RRSP: 95286-06-33A

HYDROSOLUTIONS OF CALIFORNIA, INC.

LETTER OF TRANSMITTAL

4-4-96

TO: ALAMEDA Co. DEPT. OF ENVIRONMENTAL HEALTH
1131 HARBOR BAY PARKWAY
ALAMEDA, CA 94502-6577
ATT: SUSAN HUGO

DATE: ~~3-22-96~~
SUBJECT: REQUEST FOR CONTAINMENT ZONE
4800 SAN PABLO AVE

We are enclosing: ✓ Herewith ___ Under Separate Cover

No. of Copies	Description
1	DRAFT REQUEST (RRSP: 95276-06-31)

STATUS	SENT FOR YOUR	PLEASE NOTE
✓ Preliminary	___ Approval	___ Revisions
___ Revised	___ Signature	___ Additions
___ Approved	___ Use	___ Deletions
___ Reviewed	___ File	___ Corrections
___ _____	___ Information	___ _____

Remarks: Please review & Comment

cc: file

By: [signature]

5917 Moss Creek Circle, Suite 2, Fair Oaks, California 95628
(916) 967-1222, FAX (916) 967-1223

TABLE OF CONTENTS

1.0 REQUEST TO ESTABLISH A CONTAINMENT ZONE

The City of Emeryville Redevelopment Agency requests the assignment of a parcel of land located on the northeast corner of San Pablo Avenue and 48th Street (4800 San Pablo Avenue) as a groundwater containment zone (figure 1).

The contaminant is gasoline. Low levels of benzene (maximum is 65 ug/kg) have been detected in soil. Extent of contamination is illustrated in figures 4 (sediment) and 5 (groundwater). Benzene in groundwater is detectable in concentrations ranging from 2.2 ug/l to 10 ug/l.

The leak likely occurred many years ago during the operation of the service station. Removal of the tank(s) has apparently occurred after the gasoline station terminated service. No documentation of closure has been found and subsurface investigations have not resulted in the discovery of a presently existing underground storage tank (UGST) system with exception to piping. Shallow probing was completed at 20 foot spacing, a geophysical survey was completed across the entire site and 14 exploratory borings (figure 2) were completed at ten foot to 30 foot depths. No UGSTs have been found. Based on the lack of discovered on-site tanks and low levels of TPH-G/BTXE in the

subsurface, it is assumed that source removal has been achieved. Regrading of the subject property will ultimately confirm this assumption.

Based on the boring/well investigations, soil-gas surveys, geophysical survey and correspondence with Alameda County Department of Environmental Health, it is evident that an adequate level of characterization has also been completed.

No fire or explosion hazards exist on the subject property and the majority of petroleum is found below the eight foot depth. Groundwater has been impacted however intrinsic bioremediation exists beneath the subject property (table 2).

No surface water or other known sensitive receptors are likely to be impacted by TPH in the subsurface. Temescal Creek flows into a large underground culvert immediately north of the subject property and likely losses water, intermittently, to the shallow groundwater zone (figure 5). Location of the culvert is higher than the most shallow saturated zone.

No water wells exist within proximity of the site and it is unlikely that future water sources will include shallow groundwater beneath the subject property (figure 15). Exposure pathways between receptors (groundwater well users) and the contaminant plume are not complete therefore no exposure to municipal/domestic users exist.

Due to the location and concentration of benzene in the subsurface and evidence of intrinsic bioremediation, it is unlikely that the environment is exposed to significant pollution risk. Potential limited exposure may however exist for workers involved in regrading the site for future development. In the event pockets of TPH are encountered in sediment, strategic removal will be completed. A health and safety plan has been created for this purpose (appendix A).

Estimated cost to remediate existing detectable TPH-G and BTXE range between $102,000 and $218,000 (table 3). These expenditures, however, do not guarantee a successful groundwater cleanup. Economic feasibility appears unreasonable considering the low degree of environmental risk to present and future groundwater use and exposure to public. Intrinsic bioremediation is capable of remediating low TPH levels without significant enhancements induced by man (table 2).

In the event increasing concentrations of TPH/BTXE are detected in groundwater, several contingencies have been proposed. Intrinsic bioremediation can be enhanced by; 1) the addition of artificial DO sources, 2) injection of nutrients or 3) pump and treat.

Demonstration of a stable (non-migrating) plume and a reduction of benzene within the affected groundwater will be achieved through groundwater monitoring on a quarterly basis for one year. Review of chemical data will be completed and possible modification or termination of the monitoring program will be determined from this data analysis.

Upon demonstration of a stable, non-migrating plume, the City of Emeryville Redevelopment Agency will request a no further action letter from Alameda County Department of Environmental Health.

2.0 INTRODUCTION

The City of Emeryville Redevelopment Agency (City Agency) has been evaluating the subject property located at 4800 San Pablo Avenue (northeast corner of 48th Street and San Pablo Avenue [subject property]) with respect to petroleum contamination for the last two years, approximately. Previous land use on the property had included a gasoline service station. Aerial photographs from 1950 through 1969

illustrate dispenser island-like locations and an old building. The previous property owner also confirmed that the property had operated as a service station.

Documentation with respect to the removal of the underground storage tank system is not available within public domain records. Attempts to locate these records were made by HydroSolutions of California, Inc.. In addition, a soil-gas survey, geophysical survey, aerial photo search and two soil and groundwater drilling programs were completed to assess the likely presence of tanks and petroleum hydrocarbon contaminated soil and groundwater beneath the subject property.

During the initial field drilling program, two water bearing zones were encountered. A shallow (topmost ten feet of sediment) zone of perched groundwater adjacent B-6/WB-14 was found within a limited area. Depth to the top of perched groundwater was seven feet. The primary shallow groundwater zone, as depicted in WB-7, WB-8, WB-9 and WB-12, was located approximately 20 feet below groundsurface and exists as a semi-confined aquifer. The piezometric surface in wells perforating this groundwater zone were located approximately 10 feet below groundsurface.

Based on the many methods of site evaluation, the subject property does not appear to contain underground tanks however shallow pipes are likely to exist (figure 4). Limited soil and groundwater contamination were identified beneath the subject property adjacent B-1, B-2, B-6, WB-9, WB-8 and WB-14. Detectable TPH-gasoline (TPH-G) concentrations in sediment ranged between 0.96 and 350 mg/kg. TPH-G in groundwater ranged between 220 and 1,900 mg/kg. Benzene ranged from <0.3 ug/l to 65 ug/l during the June 1994 sampling event.

In light of known adverse groundwater quality in the Emeryville area, lack of groundwater usage in the Emeryville area, on-site concentrations of TPH-G, benzene, toluene, xylene, and ethylbenzene (BTXE) in soils and localized presence of low levels of BTXE in groundwater, the subject property appears to be appropriate for consideration as a containment zone. A meeting was held December 8, 1994 with the Alameda County Environmental Health, HSCI and City of Emeryville Redevelopment Agency. It was concluded at this meeting that the site is likely to be appropriate for the non-attainment provision (containment zone) however several issues require attention. These issues include; 1) addressing health and safety concerns during construction, 2) establishing a soil sampling program for excavation and 3) demonstration of minimal contaminated groundwater migration.

Letter correspondence from Alameda County Health Care Services (County) was received September 11, 1995. This letter stated several additional items were needed to effectively utilize the non-attainment provision. In addition to the above mentioned issues, the County requested the following:

> A qualitative risk assessment should address the future land use for the site;
>
> The plume management plan should include institutional controls such as deed notification, contingency plan etc.
>
> Target analyses for the groundwater monitoring program should include TPH-diesel (TPH-D) and TPH as motor oil (TPHR) if these contaminants were detected in soil samples.
>
> Verification soil samples collected after completion of the excavation activities must be analyzed for TPH-D and TPHR in addition to TPH-G and BTXE.
>
> Stockpiled soil maybe used as backfill with prior approval from the County.
>
> Site health and safety plan shall be submitted to the County prior to implementing the remedial action.
>
> Notification of any field work must be made with the County office 72 hours in advance.
>
> Any waste (hazardous or non-hazardous) generated from this investigation shall be disposed appropriately. Documentation of all waste disposal must be provided to the County.

HydroSolutions of California, Inc. was contracted by the City of Emeryville in December 1995 to prepare a document which evaluates the applicability of utilizing the containment provision for the subject

property. This evaluation also includes the initiation of a quarterly groundwater sampling program and conducting an appraisal of potential intrinsic bioremediation.

3.0 EVALUATION CRITERIA

The applicable category for the subject property is described as a site which has groundwater pollution and residual soil pollution with limited water quality, environmental, and human health risks. Sites with this degree of pollution risk require a limited remedial response. Plume management is typically maintained for a reasonable time. The intent of this level of response is to verify the containment of the plume and lack of significant pollution risk. This is usually accomplished by demonstrating no significant migration past a designated monitoring point and completing a qualitative risk assessment.

The evaluation criteria utilized for the subject property are based on procedures described in State Water Resources Control Board Resolution No. 92-49. In summary, components of this document focus on descriptions for; 1) removing the source of the pollution concern, 2) managing environmental risks through an active plume management plan and 3) maintaining a groundwater monitoring program to demonstrate water quality trends.

Below is a summary of specific County requests addressed in later sections and applicable investigations completed to date, if any:

Evaluate the lateral and vertical extent of TPH contamination (section 3.2.2). Site investigations have been completed.

Define the containment zone and demonstrate compliance with the water quality objectives outside the containment zone (section 4.4). Monitor wells presently exist on-site.

Conduct an evaluation of exposure to human and other biological receptors. Appendix A describes the health & safety plan to be used during regrading activities. Section 3.5 will discuss results of a qualitative risk assessment of the subject property.

Evaluate the potential for TPH to degrade under natural conditions. This report will discuss the intrinsic biodegradation potential for the subject property (section 3.2.5).

Determine if the subject property shall reasonably achieve the basin water quality objectives. Site conditions related to sorption of pollutants, pollutant entrapment, heterogeneity and permeability of the effected subsurface will aid in evaluating reasonable achievement of cleanup by available technologies (section 3.3 and 3.4). Several cleanup alternatives will be considered by evaluating both technological and economic feasibility.

Remove the source of the contaminant. Past investigations evaluated the likely presence of the UGST system. Future source removal will include strategic contaminated soil excavation, if necessary, and removal (section 4.3).

Implementation of a containment management plan is to be described in this document (section 4.0). This plan will provide reasonable mitigation measures to compensate for any significant adverse environmental impacts from residual waste/pollutants in the containment zone. Past site assessment reports, source removal, groundwater monitoring program, agreements regarding land uses, notification documents and a qualitative risk assessment constitute a containment management plan.

The Regional Water Quality Control Board (RWQCB)/County and the City Agency will agree upon a monitoring frequency, reporting frequency and duration of monitoring. A groundwater monitoring program has already been initiated (January 1996). Section 4.4 will discuss the groundwater monitoring program.

Lastly, public notice of this request to designate a containment zone will be completed by the local enforcement agency provided the contents of this request comply with the requirements for establishing containment zones.

3.1 Source Removal

Source removal is defined in this request as; 1) the removal of the underground storage tank system and 2) the removal of any obvious soil contamination.

A significant amount of time and effort has been allotted to identifying the presence of an UGST system and preparing for the mitigation of leaked petroleum. The following discussion reviews work completed to date regarding the preparation for source removal.

Due to past land usage as a gasoline service station and the location of concrete slabs and asphalt patches on the subject property, HSCI completed an electromagnetic survey, soil-gas survey, aerial photo survey and geoprobe drilling program for the purpose of evaluating if the tank system had been removed. No closure documentation, stating that the tanks have been removed, has been located in public

domain sources. In addition, UGSTs or data suggesting the presence of UGSTs was not observed. The following paragraphs discuss source removal activities completed on-site.

Several sources of aerial photographs and insurance maps were reviewed to evaluate the likely presence and location of the UGST system. Sanborn maps from 1950 through 1969 appear to illustrate dispenser island locations and an old building. Present building and concrete slab locations are illustrated in similar positions as aerial photographs and Sanborn maps. Information obtained from maps and aerial photographs were compared with current asphalt and concrete patches noted on-site (figure 2). The three north trending concrete slabs were broken in the center (3-4 foot wide breaks) which may indicate past usage as a dispenser island. An asphalt patch located near WB-14 may represent the location of a previously removed UGST or piping. Soil-gas probes were also noted as easily penetrating the groundsurface near boring, B-5. The sand fill in this area suggested that an excavation may have existed at this location. All soil-gas samples measured for organic vapors indicated very low to non-detectable concentrations. No gasoline-like odors were noted during the survey.

A geophysical survey was completed on December 22, 1993. Two geophysical tools were utilized for surveying the site; 1) Schonstadt MAC 51-B Magnetic and Cable Locator and 2) Metrotech Model 810 Radio Frequency Line Tracer. The surveyor concluded that measurement at the subject property did not depict the typical signature of a buried UGST. Large metal objects are suspected in the center area however their appearance is discontinuous. The most significant anomaly was noted near B-3.

A limited geoprobe soil sampling program was initiated after the geophysical survey. The sampling program incorporated six borings, B-1 through B-6. The basis for choosing each boring location included; 1) anomalies detected during the geophysical survey, 2) material encountered beneath concrete slabs or asphalt patch and 3) location in areas which unusual observations were made during the soil-gas survey (e.g. shallow refusal during drilling, low induced vacuum).

Based on data generated by work described above, it is not likely that an UGST system is present beneath the subject property. Ultimate confirmation will be obtained when grading activities begin. Associated piping, however, is likely to be present. Source removal will include the removal of subsurface piping from the topmost several feet of sediment during regrading of the subject property.

The remaining low TPH concentrations in sediment beneath the subject property (8-10.5 feet depth) are not considered a "source material" and will therefore remain beneath the subject property. Justification for this action will be explained in later sections (3.4 Probability of Effecting a Drinking Water Source, 3.5 Qualitative Risk Assessment and 3.2.5 Intrinsic Bioremediation Potential).

3.2 Limited Migration Potential

In order for a containment zone to be designated, the subject property must be limited in areal extent. The size of the containment zone is to be no larger than necessary based on the facts of the individual designation. Also, zone dimensions must be limited to a site which cause no substantial decline in the overall yield of the groundwater basin.

Migration potential of the plume are influenced by sorption of sediment, intrinsic bioremediation, hydraulic gradient of the water table and aquifer characteristics such as hydraulic conductivity, porosity and heterogeneity.

