ENVIRONMENTAL RISK SPECIALTIES
CORPORATION

ers

May 11, 2009

Mr. Jerry Wickham, Hazardous Materials Specialist
Alameda County Environmental Health Services
Environmental Protection Division
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

RE: Interim Remedial Action Work Plan
Eagle Gas Station
4301 San Leandro Street
Oakland, California 94601

LOP StID# 2118
ACEH Case No. RO0000096
USTCF Claim No. 014551

Dear Mr. Wickham:

Thank you very much for the April 24, 2009 letter that provides your review comments and concurrence for Environmental Risk Specialties Corporation's (ERS') request for modifying the quarterly groundwater monitoring program. ERS has prepared an *Interim Remedial Action Work Plan* for the Eagle Gas Station and included herein for your review and concurrence.

Data of approximately 10 years of groundwater sampling suggests that the level of subsurface contamination under the subject site has not been significantly reduced. It suggests that residual contaminant source remains on site and natural attenuation is not an effective remedy. To reduce the potential stress of off-site contaminants migration, Mr. Muhammad Jamil and ERS concurred to apply an interim remedial action as soon as possible prior to the initiation of a full-scale site cleanup. Although the former consultant, Clearwater Group, proposed in January 2009 to use a slanted trench, which replaces the vertical well included in its July 2008 investigation work plan, to conduct a dual phase extraction pilot test at one selected location, ERS conversely proposed to conduct an interim remediation action together with a site-wide pilot test. This approach will quickly reduce contaminants in the source area and generate more reliable information for the selection of a final remedy, as well as provide data for the

design of a full-scale remedial system. Mr. Muhammad Jamil and ERS believe that sufficient site characterization data is available and this approach will be more cost-efficient.

Your assistance on this site closure project is very appreciated. Please do not hesitate to contact the undersigned should you have questions for the *Interim remedial Action Work Plan*.

Sincerely,
ERS

Jim Ho, Ph.D., P.E.
Principal Engineer

cc: Ms. Farah Naz and Mr. Muhammad Jamil

Mr. Jerry Wickham
Hazardous Materials Specialist

Alameda County Health Care Services Agency
Environmental Health Services
Environmental Protection
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502

RE: Eagle Gas Station
4301 San Leandro Street
Oakland, California 94601

LOP StID# 2118
Fuel Leak Case No. RO0000096
USTCF Claim No. 014551

Dear Mr. Wickham,

As the legally authorized representative of the above-referenced project location, I have reviewed the document entitled *"Interim Remedial Action Work Plan"*, prepared by Environmental Risk Specialties Corporation (ERS), of Walnut Creek, California. I declare, under penalty of perjury, that the information and/or recommendations contained in this document or report are true and correct to the best of my knowledge.

Sincerely,

Muhammad Jamil 5-7-09

Mr. Muhammad Jamil

Interim Remedial Action Work Plan

Eagle Gas
4301 San Leandro Street
Oakland, California 94601

LOP StID# 2118
Fuel Leak Case No. RO0000096
USTCF Claim No. 014551

Prepared for:

Ms. Farah Naz
Mr. Muhammad Jamil

Prepared by:

Environmental Risk Specialties Corporation
Walnut Creek, California

May 2009

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EXECUTIVE SUMMARY

On behalf of Ms. Farah Naz and Mr. Muhammad Jamil, Environmental Risk Specialties Corporation (ERS) has prepared an I*nterim Remedial Action Work Plan* for the Eagle Gas Station. Prior to the preparation of this Work Plan, all groundwater monitoring reports between 2000 and 2009, site investigation reports, bench test/feasibility study reports, and review comment letters/correspondence between the Alameda County Environmental Health (ACEH) and the responsible party/Clearwater Group (former consultant of the responsible party), were reviewed.

Groundwater, subsurface lithology, and contaminant impact under the Eagle Gas Station has been monitored/investigated since 2000. Contaminants of concern and lateral/vertical distribution of contaminants in soil/groundwater under the subject site have been sufficiently characterized. In addition to the elevated concentrations of Total Petroleum Hydrocarbons as gasoline, Total Petroleum Hydrocarbons as diesel, and benzene, extremely high concentrations of Methyl Tertiary Butyl Ether, and Tert-Butyl Alcohol have been detected in the shallow groundwater (Zone A). The groundwater in the deep zone (Zone B) has not been significantly impacted. Since 1999, after the removal of the former underground storage tanks, interim remediation has been frequently recommended and requested by the ACEH. Although a number of cleanup methods/remediation technologies have been proposed and tested (in bench scale) by the former consultant, interim remediation has never been performed at the subject site. In order to support an interim remedial action, Clearwater Group submitted a *2008 Soil and Groundwater Investigation Work Plan* in July 2008 and a *Proposed Modifications to Work Plan* in January 2009. These documents have been reviewed and commented on by the ACEH in the September 4, 2008 and April 24, 2009 letters. High Vacuum Dual Phase Extraction (HVDPE) apparently is the technology considered most applicable and effective under the current site conditions.

As opposed to conducting a 5-day pilot test by using the single slanted extraction trench proposed in the document of *Proposed Modifications to Work Plan* submitted by Clearwater Group, ERS proposed to conduct a combined 30-day interim remedial action and a pilot test using a truck-mounted HVDPE unit. Based on the developed and validated Site Conceptual Model, as well as the Fourth Quarter 2008 groundwater sampling data, a system of interim remedial action DPE wells, that includes 12 four-inch diameter DPE wells (D1 through D12) and one existing 4-inch diameter groundwater extraction well (EW-1), have been designed to meet the current needs and to accomplish the objectives of interim remedial action/pilot testing. The proposed DPE well system is shown in Figures 5 through 7 of this work plan.

Based on the results/performance of the proposed 30-day interim remedial action and the pilot test data, the proposed system of interim remedial action DPE wells can be upgraded, and the remediation method can be modified, if needed. A fix-based remedial system can also be designed and installed after the preparation of a Corrective Action Plan.

1. INTRODUCTION

On behalf of Ms. Farah Naz and Mr. Muhammad Jamil, Environmental Risk Specialties Corporation (ERS) has prepared this *Interim Remedial Action Work Plan* (work plan) for the Eagle Gas Station located at 4301 San Leandro Street, Oakland, California. This work plan contains the following sections:

- Section 1 – Introduction
- Section 2 – Background
- Section 3 – Objectives of Interim Remedial Action
- Section 4 – Design of Interim Remedial Action
- Section 5 – Scope of Work
- Section 6 – Schedule
- Section 7 – References
- Section 8 – Report Distribution List

1.1 Initiation of Interim Remedial Action

On April 21 and 22, 1999, two 6,000-gallon gasoline tanks, two 4,000-gallon diesel tanks, and one 300-gallon waste oil tank were removed from the station. During the Underground Storage Tank (UST) removal, strong petroleum odors were detected from the soil near the UST pit. Five confirmation soil samples collected from the walls of the UST pit suggested that an unauthorized release of petroleum had occurred. At the request of the Alameda County Environmental Health (ACEH), in a letter dated May 10, 1999, approximately 800 tons of petroleum-impacted soil was over-excavated and approximately 1,000 gallons of impacted groundwater was pumped in May 1999. Confirmation sampling after soil excavation detected extremely high concentrations of Methyl Tertiary Butyl Ether (MTBE) in groundwater. Thus, ACEH requested site investigation in the August 13, 1999 letter, as well as MTBE remediation in the letter dated August 23, 1999. Following ACEH's request in the August 13, 1999 letter, three monitoring wells, MW-1 through MW-3, were installed on September 26, 2000. The first groundwater monitoring event began in October 2000, and the first interim remedial action plan for MTBE remediation, using hydrogen peroxide, was proposed by Artesian Environmental (now Clearwater Group) of Point Richmond, California (Artesian Environmental, 1999a; 1999b).

2. BACKGROUND

2.1 Site Description

Eagle Gas Station (the Site) is set in a mixed residential and commercial area located in the southern portion of the City of Oakland, Alameda County, California, approximately 1,100 feet northeast of Interstate Highway 880 and at the southern corner of the intersection of San Leandro Street and High Street (Figure 1). The site is an active gasoline service station and is bounded by commercial properties to the southeast and southwest, by High Street to the northwest, and San Leandro Street to the northeast. The Site Plan, with on-site well locations, is shown in Figure 2.

2.2 Review of Groundwater Monitoring and Site Investigation Reports

Since the identification of the unauthorized release of petroleum hydrocarbons, the site has been under oversight by the ACEH for the required soil/groundwater investigation and remediation (see ACEH's May 10, 1999 letter). Five groundwater monitoring events were conducted between October 2000 and August 2001. Quarterly groundwater monitoring has been performed since the third quarter 2003 (3Q03) until 4Q08. For approximately 10 years since the removal of USTs in April 1999 and the discovery of subsurface contamination, elevated concentrations of Total Petroleum Hydrocarbons as gasoline (TPH-g), Total Petroleum Hydrocarbons as diesel (TPH-d), benzene, MTBE, and Tert-Butyl Alcohol (TBA) remain in groundwater under the Site. Based on the trends of concentration change observed in wells MW-1 through MW-8, presented in Appendix H of the 4Q08 report (Clearwater, 2009b), concentrations of MTBE, TPH-g, and benzene are mostly decreasing. Conversely, the concentration trend of TBA is either increasing or stabilized. It should be noted that the concentrations of MTBE, TPH-g, and benzene are relatively stable in wells MW-4 and MW-7, located downgradient of the shallow zone groundwater, or cross-gradient of the former excavation tank pit area. This observation suggests that a significant contaminant source in soil, or separate phase hydrocarbon/free product, may still exist (Note: Free product was identified in wells IS-5 and MW-8 during the 2007 Investigation). Additionally, the concentration of TPH-g in well MW-8 is also increasing. Since no groundwater monitoring was performed in 2002, the eight years of groundwater sampling data between 2000 and 2008 clearly indicates that shallow groundwater has been greatly impacted.

