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Remediation System Evaluation (RSE)
Pemaco Superfund Site

Maywood, California

REMEDIATION SYSTEM EVALUATION

PEMACO SUPERFUND SITE
MAYWOOD, CALIFORNIA

Report of the Remediation System Evaluation
Site Visit Conducted at the Pemaco Superfund Site
on January 25, 2011

Final Report

July 8, 2011

NOTICE

Work described herein was performed by Tetra Tech GEO, Inc. (Tetra Tech GEO) for the U.S. Environmental Protection Agency (USEPA). Work conducted by Tetra Tech GEO, including preparation of this report, was performed under Work Assignment #48 of USEPA contract EP-W-07-078 with Tetra Tech EM, Inc., Chicago, Illinois. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

EXECUTIVE SUMMARY

A Remediation System Evaluation (RSE) involves a team of expert hydrogeologists and engineers, independent of the site, conducting a third-party evaluation of the operating remedy. It is a broad evaluation that considers the goals of the remedy, site conceptual model, available site data, performance considerations, protectiveness, cost-effectiveness, closure strategy, and sustainability. The evaluation includes reviewing site documents, potentially visiting the site for one day, and compiling a report that includes recommendations in the following categories:

- Protectiveness
- Cost-effectiveness
- Technical improvement
- Site closure
- Sustainability

The recommendations are intended to help the site team identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation, and represent the opinions of the evaluation team. These recommendations do not constitute requirements for future action, but rather are provided for consideration by the United States Environmental Protection Agency (USEPA) Region and other site stakeholders.

The Pemaco Superfund Site is a 1.4 acre site located in east Los Angeles County, Maywood, California. The site is currently a part of the Maywood Riverfront Park, which consists primarily of open space with concrete walking paths, a gazebo, and a small public restroom. Formerly, the site operated as a chemical blending and distribution facility from the late 1940s until June 1991. The site soils and groundwater were impacted by aromatic and chlorinated solvents, flammable liquids, specialty chemicals, and oils used and stored at the site. Per the January 2005 Record of Decision, remediation would include hot-spot removal, soil capping, a dual-phase extraction system, and electrical resistance heating (ERH) to remediate source areas. Some hot-spot removal and soil capping along the northern edge and hot-spot removal in the northeast corner of the site was done between March 2005 and June 2006 as part of the Maywood Riverfront Park construction. By May 2007, both the groundwater extraction and the soil vapor extraction systems were in operation. ERH operations took place between September 2007 and April 2008. At present, the soil vapor extraction, high-vacuum dual-phase extraction, and groundwater extraction systems are still in operation. This RSE focuses on these systems and associated monitoring program.

In general, the RSE team found a well-operated system. The observations and recommendations contained in this report are not intended to imply a deficiency in the work of either the system designers or operators, but are offered as constructive suggestions in the best interest of the USEPA, the public, and the facility. These recommendations have the benefit of being formulated based on operational data unavailable to the original designers. Furthermore, site conditions and general knowledge of groundwater remediation have changed over time. For example, maximum trichloroethene (TCE) concentrations in groundwater have decreased from > 20,000 μg/L prior to remediation implementation to less than 1,000 μg/L. These reductions represent significant changes in site conditions and offer the opportunity to make changes in the remedial processes that will optimize system operation.

Recommendations are provided in effectiveness, cost reduction, technical improvement, site closure, and sustainability.

Recommendations for improving system effectiveness are as follows:

- ***C- and D-Zone Delineation and Pumping***: In the C-Zone, monitoring at wells MW-25-110 and MW-11-100 should be continued and additional pumping and/or new monitoring wells should be considered if the plume reaches MW-11-100. In the D-Zone, a new monitoring well should be installed downgradient of MW-07-130 to delineate the extent of the plume. Installing this additional well should cost about $20,000, including well installation, well development, oversight, and waste. This well should be added to the quarterly sampling list at a cost of about $4,000 per year.

- ***Assess Vapor Intrusion Risk Along 60th Street***: A soil gas sample should be collected from Trunk Line VE-1 and submitted to a state-certified laboratory for analysis for volatile organic compounds (VOCs). If any VOCs exceed established action levels, then soil vapor sampling should be conducted to assess whether a vapor intrusion risk is present in that area. The soil gas sample collection and analysis will cost less than $1,000. Assuming additional soil vapor sampling is conducted, multiple samples could be collected and analyzed for less than $15,000 total.

Recommendations for cost reduction include the following:

- ***Reduce Monitoring Well Sampling***: Reduce the number of monitoring points and the frequency of sampling as follows:

    - Monitoring wells which have shown concentration levels lower than the SSRLs for four consecutive quarters should be considered for elimination from the sampling plan. Quarterly groundwater monitoring is sufficient for containment confirmation and semiannual sampling is typically acceptable for assessing remediation progress. Table 6-1 shows the number of groundwater monitoring wells and current sampling schedule and that proposed by the RSE team. A reduction of 182 samples from the current 374 samples per year is proposed.

    - Soil vapor monitoring at the four subsurface vapor probes should be reduced from every two weeks to quarterly for a reduction from 104 soil vapor samples per year to 16 soil vapor samples per year (85% reduction). (Note that this reduction was accomplished beginning in February 2011 per SulTRAC comments.)

    - This monitoring frequency reduction represents a reduction in analytical costs of about $45,000 per year. The sampling reduction would reduce sampling labor, sub-contractor and other direct costs by at least an additional $100,000 per year.

- ***Reduce Process Sampling***:

    - Groundwater process sampling can be reduced to obtain only data required for sewer discharge and monthly influent. Assuming GAC treatment must remain, one of the GAC vessels could be removed with change-outs of the remaining vessel based on effluent results and an expected GAC breakthrough time based on data to date. There is no reason to sample well headers when individual extraction wells are sampled to determine cleanup progress and the well header data is not useful for treatment. Since 1,4-dioxane is not removed by GAC there is no reason to analyze it in the influent sample. Assuming the site team elects to continue process sampling rather than change the GAC on a pre-determined schedule, the decrease would be 80 VOC (80% reduction) and 92 1,4-dioxane analyses per year.

    - Vapor process sampling should be reduced to three per month including influent, between GAC and effluent plus annual samples of the headers. This is a reduction of 137 analyses per year (76% reduction). The combined recommended reductions in process sampling would save an estimated $58,000 per year in analytical costs assuming $100 each per VOC and 1,4-dioxane analysis of water and $300 for VOC analysis of vapor.

- ***Reduce Extraction Points and Simplify Processes***:

    - Six of the eight lines of SVE and DPE wells can be shut down based on vapor concentrations with only VE-1 (with DAB-1, DAB-2, DAB-3 and DAB-7 shut) and VE-2 (all wells open) left to operate and PA-5, PB-2, PC-5, PD-1, PD-4 and PD-6 open from the other legs. Soil sampling is recommended so further SVE and DPE wells can be shut down in areas that are clean or other individual wells along lines that are shut can be opened. This should reduce the number of extraction wells from 110 to about 25 wells and will allow focus on any remaining hot spots.

    - A rebound testing program of select well groups (lines) should be implemented to confirm that vapor concentrations do not return to levels above applicable standards. Assuming all six lines are tested and none shows significant rebound the cost could be limited to analysis of six vapor VOC samples. For more conservative costing purposes we assume that up to twenty samples will be needed and a subset of the lines will be operated for a few months before the rebound effect is eliminated; this represents a total labor and laboratory cost of about $10,000.

    - With this recommended reduction (or even without reduction in extraction wells), at a minimum one of the liquid ring blowers could be taken off-line for an electric cost reduction of $40,000 per year. With the conversion of the remaining DPE wells to vapor extraction only, the blower(s) potentially could be replaced (based on testing with the existing blowers and dilution air) by a lower vacuum blower with the same or greater flow rate per extraction point such as a regenerative blower with a 5 to 10 HP motor (providing approximately 250 scfm at 60” H2O).

   - With the reduction in extraction rate the vapor temperature will not be raised sufficiently to require cooling. The change to a 10 HP blower would cost about $50,000 in capital costs to purchase and install the blower and make required changes in the control system. However, eliminating one liquid-ring blower and replacing the other liquid-ring blower with a 10 HP regenerative blower, would reduce electric costs by about $32,000 per year (assuming $0.12 per kWh and a 90% motor efficiency for the 10HP blower motor). Alternatively, if high vacuum is determined to still be needed, the site team could investigate potential use of a variable speed drive on the remaining blower.

   - Any Perched, A, B, and A+B Zone wells with groundwater concentrations less than SSRLs should be shut down; pumping at clean wells is counterproductive, pulling contaminants toward areas that are clean. The site team should consider pumping the three excluded P-series dual extraction wells periodically instead of using DPE.

- ***Reduce Operating Labor***: Operating labor, analysis, and reporting costs can be reduced in line with the system changes as the changes are implemented. Site visits two to three times per week and reduced sampling, analysis and reporting are appropriate. The total operating wells will be reduced from over 130 to about 40. Frequent checks of PID concentrations, flow, and temperature at wells are not needed; monthly checks are sufficient. Maintenance requirements will be less and spare parts will be available from the no longer operating wells. Off-hour security is unnecessary with appropriate security alarms (noted by SulTRAC to cost $18,000 to install and less than $5,000 per year to monitor) and auto-dialer capabilities. The proposed system should require a maximum of one full time equivalent (FTE) or about $150,000 per year in operating labor costs plus security monitoring. ODCs would be reduced to less than $75,000 per year. This is a savings of $590,000 per year.

- ***Reduce Project Management***: The project management and subcontracting currently in place should also be reduced in line with the simplified system and reduced monitoring/sampling that is recommended. Sites of similar complexity to the proposed simplified system are typically operated with management and reporting budgets of $100,000 to $150,000 per year. This is a projected savings of $386,000 per year.

Recommendations for technical improvement include the following:

- For the groundwater system, water should be pumped to a single equalization tank then pumped through filters and GAC (assuming the site team elects to continue removing VOCs which is not required for discharge). For vapor, the system should use one blower (either an existing one or a smaller replacement) and discharge through the GAC. The discharge temperature with a lower flow rate should be less than 150 degrees F. This will eliminate the need for a cooling system.

- Improve reporting by preparing two semi-annual reports each year with tables to summarize and present data in a format that is "user-friendly". Such reporting would assist the site team and RPM in quickly identifying trends and data that warrant changes in system operation as wells as remedial progress.

Recommendations for gaining site closure include the following:

- Establishing soil-vapor action levels or SSRLs to make decisions regarding SVE operation, optimization, and eventual closure. The CHHSLs might be appropriate SSRLs or action levels for soil vapor at the site.

- The reported 30 baseline soil sample locations should be re-sampled to assist with further focusing of vapor extraction.

Recommendations for improved sustainability include the following:

- Recommendations to substantially reduce electricity usage will result in substantial reductions to the energy and air emission footprints. Reductions in groundwater and process monitoring will reduce the contributions of the remedy footprint assumed to be associated with laboratory analysis. Reductions in operator labor and the number of visits per week will reduce fuel usage and associated energy and air emission footprints.

- The groundwater monitoring staff is located in northern California and travels to southern California for each of the groundwater monitoring events. Using local personnel (perhaps subcontractors) for groundwater monitoring would reduce travel costs and the site's carbon footprint.

- Once the system is optimized as suggested and electricity usage is better understood, the site team can consider the potential application of renewable energy in addition to the existing use of solar power at the site. Because of the relatively short anticipated remaining remedy duration, the use of renewable energy certificates or purchased renewable energy may be most appropriate. This approach to applying renewable energy avoids the substantial investment associated with a renewable energy project and the potentially long-term system operation that is needed to payback that investment.

Table 6-3 summarizes the recommendations, including estimated costs and/or savings associated with the recommendations and is presented in Section 6.0 of this report.

PREFACE

This report was prepared as part of a project conducted by the United States Environmental Protection Agency Office of Superfund Remediation and Technology Innovation (USEPA OSRTI). The objective of this project is to conduct independent, expert reviews of soil and groundwater remedies with public funding with the purpose of optimizing the remedy for protectiveness, cost-effectiveness, and sustainability. The project contacts are as follows:

Organization	Key Contact	Contact Information
USEPA Office of Superfund Remediation and Technology Innovation (OSRTI)	Jennifer Hovis	USEPA Headquarters – Potomac Yard 2777 Crystal Drive Arlington, VA 22202 phone: 703-603-8888 hovis.jennifer@epa.gov
Tetra Tech EM, Inc. (Contractor to USEPA)	Therese Gioia	Tetra Tech EM Inc. 1 South Wacker, Suite 3700 Chicago, IL 60606 phone: 312-201-7431 therese.gioia@tetratech.com
Tetra Tech GEO, Inc. (Contractor to Tetra Tech EM, Inc.)	Doug Sutton	Tetra Tech GEO, Inc. 2 Paragon Way Freehold, NJ 07728 phone: 732-409-0344 doug.sutton@tetratech.com

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1.0 INTRODUCTION

1.1 PURPOSE

During fiscal years 2000 and 2001 independent reviews called Remediation System Evaluations (RSEs) were conducted at 20 operating Fund-lead pump-and-treat (P&T) sites (i.e., those sites with P&T systems funded and managed by Superfund and the States). Due to the opportunities for system optimization that arose from those RSEs, the USEPA Office of Superfund Remediation and Technology Innovation (OSRTI) has incorporated RSEs into a larger post-construction complete strategy for Fund-lead remedies as documented in *OSWER Directive No. 9283.1-25, Action Plan for Ground Water Remedy Optimization*, and has also started conducting RSEs at some Potential Responsible Party (PRP)-lead sites. A strong interest in sustainability has also developed in the private and public sectors. Consistent with this interest, OSRTI has developed a Green Remediation Primer (http://cluin.org/greenremediation/) and, as a pilot effort now considers green remediation during independent evaluations.

The RSE process involves a team of expert hydrogeologists and engineers that are independent of the site, conducting a third-party evaluation of the operating remedy. It is a broad evaluation that considers the goals of the remedy, site conceptual model, available site data, performance considerations, protectiveness, cost-effectiveness, closure strategy, and green remediation. The evaluation includes reviewing site documents, potentially visiting the site for one day, and compiling a report that includes recommendations in the following categories:

- Protectiveness
- Cost-effectiveness
- Technical improvement
- Site closure
- Green remediation

The recommendations are intended to help the site team identify opportunities for improvements. In many cases, further analysis of a recommendation, beyond that provided in this report, may be needed prior to implementation of the recommendation. Note that the recommendations are based on an independent evaluation, and represent the opinions of the evaluation team. These recommendations do not constitute requirements for future action, but rather are provided for consideration by the USEPA Region and other site stakeholders.

The Pemaco Superfund Site was selected by the USEPA OSRTI based on a nomination from USEPA Region 9. The site is within the Maywood Riverfront Park in Maywood, California. The site is primarily open space. It is bounded by residential and light industrial properties to the west and south and by the concrete-lined Los Angeles River to the east. Chemicals of concern (COC) in groundwater are specific volatile organic compounds (VOCs):

- Tetrachloroethene (PCE)
- Trichloroethene (TCE)
- cis-1,2-Dichloroethene (cis-1,2-DCE)
- trans-1,2-Dichloroethene (trans-1,2-DCE)

- Vinyl Chloride (VC)
- Benzene
- 1,4-Dioxane

The groundwater remedy consists of a groundwater extraction system, which extends beyond the boundaries of the Pemaco site as well as a vapor extraction system and a high-vacuum dual-phase extraction system. Electrical Resistance Heating (ERH) was used at the site previously to remove source area VOCs. The RSE provides an opportunity for an independent third-party review of these remediation efforts.

1.2 TEAM COMPOSITION

The RSE team consisted of the following individuals:

Table 1-1. Tetra Tech GEO RSE Team

Name	Affiliation	Phone	Email
Peter Rich	Tetra Tech GEO, Inc.	410-990-4607	peter.rich@tetratech.com
Scott Parsons	Tetra Tech GEO, Inc.	949-809-5222	scott.parsons@tetratech.com

In addition, the following individuals from USEPA Headquarters participated in the RSE site visit:

- Jennifer Hovis
- Emily Ferguson

1.3 DOCUMENTS REVIEWED

The following documents were reviewed. The reader is directed to these documents for additional site information that is not provided in this report.

- Revised Draft Groundwater Monitoring Report: April and October 2009 Semiannual Events (T N & Associates, Inc.) – November 2010
- 2010 Five-Year Review Report (USEPA Region 9) – September 2010
- Draft Annual Operations Report 2008 and 2009 (OTIE) – March 2010
- Draft Annual Operations Report 2007 (T N & Associates, Inc.) – January 2008
- Pemaco Bio-Pilot Interim Status Report (T N & Associates, Inc.) – November 2007
- Attachment 2 Sampling and Analysis Plan (T N & Associates, Inc.) – October 2007
- Draft Monitoring, Operations and Maintenance Plan (T N & Associates, Inc.) – February 2007

- Remedial Action Workplan (ERM) – October 2006
- Record of Decision (USEPA Region 9) – January 2005
- Final Feasibility Study Report (T N & Associates, Inc.) – April 2004
- The Pemaco Superfund Site website[1] with up to date site data and figures: http://ees.tnainc.com/pemaco/index.php

1.4 PERSONS CONTACTED

The following individuals associated with the site were present for the visit:

Table 1-2. Individuals Associated with the Site Present for the Site Visit

Name	Affiliation	Phone	Email
Rik Lantz	Sullivan	312-443-0550 ext. 16	rlantz@OneSullivan.com
Dacre Bush	OTIE	805-295-9071	dbush@otie.com
Nova Clite	OTIE	805-585-6396	nclite@otie.com
Rose Marie Caraway	USEPA	415-972-3158	Caraway.Rosemarie@epa.gov

SulTRAC (a joint venture between Sullivan International Group, Inc. [Sullivan] and Tetra Tech EM, Inc.) is the operations and maintenance (O&M) contractor for the USEPA. Tetra Tech staff were not present as key site team members. OTIE (Oneida Total Integrated Enterprises, LLC.) is a subcontractor providing reporting, analysis, operating and sampling services.

1.5 BASIC SITE INFORMATION AND SCOPE OF REVIEW

1.5.1 LOCATION

The Pemaco Superfund Site is a 1.4 acre site located at the corner of South District and 60th Street in east Los Angeles County, Maywood, California. Formerly a custom chemical blending facility, the site is currently a part of the Maywood Riverfront Park. This park is primarily open space with concrete walking paths, a gazebo, and a small public restroom. The site is bounded by Slauson Avenue to the north, the Los Angeles River to the east, and residential and light industrial properties to the south and west.

1.5.2 SITE HISTORY, POTENTIAL SOURCES, AND RSE SCOPE

The 2005 Pemaco Record of Decision (ROD) and the 2010 Five-Year Review (September 2010) provides the following information:

[1] Access to the website can be obtained by contacting Rose Marie Caraway; refer to Table 1-2 for contact information.

- The chemical blending and distribution facility operated from the late 1940s until June 1991. During this time the Pemaco facility consisted of a 22,000 ft^2 warehouse in the northern portion of the property, with 31 underground storage tanks (USTs) and at least six aboveground storage tanks (ASTs) in the south part of the site. The ASTs and USTs ranged in size from 500 to 20,000 gallons and were used to store a wide variety of chemicals, including aromatic and chlorinated solvents, flammable liquids, specialty chemicals, and oils. Multiple 55-gallon drums were also stored around the site.

- In December 1990, an environmental investigation was performed by the site owner to investigate potential leakage from 37 storage tanks. During the investigation, 16 soil borings were drilled and sampled every 5 feet (ft) from 30 ft to 40 ft. Samples were analyzed for benzene, toluene, ethyl benzene, xylenes (BTEX), and non-halogenated volatile organic compounds (NHVOCs). In addition, two samples from each boring were analyzed for VOCs. Benzene, PCE, DCE, and TCE were found to be in excess of regulatory levels, and each of the soil borings was converted to a shallow monitoring well.

