Xtra OIL COMPANY

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ALAMEDA, CA 94501
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RECEIVED

9:22 am, Jan 09, 2012

Alameda County
Environmental Health

December 19, 2011

Ms. Karel Detterman
Alameda County Environmental Health Department
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

SUBJECT: CHEMICAL OXIDATION INJECTION FEASIBILITY TEST WORK PLAN CERTIFICATION
County Case # RO 191
Xtra Oil Company
1701 Park Street
Alameda, CA

Dear Ms. Detterman:

P&D Environmental, Inc. has prepared the following document:

- Chemical Oxidation Injection Feasibility Test Work Plan dated December 19, 2011 (document 0058.W5).

I declare under penalty of perjury that the contents and conclusions in the document are true and correct to the best of my knowledge.

Should you have any questions, please do not hesitate to contact me at (510) 865-9506.

Sincerely,
Xtra Oil Company

Keith Simas

0058.L48

P&D ENVIRONMENTAL, INC.

55 Santa Clara Avenue, Suite 240
Oakland, CA 94610
(510) 658-6916

December 19, 2011
Work Plan 0058.W5

Ms. Karel Detterman
Alameda County Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

SUBJECT: CHEMICAL OXIDATION INJECTION FEASIBILITY TEST WORK PLAN
County Case # RO 191
Xtra Oil Company
1701 Park Street
Alameda, CA

Dear Ms. Detterman:

P&D Environmental, Inc. (P&D) is pleased to present this work plan for a chemical oxidation injection feasibility test to remediate dissolved petroleum hydrocarbons in groundwater at the subject site. This work plan supersedes P&D's April 15, 2011 Groundwater Extraction Feasibility Test Work Plan based on cost considerations associated with previously proposed groundwater and soil vapor extraction remediation for the subject site.

This proposed work will be performed as an interim step for implementation of the Corrective Action Plan (CAP) prepared by P&D dated October 11, 2010 (document 0058.W3). The CAP was approved by the Alameda County Department of Environmental Health (ACDEH) in an e-mail dated February 11, 2011. Although soil vapor extraction and air sparging feasibility were previously evaluated, and groundwater extraction feasibility evaluation was also proposed, this interim step will be performed to evaluate the cost-effectiveness of alternative remedial methods prior to implementation of the CAP.

A Site Vicinity Map showing geologic cross section locations is attached as Figure 1, geologic cross sections are attached as Figures 2 and 3, and a site plan showing proposed pilot test injection locations is attached as Figure 4. All work will be performed under the direct supervision of a California professional geologist.

BACKGROUND

A detailed discussion of the site background, historical monitoring and sampling, and historical investigations are provided in P&D's Remedial Action Work Plan (RAWP) dated October 24, 2007 (document 0058.W2), P&D's Corrective Action Plan (CAP) dated October 11, 2010 (document 0058.W3), and P&D's Site Conceptual Model Report dated October 8, 2010 (document 0058.R10). As an interim step for implementation of the CAP, P&D prepared a Groundwater Extraction Feasibility Work Plan dated April 15, 2011 (document 0058.W4) to verify the feasibility of groundwater extraction at the site with a selected number of wells identified in the RAWP. On May 18 and 19, 2011 P&D oversaw the installation of dual phase

extraction wells EW2, EW4, and EW5 and observation well OW2 at the subject site. The wells were installed in accordance with procedures identified in P&D's October 24, 2007 RAWP and P&D's April 15, 2011 Groundwater Extraction Feasibility Work Plan.

SCOPE OF WORK

The following tasks will be performed.

- Permitting for borehole drilling for chemical oxidizer injection, regulatory agency coordination, Underground Service Alert for buried utility location, and health and safety plan preparation.
- Pre-injection groundwater quality baseline evaluation.
- Oxidizer injection.
- Post-injection groundwater quality monitoring.
- Report preparation.

Each of these is discussed below in detail.

Permitting and Health and Safety Plan Preparation

Following ACDEH approval of this work plan, permits will be obtained from the Alameda County Public Works Agency (ACPWA) for borehole drilling for chemical oxidizer injection at proposed locations P1 through P4 (see Figures 2, 3 and 4). A health and safety plan will be prepared, the proposed drilling locations will be marked with white paint, and Underground Service Alert will be notified for underground utility location. Notification of the scheduled field dates will be provided to ACPWA and the ACDEH prior to performing field work.

