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FEASIBILITY STUDY REPORT

Heitz Trucking
4919 Tidewater Avenue, Unit B
Oakland, California

Prepared for

R.W.L. Investments, Inc.
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Oakland, California 94601

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1.0 INTRODUCTION

This Feasibility Study (FS) report has been prepared by *Applied Remedial Technologies Inc.* (*ART*) on behalf of *R.W.L. Investment, Inc.* (*Client*) to address removal of petroleum hydrocarbons existing in the subsurface soil and groundwater at the Heitz Trucking (formerly DiSalvo Trucking) facility located at 4919 Tidewater Avenue, Oakland, California (Site). The Site is listed as a fuel leak case and is being overseen by Alameda County Environmental Health Services (*ACEHS*). **Figures 1** and **2** show the Site Location and Site Plan. The FS outlines a phased approach consisting of remediation measures to contain the site plume, followed by source remediation at the Site.

Based on the feasibility evaluation of remedial alternatives for TPH-d impacted soil and groundwater beneath the Site, the Groundwater Extraction & Treatment (GWET) system with limited Source Area Remediation remedial alternative was selected as the most viable and cost-effective alternative. The proposed GWET system, which addresses treatment of the TPH-d impacted groundwater beneath the Site, would primarily consist of ten (10) 4-inch diameter extraction wells, and a granulated carbon (GAC) abatement unit comprising of carbon vessels and associated piping and instrumentation. During the course of operation of the GWET system, an evaluation will be performed to determine the extent of soil remediation that may be necessary. Following this evaluation, the remediation of the TPH-d impacted soil will be evaluated using remedial options like excavation, in-situ chemical oxidation, and bioremediation.

This report was prepared consistent with generally accepted environmental consulting principles and practices that are within the limitations described in Section 6.0.

2.0 BACKGROUND

2.1 Site Description

The essentially flat, approximately 3.61 acre Site is located on the southwest side of Tidewater Avenue near the eastern fringe of the San Francisco Bay in southwest Oakland (see **Figures 1 and 2**). The Site is at an elevation of approximately five feet above Mean Sea Level according to the USGS *Oakland East Quadrangle California 7.5 Minute Series* topographic map. Regionally, topography in the area of the Site slopes down to the west towards San Francisco Bay. There is an approximately 11,800 square-foot, single story concrete trucking and loading dock terminal along the north side of the Site, an office trailer, an approximately 2,770 square-foot, single story truck repair shop and maintenance building along the southern Site boundary, and an above-ground fuel storage tank located north of the maintenance building. Outside yard areas are located along the northwest side of the building and a much larger outside yard area is located between the buildings. The Site is listed as a fuel leak case and is being overseen by the Alameda County Environmental Health Services (ACEHS).

2.2 Previous Investigations

Previous and ongoing environmental investigations conducted at the Site show elevated concentrations of petroleum hydrocarbons (predominantly diesel) in soil and groundwater beneath the Site. A summary of the results of the previous and ongoing environmental investigations was obtained from reports by Applied Remedial Technologies (*ART*), Environmental Restoration Services (*Enrest*), ERAS Environmental, Inc. (*ERAS*), Gentech Environmental (*Gentech*), Geo-Environmental Technology (*GET*), Murray Engineering, Inc. (*MEI*), and PIERS Environmental (*PIERS*), and has been presented below.

Investigations to assess the extent of contamination in soil and groundwater have been conducted on the Site since March 1989 (*Gentech, 1994a*) when 5,000 and 10,000-gallon diesel tanks, 280 gallon waste oil tank, and a 550-gallon underground storage tank (UST), associated pumps, piping and remote fueling hydrants were removed by *GET (GET, 1989a)*. Approximately 3,000 cubic yards of contaminated soil was excavated from the area around the former USTs and stockpiled on-site for treatment. Additionally, during the over-excavation, a ten-inch diameter product pipeline leading from the USTs to the building broke and leaked 3,000 gallons of diesel-like fuel into the excavation. During the excavation activities, this material as well as other free-phase fuel was pumped from the excavation for disposal.

Analytical results of soil samples collected from these activities showed elevated concentrations of petroleum hydrocarbons (predominantly diesel) in soil beneath the Site. Excavated soil was treated on-site using an enhanced biodegradation process. This soil was piled into a landscape berm between Tidewater Avenue and the Site boundary. Contaminated groundwater was removed from the excavation and disposed. Additionally, a collection well/recovery sump and recovery trench were installed and operated from April to August 1989. A total of an estimated 2,400 gallons of diesel fuel and 20,000 gallons of contaminated groundwater were removed in total from the UST excavation, recovery trench and collection well.

In May 1989, *GET* hand-augered 22 boreholes and collected twelve soil samples for chemical analyses. The results of the soil analyses indicated there were elevated concentrations of diesel hydrocarbons in soil in close proximity of the UST excavation and along a product line that extended from the former USTs to the northeast. Additionally, results of the groundwater samples collected from the UST excavation indicated the presence of high concentrations of *VOC's* and *BTEX (GET, 1989b)*.

Gentech performed a soil and groundwater investigation at the Site in April 1994 (*Gentech, 1994b*). Fourteen soil borings (EB-1 through EB-11 and MW-1 through MW-3) were drilled on the Site. Three of the borings (MW-1 through MW-3) were converted to groundwater monitoring wells. Results of the analysis of six soil and fourteen groundwater samples are summarized on **Tables 1, 3, and 4**. The soil analytical results indicated high concentrations of diesel hydrocarbons in MW-2. Concentrations of gasoline hydrocarbons were detected in MW-3. In groundwater, elevated concentrations of diesel and gasoline hydrocarbons were detected in borings (EB-4 and EB-6) drilled to the northwest along a product line that extended toward the trucking terminal. Elevated concentrations of hydrocarbons, mostly diesel, were also detected in the borings drilled along the northeast side of the Site (EB-1, EB-2, EB-3 and EB-11).

Enrest conducted a soil and groundwater investigation at the Site in July 1995 (*Enrest, 1995*). The work included the drilling of two soil borings and installation of a groundwater monitoring well (MW4) in one of the borings. The soil borings were drilled along a product line that extended northwest from the former USTs to the terminal building. Well MW-4 was installed on the northwest side of the terminal building.

PIERS conducted a soil and groundwater investigation at the Site on December 20, 2000 (*PIERS, 2000*). Sixteen soil borings, SB-1 through SB-16, were drilled on the site to collect soil and groundwater samples. PIERS concluded that concentrations of diesel in the groundwater do not appear to have been reduced from natural attenuation since the April 1994 subsurface investigation conducted by *Gentech*, and that the groundwater plume extends off-site to the northwest. A summary of analytical results of groundwater samples are included in **Table 3.**

Groundwater monitoring has been conducted intermittently at the Site from 1994 to 2002. A total of seven groundwater monitoring events appear to have been conducted since the installation of the groundwater monitoring wells in 1994 and 1995. The groundwater flow direction has been determined to be to the northwest with a shallow gradient. A summary of historical analytical results of groundwater samples from the monitoring wells are included in **Table 4**. Historical analytical results indicate that concentrations of diesel hydrocarbons have generally declined in all four monitoring wells from 2000 to 2002.

Enrest prepared a revised Corrective Action Plan (*CAP*) dated October 4, 2002 (*Enrest, 2002*). The CAP evaluated the possible remediation alternatives of chemical oxidation, groundwater extraction and treatment and excavation and disposal of the soil in the area affected by the contamination plume. *Enrest* recommended groundwater extraction and treatment combined with injection of microbes and oxygenating chemicals for its cost compared to the other remediation alternatives. The *ACEH*S approved the recommended method of groundwater extraction method providing a pilot test was conducted to verify the groundwater extraction rate (*ACEHS, 2002*). In addition, the *ACEH*S recommended the consideration of injecting microbes, nutrients and oxygen up-gradient of the contaminant plume, as well as re-injection of treated groundwater rather than disposal to the sanitary sewer.

ERAS summarized the results of previous investigations at the Site in its *Technical Summary Report et al* (*ERAS, 2005*). The report also provided results of the Quarter 3, 2005 groundwater monitoring event as well as the Work Plan for the Feasibility Study/Remedial Investigation at the Site. The groundwater analytical results indicated the presence of a measurable thickness of LNAPL at MW-3, which was removed through bailing of the well. Additionally, TPH-d concentrations ranging from 410 μg/L to 13,300 μg/L were detected in the groundwater samples at the Site.

In February 2006, *ERAS* performed additional environmental investigations to further characterize the subsurface conditions and assess the vertical and lateral extent of petroleum hydrocarbons in soil and groundwater at the Site (*ERAS, 2006*). *ERAS* subcontracted Subdynamics Inc, a private underground utility location contractor, to locate and prepare a map of underground utilities at the site, collected and analyzed soil and groundwater samples from borings B-1 through B-9, installed an 8-inch dewatering well and four observation wells (OB-3 through OB-6), and collected soil and groundwater samples for chemical analysis from borings B-10 through B-15 to further refine the characterization and extent of the contamination. The results of the environmental investigation were used to revise the thickness of the fill material beneath the Site. Additionally, the analytical results did not indicate any presence of LNAPL; however, staining and odor were observed in the samples collected from borings in the former UST pit area. Results of these investigations are presented in **Tables 1, 3,** and **4**.

MEI performed a geotechnical investigation alongside the environmental investigation conducted by *ERAS* in February 2006. The results of the geotechnical investigation (*MEI, 2006*) were used to provide design parameters related to shoring and replacement backfill requirements for any proposed excavation at the Site. These design parameters were used in the evaluation of the proposed remedial alternatives

Following completion of the geotechnical investigation by *MEI* and the additional environmental investigations by *ERAS* in February 2006, *ART* performed a constant-rate aquifer test on well EW-1 obtain a better understanding of the aquifer properties of the underlying subsurface material. The results from the aquifer test were then applied by ART to develop a numerical groundwater flow model that was used in evaluating the proposed remedial alternatives for the Site (*ART, 2006*).

3.0 SITE CONCEPTUAL MODEL

This section details the conceptual model adopted for the site in relation to its hydrogeology, extent of contamination in soil and groundwater, and the remedial objectives

3.1 Regional Hydrogeology

The Site is located in southwest Oakland along the eastern part of the San Francisco Bay Area. The San Francisco Bay Area occupies the central part of the Santa Clara Valley, a broad alluvial valley that slopes gently northward toward San Francisco Bay and is flanked by alluvial fans deposited at the foot of the Diablo Range to the east and the Santa Cruz Mountains to the west. The upland surfaces rising abruptly approximately four miles to the east of the Site are known as the East Bay Hills.

As stated above, the Site is located on the Bay Plain at the eastern edge of San Francisco Bay. The sediments in the vicinity of the Site are fine-grained alluvial sediments that represent distal deposits of alluvial fans that were deposited by rivers draining upland surfaces to the west and east of the Property. These sediments were deposited in a low energy environment on the margins of San Francisco Bay. At shallow depths beneath these sediments are a series of Recent-age (<10,000 years) blue clay layers that become increasingly thicker toward San Francisco Bay. These clay layers are known as the Bay Mud and were deposited in San Francisco Bay during higher stands of sea level. In the vicinity of the Site, it is likely that several hundred feet of these sediments overlie sandstone and serpentine sedimentary and metamorphic rocks of the Jurassic-aged Franciscan Formation bedrock.

According to the United States Geological Survey (USGS) Oakland East Quadrangle California 7.5 Minute Series topographic map, the Site and its vicinity is at an elevation of approximately five feet above Mean Sea Level. Regionally, topography in the area of the Property slopes down to the west toward San Francisco Bay. However, the Site area in itself is very flat with little topographic change.

The regional groundwater flow follows the topography, moving from areas of higher elevation to areas of lower elevation. The regional groundwater flow direction in the area of the Property is estimated to be to the west toward San Francisco Bay. However, the groundwater gradient in this area is likely to vary due to tidal influences and there may not be a dominant groundwater gradient.

3.2 Site Hydrogeology

Soil borings from previous onsite environmental investigations indicate the area beneath the Site was likely filled to create land and lift the surface roughly 5 feet above the high tide line (*Gentech, 1994b*). The Site is underlain by artificial fill comprised of gravel and sand which may contain debris such as concrete or asphalt as well as silt and clay. The fill is underlain by organic clay with thin interbeds of organic or plant material. This material was often logged as peat in previous investigations. The isopach map (**Figure** 4) shows the estimated thickness of the artificial fill where the base of the fill is defined as the top of the clay/peat material. The clay unit forms a sort of bowl with the thickness of the fill material increasing to the north east, varying from about 1.5 feet near the southern corner and 4 to 5 feet along the north property boundary to greater than 9 feet along Tidewater Avenue (*ERAS, 2006*).

The regional groundwater flow follows the topography, moving from areas of higher elevation to areas of lower elevation. The regional groundwater flow direction in the area of the Site is estimated to be to the west towards San Francisco Bay. During various groundwater monitoring episodes from April 14, 1994 to August 19, 2005, depth to groundwater has been measured in the monitoring wells from 1.14 to 3.88 feet below top-of-casing (**Table 2**). Groundwater appears to be unconfined. The groundwater gradient at the site ranges from 0.003 to 0.04 foot/foot (0.3% to 4%). However, given the close proximity of the Tidal Canal, the groundwater beneath the Site is probably under tidal influence with daily fluctuations in groundwater flow direction (*ERAS, 2005*), and hence there may not be a dominant groundwater gradient. The potentiometric surface map for January 2006 is shown in **Figure 3**.

3.3 Remedial Objectives

Soil and groundwater cleanup goals for the contaminants of concern at the Site have not been established by *ACEHS*, which is the Site lead agency. Based on the guidance document for Environmental Screening Levels (ESLs) from the San Francisco Bay Regional Water Quality Control Board (*SFRQWCB*, 2005), the groundwater beneath the Site does not appear to be a potential source of drinking water. Additionally, based on a preliminary risk assessment at the Site (*ERAS, 2005*), *ACEHS* concurred with *ERAS* suggestion that evaluation of Site remedial alternatives could be based on the following cleanup levels for TPH-d – 500 ppm in soil and 640 ppb (µg/l) in groundwater (*ACEHS, 2005)*. These cleanup goals correspond to the commercial ESLs shown in Table B of the *SFRQWCB*, 2005 document (i.e. for “shallow” soils).

3.4 Extent of Hydrocarbons in Soil

The soil sampling conducted during previous investigations indicates that soils beneath the site are impacted with petroleum hydrocarbons as diesel. The analytical results of the soil samples collected are summarized in **Table 1**, and the estimated lateral distribution of TPH-d in fill and clay are shown in **Figure 5** and **Figure 6**, respectively. Also, the estimated vertical distribution of TPH-d is schematically shown in five cross-sections, namely A-A' through E-E', in **Appendix B**.

As illustrated in **Figure 5**, there appears to be two areas of maximum TPH-d concentration in soil. One is around the former UST pit area. Some of this soil was removed at the time of excavation of the former USTs; however, it is likely that residual groundwater contamination, including diesel LNAPL, re-contaminated the soil that was replaced in this area. The second area extends from the northeast end of the recovery trench to around well MW-2. This appears to be an area where LNAPL advanced through the fill causing heavy contamination.

As illustrated in **Figure 6**, the highest concentrations of TPH-d in clay are located around the former UST area. This could be attributed to the fact that the original UST pit was excavated into the natural clay thereby exposing the deeper clay areas to significant contamination.

3.5 Extent of Hydrocarbons in Groundwater

The estimated concentration of TPH-d in groundwater is illustrated on **Figure 7**. The map shows that the greatest groundwater contamination (TPH-d > 10,000µg/L) is located in the central area of the site between the UST pit, recovery trench and the building, and underlies the central part of the building. It should be noted that the iso-concentration map reflects the concentrations obtained from the silica gel cleanup analyses, where available; however, the use of silica gel cleanup analysis concentration values does not significantly change the overall extent of contamination. However, it is possible the area of contamination above the cleanup goal of 640 µg/L may not extend off-site as previously estimated.

4.0 FEASIBILITY STUDY OF REMEDIAL ALTERNATIVES

Several remedial alternatives were screened based on applicability and site-specific engineering/remedial design considerations. The general technical approach of the Feasibility Study (FS) was based on the CERCLA document by U.S. Environmental Protection Agency (*US EPA*, 1988) and the alternative cleanup technology guide for corrective action plan document (*US EPA*, 1994). Based on this screening, Site remediation by Groundwater Extraction & Treatment (*GWET*) was selected as the most feasible alternative. Additionally, limited remediation of the Source Areas (former UST pit area and area in the vicinity of MW-2) may be required under this selected remedial alternative.

This section identifies the different remedial alternatives that were screened for the Site, presents the screening methodology and criteria for selecting the three top alternatives, presents the methodology and results of the field tests performed to evaluate these selected alternatives, and provides a "comparative" cost analysis for implementation of the three selected remedial alternatives.

4.1 Identification of Remedial Alternatives

Based on our experience with similar projects, evaluation or discussion with technology vendors, and Technology Profiles of the Superfund Innovation Technology Evaluation (SITE) Program (*US EPA*, 2003), the following remedial alternatives for soil and groundwater clean up were identified as part of the FS:

- No Action
- Excavation and Disposal
- Groundwater Extraction & Treatment, with Limited Source Area Remediation
- Multi-Phase Extraction
- In-situ Chemical Oxidation
- In-situ Bioremediation

4.2 Screening Methodology and Criteria

Each of the remedial alternatives identified in Section 4.1 was evaluated against a set of criteria using the weighted sum method. The weighted sum method is a means of quantifying the important factors that affect the selection of an alternative. This method provides a means of reducing the number of alternatives that can be subjected to a more detailed analysis. The weighted sum method works as follows:

The weights (on a scale from "0" to "10" in this case) are determined for each criterion in relation to its importance. For example, protection of human health and the environment are of paramount importance in this evaluation. The effectiveness of achieving this criterion by the remedial alternative is therefore given the highest weight of "10". Each alternative is subsequently graded against each criterion. Again, a scale of "0" to "10" is used to grade the alternatives. A low grade means that the alternative performs poorly against that criterion. A low grade for cost for example, means that the alternative is expected to be relatively costly to implement. A grade of "0" means non-performance against that particular criterion. The grade for each alternative against a particular criterion is multiplied by its weight. The overall grade of an alternative is the sum of the products of the grades and weights of the criteria. Finally, the alternatives are ranked, starting with the alternative that has the highest weighted sum. Table 5 presents a description of each criterion used for this screening study, and includes a rationale on how the different weights were determined for each criterion.

4.3 Results of Screening of Remedial Alternatives

Table 6 presents the results of screening of the remedial alternatives identified for the hydrocarbon-impacted soil and groundwater. The two alternatives with the highest score are listed below in increasing rank:

- Excavation & Disposal
- Groundwater Extraction & Treatment with Limited Source Area Remediation

4.4 Remedial Field Tests

As part of the evaluation of the feasibility of the selected alternatives, ART performed an Aquifer Test to characterize the hydraulic properties for the fill material beneath the Site. The following section provides the methodology and the results of the aquifer test for the above stated alternatives.

4.4.1 Aquifer Pumping Test

A constant-rate aquifer test was performed to characterize the hydraulic properties, like transmissivity (T), storativity (S), and specific yield (S_y) for the fill material beneath the Site. Aquifer testing activities included baseline monitoring of the groundwater levels for 48-hours prior to initiating the step drawdown test, performance of a step-drawdown to assess the sustainable yield of the pumping well EW-1 for a constant-rate pumping test, a constant-rate aquifer test, and aquifer recovery observation. Based on the results of the step-drawdown test, a constant-rate pumping test was performed from April 25, 2006 to April 27, 2006 at a constant discharge rate of 1.91 gallons per minute (gpm). Aquifer recovery was recorded for all the wells for a period of 27.5 hours after cessation of the constant-rate aquifer test.

The aquifer testing was performed using the newly installed 8-inch diameter dewatering well EW-1 as the pumping well. The dewatering well EW-1, which was installed to a depth of approximately 11 feet below ground surface (bgs), was screened in the fill material, and the upper portion of the clay unit from approximately 1 to 11 feet bgs. Groundwater was extracted using a submersible pump and then discharged into one a 15,000-gallon Baker Tank using 1½-inch flexible PVC hose. An in-line totalizer, connected to the submersible pump, was used to monitor the flow rate during the constant-rate pump test. Pressure transducer units (MiniTrolls) with built-in dataloggers were installed in observation wells OB-3, OB-4, and OB-6, MW-2, and MW-3, which are predominately screened in the fill material, and observation well OB-5, which is screened in the clay unit (Bay Mud) underlying the fill material, to electronically monitor the response of water levels during the aquifer test. **Figure 2** shows the locations of the observation wells and the pumping well at the Site.

The computer program AQTESOLV™, which combines statistical parameter estimation methods with interactive curve-matching capabilities, was used to assist with the aquifer parameter analysis. Based on the site subsurface lithology, drawdown data from the constant-rate pumping test were analyzed using the Neuman unconfined curve-matching method to estimate the T and S_y (*Neumann, 1972*) and the Theis unconfined curve-matching method to estimate the T and S (*Theis, 1935*) for all the wells screened in the fill material. Recovery data for the test was also analyzed using the Theis recovery method to provide an additional estimate of T (*Theis, 1935*). Additionally, T was also estimated using the 'Distance-Drawdown' method (*Cooper-Jacob*) from the data obtained at the end of the pumping period.

The test data and results, which are summarized in **Table 7** and **Appendix C**, yielded the following:

- The average values of T and S estimated for the fill material were 105 ft^2/day and 0.023, respectively; and,
- Assuming a saturated thickness of 7 feet for the fill material, the average hydraulic conductivity (K) was estimated to be 15 ft/day.

Additionally, no drawdown was observed in observation well OB-5, which is screened only in the Bay Mud and is located approximately 7 feet from the pumping well EW-1, during the duration of the constant-rate aquifer test. This implies that pumping from the fill material will exhibit minimal or no influence on the groundwater levels in the clay unit underlying the subsurface fill materials.

4.5 Preliminary Cost Estimates of Selected Remedial Alternatives

As stated previously, the established TPH-d (Total Petroleum Hydrocarbons as Diesel) clean up levels, as concurred in a letter dated December 28, 2005 from the *ACEHS*, are 500 mg/kg and 640 µg/l for soil and groundwater, respectively. Based on this criterion, preliminary cost estimates were performed as part of a "comparative" cost analysis for implementation of the two selected remedial alternatives: 1) Excavation & Disposal; and, 2) Groundwater Extraction & Treatment. The order-of-magnitude cost estimates for comparing and selecting the most cost-effective remedial alternative were based on the following:

- Design & construction of the remedial alternative
- Capital equipment costs
- System operation & maintenance (O&M)
- Site closure activities

The cost estimates were based on a conceptual design and an estimated cleanup time for each alternative. The actual cleanup time will obviously vary, and estimating the cleanup time with a higher degree of accuracy will require extensive data collection, which is generally not cost-effective.

The cost estimates indicated that the Groundwater Extraction & Treatment alternative **(Table 11**) was lower than the Excavation & Disposal alternative (**Table 10**) by approximately 45 %. Based on these cost estimates, we recommend the selection of Groundwater Extraction & Treatment as the most cost-effective alternative for Site remediation. A brief description of the cost analysis for each of the above selected alternatives is described below.

4.5.1 Excavation & Disposal

The cost estimate for the implementation of the Excavation & Disposal remedial alternative, as shown in **Table 10**, was based on the Conceptual Design and Estimated Cleanup Time, as well as the cost basis provided in **Table 9**.

4.5.1.1 *Conceptual Design*

The Excavation & Disposal remedial alternative at the Site involved dewatering, demolition, excavation and disposal of impacted soil, and backfilling for addressing the TPH-d impacted soil and groundwater beneath the Site. Additionally, a sheet pile/cut-off wall was also assumed to be installed along the perimeter of the proposed excavation to mitigate the inflow of groundwater into the Site during dewatering activities.

The dewatering of the Site was proposed to be performed using 47 dewatering wells installed along the perimeter and interior of the proposed excavation at the Site. Each of the proposed dewatering wells were assumed to be installed in a manner such that the bottom of each of the proposed dewatering wells would extend in to the top portion of the clay unit which lies beneath the fill material. Assuming that groundwater levels were at a depth of approximately 1.5 to 2.5 feet bgs, it was expected that the proposed dewatering well configuration, pumping at an initial value of approximately 50 gpm, would take approximately 60 days to dewater the Site to the bottom of the fill material (excavation bottom). The dewatering rate was expected to reduce to a steady state total of approximately 0.5 gpm within sixty (60) days from the commencement of dewatering.

The extracted groundwater was proposed to be treated through a carbon adsorption system and then discharged into the sanitary sewer. The discharge permit for temporary groundwater discharge from construction dewatering is proposed to be obtained from East Bay Municipal District (*EBMUD*).

4.5.1.2 *Estimated Cleanup Time*

The basis (**Table 9**) used for the estimating the cleanup time was developed from the following sources:

- ***Shoring/Cut-off Wall Basis* -** The basis for estimating the time frame for installing the shoring/cut-off wall along the perimeter of the proposed excavation (**Figure 8a**) was obtained from the May 15, 2006 report prepared by *ART (ART, 2006a)*. The proposed design included a steel sheet pile shoring/cut-off wall, installed to a depth of 30 feet for a 100 linear foot section in the vicinity of the truck repair shop area, and a vinyl sheet pile shoring/cut-off wall installed to a depth of 12 feet for shallower excavations for the rest of the Site. The time frame required to complete installation of the sheetpile/cut-off wall was approximately 1 to 1.5 months.

- ***Demolition Basis* -** The time required to demolish the existing site buildings was assumed to be approximately 1 to 1.5 months.

- ***Site Dewatering Basis* -** Dewatering of the Site was deemed necessary prior to excavation of the impacted soil. The recommended dewatering system alternative was obtained from the May 24, 2006 report prepared by *ART (ART, 2006b)*. The report evaluated several dewatering alternatives prior to selecting the most optimum dewatering alternative for the Site. The report provided the depth, number, and location of the proposed dewatering wells, as well as the estimated dewatering rates and the time required to dewater the Site to the bottom of the proposed excavation.

As part of the evaluation of the dewatering system, a three layer three-dimensional (3-D) numerical groundwater flow model was constructed using the parameters obtained from the aquifer test, site lithologic logs, and groundwater elevations. The numerical model was then applied to evaluate dewatering alternatives, determine the numbers and optimal locations of the dewatering wells for the selected dewatering alternative, estimate the extraction rates of the proposed dewatering system, and simulate the response of the aquifer system to the proposed optimal dewatering system. *MODFLOW2000*®, which is the United States Geological Survey (USGS) Modular Three-Dimensional Finite Difference Groundwater Flow Model code, was selected as the numerical code for performing the groundwater flow simulations and simulating the response of the aquifer system to groundwater extraction, and *MODPATH* was used to simulate the particle-tracking and capture zones. The methodology of the numerical groundwater flow model construction, calibration, and simulation is shown in **Appendix D**.

Following development of the numerical groundwater flow model and performance of the model calibration, several dewatering alternatives were evaluated. Dewatering conditions at the Site were simulated by lowering the water table to the bottom of the fill material, which is the proposed excavation depth at the site (except in the vicinity of the former UST area), using a combination of perimeter and internal dewatering wells. These dewatering wells were assumed to be installed in a manner such that the bottom of each of the proposed dewatering wells is expected to lie 5 feet within the bay mud underlying the fill material. The locations of the remedial extraction wells for the selected dewatering alternative and their simulated drawdowns for the 1, 30, and 60 day periods are shown in **Figures 8A, 8B,** and **8C**, respectively

As shown in **Figure 8C**, the proposed dewatering well configuration, comprising 47 dewatering wells and pumping at an initial value of approximately 50 gpm, resulted in drawdowns greater than 4 feet within the footprint of the proposed excavation after 60 days. These 4-foot and 5-foot drawdown contours, that enveloped the Site after 60 days of dewatering, simulated the dewatering to the bottom of the proposed excavation depth based on an assumed initial water level depth of approximately 2.5 feet bgs. Furthermore, the total dewatering rate was expected to reduce from the initial value of approximately 50 gpm to approximately 0.5 gpm in 60 days.

Hence, the time required to install the dewatering wells and dewater the Site to the required excavation depth was approximately 3 to 4 months.

- ***Excavation & Disposal Basis*** **-** Groundwater and soil contours maps from the May 12, 2006 report prepared by *ERAS (ERAS, 2006)*, and shown in **Figures 4, 5,** and **6**, respectively were used to estimate the total volume of excavated soil. The soil (fill material and clay) excavation volumes estimated in **Table 9** were based on the concentration contours of 100 mg/kg for soil and 640 μg/l for groundwater. Actual volumes, particularly for excavated soil, may be greater than shown in **Table 9** due to several reasons, including leaching of hydrocarbons in groundwater from soils located beyond the soil concentration contour of 100 mg/kg, subsurface heterogeneity and localized hydrocarbon impacts. However, contingency costs associated with these additional volumes have not been considered. Based on the volumes shown in **Table 9**, it was estimated that it would require approximately 2 to 2.5 months to complete excavation activities at the Site.

- ***Backfill Basis*** **-** The backfill recommendations were obtained from the April 5, 2006 *Draft Limited Geotechnical Evaluation Report* prepared by Murray Engineers, Inc. (*MEI, 2006*). The backfill recommendations included the use of a stabilization/separation fabric, the GeoWeb cellular-confinement system, and light-weight backfill with a compacted moist unit weight of no more than 110 pcf (pounds per cubic feet). Based on the volumes shown in **Table 9**, it was estimated that it would require approximately 2 to 2.5 months to complete backfilling activities at the Site.

Hence, the total time frame required to implement the Excavation & Disposal remedial alternative is approximately 9 to 12 months from the time of installation of the proposed sheet pile/cut-off wall.

4.5.1.3 *Estimated Cost*

Based on the conceptual design and the estimated time frame, the estimated cost for implementing the Excavation & Disposal remedial alternative, as shown in **Table 10**, is approximately $3,400,000.

4.5.2 Groundwater Extraction and Treatment (GWET) System Cost Estimate with Limited Source Area Remediation

The cost estimate for the implementation of the Groundwater Extraction and Treatment (GWET) system with Limited Source Area Remediation is shown in **Table 11**, and was based on the following Conceptual Design and Estimated Cleanup Time, as well as the basis provided in **Table 9**.

4.5.2.1 *Conceptual Design*

The GWET system addresses treatment of the TPH-d impacted groundwater beneath the Site; however, the remediation of TPH-d impacted soil, if necessary, is proposed to be performed following the evaluation of the effectiveness of the proposed GWET system.

The cost estimate for the GWET system was based on extraction by submersible pumps from ten (10) 4-inch diameter remedial wells producing an initial total flow rate of approximately 22 gpm. The extracted groundwater was assumed to be treated through a granulated carbon adsorption (GAC) system prior to discharge into the storm drain.

The cost estimate for remediation of the TPH-d impacted soil, if necessary, has been based on the limited excavation of the source areas (the former UST pit area and the area in the vicinity of MW-2). During the course of operation of the GWET system, an evaluation will be performed to determine the extent of soil remediation that may be necessary. Additionally, other options (in-situ chemical oxidation, bioremediation et al), which may prove to be more cost-effective than the excavation option, will also be evaluated. Since, pilot studies for these options have not been conducted, the performance costs of these options were not developed and used in estimating the cost of the GWET remedial alternative.

For cost estimate purpose of this selected remedial alternative, the treated groundwater is proposed to be discharged into the storm drain. A *NPDES* (National Pollutant Discharge Elimination System) permit for temporary groundwater discharge shall be obtained from the RWQCB prior to discharge into the storm drain. However, the re-injection of the extracted groundwater will be evaluated during the preparation of the Remedial Action Plan (RAP).

4.5.2.2 *Estimated Cleanup Time*

In order to determine the O&M cost, the cleanup time for groundwater was estimated for the GWET system. The numerical groundwater flow model was used determine the groundwater extraction well locations, estimate the extraction rates of the GWET system, and simulate the response of the aquifer system. The results of the aquifer system response to the proposed remedial alternative were then applied to estimate the time frame required to implement and complete the proposed remedial activities at the site. As stated previously, *MODFLOW2000*® was selected as the numerical code for performing the groundwater flow simulations and simulating the response of the aquifer system to groundwater extraction, and *MODPATH* was used to simulate the particle-tracking and capture zones of the proposed groundwater extraction wells. Additionally, the *'Pore Flush'* model was used to estimate the remediation time for cleaning the Site. The methodology of the numerical groundwater flow model construction, calibration, and simulation is discussed in **Appendix D**.

The calibrated groundwater model was used to evaluate the proposed groundwater extraction remedial alternative. The proposed remedial alternative involved the placement of ten (10) extraction wells in proximity or within areas of maximum observed TPH-d concentrations in groundwater at the Site. The locations of the remedial extraction wells are shown in **Figure 9**. The capture area at the Site is illustrated by the backward tracking particle pathlines from the proposed remedial extraction wells. As shown in **Figure 9**, the simulation indicates that the proposed extraction well configuration, pumping at an initial total of approximately 22 gpm, is anticipated to capture the on and off-site contaminant plume. The extraction rate is expected to reduce to a total of approximately 1.5 gpm when the groundwater extraction at the Site attains a steady state condition within one (1) year from the commencement of extraction.

Following simulation of groundwater extraction, the one-pore flush rate was then estimated and utilized in estimating the time of remediation for the proposed remedial alternative.

Based on estimated time necessary for one-pore volume of the contaminated area to be removed by pumping from simulated extraction wells, an estimate of remediation time was made using the method described by Zheng et. al. (*Zheng*, 1991 and 1992). The number of pore-volume flushings required to reduce the concentration of a contaminant dissolved in groundwater was estimated by:

$$\mathbf{Npv = - R \ln(Ct / Co)}$$

where: Npv = number of pore volumes

R = retardation factor

Co = initial concentration of compound

Ct = target concentration of compound

The retardation factor is calculated as:

$$\mathbf{R = 1 + (K_{oc}.f_{oc}.\rho / \eta)}$$

where: K_{oc} = organic carbon partition coefficient

f_{oc} = fraction of organic carbon in the aquifer material

ρ = bulk dry density of the aquifer material

η = porosity of the aquifer

The R values were obtained from the soil properties referenced on **Table 8**. The estimated groundwater cleanup time was determined using the maximum and most recent observed contaminant concentration in groundwater. The estimated cleanup time was determined as the time to achieve reduction in the mass of the contaminant to a level corresponding to the cleanup goal concentration of the contaminant that can be left in place in groundwater (see **Table 8**). For the purpose of our evaluation, it was assumed that the on-site groundwater will be remediated to 640 μg/L for TPH-d. Based on the results shown in **Table 8**, the estimated cleanup time for groundwater is 5.18 years. The actual cleanup time will obviously vary, and estimating the cleanup time with a higher degree of accuracy will require extensive data collection, which is generally not cost-effective. However, for the purpose of estimating the cost for implementing the GWET remedial alternative, a cleanup time of 6 years has been applied.

4.5.2.3 *Estimated Cost*

Based on the conceptual design and the estimated time frame of 6 years, the estimated cost for implementing the GWET remedial alternative, as shown in **Table 11**, is approximately $1,900,000. These costs also include costs associated with limited source area excavation.

5.0 RECOMMENDED REMEDIAL ALTERNATIVE

The feasibility evaluation of remedial alternatives for TPH-d impacted soil and groundwater beneath the Site resulted in the following:

- The Groundwater Extraction & Treatment (GWET) system with limited Source Area Remediation remedial alternative was selected as the most viable and cost-effective alternative to remediate petroleum hydrocarbon impacted soil and groundwater existing beneath the site.

- The proposed GWET system, which addresses treatment of the TPH-d impacted groundwater beneath the Site, would primarily consist of ten (10) 4-inch diameter extraction wells, and a granulated carbon (GAC) abatement unit comprising of carbon vessels and associated piping and instrumentation. The extraction wells will be screened from two feet to the well completion depth of a maximum of 15 feet. The casing of all wells will consist of Schedule 40 PVC pipe with screen slot size of 0.020 inch. During preparation of the Remedial Action Plan (RAP) and construction documents, the actual location, well size and screen lengths may change due to Site access restrictions, utility locations and review of any additional information.

- The cost estimate for remediation of the TPH-d impacted soil, if necessary, has been based on the limited excavation of the source areas (the former UST pit area and the area in the vicinity of MW-2). During the course of operation of the GWET system, an evaluation will be performed to determine the extent of soil remediation that may be required. Additionally, other options (in-situ chemical oxidation, bioremediation et al), which may prove to be more cost-effective than the excavation option, will also be evaluated. Since, pilot studies for these options have not been conducted, the performance costs of these options were not developed and used in estimating the cost of the GWET remedial alternative.

- For cost estimate purpose of this selected remedial alternative, the treated groundwater is proposed to be discharged into the storm drain. A *NPDES* (National Pollutant Discharge Elimination System) permit for temporary groundwater discharge shall be obtained from the RWQCB prior to discharge into the storm drain. However, the re-injection of the extracted groundwater will be evaluated during the preparation of the RAP.

- The GWET system will be operated until cleanup goals are achieved or until such a time that the remediation effort is shown to no longer be technically and economically feasible, such as when groundwater concentrations reach asymptotic levels. At this point, we recommend implementing a risk-based corrective action (RBCA) assessment.

- Once the cleanup goals established by *ACEHS* have been met by remediation activities, a confirmatory sampling program or data analysis consistent with the guidelines of the *ACEHS* will be prepared to receive Site closure.

6.0 LIMITATIONS

This report has been prepared by Applied Remedial Technologies, Inc. (*ART*) for the exclusive use of *R.W.L. Investment, Inc.* (*Client*) to address removal of petroleum hydrocarbons existing in the subsurface soil and groundwater at the Heitz Trucking (formerly DiSalvo Trucking) facility located at 4919 Tidewater Avenue, Oakland, California (Site).

ART professional services have been performed using the degree of care and skill ordinarily exercised under similar circumstances by other engineers, geologists, and/or scientists practicing in this field. No other warranty, express or implied, is made as to the professional advice in this report.

ART offers no assurances and assumes no responsibility for site conditions or activities that were outside the Scope of Work (SOW) outlined in the attached report. In the preparation of this report, *ART* has relied on the accuracy of documents, oral information, and materials provided by others. No warranty is expressed or implied with the usage such information or material. This report may contain recommendations and conclusions, which are generally based on incomplete and/or insufficient information of the site conditions present. However, further engineering and hydrogeological investigation may reveal additional information, which may require the enclosed recommendations and conclusions to be reevaluated.

Prior to use of this report by any party other than the *Client*, the party should notify *ART* of such intended use. The attached report my not contain sufficient information for purposes of other parties or other uses. Any use or reliance on this report by a third party shall be at such party's sole risk.

The findings set forth in the attached report are strictly limited in time and scope to the date of the services described herein, and not on scientific tasks or procedures beyond the services agreed upon, or the time and budgeting constraints imposed by the *Client*. Any conditions and factors, including land use and contaminant plume migration, may change over passage of time, additional investigation may be required to update the site conditions (on-site and off-site), which may require the findings in the report to be reevaluated.

