LOWNEYASSOCIATES
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Mountain View
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NOV 3 0 2001

November 27, 2001
1424-4

Mr. Steve Kalmbach
PULTE HOME CORPORATION
7031 Koll Center Parkway, Suite 150
Pleasanton, California 94566

RE: RISK MANAGEMENT PLAN
1274 65TH STREET AND
1269 66TH STREET
EMERYVILLE, CALIFORNIA

Dear Mr. Kalmbach:

As requested, we have prepared this revised construction risk management plan for 1274 65th Street and 1269 66th Street in Emeryville, California. This document was prepared in accordance with our agreement dated July 24, 2001.

Thank you for choosing us to assist you. If you have any questions, please call and we will be glad to discuss them with you.

Very truly yours,

LOWNEY ASSOCIATES

Mark J. Arniola, R.G., R.E.A.
Project Geologist

Peter M. Langtry, R.G., C.HG.
Principal Environmental Geologist

RLH:PML:MJA:vh

Copies: Addressee (2)
Alameda County Health Care Services Agency (1)
Department of Environmental Health
Attn: Ms. Susan Hugo
California Regional Water Quality Control Board (1)
San Francisco Bay Region
Attn: Mr. Ravi Arulanantham

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LOWNEYASSOCIATES
Environmental/ Geotechnical/ Engineering Services

NOV 30 2001

Construction
Risk Management Plan

1274 65th Street and 1269 66th Street
Emeryville, California

This report has been prepared for:

Pulte Home Corporation

7031 Koll Center Parkway, Suite 150, Pleasanton, California 94566

November 27, 2001

Project No. 1424-4

Mark J. Arniola, R.G., R.E.A.
Project Geologist

Peter M. Langtry, R.G., C.HG.
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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The purpose of this construction risk management plan (RMP) is to provide guidelines for the management during construction activities of residual contaminants in soil and ground water detected beneath 1274 65th Street and 1269 66th Street in Emeryville, California.

The approximately 2-acre site, shown on Figures 1 and 2, is owned by 6598 Hollis, A California General Partnership. The site was formerly occupied by Liquid Sugars Incorporated (LSI) and used for sugar, corn syrup, and molasses storage and processing. Pulte Home Corporation is planning to redevelop the site with 27 townhomes and 28 lofts and flats.

Based on the information reviewed, petroleum impacted soil and ground water are present beneath the former underground storage tank (UST) areas at the southwestern portion of the site. Low concentrations (150 parts per billion (ppb) maximum) of volatile organic compounds (VOCs) from an off-site source also were detected in the ground water beneath the northeastern portion of the parcel. Lead above the California Regional Water Quality Control Board's (RWQCB's) residential risk based screening level (RBSL) was detected at a location near the north-central portion of the site and at another location at the south-central portion of the site; Pulte Homes Corporation intends to remove this soil prior to site development. The residual contaminants present are summarized in Section 2.1. Based on the contaminants present at the site, a health risk assessment (HRA) was prepared by our certified industrial hygienist. For a residential exposure scenario, the HRA concluded that the level of risk to human health was within acceptable limits established by the EPA.

This risk management plan presents guidelines for site activities that may result in contact with contaminated soil and ground water, during the construction of the planned development. These activities include but are not limited to the following:

- Excavation and grading;
- Subsurface utility installation, maintenance, or repair;
- Landscaping, and;
- Building foundation construction.

Guidelines for the development of the site are presented in the RMP for dust control (Section 2.3.2.1), equipment decontamination (Section 2.3.2.2), prevention of preferential pathways (Section 2.3.2.3), storm water pollution controls (Section 2.3.2.4), excavation dewatering (Section 2.3.2.5), and management of excavated and in-place soils (Section 2.3.3).

Individuals who may contact impacted soil and/or ground water will be required to follow the risk management procedures outlined in this document. Future activities may include, but are not limited to, site grading, modification or repair to utilities, construction of building foundations, and changes to paved areas. Long-term risk management for the site is discussed in the Operations and Maintenance Risk Management Plan. The property owner's association will be responsible for the long-term implementation of the RMP.

CONSTRUCTION RISK MANAGEMENT PLAN
1274 65TH STREET AND 1269 66TH STREET
EMERYVILLE, CALIFORNIA

1.0 INTRODUCTION

1.1 Purpose

The purpose of this risk management plan is to provide guidelines for the management during construction activities of residual contaminants in soil and ground water detected beneath 1274 65th Street and 1269 66th Street in Emeryville, California.

1.2 Site Background

The approximately 2-acre site, shown on Figures 1 and 2, is owned by 6598 Hollis, A California General Partnership. The site was formerly occupied by Liquid Sugars Incorporated (LSI) and used for sugar, corn syrup, and molasses storage and processing. The site is shown on Figure 2.

Based on historical information reviewed during the Phase I environmental site assessment (Lowney, 2001), the site was developed as warehouses, sheds/storage buildings, and a residence by 1903. A creek crossed the southeast corner of the site up to at least 1903; the creek appeared filled by 1911. Three additional residences were added by 1911. Four commercial buildings were added to the site by 1930. From at least 1950 to the mid-1970s, Mohawk Petroleum Corporation (a bulk fuel facility) and Diamond Alkali Corporation were located on-site. Up to twelve on-site above-ground storage tanks (ASTs) for the fuel facility were visible on aerial photographs. During the late-1960s the fuel ASTs were removed and 17 storage tanks for sugar and corn syrup were added to the site. Liquid Sugars, Inc. has occupied all or part of the site since the early 1960s. The facility formerly contained two 1,000-gallon gasoline underground storage tanks (USTs) and one 10,000-gallon diesel UST on the southwest side of the property. The three USTs were removed in November 1990, and soil samples collected beneath the USTs confirmed both gasoline and diesel releases from the USTs.

Investigations conducted by LSI to assess the nature and extent of releases from the former USTs included the drilling of 15 exploratory borings and installation of five monitoring wells from 1991 to 2000; quarterly monitoring of ground water also was performed. If subsequent information from the on-going investigation is reported, then impact to the site will be revaluated.

Based on the information reviewed, petroleum impacted soil and ground water are present beneath the former UST areas at the southwestern portion of the site. Up to 150 parts per billion (ppb) of volatile organic compounds (VOCs) also were detected in the ground water beneath the northeastern portion of the parcel (Lowney Associates, 2001). Based on information reviewed at the Alameda County Health Care Services Agency (ACHCSA) the VOCs are from an off-site source. Up to 440 parts per million (ppm) lead was detected at locations near the north-central and south-central portions of the site; the California Regional Water Quality Control Board's (CRWQCB's) residential risk based screening level (RBSL) for lead is 200 ppm. The residual contaminants present are summarized in Section 2.1. Based on the contaminants present at the site, a health risk assessment (HRA) was prepared by our certified industrial hygienist. For a residential exposure scenario, the HRA concluded that the level of risk to human health was within acceptable limits established by the EPA's National Contingency Plan.

1.3 Planned Development of the Site

Pulte Home Corporation currently plans to build a residential development on the approximately 2-acre parcel. The current site development plans include the following:

- Grading, footing, excavation, and subsurface utility installation.
- Construction of 27 townhomes and 28 lofts and flats. Thirteen of the townhomes will have two stories of living space over a two-car garage. The 14 remaining townhomes will have habitable space on the ground floor.
- Construction of landscaped and communal areas.

2.0 CONSTRUCTION RISK MANAGEMENT PLAN

2.1 Potential Contaminants of Concern

Results of the soil and ground water quality investigation are summarized in Tables 1 though 8 in Appendix A. Table 9 in Appendix A presents chemicals eliminated by our toxicologist from further consideration based on the low levels (below the U.S. EPA's preliminary remediation goals) detected on-site. Table 10 presents the selected chemicals of concern and the maximum concentrations detected.

2.1.1 Site Specific Target Levels

Based on the results of the HRA, the maximum levels of compounds detected appear acceptable for the planned development. Therefore, on-site maximum detected concentrations will be used as the site-specific target levels (SSTL) for the site with the exception of lead, which will have a target level of 255 ppm as approved by the ACHCSA and CRWQCB. Maximum concentrations detected are summarized in Table 10 in Appendix A.

2.2 Applicability of the Risk Management Plan

This risk management plan is applicable to site activities that may result in contact with contaminated soil and ground water during the construction of the planned development. These activities include but are not limited to the following:

- Excavation and grading;
- Subsurface utility installation, maintenance, or repair;
- Landscaping, and;
- Building foundation construction.

2.3 Risk Management During Construction

This section presents the risk management procedures to be followed during construction of the on-site development, including worker training, construction impact mitigation measures, excavation de-watering, and soil management protocol.

2.3.1 Site-Specific Health and Safety Worker Requirements

Prior to beginning construction, a site-specific health and safety plan (HSP) for construction workers who encounter on-site soils will be prepared by the contractors. Contractor's are responsible for the health and safety of their own employees and are required to have their own health and safety plans, and Injury and Illness Prevention Plans (IIPPs).

2.3.2 Construction Impact Mitigation Measures

During construction, measures will be taken to minimize dust generation, storm water runoff, and tracking of soil off-site. In addition, precautionary measures will be taken to not create preferential migration pathways (vertical and horizontal) for contaminants detected on-site. The construction impact mitigation measures are summarized below.

2.3.2.1 Dust Control

Construction operations will be conducted so as to minimize the creation and dispersion of dust, including the following measures:

- Application of water while grading, excavating, and loading, as needed;
- Limiting vehicle speeds to 5 miles per hour on unpaved portions of the site;
- Minimizing drop heights while loading/unloading soil; and
- Covering stockpiles of soil with residual contaminants with visqueen.

2.3.2.2 Equipment Decontamination

Contractors whose vehicles and construction equipment contact impacted site soil in Zone A or suspect soil in Zone B (as described in section 2.3.3) will be required to clean the equipment prior to leaving the site. Decontamination may include dry methods, such as brushing, scraping, or vacuuming. If the dry methods are not effective, the contractor may use wet methods, such as steam cleaning or pressure washing. The contractor, however, will be required to collect and appropriately manage the wash water. Wash water management methods may include use for dust control in areas of impacted soil and/or off-site disposal at an appropriate facility.

2.3.2.3 Prevention of Preferential Pathways

The current development plans do not include the construction of deep foundations, such as piers or piles. In addition, deed restrictions will be developed so as to not allow the installation of water supply wells on-site. Therefore, no vertical preferential pathways will be created.

Ground water historically has been present at depths of approximately 4 to 14 feet (Gribi Associates, 1999, 2000). During April 2001, ground water was encountered at depths of approximately 6½ to 20 feet (Lowney Associates, 2001). To reduce the likelihood of creating lateral preferential pathways for the migration of contaminants, any utility trench greater than 4 feet in depth will be backfilled with a low-permeability soil approved by the geotechnical engineer below a depth of 4 feet; backfill in the upper 4 feet can be composed of the soil type approved by the geotechnical engineer. Contractors installing utilities below a depth of 4 feet may use sand or gravel bedding for pipes and/or conduits; however, where sand or gravel bedding is used below a depth of 4 feet, barriers of low permeable material, such as a bentonite grout seal, will be used where the utility exits the site. The low-permeability barriers will be at least 5 feet in length.

2.3.2.4 Storm Water Pollution Controls

The Urban Runoff Pollution Prevention Program, also called the Non-Point Source Program, was developed in accordance with the requirements of the 1986 San Francisco Bay Basin Water Quality Control Plan to reduce water pollution associated with urban storm water runoff. This program was also designed to fulfill the requirements of the Federal Clean Water Act, which mandated that the EPA develop National Pollution Discharge Elimination System (NPDES) Permit application requirements for various storm water discharges, including those from municipal storm drain systems and construction site.

For properties of 5 acres or greater, a Notice of Intent (NOI) and Storm Water Pollution Prevention Plan (SWPPP) must be prepared prior to commencement of construction. Although the site is less than 5 acres, storm water management controls will be implemented to reduce the potential for impacted soils to impact storm water runoff. These storm water controls will be based on best management practices (BMPs), such as those described in the *Erosion and Sediment Control Field Manual* (CRWQCB, 1998) and the *Manual of Standards for Erosion and Sediment Control Measures, Second Edition* (ABAG, 1995). The BMPs implemented may include, but are not limited to, the following:

- Construction of berms or silt fences at the perimeter of the site, as appropriate;
- Placing of straw bale barriers around entrances to storm drains and catch basins;
- Covering stockpiles of contaminated soil with visqueen during rain events;
- Placement of gravel at project entrances/exits where soil can be removed from vehicles prior to leaving the site.

