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TRANSMITTAL

DATE: July 14, 1995
PROJECT #: 81-0618-80

TO: Scott O. Seery
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COMPANY: Alameda County Department of Environmental Health
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FROM: Tom Fojut

SUBJECT: ACDEH STID #3719
Shell Service Station
6039 College Avenue
Oakland, California

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COMMENTS:

Weiss Associates' *Comprehensive Site Evaluation and Proposed Future Action Plan* for the subject site is enclosed. Please review and call me if you have any comments or questions

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Weiss Associates *Environmental and Geologic Services*

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COMPREHENSIVE SITE EVALUATION AND PROPOSED FUTURE ACTION PLAN

for

Shell Service Station
WIC # 204-5508-3301
6039 College Avenue
Oakland, California

prepared for

Shell Oil Products Company
P.O. Box 4023
Concord, California 94524

prepared by

Weiss Associates
5500 Shellmound Street
Emeryville, CA 94608

July 12, 1995

Weiss Associates

COMPREHENSIVE SITE EVALUATION
AND
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for
Shell Service Station
WIC # 204-5508-3301
6039 College Avenue
Oakland, California

prepared by

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Emeryville, CA 94608

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Weiss Associates' work for Shell Oil Products Company, P.O. Box 4023, Concord, California, was conducted under my supervision. To the best of my knowledge, the data contained herein are true and accurate and satisfy the specified scope of work prescribed by the client for this project. The data, findings, recommendations, specifications, or professional opinions were prepared solely for the use of Shell in accordance with generally accepted professional engineering and geological practice. We make no other warranty, either expressed or implied, and are not responsible for the interpretation by others of these data.

REGISTERED GEOLOGIST
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Robert O. Devany July 12, 1995
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SUMMARY

The Shell service station at 6039 College Avenue, Oakland, California has been in operation since 1940. In 1957 and 1978, underground storage tanks were removed and replaced at this site. Between 1990 and 1993, four onsite and two offsite ground water monitoring wells were installed to assess the extent of petroleum hydrocarbons in ground water. Ground water sampling has been performed at the site for five years. Review of ground water monitoring and subsurface investigation data shows that:

- ***The plume is contained by natural subsurface conditions, and no significant plume migration is occurring:*** Petroleum hydrocarbons have been present in the subsurface at this site for at least 6 years, and possibly as long as 38 years. During this time, low permeability sediments have prevented the plume from migrating more than a few tens of feet offsite. It is unlikely that significant plume migration will take place before most of the remaining petroleum hydrocarbons attenuate.

- ***The source has been mitigated:*** Shell repaired the gasoline tank piping failure in September 1989, immediately after it was detected. The soils associated with this repair were removed. Since subsurface investigations began in 1990, the lateral and vertical extent of the subsurface petroleum hydrocarbons in ground water have remained essentially unchanged. The stability of the plume and the decline of petroleum hydrocarbon concentrations in ground water over the past several years verify that the source is depleted.

- ***The petroleum hydrocarbons remaining at the site do not present a risk to either human health or the environment:*** Contaminant concentrations in the subsurface do not exceed conservative, site-specific risk-based target levels for identified probable exposure pathways based on ASTM Risk Based Corrective Action analysis.

- ***The residual dissolved-phase petroleum hydrocarbons remaining at the site do not justify additional active remediation:*** Active remediation at this site is not cost effective due to the low soil permeability above and below the water table. The low petroleum hydrocarbon concentrations in ground water will attenuate naturally, without additional remediation.

- ***Separate-phase hydrocarbons will continue to be removed from well MW-4:*** Separate phase petroleum hydrocarbons detected in well MW-4 will be removed continually as outlined in the action plan contained in this document.

After review of these data, Shell and WA submit that: 1) petroleum hydrocarbons remaining in the site subsurface do not present a threat to human health or to the quality of the surrounding ground water; and 2) no technically or economically feasible remedial measures are appropriate for this site to further reduce the plume. Shell and WA request, therefore, that the Alameda County Department of Environmental Health (ACDEH) acknowledge that no additional remediation is necessary at this site, approve a reduction in ground water sampling, and establish a non-attainment zone (NAZ)[1] encompassing the residual petroleum hydrocarbon plume.

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[1] As defined in proposed changes to State Water Quality Control Board Resolution No. 92-49 (Draft dated January 18, 1995), Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code, Section 13304.

INTRODUCTION

At the request of Shell Oil Products Company (Shell), Weiss Associates (WA) has prepared this comprehensive site evaluation for the Shell Service Station located at 6039 College Avenue, Oakland, California. This evaluation has been completed to address the requirement for a Corrective Action Plan (CAP) for this site, as specified in the Alameda County Department of Environmental Health (ACDEH) letter to Shell Environmental Engineer Dan Kirk, dated April 12, 1995. The referenced correspondence indicates that the CAP should include i) an assessment of the impacts associated with contaminants present on site; ii) a feasibility study as necessary; iii) applicable cleanup levels; and iv) a proposed schedule for completion of proposed activities. Within this document, the issues of feasibility are addressed by the discussion of non attainment zone criteria and a schedule for completion of proposed activities is addressed by the future action plan. An assessment of the potential risk to human health associated with contaminants present on site and a determination of applicable cleanup levels is addressed in the ASTM Risk-Based Corrective Action (RBCA) analysis presented in Section 3.

1. SITE HISTORY

1.1 Site Setting

The Shell service station is located on the northern corner of Claremont Avenue and College Avenue in Oakland, California. The site is surrounded by mixed commercial and residential development and lies at an elevation of about 194 ft above mean sea level. Sediments at this site consist of fine-grained Quaternary alluvial deposits derived from the Berkeley Hills. Topography at the site slopes to the southwest at about 1.5 degrees.

1.2 Tank Removals and Site Investigations

1957 UST Removal and Replacement: (Harding Lawson Associates, 1990). In 1957, three 1,000-gallon and one 550-gallon steel USTs containing gasoline, and one 110-gallon single-walled steel waste oil tank were removed. These tanks were apparently installed when the station first opened in 1940. The tanks were replaced by three 5,000-gallon leaded gasoline tanks and one 1,000-gallon waste oil tank, all of single-wall steel construction.

1978 UST Removal and Installation: (Harding Lawson Associates, 1990). In 1978, one 8,000-gallon and three 5,000-gallon steel USTs and one 1,000-gallon waste oil tank were removed. It is not clear from the available data when the 8,000-gallon tank was installed. The tanks were replaced by three 10,000-gallon fiberglass USTs for gasoline storage.

1989 Unauthorized Release: (Harding Lawson Associates, 1990). In September 1989, the ACDEH received notification of an unauthorized release from an underground storage tank. The source of the release was reported as a slight weep at the piping connection to the submersible pump for a gasoline tank.

1990 Soil Borings: (Harding Lawson Associates, 1990). In January 1990, Harding Lawson Associates (HLA) drilled soil borings B-1 through B-6 (Figure 3) to a depth of approximately 25 feet below ground surface (bgs). Up to 610 parts per million (ppm) total petroleum hydrocarbons as gasoline (TPH-G), 5,900 ppm total petroleum hydrocarbons as diesel (TPH-D), 110,000 ppm total petroleum hydrocarbons as motor oil (TPH-MO), and 0.57 ppm benzene were detected in soil samples from borings B-3 and B-6. Petroleum hydrocarbon concentrations were near or below laboratory detection limits in soil samples collected from borings B-1, B-2, B-4, and B-5.

1990 Soil Boring and Well Installations: (Harding Lawson Associates, 1990). In February 1990, HLA drilled and installed ground water monitoring wells MW-1 through MW-4 to a depth of 25 feet bgs. Up to 230 ppm TPH-G and 1.1 ppm benzene were detected in soil samples collected from the MW-3 and MW-4 borings. Petroleum hydrocarbon concentrations were near or below laboratory detection limits in soil samples collected from the MW-2 boring.

1991 Soil Boring and Well Installation: (Harding Lawson Associates, 1991). In August 1991, HLA installed monitoring well MW-5 to a depth of 28 feet bgs. Although 23 ppm of a petroleum mixture other than gasoline was detected in a soil sample from 16 ft, no benzene was detected in any of the samples.

1993 Soil Boring and Well Installation: (Weiss Associates, 1993). In March 1993, WA drilled soil borings BH-A through BH-E and installed monitoring well MW-6. Up to 580 ppm TPH-G, 0.42 ppm benzene and 930 ppm petroleum oil and grease were detected in soil samples collected from borings BH-A, BH-C and BH-D. No petroleum hydrocarbons were detected in soil samples collected from boring BH-B and only 3.5 ppm TPH-D were detected in soil samples collected from boring BH-E (well MW-6).

Quarterly Ground Water Monitoring: (Weiss Associates, 1995 and Harding Lawson Associates, 1991). Wells MW-1 through MW-4 have been sampled quarterly since February 1990. Petroleum hydrocarbon concentrations in ground water samples from MW-3 increased initially up to 67,000 parts per billion (ppb) TPH-G and 620 ppb benzene in March 1992, but have since declined to an average of about 1,000 ppb TPH-G and 120 ppb benzene. Petroleum hydrocarbon concentrations in ground water samples from wells MW-1 and MW-2 have been near or below laboratory detection limits since sampling began.

Well MW-4 has contained separate phase hydrocarbons (SPH) during a number of sampling events since November 22, 1991. Petroleum hydrocarbon concentrations in ground water samples from MW-4 averaged 550 ppb TPH-G and 130 ppb benzene before SPH removal began in December 1991. A petroleum hydrocarbon skimmer is currently installed to remove the SPH from well MW-4 continually. The SPH appear to be composed of higher molecular weight compounds than gasoline, possibly oil from the adjacent former waste oil tank.

Well MW-5 has been sampled quarterly since August 1991. No benzene has ever been detected in ground water samples from MW-5. The only detection of TPH-G in ground water samples from MW-5 was footnoted as having an atypical gasoline chromatographic pattern.

Well MW-6 has been sampled quarterly since September 1993. Benzene concentrations were near or below laboratory detection limits for all ground water samples from MW-6 except during the last sampling. According to the analytical laboratory concentrations of TPH-G in ground water from MW-6 for this sampling had an atypical gasoline chromatographic pattern.

1.3 Remedial Actions

Shell has conducted the following remedial actions:

- In September 1989, the failed gasoline tank piping connection to the submersible pump was repaired immediately after the failure was detected.

- Since December 1991, a petroleum hydrocarbon skimmer has been installed in well MW-4 to collect SPH. Ten pounds of SPH have been removed to date.

- Between 1957 and 1978, Shell removed 10 underground fuel and waste oil tanks. Because soil excavation was necessary to replace the former tanks with the new larger tanks in 1978, it is presumed that soil was removed from the source area. The excavated soil was probably transported offsite because it was common practice to backfill fiberglass tank excavations with imported pea gravel. Records documenting the amounts and nature of contamination in the soil removed are not available.

2. EVALUATION OF NON-ATTAINMENT ZONE CRITERIA AND FUTURE ACTION PLAN

The limited extent of the remaining petroleum hydrocarbon plume and the site hydrogeologic and chemical conditions, as discussed below, indicate that this site is a candidate for establishment of a non-attainment zone (NAZ). Each of the Regional Water Quality Control Board (RWQCB) criteria for establishment of a NAZ is considered for the subject site in the following section. The criteria are as defined in the proposed amendments to the Water Quality Control Plan (Basin Plan) for the San Francisco Bay Region, as outlined in the Memorandum dated October 20, 1994 by Steven R. Ritchie, Executive Officer, RWQCB.

2.1 Plume Migration

Criterion a. The Discharger has demonstrated (e.g. pump tests, ground water monitoring, transport modeling) and will verify (e.g. ground water monitoring) that no significant pollution migration will occur due to hydrogeologic or chemical characteristics.

Site Hydrogeology: Sediments encountered during subsurface investigation drilling generally consisted of interbedded sandy clay and sandy silt and rare gravely silt to sandy silt units to the total depth explored of 50 ft. Ground water encountered during drilling ranged from 15 to 18 feet bgs.

Site Hydrology: Depth to water in the site wells has ranged from 9 to 21 feet bgs since the wells were first monitored in February 1990. On February 1, 1995, the inferred ground water flow direction was to the southwest, with a calculated gradient of 0.02 ft/ft. This flow direction is consistent with previous data.

Plume Location: Petroleum hydrocarbons in ground water beneath the site are contained primarily in the vicinity of MW-3 and MW-4, located adjacent to the former waste oil tanks. TPH-G and benzene concentrations in ground water from well MW-3 fluctuated seasonally up to 67,000 ppb TPH-G in March 1992, and 620 ppb benzene in February 1993, but have declined to an average of about 1,500 ppb TPH-G and 120 ppb benzene since June 1993. SPH consisting mainly of heavier petroleum hydrocarbons than gasoline, has been found in well MW-4 since November 1991. No TPH-G or BTEX exceeding state or federal maximum contaminant levels (MCLs) has been detected in wells MW-1, MW-2 or MW-5.

Plume Stability: Petroleum hydrocarbons are confined to a limited area and do not extend more than 80 feet offsite. Underground storage tanks containing petroleum hydrocarbons have been used at this site for 55 years and petroleum hydrocarbons have been detected in ground water for the past 5 years. Petroleum hydrocarbon concentrations in MW-3 have decreased since monitoring

can't confirm this w/ current well network

?

not so

or migration in direction not covered by well network

began in 1990, and the SPH thickness in MW-4 has been less than 0.1 feet since August 1992. The decreasing concentrations in MW-3 and the lack of corresponding increase in downgradient wells MW-5 and MW-6 indicate that the plume is attenuating naturally onsite.

2.2 Source Removal

Criteria b. Adequate source removal and/or isolation is undertaken to limit future migration of pollutants to ground water.

Adequate source removal and isolation is preventing the migration of petroleum hydrocarbons in ground water because:

factual info not available

- Soil was likely excavated during the 1978 tank removals because the newer tanks were larger than the tanks they replaced and the new tank excavation was probably backfilled with pea gravel, a common practice for fiberglass tanks.
- Site characterization data and ground water monitoring results indicate the low permeability soil and possibly bio-attenuation are containing most petroleum hydrocarbons onsite.
- Shell is removing SPH from well MW-4, and will continue to remove SPH for as long as it is detected at this site.
- The source of the release was removed when a failing gasoline tank piping connection was repaired in September 1989.

major source is former w.o. UST

2.3 Remedial Alternatives

Criteria c. Dissolved phase cleanup is not cost-effective due to limited water quality, environmental and human health risks and separate phases have been or are actively being removed.

The residual SPH, which appear to have higher molecular weights than typical fuel hydrocarbons, are confined to the vicinity of MW-4 and are being removed continually by the dedicated SPH skimmer. As discussed below, implementing remediation options to address dissolved phase cleanup would be difficult due to the low permeability sediments at this site, and is not justified by the low risk presented by the remaining plume.

Excavation: Soil excavation is generally the most expensive remedial approach. Costs of this alternative would be particularly high at this site. The depth of contamination requires handling a large volume of uncontaminated soil and excavation shoring would be required, adding considerably to the cost of this alternative. To excavate petroleum-bearing soil downgradient of the Shell station, the office building at 6074 Claremont Avenue would need to be demolished. Soil excavation is also inconsistent with the existing site use. The excavation, truck staging, and soil stockpiling would adversely impact the business activities of the current site owner. Soil excavation is therefore not considered feasible at this site.

Ground Water Extraction (GWE): GWE is one of the most common methods of controlling the migration of petroleum hydrocarbon-impacted ground water in high permeability sediments. The low permeability soil at this site is already acting to control petroleum hydrocarbon migration, and petroleum hydrocarbon removal through GWE is typically ineffective because the mass extracted is severely limited by diffusion and desorption of petroleum hydrocarbons into the ground water from the lower permeability materials within the plume. GWE is therefore considered ineffective as a remediation strategy at this site.

Soil Vapor Extraction (SVE): SVE is a remediation technique for removing volatile petroleum hydrocarbons from high permeability soils in the unsaturated zone. SVE works most effectively in coarse-grained soils where little resistance to air flow results, and where ground water is deep. SVE is performed by applying a vacuum to specified wells to draw air through petroleum hydrocarbon impacted soils in the unsaturated zone. Soil boring logs and soil sampling results at this site indicate that the unsaturated zone consists of low permeability sediments that contain low or non detectable concentrations of petroleum hydrocarbons. The high vacuum required to draw air flow through these sediments will result in high energy costs with low petroleum hydrocarbon vapor removal rates due to the lack of petroleum hydrocarbon impacted soil in the unsaturated zone. This alternative is both an infeasible and ineffective remedial approach for the subject site.

What's current DO conc? How about ORCs?

Ground Water Oxygenation: Ground water oxygenation involves introducing air and thus oxygen into the subsurface. This process encourages the growth and activity of petroleum hydrocarbon-metabolizing bacteria to promote natural petroleum hydrocarbon degradation. A tightly spaced matrix of oxygenation wells would be required to diffuse oxygen into the low permeability soil. An extensive network of oxygenation wells is expensive to install and maintain. It is uncertain whether oxygenation would significantly enhance natural bioattenuation. Further data collection, proposed later in this submittal, will allow an assessment of the effectiveness of oxygen injection.

Air Sparging: Air sparging involves simultaneously injecting pressurized air into ground water and extracting the resulting petroleum hydrocarbon saturated vapors with an SVE system. Air sparging is not a viable alternative because an SVE system is not cost effective for removing vapors from low permeability soil.

2.4 Human Health Risk

Criterion d. An acceptable plan is submitted and implemented for containing and managing the remaining human health, water quality and environmental risks, if any, posed by residual soil and ground water pollution.

Our plan for containing and managing the remaining risks posed by residual petroleum hydrocarbons at this site includes: 1) continued ground water monitoring for petroleum hydrocarbons within and downgradient of the plume for a limited period of time; 2) continued removal of SPH from well MW-4; and 3) a contingency plan to be implemented if monitoring indicates significant downgradient migration and/or increasing concentrations within the plume. Our proposed ground water monitoring schedule and contingency plan are presented in Section 4.

Following the RBCA framework, WA demonstrates in the following section that the existing concentrations of contaminants of concern associated with petroleum hydrocarbons are below site-specific risk based target levels for all exposure pathways, with the exception of direct ingestion of benzene in ground water. However, site-specific target levels for benzene in ground water are not exceeded at the selected alternative points of compliance for Tier 2, the proposed NAZ boundary, supporting the conclusion of no significant adverse human health risk from this pathway.