7.0 REFERENCES

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TABLES

TABLE 1 - SUMMARY OF ANALYTICAL RESULTS FOR SOIL SAMPLES
4919 Tidewater Avenue, Oakland, CA

Sample ID (Boring)	Date	Depth (Ft bgs)	TPH-D (mg/Kg)	TPH-G (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethylbenzene (mg/Kg)	Xylenes (mg/Kg)	O & G (mg/Kg)	TPH-WO (mg/Kg)
Excavation										
DST 1	16-Mar-89	29 inches	240	NA	NA	NA	NA	NA	NA	NA
DST 2	16-Mar-89	8.0	110	NA	NA	NA	NA	NA	NA	NA
DST 3	16-Mar-89	7.0	110	NA	NA	NA	NA	NA	15	NA
DS-1	16-Mar-89	6.0	<3	NA	<.02	<.02	<0.1	<.04	29	NA
DS-2	24-Mar-89	6.0	<3	NA	<.02	<.02	<0.1	<.04	59	NA
DS-3	24-Mar-89	Ukn	<3	NA	<.02	<.02	<0.1	<.04	NA	NA
DS-4	24-Mar-89	7.0	64	NA	<.02	<.02	<0.1	<.04	NA	NA
DS-5	24-Mar-89	Unk	<3	NA	<.02	<.02	<0.1	<.04	NA	NA
DS-6	24-Mar-89	Unk	<3	NA	<.02	<.02	<0.1	<.04	NA	NA
WOP-1	24-May-89	Unk	<3,000	NA	<.02	<.02	<.03	<.02	NA	<10,000
WOP-2	24-May-89	Unk	<3,000	NA	<.02	<.02	<.03	<.02	NA	<10,000
Tank 4	27-Mar-89	Unk	<3	<500	<.03	<.03	<0.1	<.05	NA	NA
Line Samples										
SB1	19-Jul-95	4.0	34.0	NA	ND	ND	ND	ND	NA	NA
SB2	19-Jul-95	4.0	ND	NA	ND	ND	ND	ND	NA	NA
Boring										
LS-1 (BH-4)	1-May-89	6.0	<3	NA	NA	NA	NA	NA	NA	NA
LS-2 (BH-3)	1-May-89	6.0	<3	NA	NA	NA	NA	NA	NA	NA
LS-4 (BH-6)	1-May-89	3.5	3,000	NA	NA	NA	NA	NA	NA	NA
LS-6 (BH-7)	2-May-89	6.0	40	NA	NA	NA	NA	NA	NA	NA
LS-9 (BH-10)	3-May-89	4.25	460	NA	NA	NA	NA	NA	NA	NA
LS-10 (BH-11)	3-May-89	5.0	46,000	NA	NA	NA	NA	NA	27,000	NA
LS-11 (BH-13)	3-May-89	4.0	420	NA	NA	NA	NA	NA	NA	NA
LS-12 (BH-14)	3-May-89	4.5	260	NA	NA	NA	NA	NA	NA	NA
LS-16 (BH-16)	4-May-89	3-3.25	<3	NA	NA	NA	NA	NA	NA	NA
LS-18 (BH-18)	4-May-89	3.75-4	<3	NA	NA	NA	NA	NA	NA	NA
LS-21 (BH-21)	5-May-89	4.3	<3	NA	NA	NA	NA	NA	NA	NA
LS-22 (BH-22)	5-May-89	3.3	<3	NA	NA	NA	NA	NA	NA	NA
MW-1	7-Apr-94	3.0	4.4	ND	ND	ND	ND	ND	ND	NA
MW-2	7-Apr-94	Unk	29,000	ND	ND	ND	ND	ND	36,000	NA
MW-3	7-Apr-94	4.0	150	250	0.180	ND	2.1	2.0	ND	NA
EB-3	7-Apr-94	2.0	<1	ND	ND	ND	ND	ND	ND	NA
EB-5	7-Apr-94	2.5-3	<5	ND	ND	ND	ND	ND	ND	NA
EB-6	7-Apr-94	Unk	2.5	ND	ND	ND	ND	ND	180	NA

TABLE 1 - SUMMARY OF ANALYTICAL RESULTS FOR SOIL SAMPLES
4919 Tidewater Avenue, Oakland, CA

Sample ID (Boring)	Date	Depth (Ft bgs)	TPH-D (mg/Kg)	TPH-G (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethylbenzene (mg/Kg)	Xylenes (mg/Kg)	O & G (mg/Kg)	TPH-WO (mg/Kg)
EB-8	7-Apr-94	3.0	<1	ND	ND	ND	ND	ND	ND	NA
EB11*	7-Apr-94	Unk	7.5	ND	ND	ND	ND	ND	ND	NA
MW4	19-Jul-95	4.0	<1	NA	<.005	<.005	<.005	<.005	NA	NA
MW4	19-Jul-95	8.0	<1	NA	<.005	<.005	<.005	<.005	NA	NA
SB2	20-Dec-00	6.0	<10	NA	NA	NA	NA	NA	NA	NA
SB5	20-Dec-00	6.5	<10	NA	NA	NA	NA	NA	NA	NA
SB6	20-Dec-00	7.0	<10	NA	NA	NA	NA	NA	NA	NA
SB10	20-Dec-00	6.0	<10	NA	NA	NA	NA	NA	NA	NA
SB12	20-Dec-00	6.5	<10	NA	NA	NA	NA	NA	NA	NA
SB14	20-Dec-00	7.0	<10	NA	NA	NA	NA	NA	NA	NA
SB15	20-Dec-00	6.0	<10	NA	NA	NA	NA	NA	NA	NA
SB16	20-Dec-00	6.5	14	NA	NA	NA	NA	NA	NA	NA
B-1	**24-Feb-06**	**2.75**	**1.9**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-2	**24-Feb-06**	**3.5**	**4,700**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-2	**24-Feb-06**	**7.0**	**1,100**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-3	**24-Feb-06**	**2.75**	**74**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-3	**24-Feb-06**	**7.0**	**6.0**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-4	**24-Feb-06**	**5.0**	**<0.99**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-5	**24-Feb-06**	**5.0**	**<0.99**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-5	**24-Feb-06**	**6.75**	**<0.99**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-6	**27-Feb-06**	**4.0**	**3.6**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-6	**27-Feb-06**	**6.0**	**4.8**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-7	**27-Feb-06**	**4.0**	**<0.99**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-7	**27-Feb-06**	**6.0**	**14**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-8	**27-Feb-06**	**3.0**	**<1.0**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-8	**27-Feb-06**	**4.5**	**1.6**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-9	**27-Feb-06**	**4.5**	**5,400**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-9	**27-Feb-06**	**10.0**	**4.7**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
OB-5	**7-Apr-06**	**11.0**	**1.9 (4.3)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-10	**12-Apr-06**	**4.5**	**<1.0 (<1.0)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-10	**12-Apr-06**	**9.5**	**<0.99 (<0.99)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-11	**12-Apr-06**	**4.5**	**2,900 (3,000)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-11	**12-Apr-06**	**8.5**	**1.2**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-11 **	**12-Apr-06**	**8.5**	**0.69** (0.89)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-11	**12-Apr-06**	**8.75**	**<0.99 (<0.99)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-12	**12-Apr-06**	**2.5**	**990**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-12 **	**12-Apr-06**	**2.5**	**5.1** (2.8)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

TABLE 1 - SUMMARY OF ANALYTICAL RESULTS FOR SOIL SAMPLES
4919 Tidewater Avenue, Oakland, CA

Sample ID (Boring)	Date	Depth (Ft bgs)	TPH-D (mg/Kg)	TPH-G (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethylbenzene (mg/Kg)	Xylenes (mg/Kg)	O & G (mg/Kg)	TPH-WO (mg/Kg)
B-12	**12-Apr-06**	**2.75**	**1,100 (1,300)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-12	**12-Apr-06**	**7.5**	**<0.99 (<1.0)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-13	**12-Apr-06**	**4.0**	**<0.99 (<0.99)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-14	**12-Apr-06**	**4.0**	**92 (73)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-14	**12-Apr-06**	**7.5**	**2.5 (1.9)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-15	**12-Apr-06**	**8.0**	**<0.99 (<1.0)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Location Uknown										
DS-1	20-Jun-89	Unk	<20	NA	0.092	<.05	<.05	1.456	NA	NA
DS-2	20-Jun-89	Unk	4,310	NA	<.05	<.05	0.19	0.645	NA	NA
DS-3	20-Jun-89	Unk	1,690	NA	<.05	<.05	<.05	0.284	NA	NA
DS-4	20-Jun-89	Unk	420	NA	0.197	<.05	<.05	<.05	NA	NA
LS-1	15-Jun-90	Unk	9.0	NA	NA	NA	NA	NA	NA	NA
LS-2	15-Jun-90	Unk	ND	NA	NA	NA	NA	NA	NA	NA
LS-3	15-Jun-90	Unk	ND	NA	NA	NA	NA	NA	NA	NA
LS-4	15-Jun-90	Unk	ND	NA	NA	NA	NA	NA	NA	NA
LS-5	15-Jun-90	Unk	ND	NA	NA	NA	NA	NA	NA	NA
LS-6	15-Jun-90	Unk	ND	NA	NA	NA	NA	NA	NA	NA
ESL (Residential)			**100**	**100**	**0.18**	**9.3**	**32**	**11**	**500**	**-**
ESL (Commercial)			**500**	**400**	**0.38**	**9.3**	**32**	**11**	**1,000**	**-**

NOTES
TPH-D = Total petroleum hydrocarbons quantitated as diesel. Results with silica gell cleanup in parentheses.
TPH-G = Total petroleum hydrocarbons quantitated as gasoline
MTBE = Methyl tertiary butyl ether by EPA Method 8020, with confirmation by EPA Method 8260B.
O&G = Oil and Grease
TPH-WO = Total petroleum hydrocarbons quantitated as waste oil
<50 = Analyte not detected above the laboratory method reporting limit indicated.
ND = Analyte not detected above the laboratory method reporting limit indicated.
ESL=Environmental Screening Levels shallow soil, residental land use,not potential drinking water
NA = Not Analyzed
Unk = unknown sample depth
* = Report as CB in oil and grease results by laboratory
** = Soluble Threshold Limit Concentration Results in milligrams per liter

TABLE 2 - SUMMARY OF GROUNDWATER ELEVATION DATA
4919 Tidewater Avenue, Oakland, CA

Well Number	Date Monitored	Top of Casing Elevation (ft amsl)	Depth to Liquid (feet)	Depth to Water (feet)	LNAPL Thickness (feet)	Groundwater Elevation (ft amsl)
MW-1	14-Apr-94	2.68		1.26		1.42
	17-Nov-94	2.68		3.88		-1.20
	13-Aug-95	2.68		3.09		-0.41
	23-Aug-99	2.68		2.17		0.51
	26-May-99	2.68		2.29		0.39
	26-Apr-01	2.68		1.14		1.54
	5-Sep-02	2.68		2.15		0.53
	18-Aug-05	2.68	2.54	2.54	0	0.14
	19-Aug-05	2.68	6.1	6.10	0	-3.42
	25-Jan-06	2.68	2.02	2.02	0	0.66
	9-May-06	2.68	0.30	0.30	0	2.38
	12-Jul-06	2.68	1.81	1.81	0	0.87
MW-2	14-Apr-94	3.5		1.92		1.58
	18-Nov-94	3.5		1.78		1.72
	13-Aug-95	3.5		2.95		0.55
	23-Aug-99	3.5		2.89		0.61
	26-May-99	3.5		2.96		0.54
	26-Apr-01	3.5		1.74		1.76
	5-Sep-02	3.5		3.06		0.44
	18-Aug-05	3.5	2.62	2.62	0	0.88
	19-Aug-05	3.5	2.62	2.62	0	0.88
	25-Jan-06	3.5	1.27	1.27	0	2.23
	12-Jul-06	3.5	2.42	2.42	0	1.08
MW-3	14-Apr-94	2.9		1.33		1.57
	18-Nov-94	2.9		1.23		1.67
	13-Aug-95	2.9		2.18		0.72
	23-Aug-99	2.9		2.18		0.72
	26-May-99	2.9		2.50		0.40
	26-Apr-01	2.9		1.29		1.61
	5-Sep-02	2.9		2.34		0.56
	18-Aug-05	2.9	2.04	2.08	0.04	0.85
	19-Aug-05	2.9	2.07	2.10	0.03	0.82
	25-Jan-06	2.9	0.97	0.97	0	1.93
	12-Jul-06	2.9	1.82	1.82	0	1.08
MW-4	13-Aug-95	3.87		3.33		0.54
	26-May-99	3.87		3.31		0.56
	26-Apr-01	3.87		1.69		2.18
	5-Sep-02	3.87		3.31		0.56
	18-Aug-05	3.87	3.37	3.37	0	0.50
	19-Aug-05	3.87	3.46	3.46	0	0.41
	25-Jan-06	3.87	2.5	2.5	0	1.37
	12-Jul-06	3.87	3.09	3.09	0	0.78

NOTES
ft amsl = feet above mean sea level
Depth to water measured in feet below top of casing survey point.
Groundwater Elevation reported in feet above mean sea level.

TABLE 3 - SUMMARY OF ANALYTICAL RESULTS FOR GROUNDWATER GRAB SAMPLES
4919 Tidewater Avenue, Oakland, CA

Well Number Sample Date	Date	TPH-D	TPH-G	Benzene	Toluene	Ethylbenzene	Xylenes	O&G	VOC
		all results in micrograms per liter							
WS-1(BH2)	5/2-3/89	<80	NA	NA	NA	NA	NA	NA	NA
WS-1	16-May-89	NA	NA	110	41	1,000	120	NA	8,000
WS-2	16-May-89	690,000	NA	NA	NA	NA	NA	NA	NA
WWOP-1	24-May-89	<100	NA	<2	120	260	3,300	36,000	ND
SB1-GW	20-Dec-00	<100	NA	NA	NA	NA	NA	NA	NA
SB2-GW	20-Dec-00	26,000	NA	NA	NA	NA	NA	NA	NA
SB3-GW	20-Dec-00	<100	NA	NA	NA	NA	NA	NA	NA
SB4-GW	20-Dec-00	<100	NA	NA	NA	NA	NA	NA	NA
SB5-GW	20-Dec-00	110,000	NA	NA	NA	NA	NA	NA	NA
SB6-GW	20-Dec-00	230,000	NA	NA	NA	NA	NA	NA	NA
SB7-GW	20-Dec-00	<100	NA	NA	NA	NA	NA	NA	NA
SB8-GW	20-Dec-00	<100	NA	NA	NA	NA	NA	NA	NA
SB9-GW	20-Dec-00	<100	NA	NA	NA	NA	NA	NA	NA
SB10-GW	20-Dec-00	670,000	NA	NA	NA	NA	NA	NA	NA
SB11-GW	20-Dec-00	<100	NA	NA	NA	NA	NA	NA	NA
SB12-GW	20-Dec-00	190,000	NA	NA	NA	NA	NA	NA	NA
SB13-GW	20-Dec-00	<100	NA	NA	NA	NA	NA	NA	NA
SB14-GW	20-Dec-00	44,000	NA	NA	NA	NA	NA	NA	NA
SB15-GW	20-Dec-00	48,000	NA	NA	NA	NA	NA	NA	NA
SB16-GW	20-Dec-00	2,000	NA	NA	NA	NA	NA	NA	NA
EB-1GWS	7-Apr-94	240	ND	ND	ND	ND	ND	ND	NA
EB-2GWS	7-Apr-94	64,000	2,500	ND	1.2	ND	ND	100	NA
EB-3GWS	7-Apr-94	330	ND	ND	ND	ND	ND	ND	NA
EB-4GWS	7-Apr-94	73,000	200	200	ND	0.80	4.4	38	NA
EB-5GWS	7-Apr-94	<50	ND	ND	ND	ND	ND	ND	NA
EB-6GWS	7-Apr-94	650	94	ND	ND	ND	ND	ND	NA
EB-7GWS	7-Apr-94	<50	ND	ND	ND	ND	ND	ND	NA
EB-8GWS	7-Apr-94	<50	ND	ND	ND	ND	ND	ND	NA
EB-9GWS	7-Apr-94	<50	ND	ND	ND	ND	ND	ND	NA
EB-10GWS	7-Apr-94	220	ND	ND	ND	ND	ND	3.4	NA
EB-11GWS	7-Apr-94	290	ND	ND	ND	ND	ND	ND	NA
B-1	**24-Feb-06**	**2,000**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-2	**24-Feb-06**	**12,000**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-3	**24-Feb-06**	**2,400**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-4	**24-Feb-06**	**910**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

TABLE 3 - SUMMARY OF ANALYTICAL RESULTS FOR GROUNDWATER GRAB SAMPLES
4919 Tidewater Avenue, Oakland, CA

Well Number Sample Date	Date	TPH-D	TPH-G	Benzene	Toluene	Ethylbenzene	Xylenes	O&G	VOC
		all results in micrograms per liter							
B-5	**24-Feb-06**	**490**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-6	**27-Feb-06**	**190**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-7	**27-Feb-06**	**4,100**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-8	**27-Feb-06**	**1,300**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-9	**27-Feb-06**	**13,000**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-10	**12-Apr-06**	**290 (<50)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-11	**12-Apr-06**	**1,800,000 (660,000)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-12	**12-Apr-06**	**32,000,000 (2,500,000)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-13	**12-Apr-06**	**1,100 (130)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-14	**12-Apr-06**	**4,700 (560)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
B-15	**12-Apr-06**	**1,400 (320)**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
ESL		**640**	**500**	**46**	**130**	**290**	**100**	**640**	**-**

NOTES
TPH-G = Total petroleum hydrocarbons quantitated as gasoline
TPH-D = Total petroleum hydrocarbons quantitated as diesel. Results with silica gell cleanup in parentheses.
MTBE = Methyl tertiary butyl ether
<50 = Analyte not detected above the laboratory method reporting limit indicated.
ND = Analyte not detected above the laboratory method reporting limit indicated.
ESL = Environmental Screening Levels for groundwater that is not potential drinking water
NA = Not Analyzed
O&G = Oil and Grease
VOC= Volatile Organic Compounds, no more specific information avialable in GenTech 24 March 1994, and original report not found during file review.

TABLE 4 - SUMMARY OF ANALYTICAL RESULTS FOR GROUNDWATER IN MONITORING WELLS
4919 Tidewater Avenue, Oakland, CA

Well Number	TPH-D	TPH-G	Benzene	Toluene	Ethylbenzene	Xylenes	MTBE
Sample Date	all results in micrograms per liter						
MW-1							
14-Apr-94	ND	ND	ND	ND	ND	ND	NA
17-Nov-94	ND	ND	ND	ND	ND	ND	1,100
13-Aug-95	ND	ND	ND	ND	ND	ND	NA
26-May-99	ND	60	0.6	ND	0.8	1.9	ND
23-Aug-99	ND	NA	ND	ND	ND	ND	NA
16-Oct-00	150	<50	<0.5	<0.5	<0.5	<0.5	NA
26-Apr-01	1,300	<50	<0.5	<0.5	<0.5	<0.5	NA
5-Sep-02	<50	NA	<0.5	<0.5	<0.5	<1	9.8
18-Aug-05	410(x)	<50	<1	<1	<1	<1	6.0
25-Jan-06*	**3,600**	<50	2.3	<0.5	<0.5	1.2	11.0
12-Jul-06	100	<50	<0.5	<0.5	<0.5	<1	6.2
MW-2							
14-Apr-94	FP	FP	FP	FP	FP	FP	NA
17-Oct-94	28,000	ND	ND	ND	ND	ND	NA
13-Aug-95	180	ND	ND	ND	ND	ND	NA
26-May-99	120	ND	ND	ND	ND	ND	ND
23-Aug-99	61	NA	ND	ND	ND	ND	NA
16-Oct-00	3,400	570	<0.5	<0.5	<0.5	<0.5	NA
26-Apr-01	57,000	2,400	<0.5	<0.5	<0.5	<0.5	NA
5-Sep-02	27,100	NA	<0.5	<0.5	<0.5	<1	5.1
18-Aug-05	13,300	<50	<10	<10	<10	<10	<30
25-Jan-06*	**110,000**	**1,200**	<10	<10	<10	<20	<10
12-Jul-06	**5,900**	330	<0.5	<0.5	<0.5	<1	3.6
MW-3							
14-Apr-94	7,700	250	ND	ND	ND	1.2	NA
17-Oct-94	160,000	ND	ND	ND	ND	ND	NA
13-Aug-95	1,500	ND	ND	ND	ND	ND	NA
26-May-99	1,100	160	1.6	1.1	16	54.00	ND
23-Aug-99	84	NA	ND	ND	ND	ND	NA
16-Oct-00	42,000	130	0.52	<0.5	<0.5	<0.5	NA
26-Apr-01	21,000	310	<0.5	<0.5	<0.5	<0.5	NA
5-Sep-02	1,990	NA	<0.5	<0.5	<0.5	<1	31.1
18-Aug-05	FP	FP	FP	FP	FP	FP	FP
25-Jan-06*	**21,000**	440	<2.5	<2.5	<2.5	<5.0	29
12-Jul-06	**16,000**	280	<0.5	<0.5	<0.5	<1	47
MW-4							
13-Aug-95	ND	450	2.1	0.7	4.1	13	NA
26-May-99	100	600	0.7	ND	ND	5.8	ND
23-Aug-99	180	NA	ND	ND	ND	ND	NA
16-Oct-00	75,000	890	<0.5	<0.5	<0.5	11	NA
26-Apr-01	24,000	2,100	<0.5	<0.5	<0.5	<0.5	NA
5-Sep-02	17,000	NA	<0.5	<0.5	<0.5	<1	1.2
18-Aug-05	6,200	<50	<1	<1	<1	<1	<3
25-Jan-06	**8,200**	110	2.0	0.87	<0.5	2.3	4.5
12-Jul-06	**5,200**	250	<0.5	<0.5	<0.5	<1	0.93
ESL							
Aquatic Habitat	**640**	**500**	46	130	290	100	8,000

NOTES
TPH-D = Total petroleum hydrocarbon quantitated as diesel.
TPH-G = Total petroleum hydrocarbon quantitated as gasoline.
MTBE = Methyl tertiary butyl ether.
FP=Floating Product, monitoring well sample not collected
NA = Not analyzed.
<50 = Analyte not detected above the laboratory method reporting limit indicated.
ND = Analyte not detected above the laboratory method reporting limit indicated.
* = Q1 06 TPH-D sample collected on 2-Feb-06
(x) = Chromatogram does not resemble the typical diesel pattern.
ESL = Environmental Screening Levels for groundwater that is not potentioal groundwater

TABLE 5 - SCREENING CRITERIA AND WEIGHTS

4919 Tidewater Avenue, Oakland, CA

Criterion	Weight	Percentage of Total Weight (%)	Rationale
1. Overall Protection of Human Health and Environment	10	14.3	Of paramount importance, since this is the major driving force for the actions to be taken at the Site.
2. Compliance w/ Regulatory Criteria/Regulatory Acceptance	7	10.0	Factor of high importance. This criterion takes into account expected regulatory accepance of the alternative considered.
3. Technology Status/ Commercial Availability	5	7.1	Of moderate importance. This accounts for the stage of development of a technology, and whether the technology can be readily procured.
4. Generation of Hazardous Residuals	5	7.1	Of moderate importance. This accounts for formation of hazardous by-products or contaminated streams that need to be addressed further.
5. System Reliability/Complexity/Maintainability	4	5.7	Of minor importance, since this is also partly translated in the cost. This accounts for possible operational problems that could be encountered when implementing an alternative.
6. Health & Safety Concerns During Operation	10	14.3	Factor of high importance. This is a measure of the operation of the alternative will affect the on-site personnel, system operators and the surrounding community.
7. Time to Clean Up	5	7.1	Of moderate importance.
8. Order of Magniude Cost	10	14.3	Factor of high importance. This criterion takes into account expected regulatory accepance of the alternative considered.
9. Long Term Effectiveness/Permanence	7	10.0	Of high importance. This criterion accounts for whether the treatment of targeted contaminants is permanent.
10. Community Acceptability	7	10.0	Of high importance. This criterion takes into account the degree to which use of a technology is acceptable to the public.
TOTAL	70	100	

TABLE 6 - SCREENING OF REMEDIAL ALTERNATIVES

4919 Tidewater Avenue, Oakland, CA

		No Action			Excavation and Disposal			In-situ Chemical Oxidation		
Criterion	**Weight (W)**	**Grade (G)**	**(WxG)**	**Rationale**	**Grade (G)**	**(WxG)**	**Rationale**	**Grade (G)**	**(WxG)**	**Rationale**
1. Overall Protection of Human Health and Environment	10	0	0	- Impacted soil and gw remain in place -Require Risk Assessment	6	60	-Liability transferred to TSDF	4	40	-Performance for high conc. of COCs and in bay mud is questionable; generally polishing use
2. Compliance w/ Regulatory Criteria/Regulatory Acceptance	7	0	0	-Impacted soils and gw exceed criteria	10	70	-Generally full compliance	4	28	-Performance for high conc. of COCs and in bay mud is questionable; generally polishing use
3. Technology Status/ Commercial Availability	5	10	50	-Easy to implement	10	50	-Generally available	6	30	-Few vendors for chem. ox.
4. Generation of Hazardous Residuals	5	0	0	-Impacted soils remain unaltered	0	0	-Impacted soils remain unaltered	8	40	-Relatively low
5. System Reliability/ Complexity/Maintainability	4	10	40	-Easy to implement	7	28	-Easy to implement; shoring required	7	28	-Relatively low maintenance; however reliability questionable
6. Health & Safety Concerns During Operation	10	10	100	-Not applicable/minimal	7	70	-Safety concerns during excavation & transport	8	80	-Minimal
7. Time to Clean Up	5	0	0	-Very long	10	50	-Relatively short	6	30	-Moderate to long
8. Order of Magniude Cost	10	10	100	-Relatively low	4	40	-High; removal of existing structures	7	70	-Low to medium
9. Long Term Effectiveness/ Permanence	7	0	0	-Impacted soil and gw remain in place	8	56	-Generally effective	4	28	-Performance of chem. ox. is questionable; generally polishing use
10. Community Acceptability	7	10	70	-Non-intrusive; easily acceptable	6	42	-Large excavation; however not near residential area	8	56	-In-situ; therefore generally acceptable
Total Weighted Grade			360			466			430	
RANKING			6			2			3	

TABLE 6 - SCREENING OF REMEDIAL ALTERNATIVES

4919 Tidewater Avenue, Oakland, CA

		In-situ Bioremediation			Multi Phase Extraction			Groundwater Extraction & Treatment		
Criterion	**Weight (W)**	**Grade (G)**	**(WxG)**	**Rationale**	**Grade (G)**	**(WxG)**	**Rationale**	**Grade (G)**	**(WxG)**	**Rationale**
1. Overall Protection of Human Health and Environment	10	2	20	-Performance for high conc. of COCs and in bay mud is questionable; generally polishing use	3	30	- Significant reduction of long term liability in ground-water. Diesel removal in soil is questionable	8	80	- Significant reduction of long term liability.
2. Compliance w/ Regulatory Criteria/Regulatory Acceptance	7	2	14	-Performance for high conc. of COCs and in bay mud is questionable; generally polishing use	3	21	-Generally full compliance in groundwater. Diesel in soil is questionable	7	49	-Generally full compliance
3. Technology Status/ Commercial Availability	5	6	30	-Relatively few vendors for in-situ bioremediation	10	50	-Generally available	10	50	-Generally available
4. Generation of Hazardous Residuals	5	8	40	-Relatively low	6	30	-Air emission issues -Water disposal issues	7	35	-Water disposal issues
5. System Reliability/ Complexity/Maintainability	4	8	32	-Relatively low maintenance; however reliability questionable	6	24	-Relatively more complicated -Water treatment	7	28	-Water treatment & disposal
6. Health & Safety Concerns During Operation	10	8	80	-Minimal	8	80	-Safety during operation of treatment system	8	80	-Safety during operation
7. Time to Clean Up	5	6	30	-Moderate to long	4	20	-Long; due to diesel removal in soil is questionable	5	25	-Relatively Long
8. Order of Magniude Cost	10	8	80	-Relatively Low	4	40	-High; due to diesel removal in soil is questionable	6	60	-Relatively high for gw extraction
9. Long Term Effectiveness/ Permanence	7	2	14	-Performance of in-situ bio is questionable; generally polishing use	3	21	-Generally effective for groundwater. Diesel removal in soil is questionable	4	28	-Generally effective
10. Community Acceptability	7	8	56	-In-situ; therefore therefore acceptable	7	49	-In-situ; generally acceptable; Air emission issues	7	49	-Generally acceptable; water disposal issues
Total Weighted Grade			396			365			484	
RANKING			4			5			1	

TABLE 7 - CONSTANT-RATE AQUIFER TEST RESULTS

4919 Tidewater Avenue, Oakland, CA

Pumping Well and Pumping Parameters	Observation Well	Distance from Pumping Well (feet)	Response Observed	Maximum Drawdown (feet)	Evaluation of Drawdown (D) or Recovery (R) Data	Method of Analysis	Transmissivity T (ft^2 / day)	Thickness b (ft)	Hydraulic Conductivity (ft/day)	Hydraulic Conductivity (cm/sec)	Storativity S	Specific Yield Sy
EW-1	MW-2	15.75	Y	1.55	D	Neumann	50	7	7	0.0025	0.017	0.056
Total Q = 1.91 gpm					D	Theis	95	7	14	0.0048	0.030	--
Pump On : 05/25/2006					R	Theis Recovery	73	7	10	0.0037	--	--
Pump Off : 05/27/2006												
Duration Pumped = 2910 mins	MW-3	97	Y	0.47	D	Neumann	71	7	10	0.0036	0.002	0.015
					D	Theis	143	7	20	0.0072	0.009	--
					R	Theis Recovery	153	7	22	0.0077	--	--
	OB-3	7.5	Y	1.99	D	Neumann	74	7	11	0.0037	0.012	0.040
					D	Theis	99	7	14	0.0050	0.026	--
					R	Theis Recovery	89	7	13	0.0045	--	--
	OB-4	16.75	Y	1.50	D	Neumann	84	7	12	0.0042	0.006	0.019
					D	Theis	116	7	17	0.0059	0.012	--
					R	Theis Recovery	94	7	13	0.0048	--	--
	OB-6	18.75	Y	1.48	D	Neumann	69	7	10	0.0035	0.001	0.006
					D	Theis	109	7	16	0.0055	0.004	--
					R	Theis Recovery	89	7	13	0.0045	--	--
			Estimate of Shallow Zone using the Distance-Drawdown Method				99	7	14	0.0050	--	--
				AVERAGE ARITHMETIC ESTIMATES			94	7	13	0.0047	0.012	0.027

TABLE 8 - ESTIMATED CLEANUP TIME OF GROUNDWATER (PORE VOLUME METHOD)

4919 Tidewater Avenue, Oakland, CA

Method:

Based on estimated time necessary for one-pore volume of the contaminated area to be removed by pumping from simulated extraction wells, an estimate of remediation time can be made using the method described by Zheng et al. (Ground Water, 30, pp.440-442, 1992; Ground Water, 29, pp.838-348, 1991).

The number of pore-volume flushings required to reduce the concentration of a contaminant dissolved in groundwater can be estimated by:

$$Npv = - R \ln(C_t / C_o)$$

Npv - number of pore volumes
R - retardation factor
C_o - initial concentration of the contaminant
C_t - target concentration of the contaminant

The retardation factor R is dependent of the contaminant and subsurface characteristics, and is calculated by

$$R = 1 + K_{oc} f_{oc} \rho / \nu$$

K_{oc} - organic carbon partition coefficient
f_{oc} - fraction of organic carbon in the aquifer material
ρ - bulk dry density of the aquifer material
ν - porosity of the aquifer

Once Npv is calculated, the cleanup time is estimated by multiplying Npv by the time required for one pore-volume of clean water to flush through the contaminated area. The latter is estimated from the particle tracking simulations, which were performed using MODPATH, by counting the number of arrows (on flow maps) along the computed streamlines within the affected area.

Soil Data

Parameter	Value
f_{oc}	1.00E-04
ρ (g/cc)	1.9
ν	0.3

Maximum Remediation Time Calculations and Results:

Contaminant	K_{oc}	R	C_o (ppb)	C_t (ppb)	Npv	Flush Time (yr)	Cleanup Time (yr)	Comments
TPH-d	5010	4.17	2500000	640	34.51	0.15	5.18	Vicinity of B-12
TPH-d	5010	4.17	660000	640	28.95	0.15	4.34	Vicinity of B-11
TPH-d	5010	4.17	110000	640	21.48	0.15	3.22	Vicinity of MW-2
TPH-d	5010	4.17	21000	640	14.57	0.15	2.19	Vicinity of MW-3
TPH-d	5010	4.17	5400	640	8.90	0.57	5.11	Area encompassing MW-4 to nearest Extraction Well
TPH-d	5010	4.17	1000	640	1.86	1.37	2.54	Area encompassing Tidewater Avenue to Well MW-3

Notes:

1. Maximum concentrations from field data (Quarterly Monitoring Reports)
2. Flush time estimated from MODPATH scenario results
3. K_{oc} values obtained from '*Guidance for Assessing Petroleum Hydrocarbons in Soil*' , Ohio-EPA DERR-00-DI-033, issued September 2004
4. TPH-D represented by >C8-C16

TABLE 9 - BASIS FOR COST ESTIMATE FOR SELECTED REMEDIAL ALTERNATIVES
4919 Tidewater Avenue, Oakland, CA

Description	Quantity	
	Number	Unit
1) Site Area	180,710	ft^2
2) Site Area w/ Easement	169,793	ft^2
3) Area of Dewatering of Saturated Fill	139,714	ft^2
4) Area of Excavation of Asphaltic Concrete (AC) w/ underlying baserock and Fill Material	49,950	ft^2
5) Area of Excavation of Younger Bay Mud	21,275	ft^2
6) Average Depth to Groundwater	1.00	ft
7) Average Thickness of AC w /baserock, and Fill Material; i.e. Depth to Younger Bay Mud	6.50	ft
8) Average Thickness of AC w /baserock	0.50	ft
9) Average Thickness of baserock and Fill Material	6.00	ft
10) Average Thickness of Saturated Fill for Dewatering	5.50	ft
11) Average Thickness of Younger Bay Mud for Excavation	3.00	ft
12) Unit Weight of AC, Concrete	150	pcf
13) Ratio by volume of broken to solid AC, Concrete	1.9	n/a
14) Unit Weight of Existing Fill Material	110	pcf
15) Unit Weight of Younger Bay Mud	90	pcf
16) Unit Weight of Import Light-Weight Backfill Material (compacted)	100	pcf
17) Unit Weight of Import Readily-Available Backfill Material (compacted)	115	pcf
18) Unit Weight of Import 1/2" or 3/4" crushed rock	140	pcf
19) Unit Weight of Import Readily-Available Backfill Sand (compacted)	120	pcf
20) Porosity of Fill Material	0.25	n/a
21) Porosity of Younger Bay Mud	0.50	n/a
22) Dewatering Volume of Saturated Fill Material (ignoring Specific Retention)	1,436,958	gal
23) Volume of Water in Younger Bay Mud for Excavation	238,706	gal
24) Volume of Excavation of AC (unbroken)	925	cy
25) Volume of Excavation of baserock & Fill Material	11,100	cy
26) Volume of Two Existing Soil Stockpiles (Fill Material)	400	cy
27) Total Volume of Excavation of Fill Material (incl. baserock and existing stockpiles)	11,500	cy
28) Volume of Excavation of Younger Bay Mud	2,364	cy
29) Total Volume of Excavated Material (Fill + Bay Mud)	13,864	cy
30) Total Volume of all Excavated Material (AC + Fill + Bay Mud)	14,789	cy
31) Mass of Excavated AC	1,703	ton
32) Mass of Excavated Fill Material	15,525	ton
33) Mass of Excavated Younger Bay Mud	2,611	ton
34) Total Mass of Excavated Material (Fill + Bay Mud)	18,136	ton
35) Total Mass of all Excavated Material (AC + Fill + Bay Mud)	19,839	ton
36) Length of Shoring Using Steel Sheetpiles	986	ft
37) Depth of Shoring Using Steel Sheetpiles (100 lf @30 'bgs at truck repair shop area; rest @12')	14	ft
38) Area of Shoring Using Steel Sheetpiles	13,632	ft^2
39) Length of Shoring Using Vinyl Sheetpiles	388	ft
40) Depth of Shoring Using Vinyl Sheetpiles	15	ft
41) Area of Shoring Using Vinyl Sheetpiles	5,820	ft^2
42) Average Rate of Excavation Per Day	640	ton
43) Average Rate of Backfiling Per day	480	ton
44) Average Concentration of TPHd in Groundwater for Estimating Carbon Usage	10	mg/l
45) Average Carbon Efficiency by Weight	20	percent
46) Cost of Carbon	2.50	$/lb

TABLE 9 - BASIS FOR COST ESTIMATE FOR SELECTED REMEDIAL ALTERNATIVES
4919 Tidewater Avenue, Oakland, CA

Description	Quantity	
	Number	Unit
47) Average Volume of Groundwater Pumped prior to sand filter replacement	100,000	gal
48) Number of Wells for Fill Material Dewatering	47	well
49) Time Duration of Operation of Dewatering System	8	month
50) Area of Truck Terminal Building (from Site Survey footprint)	13,548	ft^2
51) Area of Truck Repair Shop Building (from Site Survey footprint)	2,950	ft^2
52) Area of the Site Two Building Structures (from Site Survey footprint)	16,498	ft^2
53) Thickness of SOG (Slab on Grade) for Site Structures	8	inch
54) Thickness of foundation wall for Site Structures	8	inch
55) Depth of foundation wall above grade for Truck terminal Building	4	feet
56) Depth of foundation wall above grade for Truck Repair Shop	8	inch
57) Width of footing for Site Structures	18	inch
58) Thickness of footing for Site Structures	8	inch
59) Depth of footing below ground surface	18	inch
60) Perimeter Length of Truck Terminal Building	727.5	ft
61) Perimeter Length of Truck Repair Shop	227.5	ft
62) Perimeter Length of the Two Site Structures	955	ft
63) Number of Remedial Wells for GW Extraction	10	well
64) Number of Existing Monitoring Wells	4	well
65) Total Number of Wells (Remedial + Monitoring)	14	well
66) No. of Years of GWET System Operation	6	years
67) Quarterly Sampling and Analysis of Remedial and Monitoring Wells	$4,480	qtr
68) Quarterly Reports for GW Monitoring	$3,360	qtr
69) Groundwater Treatment System Average Flow Rate	10	gpm
70) NPDES System Laboratory Analytical Sampling Costs (Year 1)	$13,223	year
71) NPDES System Laboratory Analytical Sampling Costs (Year 2 onwards)	$7,635	year
70) Electrical Usage of Groundwater Treatment System	10	hp
71) Electrical Cost	$0.17	kw-hr
72) Natural Gas Cost	$0.90	therm

TABLE 10 - PRELIMINARY COST ESTIMATE FOR EXCAVATION AND DISPOSAL
4919 Tidewater Avenue, Oakland, CA

	Quantity		Preliminary Engineering Cost Estimate	
Item Description	**Number**	**Unit**	**Unit Cost**	**Total**
1.0 Preparation of Construction Documents				
1.1 Construction Drawings and Specifications incl. Grading Plan	1	ls	$34,920	$34,920
1.2 Site Survey and Topo Map	1	ls	$8,880	$8,880
1.3 Soils Report	1	ls	$18,580	$18,580
1.3 Erosion & Sedimentation Plan (N/A for work between Apr 15 and Oct 15)	1	ls	$0	$0
1.4 Landscape Plan (not required)	1	ls	$0	$0
1.5 Waste Reduction and Recycling Plan (WRRP) for Demolition	1	ls	$2,520	$2,520
1.5 Asbestos Survey Report	1	ls	$5,420	$5,420
1.7 Proposed Dust Control Measures (part of Health & Safety Plan)	1	ls	$0	$0
1.8 Permit(s) Procurement	1	ls	$25,800	$25,800
SUBTOTAL				**$96,120**
2.0 Estimated Permit Fees				
2.1 Grading Permit Fee (based on excavation volume)	1	ls	$14,859	$14,859
2.2 BAAQMD " J" Permit Fee (Regulation 11, Rule 2)	1	ls	$179	$179
2.3 EBMUD Discharge Permit Fee (based on dewatering discharge volume)	1	ls	$29,434	$29,434
2.4 Demolition Permit Fee	1	ls	$2,455	$2,455
2.5 Excavation Permit Fee - Discharge Pipe Connection To Street Sewer	1	ls	$1,298	$1,298
2.6 Sewer Permit Fee - Dewater Discharge	1	ls	$1,418	$1,418
2.7 Electrical & Plumbing Permit Fees for Temporary Power & Water	1	ls	$487	$487
2.8 Removal of 12K-gal AST (Diesel) Permit Fee - Oakland Fire Dept.	1	ls	$843	$843
SUBTOTAL				**$50,973**
3.0 Prefield Activities				
3.1 Health & Safety Plan	1	ls	$5,160	$5,160
3.2 Installation & Survey of Monuments for Excavation Monitoring	1	ls	$2,500	$2,500
3.3 Connection of Discharge Pipe to Street Sewer	1	ls	$24,360	$24,360
3.4 Clearing & Grubbing	1	ls	$5,000	$5,000
SUBTOTAL				**$37,020**
4.0 Site Demolition				
4.1 Demolition and Removal of Two Building Structures	16,498	ft^2	$5	$82,490
4.2 Breaking of Concrete Foundation (SOG w/ Perimeter Footing)	572	cy	$20	$11,448
4.3 Transportation & Disposal of Broken Concrete	1,088	cy	$30	$32,628
4.4 Capping of Utilities	1	ls	$3,000	$3,000
4.5 Removal of Truck Scale	1	ls	$2,500	$2,500
4.6 Remove 12K-gal AST w/ 12" thick Containment (12'x30'x5') & 12" SOG	1	ls	$13,924	$13,924
4.7 Removal of 50-foot Sign at Entrance	1	ls	$7,500	$7,500
SUBTOTAL				**$153,491**

TABLE 10 - PRELIMINARY COST ESTIMATE FOR EXCAVATION AND DISPOSAL
4919 Tidewater Avenue, Oakland, CA

Item Description	Quantity		Preliminary Engineering Cost Estimate	
	Number	Unit	Unit Cost	Total
5.0 Shoring/Cut-Off Wall Installation				
5.1 Installation of Steel Sheet Piling	13,632	ft^2	$20.49	$279,305
5.2 Installation of Vinyl Sheet Piling	5,820	ft^2	$19.33	$112,472
5.3 Removal of Steel Sheet Piling	13,632	ft^2	$5.02	$68,364
5.4 Removal of Vinyl Sheet Piling	5,820	ft^2	$4.87	$28,343
SUBTOTAL				**$488,485**
6.0 Dewatering System for Fill Material				
6.1 Installation of Dewatering Extraction System (Wells etc.)	1	ls	$152,750	$152,750
6.2 Installation of hold. tanks, xfer pumps, assoc. piping, treatment system etc.	1	ls	$115,560	$115,560
6.3 O&M for Dewatering System - Material and Equipment usage	1,436,958	gal	0.01	$20,893
6.4 O&M for Dewatering System - Labor (80 hrs per month @ $65/hr)	8	mo	$5,200	$41,600
6.5 Rental of holding tank, pumps, carbon vessels etc.	8	mo	$10,120	$80,960
6.6 Mob/Demob of extraction and treatment system	1	ls	$7,500	$7,500
6.7 Laboratory Testing Fee	1	ls	$1,500	$1,500
SUBTOTAL				**$420,763**
7.0 Excavation, Transportation and Disposal (Fill Material)				
7.1 Mobilization of earthwork equipment	1	ls	$5,000	$5,000
7.2 Excavate, load, haul & dispose Asphaltic Concrete (AC)	1,703	ton	$35.00	$59,599
7.3 Excavate, load, haul & dispose Fill Material in Class II Landfill	15,525	ton	$41.28	$640,794
7.4 Field Labor for Environmental Oversight and Sampling	194	hr	$90	$17,466
7.5 Confirmation Rush Analysis (TPHd) every 400 ft^2 + addtl. 15% of samples	144	ea	$120	$17,233
7.6 Dust mitigation w/ Water Truck & Sweeper	24	day	$370	$8,975
SUBTOTAL				**$749,068**
8.0 Excavation, Transportation and Disposal (Younger Bay Mud)				
8.1 Excavate, load, haul & dispose Bay Mud in Class II Landfill	2,611	ton	$43.78	$114,298
8.2 Field Labor for Environmental Oversight and Sampling	33	hr	$90	$2,937
8.3 Confirmation Rush Analysis (TPHd) every 400 ft^2 + addtl. 15% of samples	61	ea	$120	$7,340
8.4 Dust mitigation w/ Water Truck & Sweeper	4	day	$370	$1,509
SUBTOTAL				**$126,084**

TABLE 10 - PRELIMINARY COST ESTIMATE FOR EXCAVATION AND DISPOSAL
4919 Tidewater Avenue, Oakland, CA

Item Description	Quantity		Preliminary Engineering Cost Estimate	
	Number	Unit	Unit Cost	Total
9.0 Borrow, Backfill and Compact				
9.1 Installation of Mirafi 600 X	49,950	ft^2	$0.37	$18,662
9.2 Installation of Geoweb 30V6	49,950	ft^2	$2.95	$147,353
9.3 Mob of compaction equipment	1	ls	$5,000	$5,000
9.4 Import, placement of 8" deep 1/2" crushed rock	2,119	ton	$47.63	$100,935
9.5 Import, placement & compaction of light-weight backfill material	16,145	ton	$59.63	$962,673
9.6 Earthwork, observation and compaction testing	1	ls	$29,600	$29,600
9.7 Survey of Monuments for Monitoring - Post Excavation	1	ls	$2,500	$2,500
9.8 Dust mitigation w/ water Truck & Sweeper	34	day	$370	$12,445
9.9 Demob of earthwork and compaction equipment	1	day	$7,500	$7,500
SUBTOTAL				**$1,286,668**
10.0 Confirmation Borings and Sampling and Closure Report				
10.1 Confirmation Borings and Sampling	1	ls	$25,000	$25,000
10.2 Environmental Site Closure Report (Alameda County Health)	1	ls	$15,840	$15,840
10.3 Statement of Completion Report (City of Oakland)	1	ls	$5,280	$5,280
SUBTOTAL				**$46,120**
COST ESTIMATE TOTAL				**$3,454,790**

NOTES:

1) Cost of removal of on-site trailers, storage sheds etc. not included.
2) To estimate dewatering volumes, porosity instead of specific yield values were used as worst case.
3) The two existing stockpiles are assumed to be fill material.
4) Average depth to groundwater is assumed to be 1.0 feet bgs.
5) Replace Geoweb GW20V8 (heavy industrial; ship industry) with GW30V6 (for multi-residential/commercial).
6) Utility charges and usage including removal/de-energizing of overhead lines and temporary utilities not included.
7) Any leakage from cut-off wall is assumed to be minimal.
8) Disposal fee at Class II landfill is assumed to be $15/ton plus tax (8.5%) paid directly by Owner.
9) Transportation time (load and unload included) to Class II landfill is assumed to be 1.5 hours one way.
10) Import of 1/2" crushed rock is assumed to be $16.25/ton plus tax for purchase at source and paid directly by Owner.
11) Import of light-wgt backfill material is assumed to be $25/ton plus tax for purchase at source and paid directly by Owner.
12) Transportation time (load and unload included) for import of material is assumed to be 1.5 hours one way.
13) The diesel in the AST will be rendered empty and consumed by existing truck operations.
14) For the duration of the project, existing on-site trailer w/ utilities will be made available.
15) Presence of any methane in the subsurface is below target and explosive limits, and its mitigation is not included.
16) Excavation of Younger Bay Mud will not require dewatering prior to loading for off-site disposal.
17) Assume use of existing fence for site security and operation.
18) Bond Procurement and premium not included.
19) Foundation for two existing structures is slab on grade w/ perimeter footing.
20) For estimation purposes, the area of bay mud excavation is within the area of fill material excavation.
21) Shoring depth steel sheet pile is assumed as 12 feet (except truck repair shop area); as exc. does not extend to sheet pile.
22) Volume of perimeter cut slopes required for excavation are not included.
23) Costs are based on 2007 Dollars with no interest,inflation or NPV (Net Present Value) analysis.
24) Costs are order-of-magnitude estimates for purposes of comparative analysis of remedial alternatives.
25) Assume no absbestos abatement is required for the Site.