In addition to the eight years of groundwater monitoring that characterized contaminants of concern, the lateral/vertical extent of contamination, and local groundwater direction, two major soil/groundwater investigations have been conducted. The 2006 Investigation focused on the on-site source area (Clearwater, 2006a) and the 2007 Investigation focused on the delineation of off-site contamination and boundary (Clearwater, 2007). The investigation results are summarized in Sections 2.2.1 and 2.2.2.

In addition to the 2006 and 2007 investigations, an additional 2008 Investigation was proposed by Clearwater Group. The 2008 Investigation Work Plan (Clearwater, 2008) includes six tasks, of which only the task of installing off-site wells (MW-9, MW-9D, MW-10, and MW-10D) and an on-site well (MW11D) (Clearwater, 2009a), and the task of eliminating wells (MW-6, IS-1, IS-2, IS-3, IS-6, and EW-1) from the quarterly groundwater monitoring program (Clearwater, 2009b), have been completed. The task of conducting an off-site Gore-Sorber soil vapor survey was not accepted by ACEH in the September 4, 2008 letter. The tasks of conducting a High Vacuum Dual Phase Extraction (HVDPE) pilot test and the identification of a groundwater discharge point near 42nd Avenue, as well as repairing the sewer line leaks, have not been performed. In response to ACEH's comments included in the September 4, 2008 letter to the 2008 investigation work plan, Clearwater Group proposed to modify the design of the HVDPE pilot test and to add two additional tasks (Clearwater, 2009c).

A summary of key documents and ACEH's review comments or letters is presented in Appendix A. All the documents submitted by Clearwater Group related to site investigations, bench tests, feasibility study, and interim remedial action plans are included in Appendix B in chronological order.

2.2.1 2006 Investigation Results

Subsequent to ACEH's August 13, 1999 letter that requested site investigation, and the August 23, 1999 letter that requested MTBE remediation, in a letter dated May 26, 2005 ACEH again requested a soil and groundwater investigation and an interim remedial action, in addition to a Corrective Action Plan (CAP) for the subject site. Following the submission of the *Soil and Groundwater Investigation Workplan* (Clearwater, 2005a) and ACEH's review comments included in Appendix A, the 2006 investigation was performed during December 6 through 9, 2005 and March 29 through April 2, 2006. Results and findings of the 2006 on-site soil and groundwater investigation are summarized below (Clearwater, 2006a):

- The subsurface lithology is heterogeneous and is characterized by low permeability clays with occasional moderate or higher permeability lenses.
- A relatively continuous clayey gravel layer, having a thickness of approximately 5 to 15 feet, exists in the shallow zone.
- Below the relatively continuous and more permeable clayey gravel layer is another clayey layer approximately 20 to 30 feet thick. Below this thick clayey layer is another sandy/silt layer. The thickness of this sandy/silty layer has not been determined.
- Groundwater elevations are higher in the shallow-zone relative to the deep-zone by an average of approximately 7.5 feet. Downward gradient exists.
- Contaminants of concern (COC) at the site are MTBE, TBA, and TPH-g.

- The TPH-g concentration is generally less than the concentrations of MTBE and TBA. The MTBE concentration in the shallow zone is generally greater than 10,000 μg/L. A large portion of the shallow zone had TPH-g concentrations greater than 10,000 μg/L. Overall, the benzene concentration in the shallow zone is greater than 100 μg/L.

- Groundwater in the shallow zone (depth interval of 25 feet bgs or less) is heavily impacted. The major axis of the hydrocarbon plume and the MTBE plume trend along the north-south direction. The center of both plumes is near wells MW-4, EW-1, IS-3, and IS-5. The TBA plume in the shallow zone is dissimilar to the hydrocarbon and MTBE plumes. The center of the TBA plume is near wells IS-4, IS-6, MW-5, and MW-4.

- The TPH-g/MTBE distribution in the shallow zone soil is very similar to the associated shallow groundwater plumes.

- Since a clayey gravel layer with higher permeability exists in the shallow zone, and the shallow groundwater has been greatly impacted, the potential of off-site migration of contaminated groundwater is high.

- Groundwater in deep zone has not been impacted.

2.2.2 2007 Investigation Results

After ACEH's review of the 2006 investigation results, a number of additional tasks, such as the identification of steep hydraulic gradient, search of UST, study of vapor intrusion into on-site and off-site buildings, were proposed (see Appendix A). One of ACEH's major comments was to delineate the plume in the downgradient regional flow direction, along preferential pathways, and in the direction of potential discharge to Peralta (Adams) Creek. Thus, following the submission of the *Additional Subsurface Investigation Work Plan* (Clearwater, 2006b) and the *Revised Work Plan* (Clearwater, 2006c), and the inclusion of ACEH's review comments for these two work plans (see Appendix A), the 2007 soil/groundwater investigation was performed between June and October 2007. Purposes of the 2007 Investigation were:

- To further define the on-site lithology and hydrology and perform an initial characterization of the off-site lithology and hydrology.

- To determine if off-site soil and groundwater contamination originated from the Site.

- To further delineate the vertical and lateral extent of the soil and groundwater contamination.

Many tasks were included in the 2007 investigation. Details of all the tasks are described in the 2007 investigation report (Clearwater, 2007). Results and findings of the 2007 soil and groundwater investigation are summarized below (Clearwater, 2007):

- The site lithology consists primarily of interbeded clayey sediments (lean clays to fat clays, and sandy clays) of low permeability, with thin interbeds of relatively more permeable clayey sands and clayey gravels, typical of alluvial deposits.

- Zone A (shallow zone) extends from the ground surface to a depth of approximately 25 to 30 feet bgs. Zone A consists primarily of clays with discontinuous, or possibly meandering, layers of clay gravel. Zone B (deep zone) extends from approximately 25 to 30 feet bgs to at least 58 feet bgs, the deepest depth explored. The lithology of Zone B is primarily sands (poorly graded sand, well graded sand, and silty sand) with thin interbeds of lean clay. The top of Zone B appears to be the hard layer where several of the Geoprobe borings (SB-9, SB-10, and SB-12) met refusal.

- Downward gradient exists between the shallow and deep zones. Downward transport of contaminants may have been restricted by clayey soil, which acts as an aquitard. As a result, groundwater within the deep zone is relatively less contaminated than that within the shallow zone.

- Groundwater mound occurs in 2006 and 2007 investigations.

- No leak has been found in the water line. Two leaks were detected in the sewer lateral line near well IS-1.

- The soil and grab groundwater analytical results indicate that the shallow zone is highly contaminated on site, as well as off site to the south, southwest, and in the general direction of High Street.

- The deep zone is relatively less contaminated than the shallow zone, but the deep zone groundwater is contaminated at off-site borings SB-18 (14,000 µg/L MTBE and 33,000 µg/L TBA at 40 feet bgs) and SB-13 (TPH-g 23,000 µg/L at 52 feet bgs).

- The off-site plume of contamination has yet to be delineated, in the horizontal direction, to the MTBE Environmental Screening Limits. The extent of soil and groundwater contamination has yet to be defined to the non-detectable concentration in the vertical direction.

- Historical groundwater depth data indicates that the depths (10 feet bgs) of the top of screen of shallow wells are normally below the water table. The high concentration of MTBE in the shallow groundwater (observed over eight years of monitoring) could be the result of free product floating on top of the groundwater. Liquid product was observed in the bailers used to purge groundwater from wells IS-5 and MW-8.

- The six on-site soil vapor wells (VP-1 through VP-6) were sampled at depths of 3, 6, and 9 feet bgs. In general, the soil vapor contamination concentration maps showed that the

greatest concentrations occurred near the center of the site (Note: A sample was not collected from VP-1 at 9-feet because this sample point was below the groundwater).

2.3 Site-specific Site Conceptual Model

A Site Conceptual Model (SCM) for the Eagle Gas Station has been developed based on the site characterization/investigation data. It has been developed, updated and validated through the following efforts:

- An initial SCM was proposed in the 2006 Investigation Work Plan dated August 10, 2005.
- An updated SCM was presented in the 2006 Investigation Report dated May 30 2006.
- The SCM was again updated and verified using the data presented in 2007 Investigation Report dated December 5, 2007.

The developed SCM contains the following major characteristics:

1. Local lithology and groundwater are represented by Zone A (shallow zone) and Zone B (deep zone). Zone A extends from the ground surface to a depth of approximately 25 to 30 feet bgs. Zone B is the zone extending from approximately 25 to 30 feet bgs to at least 58 feet bgs. Lithology of Zone A is predominately clayey soil with discontinuous, or possibly meandering, lenses of clayey sands and clayey gravels. Zone B is primarily constituted of sands (clean sand and silty sand) with thin interbeds of clay. The top of Zone B appears to be a hard, impermeable layer.

2. Groundwater flow in Zone A appears separate from the groundwater flow in Zone B. Groundwater flow directions in Zone A and Zone B are different. A groundwater mound exists under the site in Zone A, with steep gradient to the northwest, northeast, southwest, and southeast. Groundwater gradient in Zone B is relatively flat. The 1Q09 monitoring data indicates that groundwater flow in Zone B diverges off-site from well MW-1D, with the highest gradient in the east direction.

3. Although a downward gradient exists between the upper Zone A and the lower Zone B, downward transport of contaminant may have been restricted by the clayey soil and the hard layer located on top of Zone B.

