MACTEC

RO 151

May 12, 2004

Project 53087 Task 010
Mr. Jeff Christoff
Blue Print Service Company
945 Bryant Street
San Francisco, Ca 94103

Work Plan
BPS Reprographic Services Facility
1700 Jefferson Street
Oakland, California

Dear Mr. Christoff:

MACTEC Engineering and Consulting, Inc., presents this Work Plan for the BPS Reprographic Services (BPS) facility located at 1700 Jefferson Street, Oakland, California [Site (Plate 1)]. This Work Plan was written in response to a request by the Alameda County Department of Health Care Services (ACHCS) for Site information as described in a letter dated September 27, 2002 titled Fuel Leak Case No. RO0000151, Blue Print Service, 1700 Jefferson St., Oakland CA 94612 (September 27, 2002 letter). The ACHCS requested that the Work Plan contain information associated with contaminant plume definition, underground conduits, bioremediation verification, historical groundwater monitoring, historical groundwater elevations and gradient and cross section diagrams of the Site.

The Work Plan will first present Site background information, then present and respond to each technical comment provided by the ACHCS in the September 27, 2002 letter. The technical comment responses will include the requested information described above. The Work Plan will conclude with recommendations based on the responses to the technical comments.

BACKGROUND

Three underground gasoline storage tanks were removed from the property in 1987 and a preliminary soil and groundwater investigation indicated that a release of fuel into the subsurface had occurred. Three groundwater-monitoring wells (MW-1, MW-2, and MW-3) were installed on the property to evaluate the distribution of petroleum hydrocarbons in the groundwater and to determine the direction of groundwater flow. Free phase hydrocarbon (FPH) was found in MW-1. Groundwater level measurements indicated that the local groundwater gradient was in a north to northwest direction.

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In November 1987, monitoring well MW-2 was abandoned to facilitate the construction of the present BPS facility and, in January 1988, two additional wells, MW-1A and MW-4, were installed as groundwater extraction wells. MACTEC also installed one offsite monitoring well, MW-5, in August 1988 and a second offsite well, MW-6, in April 1996. The monitoring well locations are shown on Plate 1.

In 1992, a groundwater extraction system was constructed at the site to remove FPH from the groundwater surface. Groundwater was extracted from MW-1A and MW-4 and passed through an oil-water separator that removed the FPH. The water was then drawn into a 3,000-gallon bioreactor tank for treatment by hydrocarbon reducing microbes. Air and nutrients were supplied to the water within the bioreactor to facilitate microbial growth. The treated water from the bioreactor was pumped in batches of approximately 500 gallons through three granular activated carbon vessels before discharge under a wastewater discharge permit from the East Bay Utility District to the sanitary sewer. The treatment system processed approximately 1,385,490 gallons of groundwater and an estimated 5,062 pounds of FPH were recovered.

By 1999, the oil-water separator was no longer recovering FPH and FPH was no longer present in any of the groundwater monitoring wells. Dissolved hydrocarbon concentrations were decreasing and MACTEC requested approval from The County to terminate groundwater extraction and to modify the remediation technique to insitu-bioremediation using an oxygen-releasing compound (ORC™). ORC™ is manufactured and distributed by Regenesis, Inc.; its purpose is to increase the concentration of dissolved oxygen (DO) in the groundwater and to augment the ability of naturally occurring microbial organisms in the groundwater to biodegrade the dissolved petroleum hydrocarbons. The County approved this plan in a letter dated September 28, 1999, following the submittal of an ORC™ calculation sheet and a Groundwater Monitoring Plan, dated September 23, 1999.

MACTEC implemented the *in situ* remediation technique by placing ORC™ in treatment wells: MW-1A, MW-3, MW-4, and MW-5 on September 29, 1999. The ORC™ is contained in fabric "socks" which release oxygen over time until the compound's oxygen releasing potential is depleted. MACTEC installed five socks in each treatment well at the approximate depth of the well's screened interval. As described in the Groundwater Monitoring Plan, the ORC™ socks are removed from the treatment wells two weeks before each quarterly groundwater monitoring event, then replaced after sampling is complete.

The Groundwater Monitoring Plan outlined procedures for groundwater sampling using a non-purge method approved by the Regional Water Quality Control Board in a letter dated January 31, 1997. The first quarter that the new Groundwater Monitoring Plan was implemented, sampling included duplicate sampling using both the purge and non-purge methods (see MACTEC's quarterly report, dated October 25, 1999).

During the Fourth Quarter 2002 groundwater monitoring event MACTEC removed the ORC™ socks from the treatment wells per a request from the ACHCS in a September 27, 2002 letter to BPS. The ACHCS suggested that contaminant concentrations may not be accurate due to the presence of the ORC™ socks and requested the socks be removed and DO allowed to return to back ground levels. Additionally, the ACHCS suggested in the same letter that the ORC™ socks appear to be ineffective as contaminant concentrations continue to be high in MW-1 and MW-5.

During the ORC™ socks removal effort from MW-5 it was discovered that the socks were stuck. ORC™ socks can become stuck in monitoring wells when the well casing has become disturbed or bent. This can typically be caused by even minor seismic occurrences in the area of the well. The ORC™ socks remained stuck in MW-5 despite three removal attempts including attempts incorporating an industrial winch and tripod. An ORC™ sock removal effort was performed on September 17, 2003 utilizing a drill rig. The socks were successfully removed with no damage to the monitoring well.

SEPTEMBER 27, 2002 TECHNICAL COMMENTS AND RESPONCES

Technical comments presented in the September 27, 2002 letter are presented below using the same numerical ID as in the letter. The technical comment is presented in italics with the response following in non-italicized script.

1) *Plume Undefined – high contaminant concentrations are still being found offsite (at monitoring well MW-5). Total petroleum hydrocarbons as gasoline (TPH-g) at 9,400 micrograms per liter (ug/L) and benzene at 2,300 ug/L were within historical ranges on April 24, 2002. Define the lateral extent of the plume. Please address these concerns in the work plan.*

Historically, TPH-g concentrations in MW-5 have ranged from a high of 120,000 ug/L in August of 1991 to a low of 1,700 ug/L in June of 2002. TPH-g concentration values have, generally, been decreasing since the well began being sampled. This is shown graphically on Plate 2. Since November of 2000 concentration values have, generally, been reduced an order of magnitude compared to historical values, with intermittent concentration spikes.

Historically, benzene concentrations in MW-5 have ranged from a high of 29,000 ug/L in June 29, 1994 to a low of 110 ug/L in June 14, 2002. Benzene concentration values have, generally, been decreasing since the well began being sampled. This is shown graphically on Plate 3. Since November of 2000 concentration values have, generally, been reduced an order of magnitude compared to historical values, with intermittent concentration spikes.

The general trends for both of these analytes in MW-5 suggests that the plume in the area of this well is being reduced. Plate 4 – Benzene Concentrations in Groundwater, shows successive colored isoconcentration contours beginning with groundwater monitoring data collected in August of 1991. The

icoconcentration contours are shown annually from August 1991 to March of 1993 due to limited data collected between these dates. The icoconcentration contours are shown quarterly from January 1994 up to September of 1999 when non-purge sampling and ORC™ (Oxygen Reducing Compound) treatment was initiated.

Plate 4 further suggests that offsite groundwater impact in the area of MW-5 has been reducing since groundwater monitoring began with simultaneous reduction in onsite groundwater impact. Plate 4 also suggests that the plume has generally not changed shape since September of 1997, indicating that the plume is relatively stable and laterally defined.

2) *Conduit Survey Required – The downgradient MW-6 was nondetectable for all contaminants. Determine if the plume is being intercepted.*

The Oakland Public Works Department (Public Works) was contacted requesting information on the depth of underground utility conduits in Jefferson, Seventeenth and Eighteenth Streets. MW-6 is to the west of the Site in Jefferson Street (up-gradient), and Seventeenth and Eighteenth Streets are to the North and South of the Site respectively. Public Works indicated that there are no utilities in these streets 20 feet below ground surface (bgs) and that typically no utilities in this area are deeper than 10 feet bgs. Groundwater at the Site is typically not higher than 21 feet bgs. MACTEC concludes that the plume is not being intercepted by bgs utility conduits as they are not deep enough to do so.

3) *ORC Interim Remediation Ineffective – ORC has been used in MW-1A, MW-3, MW-4 and MW-5, since September 1999. Yet contaminant concentrations continue to be high in MW-1 and MW-5. TPH-G concentrations were 35,000 ug/l and 9,400 ug/l, for MW-1 and MW-5, respectively. Benzene concentrations were 4,900 ug/l and 2,300 ug/l respectively. Unless you can show that bioremediation is occurring using verification monitoring, propose alternative remedial actions in the work plan requested below.*

In order to evaluate ORC™ treatment effectiveness, MACTEC performed a statistical comparison of groundwater contaminant concentrations collected from treatment wells prior to ORC™ treatment and after ORC™ treatment was initiated. Additionally, as requested above, MACTEC collected groundwater samples from the Site for analysis of biodegradation support parameters to evaluate whether naturally occurring bioremediation was occurring.

Oxygen-releasing compound or ORC™ is dissolved fuel-hydrocarbon contaminant remedial material manufactured and distributed by Regenesis, Inc. The purpose of ORC™ is to create an aerobic groundwater environment in the area around the application point (treatment well) by increasing the concentration of dissolved oxygen (DO). In aerobic environments microorganisms generally utilize DO to biodegrade dissolved-phase fuel-hydrocarbons. The fuel hydrocarbons are typically degraded at rates equal to the rate at which DO is replenished which is approximately equal to the average advective

transport velocity of groundwater. This mass transport limited process is typically a more efficient mode of biodegradation than the anaerobic alternative. In an anaerobic environment microorganisms generally utilize nitrate, sulfate, iron (III), and carbon dioxide to degrade dissolved phase fuel-hydrocarbons at rates that are slow relative to the advective transport velocity of groundwater. This results in the consumption of these compounds at a rate slower than the rate at which they are replenished.

BPS implemented in situ remediation using ORC™ socks on September 29, 1999. The ORC™ socks were removed in December of 2002. ORC™ socks were placed in treatment wells MW-1A, MW-3, MW-4 and MW-5 and periodically replaced as the oxidizing potential was depleted. Data from monitoring wells (MW-1, MW-3, and MW-5) prior to installation of ORC™ were compared to data from the same monitoring wells after installation of ORC™ to determine if a significant difference in contaminant concentrations existed between these two data sets. The non-parametric Mann-Whitney routine in SigmaStat V2 was used to compare these values. If the two data sets were normal and had equal variance, the t-test was employed for the comparison. Results for Benzene, Ethylbenzene, Toluene, Total Xylenes, and TPH-g were evaluated. Table 1 provides a complete set of SigmaStat reports. Descriptions of the Mann-Whitney and t-test test are included respectively with this Workplan under Attachments A and B. A summary of the statistical analysis results is provided below.

Statistical Summary - Chemical Concentrations

A statistical summary of the monitoring results is provided in Table 2. The comparison of the pre- and post- ORC™ socks data sets are summarized in Table 3. As shown in this table, installation of the ORC™ socks resulted in significant reductions in the concentrations of Benzene and Ethylbenzene in all three wells. Toluene concentrations appeared to only be significantly reduced in MW-3. Both Total Xylenes and TPH-g showed significant reductions in MW-3 and MW-5, but not MW-1. Plates 2, 3, 5, 6 and 7 display the analytical results graphically. The general trends apparent in these figures are in agreement with the statistical comparisons. It is interesting to note from these figure that the detected concentrations for all wells where there was a significant decrease after installation of the ORC™ socks show a trend towards increasing concentrations after the ORC™ socks were removed in December 2002.

Assuming all other variables equal, statistical analysis based upon the available analytical data suggests that the installation of the ORC™ socks resulted in significant reductions in concentrations in most of the wells (11 of 15 analyte well permutations, five analytes in three wells).

Bioremediation Indicator Parameter Monitoring

Bioremediation (biodegradation) indicator parameters including carbon dioxide by analytical method SM 4500, nitrate as n (nitrate) by analytical method EPA 300.0, Sulfate as SO^4 (sulfate) by analytical method EPA 300.0, and methane by analytical method RSK 175 were monitored in MW-1, MW-3 and MW-6 during the Third Quarter 2003 groundwater monitoring event. The certified analytical reports are

included with this Work Plan under Appendix C. These monitoring points were chosen for their proximity in or to the presumed contaminant plume shape. MW-1 is located near the plumes presumed center, MW-3 is located near the plumes down-gradient edge and MW-6 is located outside the plume (up-gradient) and is considered a location for background groundwater parameter data.

ORC™ socks had been removed from most wells at the Site since December 2002. ORC™ socks in MW-3 were not removed until September 2003 due to the socks being stuck as described in the quarterly monitoring reports. However, the socks were considered depleted by the December 2002. DO was monitored during the Third Quarter 2002 event for verification that DO had returned to background levels prior to collecting biodegradation indicator parameters. The DO values collected during this event were 0.9 mg/L in MW-6, 6.25 mg/L in MW-1 and 7.16 mg/L in MW-3. The DO concentration in MW-6 is indicative of typical background DO concentrations in groundwater. The DO concentrations monitored in MW-1 and MW-3 during the Third Quarter 2003 are not typical and attributed to instrument malfunction or matrix interference. DO concentrations monitored in these same wells during the Fourth Quarter 2003 (MW-1 – 0.18 mg/L, MW-3 – 0.33 mg/L and MW-6 – 0.60 mg/L) are more typical of naturally occurring DO concentrations in groundwater. The Fourth Quarter 2003 DO values suggest that DO has returned to typical background concentrations and indicate that an anaerobic environment is present at the Site.

The bioremediation indicator parameters monitored during the Third Quarter 2003 groundwater monitoring event are shown on Table 4 and suggest that anaerobic bioremediation is occurring. Typically if concentrations of electron receptors nitrate, sulfate and carbon dioxide are depleted in wells with elevated BTEX concentrations, it is a strong indication that anaerobic bioremediation is occurring. Additionally, if areas with elevated BTEX have elevated ferrous iron and methane concentrations, it is an indication that ferric iron is potentially being reduced to ferrous iron and methanogenesis is occurring during bioremediation of BTEX compounds.

As shown on Table 4 the concentration of nitrate is high compared to background data (non-detectable in MW-6) in MW-3 (5.3 mg/L) which has elevated BTEX concentrations. However, in MW-1 which also has elevated BTEX concentrations, nitrate was not detected. Monitoring results for sulfate suggests the same type of trend, depleted sulfate concentration in MW-6 (background) compared to elevated sulfate concentrations in wells with elevated BTEX. Generally, bioremediation indicator parameter results for nitrate and sulfate appear inconclusive.

As shown on Table 4 concentrations of ferrous iron and methane are both elevated in wells with elevated concentrations of BTEX. As described above this is a strong indication that anaerobic biodegradation is occurring.

Results

The statistical comparison of pre and post ORC™ groundwater concentration data sets indicate that, generally, a significant concentration reduction occurred in target compounds after the use of ORC™ treatment was initiated. This suggests that the use of ORC™ supported and enhanced the naturally occurring biodegradation of dissolved hydrocarbons. Analysis of groundwater conditions after terminating ORC™ treatment and allowing DO to return to background concentrations indicate an anaerobic environment typically exists at the Site. Bioremediation indicator parameters monitored after DO concentrations were allowed to return to background concentrations suggest that anaerobic biodegradation is occurring at the Site. However, groundwater monitoring data collected during 2003 suggest that anaerobic biodegradation is occurring at a slower rate that the previously ORC™ supported aerobic biodegradation as shown by the increase in contaminant concentrations since the ORC™ socks have been removed from the treatment wells.

4) *Groundwater Sampling After ORC™ – Samples were collected two weeks after ORC™ socks were removed from the sampled wells. We wonder if the contaminant concentrations obtained may just be temporary. Therefore, groundwater monitoring will need to be continued after ORC™ remediation has ceased until it can be determined that contaminant concentrations will not rebound.*

As described above under Site Background the ORC™ socks were removed from the monitoring wells during December of 2002 and not replaced. Groundwater has been sampled post well purging during subsequent quarterly monitoring events. Figures 2, 3, 5, 6 and 7 display the analytical results graphically. The general trends apparent in these figures are in agreement with the statistical comparisons discussed under Technical Comment 3. These figures suggest that the detected concentrations for all wells where there was a significant decrease after installation of the ORC™ socks indicate a trend towards increasing concentrations after the ORC™ socks were removed in December 2002.

5) *Migration Control Required – The contaminant plume has migrated offsite. Propose means of containing the plume in the work plan requested below. Recommend considering reuse of the pump and treat system.*

As described under Technical Comment 1, groundwater impact is present off-site, but generally appears to be declining since groundwater monitoring began in 1991. Plate 4 suggests that the plume boundaries are stable as demonstrated by the general reduction of free-product (pink color) up to June of 1997 and the following lack of significant change in plume geometry between June of 1997 and September of 1999.

6) *Nonpurge Groundwater Sampling – Nonpurge groundwater sampling has been used since September 1999, the only time nonpurge and purge results were compared. The results were inconsistent. Also, the Regional Water Quality Control Board's "Utilization of Non-Purge Approach for Sampling of Monitoring Wells Impacted by Petroleum Hydrocarbons, BTEX, and MTBE" dated January 31, 1997 required the rate of purge and measurements of dissolved oxygen (DO), specific conductance, pH, and temperature. However, only DO was submitted. Thus, the use of nonpurge sampling needs to be reevaluated. In addition to the conditions listed, we will also require:*

a) Pre-and post-purge DO and turbidity measurements to determine if groundwater is flowing through the well. If groundwater is flowing through the well it may be appropriate to omit purging activities.

b) Purging rate. Purging rate should approximate natural groundwater flow rates and should not result in significant draw down in well.

c) Once DO and Turbidity measurements indicate that groundwater is flowing through the well screen, perform pre-and post-purge measurements of the following parameters: DO, pH, temperature, conductivity, and turbidity; and pre-and post purge sample analysis to verify consistency in chemical concentrations in the well. You must demonstrate that no statistical difference exists between purge and no purge chemical concentration data including MTBE, and that no significant difference is detected in the measured parameters.

Technical Comment Number 6 was addressed in the Second Quarter 2003 Groundwater Monitoring Report dated October 17, 2003 and will be summarized here.

Pre-and post-purge DO and Turbidity measurements were collected and statistically compared. Results suggested no statistical difference between pre and post purge values. During the First and Second Quarter 2003 Monitoring Events, the monitoring wells were purged using a disposable bailer. The sampling technician did not observe significant drawdown during or after the bailing was completed. Groundwater parameter data (including DO and Turbidity) and chemical concentration data collected prior to purging the wells were statistically compared to data collected after purging the wells using the standard purging procedures also described in the Second Quarter 2003 Quarterly Report. Based upon the available evidence, the post-purge results of the April and July 2003 groundwater monitoring events are equivalent to the historical and contemporaneous pre-purge analytical and groundwater parameter data. The complete description and associated tables and graphs are included in the Second Quarter 2003 Quarterly Report.

7) *Groundwater Analyses – In addition to the analyses already performed, please include tert Amyl Methyl Ether (TAME), Ethyl tert Butyl Ether (ETBE), Diisopropyl Ether (DIPE), tert Butyl Alchohol*

(TBA), Ethylene Dibromide (EDB), and Ethylene Dichloride (EDC). After the initial round of sampling, sample for any of these contaminants found in subsequent quarters.