TABLE 11 - PRELIMINARY COST ESTIMATE FOR GWET
4919 Tidewater Avenue, Oakland, CA

Item Description	Quantity		Preliminary Engineering Cost Estimate	
	Number	Unit	Unit Cost	Total
1.0 Preparation of Design Basis and Design				
1.1 Preparation of Remedial Action Plan	1	ls	$18,120	$18,120
1.2 Preparation of NPDES Permit Application & Documents	1	ls	$16,560	$16,560
SUBTOTAL				**$34,680**
2.0 Preparation of Construction Documents				
2.1 Construction Drawings and Specifications	1	ls	$35,400	$35,400
2.2 Permit(s) Procurement	1	ls	$14,520	$14,520
SUBTOTAL				**$49,920**
3.0 Estimated Permit Fees				
3.1 Oakland City Building Permit Fee	1	ls	$1,880	$1,880
3.2 NPDES Discharge Permit Fee	1	ls	$2,000	$2,000
3.3 Well Installation Permit Fee	1	ls	$2,500	$2,500
3.4 Electrical & Plumbing Permit Fees for Temporary Power & Water	1	ls	$487	$487
SUBTOTAL				**$6,867**
4.0 Remedial System Installation				
4.1 Installation of ten (10) GW Extraction wells (4")	1	ls	27,500	$27,500
4.2 Asphalt/Concrete (A/C) Sawcutting (700 linear feet by 2 feet)	1	ls	$7,060	$7,060
4.3 Demolition & Disposal (6"-thick A/C and 2 feet wide trench)	1	ls	$13,060	$13,060
4.4 Excavation (700 linear feet by 2 feet wide by 2 feet deep)	1	ls	$27,080	$27,080
4.5 Subsurface Piping Installation (2" dia for gw; 1" dia for electrical)	1	ls	$29,360	$29,360
4.6 Backfiling & Compaction	1	ls	$26,820	$26,820
4.7 Site Resurfacing and Repair (Asphalt/Concrete)	1	ls	$31,520	$31,520
4.8 Traffic Control	1	ls	$5,200	$5,200
4.9 Installation of Treatment System and Compound	1	ls	$149,520	$149,520
4.10 Connection of Discharge Pipe to Off-Site Storm Drain	1	ls	$23,680	$23,680
4.11 Installation of PG&E Electrical Power for System Operation	1	ls	$28,800	$28,800
4.12 System Start Up Per NPDES Requirements (Lab Anal. under Item 5.0)	1	ls	$7,440	$7,440
SUBTOTAL				**$369,600**

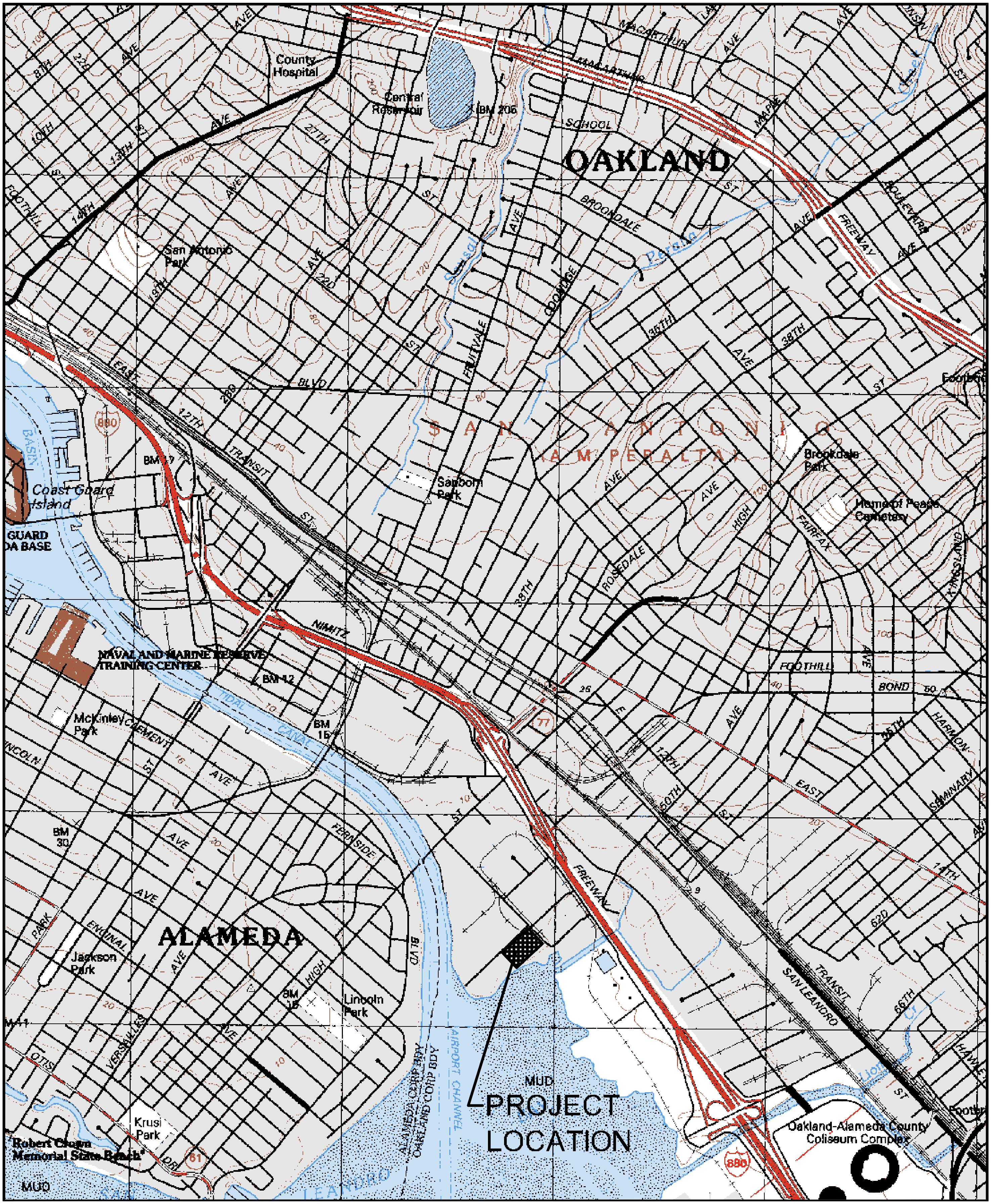
TABLE 11 - PRELIMINARY COST ESTIMATE FOR GWET
4919 Tidewater Avenue, Oakland, CA

Item Description	Quantity		Preliminary Engineering Cost Estimate	
	Number	Unit	Unit Cost	Total
5.0 Remedial System Operation and Maintenance				
5.1 Laboratory Analysis per NPDES Requirements (Year 1)	1	yr	$13,223	$13,223
5.2 Laboratory Analysis per NPDES Requirements (Year 2 through 6)	5	yr	$7,635	$38,175
5.3 Monthly O&M for GW Treatment Sys. - Material & Equipment usage	72	mo	$1,500	$108,000
5.4 Monthly O&M for GW Treatment Sys. - Labor (40 hrs/mo @ $70/hr)	72	mo	$2,800	$201,600
5.5 Yearly Average Carbon Change Cost	6	yr	$5,464	$32,782
5.6 Yearly Utility Usage (based on 10 hp of electrical usage)	6	yr	$11,109	$66,657
5.7 Quarterly O&M Reporting	24	qtr	$3,600	$86,400
SUBTOTAL				**$533,613**
8.0 Groundwater Monitoring				
8.1 Quarterly Sampling and Analysis of Remedial and Monitoring Wells	24	qtr	$4,480	$107,520
8.2 Quarterly Reports for GW Monitoring	24	qtr	$3,360	$80,640
SUBTOTAL				**$188,160**
9.0 Limited Source Area Remediation				
9.1 Excavation, Disposal & Backfiling of Limited Source Area	3,945	ton	$174.14	$687,072
SUBTOTAL				**$687,072**
10.0 Site Closure Activities				
10.1 Site Risk Assessment	1	ls	$16,440	$16,440
10.2 Removal/Abandonment of all Site Wells	14	well	$1,350	$18,900
10.2 Removal of Remedial System & Piping	1	ls	$27,120	$27,120
10.3 Environmental Site Closure Report (Alameda County Health)	1	ls	$15,480	$15,480
SUBTOTAL				**$77,940**
COST ESTIMATE TOTAL				**$1,947,852**

NOTES:

1) Costs are based on 2007 Dollars with no interest,inflation or NPV (Net Present Value) analysis.
2) Costs are order-of-magnitude estimates for purposes of comparative analysis of remedial alternatives.
3) Groundwater Extraction and Treatment system operation is assumed to be for 6 years.
4) The excavation quantity under Item 9.0 is based on source areas; former UST pit area an area in the vicinity of MW-2.
5) The source area excavation around the former UST pit area is assumed to be 80 ft by 120 ft by 7 ft deep.
6) The source area excavation in the vicinity of MW-2 is assumed to be 70 ft by 90 ft by 7 feet deep.
7) The unit weight of the excavated material is assued to be 100 pcf.
8) The unit cost of the excavation under Item 9.0 is obtained by dividing total cost of $3,454,790 shown in Table 10 by total mass of all excavated material of 19,839 tons shown in Table 9.

FIGURES



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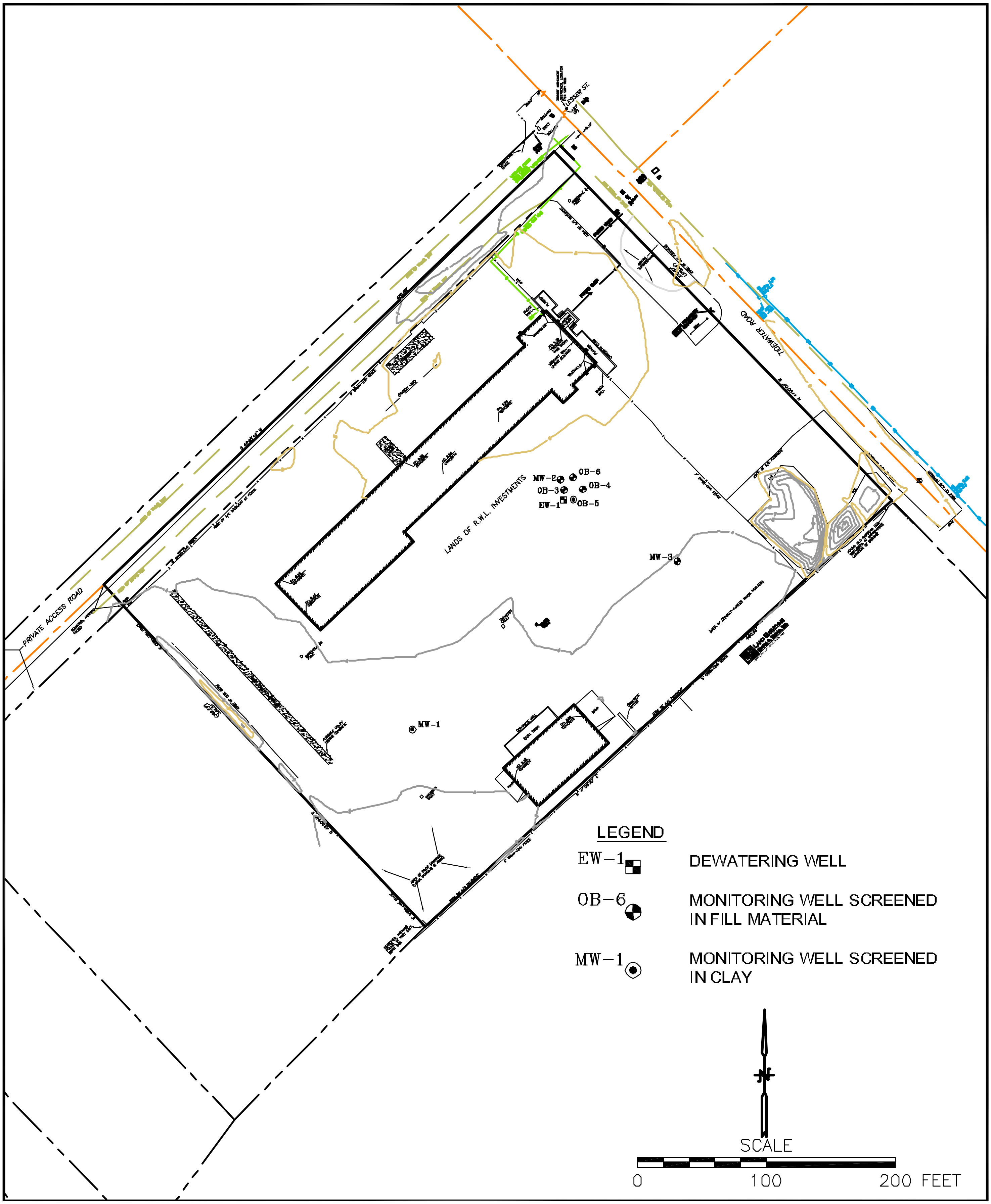
SITE LOCATION MAP

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
1

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



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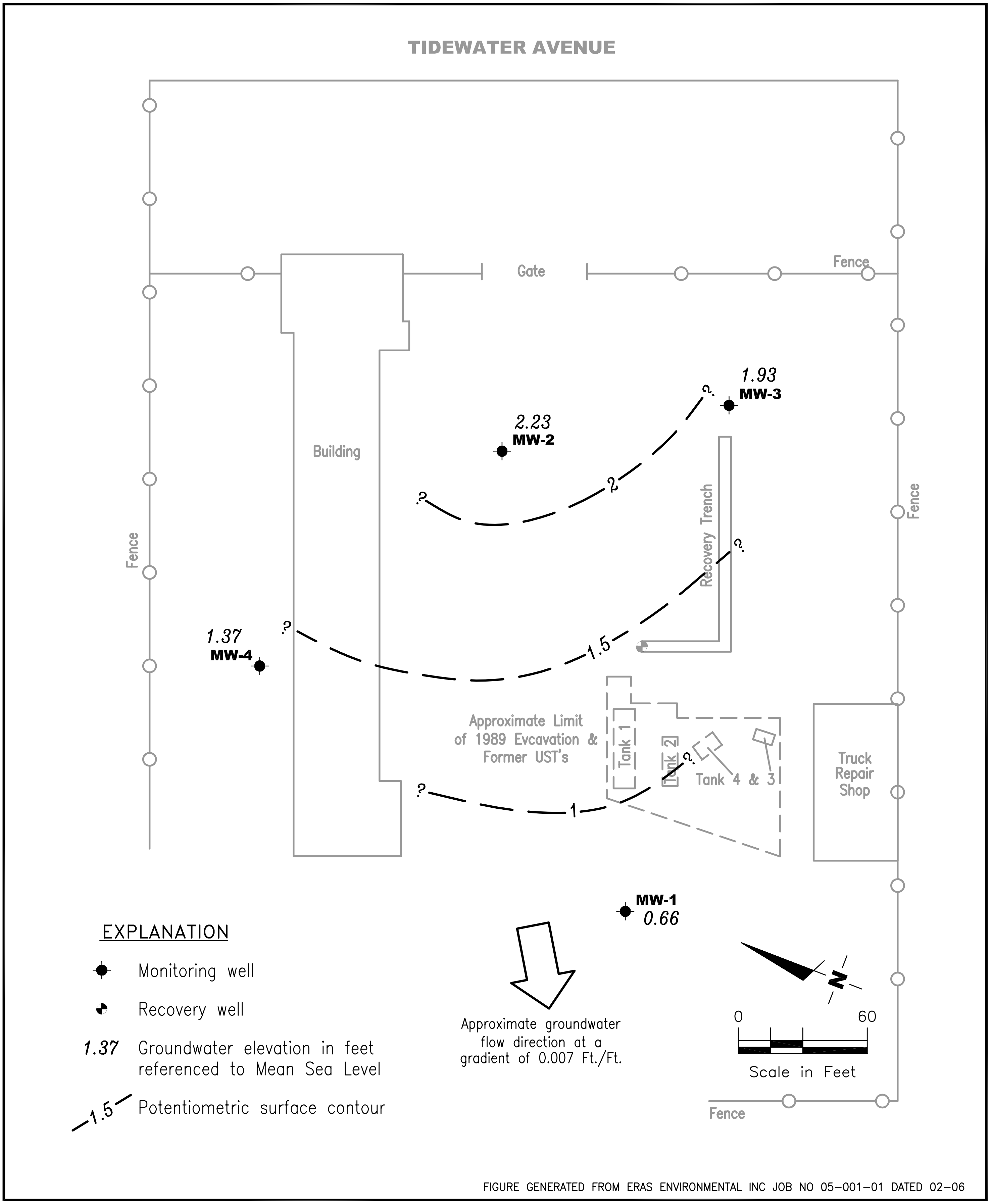
SITE PLAN AND EXISTING WELL LOCATIONS

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
2

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



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GROUNDWATER ELEVATION MAP - JANUARY 25, 2006

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO 3

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-

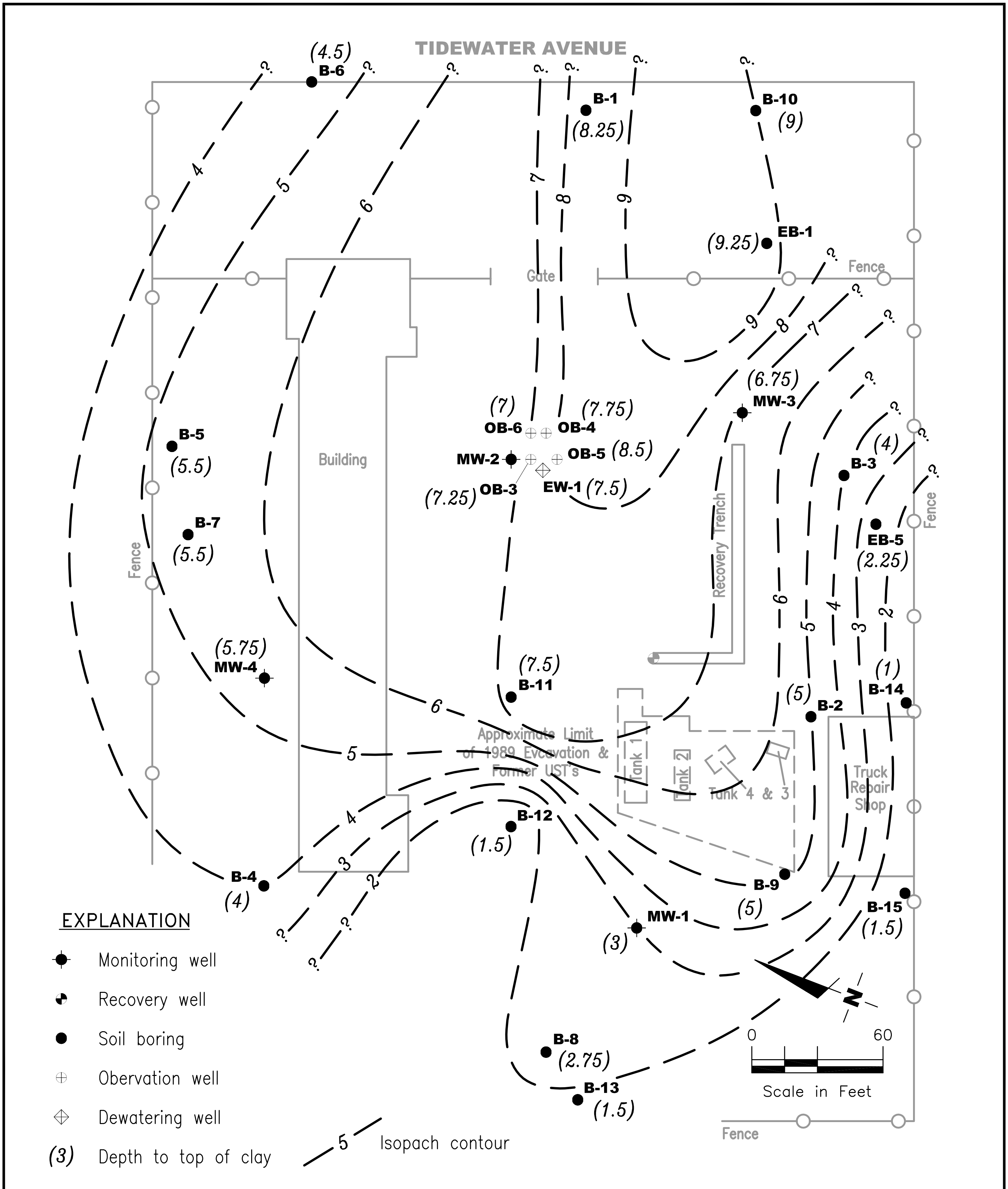

FIGURE GENERATED FROM ERAS ENVIRONMENTAL INC JOB NO 05-001-02 DATED 02-06

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ISOPACH MAP - ESTIMATED THICKNESS of ARTIFICIAL FILL

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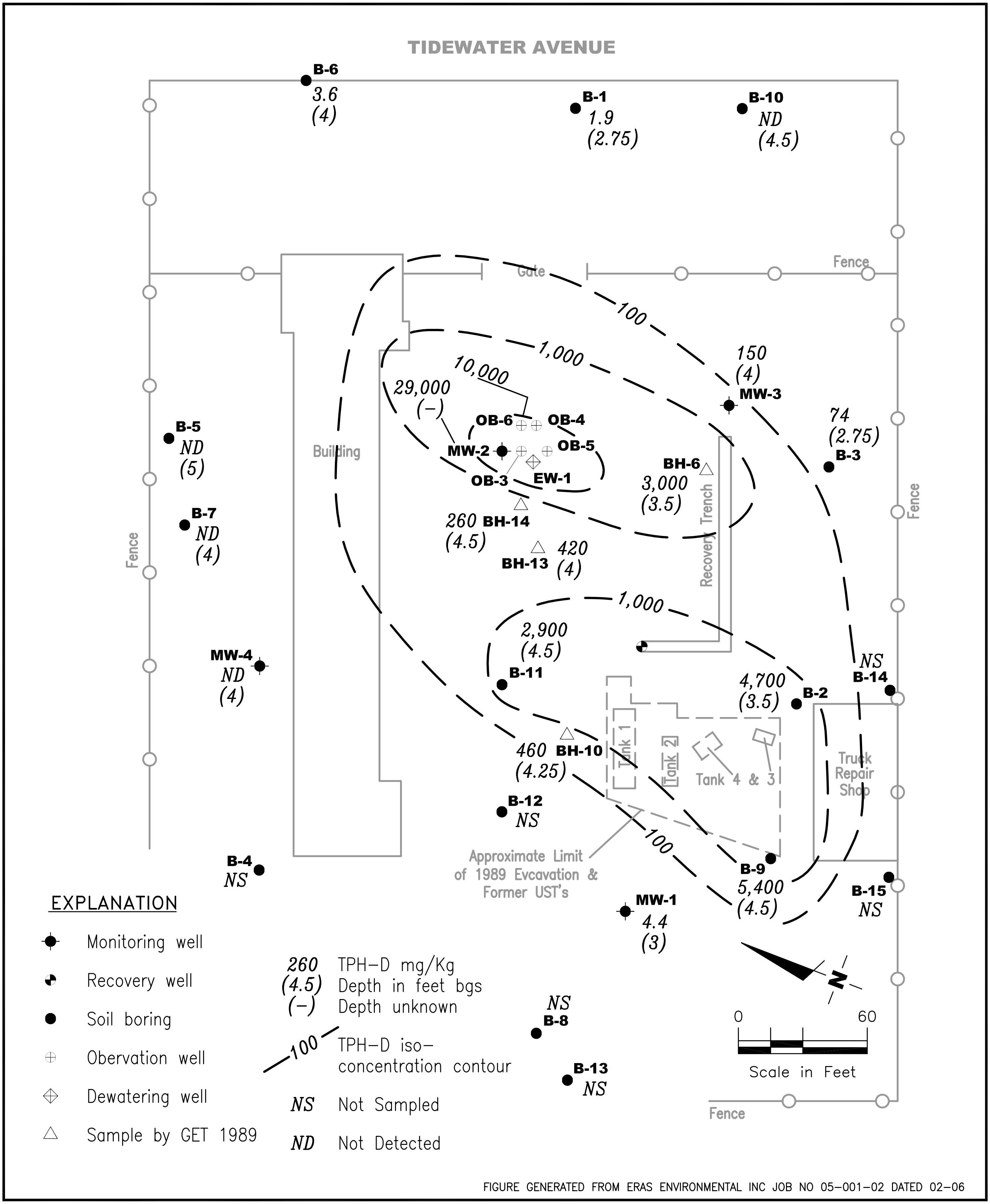
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
4

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



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ESTIMATED DISTRIBUTION of TPH-D in FILL MATERIAL

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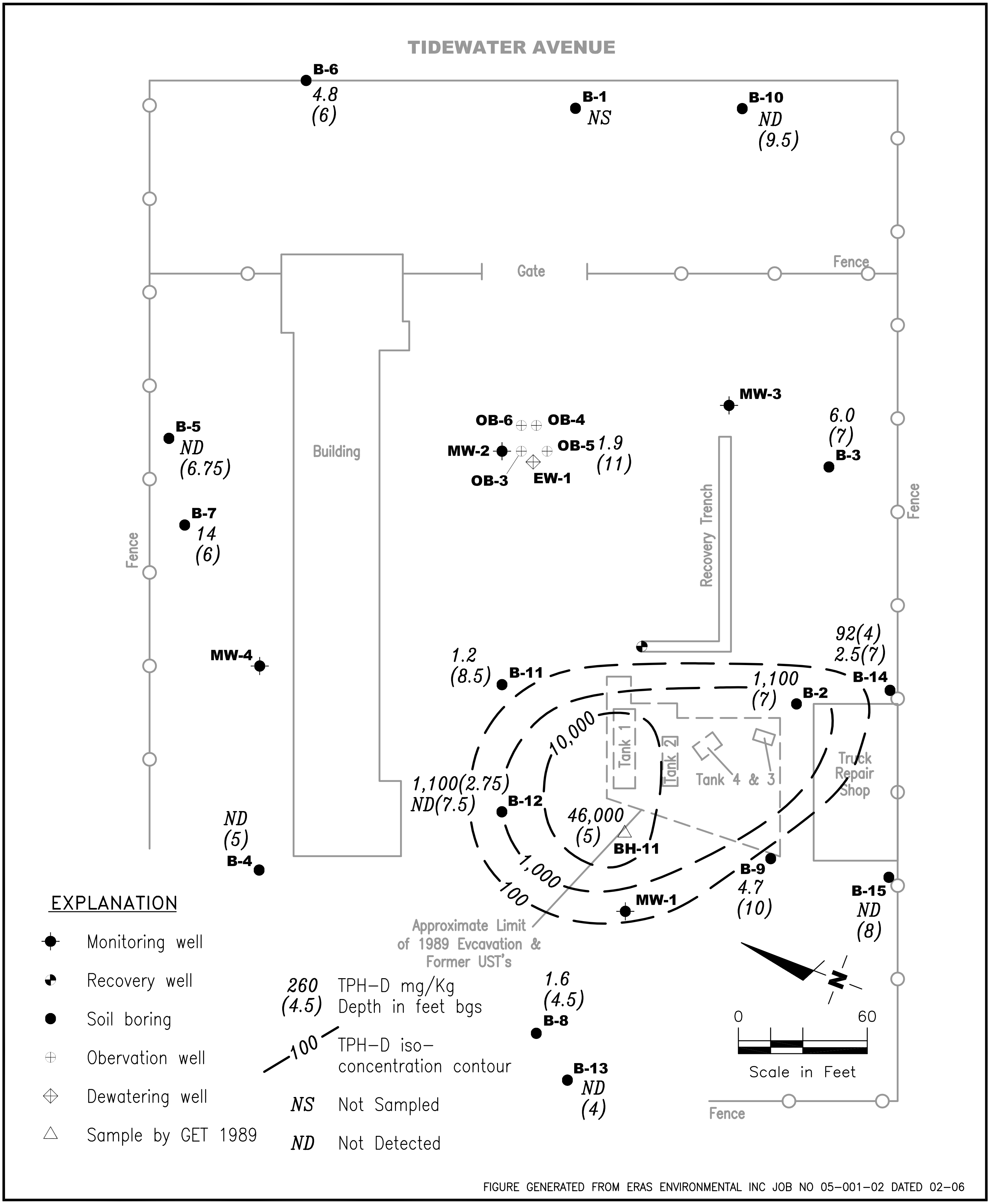
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
5

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



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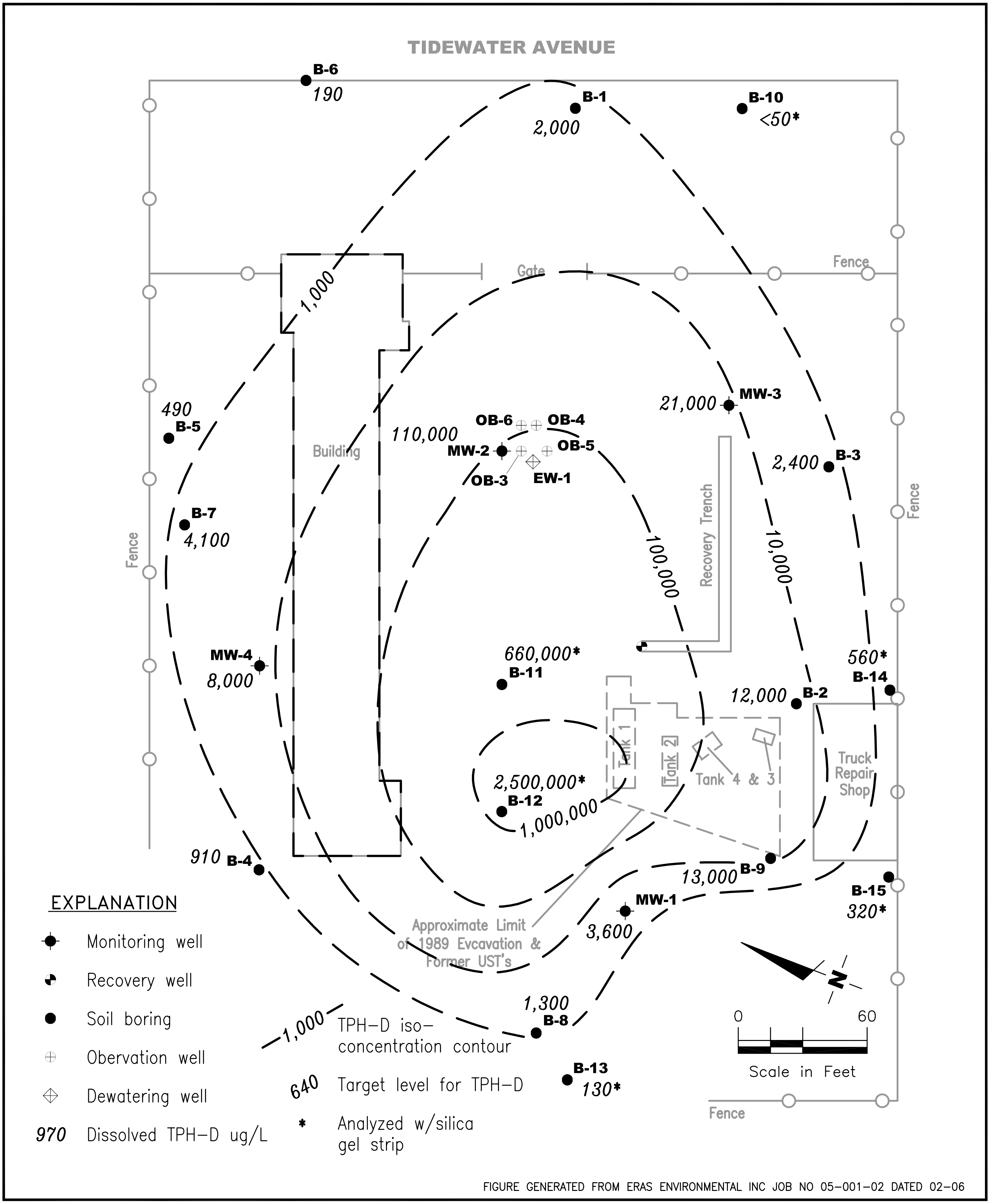
ESTIMATED DISTRIBUTION of TPH-D in CLAY

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
6

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



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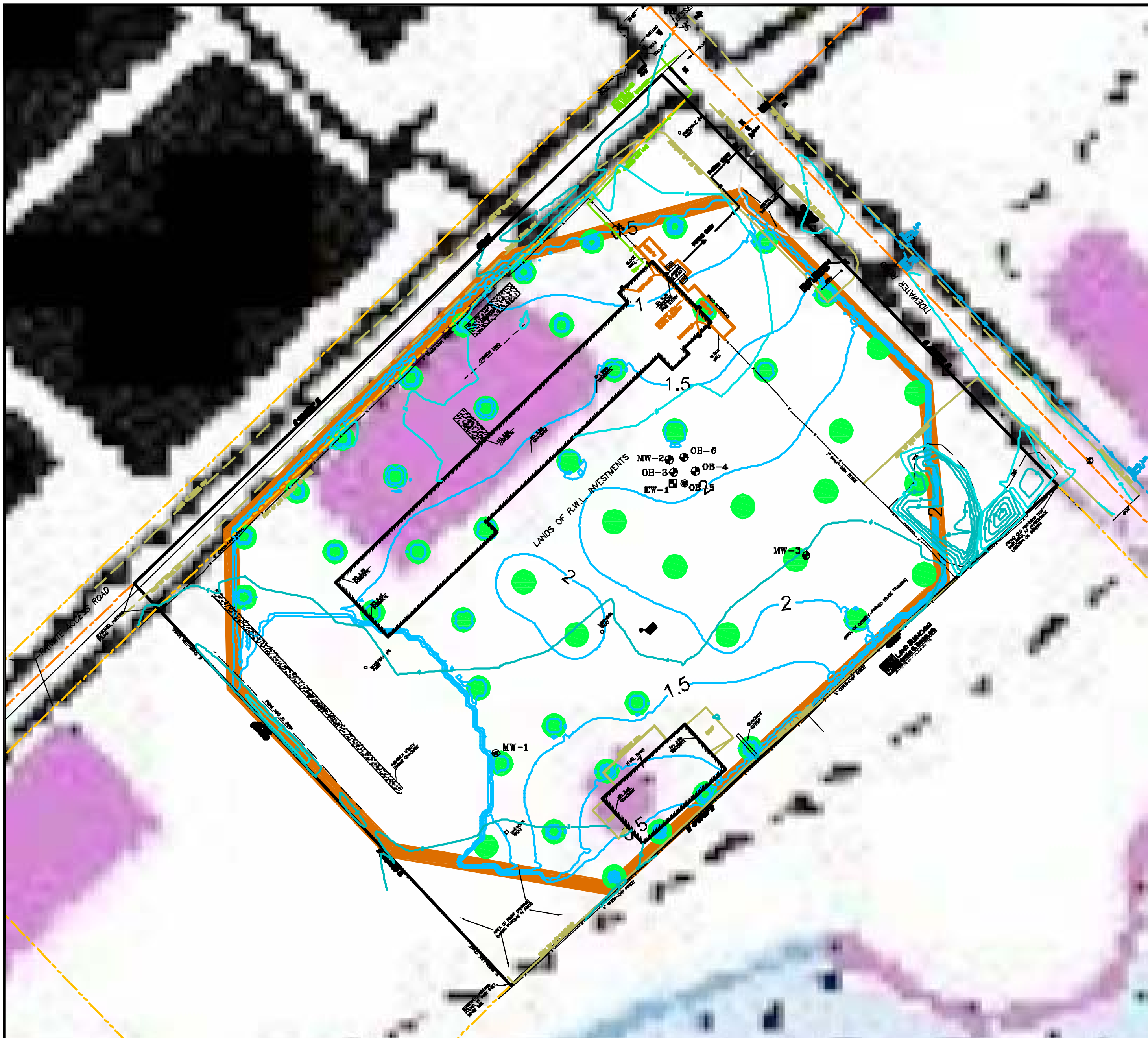
ESTIMATED DISTRIBUTION of TPH-D in GROUNDWATER

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
7

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



LEGEND

PROPOSED DEWATERING WELLS

SHEET PILE / CUT-OFF WALL

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SIMULATED DRAWDOWN FOR PROPOSED DEWATERING SYSTEM - DAY 1

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO

8A

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-

LEGEND

PROPOSED DEWATERING WELLS

SHEET PILE / CUT-OFF WALL

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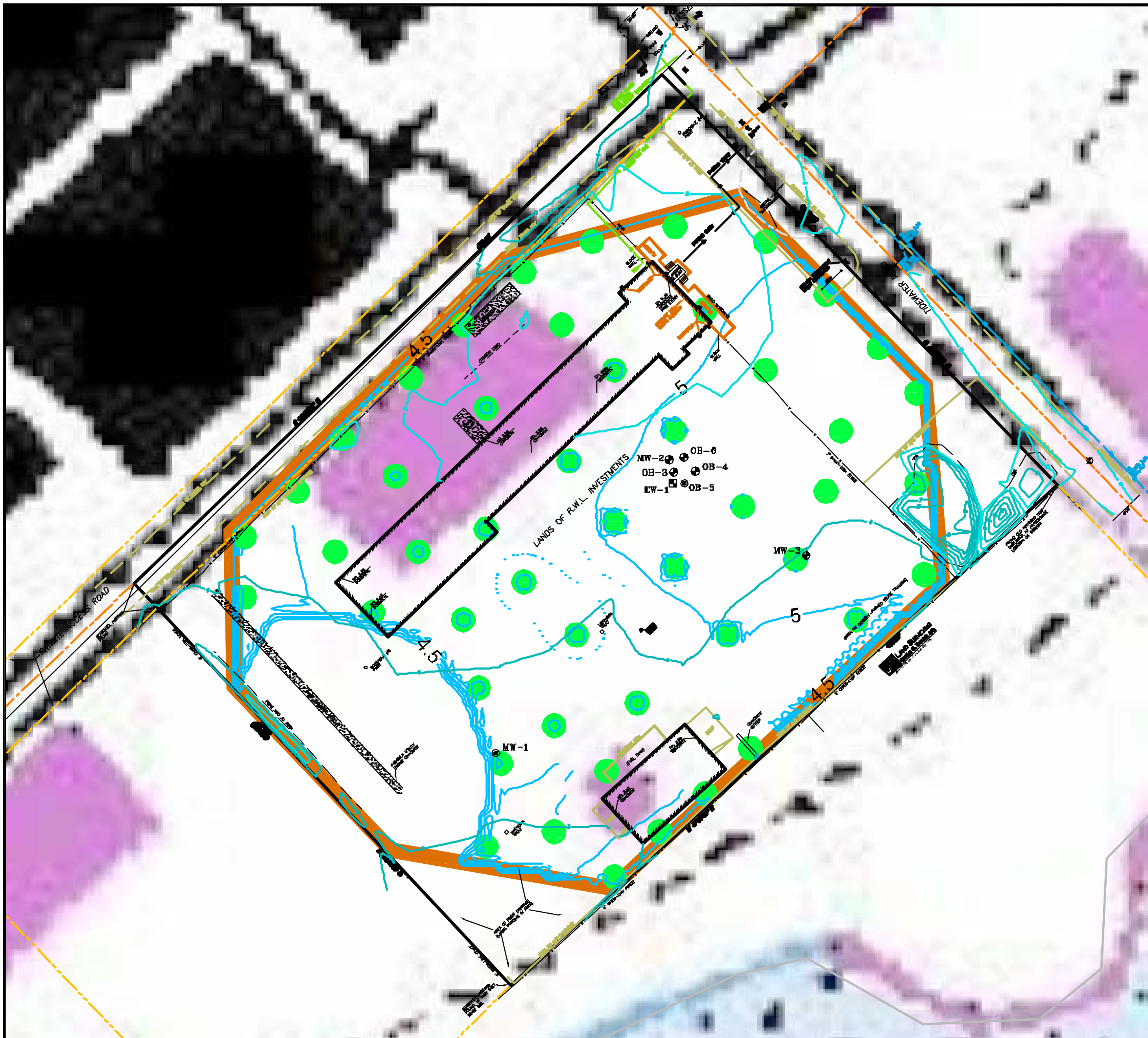
SIMULATED DRAWDOWN FOR PROPOSED DEWATERING SYSTEM - DAY 30

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
8B

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



LEGEND

PROPOSED DEWATERING WELLS

SHEET PILE / CUT-OFF WALL

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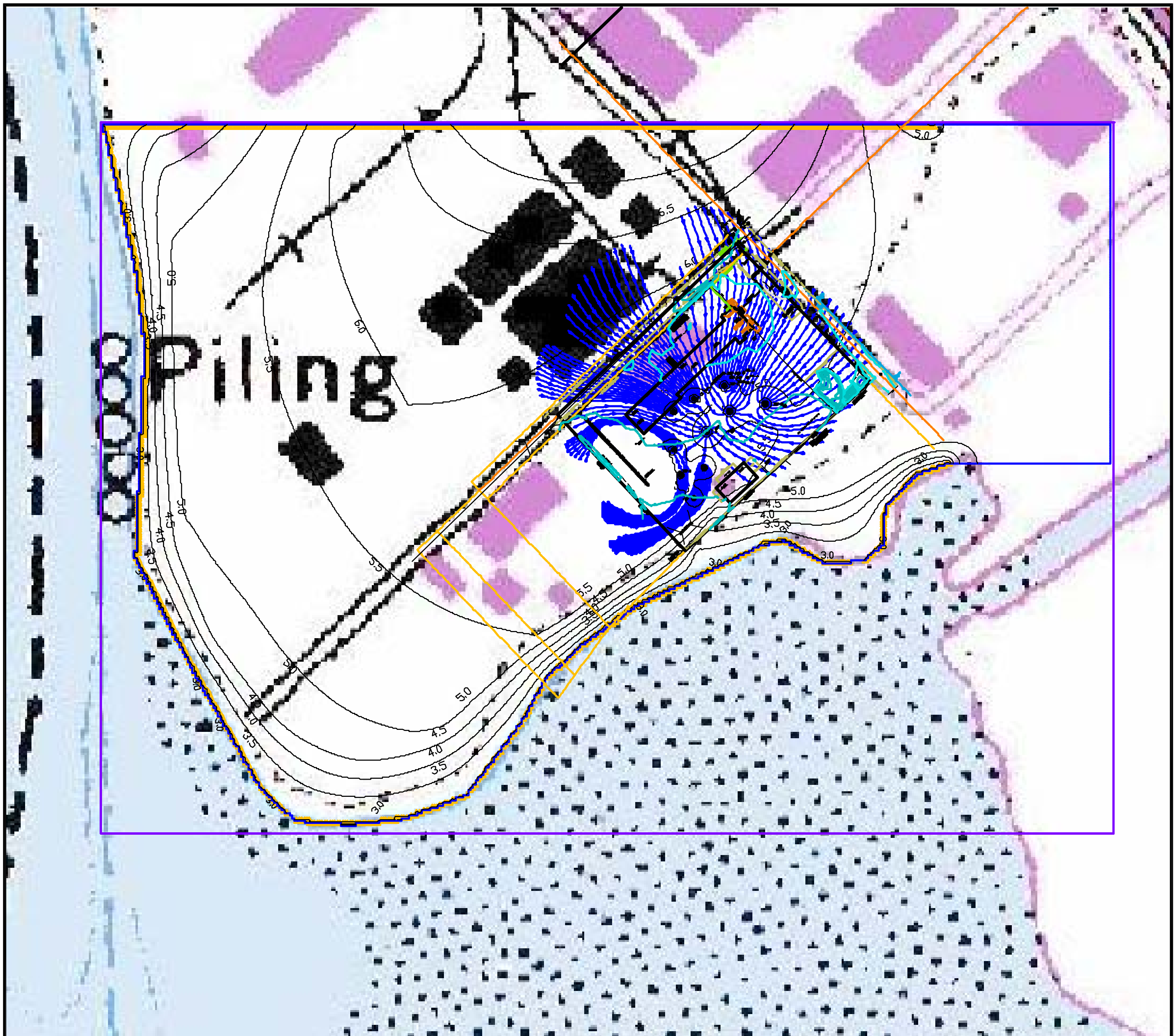
SIMULATED DRAWDOWN FOR PROPOSED DEWATERING SYSTEM - DAY 60

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
8C

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



LEGEND

PATHLINE (DISTANCE BETWEEN ARROWS IS 100 DAYS)

GROUNDWATER CONTOUR

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ESTIMATED CAPTURE AREA IN GROUNDWATER- PROPOSED GROUNDWATER EXTRACTION AND TREATMENT

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
9

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-

APPENDIX A

AVAILABLE SOIL BORING LOGS

Gen Tech Environmental, Inc. San Jose, CA

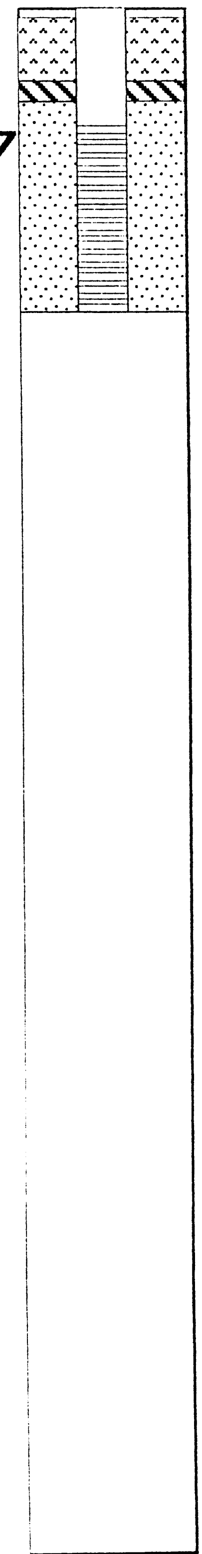
Project No. 9407 **Boring/Well No.** MW-1
Client: DiSalvo Trucking **Date Drilled:** April 8, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** ACWCFCD 94193
Water Levels: 1st Enc: 3± Static: no measurement

Exploratory Boring Log

Borehole Completion
Well Installed: 2" dia. PVC sch 40
Total Depth: 8' Casing Depth: 8'
Screen Length: 5' 0.020" Blank Length: 3'
Sand Pack: 2/12 Top Sand: 2.5' Top Bentonite: 2'
Grout Seal: 2' to surface vault box
Casing Elev. MSL: 2.68'

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log
MW-1@ con. fill.	Trace	66			Asphalt and Baserock and concrete rubble.
					Artificial FILL, wood, concrete very dense, moist.
MW-1@ @5'	No Test	3			OM-PT - SILT and PEAT, black, highly plastic, soft, very moist.
MW-1@ @7'	No Test	3		5	Same as above.
MW-1@ @9'	No Test	2			Same as above, thin interbeds of clay in peat.
				10	Bottom of Boring = 8 feet

Well Detail/ Backfill



NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil

Gen Tech Environmental, Inc. San Jose, CA

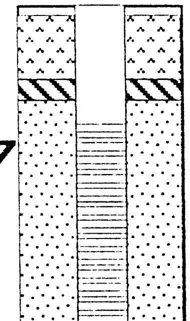
Exploratory Boring Log

Project No. 9407 **Boring/Well No.** MW-3
Client: DiSalvo Trucking **Date Drilled:** April 8, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** ACWCFCD 94193
Water Levels: 1st Enc: 4.0' Static: 2.0'

Borehole Completion
Well Installed: 2" dia. PVC sch 40
Total Depth: 8' Casing Depth: 8'
Screen Length: 5' 0.020" Blank Length: 3'
Sand Pack: 2/12 Top Sand: 2.5' Top Bentonite: 2'
Grout Seal: 2' to surface vault box
Casing Elev. MSL: 2.90'

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log
					Asphalt and Baserock and concrete rubble.
MW-3 @2'	800 ppm	28			GW - Sandy GRAVEL FILL, dark gray, 5GY4/0, 40% sand, strong diesel odor, very dense, saturated at 4'.
MW-3@ @5'	No Test	11		5	SM - Silty SAND, dark gray, 30% silt, rare gravel, odor, med. dense, saturated.
MW-3@ @7'	No Test	Push			PT - PEAT, black, laminated, methane odor, very moist.
				10	Bottom of Boring = 8 feet

Well Detail/ Backfill



NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil

Gen Tech Environmental, Inc. San Jose, CA

Exploratory Boring Log

Project No. 9407 **Boring/Well No.** EB-1
Client: DiSalvo Trucking **Date Drilled:** April 7, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** N/R
Water Levels: 1st Enc: 2.5' Static: no measurement

Borehole Completion
Well Installed: NO

Cement Grout Seal: 10.5 ' to surface

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log	Well Detail/ Backfill
					Asphalt Pavement and artificial fill	
EB-1@ 5'	Trace	9			SC - Clayey SAND, greenish gray 5GL 4.5/1, 20% silty clay, clay is highly plastic, loose, saturated.	▽
				5		
EB-1@ 10'	Trace	5		10	CL - Silty CLAY, dark greenish gray5GL 4/0, highly plastic, grasses buried in life position, odor of methane, soft-medium stiff, moist.	