The following subsections discuss the general lay of the land and geology, extent of TPH/BTXE in sediment of the vadose zone, extent of TPH and BTXE dissolved in groundwater and potential pathways of migration.

3.2.1 Geography & Hydrogeology

The subject property is located in a topographically low area approximately 4,500 feet east of the Bay. Elevation of the property is approximately 40 feet above mean sea level and ground surface slopes gently to the west.

The subject property is presently vacant. An old shed, approximately 20 feet by 20 feet is located at the northeast corner of the lot. Ground cover consists of asphalt and several concrete slabs.

The subject property is bordered by a drainage channel (Temescal Creek) along the northern perimeter. Land surface of the subject property is flat. The drainage located to the north appears to be 2-3 feet lower than the subject property. The Temescal Creek is illustrated on a 7.5 minute U.S.G.S. topographic map as originating in the vicinity of Adeline Street and 52nd Street and flows west to the high school then approximately one mile north. Presently, this

drainage appears to be a typical surface water drainage up to the northern property boundary. The drainage then discharges into an underground culvert.

The subject property is located on a broad alluvial plain bordered by the Berkeley Hills on the east and San Francisco Bay to the west. Underlying the property is an alluvial fan deposit consisting of sandy silty clay and clayey gravels. Due to the dark gray color and sediment composition, material in the topmost portion of land is likely overbank stream deposits. Shallowmost groundwater is commonly found at approximately a 20 foot depth.

The water-bearing material in the minor aquifers of the area are usually silty sand. These deposits yield small quantities of water, generally less than 35 gallons per minute.

Groundwater recharge to the shallowmost aquifer results from direct infiltration from precipitation, irrigation returns, sewer leaks and streamflow. Confined aquifers of the area have strata above and below the permeable water bearing zone. The permeable zones are filled by subsurface inflow from adjacent aquifers and leakage between aquifers.

Subject property water bearing zones are likely to be effected by seasonality caused by the precipitation cycle and urban irrigation activities. Figure 6 illustrates water levels measured at WB-8. At least one complete year of quarterly sampling is needed to confirm this occurrence however due to the nearness of the aquifer to the groundsurface, it is expected that seasonality is significant.

3.2.2 Extent of Contamination

Minor concentrations of TPH-G and BTXE have been identified in shallow sediment and groundwater. Figures 4 and 5 illustrate the lateral dimensions of known contamination in each medium.

Sediment containing TPH-G/BTXE is based on the analysis of 24 soil samples. Four of the 24 samples contain detectable TPH-G. TPH-G is detected primarily in sediment located between the 8.5 foot and fifteen foot depths. Detectable concentrations range between 0.96 - 350 mg/kg TPH-G. Detectable benzene concentrations ranged between 15 ug/kg and 960 ug/kg (mean is 292 ug/kg).

Figure 4 illustrates two areas which TPH-G, including benzene, exist. A larger area, approximately 2,900 square feet, contains TPH-G at the 8.5 foot to 15 foot depth (approximately 700 cubic yards). This zone

of sediment is located in the upper confining zone of the shallowmost semi-confined aquifer. Sediment is a clayey silt and groundwater is approximately five feet below the contaminated sediment.

The second contaminated area is illustrated with cross hatches and occurs in the top ten feet of sediment. Lateral dimensions are not known however it is assumed that a 20 foot by 18 foot by ten foot deep area has been impacted (133 cubic yards). Unlike the remainder of the property, this sediment is a very fine to fine grained sand material and is characterized from one sample with respect to TPH-G and benzene. A soil sample from the 8.5 foot to ten foot depth contained 40 mg/kg TPH-G and 63 ug/kg benzene.

Based on the January 1996 groundwater sampling event, TPH-G and BTXE exist in shallowmost groundwater above the detectable limits. TPH-G was detected in WB-8 (230 ug/l), WB-9 (300 ug/l) and WB-14 (220 ug/l). Toluene, xylene and ethylbenzene were not detected above the maximum contaminant levels (MCL). Benzene concentrations range between 2.2 ug/l and 10 ug/l (MCL for benzene is 1 ug/l). Assuming groundwater flow perpendicular to groundwater level contour lines, porosity of 15%, a saturated thickness of five feet and water quality data generated during January 1996, approximately an 1,800 square foot area may be effected and 10,100 gallons of groundwater.

A smaller area surrounding WB-14 also contains perched groundwater of approximately a 3.5 foot saturated thickness. During the January 1996 sampling event, a TPH-G concentration of 220 ug/l and benzene level of 3.2 ug/l were detected. Assuming a 20 foot by 18 foot by 3.5 foot dimension to the saturated zone and a porosity of 20%, approximately 250 gallons of groundwater may be impacted.

3.2.3 Horizontal Pathways

Horizontal pathways are typically associated with underground utilities intersecting the saturated zone of a contaminated aquifer or movement into a significantly more permeable sediment.

Water and sewer lines servicing the vicinity of the subject property are located beneath 48th Street and San Pablo Avenue. TPH-G effected groundwater however are located on the central part of the subject property and appear to have migrated north. Due to no apparent intersection of water and sewer lines (typically 6-8 foot depth) and the saturated zone (+20 feet), it is not likely that these utilities would act as a horizontal pathway for groundwater to travel off-site.

The Temescal Creek is located immediately down-gradient from the subject property and has been reconstructed as an underground conduit. The beginning of this culvert begins half way along the northern boundary of the subject property and continues west.

According to the City of Emeryville Public Works department, the culvert begins as a ten foot by fifteen foot box with a 9.5 foot diameter culvert. Based on this information, the depth of the saturated zone and the existence of the culvert and adjacent sediment, minimal impact of lateral TPH migration is likely.

3.2.4 Vertical Pathways

Currently, the subject property is abandoned. Artificial structures which penetrate vertically are not likely to exist. Assuming the tanks were removed in years past, one would expect the backfilled excavation to act as a preferential vertical pathway to possibly a 10 to 12 foot depth. The sandy zone identified adjacent WB-14 and B-6 suggests that a sandy backfill material may have been used.

Temescal Creek was reconstructed as a surface water drainage and buried culvert. Presently, no surface water flow is apparent along the groundsurface. The hydrogeologic significance of the creek is its likely vertical heterogeneity and coarse grained zones of sediment that may exist near the old drainage. Sediment identified beneath the subject property is typically a clayey silt. Wells, WB-7 and WB-8, encountered a silty gravel at the 25 to 30 foot depth which suggests more permeable deposits do exist in some localities. Leakage to surrounding sediment may also occur as a result of fractures in the conduit.

Data suggests possible recharge of groundwater to the subject property from creek drainage. A groundwater anomaly was noted in groundwater table maps generated from June 1994 and January 1996 water level data. In addition, dissolved oxygen (DO) increases as nearness to the creek increases.

A vertical pathway of unsaturated flow may exist however no data suggests continuous vertical migration beneath the bottom of the impacted shallow aquifer. The impact of a source of DO along the down-gradient portion of the subject property will be discussed in the next section.

3.2.5 Intrinsic Bioremediation Potential

Electron acceptors and nutrient availability were evaluated with water quality data collected during one sampling event (January 1996). Table 1 summarizes these data. Electron acceptors investigated in this evaluation include; dissolved oxygen (DO), nitrate and sulfate. By-products indicators of biodegradation have also been investigated. These include pH, alkalinity, iron and ammonia nitrogen. Phosphate concentration was measured to evaluate the degree of this nutrient present in groundwater.

Intrinsic bioremediation is evaluated for the shallow perched groundwater system as well as the semi-confined aquifer. Generally, background water quality of the perched water is different from the lower, more laterally extensive aquifer. It appears that the perched water zone contains significantly greater dissolved solids (as depicted by specific conductance measurements) and sulfate. Due to water sources of different water quality, it also appears that intrinsic bioremediation is occurring in a different manner. Electron acceptors and by-product measurements will be evaluated for both aquifer zones. Background concentration for each constituent are taken from up-gradient wells, WB-7 and WB-12.

Figure 7 illustrates the distribution of DO in groundwater. Up-gradient DO concentration is 1.4 mg/l. Areas within groundwater containing elevated TPH/BTXE concentrations appear to increase in DO. This is an indicator that aerobic biodegradation of BTXE is not significant across portions of the site.

The perched zone however contains significantly less DO than background (0.6 mg/l). In light of depleted levels of DO concentrations, the perched groundwater zone indicates limited aerobic degradation is occurring.

The following equation describes the overall stoichiometry of BTXE degradation caused by aerobic biodegradation. In the absence of microbial cell production, the biodegradation of benzene to carbon dioxide and water is given by:

$$C_6H_6 + 7.5O_2 \quad ---> \quad 6CO_2 \quad + 3H_2O$$

Based on this equation, the ratio of oxygen to benzene is 3:1, approximately. In the absence of microbial cell production and 1.4-3.0 mg/l DO detected in the primary groundwater zone, the subject property has the capacity to assimilate 0.5 mg/l total BTXE.

Figure 8 illustrates the distribution of nitrates in groundwater. Background nitrate concentration ranges from <0.05 mg/l to 7 mg/l. Areas with elevated TPH/BTXE concentrations and areas directly down-gradient from elevated TPH/BTXE concentrations have nondetectable levels of nitrate. Based on nondetectable nitrate levels beneath the area of the site which groundwater flows into the plume, it is likely that nitrate is a minor electron acceptor at this site.

Figure 10 illustrates the distribution of sulfate in groundwater. Background sulfate concentrations range from 35 mg/l to 40 mg/l. Areas with elevated TPH/BTXE concentrations and areas directly

down-gradient from elevated TPH/BTXE concentrations have depleted levels of sulfate. Sulfate concentrations were 8 mg/l at WB-8 and 12 mg/l at WB-9. This is a strong indicator that anaerobic biodegradation of BTXE is occurring at the site.

The following equation describes the overall stoichiometry of BTXE degradation caused by anaerobic biodegradation by sulfate. In the absence of microbial cell production, the biodegradation of benzene to carbon dioxide and water is given by:

$$C_6H_6 + 3.75SO_4 + 7.5H \rightarrow 6CO_2 + 3H_2O + 3.75H_2S$$

Based on this equation, the ratio of sulfate to BTXE is 4.6 : 1. In the absence of microbial cell production and existing background sulfate levels, the shallow groundwater at this site has the capacity to assimilate 8.7 mg/l total BTXE. The perched groundwater zone has the capacity to assimilate 35 mg/l BTXE.

It must be recognized that the kinetics of sulfate utilizing bacteria are significantly slower than aerobic degradation therefore a slow migrating groundwater flow can enhance the exposure time for complete degradation. The estimated average seepage velocity of groundwater migrating across the anaerobic portion of the plume is less than one foot per year.

Nutrient availability was evaluated from field data. Data was then compared with published information in professional journals. Based on these comparisons, the following statements can be made:

pH at the site is good to excellent;
Available nitrogen is low; and
Phosphate levels are low (based on an optimum CNP ratio: 120:10:1).

It must also be recognized that present day literature suggests that nutrient availability does not correlate with the success of intrinsic or enhanced bioremediation. Indigenous bacteria acquire nutrients in other ways.

In some cases iron is used as an electron acceptor during anaerobic biodegradation of TPH. During this process, ferric iron is reduced to the ferrous form which may be soluble in water. Ferrous iron concentrations are used as an indicator of anaerobic degradation of fuel compounds. Each 1.0 mg/l of ferrous iron produced during microbial iron oxidation results in the degradation of 0.047 mg/l BTXE.

Research in the field of microbial degradation under sufate-reducing conditions have recognized a high correlation between organic degradation, sulfate reduction and ferric iron reduction. Ferric iron

reduction may not be directly responsible for biodegradation of petroleum (toluene) but as a secondary abiotic reaction between ferric iron and biogenic hydrogen sulfide. Iron is included in this evaluation as a parameter which indirectly suggests the existence of sulfate-reducing bacteria.

The highest concentration of iron was measured at WB-9 (2.4 mg/l). Lateral distribution of iron appears to increase in the down-gradient direction. This increasing concentration trend suggests iron as an electron acceptor, sulfate reduction or both are occurring at the subject property.

Nitrogen fixation refers to the reduction of nitrogen from N_2 to the ammonia level. Ammonia nitrogen levels likely exceed background ammonia concentrations due to biological activities occurring within the contaminant plume. Nitrate reducing microorganisms convert nitrate and nitrite to N_2 by denitrification. Background concentration of ammonia nitrogen is 0.2 mg/l. Areas within the contaminant plume are higher in ammonia nitrogen than the non-contaminated areas. This distribution of ammonia nitrogen suggests a limited area of nitrate reduction. Figure 6 illustrates the distribution of ammonia nitrogen. The lack of nitrates may exist due to their relatively quick metabolic degradation as compared to nutrient loading of slow moving groundwater.

Alkalinity many times increases in areas where oxidation of organic matter occurs. Localized sources include biologically mediated aerobic or anaerobic reactions with organic matter. Furthermore, as carbon dioxide is released through microbial respiration, pH can become more acidic unless groundwater is capable of neutralizing. Alkalinity is an indicator of this capability. Figure 13 illustrates the lateral distribution of alkalinity in groundwater.

Based on the distribution of alkalinity (220-372 mg/l $CaCO_3$), an increase is noted in groundwater beneath the subject property. This trend is consistent with expected chemical responses in a microbiologically active area.

Perched groundwater contains significantly more alkalinity (592 mg/l Ca Co_3) than the primary groundwater zone. Elevated alkalinity of perched groundwater suggest conditions favorable in a microbially active area.

The perched groundwater zone is undergoing aerobic degradation. This is prevalent due to concentrations of DO existing at 0.6 mg/l, less than half the concentration of the lowest DO measurement in the primary groundwater zone. Sulfate is exceedingly higher (160 mg/l) which suggests an abundant supply of sulfate that may not be

currently used in great quantities. Phosphate and nitrates which can be used as nutrients, are non-detectable in this zone. Alkalinity is exceedingly high. Each of these conditions suggest consumption of nutrients and absorption of carbon dioxide into perched groundwater.

The primary groundwater zone appears to be effected by anaerobic degradation. DO increases across the property suggest a potential source of DO originates near the drainage (Temescal Creek). Nitrates are nondetectable with exception to WB-12 (7.0 mg/l) and sulfates diminish in concentration with down-gradient migration. Each of these anaerobic conditions would result in increased alkalinity, increased iron, and decreased ammonium nitrogen. These trends are observed at the subject property. Based on an evaluation of inorganic chemical parameters, anaerobic conditions prevail across the greater portion of the site. Aerobic conditions are generated along the down-gradient portion of the plume.