Sampling for the analytes requested in Technical Comment 7 was first performed during the Fourth Quarter 2002 Groundwater Monitoring Event. The results are described in the associated report. None of these analytes were detected in any of the groundwater samples collected from MW-1, MW-3, MW-5 and MW-6 except for EDC. EDC was detected in the samples collected from MW-1 at a concentration of 370 ug/l and MW-5 at a concentration of 220 ug/l. As a result of this detection of EDC an analysis was performed for EDC in the groundwater sample from MW-1 during the First and Second Quarter 2003 events. EDC was not detected in MW-1 during the First Quarter 2003 event at a detection limit of 120 ug/l and was detected in MW-1 during the Second Quarter 2003 at a concentration of 400 ug/l. As described in the quarterly reports, MW-5 could not be sampled during the First and Second Quarter 2003 due to obstruction by stuck ORC™ socks. The ORC™ socks were successfully removed prior to the Third Quarter 2003 Sampling Event. EDC was detected in MW-5 during the Third Quarter 2003 event at a concentration of 610 ug/l. EDC was detected in MW-1 during the Third Quarter 2003 event at the same concentration as the reporting limit, 500 ug/l. Quarterly sampling, analysis and reporting of EDC in these wells is on-going.

8) *MW-6 – Missing the well boring log and boring samples. Submit.*

The well boring log for MW-6 and any associated soil sample information was not located after a thorough file search. The July 27, 1999 Groundwater Investigation report by Harding Lawson Associates (now MACTEC) for this Site describes the installation of Well MW-6. The installation description makes no reference to an installation or boring log or to the collection and analysis of soil samples.

The Groundwater Investigation report indicates the well was installed in April of 1996 using 8 inch diameter hollow stem augers and was completed using a 2-inch-diameter Schedule 40 flush-threaded PVC pipe. The well was constructed to a depth of 35.5 feet bgs with 10 feet of 0.02-inch slotted screen. The annulus was filled with No. 2/12 sand from the bottom of the boring to a depth approximately 2 feet above the top of the screen interval followed by 2 feet of bentonite pellets hydrated with water. The remainder of the annular space was filled with cement. The well was developed using a surge block/bailer technique and pumped until the water was visually free of turbidity. Pumping was continued until at least five well volumes of groundwater were removed.

9) *All technical reports must contain a statement of professional certification with the appropriate professional signatures and seals.*

Upon receipt of the September 27, 2002 letter MACTEC began stamping the quarterly reports with the appropriate professional's signature after review.

10) *Chain of Custody – Sample stations were described as a letter and numbers. Please provide a key.*

Please refer to Appendix B (first page) of each quarterly report for the associated sample key.

11) *Legitimacy Statement – All technical reports shall be accompanied by a letter signed by an officer or legally authorized representative of the responsible party that states, at a minimum: "I declare, under penalty of perjury, that the information and/or recommendations contained in the attached proposal or report is true and correct to the best of my knowledge."*

Upon receipt of the September 27, 2002 letter BPS services was advised to began issuing a Legitimacy Statement with each set of quarterly reports submitted to the ACHCS.

12) *Historical Groundwater Monitoring Results – Please also tabulate prior to 8/1/91.*

Thorough review of historical documents revealed very little historical groundwater monitoring results prior to August 1991. Wells MW-1, MW-2 and MW-3 were installed during June 24 and 25, 1987 to evaluate the distribution of petroleum hydrocarbons in the soil and groundwater and determine the direction of groundwater movement. Upon installation of the wells FPH was reportedly found in MW-1. However, the TPH-g concentration value from when the well was purged and sampled on June 25, 1987, was lower than what is typical for a well with FPH present. The results are displayed on Table 5.

MW-1A and MW-4 were installed during January of 1988. FPH was reportedly discovered in both of these wells upon installation. Review of historical documents revealed no reference to groundwater sampling or analytical data collected from these wells on their installation date. The report *Off-Site Hydrogeologic Investigation* dated November 28, 1988, indicated these wells were purged and sampled sometime around September 12, 1988. TPH-g concentration values from this sampling event were lower than what is typical for wells with FPH present.

MW-5 was installed on August 17, 1988 and sampled. A second round of samples were collected from this well on September 12, 1988. Analytical results from these sampling events are shown on Table 5. A report entitled Additional Investigations written by Harding Lawson Associates (now MACTEC) dated October 4, 1989, describes groundwater sampling from wells MW-1, MW-1A, MW-2, MW-3, MW-4 and MW-5 that occurred on July 13, 1989. The wells were sampled as part of an investigation to determine if potential off-Site sources of gasoline contamination have contributed to contaminant impact found in BPS wells, as well as help finalize a soil and groundwater remediation plan for the Site. The analytical results from the samples collected on that date are shown on Table 5.

13) *Historical Groundwater Elevation Data – Please also tabulate data prior to 3/6/96.*

Thorough review of historical documents revealed very little historical groundwater elevation data prior to March of 1996. The only groundwater elevation data found was from September of 1988 and July of 1989. September 9, 1988 groundwater elevation and FPH thickness data were collected from all on and off Site wells as part of the Off-Site Hydrogeologic Investigation and described in the report of the same name dated November 28, 1988. These results are summarized on Table 6. Groundwater elevation and FPH thickness monitoring was also performed on July 12, 1989 as part of the investigation for off-Site sources of gasoline contamination and described in the Additional Investigations report dated October 4, 1989. The historical depth to water and groundwater elevation data are tabulated on Table 6 and adjusted to account for the presence of FPH.

14) *Historical Monitoring Well Product Thickness Measurements – Please also tabulate measurements after 6/27/95.*

Thorough review of historical documents revealed very little historical product (FPH) thickness measurements prior to June of 1995. The only tabulated FPH monitoring data found was from September of 1988 and July of 1989, the same groundwater elevation monitoring events described under Technical Comment 13. However, reference to the presence of FPH in MW-1 during September 1987 is made in the Work Plan by Harding Lawson Associates (now MACTEC) dated May 25, 1988 and in the Off-Site Hydrogeologic Investigation report. Reference to the presence of FPH in MW-1A, MW-1 and MW-4 is also made in the Work Plan dated May 25, 1988 which is prior to the earliest tabulated FPH thickness record dated September 12, 1988 (Table 6).

On September 12, 1988 water level and FPH thickness data were collected from all on and off Site wells as part of the Off-Site Hydrogeologic Investigation and described in the report of the same name and dated November 28, 1988. FPH was present in all on-Site monitoring wells at adjusted thicknesses ranging from 0.37 to 1.76 feet and in off-Site well MW-5 at an adjusted thickness of 0.04 feet. FPH thickness was also measured during groundwater elevation monitoring performed on July 12, 1989 as part of the investigation for off-Site sources of gasoline contamination and described in the Additional Investigations report dated October 4, 1989. FPH was present in all on-Site monitoring wells at adjusted thicknesses ranging from 1.55 to 2.10 feet and in off-Site well MW-5 at an adjusted thickness of 0.03 feet. The historical FPH thickness data are tabulated on Table 5.

15) *Historical Gradient – Please show using a rose diagram and also include magnitude and direction.*

Plates 8 and 9 display Rose Diagrams constructed of groundwater monitoring data collected between June 1997 and July 2003 (quarterly groundwater elevation data was not collected prior to June 1997). Plate 8 shows groundwater gradient (magnitude) with respect to direction and Plate 9 shows groundwater flow direction with respect to frequency. The rose diagrams are oriented like a compass using the 360

degree location as due north from the approximate center of the Site. The concentric circles on Plate 8, each with successively larger radii, represent equivalent increases in groundwater gradient. The concentric circles on Plate 9, each with successively larger radii, represent increasing frequency.

Plate 8 suggests that between June 1997 and July 2003, the largest groundwater gradients (between 0.001 and 0.0025 foot per foot) occurred primarily in the northwest to north groundwater flow direction as represented by the 320 to 360 degree lines. Plate 9 suggests that the direction of groundwater flow during this time period was most frequently in the west to northwest direction as represented by the 270 to 290 degree lines.

The information presented on Plates 8 and 9 corresponds with the distribution of contaminant impact in the off Site wells. MW-5 is an off-Site well located northwest from the center of the Site in the direction the larger groundwater gradients are found and in the general direction of typical groundwater flow. MW-5 has been impacted with contaminants, presumably from the Site, since it began being monitored. MW-6 is an offsite well located southwest of the Site and remains un-impacted as of the date of this report.

16) *Cross Section Diagrams – Please draw and include monitoring wells, borings, and conduits.*

Two cross sections were developed for the Site using all available soil boring and well installation logs. The cross section locations are shown on Plate 1 and the cross sections are shown on Plates 10 and 11. As discussed under Technical Comment 2 and noted on Plates 10 and 11, there are no utility conduits at depths greater than 10 feet bgs and since groundwater is typically no higher than 20 feet bgs, utility conduits were not shown on the cross-sections as they are inconsequential. The cross sections show that the Site is primarily underlain by a layer of clayey sand bounded on the top and bottom by layers of sand and silty sand. The cross sections also show below grade features including the projected location of the basement of a building adjacent to the Site and the location of the former UST excavation.

RECOMMENDATIONS

MACTEC recommends continued quarterly monitoring utilizing the procedures outlined in the ACHCS September 27, 2002 letter. MACTEC recommends re-starting the use of ORC™ as in-situ enhancement to naturally occurring bioremediation (using new ORC™ materials). Based upon the results of the statistical comparison of pre and post purge groundwater data (presented in the Second Quarter 2003 Groundwater Monitoring Report), MACTEC recommends continuing pre-purge groundwater monitoring with ACHCS approval.

MACTEC recommends that Blue Print Services send a copy of this Work Plan to the following:

Mr. Don Hwang
Alameda County
Environmental Health Services
1131 Harbor Bay Parkway, Suite 250
Alameda, California, 94502-6577

While under contract to BPS, MACTEC will continue to provide quarterly groundwater monitoring and reporting as required by The County.

If you have any questions, please contact the undersigned at (415) 278-2118.

Sincerely,

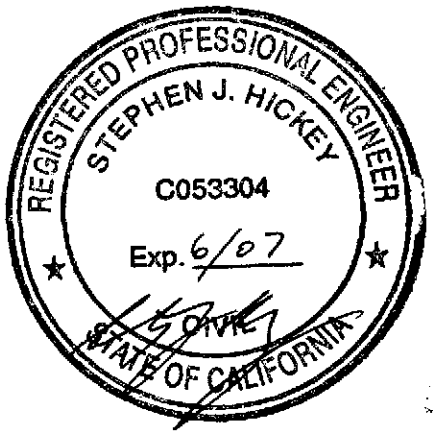
MACTEC ENGINEERING AND CONSULTING, INC.

David S. Nanstad
Project Engineer

Stephen Hickey
Senior Engineer

DSN SFOmain:/Cityblue/Workplan

4 copies submitted



Attachments:

Table 1 – SigmaStat Reports
Table 2 – Summary of Analytical Results
Table 3 – Statistical Analysis Results
Table 4 – Bioremediation-Indicator Parameters
Table 5 – Historical Groundwater Analytical Data – Prior to August 1991
Table 6 - Historical Groundwater Elevation Data and Product Thickness Measurements

Plate 1 – Site Plan (Including Cross Section Locations)
Plate 2 – TPH-g Analytical Results in MW-1, MW-3 and MW-5
Plate 3 – Benzene Analytical Results in MW-1, MW-3 and MW-5
Plate 4 – Benzene Concentrations in Groundwater 1991 to 1999
Plate 5 - Toluene Analytical Results in MW-1, MW-3 and MW-5
Plate 6 - Ethylbenzene Analytical Results in MW-1, MW-3 and MW-5
Plate 7 – Total Xylenes Analytical Results in MW-1, MW-3 and MW-5
Plate 8 – Rose Diagram - Groundwater Direction Gradient
Plate 9 – Rose Diagram - Groundwater Direction Frequency
Plate 10 – Cross Section A-A'
Plate 11– Cross Section B-B'

Appendix A – Mann-Whitney Statistical Analysis Description
Appendix B – T-Test Statistical Analysis Description
Appendix C – Certified Analytical Reports

References:

Harding Lawson Associates, Work Plan, City Blue Production Facility Site, May 25, 1988

Harding Lawson Associates, Additional Investigations, City Blue Production Facility Site, October 4, 1989

Harding Lawson Associates, Off-Site Hydrogeologic Investigation, City Blue Production Facility Site, November 28, 1988

Harding Lawson Associates, Groundwater Investigation, Blue Print Service Company, July 27, 1999

MACTEC Engineering & Consulting, Second Quarter 2003 Groundwater Monitoring Report, Blue Print Service Company, October 17, 2003

United States Air Force Guidelines for Successfully Supporting Intrinsic Remediation With an Example From Hill Air Force Base, Todd H. Wiedemeier, John T.Wilson, Ross N. Miller and Donald H. Kampbell

Department of the Air Force, Technical Protocol for Evaluating the *Natural Attenuation* of Chlorinated Ethenes in Groundwater, Todd H. Wiedemeier, John T.Wilson and Donald H. Kampbell, Jerry E. Hansen and Patrick Haas

Table 1. SigmaStat Reports
BPS Reprographic Services
1700 Jefferson Street, Oakland Californnia

MW-1

Benzene
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 10:06:00

Data source: Data 1 in Notebook

Normality Test: Failed (P = 0.004)

Group	N	Missing
benz-pre	10	0
benz-post	14	0

Group	Median	25%	75%
benz-pre	7600	6000	8600
benz-post	4900	4100	5400

T = 166.000 n(small)= 10 n(big)= 14 (P = 0.018)

The differences in the median values among the two groups are greater than would be expected by chance;
there is a statistically significant difference (P = 0.018)

Toluene
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:25:05

Data source: Data 1 in Notebook

Normality Test: Failed (P = <0.001)

Group	N	Missing
tol-pre	11	0
tol-post	13	0

Group	Median	25%	75%
tol-pre	4300	3175	5875
tol-post	5200	4775	5925

T = 114.000 n(small)= 11 n(big)= 13 (P = 0.183)

The differences in the median values among the two groups are not great enough to exclude the possibility that the difference is due to random sampling variability;
there is not a statistically significant difference (P = 0.183)

Ethylbenzene
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:28:47

Data source: Data 1 in Notebook

Normality Test: Passed (P = 0.324)

Equal Variance Test: Failed (P = 0.001)

Group	N	Missing
eb-pre	10	0
eb-post	13	0

Group	Median	25%	75%
eb-pre	1025	820	1400
eb-post	630	567.5	730

T = 169.500 n(small)= 10 n(big)= 13 (P = 0.002)

The differences in the median values among the two groups are greater than would be expected by chance;
there is a statistically significant difference (P = 0.002)

Checked _____

Approved _____

Table 1. SigmaStat Reports
BPS Reprographic Services
1700 Jefferson Street, Oakland Californnia

Total Xylenes
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:31:41

Data source: Data 1 in Notebook

Normality Test: Failed (P = 0.004)

Group	N	Missing
xyl-pre	10	0
xyl-post	13	0

Group	Median	25%	75%
xyl-pre	3900	2800	6600
xyl-post	3100	2675	3500

T = 143.000 n(small)= 10 n(big)= 13 (P = 0.163)

The differences in the median values among the two groups are not great enough to exclude the possibility that the difference is due to random sampling variability;
there is not a statistically significant difference (P = 0.163)

TPHg
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:35:26

Data source: Data 1 in Notebook

t-test — Wednesday, January 07, 2004, 09:35:26

Data source: Data 1 in Notebook

Group	N	Missing
tphg-pre	11	0
tphg-post	13	0

Group	Mean	Std Dev	SEM
tphg-pre	43.727	29.843	8.998
tphg-post	25.615	8.231	2.283

Difference 18.112

t = 2.103 with 22 degrees of freedom. (P = 0.047)

95 percent confidence interval for difference of means: 0.254 to 35.970

The difference in the mean values of the two groups is greater than would be expected by chance;
there is a statistically significant difference between the input groups (P = 0.047).

Power of performed test with alpha = 0.050: 0.412

The power of the performed test (0.412) is below the desired power of 0.800.
You should interpret the negative findings cautiously.

Checked _____

Passed _____

Table 1. SigmaStat Reports
BPS Reprographic Services
1700 Jefferson Street, Oakland Californnia

MW-3

Benzene
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:42:38

Data source: Data 2 in Notebook

Normality Test: Failed (P = <0.001)

Group	N	Missing
benz-pre	20	0
benz-post	14	0

Group	Median	25%	75%
benz-pre	200	85	895
benz-post	24	9	130

T = 150.500 n(small)= 14 n(big)= 20 (P = 0.001)

The differences in the median values among the two groups are greater than would be expected by chance; there is a statistically significant difference (P = 0.001)

Toluene
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:43:03

Data source: Data 2 in Notebook

Normality Test: Failed (P = <0.001)

Group	N	Missing
tol-pre	20	0
tol-post	13	0

Group	Median	25%	75%
tol-pre	825	300	4000
tol-post	33	6	187.5

T = 115.000 n(small)= 13 n(big)= 20 (P = <0.001)

The differences in the median values among the two groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

Ethylbenzene
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:44:25

Data source: Data 2 in Notebook

Normality Test: Failed (P = <0.001)

Group	N	Missing
eb-pre	20	0
eb-post	13	0

Group	Median	25%	75%
eb-pre	340	104	735
eb-post	25	1	38.5

T = 110.500 n(small)= 13 n(big)= 20 (P = <0.001)

The differences in the median values among the two groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

Checked _____

Approved _____

Table 1. SigmaStat Reports
BPS Reprographic Services
1700 Jefferson Street, Oakland Californnia

Total Xylenes
Mann-Whitney Rank Sum Test

Wednesday, January 07, 2004, 09:44:47

Data source: Data 2 in Notebook

Normality Test: Failed (P = <0.001)

Group	N	Missing
xyl-pre	22	0
xyl-post	13	0

Group	Median	25%	75%
xyl-pre	3750	1500	5900
xyl-post	150	14.75	222.5

T = 97.000 n(small)= 13 n(big)= 22 (P = <0.001)

The differences in the median values among the two groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

TPHg
Mann-Whitney Rank Sum Test

Wednesday, January 07, 2004, 09:45:21

Data source: Data 2 in Notebook

Normality Test: Failed (P = <0.001)

Group	N	Missing
tphg-pre	20	0
tphg-post	13	0

Group	Median	25%	75%
tphg-pre	18	7.6	43
tphg-post	3.1	0.847	4.675

T = 114.000 n(small)= 13 n(big)= 20 (P = <0.001)

The differences in the median values among the two groups are greater than would be expected by chance; there is a statistically significant difference (P = <0.001)

Checked DBW

Approved SJH

Table 1. SigmaStat Reports
BPS Reprographic Services
1700 Jefferson Street, Oakland Californnia

MW-5

Benzene
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:49:58

Data source: Data 5 in Notebook

t-test — Wednesday, January 07, 2004, 09:49:58

Data source: Data 5 in Notebook

Group	N	Missing
benz-pre	26	0
benz-post	13	0

Group	Mean	Std Dev	SEM
benz-pre	12288.46	5292.208	1037.887
benz-post	5400	5194.752	1440.765

Difference 6888.462

t = 3.855 with 37 degrees of freedom. (P = <0.001)

95 percent confidence interval for difference of means: 3267.647 to 10509.276

The difference in the mean values of the two groups is greater than would be expected by chance;
there is a statistically significant difference between the input groups (P = <0.001).