Bottom of Boring = 10.5 feet.

NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil

Gen Tech Environmental, Inc. San Jose, CA

Project No. 9407 **Boring/Well No.** EB-2
Client: DiSalvo Trucking **Date Drilled:** April 7, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** N/R
Water Levels: 1st Enc: 2.7' Static: no measurement

Exploratory Boring Log

Borehole Completion
Well Installed: NO
Cement Grout Seal: 5 ' to surface

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log	Well Detail/ Backfill
					Asphalt Pavement and artificial fill	
EB-2@ 2'	100 ppm	23			SM - Silty SAND, dark yellowish brown, moist, artificial fill?	
				5	GW - Sandy GRAVEL, dark greenish gray, up to 50% fine to coarse sand, diesel odor, saturated at 3 feet; artificial fill film on water	

Bottom of Boring = 5 feet.

Diesel film observed on groundwater in borehole.

NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil

Gen Tech Environmental, Inc. San Jose, CA

Project No. 9407 **Boring/Well No.** EB-3
Client: DiSalvo Trucking **Date Drilled:** April 7, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** N/R
Water Levels: 1st Enc: 3.2' Static: no measurement

Exploratory Boring Log

Borehole Completion
Well Installed: NO

Cement Grout Seal: 5 ' to surface

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log	Well Detail/ Backfill
					Asphalt Pavement and artificial fill	
EB-3@ 2'	ND	41			GW - Sandy GRAVEL, dark greenish gray, up to 40% fine to medium sand, slight odor, saturated at 3 feet; artificial fill? Saturated at 3.2 feet, flowing at 4 feet.	
				5	Bottom of Boring = 5 feet.	

NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil

Gen Tech Environmental, Inc. San Jose, CA

Exploratory Boring Log

Project No. 9407 **Boring/Well No.** EB-4
Client: DiSalvo Trucking **Date Drilled:** April 7, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** N/R
Water Levels: 1st Enc: 2.8' Static: no measurement

Borehole Completion
Well Installed: NO

Cement Grout Seal: 5 ' to surface

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log	Well Detail/ Backfill
					Asphalt Pavement and and Concrete	
EB-4@ 2'	No Test	10			GW - dark greenish gray 5GY4/1, 40% medium to coarse sand, loose, moist to saturated, diesel film on water.	
				5	Bottom of Boring = 5 feet.	
					Groundwater entry into borehole, diesel film on water.	

NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil; test not run if sheen or film on groundwater.

Gen Tech Environmental, Inc. *San Jose, CA*

Exploratory Boring Log

Project No. 9407 **Boring/Well No.** EB-5
Client: DiSalvo Trucking **Date Drilled:** April 7, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** N/R
Water Levels: 1st Enc: 6.2' Static: no measurement

Borehole Completion
Well Installed: NO

Cement Grout Seal: 7' to surface

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log	Well Detail/ Backfill
					Asphalt Pavement and and Concrete	
					CL - Silty CLAY, black, 20% silt, high plasticity, moist, stiff.	
EB-5@ 2'	50 ppm	9			PT - PEAT, black, organic soil, contains some disseminated clay and up to 30% silty sand, loose, very moist.	
				5	Thin silty sand interbed 6-inches thick at 3.5 feet	
EB-5@ 5'	ND	4			Odor of methane, saturated.	▽
					Bottom of Boring = 7 feet.	
				10	Groundwater enters borehole very slowly, assume peat smears borehole wall.	

NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil; test not run if sheen or film on groundwater.

Gen Tech Environmental, Inc. San Jose, CA

Exploratory Boring Log

Project No. 9407 **Boring/Well No.** EB-7
Client: DiSalvo Trucking **Date Drilled:** April 7, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** N/R
Water Levels: 1st Enc: 3.5' Static: no measurement

Borehole Completion
Well Installed: NO

Cement Grout Seal: 6' to surface

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log	Well Detail/ Backfill
					Asphalt Pavement and and Concrete	
EB-7@ 2'	Trace	21		5	CL – Silty Clay, greenish gray, 20% silt, med. plasticity, very slight odor, very stiff; interbed of peat from 3.5'-5', clay underlies the peat, clay very soft, contains veg. fragments, saturated; methane odor.	

Bottom of Boring = 6 feet.

Groundwater enters borehole very slowly.

NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil; test not run if sheen or film on groundwater.

Gen Tech Environmental, Inc. San Jose, CA

Exploratory Boring Log

Project No. 9407 **Boring/Well No.** EB-8
Client: DiSalvo Trucking **Date Drilled:** April 7, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** N/R
Water Levels: 1st Enc: 1.25' Static: no measurement

Borehole Completion
Well Installed: NO

Cement Grout Seal: 7' to surface

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log	Well Detail/ Backfill
					Asphalt Pavement and and Concrete	
EB-8@ 3'	ND	6			OL - ML - Organic SILT to SILT, dark gray, medium stiff, moist to saturated.	
				5	CL - Silty CLAY, dark gray, high plasticity, soft, saturated.	

Bottom of Boring = 7 feet.

Groundwater enters borehole very slowly.

NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil; test not run if sheen or film on groundwater.

Gen Tech Environmental, Inc. San Jose, CA

Exploratory Boring Log

Project No. 9407 **Boring/Well No.** EB-9
Client: DiSalvo Trucking **Date Drilled:** April 7, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** N/R
Water Levels: 1st Enc: 3.40' Static: no measurement

Borehole Completion
Well Installed: NO

Cement Grout Seal: 5' to surface

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log	Well Detail/ Backfill
					Asphalt Pavement and and Concrete	
EB-9@ 2'	Trace	10	▨		ML - Sandy SILT, dark greenish gray 5G 4/1, 30% fine sand, nonplastic, rare veg. fragments, very slight odor, stiff, moist to saturated. ▽	
				5		

Bottom of Boring = 5 feet.

Groundwater enters borehole very slowly.

NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil; test not run if sheen or film on groundwater.

Gen Tech Environmental, Inc. San Jose, CA

Exploratory Boring Log

Project No. 9407 **Boring/Well No.** EB-10
Client: DiSalvo Trucking **Date Drilled:** April 8, 1994
Location: 4919 Tidewater, Oakland, CA **Logged by:** EL
Drilling Method: Hollowstem Auger **Permit:** N/R
Water Levels: 1st Enc: 1.8' Static: no measurement

Borehole Completion
Well Installed: NO

Cement Grout Seal: 5' to surface

Sample No.	HAN	Blow Count	Sample	Depth	Lithology Log	Well Detail/ Backfill
					Asphalt Pavement and and Concrete sampler refusal at 1.5-2 feet	
EB-10@ 2'	None	12			ML - SILT, dark greenish gray, nonplastic, stiff, very moist to saturated; grades to Peat from 3.5-5 feet; odor.	
				5		

Bottom of Boring = 5 feet.

Groundwater enters borehole very slowly, slight sheen on water.

NOTE: HAN refers to the Modified Hanby Field Laboratory Field test, a qualitative colormetric test for Hydrocarbon presence in soil; test not run if sheen or film on groundwater.

Boring Log SB-1 **Page** 1 **of** 1

Client: D. Salvo Trucking

Date: 7/19/95

Location: 4919 Tidewater Ave., Oakland

Driller:

Method:

Sampler: BH

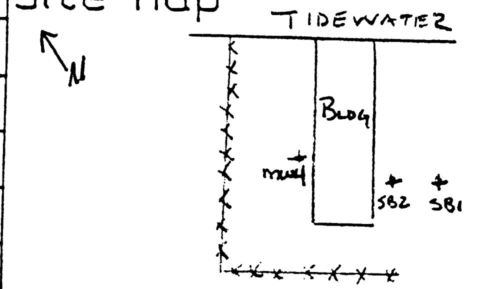
Logger: BH

Permit #:

Inspector:

Agency: Zone 7

Site Map



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt	
SB1@4'	3.5'-4.0'	N/A	WET		GW	Sandy GRAVEL - Possible Import Some broken asphalt/concrete 40% sand. mod. Petro. Odor	Portland

Total Depth: 4'

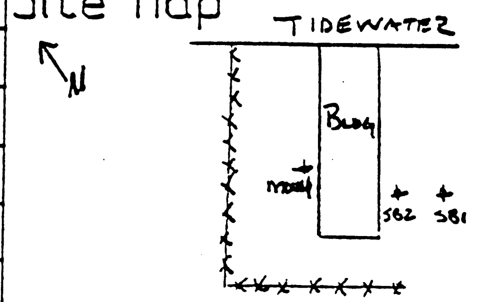
Water Level: 3'

Sanitary Seal: Portland

Well/Boring Designation: SB-1

Boring Log SB-2 Page 1 of 1

Client D. Salvo Trucking	Date 7/19/95
Location 4919 Tidewater Ave., Oakland	Site Map
Driller ERS	
Method Hand Auger (3")	Sampler BH
Logger BH	Permit #
Inspector	Agency Zone 7



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt	
SB2@4'	3.5'-4'	N/A	WET		GW	Sandy Gravel, possible import w/ med. fine grain sand med. density, slight odor.	Portland Cement
						BoH	

Total Depth: 4'

Water Level: 3'

Sanitary Seal: Portland

Well/Boring Designation: SB-2

Boring Log MW-4

Client D. Salvo Trucking

Date 7/19/95

Location 4919 Tidewater Ave., Oakland

Driller

Method

Sampler BH

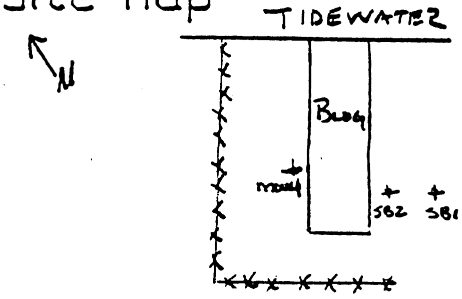
Logger BH

Permit #

Inspector

Agency Zone 7

Site Map



Samples	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials
						Asphalt
MW4@4	4'	2/2/3	Moist		SC	Clayey SAND, greenish grey 5GL 4.5/1, 25% silty clay loose, wet
MW4@8	8'	3/4/4	WET		OH/SM PT	High organic CLAY/50% Silty Sand Pt, Black, methane odor very moist, dissem. clay

Completion Data

- 8" Bolt cover
- 2" Lock cap
- 2' Portland Sanitary seal
- Bentonite seal (1')
- 2/12 Sand Pack
- Sch 40, 2" PVC Screen 0.02 slt.
- BOH

Total Depth: 8'

Water Level: 3'

Sanitary Seal: Portland

Boring Log

Client DiSalvo Trucking

Date 12-20-00

Location 4919 Tidewater Ave. Oakland

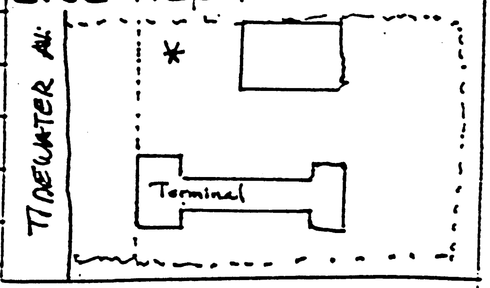
Driller Vironex

Method 2" Geo PROBE | Sampler BH

Logger BH | Permit # N/A

Inspector N/A | Agency N/A

Site Map



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	
	2						
				▽		Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4						
					ML	clayey silt, 15% f. sand w/ organics, wood	
	6					No HC odor	Portland Cement
					CH	Bay mud	
	8					BOH	

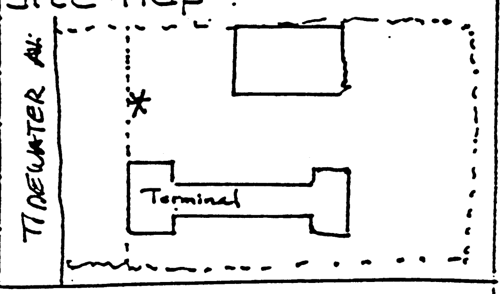
Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-1

Boring Log

Client DiSalvo Trucking | Date 12-20-00
Location 4919 Tidewater Ave. Oakland
Driller Vironex
Method 2" Geo PROBE | Sampler BH
Logger BH | Permit # N/A
Inspector N/A | Agency N/A

Site Map



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	
	2					Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4			▽		HC odor	
SB2@6'	6				CL	Silty Sandy CLAY, Dark w/ decomp. organic material	Portland Cement
					PH	Peat	
	8				KH	Bay mud	
						BOH	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-2

Boring Log

Client DiSalvo Trucking

Date 12-20-00

Location 4919 Tidewater Ave. Oakland

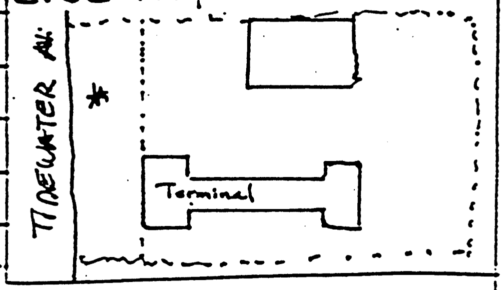
Driller Vironex

Method 2" Geo PROBE | Sampler BH

Logger BH | Permit # N/A

Inspector N/A | Agency N/A

Site Map



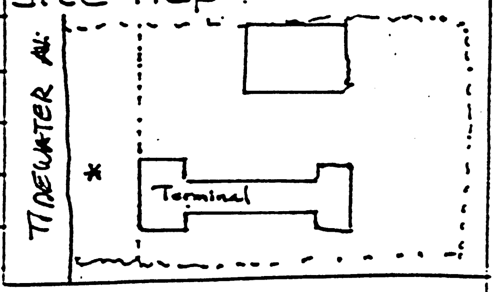
Samples	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	
	2					Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4						
					CL	Silty, Sandy CLAY, 30% silt some organics	Portland Cement
	6					No HC odor	
					MH	Bay mud	
	8					BOH	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-3

Boring Log

Client DiSalvo Trucking	Date 12-20-00
Location 4919 Tidewater Ave. Oakland	Site Map
Driller Vironex	
Method 2" Geo PROBE / Sampler BH	
Logger BH / Permit # N/A	
Inspector N/A / Agency N/A	



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	
	2						
			▽			Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	Portland Cement
	4						
					CL	Silty CLAY, 30% silt, 10% gravel soft, wet	
	6					No HC. Odor	
					CH	Bay mud	
	8					BOH	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-4

Boring Log

Client DiSalvo Trucking

Date 12-20-00

Location 4919 Tidewater Ave. Oakland

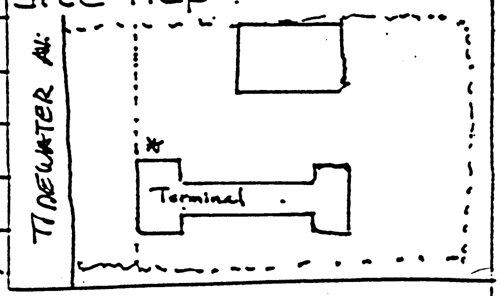
Driller Vironex

Method 2" Geo PROBE | Sampler BH

Logger BH | Permit # N/A

Inspector N/A | Agency N/A

Site Map



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	
	2						
			▽			Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4					HC odor	
					CL	Silty CLAY, 40% silt, 20% f. sand, organic material	
	6						
SB5@6.5'					ML	Sandy SILT w/ 25% f. sand, organics	
					OH	Bay mud	
	8					BOH	

Completion Data: Portland Cement

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-5

Boring Log

Client DiSalvo Trucking

Location 4919 Tidewater Ave. Oakland

Driller Vironex

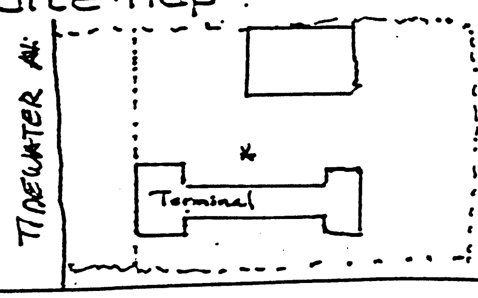
Method 2" Geo PROBE | Sampler BH

Logger BH | Permit = N/A

Inspector N/A | Agency N/A

Date 12-20-00

Site Map



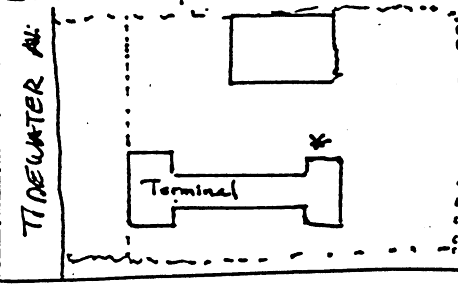
Samples	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	Portland Cement
	2					Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4			▽		↓ HC odor	
	6				SM	Silty SAND. v. Fine, loose wet w/ some organics	
					ML	Sandy SILT, w/ 15% clay, 30% sand w/ some organics	
SB6@7'				■	CH	Bay mud	
	8					BOH	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-6

Boring Log

Client DiSalvo Trucking	Date 12-20-00
Location 4919 Tidewater Ave. Oakland	Site Map
Driller Vironex	
Method 2" Geo PROBE / Sampler BH	
Logger BH / Permit # N/A	
Inspector N/A / Agency N/A	



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	
	2						
				▽ (±3')		Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4						
					CL	~~clay~~ Silty Sandy CLAY w/ organics	Portland Cement
	6				ML	Sandy SILT	
					SM	Silty SAND	
					CL	Sandy CLAY No H.C. odor	
					CH	Bay mud	
	8					BOH	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-7

Boring Log

Client DiSalvo Trucking

Date 12-20-00

Location 4919 Tidewater Ave. Oakland

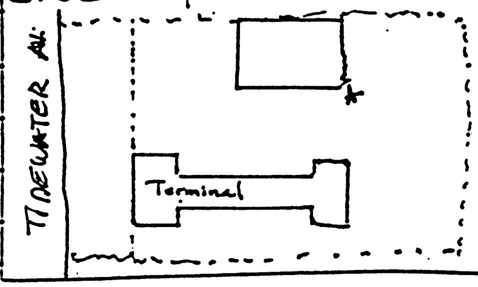
Driller Vironex

Method 2" Geo PROBE | Sampler BH

Logger BH | Permit # N/A

Inspector N/A | Agency N/A

Site Map



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	
	2						
			▽			Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4						
					PH	High organics Peat w/ decomposed wood. 30% silt or Sand.	Portland Cement
	6						
					SM	Silty SAND w/ some clay and organics	
					CL	Silty Sandy CLAY	
					CH	Bay mud	
						No H.C odor	
	8					BOH	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-8

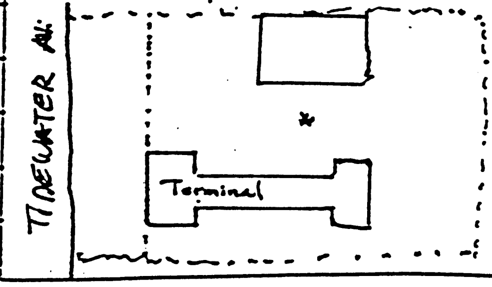
Fill material consisting of imported

Boring Log

Client DiSalvo Trucking | Date 12-20-00

Location 4919 Tidewater Ave. Oakland

Site Map



Driller Vironex

Method 2" Geo PROBE | Sampler BH

Logger BH | Permit # N/A

Inspector N/A | Agency N/A

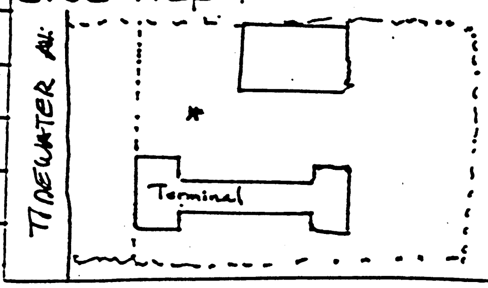
Samples	Depth	Blows Per 6 Inches	Moisture	Samples USCS	Description of Subsurface Materials	Completion Data
					Asphalt/Concrete Base Material	
	2					
				▽	Fill material consisting of imported sand.	
	4					Portland Cement
	6					
	8				BOH	
					No H.C. odor	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-9

Boring Log

Client DiSalvo Trucking	Date 12-20-00
Location 4919 Tidewater Ave. Oakland	Site Map
Driller Vironex	
Method 2" Geo PROBE	Sampler BH
Logger BH	Permit # N/A
Inspector N/A	Agency N/A



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	Portland Cement
	2						
						Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	▽ (≈3)						
	4					H.C. Odor	
					ML	Sandy SILT, dark, wet w/ organics	
SB10@6'	6			■	SM	Silty SAND, 35% silt	
					CL	Silty, sandy, CLAY	
					K#	Bay mud	
	8					BOH	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-10

Boring Log

Client: DiSalvo Trucking

Date: 12-20-00

Location: 4919 Tidewater Ave. Oakland

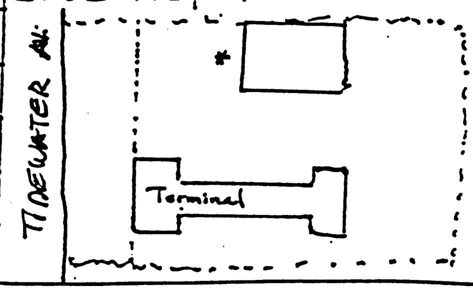
Driller: Vironex

Method: 2" Geo PROBE | Sampler: BH

Logger: BH | Permit #: N/A

Inspector: N/A | Agency: N/A

Site Map



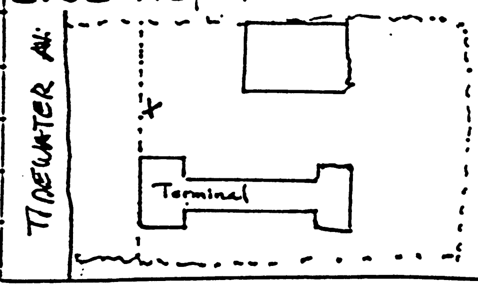
Sample #	Depth	Blows Per 6 Inches	Moisture	Samples USCS	Description of Subsurface Materials	Completion Data
					Asphalt/Concrete Base Material	Portland Cement
	2				Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
			▽			
	4					
				PA	High organics PEAT w/ decomp. wood, 30% f. sand, 20% silt wet	
	6			SM	Silty SAND w/ some organics	
				CL	Silty, Sandy, CLAY	
				CH	Bay mud	
	8				No H.C odor	
					BOH	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-11

Boring Log

Client DiSalvo Trucking	Date 12-20-00
Location 4919 Tidewater Ave. Oakland	Site Map
Driller Vironex	
Method 2" Geo PROBE / Sampler BH	
Logger BH / Permit # N/A	
Inspector N/A / Agency N/A	



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	Portland Cement
	2						
						Fill material consisting of imported sands, gravels, concrete asphalt with mixtures of imported soil (water level ▽ ±3')	
	4					H.C. odor	
					ML	Sandy SILT, w/ decomp. organic mat. 20% F. sand 15% clay	
	6						
SB-12@6.5'					CL	Silty CLAY, soft, wet, 25% silty, 20% f. sand.	
					CH	Bay mud	
	8						
						BOH	

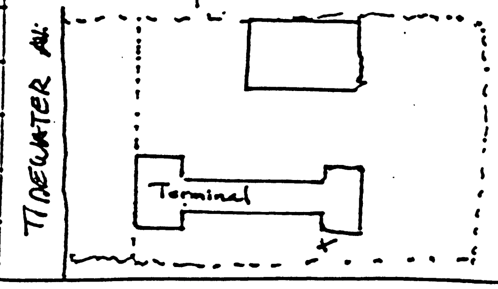
Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-12

Boring Log

Client DiSalvo Trucking | Date 12-20-00
Location 4919 Tidewater Ave. Oakland
Driller Vironex
Method 2" Geo PROBE | Sampler BH
Logger BH | Permit # N/A
Inspector N/A | Agency N/A

Site Map



Samples	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	Portland Cement
	2					Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4						
	6				ML	Sandy SILT w/ some organics 25% SAND, 15% clay, dark wet soft.	
					CL	Silty clay	
	8				CH	Bay mud	
						BOH No H.C. odor	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

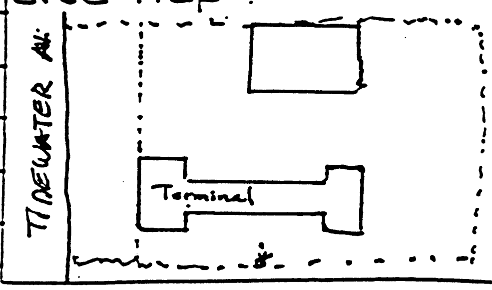
Well/Boring Designation: SB-13

Boring Log

Client: DiSalvo Trucking
Date: 12-20-00

Location: 4919 Tidewater Ave. Oakland

Site Map



Driller: Vironex

Method: 2" Geo PROBE | Sampler: BH

Logger: BH | Permit #: N/A

Inspector: N/A | Agency: N/A

Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	Portland Cement
	2						
			▽ (water level ±3')			Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4					H.C. odor	
					ML	Sandy, clayey SILT, dark w/ decomp. organics	
	6				SM	Silty, clayey SAND.	
					CL	Silty CLAY	
SB14@7'					CH	Bay mud	
	8					BOH	

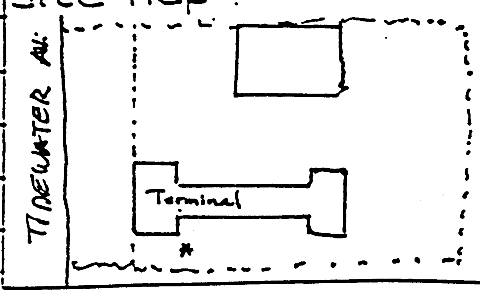
Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-14

Boring Log

Page 1 of 1

Client DiSalvo Trucking	Date 12-20-00
Location 4919 Tidewater Ave. Oakland	Site Map
Driller Vironex	
Method 2" Geo PROBE	Sampler BH
Logger BH	Permit # N/A
Inspector N/A	Agency N/A



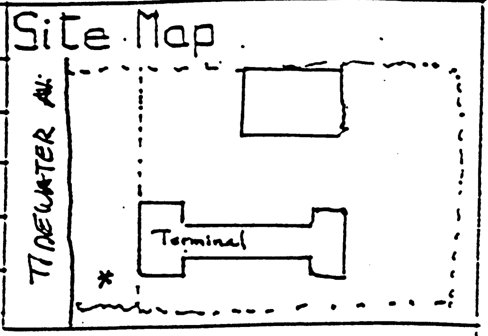
Samples	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	Portland Cement
	2						
			▽			Fill material consisting of imported Sands, Gravels, concrete asphalt with mistures of imported soil	
	4						
						H.C. odor	
					CL	Silty CLAY w/15% f. sand dark, soft, wet	
	6				SM	Silty SAND, w/10% clay & some organic material	
SB15@6				■	CL	Silty, Sandy CLAY, soft wet	
					KH	Bay mud	
	8					BOH	

Total Depth: 8'	Water Level: ±3'	Sanitary Seal: Portland Cement

Well/Boring Designation: SB-15

Boring Log

Client DiSalvo Trucking	Date 12-20-00
Location 4919 Tidewater Ave. Oakland	Site Map
Driller Vironex	
Method 2" Geo PROBE / Sampler BH	
Logger BH / Permit # N/A	
Inspector N/A / Agency N/A	



Sample #	Depth	Blows Per 6 Inches	Moisture	Samples	USCS	Description of Subsurface Materials	Completion Data
						Asphalt/Concrete Base Material	Portland Cement
	2						
			▽ (±3')			Fill material consisting of imported Sands, Gravels, concrete asphalt with mixtures of imported soil	
	4					Slight H.C odor	
	6				CL	Sandy, silty CLAY, 30% silt, 20% f. sand. Dark wet, w/ decomp organics	
					SM	~~silty sand~~ silty SAND	
				■	CL	Silty, Sandy CLAY.	
					CH	Bay mud	
	8					BOH	

Total Depth: 8' | Water Level: ±3' | Sanitary Seal: Portland Cement

Well/Boring Designation: SB-16

MAJOR DIVISIONS					TYPICAL NAMES
COARSE-GRAINED SOILS MORE THAN HALF IS COARSER THAN NO. 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
			GP		POORLY GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES.
		GRAVELS WITH OVER 15% FINES	GM		SILTY GRAVELS, SILTY GRAVELS WITH SAND
			GC		CLAYEY GRAVELS, CLAYEY GRAVELS WITH SAND
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
			SP		POORLY GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
		SANDS WITH OVER 15% FINES	SM		SILTY SANDS WITH OR WITHOUT GRAVEL
			SC		CLAYEY SANDS WITH OR WITHOUT GRAVEL
FINE-GRAINED SOILS MORE THAN HALF IS FINER THAN NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS		ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOOR, SILTS WITH SANDS AND GRAVELS
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY CLAYS WITH SANDS AND GRAVEL, LEAN CLAYS
			OL		ORGANIC SILTS OR CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS, FINE SAND OR SILTY SOILS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC SILTS OR CLAYS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT		PEAT AND OTHER HIGHLY ORGANIC SOILS

PID	Photoionization Detector
ppm	Parts per million in air
———	Observed contact
— — —	Uncertain contact
/ / /	Gradational contact
< K	Less than thousand
HC	Hydrocarbon
FeOx	Iron oxide

▼	Stabilized water level as of date indicated
▽	Observed top of saturated soil interval
□	Sample interval
■	Undisturbed sample
⊠	No recovery
Blows –	Sample drive hammer weight 140 pounds falling 30 inches. Blows required to drive sampler 1/2 foot are indicated on the log.

ABBREVIATIONS, SYMBOLS and SOIL CLASSIFICATION USED in BORING LOGS

ERAS Environmental Inc.

ƐRAS Ɛnvironmental	**Log of Boring** B-1
PROJECT: 05-001-06	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-06	LOCATION: Front NE
DATE STARTED: 2-24-06	First Water (ft. bgs.): 2.5 DATE: 2-24-06
DATE FINISHED: 2-24-06	TOTAL DEPTH: 11 feet
DRILLING METHOD: Hollow Stem Auger 8¼" OD	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Hew Drilling	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
						Asphalt + Base rock
			NR, NR	GP	▽	Sandy Gravel, dark yellowish brown (10YR 4/6), damp, dense, ~30% sand, fine to coarse well graded sand, ~70% gravel, ¼"-1½" subrounded, no product odor, Fill
	@3' 0	B1,2.75-3'	NR, NR, NR	SM		Silty Sand, dark gray, (10YR4/1), wet, medium dense, ~15% silt, ~85% fine to medium grain poorly graded sand, slight hydrocarbon odor
5						
	@7' 0	B1,6.75-7'				
10			NR	CH		Clay w/ Organics, Black (10YR2/1), wet, soft, high plasticity, no product odor, wood debris
						Bottom at boring 11 feet bgs 2-24-06
15						
20						

ƐRAS Ɛnvironmental

Log of Boring B-2

PROJECT: 05-001-06	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-06	LOCATION: N E Diesel Tank
DATE STARTED: 2-24-06	First Water (ft. bgs.): 3'3" DATE: 2-24-06
DATE FINISHED: 2-24-06	TOTAL DEPTH: 10 feet
DRILLING METHOD: Hollow Stem Auger 8 1/4"	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Hew Drilling	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
						Asphalt + Base Rock
				CL		Silty Clay, black (10YR2/1), stiff, damp, medium plasticity, diesel odor
					∇	
	@3'9" 201	B2 3.5-3.75'		SW		Gravely Sand, very dark brown (10YR2/2) wet, ~5% silt, ~70% fine to coarse well graded sand, ~25% 1/8 - 1/2" subrounded gravel, heavy staining and diesel odor
5						
			NR	CH		Clay w/ Organics, Black (10YR2/1), wet, soft, high plasticity, slight hydrocarbon odor, wood debris
	@7'3" 0	B2 7'-7.25'				
	@8'6" 0					
10						
						Bottom of boring 9.5 feet bgs 10-24-06
15						
20						

ƐRAS Ɛnvironmental

Log of Boring B-3

PROJECT: 05-001-06	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-06	LOCATION: NE along fence
DATE STARTED: 2-24-06	First Water (ft. bgs.): 2½ DATE: 2-24-06
DATE FINISHED: 2-24-06	TOTAL DEPTH: 8.5
DRILLING METHOD: Hollow Stem Auger 8¼"	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Hew Drilling	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
						Asphalt + Base Rock
						Auger to 1 foot
			NR	SW		Gravely Sand, dark yellowish brown, (10YR4/6), damp, dense, ~75% sand, fine
			NR		▽	to coarse, well graded, sand, ~25% gravel
	@3' / 0	B-3, 2.75-3'				⅛"-2" subrounded gravel, no product odor, Fill
			NR			wet @ 2½ feet slight hydrocarbon odor
			NR			from 4-4.5' black apparent burnt material, consolodated
5				CH		Clay w/ Organics, Black, (10YR2/1) wet, soft, high plasticity, no product odor, wood debris
			NR			
			NR			
	@7' / 0	B-3 7-7.25'	NR			
						Bottom of boring 8.5 feet bgs 2-24-06
10						
15						
20						

ERAS Environmental — **Log of Boring** B-4

PROJECT: 05-001-06	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-06	LOCATION: SW corner of main bldg
DATE STARTED: 2-24-06	First Water (ft. bgs.): 3.5 DATE: 2-24-06
DATE FINISHED: 2-24-06	TOTAL DEPTH: 8 feet
DRILLING METHOD: Hollow Stem Auger 8"	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Hew Drilling	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
0–1						Asphalt + Base Rock
1–3.5	@3.6" 0			GW	▽ (3.5)	Auger to 1 foot. Sandy Gravel, dark yellowish brown (10YR4/6), damp, dense, ~30% sand fine to coarse, well graded sand ~70% 1/8"–1/2" subrounded gravel, no product odor, Fill. Wet @ 3.5 feet
3.5–8	@ 3.9"	B-4 5'-5.25'		CH		Clay w/ Organics, Black (10YR2/1), wet, soft, high plasticity, no product odor, wood debris
8						Bottom of boring 8 feet bgs 2-24-06

Depth scale: 5, 10, 15, 20

ERAS Environmental

Log of Boring B-S

PROJECT: OS-001-06	ADDRESS: 4919 Tidewater
JOB NUMBER: OS-001-06	LOCATION: N of Truck Scale
DATE STARTED: 2-24-06	First Water (ft. bgs.): 4'9" DATE: 2-24-06
DATE FINISHED: 2-24-06	TOTAL DEPTH: 8.5
DRILLING METHOD: Hollow Stem Auger 8 1/4"	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Hew Drilling	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
						Asphalt + Base Rock
				SP		Auger to 1 foot Silty Sand, dark yellowish brown (10YR4/6), damp, dense, ~15% silt ~85% fine to medium grain sand, poorly graded, no product odor
			NR			
5	@5.3' 0	B-S 5'-5.25'			∇	@4'9" color change to ~~gray~~ dark gray (10YR4/1), Wet slight hydrocarbon odor
	@7' 0	B-S 6.75'-7'		CH		Clay w/ organics, black (10YR2/1), wet soft, high plasticity, no product odor, wood debris
						Bottom of boring 8.5 feet bgs 2-24-06
10						
15						
20						

Murray

ERAS Environmental

Log of Boring B-6 (B-1)

PROJECT:	ADDRESS: 4919 Tidewater Avenue Oak
JOB NUMBER: 05-001-07	LOCATION: Gravel Area off Tidewater
DATE STARTED: 2/27/06	First Water (ft. bgs.): 2.5 DATE: 2/27/06
DATE FINISHED: 2/27/06	TOTAL DEPTH: 30 feet
DRILLING METHOD: Hollow stem 8 1/4" OD	GEOLOGIST: Dave Siegel
DRILLING COMPANY: Exploration Geoservices	Reviewed By:

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
				SW	▽	SANDY GRAVEL fill, dark yellowish brown (10YR 4/6) ~35% fine to coarse gravel up to 1½" long, subangular to subrounded, dense, no petroleum odor
	0	B-6-4-4.5		SM		SILTY SAND, dark gray (Gley 1 4/N), fine to medium sand, medium dense, wet, no petroleum odor
5	0	B-6-6-6.5		CH		CLAY, dark greenish gray (Gley 2 4/5BG), high plasticity, soft, damp, no petroleum odor
10						Note Bottom of boring 30 feet. Boring below 10 feet logged by Will Carter, Murray Engineers. Boring sealed to surface with cement grout
15						
20						

ERAS Environmental

Log of Boring B-7 (Murray B-2)

PROJECT:	ADDRESS: 4919 Tidewater Avenue, Oakland
JOB NUMBER: 05-001-07	LOCATION: NW prop line near truck scale
DATE STARTED: 2/27/06	First Water (ft. bgs.): 3.5 DATE: 2/27/06
DATE FINISHED: 2/27/06	TOTAL DEPTH: 30 feet
DRILLING METHOD: Hollow stem auger 8 1/4" OD	GEOLOGIST: Dave Siegel
DRILLING COMPANY: Exploration Geoservices	Reviewed By:

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
				GW		Asphalt 1-2", very worn. GRAVELLY SAND fill, dark yellowish brown (10YR 4/6) gravel up to 1 1/2" subangular, dense, damp, no petroleum odor
				CL		GRAVELLY CLAY, very dk greenish gray (Gley 2, 4/1 10B) medium plasticity, stiff, damp, no petroleum odor
	0	B-7-3	■		▽	
	60	-3.5		SM		SILTY SAND, dark greenish gray (Gley 1 4/1, 5GY) fine to medium sand, medium dense, wet, slight petroleum odor
5						
	0	B-7-6 -6.5	■	CH		CLAY, very dark greenish gray (Gley 1, 3/1 5GY), soft, high plasticity, no petroleum odor
10						Bottom of boring 30 feet. Boring below 10 feet logged by Will Carter of Murray Engineers. Boring sealed with cement grout to surface
15						
20						

ƐRAS Ɛnvironmental

Log of Boring B-8 (Murray B-3)

PROJECT:	ADDRESS: 4914 Tidewater Avenue, Oakland
JOB NUMBER: 05-001-07	LOCATION: near SW property line
DATE STARTED: 2/27/06	First Water (ft. bgs.): 2.75 DATE: 2/27/06
DATE FINISHED: 2/27/06	TOTAL DEPTH: 30 feet
DRILLING METHOD: Hollow stem auger 8 1/4" OD	GEOLOGIST: Dave Siegel
DRILLING COMPANY:	Reviewed By:

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
						Asphalt 1-2", very worn
				SW		GRAVELLY SAND fill, dark yellowish brown (10YR 4/6), subangular up to 1 1/2", dense, damp, no petroleum odor
					▽	
		B-8-3 -3.5		SP		SAND, very dark greenish gray (Gley 2, 4/1 10BG), fine to medium, medium dense, wet, no petroleum odor
5		B-8-4.5 -4.5		CH		CLAY, greenish black (Gley 2, 2.5/10G), soft, high plasticity, damp, no petroleum odor
10						Bottom of boring 30 feet. Boring below 10 feet logged by Will Carter of Murray Engineers. Boring sealed to surface with cement grout
15						
20						

ERAS Environmental

Log of Boring B-9 (Murray B-4)

PROJECT:	ADDRESS: 419 Tidewater Avenue, Oakland
JOB NUMBER: 05-001-07	LOCATION: near W corner of repair building
DATE STARTED: 2/27/06	First Water (ft. bgs.): 2.75 DATE: 2/27/06
DATE FINISHED: 2/27/06	TOTAL DEPTH: 30 feet
DRILLING METHOD: Hollow stem auger 8 1/4" OD	GEOLOGIST: Dave Siegel
DRILLING COMPANY:	Reviewed By:

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
						Asphalt 1-2", very worn
				GW		GRAVELLY CLAY, very dark greenish gray (Gley 3/5GY) subangular up to 1 1/2", dense, damp, slight petroleum odor, 35% gravel
					▽	
				SW		SAND, very dark gray (Gley 2 4/10BG), fine to medium sand, 15% gravel, medium dense, wet, very strong petroleum odor
5		B9-4.5-5				
				CH		CLAY, greenish black (Gley 2 2.5/10G), soft high plasticity, damp, slight petroleum odor
10		B9-10-10.5				
						Bottom of boring 30 feet. Boring below 10.5 feet logged by Will Carter of Murray Engineers. Boring sealed to surface with cement grout
15						
20						

ƐRAS Ɛnvironmental | **Log of Boring** B-10

PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: Front by tidewater
DATE STARTED: 4-12-06	First Water (ft. bgs.): 1 DATE: 4-12-06
DATE FINISHED: 4-12-06	TOTAL DEPTH: 10 feet
DRILLING METHOD: Direct Push	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Vironex	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
						Gravel & weeds
				GW	▽	Sandy Gravel, brown (10YR 4/3), damp, dense, ~30% fine to coarse well graded sand, ~70% gravel 1/8"-1 1/2" subrounded gravel, no odor, fill - hand auger to 2 feet
				SM		Silty Sand, dark grey (10YR 4/1), wet, medium dense, ~15% silt, ~85% fine to coarse grain well sorted sand, no odor, fill
5	@5' / 0	B-10, 4.5-5' 8:00				
				CH		Clay, very dark greenish gray (Gley 2 3/1 10 GB), damp, soft, high plasticity, No odor
10	@10' / 0	B-10, 9.5-10' 8:45				
						Bottom of boring 10 feet bgs 4-12-06
15						
20						

ƐRAS Ɛnvironmental	Log of Boring B-11
PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: northeast of tank pit
DATE STARTED: 4-12-06	First Water (ft. bgs.): 2 DATE: 4-12-06
DATE FINISHED: 4-12-06	TOTAL DEPTH: 10 feet
DRILLING METHOD: Direct Push	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Vironex	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
						Asphalt & Baserock ¼"-2" angular hand auger 1 foot
				SW	▽	Gravely Sand w/ Silt, dark greenish grey (Gley2 4/1 10G), wet, dense, ~10% silt ~70% fine to coarse well graded sand, ~20% gravel ⅛"-1" subrounded gravel, heavy hydrocarbon odor
5	@5 / 127	B-11, 4.5'-5' 9:40				
				ML		Silt, very dark greenish gray (Gley2 3/1 10GB), wet, stiff, hydrocarbon odor
	@9 / 0	B-11, 8.5'-9'	NR	CH		Clay w/ Organics, very dark greenish gray (Gley2 3/1 10GB), damp, soft, high plasticity ~95% clay, ~5% wood organics, very slight hydrocarbon odor
10		9:46	NR			Bottom of boring 10 feet bgs 4-12-06
15						
20						

ƐRAS Ɛnvironmental

Log of Boring B-12

PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: northwest of tank pit
DATE STARTED: 4-12-06	First Water (ft. bgs.): DATE:
DATE FINISHED: 4-12-06	TOTAL DEPTH: 10 feet
DRILLING METHOD: Direct Push	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Vironex	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
0–1						Asphalt and base rock 1/4" - 2" angular - hand auger 1 foot
1–5	@3' 178	B-12 2.5-2.75'; B-12 2.75-3'	NR, NR, NR, NR	CH		Clay w/organics, very dark greenish gray (Gley 2 3/1 10GB), damp, soft, high placticity, ~95% clay, ~5% wood organics, heavy hydrocarbon odor,
5–10	@8' 0	B-12 7.5-8'	NR, NR, NR, NR			- at 7 feet very slight odor
10						Bottom of boring 10 feet bgs 4-12-06
15						
20						