3. RBCA ANALYSIS

3.1 Introduction

The objective of this RBCA assessment is to assess the potential risk to human heath associated with the known petroleum hydrocarbons present in the subsurface, using the framework and guidance of the ASTM RBCA process. This assessment is not intended to address potential impacts on ground water quality except as they relate to possible human health risk.

The ASTM RBCA framework is a tiered decision-making process whereby site contaminant levels, as determined during an initial site assessment, are compared to conservatively-derived risk-based screening level (RBSL) targets for contaminants in each environmental media. In the RBCA process, Tier 1 - *Site Classification and Non-Site-Specific-Screening Level Corrective Action Goals* - sites are classified by the urgency of need for initial corrective action, and then site-specific contaminant concentrations are compared to target Tier 1 RBSLs. The ASTM guidance provides example RBSL look-up tables intended as a guide for state and local enforcement agencies; the RBSLs in the look-up tables are not intended to be stand-alone cleanup standards. Site-specific contaminant concentrations below the RBSLs by definition represent human health risks less than the target level, and human health risk may reasonably be assumed to be insignificant if site-specific concentrations are below these target risk levels.

If the Tier 1 RBSLs are exceeded, the RBCA process provides several alternatives for subsequent action. These options include a Tier 2 application of Tier 1 RBSLs at an alternative point of compliance, a Tier 2 analysis including development of site-specific Tier 2 target levels (SSTLs), the provision of institutional or engineering mechanisms to limit or reduce exposures, or remediation to Tier 1 RBSLs. A Tier 3 evaluation is also available for large or complex sites involving more sophisticated fate and transport issues or extensive data acquisition and analysis, as examples. In the Tier 2 analysis included herein, site-specific risk-based target levels (SSTLs) have been calculated. Similarly to the Tier 1 RBSLs, the Tier 2 SSTLs represent contaminant concentrations, below which associated human health risks may reasonably be assumed to be insignificant.

Following this framework, this letter includes a brief discussion of the results of the previous site investigation activities, identification of the contaminants of concern, an analysis of possible exposure routes, and identification of potentially complete exposure pathways for this site. To complete the Tier 1 analysis, the worst-case contaminant exposure concentration is then determined for each exposure route, and these site-specific exposures are compared to the appropriate Tier 1 RBSL. For those contaminant/pathway pairs for which the site-specific concentrations exceed the very conservative Tier 1 RBSLs, we have opted to proceed to Tier 2 analysis as the most appropriate option. In Tier 2, SSTLs are calculated following the RBCA framework, and site-specific concentration(s) are compared to the appropriate Tier 2 SSTL(s) to complete the impact analysis for the site.

3.2 Tier 1 RBCA Analysis

3.2.1 Step 1 - Initial Site Assessment

Source Characterization: Initial site assessment work as defined by the RBCA framework is the collection and assembly of data required to complete a RBCA Tier 1 analysis. Extensive site characterization has been completed at this site and investigative data has been provided to the ACDEH in the following reports:

- Quarterly Technical Report dated April 13, 1990 (Harding Lawson Associates, 1990);
- Quarterly Technical Report dated October 22, 1991 (Harding Lawson Associates, 1991);
- Soil and Water Investigation dated December 30, 1993 (Weiss Associates, 1993);
- Quarterly Monitoring Report, First Quarter 1995 dated April 24 1995 (Weiss Associates, 1995).

A summary of the site investigation activities performed at this site and their results are presented in Section 1.2.

receptors
- office workers
- Shell workers

Potential for Exposure and Degradation of Beneficial Uses: No sensitive receptors (open bodies of water, drinking water wells, schools or hospitals) are located on or within 1,000 ft of the site. Workers at 6074 Claremont Avenue, a small office building, adjacent to the south border of the service station, are identified as the most likely potentially exposed population. To the best of our knowledge, this building has no basement. On site Shell service station workers are also a potentially exposed population.

With the exception of four small planters, both the service station and the area surrounding the commercial building at 6074 Claremont Avenue are paved (Figure 2). Ingestion of and dermal contact with petroleum hydrocarbon bearing soil is very unlikely due to the paved surface and an approximate 10-foot layer of clean soil beneath the surface. In addition, sediments at this site consist of interbedded sandy silts and sandy clays that are consistent with the low permeability sediments found in this area. The clean layer of low permeability sediments and the mostly paved surfaces will provide additional barriers to petroleum hydrocarbon vapor transport from impacted soil and ground water to outdoor and indoor air.

Local Ground Water Use: Ground water in this area is not currently being used, and there are no current plans for use, as a drinking water source according to the County of Alameda, Public Works Agency (WA, Personal Communication, 1995). The County of Alameda, Public Works

Agency performed a well search of the nearest two square mile quadrants surrounding the Shell service station. The one domestic well and three irrigation wells found in the well inventory report are all outside a 1/2-mile radius of the Shell service station, and far outside the extent of the subsurface petroleum hydrocarbons associated with this site. The remainder of the wells identified in the search are for monitoring or various industrial uses, and are not within the extent of petroleum hydrocarbons associated with the Shell service station. There is no current onsite use of ground water at the site, nor is Shell or WA aware of any future plans for use.

Extent of Subsurface Petroleum hydrocarbons: The sixteen soil borings and six ground water monitoring wells have fully assessed the extent of petroleum hydrocarbons in the subsurface. Benzene concentrations in soil boring and ground water samples from downgradient monitoring wells MW-5 and MW-6 were low or below laboratory detection limits. The highest benzene concentrations in soil and ground water were in the vicinity of well MW-3 near the southwest corner of the service station. Benzene concentrations were detected in soil and ground water samples from offsite soil boring BH-D. and BH-C and BH-A Soil and ground water analytic results indicate that benzene in the subsurface does not extend far offsite.

TPH-G, TPH-D and TPH-MO concentrations in soil boring and ground water samples from downgradient well MW-5 were low or below laboratory detection limits for all samples in the site records. Similarly, TPH-G, TPH-D and petroleum oil and grease concentrations in soil boring and ground water samples from downgradient well MW-6 were low or below laboratory detection limits for all samples in the site records. Concentrations of TPH-G and TPH-D were detected offsite in soil boring and ground water samples from BH-A, BH-C and BH-D. Concentrations of TPH-G, TPH-D and TPH-MO in soil boring and ground water samples were highest in the vicinity of wells MW-3 and MW-4.

Summary of Site Characterization Results: Tables 1 and 2 provide the results of the sampling activities in soil and ground water, respectively, conducted to date. Figure 3 provides a site plan and shows the extent of petroleum hydrocarbons in subsurface soils based on the site investigation results.

Contaminants of concern identified for this analysis are those VOCs detected in the site characterization: benzene, toluene, ethylbenzene and xylenes (BTEX). BTEX compounds are typically used in risk-based assessments as "indicator compounds" for evaluation of total petroleum hydrocarbons (TPH). Benzene is the key contaminant of concern for this assessment because of its carcinogenicity. TPH itself is not identified as a contaminant of concern for this analysis because the toxicological parameters required to evaluate human health risk are not available for TPH as a fuel mixture. ASTM recommends evaluation of petroleum releases using the indicator compound approach, based on the assumption that "a significant fraction of the potential impact from all [TPH] chemicals is due to the indicator compounds" (ASTM ES 38-94). The US EPA recommends the same approach.

Table 3 shows the values used in this Tier 1 analysis for each contaminant of concern. For purposes of the Tier 1 RBCA assessment, WA has made the conservative assumption that compounds are present throughout site soils and ground water at the worst case (highest) concentrations found in the soil and ground water samples during any of the past sampling or

O.K.

monitoring events. The maximum concentration of benzene detected in soil was 1.1 ppm in boring MW-3 at 15.5 feet depth, collected on February 7, 1990, and the maximum benzene concentration in ground water was 820 ppb in MW-3, collected on February 12, 1993. Although 1994 and 1995 monitoring results indicate that maximum petroleum hydrocarbon concentrations in ground water have decreased due to attenuation, WA has conservatively used the maximum concentrations in this analysis. Similarly, it is likely that concentrations of contaminants of concern in site soils have also decreased over time from those levels measured in 1990.

3.2.2 Step 2 - Site Classification and Initial Response Action

Site Classification: The RBCA framework includes initial classification of the site into one of four main categories, each related to a set of possible appropriate initial response actions. The ASTM guidance provides examples of possible site classifications and the criteria on which they are based (ASTM ES38-94).

Based on review of the information provided by the initial site characterization, Site Classification 3 is most appropriate for the site at this time. This classification has been selected based on evidence of impacted ground water, although no known drinking water supply wells are located within one-half mile of the site. Site classifications 1 and 2 were not selected because no significant concentrations of petroleum hydrocarbons associated with this site have migrated past downgradient wells MW-5 and MW-6 since monitoring began in 1990.

Initial Response Action: Based on Site Classification 3, the RBCA guidance identifies ground water monitoring and assessment of the potential impact on the beneficial uses of ground water as appropriate initial response actions. Shell has already implemented this response action, with quarterly ground water monitoring that is still continuing.

3.2.3 Step 3 - Comparison of Site Conditions With Tier 1 RBSLs

Pathways
- GW/vapor to building
- Soil/vapor to building
- Soil/vapor to outside air
- GW/vapor to outside air
- GW ingestion (!)

Identification of Potentially complete exposure pathways: Figure 4 provides the exposure pathway analysis for this site, and is taken directly from the RBCA *Figure 2: Exposure Scenario Evaluation Flowchart*. The following pathways have been identified as potentially complete: indoor inhalation of volatile compounds diffused from soil and/or ground water, outdoor inhalation of volatile compounds diffused from soil and/or ground water, and commercial/industrial use of ground water. Although SPH have been measured in well MW-4, commercial/industrial use of potable water from SPH was not chosen as a pathway because the SPH ~~are~~ isolated onsite in that location, based on sampling results presented earlier. As discussed above, no ground water supply wells currently exist within the extent of the petroleum hydrocarbon plume originating at the site, and Shell and WA are unaware of any potential for future use of ground water.

Exposure Characterization-Selection of Scenarios: The exposure scenario selected for evaluation at this site is commercial/industrial exposure at the 6074 Claremont Avenue location, which borders the southwest corner of the service station and is located within the identified petroleum hydrocarbon extent. The identified worst-case receptor is a worker at 6074 Claremont Avenue who is assumed to be exposed over a standard working lifetime of 8 hours per day for 25 years. Shell employees at the service station site are not considered the worst case receptor because they are therefore familiar with the risks of petroleum hydrocarbons as well as appropriate precautionary measures. Other receptors are not considered because they would be transient, i.e. they would only be present onsite for a limited time, and may not be present every day.

Exposure Characterization-Selection of Appropriate RBSLs: Table 3 shows the selected Tier 1 RBSLs for contaminants of concern in soil and ground water for the potentially complete exposure scenarios identified above. RBSLs corresponding to a target carcinogenic human health risk of ten in one million ($1E^{-5}$) or a target chronic hazard quotient of 1.0 (for non-carcinogenic compounds) have been selected as appropriate, conservative values for this analysis. The ten-in-a-million significance level for carcinogenic risk has been well established in California regulatory language and guidance, and used extensively by local regulatory agencies including the Department of Toxic Substances Control (DTSC), RWQCB, and the Bay Area Air Quality Management District. The RBSLs in air were not selected as appropriate, based on lack of direct air measurements at the site for comparison. The RBSLs for direct soil contact were not included because soil sample results indicate petroleum hydrocarbon concentrations are located below the surficial soil (0-3 feet depth), and thus there is no potentially complete exposure pathway for this exposure route.

Tier 1 Exposure Characterization - Site-Specific Exposure Estimates: Table 3 also shows the site-specific, worst-case concentrations of each contaminant of concern in soil and ground water used in the Tier 1 analysis. As discussed earlier, the concentrations in soil represent the maximum ever detected in any on-site soil boring, and the ground water concentrations represent the maximum ever detected in any monitoring well.

Comparison to RBSLs: Table 3 shows a comparison between the selected RBSL for each pathway and scenario of concern and the site-specific characterization results. Examination of Table 3 indicates that existing levels of ethylbenzene, toluene, and xylenes are below the target Tier 1 RBSLs for all potentially complete exposure pathways. Existing levels of benzene are above the target Tier 1 RBSLs for all potentially complete exposure pathways, except volatilization to outdoor air from ground water and soil.

3.2.4 Step 4 - Evaluation of Tier 1 Results

WA concludes that the analysis completed here using the ASTM E 38-94 Risk-Based Corrective Action Tier 1 methodology indicates that no action is required for ethylbenzene, toluene, and xylene. Existing worst-case levels of these contaminants in soils and ground water on site do not appear to pose a significant adverse human health risk. Based on the Tier 1 results for benzene, further analysis via a Tier upgrade is warranted. The Tier 2 analysis for benzene is presented below.

The target compound Tier 1 RBSLs exceeded?

3.3 Tier 2 RBCA Analysis

The Tier 1 RBCA analysis documented above indicates that the worst-case benzene concentrations in soil and/or ground water exceed the conservative, non-site specific Tier 1 target risk-based screening levels included in the Tier 1 Look-Up Table for the following pathways:

- Vapor intrusion from soil to indoor building air;
- Vapor intrusion from ground water to indoor building air;
- Leachate from soil to protect ground water at the target level for ground water; and
- Ingestion of ground water (commercial/industrial exposure).

NA

The Tier 2 RBCA analysis presented below includes the development of site-specific target levels (SSTLs) for benzene in soil and ground water for these exposure pathways, and a comparison of the worst-case concentrations in soil and ground water to the SSTLs. It is important to note that the Tier 2 SSTLs are based upon achieving the *same level of human health protection* as the Tier 1 RBSLs.

The Tier 2 analysis presented below uses the following approaches, described as appropriate for Tier 2 analyses in Step 5 of the RBCA guidance:

NA

- Application of Tier 1 RBSL values at reasonable alternative point(s) of compliance for evaluation of the ground water ingestion pathway, for benzene in both the direct ground water ingestion and leaching from soil to protect ground water pathways.
- Application of a screening-level mathematical model to develop SSTLs for benzene in the vapor intrusion to indoor air pathway for both soil and ground water, based on the predicted attenuation of contaminants from the source area to the potential receptors.

Each of those approaches is discussed in turn below.

3.3.1 Step 5- Tier 2 Site-Specific Corrective Action Goals

Table 4 shows the Tier 2 SSTLs for benzene in soil and ground water for the exposure pathways/receptor scenarios identified above. The development of Tier 2 SSTLs for benzene for the pathways of concern follows.

Benzene in the ground water ingestion pathway: As discussed in the Tier 1 analysis, ground water in this area is not currently being used as a drinking water source or as an industrial water source, nor are there plans for its future use. The one domestic well and three irrigation wells identified in the vicinity of the site are all outside a 1/2-mile radius of the Shell service station, and far outside the extent of the subsurface petroleum hydrocarbons associated with this site.

Therefore, Shell and WA have identified MW-5 and MW-6 as reasonable [redacted] of compliance for this site, with respect to the pathways related to the potential ingestion of benzene in ground water. Both monitoring wells are located downgradient of the onsite source area and are between the source area and any potential downgradient receptors.

The Tier 1 RBSLs for 1) the direct ingestion of ground water pathway and 2) the protection of ground water from leachate from soils pathway have conservatively been selected as the appropriate Tier 2 SSTLs for this analysis. These SSTLs are applied at MW-5 and MW-6 as reasonable alternative points of compliance.

Benzene in the vapor intrusion to indoor air pathways from soil and ground water: To establish appropriate SSTLs for benzene in site soil and ground water for the vapor intrusion to indoor air pathways from the two media, an adaptation of Jury's contaminant transport model described by Sanders and Stern (1994) was used. Jury originally published this model, describing the transport of organic compounds from a contaminant source through soil, in a series of papers in 1983 and 1984, followed by a later paper in 1990 (Jury *et al.*, 1983; Jury *et al.*, 1984 a,b,c; Jury *et al.*, 1990). It has been widely used since that time in various risk assessment efforts. Jury's model addresses transport from a contaminant source through an overlying soil layer, followed by volatilization from the soil surface. It further assumes first-order degradation of the contaminant over time in the media of concern, and can be solved for assuming *either* a finite or an infinite contaminant source with a specified initial contaminant concentration (C_0).

Indoor air concentration: The Sanders and Stern adaptation of Jury's model allows the calculation of a time-dependent indoor air concentration, assuming either soil or ground water contamination as the source. This is accomplished by substituting the surface zone of influence (area of the building) for the soil surface area used by Jury, under the assumption that volatile chemical transport into buildings will be controlled only by the rate of diffusion to the zone of influence. In other words, the total amount of contaminant diffusing to the surface from soil or ground water directly under the building of concern is conservatively assumed to be swept into the building. The calculation of total dose (i.e., the amount of benzene inhaled over the exposure period of interest) is then made by integrating the rate expression over the entire time period.

From soil as the source of contamination: Jury's original presentation allows the assumption that the contaminant is present in a soil layer of a specified thickness W at a specified distance L below the ground surface. This is the equivalent of a finite source of contamination at a specified initial concentration. The mathematical solution for the model under this set of assumptions is appropriate for use in establishing the SSTL for benzene in soil for this transport pathway. Appendix D1 provides the calculations in spreadsheet form, and Table 4 shows the resulting SSTL for benzene in soil for this pathway.

From ground water as the source of contamination: Jury's model also allows the assumption that the contaminant is present at a specified initial concentration in a layer of infinite thickness at some distance L below the ground surface. This is the equivalent to an infinite source of contamination.

The mathematical solution for the model under this set of assumptions is appropriate for use in establishing the SSTL for benzene in ground water for this transport pathway. The solution assumes an infinite source at an initial source strength of C_o in soil. The initial soil concentration is defined by Jury as the sum of the contaminant present at depth L *i)* adsorbed onto soil, *ii)* as vapor in the air-filled pore spaces, and *iii)* as a dissolved phase in the liquid-filled pore spaces. For this site with ground water as the contaminant source, it is appropriate to assume that initially no contaminant is adsorbed onto soil or present as a dissolved phase in soil pores, and the total initial concentration is represented by that in the soil vapor. Thus, C_o has been calculated assuming ground water contaminants volatilize into soil and are present as soil vapor at the ground water/soil interface. To convert the worst-case concentration of benzene in ground water to a concentration in the air-filled pore spaces (C_0), Henry's Law is assumed to be applicable, and the worst-case vapor concentration is calculated from the worst-case ground water concentration. This assumption is appropriate for dilute solutions of benzene in ground water, and is valid at this site. Appendix D2 provides the calculations in spreadsheet form, and Table 4 shows the resulting SSTL for benzene in ground water for this pathway.

