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TO: Alameda County HMD
ATTENTION: Rashila Logan
SUBJECT: Risk Assessment
FROM: Gary Pitchke
FAX NUMBER: 337-9335
DATE: 3/25/99
TOTAL PAGES: (INCLUDING COVER) 7

NOTES: As requested
Tables 1 & 3 to depth range.
GW contour maps from last event

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RISK-BASED CORRECTIVE ACTION REPORT

MARINER SQUARE
2415 Mariner Square Drive
Alameda, California

FEBRUARY 1999

Prepared for

Mr. John Beery
MARINER SQUARE & ASSOCIATES
2900 Main Street, Suite 100
Alameda, California 94501

Prepared by

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File No. NFE-4392-01
February 12, 1999

Mariner Square & Associates
2900 Main Street, Suite 100
Alameda, California 94501

Attention: Mr. John Beery

Subject: Mariner Square
2415 Mariner Square Drive
Alameda, California
RISK-BASED CORRECTIVE ACTION REPORT

Dear Mr. Beery:

Earth Systems Consultants Northern California (ESCNC) is providing the Risk-Based Corrective Action (RBCA) report for the above referenced site. The report presents the results of the Tier 2 evaluation for both residential and commercial. The evaluation indicates for each area that the level of risk remaining at the site is below RBCA calculated levels, except for limited areas of high concentrations. These levels indicate a low level of remaining risk from the hydrocarbons and other contaminants in soil at the site. A health based safety plan and recommendations for construction activity are included.

The main conclusions from the RBCA Tier 2 evaluation are as follows:

- Concentrations of TRPH are above the ACHCSA levels for a portion of the former bulk plant and adjacent parking lot. However, the volatile organic compounds normally associated with the TRPH are either reported as non-detectable or at low concentrations. Based upon the lack of volatile compounds, the TRPH concentrations does not provide a significant risk to use of the site.
- Groundwater monitoring and sampling at the site for four consecutive quarters indicates stable or declining concentrations of TPH as gasoline and BTEX. The monitoring results indicate a stable plume that is not migrating towards the estuary.
- Concentrations of lead in soil are generally 150 parts per million (ppm) or less, with two exceptions where the concentrations in soil are greater than 1000 ppm.
- The risk of exposure to soil and groundwater is currently low due to the proposed configuration, and as calculated for the proposed structures is in the 10E-5 to 10E-6 range. The receptor pathways are limited to dermal contact during construction and excavation. The groundwater at the site is not considered drinking water quality.

File No. NFE-4392-01
February 12, 1999

We appreciate this opportunity to be of service to Mariner Square & Associates. Should you have any questions or comments regarding this report, please feel free to contact us.

Very truly yours,

EARTH SYSTEMS CONSULTANTS
Northern California

Jeanne Buckthal
Staff Geologist

Gary Pischke
Senior Geologist
CEG 1501

Distribution: 1 to Addressee
1 to Texaco
1 to Phillips
1 to Union Pacific
2 to ACHCSA: Attention: Larry Seto

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INTRODUCTION

The Mariner Square site at 2415 Mariner Square Drive in Alameda, California (Figure 1) has been under assessment for bulk oil and hydrocarbon impacts to soil and groundwater from 1991 to 1998. In 1998, the results from groundwater sampling indicate that hydrocarbon concentrations in groundwater have declined to a level where evaluation of the site by risk assessment would provide conditional closure for the site. The proposed use of the site includes two areas: a commercial use- dry boat stack building on the west side; and a residential use- extended stay hotel use on the east side (Figure 2). Both of these uses are being evaluated in this study.

At the meeting in July 1998, the Alameda County Health Services Agency (ACHCSA) representative requested that a Risk-Based Corrective Action (RBCA) evaluation be performed on the worst case residential and commercial scenarios for the site. The risk based approach to corrective action has been developed after more than a decade of experience remediating petroleum contaminated sites, and is recommended by EPA in a memorandum from the Office of Solid Waste and Emergency Response (OSWER) number 9610.17 dated March 1, 1995. This approach allows an applicant to evaluate the potential risk to identifiable, site specific target receptors of known contaminants. The procedures are designed to provide conservative evaluations such that real risk may actually be lower.

Site Description

The subject site is located in Alameda, California in an area of commercial, light manufacturing and military usage immediately adjacent to and east of the Fleet Industrial Supply Center, Alameda Annex and west of the Oakland Inner Harbor. Currently, the site is occupied by railroad boxcars which have been converted to offices, a restaurant, and several buildings housing companies catering to the marine industry such as boat sales, storage, repairs, painting and sail manufacturing. The site includes an interlocking concrete sheet piling which forms the boundary between the north side of the site and the Alameda Estuary; a sheetpile and concrete bulkhead, which is near the eastern site boundary, installed during the construction of the Webster Tube; and wooden pilings and concrete bulkhead that support the concrete fire wall surrounding the former ASTs. The subject site was reclaimed from marshlands in the late 1890's. Available maps indicate the site now occupies tidal channels present in the former marshland (Figure 2).

Site Ownership and Past Uses

The site was previously owned by Phillips Petroleum who purchased the site from Tidewater/Texaco. The site was used for bulk fuel storage and distribution of refined oils, motor lubricants, and fuel oils for use by ships until 1972. It is estimated that the site was used for bulk fuel storage and distribution as early as 1916. During the height of bulk fuel storage and distribution, the site consisted of 16 above ground storage tanks (ASTs) of various sizes and contents, two crude oil ASTs (37,000 and 30,000 barrels), a fire wall surrounding the ASTs, two underground pipelines, a pipeline wharf, a mixing tank, a warehouse/pumphouse, a reinforced concrete oil warehouse, and various buildings.

Proposed plans for the site include dividing the property into two parcels. An extended-stay hotel and parking lot would be constructed on the eastern parcel, and a dry boat storage facility and parking lot would be constructed on the western parcel.

Summary of Past Releases/Potential Source Areas

As a result of past operations at the subject site, there is remaining contamination in the soil and groundwater beneath the site. The apparent sources of contamination include the former ASTs and the underground pipelines. The contaminants of concern have included total recoverable petroleum hydrocarbons (TRPH); total petroleum hydrocarbons as gasoline, diesel, and motor oil (TPHg, TPHd, and TPHmo, respectively); benzene, toluene, ethylbenzene, total xylenes (BTEX) and methyl tert-butyl ether (MTBE); polynuclear aromatics (PNAs); total lead; and soluble threshold limit concentration (STLC) lead.

Geology and Hydrogeology

The local geology consists of clayey to silty sand (hydraulic fill) from approximately 7 to 17 feet below ground surface (bgs). Since the site was reclaimed from marshlands, the former tidal channels may contain thicker hydraulic fill deposits than elsewhere. The hydraulic fill was mechanically placed prior to the development of this portion of Alameda. Below the hydraulic fill, the sediment consists of olive-gray sandy to silty clay with sand lenses, shells and organic matter from approximately 13 to 30 feet bgs, known as Bay Mud.

Regional groundwater flow is predominantly westerly toward San Francisco Bay, but groundwater beneath the site generally flows toward the south-southeast. The discrepancy may be the result of

several man-made barriers that could impede groundwater flow beneath the site. These barriers include interlocking concrete sheet piling that forms the boundary between the north side of the site and the Alameda Estuary; a sheetpile and concrete bulkhead, located along the eastern site boundary, installed during the construction of the Webster Tube; and wooden pilings and concrete bulkhead that support the concrete fire wall surrounding the former ASTs.

A tidal influence study completed by SCI (1992) suggests that the concrete sheet piling forming the northern property boundary on the estuary, as well as the sheet piling and bulkhead related to the Webster Tube, form effective barriers to groundwater flow. The fire wall foundation is comprised of spread footing four feet below ground surface, as found at the MW-6 excavation. The firewall's impact to groundwater flow appears to limit contaminant movement within the former tank farm.

Summary of Site Activities

On November 25, 1991, AllWest Environmental, Inc. (AllWest) performed a Phase I Environmental Site Assessment of the property (AllWest, December 3, 1991). AllWest recommended a soil and groundwater investigation related to the fuel and oil storage, refining and distribution, and for contaminants related to boat maintenance, painting and repair.

In April 1992, AllWest supervised the placement of 23 geoprobes (MS-1 through MS-23), collecting and analyzing 23 soil samples and four groundwater samples (AllWest, May 1, 1992). TRPH was detected in 20 of the soil samples with a maximum concentration of 13,000 parts per million (ppm). Two of the groundwater samples contained detectable hydrocarbons with a maximum concentration of 1,200 ppm. The analytical results for soil and groundwater samples are summarized in Tables 1 and 2, respectively.

In July 1992 Subsurface Consultants, Inc. (SCI) supervised the drilling of six soil borings and the installation of six two-inch diameter monitoring wells (MW-1 through MW-6). TPHd concentrations were detected in two of the six soil samples and ranged from non detectable to 220 ppm (SCI, December 23, 1992). The analytical results are summarized in Table 1.

On June 14, 1994, McLaren/Hart supervised the drilling of 11 soil borings (SB-A through SB-K), collecting and analyzing 28 soil samples, and installing three four-inch diameter monitoring wells (MW-7, MW-8, and MW-9 in soil borings MW-7, MW-8, and SB-C, respectively). Soil results indicated the maximum petroleum hydrocarbon level (TPHmo at 9,200 ppm) in SB-C/MW9 at a

depth of 1.5 feet. In addition, initial groundwater results from wells MW-7 through MW-9 indicated the maximum petroleum hydrocarbon level (TPHd at 2,200 parts per billion [ppb]) in well MW-9. Prior to installing the new wells, hydrocarbons were detected in groundwater samples collected from wells MW-1 through MW-6, and vinyl chloride and Freon-113 were detected in groundwater samples collected from wells MW-2 and MW-4 (McLaren/Hart, March 31, 1995). All monitoring well locations are shown on Figure 2. Soil and groundwater analytical results are summarized in Tables 1 and 2, respectively.

In a letter dated December 26, 1995, Ms. Juliet Shin of ACHCSA Environmental Protection Division required removal of the two remaining underground storage tanks (USTs) at the site. Additionally, the letter required a minimum of four consecutive quarterly groundwater monitoring events to delineate the plume of contamination and assure that migration is not occurring offsite or into the San Francisco Bay. Subsequently, groundwater monitoring events were performed in the third and fourth quarters during 1997 and the first and second quarters during 1998. The latest groundwater monitoring and sampling was performed on May 8, 1998 (Hydro-Environmental Technologies, June 12, 1998). The gradient map is shown on Figure 3.

Well MW-6 was destroyed on April 28, 1998, prior to the second quarter event. The well was destroyed during the excavation of hydrocarbon-bearing soil encountered during the search for a water main leak. The results are discussed in the May 8, 1998 quarterly monitoring report by Hydro-Environmental Technologies, Inc.

As requested in the ACHCSA letter dated July 30, 1998, ESCNC collected three hydropunch groundwater samples (HP-1 through HP-3) in the vicinity of former well MW-6 on September 3, 1998. The analytical results indicated maximum concentrations of TPHg, TPHd, and TPHmo of 10,000 ppb, 410,000 ppb, and 12,000 ppb, respectively. Benzene was only detected in HP-3 at a concentration of 1.0 ppb. Phenanthrene was detected in HP-1 at 27 ppb, and pyrene was detected in HP-3 at 26 ppb. The groundwater analytical results are included in Table 2.

On November 21, 1998, ESCNC personnel supervised the removal of two pipelines (PL1 and PL2) near MW-5 and MW-2 by Zaccor Companies, Inc. (Figure 2). All of pipeline PL1 and approximately half of pipeline PL2 were removed. The remainder of PL2 was not accessible due to overlying concrete. Twelve (12) soil samples were collected from depths ranging from 1.8 to

2.3 feet beneath the former pipelines at 20 foot intervals. The samples were analyzed for TPHg, TPHd, and TPHmo, BTEX, MTBE, total lead, and PNAs.

During the preliminary data gathering phase for the RBCA evaluation, data gaps were encountered for STLC lead and PNAs results in soil. The highest concentration of total lead at the site was detected in boring SB-J at 5,700 ppm, but the corresponding STLC lead analysis was not conducted. In addition, there were no background levels for PNAs, total lead, and STLC lead. Metals analyses in soil are summarized in Table 3.

Therefore, on December 7, 1998, two direct push borings (DP-1 and DP-2) were advanced near the locations of former soil borings SB-J and MW-1, respectively, and at depths similar to those for the initial soil samples. Soil samples were collected and analyzed for PNAs, total lead, and STLC lead. PNAs were not detected in soil samples from DP-1 and DP-2. Total lead was detected in DP-1 at 7.5 ppm and not detected in DP-2. Due to the low total lead concentration, the sample from DP-1 was not analyzed for STLC lead.