4. The upper Zone A is highly contaminated on site, as well as off site to the south, southwest, and in the general direction along High Street. The groundwater within Zone B is relatively less contaminated than that within Zone A.

5. The high concentrations of MTBE observed over eight years of monitoring in the shallow groundwater may be the result of free product MTBE floating on top of the groundwater.

6. No major ecological receptors, such as surface water bodies, homes with basements, and domestic drinking water wells, exist within a 2,000-foot range of the site that could likely be impacted by the site contamination (Clearwater, 2001; 2008).

The developed site-specific SCM has been used to assist in the design of the interim remedial action proposed in this work plan. It will also be used for the development of future remedial alternatives for the subject.

2.4 Previously Proposed Interim Remedial Actions

Since the discovery of extremely high concentrations of MTBE under the site in 1999, and the confirmation of groundwater impact in the shallow groundwater zone, interim remedial actions have been frequently proposed, updated, and reviewed by Clearwater Group and ACEH.

Artesian Environmental (formerly Clearwater Group) submitted a work plan on September 10, 1999, which proposed to conduct a soil remediation pilot study using chemical oxidation of peroxide. Since ACEH had previously indicated that much of the site cleanup should be performed prior to the installation of a new UST system, ACEH's August 23 and September 15, 1999 letters concurred with the approach of a soil remediation pilot study using chemical oxidation of peroxide. To cleanup the petroleum hydrocarbon compounds and MTBE, a second Interim Remedial Action Plan (IRAP) focused on the use of enhanced biological technology with a pure oxygen infusion system (iSOC) was submitted by Clearwater Group on January 14, 2004. Clearwater Group proposed a 3rd IRAP on June 13, 2005, that recommended the use of groundwater extraction and enhanced biological method with pure oxygen diffusers (iSOC) to clean up the site.

Below is a summary of all of the proposed Interim Remedial Actions (IRAs), which show the progression of proposed remediation methods for the subject site:

- 1st IRA proposed (September 1999) to use peroxide to remediate MTBE.

- 2nd IRA proposed (January 2004) to apply enhanced biological method using oxygen diffusers (iSOC).

- 3rd IRA proposed in June 2005 (Clearwater, 2005b) and in the *Soil and Groundwater Investigation Workplan* (Clearwater, 2005a) to use groundwater extraction and iSOC simultaneously.

- 4th IRA proposed in the *Additional Subsurface Investigation Work Plan* (Clearwater, 2006b) to use HVDPE and iSOC.

- 5th IRA proposed in the *Revised Work Plan* (Clearwater, 2006c) recommends the application of bioremediation, HVDPE, and in-situ chemical oxidation with persulfate.

- 6th IRA proposed to conduct HVDPE pilot test in the *2008 Soil and Groundwater Investigation Work Plan* (Clearwater, 2008) and the *Proposed Modifications to Work Plan* (Clearwater, 2009c)

It should be noted that the technology of HVDPE has been proposed in the 4th, 5th, and 6th IRAs. Documents and correspondence associated with all of the IRAs are included in Appendix A.

2.5 Available Bench Tests and Feasibility Study Results

A number of pilot tests and a feasibility study have been conducted to assist in the development of IRAs. The test/study results are summarized below:

- *Bench Test for Using Advanced Oxidation – A Summary Report* dated March 27, 2006, indicates that ozone is ineffective to treat MTBE and TBA under existing concentrations

- *Activated Carbon and Organoclay (EC-300) Bench Test Report* dated May 9, 2006, indicates that activated carbon and Organoclay (EC-300) are both effective in the treatment of MTBE and TBA at concentrations of 540,000 and 61,000 µg/L, respectively. Activated carbon has a better treatment efficiency than EC-300.

- *Bioremediation Feasibility Study Report* dated July 9, 2007 indicates that the subsurface environment is generally anaerobic and reducing. Lack of sufficient oxygen and essential nutrient is limiting the aerobic degradation of petroleum hydrocarbons.

- *Persulfate Bench Test Results* dated February 7, 2008, indicate that release of heavy metals such as arsenic, chromium, lead, and selenium must be carefully evaluated before in-situ treatment of the source zone using persulfate is seriously considered.

Results of the available bench tests and a feasibility study concluded that:

1. In-situ natural attenuation or enhanced bioremediation is not effective under the current site conditions.

2. In-situ chemical oxidation using ozone or persulfate is neither effective nor appropriate for the subject site.

3. Activated carbon can be effectively used to treat the extracted groundwater.

2.6 2008 Soil and Groundwater Investigation Work Plan

At the request of ACEH's January 10, 2008 letter regarding the 2007 Investigation report (See Attachment A), Clearwater Group proposed a phased approach for the 2008 Investigation (Clearwater, 2008). The purpose of the 2008 investigation was to determine the extent of off-site petroleum hydrocarbon contamination originating from the Site. The proposed 2008 Investigation would further evaluate the extent of groundwater contamination in the shallow/deep zones, determine groundwater flow directions and gradients, contaminant flow pathways, and routes of exposures in the shallow and deep zones. Data from the 2008 Investigation could be used to upgrade the existing SCM and to determine if up-gradient and/or cross-gradient sources are influencing the contaminant plumes. Clearwater Group proposed to conduct the 2008 Investigation in phases and included the following activities for the 1st phase investigation (Clearwater, 2008):

- Conducting an off-site passive (Gore-Sorber) soil vapor survey
- Installing four off-site and one on-site monitoring wells
- Determining the existence of an off-site groundwater discharge area near 42nd Avenue (Highway 77)
- Performing a HVDPE pilot test

ACEH approved the installation of five additional monitoring wells (MW-9, MW-9D, MW-10, MW-10D, and MW-11D) and the HVDPE pilot test. As a result, those five wells were installed during December 1 through 3, 2008 (Clearwater, 2009a). ACEH's review comments for the 2008 investigation work plan are summarized in Appendix A. In response to ACEH's comments to the 2008 investigation work plan (September 4, 2008 letter), Clearwater Group did not include the DPE pilot test results in a Well Installation and HVDPE Pilot Test Report. Instead, Clearwater Group modified the design of the HVDPE pilot test and added two additional tasks (Clearwater, 2009c). ACEH concurred with the proposed modification to the DPE pilot test in the April 24, 2009 letter.

3. OBJECTIVES OF INTERIM REMEDIAL ACTION

It should be noted that, after reviewing the entire fuel leak case file for the subject site, the ACEH oversight staff, for the first time, proposed a sound and complete reaction in a May 26, 2005 letter, that requested the following activities:

- Additional on-site and off-site subsurface investigation
- Development of a Site Conceptual Model
- Groundwater monitoring on a quarterly basis
- Implementation of an interim remediation program
- Preparation of a Corrective Action Plan (CAP)

The first three activities have been conducted intensively since 2005. However, an interim remedial action has never been performed, nor has a CAP been prepared. Therefore, it is imperative to commence an interim remedial action.

Based on the results of on-site/off-site soil/groundwater investigations and eight years of groundwater monitoring since 2000, the identified contaminants of concern at the subject site include: MTBE, TBA, and TPH-g. The Site Conceptual Model developed for the Eagle Gas Station indicates that, although the off-site groundwater plume boundary has not yet been fully delineated to the level of MTBE Environmental Screening Limits, on-site groundwater has been sufficiently characterized, and the on-site groundwater, primarily in the shallow zone (Zone A), is highly contaminated (Clearwater, 2008).

Since a clayey gravel layer with higher permeability exists in the shallow zone, and the shallow groundwater has been greatly impacted, implementation of an interim remediation to remove the on-site "source" of contaminants, as well as to prevent the off-site migration of contamination, is critical. Thus, the objectives of the 2009 interim remedial action for the subject site proposed in this work plan are:

- To remove the major portion of MTBE, TBA, TPH-g, TPH-d, and benzene from the impacted soil and the "hot spots" within the Shallow Zone under the property, which has been a potential source for off-site contamination.
- To extract free products and impacted groundwater within the Shallow Zone under the property.

Implementation of an interim remediation action within the source area will quickly reduce the high potential of off-site migration of contaminated groundwater, even if the off-site boundary of contamination has yet to be delineated to the MTBE Environmental Screening Limits.

4. DESIGN OF INTERIM REMEDIAL ACTION

Based on the bench test/feasibility results presented in Section 2.5, chemical oxidation and enhanced bioremediation are either inappropriate or ineffective for the cleanup of the subject site under current conditions. However, the technology of HVDPE has been repeatedly proposed in the 4th, 5th, and 6th IRAs. A design of the HVDPE pilot test has been proposed in the *2008 Soil and Groundwater Investigation Work Plan* and described in more detail in Attachment E of the work plan (Clearwater, 2008). ACEH concurred with the use of HVDPE in the following letters dated: October 19, 2006, January 4, 2007, January 10, 2008, September 4, 2008, and April 24, 2009.

In addition to the above situation, HVDPE also has been found more effective than chemical and biological methods for a similar site predominated by clayey soil in subsurface (ERS, 2007a; 2007b).

4.1 Interim Remedial Approach

It is clear that the on-site subsurface has been sufficiently characterized, a site-specific SCM has been developed, and quarterly groundwater monitoring has been conducted for seven years between 2001 and 2008 (no monitoring was performed in 2002). Since it is imperative to conduct an interim remedial action as soon as possible, in order to reduce the elevated potential of off-site migration of contaminated groundwater, the most cost-efficient approach for the subject site is a combination of an interim remedial action and a pilot test using HVDPE. Since the subsurface of the subject site is heterogeneous, data obtaining from a short-term 5-day pilot test for one particular location will be less reliable and less useful for future system design than data obtaining from a long-term, multi-location pilot test. Thus, a 30-day interim remediation/pilot test with truck-mounted HVDPE equipment, and a system of DPE interim remedial wells, is proposed in this work plan. In addition to the estimation of contaminant mass removal rate and the Range of Influence (ROI) of DPE, this 30-day interim remediation/pilot test is primarily used to determine the effectiveness of the DPE system and to collect system operational parameters to assist future upgrade of this interim remedial system, as well as the preparation of a CAP, if needed.

