential, in the commenter's view, for flood waters to carry downstream contaminated soil (Alternative S-3) or a contaminated soil/concrete mixture (Alternative S-5a).

EPA Response: EPA has determined, based on information contained in the Administrative Record that was received after the close of the public comment period, that the former Main Waste Pit to be used for on-site consolidation and disposal of contaminated soil is no longer within either the 100-year or 500-year floodplain of Pole Creek as suggested by the commenter. In 2007, a number of improvements were made to the Pole Creek channel--channel invert repair, construction of a debris basin south of Highway 126, the removal of a hydraulic restriction under Highway 126 and the railroad tracks--such that the 100-year floodplain is now completely within the bounds of the Pole Creek channel, and the portion of the Site that lies within the 500-year floodplain has been substantially reduced. Specifically, as shown on the 2010 FEMA floodplain map, the former Main Waste Pit no longer lies within the 500-year floodplain. Nevertheless, as specified in the 8/4/2011 e-mail from Ms. Leslie Klinchuch, Chevron, to Ms. Holly Hadlock, EPA, the on-site consolidation/disposal area will be designed to include "armoring" along the western edge to prevent the potential for erosion, and the required cap will prevent the infiltration of flood waters. For these reasons, EPA believes that the assessment of long term protectiveness of both Alternatives S-3 and S-5a as "high," and the positive evaluation of Alternative S-5 in terms of the criterion of reduction in toxicity, mobility, and volume, are appropriate.

5. **Comment:** One commenter noted that the Pole Creek channel may, in the future, need to provide passage for endangered steelhead trout by means of a "fish conveyance structure," and

that a capped disposal area on the western edge of the Site might preclude construction of a conveyance structure.

EPA Response: It is uncertain whether a fish conveyance structure will ever need to be constructed in the Pole Creek channel. If such a structure were required in the future and the structure had to be constructed on the east side of Pole Creek, however, EPA has determined that there is sufficient room between the former Main Waste Pit proposed for use as the consolidation/disposal area and Pole Creek to accommodate such a structure without interfering with the capped disposal area.

6. **Comment:** One commenter urged that the property should not be developed and should be restricted from future development and use.

EPA Response: In terms of health safety, the property will be clean enough to allow for safe commercial and recreational use. In terms of whether or not the property should be redeveloped at all, this issue is outside of EPA's authority to decide.

7. **Comment:** One commenter suggested that more study is needed on the groundwater cleanup alternatives in order to identify a cleanup strategy that requires less time--50 years is too long. Similarly, another commenter urged that the Site contamination to be investigated.

EPA Response: EPA believes that further research of the groundwater contamination and remedial alternatives is not necessary as extensive research already has been completed. In addition to the investigations on which the 1992 ROD is based, EPA has data from the implementation of the original remedy, the follow on studies and, most recently, the remedial investigation and the focused feasibility study which evaluated many cleanup alternatives. EPA believes that the selected remedy uses the best technology currently available for cleaning up the Site. Unfortunately, cleaning up groundwater is a slow process, especially when, as at the Site, the aquifer is below clays and fine-grained sands. The groundwater aquifer at the Site is not like a large underground lake but like a sponge. Water flows through at a slow rate and contamination gets stuck onto particles of rock. The pump and treat remedy from the 1992 ROD significantly reduced concentrations of toluene and benzene in groundwater in both the northern and southern groundwater plumes. EPA believes that air sparging and enhanced bioremediation with groundwater circulation, followed by MNA, will achieve the cleanup goals of 1 µg/L in the southern plume most quickly.

COMMENTS ON TECHNICAL ISSUES

1. **Comment:** One commenter asked how it is possible that the groundwater is contaminated but not the City's drinking water?

EPA Response: The City of Fillmore's drinking water supply comes from groundwater wells in the Sespe Creek area in northwestern Fillmore; they are over a mile from the Site and north of the groundwater flow direction. Groundwater monitoring shows that the contaminant plumes are either stable (southern plume) or shrinking (northern plume) and that the contaminants of concern, benzene and toluene, are being destroyed by naturally occurring bacteria in the groundwater before contaminants are far from the Site. Data from monitoring wells installed downgradient from the Site (one on Cook Drive, one near San Cayetano Elementary School, and one 500 yards west of Pole Creek) shows no contamination in the groundwater.

2. **Comment:** One commenter asked whether groundwater from the Site flows to the Santa Clara River.

EPA Response: No, groundwater flows west under Pole Creek, not south to the Santa Clara River.

3. **Comment:** A couple of commenters raised questions about whether the groundwater plumes could shift.

EPA Response: With more than 20 years of groundwater monitoring data, the size, location and direction of both the southern and northern groundwater plumes are well-defined. Given the quantity and consistency of the data, EPA has a high degree of confidence in the plume definitions, Moreover, as noted in the response to technical comment 1 above, the plumes are either stable or shrinking, so even if the plumes were to shift unexpectedly, there would be minimal impact on the area involved.

4. **Comment:** One commenter asked if groundwater wells have been installed downgradient of the groundwater plumes to define their extent, and whether the extent of the groundwater plumes might be greater than is shown in Figure 2 of the Proposed Plan.

EPA Response: Yes, EPA has monitored downgradient sentinel wells for 20 years, and the wells have never had contamination. The northern plume sentinel well is on Cook Drive, 120 feet west of the plume edge and the southern plume sentinel wells are on Lora Lane and Main Street, approximately 100 and 300 feet, respectively, west of the plume edge. As noted in response to the preceding comment, the extent of groundwater contamination at the Site has been well established.

5. **Comment:** One commenter suggested that all of the water in Fillmore, both drinking and groundwater, should be monitored.