2.3.2.5 Excavation De-Watering

If excavation de-watering is required, a sample of the ponded water will be collected for laboratory analyses, as discussed in Section 2.3.3.6. Depending on the analytical results, the ponded water may be:

- Used for dust control on-site;
- Discharged to storm drain;
- Discharged to sanitary sewer; or
- Disposed at an appropriate off-site facility.

If used for dust control, prior approval would be obtained from the ACHCSA agency. Discharge into the storm sewer or sanitary sewer would be performed under an approved permit from the CRWQCB or East Bay Municipal Utility District, respectively. If water is to be discharged into the sanitary sewer system, approval will also be requested from the City of Emeryville Public Works Department. If required, water will be treated prior to discharge.

2.3.3 Soil Management Protocols

As discussed in Section 1.2, soils with residual contaminants are present in the former UST areas in the southwestern portion of the site; these areas are designated as Zone A (Figure 2). Areas with no previously identified significantly impacted soil (other than the two lead-impacted areas where the soil will be excavated and off-hauled to a waste disposal facility) are designated as Zone B.

2.3.3.1 Use of Clean Soil

Clean soil will be used for the top 3 feet of landscaped outdoor communal areas. Existing site soil from Zone B could be used anywhere on the site without further testing unless the soil is subsequently observed to be visibly contaminated (e.g., stained, discolored, shiny, or oily) or has a noticeable solvent-like or hydrocarbon odor (suspect soil).

2.3.3.2 Management of In-Place Soil

Based on the analytical data collected to date, suspect soil may be encountered in Zone A during construction. The previous laboratory analyses did not detect VOCs in the soil, although up to 670 ppm gasoline and 1,500 ppm diesel were detected in the former UST areas. Soil at these concentrations of petroleum hydrocarbons likely would exhibit a petroleum odor. Because the maximum levels detected appear acceptable to remain on-site, testing will not be performed in Zone A unless soil that appears highly impacted is encountered in the excavations (such as significant staining, shiny, free product), or if air monitoring indicates action levels (as discussed in Section 2.3.3.5) are exceeded ("suspect soil"). Air monitoring is discussed in Section 2.3.3.5. If verification sampling is required, it will be performed as discussed below.

If soil suspected to be contaminated is encountered in Zone B, one soil sample will be collected for each approximately 50 lineal feet of trench excavation or 2,500 square feet of grading cut in the suspect area. The verification soil samples will be analyzed as discussed in Section 2.3.3.6.

If the analytical results of in-place verification samples show contamination below on-site SSTLs, then the soil will be left in-place. If contamination above site SSTLs is detected, then the soil will be excavated and managed as described in Section 2.3.3.3.

2.3.3.3 Management of Excavated Soils

Suspect soil excavated during construction in Zones A and B will be stockpiled on-site on top of 0.2 millimeter thick visqueen within a designated fenced enclosure. If work is conducted during rainy periods straw bale barriers shall be placed around the stockpiles and the stockpiles will covered with visqueen secured by sand bags. One discrete soil sample per approximately 50 cubic yards of stockpiled soil will be collected and analyzed as discussed in Section 2.3.3.6. If the volume of soil excavated exceeds 200 cubic yards, one discrete soil sample will be collected per approximately 100 cubic yards. If the contaminants of concern (COC) do not exceed the SSTLs, the soil may be used anywhere on-site including the upper 3 feet of outdoor communal landscaped areas. If the analytical results of stockpiled soil exceed the SSTLs, the stockpiles shall either:

- Be disposed off-site an appropriate, permitted facility; or
- Treated on-site to levels below SSTLs or placed beneath pavements with regulatory agency approval.

2.3.3.4 Regulatory Agency Notification

If suspect soil is encountered in Zone B, or if soil exceeding the SSTLs is encountered within Zone A, the ACHCS and RWQCB will be notified.

2.3.3.5 Air Monitoring

Air monitoring will be performed under the direction of the project certified industrial hygienist (CIH) while excavating and grading in Zone A and in suspect areas encountered in Zone B, if any. Periodic air monitoring will be performed in the worker breathing zone using an organic vapor meter (OVM). A Lower Explosive Limit (LEL) meter will also be used in trenches and excavations. If organic vapors exceed 50 ppmv or if an LEL of 10 percent or greater is measured, the work in the trench and within 20 feet of the trench/excavation will be stopped until levels dissipate to within acceptable limits. The project CIH may also upgrade the personal protective equipment (PPE) and/or perform personal air monitoring, as discussed in the health and safety plan.

2.3.3.6 Laboratory Analyses

If soil suspected to be contaminated is encountered, soil samples will be collected and analyzed for total petroleum hydrocarbons in the gasoline range (TPHg); benzene, toluene, ethylbenzene, and xylenes (BTEX) plus MTBE (EPA Test Method 8015M/8020); total petroleum hydrocarbons in the diesel range (TPHd) and motor oil range (TPHmo) (EPA Test Method 8015M); volatile organic compounds (VOCs) (EPA Test Method 8010); and lead. The analytical results will be compared to SSTLs to evaluate if further work is needed, such as additional health risk assessment or overexcavation.

2.3.4 Management of Abandoned Pipes and Tanks

If abandoned pipes (other than common utility lines) and/or tanks are encountered during construction, the ACHCS and RWQCB will be notified. Any abandoned tank and associated piping encountered during construction will be removed in accordance with ACHCS and RWQCB guidelines. Abandoned pipes that do not appear to be associated with a tank will be handled in accordance with regulatory guidelines as outlined below:

If the pipe contains liquid or sludge, the following steps will be taken:

- The liquid or sludge will be removed from the pipe, if feasible, and placed in appropriate containers.
- The liquid or sludge will be tested to evaluate appropriate disposal options.
- If the liquid or sludge is determined to be hazardous, the soil beneath the pipeline also will be tested to evaluate appropriate disposal options.

- ▼ The pipe and liquid or sludge will be removed from the site for appropriate disposal/recycling.

If the entire pipe is not removed during construction (if approved by the geotechnical engineer), the ends of the pipe that are to remain in-place will be capped.

2.4 Long-Term Risk Management

Individuals who may contact impacted soil and/or ground water will be required to follow the risk management procedures outlined in this document. Future activities may include, but are not limited to, site grading, modification or repair to utilities, construction of building foundations, and changes to paved areas. Long-term risk management for the site is discussed in the Operations and Maintenance Risk Management Plan. The property owner's association will be responsible for the long-term implementation of the RMP.

3.0 LIMITATIONS

This risk management plan was prepared for the use of Pulte Home Corporation. We make no warranty, expressed or implied, except that our services have been performed in accordance with environmental principles generally accepted at this time and location.

4.0 REFERENCES

Association of Bay Area Governments. May 1995. *Manual of Standards for Erosion and Sediment Control Measures, 2nd Edition.*

California Regional Water Quality Control Board (CRWQCB), 1998. *Erosion and Sediment Control Field Manual.*

Gribi Associates, August 4, 1999. *Report of Soil and Groundwater Investigation and Partial Risk Assessment, Liquid Sugars UST Site, 1275 66th Street, Emeryville, California.*

Gribi Associates, July 22, 2000. *Report of Fourth Quarterly Groundwater Monitoring and Risk-Based Corrective Action Assessment, Liquid Sugars UST Site, 1275 66th Street, Emeryville, California.*

Lowney Associates, May 2, 2001. *Phase I Environmental Site Assessment and Soil and Ground Water Quality Evaluation, 1274 65th Street and 1269 66th Street, Emeryville, California.*

Lowney Associates, May 29, 2001. *Supplementary Soil Quality Evaluation, 1274 65th Street and 1269 66th Street, Emeryville, California.*

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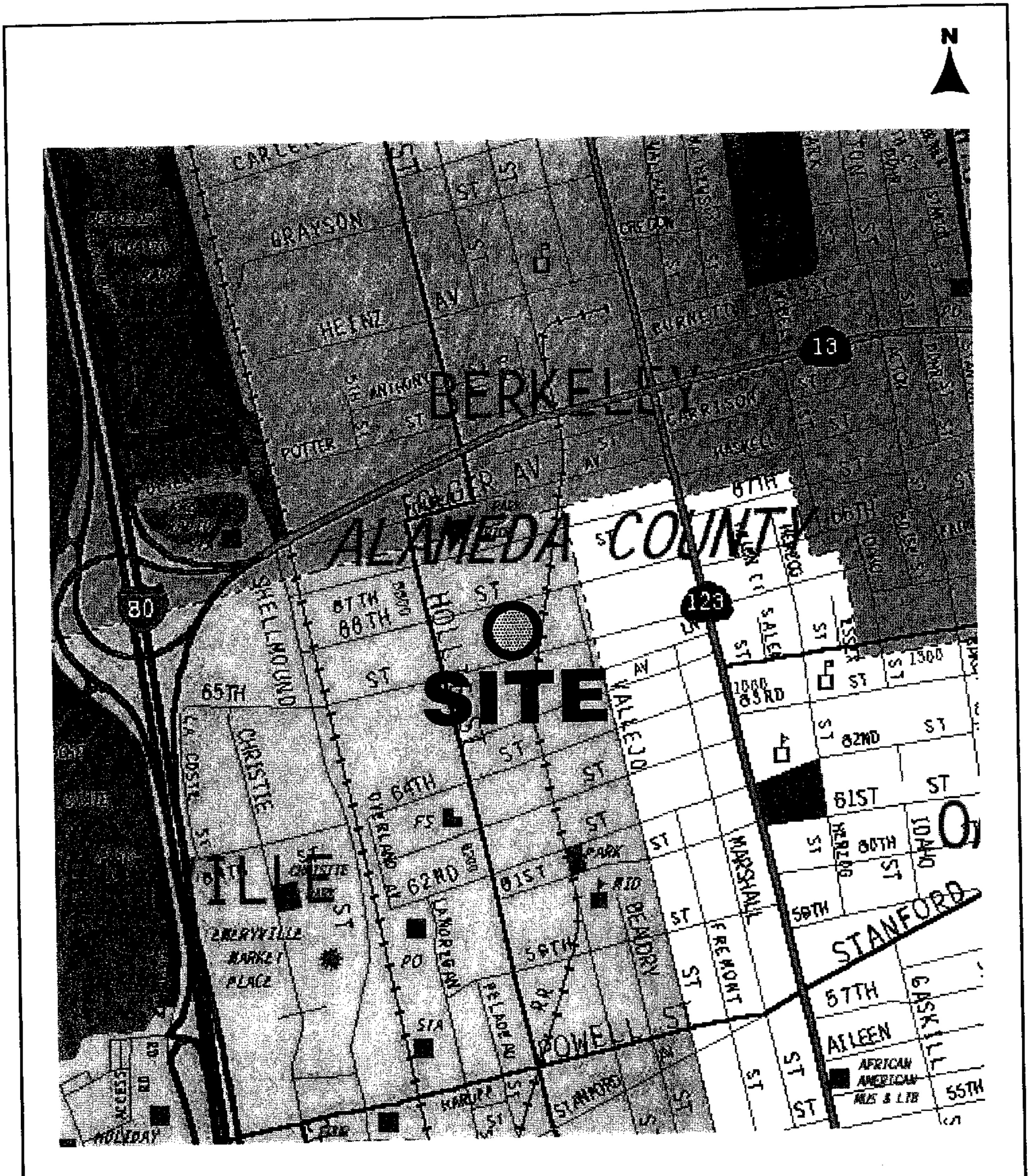