SSTL results: Application of Jury's model, as adapted by Sanders and Stern for indoor building air, results in a SSTL for benzene of 315 mg/kg in soil and 20 mg/l in ground water for this specific site at a target risk level of ten in one million. 10^{-5}

Tier 2 Exposure Characterization - Site-Specific Exposure Estimates: Table 4 also shows the site-specific, worst-case concentrations of benzene in soil and ground water used in the Tier 2 analysis. For comparison with the SSTLs for the volatilization pathways, the concentrations in soil represent the maximum ever detected in any on-site soil boring, and the ground water concentrations represent the maximum ever detected in any of the site monitoring wells. These values are the same as those used in the Tier 1 analysis. For comparison to the SSTLs for the ground water ingestion pathways, site-specific exposure estimates are based on the worst-case concentrations of benzene in soil and ground water at MW-5 and/or MW-6. These monitoring wells were established above as the alternative point of compliance for evaluation of benzene in ground water.

Comparison to SSTLs: Table 4 shows the comparison between the Tier 2 SSTL for each pathway and scenario of concern and the site-specific characterization results. Examination of Table 4 indicates that existing levels of benzene are below the Tier 2 SSTLs for all exposure pathways.

3.3.2 Step 6 -Evaluation of Tier 2 Results

Based on the results of the Tier 2 analysis presented above, it is appropriate to conclude that no further corrective action is required with respect to benzene in site soils and ground water. The worst case site-specific concentrations of benzene in site soils and ground water at appropriate points of compliance do not exceed the SSTLs developed here for benzene, supporting a conclusion that residual petroleum hydrocarbons present in the soil and ground water at this site do not represent a significant risk to human health.

3.4 RBCA Conclusions

Shell and WA conclude that the analysis completed here using the ASTM E 38-94 Risk-Based Corrective Action Tier 1 and Tier 2 methodology indicates that a response action of ground water monitoring is the most appropriate at this time. Shell is currently continuing to monitor ground water quality at the site under the oversight of the Alameda County Department of Environmental Health (ACDEH). The residual petroleum hydrocarbons present in the soil and ground water at this site do not represent a significant risk to human health. Also, as discussed in earlier submittals, the petroleum hydrocarbons present in ground water are fully assessed, are limited to the immediate site vicinity, and appear to be degrading through natural biodegradation.

Based on these conclusions, we recommend that Tier upgrade for further analysis is not required, and that no further action with the exception of continued ground water monitoring at the discretion of ACDEH is required at this site. The response action selected is consistent with the RBCA guidance and expected evaluation of the site under the Regional Water Quality Control Board's Non Attainment Zone policy. A ground water monitoring schedule is included in the Future Action Plan section of the Comprehensive Site Evaluation and Proposed Future Action Plan.

4. FUTURE ACTION PLAN

4.1 Ground Water Monitoring Plan

The proposed monitoring and sampling schedule outlined below will complete 8 years of monitoring at the subject site. This plan is only viable if the land use remains the same. Currently, all six wells at the site are monitored and sampled for petroleum hydrocarbons. No petroleum hydrocarbons exceeding DTSC MCLs have been detected in wells MW-1, MW-2 and MW-5. Petroleum hydrocarbons have been present at the site for over 5 years, and it is unlikely that extended additional monitoring will contribute any significant additional information. Additionally, WA and Shell propose sampling wells MW-3, MW-5, MW-6 and, when necessary, MW-4 for dissolved oxygen (DO), hydrocarbon-degrading microbes (HDM) and beneficial nutrients. These analyses will provide data to assess how effectively natural processes are degrading residual petroleum hydrocarbons. Therefore Shell and WA propose the following monitoring plan, which is also summarized in the table below:

1. Discontinue sampling wells MW-1 and MW-2 after the second quarter of 1995.

2. Sample wells MW-3, MW-5 and MW-6 annually for two additional years for TPH-G, BETX, DO, HDM, and nutrients.

3. Well MW-3 will also be sampled for TPH-MO. Remove any measurable SPH from well MW-4 quarterly until no SPH is found in the well for four consecutive quarters.

4. After two years, if the contingency plan is not activated, Shell will cease monitoring. If well MW-4 contains no SPH during any quarterly visit, it will be sampled for the same analytes listed above for well MW-3.

Proposed Monitoring and Sampling Schedule.

Well ID	1995 2Q	1995 3Q	1995 4Q	1996 1Q	1996 2Q	1996 3Q	1996 4Q	1997 1Q	1997 2Q	1997 3Q	1997 4Q
MW-1	G&S	---	---	---	G	---	---	---	G	---	---
MW-2	G&S	---	---	---	G	---	---	---	G	---	---
MW-3	G&S	G&S	---	---	G&S	---	---	---	G&S	---	---
MW-4*	GS&R	GS&R	GS&R	GS&R	GS&R	GS&R	GS&R	GS&R	GS&R	GS&R	GS&R
MW-5	G&S	G&S	---	---	G&S	---	---	---	G&S	---	---
MW-6	G&S	G&S	---	---	G&S	---	---	---	G&S	---	---

G = Gauge well (measure depth to water, depth to well bottom and immiscible liquid thickness).
S = Sample if well contains no SPH.
R = Remove any SPH in well.
* = Gauging, sampling, and monitoring of SPH will cease after well has not contained SPH for four consecutive quarters.

4.2 Contingency Plan

This contingency plan will ensure that petroleum hydrocarbon concentrations are maintained at or below site-specific trigger concentrations in ground water at the current downgradient edge of the plume. The contingency plan will be implemented when the concentration of benzene in a guard or boundary monitoring well is equal to or greater than the trigger concentration specified in Table 5.

Ground water collected from well MW-3 will serve as a guard well to monitor whether concentrations within the plume are stable. Wells MW-5 and MW-6 will serve as boundary wells and will confirm that the plume is not migrating. These wells will be sampled annually through 1997. In 1998, unless concentrations exceeding the specified trigger level have been detected and confirmed in one or more wells, monitoring will cease in all wells.

If ground water monitoring indicates that certain trigger conditions have been met, this contingency plan will be implemented. These conditions and contingency plan responses are summarized in Table 5. The guard well MW-3 was assigned a "baseline" concentration equal to the historical average benzene concentration detected in that well, and a "trigger" concentration equal to the average benzene concentration plus two standard deviations. The boundary wells MW-5 and MW-6 were assigned a baseline concentration equal to the laboratory detection limit and a trigger concentration ten times lower than the risk based screening level determined by the RBCA analysis in Section 3. When a trigger concentration is met or exceeded, the contingency plan will go into effect.

When triggered, the contingency plan calls for three responses:

1. The ACDEH will be notified;

2. Ground water monitoring will be performed in wells MW-3, MW-5 and MW-6 for the next two quarters; and

3. If concentrations above the trigger concentrations are detected for all three quarters, quarterly monitoring of these wells will continue until an appropriate course of action, identified by Shell and accepted by the ACDEH, is implemented. If elevated concentrations are not detected in all three quarters, the sampling plan outlined in this report will resume and remain with the current schedule.

5. CONCLUSIONS

Data collected at the site over the past 5 years demonstrate that:

- Petroleum hydrocarbon concentrations in source area well MW-3 have gradually decreased since monitoring began in 1990.

- The site is underlain by interbedded sandy clay and sandy silt. The predominantly low permeability sediments present a significant technical obstacle to the best available remediation technologies. However, these sediments are impeding offsite migration, allowing natural petroleum hydrocarbon attenuation to contain the plume.

- Benzene concentrations present in the subsurface do not exceed site-specific risk based target levels from the ASTM RBCA analysis for identified probable exposure pathways.

- The low petroleum hydrocarbon concentrations present in ground water will continue to attenuate naturally, and therefore no additional active remediation is necessary.

- Continued skimming of the SPH in well MW-4 should continue and will be removed until they are no longer detected.

Based on these findings, Shell and WA request that the ACDEH and the RWQCB accept that drinking water standards are not attainable at this site and establish a Non-Attainment Zone encompassing the residual petroleum hydrocarbon plume. The proposed monitoring and Contingency Plan will ensure that the risks posed by the residual plume are contained and managed.

6. REFERENCES

American Society for Testing and Materials, 1994. *Emergency Standard Guide for Risk-Based Correction Action Applied at Petroleum Release Sites*, ASTM ES 38-94 (including errata).

American Society for Testing and Materials, 1995. *Tier 1 Guidance Manual for Risk-Based Corrective Action and Overview of the Process, Draft*. February 1995.

Harding Lawson Associates, 1990. Quarterly Technical Report dated April 13, 1990, First Quarter 1990, Shell Service Station, 6039 College Avenue, Oakland, California.

Harding Lawson Associates, 1991. Quarterly Technical Report dated October 22, 1991, Third Quarter 1991, Shell Service Station, 6039 College Avenue, Oakland, California.

Howard, P.H. et. al., 1991. *Handbook of Environmental Degradation Rates*. Lewis, Chelses, MI.

Jury, W.A., S.F. Spencer and W.J. Farmer, 1983. *Behavior Assessment Model for Trace Organics in Soil.1. Model Description*. Journal of Environmental Quality, Vol. 12, pp. 558-564.

Jury, W.A., W.F. Spencer and W.J. Farmer, 1984a. *Behavior Assessment Model for Trace Organics in Soil.2*. Journal of Environmental Quality, Vol 13, pp 567-572

Jury, W.A., W.F. Spencer and W.J. Farmer, 1984b. *Behavior Assessment Model for Trace Organics in Soil.3*. Journal of Environmental Quality, Vol 13, pp. 573-579.

Jury, W.A., W.F. Spencer and W.J. Farmer, 1984c. *Behavior Assessment Model for Trace Organics in Soil.4*. Journal of Environmental Quality, Vol 13, pp 580-586.

Jury, W.A., D. Russo, G.Streile and H.E. Abd, . 1990. *Evaluation of Volatilization by Organic Chemicals Residing Beneath the Soil Surface*. Water Resources Research, Vol. 26, No. 1, pp. 13-20. January 1990.

Sanders, P. and Stern, A., 1994. *Calculation of Soil Cleanup Criteria for Carcinogenic Volatile Organic Compounds as Controlled by the Soil-to-Indoor Air Exposure Pathway*. Environmental Toxicology and Chemistry, Vol. 13, No. 8, pp. 1367-1373.

U.S. EPA, 1991. *Risk Assessment Guidelines for Superfund - Part A Human Health Evaluation Manual. Supplemental Guidance, Standard Default Exposure Factors*. OSWER Directive 9285.6-03, PB91-921314.

Weiss Associates, 1993. Soil and Water Investigation dated December 30, 1993, Shell Service Station, 6039 College Avenue, Oakland, California, WIC # 204-5508-3301.

Weiss Associates, 1995. Quarterly Monitoring Report dated April 24, 1995, First Quarter 1995, Shell Service Station, 6039 College Avenue, Oakland, California, WIC # 204-5508-3301.

Weiss Associates, 1995. Telephone conversation on May 26, 1995 with Andreas Godfrey, County of Alameda, Public Works Agency, to determine designated use of ground water in the area surrounding the Shell station at 6039 College Avenue, Oakland, California.

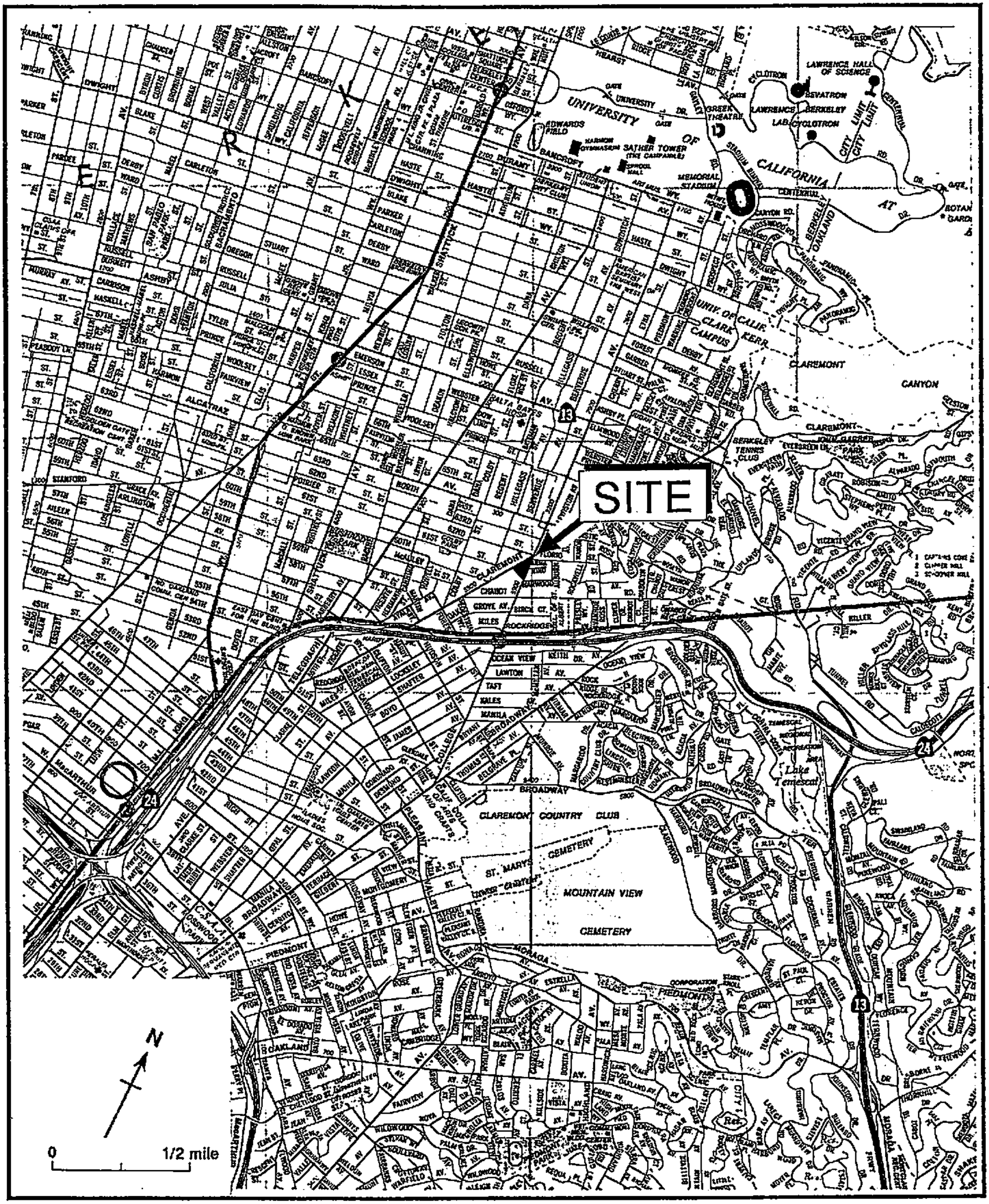


Figure 1. Site Location Map - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California