An adequate supply of electron acceptors is currently available to assimilate BTXE concentrations measured on-site. Table 2 illustrates the contribution of each electron acceptor. Availability of nutrients may limit the rate of degradation however may not significantly restrict degradation.

Intrinsic biodegradation in the primary shallow aquifer is a metabolic rate-limited condition. Rates of degradation under anaerobic conditions are typically slower than those under aerobic conditions.

3.3. Technical Feasibility of Best Available Technologies

There are many ways to aggressively attempt to remediate the subject property. Each method includes an element of risk to accomplish stringent drinking water cleanup goals (groundwater) or non-detection levels required for soil. Bioventing, vapor extraction and use of emulsifiers can be used however the success of total cleanup is not predictable. Time required to achieve cleanup also varies and can continue for many years.

One approach would be to simply excavate sediment in the area depicted in figure 4. An area approximately 80 feet by 35 feet by 15 feet deep (1,556 cubic yards) would require removal, disposal and backfilling. Assuming moderately low TPH concentrations which are allowable at a Class III disposal facility and a $76 per cubic yard cost for all work (including verification samples, geologist, permits, workplans), the estimated cost is $118,500. This remedial effort does not include addressing groundwater contamination at the 20 foot depth.

An alternative source removal strategy is to remove only known localities containing the higher concentration of TPH. The area around the perched groundwater has been discussed in past meetings. Cost for this degree of source removal is estimated to be $42,100. This alternative does not include addressing groundwater contamination at the 20 foot depth.

Groundwater containing TPH exists in two zones; 1) perched groundwater and 2) shallowmost groundwater encountered at the 20 foot depth. Mitigation of perched groundwater is accomplished by removing source material (sediment) as described above.

Mitigation of the primary groundwater zone can be achieved by constructing a line of recovery wells on the down-gradient end of the plume. Due to the low permeability and small saturated thickness of the aquifer, spacing of wells would be 2-3 feet, center to center. Assuming a 37 foot line of interception, 15-17 wells would be required. A pump intake would be installed in each well and above ground treatment of water would be accomplished with GAC or other means. Cost for expediting this alternative is estimated to be $31,000 plus approximately $5,700 per year for operation and maintenance. This scenario assumes that a NPDES permit can be obtained for discharging treated water into the Temescal Creek drainage. Seepage velocity may be 1-2 feet per year under current

conditions. The time required to pump and treat one plume volume would likely exceed several years. Depending on the amount of organic matter (non-petroleum hydrocarbons) and clay size particles in the aquifer matrix, attenuation effects would create a significantly more lengthy cleanup and greater volume of recovered groundwater to be removed.

Effectiveness of groundwater recovery can be improved by injecting nutrients and electron acceptors along the up-gradient side of the plume. To sufficiently inject nutrient additives, a twenty foot line of injection wells would be constructed (10 wells) for a cost of approximately $10,000. Discharged water along the bottom of the plume would be reinjected into up-gradient wells after nutrients were added. Cost to maintain the injection portion of the cleanup is estimated to be $500 per month. The total cost for groundwater cleanup (assuming 5 years of operation) is estimated to be $100,000.

Disadvantages in expediting groundwater cleanup is the lengthy time for TPH recovery and the probability for achieving total cleanup. Complete success is typically not achieved for many years.

The economic impact in procuring $102,000 to $218,500 for remediation of low concentrations of TPH in soil and groundwater is significant. Added improvement and protection to off-site and on-site areas is

minimal. The next two sections discuss the vulnerability of nearby water resources and results of a qualitative risk assessment of present subsurface conditions.

3.4 Probability of Effecting a Drinking Water Source

Presently, municipal water supplies are provided by East Bay MUD. Sources of water are obtained from surface water located outside the Emeryville area. No groundwater wells operated by East Bay MUD exist within the city of Emeryville.

A well database generated by the County of Alameda Public Works Agency contains four permitted wells within a mile radius, approximately, of the subject property (figure 15). Three of these wells are located in up-gradient locations. One well is located approximately one mile northwest of the subject property.

Recorded beneficial uses of these wells are industrial, irrigation and domestic. Based on the low inventory of wells in the area, distance of the above four wells from the subject property and lack of municipal uses of groundwater, present beneficial uses of shallow groundwater are negligible.

The city of Emeryville contains numerous sites which have experienced unauthorized releases of petroleum and other contaminants. Most of these releases have effected the topmost aquifer (water table or semi-confined). Based on the many chemical releases in Emeryville, current water quality conditions and lack of deeper, high yielding aquifers, future beneficial uses of shallowmost groundwater are not likely.

A pathway from the subject property to waters utilized for drinking water is not complete therefore the probability of effecting drinking water sources is negligible.

3.5 Qualitative Risk Assessment

A qualitative risk assessment has been completed and reported to the degree defined by the California Regional Water Quality Control Board narrative dated October 21, 1994 regarding implementation of Non-attainment areas. In this document, qualitative means the common sense review of pertinent information on existing and probable exposure pathways and receptors.

A qualitative assessment of risk has been completed in two parts. Immediate threats to land users such as fire hazard, explosions or environmental exposure to harmful levels of BTXE (health impairment) are examined. Secondly, long-term hazards to life, health and

environment will be evaluated. These conditions are usually associated with low concentrations of BTXE which adverse effects are not immediately evident. Due to the qualitative nature of this evaluation, a conservative mode of assessment is taken.

Potential short-term hazards evaluated in this section include explosive vapor levels, utility impacts and the presence of free-phase hydrocarbon liquid on the ground surface, surface water or groundwater.

Approximately 20 soil-gas probes were penetrated to a 4-4.5 foot depth as well as two probes penetrating an 8.5-10 foot depth. The majority of the probes detected no organic vapors (OV) utilizing a photoionization detector (Hnu meter) in the field. Maximum OV concentration detected was 2.3 ppm. Based on soil-gas survey results, concentrations of OV are significantly under the lower explosive level of gasoline.

Drill cuttings were recently transported and disposed at an off-site facility. A part of the disposal procedure was the profiling of the sediment. Ignitability was tested by EPA Method 1010. Based on these results, the flash point of the material exceeded 140 degrees

fahrenheit (reporting range is 65-140 F). Sediment (drill cuttings) from the worst case boring were sampled and used for this test. Fire hazard as related to residual petroleum contamination is not likely.

Site observation and geologic logs were used to evaluate the presence of a free-phase hydrocarbon liquid. Fourteen exploratory borings ranged in depth from 10 to 31 feet. The majority of the soil samples had no noticeable petroleum-like odors. TPH-G analysis of samples detected maximum concentrations of 350 mg/kg and 17 samples with nondetectable TPH. A total of 24 samples were analyzed. Based on laboratory results, it is unlikely that free petroleum product exists beneath the subject property. Impact to utilities are also unlikely due to the relatively low TPH concentration detected in sediment, depth of contamination (8-10 feet) and lack of on-site utilities which penetrate the 8-10 foot depth.

Long-term hazards include inhalation of petroleum vapors by workers during redevelopment of the subject property and stability and continued degradation of BTXE in groundwater. Based on soil-gas survey results, minimal exposure to inhalation of BTXE exists. It is expected that the entire site will undergo, at a minimum, removal and redistribution of the top several feet of sediment for development purposes. Old metal pipes related to the UGST system will also be removed. The surrounding bedding material may contain TPH

consequently resulting in the potential exposure of low TPH concentrations to workers. A health and safety plan is an appropriate response in anticipation to limited exposure during grading activities (Appendix A). Based on the soil-gas survey (22 probes) and 14 boring/wells, and the relatively small size of the subject property, the likelihood of encountering a significant zone of contamination is minimal.

Indicators of intrinsic bioremediation were evaluated from groundwater samples to confirm the tendency of natural subsurface processes to reduce levels of TPH-G and BTXE. Section 3.2.5 discusses the processes in more detail. According to available dissolved oxygen and sulfate in groundwater, the primary groundwater zone is capable of assimilating 9.1-9.7 mg/l BTXE. A BTXE concentration of 0.0251 mg/l and TPH-G concentration of 0.300 mg/l were measured in January 1996.

Areas along the down-gradient side of the contaminant plume appear to be a DO source area which would act as an aerobic zone of degradation. Groundwater conditions beneath the site itself appear to support primarily a sulfate-reducing bacteria environment. Groundwater contamination is assimilated at a relatively slower rate within the subject property and relatively faster along the

down-gradient end of the plume (kinetics of aerobic degradation are considered significantly faster than bacteria utilizing sulfate electron acceptors).

Perched groundwater appears deficient in DO but plentiful in sulfate. This condition and the presence of high alkalinity suggest anaerobic degradation is active within this zone. The level of sulfate within the perched groundwater is 160 mg/l, greater than 4 times sulfate concentration in the primary groundwater zone. The assimilative capacity of this zone is approximately 35 mg/l. A BTXE concentration of 0.0054 mg/l and 0.220 mg/l TPH-G were measured in January 1996.

Based on intrinsic bioremediation potential, groundwater will likely contain diminishing TPH concentrations with time. This assumes levels of electron acceptors continue in similar concentrations measured during January 1996. In addition, the City of Emeryville and East Bay MUD do not utilize its groundwater resources for municipal or domestic purposes. It is also very unlikely that these shallow groundwater zones will be used for future beneficial uses. Ultimately groundwater beneath the subject property would be expected to recharge to the Bay, not deeper aquifers. According to public works records, no water wells are located within 2,000 feet down-gradient, approximately, of the subject property. Lack of groundwater use,

depth to groundwater and the presence of natural biodegradation processes suggest negligible risk to groundwater end-users and exposure to the public.

Due to the distance from the subject property to the bay, levels of BTXE, average seepage velocity and intrinsic bioremedial potential of shallowmost groundwater, it is expected that BTXE will have degraded prior to reaching the bay. A recent study completed by the Lawrence Livermore National Laboratory stated that petroleum hydrocarbon groundwater contamination rarely exceeds a distance of 250 feet from its source due to attenuation mechanisms such as intrinsic bioremediation.

A soil sample was collected from the 10 foot depth of WB-8 and analyzed by the TCLP zero headspace extraction method and analyzed by EPA Method 8015. A TPH-G concentration of 0.96 mg/l was detected by this analysis. Based on this result, TPH is likely to be available for migration. Subsurface sediment therefore eventually can transmit TPH to groundwater where it is degraded to carbon dioxide and water. Concentrations of TPH and BTXE detected below the eight foot depth of the vadose zone are not likely a significant source but will act as an exposure pathway to deeper groundwater. Upward mobility of BTXE to

soil zones likely to be regraded (topmost 3 feet) are minimal due to BTXE concentration at the 8-10 foot depth, solubility of BTXE, moisture content and type of sediment (silty clay).

TPH presence in the vadose zone sediment does not have the potential to significantly impact surface water, wetlands or the bay. This is due to the distance to each receptor area, low concentrations at the source area and average rate migration.

4.0 CONTAINMENT MANAGEMENT PLAN

The plan to manage environmental risk includes further source removal within the vadose zone (as identified during the regrading process), land use planning, notification to current and future landowners and tenants, enhanced passive remediation and groundwater monitoring.

4.1 Current/Anticipated Land and Water Use

The subject property is currently vacant. The Planning Department of the City of Emeryville has designated the subject property as general commercial. Future land use for the subject property however is to be residential with a potential for minimal ground floor commercial space.

4.2 Notification to Current and Future Landowners, Lessees and/or Renters

The City of Emeryville Redevelopment Agency will notify future landowners and tenants of low levels of TPH present in sediment and groundwater. This document will be available to the public for review during City office hours.

A letter will be prepared which reports the qualitative level of environmental and public health risk associated with the remaining TPH/BTXE on-site. The letter will identify the subject property as a low risk soil and groundwater site which can be remediated by natural processes existing in the subsurface.

The following reports may be reviewed by the public by appointment. The location of reports is the City of Emeryville Redevelopment Agency, 12th Floor, 2200 Powell Street in Emeryville, California.

HydroSolutions of California, Inc., November 17, 1993, "Soil-gas Survey, 4800 San Pablo Avenue, Emeryville, California".

HydroSolutions of California, Inc., January 18, 1994, "Preliminary Site Assessment, 4800 San Pablo Avenue, Emeryville, California".

HydroSolutions of California, Inc., August 1994, "Site Characterization, 4800 San Pablo Avenue, Emeryville, California".

Contact person within the City for answering questions regarding the subject property is Maryann Leshin (510)596-4358.

4.3 Health & Safety Plan for Regrading Activities

It is anticipated that limited regrading of the subject property will be necessary to facilitate redevelopment. Although detectable TPH concentrations in sediment are primarily located deeper than eight feet, it is possible that limited sediment containing TPH may be present in small zones above the ten foot depth (adjacent WB-14 and dispenser islands). Due to this likelihood, a health and safety plan has been prepared for use during initial regrading activities. The health and safety plan may also be used if aeration of stockpiled sediment is utilized (contingency).

Regrading will include backfilling excavated areas with clean sediment. Overlying clean sediment will provide an additional level of protection against exposure to TPH existing in underlying areas.

The health and safety plan appears in Appendix A of this document.

4.4 Groundwater Monitoring

A groundwater monitoring program will be initiated on a quarterly basis beginning January 1996 for the purpose of; 1) evaluating trends in TPH-G, BTXE, TPH-D and motor oil concentrations and 2)

demonstrating limited migration of the dissolved TPH groundwater plume and 3) monitoring dissolved oxygen and sulfate seasonal variability.

Groundwater monitoring began this January 1996 with the resampling and analysis of all existing wells for TPH-G and BTXE. In addition, WB-8, WB-12 and WB-14, were tested for TPH-D and motor oil.

Subsequent groundwater sampling events beginning April 1996 will include wells, WB-8, WB-9 and WB-14. Wells, WB-8 and WB-14, will be analyzed for TPH-G, TPH-D, motor oil, BTXE, DO and sulfate. Well, WB-9, will be analyzed for TPH-G, BTXE, DO and sulfate. According to the County letter correspondence dated February 7, 1996, wells may be dropped from the quarterly monitoring program if no detectable TPH/BTXE is present. The January 1996 sampling event did not detect BTXE or TPH-G in wells WB-7 and WB-12.

Procedures for preparing each well are similar to past sampling events. Initially, depth to water is measured in each well utilizing an electric measuring tape. All wells are then purged with a dedicated well developer until three casing volumes are removed or the well is pumped dry. Specific conductance and pH measurements are taken at the beginning and every 2-2.5 gallons thereafter. Samples are collected with a teflon bailer and titrating tube. Water samples

are stored in 40 ml VOA glass bottles (BTXE analysis) and a one liter glass bottle (TPH-D analysis). The first portion of the sample are analyzed and recorded in the field for DO and sulfate. Standard chain-of-custody procedures are followed. A California certified laboratory completes all analysis.