Pre-Injection Groundwater Quality Baseline Evaluation

Prior to oxidizer injection, all of the wells at the site (MW1 through MW4, EW2, EW4, EW5, and OW2) will be purged using U.S. EPA low flow purge methods. The discharged water will be monitored in the field using a flow-through chamber and a calibrated Yellow Springs Instruments (YSI) multimeter with for the following parameters: pH, specific conductance, temperature, dissolved oxygen, and oxidation reduction potential (ORP). Samples will be collected from each well directly from the discharge tubing into appropriate containers and stored in a cooler with ice pending delivery to the laboratory. Chain of custody procedures will be observed for all sample handling. All of the samples will be analyzed at McCampbell Analytical, Inc. in Pittsburg California for nitrates, sulfates, dissolved total ferrous iron, methane, Chemical Oxygen Demand (COD) and Biological Oxygen Demand (BOD) in addition to the contaminants of concern (TPH-G, TPH-D, MBTEX and TBA). MBTEX and TBA analysis will be performed using EPA Method 8260B.

Oxidizer Injection

The Regenesis oxidizing product RegenOx will be injected at four locations surrounding well MW2 designated as P1 through P4 (see Figure 4) through the entire length of the treatment zone

(between the depths of 10 and 25 feet below the ground surface (bgs), see Figures 2 and 3). Based on historical water quality data for the site and stoichiometric-based computer modeling, Regenesis has recommended that the Regenox be injected at a rate of 15 pounds per foot in approximately a 5 percent solution (approximately 24 gallons per foot) through the entire length of the treatment zone, at locations that are spaced 10 feet apart. Borehole drilling for oxidizer injection and injection of the oxidizer will be performed by Vironex, Inc. of Concord, California using GeoProbe direct push technology in accordance with RegenOx In Situ Chemical Oxidation Application Instructions (see Appendix A).

During injection the pumping flow rates and any limitations on the volume that can be injected will be evaluated and recorded. The remaining portions of the boreholes will be filled with neat cement grout in accordance with ACPWA requirements.

Although Regenesis has recommended a total of three injection events and the injection of the chemical ORC A, the purpose of the currently proposed injection is limited to a pilot test to evaluate injection feasibility and to quantify associated groundwater dissolved petroleum hydrocarbon concentration changes associated with one injection event.

Post-Injection Groundwater Quality Evaluation

The locations of wells at the subject site relative to well MW2 are as follows.

- Well EW2 is located approximately 25 feet from well MW2 at a location that is approximately downgradient from well MW2 based on the groundwater flow direction obtained from onsite water level data, and that is approximately transgradient relative to well MW2 based on both subject site and nearby Former Exxon 1725 Park Street water level data.
- Wells MW1, EW4 and EW5 are all located approximately 75 to 80 feet from well MW2 at locations that are approximately transgradient relative to MW2 based on subject site water level data, and that are approximately downgradient from well MW2 based on both subject site and nearby Former Exxon 1725 Park Street water level data.
- Wells OW2 and MW4 are located approximately 95 feet from well MW2 at locations that are upgradient relative to MW2 based on subject site water level data, and that are approximately transgradient from well MW2 based on both subject site and nearby Former Exxon 1725 Park Street water level data.
- Well MW3 is located approximately 125 feet from well MW2 and is upgradient of well MW2 based on historical water quality data, and the groundwater flow direction as determined by both subject site water level data and on both subject site and nearby Former Exxon 1725 Park Street water level data.

One week and again one month after Regenesis product injection, wells MW2 and EW2 will be purged, monitored, and sampled as described above for evaluation of baseline water quality conditions, and the remaining wells will be purged and monitored for the parameters described above using the procedures described above for baseline water quality evaluation. Laboratory analysis will be performed as described above for baseline water quality evaluation.

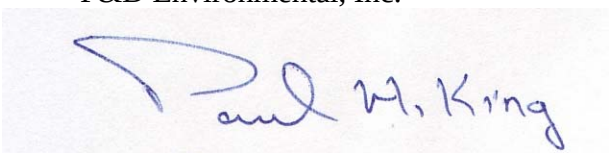
Report Preparation

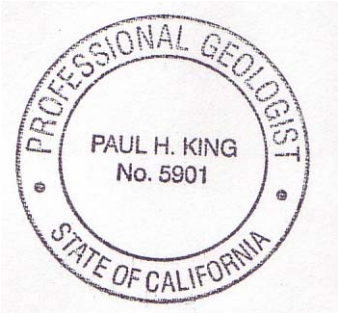
A report will be prepared documenting the baseline water quality evaluation, the injection conditions and observations, and the post-injection water quality data. The report will include maps showing the drilling locations, injection logs, purge data sheets associated with well purging, tables summarizing the laboratory results, analysis of water quality changes associated with the injection feasibility test, and a discussion and recommendations based on the findings.

Should you have any questions or comments, please do not hesitate to contact us at (510) 658-6916.

Sincerely,

P&D Environmental, Inc.





