

## Pemaco

### Excavation—High-Vacuum Dual Phase Extraction—Electrical Resistivity Heating—Pump and Treat—Biostimulation—Monitored Natural Attenuation

**Site Name:** Pemaco

**Site Location:** Maywood, California

**Technology Used:**

- Soil Vapor Extraction (SVE)
- Excavation and Capping
- High-Vacuum Dual-Phase Extraction (HVDPE)
- Electrical Resistivity Heating (ERH)
- Pump and Treat (P&T)
- Monitored Natural Attenuation (MNA)
- Biostimulation

The Record of Decision (ROD) provides the possibility of using in situ bioremediation or in situ chemical oxidation as polishing steps should the Agency deem them necessary. In the summer of 2007, EPA exercised the bioremediation option and began biostimulation with sodium lactate in the plume area.

**Regulatory Program:** U.S. EPA Superfund NPL site

**Remediation Scale:** Full

**Project Duration:** August 1997 to present

**Site Information:** The 1.4-acre Pemaco Superfund Site (Pemaco) was a chemical-blending facility and chemical distributor from the late 1940s until June 1991. The site is located at 5050 Slauson Avenue in Maywood, a city in eastern Los Angeles County. One corner of the site abuts a residential park and neighborhood. Light or heavy industrial properties border two more sides of the site. An abandoned industrial property lies to the west, and the concrete-lined Los Angeles River flows along the eastern edge of the site.

**Contaminants:** Fifty-six chemicals have been identified at concentrations exceeding preliminary remediation goals (PRGs) or federal and/or state regulatory limits in soil and/or groundwa-

ter. The chemicals of concern consist of the following groups:

- Volatile organic compounds (VOCs), including tetrachloroethene (PCE), trichloroethene (TCE), dichloroethene (DCE) vinyl chloride, and 1,4-dioxane.
- Metals
- Non-halogenated volatile organic compounds, such as acetone, benzene, ethylbenzene, and xylenes.
- Semi-VOCs, mainly polycyclic aromatic hydrocarbons.

The largest contaminant plume, which is about 1300 ft long and 750 ft wide, occurs in the second saturated zone of the aquifer (80 to 100 ft below ground surface [bgs]) and consists almost entirely of TCE and degradation products. Figure 7 presents a site conceptual model for distribution of contaminants.

Table 1 presents selected contaminants and their maximum detected concentrations in vadose zone soil. The site has extensive light non-aqueous phase liquids (LNAPL).

Chemical	Upper Vadose Zone Soil (µg/kg)	Lower Vadose Zone Soil (µg/kg)
Acetone	19,000	—*
Benzene	4,100	520
Benzo(a)anthracene	32,000	—
Benzo(a)pyrene	27,000	—
Benzo(b)fluoranthene	40,000	—
cis-1,2-Dichloroethene	3,300	730
Dibenzo(a,h)anthracene	5,200	—
Ethylbenzene	61,000	—
Tetrachloroethene	2,000	—
Toluene	98,000	—
Trichloroethene	3,300	2,100
Vinyl Chloride	280	22
Xylenes	430,000	—

\* — not above preliminary remediation goals (PRGs)

**Hydrogeology:** Surficial soil at Pemaco is non-native engineered fill comprising layers of silty sand and clayey sand placed there previously to support former roads and building pads. This fill typically extends 2-3 ft bgs and occasionally up to 6 ft bgs.

The upper vadose zone consists of silty sand with local clay and silt lenses. It is typically located between 2 and 30 ft bgs. A laterally continuous 1- to 10-ft thick clay layer exists between 30 and 40 ft bgs. Lower vadose zone soil comprises interbedded clayey silt, silty clay, silty sand, and sand from 35 to 65 ft bgs. The interval between 50 and 65 ft bgs is generally fine-grained silts and clays with thin locally silty sand lenses.

Perched water occurs in lenses of poorly graded sand, silty sand, and sandy silt, which lie on top of the site's continuous clay layer. These saturated lenses are 5-in to 5-ft thick, and they occur at various depths ranging from 20 to 40 ft bgs.