Frequency of sampling will be quarterly for one year. Subsequent to one year of sampling, data will be reviewed for no trend or a decreasing trend in TPH/BTXE concentrations. Based on this analysis, frequency of sampling, duration of sampling and/or analysis will be modified. In the event no trend or a decreasing trend is observed, monitoring will be terminated or reduced. Increases in concentrations will be interpreted as requiring continued monitoring and possibly initiation of contingency options.

Analysis of DO and sulfate are to be completed for the purpose of demonstrating the seasonal variability of each electron acceptor. Recalculation of the assimilative capacity of each constituent will be completed and compared with the level of TPH-G and BTXE detected in the sample. This information is needed to support demonstrated long-term intrinsic bioremediation at the subject property.

4.5 Contingency Plan

The contingency program will be utilized in the event significant contamination is detected during regrading of the site and/or groundwater monitoring detects an increasing trend in TPH-G and BTXE. An environmental consultant will be present to detect potential soil contamination during regrading activities.

In the event contaminated sediment is detected during regrading activities, strategic excavations will be completed to remove contaminated sediment. Excavated sediment will be stockpiled on site and allowed to aerate. After a period of time, aerated stockpiled material will be analyzed to determine whether it satisfies County cleanup action levels for sediment. If the material meets the requirements, it will be used as backfill in a portion of the subject property. If soil cleanup standards are not met, sediment will be disposed at an appropriate landfill. A signed manifest will be obtained for the disposal of sediment and submitted to the County.

During remedial excavation, sediment samples will be collected to verify that only uncontaminated sediment remains on the excavation walls and floor. Analysis of each sample will include TPH-D, TPH-G, TPHR and BTXE.

Continued groundwater monitoring is the initial contingency likely to be expedited. Intrinsic bioremediation is a relatively slow process which sometimes (especially during anaerobic degradation) requires greater than a year of monitoring to observe a decreasing trend in BTXE. If an increasing trend is identified, an extension to the monitoring program may be warranted. An inconsistent DO level along the down-gradient side may reduce the effectiveness of aerobic degradation in this area which may result in enhancing the size of the contaminant plume.

If a more aggressive action is warranted, a line of oxygen sources will be constructed at a depth which penetrates the saturated zone. This can be accomplished by advancing closely spaced small diameter borings, backfill the borings with layers of oxygen releasing material and continued monitoring of DO, TPH-G and BTXE. The intent of this remedial approach is to degrade TPH-G/BTXE along the down-gradient end of the subject property.

It is not likely that a more aggressive remedial approach would be warranted considering the low risk classification for this site.

5.0 Hazardous Material Removal

Past site investigations have generated sediment (drill cuttings) and water which has been stored in 55-gallon drums and temporarily located on the subject property. Eighteen (18) filled drums and one corroded drum were removed from the subject property and disposed according to local and state requirements. A signed manifest has been copied and provided in Appendix F.

Presently, one 55-gallon drum remains on the subject property. Drums will be used to temporarily store purged groundwater accumulated during quarterly groundwater sampling events.

ANALYSIS	WB-7	WB-8	WB-9	WB-12	WB-14
pH	6.4	6.8	6.4	7.0	6.7
Specific Conductance, uhos/cm	580	620	660	540	1300
Dissolved Oxygen, mg/l	1.4	2.4	3.0	1.4	0.6
Nitrate, mg/l	<0.05	<0.05	<0.05	7.0	<0.05
Iron, mg/l *	0.25	0.75	2.4	<0.1	0.9
Sulfate, mg/l	35	8	12	40	160
Ammonia Nitrogen, mg/l	0.15	0.30	0.7	0.2	0.45
Phosphate, mg/l	0.4	0.2	0.25	0.3	<0.1
Alkalinity, mg/l	372	320	332	220	592
Oil & Grease, mg/l	-	160	-	- **	6.9
TPH-D, ug/l	-	<50	-	- **	<50
TPH-G, ug/l	<50	230	300	<50	220
Benzene, ug/l	<0.5	2.2	10	<0.5	3.2
Toluene, ug/l	<0.5	<0.5	1.1	<0.5	<0.5
Xylene, ug/l	<0.5	2.0	4.4	<0.5	1.4
Ethylbenzene, ug/l	<0.5	5.5	9.6	<0.5	0.8

NOTE:

INORGANIC ANALYSIS COMPLETED BY COLORIMETRIC METHODOLOGIES (LA MOTTE TEST).
TOTAL PETROLEUM HYDROCARBONS (GASOLINE) AND BENZENE, TOLUENE, XYLENE AND ETHYLBENZENE ANALYZED BY EPA METHODS 8015 AND 8020.

SHADED AREAS IDENTIFY RESULTS WHICH EXCEED THE MCLs.

* UNFILTERED SAMPLE

SAMPLES COLLECTED JANUARY 1996

** SAMPLE COLLECTED FEBRUARY 16, 1996

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California 95628-2714
(916)967-1222

Title: GROUNDWATER CHEMICAL ANALYSIS
Site: 4800 SAN PABLO AVENUE, EMERYVILLE, CALIFORNIA
Project Number: 95286
Date: 01-22-96
Scale: NONE

TABLE 1

	Expressed BTXE (ug/L) Assimilative Capacity	
ELECTRON ACCEPTOR	PRIMARY WATER ZONE	PERCHED WATER ZONE
Dissolved Oxygen	450-955	191
Nitrate	0	0
Sulfate	8700	34780
Express Assimilative Capacity	9150	34971
Highest observed BTXE Conc.	25.1	5.4

On a mass basis, the ratio of oxygen consumption during BTXE metabolism is 3.14 mg oxygen to 1 mg BTXE.

On a mass basis, the ratio of ntirate consumption during BTXE metabolism is 4.9 mg nitrate to 1 mg BTXE.

On a mass basis, the ratio of sulfate consumption during BTXE metabolism is 4.6 mg to 1 mg BTXE.

The above ratios assume the absence of microbial cell production.

There is likely to be a small contribution of degradation resulting from nitrates however concentrations are not consistently detected in background wells (i.e. WB-7, WB-12).

Title: TABLE 2. EXPRESSED ASSIMILATIVE CAPACITY OF SITE

Project No.: 95286

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California
(916) 967-1222

Site: 4800 SAN PABLO AVENUE EMERYVILLE, CALIFORNIA

Scale: NONE

Date: 02-02-96

(empty)

TABLE 3. COST ESTIMATE OF BEST AVAILABLE TECHNOLOGY

SEDIMENT	
Alternative A. Soil Remediation by excavation (does not include shoring)	$118,500
Alternative B. Soil Remediation by Strategic Removal of Perched Groundwater Zone	$ 42,100
GROUNDWATER	
Alternative A. Construction of Interceptor Wells Operation and Maintenance, $5,700/year	$ 31,000
Alternative B. Alternative A plus Injection of Nutrients Operation and Maintenance, $6,000/year	$ 41,000

Assuming a 5-year recovery period for the achievement of the groundwater cleanup goals, cost may range from $59,500 to $99,500.

Total cost of cleanup can potentially range from $101,600 to $218,000. These cost estimates are not economically feasible considering the limitations of best available technologies and historic cleanup goals (MCL). The low risk of the subject property does not warrant this effort. Natural conditions are capable of reducing existing contaminants to low levels. Other attenuation mechanisms contribute to immobilizing the contaminant to the subject property.

(empty)

TABLE 4. HISTORIC GROUNDWATER LEVELS

DATE: January 11, 1996

Well	Depth to Groundwater
WB-7	8.88
WB-8	10.08
WB-9	12.67
WB-12	9.85
WB-14	6.52

DATE: July 27, 1994

Well	Depth to Groundwater
WB-7	10.48
WB-8	11.60
WB-9	14.19
WB-12	11.10
WB-14	7.77

DATE: June 20, 1994

Well	Depth to Groundwater
WB-7	9.62
WB-8	10.87
WB-9	13.48
WB-12	10.40
WB-14	7.00

Depth to water is reported in feet below top of casing. Measurements were made with an electric measuring tape.

	TPHR	TPH-G	BENZENE	TOLUENE	XYLENES	ETHYL-BENZENE
WB-7-10	-	<1	<0.005	<0.005	<0.015	<0.005
WB-7-20	-	<1	<0.005	<0.005	<0.015	<0.005
WB-8-15	<50	<1	<0.005	<0.005	<0.015	<0.005
WB-8-20	<50	<1	<0.005	<0.005	<0.015	<0.005
WB-9-15	<50	2.5	0.015	0.007	0.12	0.084
WB-9-20	<50	<1	<0.005	<0.005	<0.015	<0.005
B-10-10	-	1.5	<0.005	0.007	0.017	0.008
B-10-20	-	<1	<0.005	<0.005	<0.015	<0.005
B-11-10	-	<1	<0.005	<0.005	<0.015	<0.005
B-11-20	-	<1	<0.005	<0.005	<0.015	<0.005
WB-12-10	<50	<1	<0.005	<0.005	<0.015	<0.005
WB-12-20	<50	<1	<0.005	<0.005	<0.015	<0.005
B-13-10	-	<1	<0.005	<0.005	<0.015	<0.005
B-13-20	-	<1	<0.005	<0.005	<0.015	<0.005
WB-8-10	24	0.96	-	-	-	-

TPHR analyzed by EPA Method 418.1, oil & grease by IR spectrophotometer. Detectable limit is 50 mg/kg.
TPH-G analysis by EPA Method 5030 Purge & Trap. Detectable limit is 1 mg/kg.
Benzene, toluene, xylene and ethylbenzene analysis by EPA Method 8020. Detectable limit for benzene, toluene and ethylbenzene is 0.005 mg/kg and xylene is 0.015 mg/kg.
WB-8-10 was analyzed by TPH Volatile analysis utilizing a TCLP zero headspace extract.

Title: TABLE 5. SOIL LABORATORY DATA (PG. 1)

Project No.: 95286

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California
(916) 967-1222

Site: 4800 SAN PABLO AVENUE
EMERYVILLE, CALIFORNIA

Scale: NONE

Date: 02-2-96

TABLE 5. LABORATORY ANALYSIS

Sample Location	B	T	X	E	TPH-G	418.1
B-1-(6-7)	ND	ND	ND	ND	ND	ND
B-1-(10-10.5)	ND	0.019	0.36	0.044	7.1	3900
B-2-(8-10)	0.13	0.4	1.8	0.63	220	ND
B-2-(13-15)	ND	ND	ND	ND	ND	ND
B-3-(8-10)	0.96	ND	1.6	0.64	350	ND
B-3-(13-15)	ND	ND	ND	ND	ND	ND
B-4A-(8-10)	ND	ND	ND	ND	ND	ND
B-6-(4-5)	ND	ND	ND	ND	ND	990
B-6-(8.5-10)	0.063	ND	0.75	0.32	40	ND

Results reported in mg/kg (ppm).
No detectable levels of TPH-D and STLC Lead were detected in the above samples.
BTXE is benzene, toluene, xylene, and ethylbenzene.
BTXE analysis by EPA Method 8020. Reporting limit is 0.005 mg/kg.
TPH-Gasoline analysis by EPA Method 5030 Purge-and-trap, Reporting limit is 1 mg/kg.
TPH-Diesel analysis by modified EPA Method 8015. Reporting limit is 1 mg/kg.
Oil & Grease analysis by EPA Method 418.1 (IR Spectrophotometer). Reporting limit is 50 mg/kg.
Soluble Lead analysis by Lead STLC. Reporting limit is 0.05 mg/kg.
Lowest reporting limits are listed above. If sample extraction is diluted, reported limit increases accordingly (see laboratory reports).

	TPHR	TPH-G	BENZENE	TOLUENE	XYLENES	ETHYL-BENZENE	NITRATE	TOTAL COLIFORM	FECAL COLIFORM
WB-7	<1	<50	<0.3	<0.3	<0.9	<0.3	-	-	-
WB-8	<1	230	3.0	1.0	<0.9	0.6	<0.3	-	-
WB-9	<1	270	2.8	1.3	<0.9	<0.3	<0.3	-	-
WB-12	1.7	<50	<0.3	<0.3	<0.9	<0.3	9.2	<2	<2
WB-14	1.1	1900	65	3.2	10	<0.3	<0.3	9000	<2
MCL	-	-	1	100	1750	680	10		

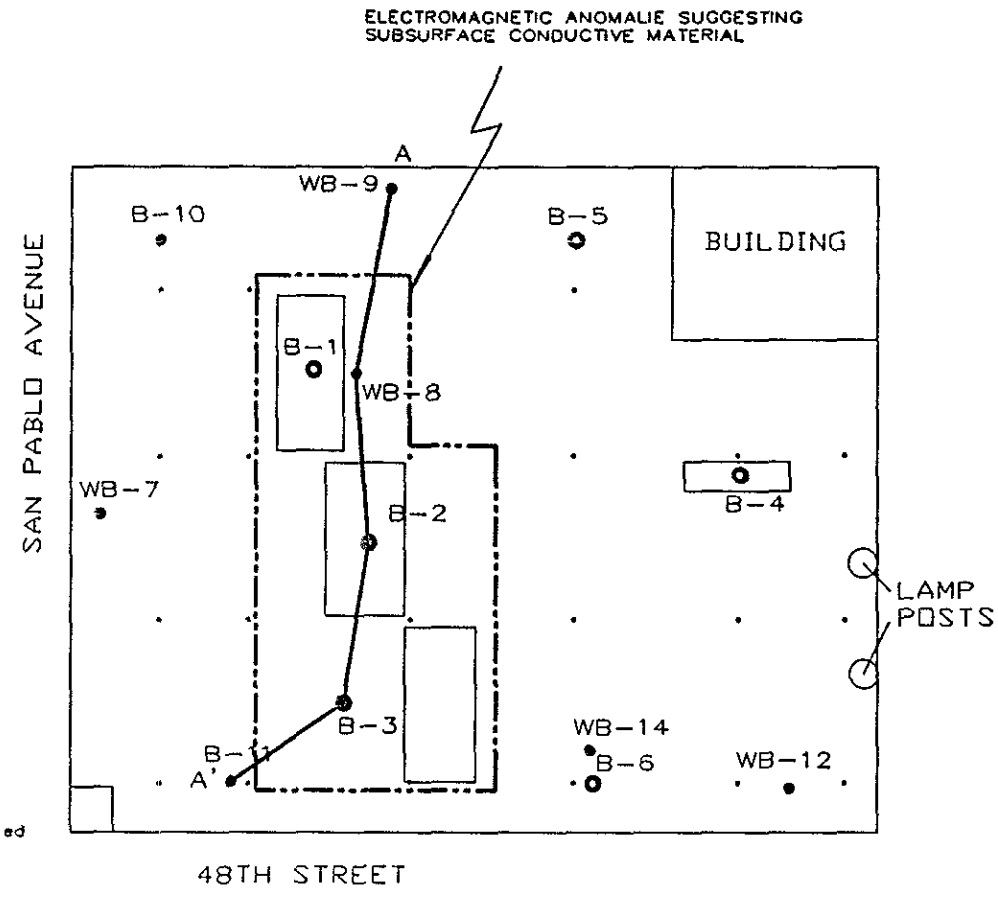
NOTES:
All chemical analysis reported in ug/l (ppb).
TPH analyzed by SM5520, Oil & Grease. Detectable limit is 1mg/l.
TPH-G analyzed by EPA Method 5030 Purge-and-Trap. Detectable limit is 50 ug/l.
Benzene, toluene, xylene and ethylbenzene analyzed by EPA Method 602. Detectable limit is 0.3 ug/l for benzene, toluene and ethylbenzene and 0.9 ug/l for xylene.
Nitrate analyzed in the field by a LaMotte field kit. Powdered cadmium is used to reduce nitrate to nitrite. The nitrite that is originally present and the reduced nitrate is determined by diazotizing sulfanilamide and coupling with N-(1 naphthyl)-ethylenediamine dehydrochloride to form a highly colored azo dye which is measured colorimetrically. Detectable limit is approximately 0.3 mg/l.
Total and Fecal Coliform analyzed by SM9221. Detectable limit is 2 MPN/100 ml.
Shaded areas identify results which exceed the MCL.]