Power of performed test with alpha = 0.050: 0.966

Toluene
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:50:20

Data source: Data 5 in Notebook

Normality Test: Failed (P = 0.003)

Group	N	Missing
tol-pre	26	0
tol-post	13	0

Group	Median	25%	75%
tol-pre	2150	400	3800
tol-post	470	85.25	3100

T = 217.500 n(small)= 13 n(big)= 26 (P = 0.211)

The differences in the median values among the two groups are not great enough to exclude the possibility that the difference is due to random sampling variability;
there is not a statistically significant difference (P = 0.211)

Ethylbenzene
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:50:53

Data source: Data 5 in Notebook

Normality Test: Failed (P = <0.001)

Group	N	Missing
eb-pre	26	0
eb-post	13	0

Group	Median	25%	75%
eb-pre	1800	1400	2000
eb-post	460	34.75	1200

T = 118.000 n(small)= 13 n(big)= 26 (P = <0.001)

The differences in the median values among the two groups are greater than would be expected by chance;
there is a statistically significant difference (P = <0.001)

Checked _____

Approved SJH

Table 1. SigmaStat Reports
BPS Reprographic Services
1700 Jefferson Street, Oakland Californnia

Total Xylenes
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:51:48

Data source: Data 5 in Notebook

t-test — Wednesday, January 07, 2004, 09:51:48

Data source: Data 5 in Notebook

Group	N	Missing
xyl-pre	26	0
xyl-post	13	0

Group	Mean	Std Dev	SEM
xyl-pre	2433.846	1439.728	282.354
xyl-post	1040.538	1084.84	300.88

Difference 1393.308

t = 3.072 with 37 degrees of freedom. (P = 0.004)

95 percent confidence interval for difference of means: 474.472 to 2312.144

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = 0.004).

Power of performed test with alpha = 0.050: 0.822

TPHg
Mann-Whitney Rank Sum Test — Wednesday, January 07, 2004, 09:52:25

Data source: Data 5 in Notebook

t-test — Wednesday, January 07, 2004, 09:52:25

Data source: Data 5 in Notebook

Group	N	Missing
tphg-pre	26	0
tphg-post	13	0

Group	Mean	Std Dev	SEM
tphg-pre	45.45	24.097	4.726
tphg-post	13.585	11.436	3.172

Difference 31.865

t = 4.499 with 37 degrees of freedom. (P = <0.001)

95 percent confidence interval for difference of means: 17.514 to 46.216

The difference in the mean values of the two groups is greater than would be expected by chance; there is a statistically significant difference between the input groups (P = <0.001).

Power of performed test with alpha = 0.050: 0.995

Checked _____

Approved 534

Table 2. Summary of Analytical Results
BPS Reprographic Services Facility
1700 Jefferson Street
Oakland, California

Chemical	Well	Type	Mean	Standard Deviation	Maximum	Hits	Count	FOD	units
Benzene	MW-1	pre	6660	2850	9200	10	10	100%	ug/L
		post	4871	754	6200	14	14	100%	ug/L
		nosocks	6600	1819	7700	3	3	100%	ug/L
	MW-3	pre	964	1939	8500	20	20	100%	ug/L
		post	75	95	330	14	14	100%	ug/L
		nosocks	240	115	370	3	3	100%	ug/L
	MW-5	pre	12288	5292	29000	26	26	100%	ug/L
		post	5400	5195	14000	13	13	100%	ug/L
		nosocks	7100	6930	12000	2	2	100%	ug/L
Ethylbenzene	MW-1	pre	1072	349	1600	10	10	100%	ug/L
		post	649	97	870	13	13	100%	ug/L
		nosocks	885	261	1200	4	4	100%	ug/L
	MW-3	pre	749	1349	6000	20	20	100%	ug/L
		post	30	40	130	13	13	100%	ug/L
		nosocks	88	44	130	4	4	100%	ug/L
	MW-5	pre	2293	2848	16000	26	26	100%	ug/L
		post	638	599	1500	13	13	100%	ug/L
		nosocks	830	948	1500	2	2	100%	ug/L
Toluene	MW-1	pre	5482	3522	14000	11	11	100%	ug/L
		post	5485	1133	8400	13	13	100%	ug/L
		nosocks	7850	2821	11000	4	4	100%	ug/L
	MW-3	pre	2382	3172	13000	20	20	100%	ug/L
		post	107	153	470	13	13	100%	ug/L
		nosocks	298	127	460	4	4	100%	ug/L
	MW-5	pre	2769	3128	14000	26	26	100%	ug/L
		post	1904	2228	6900	12	13	92%	ug/L
		nosocks	1470	1881	2800	2	2	100%	ug/L
Total Xylenes	MW-1	Pre	4990	2944	11000	10	10	100%	ug/L
		post	3069	482	3900	13	13	100%	ug/L
		nosocks	4400	1742	6700	4	4	100%	ug/L
	MW-3	pre	16945	34942	106000	22	22	100%	ug/L
		post	154	175	580	13	13	100%	ug/L
		nosocks	290	70	390	4	4	100%	ug/L
	MW-5	pre	2434	1440	6500	26	26	100%	ug/L
		post	1041	1085	2600	12	13	92%	ug/L
		nosocks	1625	1945	3000	2	2	100%	ug/L
TPH-g	MW-1	pre	44	30	120	11	11	100%	mg/L
		post	26	8	39	13	13	100%	mg/L
		nosocks	41	22	61	4	4	100%	mg/L
	MW-3	pre	255	1023	4600	20	20	100%	mg/L
		post	25	83	300	13	13	100%	mg/L
		nosocks	8	4	12	4	4	100%	mg/L
	MW-5	pre	45	24	120	26	26	100%	mg/L
		post	14	11	34	13	13	100%	mg/L
		nosocks	25	26	43	2	2	100%	mg/L

Checked _____

Approved _____

Table 3. Statistical Analysis Results
BPS Reprographic Services
1700 Jefferson Street, Oakland California

Chemical	Well	Test	Significant	p	Notes
Benzene	MW-1	Mann-Whitney	YES	0.018	
	MW-3	Mann-Whitney	YES	0.001	
	MW-5	t-test	YES	<0.001	
Ethylbenzene	MW-1	Mann-Whitney	YES	0.002	
	MW-3	Mann-Whitney	YES	<0.001	
	MW-5	Mann-Whitney	YES	<0.001	
Toluene	MW-1	Mann-Whitney	no	0.183	
	MW-3	Mann-Whitney	YES	<0.001	
	MW-5	Mann-Whitney	no	0.211	
Total Xylenes	MW-1	Mann-Whitney	no	0.163	
	MW-3	Mann-Whitney	YES	<0.001	
	MW-5	t-test	YES	0.004	
TPH-g	MW-1	t-test	no	0.047	power of test low, negative results should be viewed with caution
	MW-3	Mann-Whitney	YES	<0.001	
	MW-5	t-test	YES	<0.001	

Checked

Approved

Table 4. Groundwater Monitoring Analytical Results - Bioremediation Indicator Parameters
BPS Reprographic Services Facility
1700 Jefferson Street
Oakland, California

	Total Alkalinity as CaCO3 (mg/l)	TPH-g (mg/l	Benzene (ug/l)	DO (mg/l)	Redox	Ferous Iron (mg/l)
MW-1	480	59	7600	6.25	-166.2	1.87
MW-3	240	10	150	7.16	-300	2.06
MW-6	540	ND	ND	0.9	49.9	0.5
	Carbon Dioxide (free) (mg/l)					
MW-1	72	59	7600	6.25	-166.2	1.87
MW-3	22	10	150	7.16	-300	2.06
MW-6	74	ND	ND	0.9	49.9	0.5
	Nitrate as N (mg/l)					
MW-1	ND <1.0	59	7600	6.25	-166.2	1.87
MW-3	5.3	10	150	7.16	-300	2.06
MW-6	ND <1.0	ND	ND	0.9	49.9	0.5
	Sulfate as SO4 (mg/l)					
MW-1	25	59	7600	6.25	-166.2	1.87
MW-3	65	10	150	7.16	-300	2.06
MW-6	6.4	ND	ND	0.9	49.9	0.5
	Methane (mg/l)					
MW-1	0.017	59	7600	6.25	-166.2	1.87
MW-3	0.088	10	150	7.16	-300	2.06
MW-6	ND<0.010	ND	ND	0.9	49.9	0.5

mg/l = milligrams per liter
ND = Not detected above the reporting limit following the less than sign

Checked _____

Approved _____

Table 5. Historical Groundwater Analytical Data – Prior to August 1991
BPS Reprographic Services Facility
1700 Jefferson Street
Oakland, California

TPHg (mg/L) (Volatile Hydrocarbons)		6/25/1987[1]	8/12/1988	9/12/1988	7/13/1989
	MW-1	190	NA	NA	190
	MW-1A	NA	40[a]	NA	220
	MW-2	8	NA	NA	NA
	MW-3	6.2	NA	NA	13.0
	MW-4	NA	12[a]	NA	93.0
	MW-5	NA	32[b]	31	14
	MW-6	NA	NA	NA	NA
Benzene (µg/L)					
	MW-1	18,000	NA	NA	1,000
	MW-1A	NA	4000[a]	NA	1200
	MW-2	1,500	NA	NA	NA
	MW-3	180	NA	NA	4
	MW-4	NA	200[a]	NA	460
	MW-5	NA	17000[b]	15,000.00	7
	MW-6	NA	NA	NA	NA
Toluene (µg/L)					
	MW-1	26,000	NA	NA	8,900
	MW-1A	NA	7000[a]	NA	9,210
	MW-2	350	NA	NA	NA
	MW-3	500	NA	NA	4
	MW-4	NA	ND(30000)[a]	NA	460
	MW-5	NA	13000[b]	11,000	7
	MW-6	NA	NA	NA	NA
Ethylbenzene (µg/L)					
	MW-1	NA	NA	NA	2,900
	MW-1A	NA	NA	NA	3,100
	MW-2	NA	NA	NA	NA
	MW-3	NA	NA	NA	210
	MW-4	NA	NA	NA	1,200
	MW-5	NA	1500[b]	1,300	210
	MW-6	NA	NA	NA	NA
Total Xylenes (µg/L)					
	MW-1	3,700	NA	NA	19,000
	MW-1A	NA	7000[a]	NA	24,000
	MW-2	87	NA	NA	NA
	MW-3	170	NA	NA	420
	MW-4	NA	2000[a]	NA	9,700
	MW-5	NA	5200[b]	4,400	500
	MW-6	NA	NA	NA	NA
MTBE (µg/L) (EPA Method 8020)					
	MW-1	NA	NA	NA	NA
	MW-1A	NA	NA	NA	NA
	MW-2	NA	NA	NA	NA
	MW-3	NA	NA	NA	NA
	MW-4	NA	NA	NA	NA
	MW-5	NA	NA	NA	NA
	MW-6	NA	NA	NA	NA

mg/l = milligrams per liter
µg/l = micrograms per liter
ND = Not detected above the reporting limit following the less than sign
MTBE = methyl t-butyl ether
a Sample Date Approximated - Not defined in historical reports, MW-1A and MW-4 installed January 1988
b Well MW-5 installed August 15, 1988
1 Well installation date for MW-1, MW-2 and MW-3

Checked _____

Approved _____

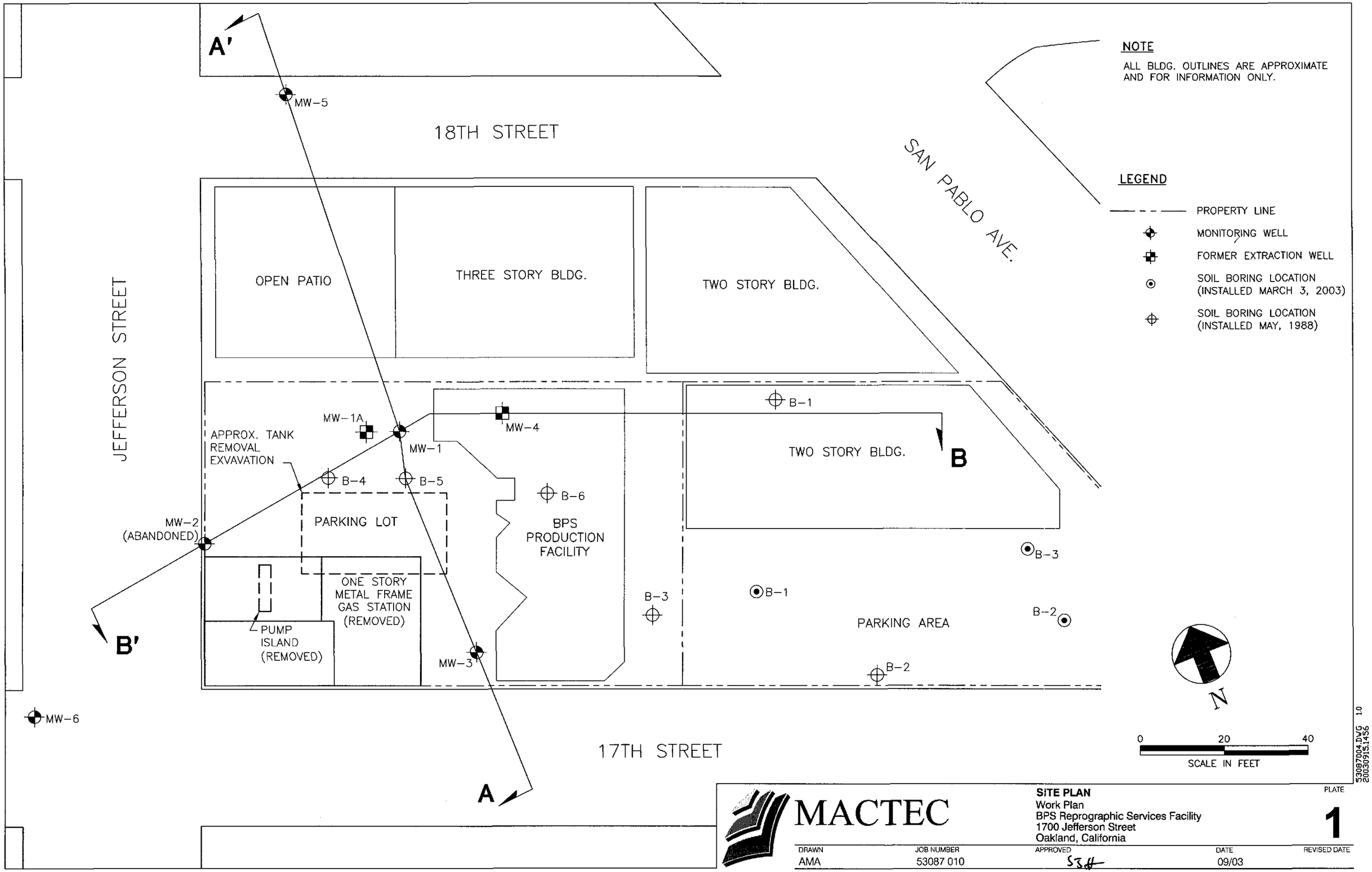
Table 6. Historical Groundwater Elevation Data and Product Thickness Measurements
BPS Reprographic Services Facility
1700 Jefferson Street
Oakland, California

	MW-1 TOC Elev. = 31.44			MW-1A TOC Elev. = 30.74			MW-3 TOC Elev. = 31.77			MW-4 TOC Elev. = 31.59			MW-5 TOC Elev. = 29.22		
Date Sampled	Water Level[1]	Adjusted Product Thickness	Water Elevation	Water Level[1]	Adjusted Product Thickness	Water Elevation	Water Level[1]	Adjusted Product Thickness	Water Elevation	Water Level[1]	Adjusted Product Thickness	Water Elevation	Water Level[1]	Adjusted Product Thickness	Water Elevation
9/12/1988	26.31	1.57	5.13	26.24	1.76	5.20	24.47	0.00	7.30	25.97	0.37	5.62	24.05	0.04	5.17
7/12/1989	26.00	1.80	5.44	26.00	1.55	4.74	24.44	0.00	7.33	27.35	2.10	4.24	24.91	0.03	4.31

TOC Elev. = top of casing elevation
NM = not monitored
P = free product
ND = no data collected
NA = not available
* This data not available due to ORC socks stuck in well
1 Water level adjusted due to presence of seperate-phase hydrocarbon

Checked _____

Approved _____



MACTEC

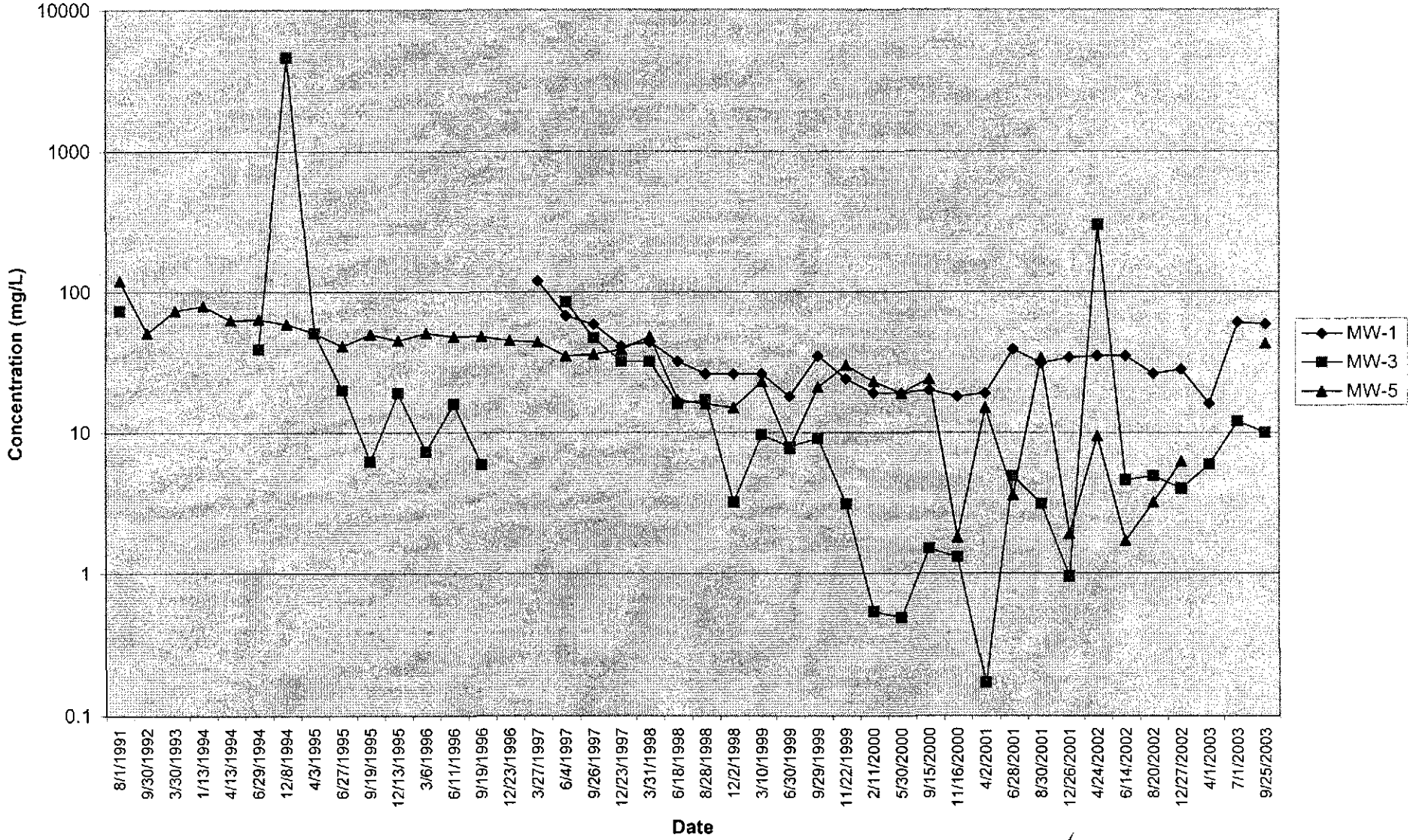
SITE PLAN
Work Plan
BPS Reprographic Services Facility
1700 Jefferson Street
Oakland, California

PLATE **1**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
AMA	53087 010	SSH	09/03	