4.2 Design Basis

Based on the developed SCM, the subsurface (shallow groundwater zone, Zone A) is heterogeneous and predominated by clayey soil with discontinuous, or possibly meandering, lenses of clayey sands and clayey gravels. Thus, conceptually, lithology of Zone A is characterized by low permeability clays, with occasional moderate or higher permeability clayey gravels and clayey sands of 5 to 15 feet thickness. Zone A extends from the ground surface to a depth of approximately 25 to 30 feet bgs. Due to the subsurface heterogeneity, a ROI

specifically within clay cannot be readily determined at the subject site. The installation of a slanted extraction trench (Clearwater, 2009c) for conducting a pilot test is not cost-effective. According to the literature and reported field data for similar sites predominated with clayey soil (ERS, 2007b; 2008; Clearwater, 2006d), a radius of influence of 10 feet can be used for the design of the DPE well system.

Based on the proposed remedial approach and the developed SCM, the proposed DPE well system includes the following features:

1. More than four DPE wells, instead of one slanted trench, are needed at the hot area near the center of the Site.

2. 4-inch diameter DPE wells screened between 5 to 20/25 feet bgs will be installed.

3. Data from a 30-day interim remediation/pilot test, instead of a 5-day test, will be more reliable to determine the mass removal rate, ROI, change of mass removal rate over time, projected duration of the remediation using HVDPE, effect on groundwater drawdown, expected groundwater yield and recovery rate. The above data can be used to determine whether a full-scale remedial system/compound is needed and groundwater pumping using air pump is feasible, as well as to estimate the size of carbon vessels needed for on-site groundwater treatment/discharge and the disposal needs if extracted water will be transported and treated off site.

4. Existing soil vapor wells and other monitoring wells will be used as observation wells for the pilot test to measure the induced vacuum and to estimate the ROI using a criterion of an induced vacuum of 0.1-inch water.

4.3 Design of the 2009 Interim Remedial System

In addition to the SCM, the most recent groundwater water sampling data collected in 4Q08 (Clearwater, 2009b), shown in Figures 3 and 4, also have been used to assist in the design of a DPE well system. The proposed DPE well system contains both vertical wells and angle wells. Each DPE well will have a 4-inch diameter casing. The screen interval of the vertical wells will be between 5 to 20/25 feet bgs. The screen of the vertical wells will be 15 to 20 feet long. All the slanted wells will bear a 40-degree angle from the vertical line, with a 20-feet long screen. The top of the screen of the slanted well will be approximately 7.5 feet bgs. The DPE well construction diagram and the design of the angle wells are shown in Figures 5 and 6, respectively.

Since the SCM indicates that the shallow groundwater zone (Zone A) is highly contaminated, the deep groundwater zone (Zone B) has not been significantly impacted, and a hard layer with limited lateral range may exist between Zones A and B, the contaminants of concern likely reside in an isolated source area. Thus, the interim remedial action DPE wells will be mainly

used to remove the contaminant mass and to test the effectiveness of extracting MTBE and TPH-g, in addition to TBA, TPH-d, and benzene, from more than one location in the source area within the shallow zone. For the design of the DPE well system, the MTBE and TPH-g plumes shown in Figures 3 and 4, respectively, are superimposed in Figure 7. To maximize the contaminant removal and minimize the number of DPE wells required, the most probable radius of influence of 10 feet has been adopted. The designed DPE well system includes: eight vertical wells (D1 through D8) and one existing 4-inch diameter groundwater extraction well (EW-1), as well as four angle wells (D9 through D12) to be installed under the gas station building. All the DPE wells are located within/near the center of the MTBE and TPH-g plumes. Although higher vertical migration from Zone A to Zone B may exist near well MW-5, according to the available subsurface cross-sections, additional DPE well(s) near this location will be considered in the future for a full-scale DPE remedial system after the results of interim remediation and pilot test are available. Locations of the interim remedial action DPE wells and their expected capture zones are shown in Figure 7.

Existing vapor wells (VP-2, VP-3, VP-4, and VP-6) will be used to measure the level of induced vacuum at various distances from the DPE wells. Since the top of screen of monitoring wells (MW-2, MW-4, MW-7, and MW-8) and oxygen diffuser wells (IS-2, IS-3, IS-4, and IS-5) is located at 10 feet bgs, these wells can also be used to measure the level of induced vacuum, if the groundwater level is drawn down and the well screen is exposed after the dual phase extraction.

5. SCOPE OF WORK

The scope of work for the 30-day interim remedial action/pilot test includes the following tasks:

Task 1 – Application for a permit for well installation (Permits for air emission and discharge of treated groundwater will be provided by the equipment/service provider. An off-site encroachment permit is not needed.)

Task 2 – Cost estimate, budget pre-approval, and solicitation of equipment/service providers (Cost pre-approval by the UST Cleanup Fund is not necessary, but preferable.)

Task 3 – Installation and development of DPE wells D1 through D12 (Wells should be developed at least 72 hours prior to DPE.)

Task 4 – Field operation of the interim remediation and pilot test (A truck-mounted DPE unit will be operated continuously 24 hours a day for 30 days. The system total flow rate, system vacuum, induced vacuum in the observation wells, and VOC concentrations in the extraction wells will be frequently measured. VOC concentrations will be directly measured from the sampling port on the manifold every hour during the daytime, using a Horiba vapor analyzer. Vapor samples also will be collected by Tedlar bags and analyzed in a certified laboratory for TPH-g, MTBE, TBA, and BTEX by EPA Methods 8015M and 8021B. Extracted groundwater from DPE wells will also be sampled and analyzed for VOCs including oxygenates and TPH-g using EPA Methods 8260B and 8015B.)

Task 5 – Evaluation and reporting of the 30-day interim remedial action/pilot test data, including recommendations in the report

Task 6 – Utilizing the pilot test data and the results/performance of the proposed interim remedial action to upgrade and/or design a full-scale site cleanup remedy, as well as to prepare a Corrective Action Plan, if needed.

6. SCHEDULE

Application for the permit will not be submitted until this work plan is approved by the ACEH. A tentative schedule for the scope of work is as follows:

Tasks	Scope of Work	Duration
	Approval of the work plan	Not known
1	Well permit application	10 days
2	• Cost estimate and solicitation of equipment/service providers • Budget pre-approval	• 4 days • 30 days
3	• Installation and development of DPE wells • Equipment mobilization	• 6 days • 1 day
4	Interim remediation and pilot test	30 days
5	Reporting	90 days
6	System upgrade	To be determined

7. REFERENCES

Artesian Environmental, *Remedial Options to Treat Elevated Concentrations of MTBE in Soil*, August 1999a.

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Clearwater, *Soil and Groundwater Investigation Workplan*, August 2005a

Clearwater, *Recommendations for Interim Remedial Actions*, June 2005b.

Clearwater, *Soil and Groundwater Investigation Report*, May 2006a.

Clearwater, *Additional Subsurface Investigation Work Plan*, October 2006b.

Clearwater, *Revised Work Plan*, December 2006c.

Clearwater, *Groundwater Extraction from Well MW-1A*, January 2006d.

Clearwater, *2007 Soil and Groundwater Investigation Report*, December 2007.

Clearwater, *2008 Soil and Groundwater Investigation Work Plan*, July 2008.

Clearwater, *Groundwater Monitoring Well Installation Report*, January 2009a.

Clearwater, *Quarterly Groundwater Monitoring Report – Fourth Quarter 2008*, February 2009b.

Clearwater, *Proposed Modifications to Work Plan*, January 2009c.

Environmental Risk Specialties (ERS), *2007 Site Investigation Report,* April 2007a.

ERS, *Feasibility Study Report and Revised Corrective Action Plan,* December 2007b.

ERS, *Work Plan Addendum for the Cleanup of Off-site Subsurface Contamination North of 900 Santa Rosa Avenue Property*, September 2008.

8. REPORT DISTRIBUTION LIST

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CERTIFICATION

This document was prepared under the supervision of a State of California Professional Engineer at Environmental Risk Specialties Corporation (ERS). All statements, conclusions, and recommendations are based solely upon published results from previous consultants, field observations by ERS, and laboratory analysis performed by a California DHS-certified laboratory related to the work performed by ERS.