4/3/92

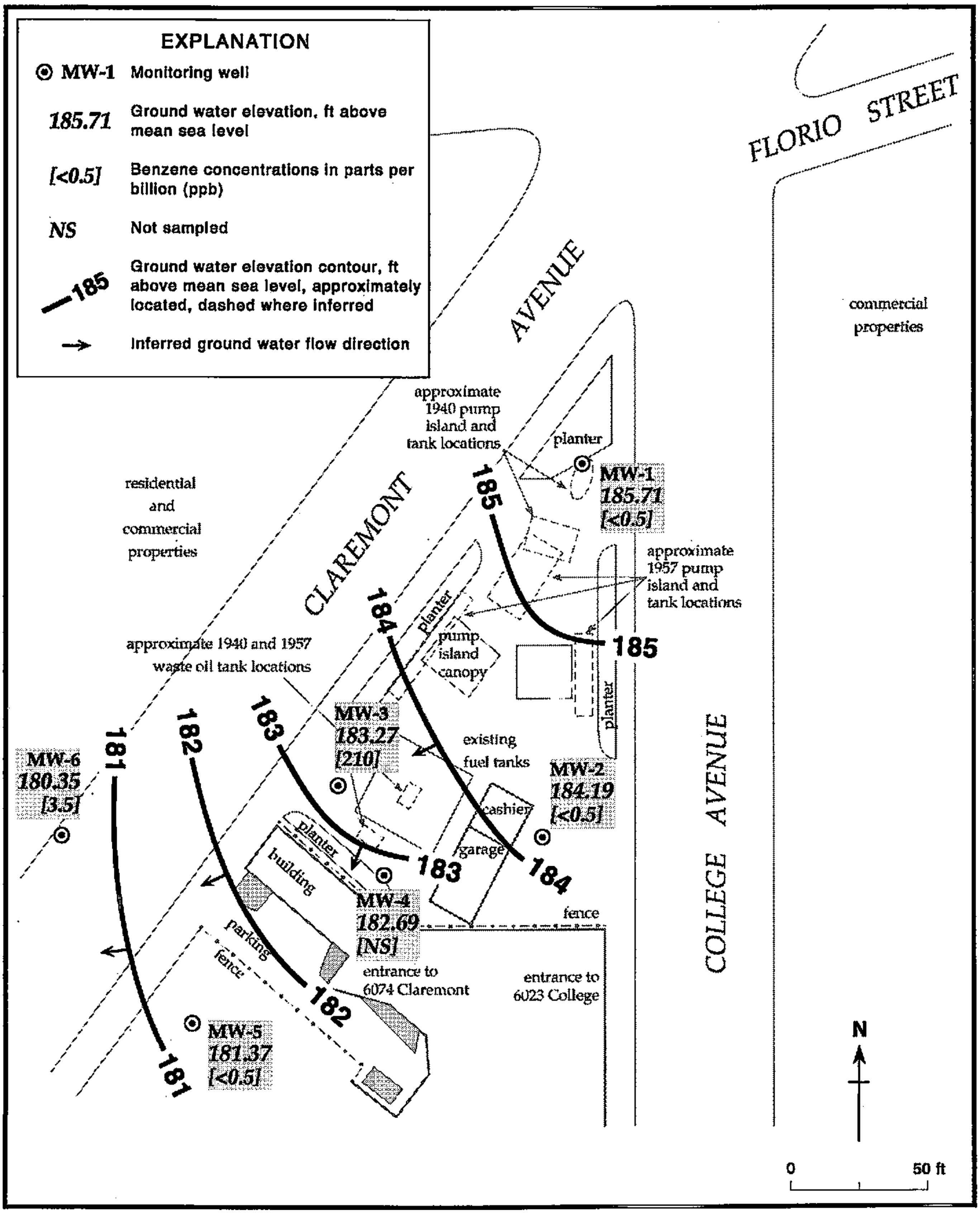
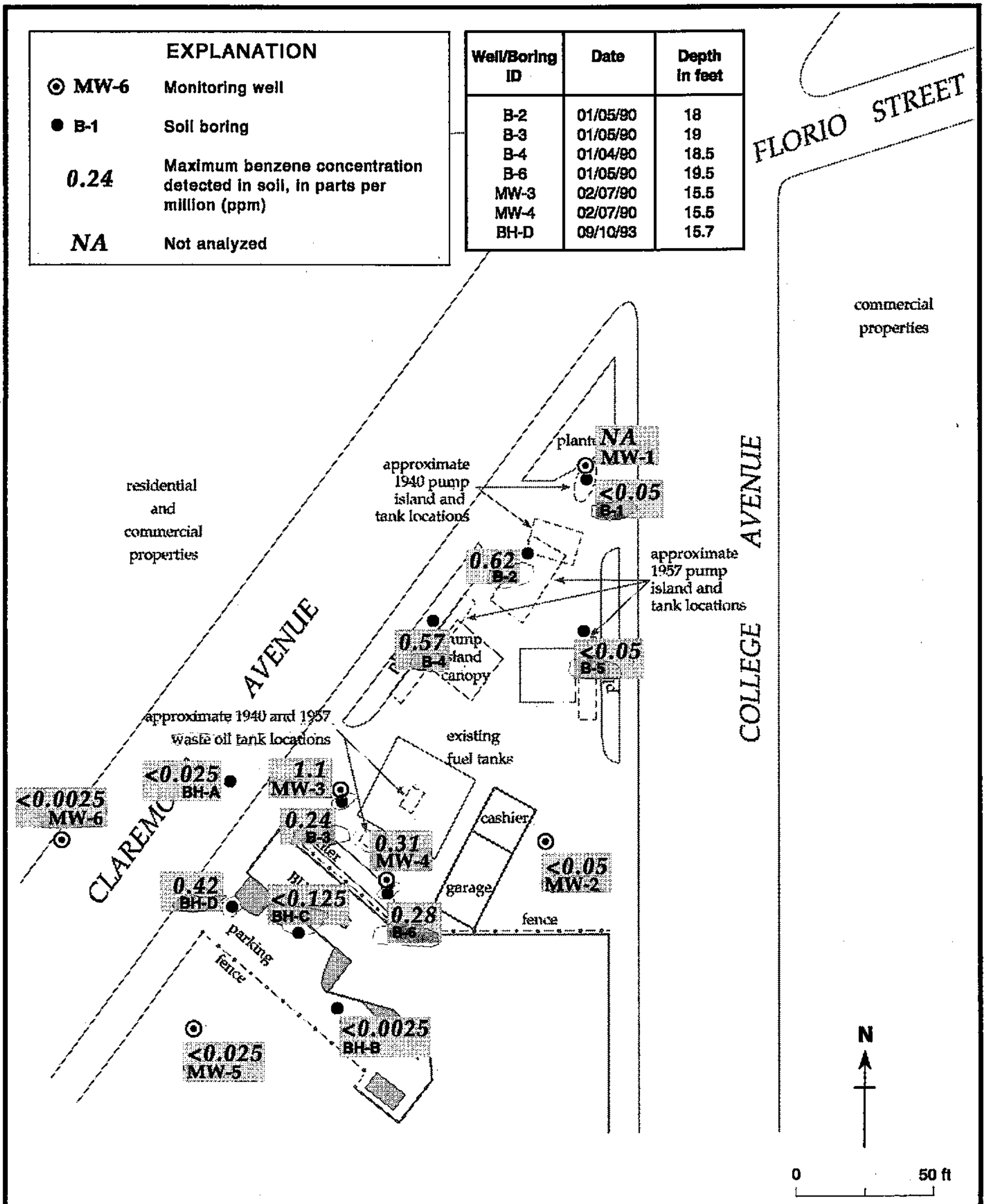
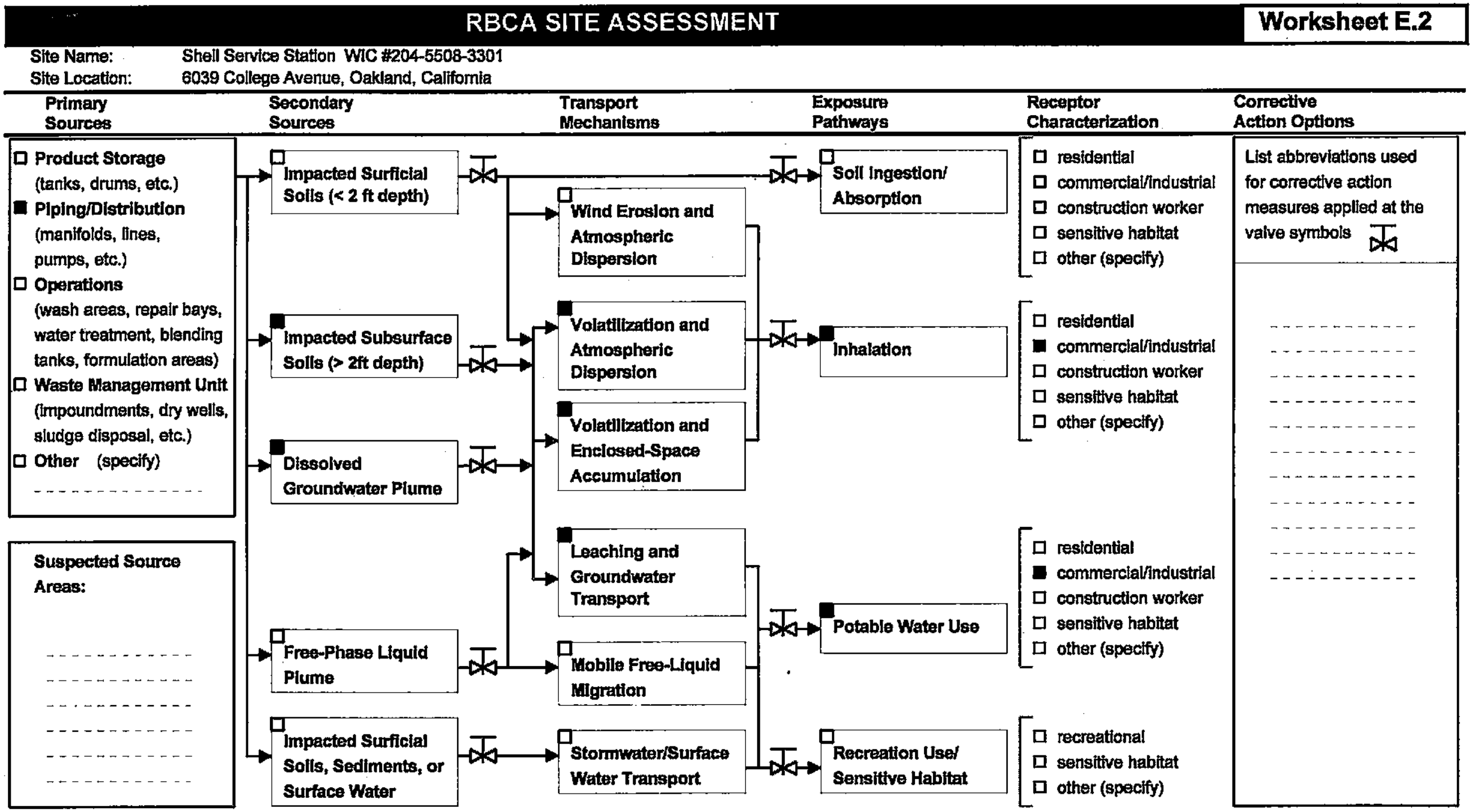


Figure 2. Monitoring Well Locations, Ground Water Elevation Contours, and Benzene Concentrations in Ground Water - February 1, 1995 - Shell Service Station WIC #204-5510-0303, 6039 College Avenue, Oakland, California



Well/Boring ID	Date	Depth in feet
B-2	01/05/90	18
B-3	01/05/90	19
B-4	01/04/90	18.5
B-6	01/05/90	19.5
MW-3	02/07/90	15.5
MW-4	02/07/90	15.5
BH-D	09/10/93	15.7

Figure 3. Soil Boring Locations and Maximum Benzene Concentrations Detected in Soil - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California



Step 1: Characterize Site Source and Exposure Pathways
- complete Tier 1 worksheets
- fill applicable boxes for sources, release mechanisms, and actual or imminent exposure pathways (☐ or ■)

Step 2: Identify Receptors, Compare Site Conditions with Tier 1 Levels
- identify receptors
- fill applicable boxes for potential receptors and RBSL value(s) exceeded (☐ or ■)

Step 3: Identify Potential Corrective Measures
- complete Tier 1 summary report
- fill in exposure pathway shut-off valves (⋈ or ⋈)
- record the abbreviation for the corrective measure above the valve, and record the abbrev. on the right-hand side of the table.

Figure 4. Exposure Scenario Evaluation Flowchart

Table 1. **Analytic Results for Soil** - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California

Well/ Boring ID	Date Sampled	Sample Depth (ft)	TPH-G	TPH-D	TPH-MO	POG	B	E	T	X	HVOCs	Pb	Cd	Cr	Zn
			← parts per million (mg/kg) →												
B-1	01/04/90	22.5	8.1	—	—	—	<0.05	<0.1	<0.1	<0.1	—	—	—	—	—
B-2	01/05/90	18	130	—	—	—	0.62	0.48	<0.1	1.2	—	—	—	—	—
	01/05/90	24	1.8	—	—	—	<0.05	<0.1	<0.1	<0.1	—	—	—	—	—
B-3	01/05/90	19	610	5,900	110,000	810	0.24	4.1	0.18	9.8	<0.5	13	<0.5	48	51
	01/05/90	21	71	750	14,000	380	0.19	0.53	<0.1	0.68	<0.5	7.6	<0.5	61	54
B-4	01/04/90	18.5	170	—	—	—	0.57	0.65	0.11	1.3	—	—	—	—	—
	01/04/90	25	<1	—	—	—	<0.05	<0.1	<0.1	<0.1	—	—	—	—	—
B-5	01/04/90	22	<1	—	—	—	<0.05	<0.1	<0.1	<0.1	—	—	—	—	—
	01/04/90	23	4.4	—	—	—	<0.05	<0.1	<0.1	<0.1	—	—	—	—	—
B-6	01/05/90	19.5	260	600	12,000	1100	0.28	1.3	<0.1	2.1	<0.5	8.1	<0.5	86	52
	01/05/90	22.5	<1	16	320	91	<0.05	<0.1	<0.1	<0.1	<0.005	9.2	<0.5	73	60
MW-2	02/08/90	11	<1	<1	<10	—	<0.05	<0.1	<0.1	<0.1	—	—	—	—	—
	02/08/90	15.5	<1	<1	<1	—	<0.05	<0.1	<0.1	<0.1	—	—	—	—	—
	02/08/90	20.5	<1	1.1	<10	—	<0.05	<0.1	<0.1	<0.1	—	—	—	—	—
MW-3	02/07/90	10	12	4.4	<10	—	<0.05	<0.1	<0.1	0.11	—	—	—	—	—
	02/07/90	15.5	230	200	1,800	—	1.1	3.1	0.7	1.9	—	—	—	—	—
	02/07/90	20.5	28	9.9	<10	—	<0.05	<0.1	<0.1	<0.1	—	—	—	—	—
MW-4	02/07/90	10.5	<1	1.2	<1	—	<0.05	<0.1	<0.11	<0.1	—	—	—	—	—
	02/07/90	15.5	140	61	6,400	—	0.31	0.92	0.34	2.6	—	—	—	—	—
	02/07/90	20.5	72	2,200	46,000	—	0.06	0.46	<0.1	0.57	—	—	—	—	—
MW-5	08/24/91	6	<1	<1.2	<12	<50	<0.005	<0.00	0.005	<0.005	—	—	—	—	—
	08/24/91	16	23*	7**	13	<50	<0.005	0.02	<0.005	0.10	—	—	—	—	—
	08/24/91	21	<1	<1.2	<12	<50	<0.005	<0.00	<0.005	<0.005	—	—	—	—	—
BH-A	09/09/93	6.0	<1	—	—	—	<0.0025	<0.00	<0.002	<0.0025	—	—	—	—	—
	09/09/93	11.0	28[a]	11[b]	—	<50	<0.0025	<0.00	<0.002	<0.0025	c	—	—	—	—
	09/09/93	16.0	130	27[b]	—	<50	<0.025	1.4	<0.025	0.51	ND	—	—	—	—
BH-B	09/09/93	11.0	<1	—	—	—	<0.0025	<0.00	<0.002	<0.0025	—	—	—	—	—
	09/09/93	15.7	<1	<1	—	<50	<0.0025	<0.00	<0.002	<0.0025	ND	—	—	—	—
BH-C	09/10/93	10.7	<1	—	—	—	<0.0025	<0.00	<0.002	<0.0025	—	—	—	—	—
	09/10/93	15.7	580[a]	4,900[d]	—	930	<0.125	<0.12	<0.125	<0.125	ND	—	—	—	—
	09/10/93	20.7	<1	—	—	—	<0.0025	<0.00	<0.002	<0.0025	—	—	—	—	—

detection limit too high

Table 1. Analytic Results for Soil and Well Borings - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California (continued)

Well/ Boring ID	Date Sampled	Sample Depth (ft)	TPH-G	TPH-D	TPH-MO	POG	B	E	T	X	HVOCs	Pb	Cd	Cr	Zn
			← parts per million (mg/kg) →												
BH-D	09/10/93	10.7	6.8[a]	8.9[b]	---	<50	<0.0025	<0.00	<0.002	<0.0025	ND	---	---	---	---
	09/10/93	15.7	150	55	---	69	0.42	<0.02	<0.025	<0.025	ND	---	---	---	---
	09/10/93	20.7	5.6	2.9[e]	---	<50	<0.0025	0.01	0.007	<0.0025	ND	---	---	---	---
BH-E	09/10/93	10.7	<1	---	---	---	<0.0025	<0.00	<0.002	<0.0025	---	---	---	---	---
(MW-6)	09/10/93	15.7	<1	3.5[b]	---	<50	<0.0025	<0.00	<0.025	<0.0025	ND	---	---	---	---

Abbreviations:

TPH-G = Total petroleum hydrocarbons as gasoline by Modified EPA Method 8015
TPH-D = Total petroleum hydrocarbons as diesel by Modified EPA Method 8015
TPH-MO = Total petroleum hydrocarbons as motor oil by EPA Method 8015
B = Benzene by EPA Method 8020
E = Ethylbenzene by EPA Method 8020
T = Toluene by EPA Method 8020
X = Xylenes by EPA Method 8020
POG = Petroleum Oil & Grease by APHA Method 5520B/F
SVOCs = Semi-Volatile Organic Compounds by EPA Method 8270
Pb = Lead by EPA Method 7241
Cd = Cadmium by EPA Method 6010
Cr = Chromium by EPA Method 6010
Zn = Zinc by EPA Method 6010
NE = Not established
--- = Not analyzed or measured
<n = Not detected at detection limits of n ppm
ND = No compounds detected

Notes:

* = Compounds detected are due to petroleum mixture other than gasoline
** = Not characteristic of standard diesel pattern
a = Positive result for TPH-G has an atypical pattern for gasoline
b = Positive result appears to be a lighter hydrocarbon than diesel
c = 1.6 ppm diethylphthalate and 0.37 ppm diethyl phthalate detected
d = Positive result appears to be a heavier hydrocarbon than diesel
e = Positive result for TPH-D has an atypical pattern for diesel

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Table 2. Analytic Results for Ground Water - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California

Well/Boring ID	Date Sampled	Depth to Water (ft)	TPH-G	TPH-D	TPH-MO	POG	B	E	T	X	SVOCs
			←			parts per billion (μg/L)					→
MW-1	02/13/90	17.73	95	650	770	---	ND	0.37	0.67	3.2	---
	05/14/90	18.92	95	ND	770	---	0.70	0.71	0.57	3.5	---
	09/12/90	19.81	ND	84	ND	---	ND	ND	ND	ND	---
	11/27/90	20.39	---	---	---	---	---	---	---	---	---
	03/08/91	16.85	ND	50	ND	---	ND	ND	ND	ND	---
	06/03/91	17.82	ND	ND	ND	---	ND	ND	ND	ND	---
	08/30/91	19.87	ND	520	ND	---	ND	ND	ND	ND	---
	11/22/91	20.58	<50	<50	<500	---	<0.5	<0.5	<0.5	<0.5	---
	03/18/92	13.55	<30	<50	---	---	<0.3	<0.3	<0.3	<0.3	---
	05/28/92	17.08	<50	<50	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/19/92	19.07	<50	<50	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/17/92	20.11	<50	<50	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/12/93	12.10	<50	<50	---	---	<0.5	<0.5	<0.5	<0.5	---
	06/10/93	14.87	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	06/10/93[dup]	14.87	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/18/93	16.90	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/19/93	19.72	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/18/94	15.08	<50	---	---	---	<0.5	<0.5	<0.5	1.7	---
	05/04/94	17.20	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/10/94	18.76	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/10/94[dup]	18.76	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/08/94	16.00	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/01/95	**10.18**	**<50**	**---**	**---**	**---**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**---**
MW-2	02/13/90	16.90	ND	560	ND	---	ND	ND	ND	ND	---
	05/14/90	18.01	ND	ND	ND	---	ND	ND	ND	ND	---
	09/12/90	19.00	ND	ND	ND	---	ND	ND	ND	ND	---
	11/27/90	19.44	ND	ND	ND	---	ND	ND	ND	ND	---
	03/08/91	15.96	ND	ND	ND	---	ND	ND	ND	ND	---
	06/03/91	17.00	ND	ND	ND	---	ND	ND	ND	ND	---
	08/30/91	18.95	ND	ND	ND	---	ND	ND	ND	ND	---
	11/22/91	19.55	<50	<50	<500	---	<0.5	<0.5	<0.5	<0.5	---
	03/18/92	12.91	<30	---	---	---	<0.3	<0.3	<0.3	<0.3	---
	05/28/92	16.25	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/19/92	18.21	<50	---	---	---	<0.5	1.2	2	1.9	---
	11/17/92	19.15	<50	---	---	---	<0.5	1.2	2	1.9	---
	02/12/93[dup]	11.60	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---