53087004.DWG 1.0
20030915.1456

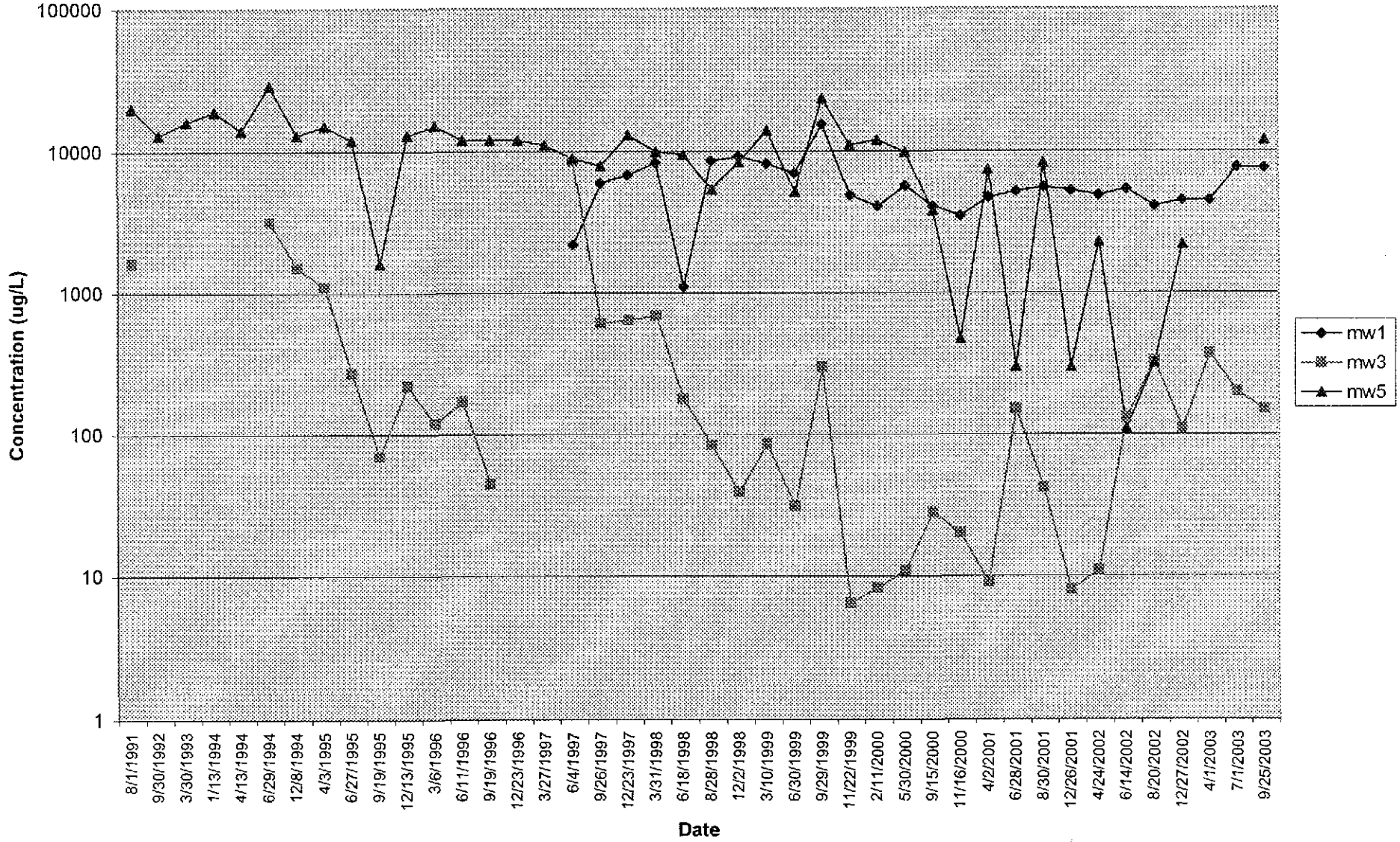
Plate 2. TPH-g Analytical Results - MW-1, MW-3 and MW-5
BPS Reprographic Services
1700 Jefferson Street
Oakland, CA



Checked _____

Approved _____

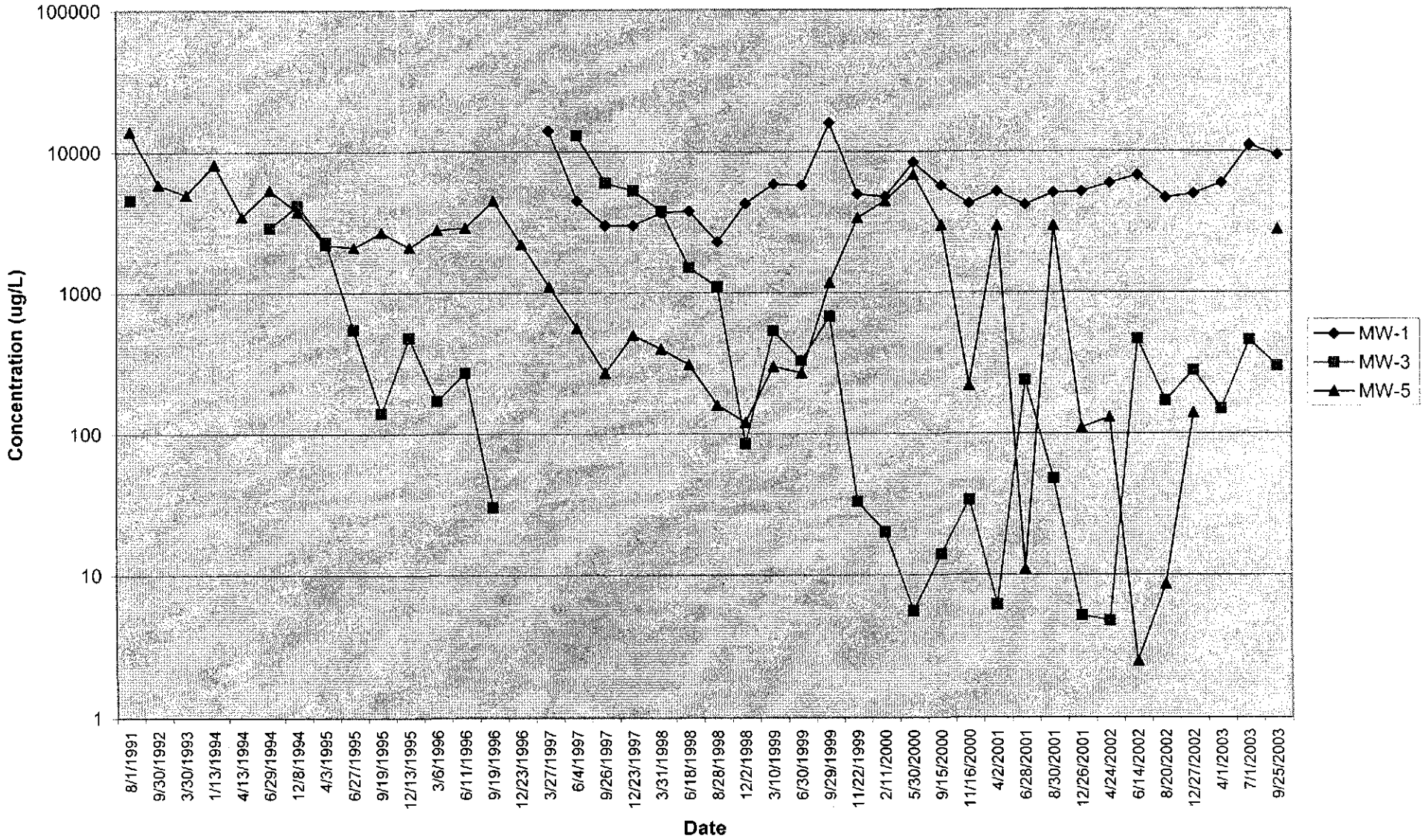
Plate 3. Benzene Analytical Results - MW-1, MW-3 and MW-5
BPS Reprographic Services
1700 Jefferson Street
Oakland, Ca



Checked

Approved

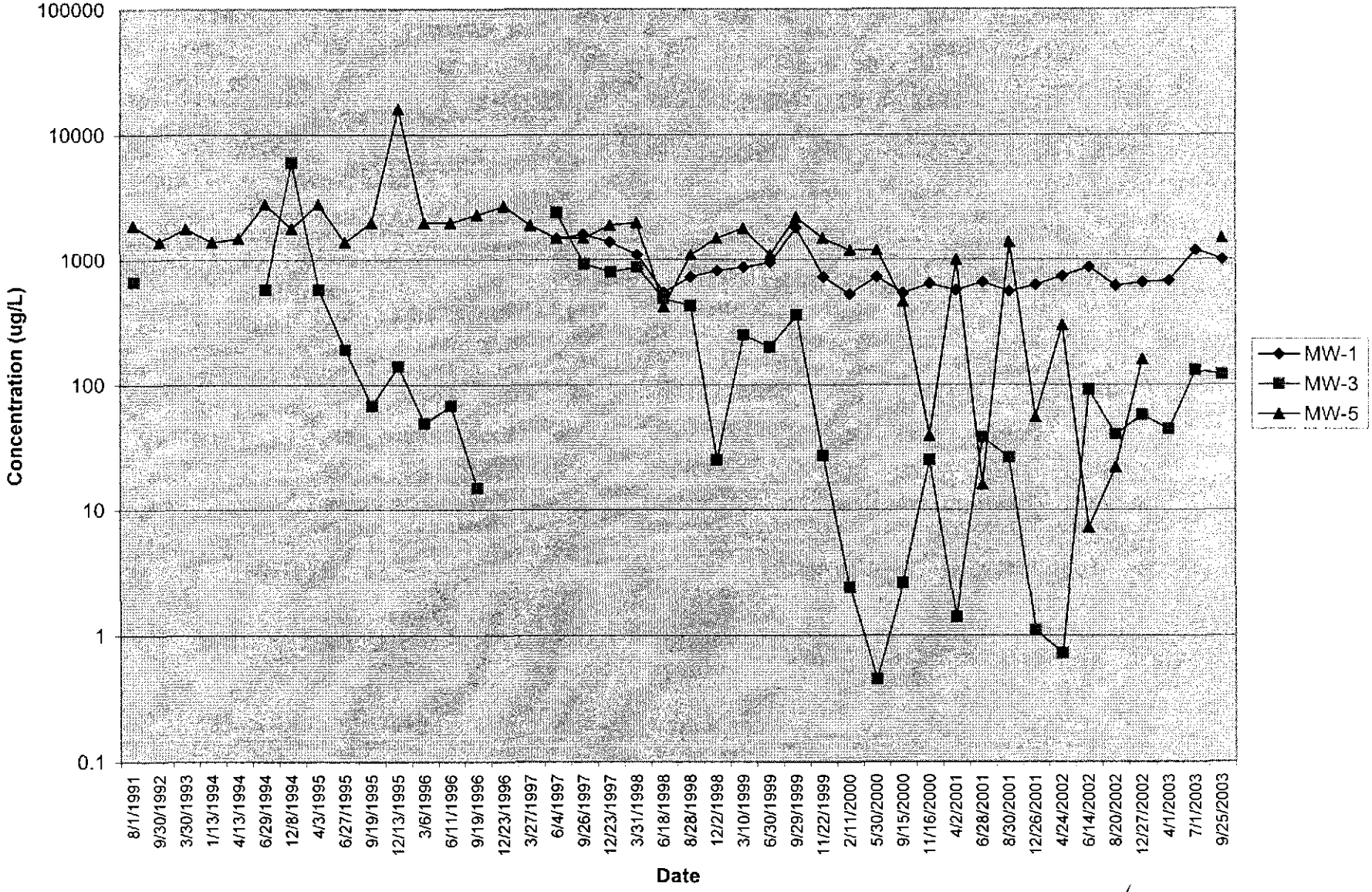
Plate 5. Toluene Analytical Results - MW-1, MW-3 and MW-5
BPS Reprographic Services
1700 Jefferson Street
Oakland, CA



Checked DBV

Approved SJH

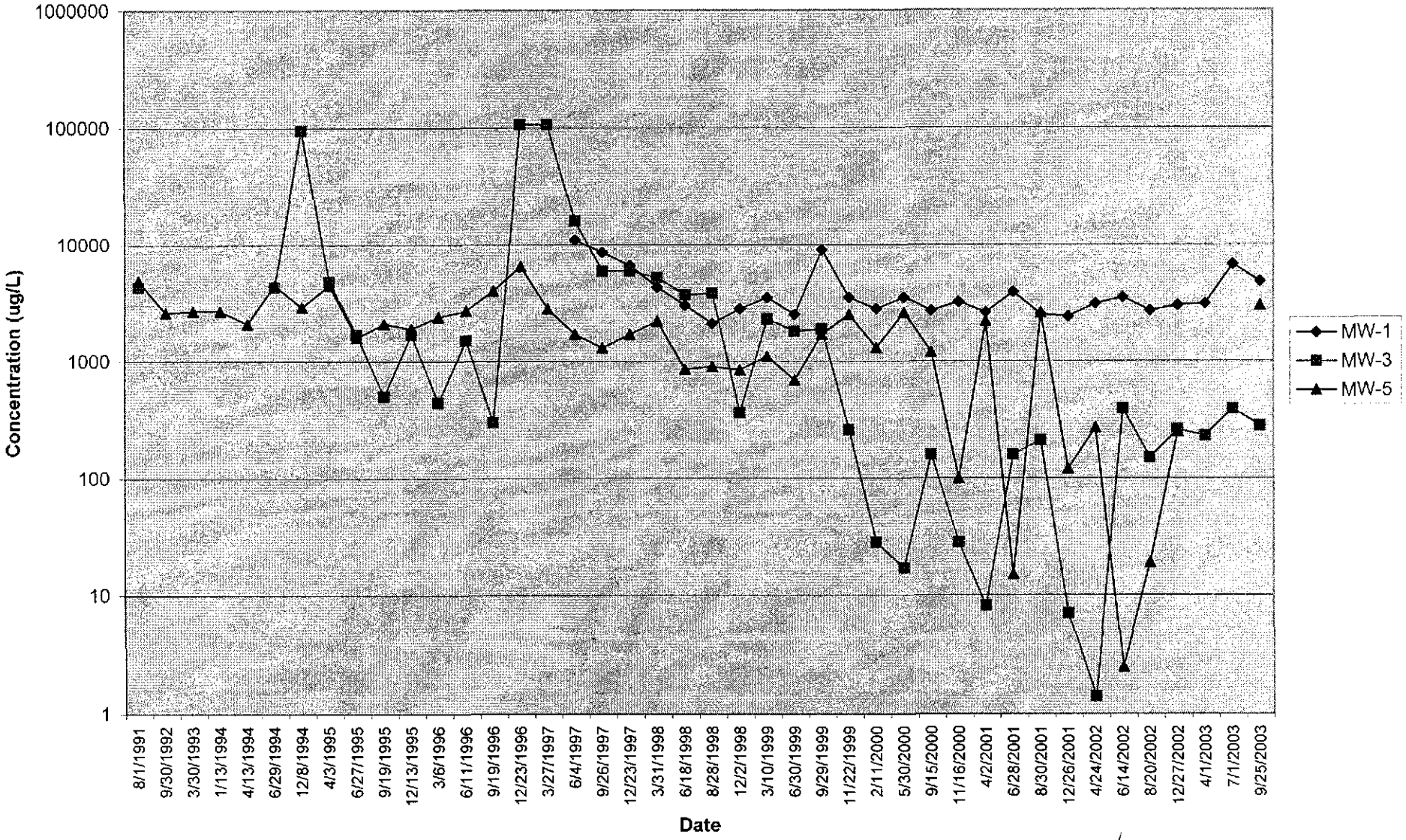
Plate 6. Ethylbenzene Analytical Results - MW-1, MW-3 and MW-5
BPS Reprographic Services
1700 Jefferson Street
Oakland, CA



Checked _____

Approved _____

Plate 7. Total Xylenes Analytical Results - MW-1, MW-3 and MW-5
BPS Reprographic Services
1700 Jefferson Street
Oakland, CA



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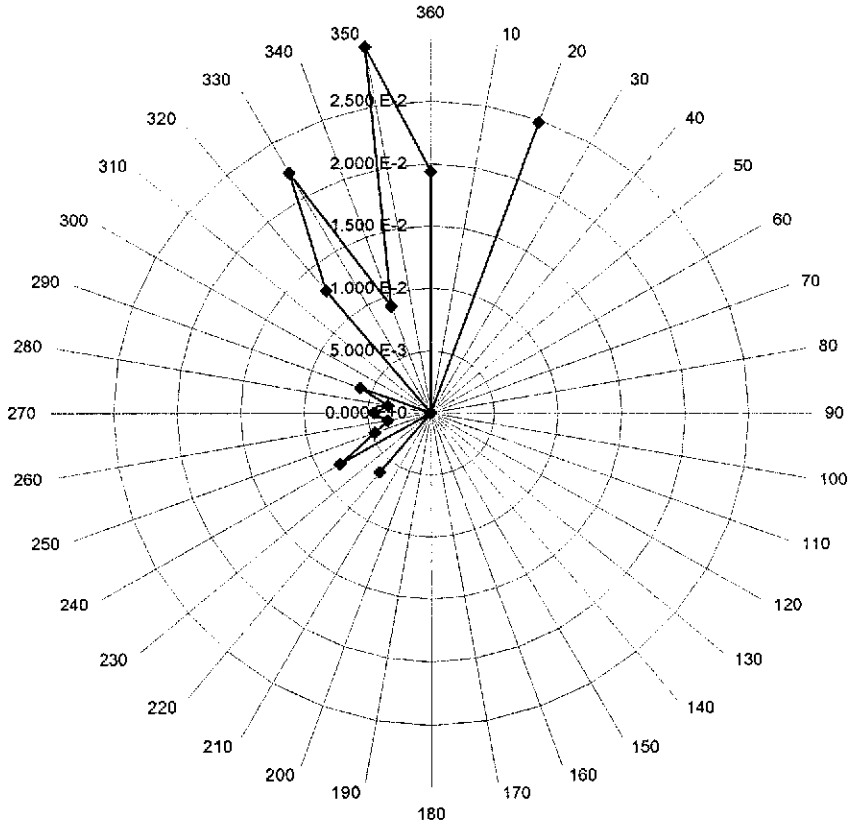
Approved _____

BPS Services
Water Direction Gradient
June 1997 through July 2003



MACTEC

Engineering and Environmental Services

Rose Diagram
Groundwater Direction Gradient
BPS Services
Oakland, California

PLATE
8

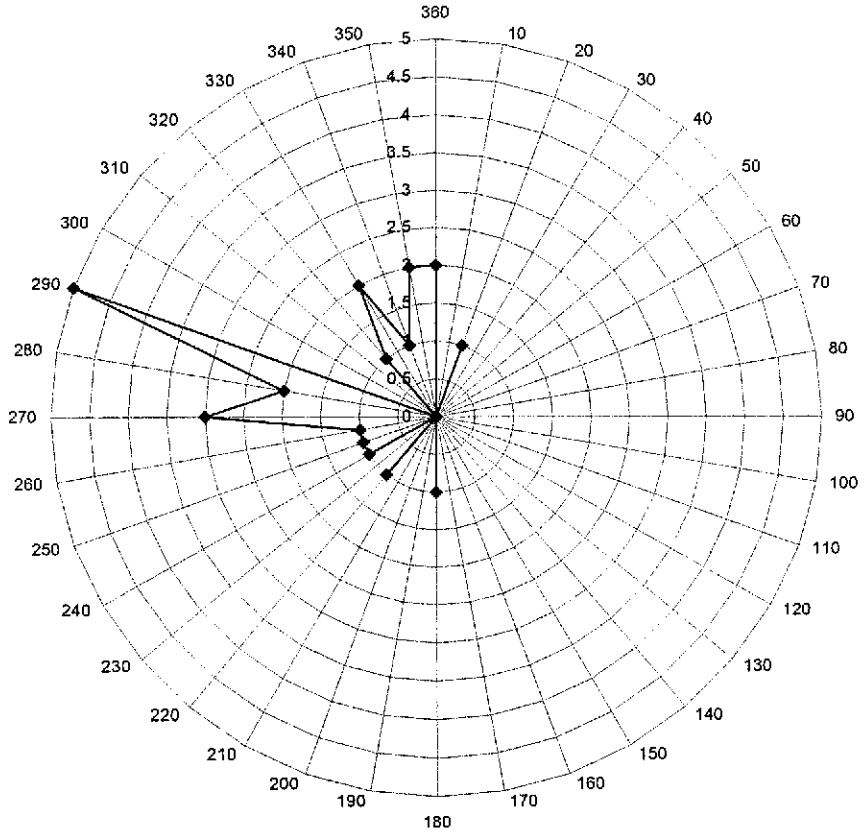
DRAWN BY	JOB NUMBER	DATE
MBP	53087 010	11/03