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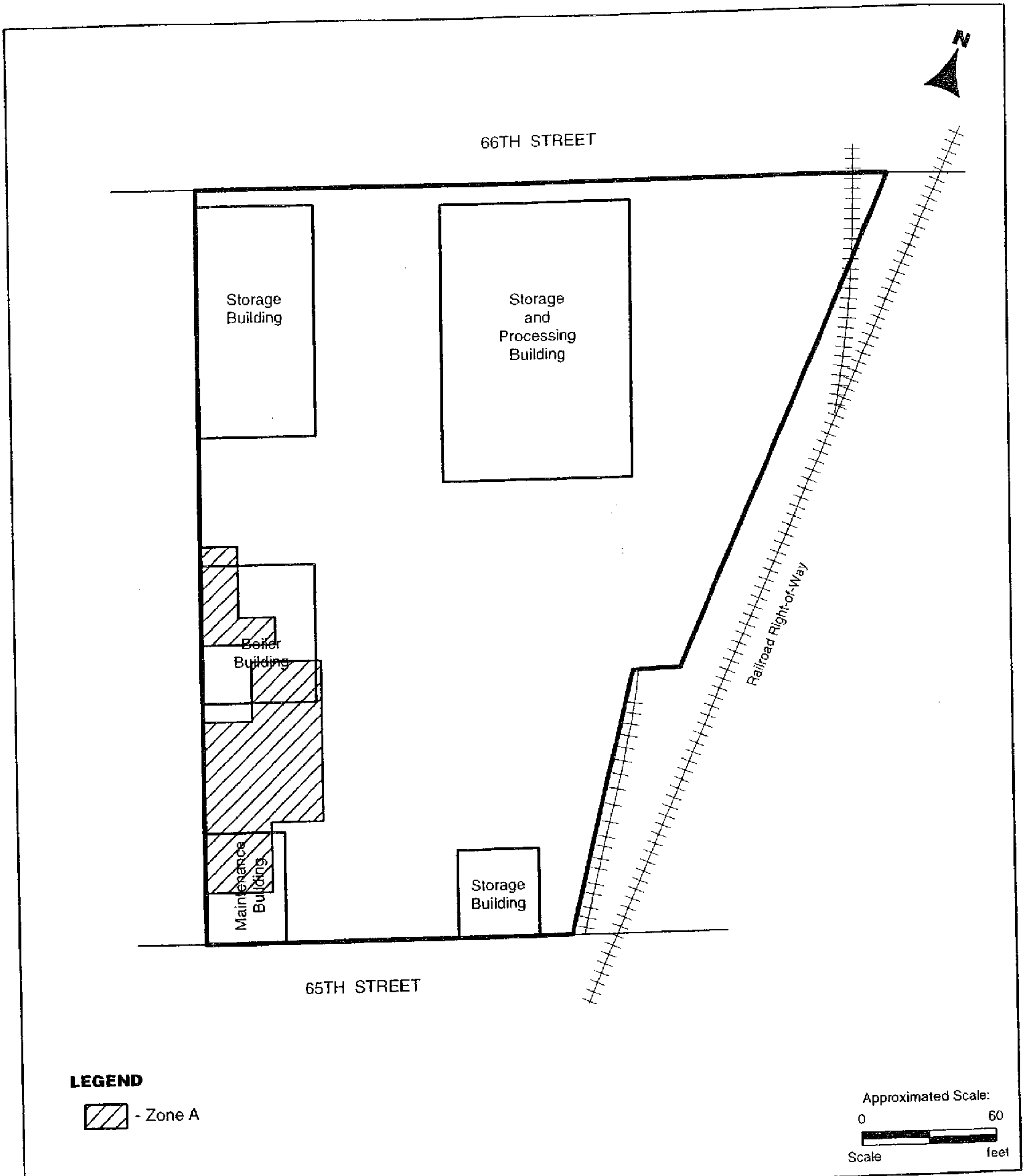
VICINITY MAP

1269 66TH STREET, 1274 65TH STREET
Emeryville, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

FIGURE 1
1424-4



Base approximated from Lowney Associates field notes.

9/01'EB

SITE PLAN

1269 66TH STREET, 1274 65TH STREET
Emeryville, California

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services

FIGURE 2
1424-4

1.0 Introduction

The objective of this screening level human health risk appraisal (HRA) is to evaluate the potential health risks posed by various chemical constituents found on-site. The HRA relies on soil and groundwater quality data contained in various reports that were prepared by Site investigators. Within this HRA report, potential exposure pathways are identified, chemicals of potential concern are identified for relevant receptors, the toxicities of the primary chemicals of concern are described, and the risks associated with potential exposures to nearly all site chemicals are quantified. Calculation of health risks incorporates exposure and exposure point assumptions, exposure point estimation, and toxicity values for each chemical of interest for all pathways of concern. As a screening level appraisal, few chemicals are eliminated from consideration and exposure point concentrations are based on maximum detected concentrations.

The primary guidance used in the development of this HRA was taken from Risk Assessment Guidance (RAGS) (U.S. EPA 1989a), Department of Toxic Substances Control (DTSC) supplemental guidance (CALEPA 1996), 1994 Cal/EPA Preliminary Endangerment Assessment Guidance Manual (Cal/EPA 1994), and Development of Health-Based Alternative to the Total Petroleum Hydrocarbon (TPH) Parameter (MADEP1994).

The remaining sections of this HRA report are organized according to steps common to most risk assessments. This includes site background information, a discussion of exposure pathways and environmental media of concern, exposure concentrations and chemicals, toxicity values, and a risk characterization summary.

2. Background

Located at 1274 65th Street and 1269 66th Street in Emeryville, California, the approximately 2-acre site was formerly used for commercial and industrial purposes. The site is located in a commercial/industrial setting and is bounded to the north by 66th Street, railroad tracks to the east, 65th Street to the south, and commercial properties to the west. A more detailed site description and history, is contained in the Lowney Associates Phase I Environmental Site Assessment and Soil and Groundwater Quality Evaluation Report dated May 2, 2001. The projected use of the site is for a medium to high-density residential project.

The site has been extensively investigated between 1993 through 2001. Soil and groundwater quality investigations have been undertaken to determine the presence of volatile organic compounds (VOCs), semi-volatile organic compounds, organochlorine pesticide compounds, polychlorinated biphenyls (PCBs), metallic compounds, and petroleum hydrocarbons associated with former uses of the site. According to the recent soil and groundwater quality investigation completed by Lowney Associates, it has been determined that site soil and groundwater display a variety of chemical constituents.

3 Site Characterization

Previous site investigators have extensively investigated the site. This assessment relies on information contained in the Lowney Associates reports entitled "Phase I Environmental Site Assessment and Soil and Groundwater Quality Evaluation Report" dated May 2, 2001, and the "Supplemental Soil Quality Investigation " report dated May 29, 2001. With respect to the underground gasoline and diesel storage tanks formerly occupying the southwest region of the site, this assessment relies on information contained in the Gribi Associates reports entitled "Report of Fourth Quarter Groundwater Monitoring and RBCA Assessment" dated July 22, 2000 and "Report of Soil and Groundwater Investigation and Partial Risk Assessment" dated August 4, 1999.

3.1 April 2001 Soil and Groundwater Quality Investigation

Lowney Associates conducted site wide soil and groundwater investigations during April and May 2001. Tables 1 through 8 summarize the analytical results of the on-site testing program by area investigated. The methods, scope and results of the April investigation are briefly summarized below.

Railroad Track Area
To evaluate soil quality in the area of the on-site railroad spurs, Lowney Associates collected soil samples from the surface to ½-foot and 2½ to 3 foot depths at four randomly selected locations (SS-10, SS-11, SS-12, SS-13). The soil samples were submitted to a state certified laboratory and analyzed for organochlorine pesticides (EPA Test Method 8081), 17 California Assessment Manual (CAM) metals (EPA Test Method 6010 and 7470), polychlorinated biphenyls (PCBs) (EPA Test Method 8082), polynuclear aromatic hydrocarbons (PNAs) (EPA Test Method 8270), and volatile organic compounds (VOCs) (EPA Test Method 8260). Analytical results indicated that no VOCs, PCBs, PNAs, or organochlorine pesticides were detected in soil samples collected from the areas of the on-site railroad spurs. One location (SS-11), where a fill soil was encountered, contained lead above residential PRGs.

Future Garden Area
To evaluate general soil quality in proposed landscaping (garden) area, Lowney Associates collected soil samples from the surface to ½-foot and 2½ to 3 foot depths at three randomly selected locations (SS-4, SS-5, and SS-7). The soil samples were submitted to a state certified laboratory and analyzed for total petroleum hydrocarbons in the gasoline range (TPHg), benzene, toluene, ethylbenzene, and xylenes (BTEX) (EPA Test Method 8015/8020); total petroleum hydrocarbons in the diesel range (TPHd) (EPA Test Method 8015M); total petroleum hydrocarbons in the motor oil range (TPHmo) (EPA Test Method 8015M), CAM 17 metals (EPA Test Method 6010 and 7470), PCBs (EPA Test Method 8082), VOCs (EPA Test Method 8260), semi-VOCs (EPA Test Method 8270), and organochlorine pesticides (EPA Test Method 8081).

Analytical results indicated the presence of 740 ppm of TPHD in soil at a depth of approximately 3 feet in a boring drilled in the boiler room, where soil has been impacted by a release of the former Mohawk Petroleum Company's fuel ASTs. Low levels of TPHg (1.3 ppm), TPHd (34 ppm), TPHmo (54 ppm), and benzene (0.0054 ppm) also were detected in the other soil samples collected from the future garden area. Two locations (SS-4 and SS-7) also contained arsenic at 25 ppm to 35 ppm, which are above typical background levels (less than 10 ppm). Analytical results are presented in Table 2.

General Soil Quality
To evaluate general soil quality, Lowney Associates collected shallow (surface to ½-foot and 2½ to 3 foot depth) soil samples from randomly selected locations at the northwest (SS-2), southeast (SS-9), and southwest (SS-8) areas of the site. Fill material including brick fragments were encountered in boring SS-9. The soil samples were submitted to a state certified laboratory and analyzed for organochlorine pesticides (EPA Test Method 8081), CAM 17 metals (EPA Test Method 6010 and 7470), and PCBs (EPA Test Method 8082).

No PCBs or organochlorine pesticides were detected, with the exception of 190 ppm lead detected in soil sample SS-9 (0-½ foot), metals were consistent with typical background concentrations. Soil sample SS-9 was collected from fill. Analytical results are presented in Table 3.

Sump Areas
Soil samples within approximately three feet of three sumps observed on the property. Soil samples were collected from within approximately one foot below the base of the sumps. The soil samples were submitted to a state certified laboratory and analyzed for CAM 17 metals (EPA Test Method 6010 and 7470), PCBs (EPA Test Method 8082). The samples were also analyzed for pH based on the on-site storage and use of hydrochloric acid.

No VOCs, irregular pH levels, or metals above typical background concentrations were detected in the soil collected near the three sumps at the site. Analytical results are presented in Table 4.

Former Auto Repair Facility Area
To evaluate soil quality in the area of an historical auto repair facility on-site, Lowney collected one shallow (1-foot to 1.5-foot depth) soil sample (SS-1) from the area of the former building. The soil sample was submitted to a state certified laboratory and analyzed for, TPHd, TPHmo, TPHg, BTEX (EPA Test Method 8015M/8020) and VOCs (EPA Test Method 8260), constituents that may be present on-site from previous automobile maintenance use. No TPHd, TPHg, BTEX, or VOCs were detected in one shallow soil sample collected at the location of the former on-site automobile repair facility. Analytical results are presented in Table 5.

Groundwater Quality evaluation
Five borings were advanced by Lowney to ground water at selected locations in the northwestern area of the property. Ground water was encountered at depths of approximately 6½ to 20 feet. Ground water samples were analyzed for VOCs using EPA Method 8260. Laboratory analysis of five ground water grab samples collected from the northeast area of the site detected PCE up to 150 ppb in samples EB-1 and EB-2. In addition, 26 ppb of 1,1-DCE was detected in the ground water from boring EB-3, located east of the storage and processing building. MTBE (83 ppb) was detected in the ground water along the western property boundary at boring EB-4. Analytical results are shown in Table 6.

Suspect Fill
To evaluate the quality of fill material in an area encountered during geotechnical activities at the site, Lowney collected one near-surface (approximately 1 to 1½ -foot depth) sample of the fill material (SS-1). The fill was a white fine-grained sand and extended to a depth of approximately two feet. The fill was not encountered in other on-site borings. The soil sample was submitted to a state certified laboratory and analyzed for CAM 17 metals (EPA Test Method 6010 and 7470), VOCs (EPA Test Method 8260), and PNAs (EPA Test Method 8270). Laboratory analysis of a sample of the fill material did not detect PNAs or VOCs, and metals appeared consistent with typical background concentrations. Analytical results are presented in Table 7.

Other Site Features

Other site features of interest reported by Lowney include the observation of a former creek crossing the southeast corner of the site on a 1903 Sanborn map. Lowney reported that the fill materials encountered in borings SS-9 and SS-11 may be fill materials associated with the backfilling of the creek. As discussed above, elevated levels of lead were detected in soil samples collected from these borings.