EPA Response: State and federal laws require public drinking water providers to monitor the drinking water they provide to ensure that the water meets all state and federal drinking water standards. The City of Fillmore, which draws all its drinking water from groundwater wells in the area of Sespe Creek, monitors the drinking water it serves the public. As for groundwater, as noted in responses to other comments, there has been and will continue to be extensive monitoring of the groundwater at, and in the vicinity of, the Site.

6. **Comment:** Several commenters expressed a general concern that the cleanup be conducted safely, including one who asked whether contaminated soil will blow toward residences during the cleanup and whether, weather conditions warranted, cleanup operations would stop until they improved.

EPA Response: Before the cleanups can begin Chevron must submit to EPA operational plans that include measures to ensure safety during cleanup activities. Regarding soil specifically, contaminated soil will not be allowed to blow toward the residences during the soil cleanup. In accordance with applicable legal requirements, air monitoring will be conducted continuously during the soil excavation process and dust suppression measures will be implemented. If unacceptable levels of dust are detected on-site during construction, work will be stopped immediately and will not resume until the contractor can ensure that dust will not blow outside the perimeter of the Site. If weather conditions are such that the cleanup cannot be conducted in a safe manner, the cleanup will be halted until it is safe to continue.

7. **Comment:** One commenter asked what current soil contaminant levels are compared to background levels?

EPA Response: The highest concentration of lead in soil is 34,000 mg/kg in one location. The local background concentration of lead is 2.2 to 26 mg/kg. The highest concentration of benzo(a)pyrene, which is considered to be the most carcinogenic PAH, is 80 mg/kg. The local ambient concentration of benzo(a)pyrene ranges from non-detect to 0.072 mg/kg.

COMMENTS ON HEALTH RISKS

1. **Comment:** One commenter expressed concern that the Site is dangerous to people.

EPA Response: At present, although contaminant concentrations in the groundwater exceed the cleanup levels (toluene and benzene in the southern plume; benzene in the northern plume), they are not dangerous to people because no one is exposed to them through any of the three exposure pathways: inhalation, ingestion, and dermal contact. The selected remedy will continue to protect people from exposure at the same time as contaminant concentrations are reduced to levels that would allow use of the groundwater for drinking water. Similarly, although concentrations of soil contaminants of concern (lead, PAHs, and VOCs in soil and soil vapor) are above levels safe for unrestricted use of the former refinery property, they do not present a danger to people because access to the property is controlled. Moreover, current toxicological data for the soil contaminants indicates that short-term exposure to them is not dangerous for people. However, because the contaminants could pose a health threat to people exposed for a longer period, such as from working on the property or engaging in recreational activities over a number of years, EPA will be cleaning up the soil to allow for safe commercial and recreational use.

2. **Comment:** One commenter asked what toxic levels of contaminants people have been exposed to?

EPA Response: EPA does not have information about potential or actual exposure levels of Fillmore residents before EPA became involved at the Site. Samples taken from 1990 to the present, however, indicate that concentrations of contaminants at the Site and on the west side of Pole Creek are below levels that would have negative health effects on any residents.

3. **Comment:** One commenter noted that a number of residents in the neighborhood west of Pole Creek have gotten cancer and some have died. Several commenters urged that there should be health assessments of all City residents, with one them suggesting that the assessment should focus on residents near the Site.

EPA Response: As noted in the response to the preceding comment, monitoring data from 1990 to the present indicates that contaminant concentrations related to the Site would not have harmful health effects on Fillmore residents, For this reason, neither a City-wide nor more focused health assessment project appears warranted.

Nevertheless, following the public meeting in June, EPA referred the matter to the Agency for Toxic Substances and Disease Registry (ATSDR), an agency of the U.S. Department of Health and Human Services. ATSDR contacted Dr. Robert Levin, Health Officer for Ventura County, about a possible cancer cluster in Fillmore. Dr. Levin responded that he is not aware of a cancer cluster in Fillmore.   ATSDR also contacted Dr. John Morgan of the California Cancer Registry, which is maintained by the California Department of Public Health, Cancer Surveillance and Research Branch. Dr. Morgan looked into the matter and, based on available information, he determined that there is not a cancer cluster in Fillmore and a connection cannot be made between the Site and cancers of residents. Current statistics indicate that 1 in 3 Americans will be diagnosed with cancer in their lifetime (U.S. Cancer Registry).

4. **Comment:** One commenter suggested that more soil sampling should be done of residences near the Site.

EPA Response: Soil samples taken along the west side of Pole Creek--behind homes along Cook Drive and at the Scout House at 128 Sespe Avenue--indicate there are not elevated concentrations of lead or PAHs in the soil of nearby residential properties.

OTHER COMMENTS

1. **Comment:** One commenter asked whether contamination found during construction of the Bridges Development debris basin was from the PCPL Site?

EPA Response: No, the contamination in the soil at the Bridges Development is not related to the PCPL Site.   The Ventura County Environmental Health Division investigated the issue and documented the excavation of 4,700 cubic yards of gray soils with a petroleum odor. Testing showed that the soils had petroleum hydrocarbons at concentrations below regulated levels. Push-probe water samples contained MTBE, a gasoline additive that was first used in the late 1980's, long after the PCPL refinery shut down. One possible source of the contamination found in construction of the debris basin is the former Ultramar gas station. The RWQCB oversaw the cleanup of that gas station in the 1990's.

2. **Comment:** One commenter proposed that the PCPL property should be used for a solar farm due to the need for clean energy.

EPA Response: EPA supports the development of alternative energy. However, decisions about the development and use of the property are outside the scope of EPA's authority except as they relate to appropriate cleanup-related issues.

3. **Comment:** A couple of commenters urged that local contractors and community members be hired for the cleanup.