ƐRAS Ɛnvironmental | **Log of Boring** B-13

PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: Back fence closest to B-8
DATE STARTED: 4-12-06	First Water (ft. bgs.): 1 DATE: 4-12-06
DATE FINISHED: 4-12-06	TOTAL DEPTH: 10 feet
DRILLING METHOD: Direct Push	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Vironex	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
0–1					▽	Asphalt and base rock ¼"–2" angular
1–10	@5' 0; @9' 0	B-13 4-4.5' 10:49; 10:53	NR NR	CH		Clay w/organics, very dark greenish gray (Gley 2 3/1 10GB), wet, soft, high plasticity, ~90% clay, ~10% wood organics, no odor. hand auger to 2½ feet
10						Bottom of boring 10 feet bgs 4-12-06
15						
20						

ƐRAS Ɛnvironmental	Log of Boring B-14
PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: east of truck repair shop
DATE STARTED: 4-12-06	First Water (ft. bgs.): 1 DATE: 4-12-06
DATE FINISHED: 4-12-06	TOTAL DEPTH: 10 feet
DRILLING METHOD: Direct Push	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Vironex	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
					▽	Concrete and base rock 1/4"-2" angular
				CH		Clay w/ organics, very dark greenish gray (Gley 2 3/1 10 G 8), wet, soft, high plasticity, ~90% clay, ~10% organics wood, no odor, hand auger to 2.5 feet
5	@5' 0	B-14 4-4.5' 12:15				
	@8' 0	B-14 7.5-8'	NR NR NR NR			
10		12:20				Bottom of boring 10 feet bgs 4-12-06
15						
20						

ƐRAS Ɛnvironmental

Log of Boring B-1S

PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: west of track repair shop
DATE STARTED: 4-12-06	First Water (ft. bgs.): DATE:
DATE FINISHED: 4-12-06	TOTAL DEPTH: 10 feet
DRILLING METHOD: Direct Push	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Vironex	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
					∇	Asphalt and Base rock ¼"-2" angular
				CH		Clay w/ organics, very dark greenish grey (Gley 2 3/1 10GB), wet, soft, high plasticity, no odor
	@3.5' 0		X, NR, NR, NR			
5			X, X, X, X, X, X			
	@9' 0	B-1S 8-8.5'	NR, NR			
10						Bottom of boring 10 feet bgs 4-12-06
15						
20						

ERAS Environmental

Log of Well EW-1

PROJECT: 05-001-10	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-10	LOCATION: near MW-2
DATE STARTED: 4-14-06	First Water (ft. bgs.): 1.5' DATE: 4-14-06
DATE FINISHED: 4-14-06	TOTAL DEPTH: 11.5 feet
DRILLING METHOD: Bucket Auger-36"	GEOLOGIST: Andrew Savage
DRILLING COMPANY: Viking	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	BLOWS/ 1/2'	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION	WELL DIAGRAM
							Asphalt + base	steel plate cover; slip cap
					GW		Sandy Gravel, brown (10YR4/3) damp, dense, ~30% fine to coarse well graded sand, ~70% gravel 1/8"-1 1/2" subrounded gravel, No odor; diesel odor starts at 1 1/2' and color changes to dark greenish gray (Gley2 4/1 10G)	2/12 sand - 1/4" gravel mix; 8 inch Sch 40 PVC .032 slot
5					SW		Sand, dark greenish gray (Gley2 4/1 10G) wet, dense, well graded fine to coarse sand, may be silt, diesel odor	
					CH		Clay w/ organics, very dark greenish gray (Gley2 3/1 10GB) damp, soft, high plasticity, Diesel odor	
10								
							Bottom of boring 11.5 feet bgs 4-14-06	
15								
20								

ƐRAS Ɛnvironmental

Log of Well OB-3

PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: 6 feet from Dewatering Well
DATE STARTED: 4-7-06	First Water (ft. bgs.): 3 DATE: 4-7-06
DATE FINISHED: 4-7-06	TOTAL DEPTH: 8 feet
DRILLING METHOD: Hollow Stem Auger 8"	GEOLOGIST: Andrew Savage
DRILLING COMPANY: BC2	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	BLOWS/ 1/2'	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
							Asphalt + Base
					GW		Sandy Gravel, brown (10YR4/3), damp, dense, ~30% fine to coarse well graded sand, ~70% gravel 1/8"-1 1/2" subrounded gravel, no odor, large chunks of concrete present, Fill
					SW	▽	diesel odor starts at 1 1/2' and color changes to dark greenish gray (Gley 2 4/1 10G)
5	@5' 0						Sand dark greenish gray (Gley 2 4/1 10G) wet, dense, well graded fine to coarse sand, diesel odor
	@6.5' 0						
	@8' 0				CH		Clay w/ Organics (wood debris), very dark greenish gray (Gley 2 3/1 10GB) damp, soft, high plasticity, Diesel Odor
							Bottom of boring 8 feet bgs 4-7-06
10							
15							
20							

WELL DIAGRAM
10-inch vault + locked well cap

Grout | Sch 40 2" PVC | Grout
Bent | | Bent
2/12 Sand | 2 inch PVC .020 Slot | 2/12 Sand
Bentonite

ERAS Environmental

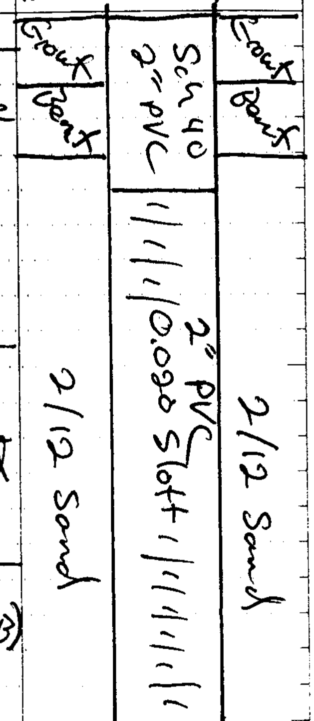
Log of Well OB-4

PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: 12 feet from dewatering well
DATE STARTED: 4-7-06	First Water (ft. bgs.): 3 DATE: 4-7-06
DATE FINISHED: 4-7-06	TOTAL DEPTH: 10 feet
DRILLING METHOD: Hollow Stem Auger 8"	GEOLOGIST: Andrew Savage
DRILLING COMPANY: BC2	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	BLOWS/ 1/2'	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION
							Asphalt + Base
	@3.5' 38.1				GW	▽	Sandy Gravel, brown (10YR4/3) damp, dense, ~30% fine to coarse well graded sand ~70% gravel 1/8"-1 1/2" subrounded gravel, no odor, large chunks of concrete, Fill diesel odor starts at 1 1/2 and color changes to dark greenish gray (Gley 2 4/1 10G)
5	@5' 23.2				SW		Sand dark greenish gray, (Gley 2 4/1 10G), wet, dense well graded fine to coarse sand diesel odor
	@6.5' 0						
	@7.5' 0				CH		Clay w/organics, very dark greenish gray (Gley 2 3/1 10GB) damp, soft, high plasticity, diesel odor
				NR			
10				NR			
15							
20							

WELL DIAGRAM

10 inch vault locked well cap



ƐRAS Ɛnvironmental

Log of Well OB-5

PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: 6 feet from dewatering well
DATE STARTED: 4-7-06	First Water (ft. bgs.): 2 DATE: 4-7-06
DATE FINISHED: 4-7-06	TOTAL DEPTH: 15 feet
DRILLING METHOD: Hollow Stem Auger	GEOLOGIST: Andrew Savage
DRILLING COMPANY: BC2	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	BLOWS/ 1/2'	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION	WELL DIAGRAM 10 inch vault locked well cap
0							Asphalt + Base	
					GW	∇ (2 ft)	Sandy Gravel, brown (10YR4/3) damp, dense, ~30% fine to coarse well graded sand, ~70% gravel 1/8"-1½" subrounded gravel, no odor, large chunks of concrete and wood debris, fill diesel odor starts at 1½' and color changes to dark greenish gray Gley2 4/1 10G)	Grout / 2 inch Sch 40 PVC / Grout
5	@5' 0			X / ■	SM		Silty Sand w/ clay, dark greenish gray (Gley 2 4/1 10G), wet, dense, ~~wet~~ ~40% fines, ~60% sand fine to coarse sand, well graded, diesel odor	
	@6.5' 0			■ / NR / NR / NR				Bentonite / Bentonite
				X	CH		Clay w/ organics (wood debris), very dark greenish gray (Gley 2 3/1 10GB), damp, soft, high plasticity, Diesel odor	
10	@10' 2.0			■ / X				2/12 Sand / 2 inch PVC .020 slot / 2/12 Sand
	@11.5' 9.7		OB-5 11-11.5'	■ / X				
	@12.5' 3.1			■ / NR / X				
15	@15' 3.5			X				
20								

ƐRAS Ɛnvironmental

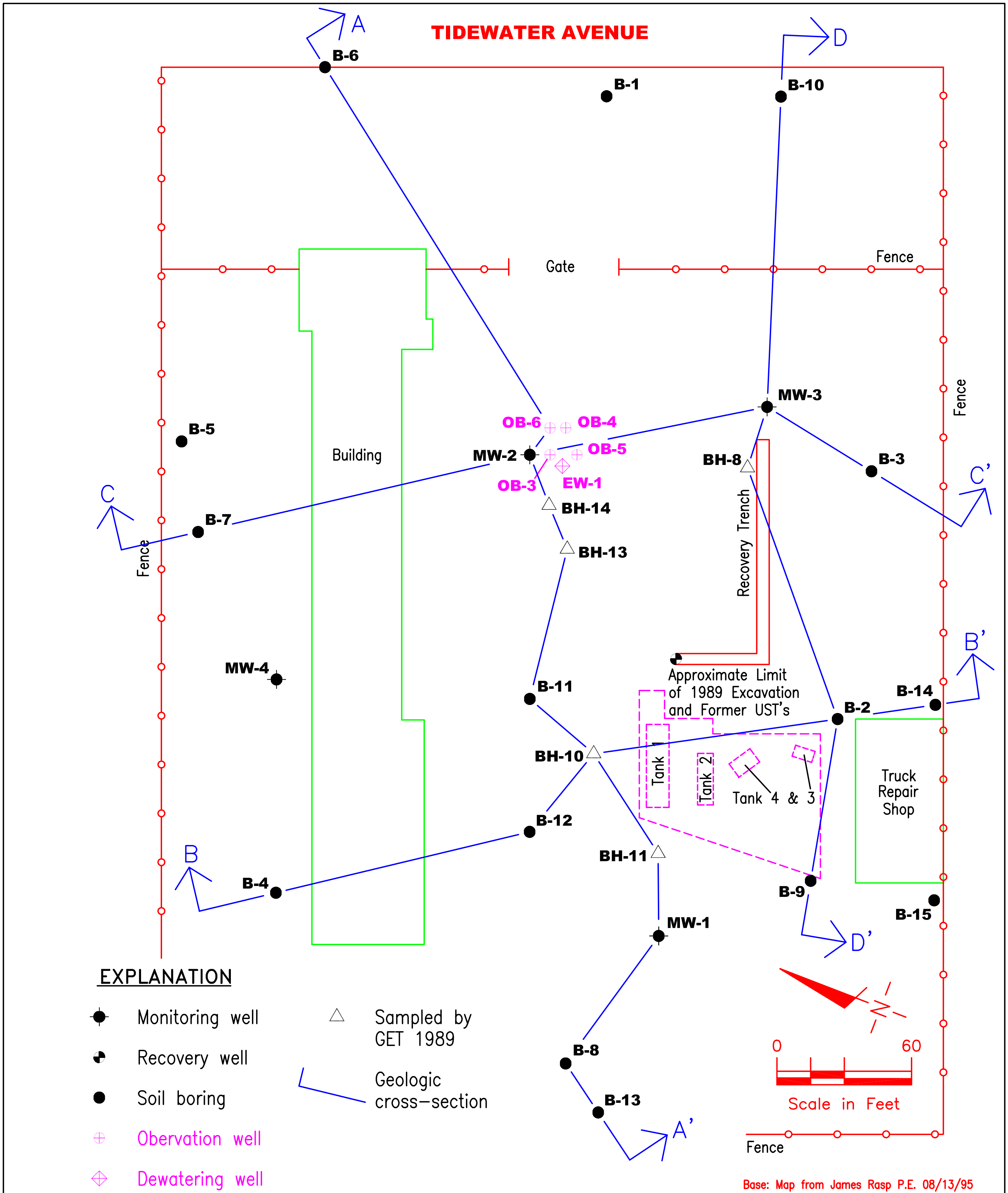
Log of Well OB-6

PROJECT: 05-001-09	ADDRESS: 4919 Tidewater
JOB NUMBER: 05-001-09	LOCATION: 14 feet from dewatering well
DATE STARTED: 4-7-06	First Water (ft. bgs.): 2.5 DATE: 4-7-06
DATE FINISHED: 4-7-06	TOTAL DEPTH: 7.5 feet
DRILLING METHOD: Hollow Stem Auger 8"	GEOLOGIST: Andrew Savage
DRILLING COMPANY: BC2	Reviewed By: Gail Jones

DEPTH ft.	PID (ppm)	BLOWS/ 1/2'	SAMPLE NO.	RECOVERY	GRAPHIC LOG	WATER LEVEL	GEOLOGIC DESCRIPTION	WELL DIAGRAM 10 inch vault locked well cap
							Asphalt + Base	Grout / Sch 40 PVC / Grout
					GW	▽	Sandy Gravel, brown (10YR4/3) damp, dense, ~30% fine to coarse well graded sand, ~70% gravel 1/8"-1 1/2" subrounded gravel, no odor, large chunks of concrete present Fill	Bent / Bent
	0 @3.5'				SM		diesel odor starts at 1 1/2' and color changes to dark greenish gray (Gley 2 4/1 10G)	2/12 Sand / 2" PVC .020 Slot / 2/12 Sand
5	0 @5'						Silty Sand w/ Clay, dark greenish gray (Gley2 4/1 10G) wet, dense, ~40% fines ~60% fine to coarse well graded sand, diesel odor	
	0 @6.5'				CH		Clay w/ organics (wood debris), very dark greenish gray (Gley 2 3/1 10GB), damp, soft, high plasticity, Diesel odor	Bentonite
10								
15								
20								

APPENDIX B

GEOLOGIC CROSS-SECTION DETAILS



SITE MAP w/CROSS SECTION LINES

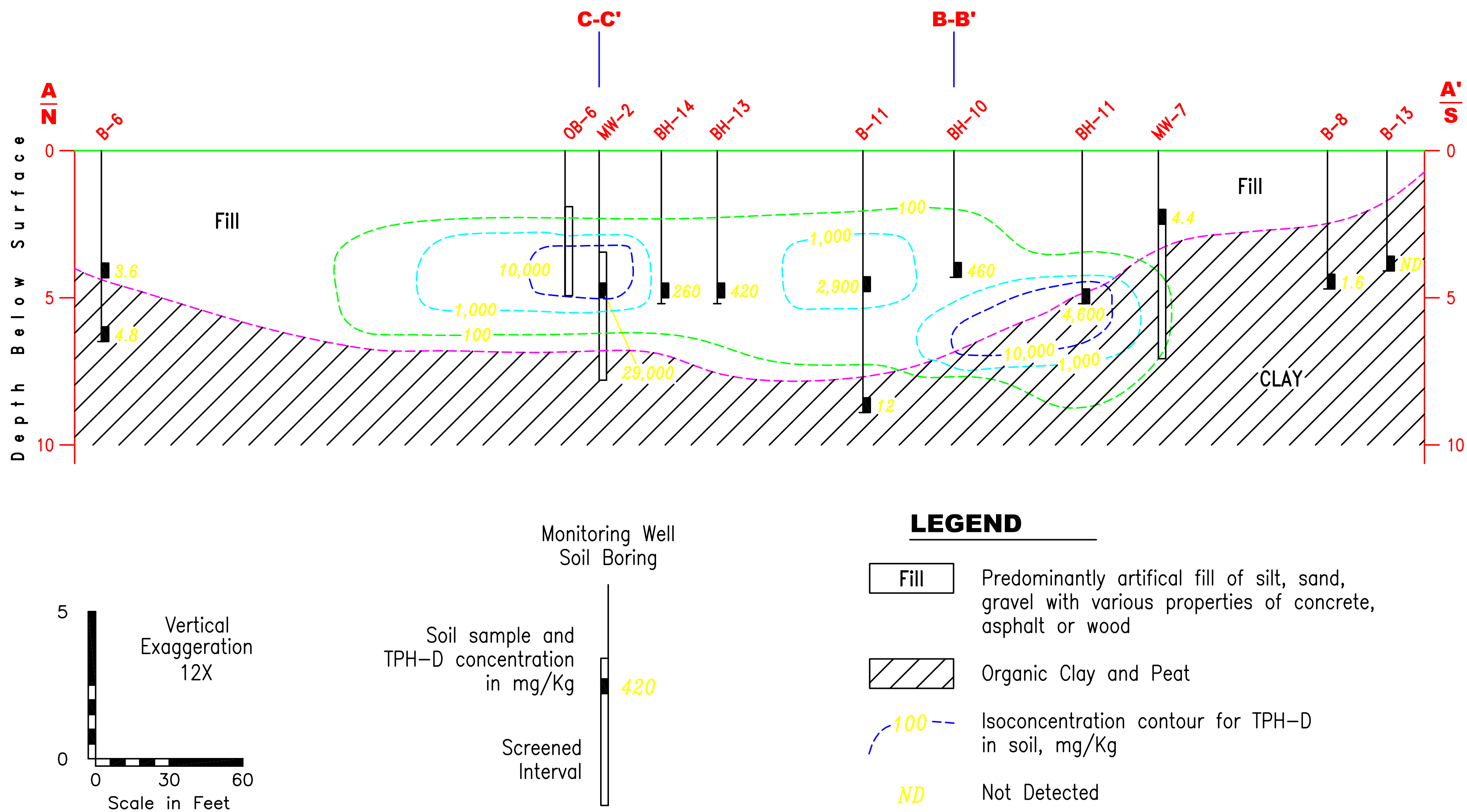
DATE
01/07
REVIEWED BY
GJ

HEITZ TRUCKING
4919 Tidewater
Oakland , California

JOB NUMBER
05–001–07
FIGURE
3

ERAS Environmental Inc.

ERAS 01-30-07 Site w-xsect 01-07.dwg



SCHEMATIC CROSS SECTION A-A'

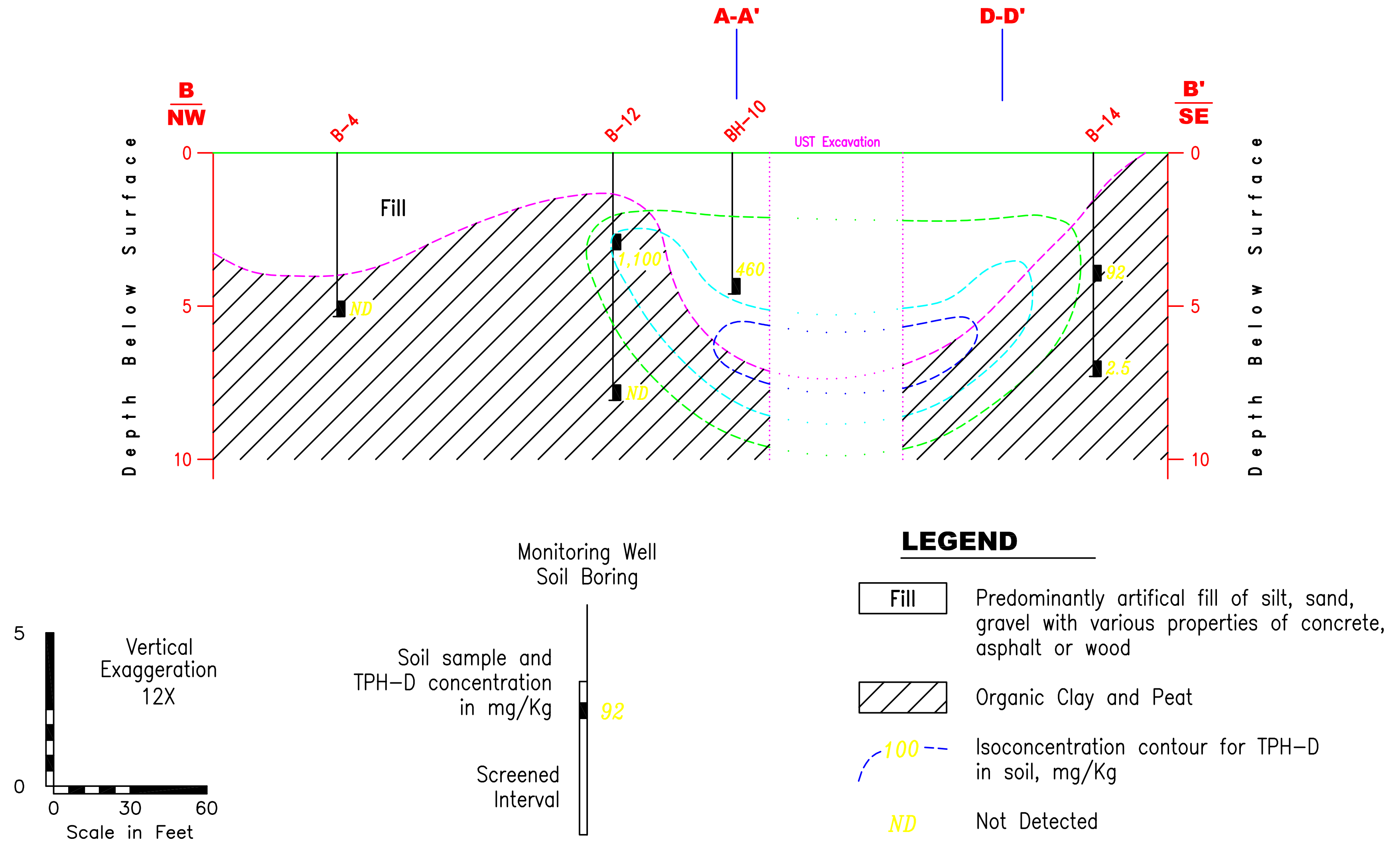
DATE
01/07
REVIEWED BY
GJ

HEITZ TRUCKING
4919 Tidewater Avenue
Oakland, California

JOB NUMBER
05-001-12
FIGURE
–

ERAS Environmental Inc.

ERAS 01-31-07 A-A-XS-01-07.dwg



SCHEMATIC CROSS SECTIONS B-B'

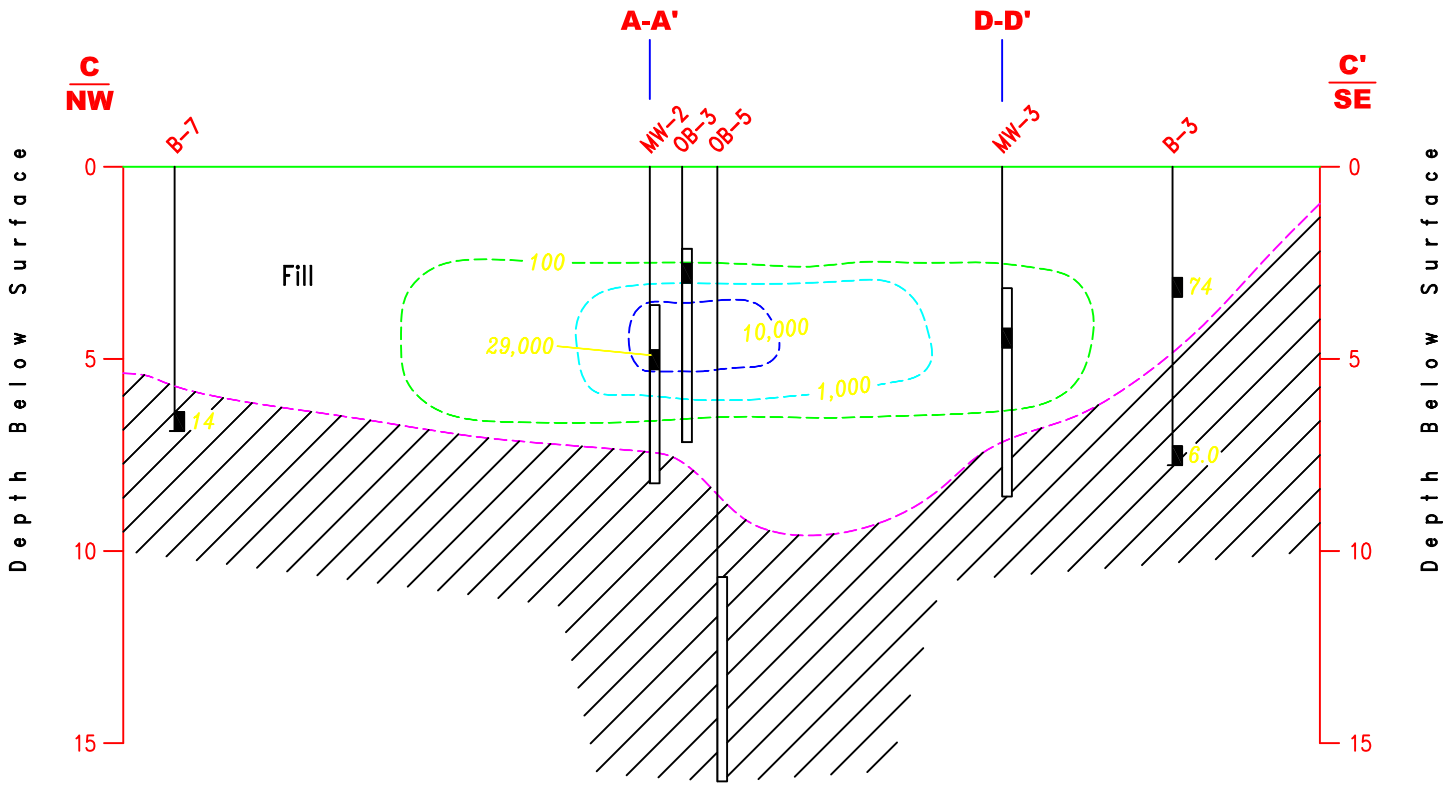
DATE
02/07
REVIEWED BY
GJ

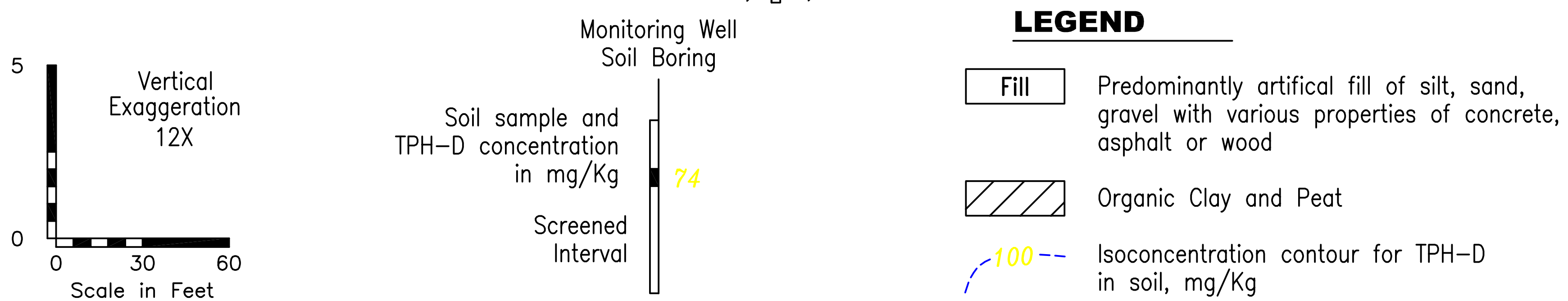
HEITZ TRUCKING
4919 Tidewater Avenue
Oakland, California

JOB NUMBER
05-001-12
FIGURE
–

ERAS Environmental Inc.

ERAS 02-01-07 BB-XS-01-07.dwg





SCHEMATIC CROSS SECTIONS C-C'

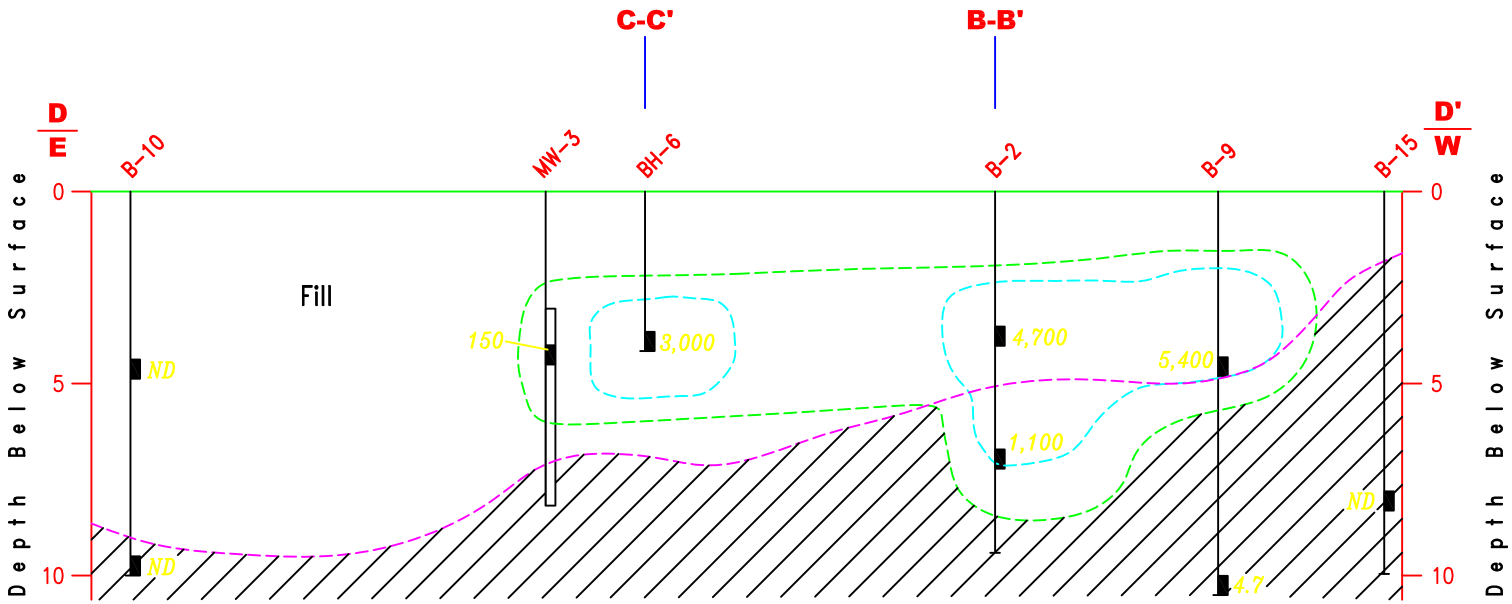
DATE
02/07
REVIEWED BY
GJ

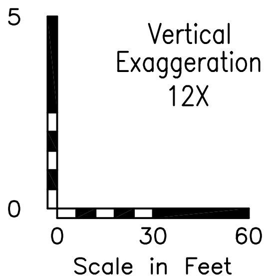
HEITZ TRUCKING
4919 Tidewater Avenue
Oakland, California

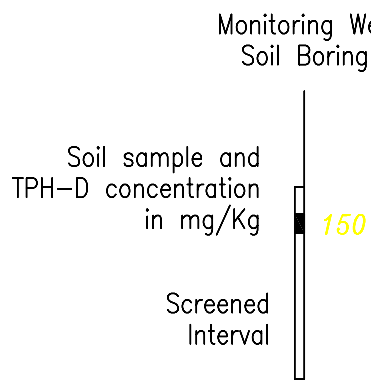
JOB NUMBER
05-001-12
FIGURE
-

ERAS Environmental Inc.

ERAS 02-02-07 CC-XS-01-07.dwg







LEGEND

Fill	Predominantly artifical fill of silt, sand, gravel with various properties of concrete, asphalt or wood
(hatched)	Organic Clay and Peat
100	Isoconcentration contour for TPH–D in soil, mg/Kg
ND	Not Detected

SCHEMATIC CROSS SECTION D-D'

DATE
01/07
REVIEWED BY
GJ

HEITZ TRUCKING
4919 Tidewater Avenue
Oakland, California

JOB NUMBER
05–001–12
FIGURE
–

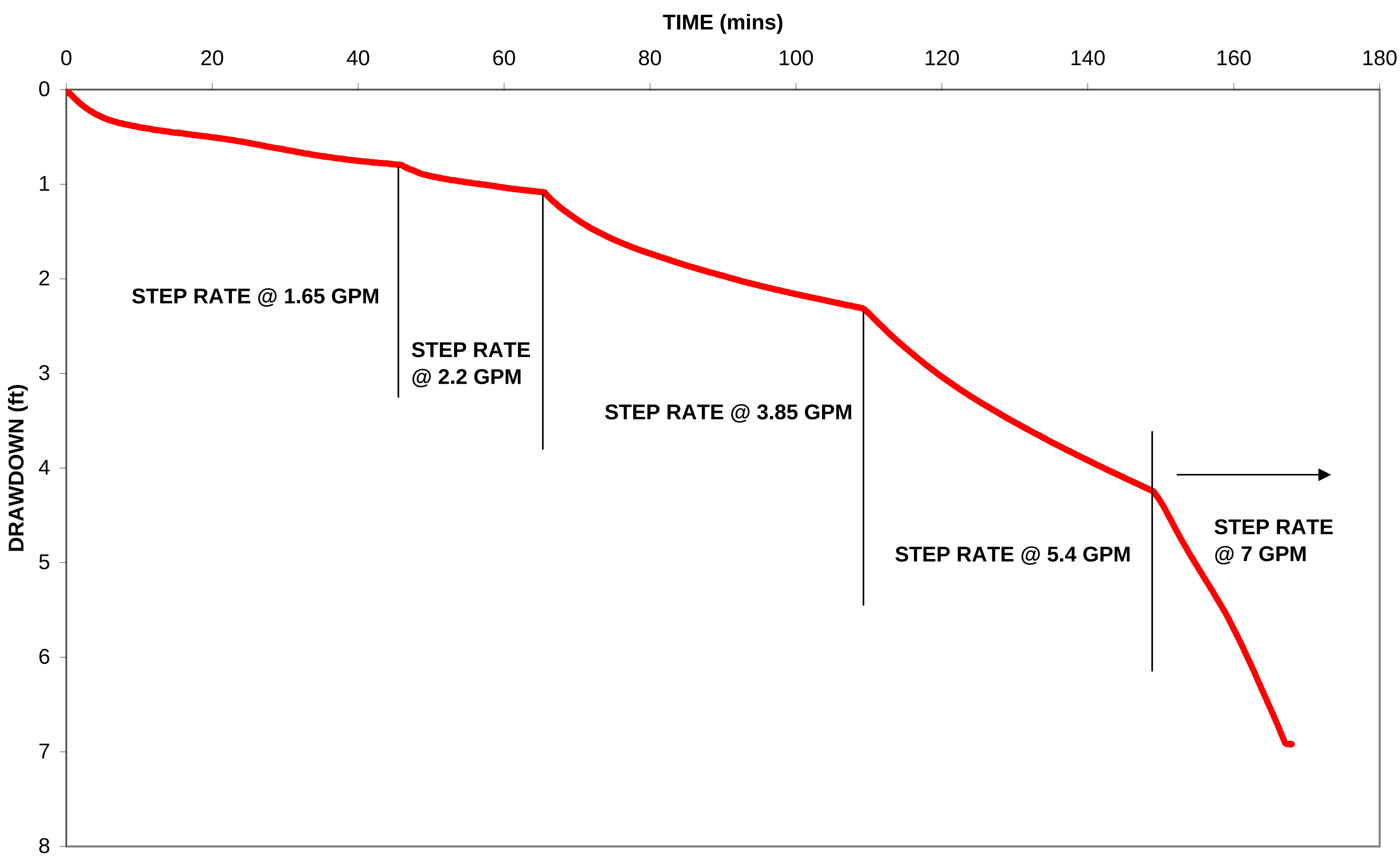
ERAS Environmental Inc.

ERAS 02-02-07 DD-XS-01-07.dwg

APPENDIX C

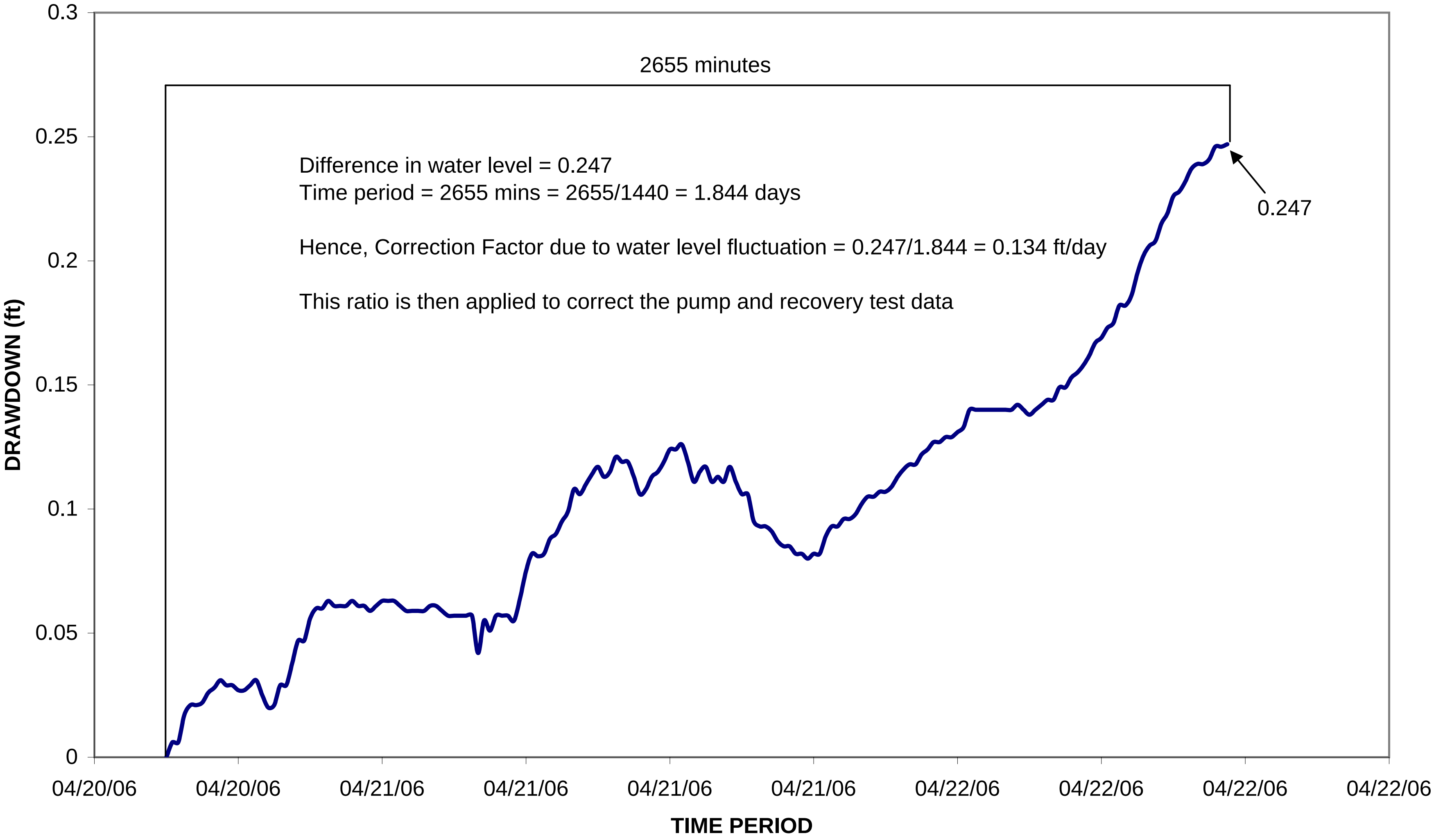
AQUIFER TEST DATA & RESULTS

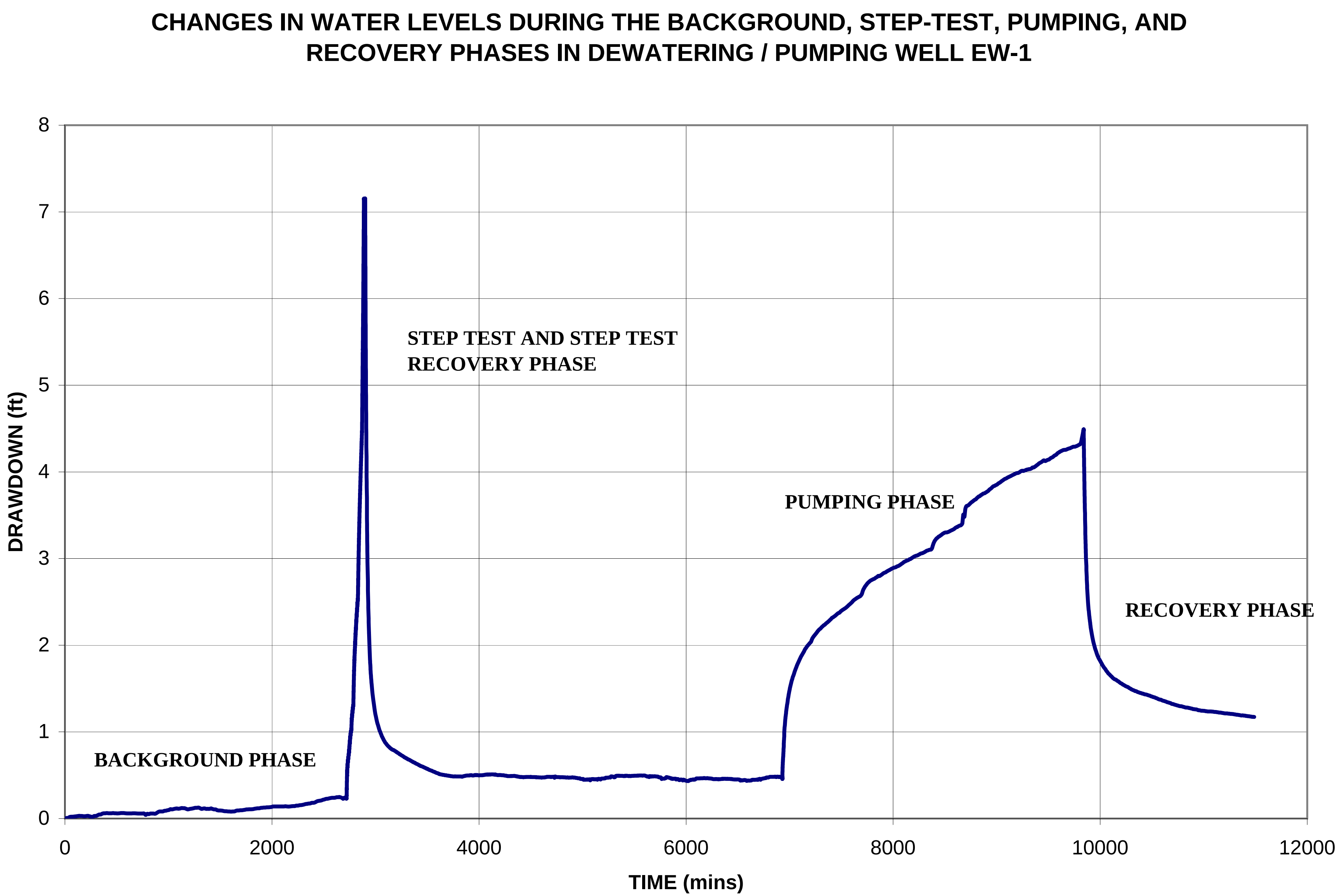
PLOT OF EW-1 STEP TEST



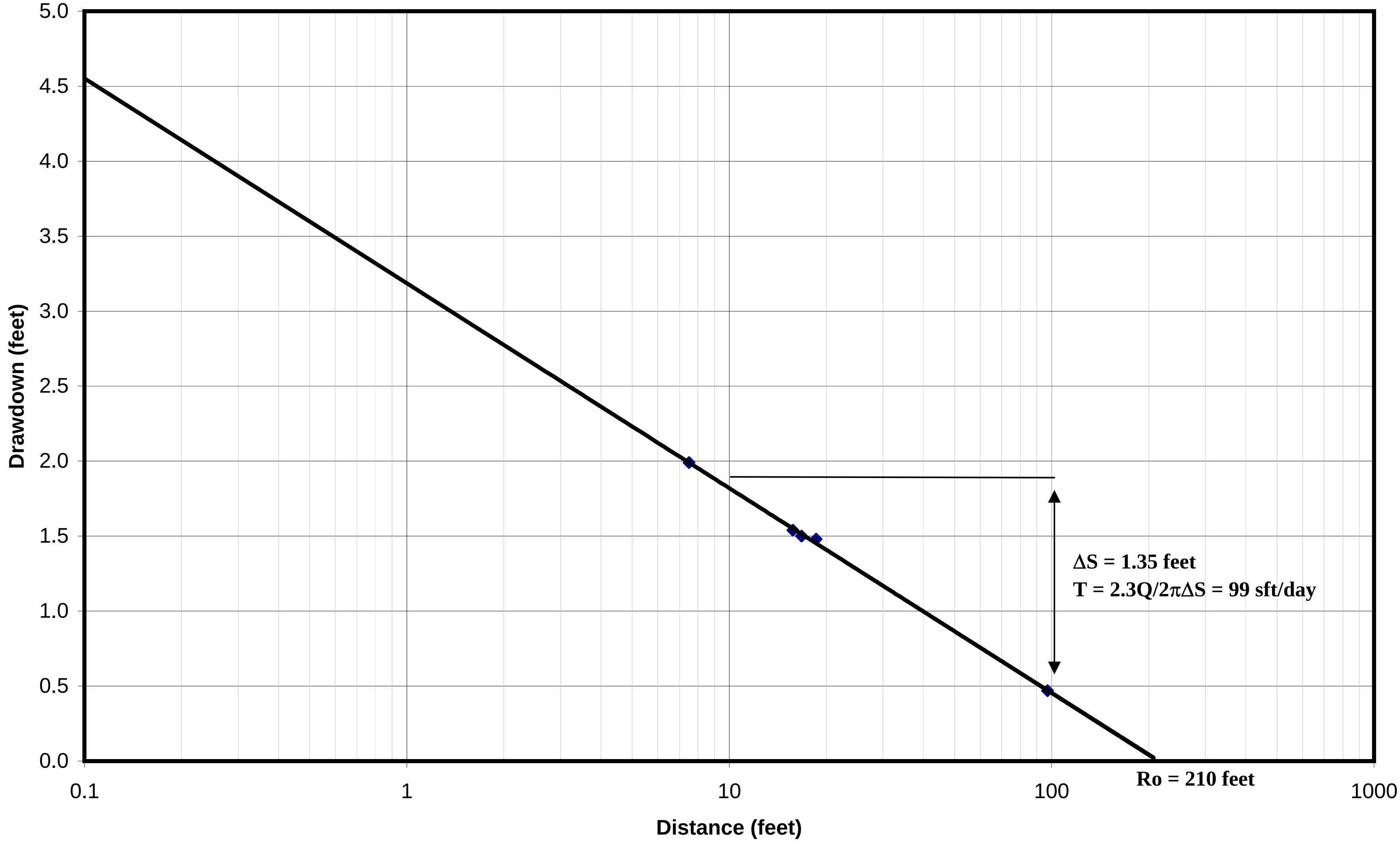
CORRECTION FACTOR DUE TO WATER LEVEL FLUCTUATION