Table 2. Analytic Results for Ground Water - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California (continued)

Well/Boring ID	Date Sampled	Depth to Water (ft)	TPH-G	TPH-D	TPH-MO	POG	B	E	T	X	SVOCs
			←			parts per billion (µg/L)					→
	02/12/93	11.60	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	06/10/93	14.14	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/18/93	16.10	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/18/93[dup]	16.10	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/19/93	18.77	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/18/94	14.55	<50	---	---	---	<0.5	<0.5	<0.5	1.6	---
	05/04/94	16.34	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/10/94	15.79	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/08/94	15.04	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/01/95	**10.08**	**<50**	**---**	**---**	**---**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**---**
MW-3	02/13/90	15.81	4,700	3,100	3,000	---	320	110	29	33	---
	02/13/90[dup]	15.81	4,600	4,500	8,300	---	380	160	8.6	57	---
	05/14/90	16.97	1,400	620	40,000	---	130	40	8.6	17	---
	05/14/90[dup]	16.97	8,200	660	10,000	---	120	38	31	13	---
	09/12/90	18.78	2,000	1,500	19,000	---	58	16	5.8	15	---
	11/27/90	18.27	540	240	460	---	18	8.7	1.5	2.5	---
	03/08/91	14.86	3,400	2,100	ND	---	630	270	33	18	---
	06/03/91	15.84	1,700	690[a]	ND	---	260	98	13	24	---
	08/30/91	17.79	870	370[b]	500	---	44	10	6.1	2.9	---
	11/22/91	18.40	310	140	500	---	18	3.3	1.2	2.9	---
	03/18/92	12.03	67,100	1,900	20,000	---	620	220	28	38	---
	05/28/92	15.16	2,300	1,100[c]	4,600	---	200	71	9	17	---
	08/19/92	17.03	5,700	1,000[c]	1,800	---	71	52	77	130	---
	11/17/92	17.94	3,600	160[c]	1,200	---	16	24	8.6	50	---
	02/12/93	9.16	4,700	560[c]	<50	---	820	130	58	77	---
	06/10/93	13.20	2,200	---	940[d]	---	310	89	23	23	---
	08/18/93	14.93	260	---	460[d]	---	27	7.0	2.0	2.2	---
	11/19/93	17.58	1,500[e]	---	960[d]	<5,000	24	37	54	17	---
	02/18/94	13.30	2,700	---	1,600	<5,000	65	16	5.2	6.3	---
	02/18/94[dup]		3,100	---	2,200	<5,000	82	19	6.7	7.9	---
	05/04/94	15.25	780	---	710	<5,000	120	21	7.5	6.9	h
	05/04/94[dup]	15.25	920	---	1,600	<5,000	120	22	7.7	7.1	i
	08/10/94	16.63	920	---	<500	<5,000	20	3.0	2.3	2.2	r
	11/08/94	13.88	1,300	---	1,300	---	180	7.0	16	12	
	11/08/94[dup]	13.88	1,200	---	730	---	170	7.2	15	11	
	02/01/95	**9.25**	**1,400**	**---**	**900[g]**	**---**	[illegible]	**11**	**8.5**	**8.7**	**t**

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Table 2. Analytic Results for Ground Water - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California (continued)

Well/Boring ID	Date Sampled	Depth to Water (ft)	TPH-G	TPH-D	TPH-MO	POG	B	E	T	X	SVOCs
			←			parts per billion (µg/L)					→
MW-4	02/13/90	16.73	ND	1,200	3,000	---	ND	ND	ND	ND	---
	05/14/90	17.88	650	350	12,000	---	160	1.9	7	3.1	---
	09/12/90	17.85	440	260	2,600	---	91	0.75	1.1	0.79	---
	09/12/90[dup]	17.85	520	1,100	16,000	---	85	0.71	0.71	0.81	---
	11/27/90	19.16	470	2,400	1,000	---	64	0.80	1.2	2.7	---
	03/08/91	15.77	1,100	2,600	15,000	---	330	88	3.5	5.8	---
	06/03/91	16.77	670[h]	1,100[i]	ND	---	240	1.6	2.3	2.3	---
	08/30/91	18.71	570	280[i]	2,000	---	64	0.9	1.8	0.9	---
	11/22/91[SPH]	---	---	---	---	---	---	---	---	---	---
	03/18/92[SPH]	13.15	---	---	---	---	---	---	---	---	---
	05/28/92[SPH]	16.22	---	---	---	---	---	---	---	---	---
	08/19/92[SPH]	18.05	---	---	---	---	---	---	---	---	---
	11/17/92[SPH]	18.89	---	---	---	---	---	---	---	---	---
	02/12/93[SPH]	11.78	---	---	---	---	---	---	---	---	---
	06/10/93	14.20	---	---	---	---	---	---	---	---	---
	08/18/93[SPH]	15.95	---	---	---	---	---	---	---	---	---
	11/19/93[SPH]	18.48	---	---	---	---	---	---	---	---	---
	02/28/94[SPH]	14.60	---	---	---	---	---	---	---	---	---
	05/04/94[SPH]	16.15	---	---	---	---	---	---	---	---	---
	08/10/94[SPH]	17.58	---	---	---	---	---	---	---	---	---
	11/08/94[SPH]	15.05	---	---	---	---	---	---	---	---	---
	02/01/95[SPH]	10.91	---	---	---	---	---	---	---	---	---
MW-5	08/30/91	16.74	ND	80	ND	---	ND	ND	ND	ND	---
	11/22/91	17.27	<50	<50	<500	---	<0.5	<0.5	<0.5	<0.5	---
	03/18/92	11.28	<30	<50	---	---	<0.3	<0.3	<0.3	<0.3	---
	05/28/92[j]	---	---	---	---	---	---	---	---	---	---
	08/19/92	15.99	<50	<50	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/17/92	16.84	<50	<50	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/12/93	10.30	<50	<50	---	---	<0.5	<0.5	<0.5	<0.5	---
	06/10/93	12.36	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/18/93	14.02	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/19/93	16.50	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/19/93[dup]	16.50	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/18/94	12.55	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	05/04/94	14.27	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---

Table 2. Analytic Results for Ground Water - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California (continued)

Well/Boring ID	Date Sampled	Depth to Water (ft)	TPH-G	TPH-D	TPH-MO	POG	B	E	T	X	SVOCs
			←			parts per billion (µg/L)					→
	08/10/94	15.60	70[o]	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/08/94	12.85	<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/01/95	**8.98**	**<50**	**---**	**---**	**---**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**---**
MW-6	09/21/93	14.64	<50	<50	---	<5,000	<0.5	<0.5	<0.5	<0.5	<10-50
	11/19/93[k]	---	---	---	---	---	---	---	---	---	---
	02/28/94	12.18	98[l]	---	---	<5,000	<0.5	<0.5	<0.5	<0.5	---
	05/04/94	13.62	<50	---	---	<5,000	<0.5	<0.5	<0.5	<0.5	<2-10
	08/10/94	14.98	80[o]	---	---	<5,000	<0.5	<0.5	<0.5	<0.5	r
	11/08/94[j]	12.20	---	---	---	---	---	---	---	---	---
	02/01/95	**8.70**	**120**	**---**	**---**	**---**	**3.5**	**3.4**	**21**	**22**	**---**
	02/01/95[dup]	**8.70**	**110**	**---**	**---**	**---**	**0.6**	**0.5**	**0.6**	**0.9**	**---**
street — BH-A	09/09/93	16.50	4,900	2,900[c]	---	<5,000	18	54	<5	11	m
BH-B	09/09/93	15.85	<50	150	---	<5,000	<0.5	<0.5	<0.5	<0.5	ND
BH-C[n]	09/10/93	15.80	640[b]	100	---	<5,000	3.5	0.6	<0.5	<0.5	ND
BH-D[n]	09/10/93	14.2	24,000[c]	25,000[c]	---	20,000	120	44	86	11	p
Bailer	08/19/92		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
Blank	11/17/92		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
Trip	02/13/90		ND	---	---	---	ND	ND	ND	ND	---
Blank	05/14/90		ND	---	---	---	ND	ND	ND	ND	---
	09/12/90		ND	---	---	---	ND	ND	ND	ND	---
	03/08/91		ND	---	---	---	ND	ND	ND	ND	---
	06/03/91		ND	---	---	---	ND	ND	ND	ND	---
	08/30/91		ND	---	---	---	ND	ND	ND	ND	---
	03/18/92		<30	<50	---	---	<0.3	<0.3	<0.3	<0.3	---
	05/28/92		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/19/92		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/17/92		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/12/93		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	06/10/93		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/19/93		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---

Table 2. Analytic Results for Ground Water - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California (continued)

Well/Boring ID	Date Sampled	Depth to Water (ft)	TPH-G	TPH-D	TPH-MO	POG	B	E	T	X	SVOCs
			←			parts per billion (µg/L)					→
	02/28/94		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	05/04/94		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	08/10/94		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	11/08/94		<50	---	---	---	<0.5	<0.5	<0.5	<0.5	---
	02/01/95		**<50**	**---**	**---**	**---**	**<0.5**	**<0.5**	**<0.5**	**<0.5**	**---**
DTSC MCLs			NE	NE	NE	---	1	680	100[a]	1,750	---

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Table 2. Analytic Results for Ground Water - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California (continued)

Abbreviations:

TPH-G = Total petroleum hydrocarbons as gasoline by Modified EPA Method 8015
TPH-D = Total petroleum hydrocarbons as diesel by Modified EPA Method 8015
TPH-MO = Total petroleum hydrocarbons as motor oil by EPA Method 8015
B = Benzene by EPA Method 8020
E = Ethylbenzene by EPA Method 8020
T = Toluene by EPA Method 8020
X = Xylenes by EPA Method 8020
POG = Petroleum Oil & Grease by EPA Method 5520B/F
SVOCs = Semivolatile organic compounds by EPA Method 8270
NE = Not established
DTSC MCLs = California Department of Toxic Substances Control Maximum Contaminant Levels drinking water
--- = Not analyzed or measured
<n = Not detected at detection limits of n ppb
ND = Not detected, detection limit not known
SPH = Separate-phase hydrocarbons in well, not sampled
dup = Duplicate sample

Notes:

a = Positive results for diesel appear to be less volatile constituents of gasoline
b = Positive results for diesel has a typical diesel pattern
c = Concentration reported as diesel is primarily due to the presence of a lighter petroleum product, possibly gasoline or kerosene
d = Concentration reported as motor oil is due to the presence of a combination of motor oil and a lighter petroleum product of hydrocarbon range C6-C12, possibly gasoline
e = Concentration reported as gasoline is due to the presence of gasoline and a discrete peak not indicative of gasoline
f = Compounds are within chromatographic range of gasoline but are not characteristic of the standard gasoline pattern
g = Results include compounds apparently due to gasoline as well as those due to diesel
h = 6.5 ppb Naphthalene detected
i = 11.0 ppb Naphthalene detected
j = Well inaccessible and not sampled
k = Well inadvertently not sampled
l = The concentration reported as gasoline is primarily due to the presence of a discrete peak not indicative of gasoline
m = 13 ppb-methylnaphthalene and 23 ppb naphthalene detected
n = Due to chain of custody mis-communication analyses run after holding time expiration
o = The positive result has an atypical pattern for gasoline analysis
p = 75 ppb 2-methylnapthalene and 18 ppb naphthalene detected
q = DTSC recommended action level; MCL not established
r = Not detected at detection limits between 10 and 50 ppb
s = Concentration reported as motor oil is due to the presence of heavier and lighter petroleum products.
t = 27 ppb Naphthalene detected

Table 3. Comparison of Site Characterization Data to ASTM Tier 1 Risk-Based Screening Levels (RBSL). * **Shell Service Station, 6039 College Avenue, Oakland, California.**

Media	Exposure Pathway	Benzene (ppm)		Ethylbenzene (ppm)		Toluene (ppm)		Xylenes (ppm)	
		RBSL (1)	Maximum Detected Onsite(3)	RBSL(2)	Maximum Detected Onsite	RBSL(2)	Maximum Detected Onsite	RBSL(2)	Maximum Detected Onsite
Soil	Volatilization to Outdoor Air (mg/kg)	~~4.6~~ 1.33	**1.1 at 15.5 ft in MW-3 on 2/7/90**	RES(4)	4.1 at 19 ft in B-3 on 1/5/90	RES	0.7 at 15.5 ft in MW-3 on 2/7/90	RES	10 at 19 ft in B-3 on 1/5/90
	Vapor Intrusion from Soil to Buildings (mg/kg)	~~0.17~~ 0.049	**1.1 at 15.5 ft in MW-3 on 2/7/90**	~~90.8~~ 1100	4.1 at 19 ft in B-3 on 1/5/90	54.5	0.7 at 15.5 ft in MW-3 on 2/7/90	~~RES~~ STET	10 at 19 ft in B-3 on 1/5/90
	Leachate to Protect Ground Water Ingestion Target Level (mg/kg)	~~0.58~~ 0.168	**1.1 at 15.5 ft in MW-3 on 2/7/90**	133	4.1 at 19 ft in B-3 on 1/5/90	361	0.7 at 15.5 ft in MW-3 on 2/7/90	~~RES~~ STET	10 at 19 ft in B-3 on 1/5/90
Ground Water	Volatilization to Outdoor Air (mg/L)	~~180~~ 53.4	0.82 in MW-3 on 2/12/93	>S(5)	0.27 in MW-3 on 3/8/91	>S	0.086 in BH-D on 9/10/93	>S	0.13 in MW-3 on 8/19/92
	Vapor Intrusion from Ground Water to Buildings (mg/L)	~~0.74~~ 0.21	**0.82 in MW-3 on 2/12/93**	>S	0.27 in MW-3 on 3/8/91	~~200~~ 85	0.086 in BH-D on 9/10/93	>S	0.13 in MW-3 on 8/19/92
	Ingestion	~~0.0987~~ 0.0286	**0.82 in MW-3 on 2/12/93**	10.2	0.27 in MW-3 on 3/8/91	20.4	0.086 in BH-D on 9/10/93	>S	0.13 in MW-3 on 8/19/92

Notes:

(1) The target risk level used for benzene is a carcinogenic risk of 1 in 100,000 (1E-5) from the target levels listed in Table 4 of the ASTM guidelines (ASTM ES 38-94), and the corrections in the errata published November 4, 1994 for commercial/industrial exposures.

(2) The target risk level used for non-carcinogenic constituents of concern is a chronic hazard quotient of 1.0 for commercial/industrial exposures.

(3) Maximum concentration detected in soil borings reported by Harding Lawson Associates, 1990. Maximum ground water concentration detected in site wells from January 1990 through February 1995 (WA and Harding Lawson Associates quarterly ground water monitoring reports).

(4) RES = Selected risk level is not exceeded for pure compound present at any concentration in soil.

(5) >S = At pure component solubility (mg/l), selected risk level is not exceeded.

* ASTM RBCA (E 1739-95) Tier 1 RBSLs (CA-modified) for benzene differ by a factor of 0.29. RBSLs for TEX have also changed from original ASTM ES 38-94 document.

Table 4. Comparison of Site Characterization Data to ASTM Tier 2 Site-Specific Target Levels (SSTLs). Shell Service Station, 6039 College Avenue, Oakland, California.

Media	Exposure Pathway	Benzene (ppm)		
		SSTL [1]	Maximum Detected Onsite[2]1	Maximum Detected at Alternative Points of Compliance[3]
Soil	Volatilization to Outdoor Air (mg/kg)	~~4.6~~ (RBSL) 1.33	**1.1 at 15.5 ft in MW-3**	**N/A**
	Vapor Intrusion from Soil to Buildings (mg/kg)	315	**1.1 at 15.5 ft in MW-3**	**N/A**
	Leachate to Protect Groundwater Ingestion Target Level (mg/Kg)	0.168 ~~0.38~~ (RBSL)	**N/A**	**Not Detected in MW-5 or MW-6** [4]
Ground Water	Volatilization to Outdoor Air (mg/L)	~~180~~ (RBSL) 53.4	0.82 in MW-3	**N/A**
	Vapor Intrusion from Ground Water to Buildings (mg/L)	18	**0.82 in MW-3**	**N/A**
	Ingestion (mg/L)	0.0286 ~~0.0987~~ (RBSL)	**N/A**	**0.0035 in MW-6**

Notes:

(1) The target risk level used for benzene is a carcinogenic risk of 1 in 100,000 (1[illegible]), from the SSTL calculations in Attachment A.

(2) Maximum concentration detected in soil borings reported by Harding Lawson Associates, 1990. Max. ground water concentration detected in site wells from January 1990 through February 1995 (WA and Harding Lawson Associates quarterly ground water monitoring reports).

(3) The selected alternative points of compliance are down gradient wells MW-5 and MW-6.

(4) The benzene detection limit for soil from MW-5 was <0.005 mg/Kg and the benzene detection limit for soil from MW-6 was <0.0025 mg/Kg.

N/A = Not Applicable.

Table 5. Contingency Plan for Maintaining Compliance, Shell Service Station WIC # 204-5508-3301, 6039 College Avenue, Oakland, California.

	Monitoring Well	Baseline Concentration (benzene)	Trigger Concentration (benzene)	Response to Trigger Concentration[1]
Guard Well	MW-3	200 ppb [2]	620 ppb [3]	1. Notify ACDEH
				2. Sample MW-3, MW-5, and MW-6 for the next two quarters
Boundary Wells	MW-5	0.5 ppb	10 ppb	
	MW-6	0.5 ppb	10 ppb	If elevated concentrations are detected for all three quarters, identify an appropriate course of action based upon determination of source. If elevated concentrations are not detected in all three quarters, resume the sampling schedule outlined in the future action plan..

Notes:

1 Response is implemented when the trigger condition is met or exceeded.

2 Average of all ground water benzene concentrations since monitoring began in February 1990.

3 Average plus two standard deviations of all ground water benzene concentrations since monitoring began in February 1990.

All conditions are for benzene unless otherwise noted.