EPA Response: EPA supports the use of local contractors in site cleanups. EPA has a program called *Superfund Job Training Initiative*, which is a job readiness program that provides training and employment opportunities for citizens living in communities affected by Superfund Sites. The website www.epa.gov/superfund/community/sfjti provides more information about this program.

4. **Comment:** One commenter complained that EPA has not kept the community informed about the Site.

EPA Response: EPA acknowledges that it could have done more to keep the community informed over the last 15 years, during which only a few factsheets were issued and a few meetings with representatives of City government or members of the community were held. As implementation of the final remedy begins, EPA promises to conduct more outreach with the community via fact sheets, the EPA website, and local news organizations.

5. **Comment:** One commenter proposed that a congressional hearing is needed about the contamination at the Site.

EPA Response: It is not clear from the comment what the commenter hopes would be accomplished through a congressional hearing. In terms of keeping federal and state representatives informed, however, in September 2009 EPA met with Brian Miller, Chief of Staff to U.S. Representative Elton Gallegly, and Linda Johnson, staffer to California State Senator George Runner to update them on the PCPL Site. EPA met with these staff members again in April 2011 to inform them about EPA's proposed cleanup and they expressed their opinions that EPA's investigation of the Site has been adequate and they support the proposed cleanup.

APPENDICES

Pacific Coast Pipeline Superfund Site
Record of Decision Amendment

Appendix A, ARARs

Requirement	Jurisdiction	Medium	Citation	Applicable or Relevant and Appropriate	Description/Discussion
Chemical-Specific ARARs					
Primary Drinking Water Standards	State	Groundwater	22 CCR 64431 and 64444	Relevant and Appropriate	California has promulgated drinking water standards for public drinking water sources under the California Safety Drinking Water Act (CH&SC Section 4010 et. seq.). California primary MCLs are established to protect public health from contaminants that may be found in drinking water sources. The referenced standards apply within the distribution network of regulated public water systems, hence they are not applicable, but are relevant and appropriate because groundwater is a potential source of drinking water. The selected remedy uses State MCLs as the cleanup levels for the COCs in groundwater because they are more stringent (See Table 8-1).
Basin Plan for Los Angeles Region	State	Groundwater	California Law Division 7 Chapter 4 Section 13240 *et seq.*	Relevant and Appropriate	The Water Quality Control Plan for the Los Angeles Region (Basin Plan, adopted November 19, 1992) contains numerical and narrative water quality objectives (WQOs) for waters of the state that ensure protection of beneficial uses and prevention of nuisances affecting beneficial use. These objectives are not merely restricted to surface water but also apply to groundwater (SWRCB, 1992). The Basin Plan is relevant and appropriate.
Action-Specific ARARs					
SWRCB - Investigation/Cleanup/Abatement of Discharges	State	Groundwater	Resolution No. 92-49	Relevant and Appropriate	To protect groundwater, this resolution requires cleanup to either background water quality or the best water quality that is reasonable if background water quality cannot be restored. Cleanup levels that differ from background water quality conditions must be consistent with the maximum benefit to the public, with current and anticipated future beneficial uses, and must conform to water quality control plans and policies. Groundwater at the site will be cleaned up to MCLs.
SWRCB - High Quality Waters	State	Groundwater	Resolution No. 68-16	Relevant and Appropriate	The Statement of Policy With Respect to Maintaining High Quality of Waters in California is the state's anti-degradation policy that provides a narrative standard which requires that high quality surface water and groundwater be maintained to the maximum extent possible. This resolution is relevant and appropriate to the goal of restoration of groundwater to its highest.
Land Use Covenants	State	Soil	22 CCR 67391.1(a), (d) – (f), (i)	Relevant and Appropriate	These state requirements specify that a land use covenant imposing appropriate limitations on land use shall be executed and recorded when hazardous substances will remain at the property at levels which are not suitable for unrestricted use of the land. The selected alternative requires cleanup to a restricted (i.e., commercial/industrial) standard. These requirements are relevant and appropriate.

Action-Specific ARARs (continued)					
RCRA Hazardous Waste Determination by Generator	Federal	Soil and Groundwater	40 CFR 261.11 through 261.24; 261.31 through 33; 262.11	Relevant and Appropriate	A hazardous waste is considered a RCRA hazardous waste if it exhibits any of the federal characteristics of ignitability, corrosivity, reactivity, or toxicity, or if it is listed as a hazardous waste by EPA. Wastes which are generated during construction, monitoring, or remediation, and that will be disposed of off-site, must be characterized and managed in accordance with certain requirements if they are determined to be RCRA hazardous. These requirements are relevant and appropriate.
California Hazardous Waste Determination for Generators	State	Soil and Groundwater	22 CCR 66261.20 through 66261.24; 22 CCR 66262.11; 22 CCR 66260.200	Relevant and Appropriate	Wastes can be classified as non-RCRA hazardous wastes if they exceed the soluble threshold limit concentration or total threshold limit concentration values. Wastes which are generated during construction, monitoring, or remediation, and that will be disposed of off-site, must be characterized and managed in accordance with state hazardous waste management requirements if they are determined to be non-RCRA hazardous. These requirements are relevant and appropriate.
CAMU Regulations	Federal	Soil	40 CFR 264.552	Relevant and Appropriate	The CAMU regulations are relevant and appropriate because the selected soil remedy involves the excavation and on-site consolidation of contaminated soil.
Staging Piles	Federal	Soil	40 CFR 265.554	Relevant and Appropriate	Staging piles are temporary storage locations for remediation waste. In the event that staging piles will be used during remedy implementation, the piles will be located within the boundaries of the AOC. Design and/or operating standards for staging piles will be required, as appropriate, depending on location, the nature of the remediation wastes contained in them, the length of anticipated use and other relevant factors.
Underground Injection Control (UIC) Regulations	Federal and State	Groundwater	40 CFR 144.12; CH&SC 25159.10 and 25159.25; 22 CCR 66260.10	Applicable	The selected groundwater remedy includes air sparging, which injects air into the subsurface. These regulations prohibit the contamination of underground drinking water sources through underground injection wells.
Ventura County Air Pollution Control District (VCAPCD)	State[1]	Air	VCAPCD Rules and Regulations	Applicable	The VCAPCD regulations are established to achieve and maintain state and federal ambient air quality standards through the federal-approved state implementation plan (SIP). Site activities that result in air emissions may be subject to VCAPCD requirements (see below).
VCAPCD Regulation for Fugitive Dust	State[1]	Air	Rule 55	Applicable	Emissions of fugitive dust shall not remain visible in the atmosphere beyond the property line of the emission source. Activities conducted in the South Coast Air Basin shall use best available control measures to minimize fugitive dust emissions and take necessary steps to prevent the track-out of bulk material onto public paved roadways as a result of their operations. Fugitive dust during earthmoving activities is a concern and requires controls; therefore, this requirement is applicable to the site.
VCAPCD Regulation for Particulate Matter - Concentration	State[1]	Air	Rule 52	Applicable	Particulate matter in excess of the concentration standard conditions shall not be discharged from any source. Particulate matter in excess of 450 milligrams per cubic meter (0.196 grain per cubic foot) in discharged gas, calculated as dry gas at standard conditions, shall not be discharged to the atmosphere from any source. Generation of particulate matter during earthmoving activities is a concern and requires controls; therefore, this requirement is applicable to the site.