- In June 1991, operations at Pemaco ended.

- In May 1992, a complaint was submitted to the Los Angeles County Fire Department, and the responding health officers deemed the site as an imminent danger to human health. In December 1993, a fire destroyed the warehouse building and some materials inside, prompting the USEPA to initiate removal action. The USEPA secured the site by removing six 55-gallon drums, verifying that all storage tanks were empty, grouting an unmarked borehole, and attaching locking caps to each standpipe. By 1994, approximately 400 55-gallon drums and three ASTs were removed from the site.

- In June 1995, the USEPA completed its Preliminary Assessment and Site Investigation and the site was entered into the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) database as CAD980737092.

- From February to May 1997, additional site characterization was conducted by the USEPA as part of an Expanded Site Investigation (ESI). This included collection of additional soil samples, installation of monitoring wells, sampling of new and existing monitoring wells, and an evaluation of Hazard Ranking System (HRS) factors. This later led to Pemaco being added to the National Priorities List (NPL) in January 1999.

- Under the direction of the USEPA Region 9 Emergency Removal Office, additional removal activities began in August 1997. Such activities included the removal of all USTs and ASTs as well as demolition of all buildings onsite. In preparation for the installation of a soil vapor extraction (SVE) system, air monitoring, surface and subsurface soil sampling, soil vapor monitoring, groundwater sampling and remedial pilot tests were conducted.

- In March 1998, an SVE system was installed with the intent of treating VOC-contaminated soils in the northeastern area of the site. The SVE system treated off-gas with a thermal oxidation unit which caused community concerns about potential dioxin emissions that eventually led to system shut-down in March 1999. In the period of system operation, over 90,000 pounds (lbs) of hydrocarbons and solvents were removed from the vadose zone soils.

- Remedial investigations and feasibility studies were conducted by the USEPA from January 2000 to March 2002. Based on these studies, additional, deeper monitoring wells were installed and additional indoor air sampling was conducted in the summer of 2003. In August 2003, a second round of indoor air sampling was conducted in 28 homes in the neighborhood surrounding the site. These results as well as previous indoor air sampling results were used to determine that a separate remedy for homes in the neighborhood was not necessary.

- In January 2005, the Pemaco Record of Decision was approved. According to the ROD, remediation would include hot-spot removal, soil capping, a dual-phase extraction system, and ERH to remediate source areas. The installation of groundwater and vapor monitoring wells around the site and in the surrounding neighborhood was also necessary. Some hot-spot removal and soil capping along the northern edge and hot-spot removal in the northeast corner of the site was done between March 2005 and June 2006 as part of the Maywood Riverfront Park construction. Construction of the dual-phase extraction system began in August 2005 and ERH electrodes were installed in October 2006. By May 2007, both the groundwater extraction and the soil vapor extraction systems were in operation. ERH operations took place between September 2007 and April 2008.

- At present, the soil vapor extraction, high-vacuum dual-phase extraction, and groundwater extraction systems are still in operation.

1.5.3 GEOLOGIC/HYDROGEOLOGIC SETTING

The hydrogeologic setting at the Pemaco site is complex. There are six contaminated groundwater zones that underlie the Pemaco site: The Perched Zone and Exposition Aquifer Zones ‘A’ through ‘E’. Two additional aquifers (the Jefferson and Lynwood Aquifers) underlie the Exposition Aquifer and are believed to be free of contamination from the Pemaco site. The cross-section in Appendix A shows these zones.

The soils above the shallowest groundwater zone are composed mainly of silty sands, gravelly sands, clayey gravels, and silty sands interbedded with poorly graded sands and lean clays. These soils are referred to as Surface and Near-surface Soils (0-3 ft below ground surface [bgs]) and the Upper Vadose Zone (3-25 ft bgs).

The shallowest of the groundwater zones is the Perched Zone. Groundwater in this zone is typically from 25 to 40 ft bgs and flows towards the southwest; however, groundwater flow has been known to be to the south and southeast in some localized locations. Laminated lenses of poorly graded sands, silty sands, and sandy silts ranging from 5 inches to 5 ft in thickness make depth to water highly variable. The Perching Clay (a non-water bearing layer) ranges in thickness from 1 to 10 ft and is found between 30 to 40 ft bgs. It consists of silty clays interbedded with clayey and sandy silts.

Soils separating the Perched Zone and the Exposition Aquifer System are referred to as the Lower Vadose. This formation is comprised of sand to 50 ft bgs and fine-grained sandy/clayey silts interbedded with clay to 65 ft bgs.

Zones ‘A’ through ‘E’ comprise the Exposition Aquifer System. These zones are composed of fine silty sands, poorly graded sands, well-graded sands, silty sands, and sandy gravels separated by silt and clay. Table 1-3 details the depth, thickness, and groundwater flow direction of each layer.

Table 1-3. Details of Zones ‘A’ through ‘E’

Zone	Depth of Zone (ft bgs)	Thickness of Zone	GW Flow Direction
A	65 – 75	3 in – 10 ft	south-southwest
B	80 – 90	1.5 – 10 ft	southwest
C	100 – 105	2 – 6 ft	south to southeast
D	125 – 145	6 – 15 ft	southwest
E	160 – 175	Approximately 1 ft	N/A

1.5.4 POTENTIAL RECEPTORS

Based on discussions during the RSE site visit, the primary potential receptors are groundwater users and vapor intrusion into nearby residences:

- With respect to groundwater users, there are three public supply wells in the vicinity, and the closest of those wells is approximately 1,800 ft from the site and reported by the site team to be screened at an interval starting over 300 ft deep. There has been no indication that groundwater contamination extends to that depth or distance. The 2005 ROD considered groundwater ingestion to be an incomplete exposure pathway because there are no production wells in the Exposition ‘A’ and ‘B’ groundwater zones.

- Nearby residences are potential receptors via vapor intrusion. According to the 2010 Five-Year Review Report, vapor intrusion was evaluated extensively during the Remediation Investigation (RI) phase of the project and during implementation of the ERH phase of the remedy. The USEPA conducted indoor sampling of the residential homes located on Walker Avenue, 59th Place, and 60th Street during the spring of 2007. The conclusion based on the indoor air sampling was that indoor air concentrations were not significantly different from the outdoor air concentrations; therefore, any contribution possibly associated with vapor intrusion could not be determined.

- The USEPA collected soil vapor samples bi-weekly from permanent probes set into Walker Avenue and 59th Place to assess whether or not subsurface vapors increased during ERH implementation. The USEPA determined that soil vapor concentrations in the probes do not exceed action levels. However, the action levels were unspecified, and the ROD does not present site-specific remediation levels (SSRLs) for soil vapor.

- Monitoring of subsurface vapor between the site and nearby residences showed a significant decrease in contaminant concentrations when the dual-phase extraction (DPE) system was started (soil vapor and groundwater). Only two monitoring points (two depths at each) are currently sampled regularly and concentrations at these points have been very low in recent sample analysis.

1.5.5 DESCRIPTION OF GROUNDWATER PLUME

The major groundwater COCs at the Pemaco site include PCE, TCE, cis-1,2-DCE, trans-1,2-DCE, VC, 1,4-dioxane, and benzene; however, the primary focus is on TCE cleanup. Table 1-4 lists maximum 2009 concentration levels for these COCs as well as the SSRLs. The SSRLs for this site are based on the federal/state Maximum Contaminant Levels (MCL) or on the Preliminary Remediation Goal (PRG) for the chemicals that do not have an MCL.

Table 1-4. Maximum Concentrations (µg/L) of Select COCs - 2009

Contaminant	Zone						
	SSRL	Perched	A	B	C	D	E
PCE	5	*200*	3.5	4.4	0.14	ND	N/A
TCE	5	*12*	*370*	*720*	*990*	*120*	<5
cis-1,2-DCE	6	*33*	*68*	*130*	*81*	3	<6
trans-1,2-DCE	10	7	3.8	8	1.1	ND	N/A
VC	0.5	*14*	ND	*3.2*	0.5	*1.3*	N/A
1,4-Dioxane	3	*330*	*5.4*	*9.5*	2.5	ND	N/A
Benzene	1	*2.7*	0.37	*5.4*	*5.1*	*16*	N/A

Note: Italicizing indicates values above SSRL
µg/L = micrograms per liter
ND = not detected at method detection limit
N/A = information not available

The Perched and A-Zone plumes are mainly confined to the site. The ERH efforts in 2007/2008 removed a high percentage of the mass in the Perched and A-Zones. Continued pumping dewaters the wells in these zones, and there is no evidence of plume migration that requires containment. Several Perched and A-Zone wells that are currently pumped have VOC concentrations below SSRLs. The B-Zone plume appears to have migrated from the source area to the south. A line of hydraulic containment wells are in place and containment effectiveness is supported by the concentrations at MW-08-85 below SSRLs. However, the B-Zone containment pumping wells are relatively unproductive and other traditional hydraulic containment evaluation methods may not be useful. The C- and D- zones have relatively few wells; it appears that contamination has migrated from the source zone to the south. The C-Zone is delineated in the downgradient direction by one well (MW-11-100) with VOCs below SSRLs.

TCE concentrations have been detected above SSRLs in D-Zone wells MW24-140 (most recently in 2008 according to the 2010 Five-Year Review Report), MW07-130, and well MW25-130. TCE concentrations in well MW25-130 have increased from less than 5 µg/L in 2003 to 120 µg/L in October 2009. TCE concentrations also exceed SSRLs in well MW07-130, the most downgradient D-Zone well (October 2009 data). Figures showing the VOC concentrations in each zone are included in Appendix A.

2.0 SYSTEM DESCRIPTION

The operating systems at the site include the following:

- Extraction and treatment of soil vapor; discharge limits specified by the South Coast Air Quality Management District (SCAQMD) Permit for the subject treatment system.

- Extraction and treatment of groundwater; discharge limits specified by the Los Angeles County Sewer District (LACSD), including a total VOCs discharge concentration of less than 1,000 µg/L.

These active remedy components are discussed in more detail below.

2.1 EXTRACTION SYSTEMS

Extraction systems include soil vapor extraction wells, groundwater extraction wells and dual phase (both vapor and groundwater) extraction wells:

- Soil Vapor Extraction – The vapor extraction system consists of 28 vapor recovery wells (denoted VR-01LV toVR-19LV and VR-02P, VR-04P, VR-05P, VR-07P, VR-10P through VR-12P, VR-17P and VR-18P), and 58 electrode points installed as part of the ERH operation hooked up to vacuum lines from the treatment system building.

- Groundwater Extraction – The groundwater extraction system consists of 34 Exposition Aquifer zone extraction wells. The Exposition Aquifer wells are divided into the following:

    - 12 A-Zone wells (denoted DA-1 through DA-12), which are 65 to 75 ft deep;
    - 12 B-Zone wells (denoted DB-1 through DB-12), which are approximately 80 to 100 ft deep;
    - 8 A- and B-Zone wells (denoted DAB-1 through DAB-8);
    - 1 C-Zone well (denoted MW-25-110); and,
    - 1 D-Zone well (denoted MW-25-130).

    Each of these extraction wells contains a pneumatic submersible pump, and the overall average flow rate is approximately 31 gallons per minute (gpm). As of December 2009, the pumps from DA-2, DAB-4 and DAB-5 were removed due to the wells going dry.

- Dual-Phase Extraction – The 23 dual-phase extraction wells are equipped with a vacuum drop tube for combined vapor and groundwater extraction. The DPE Perched Zone wells are approximately 30 to 40 ft deep and are denoted PA-1 through PA-5, PB-1 through PB-7, PC-1, PC-2, PC-5, PC-6, PD-1 and PD-4 through PD-9. Vacuum is also applied to the A-Zone, B-Zone and combined A- and B- (DAB) zone wells.

The layout of the extraction systems is shown in one of the figures included in Appendix A.

2.2 TREATMENT SYSTEMS

The four vacuum header lines from the DPE wells are routed to knockout sumps just outside the treatment building. Vapor from these sumps is then drawn into a moisture separator inside the treatment building. Vapor from the other four vapor extraction headers associated with the SVE system also enters the treatment building in the moisture separator. From the separator, vapor is drawn through filters and then into the two liquid ring blowers, each powered by 75 HP motors. From the blowers the vapor is cooled from approximately 160 degrees F using a potable water cooling system, and is then treated in two 4,000 lb granular activated carbon (GAC) vessels in series. The treated vapor is then exhausted into the atmosphere. Vapor flow is typically 600 standard cubic ft per minute (scfm) with the two liquid ring blowers operating.

Groundwater is carried from the well fields to the treatment system via three subsurface header lines. The groundwater entering the treatment building is pumped into a 1,000-gallon equalization/settling tank. Water from the DPE knockout sumps is also pumped into the 1,000-gallon tank. Silt that settles in the tank is cleaned out approximately once per month. Water from the 1,000 gallon tank is pumped (3 HP motor) through filters into a 4,000-gallon holding tank. Condensate from the soil vapor moisture separator and non-contact cooling water is also pumped into the 4,000 gallon holding tank. From the holding tank the water is pumped (5 HP motor) through additional filters followed by two 3,000 lb GAC vessels in series prior to discharge to the sanitary sewer (i.e., POTW).

A process diagram showing treatment system components is included in Appendix A.

2.3 MONITORING PROGRAM

The monitoring program at the site (at the time of the RSE site visit) consists of daily, semi-weekly, weekly, bi-weekly, monthly, quarterly, and semi-annual sampling/monitoring events. Monitoring includes daily checks of tens of vacuum/pressure, temperature and flow measurement devices in the treatment plant, and weekly photoionization detector (PID), temperature, vacuum and flow readings in the well field. Sampling includes groundwater and vapor process sampling in the treatment plant, 128 active groundwater extraction and monitoring wells, 28 vapor recovery wells, 21 soil-vapor monitoring probes, and 30 multi-level temperature monitoring probes. The following is a schedule of sampling/monitoring events:

- *Groundwater monitoring (monitoring and extraction wells)*: includes 12 wells monthly for VOC analysis, an additional 28 wells quarterly for VOC analysis, an additional 59 wells semi-annually for VOC analysis, and 40 wells semi-annually for 1,4-dioxane analysis. This totals 374 VOC analyses per year and 80 1,4-dioxane analyses per year. Many of the sampled wells have concentrations of VOCs that are non-detectable or are below SSRLs.

- *Off-site soil-vapor samples*: four samples (at 5-foot and 15-foot depths at two locations in the street separating the site from the nearest residential properties) are collected biweekly (104 times per year) to monitor for potential soil-vapor migration toward the residential properties. (The site team notes that subsequent to the RSE site visit the sampling frequency was reduced to quarterly in February 2011.) The most recent results on the Pemaco Superfund Site website (http://ees.tnainc.com/pemaco/index.php) indicated no detected VOCs at both depths at SSV-7, and indicated TCE at 0.12J parts per billion by volume (ppbv) at 5-ft depth and TCE of 4.9 ppbv at 15 ft depth at SSV-6. Neither the 2005 ROD nor the 2010 Five-Year Review Report specifies SSRLs or action levels for soil vapor. However, the USEPA determined in the 2010 Five-Year Review Report that these soil vapor concentrations do not exceed action levels. It is noted that these TCE concentrations are well below the residential California Human Health Screening Level (CHHSL or "chisels") for TCE in shallow soil vapor (less than five ft bgs) of 528 micrograms per cubic meter ($\mu g/m^3$), which is equivalent to 96 ppbv. See Section 3.1 for additional discussion on CHHSLs.

- *Groundwater process sampling*: eight samples per month are analyzed for VOCs, 1,4-dioxane, and hexane. These samples include the three influent headers, total influent, pre-GAC, mid-GAC (between the lead and lag units), post-GAC, and effluent samples. An additional sample is collected quarterly at SP-212, the heat exchanger unit. The total number of samples per year is 100. In addition, eight discharge samples per year are analyzed for POTW pretreatment parameters.

- *Vapor process sampling*: an estimated 15 samples per month (180 per year) are collected and analyzed for VOCs, including samples from each vapor extraction header, a combined influent sample, mid-GAC, post-GAC and effluent samples.

The physical data and operational parameters are collected daily, weekly, and monthly to determine maintenance needs and system operational parameters in combination with a System Control and Data Acquisition (SCADA) system which indicates system maintenance needs.

3.0 SYSTEM OBJECTIVES, PERFORMANCE, AND CLOSURE CRITERIA

3.1 CURRENT SYSTEM OBJECTIVES AND CLOSURE CRITERIA

The 2005 ROD identifies the following groundwater and indoor air remedial action objectives (RAOs):

- Restore the groundwater quality in the Perched Zone and Exposition Zones to drinking water standards (MCLs).
- Prevent vertical migration of COCs from the Perched Zone and deeper Exposition Zones at rates that would cause groundwater to exceed drinking water standards.
- Prevent further offsite migration of contaminated groundwater beneath additional adjacent properties.
- Prevent migration of contaminated groundwater to local production wells.
- Remediate COCs in soil and groundwater to drinking water standards and other health-based action levels to eliminate potential exposures to indoor air contaminants created by site contamination.
- Prevent further migration of soil vapor in excess of Applicable or Relevant and Appropriate Requirements (ARARs) and standards that are protective of human health and the environment.

The 2005 ROD also stated that the remedy will prohibit future residential use of the former Pemaco property, and that extraction wells and pumping rates should be implemented to prevent contamination from migrating beyond the downgradient extent of the plume (at the time of the remedy implementation). The following performance criteria need to be met in groundwater to indicate completion of the remedy.

Table 3-1. Site-Specific Remediation Levels (SSRLs)

Chemical of Concern	Remediation Level (µg/L)
PCE	5.0
TCE	5.0
cis-1,2-DCE	6.0
trans-1,2-DCE	10.0
VC	0.5
1,4-Dioxane	3.0
Benzene	1.0

The aforementioned CHHSLs are concentrations of 54 hazardous chemicals in soil or soil gas that the California Environmental Protection Agency (Cal/EPA) considers to be below thresholds of concern for risks to human health. The thresholds of concern used to develop the CHHSLs are an excess lifetime cancer risk of one-in-a-million (10^{-6}) and a hazard quotient of 1.0 for non-cancer health effects. The CHHSLs were developed using standard exposure assumptions and chemical toxicity values published by the USEPA and Cal/EPA, and as such CHHSLs apply to the site and should be considered for vapor monitoring and vapor extraction system operation. The shallow soil gas (less than 5 ft bgs) TCE CHHSLs are the applicable levels for comparison at the site. The commercial/industrial and residential land use CHHSLs for TCE are 324 ppbv and 96 ppbv (1770 and 528 $\mu g/m^3$), respectively.

The 2005 ROD estimated a time frame of five years of active remediation (remediation began in April 2007) and an additional five years to achieve the RAOs. Pump-and-treat in the A- and B-zones was selected for areas with TCE above 10 µg/L, while areas with lower concentrations were designated for monitored natural attenuation.

3.2 WATER DISCHARGE PERMIT

Treated groundwater is discharged to the LACSD under Industrial Wastewater Discharge Permit Number 016961. The permit requires quarterly samples for VOCs, semi-volatile organic compounds (SVOCs) and several standard wastewater parameters. The total VOC discharge limit is 1,000 µg/L. Total VOC concentrations in the extracted groundwater are now well below the discharge limit, precluding the need for treatment to meet the discharge standard. For example, influent to the treatment plant, including 1,4-dioxane, was approximately 96 µg/L in February 2011. While the current permit requires treatment by GAC regardless of the influent concentration, the site team should consider whether the permit can be amended to reflect current conditions.

3.3 VAPOR DISCHARGE

The site team reports in the Annual Operations Report (2008-2009) that vapor emissions are subject to discharge limits based on results of Tier 2 Screening Risk Assessment conducted as part of the SCAQMD Permit. The TCE emissions limit based on the assessment is 110 ppbv. The site team samples and analyzes VOCs in the vapor discharge monthly.