Checked

Approved

U:\CityBlue\workplan\Workplan Final\BPSGW_RoseDiagram

BPS Services
Water Direction Frequency
June 1997 through July 2003



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Engineering and Environmental Services

Rose Diagram
Groundwater Direction Frequency
BPS Services
Oakland, California

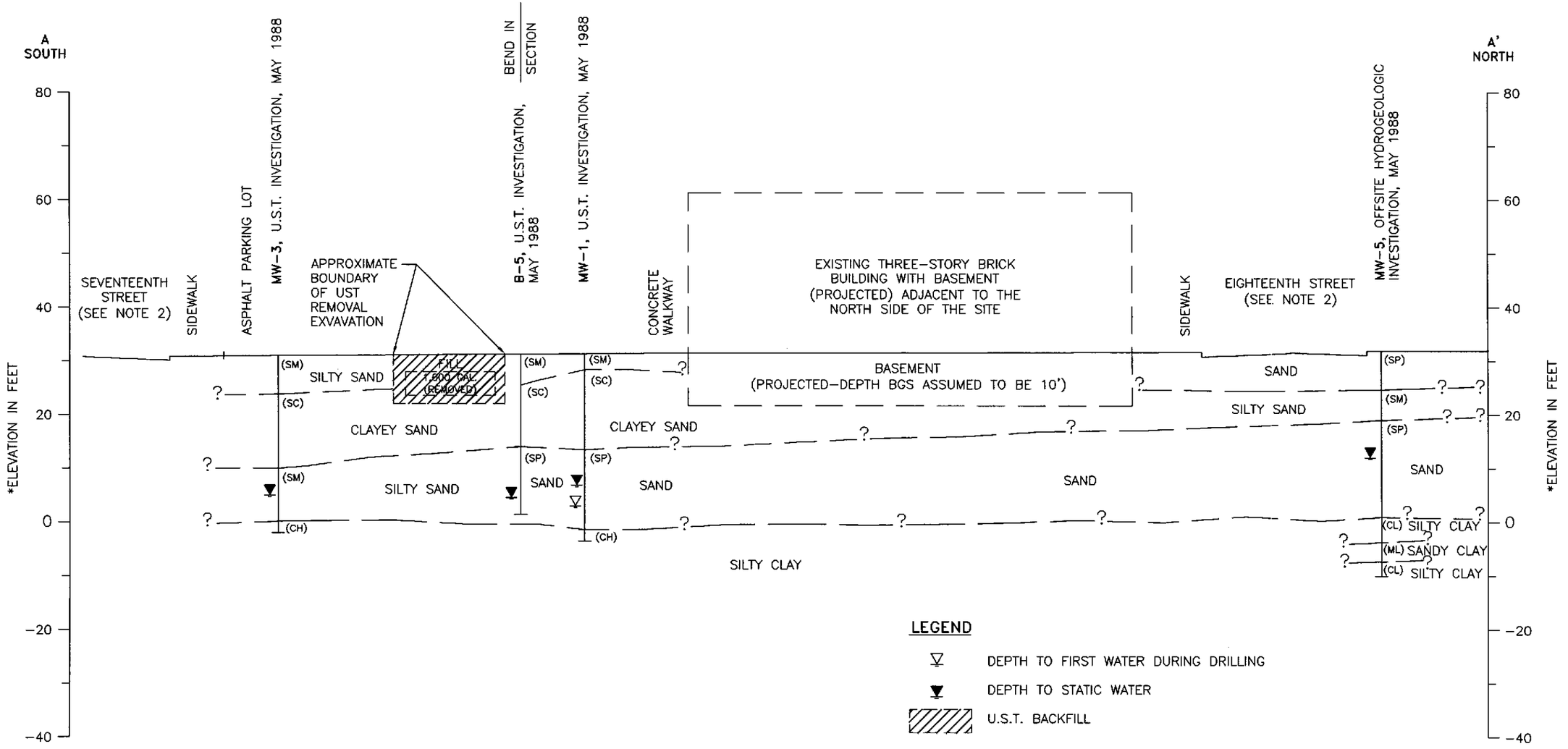
PLATE
9

DRAWN BY	JOB NUMBER	DATE
MBP	53087 010	11/03

Checked

Approved

U:\CityBlue\workplan\Workplan Final\BPSGW_RoseDiagram



NOTES

1. SEE PLATE 1 FOR CROSS SECTION LOCATION.
2. OAKLAND PUBLIC WORKS DEPARTMENT INDICATED THERE ARE NO UTILITIES IN SEVENTEENTH OR EIGHTEENTH STREETS 20 FEET BGS OR DEEPER AND THAT UTILITIES DEEPER THAN 10 FEET BGS ARE UNLIKELY. GROUNDWATER IS TYPICALLY NOT HIGHER THAN 21.07 BGS (MW-5, TABLE 2).

LEGEND

▽	DEPTH TO FIRST WATER DURING DRILLING
▼	DEPTH TO STATIC WATER
▨	U.S.T. BACKFILL
SM	SILTY SAND
SC	CLAYEY SAND
—?—	INTERPRETED SOIL STRATIGRAPHIC BOUNDARY
*	ELEVATIONS ARE RELATIVE TO CITY OF OAKLAND DATUM.
U.S.T.	UNDERGROUND STORAGE TANK
B.G.S.	BELOW GROUND SURFACE

0 20 40
SCALE IN FEET

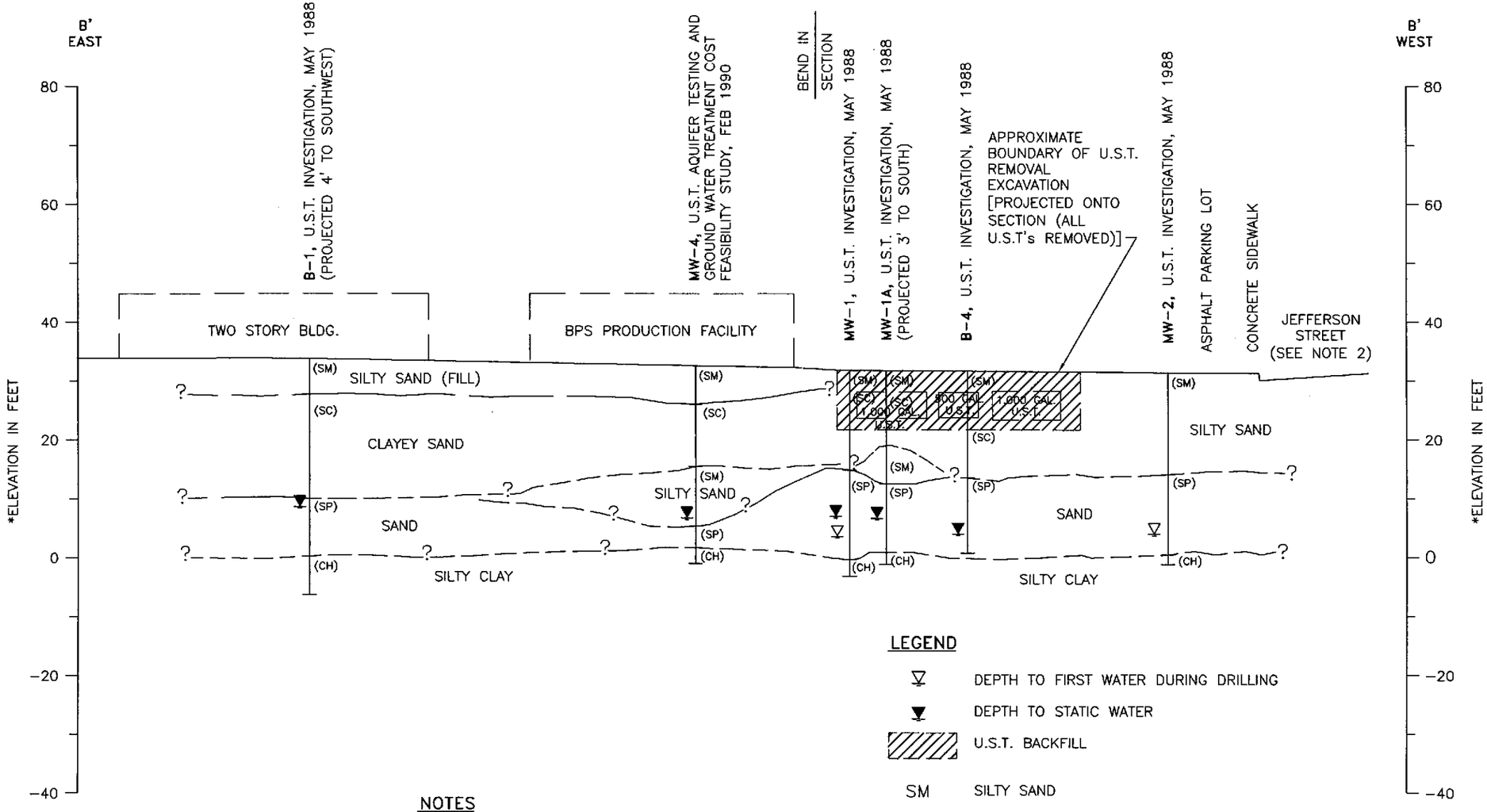
MACTEC

GENERALIZED GEOLOGIC CROSS SECTION A-A'
Work Plan
BPS Reprographic Services Facility
1700 Jefferson Street
Oakland, California

PLATE **10**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
AMA	53087 010	STH	09/03	

53087005.DWG 1.0
20040324.1333



NOTES

1. SEE PLATE 1 FOR CROSS SECTION LOCATION.
2. OAKLAND PUBLIC WORKS DEPARTMENT INDICATED THERE ARE NO UTILITIES IN JEFFERSON STREET 20 FEET BGS OR DEEPER AND THAT UTILITIES DEEPER THAN 10 FEET BGS ARE UNLIKELY. GROUNDWATER IS TYPICALLY NOT HIGHER THAN 21.07 BGS (MW-5, TABLE 2).

LEGEND

▽	DEPTH TO FIRST WATER DURING DRILLING
▼	DEPTH TO STATIC WATER
▨	U.S.T. BACKFILL
SM	SILTY SAND
SC	CLAYEY SAND
?—	INTERPRETED SOIL STRATIGRAPHIC BOUNDARY
*	ELEVATIONS ARE RELATIVE TO CITY OF OAKLAND DATUM.
U.S.T.	UNDERGROUND STORAGE TANK
B.G.S.	BELOW GROUND SURFACE

0 20 40
SCALE IN FEET

MACTEC

GENERALIZED GEOLOGIC CROSS SECTION B-B'
Work Plan
BPS Reprographic Services Facility
1700 Jefferson Street
Oakland, California

PLATE **11**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
AMA	53087 010	SSH	09/03	

53087006.DWG 1.0
20040324.1332

APPENDIX A

MANN-WHITNEY STATISTICAL ANALYSIS DESCRIPTION

Mann - Whitney test

This test is a non-parametric alternative to the two-sample Student *t*-test. It also goes by the names Wilcoxon test and the *U*-test. The Mann-Whitney test is performed by combining the two data sets we want to compare, sort them into ascending order, and assign each point a rank: smallest value is given rank = 1; the largest observation is ranked $n_1 + n_2$. Should some of the observations be identical, one assigns the average rank to all these values. E.g., if the 7th and 8th sorted values are identical, we assign to each the rank 7.5. The idea here is that if the samples consist of random drawings from the same population one would expect the ranks for both samples to be scattered more-or-less uniformly through the sequence.

After arranging the data, we add up the ranks for each data set into *rank sums* which we denote W_1 and W_2. The sum of $W_1 + W_2$ must obviously equal the sum of the first $(n_1 + n_2)$ integers which is

$$\frac{1}{2}(n_1 + n_2)(n_1 + n_2 + 1) \tag{1}$$

Many early rank sum tests were based on W_1 or W_2 but now it is customary to use the statistic *U*defined as

$$U_1 = n_1 n_2 + \frac{1}{2} n_1 (n_1 + 1) - W_1 \tag{1}$$

or

$$U_2 = n_1 n_2 + \frac{1}{2} n_2 (n_2 + 1) - W_2 \tag{3}$$

or simply *U*, the smallest of U_1 and U_2. This statistic takes on values from 0 to $n_1 \cdot n_2$ and its sampling distribution is symmetrical about $n_1 n_2/2$. The test, then, consists of comparing the calculated *U* statistic to a critical U_α value given the sample sizes and desired level of significance α.

Taken from:

http://www.higp.hawaii.edu/~cecily/courses/gg313/DA_book/node60.html

APPENDIX B

T-TEST STATISTICAL ANALYSIS DESCRIPTION

t-Test

Student" (real name: W. S. Gossett [1876-1937]) developed statistical methods to solve problems stemming from his employment in a brewery. Student's *t*-test deals with the problems associated with inference based on "small" samples: the calculated mean (X_{avg}) and standard deviation (σ) may by chance deviate from the "real" mean and standard deviation (i.e., what you'd measure if you had many more data items: a "large" sample).

$$t = \frac{\left| \overline{x}_1 - \overline{x}_2 \right|}{\sqrt{\frac{v_1}{n_1} + \frac{v_2}{n_2}}} \qquad df = (n_1 + n_2) - 2$$

Using df and the value calculated for t, the t-test statistic is looked up in a standard table (for Example Gilbert, table A2), at a given confidence level. The 95th confidence level was used in the values reported in the text.

Gilbert, R.O., 1987. *Statistical Methods for Environmental Pollution Monitoring.* Van Nostrand Reinhold. ISBN 0-442-23050-8.

APPENDIX C

CERTIFIED ANALYTICAL REPORTS

Table B1. Sample Location/Sample Description Cross-Reference
BPS Reprographic Services Facility
1700 Jefferson Street
Oakland, California

Well/Sample Number	Client Sample ID
MW-1	3530871
MW-3	3530872
MW-5	3530873
MW-6	3530874
Field Blank	3530875

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Sequoia Analytical

1455 McDowell Blvd, North Ste D
Petaluma, CA 94954
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FAX (707) 792-0342
www.sequoialabs.com

9 October, 2003

David Nanstad
Harding ESE - Novato
5341 Old Redwood Highway, Suite 300
Petaluma, CA 94954

RE: General Commercial
Work Order: P310037

Enclosed are the results of analyses for samples received by the laboratory on 09/25/03 08:30. If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Stacy P. Hoch

Stacy P. Hoch
Dept Manager - Client Services

CA ELAP Certificate #2374

Checked _____

Approved _____

Sequoia Analytical

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

ANALYTICAL REPORT FOR SAMPLES

Sample ID	Laboratory ID	Matrix	Date Sampled	Date Received
03530874	P310037-01	Water	09/24/03 12:00	09/25/03 08:30
03530872	P310037-02	Water	09/24/03 16:00	09/25/03 08:30
03530871	P310037-03	Water	09/24/03 17:05	09/25/03 08:30
03530873	P310037-04	Water	09/24/03 17:40	09/25/03 08:30
03530875	P310037-05	Water	09/24/03 18:20	09/25/03 08:30

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Total Petroleum Hydrocarbons as Gasoline and BTEX by EPA 8015B/8021B

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
03530874 (P310037-01) Water Sampled: 09/24/03 12:00 Received: 09/25/03 08:30									
Gasoline Range Organics	ND	50	ug/l	1	3100097	10/06/03	10/06/03	EPA 8015B/8021B	
Benzene	ND	0.50	"	"	"	"	"	"	
Toluene	ND	0.50	"	"	"	"	"	"	
Ethylbenzene	ND	0.50	"	"	"	"	"	"	
Xylenes (total)	ND	0.50	"	"	"	"	"	"	
Methyl tert-butyl ether	ND	2.5	"	"	"	"	"	"	
Surrogate: a,a,a-Trifluorotoluene		*101 %*		*65-135*	"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*90 %*		*65-135*	"	"	"	"	
03530872 (P310037-02) Water Sampled: 09/24/03 16:00 Received: 09/25/03 08:30									
Gasoline Range Organics	**10000**	1000	ug/l	20	3100097	10/06/03	10/06/03	EPA 8015B/8021B	
Benzene	**150**	10	"	"	"	"	"	"	
Toluene	**300**	10	"	"	"	"	"	"	
Ethylbenzene	**120**	10	"	"	"	"	"	"	
Xylenes (total)	**280**	10	"	"	"	"	"	"	
Methyl tert-butyl ether	**52**	50	"	"	"	"	"	"	QR-04
Surrogate: a,a,a-Trifluorotoluene		*102 %*		*65-135*	"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*91 %*		*65-135*	"	"	"	"	
03530871 (P310037-03) Water Sampled: 09/24/03 17:05 Received: 09/25/03 08:30									
Gasoline Range Organics	**59000**	25000	ug/l	500	3100097	10/06/03	10/06/03	EPA 8015B/8021B	
Benzene	**7600**	250	"	"	"	"	"	"	
Toluene	**9400**	250	"	"	"	"	"	"	
Ethylbenzene	**1000**	250	"	"	"	"	"	"	
Xylenes (total)	**4800**	250	"	"	"	"	"	"	
Methyl tert-butyl ether	ND	1200	"	"	"	"	"	"	
Surrogate: a,a,a-Trifluorotoluene		*105 %*		*65-135*	"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*92 %*		*65-135*	"	"	"	"	

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Total Petroleum Hydrocarbons as Gasoline and BTEX by EPA 8015B/8021B

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
03530873 (P310037-04) Water Sampled: 09/24/03 17:40 Received: 09/25/03 08:30									
Gasoline Range Organics	**43000**	25000	ug/l	500	3100097	10/06/03	10/06/03	EPA 8015B/8021B	
Benzene	**12000**	250	"	"	"	"	"	"	
Toluene	**2800**	250	"	"	"	"	"	"	
Ethylbenzene	**1500**	250	"	"	"	"	"	"	
Xylenes (total)	**3000**	250	"	"	"	"	"	"	
Methyl tert-butyl ether	ND	1200	"	"	"	"	"	"	
Surrogate: a,a,a-Trifluorotoluene		*102 %*	*65-135*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*99 %*	*65-135*		"	"	"	"	
03530875 (P310037-05) Water Sampled: 09/24/03 18:20 Received: 09/25/03 08:30									
Gasoline Range Organics	ND	50	ug/l	1	3100097	10/06/03	10/06/03	EPA 8015B/8021B	
Benzene	ND	0.50	"	"	"	"	"	"	
Toluene	ND	0.50	"	"	"	"	"	"	
Ethylbenzene	ND	0.50	"	"	"	"	"	"	
Xylenes (total)	ND	0.50	"	"	"	"	"	"	
Methyl tert-butyl ether	ND	2.5	"	"	"	"	"	"	
Surrogate: a,a,a-Trifluorotoluene		*105 %*	*65-135*		"	"	"	"	
Surrogate: 4-Bromofluorobenzene		*91 %*	*65-135*		"	"	"	"	

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Volatile Organic Compounds by EPA Method 8260B