Concentrations of TPHmo ranged from less than 1.0 to 1,600 ppm; TPHd ranged from less than 1.0 to 1,000 ppm; and TPHg ranged from less than 1.0 to 1,100 ppm. Benzene and MTBE were not detected in any samples. Total lead concentrations ranged from less than 5.0 to 150 ppm. The sample with the reported 150 ppm total lead was also analyzed for STLC lead. The result was 7.9 ppm, indicating some soluble lead in the soil. The PNAs naphthalene and 2-methylnaphthalene were reported at 230 ppm and 260 ppm, respectively. The analytical results are summarized in Tables 1, 3 and 4. The results are reported in the ESCNC pipeline removal report dated January 4, 1999.

Summary of Beneficial Uses

The beneficial uses at the site include a proposed redevelopment of the site to include a dry stack boat storage warehouse, an extended stay hotel, and associated parking lots. The groundwater beneath the site does not appear to have a potential future beneficial use due to its brackish nature. Total dissolved solids (TDS) at the site range from 580 ppm (MW-4) to 4,100 ppm (MW-8). Results are shown in Table 3. Offsite TDS has been reported by the adjacent Navy property as greater than 3,000 ppm. There are no water supply wells located downgradient (south-southeast) within 1/4-mile of the site. Groundwater is not used for beneficial use in the area. There is no

surface water at the site, however, the Oakland/Alameda Estuary is located north of and adjacent to the site. The estuary is used for recreation use.

RISK ASSESSMENT

The risk assessment at the subject site was conducted in accordance with the American Society for Testing and Materials (ASTM) Standard Guide E1739-95^{e1}, the Risk-Based Corrective Action Applied at Petroleum Release Sites. The RBCA is a tiered approach involving increasingly detailed levels of data collection and analysis, and the assumptions of earlier tiers are replaced with site specific data and information. The Tier 1 evaluation involves a general look-up table, containing risk-based screening levels (RBSLs) derived for standard exposure scenarios, to determine whether the site conditions warrant regulatory closure. If site conditions exceed the RBSLs, a Tier 2 evaluation allows the option of determining site-specific target levels (SSTLs) and points of compliance using site-specific parameters. For this site, **Tier 2 evaluations for commercial and residential were requested by the ACHCSA.**

Additional resources used in this risk assessment were the Rationale for Modifying the Tier 1 Petroleum Hydrocarbon Saltwater Ecological Protection Zone (SEPZ) Levels for the San Francisco International Airport (draft December 10, 1997) by the Regional Water Quality Control Board (RWQCB); the Department of Toxic Substances Control's (DTSC) Assessment of Health Risks from Organic Lead in Soil (August 1992); and the DTSC Memorandum to the Preliminary Endangerment Assessment Guidance Manual - Errata Sheet (March 20, 1998).

For the contamination remaining at the subject site to pose a possible threat to human health or the environment, there must be a transport mechanism, a complete exposure pathway, and a potential receptor. Transport mechanisms may include air, water, or soil. Exposure pathways include ingestion, inhalation, and dermal contact. Potential receptors include any persons, structures, utilities, surface waters, or groundwater that may come into contact with the transport mechanism via an exposure pathway.

For the proposed commercial area of the subject site, the potential onsite receptors would include construction workers, employees, groundwater, and the estuary. For the proposed residential area of the subject site, the potential onsite receptors would include construction workers, employees, short-term hotel residents, groundwater, and the estuary.

Discussion of Evaluation

To evaluate the risk to human health and the environment of the remaining contamination at the subject site, the property was divided into commercial (dry boat storage) and residential (extended-stay hotel) settings based on the boundary shown on Figure 2. The location of contamination within each setting was further subdivided into surface soils (less than 3 feet deep), subsurface soils (equal to and greater than 3 feet deep), and groundwater. The primary remaining contaminants of concern in soil, as identified by the ACHCSA, at the site are TRPH, PNAs, and total lead. Contaminants of concern in groundwater are mainly PNAs and BTEX.

Surface Soil Contamination Evaluation

Surface soil samples were collected from borings MS-16 through MS-23 and analyzed for TRPH and BTEX. TRPH concentrations ranged from non-detectable in MS-22 to 11,000 ppm in MS-18 (Figure 4). The surface soil sample collected from boring SB-C was analyzed for TPHmo and BTEX. TPHmo was detected at a concentration of 9,200 ppm in SB-C. BTEX results for surface soil samples indicated concentrations below detection limits or below levels of regulatory concern.

Surface soil samples were collected from borings SB-A through SB-K and analyzed for total lead. Total lead concentrations ranged from 8.0 ppm in SB-D to 5,700 ppm in SB-J (Figure 5). STLC lead was analyzed for surface samples collected from borings MW-2, MW-5, SB-G, SB-H, and SB-K and ranged from 2.7 ppm in SB-G to 28 ppm in MW-2.

PNAs concentrations in soil ranged from non-detectable to 260 ppm Naphthalene. Analytical results for soil samples are summarized in Tables 1,3 and 4.

Based on analytical results, contamination remaining in surface soil at the subject site includes TRPH, TPHmo, total lead, STLC lead, and PNAs.

Subsurface Soil Contamination Evaluation

TRPH concentrations in subsurface soil ranged from non-detectable up to 13,000 ppm in MS-4. Of the subsurface samples, ten contained TRPH concentrations greater than 2,000 ppm (Figure 4). TPHmo concentrations in subsurface soil greater than 2,000 ppm were identified in two samples collected near MW-6 and one sample collected beneath tank T1. However, the soil in the vicinity of MW-6 was overexcavated and backfilled with clean soil. The maximum concentration of TPHg

in subsurface soil was 350 ppm beneath tank T1. BTEX results for surface soil samples indicated concentrations below detection limits or below levels of regulatory concern.

Total lead concentrations in subsurface soil ranged from 3.5 ppm beneath tank T1 to 150 ppm beneath tank T2 (Figure 5). STLC lead concentrations ranged from non-detectable in DP-2 to 0.79 ppm in MW-3.

PNA concentrations were not detected in subsurface soil samples DP1 and DP2. DP2 was sampled to provide background levels for PNAs.

Based upon soil sample results, TRPH is widespread throughout the site, but does not contain volatile compounds, i.e. BTEX (Table 1). The soil sample results from the pipeline further indicate that the volatile portion of the hydrocarbons in the soil has been reduced by biodegradation or was not present in high percentages in the original fuel oil released at the site. As a result of this evaluation, BTEX has not been included in the chemicals of concern in the RBCA Tier 2 evaluation.

Groundwater Contamination Evaluation

Based upon proximity to the estuary and TDS results, the groundwater at the site is not considered drinking water. As a result of this observation, the potential risk exposure of drinking water was eliminated from the RBCA Tier 2 evaluation.

BTEX have been detected in groundwater beneath the site. However, the most recent four consecutive quarters of monitoring have shown the BTEX levels to be stable or declining in the monitoring wells remaining at the site.

Prior to the destruction of well MW-6, free product was reported. The free product was removed by a combination of Petrotrap collection method and soil excavation in the vicinity of MW-6. A follow-up hydropunch event sampled the groundwater in the area of MW-6, and free product was not encountered. A replacement well is proposed for the MW-6 area after completion of construction on the dry stack building. Free product was not reported in the other wells and has not been included in the RBCA Tier 2 evaluation.

Concentrations of vinyl chloride have been reported in groundwater at the site. Four consecutive quarters of monitoring and sampling results indicated that concentrations of vinyl chloride have declined to non-detectable levels by laboratory methods. Vinyl chloride has not been included in the RBCA evaluation.

Groundwater contamination beneath the site includes PNAs and BTEX. With the TDS levels and the declining BTEX concentrations, BTEX was not included in the RBCA Tier 2 evaluation for drinking water. Benzene in groundwater is included in the evaluation as risk from potential vapor inhalation in an enclosed space. Groundwater analytical results are summarized in Tables 2, 5 and 6.

RBSLs and SSTLs Evaluation

Residential:

The borings and wells located within the residential area are MS-1 through MS-4, MS-7, MS-8, MS-11, MS-13, MS-14, MS-22, MS-23, SB-A, SB-B, SB-F, SB-G, SB-H, SB-I, SB-K, MW-1, MW-2, MW-5, MW-7, and MW-8. The residential evaluation includes the former pipelines adjacent to MW-2 and MW-5.

The Tier 2- Expanded Site Assessment- was used to evaluate the site where the main concerns are contact with TRPH, PNAs (naphthalene) and lead in surface soil, and benzene in groundwater. The pathways, exposure scenarios, and chemicals are limited to the following, respectively, contact from surface soil during construction and from residual amounts in surface soil in landscaped areas, and an enclosed residential structure built as slab on grade. The main exposure pathways would be dermal contact and possible ingestion of surface soil. Based upon surface and subsurface soils results, inhalation from benzene is not considered in the risk evaluation. However, inhalation of benzene from groundwater is considered in the risk evaluation.

The Tier 2 evaluation as defined in the ASTM guidelines makes the following assumptions:

- The equations are biased towards predicting exposure concentrations in excess of those likely to occur.
- The evaluation was performed after biodegradation of hydrocarbon compounds in soil and groundwater has occurred at the site.

The exposure pathway is limited to dermal contact with the soil, which occurs during construction of the buildings and parking lots, and during contact with residual soil in landscaped areas. Based upon results of volatile contaminants at the site, BTEX, no significant vapor concentrations are anticipated to be encountered at the site from the surface and subsurface soil. The PNAs are considered to not have a vapor component. BTEX in ground water is considered for vapor inhalation in an enclosed space.

The Tier 2 evaluation was performed using the following equations from the ASTM guideline E 1739.

Equation 1 derives the volatilization factors VF_{wesp} for groundwater to enclosed space vapors. The equation is listed in Table X2.5 of the ASTM guideline. Associated equations are $D_{eff/ws}$ Effective diffusion coefficient between groundwater and soil based on vapor-phase concentration, $D_{eff/s}$ Effective diffusion coefficient in soil based on vapor-phase concentration $D_{eff/cap}$ Effective diffusion coefficient through capillary fringe, and $D_{eff/crack}$ Effective diffusion coefficient through foundation cracks. These parameters are contained within the following equations.

Equation 1.

$$VFw_{esp}\left[\frac{(\mathrm{mg/m^3\cdot air})}{(mg/l\cdot H_2O)}\right] = \frac{H\left[\frac{D_{ws}^{eff}/L_{gw}}{ER\bullet L_B}\right]}{1+\left[\frac{D_{ws}^{eff}/L_{gw}}{ER\bullet L_B}\right]+\left[\frac{D_{ws}^{eff}/Lgw}{\left(D_{crack}^{eff}/L_{crack}\right)\eta}\right]} x10^3 \frac{L}{m^3}$$

Equation 1a.

$$D_{ws}^{eff}\left[\frac{cm^2}{s}\right] = \left(h_{cap}+h_v\right)+\left[\frac{h_{cap}}{D_{cap}^{eff}}+\frac{h_v}{D_s^{eff}}\right]^{-1}$$

Equation 1b.

$$D_s^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\frac{\theta_{as}^{3.33}}{\theta_\tau^2}+D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_\tau^2}$$

Equation 1c.

$$D_{cap}^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\frac{\theta_{acap}^{3.33}}{\theta_\tau^2}+D^{wat}\frac{1}{H}\frac{\theta_{wcap}^{3.33}}{\theta_\tau^2}$$

Equation 1d.

$$D_{crack}^{eff}\left[\frac{cm^2}{s}\right] = D^{air}\frac{\theta_{scrack}^{3.33}}{\theta_\tau^2} + D^{wat}\frac{1}{H}\frac{\theta_{wcrack}^{3.33}}{\theta_\tau^2}$$

A summary of parameters used within the equations is listed in Table 7. The parameters have been adjusted to match the conditions found at the subject site.

Equation 2 develops the Risk-Based Screening Level (RBSL) for groundwater and Enclosed space (indoor) vapor inhalation. The rate of inhalation for air is included with this section as Equation 2a.

Equation 2.

$$RBSL_w\left[\frac{mg}{L\cdot H_2O}\right] = \frac{RBSL_{air}\left[\frac{\mu g}{m^3\cdot air}\right]}{VF_{wesp}} \times 10^{-3}\frac{mg}{\mu g}$$

Equation 2a.

$$RBSL_{air}\left[\frac{\mu g}{m^3\cdot air}\right] = \frac{TR\times BW\times AT_C\times \mathbf{365}\frac{days}{year}\times \mathbf{10^3}\frac{\mu g}{mg}}{SF_I\times IR_{air}\times EF\times ED}$$

Based upon the results from equation 2, a value is calculated which is compared to a residential RBSL which corresponds to a certain risk between 10E-4 and 10E-6 for residential developments.