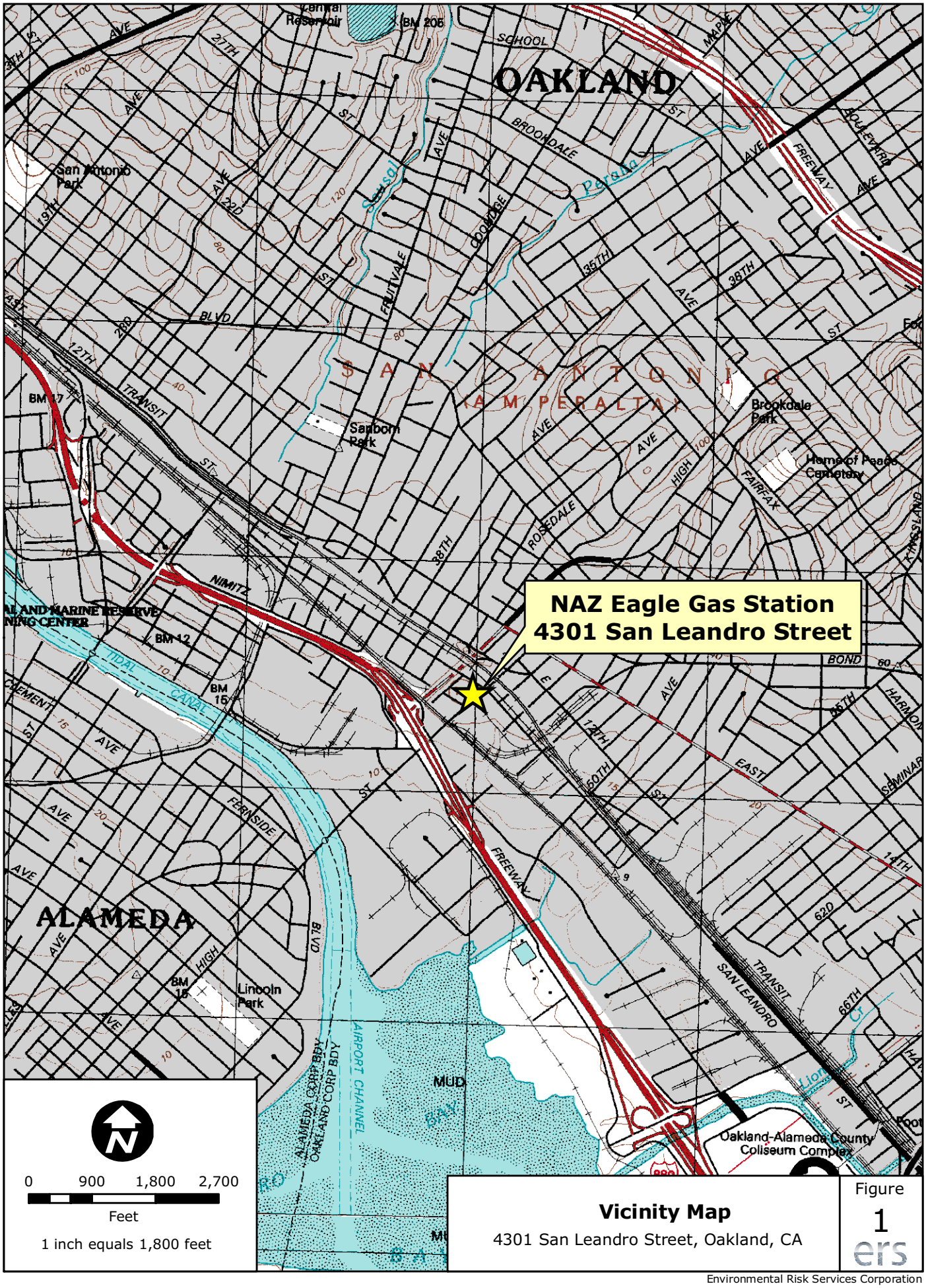
Information and interpretation presented herein are for the sole use of the client and regulating agency. The service performed by ERS has been conducted in a manner consistent with the level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions in the area of the property. No other warranty, expressed or implied, is made.