Action-Specific ARARs (continued)					
VCAPCD Regulation for Solid Particulate Matter - Weight	State[1]	Air	Rule 53	Applicable	Solid particulate matter including lead and lead compounds discharged into the atmosphere from any source shall not exceed the rates Table 450(a) of Rule 405. Nor shall solid particulate matter including lead and lead compounds in excess of 0.23 kilogram (0.5 pound) per 907 kilograms (2,000 pounds) of process weight be discharged to the atmosphere. Emissions shall be averaged over one complete cycle of operation or one hour, whichever is the lesser time period. Generation of particulate matter during earthmoving activities is a concern and requires controls; therefore, this requirement is applicable to the site.
Location-Specific ARARs					
Executive Order on Floodplain protection	Federal	Soil and Groundwater	Executive order 11988, Floodplain Management (5)2411977	Applicable	EO 11988, in relevant part, requires federal agencies to determine whether a proposed action as defined therein will occur within a floodplain; if so, to consider alternatives to the proposed action in the floodplain; and if the proposed action is the "only practicable alternative," to minimize potential harm to the floodplain. EO 11988 is applicable because Site remedial activities will take place within the 500-year floodplain.
Guidance and Advisories To Be Considered					
California Water Well Standards	State	Groundwater	DWR Bulletin 74-90	---	Standard well construction/destruction for water wells within California. The previous guidance was established in Bulletin 74-81.
Regional Screening Levels (RSLs)	Federal	Soil and Groundwater	EPA Website	---	A risk-based screening tool established for multiple media (soil, water, and air). http://www.epa.gov/region9/superfund/prg/index.html
California Human Health Screening Levels (CHHSLs)	State	Soil and Soil Gas	CalEPA, OEHHA Websites	---	A State risk-based screening tool for evaluation of soil and soil gas on contaminated properties. http://www.calepa.ca.gov/Brownfields/documents/2005/CHHSLsGuide.pdf http://www.oehha.org/risk/pdf/LeadCHHSL091709.pdf
Area of Contamination (AOC) Policy	Federal	Soil	55 FR 8758-8760 (March 8, 1990)	---	Based on operational history and site data, the contaminated soil to be consolidated is not a listed or characteristic waste and would be managed onsite to reduce, control, or mitigate exposure. Should a characteristic waste be found during remedial design or remedial action, it will be managed consistent with this AOC policy.

Notes:
- ALs = Action Levels
- AOC = Area of Contamination
- ARARs = Applicable or Relevant and Appropriate Requirements
- BMPs = Best Management Practices
- CalEPA = California Environmental Protection Agency
- CAMU = Corrective Action Management Unit
- CCR = California Code of Regulations
- CFR = Code of Federal Regulations
- CH&SC = California Health and Safety Code
- CHHSLs = California Human Health Screening Levels

- DTSC = Department of Toxic Substances Control
- DWR = Department of Water Resources
- EPA = U.S. Environmental Protection Agency
- FR = Federal Register
- LARWQCB = Los Angeles Regional Water Quality Control Board
- MCLs = Maximum Contaminant Levels
- MCLGs = Maximum Contaminant Level Goals
- OEHHA = California Office of Environmental Health Hazard Assessment
- RCRA = Resourse Conservation and Recovery Act
- RSLs = Regional Screening Levels
- SIP = State Implementation Plan
- SWRCB = State Water Resource Control Board
- TSDF = Treatment, Storage, and Disposal Facility
- UIC = Underground Injection Control
- VCAPCD = Ventura County Air Pollution Control District
- WQOs = Water Quality Objectives

[1] = VCAPCD rules are included in the State Implementation Plan (SIP) that is submitted to the U.S. EPA and so become de facto state regulations.