Paul H. King
Professional Geologist #5901
Expires 12/31/11

Attachments:

Figure 1 – Site Vicinity Map Showing Geologic Cross Section Locations and Benzene Concentrations in Groundwater
Figure 2 – Geologic Cross Section A-A' Showing Benzene in Groundwater
Figure 3 – Geologic Cross Section B-B' Showing Benzene in Groundwater
Figure 4 – Site Plan Showing Well and Proposed Pilot Test Injection Locations

Appendix A - RegenOx In Situ Chemical Oxidation Application Instructions

PHK
0058.W5

FIGURES

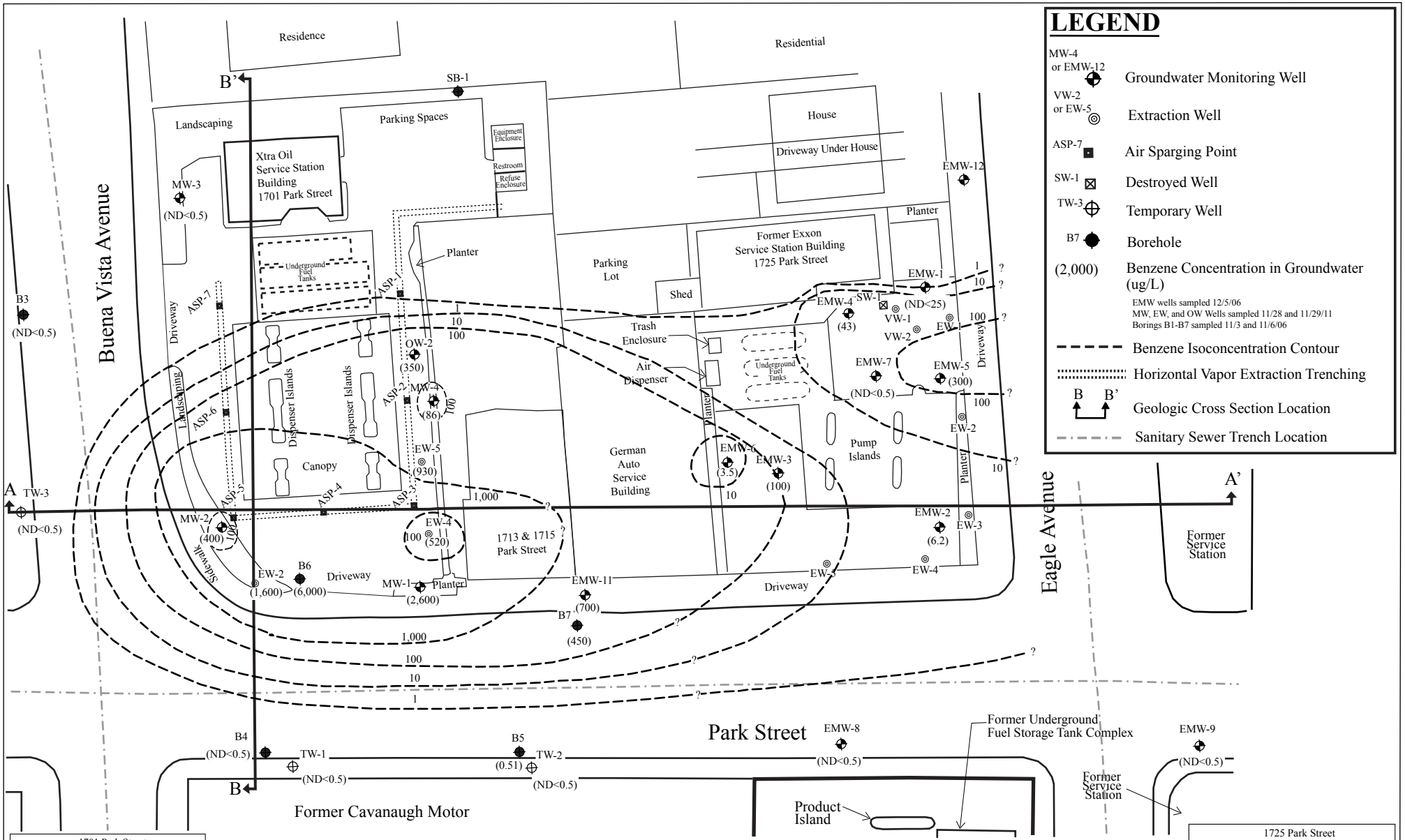


Figure 1
Site Vicinity Map Showing Geologic Cross Section Locations and Benzene Concentrations in Groundwater
3889 Castro Valley Boulevard
Castro Valley, California

Base Map From:
Alisto Engineering Group, 9/23/2005
and Environmental Resources, Inc.,
6/15/2004