Sincerely,

ENVIRONMENTAL RISK SPECIALTIES CORPORATION

Jim Ho, PE #C68639

FIGURES

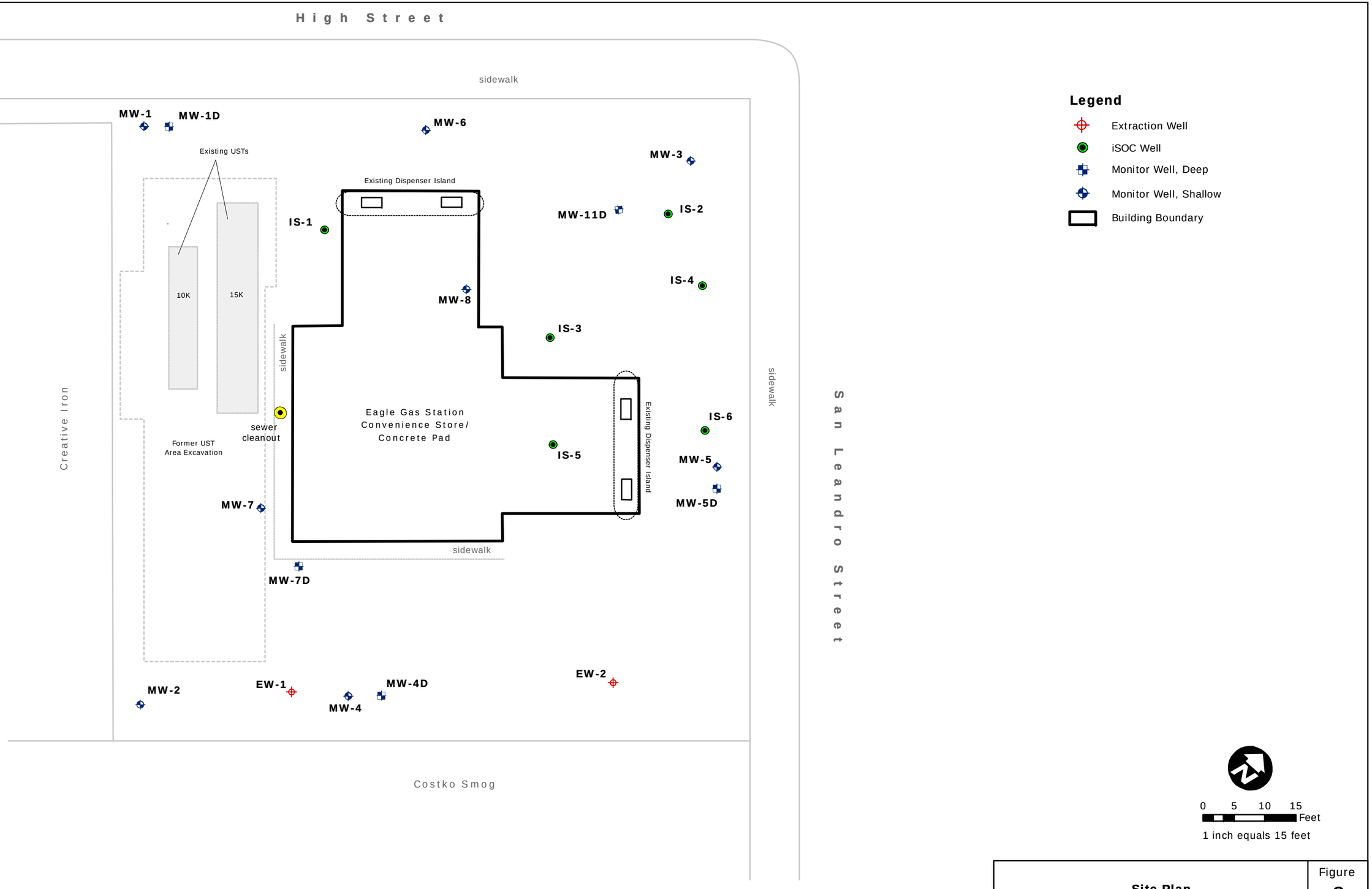


Vicinity Map

4301 San Leandro Street, Oakland, CA

Figure 1

Environmental Risk Services Corporation



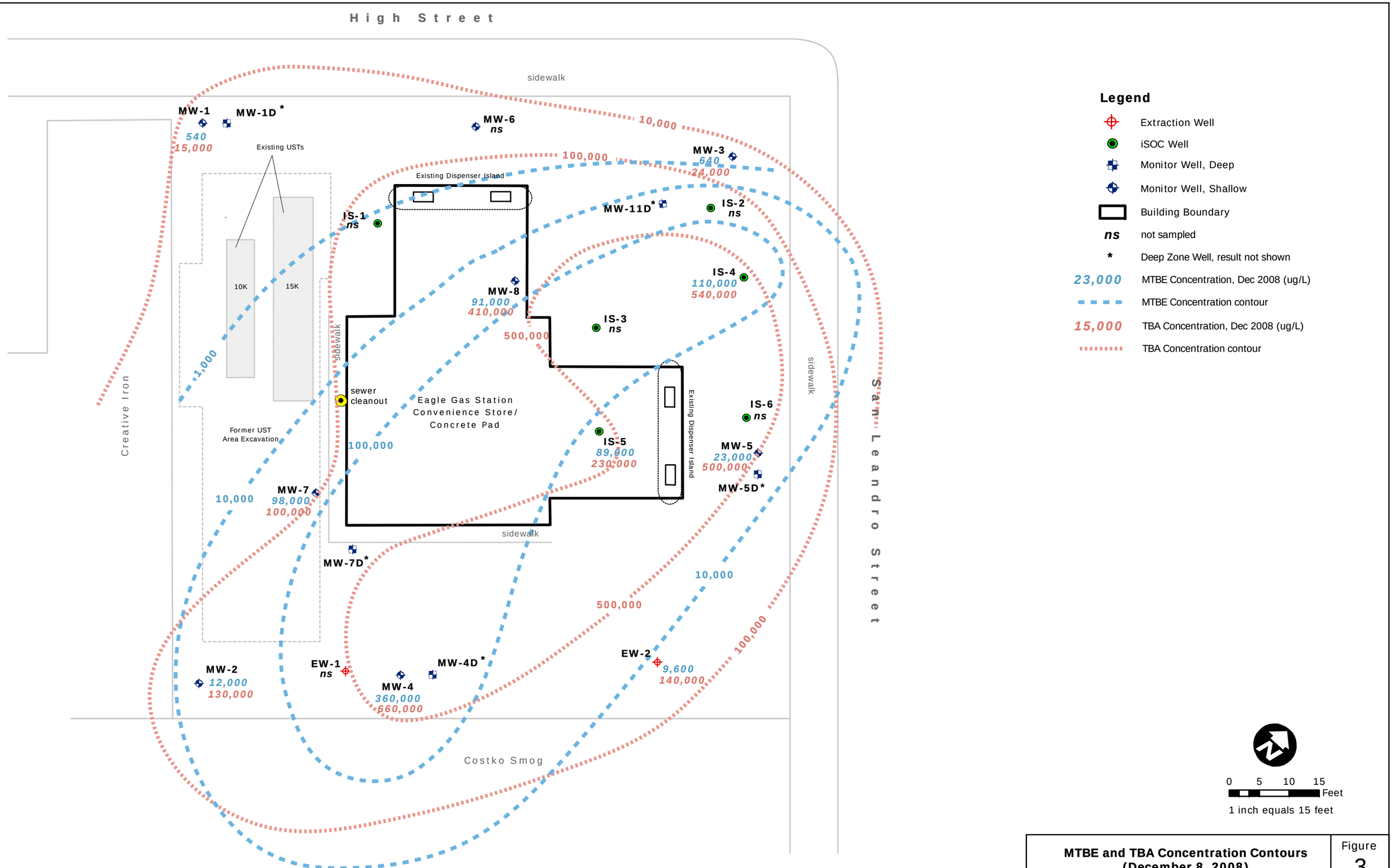
Site Plan

Eagle Gas Station, 4301 San Leandro Street, Oakland, CA

Figure 2

ers

Environmental Risk Services Corporation



Legend

- Extraction Well
- iSOC Well
- Monitor Well, Deep
- Monitor Well, Shallow
- Building Boundary
- *ns* not sampled
- * Deep Zone Well, result not shown
- *23,000* MTBE Concentration, Dec 2008 (ug/L)
- MTBE Concentration contour
- *15,000* TBA Concentration, Dec 2008 (ug/L)
- TBA Concentration contour

0 5 10 15 Feet

1 inch equals 15 feet

MTBE and TBA Concentration Contours (December 8, 2008)

Eagle Gas Station, 4301 San Leandro Street, Oakland, CA

Figure 3

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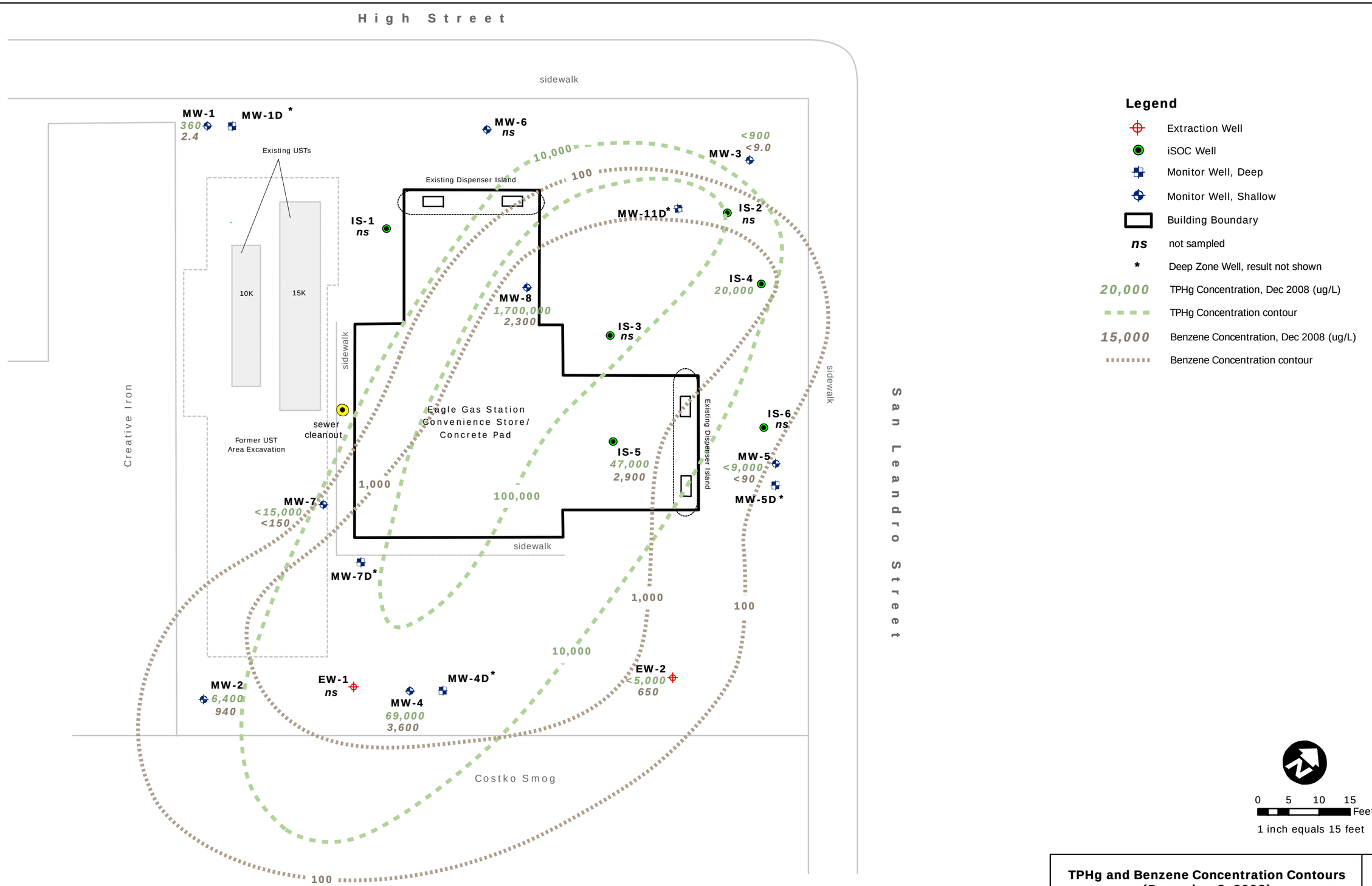
Environmental Risk Services Corporation



Legend

- Extraction Well
- iSOC Well
- Monitor Well, Deep
- Monitor Well, Shallow
- Building Boundary
- *ns* — not sampled
- * — Deep Zone Well, result not shown
- 20,000 — TPHg Concentration, Dec 2008 (ug/L)
- TPHg Concentration contour
- 15,000 — Benzene Concentration, Dec 2008 (ug/L)
- Benzene Concentration contour

0 5 10 15 Feet

1 inch equals 15 feet

TPHg and Benzene Concentration Contours (December 8, 2008)

Eagle Gas Station, 4301 San Leandro Street, Oakland, CA

Figure 4

ers

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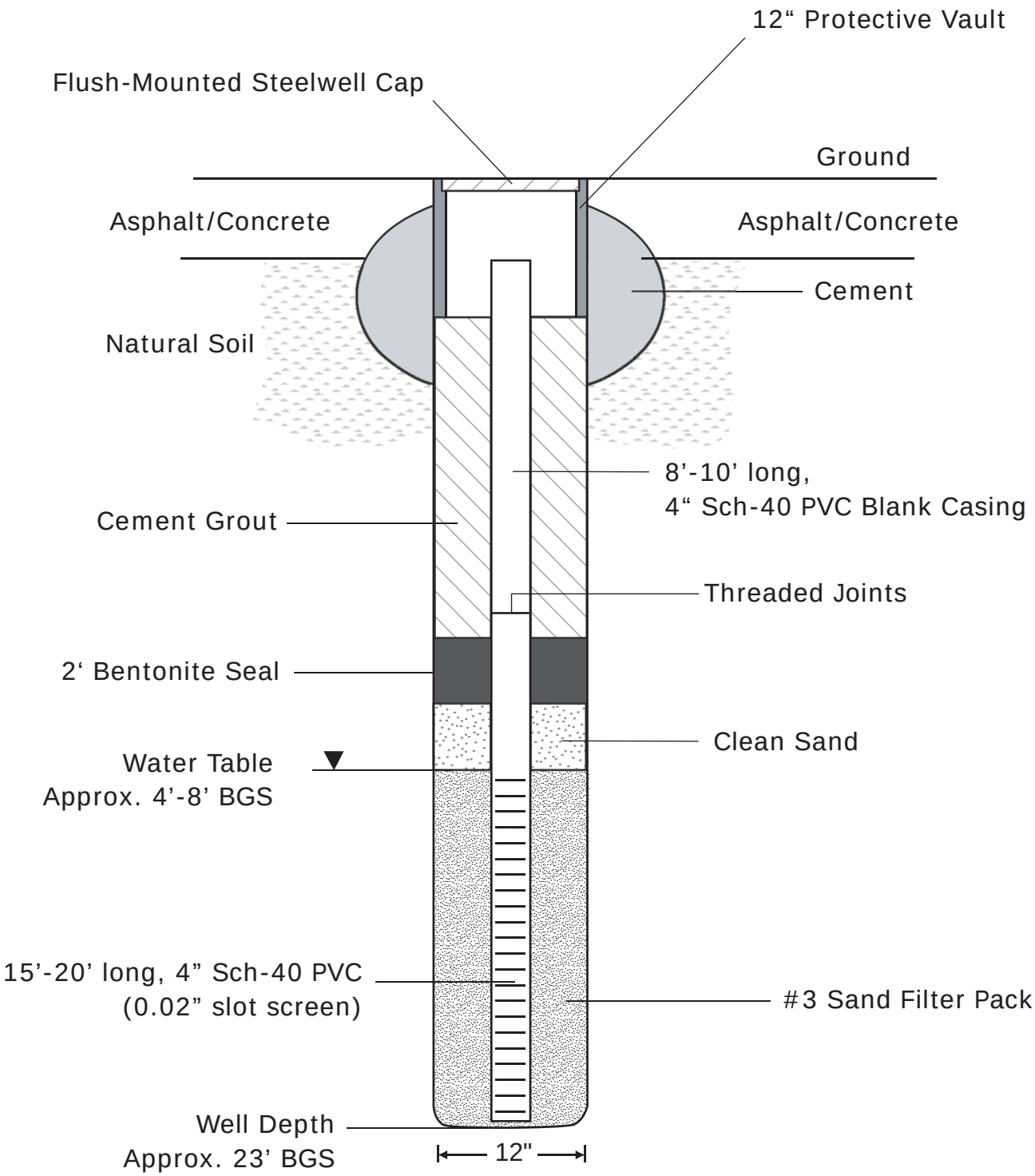

Note: Figure not to scale.