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
03530872 (P310037-02) Water Sampled: 09/24/03 16:00 Received: 09/25/03 08:30									
Methyl tert-butyl ether	ND	2.5	ug/l	5	3100167	10/08/03	10/08/03	EPA 8260B	
Surrogate: Dibromofluoromethane		*118 %*		*84-122*		"	"	"	"
03530871 (P310037-03) Water Sampled: 09/24/03 17:05 Received: 09/25/03 08:30									
1,2-Dichloroethane	**500**	500	ug/l	500	3100127	10/07/03	10/07/03	EPA 8260B	
Surrogate: Dibromofluoromethane		*119 %*		*84-122*		"	"	"	"
Surrogate: 1,2-Dichloroethane-d4		*113 %*		*74-135*		"	"	"	"
Surrogate: Toluene-d8		*102 %*		*84-119*		"	"	"	"
Surrogate: 4-Bromofluorobenzene		*104 %*		*86-119*		"	"	"	"
03530873 (P310037-04) Water Sampled: 09/24/03 17:40 Received: 09/25/03 08:30									
1,2-Dichloroethane	**610**	500	ug/l	500	3100127	10/07/03	10/07/03	EPA 8260B	
Surrogate: Dibromofluoromethane		*102 %*		*84-122*		"	"	"	"
Surrogate: 1,2-Dichloroethane-d4		*104 %*		*74-135*		"	"	"	"
Surrogate: Toluene-d8		*102 %*		*84-119*		"	"	"	"
Surrogate: 4-Bromofluorobenzene		*104 %*		*86-119*		"	"	"	"

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Conventional Chemistry Parameters by APHA/EPA Methods

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
03530874 (P310037-01) Water Sampled: 09/24/03 12:00 Received: 09/25/03 08:30									
Total Alkalinity as CaCO3	**540**	20	mg/l	1	3100191	10/08/03	10/08/03	EPA 310.1	
Carbonate Alkalinity as CaCO3	ND	20	"	"	"	"	"	"	
Bicarbonate Alkalinity as CaCO3	**540**	20	"	"	"	"	"	"	
Hydroxide Alkalinity as CaCO3	ND	20	"	"	"	"	"	"	
Carbon dioxide, free	**74**	5.0	"	"	3100240	"	10/09/03	SM 4500 CO2 D	
03530872 (P310037-02) Water Sampled: 09/24/03 16:00 Received: 09/25/03 08:30									
Total Alkalinity as CaCO3	**240**	20	mg/l	1	3100191	10/08/03	10/08/03	EPA 310.1	
Carbonate Alkalinity as CaCO3	ND	20	"	"	"	"	"	"	
Bicarbonate Alkalinity as CaCO3	**240**	20	"	"	"	"	"	"	
Hydroxide Alkalinity as CaCO3	ND	20	"	"	"	"	"	"	
Carbon dioxide, free	**22**	5.0	"	"	3100240	"	10/09/03	SM 4500 CO2 D	
03530871 (P310037-03) Water Sampled: 09/24/03 17:05 Received: 09/25/03 08:30									
Total Alkalinity as CaCO3	**480**	20	mg/l	1	3100191	10/08/03	10/08/03	EPA 310.1	
Carbonate Alkalinity as CaCO3	ND	20	"	"	"	"	"	"	
Bicarbonate Alkalinity as CaCO3	**480**	20	"	"	"	"	"	"	
Hydroxide Alkalinity as CaCO3	ND	20	"	"	"	"	"	"	
Carbon dioxide, free	**72**	5.0	"	"	3100240	"	10/09/03	SM 4500 CO2 D	

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Anions by EPA Method 300.0

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
03530874 (P310037-01) Water	**Sampled: 09/24/03 12:00**	**Received: 09/25/03 08:30**							
Nitrate as N	ND	1.0	mg/l	5	3100027	09/25/03	09/25/03	EPA 300.0	
Sulfate as SO4	**6.4**	5.0	"	"	"	"	"	"	
03530872 (P310037-02) Water	**Sampled: 09/24/03 16:00**	**Received: 09/25/03 08:30**							
Nitrate as N	**5.3**	1.0	mg/l	5	3100027	09/25/03	09/25/03	EPA 300.0	
Sulfate as SO4	**65**	5.0	"	"	"	"	"	"	
03530871 (P310037-03) Water	**Sampled: 09/24/03 17:05**	**Received: 09/25/03 08:30**							
Nitrate as N	ND	1.0	mg/l	5	3100027	09/25/03	09/25/03	EPA 300.0	
Sulfate as SO4	**25**	5.0	"	"	"	"	"	"	

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Dissolved Volatile Gases by Method RSK 175 Modified

Sequoia Analytical - Sacramento

Analyte	Result	Reporting Limit	Units	Dilution	Batch	Prepared	Analyzed	Method	Notes
03530874 (P310037-01) Water	**Sampled: 09/24/03 12:00**	**Received: 09/25/03 08:30**							
Methane	ND	0.010	mg/l	1	3100105	10/08/03	10/08/03	RSK 175	
03530872 (P310037-02) Water	**Sampled: 09/24/03 16:00**	**Received: 09/25/03 08:30**							
Methane	**0.088**	0.010	mg/l	1	3100105	10/08/03	10/08/03	RSK 175	
03530871 (P310037-03) Water	**Sampled: 09/24/03 17:05**	**Received: 09/25/03 08:30**							
Methane	**0.017**	0.010	mg/l	1	3100105	10/08/03	10/08/03	RSK 175	

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Sequoia Analytical

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Petaluma, CA 94954
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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Total Petroleum Hydrocarbons as Gasoline and BTEX by EPA 8015B/8021B - Quality Control

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3100097 - EPA 5030, waters										
Blank (3100097-BLK1)				Prepared & Analyzed: 10/06/03						
Gasoline Range Organics	ND	50	ug/l							
Benzene	ND	0.50	"							
Toluene	ND	0.50	"							
Ethylbenzene	ND	0.50	"							
Xylenes (total)	ND	0.50	"							
Methyl tert-butyl ether	ND	2.5	"							
Surrogate: a,a,a-Trifluorotoluene	*302*		"	*300*		*101*	*65-135*			
Surrogate: 4-Bromofluorobenzene	*270*		"	*300*		*90*	*65-135*			
Laboratory Control Sample (3100097-BS1)				Prepared & Analyzed: 10/06/03						
Gasoline Range Organics	2170	50	ug/l	2750		79	65-135			
Benzene	38.2	0.50	"	34.0		112	65-135			
Toluene	203	0.50	"	208		98	65-135			
Ethylbenzene	45.6	0.50	"	47.0		97	65-135			
Xylenes (total)	222	0.50	"	241		92	65-135			
Methyl tert-butyl ether	60.9	2.5	"	56.0		109	65-135			
Surrogate: a,a,a-Trifluorotoluene	*321*		"	*300*		*107*	*65-135*			
Surrogate: 4-Bromofluorobenzene	*287*		"	*300*		*96*	*65-135*			
Matrix Spike (3100097-MS1)	**Source: P309471-17**			Prepared & Analyzed: 10/06/03						
Gasoline Range Organics	2230	50	ug/l	2750	74	78	65-135			
Benzene	40.3	0.50	"	34.0	ND	119	65-135			
Toluene	221	0.50	"	208	ND	106	65-135			
Ethylbenzene	48.6	0.50	"	47.0	ND	103	65-135			
Xylenes (total)	232	0.50	"	241	ND	96	65-135			
Methyl tert-butyl ether	74.4	2.5	"	56.0	10	115	65-135			
Surrogate: a,a,a-Trifluorotoluene	*352*		"	*300*		*117*	*65-135*			
Surrogate: 4-Bromofluorobenzene	*291*		"	*300*		*97*	*65-135*			

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Approved _____

Sequoia Analytical

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Total Petroleum Hydrocarbons as Gasoline and BTEX by EPA 8015B/8021B - Quality Control

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3100097 - EPA 5030, waters										
Matrix Spike Dup (3100097-MSD1)	**Source: P309471-17**			Prepared & Analyzed: 10/06/03						
Gasoline Range Organics	2240	50	ug/l	2750	74	79	65-135	0.4	20	
Benzene	40.2	0.50	"	34.0	ND	118	65-135	0.2	20	
Toluene	212	0.50	"	208	ND	102	65-135	4	20	
Ethylbenzene	48.9	0.50	"	47.0	ND	104	65-135	0.6	20	
Xylenes (total)	233	0.50	"	241	ND	97	65-135	0.4	20	
Methyl tert-butyl ether	72.8	2.5	"	56.0	10	112	65-135	2	20	
Surrogate: a,a,a-Trifluorotoluene	*335*		"	*300*		*112*	*65-135*			
Surrogate: 4-Bromofluorobenzene	*290*		"	*300*		*97*	*65-135*			

Checked _____

Approved _____

Sequoia Analytical

1455 McDowell Blvd, North Ste D
Petaluma, CA 94954
(707) 792-1865
FAX (707) 792-0342
www.sequoialabs.com

Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3100127 - EPA 5030 waters										
Blank (3100127-BLK1)				Prepared & Analyzed: 10/07/03						
Acetone	ND	10	ug/l							
Benzene	ND	1.0	"							
Bromobenzene	ND	1.0	"							
Bromochloromethane	ND	1.0	"							
Bromodichloromethane	ND	1.0	"							
Bromoform	ND	1.0	"							
Bromomethane	ND	1.0	"							
2-Butanone	ND	10	"							
n-Butylbenzene	ND	1.0	"							
sec-Butylbenzene	ND	1.0	"							
tert-Butylbenzene	ND	1.0	"							
Carbon disulfide	ND	10	"							
Carbon tetrachloride	ND	1.0	"							
Chlorobenzene	ND	1.0	"							
Chloroethane	ND	1.0	"							
Chloroform	ND	1.0	"							
Chloromethane	ND	1.0	"							
2-Chlorotoluene	ND	1.0	"							
4-Chlorotoluene	ND	1.0	"							
Dibromochloromethane	ND	1.0	"							
1,2-Dibromo-3-chloropropane	ND	1.0	"							
1,2-Dibromoethane (EDB)	ND	1.0	"							
Dibromomethane	ND	1.0	"							
1,2-Dichlorobenzene	ND	1.0	"							
1,3-Dichlorobenzene	ND	1.0	"							
1,4-Dichlorobenzene	ND	1.0	"							
Dichlorodifluoromethane	ND	1.0	"							
1,1-Dichloroethane	ND	1.0	"							
1,2-Dichloroethane	ND	1.0	"							
1,1-Dichloroethene	ND	1.0	"							
cis-1,2-Dichloroethene	ND	1.0	"							
trans-1,2-Dichloroethene	ND	1.0	"							
1,2-Dichloropropane	ND	1.0	"							
1,3-Dichloropropane	ND	1.0	"							
2,2-Dichloropropane	ND	1.0	"							
1,1-Dichloropropene	ND	1.0	"							

Checked _____

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3100127 - EPA 5030 waters										
Blank (3100127-BLK1)				Prepared & Analyzed: 10/07/03						
cis-1,3-Dichloropropene	ND	1.0	ug/l							
trans-1,3-Dichloropropene	ND	1.0	"							
Ethylbenzene	ND	1.0	"							
Freon 113	ND	1.0	"							
Hexachlorobutadiene	ND	1.0	"							
2-Hexanone	ND	10	"							
Isopropylbenzene	ND	1.0	"							
p-Isopropyltoluene	ND	1.0	"							
Methylene chloride	ND	1.0	"							
4-Methyl-2-pentanone	ND	10	"							
Methyl tert-butyl ether	ND	1.0	"							
Naphthalene	ND	1.0	"							
n-Propylbenzene	ND	1.0	"							
Styrene	ND	1.0	"							
1,1,2,2-Tetrachloroethane	ND	1.0	"							
1,1,1,2-Tetrachloroethane	ND	1.0	"							
Tetrachloroethene	ND	1.0	"							
Toluene	ND	1.0	"							
1,2,3-Trichlorobenzene	ND	1.0	"							
1,2,4-Trichlorobenzene	ND	1.0	"							
1,1,2-Trichloroethane	ND	1.0	"							
1,1,1-Trichloroethane	ND	1.0	"							
Trichloroethene	ND	1.0	"							
Trichlorofluoromethane	ND	1.0	"							
1,2,3-Trichloropropane	ND	1.0	"							
1,3,5-Trimethylbenzene	ND	1.0	"							
1,2,4-Trimethylbenzene	ND	1.0	"							
Vinyl acetate	ND	20	"							
Vinyl chloride	ND	1.0	"							
m,p-Xylene	ND	1.0	"							
o-Xylene	ND	1.0	"							
Surrogate: Dibromofluoromethane	*5.55*		"	*6.00*		*92*	*84-122*			
Surrogate: 1,2-Dichloroethane-d4	*5.55*		"	*6.00*		*92*	*74-135*			
Surrogate: Toluene-d8	*6.20*		"	*6.00*		*103*	*84-119*			
Surrogate: 4-Bromofluorobenzene	*6.02*		"	*6.00*		*100*	*86-119*			

Checked _____

Approved SJH

Sequoia Analytical

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Petaluma, CA 94954
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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3100127 - EPA 5030 waters										
Laboratory Control Sample (3100127-BS1)				Prepared & Analyzed: 10/07/03						
Benzene	5.01	1.0	ug/l	5.00		100	81-118			
Chlorobenzene	5.22	1.0	"	5.00		104	88-119			
1,1-Dichloroethene	4.58	1.0	"	5.00		92	77-121			
Toluene	4.66	1.0	"	5.00		93	84-119			
Trichloroethene	5.23	1.0	"	5.00		105	83-126			
Surrogate: Dibromofluoromethane	*6.24*		"	*6.00*		*104*	*84-122*			
Surrogate: 1,2-Dichloroethane-d4	*5.92*		"	*6.00*		*99*	*74-135*			
Surrogate: Toluene-d8	*6.26*		"	*6.00*		*104*	*84-119*			
Surrogate: 4-Bromofluorobenzene	*5.95*		"	*6.00*		*99*	*86-119*			
Laboratory Control Sample Dup (3100127-BSD1)				Prepared & Analyzed: 10/07/03						
Benzene	4.86	1.0	ug/l	5.00		97	81-118	3	20	
Chlorobenzene	5.10	1.0	"	5.00		102	88-119	2	20	
1,1-Dichloroethene	4.53	1.0	"	5.00		91	77-121	1	20	
Toluene	4.50	1.0	"	5.00		90	84-119	3	20	
Trichloroethene	5.06	1.0	"	5.00		101	83-126	3	20	
Surrogate: Dibromofluoromethane	*6.17*		"	*6.00*		*103*	*84-122*			
Surrogate: 1,2-Dichloroethane-d4	*6.00*		"	*6.00*		*100*	*74-135*			
Surrogate: Toluene-d8	*6.18*		"	*6.00*		*103*	*84-119*			
Surrogate: 4-Bromofluorobenzene	*6.21*		"	*6.00*		*104*	*86-119*			
Batch 3100167 - EPA 5030 waters										
Blank (3100167-BLK1)				Prepared & Analyzed: 10/08/03						
Methyl tert-butyl ether	ND	0.50	ug/l							
Surrogate: Dibromofluoromethane	*6.08*		"	*6.00*		*101*	*84-122*			

Checked _____

Approved _____

Sequoia Analytical

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Volatile Organic Compounds by EPA Method 8260B - Quality Control

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3100167 - EPA 5030 waters										
Laboratory Control Sample (3100167-BS1)				Prepared & Analyzed: 10/08/03						
Methyl tert-butyl ether	4.94	0.50	ug/l	5.00		99	77-123			
Surrogate: Dibromofluoromethane	*6.44*		"	*6.00*		*107*	*84-122*			
Laboratory Control Sample Dup (3100167-BSD1)				Prepared & Analyzed: 10/08/03						
Methyl tert-butyl ether	5.11	0.50	ug/l	5.00		102	77-123	3	20	
Surrogate: Dibromofluoromethane	*6.37*		"	*6.00*		*106*	*84-122*			

Checked _____

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Sequoia Analytical

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Conventional Chemistry Parameters by APHA/EPA Methods - Quality Control

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3100191 - General Preparation										
Blank (3100191-BLK1)				Prepared & Analyzed: 10/08/03						
Total Alkalinity as CaCO3	ND	20	mg/l							
Carbonate Alkalinity as CaCO3	ND	20	"							
Bicarbonate Alkalinity as CaCO3	ND	20	"							
Hydroxide Alkalinity as CaCO3	ND	20	"							
Laboratory Control Sample (3100191-BS1)				Prepared & Analyzed: 10/08/03						
Total Alkalinity as CaCO3	246	20	mg/l	250		98	80-120			
Duplicate (3100191-DUP1)	**Source: P310129-01**			Prepared & Analyzed: 10/08/03						
Total Alkalinity as CaCO3	194	20	mg/l		200			3	20	

Checked _____

Approved _____

Sequoia Analytical

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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Anions by EPA Method 300.0 - Quality Control

Sequoia Analytical - Petaluma

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3100027 - General Preparation										
Blank (3100027-BLK1)				Prepared & Analyzed: 09/25/03						
Nitrate as N	ND	0.20	mg/l							
Sulfate as SO4	ND	1.0	"							
Laboratory Control Sample (3100027-BS1)				Prepared & Analyzed: 09/25/03						
Nitrate as N	9.30	0.20	mg/l	10.0		93	90-110			
Sulfate as SO4	9.19	1.0	"	10.0		92	90-110			
Matrix Spike (3100027-MS1)	**Source: P310037-03**			Prepared & Analyzed: 09/25/03						
Nitrate as N	24.3	1.0	mg/l	25.0	ND	97	80-120			
Sulfate as SO4	54.1	5.0	"	25.0	25	116	80-120			
Matrix Spike Dup (3100027-MSD1)	**Source: P310037-03**			Prepared & Analyzed: 09/25/03						
Nitrate as N	24.0	1.0	mg/l	25.0	ND	96	80-120	1	20	
Sulfate as SO4	49.5	5.0	"	25.0	25	98	80-120	9	20	

Checked _____

Approved _____

Sequoia Analytical

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Petaluma, CA 94954
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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Dissolved Volatile Gases by Method RSK 175 Modified - Quality Control

Sequoia Analytical - Sacramento

Analyte	Result	Reporting Limit	Units	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit	Notes
Batch 3100105 - General Prep										
Blank (3100105-BLK1)				Prepared & Analyzed: 10/08/03						
Methane	ND	0.010	mg/l							
Laboratory Control Sample (3100105-BS1)				Prepared & Analyzed: 10/08/03						
Methane	0.0612	0.010	mg/l	0.0942		65	50-150			
Matrix Spike (3100105-MS1)	**Source: P310037-01**			Prepared & Analyzed: 10/08/03						
Methane	0.0491	0.010	mg/l	0.0942	ND	52	50-150			
Matrix Spike Dup (3100105-MSD1)	**Source: P310037-01**			Prepared & Analyzed: 10/08/03						
Methane	0.0440	0.010	mg/l	0.0942	ND	47	50-150	11	20	Q-LIM

Checked _____

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Sequoia Analytical

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Petaluma, CA 94954
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Harding ESE - Novato	Project: General Commercial	P310037
5341 Old Redwood Highway, Suite 300	Project Number: BPS Services - City Blue/53087.007	**Reported:**
Petaluma CA, 94954	Project Manager: David Nanstad	10/09/03 16:58

Notes and Definitions

Q-LIM	The percent recovery was outside of the control limits. The samples results may still be useful for their intended purpose.
QR-04	Primary and confirmation results varied by greater than 40% RPD. The results may still be useful for their intended purpose.
DET	Analyte DETECTED
ND	Analyte NOT DETECTED at or above the reporting limit
NR	Not Reported
dry	Sample results reported on a dry weight basis
RPD	Relative Percent Difference

Checked _____

Approved _____

Harding ESE
A MACTEC Company
90 Digital Drive
Novato, CA 94949
(415) 883-0112

CHAIN OF CUSTODY FORM

Seq. No.: № 10299

Lab: Sequoia

Samplers: David Browne

Job Number: 53087.007

Name/Location: BPS Services - City Blue

Project Manager: Dave Nonstatt

Recorder: David Browne
(Signature Required)