P&D Environmental, Inc.
55 Santa Clara Ave., Suite 240
Oakland, CA 94610

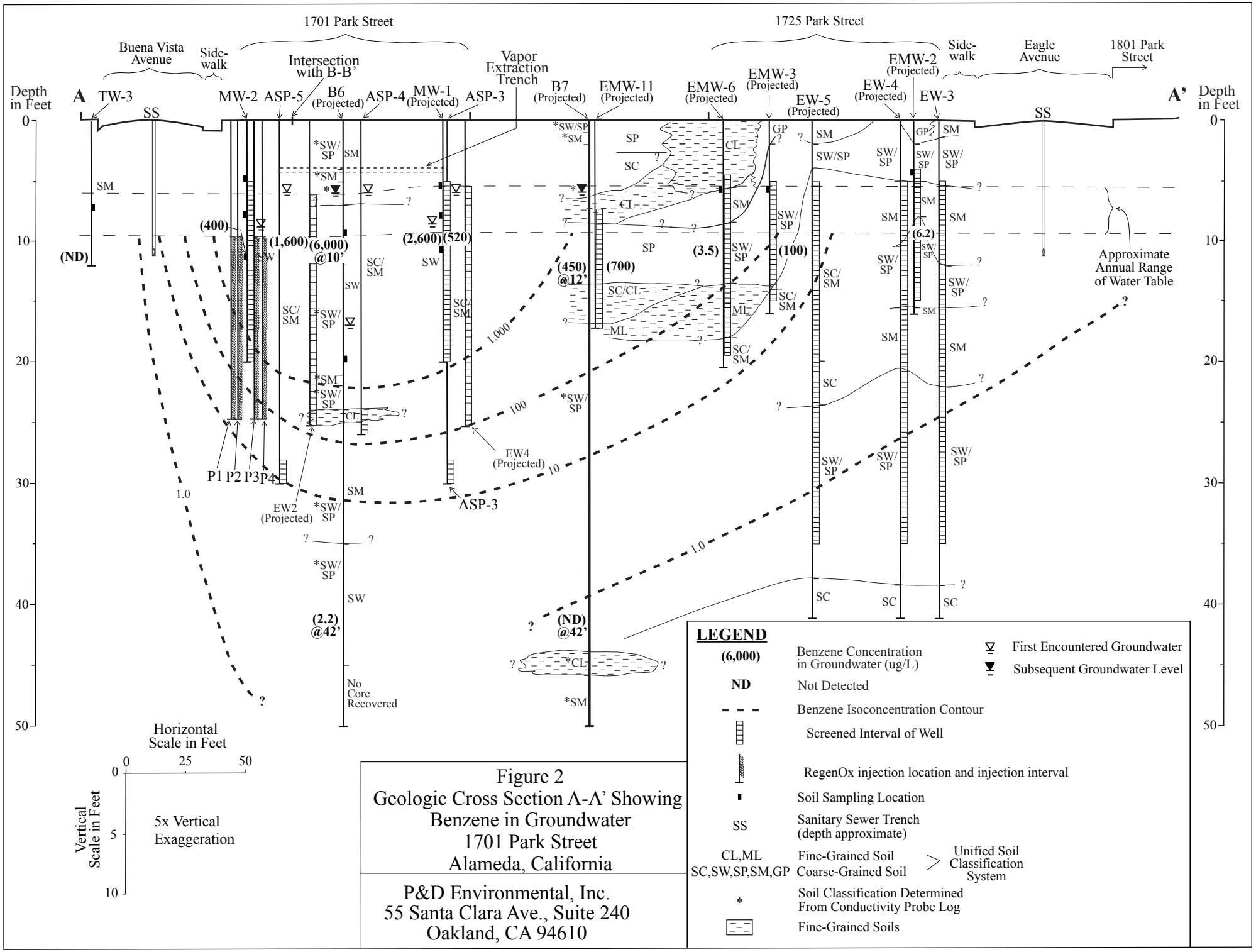


Figure 2
Geologic Cross Section A-A' Showing
Benzene in Groundwater
1701 Park Street
Alameda, California