Dual Phase Extraction Well Construction Diagram

Eagle Gas Station, 4301 San Leandro Street, Oakland, CA

Figure 5

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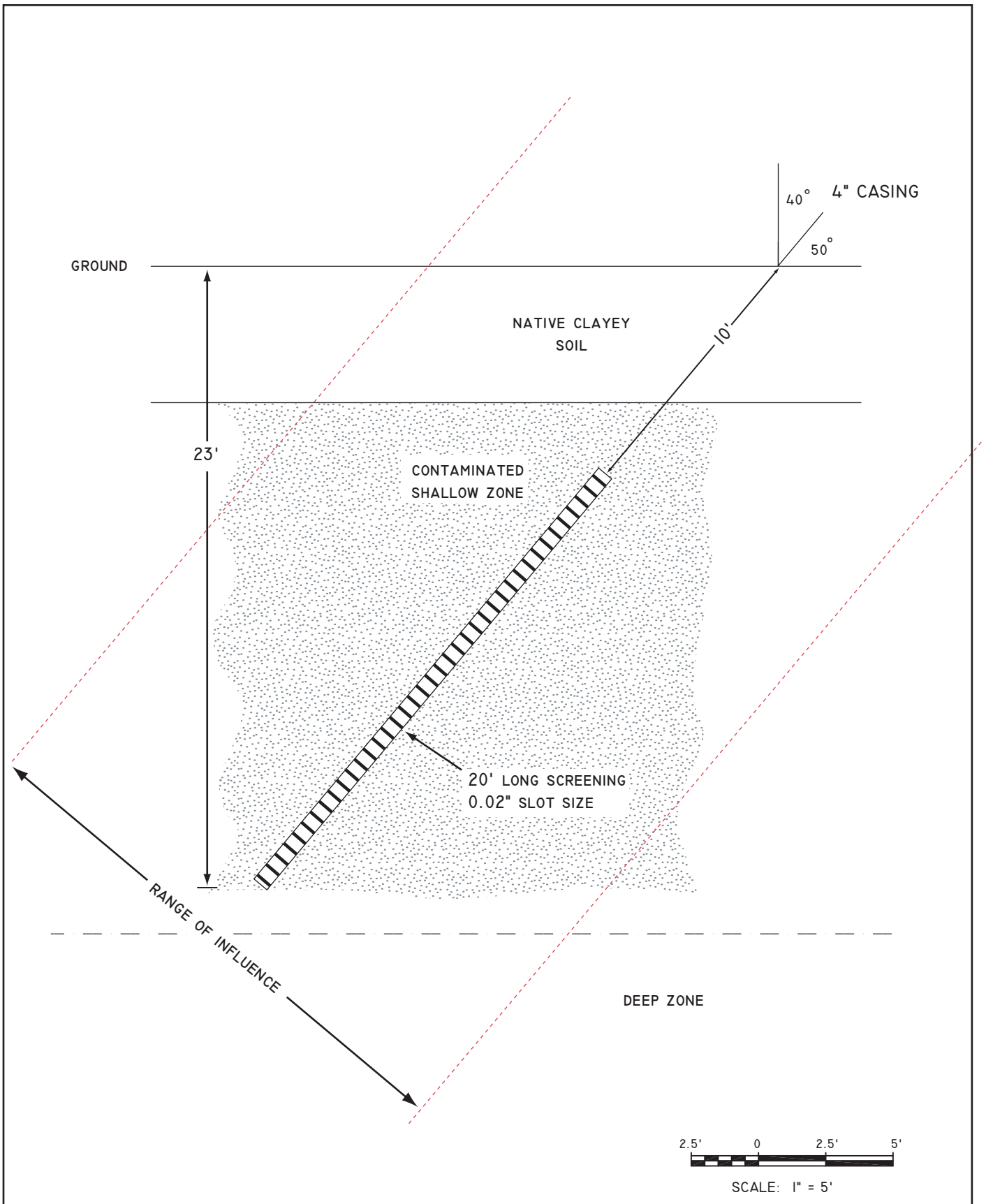

LEGEND

RANGE OF INFLUENCE

CONTAMINATED SHALLOW ZONE

Angle Dual Phase Extraction Well Design

Eagle Gas Station, 4301 San Leandro Street, Oakland, CA

Figure 6

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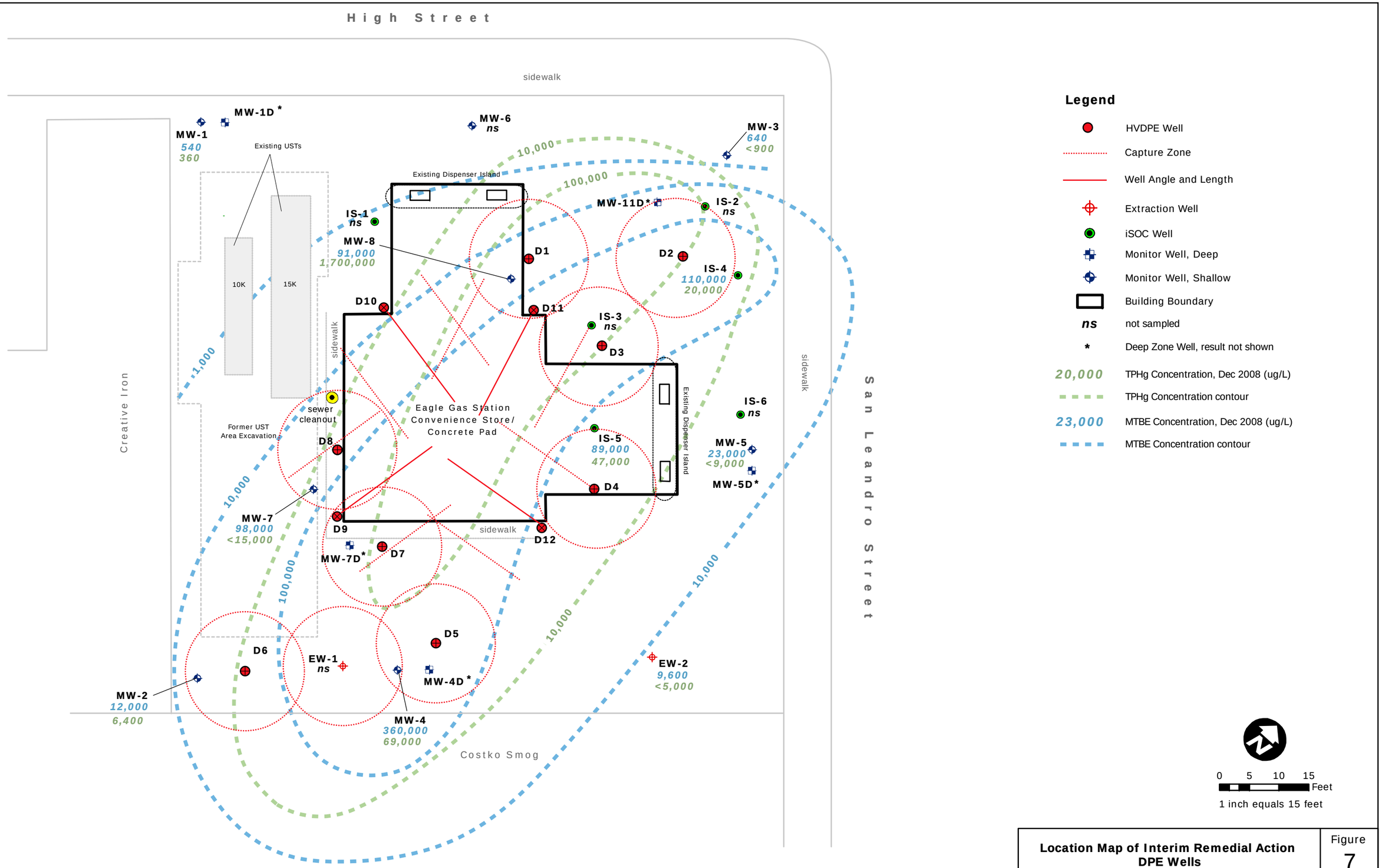

Legend

- HVDPE Well
- Capture Zone
- Well Angle and Length
- Extraction Well
- iSOC Well
- Monitor Well, Deep
- Monitor Well, Shallow
- Building Boundary
- *ns* — not sampled
- * — Deep Zone Well, result not shown
- 20,000 — TPHg Concentration, Dec 2008 (ug/L)
- TPHg Concentration contour
- 23,000 — MTBE Concentration, Dec 2008 (ug/L)
- MTBE Concentration contour