The Tier 2 Risk evaluation used the above equations with the parameters listed in Table 7. The evaluation is divided into two sections based upon the equations. The first section calculates the volatilization factors for the gasoline compounds, BTEX. The second section calculates the associated risk.

The Tier 2 evaluation as defined in the ASTM guidelines makes the following assumptions:

- The equations are biased towards predicting exposure concentrations in excess of those likely to occur.
- The exposure pathway is limited to vapors in the soil from groundwater, which migrate to hypothetical cracks in a slab causing enclosed space exposure.

- That vapor concentrations remains constant over the duration of exposure, and all inhaled chemicals are absorbed.

Volatilization factor calculations

The volatilization factors were calculated with the parameters as follows:

Equation 1a for benzene.

$$D_{ws}^{eff}\left[\frac{cm^2}{s}\right] = (20+152) + \left[\frac{20}{2.1x10^{-5}} + \frac{152}{.0073}\right]^{-1}$$

$$= 0.0002$$

Equation 1b for benzene:

$$D_s^{eff} = 0.093\frac{0.26^{3.33}}{0.38^2} + 1.1\times10^{-5}\frac{1}{0.22}\frac{0.12^{3.33}}{0.38^2}$$

$$= 0.0073$$

Equation 1c for benzene.

$$D_{cap}^{eff}\left[\frac{cm^2}{s}\right] = 0.093\frac{.038^{3.33}}{.38^2} + 1.1x10^{-5}\frac{1}{.22}\frac{.342^{3.33}}{.38^2}$$

$$= 2.12x10^{-5}$$

Equation 1d for benzene

$$D_{crack}^{eff}\left[\frac{cm^2}{s}\right] = .093\frac{.26^{3.33}}{.38_\tau^2} + 1.1x10^{-5}\frac{1}{.22}\frac{.12^{3.33}}{.38_\tau^2}$$

$$= 0.0073$$

Using the solution for benzene as the most volatile compound, VF_{wesp} was solved with equation 1, as follows:

$$VF_{wesp} = \frac{.22 \bullet \left[\frac{.0002/155}{.00014 \bullet 200}\right]}{1+\left[\frac{.0002/155}{0.00014 \bullet 200}\right]+\left[\frac{.0002/155}{(0.0073/15)x.01}\right]} \times 10^3$$

$$= .3715$$

Risk calculations

Using the above result for benzene, the $RBSL_W$ for benzene in an enclosed space (indoor) vapor inhalation was calculated using Equation 2. The $RBSL_{air}$ was calculated first to derive this parameter for equation 2.

The $RBSL_{air}$ is calculated as follows:

$$RBSL_{air}\left[\frac{\mu g}{m^3 \cdot air}\right] = \frac{10^{-6} \times 70 kg \times 70 years \times 365 days / year \times 10^3 \frac{\mu g}{mg}}{0.029 kg \cdot day / mg \times 15 m^3 / day \times 350 days / year \times 30 years}$$

$$= 39.15$$

Solving for $RBSL_W$ yields the following:

$$RBSL_w = \frac{39.15 \mu g / m^3}{.3715} \times 10^{-3} mg / \mu g$$

$$= 1.05$$

The indoor air screening level for inhalation exposure for benzene at a cancer risk of 1E-06 is 0.11 µg/m3, and at a cancer risk of 1E-04 is 11.37 µg/m3. The calculated value is toward the 1E-06 range of risk.

Surficial and Subsurface Soil Evaluation

Equation 3 derives the ingestion of soil, inhalation of vapors and particulates, and dermal contact for surficial and excavated soil less than three feet deep for non-carcinogenic effects. The equation is listed in Table X2.3 of the ASTM guideline. Parameters used within the equation are listed in Table 9. These parameters are contained in the following equations.

Equation 3.

$$RBSL_s\left[\frac{(mg)}{(kg \cdot soil)}\right] = \frac{THQ \times BW \times AT_n \times 365}{EF \times ED\left[10^{-6}\frac{kg}{mg} \times \frac{IR_{soil} \times RAF_o + SA \times M \times RAF_d}{RfD_o} + \frac{SF_i \times IR_{air} \times \left(VF_{ss} + VF_p\right)}{RfD_i}\right]}$$

Equation 3 was calculated using the residential values in Table 7 and for naphthalene, the PNA with highest concentrations in the soil, in Table 4. The PNAs are not considered volatile, and are not solved for the air component.

Equation 3.

$$RBSL_S\left[\frac{(mg)}{(kg\cdot soil)}\right] = \frac{1.0\times70\times30\times365}{350\times30\left[10^{-6}\frac{kg}{mg}\times\frac{100\times1.0+3160\times0.5\times0.05}{0.004}+\frac{SF_i\times IR_{air}\times\left(VF_{ss}+VF_p\right)}{R_fD_i}\right]}$$

$$RBSL_S\left[\frac{(mg)}{(kg\cdot soil)}\right] = \frac{766,500}{10,500\left[10^{-6}\frac{kg}{mg}\times\frac{7,900}{0.004}+0\right]}$$

$$RBSL_S\left[\frac{(mg)}{(kg\cdot soil)}\right] = \frac{766,500}{207,375} = 3.7$$

Based upon the results from equation 3, the calculated value of 3.7 ppm for naphthalene is compared to a residential RBSL. The lookup table value for residential RBSL corresponds to a chronic Health Quotient (HQ) at 977 ppm. The calculated value is higher than most of the reported concentrations for naphthalene, except for the results from samples from PL1-2 (230 ppm), PL1-7 (9.0 ppm), and PL2-1 (5.3 ppm). All of these are below the RBSL in the lookup table. The San Francisco International Airport Saltwater Ecological Protection Zone (SEPZ) includes the soil and groundwater from 300 feet inland to the shoreline of the Bay. The subject site sample results indicate one location in the residential area with naphthalene above the SEPZ concentrations. The SEPZ value for naphthalene is 49 ppm, which can be used as a SSTL at the subject site.

Commercial:

Data for the evaluation were taken from boring and wells within the commercial area MS-6, MS-9, MS-10, MS-12, MS-15 through MS-21, SB-C, SB-D, SB-E, SB-J, MW-3, MW-4, MW-6, and MW-9. The commercial evaluation includes the results of the soil sampling at DP-1.

The Tier 2- Expanded Site Assessment- was used to evaluate the site where the main concerns are contact with TRPH, PNAs (naphthalene) and lead in surface soil. The pathways, exposure scenarios, and chemicals are limited to the following, respectively, contact from soil during construction and from residual amounts in soil in landscaped areas.

The Tier 2 evaluation as defined in the ASTM guidelines makes the following assumptions:

- The equations are biased towards predicting exposure concentrations in excess of those likely to occur.

No parameters were available for use with total lead and TRPH. The TRPH levels exceed 2,000 ppm as defined by the ACHCSA in ten samples from the bulk terminal. Total lead exceeds 400 ppm US EPA Preliminary Remediation Goals (PRG) in two samples from the bulk terminal.

Summary of Assessment

The main results from the RBCA Tier 2 evaluation are as follows:

- Concentrations of TRPH are above the ACHCSA levels of 2,000 ppm for a portion of the former bulk plant and adjacent parking lot. However, the volatile organic compounds normally associated with TRPH are either reported as non-detectable or at low concentrations.
- Groundwater monitoring and sampling at the site for four consecutive quarters indicates stable or declining concentrations of TPH as gasoline and BTEX. The monitoring results indicate a stable plume that is not migrating towards the estuary, hence groundwater is not considered a transport medium.
- Concentrations of lead in soil are generally 150 ppm or less, except two locations where the concentrations in soil are greater than 1,000 ppm.
- The risk of exposure to soil and groundwater is minimal due to the proposed configuration of buildings and pavement. The calculated risk from benzene in groundwater to the proposed enclosed space within the structures is between 1E-05 and 1E-06. The groundwater at the site is not considered drinking water quality.
- The only complete pathway for the site is limited to dermal contact during construction and excavation. Naphthalene is the only compound that is considered to provide a significant risk during construction. RBSLs levels calculated for naphthalene were 3.7 ppm for residential and 10.4 ppm for commercial. Concentrations of naphthalene reported at the site are generally below these levels. As an alternative value, the SSTL used for naphthalene is considered to be 49 ppm, based upon the SFIA SEPZ value.
- Subsurface soils (below 3 feet) are not included as a transport medium because concentrations are below the levels of concern for volatiles.

CONCLUSIONS

Based upon the above summary, the following conclusions may be made.

- Risk at the site is limited to dermal contact during construction and excavation at the site. Other risks from contact to groundwater and vapors are limited by site conditions and concentrations, respectively.

- Volatile organic compounds are not present in high enough concentrations in soil to provide a risk from inhalation from vapors in the soil through cracks in foundations or from soil in landscape areas. Benzene was not detected in the soil sample results from the assessments performed at the site. Benzene concentrations were reported in groundwater, and do not provide risk greater than between 1E-05 and 1E-06.

- TRPH in soil at the site does not contain volatile compounds and does not represent a significant risk to human health or the environment for residential or commercial use.

Construction Health and Safety Plan/ Risk Management Plan

Confirmation sampling may be required in known areas of high lead and PNAs concentrations. Sampling may also be required in areas of known high concentrations of TRPH to verify the trend of low volatile organic compounds observed on the site.

Dermal contact with lead and/or PNA bearing soil should be limited by wearing the appropriate personal protection equipment. Lead bearing soil should be maintained in moist condition to prevent inhalation of lead in dust.

RECOMMENDATIONS

Based upon the RBCA evaluation, ESCNC recommends removal only of the concentrations of lead above 400 ppm and PNAs- naphthalene above 49 ppm.

Based upon the review of existing risk at the site, ESCNC recommends closure of the site conditional on monitoring and sampling of the MW-6 replacement well, removal of lead in soil concentrations above 400 ppm, and destruction of the remaining groundwater monitoring wells. The MW-6 replacement well will be destroyed at a later date after completion of an appropriate monitoring period.

LIMITATIONS

It is possible that variations in soil or groundwater conditions exist beyond the points explored in past investigations. Also, site conditions are subject to change with time due to variations in rainfall, temperature, regional water usage, or other factors.

The service performed by Earth Systems Consultants, Northern California has been conducted in a manner consistent with the level of care and skill ordinarily exercised by members of our profession currently practicing under similar conditions in the area of the site. No other warranty, expressed or implied, is made.

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- The evaluation was performed after biodegradation of hydrocarbon compounds in soil and groundwater has occurred at the site.

The exposure pathway is limited to dermal contact with the soil, which occurs during construction of the buildings and parking lots.

The Tier 2 evaluation was performed using the following equations from the ASTM guideline E 1739. Equation 1 derives the ingestion of soil, inhalation of vapors and particulates, and dermal contact for surficial and excavated soil less than three feet in depth for non-carcinogenic effects. The equation is listed in Table X2.3 of the ASTM guideline. Parameters used within the equation are listed in Table 7. These parameters are contained within the following equations.

Equation 3 is calculated using the commercial values in Table 7. Naphthalene is the compound of concern in the equation.