Five distinct saturated zones are separated by silt and clay intervals. The first zone, between 65 and 75 ft bgs, is fine silty and poorly graded sands that are locally interbedded with well-graded sands. The second zone, which is typically 80 to 90 ft bgs and 1.5 to 10 ft thick, contains fine silty sands, poorly graded sands, and poorly graded sands with silt. The third saturated zone at 95 to 110 ft bgs contains saturated fine silty sands, poorly graded sands, and poorly graded sands with silt. The fourth zone is 6 to 15 ft thick and contains interbedded mixtures of silts, sands, and gravels. The fifth zone occurs between 160 and 175 ft bgs and consists of alternating 1-ft layers of fine silty sands and well-graded sands.

**Project Goals:** The goals of the 2005 ROD are to prevent direct human contact with contaminated soil; lower soil contamination so that potential leaching would not impact groundwater; prevent further offsite migration of contaminated

groundwater thereby minimizing vapor intrusion to nearby residential housing; prevent vertical migration of contaminants at levels exceeding maximum contaminant levels (MCLs); and restore the onsite groundwater quality to drinking water standards.



Figure 1. Investigating Subsurface Contamination at Pemaco with a Direct Push Rig

Source: U.S. EPA

**Cleanup Approach:** In 1997, EPA excavated and disposed of the underground and above-ground storage tanks, all piping, asphalt, and concrete, and the large warehouse that was completely destroyed by fire four years earlier. Following the removal action, the site was graded and grass was planted to prevent surface erosion.

During the removal, gross subsurface contamination was observed around the tanks, and a SVE system was constructed in 1998 to address the shallow contamination. The system consisted of 16 extraction wells, a pre-treatment activated carbon unit, and a thermal oxidation unit operated at temperatures greater than 1,400°F for polishing (Figure 2). By December 1998, the system had recovered and treated 136,000 lbs of contaminants. Because of community concern about potential air emissions from the thermal oxidation unit, the system was shut down in March 1999.



Figure 2. Thermal Oxidation Unit for Treating Vapors Captured by the 1998 SVE System

Source: U.S. EPA

An HVDPE was installed to address the contaminant plume in the perched groundwater that extends for about 200 ft. While the system dewateres the saturated zone, the high vacuum recovers contaminant vapors in both the unsaturated and formerly saturated zones. The system uses ultraviolet oxidation and granular activated carbon (GAC) to treat the produced water (Figure 3). It uses flameless thermal oxidation (ceramic reactor bed—Figure 4) followed by GAC to treat the vapors. In response to community concerns, the treatment system is equipped with a post-treatment heat exchanger and a second GAC unit to reduce the possibility that dioxins may escape to the environment. Exhaust gases from the unit are monitored.

The subsurface to 100 ft bgs has many interbedded fine-grained layers that are likely to be contaminant source areas that are diffusion limited. Hence they are unlikely to be effectively treated by a P&T or SVE system.

Heating of fine-grained units is an effective method for driving contaminants out of them so that they can be captured by SVE wells. Thus, an ERH system with about 58 electrode wells, 30 thermocouple wells to measure temperature distribution and level, and 89 vapor extraction

wells, was installed in the source area. The system became operational in August 2007. The ERH was activated for 200 days, from September 25, 2007, to April 10, 2008.

Prior to the start of heating, EPA conducted biotreatment in an area (65 to 75 ft bgs) of TCE-contaminated groundwater located adjacent to the ERH area. EPA may follow up with additional bioremediation treatment sometime in the future, but as of 2013 have not.



Figure 3. Water Treatment System Carbon Units

Source U.S. EPA

Twenty two-phase extraction wells in the first two water bearing zones were installed (U.S. EPA 2004) in the area of the plume where TCE concentrations were between 1,000  $\mu\text{g/L}$  and 10,000  $\mu\text{g/L}$ . These wells have a pump that extracts the groundwater while a vacuum is applied to the well head. The same system used to treat the contaminated perched zone water and soil vapors is also used for these wells.