P&D Environmental, Inc.
55 Santa Clara Ave., Suite 240
Oakland, CA 94610

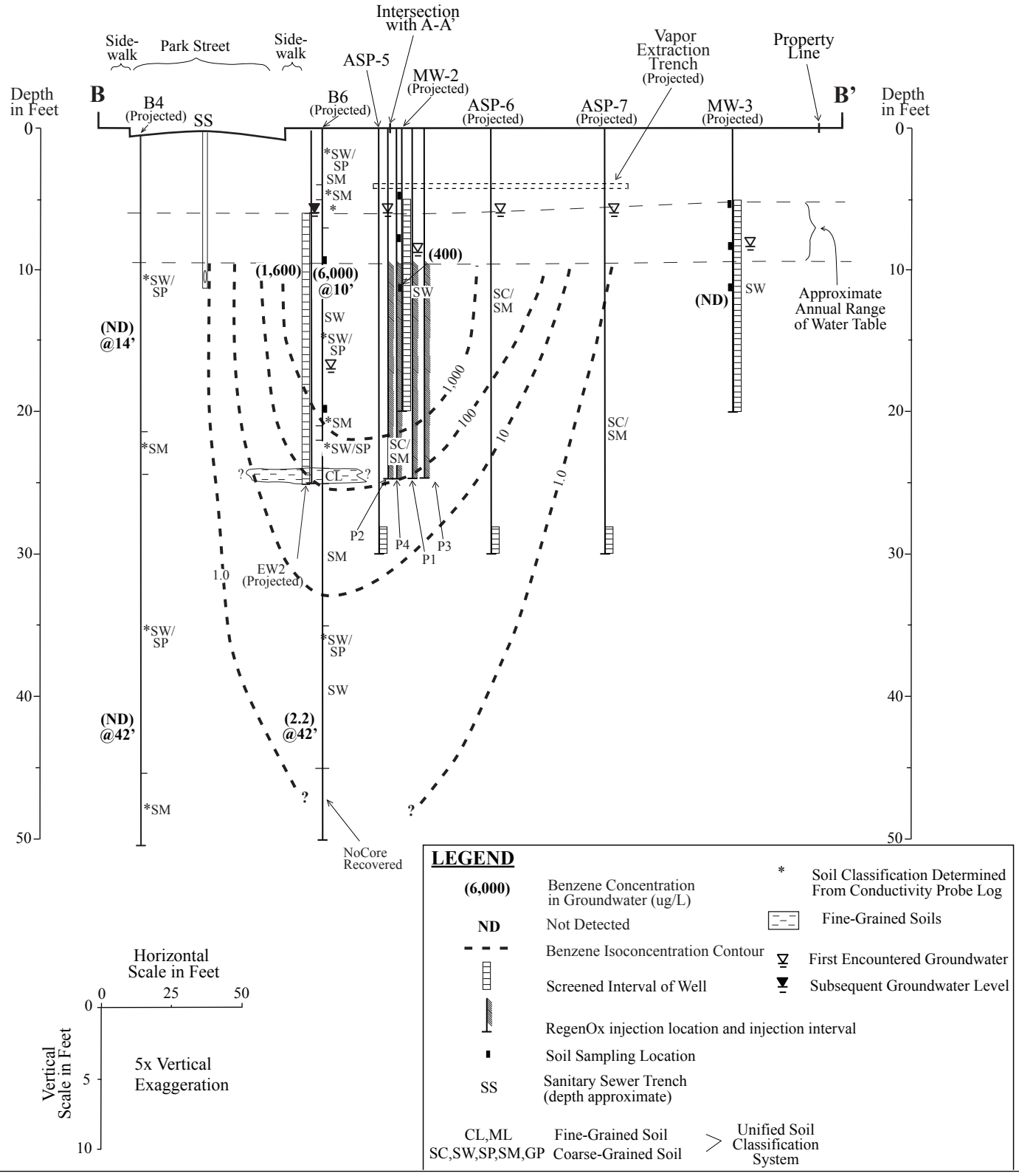


Figure 3
Geologic Cross Section B-B' Showing
Benzene in Groundwater
1701 Park Street
Alameda, California