4.0 FINDINGS

4.1 GENERAL FINDINGS

The RSE team observed that the active remedy components are operated by capable and organized operators. The observations provided below are not intended to imply a deficiency in the work of the system designers, system operators, or site managers but are offered as constructive suggestions in the best interest of the USEPA and the public. These observations have the benefit of being formulated based upon operational data unavailable to the original designers. Furthermore, site conditions and general knowledge of groundwater remediation have changed over time. For example, maximum TCE concentrations in groundwater exceeded 20,000 µg/L prior to the implementation of the remediation system four years ago. Since then, maximum TCE concentrations in groundwater have been reduced to less than 1,000 µg/L (see Table 1-4). These reductions represent significant changes in site conditions and offer the opportunity to make changes in the remedial processes that will optimize system operation.

4.2 SUBSURFACE PERFORMANCE AND RESPONSE

4.2.1 PLUME CAPTURE

The site team reports that hydraulic containment in the Perched and A-Zones is not a concern because the units are dewatered from remediation pumping and groundwater monitoring results indicate that the plume is not migrating in the Perched and A-Zones. The RSE team agrees with this assessment. Continued pumping and associated vapor extraction is conducted to remove mass and to reach SSRLs.

As discussed in Section 2.1, groundwater is extracted from the Perched Zone by 23 DPE wells, and from the A-Zone by 12 extraction wells. These wells were sampled in October 2010 (http://ees.tnainc.com/pemaco//index.php). In the Perched Zone, VOC concentrations were less than SSRLs in 15 wells, and SSRLs were exceeded in three Perched Zone wells (PB-02, PB-05 and PD-06). Five Perched Zone wells (PA-01, PA-02, PB-06, PC-01, and PD-01) were dry and could not be sampled. In the A-Zone, VOC concentrations were less than SSRLs in groundwater samples collected from four of the 12 A-Zone extraction wells (DA-8, DA-10, DA-11, DA-12).

The site team reports that they are operating the groundwater extraction system to contain the B-Zone plume from migrating to the south. A line of seven extraction wells (DAB-1 through DAB-7) in 60th Street are pumped for this purpose. Three of these seven pumping wells (DAB-1, DAB-2, and DAB-7) had concentrations below SSRLs according to the most recent data and two (DAB-4 and DAB-5) were dry. A total of 12 other wells (DB-1 through DB-12) in the B-Zone are pumped apparently for mass removal purposes. Four of these 12 wells (DB-5, DB-9, DB-11 and DB-12) had concentrations below SSRLs in the most recent sampling data.

The pumping wells with concentrations less than SSRLs have a total flow rate of approximately 15 gpm. The system total flow rate is 30 gpm. At the time of the RSE site visit, the site team had not prepared or implemented a plan to remove pumping wells as COC concentrations reach

SSRLs. (SulTRAC reports that subsequent to the RSE site visit, it provided recommendations to the USEPA Remedial Project Manager in a letter dated March 2, 2011 with the subject "High-Vacuum Dual-Phase Extraction Well Reduction".)

In the C- and D-Zones, periodic groundwater pumping has been employed at individual wells (MW-24 and MW-25) when elevated VOCs have been found. Data available at the time the 2005 ROD was prepared indicated that COC migration was not a concern in these zones. Accordingly, hydraulic containment in the C- and D-Zones has not been a remedial objective to date. However, more recent data indicate that the lateral and vertical migration of TCE in these zones may be of concern, and additional delineation and hydraulic containment may be necessary in the C- and D-Zones.

4.2.2 GROUNDWATER CONTAMINANT CONCENTRATIONS

Groundwater concentrations declined significantly with ERH implementation (2006 versus 2009 data) throughout the plume in the Perched, A- and B-Zones. The C-Zone and D-Zone groundwater did not have decreases in maximum TCE concentrations.

Table 4-1. Maximum TCE Concentrations (2006 & 2009)

Zone	Max. TCE Conc. - 2006 (µg/L)	Max. TCE Conc. - 2009 (µg/L)
Perched	230	12 J
A	13,000	190
B	22,000	720
C	120	990
D	80 J	120

Notes: J = Estimated detection; compound detected between the method detection limit and the method reporting limit.

TCE is the main contaminant of concern at the site, but there have been consistent detections of 1,4-dioxane at levels around 5 µg/L in the groundwater system influent. The current treatment system does not address 1,4-dioxane and the LACSD discharge permit does not require sampling or specify a discharge limit for 1,4-dioxane. The 2005 ROD specifies a SSRL for 1,4-dioxane of 3 µg/L. The State of California drinking water notification level (NL) for 1,4-dioxane was recently reduced from 3 µg/L to 1 µg/L.

The sewer discharge criteria of 1,000 µg/L total VOCs is about ten times the typical recent influent level to the treatment system (approximately 96 µg/l in February 2011).

4.2.3 INSTITUTIONAL CONTROLS TO PREVENT USE OF IMPACTED GROUNDWATER

The following description is provided in the 2010 Five-Year Review regarding the procedures for preventing use of impacted groundwater:

The objectives of the institutional controls (ICs) defined by the ROD included:

- *Prohibit sensitive uses such as residential, hospital, school, child-care facility, and hospice;*

- *Prohibit groundwater extraction and/or use without prior review and written approval of DTSC, except as provided for in the ROD;*

- *Prohibit alteration, disturbance, or excavation of soil and caps without a DTSC-approved excavation work plan, except as provided for in the ROD;*

- *Require contaminated soils brought to the surface by grading, excavation, trenching, or backfilling to be managed in accordance with state and federal law.*

The ROD required that the City of Maywood prohibit residential use of the property through zoning and required that a State of California Land Use Covenant with the City of Maywood might be required to permanently change the allowable land use at the site. EPA signed a Covenant Not to Sue Agreement with the Trust for Public Land and the City of Maywood during 2004. The Covenant discusses that the City of Maywood would allow EPA access to continue cleanup of the site and that residential housing would not be allowed on former Pemaco property. Work on the zoning change was started in 2004, and was incorporated into City of Maywood paperwork for construction of the park. EPA will work with the State of California and the City of Maywood to finalize the land use covenant for the site.

To date, the City of Maywood has not changed the zoning of the site to prevent residential use. In addition, the State of California has not yet finalized a land use covenant for the site.

4.3 COMPONENT PERFORMANCE

4.3.1 GROUNDWATER EXTRACTION SYSTEM

The groundwater extraction system consists of pneumatic submersible pumps powered by an air compressor in 33 wells. These pumps discharge water as it fills the pumps. Flow rates from the wells range from an average of 7.6 gallons per day (gpd) to 5,904 gpd. The wells discharge to three common PVC headers to the treatment plant. About 95% of extracted water (about 30 gpm) comes from these pumps with additional contribution from the 23 DPE wells and condensate from the vapor extraction system.

4.3.2 VAPOR EXTRACTION SYSTEM

The vapor extraction system consists of 28 vapor recovery wells, 23 DPE wells, and the 58 electrode points installed as part of the ERH operation. Vapors are conveyed from these wells and electrode points via eight trunk lines to a manifold at the treatment plant as shown in Appendix A and summarized below:

- Trunk Line VE-1 conveys soil vapors from wells DAB-1 through DAB-7 (located in 60th Street in close proximity to the residential properties) to the manifold. This trunk line has not been sampled since May 2007 when TCE was detected at a concentration of 230 ppbv (http://ees.tnainc.com/pemaco//index.php), exceeding the residential shallow soil gas CHHSL of 96 ppbv.

- Trunk Line VE-2 conveys soil vapors from wells DAB-8 and DA-1/DB-1 through DA-7/DB-7 (located in the southwest portion of the property in close proximity to the residential properties) to the manifold. TCE was detected at a concentration of 1,700 ppbv in this trunk line in February 2011 (http://ees.tnainc.com/pemaco//index.php), exceeding the residential and commercial shallow soil gas CHHSLs of 96 ppbv and 320 ppbv, respectively. (It is noted that the April 2011 TCE concentration at this trunk line was 9.7 ppbv.)

- Trunk Line VE-3 conveys soil vapors from ERH electrode points, and DA-8/DB-8 through DA-10/DB-10 (located along the eastern edge of the property away from the residential properties) to the manifold. TCE was detected at a concentration of 160 ppbv in this trunk line in November 2010 (http://ees.tnainc.com/pemaco//index.php), exceeding the residential shallow soil gas CHHSL of 96 ppbv but below the commercial shallow soil gas CHHSL of 320 ppbv. (SulTRAC notes that this trunk line is not extracting soil vapors as of May 26, 2011 due to leaks.)

- Trunk Line VE-4 conveys soil vapors from ERH electrode points and wells DA/DB-11, and DA/DB-12 (located along the eastern edge of the property away from the residential properties) to the manifold. TCE was detected at a concentration of 4 ppbv in this trunk line in November 2010 (http://ees.tnainc.com/pemaco//index.php), below the residential shallow soil gas CHHSL of 96 ppbv. (SulTRAC notes that this trunk line is not extracting soil vapors as of May 26, 2011 due to leaks.)

- Trunk Line DPE-A conveys soil vapors from wells PA-1 through PA-5 (located in close proximity to the residential properties and the corner of 59th Place and Walker Avenue) to the manifold. TCE was detected at a concentration of 46 ppbv in this trunk line in February 2011 (http://ees.tnainc.com/pemaco//index.php), below the residential shallow soil gas CHHSL of 96 ppbv.

- Trunk Line DPE-B conveys soil vapors from wells PB-1 through PB-7 (located away from the residential properties in the northwest corner of the site) to the manifold. TCE was detected at a concentration of 38 ppbv in this trunk line in February 2011 (http://ees.tnainc.com/pemaco//index.php), below the residential shallow soil gas CHHSL of 96 ppbv.

- Trunk Line DPE-C conveys soil vapors from wells PC-1, PC-4, PC-5, and PC-6 (located away from the residential properties on the east side of the site) to the manifold. TCE was detected at a concentration of 7.9 ppbv in this trunk line in February 2011 (http://ees.tnainc.com/pemaco//index.php), below the residential shallow soil gas CHHSL of 96 ppbv.

- Trunk Line DPE-D conveys soil vapors from wells PD-1, PD-4, PD-5, PD-6, PD-7, PD-8, and PD-9 (located away from the residential properties on the east side of the site) to the manifold. TCE was detected at a concentration of 120 ppbv in this trunk line in February 2011 (http://ees.tnainc.com/pemaco//index.php), exceeding the residential shallow soil gas CHHSL of 96 ppbv but below the commercial shallow soil gas CHHSL of 320 ppbv.

Recent individual well vapor sampling results of the DPE wells show only PA-5, PB-2, and PC-5 above the residential TCE CHHSL with PD-1, PD-4 and PD-6 at concentrations just below the CHHSL.

4.3.3 TREATMENT SYSTEM FOR EXTRACTED WATER

The currently operated groundwater system removed a reported 6.51 lbs of TCE in 2009 at an average concentration that declined from 89 µg/L in January 2009 to 39 µg/L in December 2009. Non-TCE VOC mass removal during this time totaled 7 lbs. The most recent influent (SP-204) data from February 2011 shows 79 µg/L of TCE. Therefore, mass removal has remained relatively steady over the past two years but (as discussed above) many extraction wells do not contribute to mass removal or plume containment.

The groundwater influent VOC levels are about 10% of the total VOC discharge permit limit; however, the site team continues to remove VOCs using GAC as is required by the current LACSD discharge permit. Treatment to remove sediment from the extracted groundwater is needed prior to discharge to the sewer. Both 3,000-lb GAC vessels are changed out about every nine months. The site team reported that these changes are due to fouling caused by sediment rather than VOC breakthrough.

4.3.4 VAPOR TREATMENT SYSTEM

The vapor treatment system removed approximately 28 lbs of TCE in 2009. Influent vapor concentrations during 2009 were typically about 1 milligram per cubic meter (mg/m^3). Over 2,000 lbs of other VOCs were removed during 2009 but the majority of this mass was from n-hexane. Hexane does not have a SSRL in the site 2005 ROD or a vapor discharge limit in the SCAQMD Permit, and the n-hexane Residential Air Region 9 Regional Screening Level is over 500 times higher than TCE. The most recent result from February 2011 shows influent TCE at 840 ppbv, which is above the emissions standard of 110 ppbv and therefore requires treatment

GAC is used for vapor treatment to meet the emissions standards. Both 4,000-lb GAC units are replaced about once per year.

4.4 COMPONENTS OR PROCESSES THAT ACCOUNT FOR MAJORITY OF ANNUAL COSTS

Annual cost estimates for operating this remedy are summarized below based on information provided by the site team for 2010 actual costs and/or estimated by the RSE team based on discussions with the site team.

Table 4-2. Annual Operating Costs

Item Description	**Approximate Annual Cost**
Project Management	$ 635,896
Labor	*$376,093*
Other Direct Costs	*$29,093*
Subcontractors	*$230,711*
Operations and Maintenance	$818,854
Labor	*$ 396,343*
Other Direct Costs	*$161,510*
Subcontractors	*$261,000*
Sampling	$259,581
Labor	*$122,852*
Other Direct Costs	*$51,324*
Subcontractors	*$85,405*
Electricity	$102,000
Materials	$17,903
Lab Analysis, CLP, Region 9 Lab	$145,000
Disposal	$38,338
Total Estimated Annual Cost	**$2,015,572**

Additional details regarding these items are provided below.

4.4.1 UTILITIES

Per the SulTRAC May 26, 2011 comment letter, power costs are approximately $8,500 per month ($102,000 per year). Assuming an approximate rate of $0.12 per kWh (including demand and customer charges) for general service from Southern California Edison, this represents an average demand of 96 kW. SulTRAC indicates that the two 75 HP liquid ring blowers operate at 90% efficiency and represent approximately 80% of the system load. This suggests that the blowers are operating at less than 65% of full load.

The system building has solar panels installed to help offset electric usage. Site fact sheets report that the solar output is approximately 4,500 kWh per year. The system therefore offsets approximately $540 per year in electrical costs.

4.4.2 NON-UTILITY CONSUMABLES AND DISPOSAL COSTS

GAC for the vapor system and GAC for the water system are each replaced at a rate of about 8,000 lbs per year. The cost per pound of GAC was not reported by the site team but is probably on the order of $2 per lb including changeout.

4.4.3 LABOR

Project management costs include staff for sampling management, engineering support, site operation, Health and Safety (H&S), and subcontractor technical support (OTIE-website and database support and technical support). We note that the project management costs shown in Table 4-2 for 2010 include a Five-Year Review effort, so they may be higher than would be expected in future years.

SulTRAC has two full-time system operators, a subcontracted half-time system operator, and off-hour security guards. The staff conducts daily system checks, weekly well checks, process sampling and requires significant maintenance time to keep the pumps and the complex system running. Additional staff collect periodic monitoring well samples.

4.4.4 CHEMICAL ANALYSIS

For monitoring wells, there are approximately 374 VOC analyses per year and 80 per year for 1,4-dioxane, with subsets of wells sampled monthly, quarterly and semi-annually. Process water monitoring includes eight analyses per month for VOCs, 1,4-dioxane and hexane; bimonthly analysis for select sewer discharge permit parameters; quarterly analysis for long-form discharge permit parameters, and a quarterly sample at the heat exchanger.

Vapor process monitoring includes 15 analyses per month for VOCs.

Monthly process sampling for both vapor and water includes influent manifold legs (three water, eight vapor), total influent, pre-, mid- and post- GAC and a final effluent sample (redundant with the post-GAC sample).

The site team reported that sampling frequency is being regularly reduced from the frequency in effect during ERH operation, but the RSE team believes there is still a larger amount of data collected than is likely needed. The site team reported that they did not have a program in place to remove monitoring wells from the sampling list at the time of the RSE site visit. (Subsequent to the RSE site visit, SulTRAC reported that they submitted a letter to the EPA RPM on March 2, 2011 with recommendations.) Sampling frequency reductions are occurring, but it is unclear how they are formulated. Frequent process influent manifold sampling data (both vapor and water) is not currently being used for system operation decisions.

4.5 APPROXIMATE ENVIRONMENTAL FOOTPRINTS ASSOCIATED WITH THE REMEDY

Direct energy usage for the site includes electricity and diesel associated with materials transportation. Energy is also associated with manufacturing of materials that are used at the site (e.g., GAC and salt for water softening). Air emissions of greenhouse gases, nitrogen oxides (NOx) and sulfur oxides (SOx) result from the direct energy usage and from manufacturing site-related materials. Greenhouse gas emissions are of global concern, and other pollutants are of more local concern as they adversely affect local/regional air quality. Briefly, NOx are respiratory irritants and precursors to ground level ozone. Sulfur dioxide is also a respiratory irritant and is a precursor to acid rain. Emissions of other pollutants may also be of concern, but these common pollutants were selected because emissions information is more readily available for them and they may be adequate indicators for other potential air emissions.

Footprint analysis spreadsheets currently under testing by USEPA Region 9 were used to calculate the energy and emissions footprints for the remedy on an annual basis (see Appendix B). Footprint results are summarized in Table 4.3.

Table 4-3. Summary of Annual Footprint Results

Green and Sustainable Remediation Parameter	Annual Value (per year)
Greenhouse gas emissions (carbon dioxide equivalents [CO_{2e}])	1,700,000 lbs
Criteria pollutant emissions	16,000 lbs
Hazardous Air Pollutant (HAP) emissions	420 lbs
Total energy use	11,100 MMBtus
Renewable Energy Generation	170 MMBtus
Groundwater extracted	14,600,000 gallons
Potable water use	1,000,000 gallons

Notes: CO_2e = carbon dioxide equivalents of global warming potential
Criteria pollutant emissions are limited to NOx, SOx, and PM emissions
MMBtus = 1,000,000 Btus

For the greenhouse gas emissions (CO_2e) approximately 84% is associated with electricity generation and transmission, and the remaining 16% is from various other activities, including laboratory analysis, treatment of water by the POTW, GAC regeneration, and fuel used for transportation.

With respect to water usage, most of the water use (about 40,000 gpd) is from the groundwater extraction system, the remainder (3,800 gpd) is potable water used for cooling. The water that is extracted and treated from this system is discharged to the sanitary sewer, and therefore is unavailable as a resource for groundwater usage.

Waste disposal associated with this remedy is minimal. With respect to more qualitative issues, the remedy does not cause any aesthetic issues (noise, visual, and odor) and there are no major traffic issues associated with the remedy that would impact the surrounding land or ecosystems.

4.6 REGULATORY COMPLIANCE

During the RSE process, the site team did not report any exceedances of discharge standards or other compliance-related standards.

4.7 SAFETY RECORD

During the RSE process, the site team did not report any health and safety concerns or incidents related to the remedial activities.

5.0 EFFECTIVENESS OF THE SYSTEM TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT

5.1 GROUNDWATER

The following protectiveness statement was included in the 2010 Five-Year Review:

> *The remedy at the Pemaco Superfund site currently protects human health and the environment, because exposure pathways that could result in unacceptable risks are being controlled.*
>
> *However, in order to be protective in the long-term, the following actions should be taken:*
>
> - *The City of Maywood should change the zoning of the Pemaco property.*
> - *DTSC should finalize a Land Use Covenant to permanently change the site's land use to recreational.*
> - *USEPA will assess the area around MW-25-130 and evaluate whether further action is warranted.*

MW-25-130 is a well in the D-Zone in which TCE concentrations have been detected above SSRLs, and these impacts are not delineated. The RSE team agrees with the recommended actions in the 2010 Five-Year Review. The RSE team does not believe that further extraction of water at wells with levels below SSRLs is warranted. In addition to generating extra water to be handled, this pumping can draw impacted water from contaminated areas to clean areas and also increases use of electricity.