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Sacramento, California 95628-2714
(916)967-1222

Title: GROUNDWATER QUALITY (JUNE 1994)
Site: 4800 SAN PABLO AVENUE EMERYVILLE, CALIFORNIA
Project Number: 94286-03
Date: 07-25-94
Scale: NONE
TABLE 6

Reproduced from USGS 7.5 Minute Series V895 (topographic)

Title: SUBJECT PROPERTY LOCATION MAP	Project No.: 93286-01	FIGURE 1
HydroSolutions of California, Inc. 11470 Sunrise Gold Circle, Suite 4 Rancho Cordova, California 95742 (916) 852-0188	Site: 4800 San Pablo Avenue Emeryville, California	
	Scale: 1 inch=2,000 feet	Date: 11-16-93



EXPLANATION

- B-5 — BORING
- WB-7 — GROUNDWATER MONITOR WELL
- SOIL-GAS SAMPLE

NOTES:

Exploratory drilling completed December 23, 1993 and June 16-17, 1994.

A Geoprobe system was used as the coring device for B-1 through B-6. A hollow stem augur was utilized for WB-7 through B-13.

Groundwater was encountered in boring, B-6, at 8.5 feet. Borings, B-1 through B-5 did not penetrate groundwater.

Soil-gas probes are illustrated as small dots. Twenty two probes were inserted to a 4.5-10.5 foot depth. Probes were removed after use.

Soil samples analyzed for total petroleum hydrocarbons, benzene, toluene, xylene, ethylbenzene, oil & grease, and soluble lead (B-1 through B-6).

Ground water monitoring wells designated as WB-__ . All wells except WB-14 are 30 feet deep, perforated between the 20 and 30 foot depths, gravel pack to 18 foot depth and grouted to the ground surface. A locking well head is constructed at grade for each well.

Well, WB-14, is 12 feet in depth, perforated between 7 and 12 feet, gravel packed to a 5 foot depth and grouted to the ground surface.

Borings, WB-7 through B-13, were surveyed with a transit and rod.

0 20 40 feet

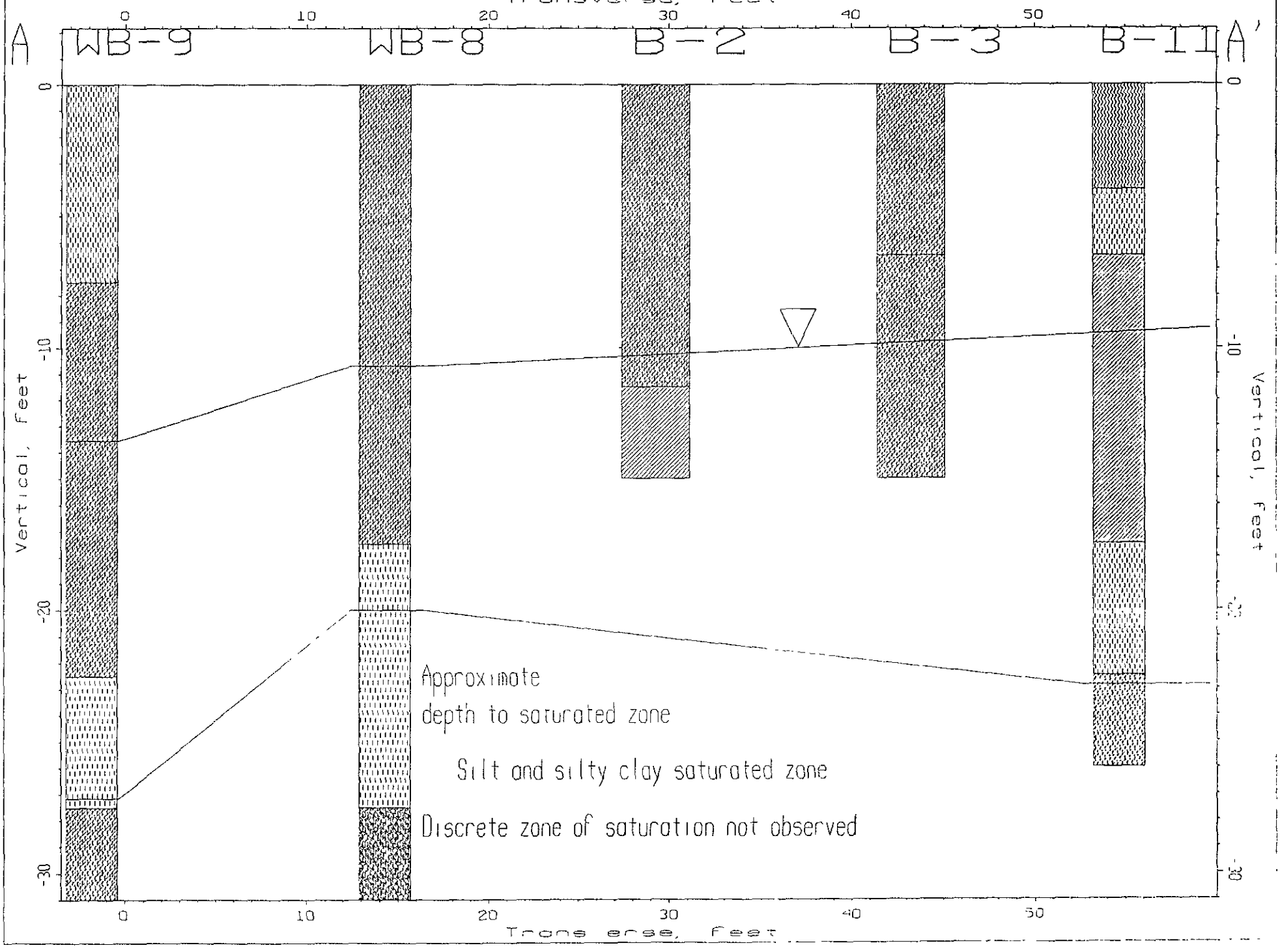
APPROXIMATE SCALE

B-13

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California 95628-2714
(916) 967-1222

Title	BORING/WELL LOCATION MAP
Site	4800 SAN PABLO AVENUE EMERYVILLE, CALIFORNIA
Project Number	95286
Date	01-22-96
Scale	AS SHOWN
FIGURE	2

FIGURE 4 NORTH-SOUTH CROSS-SECTION
4800 SAN PABLO AVENUE, SACRAMENTO



NOTES:

Exploratory drilling completed December 23, 1993 and June 16-17, 1994.

A Geoprobe system was used as the coring device for B-1 through B-6. A hollow stem augur was utilized for WB-7 through B-13.

Groundwater was encountered in boring, B-6, at 8.5 feet. Borings, B-1 through B-5 did not penetrate groundwater.

Soil-gas probes are illustrated as small dots. Twenty two probes were inserted to a 4.5-10.5 foot depth. Probes were removed after use.

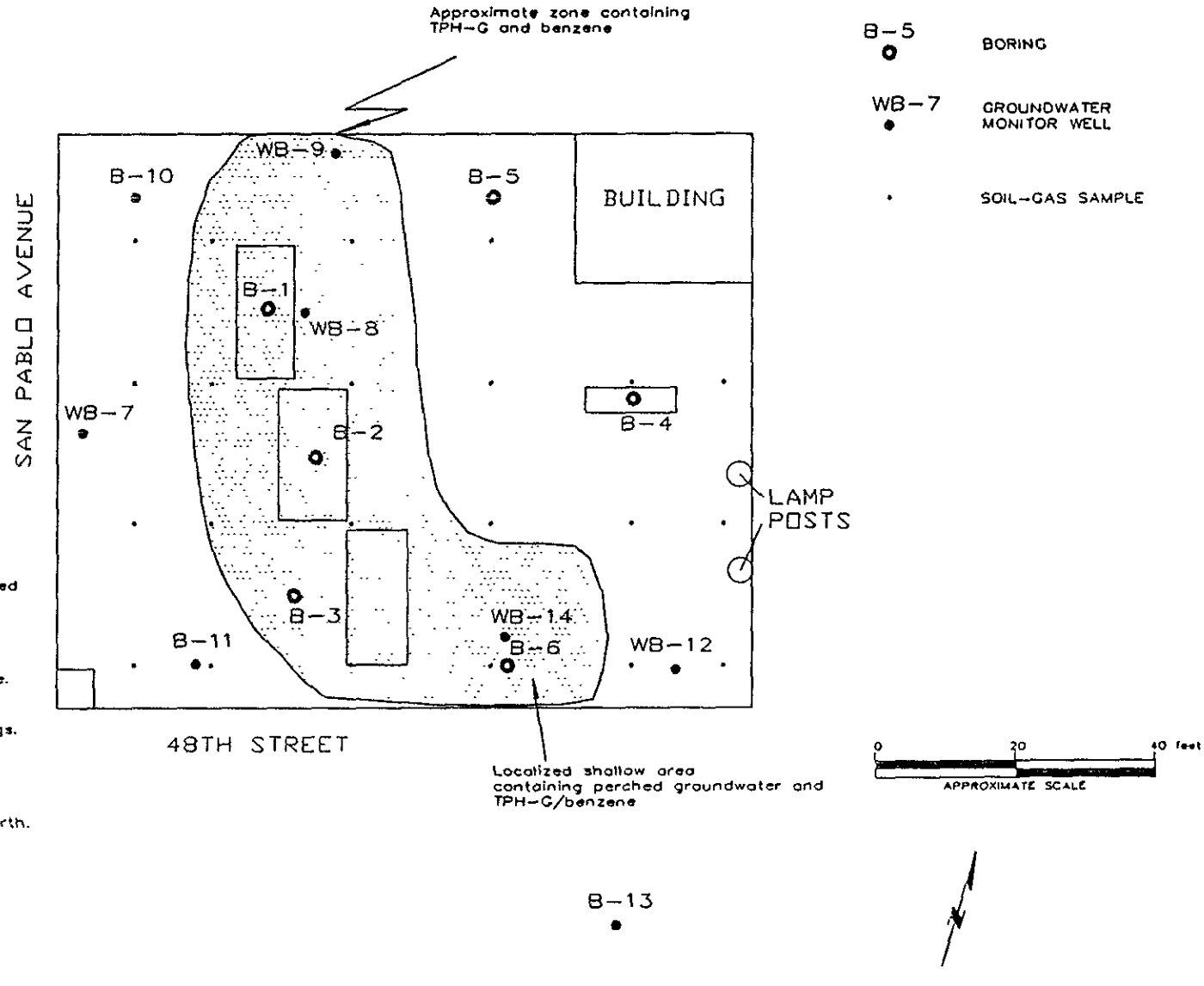
Soil samples analyzed for total petroleum hydrocarbons, benzene, toluene, xylene, ethylbenzene, oil & grease, and soluble lead (B-1 through B-6).

Ground water monitoring wells designated as WB-__ . All wells except WB-14 are 30 feet deep, perforated between the 20 and 30 foot depths, gravel pack to 18 foot depth and grouted to the ground surface. A locking well head is constructed at grade for each well.

Well, WB-14, is 12 feet in depth, perforated between 7 and 12 feet, gravel packed to a 5 foot depth and grouted to the ground surface.

Benzene concentrations illustrated adjacent borings. Reported in ug/l. Exact lateral dimensions approximate.

Direction of groundwater table slope is to the north.



HydroSolutions of California, Inc. 5917 Moss Creek Circle, Suite 2 Fair Oaks, California 95628-2714 (916) 967-1222	Title: EXTENT OF SOIL CONTAMINATION (BENZENE) Site: 4800 SAN PABLO AVENUE EMERYVILLE, CALIFORNIA	Project Number: 95286 Date: 01-22-96 Scale: AS SHOWN	FIGURE 4

NOTES:

Exploratory drilling completed December 23, 1993 and June 16-17, 1994.

A Geoprobe system was used as the coring device for B-1 through B-6. A hollow stem augur was utilized for WB-7 through B-13.

Groundwater was encountered in boring, B-6, at 8.5 feet. Borings, B-1 through B-5 did not penetrate groundwater.

Soil-gas probes are illustrated as small dots. Twenty two probes were inserted to a 4.5-10.5 foot depth. Probes were removed after use.

Soil samples analyzed for total petroleum hydrocarbons, benzene, toluene, xylene, ethylbenzene, oil & grease, and soluble lead (B-1 through B-6).

Ground water monitoring wells designated as WB-___ . All wells except WB-14 are 30 feet deep, perforated between the 20 and 30 foot depths, gravel pack to 18 foot depth and grouted to the ground surface. A locking well head is constructed at grade for each well.

Well, WB-14, is 12 feet in depth, perforated between 7 and 12 feet, gravel packed to a 5 foot depth and grouted to the ground surface.