0 5 10 15 Feet

1 inch equals 15 feet

Location Map of Interim Remedial Action
DPE Wells
Eagle Gas Station, 4301 San Leandro Street, Oakland, CA

Figure 7

ers

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APPENDIX A

SUMMARY OF KEY DOCUMENTS AND ACEH'S REVIEW COMMENTS

1ST Interim Remedial Action Plan (IRAP) (Sep 10, 1999)

- Propose to use hydrogen peroxide to remediate MTBE

2ND IRAP (Jan 14, 2004)

- Propose to use enhanced biological method (iSOC) to cleanup the site

ACEH October 18, 2001 letter (review 2Q01 Groundwater monitoring Report, Sensitive Receptor Survey and Work Plan submitted August 3, 2001)

- Did not approve Clearwater's proposal of installing 8 off-site monitoring wells.
- Recommend additional on-site wells

ACEH May 26, 2005 letter (review 2nd IRAP dated January 14, 2004)

- IRA should be initiated to remove the source (remediation is necessary at and downgradient from the site)
- Need a SCM that will form the foundation for developing the most cost-effective corrective action plan
- Need 2006 Soil and Groundwater Investigation Work Plan including an initial SCM
- CAP should be submitted 60 days after ACEH comments on the Soil and Groundwater Investigation Report

ACEH June 24, 2005 letter

- Repeat the need to have IRA mentioned in May 26, 2005 letter
- Agree to install EW-1 and EW-2 and ISOC wells prior to the implementation of 2006 investigation

3rd IRAP (June 13, 2005)

- Propose to use groundwater extraction and enhanced biological method (iSOC) to cleanup the site

2006 *Soil and Groundwater Investigation Work Plan* (August 10, 2005)

- Initial SCM proposed in this work plan

- Proposed tasks for characterizing lateral and vertical extent of soil/groundwater contamination, lithology and hydrogeology,

- Estimate time frame of MTBE release and mass flux

ACEH Sep 21 and Nov 1, 2005 letters (review 3rd IRAP and *2006 Soil and Groundwater Investigation Work Plan* and associated response to comments)

- Agree to the implementation of EW-1 and EW-2 and ISOC wells prior to 2006 investigation

- Need an Interim Remediation System and a system Start-up Report

2006 Soil and Groundwater Investigation Report (May 30, 2006)

ACEH June 27, 2006 letter (review 2006 *Soil and Groundwater Investigation Report*)

- Review existing water level data, soil boring logs, and well construction data to identify possible cause of steep gradient between EW-1 and MW-2, and other more locations.

- Well screen below the water table should not be longer than 5 ft

- Well should be screened in coarse-grained layers that may be preferential pathways

- Additional USTs should be searched

- Agree to conduct vapor intrusion into on-site and off-site buildings

- Off-site investigation should delineate the plume in the downgradient regional flow direction, along preferential pathways, and in the direction of potential discharge to Peralta (Adams) Creek

ACEH August 11, 2006 letter (review response to comments for ACEH's June 27, 2006 letter)

- Request an additional investigation work plan by September 22, 2006

- Clearwater submitted *Additional Subsurface Investigation Work Plan* (Oct 6, 2006) and a *Revised Work Plan* (Dec 19, 2006)

- Review existing water level data, soil boring logs, and well construction data to identify possible cause of high gradient between EW-1 and MW-2, and other more locations.

- Need to present the deep well installation and geophysical survey results in the Work Plan

- No need to do dating for TPH and MTBE

- Agree to conduct vapor intrusion sampling for off-site building and to analyze groundwater samples for sewer line leakage

- ACEH accepted the June 13, 2005 letter entitled *Recommendations for Interim Remedial Action*. ACEH wants to see a discussion of how the proposed data collection in 2007 Investigation will be used to plan IR

- ACEH wants to see a schedule for IR

ACEH October 19, 2006 (review of *Additional Subsurface Investigation Work Plan,* Oct 6, 2006)

- Need a *Revised Work Plan*

- Agree to prepare a Bioremediation FS

- The purpose of the off-site investigation is to delineate the extent of groundwater contamination in the Upper and Lower zones. Thus, the off-site borings should extent to a minimum depth of 50 ft bgs

- Proceed with the HVDPE pilot test for IR. Need full description of the HVDPE test in the Revised Work Plan

- The site needs a more aggressive remedial method. ISOC is not a viable method for IR.

- Agree to conduct bioremediation FS

- Do not install wells in the upgradient direction

- Discontinue analyses for EDB, EDC, methanol, and ethanol during groundwater monitoring

ACEH January 4, 2007 letter (review of *Revised Work Plan*, Dec 19, 2006)

- Need to report on progress in finding and repairing the leaks in water lines and sewer laterals

- Need a 2007 Site Investigation and Interim Remediation Report by May 25, 2007 (Clearwater submitted the 2007 investigation report on Dec 5, 2007)

- Disagree to conduct discrete-level groundwater sampling in wells or bore holes even with Low Flow Rate sampling

- Off-site investigation is to delineate the extent of contamination in both Upper and Lower zones. Thus, in addition to sampling first encountered groundwater from each

off-site boring, grab groundwater sampling is needed in each significant water-bearing zone in the 50 ft bgs interval.

- Implement HVDPE pilot test. Test should be conducted on wells within each of the contamination source area

- Agree to conduct a Persulfate bench Test (test results are presented in 2/7/08 test report)

ACEH January 10, 2008 letter (review of *2007 Soil and Groundwater Investigation Report*)

- Discontinue analyses for MNA parameters

- Need a work plan to modify existing groundwater monitoring program

- No additional soil vapor sampling and vapor wells are needed

- Agree with HVDPE pilot test. Top of screen should be deeper than 3.5 bgs. Need to include duration, operation, and monitoring in a HVDPE pilot test plan.

- Need to report the progress of fixing the two leaks in sewer line.

- Need a 2008 work plan to conduct Gore survey to help locate future off-site soil borings and wells (work plan was due on March 21, 2008, Clearwater submitted on July 2, 2008)

2008 Soil and Groundwater Investigation Work Plan (July 2, 2008)

- Conduct off-site Gore-Sorber

- Install five off-site wells and one on-site wells (Note: only four off-site wells were installed)

- Modify groundwater monitoring program by eliminating MW-6, IS-1, IS-2, IS-3, IS-6, and EW-1 from quarterly sampling

- Determining whether 42nd Avenue acts as a groundwater discharge point

- Repair the sewer line leaks

- Perform HVDPE pilot test (Clearwater stated that this in-situ technology shows promise for reducing the contamination at the site, while allowing the current business to operate with as little disruption as possible)

ACEH September 4, 2008 letter (review of *2008 Soil and Groundwater Investigation Work Plan*)

- Since Gore locations are largely within areas where soil and groundwater sampling was previously conducted, Gore survey is not accepted.
- Agree to eliminate MW-6, IS-1, IS-2, IS-3, IS-6, and EW-1 from quarterly sampling
- Historical soil data indicates most of the contamination appears to be in the zone of seasonal water table fluctuations between depths of 8 to 14 ft bgs. Top of DPE wells should be deeper than 5 ft bgs.
- Include the HVDPE test results in Well Installation and HVDPE Pilot Test Report due January 11, 2009. (Note: Clearwater only submitted a well installation report on January 21, 2009. Clearwater proposed a modification of the 2008 Soil and Groundwater Investigation Work Plan on January 14, 2009)
- Two leaks were identified in the sewer line in the 2007 Investigation Report. Need to report on the progress in repairing the leaks.
- Need to present drawings of the 42nd Avenue on-ramp and the plans for evaluating whether contaminated groundwater from the site is discharging to this area in the HVDPE Pilot Test Report.

Modifications to *2008 Soil and Groundwater Investigation Work Plan* (January 14, 2009)

- Modify the HVDPE pilot test from using a DPE well to a DPE trench
- Modify the sampling protocol, sampling wells and sampling frequency
- Clearwater proposed to obtain groundwater data from OUSD and Clorox wells

APPENDIX B

LIST OF KEY DOSUMENTS

Number	Documents	Date	Note
1	Recommendations for Interim Remedial Actions	6/13/2005	3rd request for IRA
2	Soil and Groundwater Investigation Workplan	8/10/2005	• Prepare for #6 • Include an initial SCM
3	Workplan for Ozone Bench Test	12/19/2005	Prepare for #4
4	Bench Test for Using Advanced Oxidation – A Summary Report	3/27/2006	For MTBE and TBA treatment
5	Activated carbon and Organoclay (EC-300) Bench Test report	5/9/2006	For 3rd IRA
6	2006 Soil and Groundwater Investigation Report	5/30/2006	First update of SCM
7	Additional Subsurface Investigation Work Plan	10/6/2006	• Propose 2007 off-site investigation • For #12
8	Revised Work Plan	12/19/2006	• Revise #7 • Prepare for #9,10,12,13
9	Site Data Review and Design of HVDPE Pilot Test Plan	6/18/2007	For 6th IRA
10	Bioremediation Feasibility Study Report	7/9/2007	For 5th IRA
11	Request for Extension of HVDPE Pilot Test	11/5/2007	Propose to include HVDPE pilot test in #12
12	2007 Soil and Groundwater Investigation Report	12/5/2007	Second update of SCM
13	Persulfate Bench Test Results	2/7/2008	For 5th IRA
14	2008 Soil and Groundwater Investigation Work Plan	7/2/2008	• Propose 2008 off-site investigation

			• For 6th IRA
15	Proposed Modification to Work Plan	1/14/2009	Modify #14
16	Groundwater Monitoring Well Installation Report	1/21/2009	Report for MW-9, MW-9D, MW-10, MW-10D, MW-11D installation