Equation 3b.

$$RBSL_S\left[\frac{(mg)}{(kg\cdot soil)}\right]=\frac{1.0\times70\times25\times365}{250\times25\left[10^{-6}\frac{kg}{mg}\times\frac{50\times1.0+3160\times0.5\times0.05}{0.004}+\frac{SF_i\times IR_{air}\times\left(VF_{ss}+VF_p\right)}{RfD_i}\right]}$$

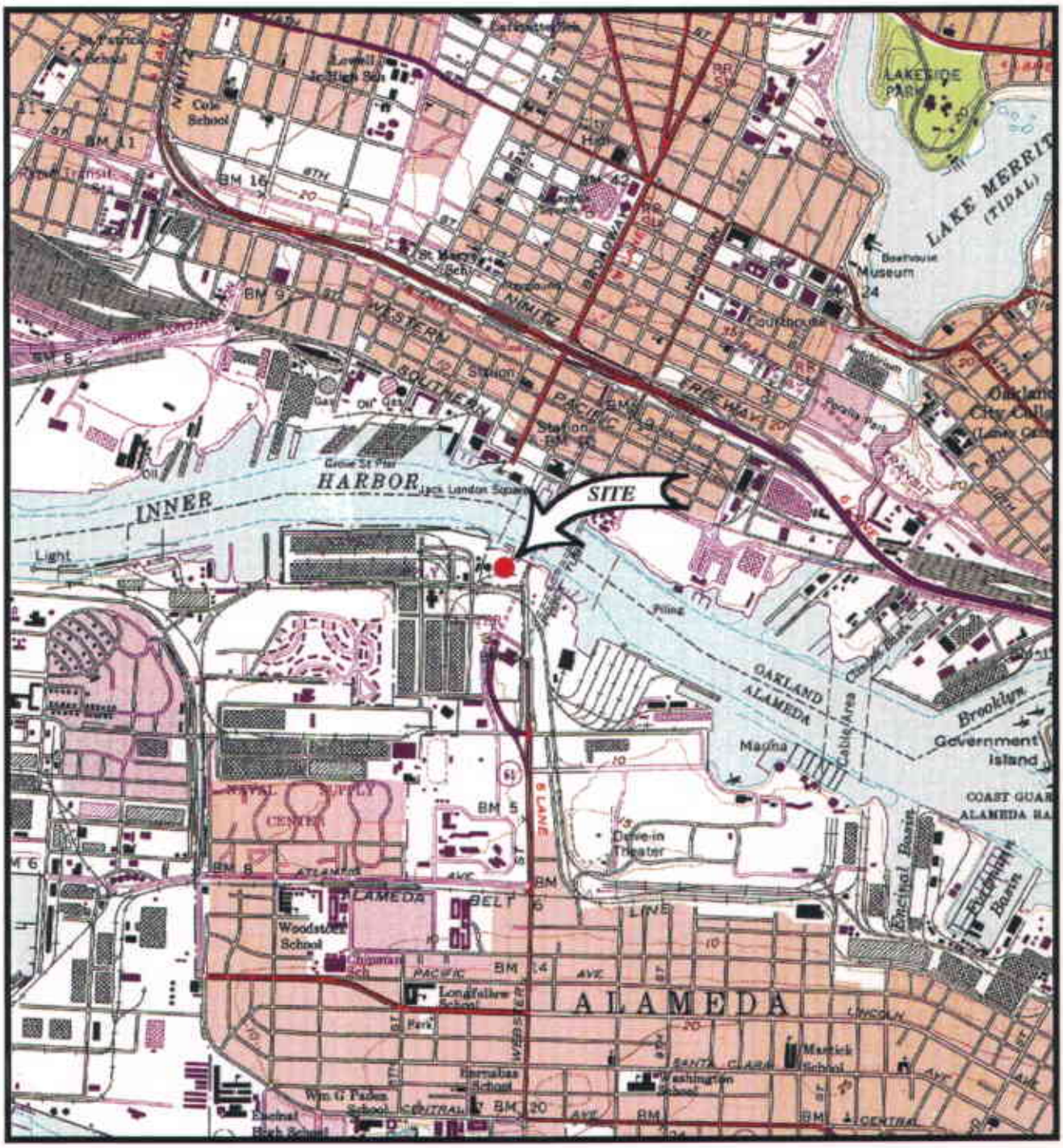
$$RBSL_S\ \frac{(mg)}{(kg?soil)}=\frac{638.750}{6.250\ 10^{-6}\ \frac{kg}{mg}\left(\frac{3.950}{0.004}+0\right.}$$

$$RBSL_S\ \frac{(mg)}{(kg?soil)}=\frac{638.750}{61.718}=10.4$$

The calculated value of 10.4 ppm was compared to a commercial RBSL, which corresponds to a chronic HQ at 1500 ppm. Results from boreholes DP-1 and DP-2 for PNAs indicated non-detectable levels. DP-2 results indicate background levels for the site. The evaluation anticipates that PNAs in soil are present in the commercial portion of the site, and would anticipate a similar distribution as found at the residential portion. The SSTL of 49 ppm stated in the residential evaluation will be used for the commercial portion.

FIGURES

File No. NFE-4392-01
February 1999



Approximate Scale 1: 24,000

1 0 1 Mile

1 0 1 Kilometer

Base: U.S.G.S. 7.5 minute Oakland West Quadrangle (1980)
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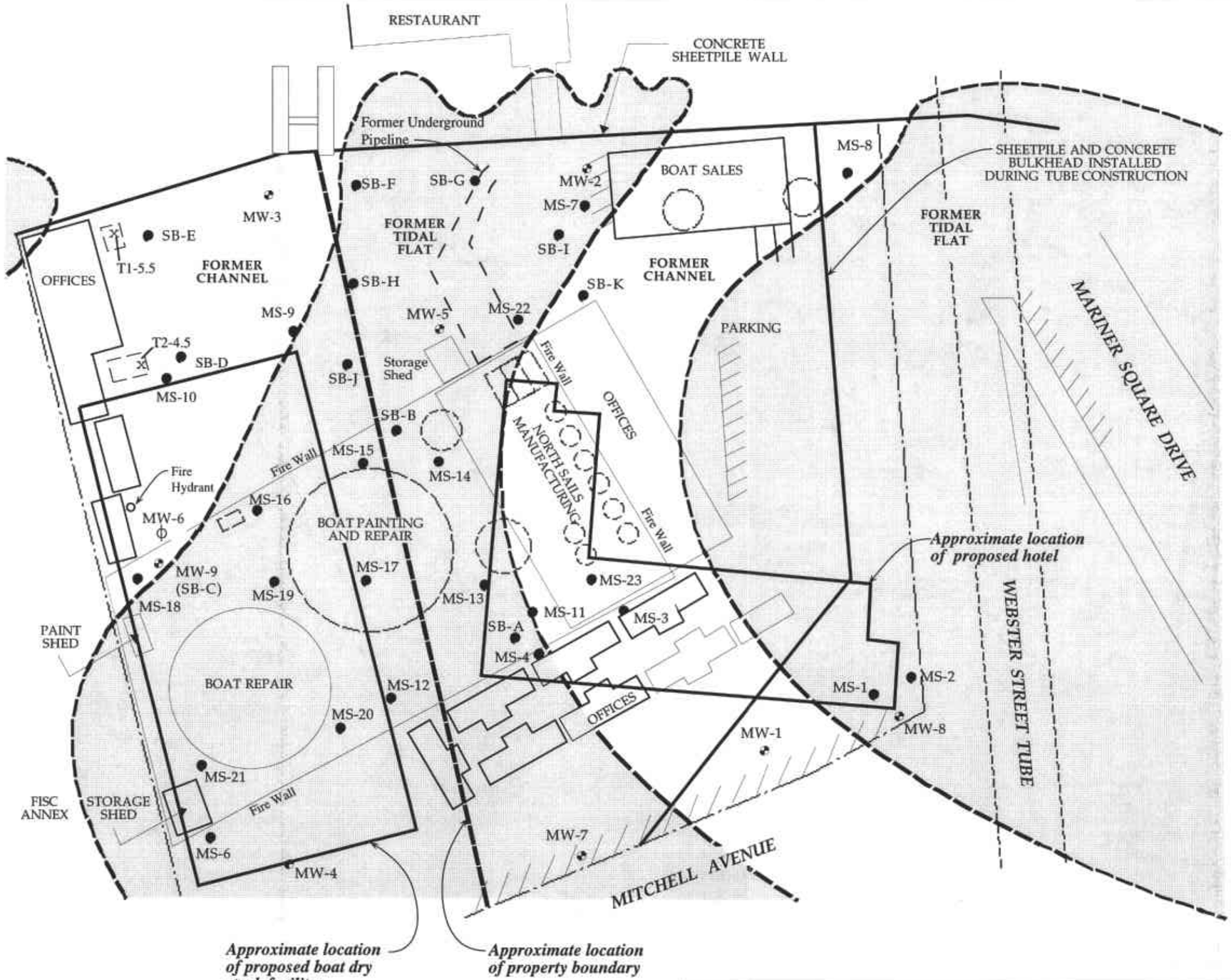
Earth Systems Consultants Northern California	Mariner Square 2415 Mariner Square Drive Alameda, California	**SITE LOCATION** **Figure 1**



Note: Adapted from Site Plans from McLaren Hart

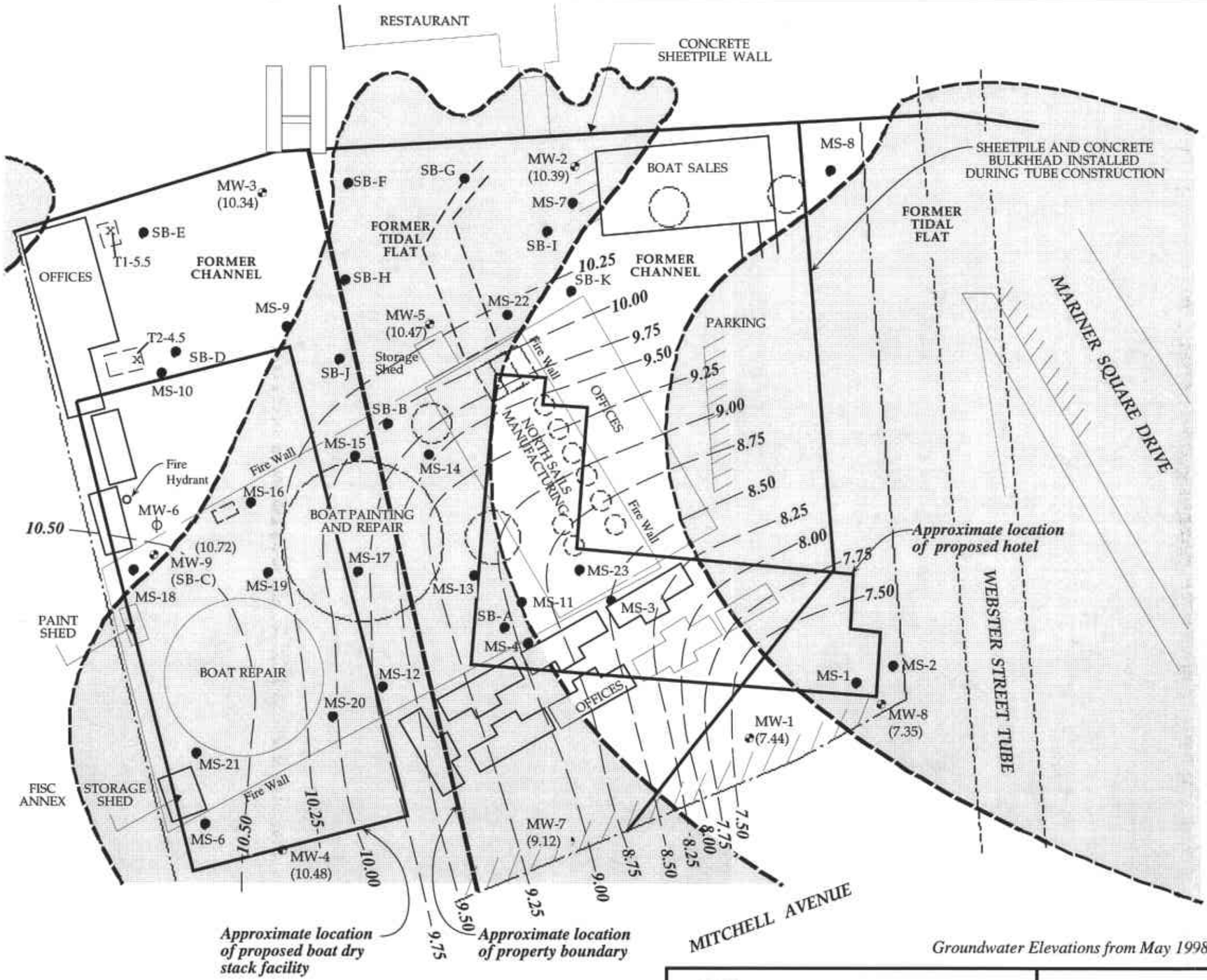
Earth Systems Consultants
Northern California

Mariner Square
Alameda, California

SITE PLAN

Date: February 1999
File No: NFE-4392-01

Figure 2



LEGEND

- = MONITORING WELL
- ϕ = DESTROYED WELL
- ● = SOIL BORING
- = EXISTING STRUCTURES
- = FORMER ABOVE GROUND FUEL STORAGE TANKS
- = FORMER UNDER GROUND GASOLINE STORAGE TANK
- = FORMER TIDAL CHANNEL (RADBRUCH, 1957)
- = APPROXIMATE PROPERTY BOUNDARY
- MS-8 = BORING/WELL/SAMPLE LOCATION
- 10.25 = APPROXIMATE GROUNDWATER ELEVATION CONTOUR
- MW-2 (10.39) = GROUNDWATER ELEVATION