Saturated zone at WB-14 is more shallow than water table (i.e. 7-10 foot depth instead of 20-25 foot depth). Static water level of perched groundwater zone is 8.56 feet below groundsurface. Static water level of water table at WB-12 is 9.85 feet below groundsurface.

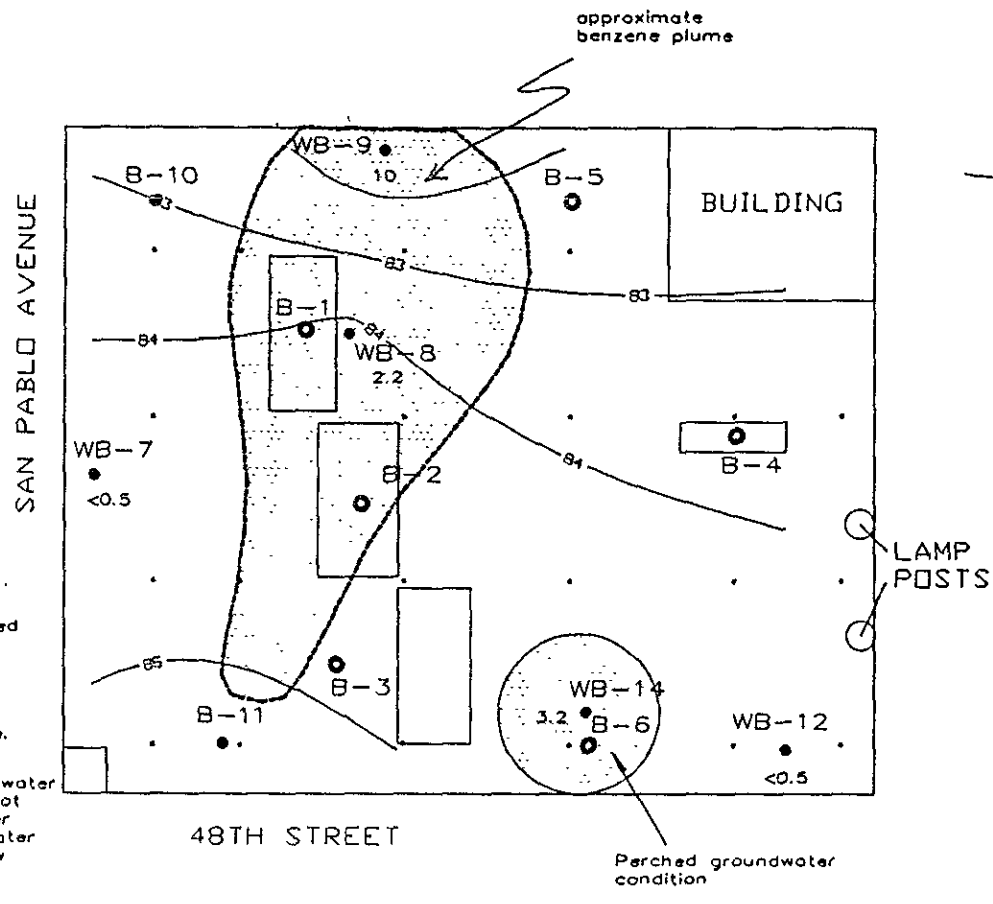
Direction of groundwater table slope is to the north.

Ground water level elevations are relative elevations.

Borings, WB-7 through B-13, were surveyed with a transit and rod.

Groundwater data interpreted by kriging methodology. Data from WB-7, WB-8, WB-9 and WB-12 utilized.

Water level measurements and water samples collected January 1996.



EXPLANATION

B-5 BORING

WB-7 1.2 GROUNDWATER MONITOR WELL AND BENZENE CONCENTRATION

80 GROUNDWATER TABLE CONTOUR LINE AND RELATIVE ELEVATION (FT)

SOIL-GAS SAMPLE

0 20 40 feet
APPROXIMATE SCALE

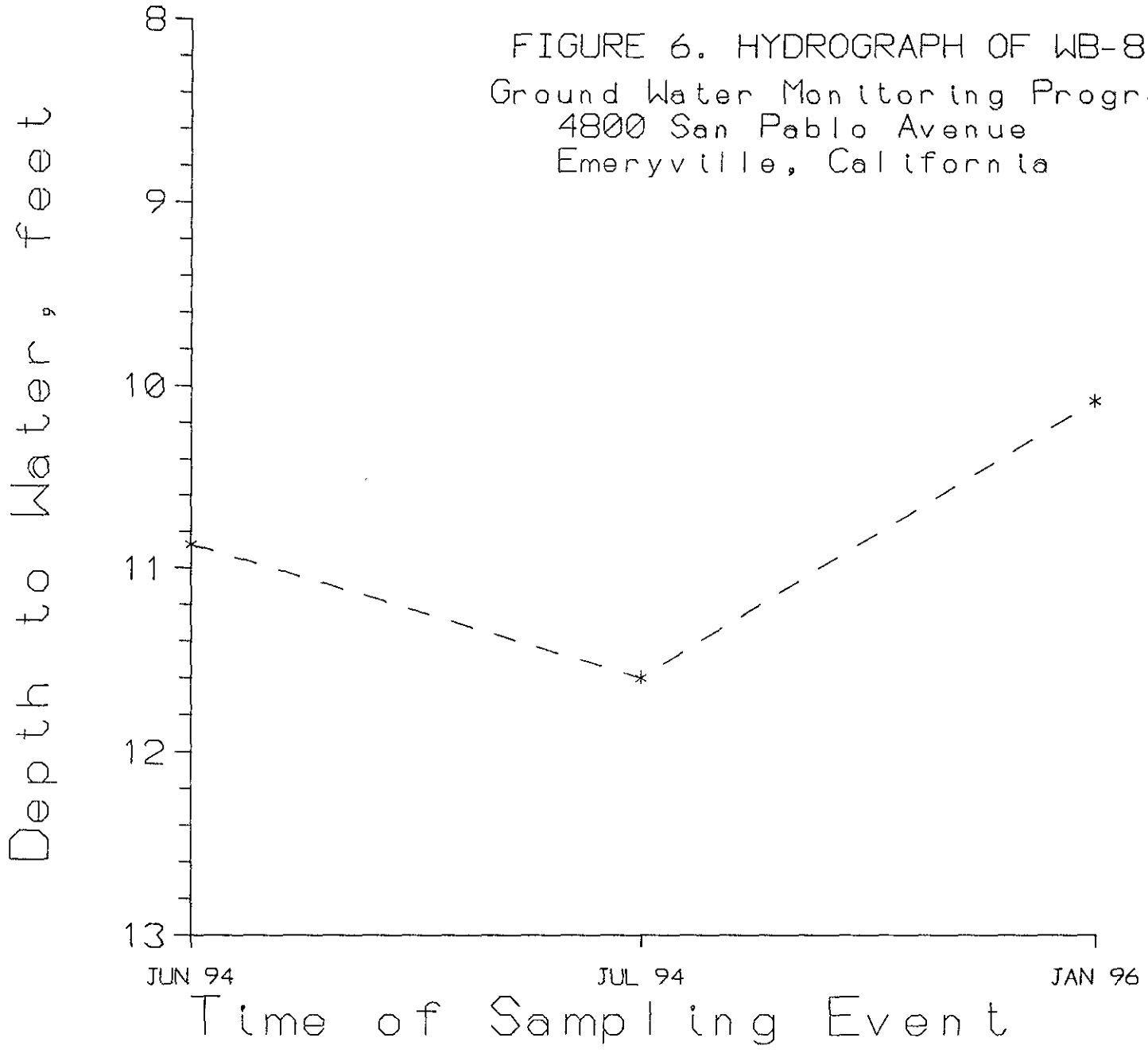
B-13

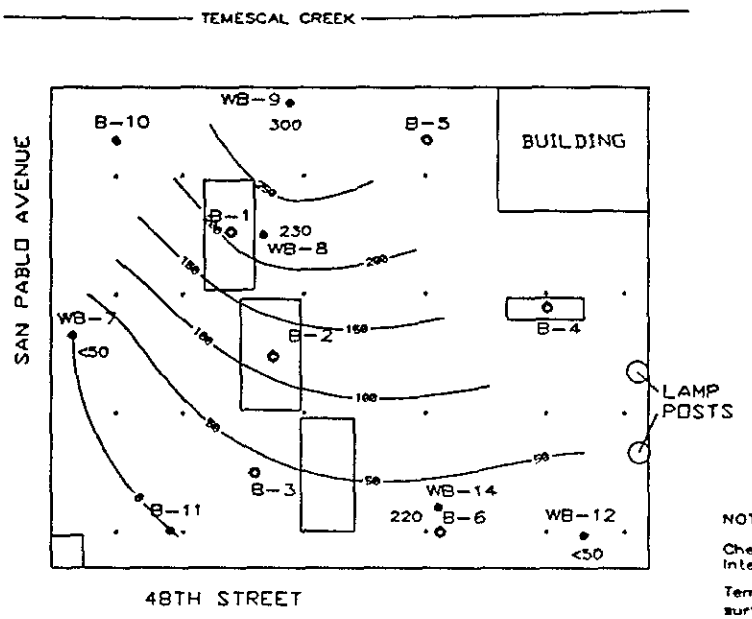
HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California 95628-2714
(916) 967-1222

Title	JANUARY 1996 GROUNDWATER TABLE MAP
Site	4800 SAN PABLO AVENUE EMERYVILLE, CALIFORNIA
Project Number	95286
Date	01-22-96
Scale	AS SHOWN
FIGURE	5

FIGURE 6. HYDROGRAPH OF WB-8

Ground Water Monitoring Program
4800 San Pablo Avenue
Emeryville, California





EXPLANATION

B-5 BORING

WB-7 GROUNDWATER MONITOR WELL

80 PETROLEUM HYDROCARBONS (TPH-G) CONTOUR LINE AND CONCENTRATION

SOIL-GAS SAMPLE

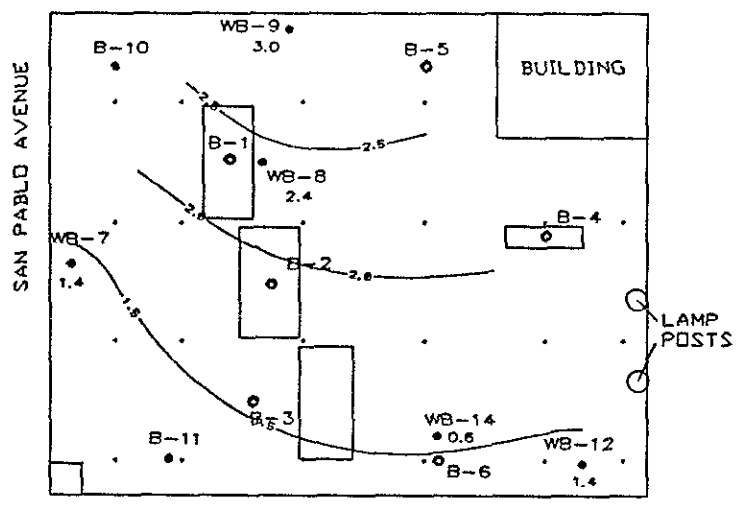
0 20 40 feet
APPROXIMATE SCALE

NOTE:

Chemical concentrations interpolated by kriging methodology. Interpretation only used to illustrate trend in concentration gradient.

Temescal Creek drainage appears abandoned. Area is backfilled. No visible surface water flow was present in January 1996.

B-13



80 DISSOLVED OXYGEN (MG/L) CONTOUR LINE AND CONCENTRATION

NOTE:

Dissolved oxygen measured in the field by a modified Winkler Method (titration). A LaMotte kit was used (accepted by EPA).

WB-14 not included in interpretation due to representing a perched water condition.

B-13

Title: FIGURE 7. DISSOLVED OXYGEN IN GROUNDWATER

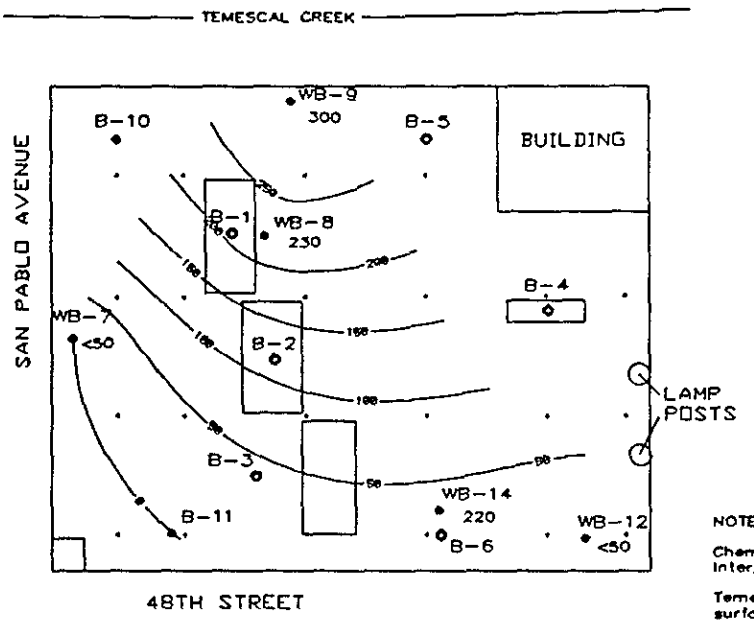
Project No.: 95286

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California
(916) 967-1222

Site: 4800 San Pablo Avenue Emeryville, California

Scale: AS SHOWN

Date: 01-22-96



EXPLANATION

- B-5 — BORING
- WB-7 — GROUNDWATER MONITOR WELL
- 80 — PETROLEUM HYDROCARBONS (TPH-G) CONTOUR LINE AND CONCENTRATION
- SOIL-GAS SAMPLE

0 30 40 feet
APPROXIMATE SCALE

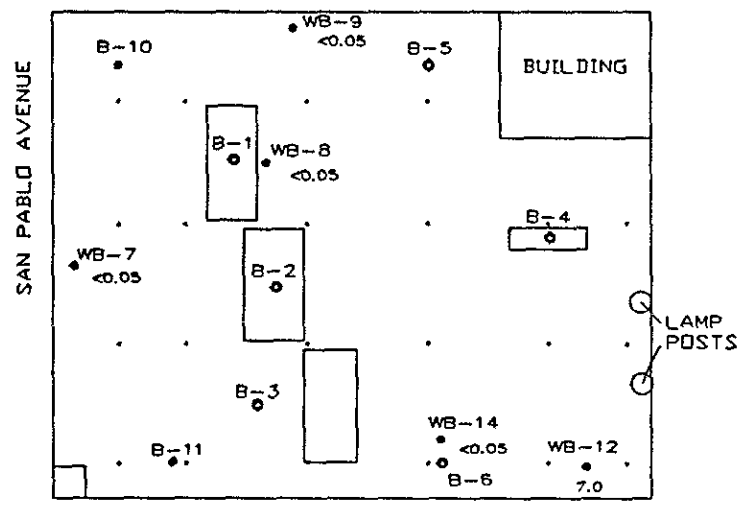
N

NOTE:

Chemical concentrations interpolated by kriging methodology. Interpretation only used to illustrate trend in concentration gradient.