P310037

MATRIX: Water	Soil	Air		#CONTAINERS & PRESERV.: Unpres	H_2SO_4	HNO_3	HCL		SAMPLE NUMBER: YR	SEQ	DATE: YR	MO	DAY	TIME	STATION DESCRIPTION: P310037	DEPTH
X				4			3		03	530874	03	09	24	1200		
X				4			3		03	530872	03	09	24	1600		
X				3			3		03	530871	03	09	24	1705		
X							3		03	530873	03	09	24	1740		
X							1		03	530875	03	09	24	1820		

ANALYSIS REQUESTED

Sample (SEQ)	Gasoline Range Organics 8015B	Diesel Range Organics 8015B	BTEX plus MTBE (8020)	CCR Title 22 Metals (17)	EPA 8021B	EPA 8260B	EPA 8270C	TPH gas (8015)	Nitrate (300.0)	Sulfate (300.0)	Alkalinity (310.1)	Methane (RSK175)
530874			X					X	X	X	X	X
530872			X					X	X	X	X	X
530871			X					X	X	X	X	X
530873			X					X				
530875			X					X				

ADDITIONAL INFORMATION

SAMPLE NUMBER: YR	SEQ	TURNAROUND TIME/REMARKS
		STANDARD TAT

COOLER CUSTODY SEALS INTACT ☐

NOT INTACT ☐

COOLER TEMPERATURE 4.8 °C

CHAIN OF CUSTODY RECORD

Signature	Print Name	Company	Date/Time
Relinquished By: David Browne	David Browne	MACTEC	9/29/03 0830
Received By: Gail Herrmann	GAIL HERRMANN	Sequoia	9/29/03 830
Relinquished By:			
Received By:			
Relinquished By:			
Received By:			
Received By:			

Method of Shipment:

Laboratory Copy Project Office Copy Field or Office Copy

revised

P30100 (struck through)

P310037

Harding ESE
A MACTEC Company
90 Digital Drive
Novato, CA 94949
(415) 883-0112

CHAIN OF CUSTODY FORM

Seq. No.: N° 10299

Lab: Sequoia

Samplers: David Browne

Job Number: 53087.007

Name/Location: BPS Services – City Blue

Project Manager: Dave Nasslutt

Recorder: David Browne (Signature Required)

Matrix	#Containers & Preserv. (Unpres.)	#Containers & Preserv. (HCL)	Sample Number YR	Sample Number SEQ	Date YR	Date MO	Date DAY	Time	Station Description	Depth	Analysis Requested
										-01	
Water X	4	3	03	[illegible]30872	03	09	24	1[illegible]00	MW-3	02	BTEX plus MTBE (8020), TPH gas (8015), Nitrate (300.0), Sulfate (300.0), Alkalinity (310.1), Methane (RSK175), CO_2
Water X	2	3	03	[illegible]0871	03	09	24	1205	MW-4	03	BTEX plus MTBE (8020), TPH gas (8015), Nitrate (300.0), Sulfate (300.0), Alkalinity (310.1), Methane (RSK175), CO_2
Water X		2	03	530873	03	09	24	1[illegible]10	MW-5	04	BTEX plus MTBE (8020), TPH gas (8015)
Water X		1	03	530875	03	09	24	1320	Trip	05	BTEX plus MTBE (8020)

Analysis Requested (column headings): Gasoline Range Organics 8015B; Diesel Range Organics 8015B; BTEX plus MTBE (8020); CCR Title 22 Metals (17); EPA 8021B; EPA 8260B; EPA 8270C; TPH gas (8015); Nitrate (300.0); Sulfate (300.0); Alkalinity (310.1); Methane (RSK175); DC; CO_2

ADDITIONAL INFORMATION

Sample Number YR	Sample Number SEQ	Turnaround Time/Remarks
		STANDARD TAT

CHAIN OF CUSTODY RECORD

	Signature	Print Name	Company	Date/Time
Relinquished By:	David Browne	David Browne	MACTEC	9/26/03 0830
Received By:	Gail Herrmann	GAIL HERRMANN	Sequoia	9/26/03 15[illegible]
Relinquished By:				
Received By:				
Relinquished By:				
Received By:				
Received By:				

Method of Shipment:

SEP 30 2003 10:00 FR HARDING LAWSON SAN FR415 777 [illegible] TO 17077920342 P.02/02

** TOTAL PAGE.02 **

SEQUOIA ANALYTICAL SAMPLE RECEIPT LOG

CLIENT NAME: Stantec
REC. BY (PRINT)
WORKORDER: 310037

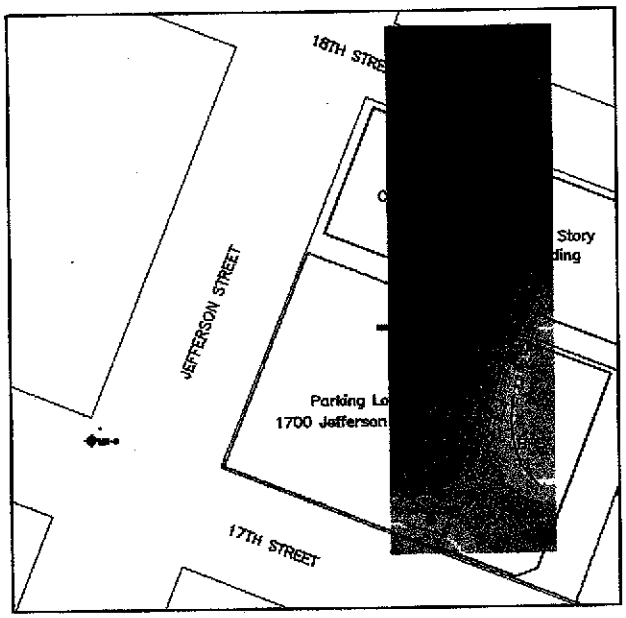
DATE Received at Lab: 9/25/03
TIME Received at Lab: 830
LOG IN DATE: 9/26/03

(Drinking water) for regulatory purposes: YES/NO
(Wastewater) for regulatory purposes: YES/NO

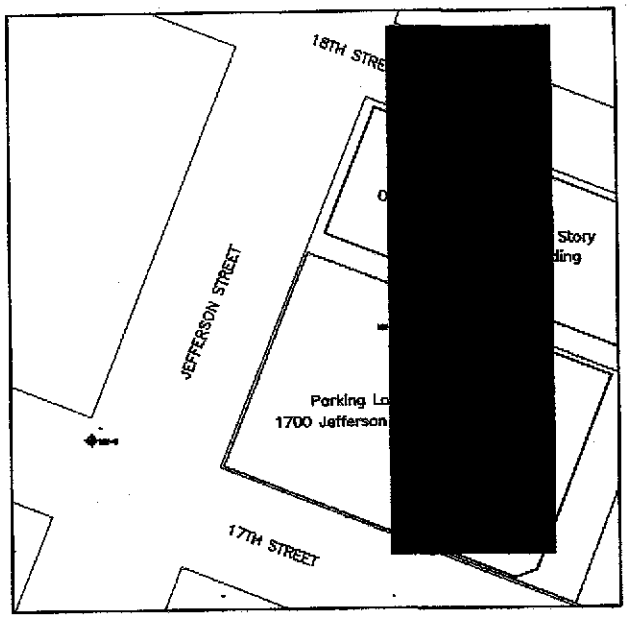
CIRCLE THE APPROPRIATE RESPONSE		LAB SAMPLE #	#	CLIENT ID	DESCRIPTION	SAMPLE MATRIX	DATE SAMPLED	CONDITION (ETC.)
1. Custody Seal(s)	Present / (Absent) Intact / Broken*			03530874	3-VV, 3PV	W	9/24/03	
2. Chain-of-Custody	(Present) / Absent*			2	500 pj			
3. Traffic Reports or Packing List:	Present / (Absent)			1	2-VV-3PV 500 pj			
4. Airbill:	Airbill / Sticker Present / (Absent)			3	3 PVS			
5. Airbill #:				5	1 PV			
6. Sample Labels:	(Present) / Absent							
7. Sample IDs:	(Listed) / Not Listed on Chain-of-Custody							
8. Sample Condition:	(Intact) / Broken* / Leaking*							
9. Does information on custody reports, traffic reports and sample labels agree?	(Yes) / No*							
10. Sample received within hold time:	(Yes) / No*							
11. Proper Preservatives used:	(Yes) / No*							
12. Temp Rec. at Lab: (Acceptance range for samples requiring thermal pres.:4+/-2°C)	4.8 (Yes) / No*							

*If Circled, contact Project Manager and attach record of resolution.

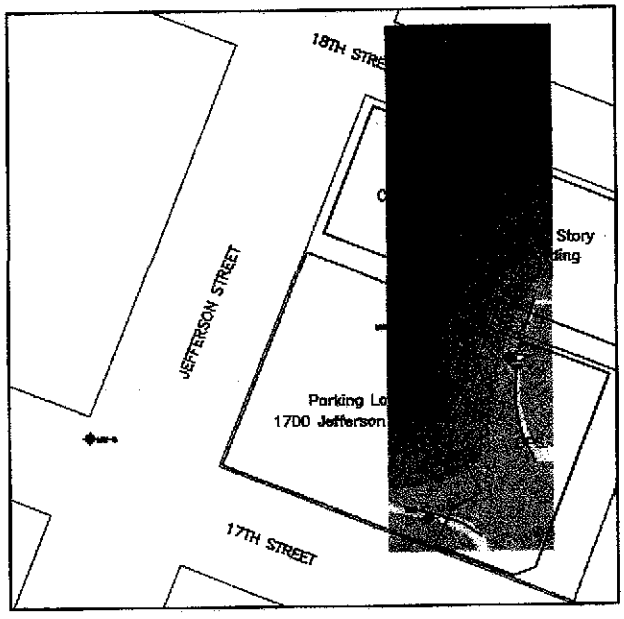
91-AUG, Benzene



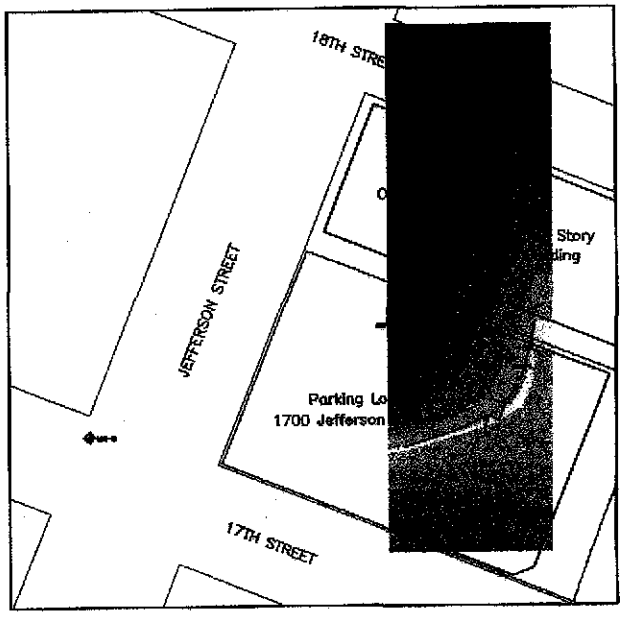
92-SEPT, Benzene



95-APR, Benzene



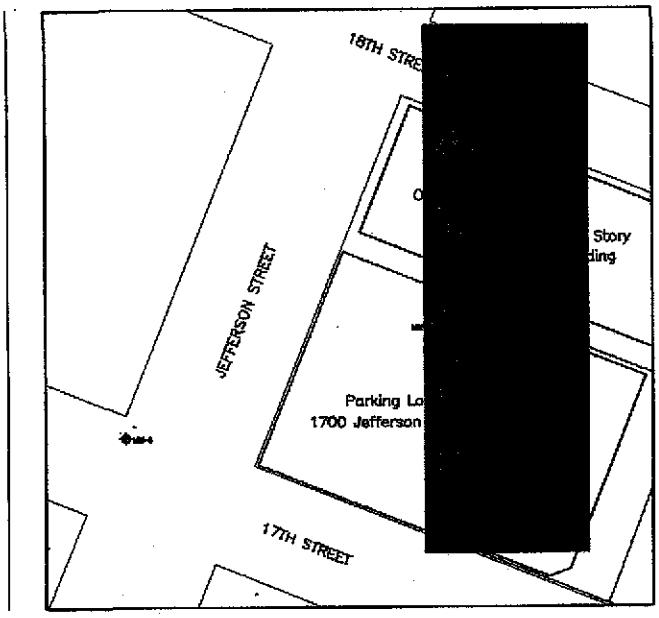
95-JUN, Benzene



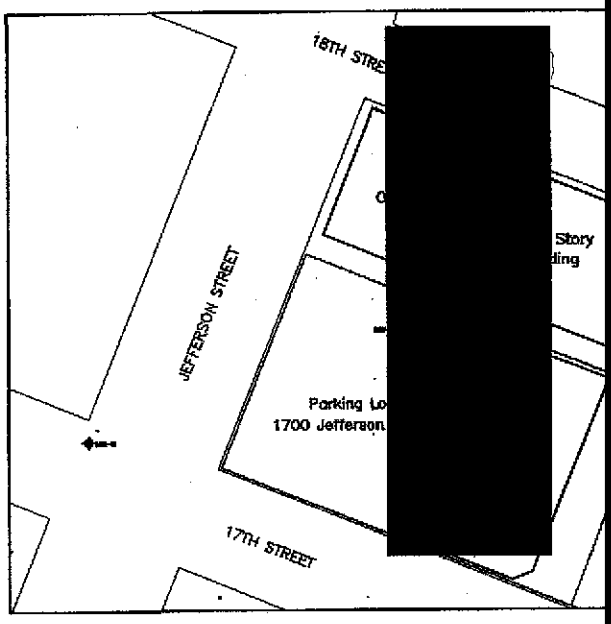
98-DEC, Benzene

97-MAR, Benzene

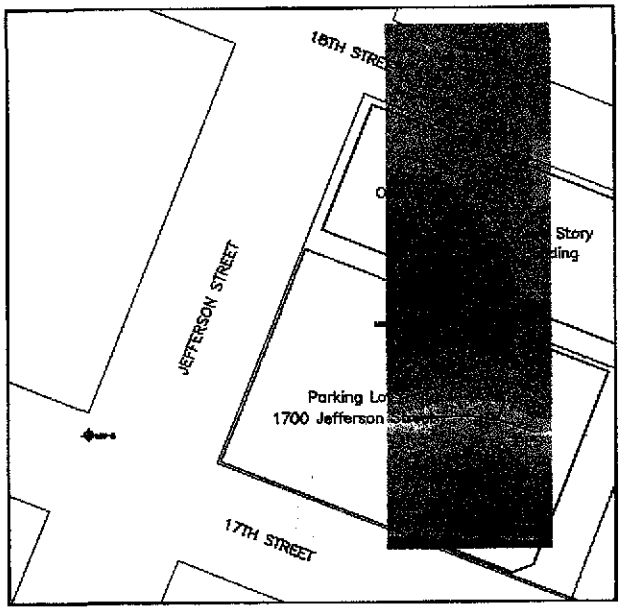
93-MAR, Benzene



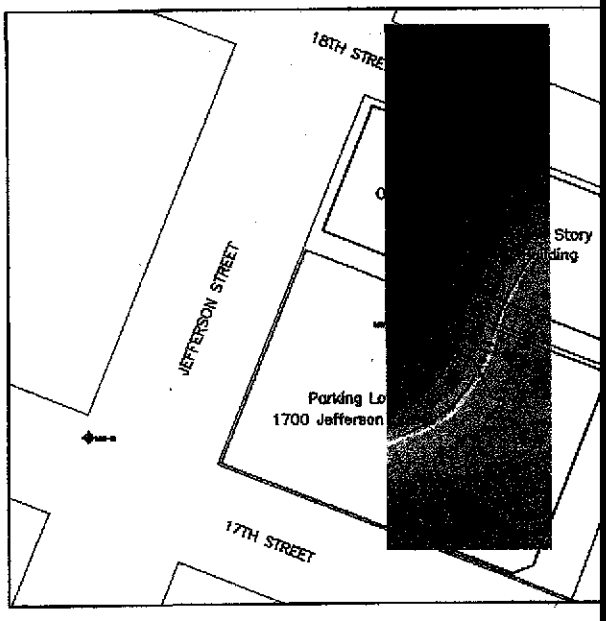
94-JAN, Benzene



95-SEP, Benzene



95-DEC, Benzene



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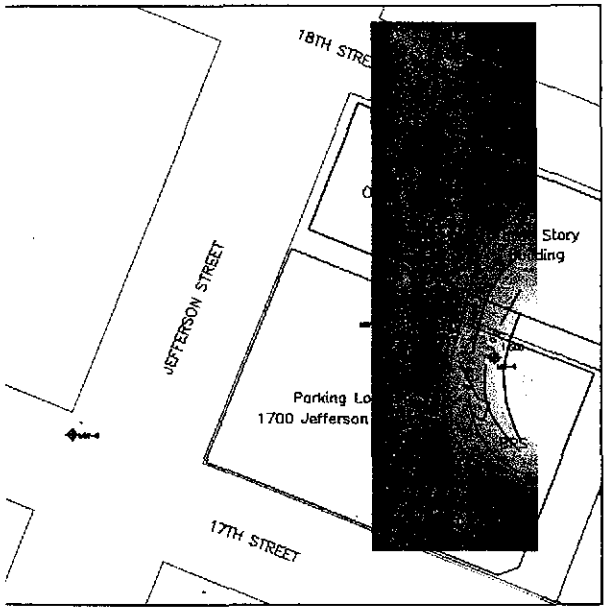
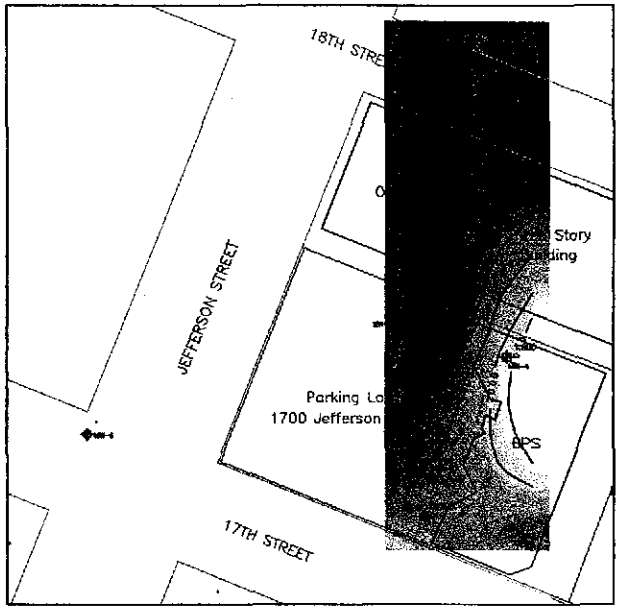
97-JUN, Benzene