5.2 SURFACE WATER

The RSE did not focus on surface water, but the RSE team believes it is unlikely that the low levels of VOCs observed in the groundwater plume would have negative impacts on surface water quality, including the water quality of the Los Angeles River.

5.3 AIR

Shallow soil gas had been monitored in 10 locations (5 and 15 ft depth at each location) in the streets between the site and residences. The sampling is now reduced to two locations. The levels seen in the soil gas probes do not represent a concern for vapor intrusion. Two of the eight operating SVE lines have levels above residential CHHSLs in the last reported sampling results and are near residences.

5.4 SOIL

The soil removal and capping associated with the Maywood Riverfront Park construction eliminated any potential exposure to impacted soils outside of the fenced area around the former ERH area and the operating treatment plant.

The site team reported that 30 baseline subsurface soil samples were taken at the site for future remediation comparison. The RSE team recommends that the re-sampling take place as soon as possible and the SVE system operation be adjusted accordingly.

5.5 WETLANDS AND SEDIMENTS

Wetlands and sediments were not addressed as part of the RSE, but are not expected to be a concern.

6.0 RECOMMENDATIONS

Cost estimates provided herein have levels of certainty comparable to those done for CERCLA Feasibility Studies (-30%/+50%), and these cost estimates have been prepared in a manner consistent with USEPA 540-R-00-002, *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study*, July 2000.

The ERH application along with system operation have been effective to date in removing VOC mass and reducing the potential risk to human health as well as VOC concentrations in groundwater and soil vapor. While the site team has reduced sampling and other aspects of operation to some extent since the ERH application was completed, the RSE team believes that further major scope reductions should be implemented. The RSE team suggests that the site team consider (without deferring to current site practices) how a site with the current conditions at Pemaco would be addressed. The RSE team believes that the system as it currently stands has extraction points that do not need to be operated; has blowers that are significantly oversized for an appropriately reduced extraction rate; and has a monitoring, sampling, and security program that is excessive for current conditions. The site team has concerns about community reaction to any reductions in site activities, but the RSE team believes that all the suggested changes discussed in further detail below will lead to more effective and understandable system operation that will reduce cost, improve sustainability parameters, and allow the site team to focus on the remaining site concerns.

The initial 2005 ROD-specified five-year period (2007 to 2012) of active remediation to date appears to have been fairly successful. The RSE team believes there will be a small active component for an additional period. The duration of this extended period may be approximately 5 years (e.g., 2012 to 2017), but the site team should be able to reduce it to a minor effort/cost in comparison with efforts to date.

6.1 RECOMMENDATIONS TO IMPROVE EFFECTIVENESS

6.1.1 LOWER (C- AND D-) ZONE DELINEATION AND PUMPING

In the C-Zone, pumping at MW-25-110 appears to have decreased VOC concentrations, and downgradient well MW-11-100 does not have VOC detections (10/2009 sampling). Monitoring at these wells should be continued and additional pumping and/or new monitoring wells should be considered if the plume reaches MW-11-100. In the D-Zone, a new monitoring well (at a minimum) should be installed downgradient of MW-07-130 to delineate the extent of the plume. Installing this additional well should cost about $20,000, including well installation, well development, oversight, and waste. This well should be added to the quarterly sampling list at a cost of about $4,000 per year. Additional monitoring points may be needed to delineate the D-Zone plume.

6.1.2 ASSESS VAPOR INTRUSION RISK ALONG 60TH STREET

According to the data posted on the project website, a soil vapor sample from Trunk Line VE-1 (sample port SP-117) has not been analyzed by an analytical laboratory for VOCs since May 2007 when TCE was detected at a concentration of 230 ppbv, exceeding the residential CHHSL of 96 ppbv. Wells DAB-1 through DAB-7 feed into Trunk Line VE-1. These wells are situated in an east-west line along 60th Street and wells DAB-1 through DAB-4 are located directly in front of residential properties.

A soil gas sample should be collected from Trunk Line VE-1 and submitted to a state-certified laboratory for analysis for VOCs. If any VOCs exceed CHHSLs (or another action level established by USEPA) then soil vapor sampling should be conducted to assess whether a vapor intrusion risk is present in that area. The soil gas sample collection and analysis will cost less than $1,000. Assuming additional soil vapor sampling is conducted, multiple samples could be collected and analyzed for less than $15,000 total.

6.2 RECOMMENDATIONS TO REDUCE COSTS

Extremely frequent monitoring, 2.5 full-time operators, and off-hour security are a relic from ERH operation and are no longer necessary for the current system, which is a low-flow/low-VOC concentration P&T and SVE system. Similar optimized systems in the Superfund program are operated at total costs of well below $500,000 per year (examples include Cleburn Street Well Superfund Site in Nebraska, the Modesto Groundwater Contamination site in California, and the Colbert Landfill Superfund Site in Washington). Details of recommended cost reductions are in the subsections that follow.

6.2.1 REDUCE MONITORING WELL SAMPLING

It is recommended that the number of monitoring wells and the frequency of sampling be reduced. Monitoring wells that have shown concentration levels lower than the SSRLs for four consecutive quarters should be considered for elimination from the sampling plan. The number of groundwater monitoring wells sampled in the source zone is excessive and can be greatly reduced. Quarterly groundwater monitoring is sufficient for containment confirmation and semi-annual sampling is typically acceptable for assessing remediation progress. Table 6-1 shows the number of groundwater monitoring wells and current sampling schedule and that proposed by the RSE team.

Table 6-1. Proposed Number of Groundwater Wells and Sampling Schedule

Zone	**Monthly** Current/Proposed	**Quarterly** Current/Proposed	**Semi-annual** Current/Proposed
Perched Zone	0/0	0/0	27/21
Zone A	0/0	8/2	10/8*
Zone B	9/0	14/9	17/26
Zone C	3/0	3/3	1/3
Zone D/E	0/0	3/2	4/6

*DAB wells counted in the B-Zone wells

This represents a reduction of 182 samples, from the current 374 to 192 samples per year (48.7% reduction). Further removal of wells from the sampling program can be accomplished as they are no longer considered necessary to determine plume remediation or migration. The Perched Zone, in particular should have many wells that can be removed as soon as it can be confirmed that rebound of VOC concentrations is not a concern at a specific well when vapor and water extraction is terminated.

Wells recommended to be sampled quarterly include:

DA-3	DA-5	DB-1	DB-2	DB-3	
DB-4	DAB-4	DAB-5	DAB-6	DAB-7	
MW-13-85	MW-25-110	MW-05-105	MW-24-110	MW-25-130	MW-07-130

.

Wells recommended for semi-annual sampling include:

PA-5	PB-1	PB-2	PB-3	PB-4	PB-5
PB-7	SV-1	SV-3	SV-5	PC-5	PC-6
PD-4	PD-5	PD-6	PD-7	PD-8	PD-9
B-20	B-21	B-38	MW-7-75	MW-26-75	DA-1
DA-2	DA-6	DA-7	DA-8	DA-9	DAB-1
DAB-2	DAB-3	DAB-8	MW-3-90	MW-4-90	MW-05-85
MW-6-85	MW-8-85	MW-9-85	MW-10-90	MW-12-90	MW-13-85
MW-20-85	MW-22-90	MW-26-90	MW-29-90	MW-33-90	RW-1-95
DB-5	DB-6	DB-7	DB-8	DB-9	DB-10
DB-12	MW-10-110	MW-11-100	MW-23-110	MW-5-135	MW-06-135
MW-10-170	MW-12-150	MW-23-145	MW-24-140		

In addition, soil vapor monitoring at the four subsurface vapor probes (two probes at each of two locations) should be reduced from every two weeks to quarterly for a reduction from 104 soil vapor samples per year to 16 soil vapor samples per year (85% reduction). (Note that this reduction was accomplished beginning in February 2011 based on SulTRAC comments on the draft RSE report.)

This monitoring frequency reduction represents a reduction in analytical costs of about $45,000 per year assuming VOC and 1,4-dioxane analysis (from a subset of wells) of groundwater costs $100 each and VOC analysis of vapor costs $300 each. The sampling reduction would reduce sampling labor, subcontractor and other direct costs (ODCs) by at least an additional $100,000 per year. This is a 38.5% reduction from current costs.

6.2.2 REDUCE PROCESS SAMPLING

Groundwater process sampling was reported by the site team to currently include eight samples per month and a quarterly heat exchanger sample (100 total per year) that are analyzed for VOCs and 1,4-dioxane and eight effluent samples per year that are analyzed for sewer discharge pretreatment parameters. This sampling frequency exceeds the permit requirements, which the RSE team believes is 8 effluent samples per year but SulTRAC believes may be as high as 40 samples per year. Process sampling can be reduced to obtain only data required for sewer discharge and monthly influent. Because VOC removal is not required to meet permit limits, one of the GAC vessels could be removed with change-outs of the remaining vessel based on effluent results and an expected GAC breakthrough time based on data to date. There is no reason to sample well headers when individual extraction wells are sampled to determine cleanup progress and the well header data is not useful for treatment. Since 1,4-dioxane is not removed by GAC there is no reason to analyze it in the influent sample. A decrease to 8 effluent samples per year would eliminate 80 VOC analyses (80% reduction) and 92 1,4-dioxane analyses per year. A decrease to 40 effluent samples per year would eliminate 48 VOC analyses and 60 1,4-dioxane analyses per year.

Vapor process sampling was reported by the site team to include 15 samples per month (180 per year) for VOCs, including samples from each vapor extraction header, two from the combined influent location, a mid-GAC and an effluent sample. Sampling should be reduced to three per month including influent, between GAC, and effluent plus annual samples of the headers. This is a reduction of 137 analyses per year (76% reduction).

The combined recommended reductions in process sampling could save up to an estimated $58,000 per year in analytical costs assuming $100 each per VOC and 1,4-dioxane analysis of water and $300 for VOC analysis of vapor.

6.2.3 REDUCE EXTRACTION POINTS AND SIMPLIFY PROCESSES

Six of the eight lines of SVE and DPE wells can be shut down based on vapor concentrations with only VE-1 (with DAB-1, DAB-2, DAB-3 and DAB-7 shut) and VE-2 (all wells open) left to operate and PA-5, PB-2, PC-5, PD-1, PD-4 and PD-6 open from the other legs. This assumes that testing of vapor header lines will indicate that the lines are not leaking; if the lines are leaking they should be repaired. Soil sampling (see Section 6.4) is recommended so further SVE and DPE wells can be shut down in areas that are clean or other individual wells along lines that are shut can be opened. This should reduce the number of extraction wells from 110 to about 25 wells and will allow extraction to focus on any remaining hot spots.

A rebound testing program for select well groups (lines) should be implemented to confirm that vapor concentrations do not return to levels above applicable standards when extraction is terminated. Assuming all six shut off extraction lines are tested after a selected time period (about three months) and none shows significant rebound the cost could be limited to analysis of six vapor VOC samples. For more conservative costing purposes we assume that up to twenty samples will be needed and a subset of the lines will be operated and sampled for a few months after initial rebound testing before the rebound effect is eliminated; this represents a total labor and laboratory cost of about $10,000.

With this recommended reduction, at a minimum one of the liquid ring blowers could be taken off-line for an electric cost reduction of $40,000 per year. With the conversion of the remaining DPE wells to vapor extraction only, the blower(s) potentially could be replaced (based on testing with the existing blowers and dilution air) by a lower vacuum blower with the same or greater flow rate per extraction point such as a regenerative blower with a 5 to 10 HP motor (providing approximately 250 scfm at 60" H_2O). With the reduction in extraction rate the vapor temperature will not be raised sufficiently to require cooling. The change to a 10 HP blower would cost about $50,000 in capital costs to purchase and install the blower and make required changes in the control system. However, eliminating one liquid-ring blower and replacing the other liquid-ring blower with a 10 HP regenerative blower, would reduce electric costs by an additional $32,000 per year (assuming $0.12 per kWh and a 90% motor efficiency for the 10 HP blower motor). Alternatively, if high vacuum is determined to still be needed, the site team could investigate potential use of a variable speed drive on the remaining blower.

Any Perched, A, B, and A+B Zone wells with groundwater concentrations less than SSRLs should be shut down; pumping at clean wells is counterproductive, pulling contaminants toward areas that are clean. Based on available lab results, this includes 20 of the 23 P-series dual extraction wells (excluded wells: PD-6, PB-5 and PB-2) and 12 of the 33 groundwater extraction wells (DAB-1, 2, 3 and 7, DA-8, 10, 11 and 12 and DB-5, 9, 11 and 12). The site team should consider pumping the three excluded P-series dual extraction wells periodically instead of using DPE. In addition to the 12 groundwater extraction wells, DAB-4 and DAB-5 are dry and pumps have been removed. The clean DA, DAB and DB wells are currently pumping about 15 gpm or half of the current system flow rate (cost impacts are discussed in Sections 6.2.2 and 6.2.4). (SulTRAC reports that on March 2, 2011, subsequent to the RSE site visit, they provided recommendations for reduced pumping to USEPA.)

6.2.4 REDUCE OPERATING LABOR

Operating labor, analysis, and reporting costs can be reduced in line with the system changes as the changes are implemented. Site visits two to three times per week and reduced sampling, analysis and reporting are appropriate. The total operating wells will be reduced from over 130 to about 40. Frequent checks of PID concentrations, flow, and temperature at wells are not needed; monthly checks are sufficient. Maintenance requirements will be less and spare parts will be available from the discontinued wells. Off-hour security is unnecessary with appropriate security alarms (noted by SulTRAC to cost $18,000 to install and less than $5,000 per year to monitor) and auto-dialer capabilities. The proposed system should require a maximum of one full-time equivalent (FTE) or about $150,000 per year in operating labor costs plus security monitoring. ODCs would be reduced to less than $75,000 per year. This is a savings of $590,000 per year from the reported $820,000 per year.

6.2.5 REDUCE PROJECT MANAGEMENT

The project management and subcontracting currently in place should also be reduced in line with the simplified system and reduced monitoring/sampling that is recommended. Sites of similar complexity to the proposed simplified system in the Fund-lead program are typically operated with management and reporting budgets of $100,000 to $150,000 per year. Assuming $100,000 of the $636,000 reported in Section 4.4 are non-routine costs for the assistance with the Five-Year Review and preparation of reports from previous years, it appears that savings of at least $386,000 might be realized in routine project management, technical support, and reporting. Some of these savings will result from a simpler system to operate, fewer staff to manage, and less data to collect and manage. Additional funds beyond the routine estimated project management and reporting budget of $100,000 to $150,000 might be needed for future non-routine costs in this category, and it is recommended that these funds be tracked separately so that routine and non-routine costs can be better controlled.

Table 6-2 summarizes our conservatively estimated costs for managing and operating an optimized system.

Table 6-2. Optimized Annual Operating Costs

Item Description	Estimated Annual Cost
Project Management, Support, and Reporting (including subcontractors)	$150,000
Operator labor (includes subcontractors)	$150,000
Operator ODCs	$75,000
Annual Security Service	$5,000
Electricity	$30,000
Monitoring Well Sampling Labor (including subcontractors) and ODCs	$160,000
Laboratory Analysis	$42,000
Disposal (assumes one GAC unit operated for water discharge)	$30,000
Materials	$18,000
Total	**$660,000**

6.3 RECOMMENDATIONS FOR TECHNICAL IMPROVEMENT

The current system is complex and can be greatly simplified with changes in extraction configuration as discussed above. For the groundwater system, water should be pumped to a single equalization tank then pumped through filters and a single GAC unit (as required by the current discharge permit). For vapor, the system should use one blower (either with a lower HP regenerative unit or an existing blower with a variable speed drive) and discharge through the GAC. The discharge temperature with a lower flow rate will be less than 150 degrees F. This will eliminate the need for a cooling system.

6.3.1 REPORTING IMPROVEMENTS

Despite the large amounts of data that are currently collected, there do not appear to be any procedures in place to summarize and present data in a format that is "user-friendly" for comparing current data to SSRLs and other key parameters. Such reporting would assist the site team and RPM in quickly identifying trends and data that warrant changes in system operation as wells as remedial progress. Accordingly, we recommend that the site team prepare two semi-annual reports each year. These reports should include the following:

- Individual maps for the Perched Zone, A-Zone, B-Zone, C-Zone, and D-Zone showing the most recent water elevation data and contour lines illustrating the site team's interpretation of the groundwater flow direction in that zone. Data gaps should be identified with dash lines or query lines. Dry wells should be identified as such. Water levels at extraction wells should generally not be used for contouring.

- Individual maps for the Perched Zone, A-Zone, B-Zone, C-Zone, and D-Zone showing the most recent TCE groundwater data (and any other COCs exceeding SSRLs) and contour lines illustrating the site team's interpretation of the groundwater plume(s) dimensions in that zone. Data gaps should be identified with dash lines or query lines. Dry wells should be identified as such. Concentrations exceeding SSRLs should be highlighted.

- A map showing the most recent TCE soil vapor data (and any other COCs exceeding SSRLs) and contour lines illustrating the site team's interpretation of the soil vapor plume dimensions. Data gaps should be identified with dash lines or query lines. Concentrations exceeding SSRLs should be highlighted.

- A table summarizing the groundwater analytical data collected from wells that reporting period. Detections should be in bold. SSRL exceedances should be highlighted.

- A table summarizing the soil vapor analytical data collected that reporting period. Detections should be in bold. SSRL exceedances should be highlighted.

- A table summarizing the process groundwater data collected that reporting period. The table should show all permit effluent limitations. Detections should be in bold. Permit exceedances should be highlighted.

- Charts for select monitoring wells plotting TCE vs. time and comparing TCE concentrations to the SSRL.

- A summary of work completed that period.
- A summary of volume of groundwater recovered, mass of VOCs and TCE recovered in groundwater, and mass of VOCs and TCE recovered in soil vapor.
- A text section identifying all SSRLs (including the total number of groundwater wells sampled followed by the number of wells that exceeded SSRLs and the number that did not exceed SSRLs), action level, and permit exceedances.
- A summary of work to be completed in the upcoming reporting period.
- A discussion on remedy optimization opportunities.

Each semi-annual report should cost about $15,000 each, recognizing that the first report may cost more to establish the reporting template. The cost of these reports is included in our estimated project management and reporting costs presented in Section 6.2.5.

Table 6-3 summarizes the operation and maintenance and reporting recommendations and associated change in annual costs discussed previously.

Table 6-3. Recommendations Cost Summary Table

Recommendation	Reason	Additional Capital Costs ($)	Estimated Change in Annual Costs ($/yr)	Estimated Change in Life-Cycle Costs $*	Estimated Change in Life-Cycle Costs (net present value) $**
1. 6.1.1 – Continue Monitoring MW-25-110 and MW-11-100. Add additional well(s) if plume reaches MW-11-100	Effectiveness	-	-	-	-
2. 6.1.1 – Install D-Zone well down-gradient of MW-07-130	Effectiveness	20,000	4,000	40,000	38,868
3. 6.1.2 – Vapor Sampling of VE-1	Effectiveness	15,000	-	15,000	15,000
4. 6.2.1 – Reduce Sampling Labor and ODCs	Cost Effectiveness	-	(100,000)	(500,000)	(471,710)
5. 6.2.1 – Reduce Monitoring Well Analysis	Cost Effectiveness	-	(45,000)	(225,000)	(212,270)
6. 6.2.2 – Reduce Process Sampling Analysis	Cost Effectiveness	-	(58,000)	(290,000)	(273,592)
7. 6.2.3 – Reduce Extraction Points (operate one blower)	Cost Effectiveness/	10,000	(40,000)	(190,000)	(178,684)
8. 6.2.3 – Replace Blowers with a Regenerative Blower of about 10 HP (reduction in addition to operating only one existing blower)	Cost Effectiveness	50,000	(32,000)	(110,000)	(100,944)
9. 6.2.4 – Reduce Operating Labor and ODCs	Cost Effectiveness	18,000	(590,000)	(2,925,000)	(2,765,090)
10. 6.2.5 – Reduce Project Management	Cost Effectiveness	-	(386,000)	(1,930,000)	(1,820,762)
11. 6.3.1 – Improve Reporting	Technical Improvement	-		-	-

Costs in parentheses imply cost reductions
* assumes 5 years of operation with a discount rate of 0% (i.e., no discounting)
** assumes 5 years of operation with a discount rate of 3% and no discounting in the first year (P/A=4.717)

6.4 CONSIDERATIONS FOR GAINING SITE CLOSE OUT

The remediation system (ERH followed by groundwater and vapor extraction) has been successful in reducing concentrations substantially to date. It appears likely that RAOs can be achieved within a reasonable timeframe with optimization of the extraction system. The original ROD five-year active remedy span with an end date in April 2012 is relatively accurate with only a small portion of the active remedy still necessary after that date for an assumed five additional years. There does not appear to be any reason to test or attempt different technologies to accelerate progress to RAOs at this time. Vapor and groundwater extraction efforts should be focused on the remaining wells where SSRLs and applicable CHHSLs are still exceeded; most of the vapor extraction points and many groundwater extraction wells can be shut off.