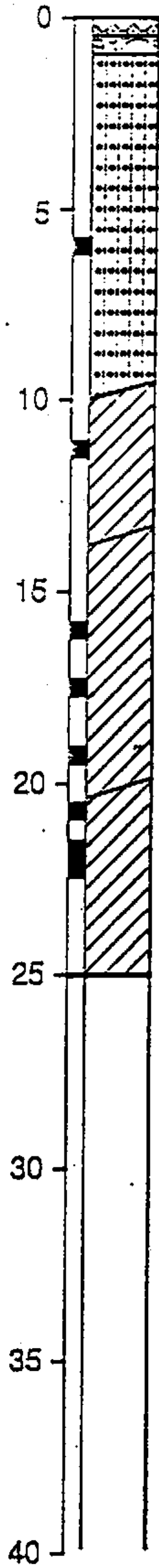
APPENDIX C

BORING LOGS

Equipment Hollow Stem Auger

Elevation -- Date 01/04/90

Blows/foot *	Photo Ionization Detector (ppm) HNu	Gasoline Odor
8	0	none
33	0	none
12	0	none
15	1	none
30	0	none
33	0	none
58	0	none



Asphalt

Baserock

DARK BROWN SILTY SAND (SM), medium dense, dry, very fine to fine sand

BROWN SANDY LEAN CLAY (CL), very stiff, dry, very fine sand, no plasticity

BROWN LEAN CLAY WITH SAND (CL), stiff, moist, lean

same, moderate plasticity

same, mottled with gray clay

BROWN LEAN CLAY WITH GRAVEL (CL), very stiff, dry, lean

Bottom of boring at 25 feet

* Blows converted to Standard Penetration Test

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring B–1
Shell Service Station
6093 College Avenue
Oakland, California

PLATE **B-1**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
S. Patel	4022,233.03	MJB	10/10/91	

Equipment Hollow Stem Auger

Elevation -- Date 01/05/90

Blows/foot*	Photo Ionization Detector (ppm)	Petroleum Hydrocarbon Odor	Depth (ft)	Description
			0	Asphalt Baserock
21	0	None	5	No recovery, brown loose sandy material and asphalt in bottom of split barrel
			10	
35	3.4	Slight		BROWN-GRAY MOTTLED SANDY LEAN CLAY (CL), medium dense, moist, fine to coarse sand
			15	GRAY SANDY SILT (ML), medium dense, moist, very fine sand
16	6.3	Slight		GREEN-GRAY MOTTLED SANDY SILT (ML), dense, wet, very fine sand
9	720	Strong		
28	134	Strong	20	BROWN-GRAY MOTTLED SILT WITH SAND (ML), dense, dry, very fine sand
48	4.0	Slight		BROWN-GRAY SAND AND GRAVEL WITH SILT (GM), dense, moist, fine to medium gravel ~25%
	140	Strong		
20	0.5	None	25	BROWN SILTY SAND WITH GRAVEL (SP), medium dense, saturated at 22.5 to 23 feet, gravel absent at 23.5 feet
				Bottom of boring at 24 feet
			30	
			35	
			40	

* Blows converted to Standard Penetration Test

Harding Lawson Associates
Engineers and Geoscientists

Log of Boring B-2
Shell Service Station
6039 College Avenue
Oakland, California

PLATE **B-2**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
YC	4022,233.03	[signature]	10/10/91		

Equipment Hollow Stem Auger

Elevation -- Date 01/05/90

Blows/foot*	Photo Ionization Detector (ppm)	Petroleum Hydrocarbon Odor
10	0	None
43	56	Strong
14	95	Strong
12	240	Strong
8	220	Strong
28	170	Strong
29	18	Slight

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40

Asphalt
Baserock

DARK BROWN SANDY SILT (ML), medium dense, moist, very fine sand

BROWN-GRAY MOTTLED SANDY CLAY (CL), hard, moist, very fine sand, occasional gravel

GREEN-GRAY SANDY SILT WITH CLAY (ML), very stiff, moist, very fine sand, slight plasticity

GRAY SANDY SILT (ML), medium dense, dry, very fine sand, non-plastic

GRAY SANDY SILT (ML), medium dense, wet, very fine sand

BROWN SANDY SILT (ML), dense, saturated, very fine sand, some clay

Bottom of boring at 22.5 feet

* Blows converted to Standard Penetration Test

Harding Lawson Associates
Engineers and Geoscientists

Log of Boring B-3
Shell Service Station
6039 College Avenue
Oakland, California

PLATE
B-3

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
YC	4022,233.03		10/10/91		

Equipment Hollow Stem Auger

Elevation — — Date 1/4/90

Blows/foot*	Photo Ionization Detector (ppm)	Petroleum Hydrocarbon Odor
24	0	None
26	0	None
27	1.1	None
25	1	None
34	0	None
25	1	None
15	8	Slight
25	25	Strong
16	230	Strong
24	270	Strong
51	23	Strong
51	3	Slight
48	0	None
29	0	None

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40

Sample

Asphalt

Baserock

BROWN SILTY SAND (SM), medium dense, dry, some gravel

DARK BROWN SANDY SILT (ML), dense, dry, some gravel

BROWN SANDY SILT WITH CLAY (ML), stiff, dry, no plasticity

GRAY-BROWN MOTTLED CLAY (CL), stiff, dry, some sand, slight plasticity

BROWN SANDY SILT (ML), stiff, dry, no plasticity

BROWN-GRAY MOTTLED SANDY LEAN CLAY (CL), stiff, dry, slight plasticity, very fine sand

BROWN-GRAY SAND WITH CLAY (SC), dense, dry, some fine gravel, fine sand stringers

GRAY SILT (ML), stiff, moist, some fine sand, slight plasticity, claystone fragments

GRAY SILTY SAND WITH GRAVEL (SP), medium dense, moist, multi-color gravel, green sand, claystone fragments

GREEN-GRAY LEAN CLAY (CL), medium stiff, moist, some fine sand, medium plasticity

BROWN SANDY LEAN CLAY (CL), hard, dry, fine sand and occasional fine gravel

Bottom of boring at 25 feet

* Blows converted to Standard Penetration Test

Harding Lawson Associates
Engineers and Geoscientists

Log of Boring B-4
Shell Service Station
6039 College Avenue
Oakland, California

PLATE **B-4**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
YC	4022,233.03	[signature]	10/10/91		

Equipment Hollow Stem Auger

Elevation -- Date 01/04/90

Blows/foot*	Photo Ionization Detector (ppm)	Petroleum Hydrocarbon Odor	Depth (ft)	Description
			0	Asphalt Baserock
			5	DARK BROWN SILTY SAND (SM), medium dense, dry, occasional fine gravel, orange mottling
20	0	None		
			10	BROWN SANDY SILT WITH CLAY (ML), very stiff, dry, very fine sand, no plasticity
27	0	None		
			15	BROWN-GRAY SILT WITH SAND (ML), very stiff, dry, very fine sand, no plasticity
12	3	None		
			20	BROWN-GRAY MOTTLED SANDY LEAN CLAY (CL), very stiff, dry, very fine sand, no plasticity
28	9	Slight		
19	1	None		BROWN SANDY LEAN CLAY (CL), stiff, saturated from 21.5 to 21.7 feet, moist at 22 feet
			25	Bottom of boring at 23 feet
			30	
			35	
			40	

*Blows converted to Standard Penetration Test

Harding Lawson Associates
Engineers and Geoscientists

Log of Boring B-5
Shell Service Station
6039 College Avenue
Oakland, California

PLATE
B-5

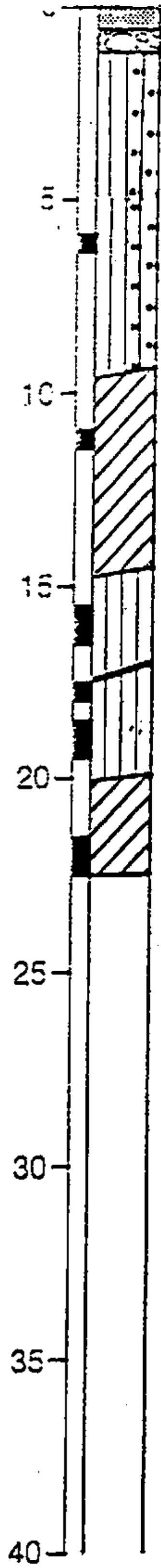
DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
YC	4022,233.03		10/10/91		

Equipment Hollow Stem Auger

Elevation -- Date 01/05/90

Blows/foot*	Photo Ionization Detector (ppm)	Petroleum Hydrocarbon Odor
13	0	None
35	0	None
16	130	Strong
12	119	Strong
9	140	Strong
12		
33	6	Slight

Depth (ft) / Sample



Asphalt
Baserock

DARK BROWN SANDY SILT (SM-ML), medium dense, moist, sand >50% 5 to 5.5 feet, root material, fine to medium sand

BROWN-GRAY MOTTLED SANDY CLAY (CL), very stiff, dry, occasional gravel, fine to medium sand

GREEN-GRAY SANDY SILT WITH CLAY (ML), stiff, moist, very fine sand, slight plasticity

GRAY SILT (ML), medium dense, moist, some very fine sand <12%

GREEN-GRAY SILT WITH CLAY (ML), stiff, saturated, slight plasticity

BROWN LEAN CLAY WITH SAND (CL), hard, dry, with gray mottling, very fine sand

Bottom of boring at 22.5 feet

* Blows converted to Standard Penetration Test

Harding Lawson Associates
Engineers and Geoscientists

Log of Boring B-6
Shell Service Station
6039 College Avenue
Oakland, California

PLATE **B-6**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
YC	4022,233.03	[signature]	10/10/91		

Equipment Hollow Stem Auger

Elevation -- Date 02/08/90

Blows/foot *	Photo Ionization Detector (ppm) HNu	Well Screen Interval	Gasoline Odor	Depth (ft.)	Description
				0	Asphalt
					Brown baserock/sandy clay
					BROWN LEAN CLAY (CL), stiff, moist, with sand and silt
no samples obtained from 0-25 feet (see Log of Boring B-1)				5–15	
				20	BROWN SILT (ML), stiff, moist, with clay
				25	begin sampling at 25 feet
22	0		none		MOTTLED ORANGE BROWN SILT (ML), medium dense, moist, with increasing sand content towards bottom of sample
14	0		none		same, (ML)
24	0		none	30	BROWN SILTY SAND WITH GRAVEL (SP), medium dense, saturated, gravel ≤ 0.25 inches, medium to coarse sand
29	0		none		same, increase sand (fine to medium)
16	0		none		same, (SP)
					BROWN SILT WITH GRAVEL (ML), medium dense, moist, gravel <0.5 inch, some sand
25	0		none	35	DARK BROWN LEAN CLAY (CL), very stiff, moist, with sand
29	0		none		
21	0		none		MOTTLED BROWN-GRAY CLAY (CL), increased sand, some gravel, <0.15 inch
26	0		none	40	BROWN SILTY SAND WITH GRAVEL (SM), medium dense, moist, gravel <0.25 inch, with clay

(Continuation of Log)

Blows/foot *	Photo Ionization Detector (ppm) HNu	Well Screen Interval	Gasoline Odor	Depth (ft.)	Description
29	0		none	40	BROWN SILTY SAND WITH GRAVEL (SM)
32	0		none		BROWN LEAN CLAY WITH GRAVEL (CL), hard, moist, gravel ≤ 0.5 inches
42	0		none	45	MOTTLED BROWN ORANGE SILT (ML), medium dense, moist, some gravel decreasing towards bottom
48	0				
15	0				same, mottled gray brown, partial cementation (ML)
31	0			50	Bottom of boring at 50 feet
				55–80	

* Blows converted to Standard Penetration Test

MW-1

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring MW-1
Shell Service Station
6039 College Avenue
Oakland, California

PLATE
B-7

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
S. Patel	4022,233.03	MSD	10/10/91	

Equipment Hollow Stem Auger

Elevation — — Date 02/08/90

Blows/foot*	Photo Ionization Detector (ppm)	Well Screen Interval	Petroleum Hydrocarbon Odor	Depth (ft)	Sample	
				0		Asphalt Baserock
13	0		None	5		DARK BROWN SANDY LEAN CLAY (CL), stiff, moist, no plasticity
33	0		None	10		Same, brown, hard
13	0		None	15		MOTTLED BROWN-GRAY CLAY (CL), dry, slight plasticity
43	0		None	20		Same, orange-brown, hard, moist, with increased silt content
12	0		None	25		BROWN SILT (ML), medium dense, moist
						Bottom of boring at 25.0 feet
				30		
				35		
				40		

MW-2

* Blows converted to Standard Penetration Test

Harding Lawson Associates
Engineers and Geoscientists

Log of Boring MW-2
Shell Service Station
6039 College Avenue
Oakland, California

PLATE **B-8**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
YC	4022,233.03		10/10/91		

Equipment Hollow Stem Auger

Elevation — —   Date 02/07/90

Blows/foot*	Photo Ionization Detector (ppm)	Well Screen Interval	Petroleum Hydrocarbon Odor	Depth (ft)	Sample	Description
				0		Asphalt Baserock
11	20		Slight	5		BROWN SILT (ML), very hard, moist, some clay
34	100		Strong	10		MOTTLED GRAY-BROWN SILTY CLAY (CL-ML), hard, moist
17	110		Strong	15		MOTTLED GRAY-BROWN SILT (ML), hard, moist, noticeable gasoline sheen
10	30		Strong	20		Same, very stiff
28	100		Strong	25		BROWN SANDY LEAN CLAY WITH GRAVEL (CL), hard, moist
						Bottom of boring at 26.5 feet
				30		
				35		
				40		

* Blows converted to Standard Penetration Test

MW-3

Harding Lawson Associates
Engineers and Geoscientists

Log of Boring MW-3
Shell Service Station
6039 College Avenue
Oakland, California

PLATE
B-9

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
YC	4022,233.03	[signature]	10/10/91		

Equipment: Hollow Stem Auger

Elevation: — —   Date: 02/07/90

Blows/foot*	Photo Ionization Detector (ppm)	Well Screen Interval	Petroleum Hydrocarbon Odor	Depth (ft)	Sample	Description
33	0		None	5		BROWN SILT WITH GRAVEL (ML), hard, dry, gravel to 1.5-inch diameter
44	0		None	10		BROWN LEAN CLAY (CL), hard, moist, some black mottling, some silt
14	150		Strong	15		GREENISH-BROWN SILT (ML), hard, moist, slight plasticity
						GRAY SILT (ML), stiff, saturated, noticeable separate phase product
69	200		strong	20		BROWN LEAN CLAY (CL), hard, moist
23	10		Slight	25		Same, some gravel to 1.5-inch
						Bottom of boring at 26.5 feet
				30		
				35		
				40		

* Blows converted to Standard Penetration Test

MW-4

Harding Lawson Associates
Engineers and Geoscientists

Log of Boring MW-4
Shell Service Station
6039 College Avenue
Oakland, California

PLATE **B-10**

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
YC	4022,233.03		10/10/91		

Equipment Hollow Stem Auger

Elevation —— Date 8/26/91

Blows/foot*	Photo Ionization Detector (ppm)	Petroleum Hydrocarbon Odor	Depth (ft)	Description
			0	Asphalt Baserock to 6 inches DARK BROWN LEAN CLAY (CL), moist Rig chatter
6	not measured	none	5	BROWN LEAN CLAY WITH SAND AND GRAVEL (CL), medium stiff, moist, gravel less than 1 inch
16	0	none	10	MOTTLED BROWN LEAN CLAY (CL), very stiff, moist
13	2	faint	15	MOTTLED GRAY-BROWN SILT (ML), stiff, moist
22	0	none	20	MOTTLED BROWN LEAN CLAY (CL), very stiff, saturated
10	0	none	25	Same, stiff
20	0	none	30	MOTTLED BROWN SILT WITH SAND (ML), very stiff, moist Bottom of boring at 31.5 feet
			35	
			40	

Well Screen Interval

* Blows converted to Standard Penetration Test

MW-5

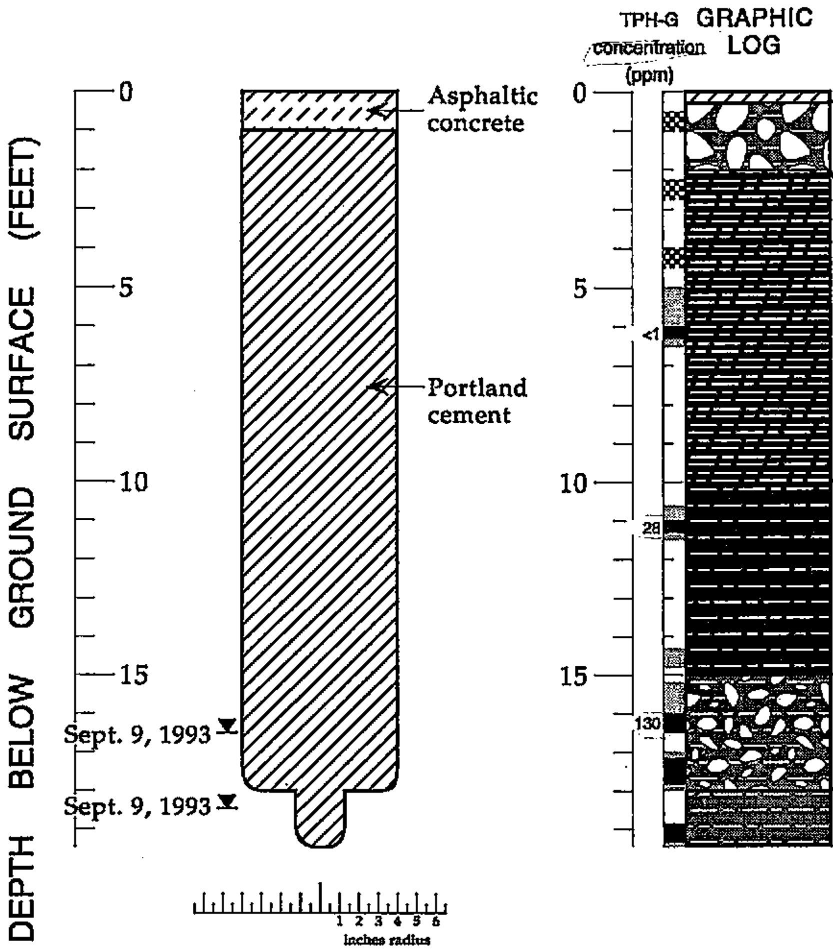
Harding Lawson Associates
Engineers and Geoscientists