3.2 May 2001 Soil Quality Investigation

On May 17, 2001 Lowney completed (SS-15 through SS-25) to approximate depths of 5 to 10 feet. The borings were drilled to evaluate subsurface conditions along the projected location of a former creek on the eastern portion of the site based on the location shown on the 1903 Sanborn map and site access constraints. Additionally, soil samples were collected from borings SS-16, SS-18, SS-19, SS-22, SS-23, and SS-24 to evaluate the quality of the creek fill, including an evaluation of soil quality in the area of former borings SS-9 and SS-11 where elevated concentrations of lead were detected. Apparent fill material was encountered in borings SS-16, SS-17, SS-18, SS-20, SS-21, SS-22, and SS-23 to depths of 2 to 4 feet below the ground surface. The fill at these locations was primarily a clayey gravel with sand. Fragments of brick and wood were observed in the fill at boring SS-22 at 3½ to 4 feet below the ground surface.

Soil samples SS-16, SS-18, SS-19, and SS-22 were analyzed for total petroleum hydrocarbons in the gasoline range (TPHg); benzene, toluene, ethylbenzene, and xylenes (BTEX) (EPA Test Method 8015/8020); total petroleum hydrocarbons in the diesel range (TPHd) and motor oil range (TPHmo) (EPA Test Method 8015); and

17 California Assessment Manual (CAM) metals. In addition, soil samples SS-18 and SS-22 were additionally analyzed for polynuclear aromatic hydrocarbons (PNAs) (EPA Test Method 8310) and sample SS-18 for polychlorinated biphenyls (PCBs) (EPA Test Method 8082). Samples SS-23 and SS-24 were analyzed for total lead.

No TPHmo, BTEX, or PCBs were detected in the samples analyzed. Low concentrations of the PNAs naphthalene, fluorene, and phenanthrene were detected in boring SS-18, but at levels significantly below residential PRGs. TPHg and TPHd also were detected at 47 ppm and 680 ppm in boring SS-18, respectively.

With the exception of lead, metals detected appeared to be consistent with typical background concentrations. Elevated levels of lead were detected in soil from borings SS-22 (140 ppm) and SS-23 (280 ppm). STLC lead analysis of soil from boring SS-9 detected lead (16 ppm), exceeding the hazardous waste limit of 5 ppm. Analytical results are presented in Tables 8A and 8B.

3.3 Former Underground Gasoline and Diesel Storage Tanks

At the southwest corner of the site, former underground gasoline and diesel storage tanks (USTs) have been investigated between 1993 through 2000 (three USTs were removed from the site in 1992). Petroleum-impacted soil is present in the former UST area. This assessment considered the chemical data contained in the Gribi Associates reports entitled "Report of Fourth Quarter Groundwater Monitoring and RBCA Assessment" dated July 22, 2000 and "Report of Soil and Groundwater Investigation and Partial Risk Assessment" dated August 4, 1999. Relative to the former USTs, soil quality data contained in the 1999 Gribi Associates report is used for soil exposure point concentrations. Groundwater quality data from March 2000 monitoring event (Gribi Associates, 2000) is used for groundwater exposure point concentrations.

4. Selection of Chemicals of Potential Concern

All chemicals detected were initially screened to select chemicals for further risk evaluation. The screening process included comparison of the maximum detected soil concentration (or 95% upper confidence level (UCL) arithmetic mean soil concentration) to the U.S. EPA preliminary remedial goal (PRG). PRGs are risk based screening concentrations calculated based on incidental ingestion and dermal contact with affected soil media. Chemicals (where ingestion and dermal exposure are appropriate pathways) were eliminated from further consideration if their maximum detected concentration and/or UCL was at or below the PRG concentration.

In addition, for metallic compounds, if the 95% UCL concentration was within the range of Bay Area soil background concentrations, they were eliminated from further consideration. Finally, chemicals detected in areas where surficial soils will be excavated and disposed of offsite were also eliminated from further consideration. Within the Future Garden Area, approximately 2 to 3 feet of soil will be excavated and replaced with clean fill.

Tables 1 through 8 compare site concentrations (by area location) to residential PRGs. The chemicals eliminated during the screening process are identified in Table 9.

The screening process was applied to arsenic even though concentrations detected were well within the Bay Area background expectation. The maximum detected concentration of arsenic was 35 mg/kg within the Future Garden Area. The site wide 95% UCL without consideration of the Future Garden Area excavation was estimated at 7.3 mg/kg (28 sample data set). Assuming excavation, the site wide arsenic 95% UCL was estimated at 3.7 mg/kg for a 26-sample data set. Region IX U.S. EPA has developed an alternative PRG for arsenic in recognition of high background concentrations. Region IX residential PRGs for arsenic are 0.39 mg/kg and 22 mg/kg for carcinogenic and non-carcinogenic endpoints respectively. Arsenic was eliminated as a potential chemical of concern because of the planned excavation of the Future Garden Area and since concentrations are well within the Bay Area background expectation.

4.1 Chemicals of Potential Concern

The screening process was not applied to several chemicals since significant exposure pathways are not implicit in PRG values. These chemicals include volatile chemicals in site soil and groundwater and lead in site soil. With respect to chemicals detected in site groundwater, all volatile chemicals detected were selected for further assessment. Lead is included as chemical of potential concern, since Cal/EPA requires the use of the lead uptake model for evaluating risks. Table 10 presents the final list of chemicals of potential concern (COPCs). For all COPCs, the maximum concentration detected and location of the maximum is summarized in Table 10.

Since petroleum hydrocarbons including gasoline, diesel, and oil range hydrocarbons are included in the final list of COPCs, a summary of the composition of petroleum products is provided below.

Petroleum Hydrocarbon Compounds
Petroleum hydrocarbon compounds (PhDs) are complex mixtures of hydrocarbons. Gasoline is a fuel product blended from several refinery process streams. Gasoline predominantly consists of hydrocarbons having carbon numbers in the range of C4 through C12. The concentration of benzene, toluene, ethyl benzene and xylenes (BTEX) in gasoline varies dependent on the feedstock and refinery process, but is in the range of 10-20% of total hydrocarbons. Other aromatics may account for up to another 39% and aliphatics about 49-62%.

Diesel fuel is also obtained from distilled process streams. Diesel is less volatile than gasoline and consists of hydrocarbons having carbon numbers in the range of approximately C9 through C20. Aliphatic hydrocarbons may account for about 64% of the total hydrocarbon content, alkenes for about 1-2% and aromatics for about 35%. Small amounts of n-hexane (less than 0.1%), benzene (below 0.02%), toluene, xylenes and ethyl benzene (0.25 to 0.5%) may also be found in diesel fuel. Oil range hydrocarbons are non-volatile and generally consist of various classes of hydrocarbons in the carbon range of C15 to C50.

5.0 Exposure Assessment

Exposure assessment is the process of identifying human populations that could potentially come into contact with site-related chemicals and the route (s) of potential exposure. For risk calculations exposure assessment includes the following steps: characterizing the exposure setting and identifying potentially exposed populations, identifying exposure pathways, and quantifying exposure. Each of these steps is described below.

5.1 Exposure Setting

The first step in exposure assessment is to characterize the site in terms of its physical setting, land use, and associated human populations that may be exposed to site-related substances. This information is used to identify possible exposure pathways for each potentially exposed population and to determine appropriate exposure intake variables to quantify exposure. The Lowney reports provide a description of the physical setting of the site.
The site will be developed as a moderate to high-density residential development, which will include town homes, lofts, flats, landscaping, walkways and parking. Therefore, under future land use conditions, residents are assumed to have potential exposure to chemicals in site media.

5.2 Exposure Pathway Identification

An exposure pathway is the course a chemical takes from a source to an exposed organism. Exposure pathways include the following four elements: 1) a source; 2) a mechanism of release, retention, or transport of a chemical in a given medium (e.g., air, water, or soil); 3) a point of contact with the affected medium (i.e., exposure point); and 4) an exposure route at the point of contact (e.g., ingestion or inhalation). If any of these elements is missing, the pathway is considered "incomplete" (i.e., it does not present a means of exposure).

The exposure pathways applicable to this site include:

- incidental ingestion of soil,
- dermal contact with soil, and
- inhalation of volatile contaminants volatilizing from soil and groundwater and migrating into occupied spaces.

The following exposure pathways were considered and rejected.

Ingestion of vegetables or other fruits, or of meat, milk, or eggs that may be affected by site chemicals-
Transport of site chemicals off-site to residential neighborhoods is not expected. In addition, DTSC notes that the high-density nature of residential development precludes vegetable gardening to any meaningful degree (CalEPA/DTSC 1996).

Inhalation of chemicals volatilizing from soil and migrating into ambient air-
With respect to volatile compounds in site soil and groundwater, indoor air exposure is a far more significant pathway than ambient exposure. In this assessment, ambient exposures to volatile contaminants are not considered. Indoor exposure estimates will provide a proxy for absolute worst-case ambient exposure estimates.

Inhalation of contaminated dusts due to wind erosion-
The site will be capped with a medium high-density residential project that includes structures, paving, and landscaping. Due to low concentrations of chemicals detected and the site features mentioned, this potential exposure pathway is considered insignificant.

5.3 Exposure Quantification

Exposure estimates (intakes or administered doses) are defined as the mass of a substance taken into the body, per unit of body weight, per unit of time. Exposures are quantified by calculating the dose or chronic daily intake (CDI) of a chemical using exposure assumptions and calculation methods provided in regulatory guidance. Assumptions concerning exposure duration and body weights of residential receptors used in the exposure algorithms are provided by the DTSC (DTSC 1992).

For this screening level evaluation, a deterministic approach is used to quantify exposure. Exposures are quantified by calculating the dose or chronic daily intake (CDI) of a chemical using exposure assumptions and calculation methods provided in regulatory guidance. Assumptions concerning exposure duration and body weights of residential receptors used in the exposure algorithms are provided by the DTSC (DTSC 1996). For assessing carcinogenic effects, CDIs are calculated by prorating the total cumulative dose over a lifetime; the average lifespan is assumed to be 70 years (U.S. EPA 1991a). Exposure quantification is further described below.

5.3.1 Exposure Frequency and Duration

For maximum case risks, calculations assume that a hypothetical receptor resides at home for thirty years, representing the national upper bound 90th percentile for stay at one residence. This scenario is simulated by a residential receptor that has contact with Site soil as a child for 6 years and as an adult for 24 years for a total exposure period of 30 years.

5.3.2 Exposure Assumptions by Pathway

Soil Ingestion

The exposure algorithm for soil ingestion is presented in Appendix A to this HRA. The algorithm represents incidental ingestion of surface soil as a result of direct contact with soil on hands, followed by hand-to-mouth activity (either inadvertent or associated with eating or smoking). The default residential scenario exposure parameters include: soil ingestion rate of 100 mg/day for adults, 200 mg/day for a child, exposure frequency of 350 days per year, and an exposure duration of 30 years (DTSC 1996). For this exposure scenario, 100% absorption of the ingested contaminant is assumed

Dermal Contact With Soil

The exposure algorithm for dermal contact (Appendix A) presents the method for calculating dermal dose. Dermal exposure is expressed as an absorbed dose by incorporating a chemical-specific absorption factor (ABS) into the exposure equation. Dermal absorption values for the chemicals of concern are from Cal EPA Preliminary

Endangerment Assessment (PEA) Guidance and from US EPA Preliminary Remediation Goals (PRGs). For the residential exposure scenario, this assessment assumes skin surface areas of 2800 cm^2 and 5700 cm^2 for child and adult respectively, which is equivalent to 25% of the total body surface area (EPA 1996). The soil-to-skin adherence factor (AF) refers to the amount of soil that remains deposited on the skin after contact. Based on U.S. EPA 2000, this screening level assessment assumes an AF of 0.2 mg soil/cm^2 of exposed skin for a child and 0.07 mg soil/cm^2 for an adult. Exposure frequency and duration for the child receptor are the same as those described for the soil ingestion pathway. However, for an adult, the frequency of dermal contact with site soils is assumed to be 100 days per year. In this assessment, oral slope factors or reference doses are not adjusted to account for "absorbed versus administered doses".

Inhalation

Appendix A contains the exposure algorithm for inhalation of volatile compounds. Inhalation of volatile compounds migrating into indoor air assumes default-breathing rates for all receptors. An adult is assumed to breathe 20 cubic meters (m^3) of air daily, and a child is assumed to breathe 10 m^3 of air daily. Frequency of exposure is assumed to be 350 days per year. In addition, 100% absorption through the inhalation route is assumed. Table 11 provides a summary of exposure parameters used in this assessment.