6.4.1 ESTABLISH SSRLS FOR SOIL VAPOR

As discussed in Section 2.3, neither the 2005 ROD nor the 2010 Five-Year Report specifies SSRLs or action levels for soil vapor. However, USEPA determined in the 2010 Five-Year Review Report that the soil vapor concentrations at the site do not exceed action levels. The lack of documented soil-vapor action levels or SSRLs creates ambiguity for the site team (and other stakeholders) that makes it difficult to make decisions regarding SVE operation, optimization, and eventual closure. The CHHSLs might be appropriate SSRLs or action levels for soil vapor at the site.

The reported 30 baseline soil sample locations should be re-sampled to assist with further focusing of vapor extraction.

6.5 RECOMMENDATIONS FOR IMPROVED SUSTAINABILITY

The above recommendations provide substantial opportunity to reduce the remedy footprint. Recommendations to substantially reduce the electricity usage will result in substantial reductions to the energy and air emission footprints. In addition, options are suggested for reducing blower size and operation to decrease or eliminate potable water that is used for cooling purposes. Reductions in groundwater and process monitoring will reduce the contributions of the remedy footprint assumed to be associated with laboratory analysis. Reductions in operator labor and the number of visits per week will reduce fuel usage and associated energy and air emission footprints.

The site team reported that the groundwater monitoring staff is located in northern California and travels to southern California for each of the aforementioned groundwater monitoring events. Using local personnel (perhaps subcontractors) for groundwater monitoring would reduce travel costs and the site's carbon footprint.

Once the system is optimized as suggested and electricity usage is better understood, the site team can consider the potential application of renewable energy in addition to the existing use of solar power at the site. Because of the relatively short anticipated remaining remedy duration, the use of renewable energy certificates or purchased renewable energy may be most appropriate. This approach to applying renewable energy avoids the substantial investment associated with a renewable energy project and the potentially long-term system operation that is needed to payback that investment.

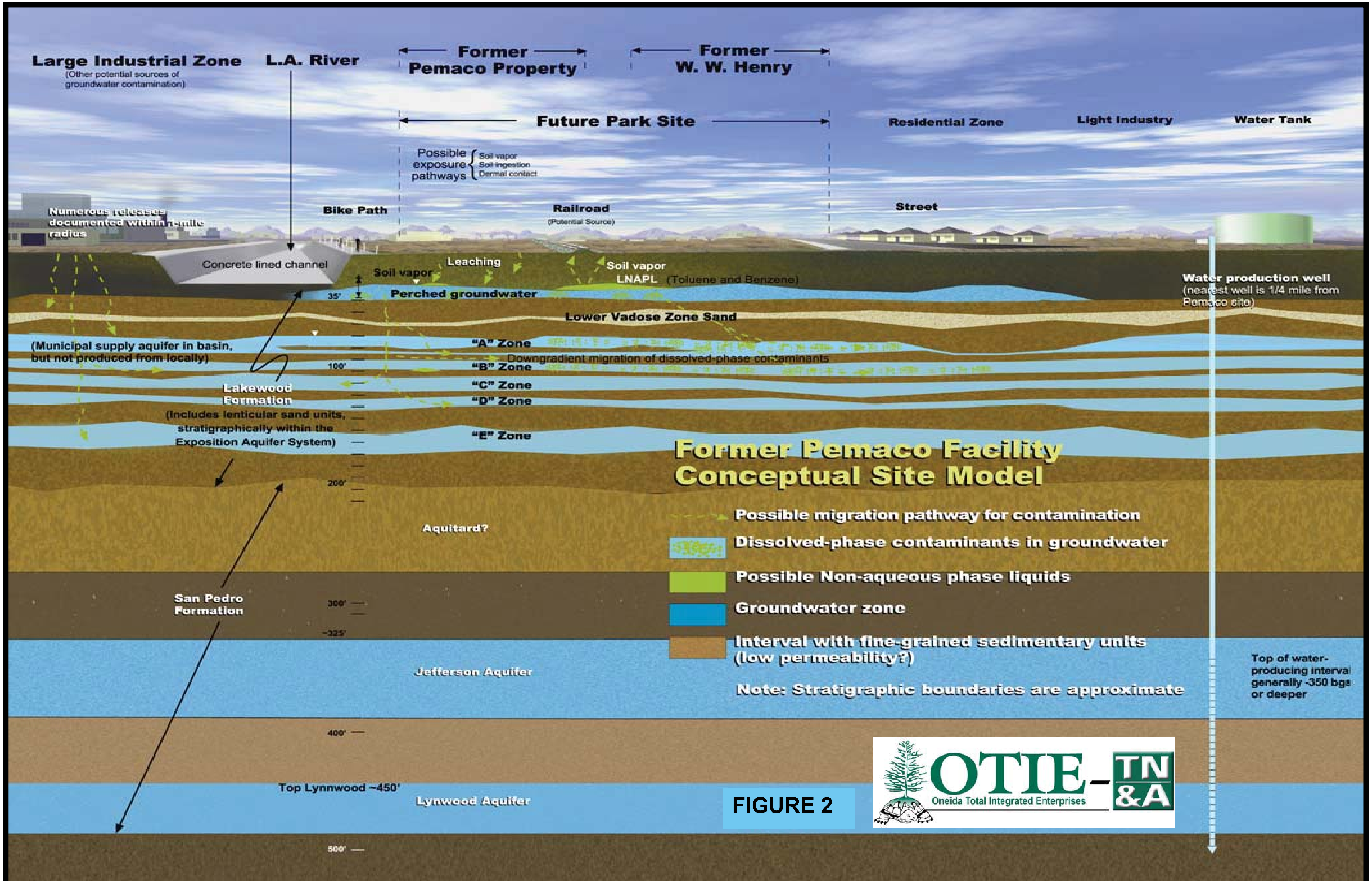
Table 6-3 provides a sustainability summary for the recommendations provided in this report.

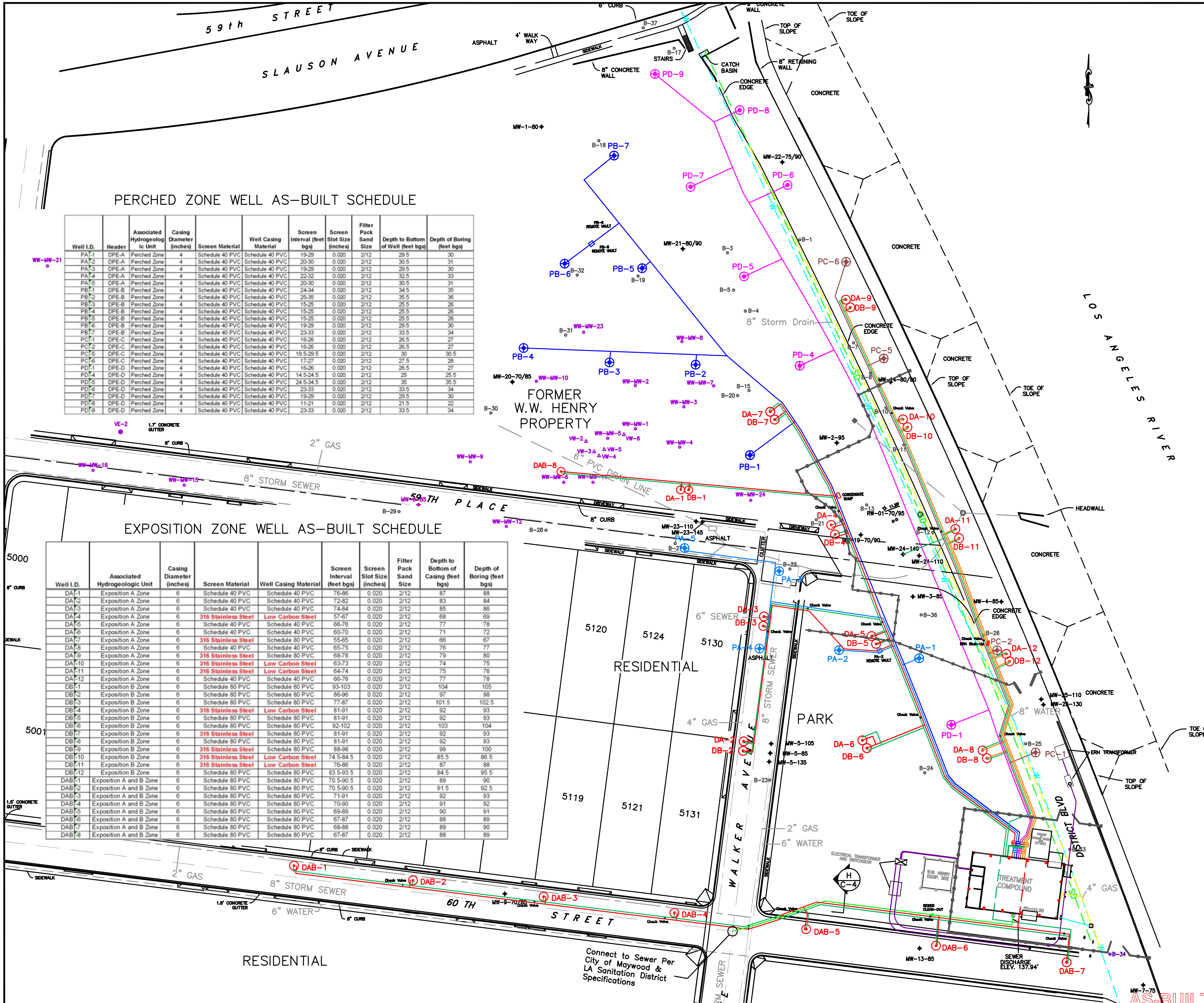
Table 6-4. Sustainability Summary for Recommendations

Recommendation	Reason	Effects on Sustainability
1. 6.1.1 – Continue Monitoring MW-25-110 and MW-11-100. Add additional well(s) if plume reaches MW-11-100	Effectiveness	Minor
2. 6.1.1 – Install D-Zone well down-gradient of MW-07-130	Effectiveness	Minor
3. 6.1.2 – Vapor Sampling of VE-1	Effectiveness	Minor
4. 6.2.1 – Reduce Sampling Labor and ODCs	Cost Effectiveness	Minor
5. 6.2.1 – Reduce Monitoring Well Analysis	Cost Effectiveness	Major – Laboratory analysis has a footprint associated with the bottle shipments, preservative usage, materials and waste generated from sample preservation and use, and electricity used for instrumentation, ventilation, and sample cooling. These footprints have not been accurately quantified but are likely significant, and significant reductions in sample analysis are anticipated to result in significant footprint reductions.
6. 6.2.2 – Reduce Process Sampling Analysis	Cost Effectiveness	Major – Laboratory analysis has a footprint associated with the bottle shipments, preservative usage, materials and waste generated from sample preservation and use, and electricity used for instrumentation, ventilation, and sample cooling. These footprints have not been accurately quantified but are likely significant, and significant reductions in sample analysis are anticipated to result in significant footprint reductions.
7. 6.2.3 – Reduce Extraction Points (operate one blower)	Cost Effectiveness	Major - Reductions in electricity usage could reduce CO_2e emissions by over 500,000 lbs per year along with significant reductions in energy usage and emissions of criteria pollutants and hazardous air pollutants.
8. 6.2.4 – Reduce Operating Labor and ODCs	Cost Effectiveness	Minor
9. 6.2.5 – Reduce Project Management	Cost Effectiveness	None
10. 6.3.1 – Simplify Systems/Reporting	Technical Improvement	Minor

APPENDIX A

SELECT FIGURES FROM SITE DOCUMENTS


Large Industrial Zone
(Other potential sources of groundwater contamination)
L.A. River
Former Pemaco Property
Former W. W. Henry
Future Park Site
Residential Zone
Light Industry
Water Tank
Possible exposure pathways
Soil vapor
Soil ingestion
Dermal contact
Numerous releases documented within ½-mile radius
Bike Path
Railroad
(Potential Source)
Street
Concrete lined channel
Leaching
Soil vapor
Soil vapor
LNAPL (Toluene and Benzene)
Water production well
(nearest well is 1/4 mile from Pemaco site)
35'
Perched groundwater
Lower Vadose Zone Sand
(Municipal supply aquifer in basin, but not produced from locally)
"A" Zone
Downgradient migration of dissolved-phase contaminants
100'
"B" Zone
"C" Zone
"D" Zone
Lakewood Formation
(Includes lenticular sand units, stratigraphically within the Exposition Aquifer System)
"E" Zone
Former Pemaco Facility
Conceptual Site Model
200'
Aquitard?
Possible migration pathway for contamination
Dissolved-phase contaminants in groundwater
Possible Non-aqueous phase liquids
Groundwater zone
Interval with fine-grained sedimentary units (low permeability?)
Note: Stratigraphic boundaries are approximate
San Pedro Formation
300'
~325'
Jefferson Aquifer
Top of water-producing interval generally -350 bgs or deeper
400'
Top Lynnwood ~450'
Lynwood Aquifer
500'
OTIE-TN&A
Oneida Total Integrated Enterprises
FIGURE 2



PERCHED ZONE WELL AS-BUILT SCHEDULE

Well I.D.	Header	Associated Hydrogeologic Unit	Casing Diameter (inches)	Screen Material	Well Casing Material	Screen Interval (feet bgs)	Screen Slot Size (inches)	Filter Pack Sand Size	Depth to Bottom of Well (feet bgs)	Depth of Boring (feet bgs)
PA-1	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19-29	0.020	2/12	29.5	30
PA-2	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	20-30	0.020	2/12	30.5	31
PA-3	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19-29	0.020	2/12	29.5	30
PA-4	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	22-32	0.020	2/12	32.5	33
PA-5	DPE-A	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	20-30	0.020	2/12	30.5	31
PB-1	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	24-34	0.020	2/12	34.5	35
PB-2	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	25-35	0.020	2/12	35.5	36
PB-3	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	15-25	0.020	2/12	25.5	26
PB-4	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	15-25	0.020	2/12	25.5	26
PB-5	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	15-25	0.020	2/12	25.5	26
PB-6	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19-29	0.020	2/12	29.5	30
PB-7	DPE-B	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	23-33	0.020	2/12	33.5	34
PC-1	DPE-C	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	16-26	0.020	2/12	26.5	27
PC-2	DPE-C	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	16-26	0.020	2/12	26.5	27
PC-5	DPE-C	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19.5-29.5	0.020	2/12	30	30.5
PC-6	DPE-C	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	17-27	0.020	2/12	27.5	28
PD-1	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	16-26	0.020	2/12	26.5	27
PD-4	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	14.5-24.5	0.020	2/12	25	25.5
PD-5	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	24.5-34.5	0.020	2/12	35	35.5
PD-6	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	23-33	0.020	2/12	33.5	34
PD-7	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	19-29	0.020	2/12	29.5	30
PD-8	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	11-21	0.020	2/12	21.5	22
PD-9	DPE-D	Perched Zone	4	Schedule 40 PVC	Schedule 40 PVC	23-33	0.020	2/12	33.5	34

EXPOSITION ZONE WELL AS-BUILT SCHEDULE

Well I.D.	Associated Hydrogeologic Unit	Casing Diameter (inches)	Screen Material	Well Casing Material	Screen Interval (feet bgs)	Screen Slot Size (inches)	Filter Pack Sand Size	Depth to Bottom of Casing (feet bgs)	Depth of Boring (feet bgs)
DA-1	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	76-86	0.020	2/12	87	88
DA-2	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	72-82	0.020	2/12	83	84
DA-3	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	74-84	0.020	2/12	85	86
DA-4	Exposition A Zone	6	316 Stainless Steel	Low Carbon Steel	57-67	0.020	2/12	68	69
DA-5	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	66-76	0.020	2/12	77	78
DA-6	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	60-70	0.020	2/12	71	72
DA-7	Exposition A Zone	6	316 Stainless Steel	Schedule 80 PVC	55-65	0.020	2/12	66	67
DA-8	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	65-75	0.020	2/12	76	77
DA-9	Exposition A Zone	6	316 Stainless Steel	Schedule 80 PVC	68-78	0.020	2/12	79	80
DA-10	Exposition A Zone	6	316 Stainless Steel	Low Carbon Steel	63-73	0.020	2/12	74	75
DA-11	Exposition A Zone	6	316 Stainless Steel	Low Carbon Steel	64-74	0.020	2/12	75	76
DA-12	Exposition A Zone	6	Schedule 40 PVC	Schedule 40 PVC	66-76	0.020	2/12	77	78
DB-1	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	93-103	0.020	2/12	104	105
DB-2	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	86-96	0.020	2/12	97	98
DB-3	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	77-87	0.020	2/12	101.5	102.5
DB-4	Exposition B Zone	6	316 Stainless Steel	Low Carbon Steel	81-91	0.020	2/12	92	93
DB-5	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	81-91	0.020	2/12	92	93
DB-6	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	92-102	0.020	2/12	103	104
DB-7	Exposition B Zone	6	316 Stainless Steel	Schedule 80 PVC	81-91	0.020	2/12	92	93
DB-8	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	81-91	0.020	2/12	92	93
DB-9	Exposition B Zone	6	316 Stainless Steel	Schedule 80 PVC	88-98	0.020	2/12	99	100
DB-10	Exposition B Zone	6	316 Stainless Steel	Low Carbon Steel	74.5-84.5	0.020	2/12	85.5	86.5
DB-11	Exposition B Zone	6	316 Stainless Steel	Low Carbon Steel	76-86	0.020	2/12	87	88
DB-12	Exposition B Zone	6	Schedule 80 PVC	Schedule 80 PVC	83.5-93.5	0.020	2/12	94.5	95.5
DAB-1	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	70.5-90.5	0.020	2/12	89	90
DAB-2	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	70.5-90.5	0.020	2/12	91.5	92.5
DAB-3	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	71-91	0.020	2/12	92	93
DAB-4	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	70-90	0.020	2/12	91	92
DAB-5	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	69-89	0.020	2/12	90	91
DAB-6	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	67-87	0.020	2/12	88	89
DAB-7	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	68-88	0.020	2/12	89	90
DAB-8	Exposition A and B Zone	6	Schedule 80 PVC	Schedule 80 PVC	67-87	0.020	2/12	88	89

LEGEND:

- DAB-5: EXTRACTION WELL SCREENED THROUGH BOTH 'A' AND 'B' ZONES
- DA-1 DB-1: EXTRACTION WELL WITH INDIVIDUAL SCREENS FOR THE 'A' AND 'B' ZONES
- P15-D: PERCHED ZONE WELL
- B-8: PEMACO WELL, EXISTING MONITORING WELL, PERCHED ZONE (<35 FEET BGS)
- MW-2: PEMACO WELL, EXISTING MONITORING WELL, EXPOSITION AQUIFER
- RW-01: PEMACO WELL, EXISTING RECOVERY WELL LOCATION
- WW-MW-5: W.W. HENRY WELL, EXISTING GROUNDWATER MONITORING WELL
- VW-6: W.W. HENRY WELL, EXISTING DPE WELL – DEEP, INTERMEDIATE AND SHALLOW
- VE-3: W.W. HENRY WELL, EXISTING SVE WELL
- SEWER DISCHARGE
- EXISTING WATER LINE
- EXISTING SEWER LINE
- EXISTING GAS LINE
- FENCE LINE
- C.S.: CONDENSATE SUMP
- G.W.: GROUNDWATER SUMP

PERCHED ZONE PIPING:

- LIGHT BLUE: DPE-A 5 WELLS (PA-1 TO PA-5) WEST TRENCH
- DARK BLUE: DPE-B 7 WELLS (PB-1 TO PB-7) WEST TRENCH
- BROWN: DPE-C 4 WELLS (PC-1, PC-4 TO PC-6) WEST TRENCH
- PURPLE: DPE-D 7 WELLS (PD-1, PD-4 TO PD-9) EAST TRENCH

EXPOSITION ZONE PIPING:

- GREEN 1: GW-1 7 WELLS (DAB-1 TO DAB-7) SOUTH TRENCH
- GREEN 2: GW-2 15 WELLS (DAB-8, DA/DB-1 TO DA/DB-7) WEST TRENCH
- GREEN 3: GW-3 11 WELLS (DA/DB-8 TO DA/DB-12, MW-24-140) EAST TRENCH
- RED 1: VE-1 7 WELLS (DAB-1 TO DAB-7) SOUTH TRENCH
- RED 2: VE-2 15 WELLS (DAB-8, DA/DB-1 TO DA/DB-7) WEST TRENCH

ERH AREA PIPING:

- ORANGE: ERH, VE-3 EAST TRENCH 6 DEEP WELLS (DA/DB-8 TO DA/DB-10), ERH WELLS TBD BY ERH SUBCONTRACTOR
- ORANGE: ERH, VE-4 EAST TRENCH 4 DEEP WELLS (DA/DB-11 TO DA/DB-12), ERH WELLS TBD BY ERH SUBCONTRACTOR

NOTES:

1. THE TRENCH NETWORK IS COMPRISED OF THREE MAIN TRENCHES REFERRED TO IN THE DRAWINGS AND SPECIFICATIONS AS THE EAST, WEST AND SOUTH TRENCHES.
2. INSTALL WELLS ACCORDING TO SCHEDULES SHOWN ON THIS DRAWING. FINAL DEPTH AND SCREEN INTERVALS SHALL BE DETERMINED BY THE INSTALLING GEOLOGIST OR ENGINEER BASED ON THE OBSERVED DEPTH OF THE TARGET INTERVAL.
3. TRENCH AND WELL LOCATIONS HAVE BEEN POSITIONED SO AS TO NOT INTERFERE WITH MAYWOOD PARK CONSTRUCTION LINES, GRADES AND DRAINAGE STRUCTURES. REPOSITIONING OF WELLS, PIPES OR TRENCHES SHALL BE COORDINATED WITH THE CITY OF MAYWOOD AND THE PARK CONTRACTOR.

0 40 80
APPROXIMATE SCALE IN FEET

PEMACO WELL FIELD MAP

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE
MAYWOOD, CALIFORNIA

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

PREPARED BY:
TN & A — T N & Associates, Inc. Engineering and Science

SCALE: AS SHOWN
DESIGNED: JW & GN
DRAWN: CBG
CHECKED: JW
APPROVED
AS BUILTS
DATE: 12/11/07
FIGURE 1.2
REV 0

LEGEND:

PA-1, PB-1, PC-1, PD-1 — USEPA, EXTRACTION WELL, PERCHED ZONE

B-01, SV-01 — USEPA, MONITORING WELL, PERCHED ZONE

WELL ID — SAMPLE DATES

PB-02	4/15/09	10/21/09
Benzene (ug/l)	5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	9.6	8.4
Tetrachloroethene (ug/l)	5 U	0.5 U
Toluene (ug/l)	5 U	0.5 U
Trichloroethene (ug/l)	5 U	0.5 U
Vinyl chloride (ug/l)	5 U	0.68

COCs — ANALYTICAL RESULTS — RESULT EXCEEDS SSRL

NOTES:

1. USEPA - United States Environmental Protection Agency, Region IX.
2. (ug/L) - Micrograms per Liter
3. COCs - Contaminants of Concern
4. SSRL - Site Specific Remediation Level
5. FP - Free Product
6. NS - Not Sampled

0 40 80
APPROXIMATE SCALE IN FEET

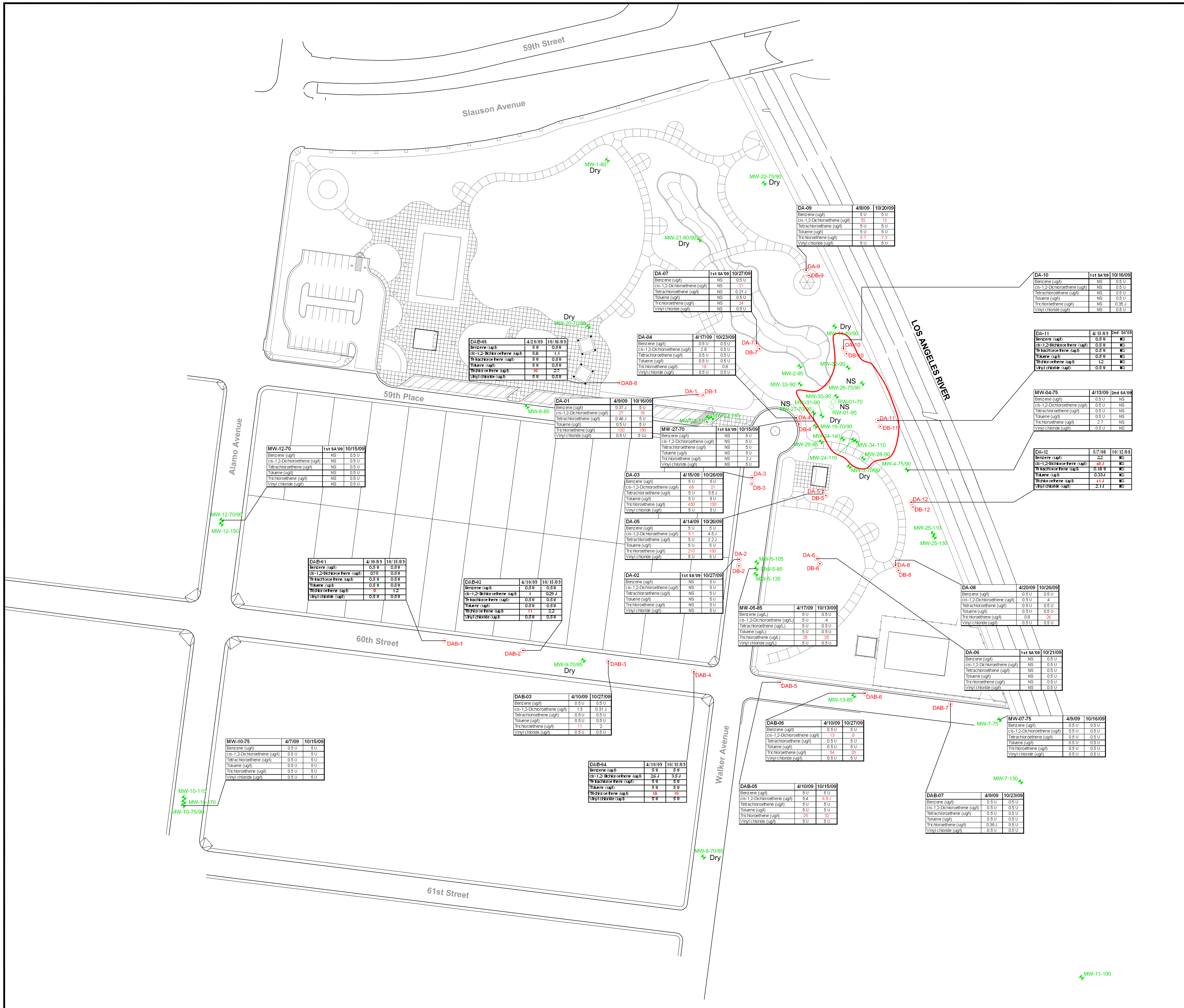
SELECTED ANALYTES IN GROUNDWATER PERCHED ZONE

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE
MAYWOOD, CALIFORNIA

PREPARED FOR:
U.S. Environmental Protection Agency
Region V
San Francisco, California

PREPARED BY: OTIE

SCALE: AS SHOWN
APPROVED
DATE: 04/30/10
DESIGNED: JM & GB
DRAWN: GB
CHECKED: JM
FIGURE 5-1
REV 0



DA-09	4/8/09	10/20/09
Benzene (ug/l)	5 U	5 U
cis-1,2-Dichloroethene (ug/l)	52	13
Tetrachloroethene (ug/l)	5 U	5 U
Toluene (ug/l)	5 U	5 U
Trichloroethene (ug/l)	8.7	7.3
Vinyl chloride (ug/l)	5 U	5 U

DA-07	1st SA'09	10/27/09
Benzene (ug/l)	NS	0.5 U
cis-1,2-Dichloroethene (ug/l)	NS	21
Tetrachloroethene (ug/l)	NS	0.21 J
Toluene (ug/l)	NS	0.5 U
Trichloroethene (ug/l)	NS	24
Vinyl chloride (ug/l)	NS	0.5 U

DA-10	1st SA'09	10/16/09
Benzene (ug/l)	NS	0.5 U
cis-1,2-Dichloroethene (ug/l)	NS	0.5 U
Tetrachloroethene (ug/l)	NS	0.5 U
Toluene (ug/l)	NS	0.5 U
Trichloroethene (ug/l)	NS	0.35 J
Vinyl chloride (ug/l)	NS	0.5 U

DAB-08	4/20/09	10/16/09
Benzene (ug/l)	5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	5.8	1.1
Tetrachloroethene (ug/l)	5 U	0.5 U
Toluene (ug/l)	5 U	0.5 U
Trichloroethene (ug/l)	16	2.7
Vinyl chloride (ug/l)	5 U	0.5 U

DA-04	4/17/09	10/23/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	2.8	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	18	0.8
Vinyl chloride (ug/l)	0.5 U	0.5 U

DA-11	4/15/09	2nd SA'09
Benzene (ug/l)	0.5 U	NS
cis-1,2-Dichloroethene (ug/l)	0.5 U	NS
Tetrachloroethene (ug/l)	0.5 U	NS
Toluene (ug/l)	0.5 U	NS
Trichloroethene (ug/l)	1.2	NS
Vinyl chloride (ug/l)	0.5 U	NS

DA-01	4/9/09	10/16/09
Benzene (ug/l)	0.37 J	5 U
cis-1,2-Dichloroethene (ug/l)	27	18
Tetrachloroethene (ug/l)	0.46 J	5 U
Toluene (ug/l)	0.5 U	5 U
Trichloroethene (ug/l)	130	190
Vinyl chloride (ug/l)	0.5 U	5 UJ

MW-04-75	4/13/09	2nd SA'09
Benzene (ug/l)	0.5 U	NS
cis-1,2-Dichloroethene (ug/l)	0.5 U	NS
Tetrachloroethene (ug/l)	0.5 U	NS
Toluene (ug/l)	0.5 U	NS
Trichloroethene (ug/l)	2.7	NS
Vinyl chloride (ug/l)	0.5 U	NS

MW-27-70	1st SA'09	10/15/09
Benzene (ug/l)	NS	5 U
cis-1,2-Dichloroethene (ug/l)	NS	5 U
Tetrachloroethene (ug/l)	NS	5 U
Toluene (ug/l)	NS	5 U
Trichloroethene (ug/l)	NS	2 J
Vinyl chloride (ug/l)	NS	5 U

MW-12-70	1st SA'09	10/15/09
Benzene (ug/l)	NS	0.5 U
cis-1,2-Dichloroethene (ug/l)	NS	0.5 U
Tetrachloroethene (ug/l)	NS	0.5 U
Toluene (ug/l)	NS	0.5 U
Trichloroethene (ug/l)	NS	0.5 U
Vinyl chloride (ug/l)	NS	0.5 U

DA-12	5/7/08	10/12/08
Benzene (ug/l)	2.2	NS
cis-1,2-Dichloroethene (ug/l)	48 J	NS
Tetrachloroethene (ug/l)	0.18 U	NS
Toluene (ug/l)	0.33J	NS
Trichloroethene (ug/l)	41 J	NS
Vinyl chloride (ug/l)	2.1 J	NS

DA-03	4/15/09	10/26/09
Benzene (ug/l)	5 U	5 U
cis-1,2-Dichloroethene (ug/l)	68	21
Tetrachloroethene (ug/l)	5 U	3.5 J
Toluene (ug/l)	5 U	5 U
Trichloroethene (ug/l)	450	130
Vinyl chloride (ug/l)	5 U	5 U

DA-05	4/14/09	10/26/09
Benzene (ug/l)	5 U	5 U
cis-1,2-Dichloroethene (ug/l)	9.1	4.5 J
Tetrachloroethene (ug/l)	5 U	2.2 J
Toluene (ug/l)	5 U	5 U
Trichloroethene (ug/l)	210	100
Vinyl chloride (ug/l)	5 U	5 U

DAB-01	4/10/09	10/15/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.75	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	8	1.2
Vinyl chloride (ug/l)	0.5 U	0.5 U

DA-02	1st SA'09	10/27/09
Benzene (ug/l)	NS	5 U
cis-1,2-Dichloroethene (ug/l)	NS	5 U
Tetrachloroethene (ug/l)	NS	5 U
Toluene (ug/l)	NS	5 U
Trichloroethene (ug/l)	NS	5 U
Vinyl chloride (ug/l)	NS	5 U

DAB-02	4/10/09	10/15/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	1	0.29 J
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	11	2.2
Vinyl chloride (ug/l)	0.5 U	0.5 U

DA-08	4/20/09	10/26/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	4
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	0.8	26
Vinyl chloride (ug/l)	0.5 U	0.5 U

MW-05-85	4/17/09	10/13/09
Benzene (ug/L)	5 U	0.5 U
cis-1,2-Dichloroethene (ug/L)	5 U	4
Tetrachloroethene (ug/L)	5 U	0.5 U
Toluene (ug/L)	5 U	0.5 U
Trichloroethene (ug/L)	25	25
Vinyl chloride (ug/L)	5 U	0.5 U

DA-06	1st SA'09	10/21/09
Benzene (ug/l)	NS	0.5 U
cis-1,2-Dichloroethene (ug/l)	NS	0.5 U
Tetrachloroethene (ug/l)	NS	0.5 U
Toluene (ug/l)	NS	0.5 U
Trichloroethene (ug/l)	NS	0.5 U
Vinyl chloride (ug/l)	NS	0.5 U

DAB-03	4/10/09	10/27/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	1.3	0.31 J
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	11	2
Vinyl chloride (ug/l)	0.5 U	0.5 U

MW-07-75	4/9/09	10/16/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	0.5 U	0.5 U
Vinyl chloride (ug/l)	0.5 U	0.5 U

DAB-06	4/10/09	10/27/09
Benzene (ug/l)	0.5 U	5 U
cis-1,2-Dichloroethene (ug/l)	13	8
Tetrachloroethene (ug/l)	0.5 U	5 U
Toluene (ug/l)	0.5 U	5 U
Trichloroethene (ug/l)	54	33
Vinyl chloride (ug/l)	0.5 U	5 U

MW-10-75	4/7/09	10/15/09
Benzene (ug/l)	0.5 U	5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	5 U
Tetrachloroethene (ug/l)	0.5 U	5 U
Toluene (ug/l)	0.5 U	5 U
Trichloroethene (ug/l)	0.5 U	5 U
Vinyl chloride (ug/l)	0.5 U	5 U

DAB-04	4/10/09	10/15/09
Benzene (ug/l)	5 U	5 U
cis-1,2-Dichloroethene (ug/l)	2.6 J	3.5 J
Tetrachloroethene (ug/l)	5 U	5 U
Toluene (ug/l)	5 U	5 U
Trichloroethene (ug/l)	18	19
Vinyl chloride (ug/l)	5 U	5 U

DAB-05	4/10/09	10/15/09
Benzene (ug/l)	5 U	5 U
cis-1,2-Dichloroethene (ug/l)	5.4	6.8 J
Tetrachloroethene (ug/l)	5 U	5 U
Toluene (ug/l)	5 U	5 U
Trichloroethene (ug/l)	25	32
Vinyl chloride (ug/l)	5 U	5 U

DAB-07	4/9/09	10/23/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	0.38 J	0.5 U
Vinyl chloride (ug/l)	0.5 U	0.5 U

LEGEND:

- DAB-1 — USEPA, EXTRACTION WELL, SCREENED THROUGH BOTH "A" AND "B" ZONES
- DA-1 / DB-1 — USEPA, EXTRACTION WELL, INDIVIDUAL SCREENS FOR THE "A" AND "B" ZONES
- MW-1-80 — USEPA, MONITORING WELL, EXPOSITION AQUIFER
- RW-1-70 — USEPA, RECOVERY WELL, EXPOSITION AQUIFER (CURRENTLY USED AS A MONITORING WELL)
- ELECTRICAL RESISTANCE HEATING AREA

WELL ID — SAMPLE DATES — COCs — ANALYTICAL RESULTS — RESULT EXCEEDS SSRL

NOTES:

1. USEPA - United States Environmental Protection Agency, Region IX.
2. (ug/L) - Micrograms per Liter
3. COCs - Contaminants of Concern
4. SSRL - Site Specific Remediation Limit
5. NS - Not Sampled
6. R - Laboratory Rejected Result