Temescal Creek drainage appears abandoned. Area is backfilled. No visible surface water flow was present in January 1996.

B-13



- WB-7 — GROUNDWATER MONITOR WELL & NITRATE CONCENTRATION (MG/L)

Analysis completed by LaMotte field kit.

B-13

Title: FIGURE 8. NITRATES IN GROUNDWATER

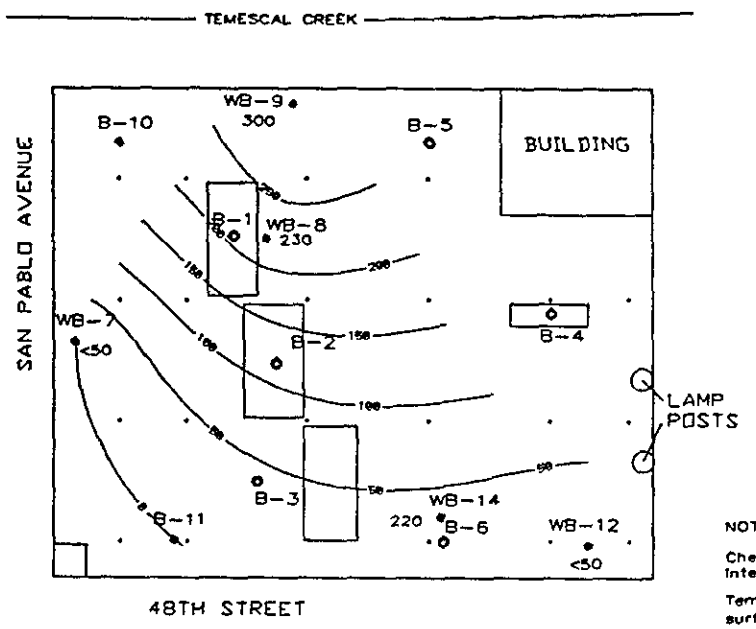
Project No.: 95286

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California
(916) 967-1222

Site: 4800 San Pablo Avenue
Emeryville, California

Scale: AS SHOWN

Date: 01-22-96



EXPLANATION

B-5 BORING

WB-7 GROUNDWATER MONITOR WELL

80 PETROLEUM HYDROCARBONS (TPH-G) CONTOUR LINE AND CONCENTRATION

SOIL-GAS SAMPLE

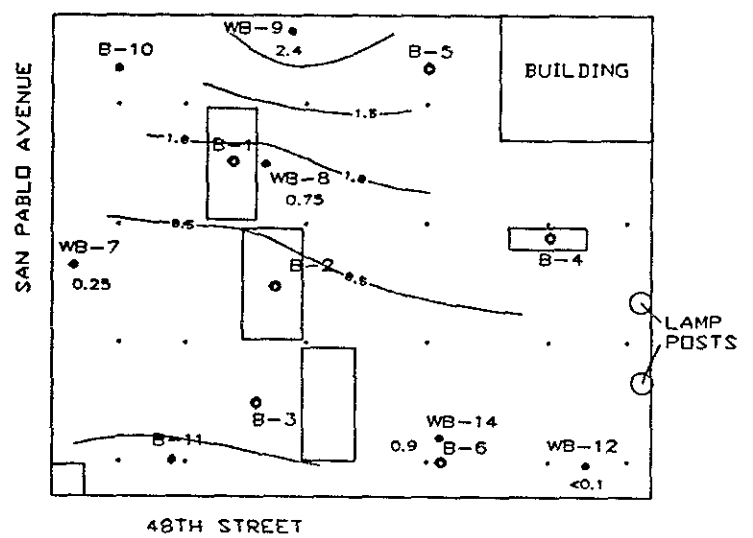
0 20 40 feet
APPROXIMATE SCALE

NOTE:

Chemical concentrations interpolated by kriging methodology. Interpretation only used to illustrate trend in concentration gradient.

Temescal Creek drainage appears abandoned. Area is backfilled. No visible surface water flow was present in January 1996.

B-13



80 IRON (MG/L) CONTOUR LINE AND CONCENTRATION

Analysis completed by LaMotte field kit.

WB-14 not included in interpretation due to representing a perched water condition.

B-13

Title:

FIGURE 9. IRON IN GROUNDWATER

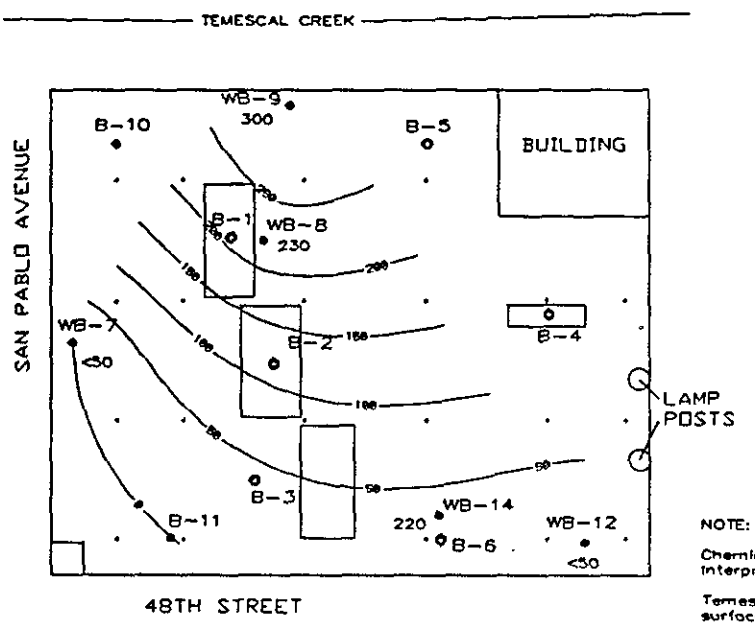
Project No.: 95286

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California
(916) 967-1222

Site: 4800 San Pablo Avenue
Emeryville, California

Scale: AS SHOWN

Date: 01-22-96



EXPLANATION

B-5 BORING

WB-7 GROUNDWATER MONITOR WELL

60 PETROLEUM HYDROCARBONS (TPH-G) CONTOUR LINE AND CONCENTRATION

SOIL-GAS SAMPLE

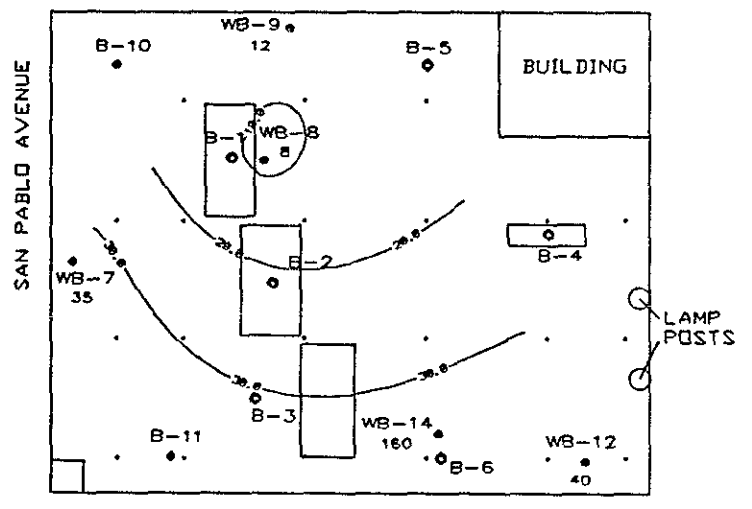
0 20 40 feet
APPROXIMATE SCALE

NOTE:

Chemical concentrations interpolated by kriging methodology. Interpretation only used to illustrate trend in concentration gradient.

Temescal Creek drainage appears abandoned. Area is backfilled. No visible surface water flow was present in January 1996.

B-13



60 SULFATE (MG/L) CONTOUR LINE AND CONCENTRATION

Analysis completed by LaMotte field kit.

WB-14 not included in interpretation due to representing a perched water condition.

B-13

Title: FIGURE 10. SULFATE IN GROUNDWATER

Project No.: 95286

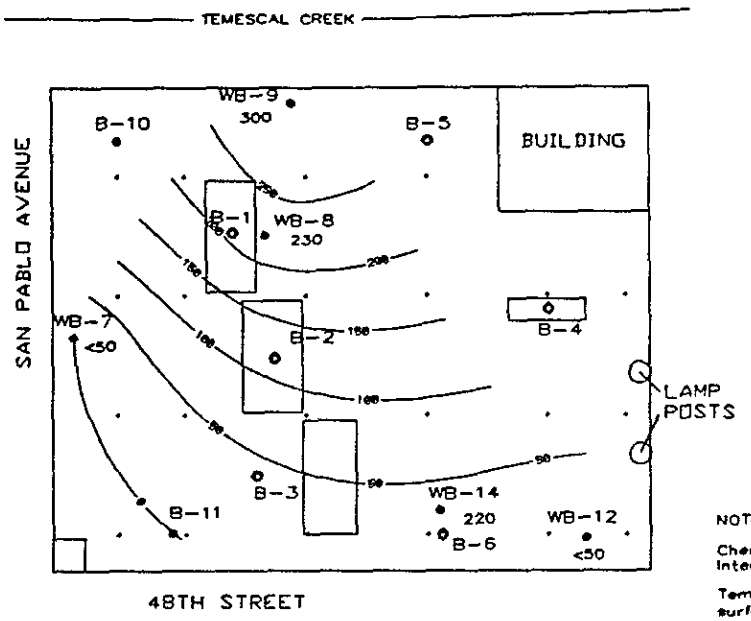
HydroSolutions of California, Inc.

5917 Moss Creek Circle, Suite 2
Fair Oaks, California
(916) 967-1222

Site: 4800 San Pablo Avenue
Emeryville, California

Scale: AS SHOWN

Date: 01-22-96



EXPLANATION

B-5 BORING

WB-7 GROUNDWATER MONITOR WELL

PETROLEUM HYDROCARBONS (TPH-G) CONTOUR LINE AND CONCENTRATION

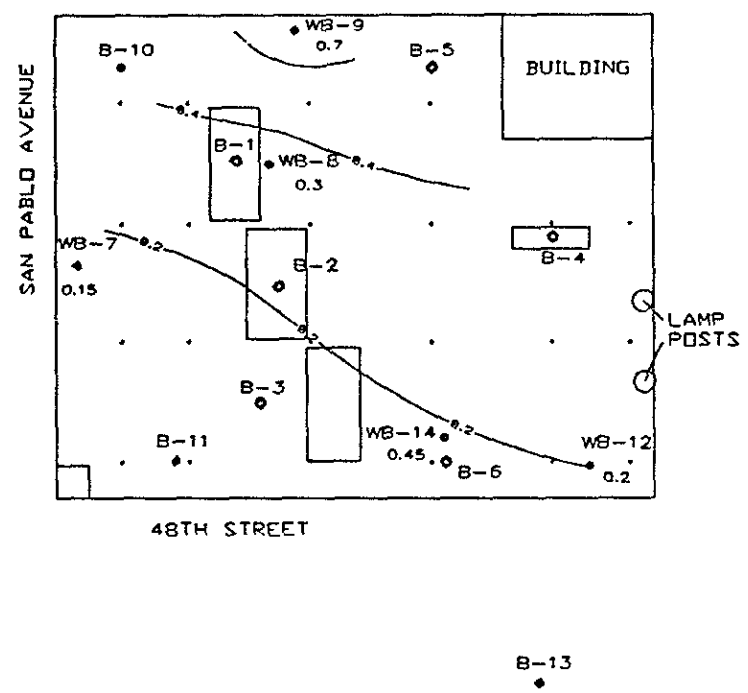
SOIL-GAS SAMPLE

0 20 40 feet
APPROXIMATE SCALE

NOTE:

Chemical concentrations interpolated by kriging methodology. Interpretation only used to illustrate trend in concentration gradient.

Temescal Creek drainage appears abandoned. Area is backfilled. No visible surface water flow was present in January 1996.



AMMONIA NITROGEN (MG/L) CONTOUR LINE AND CONCENTRATION

Analysis completed by LaMotte field kit.

WB-14 not included in interpretation due to representing a perched water condition.

Title:
FIGURE 11. AMMONIA NITROGEN IN GROUNDWATER

Project No.: 95286

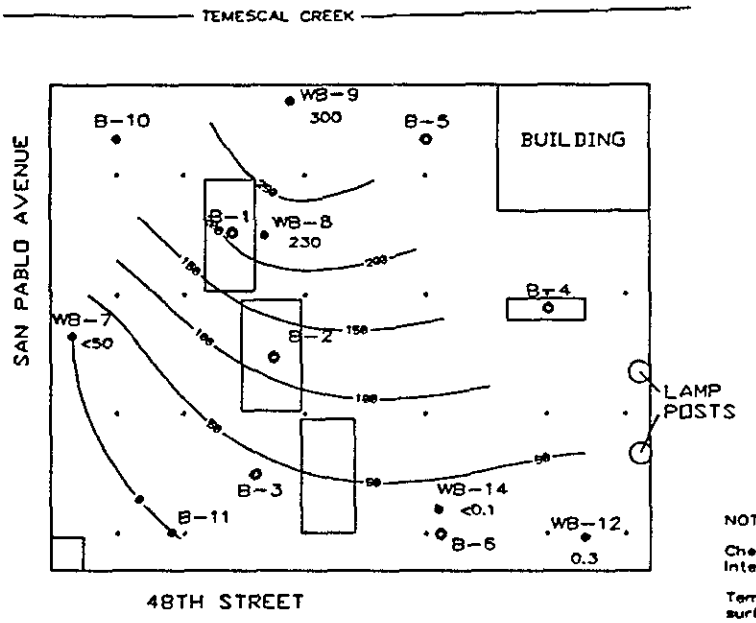
HydroSolutions of California, Inc.