5.4 Source Terms and Exposure Point Concentrations

In all cases, source terms and/or exposure point concentrations are either derived from the maximum detected concentration or 95% UCL (Table10) of each chemical of concern.

5.4.1 Volatilization from Subsurface Soil and Groundwater to Indoor Air Pathway

Volatilization of contaminants located in site soil and groundwater and the subsequent mass transport of these vapors into indoor spaces constitutes a potential inhalation exposure pathway. To evaluate this pathway the Johnson and Ettinger Model (U.S. EPA 1998 Version 1.2) is used to calculate volatilization factors for each site COPC. The volatilization factor (VF) relates the chemical concentration in groundwater or soil to the indoor air concentration (exposure point concentration) of the chemical contaminant. The model is a one–dimensional analytical solution to convective and diffusive vapor transport into indoor air spaces and provides an attenuation coefficient that relates the vapor concentration in the indoor space to the vapor concentration at he source of contamination. Inputs to the model include chemical properties of the contaminant, saturated and unsaturated soil properties, depth of contamination, and the structural properties of the building. The model assumes a slab on grade foundation that is 15 centimeters thick.

The model uses an equilibrium-partitioning algorithm to convert a soil or groundwater concentration to a source vapor concentration. From the source vapor concentration, the model estimates the mass transport of vapor through the vadose zone and transport into an occupied space. The model calculates a chemical specific attenuation coefficient (constant), which is the ratio of the chemical's indoor air concentration to the chemical's source vapor concentration.

Based on the work completed by Lowney Associates, risk calculations assume that the depth to groundwater is 6.5 feet bgs, and the predominant soil type (diffusion path) consist of sandy clays (fine grained soils). The input parameters used for risk calculations are summarized below. Table A-1 in Attachment A to this report presents intermediate calculations for benzene in soil and 1,1 dichloroethylene in groundwater for the exposure scenarios described below.

Input Parameters

Soil Type	Total Porosity	Moisture Content	Carbon Content (Foc)	Volumetric Air Exchange Rate
SC	0.43	0.30	0.006	0.45 ACH

Table notes: SC = sandy clay. ACH = volumetric air changes per hour. ACH (0.45) is a U.S EPA default assumption.

For petroleum hydrocarbon compounds as gasoline and diesel, this exposure assessment utilizes the assignment of indicator compounds to approximate the toxicity of these compounds. With the exception of hexane, benzene, toluene, ethyl benzene, xylenes and several polycyclic aromatics (PAHs), chemical-specific toxicity parameters for individual petroleum hydrocarbon components have not been developed by U.S. EPA. In this assessment, based on MADEP1994, a reference compound approach is used to approximate the risks associated with exposure to other than BTEX gasoline and diesel range compounds. Reference compounds identified for each group are as follows:

hexane – for TPHg aliphatics (C4 though C8)

ethyl benzene – for TPHg aromatics (C7 through C12) other than BTEX compounds

n-nonane - for TPHd alkanes and cyclo-alkanes (C9 through C18)

pyrene - for TPHd aromatic and alkene compounds (C9 through C32)

To assess potential risks and indoor air quality, surrogate chemicals were selected for each class of compounds to approximate fate and transport and potential toxicity. In each case, surrogate compounds are conservatively selected to ensure that exposure point concentrations and risks were unlikely to be underestimated. Other than BTEX aromatics, for gasoline range vapor compounds, fate and transport is approximated by ethylbenzene, hexane is assigned to represent the potential toxicity of the aliphatic content (40%) and ethyl benzene (40%) approximates the toxicity of the aromatic content (40%). As a conservative measure, for TPHd soil vapor, naphthalene is assigned to approximate fate and transport, n-nonane is assigned to represent the potential toxicity of the aliphatic content (64%), and the aromatic fraction (35%) assumes a toxicity constant equivalent to pyrene.

MTBE is not included in the Johnson and Ettinger Model database. To estimate an exposure point concentration, vapor partitioning (source concentrations) from groundwater is calculated from the compound specific dimensionless Henry's constants, then a model derived attenuation factor is applied to estimate the exposure point concentration. For MTBE, this assessment conservatively assumes an attenuation factor equivalent to that of benzene. The dimensionless Henry's constant for MTBE at 15° centigrade is estimated at 0.0154 from RWQCB 2000.

6.0 Toxicity Parameters

Toxicity values are used to quantify the relationship between the extent of exposure to a chemical and the likelihood of adverse health consequences. EPA-derived toxicity values used in risk assessments are termed slope factors and reference doses (RfDs). Slope factors are used to estimate the incremental lifetime risk of developing cancer corresponding to CDIs calculated in the exposure assessment. The potential for noncancer health effects is evaluated by comparing estimated daily intakes with reference doses (RfDs) or reference concentrations (RfCs), which represent daily intakes at which no adverse effects are expected to occur over a lifetime of exposure. Both slope factors and RfDs are specific to the route of exposure [e.g., inhalation, or ingestion (oral) exposure].

Where the California cancer potency factors are more stringent than those derived by EPA, the California values are used in the HRA to estimate potential cancer risks from exposure to chemicals at the Site. Toxicity parameters (slope factors and reference doses) used in the risk calculations are summarized in Table 12.

7.0 Risk Characterization

Cancer risks for a single carcinogen are calculated by multiplying the carcinogenic CDI of the chemical by its slope factor. A 1×10^{-6} cancer risk represents a one in one million additional probability that an individual may develop cancer over a 70-year lifetime as a result of the exposure conditions evaluated. Because cancer risks are assumed to be additive, risks associated with simultaneous exposure to more than one carcinogen are aggregated to determine a total pathway cancer risk.

Unlike carcinogenic effects, noncancer effects are not expressed as a probability. Instead, these effects are expressed as the ratio (HI) of the estimated exposure over a specified time period to the RfD derived for a similar exposure period. This ratio is termed a hazard quotient. If the CDI exceeds the RfD (i.e., hazard quotient >1), there may be concern for noncancer adverse health effects. Exposures resulting in a hazard quotient that is less than unity are unlikely to result in noncancer health effects.

Exposure point concentrations were used to calculate the chronic daily intake (dose). The resultant dose, for the exposure conditions examined were then multiplied by a carcinogenic potency factor or compared to a reference dose for non-carcinogenic risks. Hazard quotients for individual chemicals are conservatively summed for each exposure pathway to determine a hazard index.

Results

Worst-case Exposure point concentrations and/or source terms were used to calculate the chronic daily intake (dose). The resultant doses, for the exposure conditions examined were then multiplied by a carcinogenic potency factor or compared to a reference dose for non-carcinogenic risks. Estimated risks are summarized below and detailed risks by pathway and chemical are presented in the Risk Presentation Table 13.

Risk Summary

Pathway	Carcinogenic Risks	Non-Carcingenic Risks (HI)
Ingestion of Soil	2.5×10^{-8}	0.27
Dermal Contact with Soil	1.8×10^{-8}	0.065
Indoor Air Exposure from Soil Volatilization	2.6×10^{-6}	0.34
Indoor Air Exposure from Groundwater Volatilization	4.1×10^{-6}	0.06

Total	6.8 x 10^{-6}	0.71

Assuming a residential receptor has exposure to the maximum chemical concentrations detected for a duration of approximately 30 years, total site carcinogenic risks are approximated at 6.8 x 10^{-6} and the non-carcinogenic hazard quotient is 0.71. The risk drivers are primarily associated with soil and groundwater volatilization. Benzene is the primary risk chemical for soil volatilization, and 1,1-DCE is the primary risk driver for groundwater volatilization. Given the worst case assumptions used in this assessment total site risks are considered to be in the acceptable range.

For lead, risks are estimated by using the Cal/EPA Lead Risk Assessment Spreadsheet (Version 7). The spreadsheet estimates the blood lead concentration of an exposed receptor using exposure algorithms and pathway specific lead uptake constants. A lead concentration of concern yields a blood lead concentration of 10 micrograms per deciliter of blood (ug/dl) in 99% of an exposed population. Using the Site wide 95% UCL concentration of 77.7 mg/kg results in predicted blood lead levels of less than 10 ug/dl. Therefore, Site wide lead concentrations are considered to be in the acceptable range. The results of this evaluation are presented in Appendix A.

Uncertainty

Risk calculations presented herein are subject to several uncertainties. The primary uncertainties are related to the subsurface environment, the foundation characteristics and volumetric air exchange rate assumed for residential structures, and the assumed contributions to risks from non-BTEX related hydrocarbons. With respect to the subsurface environment, calculations assume porosity and organic carbon content that represent conservative U.S. EPA (EPA 2000) default assumptions. The moisture content parameter (30%) is assumed to be a reasonable average parameter for bay area soils, and risk calculations assume sandy clay soil beneath the site. In addition, the depth to groundwater beneath the Site reportedly varies from 6.5 feet bgs to 22 feet bgs. This assessment conservatively assumed an average depth of 6.5 feet bgs, thus shortening the diffusion path and increasing risks.

With respect to building characteristics, this assessment assumes that a residential structure with a slab foundation sits directly above maximum concentrations that are assumed to remain constant over a 30-year exposure period. The "infinite source assumption" and assumptions concerning the placement of a structure over impacted soil and groundwater are major sources of risk overestimation. With respect to the volumetric air exchange rate, the U.S. EPA default assumption of 0.45 air changes per hour was used in the calculations. This value is consistent with the ASTM default rate of 0.5ACH and much lower than the RWCQB 2000 assumed rate of 2 ACH. The greater the assumed ACH, the lower the contaminant concentration, thus the lower the predicted risk.

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Table 1A. Analytical Results of Selected Shallow Soil Samples Railroad Track Area

(Concentrations in parts per million)

Sample Number	Depth (feet)	Arsenic[1]	Cadmium[1]	Lead[1]	Mercury[1]
SS-10	0-½	<1.0	<0.50	6.0	0.061
SS-10	2½-3	1.7	<0.50	3.6	<0.050
SS-11	0-½	<1.0	0.53	11	0.080
SS-11	2½-3	3.4	2.8	440	0.20
SS-12	0-½	<1.0	0.71	3.7	0.050
SS-12	2½-3	1.6	<0.50	11	0.060
SS-13	0-½	2.5	1.2	28	0.070
SS-13	2½-3	2.0	<0.50	7.0	0.050
Residential PRG*		0.39/ 22**	9.0	200***	23
TTLC		500	100	350	20

< Indicates that the compound was not detected at or above the stated laboratory reporting limit
* Preliminary Remediation Goal–EPA Region 9, 2000
** Cancer end point/non-cancer end point
*** Residential Risk Based Screening Level (RBSL), CRWQCB, August 2000
1 Other CAM metals were non-detect or appeared consistent with typical background levels
TTLC – Total Threshold Limit Concentration

Table 1B. Analytical Results of Selected Shallow Soil Samples Railroad Track Area

(Concentrations in parts per million)

Sample Number	Depth (feet)	PNAs	PCBs	VOCs	Organo-chlorine Pesticides
SS-10	0-½	ND	ND	ND	ND
SS-10	2½-3	ND	ND	ND	ND
SS-11	0-½	ND	ND	ND	ND
SS-11	2½-3	ND	ND	ND	ND
SS-12	0-½	ND	ND	ND	ND
SS-12	2½-3	ND	ND	ND	ND
SS-13	0-½	ND	ND	ND	ND
SS-13	2½-3	ND	ND	ND	ND

ND Not detected above laboratory detection limits

Table 2A. Analytical Results of Selected Shallow Soil Samples
Future Garden Area
(Concentrations in parts per million)

Sample Number	Depth (feet)	TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Xylenes
SS-4	0-½	<1.0	3.3	<50	<0.005	<0.005	<0.005	<0.005
SS-4	2½-3	66	740	<500	<0.62	<0.62	<0.62	<0.62
SS-5	0-½	<1.0	<1.0	<50	0.0054	<0.005	<0.005	<0.005
SS-5	2½-3	1.3	1.0	<50	<0.005	<0.005	<0.005	<0.005
SS-7	0-½	<1.0	34	54	<0.005	<0.005	<0.005	<0.005
SS-7	2½-3	<1.0	<1.0	<50	<0.005	<0.005	<0.005	<0.005
Residential PRG*		NE	NE	NE	0.65	520	230	210

< Indicates that the compound was not detected at or above the stated laboratory reporting limit
* Preliminary Remediation Goal–EPA Region 9, 2000
NE Not established