0 60 120
APPROXIMATE SCALE IN FEET

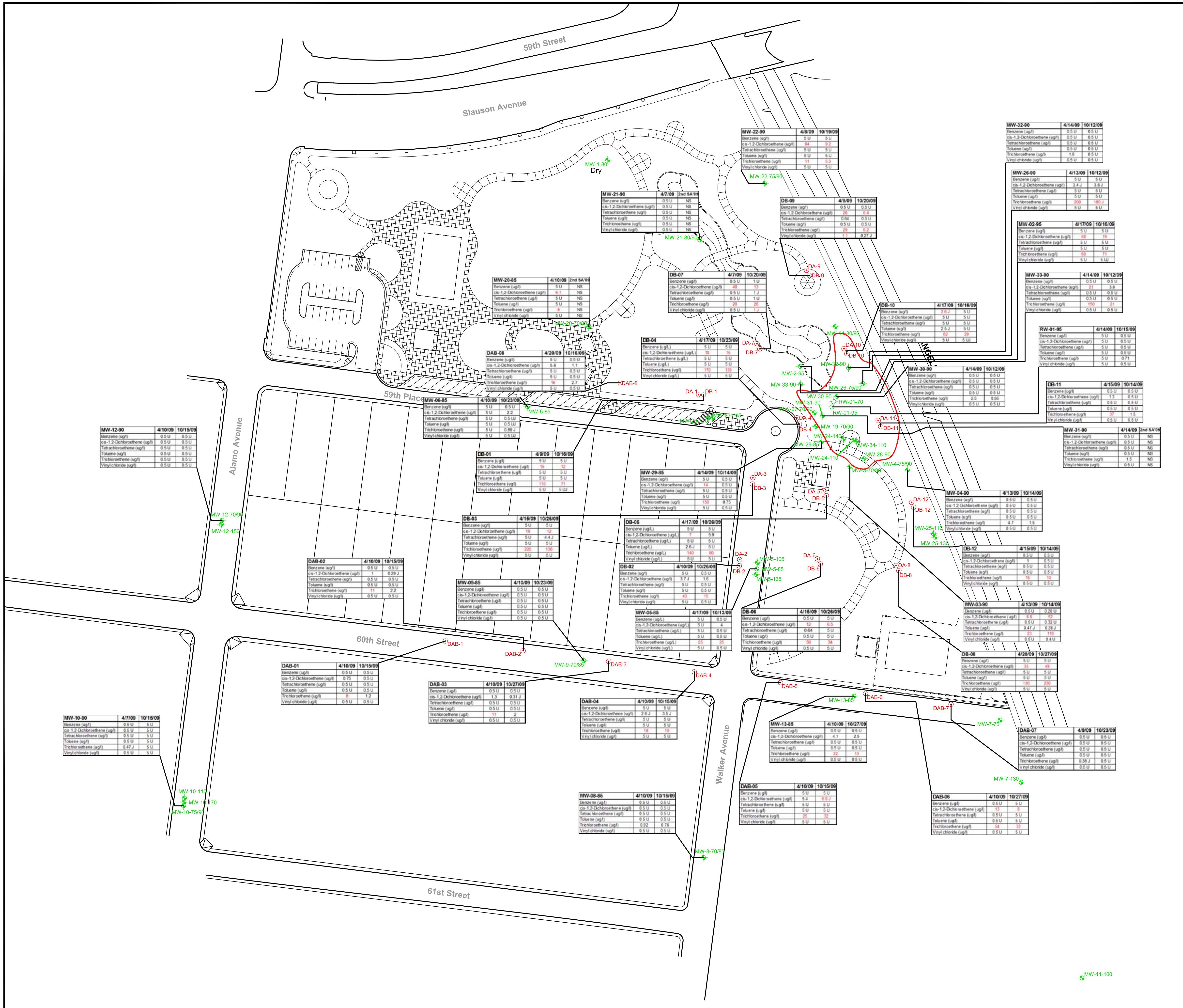
SELECTED ANALYTES IN GROUNDWATER EXPOSITION 'A' ZONE

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE
MAYWOOD, CALIFORNIA

PREPARED FOR:
U.S. Environmental Protection Agency
Region V
San Francisco, California

PREPARED BY:
OTIE

SCALE: AS SHOWN	APPROVED	DATE: 04/30/10
DESIGNED: JM & GB		FIGURE 5-2
DRAWN: GB		REV 0
CHECKED: JM		



LEGEND:

- DAB-1 — USEPA, EXTRACTION WELL, SCREENED THROUGH BOTH "A" AND "B" ZONES
- DA-1, DB-1 — USEPA, EXTRACTION WELL, INDIVIDUAL SCREENS FOR THE "A" AND "B" ZONES
- MW-1-80 — USEPA, MONITORING WELL, EXPOSITION AQUIFER
- RW-1-95 — USEPA, RECOVERY WELL, EXPOSITION AQUIFER (CURRENTLY USED AS A MONITORING WELL)
- — — ELECTRICAL RESISTANCE HEATING AREA

NOTES:

1. USEPA - United States Environmental Protection Agency, Region IX
2. (ug/L) - Micrograms per Liter
3. COCs - Contaminants of Concern
4. SSRL - Site Specific Remediation Limit
5. NS - Not Sampled
6. NI - Not Installed

SELECTED ANALYTES IN GROUNDWATER EXPOSITION 'B' ZONE

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE
MAYWOOD, CALIFORNIA

PREPARED FOR:	PREPARED BY:
U.S. Environmental Protection Agency Region V San Francisco, California	OTIE Oneida Total Integrated Enterprises

SCALE: AS SHOWN	APPROVED	DATE: 04/30/10
DESIGNED: JM & GB		FIGURE 5-3
DRAWN: GB		REV 0
CHECKED: JM		

MW-23-110	4/16/09	10/13/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	1.8	0.47 J
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	6.4	1.1
Vinyl chloride (ug/l)	0.5 U	0.5 U

MW-24-110	4/14/09	10/12/09
Benzene (ug/l)	5 U	5 U
cis-1,2-Dichloroethene (ug/l)	19	7.9 J
Tetrachloroethene (ug/l)	5 U	5 U
Toluene (ug/l)	5 U	5 U
Trichloroethene (ug/l)	150	60
Vinyl chloride (ug/l)	5 U	5 U

MW-34-110	4/15/09	10/14/09
Benzene (ug/l)	0.5 U	5 U
cis-1,2-Dichloroethene (ug/l)	6	3.4 J
Tetrachloroethene (ug/l)	0.5 U	5 U
Toluene (ug/l)	0.36 J	5 U
Trichloroethene (ug/l)	41	56
Vinyl chloride (ug/l)	0.5 U	5 U

MW-25-110	4/13/09	10/12/09
Benzene (ug/L)	5 U	5 U
cis-1,2-Dichloroethene (ug/L)	17	5 U
Tetrachloroethene (ug/L)	5 U	5 U
Toluene (ug/L)	5 U	5 U
Trichloroethene (ug/L)	240	7.7
Vinyl chloride (ug/L)	5 U	5 U

MW-05-105	4/14/09	10/13/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	1.3	0.53
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	11	3.8
Vinyl chloride (ug/l)	0.5 U	0.5 U

MW-10-110	4/7/09	10/15/09
Benzene (ug/l)	5 U	5 U
cis-1,2-Dichloroethene (ug/l)	5 U	5 U
Tetrachloroethene (ug/l)	5 U	5 U
Toluene (ug/l)	5 U	5 U
Trichloroethene (ug/l)	2.6 J	2.3 J
Vinyl chloride (ug/l)	5 U	5 U

MW-11-100	4/9/09	10/13/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	0.5 U	0.2 J
Vinyl chloride (ug/l)	0.5 U	0.5 U

LEGEND:

- MW-1-80 — USEPA, MONITORING WELL, EXPOSITION AQUIFER
- RW-1-70 — USEPA, RECOVERY WELL, EXPOSITION AQUIFER (CURRENTLY USED AS A MONITORING WELL)

WELL ID — SAMPLE DATES

COCs — ANALYTICAL RESULTS

MW-25-110	4/13/09	10/12/09
Benzene (ug/L)	5 U	5 U
cis-1,2-Dichloroethene (ug/L)	17	5 U
Tetrachloroethene (ug/L)	5 U	5 U
Toluene (ug/L)	5 U	5 U
Trichloroethene (ug/L)	240	7.7
Vinyl chloride (ug/L)	5 U	5 U

RESULT EXCEEDS SSRL

NOTES:

1. USEPA - United States Environmental Protection Agency, Region IX
2. (ug/L) - Micrograms per Liter
3. COCs - Contaminants of Concern
4. SSRL - Site Specific Remediation Limit
5. NS - Not Sampled
6. NI - Not Installed

0 120 240

APPROXIMATE SCALE IN FEET

SELECTED ANALYTES IN GROUNDWATER
EXPOSITION 'C' ZONE

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE
MAYWOOD, CALIFORNIA

PREPARED FOR:
U.S. Environmental Protection Agency
Region V
San Francisco, California

PREPARED BY:
OTIE
Oneida Total Integrated Enterprises

SCALE: AS SHOWN
APPROVED
DATE: 04/30/10
DESIGNED: JM & GB
DRAWN: GB
CHECKED: JM
FIGURE 5-4
REV 0

MW-23-145	4/9/09	10/13/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	1.6	0.85
Vinyl chloride (ug/l)	0.5 U	0.5 U

MW-24-140	4/13/09	10/14/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	0.58	0.5 U
Vinyl chloride (ug/l)	0.5 U	0.5 U

MW-12-150	4/10/09	10/15/09
Benzene (ug/l)	0.5 U	5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	5 U
Tetrachloroethene (ug/l)	0.5 U	5 U
Toluene (ug/l)	0.5 U	5 U
Trichloroethene (ug/l)	0.5 U	5 U
Vinyl chloride (ug/l)	0.5 U	5 U

MW-25-130	4/13/09	10/23/09
Benzene (ug/l)	0.5 U	5 U
cis-1,2-Dichloroethene (ug/l)	1.3	5 U
Tetrachloroethene (ug/l)	0.5 U	5 U
Toluene (ug/l)	0.5 U	5 U
Trichloroethene (ug/l)	99	120
Vinyl chloride (ug/l)	0.5 U	5 U

MW-05-135	4/17/09	10/13/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	3.3	1.4
Vinyl chloride (ug/l)	0.5 U	0.5 U

MW-10-170	4/7/09	10/15/09
Benzene (ug/l)	0.5 U	5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	5 U
Tetrachloroethene (ug/l)	0.5 U	5 U
Toluene (ug/l)	0.5 U	5 U
Trichloroethene (ug/l)	0.5 U	5 U
Vinyl chloride (ug/l)	0.5 U	5 U

MW-07-130	4/9/09	10/16/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	14	9.5
Vinyl chloride (ug/l)	0.5 U	0.5 U

LEGEND:

MW-1-80 — USEPA, MONITORING WELL, EXPOSITION AQUIFER

RW-1-70 — USEPA, RECOVERY WELL, EXPOSITION AQUIFER (CURRENTLY USED AS A MONITORING WELL)

WELL ID — SAMPLE DATES

MW-07-130	4/9/09	10/16/09
Benzene (ug/l)	0.5 U	0.5 U
cis-1,2-Dichloroethene (ug/l)	0.5 U	0.5 U
Tetrachloroethene (ug/l)	0.5 U	0.5 U
Toluene (ug/l)	0.5 U	0.5 U
Trichloroethene (ug/l)	14	9.5
Vinyl chloride (ug/l)	0.5 U	0.5 U

COCs — ANALYTICAL RESULTS

RESULT EXCEEDS SSRL

NOTES:

1. USEPA - United States Environmental Protection Agency, Region IX
2. (ug/L) - Micrograms per Liter
3. COCs - Contaminants of Concern
4. SSRL - Site Specific Remediation Limit
5. NS - Not Sampled

0 120 240

APPROXIMATE SCALE IN FEET

SELECTED ANALYTES IN GROUNDWATER
EXPOSITION 'D & E' ZONES

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE
MAYWOOD, CALIFORNIA

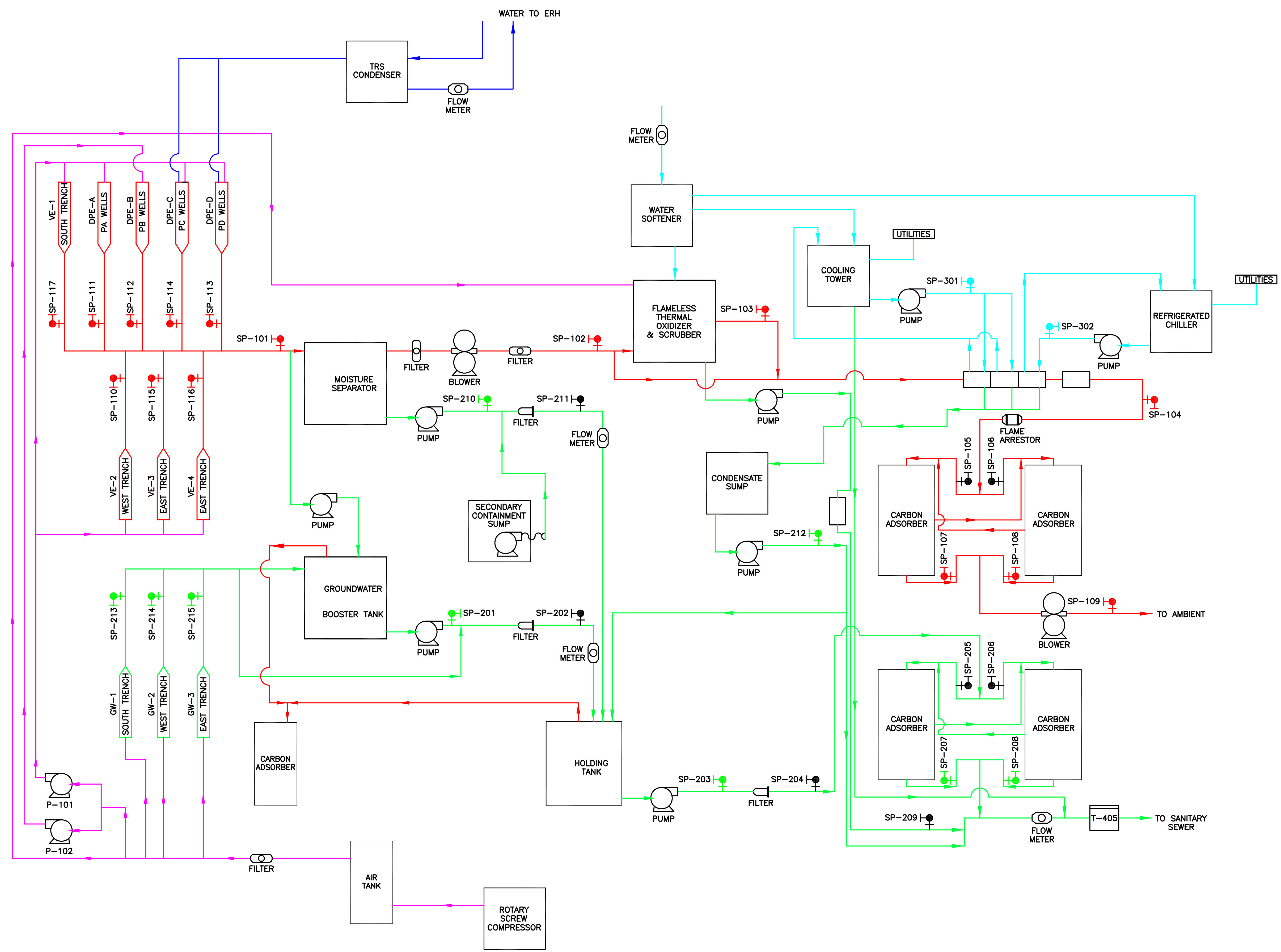
PREPARED FOR:
U.S. Environmental Protection Agency
Region V
San Francisco, California

PREPARED BY:
OTIE
Oneida Total Integrated Enterprises

SCALE: AS SHOWN | APPROVED | DATE: 04/30/10

DESIGNED: JM & GB
DRAWN: GB
CHECKED: JM

FIGURE 5-5 | REV 0



LEGEND:

NON-CONTACT CLEAN WATER LINES
SOIL VAPOR LINES
GROUNDWATER LINES

SAMPLE PORTS:

SP-101 SP-1## Indicate Vapor Locations
SP-201 SP-2## Indicate Water Locations
SP-301 SP-3## Indicate Cooling Water Locations
SP-### Additional Ports Available for Sampling

PEMACO COMPOUND
SAMPLE PORTS FOR CHEMICAL MONITORING

PEMACO SUPERFUND SITE
5050 EAST SLAUSON AVENUE
MAYWOOD, CALIFORNIA

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

PREPARED BY:
T N & Associates, Inc.
Engineering and Science

SCALE: AS SHOWN
DESIGNED: JW & GN
DRAWN: DC
CHECKED: JW
APPROVED
DRAFT-FINAL
DATE: 12/15/06
FIGURE 3
REV 1

APPENDIX B

FOOTPRINT CALCULATIONS

(Reference values and supporting information available upon request)

Input for Groundwater and Vapor Treatment Systems

General Scope	***Typical Scope Items***	***Useful Information***
Annual O&M of groundwater and vapor treatment systems.		

Labor, Mobilizations, Mileage, and Fuel

Participant	Crew Size	Number of Days	Hours Worked Per Day	Total Hours Worked	Trips to Site	Roundtrip Miles to Site	Mode of Transport.	Fuel Type	Total Miles Traveled	Miles Per Gallon	Total Fuel Used	Activity or Notes
Field Staff (Full Time)	2	260	8	4160	260	26	Car	Gasoline	6760	20	338	13 miles from home
Field Staff (Half Time)	1	156	6.67	1040.52	156	36	Car	Gasoline	5616	20	280.8	18 miles from hotel
Field Staff (Half Time) Travel	1	0	0	0	52	240	Car	Gasoline	12480	20	624	120 miles from San Diego

Equipment Use, Mobilization, and Fuel Usage

Equipment Type	HP	Load Factor	Equip. Fuel Type	Gallons Fuel Used per Hour	Total Hours Operated	Gallons Fuel Used On-Site	Trips to Site	Roundtrip Miles to Site	Total Miles Transported	Transport Fuel Type	Miles per Gallon	Gallons Fuel Used for Transport.	Activity or Notes

Electricity Usage

Equipment Type	HP	% Full Load	Efficiency	Electrical Rating (kW)	Hours Used	Energy Used (kWh)	Notes
Liquid Ring Blower #1	75	63	90	39.2	8760	343085.4	estimated
Liquid Ring Blower #2	75	63	90	39.2	8760	343085.4	estimated
Air Compressor	30	80	75	23.87	2000	47744	estimated
Pumps	20	80	75	15.9	2000	31829.33333	estimated
Equip. with kW rating				5	8760	43800	estimated usage for treatment building
Equip. with kW rating							
Direct kWh info.							
			Totals	123.1	1,292,923	809,544	

Cells shaded in dark gray are not relevant to the equipment types noted

"Direct kWh info" refers to total electricity usage calculated or provided elsewhere (e.g., an electric meter).

Natural Gas Usage

Equipment Type	Power Rating (btu/hr)	Efficiency	Total Hours Used	Btus Required	Total Therms Used	Notes
		Totals		0	0	

If heat load is known instead of unit power rating, then enter power rating as 125% of heat load and choose 80% for efficiency.

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Input for Groundwater and Vapor Treatment Systems

Materials Usage

Material Type	Unit	Quantity	Site-Spec. One-Way Distance (miles)*	Number of Trips	Total One-Way Miles	Mode of Transport.	Fuel Type	Fuel Use Rate (mpg or gptm)	Total Fuel Use	Notes
GAC: regenerated	lbs	8,000		1	1000	Truck Light Load (gptm)	Diesel	0.024	96	VGAC: 2, 4000 lb units
GAC: regenerated	lbs	6,000		1	1000	Truck Light Load (gptm)	Diesel	0.024	72	LGAC: 2, 3000 lb units
Other 3	lbs	511			0					softener salt
Other 4	0	2,036		5	0					filters
										the softener salt and filters represent
										a negligible contribution to the footprint
			Empty Return Trips			**Truck A (< 5 tons)**				no empty return trips assumed

** Leave site-specific one-way miles blank if value is not known and a default will be used for calculating Fuel Use Rate reported in miles per gallon (mpg) and gallons per ton-mile (gptm)*

Laboratory Analysis

Parameter and Notes	Unit Cost	Number of Samples	Total Cost
Total Lab Costs			$145,000
Other			0
Other			0
Other			0
Other			0
Other			0
Other			0
Other			0
Other			0
Other			0
	Totals	**0**	**$145,000**

Waste Generation

Waste Type	Unit	Quantity	Site-Spec. One-Way Distance (miles)	Number of Trips	Total One-Way Miles	Mode of Transport.	Fuel Type	Fuel Use Rate	Total Fuel Use	Notes
Non-hazardous landfill	tons				0					
	tons									
	tons									
	tons									
	tons									
			Empty Return Trips			**Truck A (< 5 tons)**				

** Leave site-specific one-way miles blank if value is not known and a default will be used for calculating gptm = gallons per ton-mile*
total-one way miles

On-Site Water Usage (1000 x gallons) / ***Fate of On-Site Water Usage (1000 x gallons)***

Resource Type	Quantity	Use of Resource	Discharge Location	Notes
Potable water	1,031	Cooling per year	Discharge to POTW	3,800 gpd
Extracted GW #1	14,600	gw extraction system per year	Discharge to POTW	40,000 gpd; discharged to Los Angeles County Sanitary District Sewer; ~$14,000 per year
Water table drawdown (ft)				

If potable water is trucked to site, use "potable water" in materials section to calculate fuel use. Only the potable water use from the On-Site Water Use Section will be input into the Summary tab. It is assumed that the quantity of potable water in the Materials section is accounted for in in the On-Site Water Use Section.