Appendix B, Table 1

Cost Estimate Summary - Selected Remedy

GW South Plume

Capital Costs for Southern Groundwater Plume				
Description	Quantity	Unit	Cost	Total
Pre-Field Activity				
- Logistics / Coordination	1	Lump Sum	$4,000	$4,000
- Logistics / Coordination	1	Lump Sum	$4,000	$4,000
- Well Install/Destroy Permits from VC	1	Lump Sum	$5,000	$5,000
- Well Install/Destory Work Plan for EPA / VC	1	Lump Sum	$7,500	$7,500
- Remedial Action Work Plan to EPA	1	Lump Sum	$15,000	$15,000
SUBTOTAL				$35,500
Install Groundwater Monitoring Wells				
- 4" Monitoring Well to 80 ft bgs	1	Each	$9,500	$9,500
- Waste Disposal	1	Lump Sum	$1,550	$1,550
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$11,050
Destroy Groundwater Monitoring Wells				
- Destroy Well (4" at Various Depths)	11	Lump Sum	$3,500	$38,500
- Destoy Wells (6" at Various Depths)	1	Lump Sum	$5,700	$5,700
- Waste Disposal	1	Lump Sum	$5,000	$5,000
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$49,200
Air Sparge System for PILOT TESTING (6 Months)				
- 2" Air Sparge Wells to 80 ft bgs	6	Each	$12,000	$72,000
- Core Analysis - assuming 80 feet	6	Each	$2,500	$15,000
- 2" Monitoring Well to 65 ft bgs	6	Each	$7,500	$45,000
- 3 Port CMTs to 50 ft bgs (monitor vadose)	6	Each	$1,000	$6,000
- Air Sparge Trailer	6	Months	$2,000	$12,000
- Pressure Transducers	12	Each	$2,000	$24,000
- Conveyance Piping	1	Lump Sum	$5,000	$5,000
- Connect System - Verify Controls	3	Days	$2,000	$6,000
- Waste Disposal	1	Lump Sum	$5,000	$5,000
- Tracer	1	Lump Sum	$1,000	$1,000
- Startup and Testing (fieldwork - two staff)	9	Event	$3,000	$27,000
- Startup and Testing (mobile laboratory)	9	Event	$2,000	$18,000
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$236,000
Air Sparge System - ESTIMATED FULL DESIGN				
- 2" Air Sparge Wells to 80 ft bgs	45	Each	$12,000	$540,000
- 2" Monitoring Well to 65 ft bgs	9	Each	$2,500	$22,500
- 3 Port CMTs to 50 ft bgs (monitor vadose)	9	Lump Sum	$7,500	$67,500
- Air Sparge System	2	Lump Sum	$75,000	$150,000
- Pressure Transducers	9	Each	$1,790	$16,110
- Conveyance Piping	2000	Foot	$35	$70,000
- Control Panel with Telemetry	2	Lump Sum	$10,000	$20,000
- Connect System - Verify Controls	15	Days	$2,000	$30,000
- Waste Disposal	1	Lump Sum	$25,000	$25,000
- Startup and Testing	5	Days	$2,000	$10,000
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$951,110

Circulation System for PILOT TESTING (6 Months)				
- 6" Circulation Well to 120 ft bgs	6	Each	$20,000	$120,000
- Core Analysis - assuming 120 feet	6	Each	$2,500	$15,000
- Pumping Equipment for Well	6	Each	$4,000	$24,000
- Monitoring Wells for System Evaluation	6	Each	$9,500	$57,000
- Pressure Transducers	12	Each	$2,000	$24,000
- Conveyance Piping	1	Lump Sum	$5,000	$5,000
- Connect System - Verify Controls	3	Days	$2,000	$6,000
- Waste Disposal	1	Lump Sum	$2,500	$2,500
- Tracer	1	Lump Sum	$1,000	$1,000
- Startup and Testing (fieldwork - two staff)	9	Event	$3,000	$27,000
- Startup and Testing (mobile laboratory)	9	Event	$2,000	$18,000
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$299,500
Circulation System - ESTIMATED FULL DESIGN				
- 6" Circulation Well to 120 ft bgs	14	Each	$20,000	$280,000
- Pumping Equipment for Well	14	Each	$4,000	$56,000
- Monitoring Wells for System Evaluation	3	Each	$9,500	$28,500
- Pressure Transducers	29	Each	$1,790	$51,910
- Conveyance Piping	2000	Foot	$35	$70,000
- Control Panel with Telemetry	2	Lump Sum	$10,000	$20,000
- Connect System - Verify Controls	15	Days	$2,000	$30,000
- Waste Disposal	1	Lump Sum	$25,000	$25,000
- Startup and Testing	5	Days	$2,000	$10,000
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$571,410
Miscellaneous Items				
- Power	2	Lump Sum	$5,000	$10,000
- SCADA (remote sensing)	1	Lump Sum	$80,000	$80,000
- Install Treatment Pad (incl. building permits)	1	Lump Sum	$35,000	$35,000
- Surveying	1	Lump Sum	$3,000	$3,000
- Sampling Pump	0	Lump Sum	$0	$0
- Water Quality Meter	0	Lump Sum	$0	$0
- Water Level Meter (interface probe)	0	Lump Sum	$0	$0
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$128,000
SUBTOTAL				$2,852,213
Project Management	0.05	%		$142,611
Remedial Design	0.08	%		$228,177
Construction Management	0.06	%		$171,133
Institutional Controls	1	Lump Sum	$20,000	$20,000
SUBTOTAL				$561,920
TOTAL CAPITAL COSTS				**$3,414,133**

Annual O&M Costs for Southern Groundwater Plume (Years 1-6)				
Description	Quantity	Unit	Cost	Total