P&D Environmental, Inc.
55 Santa Clara Ave., Suite 240
Oakland, CA 94610

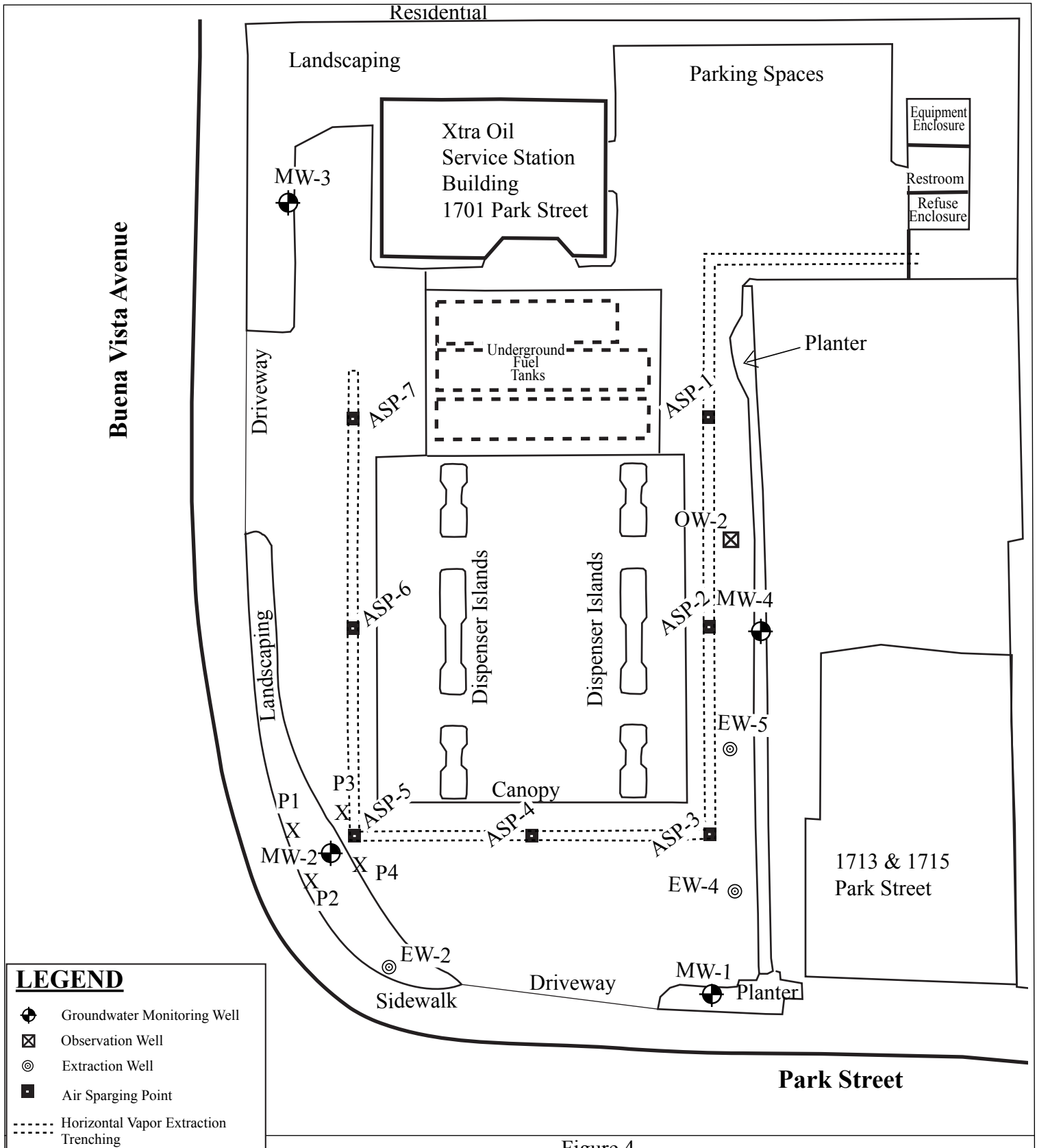


Figure 4
Site Plan Showing Well and Proposed Pilot Test Injection Locations
Xtra Oil Company
1701 Park Street
Alameda, California

Basemap from: Alisto Engineering Group September 2005, and Google Earth October 2009	P&D Environmental, Inc. 55 Santa Clara Ave., Suite 240 Oakland, CA 94610	0 12.5 25 Approximate Scale in Feet N

APPENDIX A

RegenOx In Situ Chemical Oxidation Application Instructions

REGENESIS

RegenOx™

CHEMICAL OXIDATION REDEFINED

RegenOx™ *In Situ* Chemical Oxidation Application Instructions

Using Direct-Push Injection (Step-by-Step Procedures)

RegenOx™ is the new generation of chemical oxidation. RegenOx™ is a proprietary (patent-applied-for) *in situ* chemical oxidation process using a solid oxidant complex (sodium percarbonate/catalytic formulation) and an activator complex (a composition of ferrous salt embedded in a micro-scale catalyst gel). RegenOx™ with its catalytic system has very high activity, capable of treating a very broad range of soil and groundwater contaminants including both petroleum hydrocarbons and chlorinated solvents.

Instructions

1) Prior to the installation of RegenOx™, any surface or overhead impediments should be identified as well as the location of all underground structures. Underground structures include but are not limited to utility lines; tanks; distribution piping; sewers; drains; and landscape irrigation systems. The planned installation locations should be adjusted to account for all impediments and obstacles. These considerations should be part of the SSHP or HASP.

2) Pre-mark the installation locations, noting any points that may have different vertical application requirements or total depth.

3) Set up the direct push unit over each point and follow the manufacturer standard operating procedures (SOP) for the direct push equipment. Care should be taken to assure that probe holes remain in the vertical.

4) For most applications, Regenesis suggests using 1.5-inch O.D./0.625-inch I.D drive rods. However, some applications may require the use of 2.125-inch O.D./1.5-inch I.D. or larger drive rods.