NORTH

0 60 120

APPROXIMATE SCALE IN FEET

Groundwater Elevations from May 1998 monitoring event by HETI

Note: Adapted from Site Plans from McLaren Hart

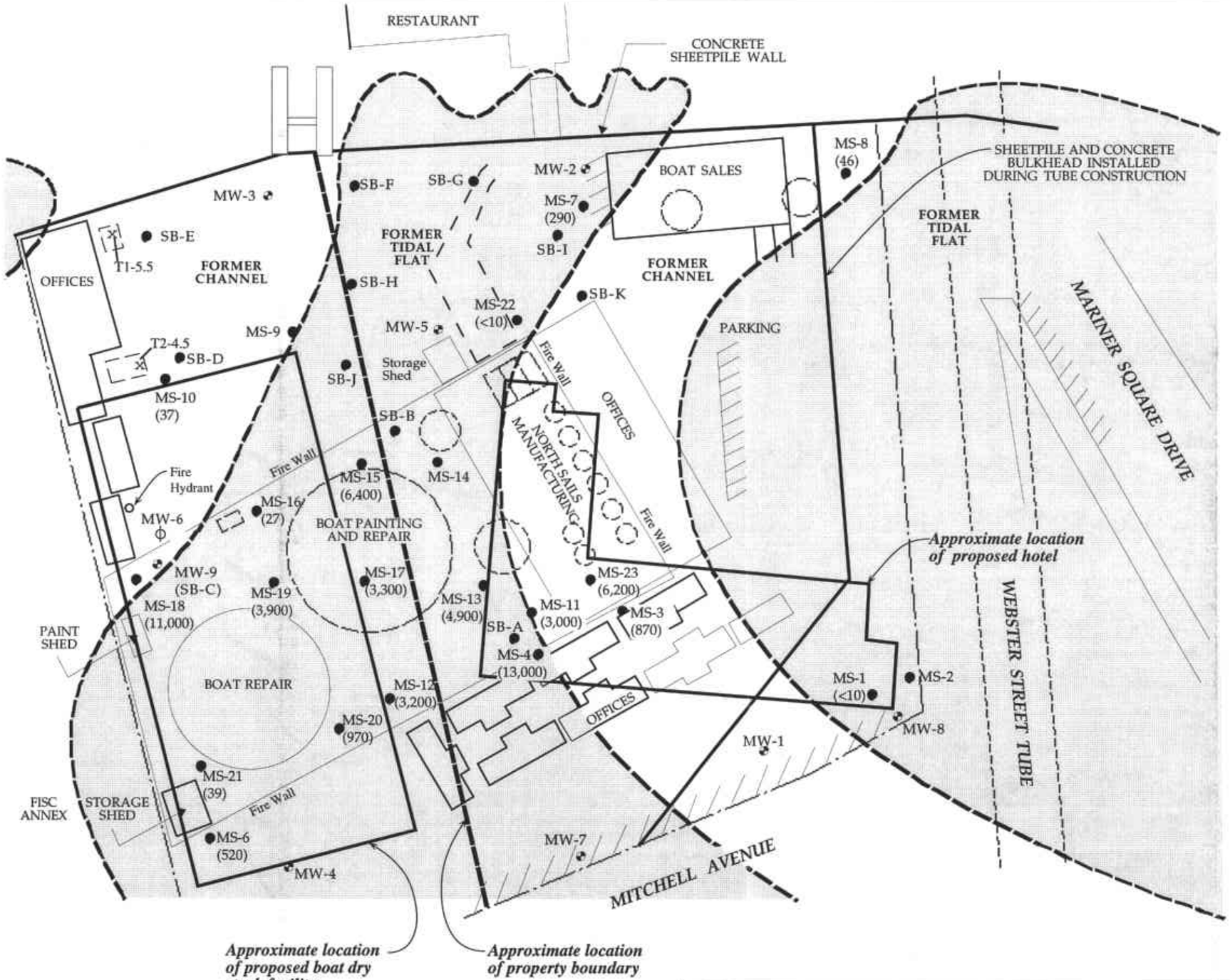
Earth Systems Consultants
Northern California

Mariner Square
Alameda, California

GROUNDWATER GRADIENT MAP

Date: February 1999
File No: NFE-4392-01

Figure 3



LEGEND

- = MONITORING WELL
- ϕ = DESTROYED WELL
- ● = SOIL BORING
- = EXISTING STRUCTURES
- = FORMER ABOVE GROUND FUEL STORAGE TANKS
- = FORMER UNDER GROUND GASOLINE STORAGE TANK
- = FORMER TIDAL CHANNEL (RADBRUCH, 1957)
- = APPROXIMATE PROPERTY BOUNDARY
- MS-8 = BORING/WELL/SAMPLE LOCATION
- (870) = TRPH IN SOIL (PPM)

NORTH

0 60 120

APPROXIMATE SCALE IN FEET

Note: Adapted from Site Plans from McLaren Hart

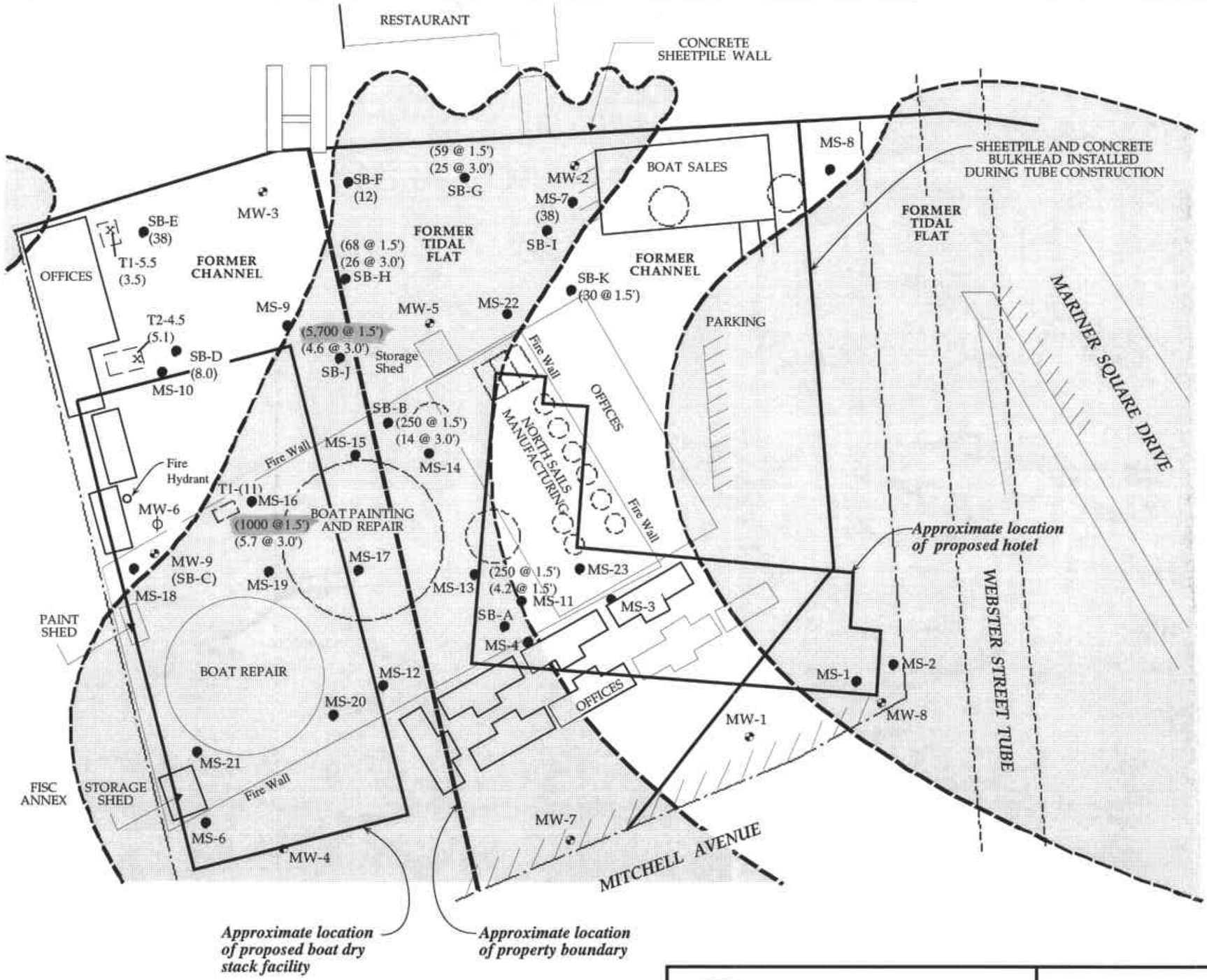
Earth Systems Consultants
Northern California

Mariner Square
Alameda, California

TRPH IN SOIL CONCENTRATIONS

Date: February 1999
File No: NFE-4392-01

Figure 4



LEGEND

- = MONITORING WELL
- ϕ = DESTROYED WELL
- ● = SOIL BORING
- = EXISTING STRUCTURES
- = FORMER ABOVE GROUND FUEL STORAGE TANKS
- = FORMER UNDER GROUND GASOLINE STORAGE TANK
- = FORMER TIDAL CHANNEL (RADBRUCH, 1957)
- = APPROXIMATE PROPERTY BOUNDARY
- MS-8 = BORING/WELL/SAMPLE LOCATION
- (150) = LEAD (PPM) CONCENTRATIONS IN SOIL
- (42 @ 3.0') = LEAD CONCENTRATIONS AT DEPTH

NORTH

0 60 120

APPROXIMATE SCALE IN FEET

Note: Adapted from Site Plans from McLaren Hart

Earth Systems Consultants
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Mariner Square
Alameda, California

LEAD IN SOIL CONCENTRATIONS

Date: February 1999
File No: NFE-4392-01

Figure 5

TABLE 1
HISTORICAL SOIL SAMPLE ANALYTICAL RESULTS - ORGANICS
MARINER SQUARE, ALAMEDA, CALIFORNIA

BORING/ WELL NUMBER	DEPTH (feet)	DATE	TPHg (ppm)	TPHd (ppm)	TPHmo (ppm)	TRPH (ppm)	OIL & GREASE (ppm)	BENZENE (ppm)	TOTAL TOLUENE (ppm)	ETHYL-BENZENE (ppm)	XYLENES (ppm)	MTBE (ppm)	VOCs (ppm)	VINYL CHLORIDE (ppb)	TOC (ppm)
T-1	5.0	12/17/90	ND*	-	-	-	-	ND*	ND*	ND*	0.0063	-	-	-	-
T-2	5.0	12/17/90	ND*	-	-	-	-	ND*	0.017	ND*	0.020	-	-	-	-
D-1	1.0	12/17/90	ND*	-	-	-	-	ND*	ND*	ND*	ND *	-	-	-	-
MS-1	4.0	4/7/92	-	-	-	<10	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-2	4.0	4/7/92	-	-	-	-	-	-	-	-	-	-	-	-	-
MS-3	4.0	4/7/92	-	-	-	870	-	<0.005	<0.005	0.027	0.054	-	ND	-	-
MS-4	4.0	4/7/92	-	-	-	13,000	-	<0.50	<0.50	1.00	1.20	-	ND	-	-
MS-5	4.0	4/7/92	-	-	-	170	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-6	4.0	4/7/92	-	-	-	520	-	<0.10	<0.10	<0.10	<0.20	-	ND	-	-
MS-7	4.0	4/7/92	-	-	-	290	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-8	4.0	4/7/92	-	-	-	46	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-9	4.0	4/7/92	-	-	-	12	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-10	4.0	4/7/92	-	-	-	37	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-11	4.0	4/8/92	-	-	-	3,000	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-12	4.0	4/8/92	-	-	-	3,200	-	<0.10	<0.10	0.140	0.270	-	ND	-	-
MS-13	4.0	4/8/92	-	-	-	4,900	-	<0.10	<0.10	<0.10	<0.20	-	ND	-	-
MS-14	4.0	4/8/92	-	-	-	6,300	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-15	4.0	4/8/92	-	-	-	6,400	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-16	0.4	4/8/92	-	-	-	27	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-17	0.2	4/8/92	-	-	-	3,300	-	<0.50	<0.50	1.60	8.4	-	ND	-	-
MS-18	0.4	4/8/92	-	-	-	11,000	-	<0.20	<0.20	<0.20	<0.40	-	ND	-	-
MS-19	0.4	4/8/92	-	-	-	3,900	-	<0.10	<0.10	<0.10	<0.20	-	ND	-	-
MS-20	0.4	4/8/92	-	-	-	970	-	<0.005	<0.005	<0.005	<0.005	-	ND	-	-
MS-21	0.4	4/8/92	-	-	-	39	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-22	0.4	4/8/92	-	-	-	<10	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MS-23	0.5	4/8/92	-	-	-	6,200	-	<0.005	<0.005	<0.005	<0.010	-	ND	-	-
MW-1	7.0	7/22/92	-	<1	-	-	<50	<0.005	<0.005	<0.005	<0.005	-	ND	-	-
MW-2	6.0	7/22/92	-	40	-	-	66	<0.80	<0.80	21.0	10.0	-	ND	-	-
MW-3	4.5	7/22/92	-	<1	-	-	<50	<.005	<0.005	<0.005	<0.005	-	ND	-	-
MW-4	4.0	7/22/92	-	<1	-	-	<50	<0.005	<0.005	<0.005	<0.005	-	ND	-	-
MW-5	4.5	7/22/92	-	220	-	-	<50	<0.40	0.50	1.6	1.4	-	ND	-	-
SB-A	1.5	9/15/94	-	-	-	-	-	-	-	-	-	-	-	-	6,700
SB-A	5.5	9/15/94	-	-	-	-	-	<0.005	<0.0063	<0.005	<0.046	-	-	<10	960
SB-B	1.5	9/16/94	-	-	-	-	-	-	-	-	-	-	-	-	19,000
SB-B	4.5	9/16/94	-	-	-	-	-	-	-	-	-	-	-	-	<500
SB-C/MW-9	1.5	9/16/94	-	-	9,200	-	-	<0.005	13	5.8	<0.005	-	-	<20	4,000
SB-C/MW-9	5.5	9/16/94	-	-	-	-	-	-	-	-	-	-	-	-	<500
SB-D	4.5	9/16/94	<50	810	140	-	-	<0.050	<0.073	<0.050	1.380	-	-	-	-
SB-E	4.5	9/16/94	<10	<10	60	-	-	<0.005	0.019	<0.005	<0.005	-	-	-	-
MW-7	4.0	9/15/94	<30	<30	200	-	-	<0.005	0.014	<0.005	<0.005	-	-	<10	-