Log of Boring MW-5
Shell Service Station
6039 College Avenue
Oakland, California

PLATE
B-11

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED	DATE
S. Patel	4022,233.03	MTB	10/10/91		

BORING BH-A



DESCRIPTION

Asphaltic concrete

Silty GRAVEL (GM); gray-brown; very dense; damp; 25% fines; 25% fine to very coarse sand; 50% gravel to 0.75" diameter; moderate K [fill]

Clayey SILT (ML); brown; firm; damp; 10% clay; 70% silt; 20% very fine to fine sand; low plasticity; low K

5% clay; 80% silt; 15% fine to very fine sand at 5.0'

Silty gravelly sand unit with Fe staining at 6.0'

Silty CLAY (CL); light brown; very stiff; damp; 50% clay; 40% silt; 10% very fine sand; high plasticity; very low K

Gravelly SILT (ML); brown; very stiff; damp; 50% silt; 10% fine to very fine sand; 40% gravel to 0.5" diameter; nonplastic; moderate K

SILT (ML); light brown; soft; wet; 10% clay; 80% silt; 10% very fine sand; low plasticity; moderate K

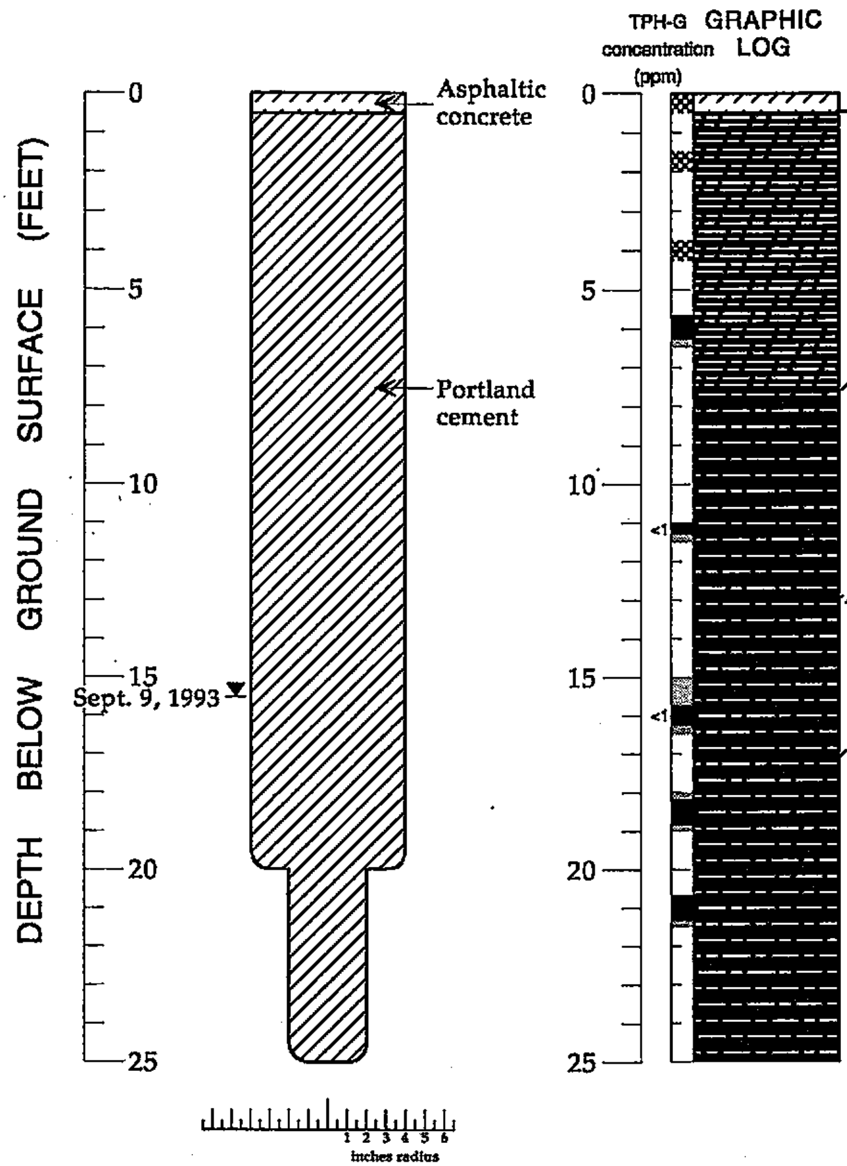
EXPLANATION

- Water level during drilling (date)
- Water level (date)
- Contact (dotted where approximate)
- —?—?— Uncertain contact
- Gradational contact
- Location of recovered drive sample
- Location of drive sample sealed for chemical analysis
- Cutting sample
- K = Estimated hydraulic conductivity

Logged By: David C. Elias
Supervisor: N. Scott MacLeod; RG 5747
Drilling Company: Soils Exploration Services, Vacaville, CA
License Number: C57-582696
Driller: Ken Lenk
Drilling Method: Hollow-stem auger
Date Drilled: September 9, 1993
Type of Sampler: Split spoon (1.5", 2", 2.5" ID)
Ground Surface Elevation: ~193 feet above mean sea level
TPH-G: Total petroleum hydrocarbons as gasoline in soil by modified EPA Method 8015

Boring Log BH-A - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Berkeley, California

BORING BH-B



DESCRIPTION

Asphaltic concrete

Clayey SILT (ML); brown; soft; damp; 15% clay; 75% silt; 10% very fine sand; medium plasticity; low K

Silty CLAY (CL); light brown; very stiff; damp; 50% clay; 40% silt; 10% very fine sand; high plasticity; very low K

Clayey SILT to Silty CLAY (ML/CL); light brown; soft; damp; 45% clay; 45% silt; 10% very fine sand; medium plasticity; very low K

Silty CLAY (CL); light brown; stiff; damp to moist; 50% clay; 40% silt; 10% very fine sand; high plasticity; very low K

Moist at 20.0'

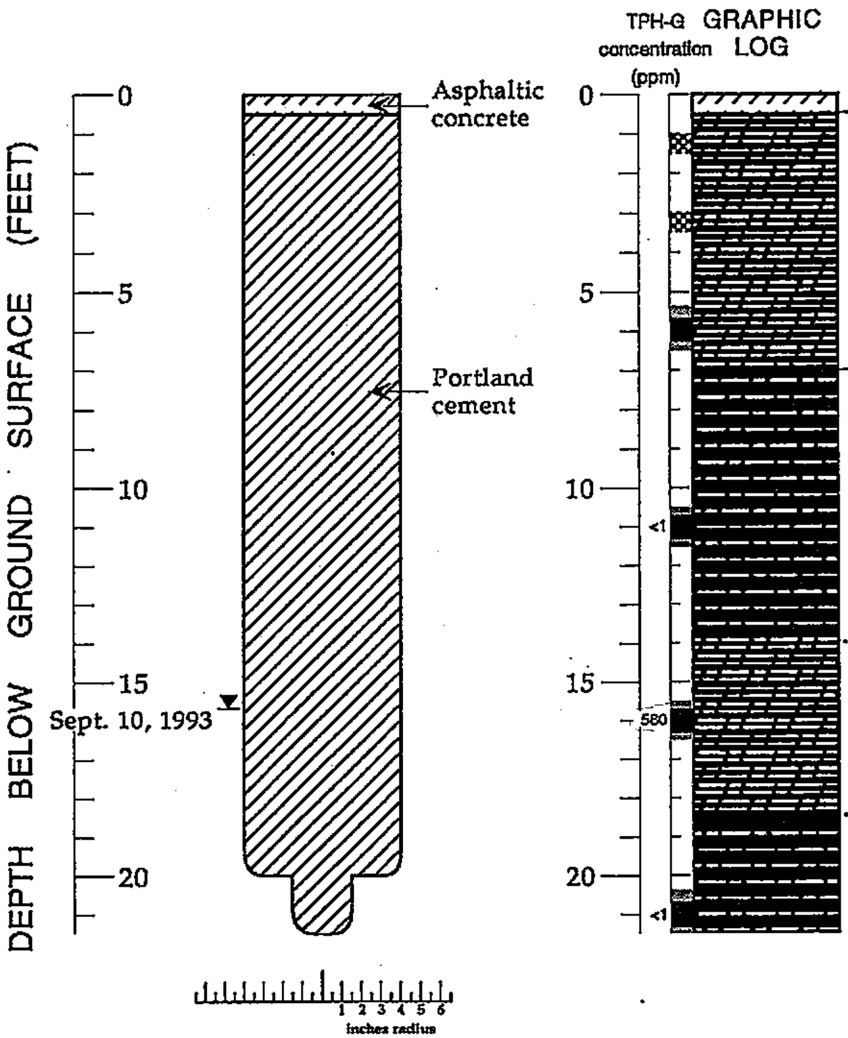
EXPLANATION

▼	Water level during drilling (date)
▽	Water level (date)
——······	Contact (dotted where approximate)
—?—?—	Uncertain contact
/////////	Gradational contact
(shaded box)	Location of recovered drive sample
(black box)	Location of drive sample sealed for chemical analysis
(checkered box)	Cutting sample
K =	Estimated hydraulic conductivity

Logged By: David C. Elias
Supervisor: N. Scott MacLeod; RG 5747
Drilling Company: Soils Exploration Services, Vacaville, CA
License Number: C57-582696
Driller: Ken Lenk
Drilling Method: Hollow-stem auger
Date Drilled: September 9, 1993
Type of Sampler: Split spoon (1.5", ID)
Ground Surface Elevation: ~193 feet above mean sea level
TPH-G: Total petroleum hydrocarbons as gasoline in soil by modified EPA Method 8015

Boring Log BH-B - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Berkeley, California

BORING BH-C



DESCRIPTION

Asphaltic concrete

Clayey SILT (ML); dark brown; soft; damp; 15% clay; 75% silt; 10% very fine sand; medium plasticity; low K

(contact-driller)

Silty CLAY (CL); light brown; very stiff; damp; 50% clay; 40% silt; 10% very fine sand; high plasticity; very low K

Brown mottled gray at 10.0'

Clayey SILT (ML); gray; stiff; moist; 15% clay; 75% silt; 10% very fine sand; medium plasticity; low K

Silty CLAY (CL); light brown; very stiff; damp to moist; 50% clay; 40% silt; 10% very fine sand; high plasticity; very low K

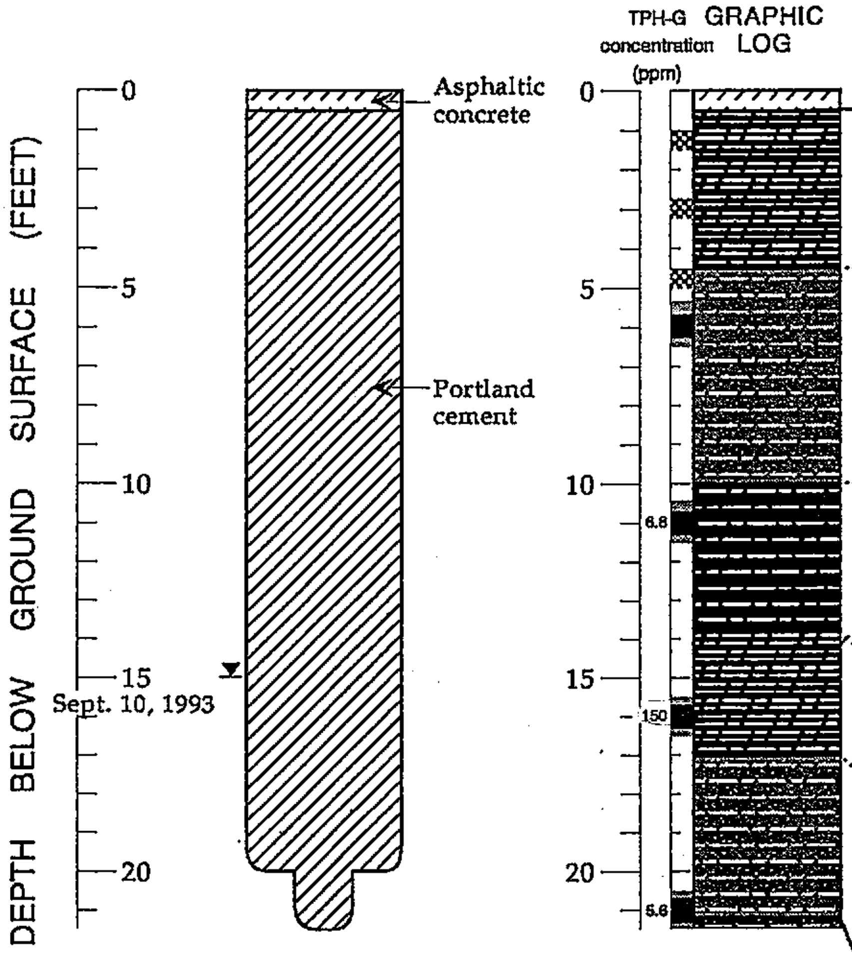
EXPLANATION

- Water level during drilling (date)
- Water level (date)
- Contact (dotted where approximate)
- —?—?— Uncertain contact
- Gradational contact
- Location of recovered drive sample
- Location of drive sample sealed for chemical analysis
- Cutting sample
- K = Estimated hydraulic conductivity

Logged By: David C. Elias
Supervisor: N. Scott MacLeod; RG 5747
Drilling Company: Soils Exploration Services, Vacaville, CA
License Number: C57-582696
Driller: Gene Bernard
Drilling Method: Hollow-stem auger
Date Drilled: September 10, 1993
Type of Sampler: Split spoon (2", ID)
Ground Surface Elevation: ~193 feet above mean sea level
TPH-G: Total petroleum hydrocarbons as gasoline in soil by modified EPA Method 8015

Boring Log BH-C - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Berkeley, California

BORING BH-D



DESCRIPTION

Asphaltic concrete

Clayey SILT (ML); brown; soft; damp; 15% clay; 75% silt; 10% very fine sand; medium plasticity; low K

Sandy SILT (ML); brown; stiff; damp; 10% clay; 60% silt; 20% fine to very coarse sand; 10% gravel to 0.5" diameter; low plasticity; low K

Silty CLAY (CL); light brown mottled gray; very stiff; damp; 50% clay; 40% silt; 10% very fine sand; high plasticity; very low K

Silty CLAY/Clayey SILT (CH/MH); gray; stiff; damp; 45% clay; 45% silt; 10% very fine sand; medium to high plasticity; very low K

Sandy SILT/Clayey SILT (ML); gray-brown; firm; wet; 15% clay; 60% silt; 15% fine to very coarse sand; medium plasticity; low K

Silty sand to silty gravel unit at 20.0'

Silty CLAY to Sandy CLAY (ML); brown mottled dark brown; very stiff; moist to wet; 40% clay; 30% silt; 30% fine to medium sand; medium plasticity; low K

EXPLANATION

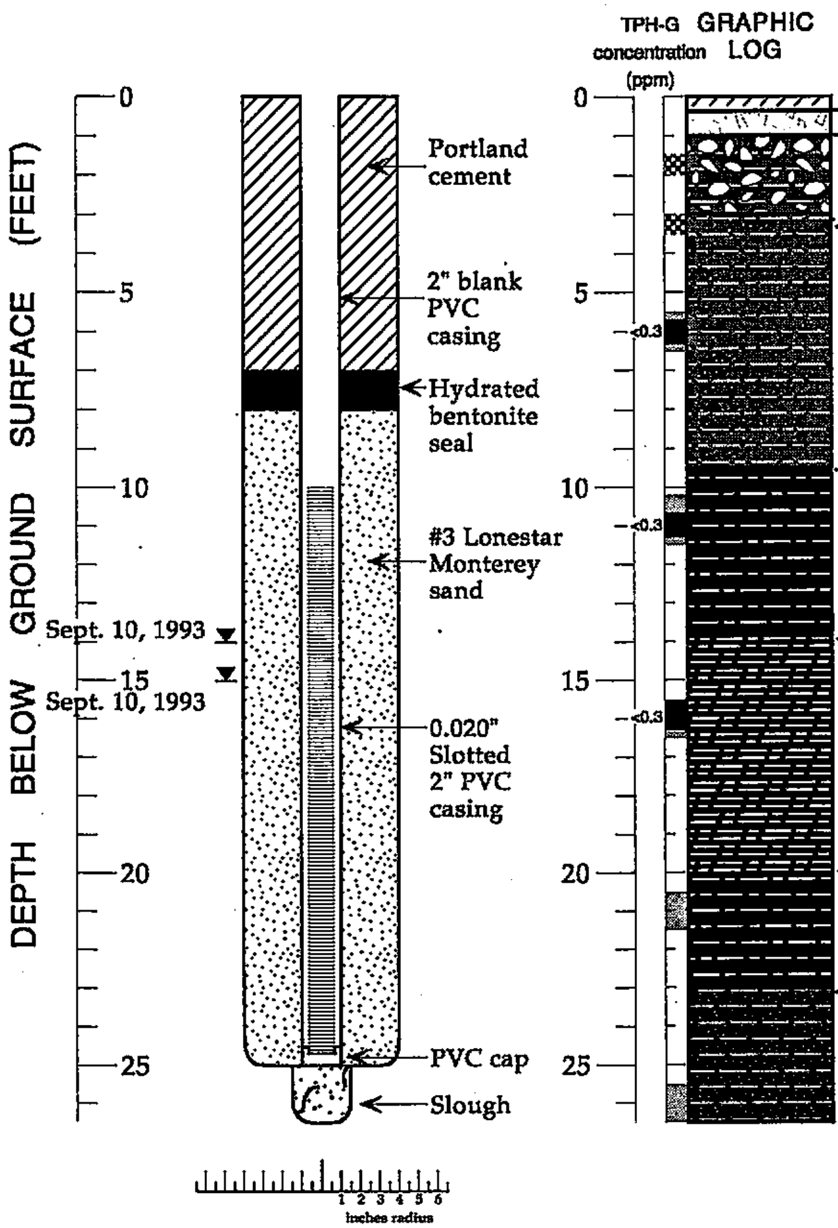
- ▼ Water level during drilling (date)
- ∇ Water level (date)
- ——— Contact (dotted where approximate)
- —?—?— Uncertain contact
- ////////// Gradational contact
- Location of recovered drive sample
- Location of drive sample sealed for chemical analysis
- Cutting sample
- K = Estimated hydraulic conductivity