Table 2B. Analytical Results of Selected Shallow Soil Samples
Future Garden Area
(Concentrations in parts per million)

Sample Number	Depth (feet)	Arsenic[1]	Cadmium[1]	Lead[1]	Mercury[1]
SS-4	0-½	25	0.62	14	0.067
SS-4	2½-3	11	0.97	5.8	0.14
SS-5	0-½	1.8	1.1	14	0.079
SS-5	2½-3	<1.0	<0.5	3.7	<0.050
SS-7	0-½	35	0.67	19	0.088
SS-7	2½-3	3.4	0.60	27	0.13
Residential PRG*		0.39/ 22**	9.0	200***	23
TTLC		500	100	350	20

< Indicates that the compound was not detected at or above the stated laboratory reporting limit
* Preliminary Remediation Goal–EPA Region 9, 2000
** Cancer endpoint/non-cancer endpoint
*** Residential Risk Based Screening Level (RBSL), CRWQCB, August 2000
1 Other CAM metals were non-detect or appeared consistent with typical background levels
TTLC – Total Threshold Limit Concentration

Table 2C. Analytical Results of Selected Shallow Soil Samples
Future Garden Area
(Concentrations in parts per million)

Sample Number	Depth (feet)	PCBs	VOCs	Semi-VOCs	Organo-chlorine Pesticides
SS-4	0-½	ND	ND	ND	ND
SS-4	2½-3	ND	ND	0.70[1]	ND
SS-5	0-½	ND	ND	ND	ND
SS-5	2½-3	ND	ND	ND	ND
SS-7	0-½	ND	70[2]	ND	ND
SS-7	2½-3	ND	ND	ND	ND

ND Not detected above laboratory detection limits
1 SVOCs detected were 0.16 ppm dibenzofuran (no residential PRG), 0.54 ppm fluorine (residential PRG = 2,300 ppm
2 VOC detected was 70 ppm acetone

Table 3. Analytical Results of Selected Shallow Soil Samples
General Soil Quality
(Concentrations in parts per million)

Sample Number	Depth (feet)	Arsenic[1]	Cadmium[1]	Lead[1]	Mercury[1]	PCBs	Organo-chlorine Pesticides
SS-2	0-½	<1.0	0.92	16	0.10	ND	ND
SS-2	2½-3	2.8	0.050	4.1	0.050	ND	ND
SS-8	0-½	6.6	1.0	14	0.19	ND	ND
SS-8	2½-3	3.8	0.87	9.8	0.30	ND	ND
SS-9	0-½	2.3	0.76	190	0.22	ND	ND
SS-9	2½-3	6.3	<0.50	6.8	<0.050	ND	ND
Residential PRG*		0.39/ 22**	9.0	200***	23	--	--
TTLC		500	100	350	20	--	--

< Indicates that the compound was not detected at or above the stated laboratory reporting limit
* Preliminary Remediation Goal–EPA Region 9, 2000
** Cancer endpoint/non-cancer endpoint
*** Residential Risk Based Screening Level (RBSL), CRWQCB, August 2000
1 Other CAM metals were non-detect or appeared consistent with typical background levels
ND Not detected above laboratory detection limits
TTLC – Total Threshold Limit Concentration

Table 4. Analytical Results of Selected Shallow Soil Samples
Sump Areas
(Concentrations in parts per million)

Sample Number	Depth (feet)	Arsenic[1]	Cadmium[1]	Lead[1]	Mercury[1]	VOCs	pH
SS-3	2-2½	6.4	0.96	48	2.5	ND	9.0
SS-6	3-3½	1.8	<0.5	4.1	<0.05	ND	8.8
SS-9	3½-4	<1.0	0.86	5.4	0.11	ND	7.5
Residential PRG*		0.39/ 22**	9.0	200	23	NE	NE
TTLC		500	100	350	20		

< Indicates that the compound was not detected at or above the stated laboratory reporting limit
* Preliminary Remediation Goal–EPA Region 9, 2000
** Cancer endpoint/non-cancer endpoint
*** Residential Risk Based Screening Level (RBSL), CRWQCB, August 2000
1 Other CAM metals were non-detect or appeared consistent with typical background levels
NE Not established
ND Not detected above laboratory detection limits
TTLC – Total Threshold Limit Concentration

Table 5. Analytical Results of Selected Shallow Soil Sample
Former Auto Repair Facility Area

(Concentrations in parts per million)

Sample Number	Depth (feet)	TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Xylenes	VOCs
SS-1	1-1½	<1.0	<1.0	<50	<0.005	<0.0005	<0.005	<0.005	ND
Residential PRG*		NE	NE	NE	0.65	520	230	210	--

< Indicates that the compound was not detected at or above the stated laboratory reporting limit
* Preliminary Remediation Goal–EPA Region 9, 2000
NE Not established
ND Not detected above laboratory detection limits

Table 6. Analytical Results of Selected Ground Water Samples
(Concentrations in parts per billion)

Boring Number	Date	1,1-DCA	1,1-DCE	PCE	1,1,1-TCA	MTBE
EB-1W	4/16/01	<5.0	<5.0	11	<5.0	<50
EB-2W	4/16/01	<5.0	<5.0	150	<5.0	<50
EB-3W	4/17/01	2.9	26	<0.5	1.6	<5.0
EB-4W	4/16/01	<2.0	<2.0	<2.0	<2.0	83
EB-5W	4/17/01	<1.0	<1.0	<1.0	<1.0	<10
MCL*		5.0	6.0	5.0	200	13

< Indicates that the compound was not detected at or above the stated laboratory reporting limit
* Drinking water Maximum Contaminant Levels–California DHS, January 31, 2001

Table 7. Analytical Results of Selected Shallow Soil Sample
Suspect fill (White Sand)
(Concentrations in parts per million)

Sample Number	Depth (feet)	Arsenic[1]	Cadmium[1]	Lead[1]	Mercury[1]	PNAs	VOCs
SS-14	1-1½	<1.0	<1.0	12	<0.050	ND	ND
Residential PRG*		0.39/ 22**	9.0	200***	23	--	--
TTLC		500	100	350	20		

< Indicates that the compound was not detected at or above the stated laboratory reporting limit
* Preliminary Remediation Goal–EPA Region 9, 2000
** Cancer endpoint/non-cancer endpoint
*** Residential Risk Based Screening Level (RBSL), CRWQCB, August 2000
1 Other CAM metals were non-detect or appeared consistent with typical background levels
ND Not detected above laboratory detection limits
TTLC – Total Threshold Limit Concentration

**Table 8A. Analytical Results of Selected Soil Samples
(Concentrations in parts per million)**

Boring Number	Depth (feet)	TPHg	TPHd	TPHmo	Benzene	Toluene	Ethyl-benzene	Xylenes
SS-16	1½ – 2	<1.0	2.5	<50	<0.005	<0.005	<0.005	<0.005
SS-18	5 – 5½	47	680	<250	<0.62	<0.62	<0.62	<0.62
SS-19	4 – 4½	<1.0	<1.0	<50	<0.005	<0.005	<0.005	<0.005
EB-22	3½ - 4	<1.0	4.4	<50	<0.005	<0.005	<0.005	<0.005
Residential PRG*		NE	NE	NE	0.65	520	230	210

< Indicates that the compound was not detected at or above the stated laboratory reporting limit
* Preliminary Remediation Goal–EPA Region 9, 2000
NE Not established

**Table 8B. Analytical Results of Selected Soil Samples
(Concentrations in parts per million)**

Boring Number	Depth (feet)	Arsenic[1]	Cadmium[1]	Lead[1]	Nickel[1]	Zinc[1]	PNAs	PCBs
SS-16	1½ – 2	3.1	1.5	6.8	7.3	70	--	--
SS-18	5 - 5½	2.3	1.2	35	19	57	0.31[2]	ND
SS-19	4 - 4½	2.5	<0.5	4.4	12	12	--	--
SS-22	3½ - 4	5.9	1.2	140	16	480	ND	--
SS-23	3½ - 4	--	--	280	--	--	--	--
SS-24	2 - 2½	--	--	12	--	--	--	--
Residential PRG*		0.39/22[3]	9.0	200**	150	23,000		0.22
TTLC		500	100	350	2,000	5,000		1.0

* Preliminary Remediation Goal–EPA Region 9, 2000
** Residential Risk Based Screening Level (RBSL), CRWQCB, August 2000
ND Not detected at or above laboratory reporting limit
TTLC – Total Threshold Limit Concentration
1 Other CAM metals were non-detect or consistent with typical background levels
2 PAHs detected included O.031 ppm napthalene, 0.13 ppm fluorene, and 0.14 ppm phenanthrene
3 Cancer endpoint/non-cancer endpoint

Table 9. Chemicals Eliminated from Further Consideration

Chemical Eliminated	Reason for Elimination
Arsenic	Site wide 95% UCL (with out excavation) = 7.3 mg/kg. UCL is within Bay background range. Area where maximum concentrations detected (Future Garden) will be excavated and clean fill will replace excavated soil. Site wide UCL after excavation = 3.7 mg/kg
Cadmium	Maximum detected concentration of 2.8 mg/kg is below PRG (9 mg/kg)
Mercury	Maximum detected concentration of 2.5 mg/kg is below PRG (23 mg/kg)
Naphthalene	Maximum detected concentration 0.31 mg/kg is below PRG (51 mg/kg)
Fluorine	Maximum detected concentration 0.54 mg/kg is below PRG (2600 mg/kg)
Dibenzofuran	Maximum detected concentration 0.16 mg/kg is below PRG (290 mg/kg)
Phenanthrene	Infrequent detection and maximum detected concentration 0.14 mg/kg is below the PRG for pyrene (2300 mg/kg) which has similar toxicity

Table 10. Chemicals of Concern

Chemical	Maximum Detected Concentrations	Location of the Maximum and Source of Data
Lead		
Soil	440 mg/kg (77.7 mg/kg UCL) (Note: approved SSTL is 255 ppm)	Lowney SS-11 (3 ft)
Diesel (TPHd)		
Soil	740 mg/kg	Lowney SS-4 (3ft)
Soil	1300 mg/kg	GRIBI IBW-7.3 (7.5 ft)
Ground water	1600 ug/l	GRIBI MW-1 (22 ft)
Gasoline (TPHg)		
Soil	66 mg/kg	Lowney SS-4 (3ft)
Soil	74 mg/kg	GRIBI IB-5.2 (6.5 ft)
Ground water	1400 ug/l	GRIBI MW-2 (22.7 ft)
Oil (TPHo)		
Soil	54 mg/kg soil	Lowney SS-7 (0.5 ft)
Soil	34 mg/kg	GRIBI IB-4.1 (3 ft)
Benzene		
Soil	0.0054 mg/kg soil	Lowney SS-5 (0.5 ft)
Soil	0.16 mg/kg	GRIBI IB-5.2 (6.5 ft)
Ground water	130 ug/l	GRIBI MW-5 (21.24 ft)
Toluene		
Soil	0.24 mg/kg	GRIBI IB-5.2 (6.5 ft)
Ground water	1.5 ug/l	GRIBI MW-1 (22 ft)
Ethyl benzene		
Soil	0.096 mg/kg	GRIBI IB-5.2 (6.5 ft)
Ground water	15 ug/l	GRIBI MW-4 (21 ft)
Xylenes		
Soil	0.81 mg/kg	GRIBI IB-5.2 (6.5 ft)
Ground water	2.8 ug/l	GRIBI MW- 1&5 (22, 21.24 ft)
MTBE		
Ground water	83 ug/l	Lowney EB-4W
Ground water	30 ug/l	GRIBI MW-5 (21.24 ft)
1,1-dichloroethane (DCA)		
Ground water	2.9 ug/l	Lowney EB-3W
1,1-dichlorethene (DCE)		
Ground water	26 ug/l	Lowney EB-3W
Perchlorethylene (PCE)		
Ground water	150 ug/l	Lowney EB-2W
1,1,1-trichloroethane (TCA)		
Ground water	1.6 ug/l	Lowney EB-3W

Table 11. Receptor Specific Exposure Parameters

	Bwt	SA (cm^2)	AF (mg/cm^2)	IR (mg/day)	BR (m^3/d)	Exposure Frequency and Duration
Adult[a] Resident	70 kg	5800	0.07	100	20	350 days per year (100 days per year for Dermal)
child[a] 1-6 Resident	15 kg	2000	0.2	200	10	350 days per year

Table notes:
a. Unless other wise indicated, default exposure parameters from US EPA PRGs
Bwt= body weight, SA= exposed skin surface area, AF= soil adherence factor, IR= soil ingestion rate. BR = breathing rate

Table 12. Chemical Specific Toxicity and Dermal Absorbance Factors

Chemical	ABS	SFi $(mg/kg\text{-}day)^{-1}$	SFo $(mg/kg\text{-}day)^{-1}$	RfDi mg/kg-day	RfDo mg/kg-day
Benzene	0.1	0.1	0.1	0.0017	0.003
MTBE	0.1	0.0018	NA	0.86	NA
Perchloroethylene	0.1	0.021	NA	0.11	NA
Ethyl benzene	0.1	NA	NA	0.291	0.1
Hexane	0.1	NA	NA	0.057	0.057
Toluene	0.1	NA	NA	0.11	0.2
Xylenes	0.1	NA	NA	0.2	2
1,1-DCA	0.1	0.0057	NA	0.14	NA
1,1-DCE	0.1	0.18	NA	0.009	NA
TCA	0.1	NA	NA	0.29	NA
Nonane[a]	0.1	NA	NA	0.6	0.6
Eicosane[a]	0.1	NA	NA	NA	6
Pyrene	0.1	NA	NA	0.03	0.03

Table notes:
a. Potency from MADEP 1994
ABS = dermal absorption factors from CalEPA 1994. SFi= inhalation slope factor. All SFis & SFos are from Cal EPA.
NA= not available, not applicable, or not applicable for the exposure pathways considered in this assessment. Unless otherwise stated, all reference dose parameters are from U.S EPA 2000 PRGs.