Semiannual Monitoring/Sampling (routine wells)				
- Fieldwork	2	Event	$2,500	$5,000
- Waste Disposal	2	Each	$500	$1,000
- Analytical	2	Each	$1,200	$2,400
SUBTOTAL				$8,400
Treatment Systems				
- Site Visits (routine)	52	Event	$750	$39,000
- Site Visits (maintenance)	4	Event	$1,250	$5,000
- Optimization / Monitoring	12	Event	$3,500	$42,000
- Sampling	12	Event	$750	$9,000
- Analytical Testing	12	Each	$765	$9,180
SUBTOTAL				$104,180
Miscellaneous Items				
- Power to Treatment System	12	Each	$3,000	$36,000
- Repairs to Treatment System	1	Each	$3,000	$3,000
- Dedicator Sampling System	1	Each	$2,000	$2,000
- Water Quality Meter	1	Each	$1,000	$1,000
- Well Maintenance Activity	1	Each	$2,500	$2,500
SUBTOTAL				$44,500
Compliance Reporting				
- Monitoring/Sampling Report	2	Each	$20,000	$40,000
- Agency Correspondence	2	Each	$1,000	$2,000
SUBTOTAL				$42,000
SUBTOTAL				$248,850
Project Management	0.05	%		$12,443
Technical Support	0.1	%		$24,885
Institutional Controls	1	Lump Sum	$2,000	$2,000
SUBTOTAL				$39,328
TOTAL ANNUAL O&M COSTS				**$288,178**

Annual O&M Costs for Southern Groundwater Plume (Years 7-10)				
Description	Quantity	Unit	Cost	Total
Semiannual Monitoring/Sampling (routine wells)				
- Fieldwork	2	Event	$2,500	$5,000
- Waste Disposal	2	Each	$500	$1,000
- Analytical	2	Each	$1,200	$1,200
SUBTOTAL				$7,200
Groundwater Circulation System				
- Site Visits (routine)	26	Event	$750	$19,500
- Site Visits (maintenance)	4	Event	$1,250	$5,000
- Optimization / Monitoring	12	Event	$3,500	$42,000
- Sampling	2	Event	$750	$1,500
- Analytical Testing	2	Each	$765	$1,530
SUBTOTAL				$69,530

Miscellaneous Items				
- Power to Treatment System	12	Each	$3,000	$36,000
- Repairs to Treatment System	1	Each	$3,000	$3,000
- Dedicator Sampling System	1	Each	$2,000	$2,000
- Water Quality Meter	1	Each	$1,000	$1,000
- Well Maintenance Activity	1	Each	$2,500	$2,500
SUBTOTAL				$44,500
Compliance Reporting				
- Monitoring/Sampling Report	2	Each	$20,000	$40,000
- Agency Correspondence	2	Each	$1,000	$2,000
SUBTOTAL				$42,000
SUBTOTAL				$204,038
Project Management	0.05	%		$10,202
Technical Support	0.1	%		$20,404
Institutional Controls	1	Lump Sum	$2,000	$2,000
SUBTOTAL				$32,606
TOTAL ANNUAL O&M COSTS				**$236,643**

Annual O&M Costs for Southern Groundwater Plume (Years 11-15)

Description	Quantity	Unit	Cost	Total
Annual Monitoring/Sampling				
- Fieldwork	1	Event	$2,500	$2,500
- Waste Disposal	1	Each	$500	$500
- Analytical	1	Each	$1,200	$1,200
SUBTOTAL				$4,200
Groundwater Circulation System				
- Site Visits (routine)	26	Event	$750	$19,500
- Site Visits (maintenance)	4	Event	$1,250	$5,000
- Optimization / Monitoring	12	Event	$3,500	$42,000
- Sampling	2	Event	$750	$1,500
- Analytical Testing	2	Each	$765	$1,530
SUBTOTAL				$69,530
Miscellaneous Items				
- Power to Treatment System	12	Each	$3,000	$36,000
- Repairs to Treatment System	1	Each	$3,000	$3,000
- Dedicator Sampling System	1	Each	$2,000	$2,000
- Water Quality Meter	1	Each	$1,000	$1,000
- Well Maintenance Activity	1	Each	$2,500	$2,500
SUBTOTAL				$44,500
Compliance Reporting				
- Monitoring/Sampling Report	2	Each	$20,000	$40,000
- Agency Correspondence	2	Each	$1,000	$2,000
SUBTOTAL				$42,000
SUBTOTAL				$200,288

Project Management	0.05	%		$10,014
Technical Support	0.1	%		$20,029
Institutional Controls	1	Lump Sum	$2,000	$2,000
SUBTOTAL				$32,043
TOTAL ANNUAL O&M COSTS				**$232,331**

Annual O&M Costs for Southern Groundwater Plume (Year 16+)				
Description	Quantity	Unit	Cost	Total
Annual Monitoring/Sampling				
- Fieldwork	1	Event	$2,500	$2,500
- Waste Disposal	1	Each	$500	$500
- Analytical	1	Each	$1,200	$1,200
SUBTOTAL				$4,200
Miscellaneous Items				
- Dedicator Sampling System	1	Each	$750	$750
- Water Quality Meter	1	Each	$750	$750
- Well Maintenance Activity	1	Each	$2,500	$2,500
SUBTOTAL				$4,000
Compliance Reporting				
- Monitoring/Sampling Report	1	Each	$10,000	$10,000
- Agency Correspondence	1	Each	$1,000	$1,000
SUBTOTAL				$11,000
SUBTOTAL				$24,000
Project Management	0.05	%		$1,200
Technical Support	0.1	%		$2,400
Institutional Controls	1	Lump Sum	$2,000	$2,000
SUBTOTAL				$5,600
TOTAL ANNUAL O&M COSTS				**$29,600**

Periodic Costs for Southern Groundwater Plume					
Description	Year	Quantity	Unit	Cost	Total
Construction Completion Report	1	1	Each	$35,000	$35,000
Status Updates with EPA	1	1	Each	$5,000	$5,000
SUBTOTAL					$50,000
Five Year Reviews	5 to 25	5	Each	$5,000	$25,000
Update Institutional Control Plan	5 to 25	5	Each	$2,000	$10,000
SUBTOTAL					$43,750
Destroy Monitoring Wells					
- 4" Monitoring Wells at Various Depths	25	12	Each	$6,500	$78,000
- 6" Extraction Wells at Various Depths	25	2	Each	$8,000	$16,000
- 2" Air Sparge Wells to 80 ft bgs	25	51	Each	$7,000	$357,000
- 2" Monitoring Well to 65 ft bgs	25	15	Each	$7,000	$105,000