Logged By: David C. Elias
Supervisor: N. Scott MacLeod; RG 5747
Drilling Company: Soils Exploration Services, Vacaville, CA
License Number: C57-582696
Driller: Gene Bernard
Drilling Method: Hollow-stem auger
Date Drilled: September 10, 1993
Type of Sampler: Split spoon (2", ID)
Ground Surface Elevation: ~193 feet above mean sea level
TPH-G: Total petroleum hydrocarbons as gasoline in soil by modified EPA Method 8015

Boring Log BH-D - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Berkeley, California

WEISS ASSOCIATES

WELL MW-6 (BH-E)



DESCRIPTION

Asphaltic concrete

Concrete and gravel roadbase

Gravelly SILT (ML); brown; soft; damp; 60% silt; 15% fine to very coarse sand; 25% gravels and cobbles to 0.75" diameter; low plasticity; high K

Clayey SILT to Sandy SILT (ML); dark brown; stiff; damp; 15% clay; 70% silt; 15% very fine sand; medium plasticity; low K

25% clay; 60% silt; 15% very fine sand at 8.0'

Silty CLAY (CL); brown; stiff; damp; 50% clay; 35% silt; 10% fine to very coarse sand; 5% gravel; high plasticity; very low K

SILT (ML); gray mottled brown; stiff; moist; 10% clay; 90% silt; low plasticity; moderate K

Silty CLAY (CL); light brown; very stiff; wet; 65% clay; 20% silt; 10% very fine to coarse sand; 5% angular gravel; medium to high plasticity; very low K

Gravelly CLAY to Sandy CLAY (CL); light brown; hard; wet; 80% clay; 10% sand; 10% gravel; high plasticity; very low K

EXPLANATION

- ▼ Water level during drilling (date)
- ▽ Water level (date)
- ——······ Contact (dotted where approximate)
- —?—?— Uncertain contact
- ////////// Gradational contact
- Location of recovered drive sample
- Location of drive sample sealed for chemical analysis
- Cutting sample
- K = Estimated hydraulic conductivity

Logged By: David C. Elias/Jeni C. Martin
Supervisor: N. Scott MacLeod; RG 5747
Drilling Company: Soils Exploration Services, Vacaville, CA
License Number: C57-582696
Driller: Gene Bernard
Drilling Method: Hollow-stem auger
Date Drilled: September 10, 1993
Well Head Completion: 2" locking well-plug, traffic-rated vault
Type of Sampler: Split spoon (2" ID)
Ground Surface Elevation: 189.3 feet above mean sea level
TPH-G: Total petroleum hydrocarbons as gasoline in soil by modified EPA Method 8015

Boring Log and Well Construction Details - Well MW-6 (BH-E) - Shell Service Station WIC #204-5508-3301, 6039 College Avenue, Oakland, California

APPENDIX D1

TIER 2 SSTL CALCULATIONS FOR BENZENE IN SOIL - VOLATILIZATION TO INDOOR AIR PATHWAY

Shell 6039 College Ave Site, Site-Specific Values
Jun-95
WA implementation of Jury model, from Sanders and Stern 1994

Appendix D1 - CALCULATIONS - Soil to Indoor Air SSTL

[redacted] Chemical and Soil Values (symbol notation from ASTM for consistency)

Source		Soil Specific Parameters	
ASTM 94	ρ_s	1700	Bulk Density(kg/m^3)
ASTM 94	θ_{as}	0.26	Air Content (v/v)
ASTM 94	θ_{ws}	0.12	Water Content (v/v)
ASTM 94	θ_t	0.38	Porosity (v/v)
		Chemical Specific Parameters	
		benzene	Chemical Name
ASTM 94	H	0.222	Henry's Constant
S+S 94	Thalf	16	Contaminant Half Life (d)
ASTM 94	D^{air}	9.30E-06	Air Diffusion Coefficient (m^2/s)
ASTM 94	D^{wat}	1.10E-09	Water Diffusion Coefficient (m^2/s)
ASTM 94	f_{oc}	0.01	Organic Carbon Fraction
ASTM 94	K_{oc}	0.038	Organic Carbon Partition Coefficient (m^3/Kg) (Log Koc = 1.58)
calc, Jury	D^{eff}	1.95E-07	Effective Diffusion Coefficient (m^2/s)

Site Specific Parameters (symbol notation consistent with Sanders and Stern)

C_{soil}	1.1	Soil Concentration (mg/kg)	MW-3 at 15.5 ft in 1990
Co	1.87	Soil Concentration by Volume (g/m^3)	using 1.7 density
L	3.048	Depth to Contamination (m)	first detectable at 10'
W	2.56	Thickness of Contamination Zone (m)	lowest GW at 18.4' bgs, max th. 8.4'
A	92.90	Zone of Influence, Building Area (m^2)	Bldg 50'x20'
Qb	230.77	Building Ventilation Rate (m^3/Hr)	ht= 300 cm(ASTM), vent rate = .00023/sec (ASTM)
I	15	Inhalation volume (m^3/day)	office workers = 15 per EPA 1991

default values

Equation Parts a, b and c : a=x, b=y, c=z

x	3.98	x=(ln(2)/Thalf)^.5 (yr^-.5)
y	0.614997	$y=L/(2*D^{eff}$^.5) (yr^.5)
z	1.131594	$z=(L+W)/(2*D^{eff}$^.5) (yr^.5)

Integration Constants

ICs	0.146606	$ICs=(Co*A*I*D^{eff}$^.5)/(2*a*Qb) (grams)

Formulas

$$D^{eff}=\frac{\left(\theta_{as}^{10/3}D^{air}H+\theta_{ws}^{10/3}D_{wat}\right)/\theta_t^{2}}{\left(\rho_s f_{oc}K_{oc}+\theta_{ws}+\theta_{as}H\right)}$$

$$dose=\frac{CoAI}{2xQb}\sqrt{De}\left\{\left[\begin{array}{l}\exp(2yx)erf\left(x\sqrt{t}+\frac{y}{\sqrt{t}}\right)\\+\exp(-2yx)erf\left(x\sqrt{t}-\frac{y}{\sqrt{t}}\right)\end{array}\right]_{\sqrt{t1}}^{\sqrt{t2}}-\left[\begin{array}{l}\exp(2zx)erf\left(x\sqrt{t}+\frac{z}{\sqrt{t}}\right)\\+\exp(-2zx)erf\left(x\sqrt{t}-\frac{z}{\sqrt{t}}\right)\end{array}\right]_{\sqrt{t1}}^{\sqrt{t2}}\right\}$$

Integration (you need to understand the ERF function application when entering values here)

Industrial 25 yrs (250 d/yr)

0.0001	Lower Time Limit (yr)	17.12329	Upper Time Limit (yr)
0.01	Sq root LTL (yr^.5)	4.14	Sq root UTL (yr^.5)
133.0929	Term 1	133.0929	Term 1
-0.00751	Term2	0.007514	Term2
-8099.26	Term3	-8099	Term3
0.000123	Term4	-0.00012	Term4

Site dose (mg)=	2.2	=	3.49E-08 risk
Acceptable Dose (mg) =	620	=	1.0E-05 risk

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Weiss Associates

Shell 6039 College Ave Site, Site-Specific Values
Backcalculate to acceptable concentration

Appendix D1 - CALCULATIONS - Soil to Indoor Air SSTL

Default Chemical and Soil Values (symbol notation from ASTM for consistency)

Source			Soil Specific Parameters
ASTM 94	ρ_s	1700	Bulk Density(kg/m^3)
ASTM 94	θ_{as}	0.26	Air Content (v/v)
ASTM 94	θ_{ws}	0.12	Water Content (v/v)
ASTM 94	θ_t	0.38	Porosity (v/v)
			Chemical Specific Parameters
		benzene	Chemical Name
ASTM 94	H	0.222	Henry's Constant
S+S 94	Thalf	16	Contaminant Half Life (d)
ASTM 94	D^{air}	9.30E-06	Air Diffusion Coefficient (m^2/s)
ASTM 94	D^{wat}	1.10E-09	Water Diffusion Coefficient (m^2/s)
ASTM 94	f_{oc}	0.01	Organic Carbon Fraction
ASTM 94	K_{oc}	0.038	Organic Carbon Partition Coefficient (m^3/Kg) (Log Koc = 1.58)
calc, Jury	D^{eff}	1.95E-07	Effective Diffusion Coefficient (m^2/s)

Site Specific Parameters (symbol notation consistent with Sanders and Stern)

C_{soil}	**315**	**Soil Concentration (mg/kg)= SSTL**	MW-3 at 15.5 ft in 1990
Co	534.99	Soil Concentration by Volume (g/m^3)	using 1.7 density
L	3.048	Depth to Contamination (m)	first detectable at 10'
W	2.56	Thickness of Contamination Zone (m)	lowest GW at 18.4' bgs, max th. 8.4'
A	92.90	Zone of Influence, Building Area (m^2)	Bldg 50'x20'
Qb	230.77	Building Ventilation Rate (m^3/Hr)	ht= 300 cm(ASTM), vent rate = .00023/sec (ASTM)
I	15	Inhalation volume (m^3/day)	office workers = 15 per EPA 1991

Equation Parts a, b and c : a=x, b=y,c=z

x	3.98	x=(ln(2)/Thalf)^.5 (yr^-.5)
y	0.614997	y=L/(2*D^{eff}^.5) (yr^.5)
z	1.131594	z=(L+W)/(2*D^{eff}^.5) (yr^.5)

Integration Constants

ICs	41.94277	ICs=(Co*A*I*D^{eff}^.5)/(2*a*Qb) (grams)

Formulas

$$D^{eff} = \frac{\left(\theta_{as}^{10/3} D^{air} H + \theta_{ws}^{10/3} D_{wat}\right)/\theta_t^2}{\left(\rho_s f_{oc} K_{oc} + \theta_{ws} + \theta_{as} H\right)}$$

$$dose = \frac{CoAI}{2xQb}\sqrt{De}\left\{\left[\begin{array}{l}\exp(2yx)erf\left(x\sqrt{t}+\frac{y}{\sqrt{t}}\right)\\ +\exp(-2yx)erf\left(x\sqrt{t}-\frac{y}{\sqrt{t}}\right)\end{array}\right]_{\sqrt{t1}}^{\sqrt{t2}} - \left[\begin{array}{l}\exp(2zx)erf\left(x\sqrt{t}+\frac{z}{\sqrt{t}}\right)\\ +\exp(-2zx)erf\left(x\sqrt{t}-\frac{z}{\sqrt{t}}\right)\end{array}\right]_{\sqrt{t1}}^{\sqrt{t2}}\right\}$$

Integration (you need to understand the ERF function application when entering values here)

Industrial 25 yrs (250 d/yr)

0.0001	Lower Time Limit (yr)	17.12329	Upper Time Limit (yr)
0.01	Sq root LTL (yr^.5)	4.14	Sq root UTL (yr^.5)
133.0929	Term 1	133.0929	Term 1
-0.00751	Term2	0.007514	Term2
-8099.26	Term3	-8099	Term3
0.000123	Term4	-0.00012	Term4

Site dose (mg)= 620 = 1.0E-05 risk
Acceptable Dose (mg) = 620 = 1.0E-05 risk

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APPENDIX D2

TIER 2 SSTL CALCULATIONS FOR BENZENE IN GROUND WATER - VOLATILIZATION TO INDOOR AIR PATHWAY

Shell 6039 College Ave Site, Site-Specific Values
Jun-95
WA implementation of Jury model, from Sanders and Stern 1994
adapted for GW as initial source

Appendix D2 - CALCULATIONS - Ground Water to Indoor Air SSTL

Default Chemical and Soil Values (symbol notation from ASTM for consistency)

Source	Soil Specific Parameters		
ASTM 94	ρ_s	1700	Bulk Density(kg/m^3)
ASTM 94	θ_{as}	0.26	Air Content (v/v)
ASTM 94	θ_{ws}	0.12	Water Content (v/v)
ASTM 94	θ_t	0.38	Porosity (v/v)
	Chemical Specific Parameters		
		benzene	Chemical Name
ASTM 94	H	0.222	Henry's Constant
Howard	Thalf	365	Contaminant Half Life (d) in GW, Howard 1991
ASTM 94	D^{air}	9.30E-06	Air Diffusion Coefficient (m^2/s)
ASTM 94	D^{wat}	1.10E-09	Water Diffusion Coefficient (m^2/s)
ASTM 94	f_{oc}	0.01	Organic Carbon Fraction
ASTM 94	K_{oc}	0.038	Organic Carbon Partition Coefficient (m^3/Kg) (Log Koc = 1.58)
calc, Jury	D^{eff}	1.95E-07	Effective Diffusion Coefficient (m^2/s)

Site Specific Parameters (symbol notation consistent with Sanders and Stern)

C_{water}	0.82	Ground Water Concentration (mg/L)	MW-3 in February 1993
Co	0.18204	(g/m^3)	Conc * Kh
L	4.67	Depth to Contamination (m)	Average depth to ground water in MW-3
W	6,378,000	Thickness of Contamination Zone (m)	Radius of earth (eq. to infinite thickness, non-receeding source)
A	92.90	Zone of Influence, Building Area (m^2)	Bldg 50'x20'
Qb	230.77	Building Ventilation Rate (m^3/Hr)	ht= 300 cm(ASTM), vent rate = .00023/sec (ASTM)
I	15	Inhalation volume (m^3/day)	office workers = 15 per EPA 1991

Equation Parts a, b and c : a=x, b=y,c=z

x	0.83	x=(ln(2)/Thalf)^.5 (yr^-.5)
y	0.9422685	y=L/(2*D^eff^.5) (yr^.5)
z	1286893.5	z=(L+W)/(2*D^eff^.5) (yr^.5)

Integration Constants

ICs	0.0681655	ICs=(Co*A*I*D^eff^.5)/(2*a*Qb) (grams)

Formulas

$$D^{eff} = \frac{\left(\theta_{as}{}^{10/3} D^{air} H + \theta_{ws}{}^{10/3} D_{wat}\right)/\theta_t{}^2}{\left(\rho_s f_{oc} K_{oc} + \theta_{ws} + \theta_{as} H\right)}$$

$$dose = \frac{CoAI}{2xQb}\sqrt{De}\left[\begin{array}{l}\exp(2yx)erf\left(x\sqrt{t}+\frac{y}{\sqrt{t}}\right)\\ +\exp(-2yx)erf\left(x\sqrt{t}-\frac{y}{\sqrt{t}}\right)\end{array}\right]_{\sqrt{t1}}^{\sqrt{t2}}$$

Integration (you need to understand the ERF function application when entering values here)

Industrial 25 yrs (250 d/yr)

0.0001	Lower Time Limit (yr)	17.12329	Upper Time Limit (yr)
0.01	Sq root LTL (yr^.5)	4.14	Sq root UTL (yr^.5)
4.801747	Term 1	4.801746	Term 1
-0.20826	Term2	0.208258	Term2

Site dose (mg)= 28.4 = 4.6E-07 risk
Acceptable Dose (mg) = 620 = 1.0E-05 risk

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WA

Shell 6039 College Ave Site, Site-Specific Values
Backcalculate to acceptable concentration= SSTL

Appendix D2 - CALCULATIONS - Ground Water to Indoor Air SSTL

Default Chemical and Soil Values (symbol notation from ASTM for consistency)

Source	Soil Specific Parameters		
ASTM 94	ρ_s	1700	Bulk Density(kg/m^3)
ASTM 94	θ_{as}	0.26	Air Content (v/v)
ASTM 94	θ_{ws}	0.12	Water Content (v/v)
ASTM 94	θ_t	0.38	Porosity (v/v)
	Chemical Specific Parameters		
		benzene	Chemical Name
ASTM 94	H	0.222	Henry's Constant
S+S 94	Thalf	365	Contaminant Half Life (d) in GW (Howard, 1991)
ASTM 94	D^{air}	9.30E-06	Air Diffusion Coefficient (m^2/s)
ASTM 94	D^{wat}	1.10E-09	Water Diffusion Coefficient (m^2/s)
ASTM 94	f_{oc}	0.01	Organic Carbon Fraction
ASTM 94	K_{oc}	0.038	Organic Carbon Partition Coefficient (m^3/Kg) (Log Koc = 1.58)
calc, Jury	D^{eff}	1.95E-07	Effective Diffusion Coefficient (m^2/s)

Site Specific Parameters (symbol notation consistent with Sanders and Stern)

C_{water}	**18**	**Ground Water Concentration (mg/L)= SSTL**	
Co	3.9738	(g/m^3)	Conc * Kh
L	4.67	Depth to Contamination (m)	Average depth to ground water in MW-3
W	6,378,000	Thickness of Contamination Zone (m)	Radius of earth (eq. to infinite thickness, non-receeding source)
A	92.90	Zone of Influence, Building Area (m^2)	Bldg 50'x20'
Qb	230.77	Building Ventilation Rate (m^3/Hr)	ht= 300 cm(ASTM), vent rate = .00023/sec (ASTM)
I	15	Inhalation volume (m^3/day)	office workers = 15 per EPA 1991

Equation Parts a, b and c : a=x, b=y, c=z

x	0.83	x=(ln(2)/Thalf)^.5 (yr^-.5)
y	0.9422685	y=L/(2*D^eff^.5) (yr^.5)
z	1286893.5	z=(L+W)/(2*D^eff^.5) (yr^.5)

Integration Constants

ICs	1.4880034	ICs=(Co*A*I*D^eff^.5)/(2*a*Qb) (grams)

Formulas

$$D^{eff} = \frac{\left(\theta_{as}^{10/3} D^{air} H + \theta_{ws}^{10/3} D_{wat}\right)\theta_t^{2}}{\left(\rho_s f_{oc} K_{oc} + \theta_{ws} + \theta_{as} H\right)}$$

$$dose = \frac{CoAI}{2xQb}\sqrt{De}\left[\exp(2yx)erf\left(x\sqrt{t}+\frac{y}{\sqrt{t}}\right) + \exp(-2yx)erf\left(x\sqrt{t}-\frac{y}{\sqrt{t}}\right)\right]_{\sqrt{t1}}^{\sqrt{t2}}$$

Integration (you need to understand the ERF function application when entering values here)

Industrial 25 yrs (250 d/yr)

0.0001	Lower Time Limit (yr)	17.12329	Upper Time Limit (yr)
0.01	Sq root LTL (yr^.5)	4.14	Sq root UTL (yr^.5)
4.801747	Term 1	4.801746	Term 1
-0.20826	Term2	0.208258	Term2

Site dose (mg)=	620	=	1.0E-05 risk
Acceptable Dose (mg) =	620	=	1.0E-05 risk

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