5917 Moss Creek Circle, Suite 2
Fair Oaks, California
(916) 967-1222

Site:
4800 San Pablo Avenue
Emeryville, California

Scale: AS SHOWN

Date: 01-22-96



EXPLANATION

B-5 BORING

WB-7 GROUNDWATER MONITOR WELL

60 PETROLEUM HYDROCARBONS (TPH-G) CONTOUR LINE AND CONCENTRATION

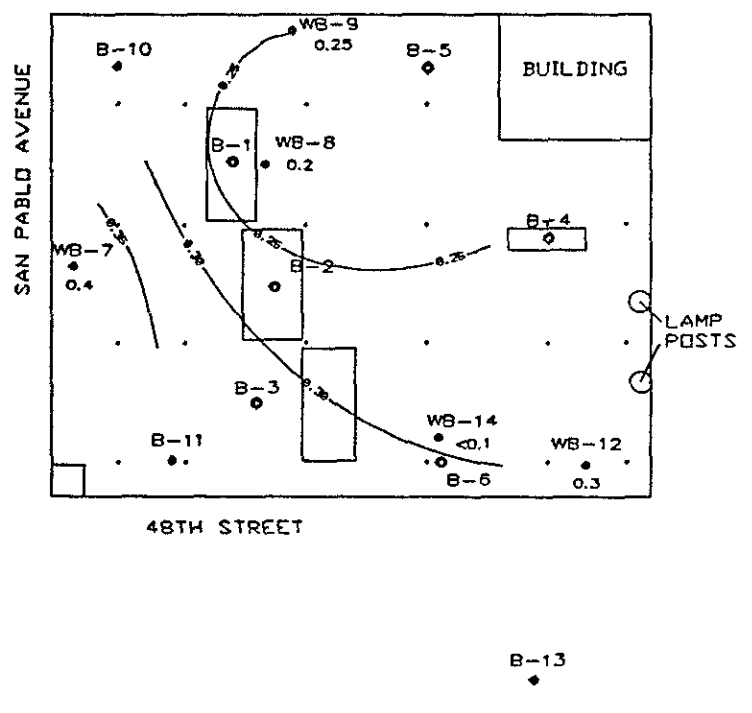
SOIL-GAS SAMPLE

0 20 40 feet
APPROXIMATE SCALE

NOTE:

Chemical concentrations interpolated by kriging methodology. Interpretation only used to illustrate trend in concentration gradient.

Temescal Creek drainage appears abandoned. Area is backfilled. No visible surface water flow was present in January 1996.



60 PHOSPHATE (MG/L) CONTOUR LINE AND CONCENTRATION

Analysis completed by LaMotte field kit.

WB-14 not included in interpretation due to representing a perched groundwater condition.

Title: FIGURE 12. PHOSPHATE IN GROUNDWATER

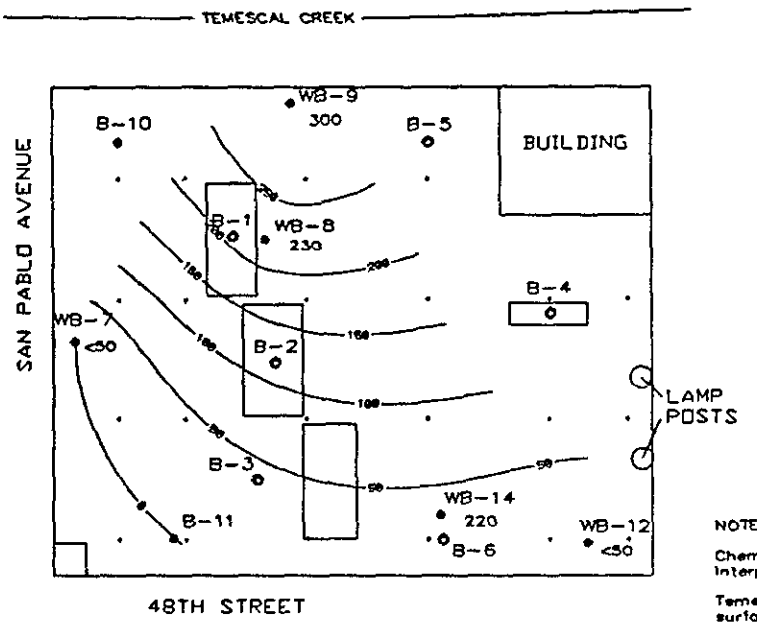
Project No.: 95286

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California
(916) 967-1222

Site: 4800 San Pablo Avenue Emeryville, California

Scale: AS SHOWN

Date: 01-22-96



EXPLANATION

B-5 BORING

WB-7 GROUNDWATER MONITOR WELL

80 PETROLEUM HYDROCARBONS (TPH-G) CONTOUR LINE AND CONCENTRATION

SOIL-GAS SAMPLE

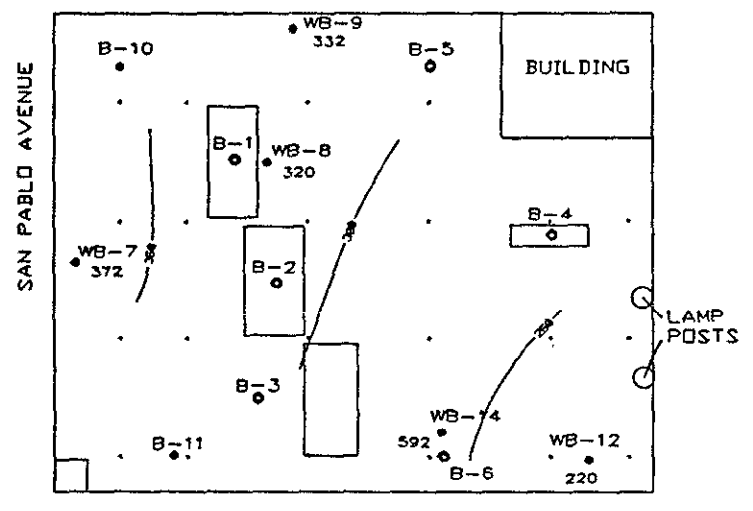
0 20 40 feet
APPROXIMATE SCALE

NOTE:

Chemical concentrations interpolated by kriging methodology. Interpretation only used to illustrate trend in concentration gradient.

Temescal Creek drainage appears abandoned. Area is backfilled. No visible surface water flow was present in January 1996.

B-13



80 ALKALINITY (MG/L) CONTOUR LINE AND CONCENTRATION

Analysis completed by LaMotte field kit.

WB-14 not included in interpretation due to representing a perched groundwater condition.

B-13

Title: FIGURE 13. ALKALINITY IN GROUNDWATER

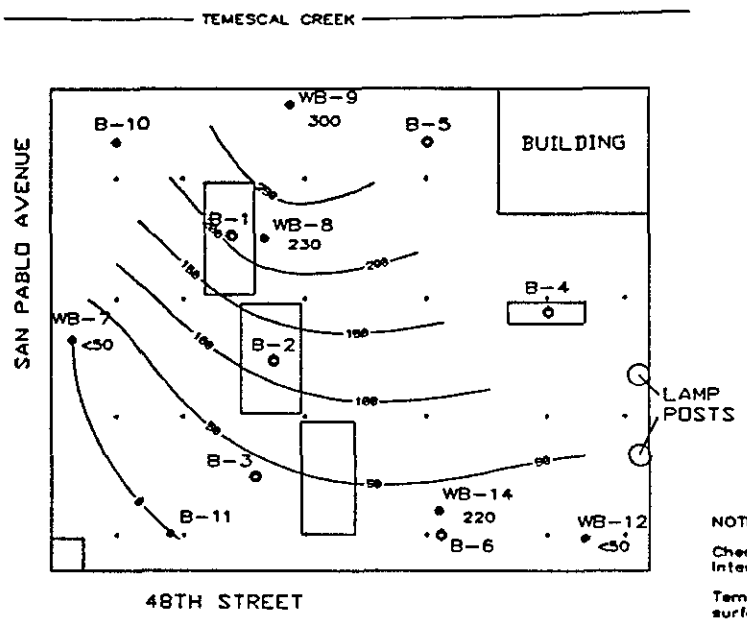
Project No.: 95286

HydroSolutions of California, Inc.
5917 Moss Creek Circle, Suite 2
Fair Oaks, California
(916) 967-1222

Site: 4800 San Pablo Avenue Emeryville, California

Scale: AS SHOWN

Date: 01-22-96



EXPLANATION

B-5 BORING

WB-7 GROUNDWATER MONITOR WELL

80 PETROLEUM HYDROCARBONS (TPH-G) CONTOUR LINE AND CONCENTRATION

SOIL-GAS SAMPLE

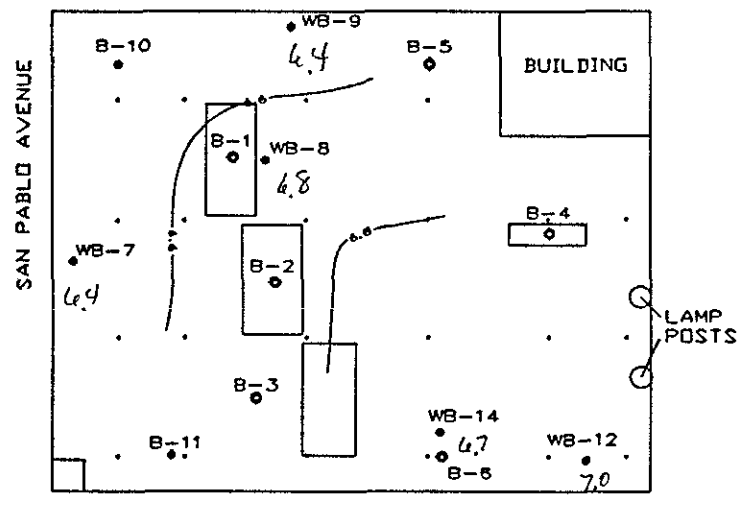
0 20 40 feet
APPROXIMATE SCALE

NOTE:

Chemical concentrations interpolated by kriging methodology. Interpretation only used to illustrate trend in concentration gradient.

Temescal Creek drainage appears abandoned. Area is backfilled. No visible surface water flow was present in January 1996.

B-13



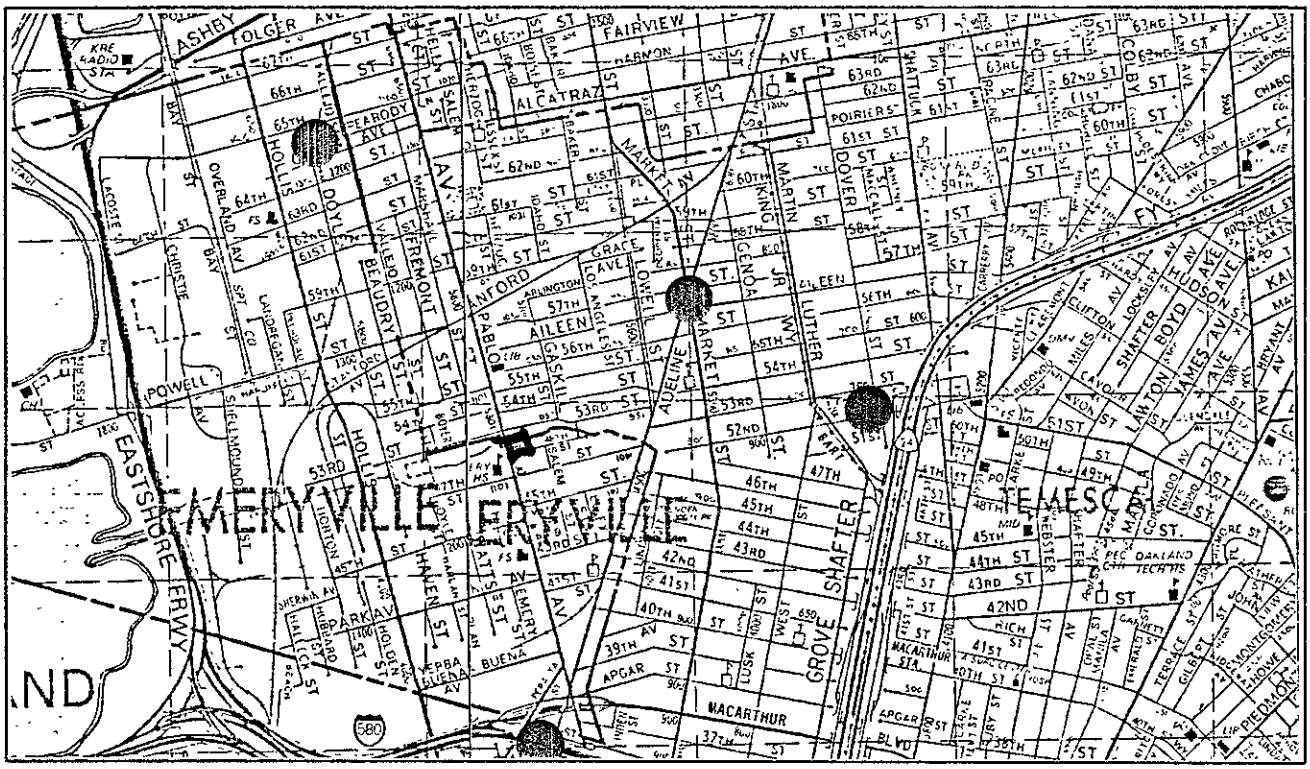
80 pH CONTOUR LINE AND CONCENTRATION

Measurement made with a Myron L field meter.

WB-14 not included in interpretation due to representing a perched groundwater condition.

B-13

Title: FIGURE 14. PH IN GROUNDWATER	Project No.: 95286
HydroSolutions of California, Inc. 5917 Moss Creek Circle, Suite 2 Fair Oaks, California (916) 967-1222	Site: 4800 San Pablo Avenue Emeryville, California
	Scale: AS SHOWN Date: 01-22-96



SUBJECT PROPERTY

NOTE:

Well data obtained from database generated by the County of Alameda, Public Works Agency.

Wells illustrated above include industrial, irrigation and domestic beneficial uses only. Monitoring, piezometers, borings, destroyed or abandoned wells are not included.

Title: DOMESTIC, IRRIGATION & INDUSTRIAL WELLS ADJACENT SUBJECT PROPERTY		Project No.: 95286	FIGURE 15
HydroSolutions of California, Inc. 5917 Moss Creek Circle, Suite 2 Fair Oaks, California 95628-2714 (916) 967-1222	Site: 4800 San Pablo Avenue Emeryville, California		
	Scale: None	Date: 01-22-96	