-6" Circulation Well to 120 ft bgs	25	20	Each	$11,000	$220,000
Remove Treatment System	25	1	Each	$40,000	$40,000
Closure Action Report	25	1	Each	$15,000	$15,000
SUBTOTAL					$1,038,750

TOTAL PERIODIC COSTS **$1,132,500**

Present Value Analysis for Southern Groundwater Plume

Cost Type	Year	Capital Cost	Annual O&M	Total Cost	Discount Factor (7%)	Present Worth
Capital Cost	0	$822,148	$0	$822,148	1.000	$822,148
Annual O&M	1	$1,311,772	$288,178	$1,599,949	0.935	$1,581,096
Annual O&M	2		$288,178	$288,178	0.873	$251,705
Annual O&M	3		$288,178	$288,178	0.816	$235,239
Annual O&M	4		$288,178	$288,178	0.763	$219,849
Annual O&M	5		$288,178	$288,178	0.713	$205,467
Annual O&M	6	$443,067	$288,178	$731,245	0.666	$635,092
Annual O&M	7	$837,147	$236,643	$1,073,790	0.623	$984,516
Annual O&M	8		$236,643	$236,643	0.582	$137,728
Annual O&M	9		$236,643	$236,643	0.544	$128,718
Annual O&M	10		$236,643	$236,643	0.508	$120,297
Annual O&M	11		$232,331	$232,331	0.475	$110,379
Annual O&M	12		$232,331	$232,331	0.444	$103,158
Annual O&M	13		$232,331	$232,331	0.415	$96,409
Annual O&M	14		$232,331	$232,331	0.388	$90,102
Annual O&M	15		$232,331	$232,331	0.362	$84,207
Annual O&M (16 to 25)	10		$29,600	$296,000	2.546	$75,352
Periodic Cost #1 (Completion Report)	1		$50,000	$50,000	1.000	$50,000
Periodic Cost #2 (5yr Reviews)	25		$1,750	$43,750	11.654	$20,394
Periodic Cost #3 (Final Well Destroy)	25		$41,550	$1,038,750	11.654	$484,206

TOTAL PRESENT VALUE OF ALTERNATIVE **$6,436,062**

Notes:

- Cost estimate accuracy is within +50% to -30%.
- Details provided in Remedial Investigation / Focused Feasibility Study (January 2011).

Appendix B, Table 2

Cost Estimate Summary - Selected Remedy

GW North Plume

Capital Costs for Northern Groundwater Plume				
Description	Quantity	Unit	Cost	Total
Pre-Field Activity				
- Logistics / Coordination	1	Lump Sum	$4,000	$4,000
- Logistics / Coordination	1	Lump Sum	$4,000	$4,000
- Well Install/Destroy Permits from VC	1	Lump Sum	$2,000	$2,000
- Well Install/Destroy Work Plan for EPA / VC	1	Lump Sum	$7,500	$7,500
- Remedial Action Work Plan to EPA	1	Lump Sum	$15,000	$15,000
SUBTOTAL				$32,500
Install Groundwater Monitoring Wells Lump Sum				
- 4" Monitoring Well to 110 ft bgs	2	Each	$10,000	$20,000
- Waste Disposal	1	Lump Sum	$1,550	$1,550
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$21,550
Destroy Groundwater Monitoring Wells Lump Sum				
- Destroy Well (4" at Various Depths)	14	Each	$4,500	$63,000
- Waste Disposal	1	Lump Sum	$5,000	$5,000
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$68,000
Miscellaneous Items				
- Sampling Pump	0	Lump Sum	$0	$0
- Water Quality Meter	0	Lump Sum	$0	$0
- Water Level Meter (interface probe)	0	Lump Sum	$0	$0
- Field Oversight during construction	0	Lump Sum	$0	$0
SUBTOTAL				$0
SUBTOTAL				$152,563
Project Management	0.08	%		$12,205
Remedial Design	0.15	%		$22,884
Construction Management	0.1	%		$15,256
Institutional ControLump Sum	1	Lump Sum	$20,000	$20,000
SUBTOTAL				$70,346
TOTAL CAPITAL COSTS				**$222,908**

Annual O&M Costs for Northern Groundwater Plume (Years 1 - 50)				
Description	Quantity	Unit	Cost	Total
Annual Monitoring/Sampling (routine wells Lump Sum)				
- Fieldwork	1	Event	$1,500	$1,500
- Waste Disposal	1	Each	$500	$500
- Analytical	1	Each	$700	$700
SUBTOTAL				$2,700
Miscellaneous Items				
- Dedicator Sampling System	1	Each	$1,000	$1,000
- Water Quality Meter	1	Each	$500	$500
- Well Maintenance Activity	1	Each	$2,500	$2,500
SUBTOTAL				$4,000
Compliance Reporting				
- Monitoring/Sampling Report	1	Each	$6,000	$6,000
- Agency Correspondence	1	Each	$1,500	$1,500
SUBTOTAL				$7,500
SUBTOTAL				$17,750
Project Management	0.05	%		$888

Technical Support	0.1	%		$1,775
Institutional ControLump Sum	1	Lump Sum	$2,000	$2,000
SUBTOTAL				$4,663
TOTAL ANNUAL O&M COSTS				**$22,413**