5) Advance drive rods through the surface pavement, as necessary, following SOP.

6) Push the drive rod assembly with an expendable tip to the desired maximum depth. Regenesis suggests pre-counting the number of drive rods needed to reach depth prior to starting injection activities.

7) After the drive rods have been pushed to the desired depth, the rod assembly should be withdrawn three to six inches. Then the expendable tip can be dropped from the drive rods, following SOP. If an injection tool was used instead of an expendable tip, the application of material can take place without any preliminary withdrawal of the rods.

8) In some cases, introduction of a large column of air prior to RegenOx™ application may be problematic because the air can block water flow to the treatment area. This is particularly the case in deep injections (>50 ft) with large diameter rods (>1.5-inch O.D.). To prevent the injection of air into the aquifer during RegenOx™ application, as well as to prevent problems associated with heaving sands, fill the drive rods with water, or the RegenOx™ mixture prior dropping the expendable tip or exposing the injection tool.

9) The RegenOx™ percent of the oxidizer in solution should range between 3% to 5%. Although solutions up to 8% may be used, this will likely increase the difficulty of injection due to reactivity. Solutions with greater than 8% oxidizer in solution will result in excess reaction and flocculation prior to injection and are not typically recommended

   Measure the appropriate quantity of RegenOx™ Oxidizer for one to four vertical foot of injection into a 55 gallon drum or mixing tank. The volume of water per injection location can be calculated from the following formula:

$$\frac{\text{RegenOx Oxidizer lbs/foot}}{(8.34\ \text{lbs/gal water})(\%\ \text{R}egenOx\_Oxidizer\ \text{solids})}\left[1-(\%\ \text{R}egenOx\_Oxidizer\ \text{solids})\right]$$

   Tighter formations (clays and silts), and even some fine sand formations will likely require higher oxidant percentages since less volume can be injected per location. The following are guides to various RegenOx™ mixing ratios based on the above equation.

   - to make a roughly 3% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 38 gallons of water.
   - to make a roughly 4% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 28 gallons of water.
   - to make a roughly 5% oxidant solution for every 10 lbs of oxidant and 10 lbs of activator (20 lbs total RegenOx™), use 22 gallons of water.

10) Pour the pre-measured quantity of RegenOx™ Oxidizer into the pre-measured volume of water to make the desired target % oxidant in solution. NOTE: always pour the Oxidizer into water, do not pour water into the Oxidizer. Mix the water and oxidant with a power drill and paint stirrer or other mechanical mixing device to ensure that the Oxidizer has dissolved in the water.

11) Pour the applicable quantity of the pre-mixed RegenOx™ Activator into the oxidant:water solution. Mix the Oxidant and Activator using a power drill paint stirrer or other mechanical mixing device for at least 5 minutes until a homogenous mixture is formed. After mixing the RegenOx™ mixture should be injected into the subsurface as soon as possible.

12) Do not mix more RegenOx™ material than will be used over roughly 1 to 4 feet of injection so as to minimize potential above ground reaction/flocculation prior to injection.

    Transfer the contents of the mixing tank to the pump using gravity feed or appropriate transfer pump. (See Section 9.2: Pump Selection) For some types of pumps, it may be desirable to perform a volume check prior to injecting RegenOx™

13) Connect the delivery hose to the pump outlet and the delivery sub-assembly. Circulate RegenOx™ though the hose and the delivery sub-assembly to displace air in the hose. NOTE: an appropriately sized pressure gauge should be placed between the pump outlet and the delivery sub-assembly in order to monitor application pump pressure and detect changes in aquifer backpressures during application.

14) Connect the sub-assembly to the drive rod. After confirming that all of the connections are secure, pump the RegenOx™ through the delivery system to displace the water/fluid in the rods.

15) Slowly withdraw the drive rods. Commonly RegenOx™ injection progress at 1-foot intervals. However, continuous injection while slowly withdrawing single lengths of drive rod (3 or 4 feet) is an acceptable option. The pre-determined volume of RegenOx™ should be pumped into the aquifer across the desired treatment interval.

16) Remove one section of the drive rod. The drive rod may contain some residual RegenOx™. Place the RegenOx™-filled rod in a clean, empty bucket and allow the RegenOx to drain. Eventually, the RegenOx™ should be returned to the RegenOx™ pump hopper for reuse.

17) Monitor for any indications of aquifer refusal. This is typically indicated by a spike in pressure as indicated or (in the case of shallow applications) RegenOx™ "surfacing" around the injection rods or previously installed injection points. At times backpressure caused by reaction off-gassing will impede the pumps delivery volume. This can be corrected by bleeding the pressure off using a pressure relief/bypass valve (placed inline between the pump discharge and the delivery sub-assembly) and then resume pumping. If aquifer acceptance appears to be low, as indicated by high back pressure, allow sufficient time for the aquifer to equilibrate prior to removing the drive rod.