For the portion of the plume where TCE concentrations are greater than 10  $\mu\text{g/L}$  but less than 1,000  $\mu\text{g/L}$ , 15 extraction wells were installed at

the leading edge for containment (U.S. EPA 2004). At the request of the state, one containment extraction well was installed in the fourth saturated zone to address low levels of TCE.

MNA was used to address the leading edge of the plume where TCE concentrations are 10 µg/L or less.

**Project Results:** The initial SVE system that was installed in the tank area source zone removed about 136,000 lbs of contaminants.

Soil samples collected in 2006 prior to ERH implementation showed that TCE, *cis*-1,2-dichloroethylene (*cis*-1,2-DCE), vinyl chloride, and methylene chloride exceeded project-specific, site-specific remediation levels (SSRLs). The highest concentration of TCE (above 6,000 µg/kg) was found between 80 and 90 ft bgs.

Post-ERH soil sampling performed in October 2008 to evaluate the effectiveness of the ERH remedy shows significant reductions in VOC levels. Post-ERH contaminant concentrations did not exceed the Pemaco SSRLs established for the zone between 25 and 65 ft bgs. There was an approximate 99% reduction in TCE concentrations between pre- and post-ERH soil samples. Fluctuations of TCE and other contaminants have occurred over the duration of the ERH remedy, but the overall size and extent of the plume have decreased significantly.

Figures 5 and 6 show the changes in maximum TCE concentrations in groundwater samples taken 65 to 75 bgs in 2006-2007, before remediation, and in 2009, after ERH application.

Table 2 presents contaminants and their concentrations in perched zone groundwater before and after ERH treatment.

Since the implementation of HVDPE, approximately 28 pounds of TCE and 121 pounds of total VOCs have been removed from the groundwater. Concentrations of COCs in

groundwater have decreased significantly within the ERH treatment area and continue to show a downward trend. Currently, several extraction wells just beyond the ERH boundary have TCE concentrations an order of magnitude higher than the SSRL of 5 µg/L.

Continued HVPDE and groundwater monitoring are necessary to ensure that remedial action objectives are met. This area will also be addressed with a second bio-treatment injection, if necessary.

The groundwater and vapor treatment system continue to operate, and concentrations of chemicals in the subsurface are decreasing.

Table 2. Pre-HVDPE and Post -ERH Maximum Concentrations of Select Contaminants in Groundwater 65 to 75 bgs

Analyte	SSRL (µg/L)	pre-HVDPE 2006-2007 Conc. (µg/L)	Post-ERH 2009 Conc. (µg/L)
PCE	5	13	3.5J
TCE	5	15,000 J	370
<i>cis</i> -1,2-DCE	6	6400	68
<i>trans</i> -1,2-DCE	10	79	3.8J
Vinyl Chloride	0.5	670	ND
1,1-DCE	6	29J	5.4
Benzene	1	14	0.37J

J - Estimated detection; compound detected between the method detection limit and the method reporting limit.

**Sources:**

Caraway, R. 2001. Pemaco Superfund Site Summary of Groundwater and Soil Investigations. U.S. Environmental Protection Agency, 31 pp.  
[http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/d2f04234b1cb882c882576cd006b6e26/\\$FILE/Field%20Investigation%20Spring\\_01.pdf](http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/d2f04234b1cb882c882576cd006b6e26/$FILE/Field%20Investigation%20Spring_01.pdf)

U.S. EPA. Pemaco Site Description webpage. U.S. Environmental Protection Agency.

<http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/BySite/Pemaco?OpenDocument#documents>

U.S. EPA. 2004. Pemaco Superfund Site Feasibility Study, April 5, 2004. 145 pp.

[http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/93f5ba4e2205be958825727b006e6276/\\$FILE/Pemaco%20Feasibility%20Study.pdf](http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/93f5ba4e2205be958825727b006e6276/$FILE/Pemaco%20Feasibility%20Study.pdf)

U.S. EPA. 2005. Record of Decision: Pemaco Superfund Site Maywood, California, January 13, 2005. U.S. Environmental Protection Agency Region 9, 204 pp.