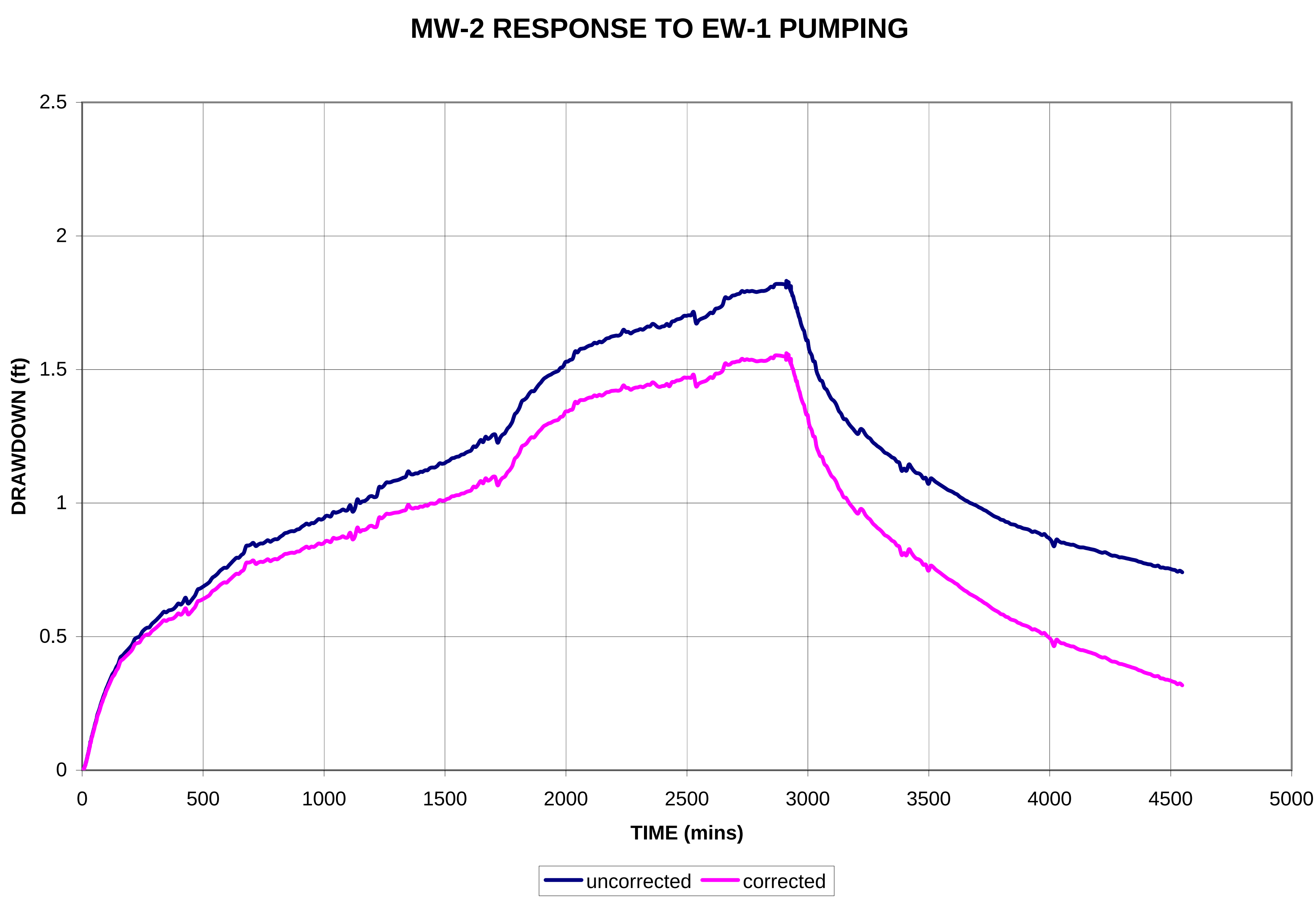
EW-1 BACKGROUND DATA

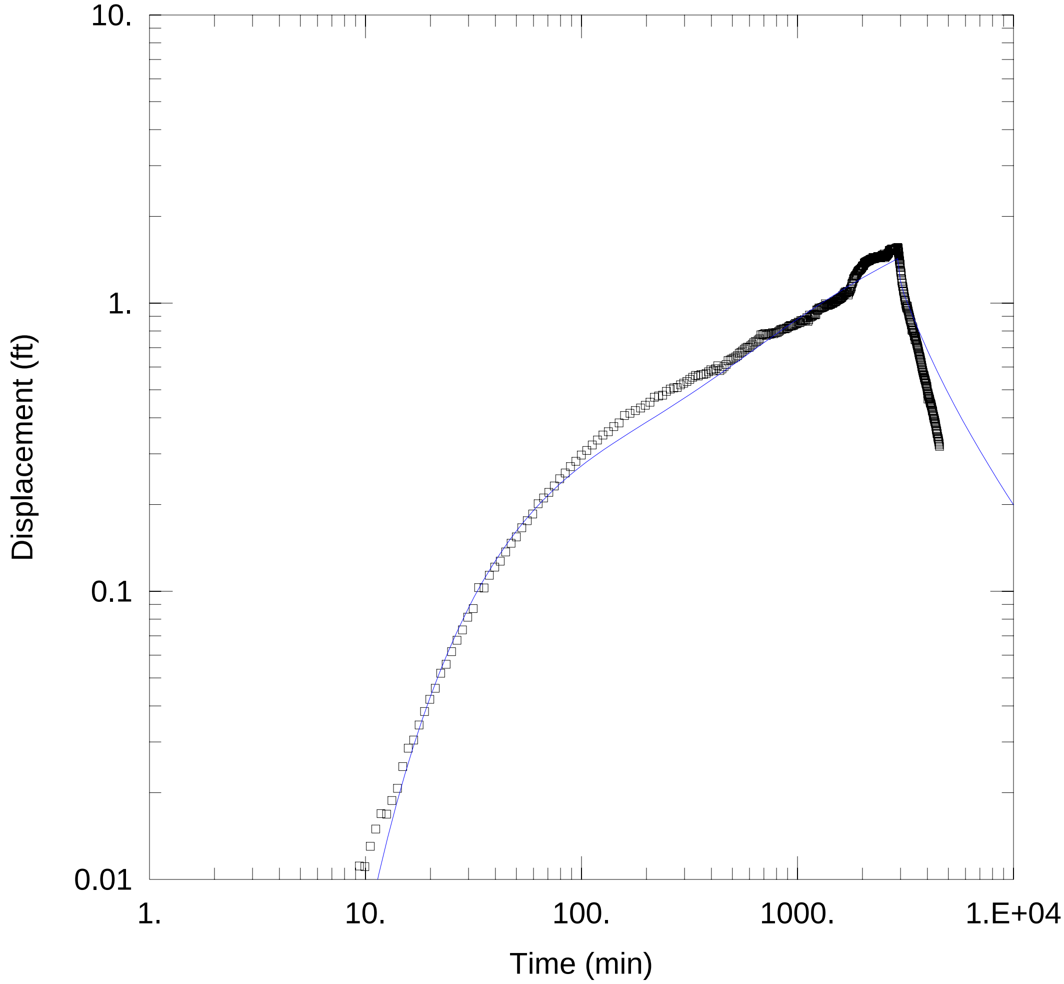



CHANGES IN WATER LEVELS DURING THE BACKGROUND, STEP-TEST, PUMPING, AND RECOVERY PHASES IN DEWATERING / PUMPING WELL EW-1
DRAWDOWN (ft)
TIME (mins)
STEP TEST AND STEP TEST RECOVERY PHASE
PUMPING PHASE
RECOVERY PHASE
BACKGROUND PHASE
0
1
2
3
4
5
6
7
8
0
2000
4000
6000
8000
10000
12000

Pumping Test - Distance vs Drawdown Relationship




MW-2 RESPONSE TO EW-1 PUMPING
DRAWDOWN (ft)
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
TIME (mins)
uncorrected
corrected



MW-2 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (NEUMAN)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

AQUIFER DATA

Saturated Thickness: 7. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-2	-15	-4

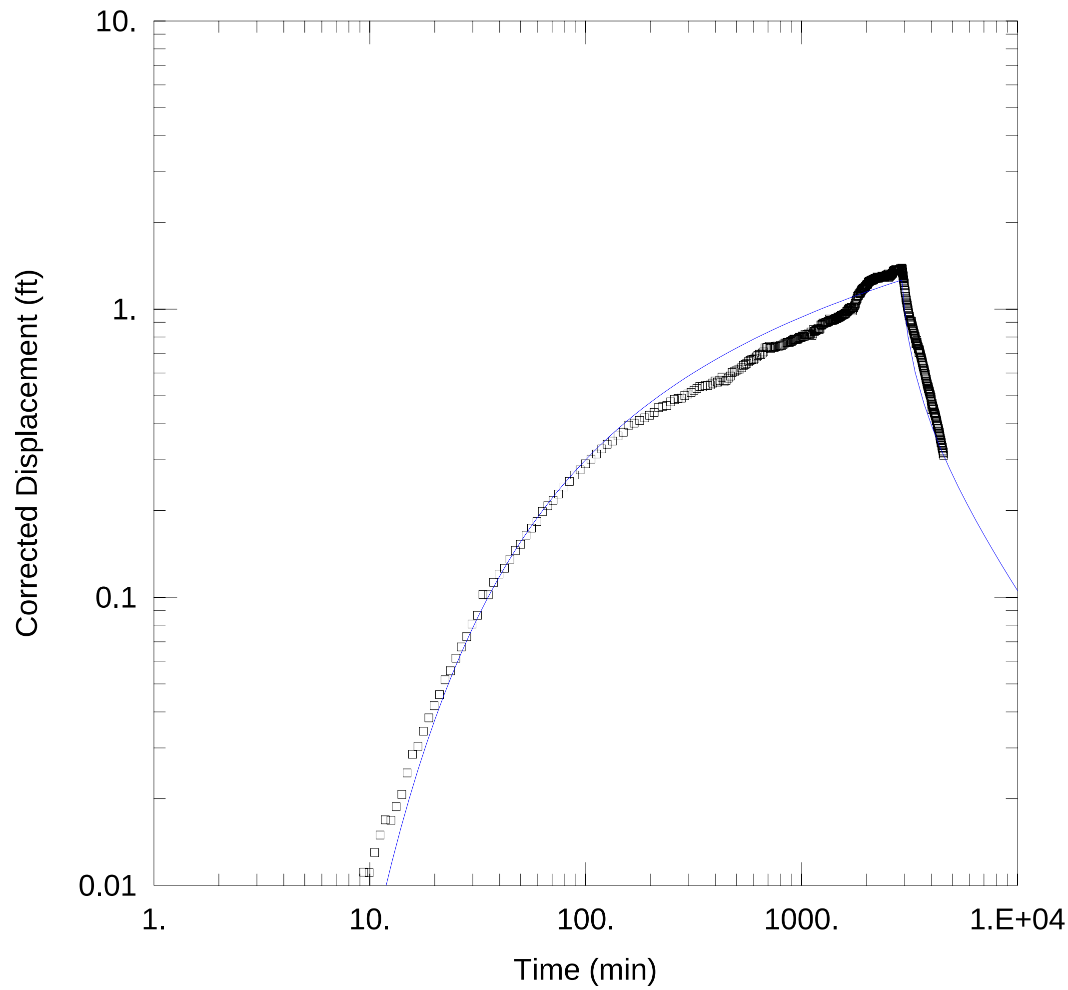
SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

T = 49.45 ft^2/day
Sy = 0.07196

S = 0.0168
ß = 0.6



MW-2 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (THEIS)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-2	-15	-4

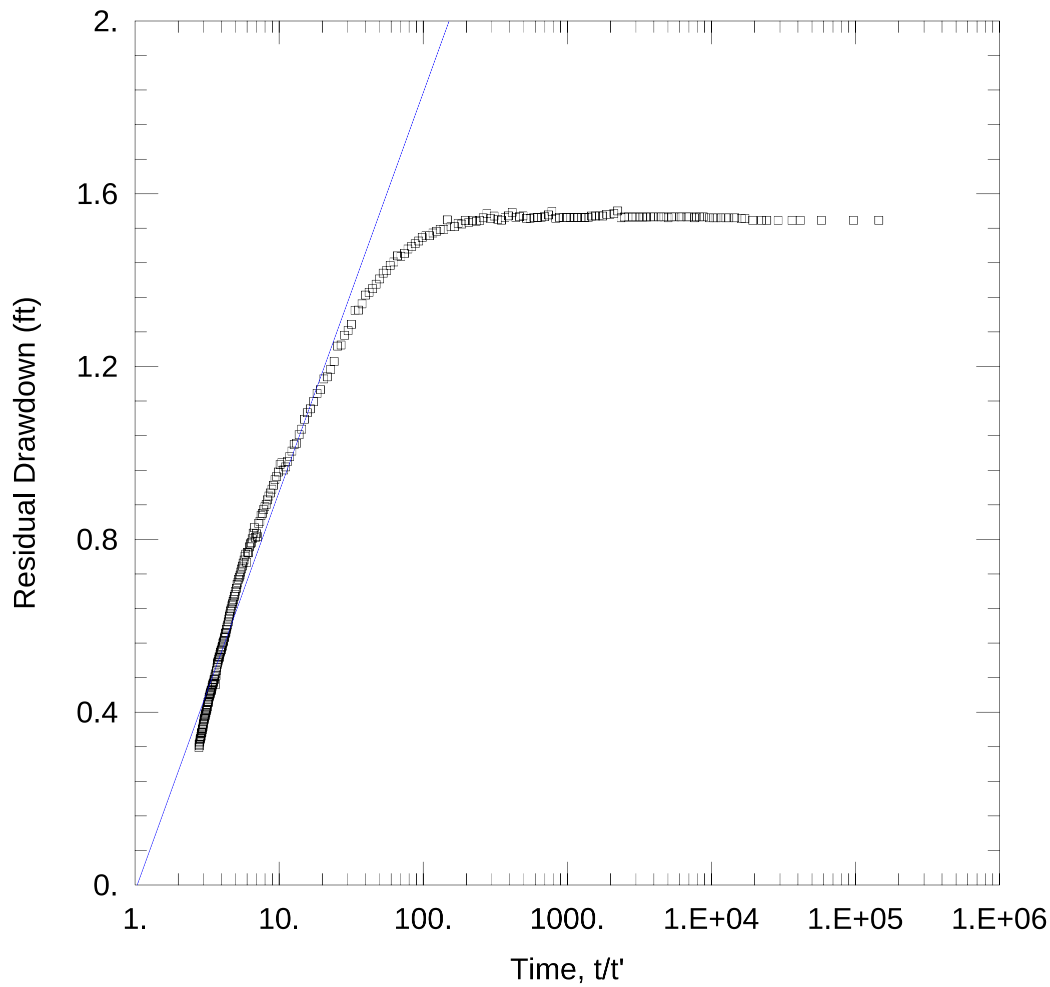
SOLUTION

Aquifer Model: Unconfined

Solution Method: Theis

T = 95.07 ft^2/day
Kz/Kr = 0.1

S = 0.03
b = 7. ft



MW-2 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (RECOVERY)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

AQUIFER DATA

Saturated Thickness: 7. ft

Anisotropy Ratio (Kz/Kr): 0.122

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-2	-15	-4

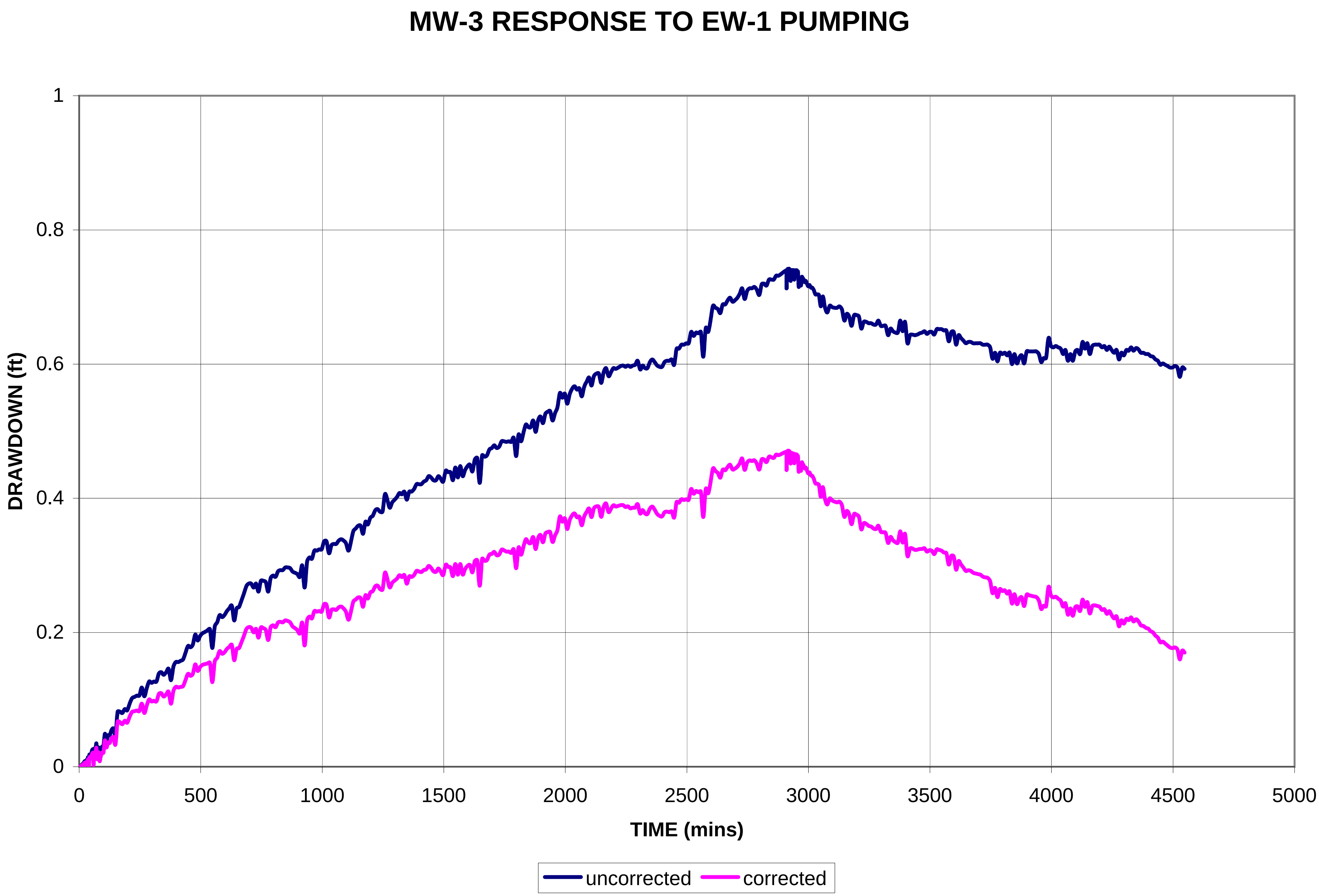
SOLUTION

Aquifer Model: Confined

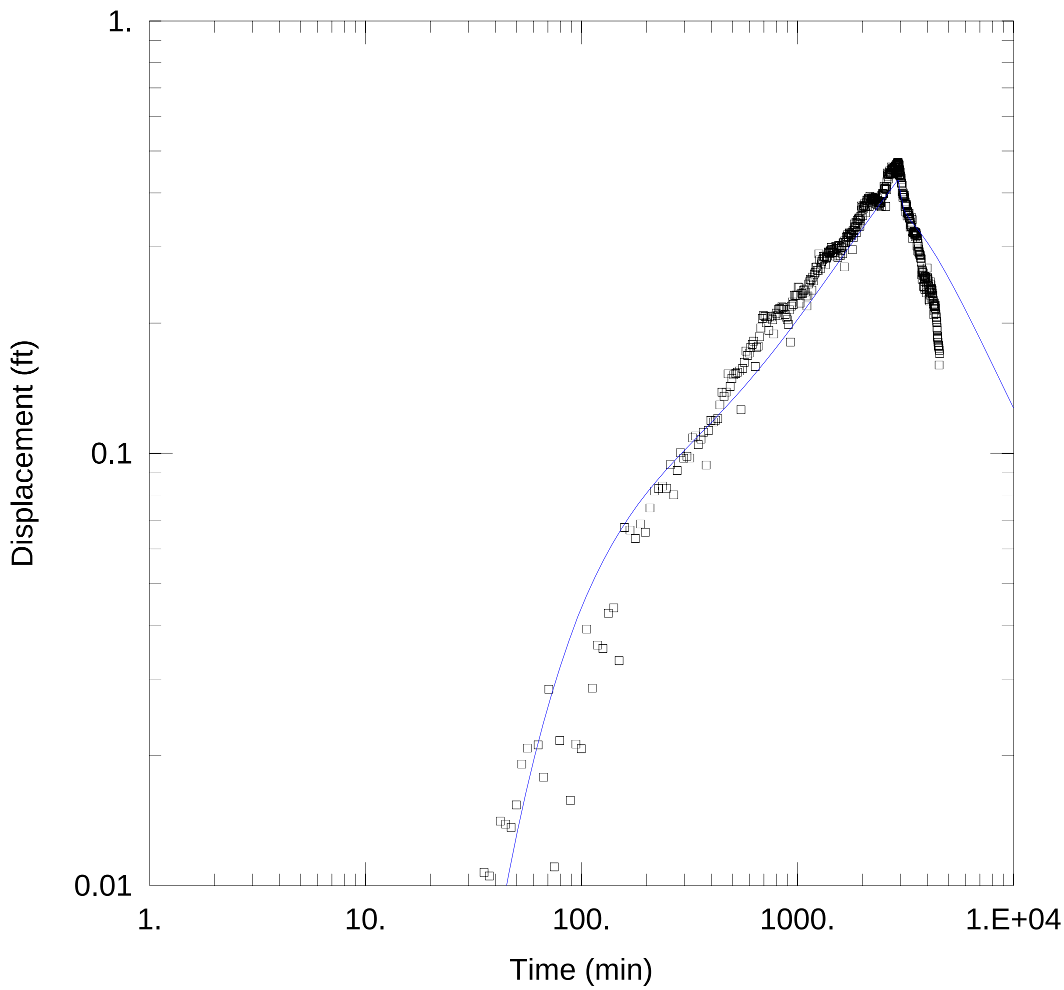
Solution Method: Theis (Recovery)

T = 72.93 ft^2/day

S/S' = 1.037



MW-3 RESPONSE TO EW-1 PUMPING
DRAWDOWN (ft)
TIME (mins)
0
0.2
0.4
0.6
0.8
1
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
uncorrected
corrected



MW-3 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (NEUMAN)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

AQUIFER DATA

Saturated Thickness: 7. ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-3	92	-30

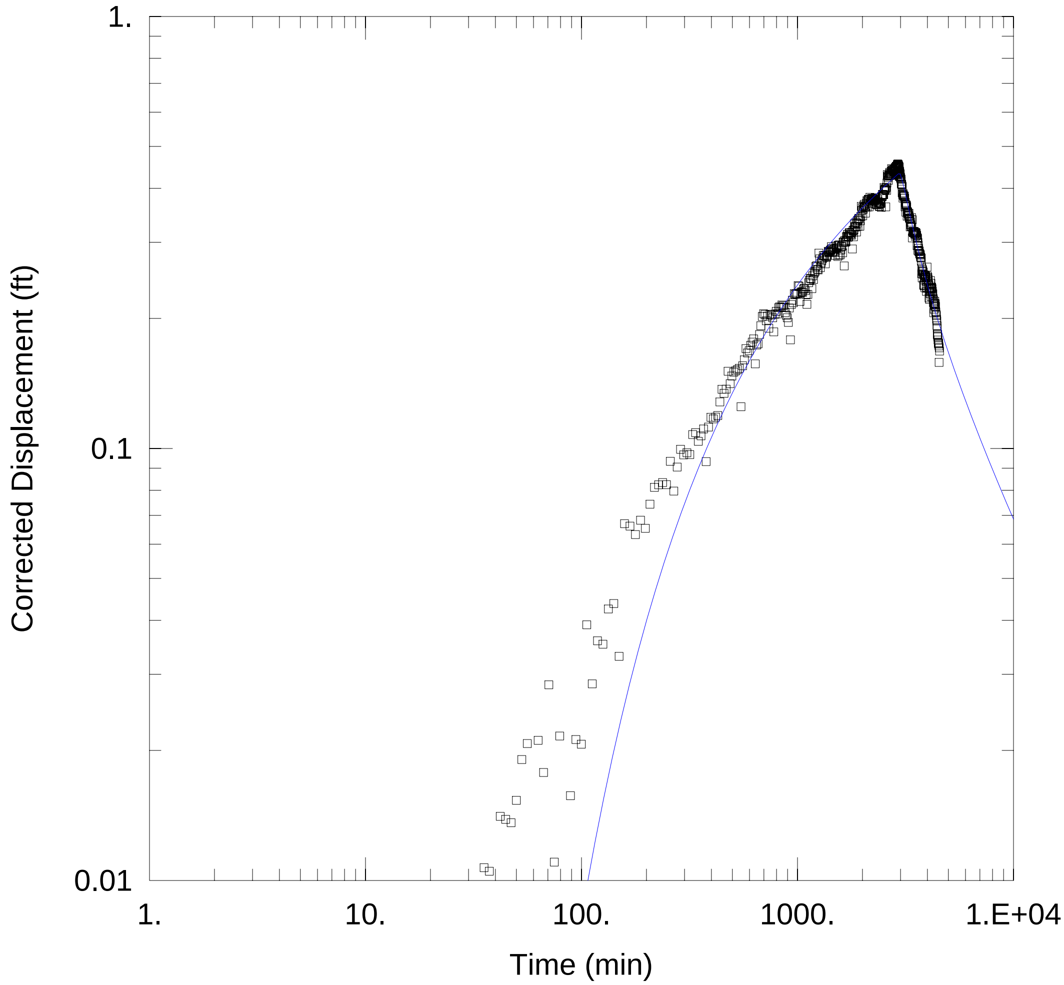
SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

T = 70.9 ft^2/day
Sy = 0.01448

S = 0.002016
ß = 1.5



MW-3 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (THEIS)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-3	92	-30

SOLUTION

Aquifer Model: Unconfined

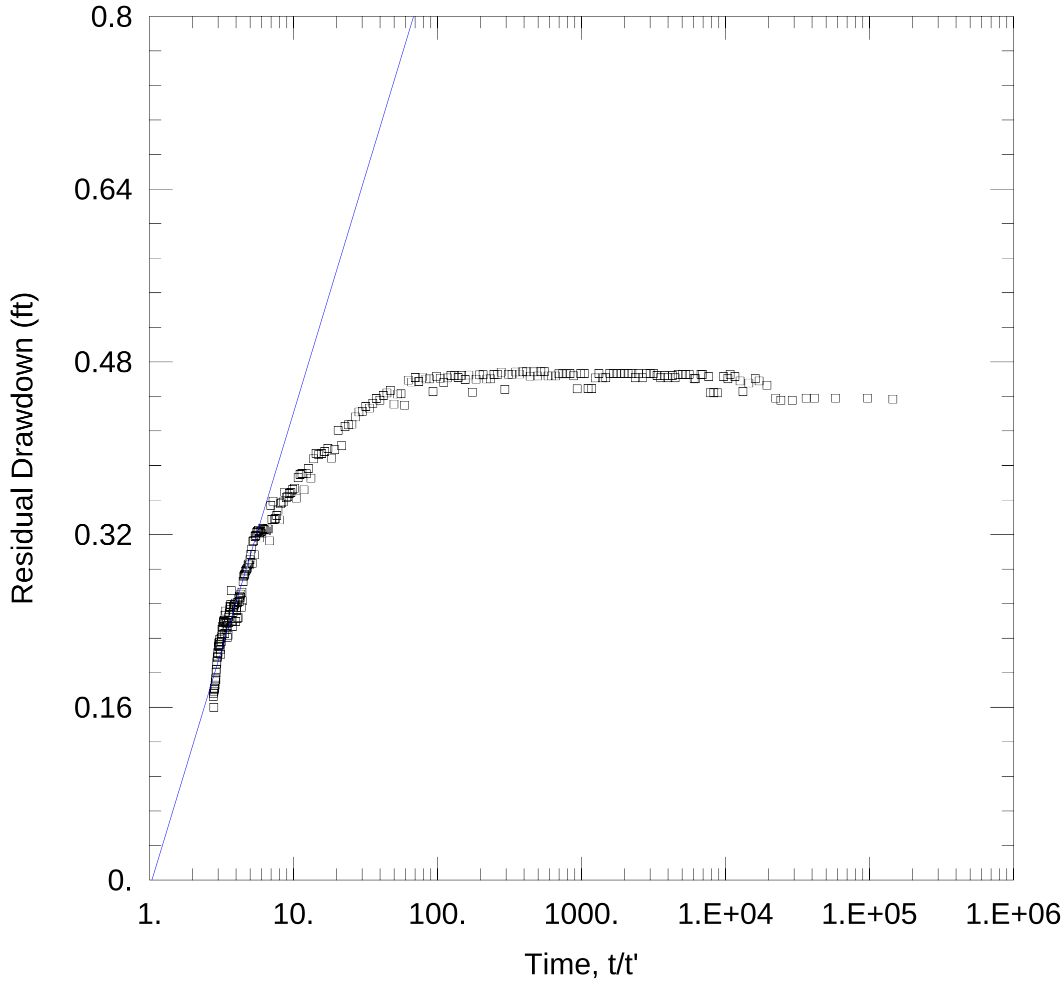
Solution Method: Theis

T = 142.9 ft^2/day

S = 0.009087

Kz/Kr = 0.1

b = 7. ft



MW-3 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (RECOVERY)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-3	92	-30

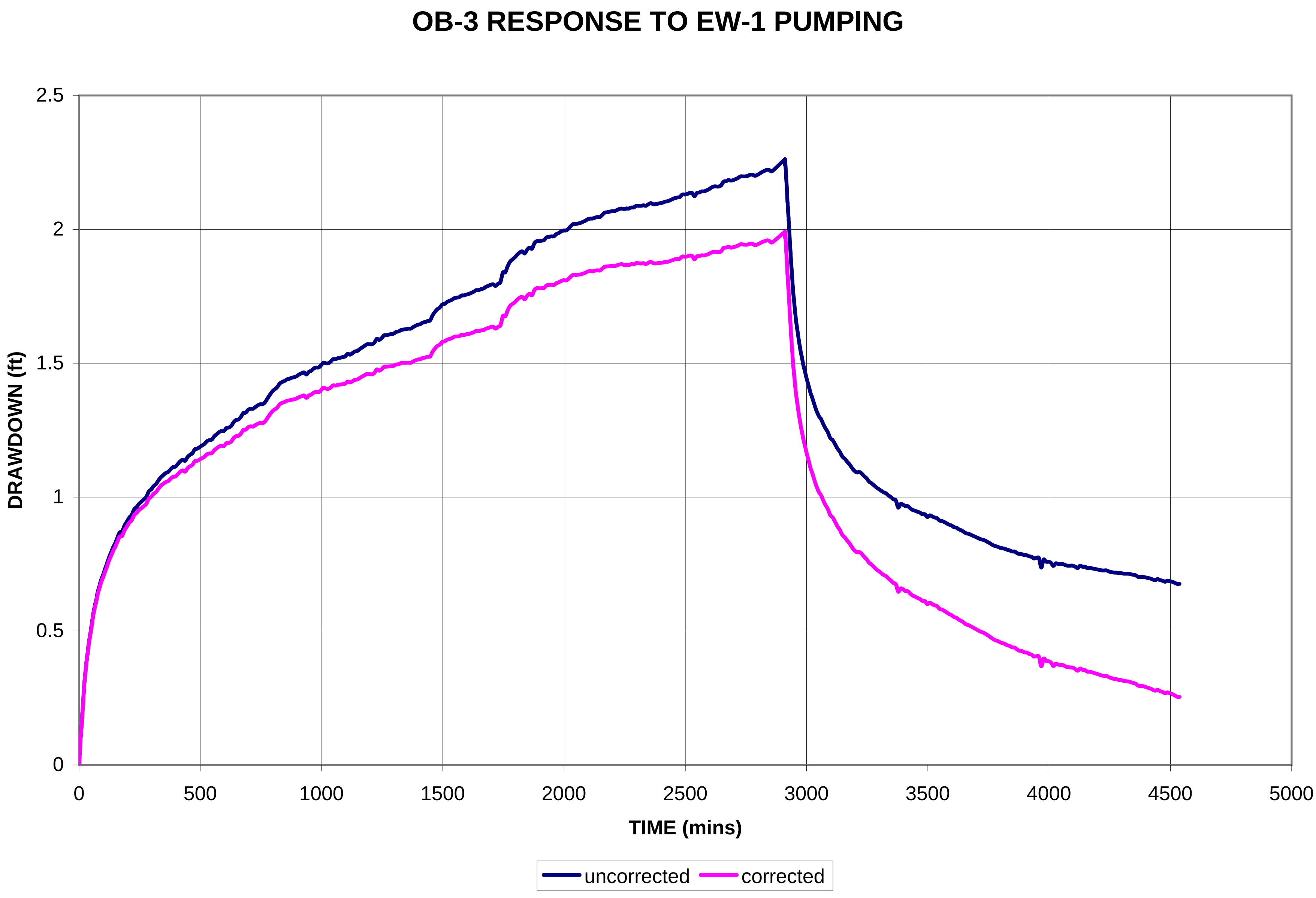
SOLUTION

Aquifer Model: Confined

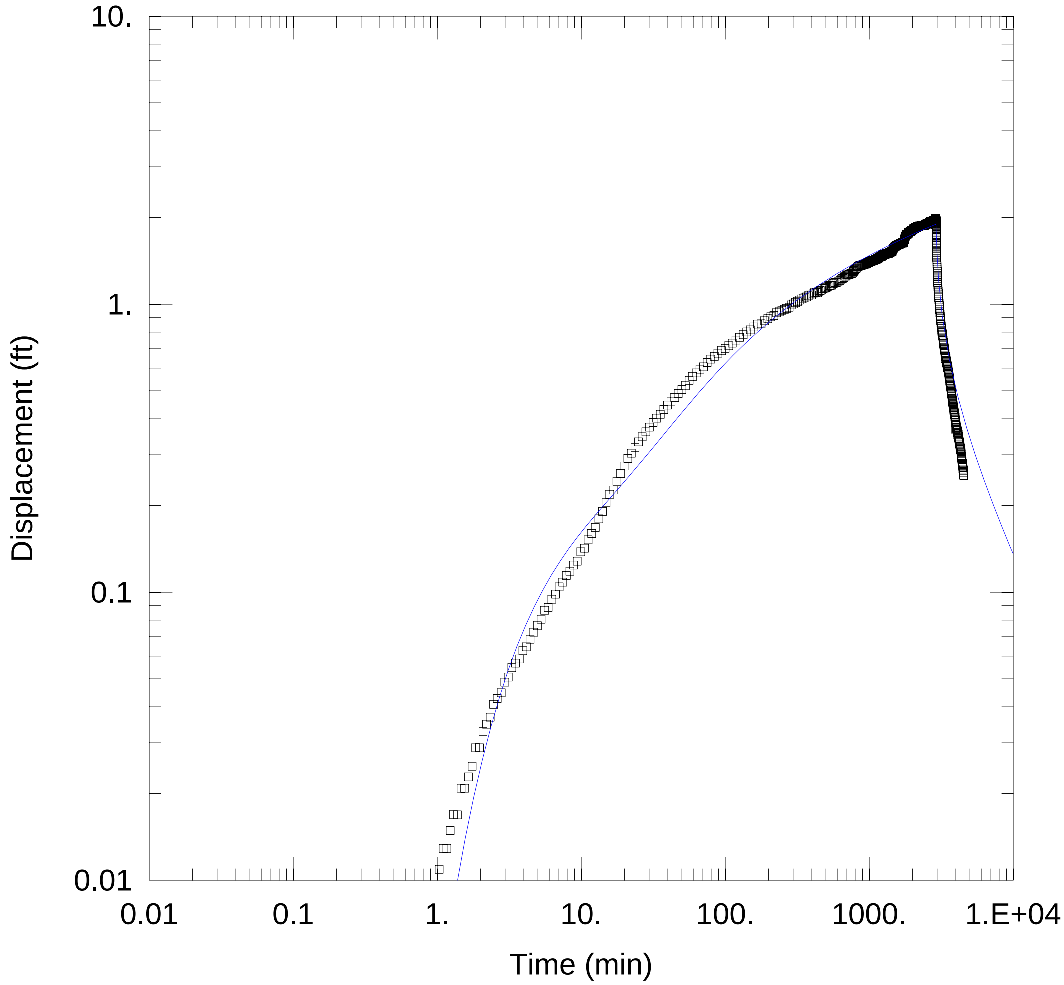
Solution Method: Theis (Recovery)

T = 153. ft^2/day

S/S' = 1.041



OB-3 RESPONSE TO EW-1 PUMPING
DRAWDOWN (ft)
0
0.5
1
1.5
2
2.5
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
TIME (mins)
uncorrected
corrected



OB-3 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (NEUMAN)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ OB-3	-4	-6.15

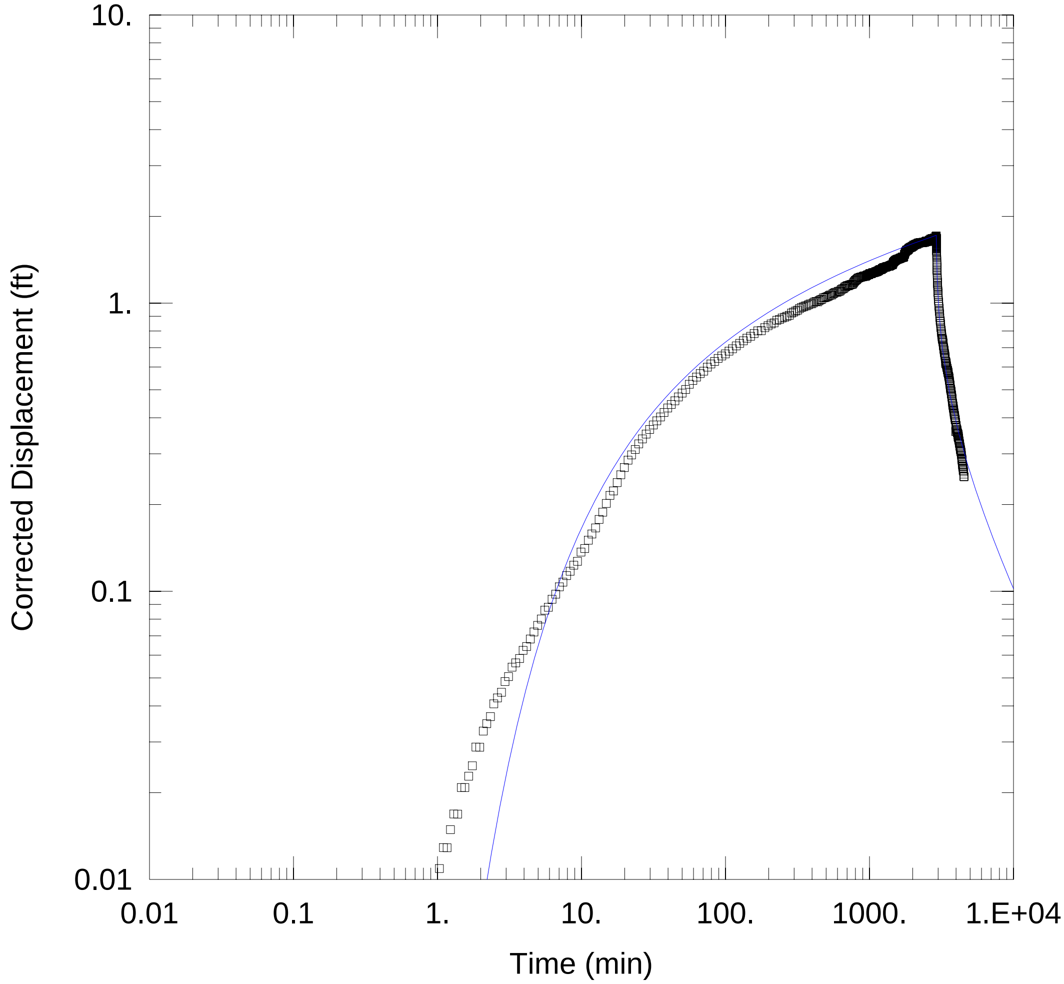
SOLUTION

Aquifer Model: Unconfined

Solution Method: Neuman

T = 74.03 ft^2/day
Sy = 0.04017

S = 0.01179
ß = 0.8



OB-3 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (THEIS)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ OB-3	-4	-6.15

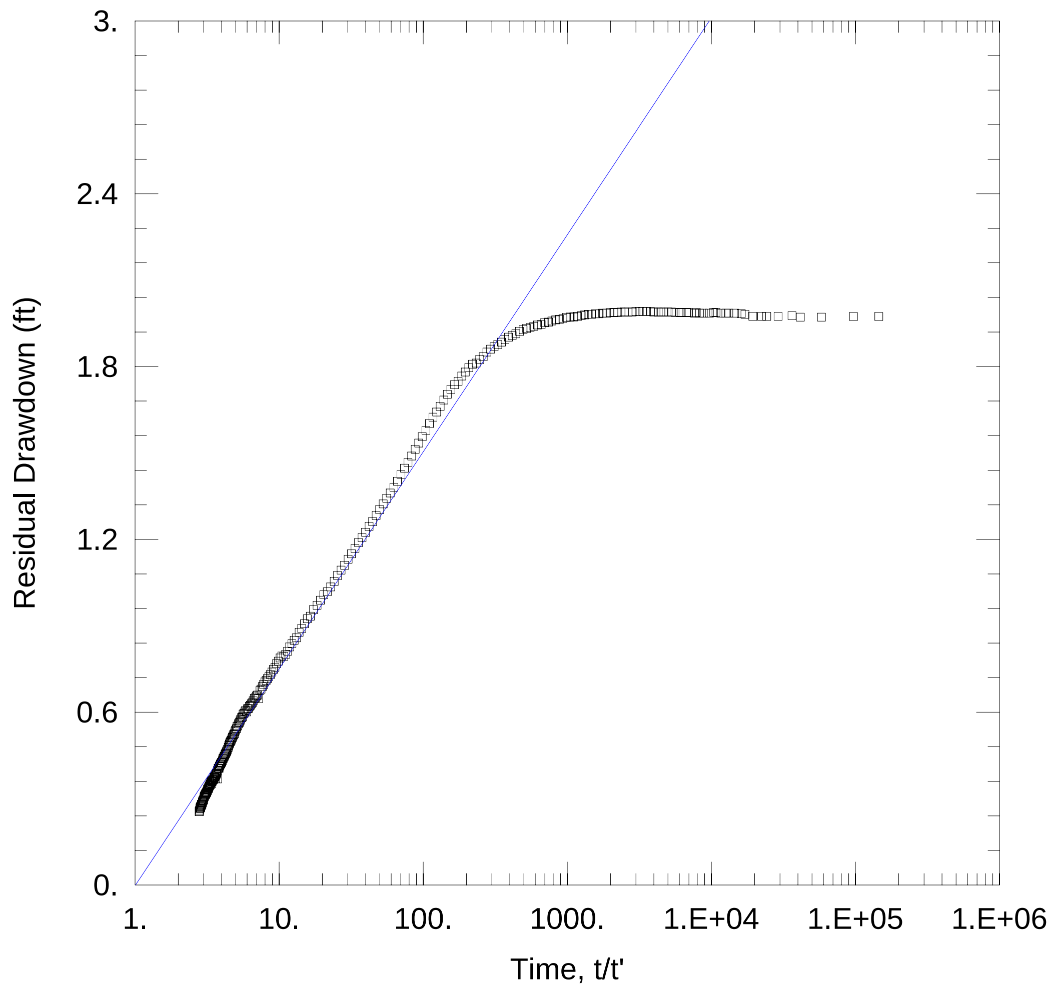
SOLUTION

Aquifer Model: Unconfined

Solution Method: Theis

T = 98.52 ft^2/day
Kz/Kr = 0.7283

S = 0.02554
b = 7. ft



OB-3 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (RECOVERY)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ OB-3	-4	-6.15