Table 13
Risk Presentation
Residential Receptor
Emeryville Site

		IR	Conv Fact	ABS	#/YR	ED	BW	AT	
Child	carcinogen	200	1.00E-06	1	350	6	6.67E-02	3.91E-05	1.10E-06
	non carcinogen	200	1.00E-06	1	350	6	6.67E-02	4.57E-04	1.28E-05
Adult	carcinogen	100	1.00E-06	1	350	24	1.43E-02	3.91E-05	4.70E-07
	noncarcinogen	100	1.00E-06	1	350	24	1.43E-02	1.14E-04	1.37E-06

Child Ingestion Chemical Name	SoilConc mg/kg	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient
Benzene	0.16	1.75E-07	0.1	1.75E-08	2.05E-06	0.003	0.000681887
Toluene	0.24				3.07E-06	0.2	1.53425E-05
Ethylbenzene	0.096				1.23E-06	0.1	1.2274E-05
Xylenes	0.81				1.04E-05	2	5.17808E-06
TPHd (nap-nonan)	832				1.06E-02	0.6	0.017729072
TPHd(Nap-pyr)	455				5.82E-03	0.03	0.19391172
TPHg(hexane)	29.6				3.78E-04	0.057	0.00663943
TPHg(aromatics)	29.6				3.78E-04	0.1	0.003784475
TPHo(eicosane)	54				6.90E-04	6	0.000115068

Adult Ingestion Chemical Name	Soil Conc mg/kg	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient
Benzene	0.16	7.51E-08	0.1	7.51E-09	2.19E-07	0.003	7.30594E-05
Toluene	0.24				3.29E-07	0.2	1.64384E-06
Ethylbenzene	0.096				1.32E-07	0.1	1.31507E-06
Xylenes	0.81				1.11E-06	2	5.54795E-07
TPHd (nap-nonan	832				1.14E-03	0.6	0.001899543
TPHd(Nap-pyr)	455				6.23E-04	0.03	0.020776256
TPHg(hexane)	29.6				4.05E-05	0.057	0.000711367
TPHg(aromatics)	29.6				4.05E-05	0.1	0.000405479
TPHo(eicosane)	54				7.40E-05	6	1.23288E-05
			Total Ingestion	2.50E-08			2.47E-01

Table 13
Risk Presentation
Residential Receptor
Emeryville Site

Ingestion Chemical Name	SoilConc mg/kg	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient

Dermal Contact

		SA	Conv Fact	AF	ABS	#/YR	ED	BW	AT	
Child	carcinogen	2800	1.00E-06	0.2	1	350	6	6.67E-02	3.91E-05	3.07E-06
	non carcinogen	2800	1.00E-06	0.2	1	350	6	6.67E-02	4.57E-04	3.58E-05
Adult	carcinogen	5700	1.00E-06	0.07	1	100	24	1.43E-02	3.91E-05	5.35E-07
	noncarcinogen	5700	1.00E-06	0.07	1	100	24	1.43E-02	1.14E-04	1.56E-06

Child Dermal Contact Chemical Name	SoilConc mg/kg	ABS	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient
Benzene	0.16	0.1	4.91E-08	0.1	4.91E-09	5.73E-07	0.003	0.000190928
Toluene	0.24	0.1				8.59E-07	0.2	4.29589E-06
Ethylbenzene	0.096	0.1				3.44E-07	0.1	3.43671E-06
Xylenes	0.81	0.1				2.90E-06	2	1.44986E-06
TPHd (nap-nonan)	832	0.1				2.98E-03	0.60	0.00496414
TPHd(Nap-pyr)	455	0.1				1.63E-03	0.03	0.054295282
TPHg(hexane).	29.6	0.1				1.06E-04	0.057	0.00185904
TPHg(aromatics)	29.6	0.1				1.06E-04	0.1	0.001059653
TPHo(eicosane)	54	0.1				1.93E-04	6	3.22192E-05

Adult Dermal Contact Chemical Name	Soil Conc mg/kg		CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient
Benzene	0.16	0.1	8.57E-09	1.5	1.29E-08	2.50E-08	0.003	8.32877E-06
Toluene	0.24	0.1				3.75E-08	0.2	1.87397E-07
Ethylbenzene	0.096	0.1				1.50E-08	0.1	1.49918E-07
Xylenes	0.81	0.1				1.26E-07	2	6.32466E-08
TPHd (nap-nonan)	832	0.1				1.30E-04	0.6	0.000216548
TPHd(Nap-pyr)	455	0.1				7.11E-05	0.03	0.002368493
TPHg(hexane)	29.6	0.1				4.62E-06	0.057	8.10959E-05
TPHg(aromatics)	29.6	0.1				4.62E-06	0.1	4.62247E-05
TPHo(eicosane)	54	0.1				8.43E-06	6	1.40548E-06
				Total Dermal	1.78E-08			6.51E-02

Table 13
Risk Presentation
Residential Receptor
Emeryville Site

Ingestion Chemical Name	SoilConc mg/kg	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient

Indoor Air Exposure from Soil Volatilization

	IR	ABS	#/YR	ED	BW	AT	
Child							
carcinogen	10	1	350	6	6.67E-02	3.91E-05	0.054794521
non carcinogen	10	1	350	6	6.67E-02	4.57E-04	0.639269406
Adult							
carcinogen	20	1	350	24	1.43E-02	3.91E-05	0.093933464
noncarcinogen	20	1	350	24	1.43E-02	1.14E-04	0.273972603

Child Inhalation Chemical Name	Soil Gas mg/m3	Attenuation Coefficient	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient
Benzene	41.4	4.25E-06	9.64E-06	0.1	9.64E-07	1.12E-04	0.0017	0.066164384
Toluene	30.2	4.24E-06				8.19E-05	0.11	0.000744156
Ethylbenzene	7.4	4.18E-06				1.98E-05	0.291	6.79515E-05
Xylenes	52.1	4.15E-06				1.38E-04	0.02	0.006910982
TPHd (nap-nonan)	656	4.16E-06				1.74E-03	0.6	0.002907568
TPHd(Nap-pyr)	359	4.16E-06				9.55E-04	0.03	0.031823683
TPHg(hexane)	2280	4.25E-06				6.19E-03	0.057	0.108675799
TPHg(aromatics)	2280	4.18E-06				6.09E-03	0.291	0.020936403
								2.38E-01
				Total Child	9.64E-07			

Adult Inhalation Chemical Name	air conc. mg/m3	Attenuation Coefficient	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient
Benzene	41.4	4.25E-06	1.65276E-05	0.1	1.65E-06	4.82055E-05	0.0017	0.028356164
Toluene	30.2	4.24E-06				3.50816E-05	0.11	0.000318924
Ethylbenzene	7.4	4.18E-06				8.47452E-06	0.291	2.91221E-05
Xylenes	52.1	4.15E-06				5.9237E-05	0.02	0.002961849
TPHd (nap-nonan)	656	4.16E-06				0.00074766	0.6	0.0012461
TPHd(Nap-pyr)	359	4.16E-06				0.000409162	0.03	0.013638721
TPHg(hexane)	2280	4.25E-06				0.002654795	0.057	0.046575342
TPHg(aromatics)	2280	4.18E-06				0.002611068	0.291	0.008972744
								1.02E-01
				Total Adult	1.65E-06			
								3.40E-01
				Total Soil Volatilization	2.62E-06			

Table 13
Risk Presentation
Residential Receptor
Emeryville Site

Ingestion Chemical Name	SoilConc mg/kg	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient
Inhalation /Gound Water Volatilization	IR	ABS	#/YR	ED	BW	AT	
Child							
carcinogen	10	1	350	6	6.67E-02	3.91E-05	0.054794521
non carcinogen	10	1	350	6	6.67E-02	4.57E-04	0.639269406
Adult							
carcinogen	20	1	350	24	1.43E-02	3.91E-05	0.093933464
noncarcinogen	20	1	350	24	1.43E-02	1.14E-04	0.273972603

Child Inhalation Chemical Name	Soil Gas mg/m3	Attenuation Coefficient	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient
benzene	19.1	4.07E-06	4.26E-06	0.1	4.26E-07	4.97E-05	0.0017	0.029232286
MTBE	1.28	4.07E-06	2.85E-07	0.0018	5.14E-10	3.33E-06	0.857	3.88604E-06
toluene	0.247	4.06E-06				6.41E-07	0.11	5.82793E-06
ethylbenzene	2.77	3.98E-06				7.05E-06	0.29	2.43024E-05
xylenes	0.478	3.94E-06				1.20E-06	0.2	6.01974E-06
1,1-DCA	0.446	3.99E-06	9.75E-08	0.0057	5.56E-10	1.14E-06	0.14	8.12575E-06
1,1-DCE	19.8	4.07E-06	4.42E-06	0.18	7.95E-07	5.15E-05	0.009	0.005724018
PCE	66.9	3.95E-06	1.45E-05	0.021	3.04E-07	1.69E-04	0.11	0.001535729
TCA	0.736	3.99E-06				1.88E-06	0.29	6.47346E-06
TPHg-hex	103	3.98E-06				2.62E-04	0.057	0.004597581
TPHg-aromat	103	3.98E-06				2.62E-04	0.29	0.000903662
				Total Child	1.53E-06			4.20E-02

Adult Inhalation Chemical Name	air conc. mg/m3	Attenuation Coefficient	CDI (mg/kg-day)	SF (kg-day/mg)	Risk	CDI (mg/kg-day)	RFD (mg/kg-day)	Hazard Quotient
benzene	19.1	4.07E-06	7.30E-06	0.1	7.30E-07	2.13E-05	0.0017	0.012528122
MTBE	1.28	4.07E-06	4.89E-07	0.0018	8.81E-10	1.43E-06	0.857	1.66545E-06
toluene	0.247	4.06E-06				2.75E-07	0.11	2.49768E-06
ethylbenzene	2.77	3.98E-06				3.02E-06	0.29	1.04153E-05
xylenes	0.478	3.94E-06				5.16E-07	0.2	2.57989E-06
1,1-DCA	0.446	3.99E-06	1.67E-07	0.0057	9.53E-10	4.88E-07	0.14	3.48247E-06
1,1-DCE	19.8	4.07E-06	7.57E-06	0.18	1.36E-06	2.21E-05	0.009	0.002453151
PCE	66.9	3.95E-06	2.48E-05	0.021	5.21E-07	7.24E-05	0.11	0.000658169
TCA	0.736	3.99E-06				8.05E-07	0.29	2.77434E-06
TPHg-hex	103	3.98E-06				1.12E-04	0.057	0.001970392
TPHg-aromat	103	3.98E-06				1.12E-04	0.29	0.000387284
				Total Adult	2.62E-06			1.80E-02
				Total GW Vol	4.14E-06			6.01E-02
				Total All Pathway	6.80E-06			7.12E-01

Appendix A
Exposure Algorithms
Selected Modeling Outputs
Lead Risk Assessment Spreadsheet

SOIL INGESTION EXPOSURE ALGORITHM

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times EF \times ED \times CF}{BW \times AT}$$

where:

CS = chemical concentration in soil (mg/kg)
IR = Ingestion rate (mg/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
CF = conversion factor (10^{-6} kg/mg)
BW = body weight (kg)
AT = averaging time (dyas)
- carcinogenic effects: 70-year lifetime × 365 days/year
- noncarcinogenic effects: ED × 365 days/year

Exposure Assumptions[a]

Parameter	Residential Scenario
Cs	Chemical Specific
IR	200 child, 100 adult
EF	350
ED	6 child, 24 adult
BW	15, child, 70 adult

[a] See text.