Miscellaneous Emissions and Reductions

Item	Quantity	Activity or Notes
Other HAP emissions	28	untreated off-gas from SVE system
Other GHG emissions		
Other GHG reductions		
Other NOx reductions		
Other SOx reductions		
Other PM reductions		

On-Site Renewable Energy Generation

Item	Quantity	Activity or Notes
Photovoltaic (kWh)	4500	solar panels save ~4,500 kWh/yr and off-set office trailer electricity usage
Renewable Energy #1 (kWh)		
Renewable Energy #2 (kWh)		

Purchased Renewable Energy (including Renewable Energy Certificates "RECs")

Item	Quantity	Activity or Notes
Purchased from Utility (kWh)		
RECs (kWh)		

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	Totals For Parameters Used, Extracted, Emitted, or Generated - Pemaco Operating Remedies														
	Energy Used Mbtu	**Grid Electricity Used MWh**	**All Water Used gal x 1000**	**Potable Water Used gal x 1000**	**Groundwater Extracted gal x 1000**	**CO2e Emitted lbs**	**NO x Emitted lbs**	**SO x Emitted lbs**	**PM Emitted lbs**	**Solid Waste Generated tons**	**Haz. Waste Generated tons**	**Air Toxics Emitted lbs**	**Mercury Released lbs**	**Lead Released lbs**	**Dioxins Released lbs**
Level 1 - O&M															
On-Site	2,933,624.	815.	15,631.	1,031.	14,600.	0	0	0	0	5.	0	28.	0	0	0
Electricity Generation	6,314,444.	49.	1,619.	0	0	1,246,698.	3,157.	8,095.	761.	0.7	0	323.8177	0.018619515	0.137622503	0.000000194291
Transportation	177,459.	0	0	0	0	28,139.	166.	7.	2.	0	0	0.0494	0	0	0
Other Off-Site	1,688,949.	167.	451.	0	0	403,608.	1,700.	1,976.	196.	37.6	0	67.282	0.004173013	0.037829631	0.00000004053
O&M Total	***11,114,476.***	***1,031.***	***17,701.***	***1,031.***	***14,600.***	***1,678,445.***	***5,023.***	***10,078.***	***959.***	***43.3***	***0***	***419.1491***	***0.022792528***	***0.175452134***	***0.000000234821***
Level 2 - Not Used															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not Used Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Level 3 - Not Used															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not Used Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Level 4 - Not Used															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not Used Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Level 5 - Not Used															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not Used Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Level 6 - Not Used															
On-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electricity Generation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transportation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Off-Site	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Not Used Total	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***	***0***
Total	***11,114,476.***	***1,031.***	***17,701.***	***1,031.***	***14,600.***	***1,678,445.***	***5,023.***	***10,078.***	***959.***	***43.3***	***0***	***419.1491***	***0.022792528***	***0.175452134***	***0.000000234821***

Level 2 (Not Used) Parameters Used, Extracted, Emitted, or Generated - Pemaco Operating Remedies

		Quantity Used	Energy		Grid Electricity		All Water		Potable Water		Groundwater		CO2e		NO x		SO x		PM		Solid Waste		Haz. Waste		Air Toxics		Mercury		Lead		Dioxins	
			Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Extracted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Generated	Conv. Factor	Generated	Conv. Factor	Emitted	Conv. Factor	Released	Conv. Factor	Released	Conv. Factor	Released
				Mbtu		MWh		gal x 1000		gal x 1000		gal x 1000		lbs		lbs		lbs		lbs		tons		tons		lbs		lbs		lbs		lbs
Totals				*0*		*0*		*0*		*0*		*0*		*0*		*0*		*0*		*0*		*0*		*0*		*0*		*0*		*0*		*0*
ON-SITE																																
Energy																																
Diesel (on-site use)	gal	0	139	0	0	0	0	0	0	0	0	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0	0	0	0	5E-06	0	0	0	0	0	0	0
Gasoline (on-site use)	gal	0	124	0	0	0	0	0	0	0	0	0	19.6	0	0.11	0	0.0045	0	0.0005	0	0	0	0	0	4E-05	0	0	0	0	0	0	0
Natural gas (on-site use)	ccf	0	103	0	0	0	0	0	0	0	0	0	12.2	0	0.01	0	6E-06	0	0.0008	0	0	0	0	0	8E-06	0	3E-08	0	5E-08	0	0	0
Electricity (on-site use)	MWh	0	3413	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Photovoltaic (on-site system)	MWh	0	37922	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Energy 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Energy 3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Water																																
Groundwater Extracted On-site	gal x 1000	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potable Water Used On-site	gal x 1000	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other On-Site Water 1	gal x 1000	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other On-Site Water 2	gal x 1000	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other On-Site Water 3	gal x 1000	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waste Generation																																
On-Site Solid Waste Generation	ton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
On-Site Solid Waste Disposal		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-Site Hazardous Waste Generation	ton	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
On-Site Hazardous Waste Disposal		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other																																
On-site process emissions (HAPs)	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
On-site process emissions (GHGs)	lbs CO2e	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site GHG storage	lbs CO2e	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site NOx reduction	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site SOx reduction	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
On-site PM reduction	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ON-SITE TOTAL			0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**
ELECTRICITY GENERATION																																
Electricity production	MWh	0	7800	0	0.06	0	2	0	0	0	0	0	1540	0	3.9	0	10	0	0.94	0	0.0009	0	0	0	0.4	0	2E-05	0	0.0002	0	2E-10	0
Purchased Renewa ble Electricity	MWh	0	0	0	0	0	-2	0	0	0	0	0	-1540	0	-3.9	0	-10	0	-0.94	0	-9E-04	0	0	0	-0.4	0	-2E-05	0	-2E-04	0	-2E-10	0
TRANSPORTATION																																
Diesel (off-site use)	gal	0	139	0	0	0	0	0	0	0	0	0	22.5	0	0.17	0	0.0054	0	0.0034	0	0	0	0	0	5E-06	0	0	0	0	0	0	0
Gasoline (off-site use)	gal	0	124	0	0	0	0	0	0	0	0	0	19.6	0	0.11	0	0.0045	0	0.0005	0	0	0	0	0	4E-05	0	0	0	0	0	0	0
Natural gas (off-site use)	ccf	0	103	0	0	0	0	0	0	0	0	0	12.2	0	0.01	0	6E-06	0	0.0008	0	0	0	0	0	8E-06	0	3E-08	0	5E-08	0	0	0
Other Transportation 1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Transportation 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Transportation 3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Transportation 4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Transportation 5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TRANSPORTATION TOTAL			0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**	0	**0**

			Level 2 (Not Used) Parameters Used, Extracted, Emitted, or Generated - Pemaco Operating Remedies																													
		Quantity Used	Energy		Grid Electricity		All Water		Potable Water		Groundwater		CO2e		NO x		SO x		PM		Solid Waste		Haz. Waste		Air Toxics		Mercury		Lead		Dioxins	
			Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Used	Conv. Factor	Extracted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Emitted	Conv. Factor	Generated	Conv. Factor	Generated	Conv. Factor	Emitted	Conv. Factor	Released	Conv. Factor	Released	Conv. Factor	Released
				Mbtu		MWh		gal x 1000		gal x 1000		gal x 1000		lbs		lbs		lbs		lbs		tons		tons		lbs		lbs		lbs		lbs
OFF-SITE OTHER																																
Materials																																
Asphalt	tons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bentonite	tons	0	55	0	0.0027	0	0.13	0	0	0	0	0	6.7	0	0.033	0	0.03	0	0.004	0	0	0	0	0	4E-07	0	6E-11	0	1E-09	0	2E-16	0
Borrow (clean soil)	tons	0	15.75	0	6E-05	0	8E-05	0	0	0	0	0	2.52	0	0.0176	0	0.0018	0	0.0004	0	4E-08	0	0	0	1E-05	0	5E-09	0	2E-07	0	3E-15	0
Cement	dry-ton	0	4100	0	0.13	0	0.41	0	0	0	0	0	1800	0	3.6	0	2.1	0	0.0063	0	0	0	0	0	0.058	0	6E-05	0	0.0001	0	9E-11	0
Cheese Whey	lbs	0	1.87	0	0	0	0	0	0	0	0	0	1.1	0	0.0083	0	0.0099	0	0.0002	0	0	0	0	0	0	0	0	0	0	0	0	0
Concrete	tons	0	3019	0	0.096	0	0.34	0	0	0	0	0	1322	0	2.6	0	1.5	0	0.0054	0	1E-08	0	0	0	0.043	0	4E-05	0	1E-04	0	6E-11	0
Diesel Produced	gal	0	18.5	0	0.0006	0	0.0008	0	0	0	0	0	2.7	0	0.0064	0	0.013	0	0.0003	0	4E-07	0	0	0	0.0001	0	5E-08	0	2E-06	0	3E-14	0
Emulsified vegetable oil	lbs	0	3.6	0	6E-05	0	2E-05	0	0	0	0	0	3.51	0	0.0265	0	0.031	0	0.0017	0	0	0	0	0	0	0	0	0	0	0	0	0
GAC: regenerated	lbs	0	9.6	0	0.0004	0	0.0064	0	0	0	0	0	2	0	0.025	0	0.015	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GAC: virgin coal-based	lbs	0	10.8	0	5E-05	0	0	0	0	0	0	0	4.5	0	0.12	0	0.074	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
GAC: virgin coconut-based	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gasoline Produced	gal	0	21	0	0.0006	0	0.0008	0	0	0	0	0	4.4	0	0.008	0	0.019	0	0.0005	0	4E-07	0	0	0	0.0002	0	9E-08	0	2E-06	0	3E-14	0
Gravel/sand/clay	ton	0	55	0	0.0027	0	0.13	0	0	0	0	0	6.7	0	0.033	0	0.03	0	0.004	0	0	0	0	0	4E-07	0	6E-11	0	1E-09	0	2E-16	0
HDPE	lb	0	31	0	0.0003	0	0.0023	0	0	0	0	0	1.9	0	0.0032	0	0.0041	0	0.0006	0	4E-07	0	1E-06	0	3E-06	0	3E-09	0	2E-09	0	1E-09	0
Hydrochloric acid (30%, SG = 1.18)	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydrogen peroxide (50%, SG=1.19)	lbs	0	4.95	0	0.0006	0	0.019	0	0	0	0	0	1.35	0	0.0087	0	0.0066	0	0.0025	0	1E-05	0	5E-07	0	0.0002	0	0	0	0	0	0	0
Hydroseed	lbs	0	0.049	0	1E-07	0	0.0001	0	0	0	0	0	0.0046	0	3E-06	0	5E-05	0	3E-07	0	0	0	0	0	8E-07	0	2E-11	0	1E-10	0	0	0
Lime	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Molasses	lbs	0	1.31	0	5E-06	0	9E-05	0	0	0	0	0	0.4	0	0.003	0	0.0026	0	6E-05	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural Gas Produced	ccf	0	5.2	0	0.0003	0	8E-05	0	0	0	0	0	2.2	0	0.0037	0	0.0046	0	7E-05	0	0	0	0	0	6E-06	0	2E-08	0	9E-07	0	5E-14	0
Nitrogen fertilizer	lbs	0	16.2	0	2E-05	0	0	0	0	0	0	0	1.5	0	0.0008	0	0.0174	0	7E-05	0	0	0	0	0	0.0003	0	6E-09	0	4E-08	0	0	0
Other Material #1 - PV System	W	0	33.6	0	0.0003	0	0	0	0	0	0	0	4.47	0	0.015	0	0.032	0	0.0006	0	0	0	3E-06	0	3E-06	0	0	0	3E-06	0	0	0
Other Material #2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Material #3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Material #4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other Material #5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Phosphorus fertilizer	lbs	0	3.39	0	7E-05	0	0	0	0	0	0	0	0.35	0	0.0017	0	0.017	0	0.0001	0	0	0	0	0	5E-05	0	2E-09	0	5E-08	0	0	0
Polymer	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potable Water	gal x 1000	0	9.2	0	0.0004	0	0.021	0	0	0	0	0	5	0	0.0097	0	0.0059	0	0.016	0	8E-07	0	0	0	2E-05	0	8E-09	0	7E-08	0	1E-13	0
Potassium permanganate	lbs	0	29.22	0	0.0016	0	0.003	0	0	0	0	0	4.5	0	0.021	0	0.016	0	0.0017	0	1E-06	0	0	0	0.0006	0	4E-08	0	4E-07	0	4E-13	0
PVC	lbs	0	22	0	0.0006	0	0.0069	0	0	0	0	0	2.6	0	0.0048	0	0.0076	0	0.0012	0	2E-06	0	2E-06	0	0.0005	0	3E-07	0	1E-07	0	7E-09	0
Sequestering agent	lbs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sodium hydroxide (dry bulk)	lbs	0	6.6	0	0.0003	0	0.0012	0	0	0	0	0	1.37	0	0.003	0	0.0048	0	0.0005	0	2E-05	0	5E-07	0	6E-05	0	2E-07	0	3E-08	0	2E-14	0
Stainless Steel	lb	0	11.6	0	0.0006	0	0.0023	0	0	0	0	0	3.4	0	0.0075	0	0.012	0	0.0044	0	0.0006	0	0	0	0.0001	0	0	0	5E-07	0	2E-12	0
Steel	lb	0	4.4	0	0.0002	0	0.0006	0	0	0	0	0	1.1	0	0.0014	0	0.0017	0	0.0006	0	0.0003	0	0	0	7E-05	0	1E-07	0	3E-06	0	7E-12	0
Tree: root ball	trees	0	3.7	0	2E-06	0	0.004	0	0	0	0	0	0.6	0	0.003	0	0.0006	0	3E-05	0	1E-08	0	0	0	6E-06	0	2E-09	0	6E-08	0	0	0
Tree: whip	trees	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Off-Site Services																																
Off-site waste water treatment	gal x 1000	0	15	0	0.0007	0	0.0029	0	0	0	0	0	4.4	0	0.016	0	0.015	0	0.0017	0	0.0024	0	0	0	0.0006	0	4E-08	0	4E-07	0	3E-13	0
Off-site Solid Waste Disposal	ton	0	160	0	0.0077	0	0.15	0	0	0	0	0	25	0	0.14	0	0.075	0	0.4	0	8E-06	0	0	0	0.0014	0	1E-06	0	8E-06	0	1E-11	0
Off-site Haz. Waste Disposal	ton	0	176	0	0.0085	0	0.165	0	0	0	0	0	27.5	0	0.154	0	0.0825	0	0.44	0	9E-06	0	0	0	0.0015	0	1E-06	0	8E-06	0	1E-11	0
Off-site Laboratory Analysis	$	0	6.49	0	0.0004	0	0.0007	0	0	0	0	0	1	0	0.0048	0	0.0036	0	0.0004	0	0	0	0	0	0.0001	0	8E-09	0	9E-08	0	8E-14	0
Other 1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 4	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 5	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other																																
Potable Water Transported	gal x 1000	0	7.4	0	0.0006	0	0.0013	0	0	0	0	0	0.9948	0	0.0025	0	0.0065	0	0.0006	0	6E-07	0	0	0	0.0003	0	1E-08	0	1E-07	0	2E-13	0
Electricity transmission	MWh	0	410	0	0.12	0	0.24	0	0	0	0	0	184.8	0	0.468	0	1.2	0	0.1128	0	0.0001	0	0	0	0.048	0	3E-06	0	2E-05	0	3E-11	0
Other 1	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 2	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other 3	TBD	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
OFF-SITE OTHER TOTAL			0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Power Sources and Global Emissions Factors for Electricity Provided by
Southen California Edison

Type	% Used*	Water (gal/kWh)		CO2e (lbs/kWh)		NOx (lbs/kWh)		SOx (lbs/kWh)		PM (lbs/kWh)		HAPs (lbs/kWh)		Lead (lbs/kWh)		Mercury (lbs/kWh)		Dioxins (lbs/kWh)	
		Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted	Full Load	Adjusted
Biomass	2%	168	3.36	0	0	0.0015	0.00003	0.00060	0.000012	0.000084	0.00000168	0	0	0	0	0	0	0	0
Coal	8%	0.94	0.0752	2.4	0.192	0.0067	0.000536	0.015	0.0012	0.0017	0.000136	0.0007	0.000056	0.00000024	1.92E-08	0.000000042	3.36E-09	3.8E-13	2.8576E-14
Geothermal	9%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hydro	6%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Natural Gas	50%	0.79	0.395	1.4	0.7	0.0012	0.0006	0.012	0.006	0.000088	0.000044	0.000193	0.0000965	1.31E-08	6.55E-09	2.9E-09	1.45E-09	0	0
Nuclear	21%	0.72	0.1512	0.024	0.00504	0.000056	0.0000118	0.000131	0.00002751	0.0000126	2.646E-06	0.0000053	1.113E-06	5.2E-09	1.092E-09	4.6E-10	9.66E-11	2.9E-15	4.3848E-16
Oil	0%	3.52	0	1.9	0	0.0036	0.0000000	0.0041	0	0.00029	0	0.0000902	0	0.00000129	0	1.01E-08	0	1.04E-12	0
Solar	1%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wind	3%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0%	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total based on kWh at plant	**100%**		**4**		**0.9**		**0.00118**		**0.0072**		**0.000184**		**0.0001536**		**0.00000003**		**5E-09**		**3E-14**
Total based on kWh at point of use (0.12 kWh/kWh lost in transmission)			**4.5**		**1.01**		**0.00132**		**0.0081**		**0.000206**		**0.000172**		**0.00000003**		**6E-09**		**3E-14**

** Based on the following:*
2008 Power Content Label prepared by Southern California Edison.
The above table provides the conversion factors to convert each kWh of electricity from each generation type into each of the environmental parameters.
"Adjusted" refers to adjusting the footprint value by the percentage of electricity from that particular generation type (e.g., the adjusted value for CO2e emitted by nuclear is 10% of the full-load value if the % of electricity generated by nuclear is 10%).

Notes:
*- Water consumption for thermoelectric power plants in U.S. - 0.47 gallons per kWh**
- Water consumption for hydroelectric power assumed to be 0 gallons per kWh (i.e., considers evaporation from reservoir as non-additive)
*- Water consumption for coal resource extraction and fuel processing - 0.16 cubic meters per GJ of extracted energy, and 33% thermal energy conversion to electricity***
*- Water consumption for uranium resource extraction and fuel processing - 0.086 cubic meters per GJ of extracted energy and 33% thermal energy conversion to electricity***
*- Water consumption for natural gas resource extraction and fuel processing - 0.11 cubic meters per GJ of extracted energy and 33% thermal energy conversion to electricity***
*- Water consumption for oil resource extraction and fuel processing - 1.06 cubic meters per GJ of extracted energy and 33% thermal energy conversion to electricity***
*- Water consumption for biomass based on 55 cubic meters per GJ of extracted energy and 33% thermal energy conversion to electricity****
*- CO2e, Nox, SOx, and PM emissions from NREL LCI for each fuel type *****

** Consumptive Water Use for U.S. Power Production, December 2003 • NREL/TP-550-33905*
*** Gleick PH. Water and energy. Annu. Rev. Energy Environ. Vol 19, 1994. p 267-99.*
**** The Water Footprint of Energy Consumption : an Assessment of Water Requirements of Primary Energy Carriers, Winnie Gerbens-Leenes, Arjen Hoekstra, Theo an der Meer, ISESCO Science and Technology Vision, Volume 4 - Number 5, May 2008*
***** "NREL LCI" refers to the U.S. Dept. of Energy, National Renewable Energy Laboratory (NREL), Life-Cycle Inventory Database (www.nrel.gov/lci) maintained by the Alliance for Sustainable Energy, LLC.*