TABLE 1
HISTORICAL SOIL SAMPLE ANALYTICAL RESULTS - ORGANICS
MARINER SQUARE, ALAMEDA, CALIFORNIA

BORING/ WELL NUMBER	DEPTH (feet)	DATE	TPHg (ppm)	TPHd (ppm)	TPHmo (ppm)	TRPH (ppm)	OIL & GREASE (ppm)	BENZENE (ppm)	TOTAL TOLUENE (ppm)	ETHYL-BENZENE (ppm)	XYLENES (ppm)	MTBE (ppm)	VOCs (ppm)	VINYL CHLORIDE (ppb)	TOC (ppm)
MW6-N1	4.5	4/28/98	<1	<9	41	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
MW6-S1	3	4/28/98	<1	3,200	24,000	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
MW6-W1	3	4/28/98	<1	2,100	6,800	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
MW6-E1	3	4/28/98	<1	47	380	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
MW6-W2	3	5/4/98	<1	<1	<5	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
MW6-N2	3.5	5/4/98	<1	<1	<5	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
MW6-E2	3	5/4/98	<1	<1	8	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-
T1-5.5 (1)	5.5	8/6/97	350	230	8,900	-	-	<0.05	<0.10	0.3	0.71	<1.0	-	-	-
T2-4.5 (1)	4.5	8/6/97	0.550	10	12	-	-	<0.001	<0.002	<0.002	<0.004	<0.010	-	-	-
PL1-1	2.0	11/21/98	<1	590	1,600	-	-	<0.005	<0.005	<0.005	<0.005	<0.05	-	-	-
PL1-2	2.0	11/21/98	1,100	470	920	-	-	<1.0	<1.0	<1.0	1.7	<10	-	-	-
PL1-3	2.2	11/21/98	25	30	28	-	-	<0.05	0.065	0.087	0.17	<10	-	-	-
PL1-4	2.0	11/21/98	<1	15	24	-	-	<0.005	<0.005	<0.005	<0.005	<0.05	-	-	-
PL1-5	1.8	11/21/98	<1	<1	<1	-	-	<0.005	<0.005	<0.005	<0.005	<0.05	-	-	-
PL1-6	1.8	11/21/98	23	110	200	-	-	<0.05	0.07	0.077	0.85	<0.5	-	-	-
PL1-7	2.0	11/21/98	130	59	89	-	-	<0.5	<0.5	2.8	2	<5.0	-	-	-
PL2-1	2.3	11/21/98	<100	210	81	-	-	<0.5	0.54	1.1	<0.5	<5.0	-	-	-
PL2-2	2.2	11/21/98	8.3	28	46	-	-	<0.005	<0.005	<0.005	<0.005	<0.05	-	-	-
PL2-3	1.9	11/21/98	<1	<1	73	-	-	<0.005	<0.005	.0061	<0.005	<0.05	-	-	-
PL2-4	2.0	11/21/98	<1	<1	130	-	-	<0.005	<0.005	<0.005	<0.005	<0.05	-	-	-
PL2-5	2.0	11/21/98	150	1,000	1,400	-	-	<0.005	<0.005	<0.005	<0.005	<0.05	-	-	-

ppm	Parts per million
ppb	Parts per billion
<	Analyte not detected at or above specified laboratory reporting limit.
-	Not Analyzed
ND	No analytes detected above laboratory reporting limits, reporting limits vary for each analyte
ND*	Analyted not detected, reporting limit not specified
TPHg	Total Petroleum Hydrocarbons as gasoline
TPHd	Total Petroleum Hydrocarbons as diesel
TPHmo	Total Petroleum Hydrocarbons as motor oil
TRPH	Total Recoverable Petroleum Hydrocarbons
VOCs	Volatile Organic Compounds
TOC	Total Organic Carbon
MTBE	Methy Tert-Butyl Ether

TABLE 2
HISTORICAL GROUNDWATER ANALYTICAL RESULTS - ORGANICS and TDS
MARINER SQUARE, ALAMEDA, CALIFORNIA

WELL NUMBER	DATE	TPHg (ppb)	TPHd (ppb)	TPHmo (ppb)	TRPH (ppm)	OIL & GREASE (ppb)	BENZENE (ppb)	TOLUENE (ppb)	ETHYL-BENZENE (ppb)	TOTAL XYLENES (ppb)	MTBE (ppb)	VOCs (ppb)	VINYL CHLORIDE (ppb)	TDS (ppm)
MS-1	4/7/92	-	-	-	<1	-	<5	<5	<5	<10	-	ND	-	-
MS-7	4/7/92	-	-	-	<1	-	<5	<5	<5	<10	-	ND	-	-
MS-13	4/7/92	-	-	-	23	-	<5	<5	<5	<10	-	ND	-	-
MS-18	4/7/92	-	-	-	1,200	-	<50	<50	<50	<100	-	ND	-	-
MW-1	8/3/92	-	580	<5000	-	-	<0.5	<0.5	<0.5	<0.5	-	-	-	-
	11/20/92	<50	600	<5000	-	-	<0.5	<0.5	<0.5	<0.5	-	-	<2	-
	9/27/94	<50	530	<50	-	-	<0.3	<0.3	<0.3	<0.3	-	-	-	-
	6/28/96	<100	<50	<200(1)	-	-	<0.5	<1.0	<1.0	<2.0	-	-	<0.5	-
	10/31/96	<100	93	<200	-	-	<0.5	<1.0	<1.0	<2.0	<10	-	<1.0	-
	9/30/97	120	<50	<200	-	-	4.7	<1.0	3.7	21	<10	-	<0.8	-
	12/12/97	<50	<50	<200	-	-	<0.5	<0.5	<0.5	<2.0	<5	-	<2	-
	2/18/98	<50	<50	<200	-	-	1.5	0.6	1.8	8	<5	-	<2	-
	5/8/98	<50	<50	<200	-	-	1.0	<0.5	0.7	5	<5	-	<2	-
MW-2	8/3/92	-	2200	<5000	-	-	<0.5	6.5	3.2	5.3	-	-	-	-
	11/20/92	340	2100	<5000	-	-	<0.5	<0.5	<0.5	2.4	-	-	<2	-
	9/26/94	320	<50	240	-	-	<3.0	<3.0	<3.0	<3.0	-	-	-	-
	6/28/96 (2)	980	100 (3,4)	<200 (1)	-	-	0.5	<1.0	2.3	3.1	-	-	<0.5	-
	10/31/96	220	180	<200	-	-	<0.5	<1.0	<1.0	<2.0	<10	-	<1.0	-
	9/30/97	900	150 (3)	<200	-	-	0.8	<1.0	2	6.2	<10	-	<0.8	-
	12/12/97	360	<50	<200	-	-	1.1	<0.5	2.2	3	<5	-	<2	-
	2/18/98	90	<50	<200	-	-	<0.5	<0.5	1.1	2	<5	-	<2	-
	5/8/98	170	<50	<200	-	-	<0.5	<0.5	1.7	3	<5	-	<2	-
MW-3	8/3/92	-	1000	<5000	-	-	<0.5	1	<0.5	2.4	-	-	-	-
	11/20/92	98	2000	<5000	-	-	<0.5	<0.5	0.9	1	-	-	<2	-
	9/27/94	<50	720	<50	-	-	<3.0	<0.3	<0.3	<0.3	-	-	-	-
	6/28/96	<100	120 (3)	<200 (1)	-	-	<0.5	<1.0	<1.0	<2.0	-	-	<0.5	-
	10/31/96	<100	160	<200	-	-	<0.5	<1.0	<1.0	<2.0	<10	-	<1.0	-
	9/30/97	<100	70 (8)	<200	-	-	0.8	<1.0	<1.0	3.3	<10	-	<0.8	-
	12/12/97	80	<50	<200	-	-	0.7	<0.5	0.7	4	9	-	<2	-
	2/18/98	60	<50	<200	-	-	<0.5	<0.5	<0.5	4	7	-	<2	-
	5/8/98	<50	<50	<200	-	-	0.5	<0.5	0.5	4	<5	-	<2	-

TABLE 2
HISTORICAL GROUNDWATER ANALYTICAL RESULTS - ORGANICS and TDS
MARINER SQUARE, ALAMEDA, CALIFORNIA

WELL NUMBER	DATE	TPHg (ppb)	TPHd (ppb)	TPHmo (ppb)	TRPH (ppm)	OIL & GREASE (ppb)	BENZENE (ppb)	TOLUENE (ppb)	ETHYL-BENZENE (ppb)	TOTAL XYLENES (ppb)	MTBE (ppb)	VOCs (ppb)	VINYL CHLORIDE (ppb)	TDS (ppm)
MW-4	8/2/92	-	1300	<5000	-	-	16	2.6	0.6	2.7	-	-	9.0	-
	11/20/92	330	2400	<5000	-	-	31	5.2	0.7	2	-	-	13	-
	9/27/94	<50	890	<50	-	-	12	0.43	<0.3	<0.3	-	-	8.0	580
	6/28/96	180	170 (3,4)	<200 (1)	-	-	4	<1.0	<1.0	<2.0	-	-	2.5	-
	10/31/96	110	330	<200	-	-	6.2	<1.0	<1.0	<2.0	<10	-	4.3	-
	9/30/97	650	170 (3)	<200	-	-	3.9	<1.0	<1.0	<2.0	460	-	3.1	-
	12/12/97	260	<50	<200	-	-	4.9	0.9	<0.5	<2.0	320	-	3	-
	2/18/98	240	<50	<200	-	-	1.0	1.0	2.1	10	290	-	2	-
	5/8/98	90	<50	<200	-	-	0.5	0.5	0.8	5	30	-	<2	-
MW-5	8/3/92	-	2200	<5000	-	-	9	6	49	11	-	-	-	-
	8/5/92	-	-	-	-	-	-	-	-	-	-	-	-	-
	11/20/92	4800	1500	<5000	-	-	7.6	12	5.8	26	-	-	<2	-
	9/26/94	3100	780	<500	-	-	7.9	11	8.7	14	-	-	-	-
	6/28/96	5000	610 (3,4)	790 (1)	-	-	1.2	6.8	21	14	-	-	<0.5	-
	10/31/96	6800	4900	860	-	-	20	5.9	15	19	<10	-	<1.0	-
	9/30/97	9000	4100 (3)	520	-	-	35	5.3	36	32	12	-	<0.8	-
	12/12/97	3400	90	<200	-	-	26	4.6	5.9	13	11	-	<2	-
	2/18/98	3200	<50	<200	-	-	7.9	1.4	14	12	<5	-	<2	-
	5/8/98	3900	<50	<200	-	-	8.0	22	19	10	<5	-	<2	-
MW-6	9/27/94	1100	9900	3200	-	-	<3.0	<3.0	<3.0	<3.0	-	-	<1.0	-
	10/7/94	**Not Sampled - Sheen Present**												
	10/14/94													
	10/21/94													
	10/25/94													
	6/28/96													
	10/31/96													
	9/30/97													
	12/12/97	21000	1900000	43000	-	-	5	<0.5	8	19	<50	-	<2	-
	2/18/98	70000	<50	<200	-	-	20	20	20	70	<100	-	<2	-
	4/28/98	800	920	<200	-	-	<0.5	<0.5	<0.5	<2	<5	-	<2	-
	4/28/98	**Well Destroyed**												
MW-7	9/27/94	<250	1800	<250	-	-	<0.3	<0.3	<0.3	<0.3	-	-	<1.0	-
	6/28/94	560	490 (3,4)	<200 (1)	-	-	0.6	<1.0	<1.0	2.7	-	-	<0.5	-
	10/31/96	200	420	<200	-	-	1.1	<1.0	<1.0	<2.0	<10	-	<1.0	-
	9/30/97	750	190 (3)	<200	-	-	8.1	5.3	<1.0	6.9	<10	-	<0.8	-
	12/12/97	420	<50	<200	-	-	7.9	<0.5	<0.5	5	<5	-	<2	-
	2/18/98	650	<50	<200	-	-	9.5	0.6	<0.5	6	16	-	<2	-
	5/8/98	710	<50	<200	-	-	3.4	4.8	0.8	7	34	0.9 (5)	<2	-