<http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/3dc283e6c5d6056f88257426007417a2/7e5c8736>

[76b1315c882576ce0003839d/\\$FILE/Pemaco%20ROD%2001\\_2005.pdf](http://yosemite.epa.gov/r9/sfund/r9sfdocw.nsf/76b1315c882576ce0003839d/$FILE/Pemaco%20ROD%2001_2005.pdf)

U.S. EPA. 2010. First Five-Year Review Report For Pemaco Superfund Site Maywood, California September 2010, 166 pp.

<http://www.epa.gov/superfund/sites/fiveyear/f2010090003756.pdf>

**Project Contacts:**

Rosemarie Caraway, Remedial Project Manager

U.S. Environmental Protection Agency

Phone: 415-972-3158

Email: [caraway.rosemarie@epa.gov](mailto:caraway.rosemarie@epa.gov)

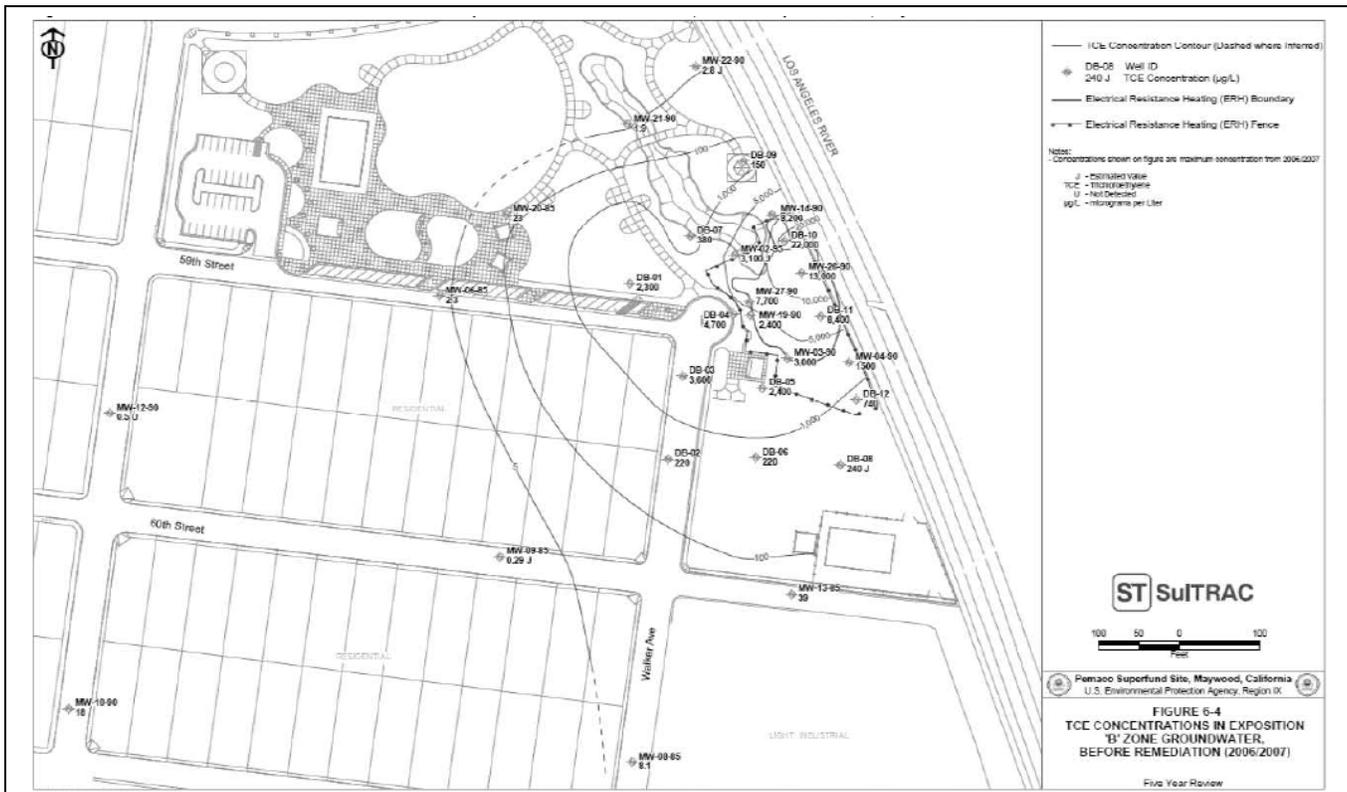


Figure 5. Pre-HVDPE Maximum Concentrations of TCE in Groundwater Zone 80 to 90 ft bgs