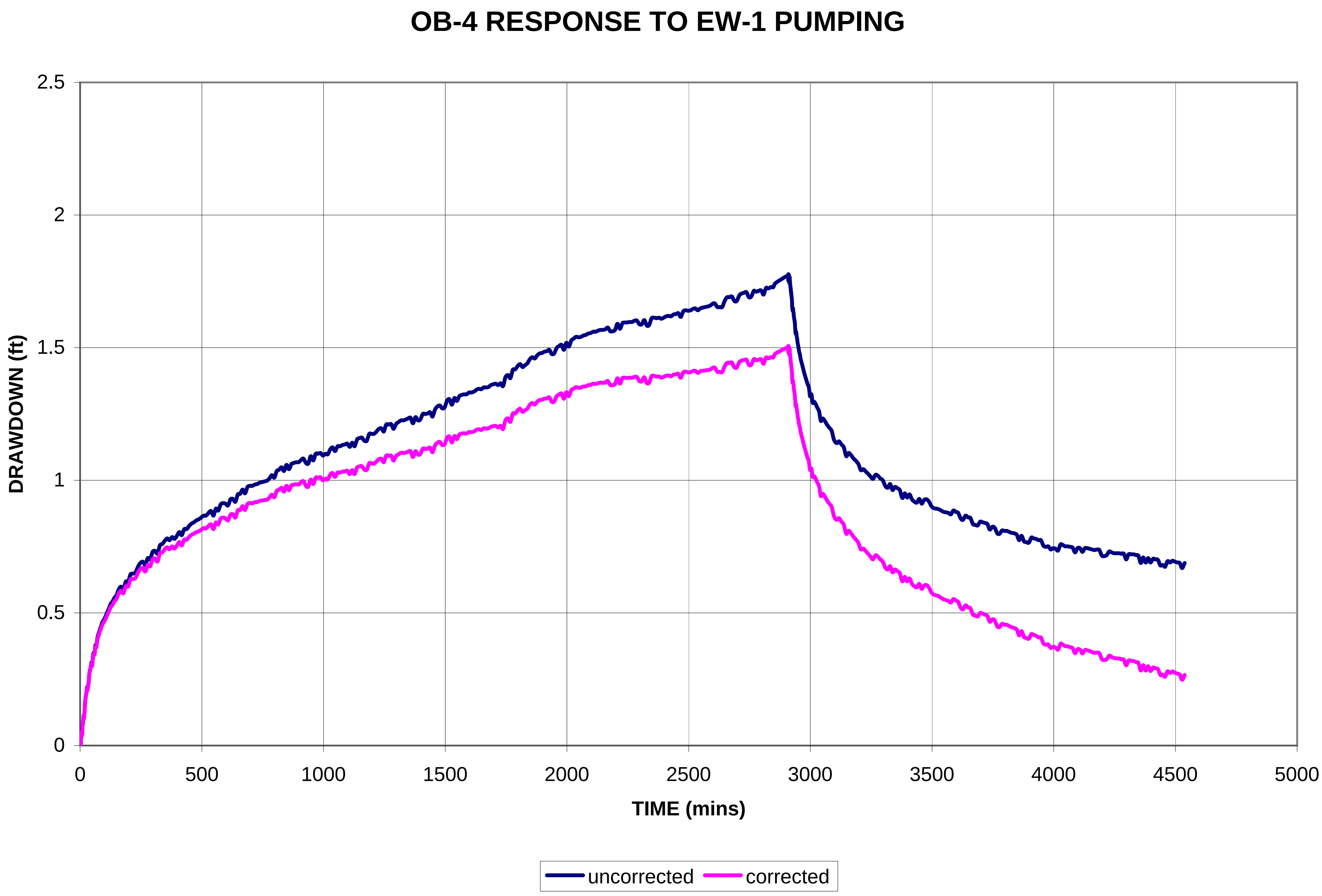
SOLUTION

Aquifer Model: Confined

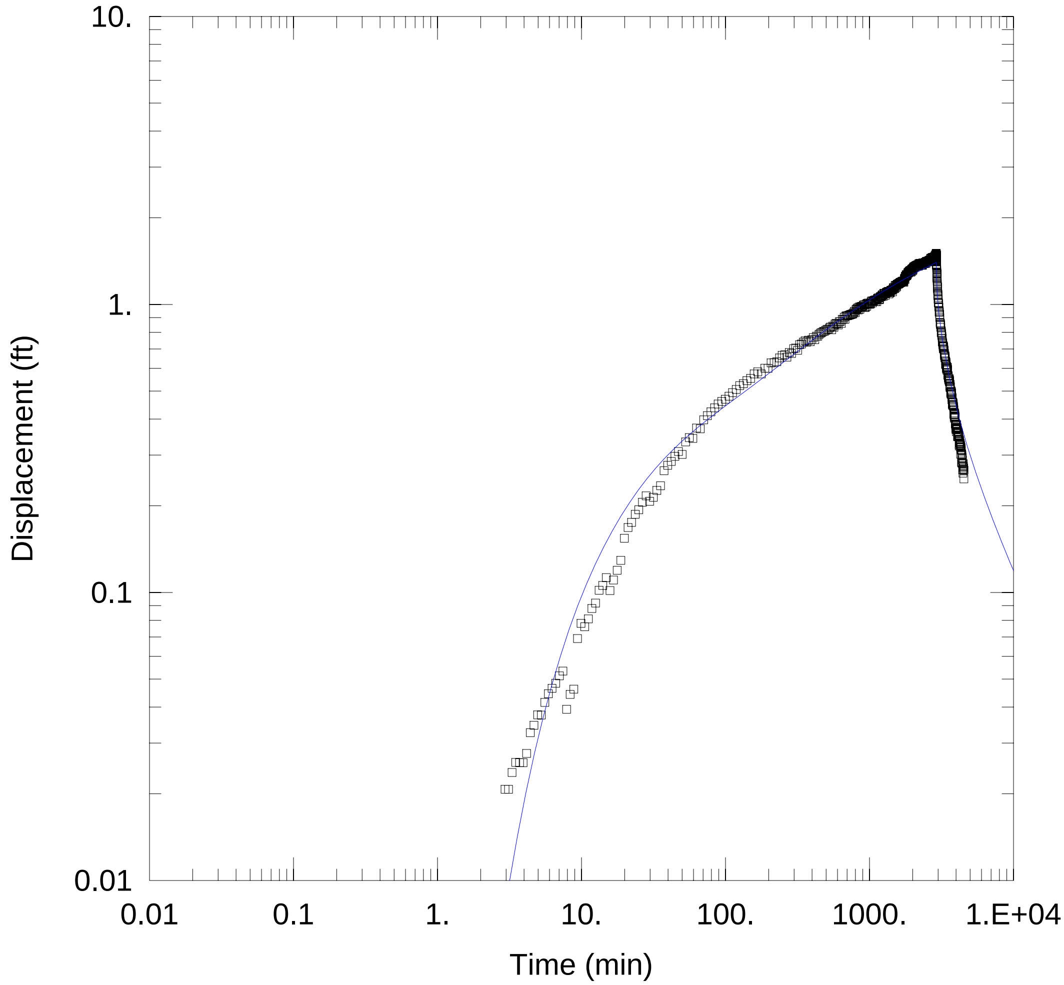
Solution Method: Theis (Recovery)

T = 89.45 ft^2/day

S/S' = 1.01



OB-4 RESPONSE TO EW-1 PUMPING
DRAWDOWN (ft)
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
TIME (mins)
uncorrected
corrected



OB-4 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (NEUMAN)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ OB-4	3	-16.4

SOLUTION

Aquifer Model: Unconfined

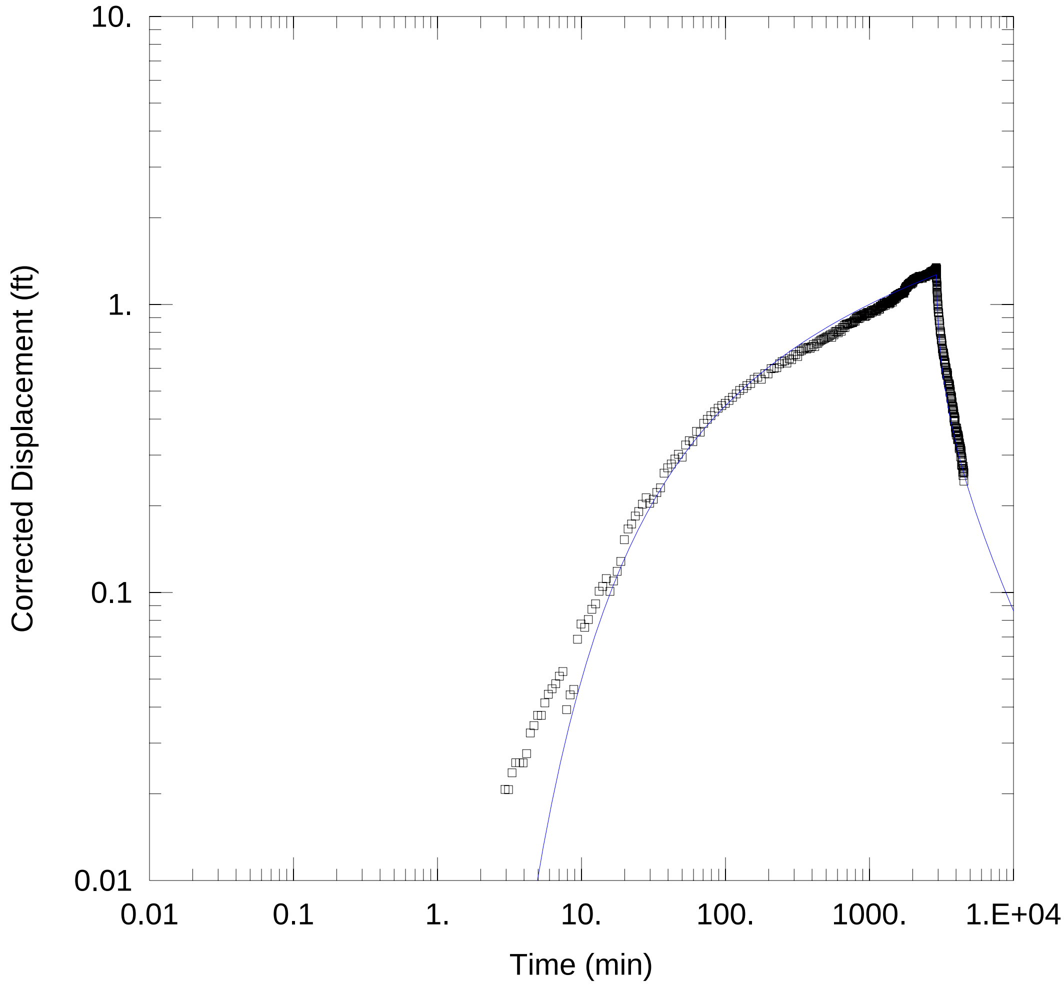
Solution Method: Neuman

T = 84.08 ft^2/day

Sy = 0.01888

S = 0.006066

ß = 0.2



OB-4 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (THEIS)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ OB-4	3	-16.4

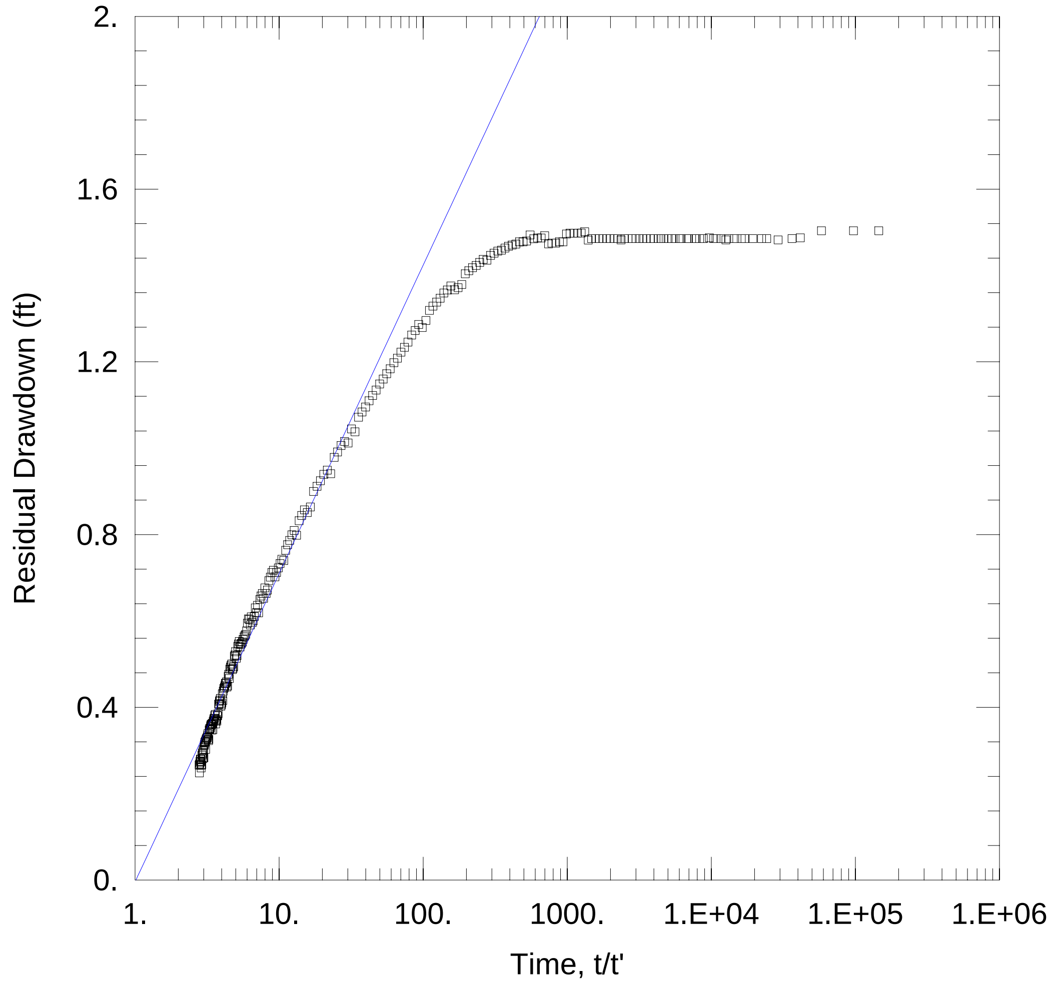
SOLUTION

Aquifer Model: Unconfined

Solution Method: Theis

T = 116.3 ft^2/day
Kz/Kr = 0.1

S = 0.01235
b = 7. ft



OB-4 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (THEIS RECOVERY)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ OB-4	3	-16.4

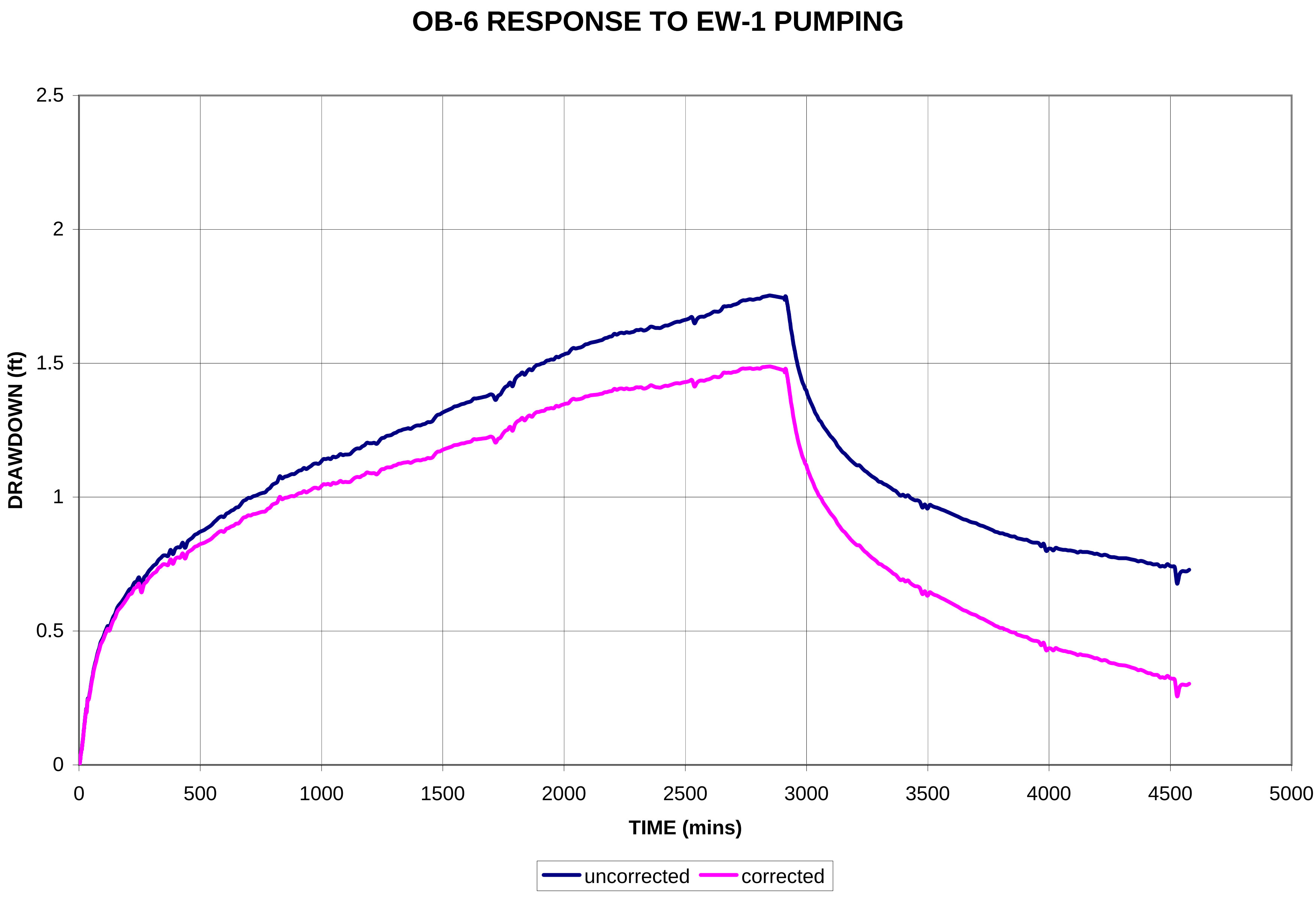
SOLUTION

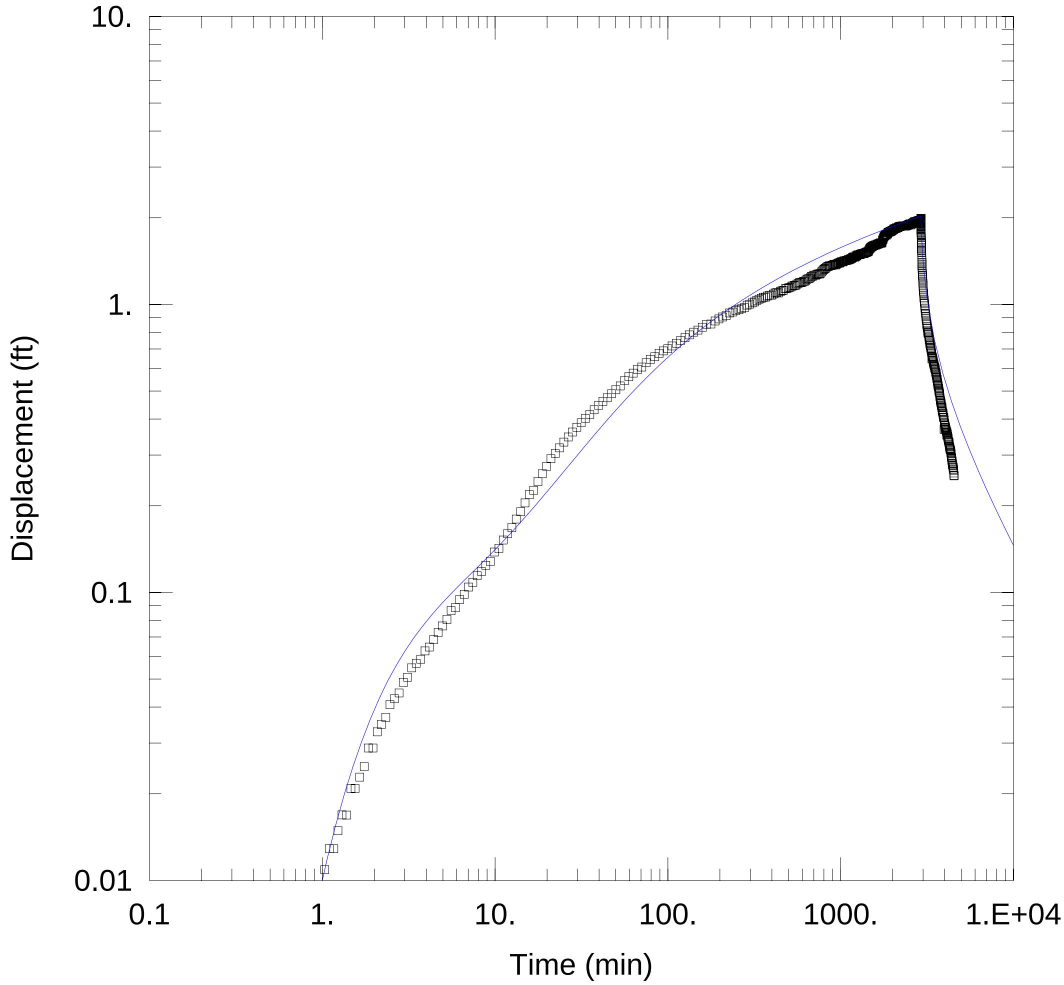
Aquifer Model: Confined

Solution Method: Theis (Recovery)

T = 94.34 ft^2/day

S/S' = 1.015


OB-6 RESPONSE TO EW-1 PUMPING
DRAWDOWN (ft)
2.5
2
1.5
1
0.5
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
TIME (mins)
uncorrected
corrected



OB-6 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (NEUMAN)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ OB-6	-5	-18.1

SOLUTION

Aquifer Model: Unconfined

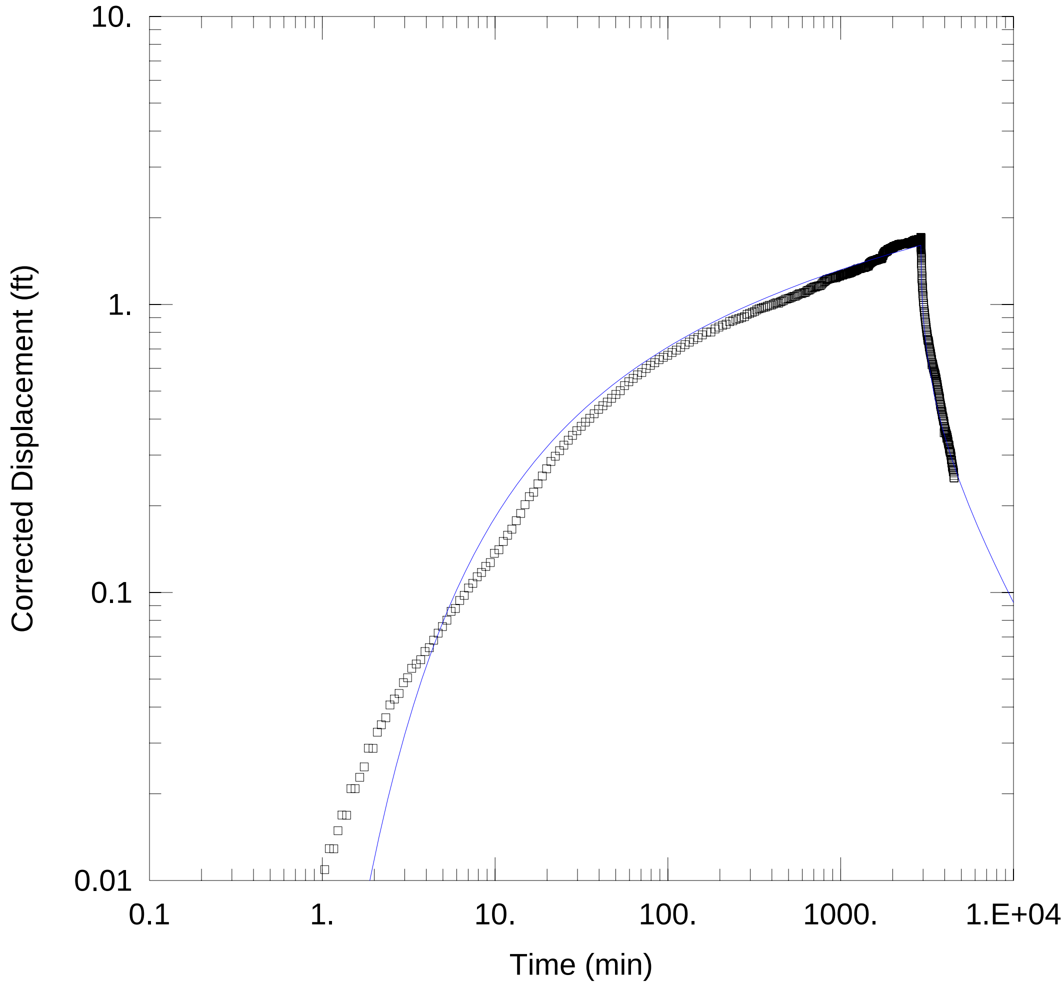
Solution Method: Neuman

T = 68.92 ft^2/day

S = 0.001169

Sy = 0.006386

ß = 1.5



OB-6 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (THEIS)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ OB-6	-5	-18.1

SOLUTION

Aquifer Model: Unconfined

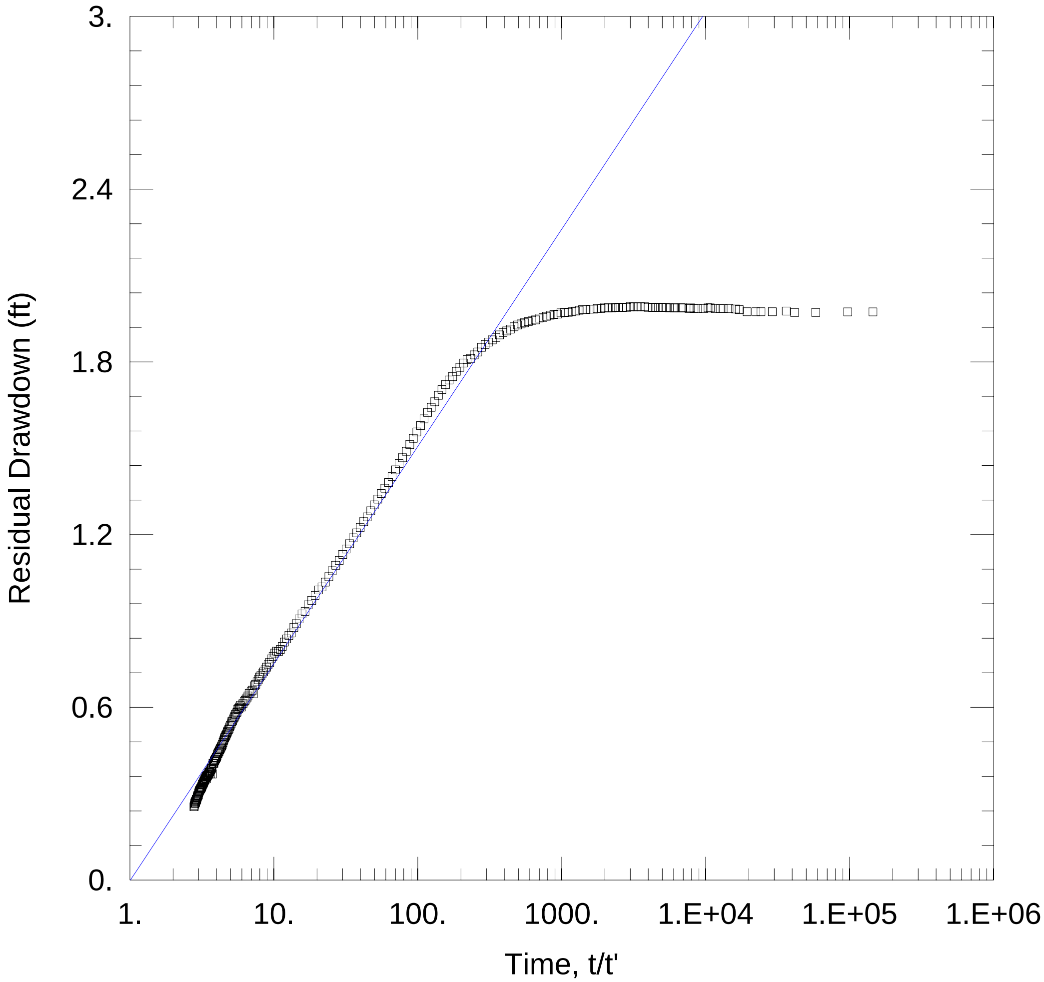
Solution Method: Theis

T = 109. ft^2/day

S = 0.003559

Kz/Kr = 0.1

b = 7. ft



OB-6 RESPONSE TO EW-1 PUMPING AT 1.91 GPM (RECOVERY)

PROJECT INFORMATION

Company: Applied Remedial Technologies
Client: R.W.L. Investments, Inc.
Project: 170-1
Location: 4919 Tidewater Ave., Oakland
Test Well: EW-1
Test Date: 04/25/06

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
EW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ OB-6	-5	-18.1

SOLUTION

Aquifer Model: Confined

Solution Method: Theis (Recovery)

T = 89.3 ft^2/day

S/S' = 1.01

APPENDIX D

NUMERICAL GROUNDWATER FLOW MODEL

APPENDIX D - GROUNDWATER FLOW MODEL

D-1 Introduction

As part of the feasibility analysis of the Excavation & Disposal (E&D) and Groundwater Extraction & Treatment (GWET) remedial alternatives, a three dimensional (3-D) numerical groundwater flow model was constructed using the results of the aquifer testing activities. The E&D remedial alternative requires that the saturated Site sediments that lie within the footprint of the proposed excavation be dewatered to its bottom prior to commencement of excavation. Additionally, the dewatering of the Site should also evaluate the impacts and effectiveness of proposed mitigation measures like sheet piling on the existing groundwater flow, and on the proposed dewatering activities. The GWET remedial alternative requires the evaluation of the most optimal way of capturing the petroleum hydrocarbon impacted groundwater plume beneath the Site. Hence, the groundwater model was used as a tool to simulate pre-pumping or steady state and transient calibration conditions, evaluate the proposed dewatering and groundwater extraction well locations, estimate the extraction rates of the proposed remedial wells, and simulate the response of the aquifer system to the proposed remedial alternatives. These results were then applied to estimate the time frame and projected cost required to implement the proposed remedial alternatives at the Site.

D-2 Numerical Groundwater Code Description

MODFLOW2000®, which is the United States Geological Survey (USGS) Modular Three-Dimensional Finite Difference Groundwater Flow Model code, was selected as the numerical code for performing the groundwater flow simulations and simulating the response of the aquifer system to groundwater extraction, and *MODPATH* was used to simulate the particle-tracking and capture zones. The most recent version of the graphical interface program Groundwater Modeling System (GMS) Version 6.0 was used to assemble and construct the input files for the numerical model. GMS is a pre-processor and post-processor that facilitates data preparation, manipulation, visualization, and presentation of MODFLOW2000® input and output files. Depending upon the boundary conditions or the various external stresses that need to be simulated for a given model domain, the following MODFLOW2000® packages were utilized during the groundwater flow and predictive simulations:

- .BAS The primary package used for model initialization, layer definition, initial potentiometric conditions, water budget balance, definition of the types of simulations;
- .BCF For layer hydraulic properties and elevation control;
- .WEL To simulate the extraction from dewatering well EW-1 during the transient calibration simulation;
- .DRN To simulate the extraction from the proposed remedial dewatering or extraction wells during the remedial alternative simulations;
- .HFB To simulate the shoring/cut-off wall for the dewatering simulation; and,
- .PCG2 For utilization of the Preconditioned Conjugate Gradient matrix equation solver;

D-3 Model Geometry and Grid

The model domain dimensions (**Figure D-1**) were positioned relatively distant from the proposed Site boundaries to minimize impact of the imposed boundary conditions on the predictive performance of the model and reduce the effects of errors from input uncertainties on the model results. In plan view, the model's grid blocks were mutually perpendicular lines that were spaced on a 5 foot by 5 foot grid. Model solution nodes were located at the center of each cell and the model grid was oriented northeast-southwest. The vertical thickness of the model (approximately 20 feet) was represented in the model by three layers of grid cells.

The vertical multi-layer system was derived from the conceptual model, and was assumed to represent two geologically different aquifer units: Layer 1 represented the fill material; Layers 2 and 3 represented the clay unit/Bay Mud, which was primarily comprised of silty clay/clayey materials. The clay unit was represented by model layers 2 and 3 so as to properly represent the proposed mitigation measures (sheet pile/cut-off wall) during the simulation of Site dewatering. For the dewatering simulation, the bottom of the proposed sheet pile/cut-off wall was assumed to lie within Layer 2. Layer 1 of the model domain was designated as unconfined, whereas the underlying Layers 2 and 3 were fully convertible from confined to unconfined conditions. The flow between the layers was represented by the vertical hydraulic conductivity or leakance, except for the bottom most layer.

D-4 Layer Elevations

Layer surface and bottom elevations were assigned in GMS using the lithologic data from all boring logs and monitoring wells within the model domain. In areas where little or no data was available, additional ground elevation values were manually input through the GMS interface based on visual comparison with the USGS topographic map. The completed ground surface elevation data set was translated to the top of Layer 1 (using the krigging interpolation method) until it matched the surface features of the topographic map. Similarly, the depth of the fill material was also obtained from the logs of on-site and off-site soil borings and the on-site monitoring well network. In areas where little or no data was available, it was assumed that the fill bottom was at a minimum of 3 feet below ground surface (representing our assumption that 3 feet of fill was placed over the Bay Mud during the construction of this area). These additional fill depth elevation values were manually input through the GMS interface based on visual comparison with USGS topographic map. The completed ground elevation data set was translated to the bottom of model layer 1 (using the krigging interpolation method), and contoured within GMS until it matched the data from the boring logs.

Based on the interpreted surfaces from the on-site and off-site boring logs, and the depth of the proposed mitigation measure (sheet pile/cut-off wall) for the dewatering/excavation remedial alternative, model layers 2 and 3 were assigned a thickness of 5 and 8, feet, respectively, at the site and its immediate vicinity. After completion of this exercise, the layer surfaces were exported directly to MODFLOW2000® using the GMS interface.

D-5 Boundary Conditions

Boundary conditions along the perimeter of the model domain were largely defined from existing well data and topographic features. The perimeter boundary conditions were assigned using a combination of no-flow and general head boundaries. General heads were assigned to boundaries that simulated either inflow to or outflow from the model domain. The initial general head boundary nodes were estimated by projecting the inferred groundwater elevations in the central portion of the model domain to the edges of the model boundaries, and adjusted during the calibration process. As the groundwater in the model domain flows from the north direction to the southeast/west direction towards San Francisco Bay, it was assumed that the majority of groundwater inflow and outflow in the model domain occurs along these boundaries; hence, these boundaries of the model domain were designated as general head boundaries.

No-flow boundaries were assigned to areas where groundwater flow was interpreted to be parallel to the perimeter of the model domain or where no groundwater flow into the model domain was expected. As the majority of flow into or out of the model domain is assumed to be across the north and southeast/west boundaries of the model domain, the east boundaries of the model domain were designated as a no-flow boundary. Figure D-1 depicts the boundary conditions associated with the model domain.

It is expected that flow across or related to a particular model boundary may change during and as a result of remedial activities. However, any change in the boundary condition is expected to have minimal effect on the groundwater conditions at the site and its vicinity.

D-6 Aquifer Properties

Input data for MODFLOW2000® include aquifer top and bottom elevations, hydraulic conductivity, anisotropy, specific yield, and specific storage. Specific yield and specific storage values were only used during transient simulation runs. The .BCF package of MODFLOW2000® was used to simulate the remaining aquifer properties within the model domain.

An initial horizontal hydraulic conductivity (K_h) value of 15 ft/day, which was estimated from the constant-rate aquifer test, was assigned to each model cell of the fill material (model layer 1). However, the initial estimate of the hydraulic conductivity of the clay unit/Bay Mud (model layers 2 and 3) was based on available lithologic logs and literature values, and was assigned an initial value of 0.001 ft/day. These initial hydraulic conductivity values for the model layers were further refined during the steady state and transient calibration simulations of the model by incorporating additional zones of K_h. In addition, to provide a complete coverage of the model domain, the K_h values in outlying areas, not influenced by the aquifer tests, were assigned to be similar to those observed at the site.

The hydraulic communication between the two model layers was simulated using leakance, which is estimated from the ratio of thickness over vertical hydraulic conductivity (K_v). Because field measurements of K_v data for the soils underlying the site are not available, a typical ratio of horizontal-to-vertical hydraulic conductivity was used as a means of estimating and distributing values of K_v. Based on the conceptual model of groundwater flow and the assumption that horizontal flow is dominant, the vertical conductivity values for a given cell in all the model layers were assumed to be approximately one order of magnitude lower than the horizontal conductivity for that cell. Leakance values were then calculated using the following equation:

$$Leakance = \{1/2Qz_u/K_{zu} + 1/2Qz_u/K_{zL}\}^{-1};$$

where,

$1/2Qz_u$	-	the half-thickness of the upper layer;
$1/2Qz_u$	-	the half-thickness of the lower layer;
K_{zu}	-	the vertical conductivity of the upper layer;
K_{zL}	-	the vertical conductivity of the lower layer.

Based on the above formula, and the assumed K_v and thickness values for the layers, the initial leakance values assigned to the fill material (model layer 1) and the clay unit (model layer 2) were 0.001 and 1, respectively. Leakance values were refined graphically during the steady state and transient calibration simulations until a consistent correlation was reached between the predicted and observed head values.

For the transient simulation runs in MODFLOW, the primary and secondary storage coefficient terms are required. The primary storage coefficient is always the specific yield (S_y) or unconfined storage coefficient for an unconfined layer and the confined storage coefficient for a confined layer. The secondary storage coefficient is always the specific yield (S_y), and is only applied by the model if the model layer becomes unconfined. The initial primary storage coefficient value in the fill material (model layer 1) was assigned from the estimated aquifer parameters. The initial primary storage coefficient terms assigned to the clay unit/Bay Mud were assumed from literature values for similar materials. *Freeze and Cherry* state that the S_y values typically lies within a range of 0.01 (for clays) to 0.3 (for coarse sands), and the confined storage coefficient range in value from 0.005 to 0.00005. Based on the results of the constant-rate aquifer test and the literature values, the initial storage coefficient values assigned to the preliminary model simulations were 0.027 and 0.001 to the fill material (model layer 1) and the clay unit/Bay Mud (model layers 2 and 3), respectively. Storage coefficient values were refined graphically during the transient calibration simulation until a reasonable correlation was reached between the predicted and observed head values.

Recharge due to precipitation was not used in this model presentation as most of the domain area is paved, and minimal infiltration of rainfall to the groundwater would have occurred at the site.

D-7 Groundwater Extraction

Following the calibration of the groundwater flow model under ambient (non-pumping) steady state conditions, the .WEL package of MODFLOW2000® was used to simulate groundwater extraction. However, in certain simulations, the cells where the proposed wells were simulated had a tendency to go dry due to solver limitations. In such cases, the .DRN package was utilized, where each of the dewatering or extraction wells was set up as a drain cell.

The transient calibration of the model was performed by applying the .WEL package to simulate the EW-1 constant rate aquifer test. The .DRN package was used to simulate the groundwater extraction from the dewatering or groundwater extraction wells during the simulation of their respective remedial alternatives. For the modeling effort, the hydraulic conductance value allotted to each drain cell (500 ft^3/day) was estimated from the product of the cell area (5 x 5 ft) and the hydraulic conductivity of the subsurface material at that location (20 ft/day).

For the dewatering simulation, the drawdown observed in the proposed dewatering wells was simulated by setting the bottom elevation of the drain cell below the bottom of model layer 1 (fill material) such that it would simulate the condition of the groundwater level below the proposed excavation depth.

For the GWET remedial alternative simulation, the .DRN package was utilized to simulate extraction from ten extraction wells. The drawdown observed in each groundwater extraction well was simulated by setting the bottom elevation of the drain cell 0.01 feet above the bottom of model layer 1 (fill material).

D-8 Calibration

Before a groundwater flow model can be used for predictive simulation, it is necessary to obtain an acceptable correlation between the simulated and observed hydraulic head values under natural flow and/or stressed aquifer conditions. Because of the complexity of hydrogeologic systems, initial estimates of model parameters generally do not produce simulated results that are completely consistent with observed field conditions. Hence, calibration, which is defined as the process by which model parameters defining the modeled system are adjusted within typical model criteria ranges, is performed until an acceptable correlation between observed and simulated hydraulic head values is achieved.

An ideal calibration process involves calibrating a steady state model to groundwater levels within a monitoring well network in non-pumping or natural flow conditions. However, due to limited availability of groundwater level data within the model domain (only four monitoring wells are installed within the model domain), comparison of observed and simulated groundwater levels in monitoring wells is minimal. Hence, a statistical or quantitative calibration of the steady state model (convergence and residual statistics) was not performed. However, a qualitative evaluation of the calibration was performed by comparing the shape and gradient of the simulated and observed potentiometric surface of the calibrated model. Model parameters and boundary conditions were adjusted in a systematic manner until a reasonable fit of the shape and gradient of the observed and simulated potentiometric surface for the fill material was obtained.

The water budget for the steady state simulation showed that there was approximately 1.58 ft^3/d (0.91%) discrepancy between the inflow and outflow of the steady state model. The *ASTM Standard D 5981-96* considers a water budget discrepancy of less than 5% adequate.

D-9 Groundwater Flow Model Transient Calibration

The transient calibration simulation was performed to evaluate whether the groundwater flow model is capable of reliably predicting responses to aquifer stresses such as an aquifer pump test. The transient calibration was performed by simulating the EW-1 constant-rate aquifer test, and comparing predicted and observed drawdowns at selected observation points in the vicinity of the pumping well. Groundwater extraction from the fill material was simulated at a constant rate of 1.9 gallons per minute (gpm) from well EW-1 for a period of 2.021 days (48.50 hours).

Simulation of the EW-1 constant-rate pumping test also provided the final storage coefficients for the subsurface fill material. If the modeled correlation between the predicted and observed responses was insufficient, then the model calibration was revisited by adjusting the model parameters, like hydraulic conductivity and storage coefficient, until a good correlation was obtained. Table D-1 summarizes the observed and simulated responses of the observation wells at the end of the pump test. **Figures D-2A**, **D-2B**, and **D-2C** show the drawdown vs. time plots of some of the observation wells in the fill material for the duration of the pumping test.

Based on the simulated responses, the model adequately predicted the behavior of the observed responses of the observation wells to pumping from EW-1 during the constant-rate aquifer test. Any discrepancies between the observed and predicted responses for the test can be attributed to the “coarse” discretization of the model grid and localized variations in aquifer characteristics.

The water budget for the transient simulation showed that there was approximately 0.18 ft^3/d (0.02%) discrepancy between the inflow and outflow of the steady state model. The *ASTM Standard D 5981-96* considers a water budget discrepancy of less than 5% adequate.

D-10 Calibrated Aquifer Parameters

Based on the results of the steady state and transient calibration simulations, the final calibrated hydraulic conductivity assigned to the clay unit/Bay Mud (model layers 2 and 3) was 0.001 ft/day. However, several hydraulic conductivity zones were assigned to model layer 1 (fill material) due to localized heterogeneities within the subsurface fill materials. **Figure D-3** shows the calibrated K zones and values for the fill material (Layer 1) within the model domain.