TABLE 2
HISTORICAL GROUNDWATER ANALYTICAL RESULTS - ORGANICS and TDS
MARINER SQUARE, ALAMEDA, CALIFORNIA

WELL NUMBER	DATE	TPHg (ppb)	TPHd (ppb)	TPHmo (ppb)	TRPH (ppm)	OIL & GREASE (ppb)	BENZENE (ppb)	TOLUENE (ppb)	ETHYL-BENZENE (ppb)	TOTAL XYLENES (ppb)	MTBE (ppb)	VOCs (ppb)	VINYL CHLORIDE (ppb)	TDS (ppm)
MW-8	9/27/94	<50	320	<50	-	-	<0.3	<0.3	<0.3	<0.3	-	-	-	4100
	6/28/96	<100	58 (3)	<200 (1)	-	-	<0.5	<1.0	<1.0	<2.0	-	-	<0.5	-
	10/31/96	<100	120	<200	-	-	<0.5	<1.0	<1.0	<2.0	<10	-	<1.0	-
	9/30/97	110	70 (3)	<200	-	-	4.2	<1.0	3.4	16	<10	-	<0.8	-
	12/12/97	<50	<50	<200	-	-	<0.5	<0.5	<0.5	<2.0	15	-	<2	-
	2/18/98	<50	<50	<200	-	-	0.9	<0.5	0.8	3	<5	-	<2	-
	5/8/98	<50	<50	<200	-	-	<0.5	<0.5	<0.5	<2.0	<5	-	<2	-
MW-9	9/26/94	<500	2200	<500	-	-	<0.3	<0.3	<0.3	<0.3	-	-	<1.0	-
	6/28/96	390	550 (3,4)	<200 (1)	-	-	5.2	<1.0	<1.0	<2.0	-	-	<0.5	-
	10/31/96	300	590	720	-	-	5.9	<1.0	<1.0	<2.0	<10	-	<1.0	-
	9/30/97	150	460 (3)	<200	-	-	0.6	<1.0	<1.0	2.7	<10	-	<0.8	-
	12/12/97	180	<50	<200	-	-	<0.5	<0.5	<0.5	<2.0	<5	-	<2	-
	2/18/98	100	<50	<200	-	-	<0.5	0.5	<0.5	<2.0	6	-	<2	-
	5/8/98	70	130	<200	-	-	<0.5	<0.5	<0.5	<2.0	16	-	<2	-
HP-1	9/3/98	10,000 (6)	410,000	12,000	-	-	<0.5	18	8	63	<0.5	-	<5.0	-
HP-2	9/3/98	1,400 (6)	230,000	10,000	-	-	<0.5	4	2	24	<0.5	-	<5.0	-
HP-3	9/3/98	230 (6)	78,000	3,000	-	-	1.0	<0.5	<0.5	<1.0	<0.5	-	<5.0	-
T1-D	8/6/97	-	9,800	-	29	-	-	-	-	-	-	-	ND	-
T1-G	8/6/97	230 (6)	78,000	3,000	-	-	4.3	9	12	84	<0.5	-	ND	-

Notes:

TPHG	Total Petroleum Hydrocarbons as gasoline
THPd	Total Petroleum Hydrocarbons as diesel
TPHmo	Total Petroleum Hydrocarbons as motor oil
TRPH	Total Recoverable Petroleum Hydrocarbons
MTBE	Methyl Tert-butyl ether
VOCs	Volatile Organic Compounds
TDS	Total Dissolved Solids
ppb	parts per billion
ppm	parts per million
<	Analyte not detected at or above stated detection limit

(1) Lubricating oil can not be qualitatively identified by type of oil because of chromatographic likeness of different oil types. Due to non-volatility of certain oils, much of the oil present may never be quantified by this gas chromatographic method. Quantitation obtained for lubricating oil by this method should, therefore, be treated as an estimate. This method quantifies lubricating oil agains 10-W-40 standards. For the most accurate analysis of lubricating oil, an infrared method is recommended.

(2) Water sample also analyzed for Freon 113 by EPA Method 8010A. Results were below the detection limit of 1.0 µg/L.

(3) Qualitative identification is uncertain because the material present does not match laboratory standards.

(4) Quantitation uncertain due to matrix interferences

(5) Tetracholoroethene

TABLE 3
HISTORICAL SOIL SAMPLE ANALYTICAL RESULTS - INORGANICS
MARINER SQUARE, ALAMEDA, CALIFORNIA

BORING/WELL NUMBER	Depth (feet)	Date	TTLC METALS (ppm)																	STLC (ppm)
			Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Hg	Mo	Ni	Se	Ag	Tl	V	Zn	Pb
T-1	5.0	12/17/90	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-	-	-	-
T-2	5.0	12/17/90	-	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-
D-1	1.0	12/17/90	-	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-
MW-1	4.0	7/22/92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.10
MW-2	1.5	7/22/92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.0
MW-3	4.5	7/22/92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.79
MW-4	4.5	7/22/92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09
MW-5	1.5	7/22/92	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.0
SB-A	1.5	9/15/94	29	7.2	410	0.32	<0.50	44	6.7	28	250	0.33	1.7	26	<0.25	<1.0	<0.50	33	370	-
	3.0	9/15/94	-	-	-	-	-	-	-	-	4.2	-	-	-	-	-	-	-	-	-
SB-B	1.5	9/16/94	<2.5	1.8	88	<0.25	1.2	40	7.3	17	250	0.20	<1.0	36	<0.25	<1.0	<0.50	28	580	-
	3.0	9/16/94	-	-	-	-	-	-	-	-	14	-	-	-	-	-	-	-	-	-
SB-C	1.5	9/16/94	<2.5	3.4	120	<0.25	<0.50	52	8.5	25	1,000	0.26	1.4	47	<0.25	<1.0	<0.50	38	210	-
	3.0	9/16/94	-	-	-	-	-	-	-	-	5.7	-	-	-	-	-	-	-	-	-
SB-D	1.5	9/16/94	<2.5	3.3	36	<0.25	<0.50	35	3.8	18	8.0	<0.10	<1.0	25	<0.25	<1.0	<0.50	20	18	-
SB-E	1.5	9/16/94	<2.5	1.4	82	<0.25	<0.50	35	4.3	14	38	<0.10	<1.0	28	<0.25	<1.0	<0.50	25	51	-
SB-F	1.5	9/16/94	<2.5	1.2	31	<0.25	<0.50	31	3.1	6.2	12	<0.10	<1.0	20	<0.25	<1.0	<0.50	18	34	-
SB-G	1.5	9/16/94	<2.5	2.2	69	<0.25	<0.50	39	4.9	13	59	<0.10	<1.0	31	<0.25	<1.0	<0.50	25	150	2.7
	3.0	9/16/94	-	-	-	-	-	-	-	-	25	-	-	-	-	-	-	-	-	-
SB-H	1.5	9/16/94	<2.5	3.0	76	<0.25	<0.50	46	5.1	47	68	<0.10	<1.0	35	<0.25	<1.0	<0.50	28	160	2.8
	3.0	9/16/94	-	-	-	-	-	-	-	-	26	-	-	-	-	-	-	-	-	-
SB-I	1.5	9/16/94	<2.5	<5.0	48	<0.25	<0.50	36	10	90	38	<0.10	1.1	29	<0.25	<1.0	<0.50	24	100	-
SB-J	1.5	9/16/94	170	11	570	<0.25	1.9	54	11	300	5,700	0.16	2.0	43	<0.25	<1.0	<0.50	31	2,700	-
	3.0	9/16/94	<2.5	-	-	-	-	-	-	5.4	4.6	-	-	-	-	-	-	-	16	-
SB-K	1.5	9/16/94	<2.5	5.0	96	<0.25	<0.50	44	5.6	4,200	30	<0.10	1.3	33	<0.25	1.0	<0.50	28	150	21
	3.0	9/16/94	-	-	-	-	-	-	-	6.5	-	-	-	-	-	-	-	-	-	-
DP-1(PL1-1.5)	1.5	12/7/98	-	-	-	-	-	-	-	-	<5.0	-	-	-	-	-	-	-	-	1.6
DP-1	4.0	12/7/98	-	-	-	-	-	-	-	-	7.5	-	-	-	-	-	-	-	-	0.64
DP-2	4.0	12/7/98	-	-	-	-	-	-	-	-	<5.0	-	-	-	-	-	-	-	-	<0.25
PL1-1	2.0	11/21/98	-	-	-	-	-	-	-	-	140	-	-	-	-	-	-	-	-	-
PL1-2	2.0	11/21/98	-	-	-	-	-	-	-	-	130	-	-	-	-	-	-	-	-	-
PL1-3	2.2	11/21/98	-	-	-	-	-	-	-	-	37	-	-	-	-	-	-	-	-	-
PL1-4	2.0	11/21/98	-	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-
PL1-5	1.8	11/21/98	-	-	-	-	-	-	-	-	<5.0	-	-	-	-	-	-	-	-	-
PL1-6	1.8	11/21/98	-	-	-	-	-	-	-	-	33	-	-	-	-	-	-	-	-	-
PL1-7	2.0	11/21/98	-	-	-	-	-	-	-	-	63	-	-	-	-	-	-	-	-	-
PL2-1	2.3	11/21/98	-	-	-	-	-	-	-	-	120	-	-	-	-	-	-	-	-	-
PL2-2	2.2	11/21/98	-	-	-	-	-	-	-	-	28	-	-	-	-	-	-	-	-	-
PL2-3	1.9	11/21/98	-	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	7.8
PL2-4	2.0	11/21/98	-	-	-	-	-	-	-	-	58	-	-	-	-	-	-	-	-	-
PL2-5	2.0	11/21/98	-	-	-	-	-	-	-	-	140	-	-	-	-	-	-	-	-	-

ppm = Parts per million
< = Analyte not detected at or above specified reporting limit
TTLC = Total threshold limit concentration (CCR Title 22)
STLC = Soluble threshold limit concentration (CCR Title 22)
- = Not Analyzed
Sb = Antimony
Se = Selenium
Ag = Silver
As = Arsenic
Ba = Barium
Be = Beryllium
Cd = Cadmium
Co = Cobalt
Tl = Thallium
V = Vanadium
Cu = Copper
Pb = Lead
Hg = Mercury
Mo = Molybdenum
Ni = Nickel
Zn = Zinc

TABLE 4
Soil Analytical Results - Polynuclear Aromatic Compounds
Mariner Square, Alameda, CA
(in parts per million)