Source: U.S. EPA 2010

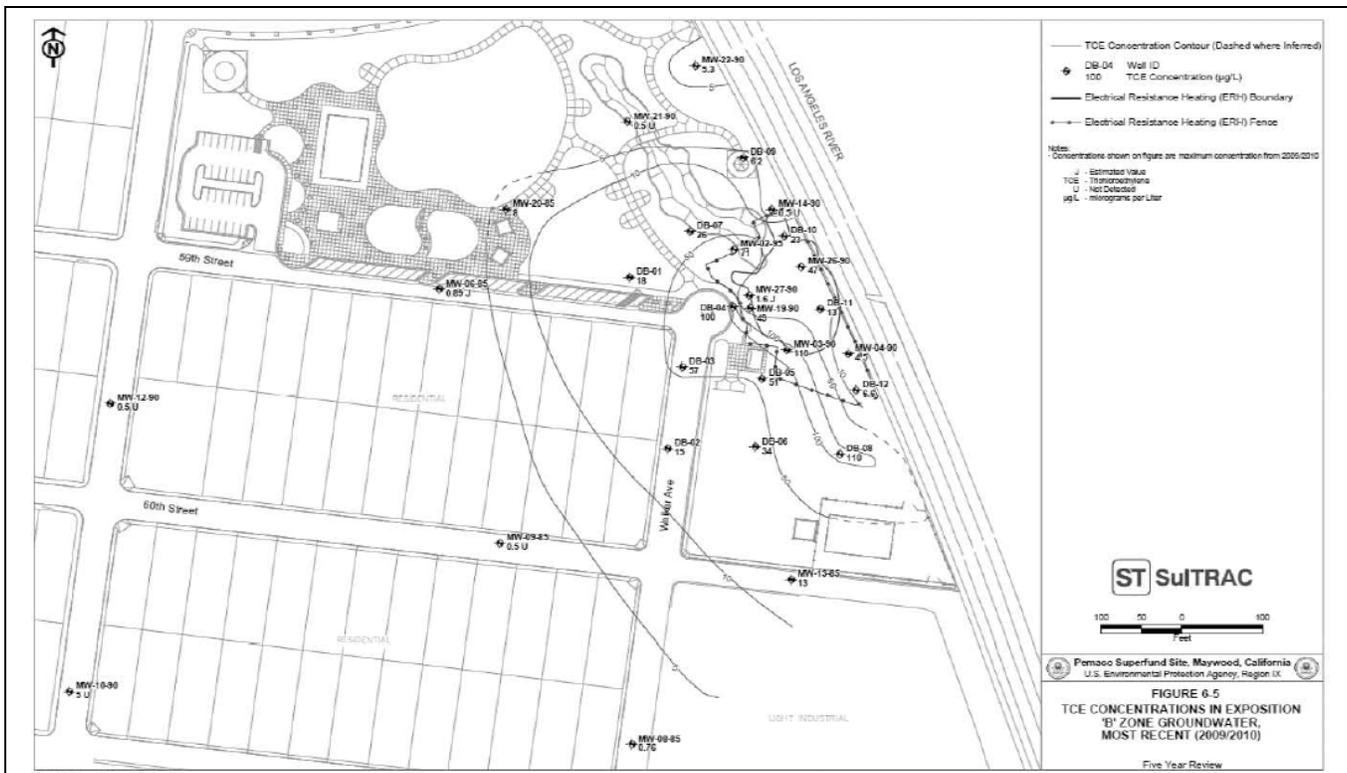


Figure 6. Post-ERH Maximum Concentrations of TCE in Groundwater Zone 80 to 90 ft bgs

Source: U.S. EPA 2010