As stated previously, the primary storage coefficient is always the specific yield (S_y) or unconfined storage coefficient for an unconfined layer and the confined storage coefficient for a confined layer. The secondary storage coefficient is always the specific yield (S_y), and is only applied by the model if the model layer becomes unconfined. The S_y assigned to model layer 1 (fill material) was 0.02 and 0.01 to model layers 2 and 3 (clay unit/Bay Mud). The secondary storage coefficient value of 0.012 was only assigned to model layers 2 and 3.

D-11 Sensitivity Analysis

Following completion of model calibration, a sensitivity analysis was performed to identify which model input parameters have the most impact on the degree of calibration. This section presents the results of sensitivity analysis simulations performed on the calibrated model.

The sensitivity analyses were limited to those model parameters found to have significant effect on results during calibration. A qualitative analysis of the model was performed during the initial stages of the model calibration to determine which parameters most affect the calibration process. Based upon this analysis, it was found that Horizontal hydraulic conductivity (K_h) and leakance in model layer 1 (fill material) were the most sensitive model parameters for the calibrated conditions. Also during calibration, other poorly constrained model parameters, such as the boundary conditions and horizontal and vertical hydraulic conductivity in Layers 2 and 3 were found to affect the calibration only in a limited way. Hence, further sensitivity analysis of these parameters was not necessary as changes in these values had relatively little impact at the Site area in comparison with that observed for the K_h and leakance parameters.

During the sensitivity analysis, K_h and leakance, were increased or decreased in a systematic way for each layer while other parameters were held constant. This approach assesses the sensitivity of model results to individual parameters, the uncertainty of model predictions, and the potential need for addressing parameter uncertainty in the future. Model sensitivity was examined by observing changes in the mean absolute residual, bias of the resulting simulated water levels, and the water balance at the site.

Sensitivity analysis of K_h showed that increasing the K_h by an order of magnitude resulted in increasing the transmissivity of the model layers, which resulted in a moderate variation in the overall calibration of groundwater flow within the model domain, and an increase in the quantity of underflow into the system. Decreasing the K_h by an order of magnitude resulted in decreasing the quantity of underflow into the groundwater system.

Similar analysis of the sensitivity of the model to variations in the leakance also indicated variations in the overall calibration of groundwater flow within the model domain. Increasing the leakance values by an order of magnitude resulted in an increase in the communication between the model layers 1 through 3, an increased variation in the overall calibration of groundwater flow within the model domain, and a minimal increase in the quantity of underflow into the system. Decreasing the leakance by an order of magnitude resulted in decreasing the communication between the model layers 1 through 3. However, only moderate variation in the overall calibration of groundwater flow within the model domain and negligible change in the quantity of underflow into the groundwater system was observed.

In summary, an increase or decrease in the K_h by an order of magnitude has moderate effects on the overall calibration, and significant effects in the groundwater underflow into the system, and a change in the leakance has moderate effects on the extent of hydraulic communication between model layers 1 through 3.

D-12 Simulation of Proposed Remedial Alternatives

Following the completion of the sensitivity analysis of the groundwater model, the calibrated groundwater model was used to simulate the proposed remedial alternatives. As stated previously, the E&D remedial alternative requires the simulation of optimal Site dewatering and the GWET remedial alternative requires the simulation of effective capture of the petroleum hydrocarbon impacted groundwater plume beneath the Site.

As stated in *Section D-7*, the .DRN package was used to simulate the groundwater extraction from the dewatering or groundwater extraction wells during the simulation of their respective remedial alternatives. For the dewatering simulation, the drawdown observed in the proposed dewatering wells was simulated by setting the bottom elevation of the drain cell below the bottom of model layer 1 (fill material) such that it would simulate the condition of the groundwater level below the proposed excavation depth. For the GWET remedial alternative simulation, the .DRN package was utilized to simulate extraction from ten extraction wells. The drawdown observed in each groundwater extraction well was simulated by setting the bottom elevation of the drain cell 0.01 feet above the bottom of model layer 1 (fill material).

This section provides a brief description of the results of the dewatering and GWET predictive simulations.

D-12-1 Dewatering Simulations

Following calibration of the groundwater flow model, several dewatering alternatives were evaluated. Dewatering conditions at the Site were simulated by lowering the water table to the bottom of the fill material underlying the Site (approximately 1.5 feet to 9 feet bgs). This depth corresponds to the depth of the excavation bottom within the proposed footprint at the Site (except in the vicinity of the former UST area). Dewatering simulations were performed using a combination of perimeter and internal dewatering wells for a period of 180 days, as it represented the time period under which the drawdowns reached a steady state condition under most simulation conditions. Based on the initial water levels of approximately 2.5 feet bgs, the modeled drawdown condition in which the 4-foot and 5-foot drawdown contours envelop the Site are assumed to provide the necessary dewatering till the bottom of the proposed excavation. The dewatering predictive simulations provided the pumping duration required to dewater the site, the initial pumping rates required to dewater the site, and the drawdowns observed at and near the site. Additionally, the simulations also evaluated the effects of groundwater levels and aquifer parameters like hydraulic conductivity, leakance, and storativity (storage coefficient) of the model layers on the dewatering of the Site. The following is a discussion of the dewatering simulations results:

- The selected dewatering design involved the placement of 47 extraction wells along the perimeter and the interior of the Site. The locations of the dewatering wells for the selected dewatering alternative and the simulated drawdowns for the 1, 30, and 60 day periods are shown in **Figures D-4A**, **D-4B**, and **D-4C**, respectively.

- As shown in **Figure D-4C**, the selected dewatering well configuration, pumping at an initial value of approximately 50 gpm, resulted in drawdowns greater than 4 feet within the footprint of the proposed excavation after 60 days. Furthermore, the total dewatering rate reduced from the initial value of approximately 50 gpm to approximately 0.5 gpm in 60 days.

- *Effects of Groundwater Levels* – An increase in the groundwater levels in the fill material beneath the Site will increase the time to dewater the Site.

- *Effects of Storativity* – The specific yield (S_y) is the primary parameter used to estimate the time required to dewater the site; hence, it is necessary to understand the impacts of higher or lower S_y to the dewatering of the site. Therefore, sensitivity analysis was performed to understand the impacts of the S_y on dewatering the site. Results of these simulations indicated that the time required to dewater the fill material (model layer 1) increased significantly when the S_y was increased. For such a condition, additional wells would be required to completely dewater the site within a limited time frame.

- *Effects of Hydraulic Conductivity* – An increase in the hydraulic conductivity by twice the model calibrated values results in a decrease in the total drawdown at the site under the same pumping conditions as the Base simulation. Hence, increased flow rates in the existing wells or additional wells would be required to completely dewater the site. A decrease in the hydraulic conductivity to half the original calibrated values in the model layers results in decreasing the time to dewater the Site.

- *Effects of Leakance* – An increase in the leakance values by an order of magnitude times the original calibrated values in all the model layers resulted in decreasing the time to dewater the site. A decrease in the leakance values by one order of magnitude in model layers 1 and 2 did not dewater the site until the end of the simulation run (160 days). Additional wells would be required to completely dewater the site under such a condition.

D-12-2 GWET Simulations

The calibrated groundwater model was used to simulate and evaluate the effectiveness of the proposed GWET remedial alternative. The capture area of the GWET extraction wells at the Site is illustrated by the backward tracking particle pathlines (simulated using *MODPATH*) from the proposed extraction wells. The following is a discussion of the results of the GWET remedial alternative simulation:

- The proposed GWET remedial alternative involved the placement of ten (10) extraction wells in proximity or within areas of maximum observed TPH-d concentrations in groundwater at the Site. The locations of the remedial extraction wells are shown in **Figure D-5**.

- As shown in **Figure D-5**, the simulation indicates that the proposed extraction well configuration, pumping at an initial total of approximately 22 gpm, is anticipated to capture the petroleum hydrocarbon impacted groundwater plume. The extraction rate is expected to reduce to a total of approximately 1.5 gpm when the groundwater extraction at the Site attains a steady state condition within one (1) year from the commencement of extraction.

- Following the completion of the GWET remedial alternative simulation, the *'Pore Flush'* model was used to estimate the remediation time for cleaning the Site using the proposed extraction well configuration.

D-13 Conclusions

As part of the feasibility analysis of the Excavation & Disposal (E&D) and Groundwater Extraction & Treatment (GWET) remedial alternatives, a three dimensional (3-D) numerical groundwater flow model was constructed using the results of the aquifer testing activities. The E&D remedial alternative required the simulation of optimal Site dewatering and the GWET remedial alternative required the simulation of effective capture of the petroleum hydrocarbon impacted groundwater plume beneath the Site. The groundwater model was used as a tool to evaluate the proposed dewatering and groundwater extraction well locations, estimate the extraction rates of the proposed remedial wells, and simulate the response of the aquifer system to the proposed remedial alternatives. These results were then applied to estimate the time frame and projected cost required to implement the proposed remedial alternatives at the Site.

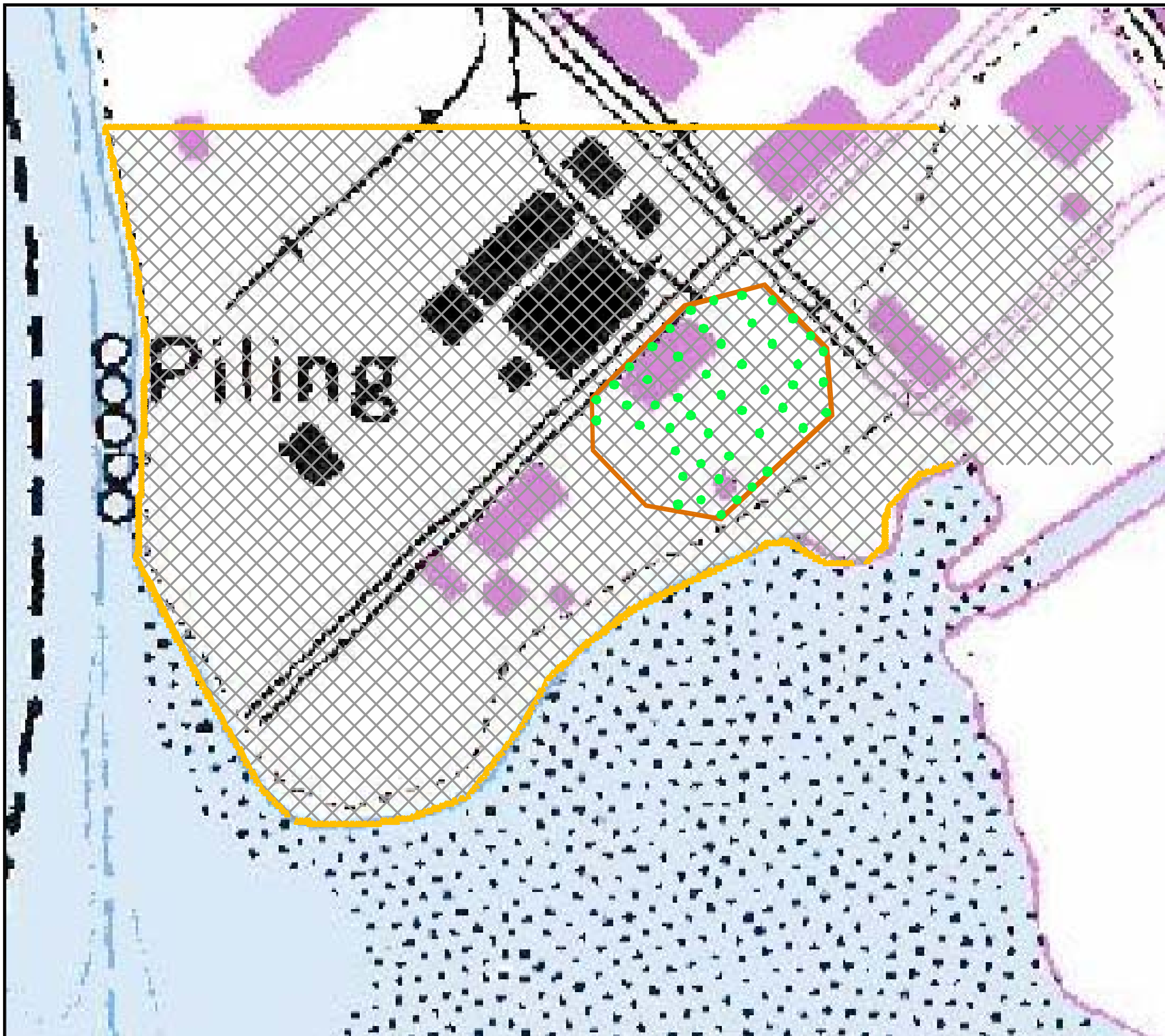
The result of the dewatering simulating indicated that selected that a total of 47 dewatering wells, placed along the perimeter and the interior of the Site and pumping at an initial value of approximately 50 gpm, would take approximately 60 days to dewater the proposed excavation.

The result of the GWET remedial alternative simulation indicated that a total of ten (10) extraction wells, located in proximity or within areas of maximum observed TPH-d concentrations in groundwater at the Site, and pumping at an initial rate of approximately 22 gpm, would effectively capture the petroleum hydrocarbon impacted groundwater plume beneath the Site.

TABLE D-1 - TRANSIENT CALIBRATION - RESULTS OF EW-1 CONSTANT-RATE PUMP TEST

4919 Tidewater Avenue, Oakland, CA

Well Name	Drawdown (ft)		Residuals (ft)
	Observed	Simulated	
MW-2	1.55	1.37	0.18
MW-3	0.47	0.32	0.15
OB-3	1.99	1.91	0.08
OB-4	1.50	1.28	0.22
OB-6	1.48	1.2	0.28



LEGEND

PROPOSED DEWATERING WELLS

SHEET PILE / CUT-OFF WALL

GENERAL HEAD BOUNDARY

MODEL DOMAIN

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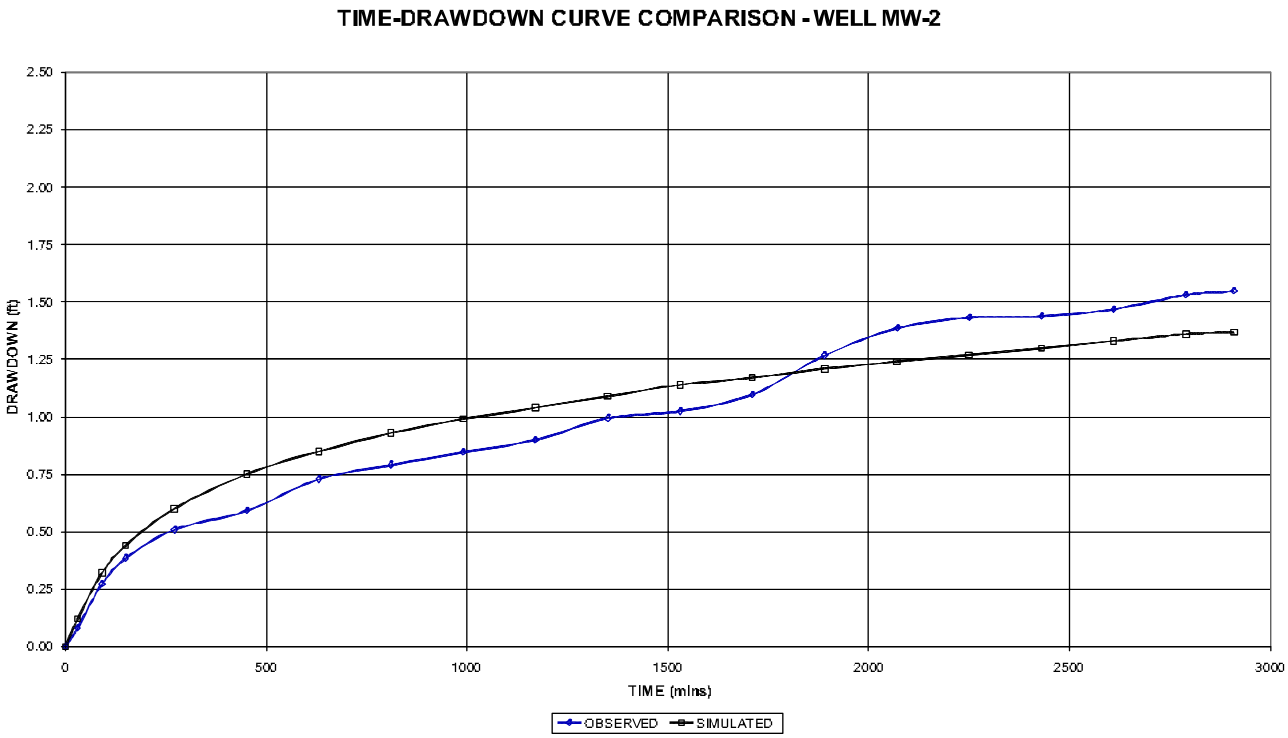
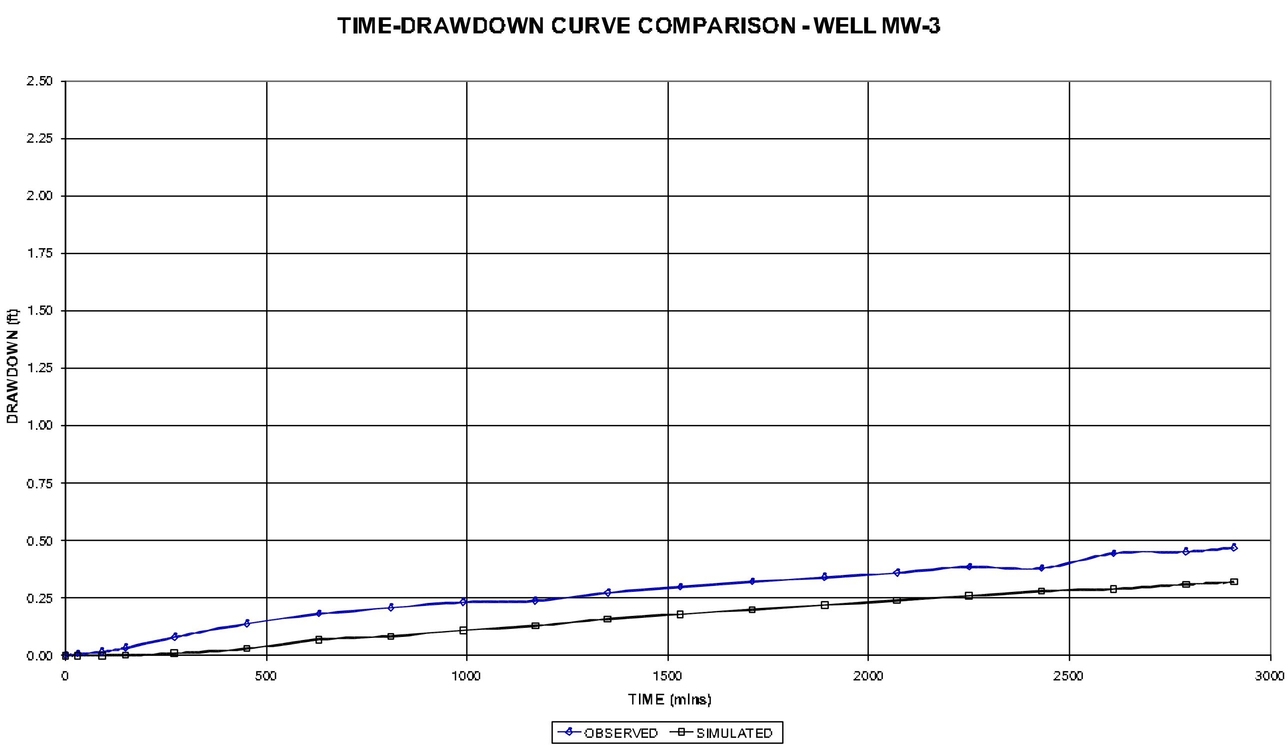
MODEL DOMAIN AND
BOUNDARY CONDITIONS

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
D-1

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-





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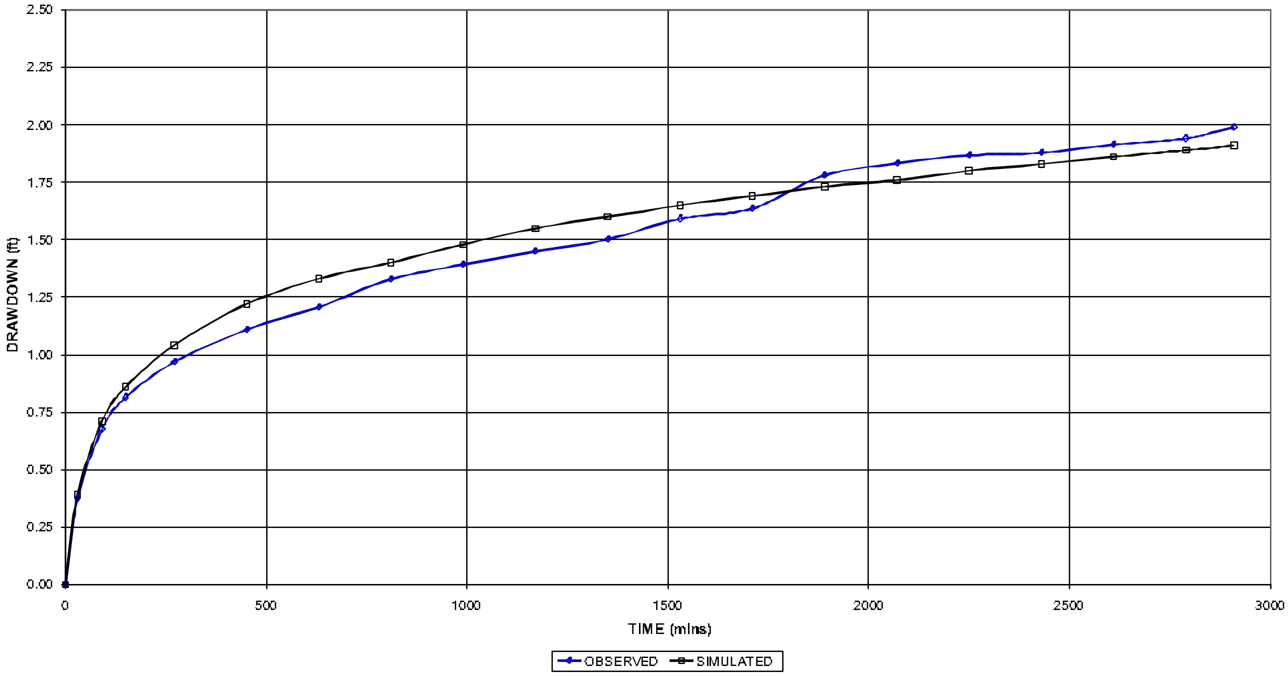
TIME-DRAWDOWN CURVE
MW-2 AND MW-3

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

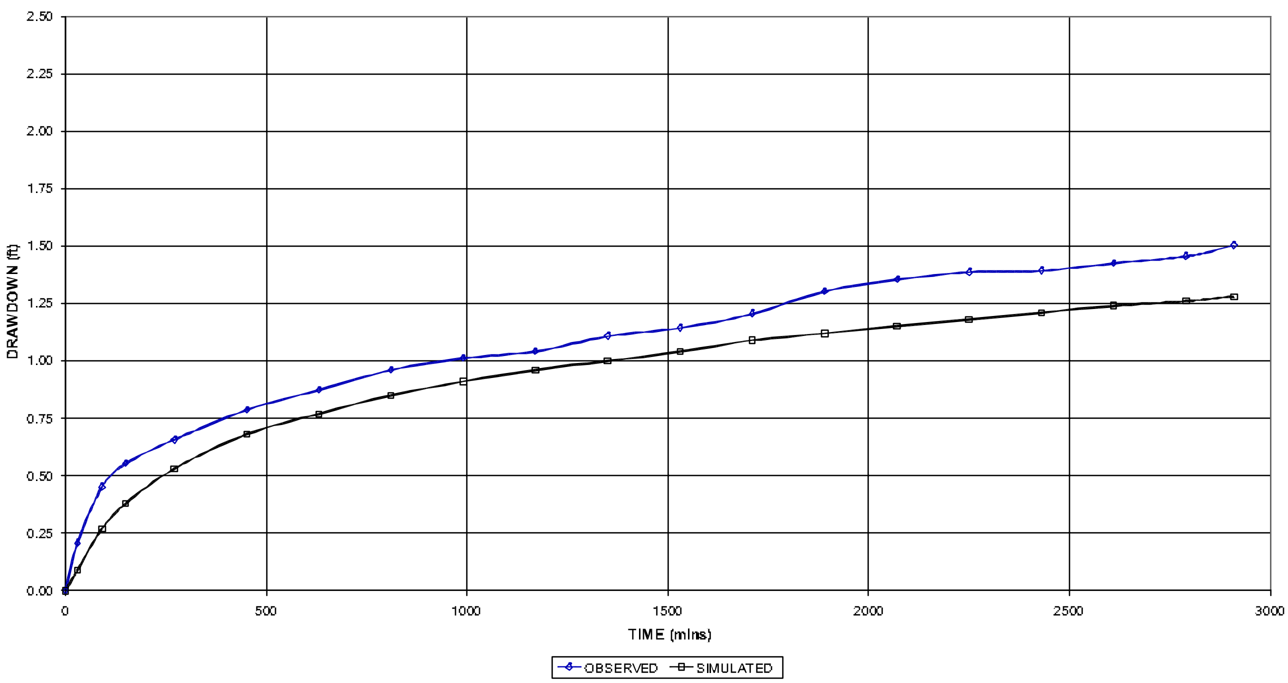
FIGURE NO
D-2A

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-

TIME-DRAWDOWN CURVE COMPARISON - WELL OB-3



TIME-DRAWDOWN CURVE COMPARISON - WELL OB-4



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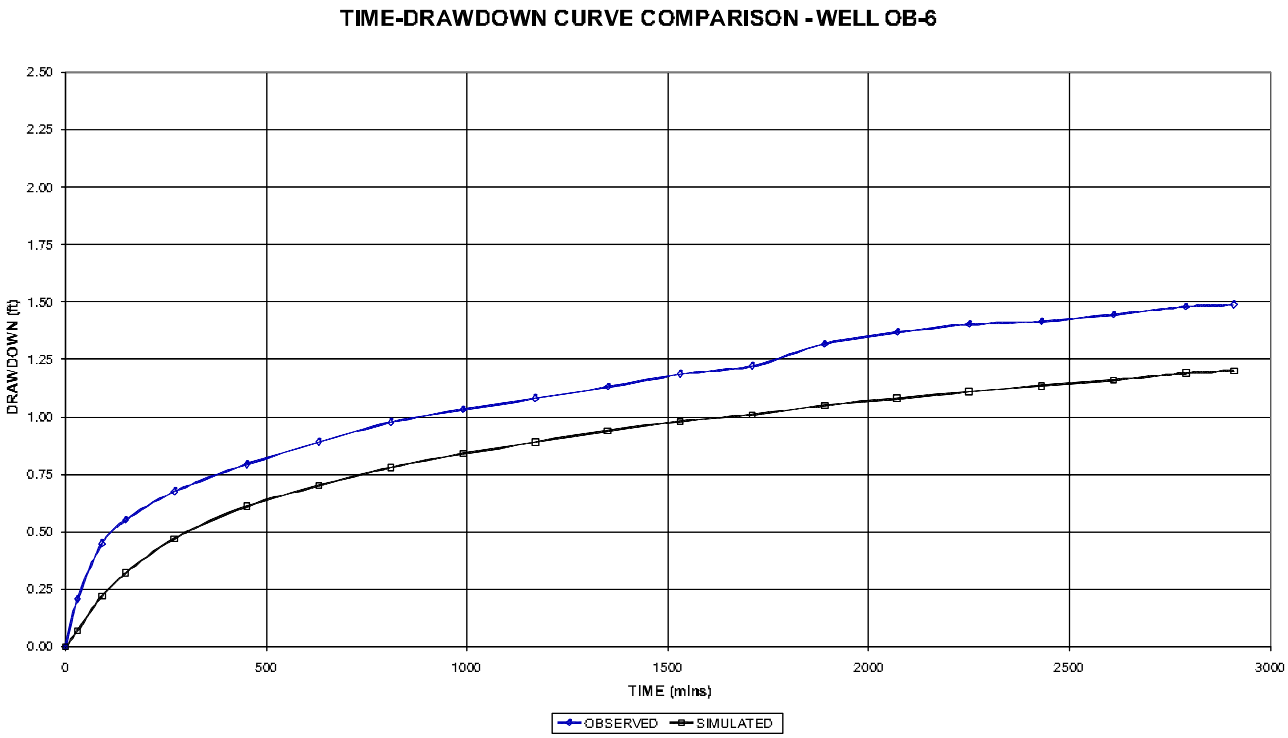
TIME-DRAWDOWN CURVE
OB-3 AND OB-4
HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
D-2B

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



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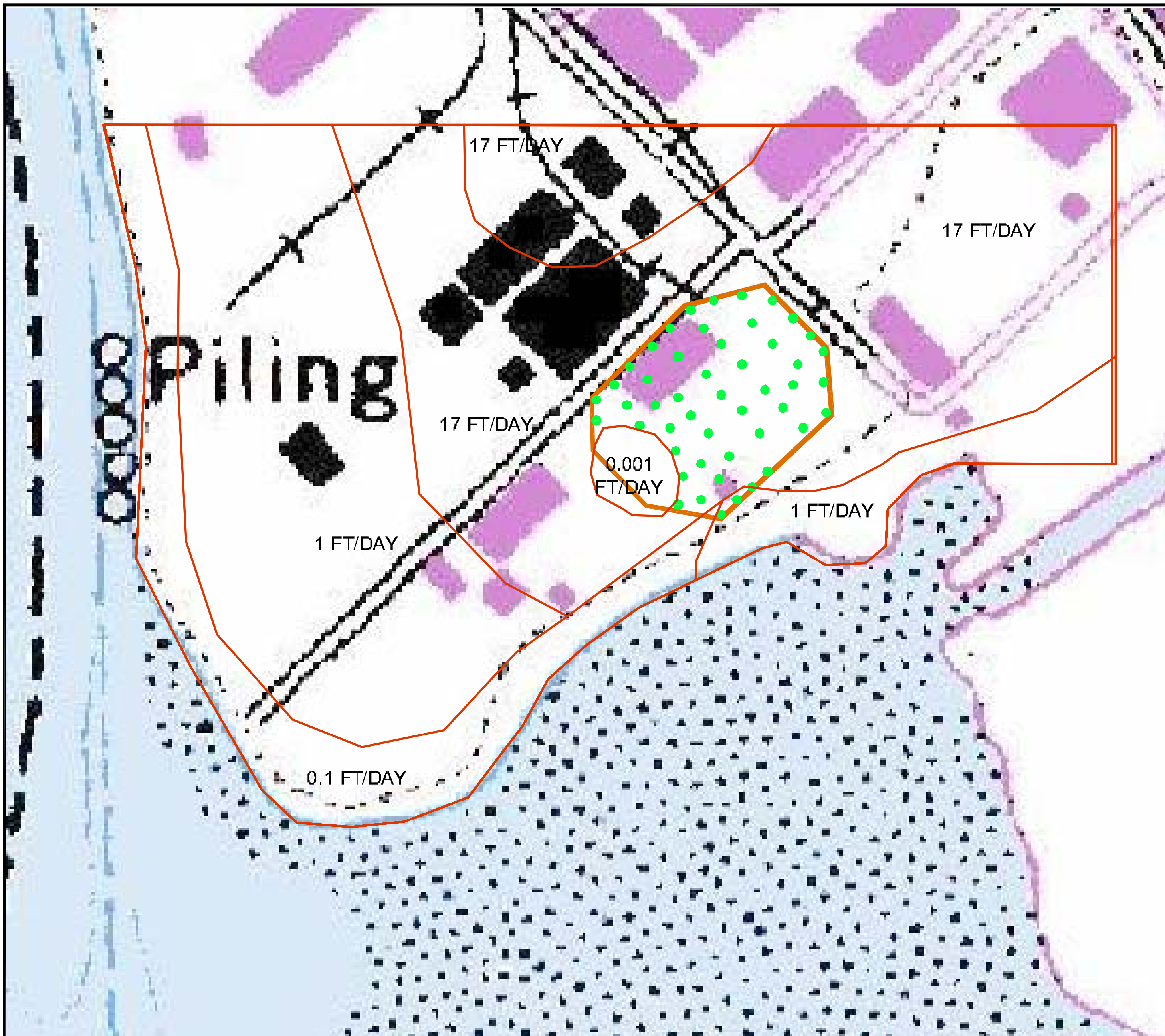
TIME-DRAWDOWN CURVE
OB-6

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
D-2C

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



LEGEND

PROPOSED DEWATERING WELLS

SHEET PILE / CUT-OFF WALL

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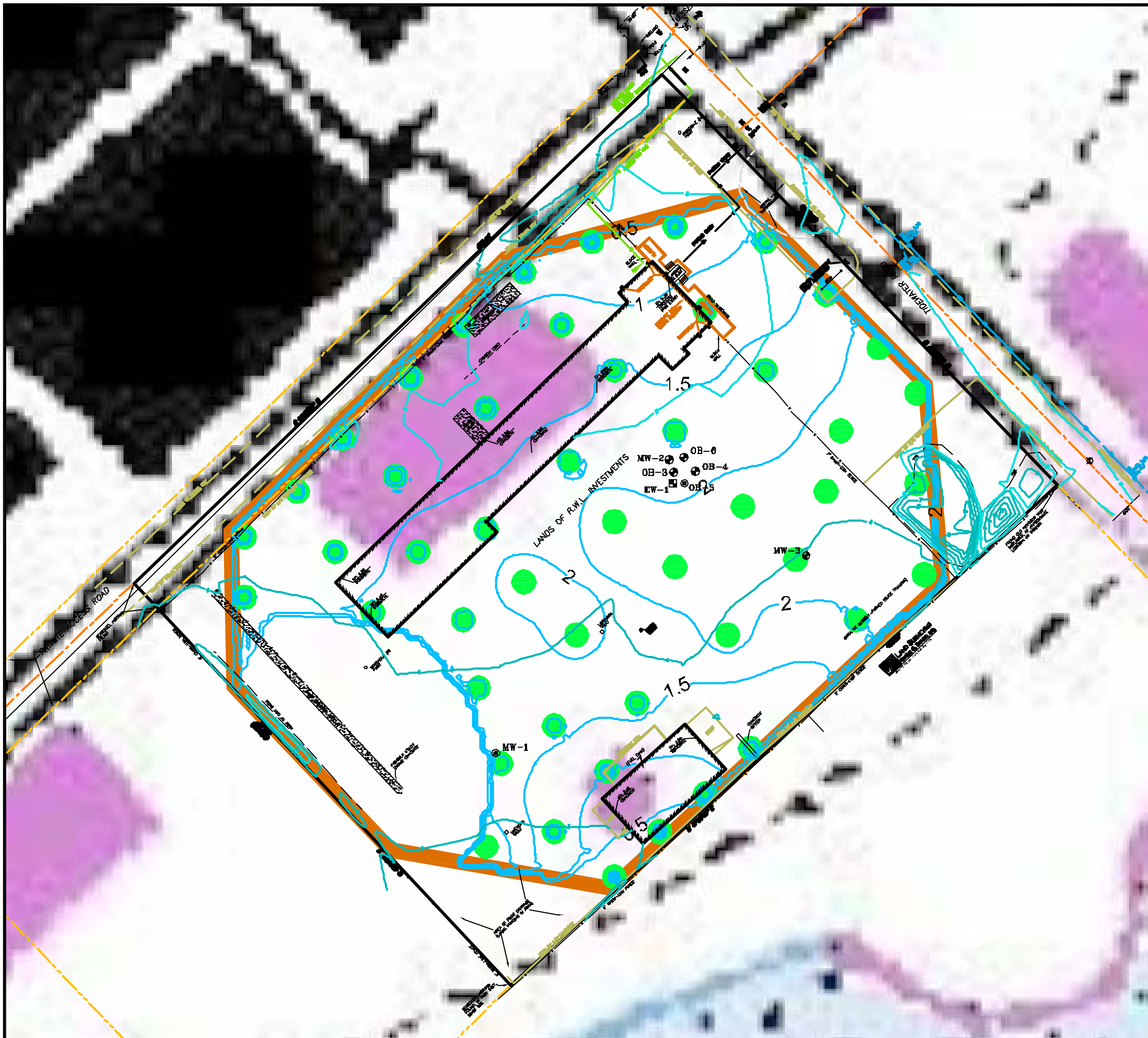
HYDRAULIC CONDUCTIVITY 'K' ZONES
FILL MATERIAL (MODEL LAYER 1)

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
D-3

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



LEGEND

PROPOSED DEWATERING WELLS

SHEET PILE / CUT-OFF WALL

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SIMULATED DRAWDOWN FOR PROPOSED DEWATERING SYSTEM - DAY 1

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO

D-4A

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-

LEGEND

PROPOSED DEWATERING WELLS

SHEET PILE / CUT-OFF WALL

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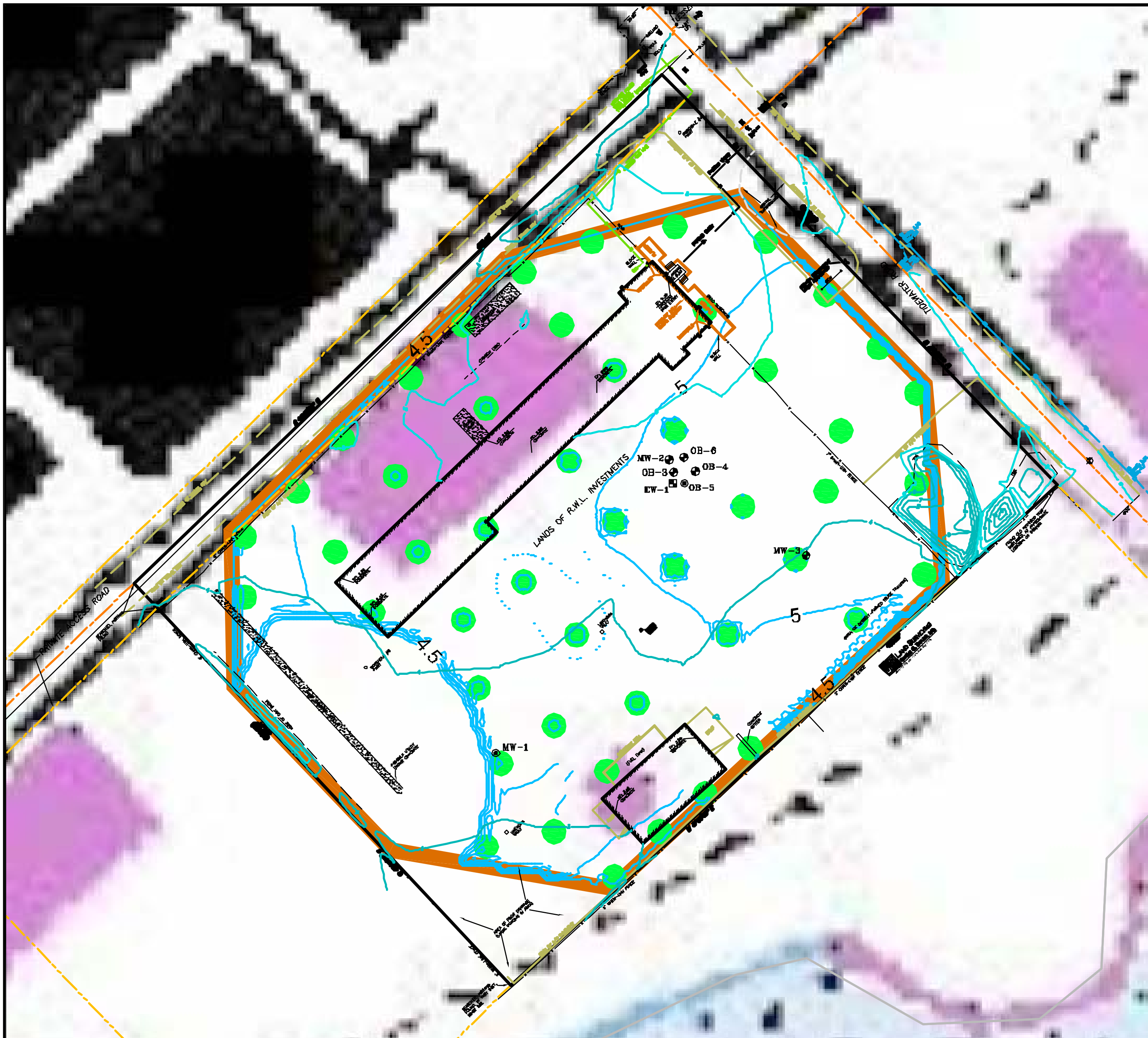
SIMULATED DRAWDOWN FOR PROPOSED DEWATERING SYSTEM - DAY 30

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
D-4B

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



LEGEND

PROPOSED DEWATERING WELLS

SHEET PILE / CUT-OFF WALL

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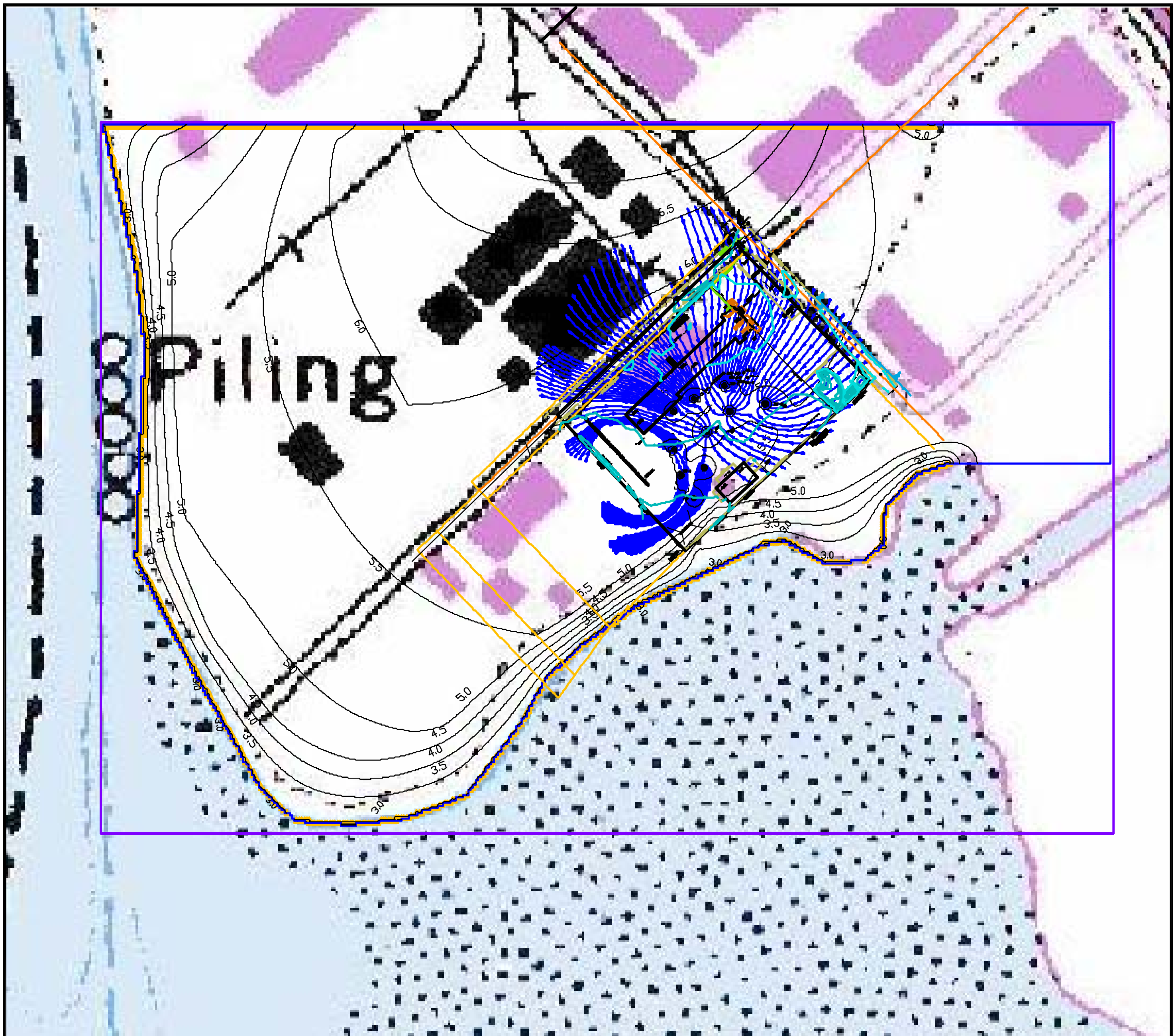
SIMULATED DRAWDOWN FOR PROPOSED DEWATERING SYSTEM - DAY 60

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO

D-4C

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-



LEGEND

PATHLINE (DISTANCE BETWEEN ARROWS IS 100 DAYS)

GROUNDWATER CONTOUR

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MODEL DOMAIN AND BOUNDARY CONDITIONS

HEITZ TRUCKING
4919 TIDEWATER AVENUE
OAKLAND, CALIFORNIA

FIGURE NO
D-5

DRAWN	JOB NO.	APPROVED	DATE	REVISION DATE
PPV	172-02	VO	2-26-07	-