Boring No.	Sample Date	Depth	Naphthalene	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo [a] - Anthracene	Chrysene	Benzo [b] - Fluoranthene	Benzo [k] - Fluoranthene	Benzo [a] - Pyrene	Dibenzo [a,h] - Anthracene	Indeno [1,2,3-cd] - Pyrene
PL1-1	11/21/98	2.0	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4	<3.4
PL1-2	11/21/98	2.0	**230**	**260**	<34	<34	<34	<34	<34	<34	<34	<34	<34	<34	<34	<34	<34	<34
PL1-3	11/21/98	2.2	**0.99**	**2.6**	<0.67	**0.86**	**1.2**	**2.9**	**0.83**	**1.2**	**0.9**	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
PL1-4	11/21/98	2.0	<0.67	<0.67	<0.67	<0.67	<0.67	**1.3**	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
PL1-5	11/21/98	1.8	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
PL1-6	11/21/98	1.8	**1.7**	**1.2**	<0.67	<0.67	<0.67	**1.9**	<0.67	**1.0**	**1.1**	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
PL1-7	11/21/98	2.0	**9.0**	<3.4	<3.4	<3.4	**4.3**	**24**	**8.6**	**19**	**14**	**5.8**	**4.3**	**3.7**	<3.4	<3.4	<3.4	<3.4
PL2-1	11/21/98	2.3	**5.3**	**3.5**	<0.67	**4.3**	**5.2**	**9.2**	**2.0**	**3.5**	**2.6**	**0.92**	**0.76**	**1.1**	<0.67	**0.82**	<0.67	<0.67
PL2-2	11/21/98	2.2	**2.2**	**0.81**	<0.67	**0.86**	**1.3**	**3.6**	**0.91**	**1.2**	**1.1**	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
PL2-3	11/21/98	1.9	<0.67	<0.67	<0.67	<0.67	<0.67	**1.2**	<0.67	**1.4**	**1.2**	<0.67	**0.70**	**1.26**	<0.67	**0.73**	<0.67	<0.67
PL2-4	11/21/98	2.0	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
PL2-5	11/21/98	2.0	**1.2**	<0.67	<0.67	<0.67	<0.67	**1.8**	<0.67	**0.8**	**1.5**	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
DP-1-4	12/7/98	4.0	<0.67	-	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67
DP-2-4	12/7/98	4.0	<0.67	-	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67	<0.67

< Less than indicated detection limit

TABLE 5
Groundwater Analytical Results - Polynuclear Aromatics
Mariner Square, Alameda, CA
(in parts per billion)

Well No.	Sample Date	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo {a} - Anthracene	Chrysene	Benzo [b] - Fluoranthene	Benzo [k] - Fluoranthene	Benzo [a] - Pyrene	Dibenzo [a,h] - Anthracene	Benzo [g,h,i] - Perylene	Indeno [1,2,3-cd] - Pyrene
MW-1	6/28/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	10/31/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	9/30/97	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/12/97	0.6	<1.0	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2/18/98	2.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	5/8/98	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
MW-2	6/28/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	0.82	0.77	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	10/31/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	9/30/97	<2.0	12.0	3.3	<2.0	<1.0	<1.0	1.0	1.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/12/97	<0.5	<1.0	<0.5	<0.1	<0.1	<0.1	0.2	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2/18/98	<1.0	8.0	5.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	5/8/98	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
MW-3	6/28/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	10/31/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	9/30/97	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/12/97	0.6	<1.0	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2/18/98	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	5/8/98	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
MW-4	6/28/96	<2.0	2.5	2.3	<2.0	<1.0	<1.0	1.8	2.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	10/31/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	0.92	1.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	9/30/97	<2.0	<2.0	3.7	<2.0	<1.0	<1.0	1.5	1.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/12/97	0.8	<1.0	<0.5	<0.1	<1.0	<0.1	0.4	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2/18/98	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	5/8/98	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
MW-5	6/28/96	2.0	96 (1)	3.0	<2.0	9.5	2.3	8.6	8.4	1.0	0.68	<0.5	<0.5	0.78	<0.5	0.57	<0.5
	10/31/96	<2.0	150	8.3	2.4	14	2.9	11	15	1.9	1.8	0.51	<0.5	0.84	<0.5	<0.5	<0.5
	9/30/97	2.6	100.0	11.0	5.0	16.0	3.9	15.0	16.0	2.1	2.5	<0.5	<0.5	1.1	<0.5	<0.5	<0.5
	12/12/97	<0.5	<1.0	1.0	0.8	2.9	0.6	1.7	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2/18/98	<1.0	150.0	170.0	6.0	3.0	2.0	11.0	7.0	1.0	2.0	<1.0	<1.0	1.0	<1.0	<1.0	<1.0
	5/8/98	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0

TABLE 5
Groundwater Analytical Results - Polynuclear Aromatics
Mariner Square, Alameda, CA
(in parts per billion)

Well No.	Sample Date	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo (a) - Anthracene	Chrysene	Benzo [b] - Fluoranthene	Benzo [k] - Fluoranthene	Benzo [a] - Pyrene	Dibenzo [a,h] - Anthracene	Benzo [g,h,i] - Perylene	Indeno [1,2,3-cd] - Pyrene
MW-6	6/28/96	**Not Sampled - Separate Phase Hydrocarbons**															
	10/31/96																
	9/30/97																
	12/12/97	<100	<200	<100	90.0	80.0	<20	250.0	40.0	25.0	<20	<20	<20	<20	<20	<20	<20
	2/18/98	<20	<20	<20	<20	<20	<20	90.0	110.0	<20	190.0	130.0	<20	70.0	62.0	23.0	<20
	4/28/98	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
	4/28/98	DESTROYED															
MW-7	6/28/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	10/31/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	9/30/97	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/12/97	1.0	<1.0	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2/18/98	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	5/8/98	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0	<6.0
MW-8	6/28/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	10/31/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	9/30/97	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/12/97	0.6	<1.0	<0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2/18/98	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	5/8/98	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
MW-9	6/28/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	0.73	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	10/31/96	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	0.69	1.10	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	9/30/97	<2.0	<2.0	<2.0	<2.0	<1.0	<1.0	<0.5	0.56	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	12/12/97	1.4	<1.0	<0.5	0.2	<0.1	0.2	0.6	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	2/18/98	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	5/8/98	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0

TABLE 5
Groundwater Analytical Results - Polynuclear Aromatics
Mariner Square, Alameda, CA
(in parts per billion)

Well No.	Sample Date	Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene	Fluoranthene	Pyrene	Benzo {a} - Anthracene	Chrysene	Benzo [b] - Fluoranthene	Benzo [k] - Fluoranthene	Benzo [a] - Pyrene	Dibenzo [a,h] - Anthracene	Benzo [g,h,i] - Perylene	Indeno [1,2,3-cd] - Pyrene
HP-1(2)	9/3/98	<25	<25	<25	<62	27	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
	9/3/98	<25	<25	<25	<62	<25	26	<25	<25	<25	<25	<25	<25	<25	<25	<25	<25
	9/3/98	<42	<42	<42	<110	<42	<42	<42	<42	<42	<42	<42	<42	<42	<42	<42	<42

Notes:

Polynuclear Aromatics analyzed by EPA Method 8310

<: Not detected at or above the specified laboratory detection limit.
(1): The qualitative identification for Acenaphthylene is uncertain due to matrix interferences.
(2): Reporting Limits raised and surrogates out of control limits due to matrix inferences

TABLE 6
HISTORICAL GROUNDWATER SAMPLE ANALYTICAL RESULTS - INORGANCS
MARINER SQUARE, ALAMEDA, CALIFORNIA

WELL NUMBER	DATE	Priority Pollutant Metals (parts per billion)												
		Sb	As	Be	Cd	Cr	Cu	Pb	Hg	Ni	Se	Ag	Tl	Zn
MW-5	5/25/93	<60	10	<2	<5	10	30	82	<0.2	<30	<5	<10	<5	60
MW-5	9/26/94	<50	<10	<5	<10	<10	<20	<3	<0.2	<20	<5	<10	<10	<20
MW-6	9/27/94	<50	<10	<5	<10	<10	<20	<3	<0.2	<20	<5	<10	<10	<20
MW-6	5/25/93	<60	<5	<2	<5	30	30	<3	<0.2	50	<5	<10	<5	40
MW-1	9/27/94	<50	22	<5	<10	<10	<20	<3	<0.2	<20	<5	<10	<10	<20
MW-2	9/26/94	<50	<10	<5	<10	<10	<20	<3	<0.2	<20	<5	<10	<10	<20
MW-3	9/27/94	<50	<10	<5	<10	<10	<20	<3	<0.2	<20	<5	<10	<10	<20
MW-4	9/27/94	<50	<10	<5	<10	<10	<20	<3	<0.2	<20	<5	<10	<10	<20
MW-7	9/27/94	<50	20	<5	<10	<10	<20	<3	<0.2	<20	<5	<10	<10	<20
MW-8	9/27/94	<50	13	<5	<10	<10	<20	<3	<0.2	<20	<5	<10	<10	<20
MW-9	9/26/94	<50	<10	<5	<10	<10	<20	<3	<0.2	<20	<5	<10	<10	<20

Notes:

<	Analyte not detected at or above the specified laboratory reporting limit
Ag	Silver
As	Arsenic
Be	Beryllium
Cd	Cadmium
Cu	Copper
Cr	Chromium
Hg	Mercury
Ni	Nickel
Pb	Lead
Sb	Antimony
Se	Selenium
Tl	Thallium
Zn	Zinc

Table 7
Risk Evaluation Parameters

Tier 2 Soil, Building, Surface and Subsurface Parameters

Parameter	Definition (Units)	Residential
η	Areal fraction of cracks in foundations/walls (cm^2 cracks/ cm^2 total area)	0.01 cm^2 cracks/cm^2 total area
ρ_s	Soil Bulk Density (g soil/ cm^3 soil)	1.7 g / cm^3
θ_T	Total Soil porosity (cm^3/cm^3 soil)	0.38 cm^3/cm^3 soil
θ_{scrack}	Volumetric air content in foundation/wall cracks (cm^3air/cm^3 total volume)	0.26 cm^3 air/cm^3 total volume
θ_{as}	Volumetric air content in vadose zone soils (cm^3 air/cm^3 soil)	0.26 cm^3 air/ cm^3 soil
θ_{wcrack}	Volumetric water content in foundation/wall cracks (cm^3 H_2O/ cm^3 total volume)	0.12 cm^3 H_2O/ cm^3 total volume
θ_{ws}	Volumetric water content in vadose zone soils (cm^3 H_2O/ cm^3 soil)	0.12 cm^3 H_2O/ cm^3 soil
f_{OC}	Fraction of organic carbon in soil (g-C/g soil)	0.01
K_s	Soil-water sorption coefficient (g. H_2O/ g. soil)	f_{oc} x k_{oc}
$D_{eff/crack}$	Effective diffusion coefficient for foundation crack (cm^2/s)	Calculation
$D_{eff/s}$	Effective diffusion coefficient for soil (cm^2/s)	Calculation
D^{air}	Diffusion coefficient in air (cm^2/sec)	Benzene- 0.093 cm^2/sec
D^{wat}	Diffusion coefficient in water (cm^2/sec)	Benzene - 1.1 x 10^{-5} cm^2/sec
ER	Enclosed space air exchange rate (L/s)	0.00014 s^{-1}
H	Henry's Law constant (cm^3 H_2O/cm^3 air)	Benzene used - 0.22 L H_2O/L air or 5.5 x 10^{-3} m^3atm/mol
Hcap	Thickness of capillary fringe(cm)	20 cm
Hv	Thickness of vadose zone (cm)	152 cm
L_B	Enclosed space volume/infiltration area ratio (cm)	200 cm
L_{crack}	Enclosed-space foundation or wall thickness (cm)	15 cm
L_{gw}	Depth to groundwater (cm)	155 cm
k_{oc}	Carbon-water sorption coefficient (g. H_2O/g C)	Benzene- log =1.92
VF_{wesp}	Volatilization Factor vapor from groundwater to enclosed space (mg/m^3 air/ mg/kg soil)	Calculation

Tier 2 Exposure Parameters

Parameter	Definition (Units)	Residential	Commercial/Industrial
AT_n	Averaging time for noncarcinogens (year)	30 years	25 years
BW	Adult body weight (kg)	70 kg	70 kg
ED	Exposure duration (years)	30 years	25 years
EF	Exposure frequency (days/year)	350 days/year	250 days/year
IR_{air}	daily outdoor inhalation rate, (m^2/day)	20 m^3/day	20 m^3/day
IR_{soil}	Soil ingestion rate (mg/day)	100 mg/day	50 mg/day
M	soil to skin adherence factor, (mg/cm^2)	0.5	0.5
RAF_d	Dermal relative absorption factor, volatiles/PAHs	0.05	0.05
RAF_o	Oral relative absorption factor	1.0	1.0
$RBSL_s$	Risk-Based screening level for subsurface soil (mg/kg s)	Calculation	Calculation
RfD_o	Oral chronic reference dose, mg/kg-day	Naphthalene,0.004	0.004
SA	Skin surface area,(cm^2/day)	3160	3160
THQ	Target Hazard quotient for individual constituents, unitless	1.0	1.0
VF_{ss}	Volatilization factor, surficial soils vapors	Chemical Specific	Chemical Specific
VF_p	Volatilization factor, surficial soils particulates	Chemical Specific	Chemical Specific Parameters

Derived from ASTM guideline E 1739