18) Repeat steps 13 through 23 until treatment of the entire contaminated vertical zone has been achieved. It is recommended that the procedure extend to the top of the capillary fringe/smear zone, or to the top of the targeted treatment interval.

19) Install an appropriate seal, such as bentonite, above the RegenOx™ material through the entire vadose zone. Prior to emplacing the borehole seal, we recommend placing clean sand in the hole to the top of the RegenOx™ treatment zone (especially important in holes that stay open). Bentonite chips or granular bentonite should be placed immediately above the treatment zone, followed by a cement/bentonite grout to roughly 0.5 feet below ground surface. Quick-set concrete should then be used as a surface seal.

20) Remove and clean the drive rods as necessary.

21) Finish the borehole at the surface as appropriate (concrete or asphalt cap, as needed). We recommend a quick set concrete to provide a good surface seal with minimal set up time.

22) A proper borehole and surface seal assures that the RegenOx™ remains properly placed and prevents contaminant migration from the subsurface. Each borehole should be sealed immediately following RegenOx™ application to minimize RegenOx™ surfacing during the injection process. If RegenOx™ continues to "surface" up the direct push borehole, an appropriately sized (oversized) disposable drive tip or wood plug/stake can be used to plug the hole until the aquifer pressures equilibrates and the RegenOx™ stops surfacing. If wells are used for RegenOx™ injection the RegenOx™ injection wells and all nearby groundwater monitoring wells should be tightly capped to reduce potential for surfacing through nearby wells.

23) Periodically compare the pre- and post-injection volumes of RegenOx™ in the holding tank or pump hopper using the pre-marked volume levels. Volume level may not be present on all tanks or pump hoppers. In this case, volume level markings can be temporarily added using known amounts of water and a carpenter's grease pencil (Kiel crayon).

24) Move to the next probe point, repeating steps 8 through 29. We recommend that the next RegenOx™ injection point be as far a distance as possible within the treatment zone from the previous RegenOx™ injection point. This will further minimize RegenOx™ surfacing and short circuiting up an adjacent borehole. When possible, due to the high volumes of liquid being injected, working from the outside of the injection area towards the center will limit expansion of the plume.

REGENESIS

Pump Selection

Regenesis has evaluated a number of pumps and many are capable of delivering RegenOx™ to the subsurface at a sufficient pressure and volumetric rate. However, even though a number of the evaluated pumps may be capable of delivering the RegenOx™ to the subsurface based on adequate pressures and delivery rates, each pump has its own set of practical issues that may make it more or less difficult to manage in a field setting.

In general, Regenesis strongly recommends using a pump with a pressure rating of 200 pounds per square inch (psi) in sandy soil settings, and 800 psi in silt, clay or weathered bedrock settings. Any pump under consideration should have a minimum delivery rate of 5 gallons per minute (gpm). A lower gpm rated pump may be used; however, they are not recommended due to the amount of time required to inject the volume of liquids typically associated with a RegenOx™ injection (i.e. 1,000 lbs of RegenOx™ [500 lbs Oxidant/500 lbs Activator] require roughly 1,100 gallons of water to make a 5% Oxidant solution).

Quite often diaphragm pumps are used for the delivery of chemical oxidants. Generally, these pumps operate pressures from 50-150 psi. Some of these pumps do not have the pressure head necessary to overcome the back pressure encountered in silt and clay lenses. In these cases the chemical oxidant thus ends up being delivered to the surrounding sands (the path of least resistance) and is not delivered to soil with residual adsorbed contamination. The use of a positive displacement pump such as a piston pump or a progressing cavity pump is may be superior because these pumps have the pressure necessary to overcome the resistance of low permeability soils. NOTE: be aware that application at pressures that are too high may over-consolidate the soil and minimize the direct contact of the oxidant. The key is to inject at a rate and pressure that maximizes the radius of influence without causing preferential flow. This can be achieved by injecting at the minimum pressure necessary to overcome the particular pressures associated with your site soil conditions.

Whether direct injection or wells are used, it is best to start by injecting RegenOx™ outside the contaminated area and spiral laterally inwards toward the source. Similarly, RegenOx™ should be applied starting vertically at the bottom elevation of contamination, through the layer of contamination, and a couple of feet above the layer of contamination. The reagents can be pushed out from the well bore with some water.

Pump Cleaning

For best results, flush all moving parts and hoses with clean water at the end of the day; flush the injection system with a mixture of water and biodegradable cleaner such as Simple Green.

For more information or technical assistance please call Regenesis at 949-366-8000