97-SEP, Benzene

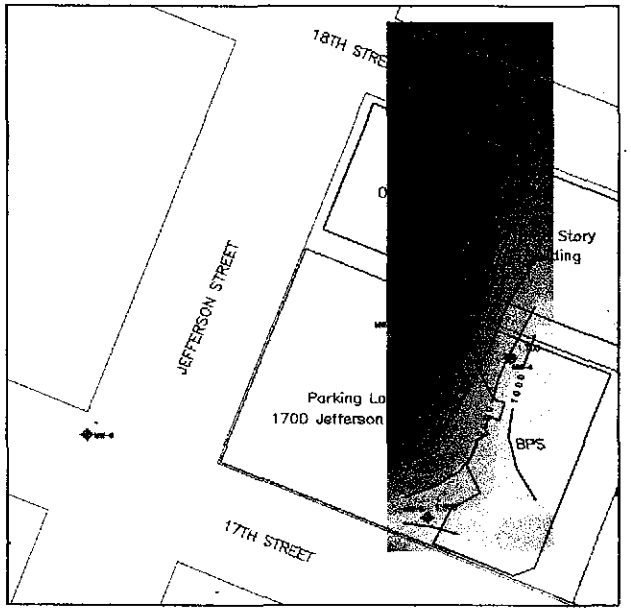
94-APR, Benzene



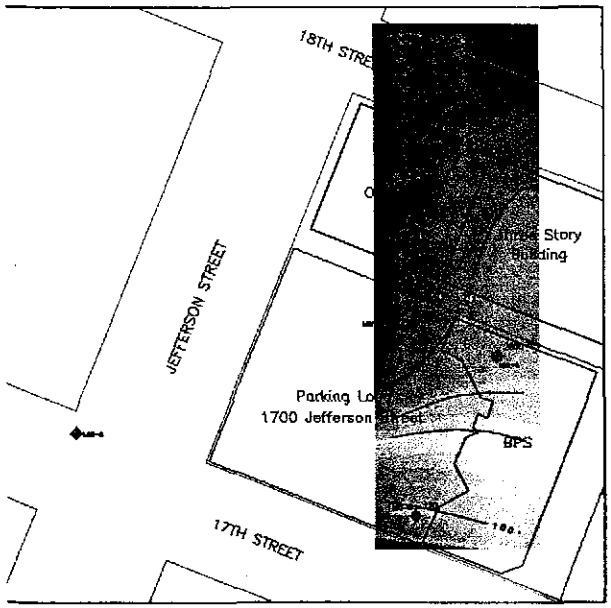
94-JUN, Benzene



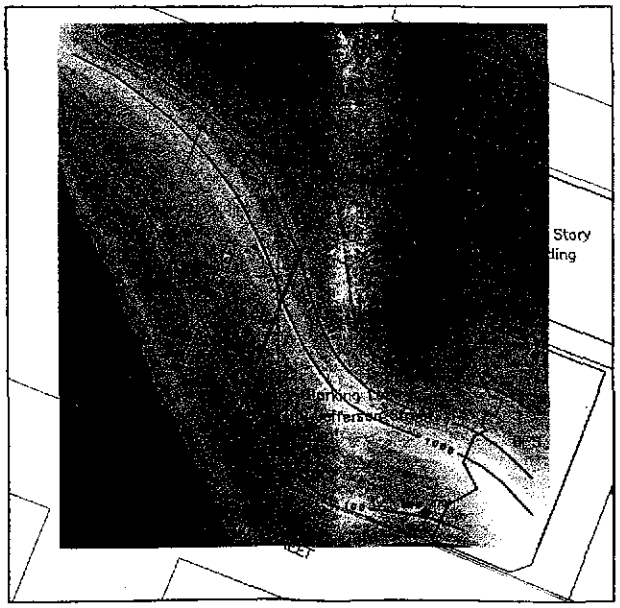
94-DEC, Benzene



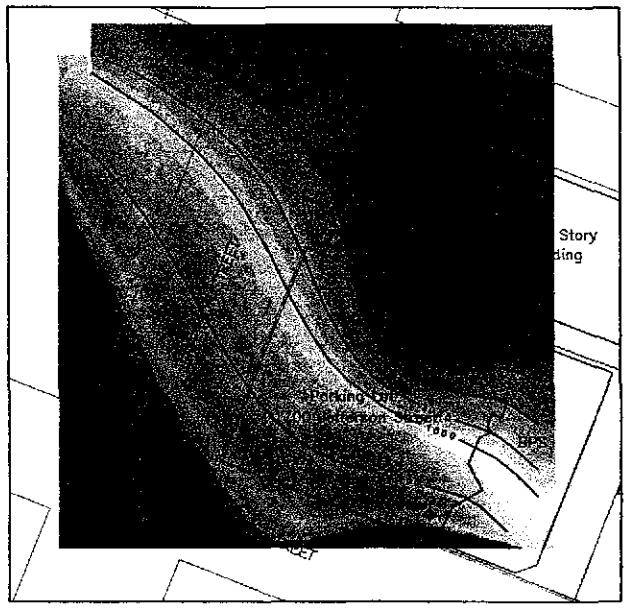
96-MAR, Benzene



96-JUN, Benzene



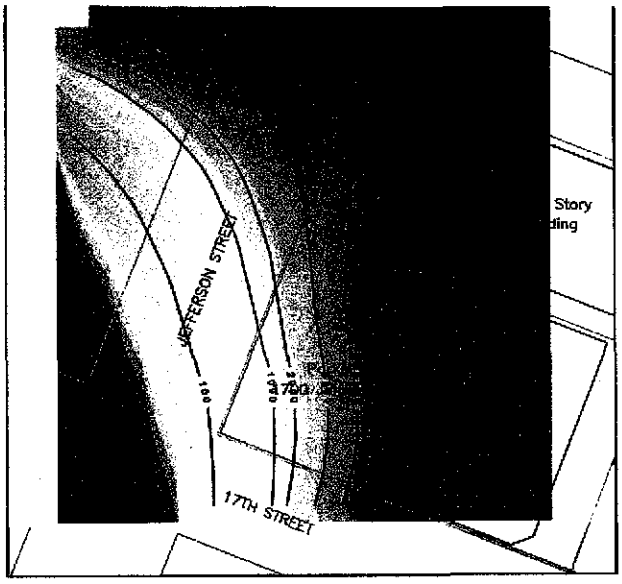
96-SEP, Benzene

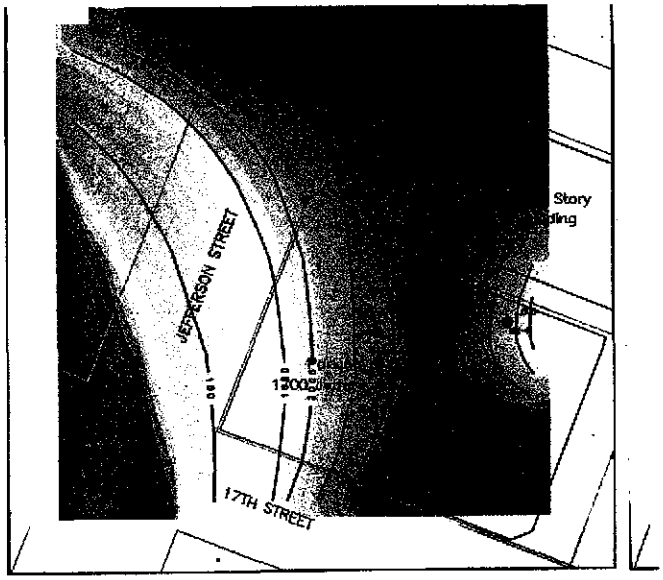


97-DEC, Benzene

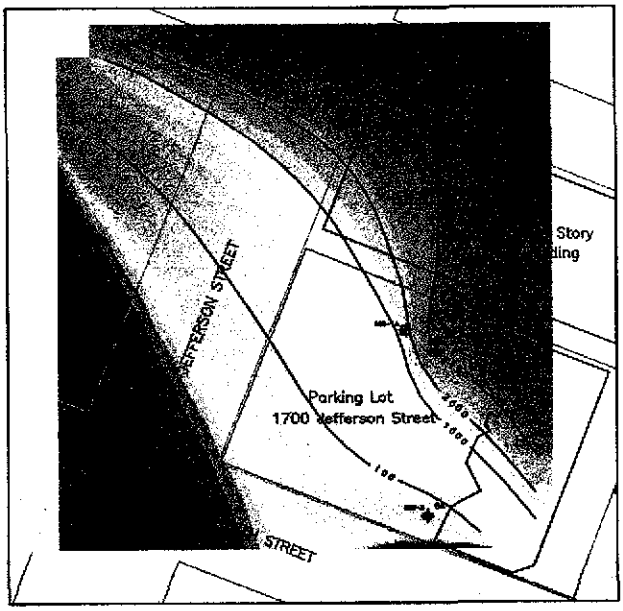
98-MAR, Benzene

98-JUN, Benzene

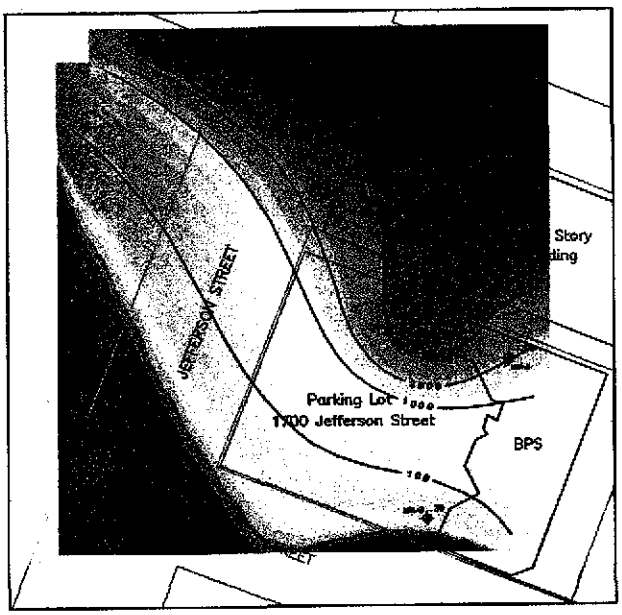




98-AUG, Benzene



98-DEC, Benzene



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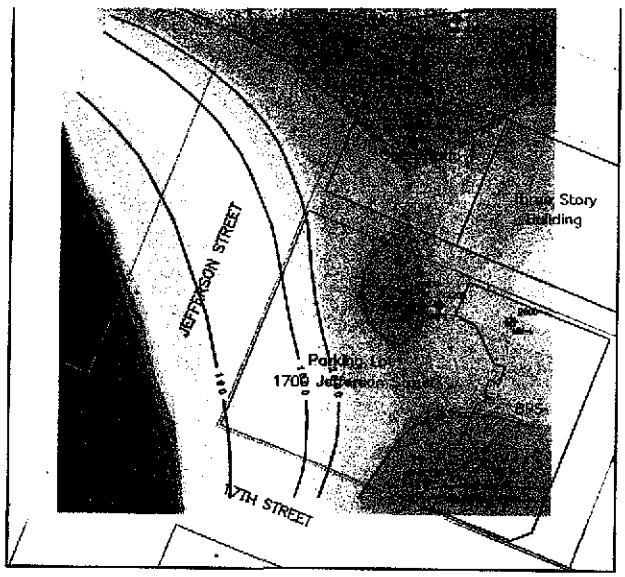
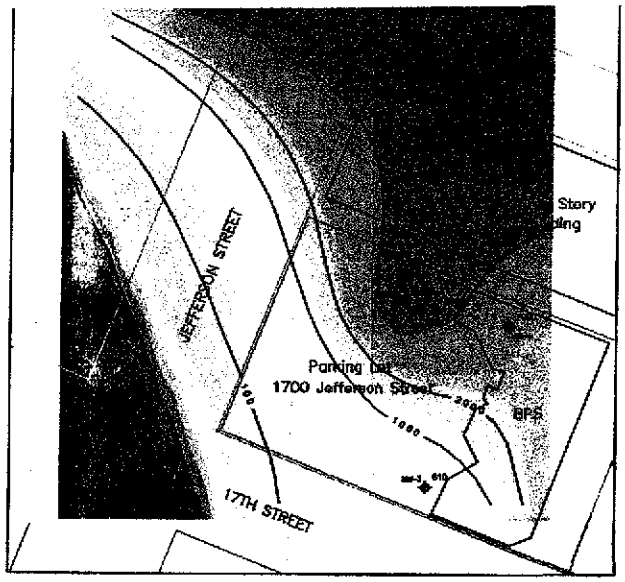
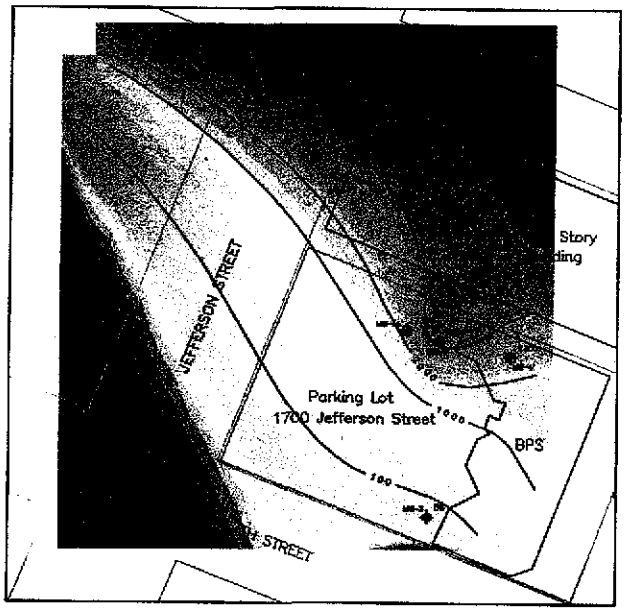
NO.	DATE	REVISIONS	BY	CHK

DRAWN: Rws	PROJECT
ENGINEER:	SCALE: ratio
CHECKED:	APPROVE
DATE:	DATE:

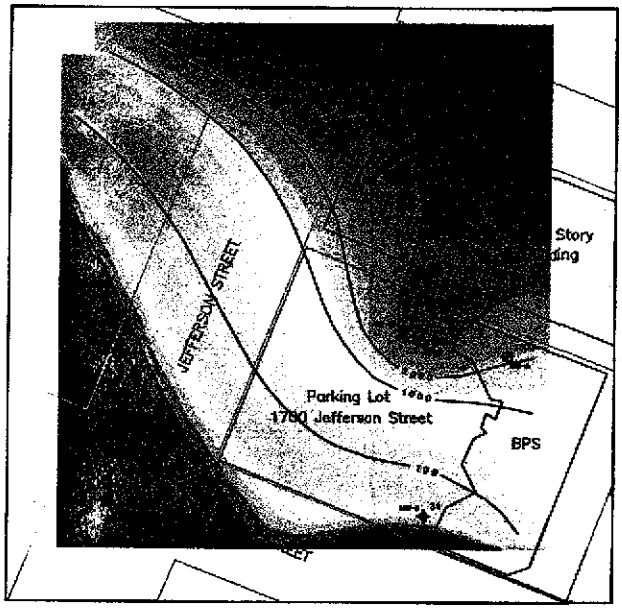




99-MAR, Benzene



99-JUN, Benzene



NO: 53087 006

Check Graphic

D: S.J. Hickey

4-29-04

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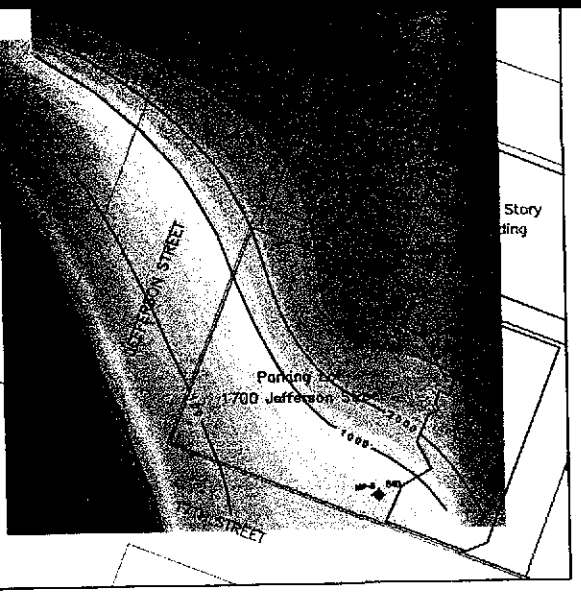

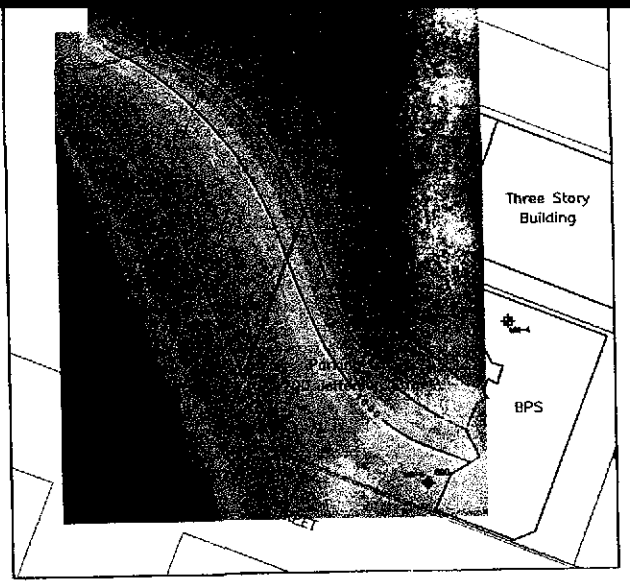

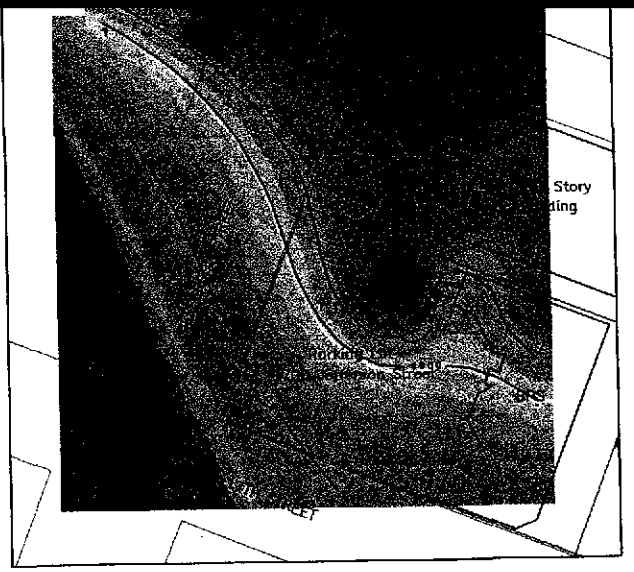

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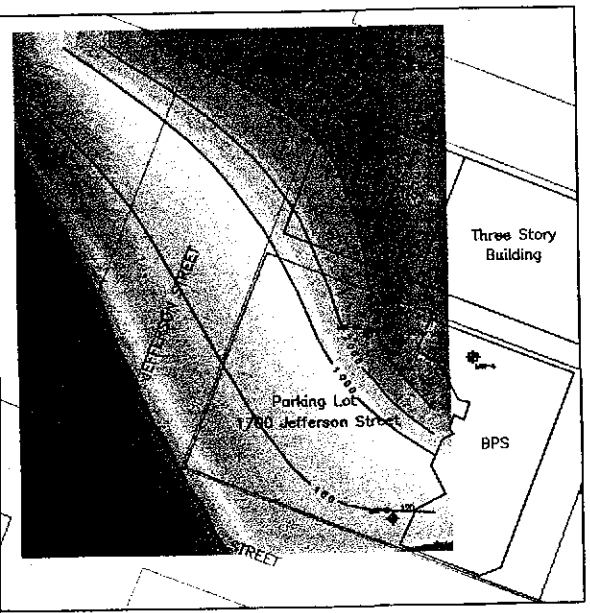

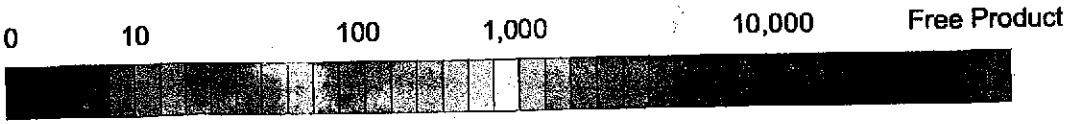

Benzene in Groundwater
(ug/L)

Site Assessment 1701 San Pablo Avenue Oakland, California	Benzene Concentrations in Groundwater 1991 - 1999

PLATE	4
SHEET:	1 OF 1
REVISION NUMBER:	
DATE:	01/04

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