Periodic Costs for Northern Groundwater Plume					
Description	Year	Quantity	Unit	Cost	Total
Construction Completion Report	1	1	Each	$10,000	$10,000
Status Updates with EPA	1	1	Each	$5,000	$5,000
SUBTOTAL					$18,750
Five Year Reviews	5 to 50	10	Each	$5,000	$50,000
Update Institutional Control Plan	5 to 50	10	Each	$2,000	$20,000
SUBTOTAL					$87,500
Destroy WelLump Sum (4" at Various Depths)	50	5	Each	$7,000	$35,000
Destoy WelLump Sum (6" at Various Depths)	50	2	Each	$8,500	$17,000
Closure Action Report	50	1	Each	$15,000	$15,000
SUBTOTAL					$83,750
TOTAL PERIODIC COSTS					**$190,000**

Present Value Analysis for Northern Groundwater Plume						
Cost Type	Year	Capital Cost	Annual O&M	Total Cost	Discount Factor (7%)	Present Worth
Capital Cost	0	$222,908	$0	$222,908	1.000	$222,908
Annual O&M (1 to 10)	10		$22,413	$224,125	7.024	$157,416
Annual O&M (11 to 20)	10		$22,413	$224,125	3.570	$80,022
Annual O&M (21 to 30)	10		$22,413	$224,125	1.815	$40,679
Annual O&M (31 to 40)	10		$22,413	$224,125	0.923	$20,679
Annual O&M (41 to 50)	10		$22,413	$224,125	0.469	$10,512
Periodic Cost #1 (Completion Report)	1		$18,750	$18,750	1.000	$18,750
Periodic Cost #2 (5yr Reviews)	50		$1,750	$87,500	13.801	$24,151
Periodic Cost #3 (Final Well Destroy)	50		$1,675	$83,750	13.801	$23,116
TOTAL PRESENT VALUE OF ALTERNATIVE						**$598,235**

Notes:

- Cost estimate accuracy is within +50% to -30%.
- Details provided in Remedial Investigation / Focused Feasibility Study (January 2011).

Appendix B, Table 3
Cost Estimate Summary - Selected Remedy
Soil

Capital Costs for Soil Cosolidation in Main Waste Pit				
Description	Quantity	Unit	Cost	Total
Pre-Field Activity				
- Logistics / Coordination	1	Lump Sum	$11,000	$11,000
- Logistics / Coordination	1	Lump Sum	$11,000	$11,000
- Contractor Mobilization / Demobilization	1	Lump Sum	$53,000	$53,000
- Perimeter Dust Monitoring	1	Lump Sum	$10,000	$10,000
- Traffic Control Plan	1	Lump Sum	$15,000	$15,000
- Air Monitoring Plan	1	Lump Sum	$10,000	$10,000
- Grading Plan	1	Lump Sum	$20,000	$20,000
- Remedial Action Work Plan to EPA	1	Lump Sum	$35,000	$35,000
SUBTOTAL				$165,000
Site Work				
- Dust Monitoring	1	Lump Sum	$76,000	$76,000
- Confirmation Sampling	1	Lump Sum	$49,000	$49,000
- Site Preparation	1	Lump Sum	$66,000	$66,000
- Soil Excavations	1	Lump Sum	$171,000	$171,000
- Backfill Open Excavations w/ Clean Fill	1	Lump Sum	$129,000	$129,000
- Consolidation within Main Waste Pit	1	Lump Sum	$70,000	$70,000
- Install CAP	1	Lump Sum	$245,000	$245,000
SUBTOTAL				$806,000
SUBTOTAL				$1,213,750
Project Management	0.06	%		$72,825
Remedial Design	0.12	%		$145,650
Construction Management	0.08	%		$97,100
Institutional Controls	1	Lump Sum	$20,000	$20,000
SUBTOTAL				$335,575
TOTAL CAPITAL COSTS				**$1,549,325**

Annual O&M Costs for Soil Cosolidation in Main Waste Pit				
Description	Quantity	Unit	Cost	Total
None Expected				
- None.	0	Lump Sum	$0	$0
- None.	0	Lump Sum	$0	$0
- None.	0	Lump Sum	$0	$0
SUBTOTAL				$0
None Expected				
- None.	0	EA	$0	$0
- None.	0	EA	$0	$0
- None.	0	EA	$0	$0
SUBTOTAL				$0
None Expected				
- None.	0	CY	$0	$0
- None.	0	CY	$0	$0
- None.	0	CY	$0	$0
SUBTOTAL				$0

SUBTOTAL					$0
Project Management		0	%		$0
Technical Support		0	%		$0
Institutional Controls		0	Lump Sum	$0	$0
SUBTOTAL					$0
TOTAL ANNUAL O&M COSTS					**$0**

Periodic Costs for Soil Cosolidation in Main Waste Pit					
Description	Year	Quantity	Unit	Cost	Total
Construction Completion Report	1	1	Each	$35,000	$35,000
Status Updates with EPA	1	1	Each	$3,000	$3,000
SUBTOTAL					$47,500
None Expected	0	0	EA	$0	$0
None Expected	0	0	EA	$0	$0
SUBTOTAL					$0
None Expected	0	0	EA	$0	$0
None Expected	0	0	EA	$0	$0
SUBTOTAL					$0
TOTAL PERIODIC COSTS					**$47,500**

Present Value Analysis for Soil Consolidation in Main Waste Pit						
Cost Type	Year	Capitol Cost	Annual O&M	Total Cost	Discount Factor (7%)	Present Worth
Capitol Cost	0	$1,549,325	$0	$1,549,325	1.00	$1,549,325
Periodic Cost #1 (Completion Report)	1		$47,500	$47,500	0.93	$44,393
TOTAL PRESENT VALUE OF ALTERNATIVE						**$1,593,718**

Notes:

- Cost estimate accuracy is within +50% to -30%.
- Details provided in Remedial Investigation / Focused Feasibility Study (January 2011).