INHALATION EXPOSURE ALGORITHM

$$\text{Intake (mg/kg-day)} = \frac{CA \times IR \times EF \times ED}{BW \times AT}$$

where:

CA = chemical concentration in air (mg/m^3)
IR = inhalation rate (m^3/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time(days)
- carcinogenic effects:70-year lifetime × 365 days/year
- noncarcinogenic effects: ED × 365 days/year

Exposure Assumptions[a]

Parameter	Indoor Residential Scenario
CA	Chemical Specific
IR	(20 adult, 10 child)
EF	350
ED	6 child, 24 adult
BW	15 child, 70adult

[a] See text Section

SOIL DERMAL EXPOSURE ALGORITHM

$$\text{Absorbed dose (mg/kg-day)} = \frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$$

where:

CS = chemical concentration in soil (mg/kg)
CF = conversion factor (10^{-6} kg/mg)
SA = skin surface area available for contact (cm^2/event)
AF = soil-to-skin adherence factor (mg/cm^2)
ABS = absorption factor (unitless)
EF = exposure frequency (events/year)
ED = exposure duration (years)
BW = body weight (kg)
AT = averaging time (days)
- carcinogenic effects: 70-year lifetime × 365 days/year
- noncarcinogenic effects: ED × 365 days/year

Typical Exposure Assumptions[a]

Parameter	Commercial Scenario Onsite Construction Worker
CS	Chemical Specific
SA	2800 child, 5700 adult
AF	0.2 child, .07 adult
ABS [b]	.10
EF	350 child, 100 adult
ED[c]	6 child, 24 adult
BW	15, child, 70 adult

[a] See Text

[b] Cal EPA PEA Guidance (see text).

[c] Exposure scenario assumption, see text.

DATA ENTRY SHEET

VERSION 1.2
September, 1998

CALCULATE RISK-BASED SOIL CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL SOIL CONCENTRATION (enter "X" in "YES" box and initial soil conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial soil conc., C_R (μg/kg)	Chemical
71432	160	Benzene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to top of contamination, L_t (cm)	**ENTER** Average soil temperature, T_S (°C)	**ENTER** Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm²)
15	198	15	SC		

ENTER Vadose zone soil dry bulk density, ρ_b^A (g/cm³)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm³/cm³)	**ENTER** Vadose zone soil organic carbon fraction, f_{oc}^V (unitless)
1.5	0.43	0.3	0.006

ENTER Averaging time for carcinogens, AT_C (yrs)	**ENTER** Averaging time for noncarcinogens, AT_{NC} (yrs)	**ENTER** Exposure duration, ED (yrs)	**ENTER** Exposure frequency, EF (days/yr)	**ENTER** Target risk for carcinogens, TR (unitless)	**ENTER** Target hazard quotient for noncarcinogens, THQ (unitless)
70	30	30	350	1.0E-06	1

Used to calculate risk-based soil concentration.

DATA ENTRY SHEET

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION (enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
75354	26	1,1-Dichloroethylene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	198	SC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SC			1.5	0.43	0.3

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	30	30	350

Used to calculate risk-based groundwater concentration.

DCE

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm³/cm³)	Vadose zon effective total fluid saturation, S_{te} (cm³/cm³)	Vadose zone soil intrinsic permeability, k_i (cm²)	Vadose zone soil relative air permeability, k_{rg} (cm²)	Vadose zone soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
183	0.130	0.606	4.49E-10	0.611	2.74E-10	30.00	0.43	0.084	0.346	3,844

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)
5.63E+04	9.24E+05	4.16E-04	15	6,359	1.80E-02	7.61E-01	1.77E-04	5.47E-04	1.30E-04	3.58E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (µg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (µg/m³)	Unit risk factor, URF (µg/m³)⁻¹	Reference conc., RfC (mg/m³)
183	15	1.98E+04	0.10	2.62E-01	5.47E-04	3.84E+02	1.38E+08	4.07E-06	8.04E-02	5.0E-05	NA

Benzene

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Floor-wall seam perimeter, X_{crack} (cm)	Initial soil concentration used, C_R (μg/kg)	Bldg. ventilation rate, $Q_{building}$ (cm^3/s)
183	0.130	0.606	4.49E-10	0.611	2.74E-10	3,844	160	5.63E+04

Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization a e. groundwat temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Diffusion path length, L_d (cm)
9.24E+05	4.16E-04	15	8,071	3.47E-03	1.47E-01	1.77E-04	5.40E-04	183

Convection path length, L_p (cm)	Soil-water partition coefficient, K_d (cm^3/g)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)
15	3.53E-01	4.14E+04	0.10	2.62E-01	5.40E-04	3.84E+02	1.76E+08	4.25E-06	1.76E-01

Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.3E-06	NA

LEAD RISK ASSESSMENT SPREADSHEET
CALIFORNIA DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USER'S GUIDE to version 7

INPUT

MEDIUM	LEVEL
Lead in Air (ug/m^3)	0.028
Lead in Soil/Dust (ug/g)	77.7
Lead in Water (ug/l)	15
% Home-grown Produc	7%
(ug/m^3)	1.5

OUTPUT

	Percentile Estimate of Blood Pb (ug/dl)					PRG-99	PRG-95
	50th	90th	95th	98th	99th	(ug/g)	(ug/g
BLOOD Pb, ADULT	1.4	2.5	2.9	3.6	4.1	676	1063
BLOOD Pb, CHILD	2.5	4.5	5.4	6.5	7.4	146	247
BLOOD Pb, PICA CHILD	3.0	5.5	6.5	8.0	9.1	94	159
BLOOD Pb, OCCUPATIO	1.2	2.1	2.5	3.0	3.5	3475	5464

EXPOSURE PARAMETERS

	units	adults	children
Days per week	days/wk	7	
Days per week, occupational		5	
Geometric Standard Deviation		1.6	
Blood lead level of concern (ug/dl)		10	
Skin area, residential	cm^2	5700	2900
Skin area occupational	cm^2	2900	
Soil adherence	ug/cm^2	70	200
Dermal uptake constant	(ug/dl)/(ug/d	0.0001	
Soil ingestion	mg/day	50	100
Soil ingestion, pica	mg/day		200
Ingestion constant	(ug/dl)/(ug/d	0.04	0.16
Bioavailability	unitless	0.44	
Breathing rate	m^3/day	20	6.8
Inhalation constant	(ug/dl)/(ug/d	0.08	0.19
Water ingestion	l/day	1.4	0.4
Food ingestion	kg/day	1.9	1.1
Lead in market basket	ug/kg	3.1	
Lead in home-grown produce	ug/kg	35.0	

PATHWAYS

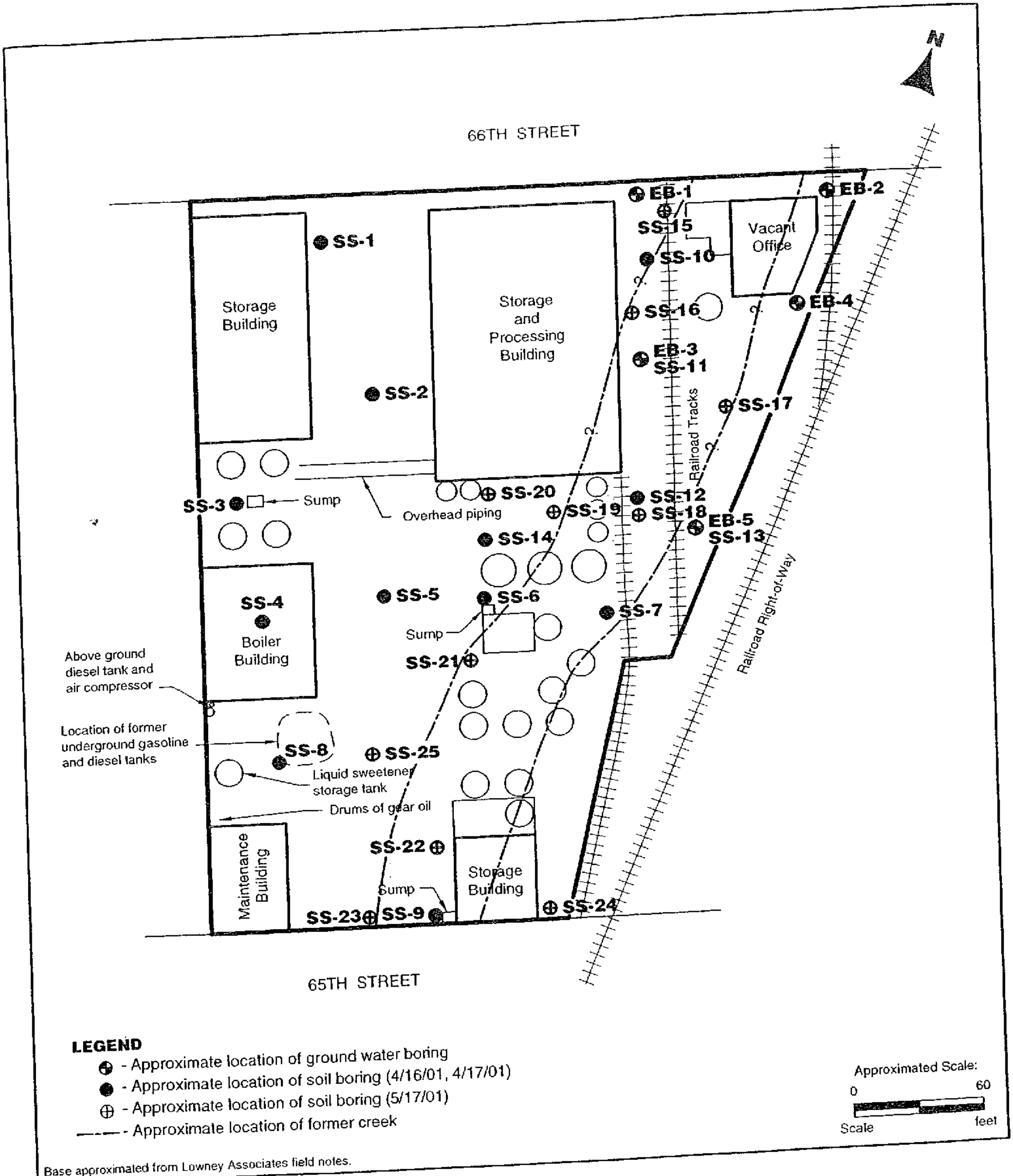
ADULTS	Residential			Occupational		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	3.8E-5	0.00	0%	1.4E-5	0.00	0%
Soil Ingestion	8.8E-4	0.07	5%	6.3E-4	0.05	4%
Inhalation, bkgrnd		0.05	3%		0.03	3%
Inhalation	2.5E-6	0.00	0%	1.8E-6	0.00	0%
Water Ingestion		0.84	62%		0.84	73%
Food Ingestion, bkgrnd		0.22	16%		0.23	20%
Food Ingestion	2.4E-3	0.19	14%			0%

CHILDREN	typical			with pica		
	Pathway contribution			Pathway contribution		
Pathway	PEF	ug/dl	percent	PEF	ug/dl	percent
Soil Contact	5.6E-5	0.00	0%		0.00	0%
Soil Ingestion	7.0E-3	0.55	22%	1.4E-2	1.09	36%
Inhalation	2.0E-6	0.00	0%		0.00	0%
Inhalation, bkgrnd		0.04	1%		0.04	1%
Water Ingestion		0.96	39%		0.96	32%
Food Ingestion, bkgrnd		0.50	20%		0.50	17%
Food Ingestion	5.5E-3	0.43	17%		0.43	14%

Click here for REFERENCES

APPENDIX B

SITE PLAN SHOWING SOIL AND GROUND WATER LOCATIONS FROM LOWNEY ASSOCIATES INVESTIGATIONS



3/01 EB

SITE PLAN

1269 66TH STREET, 1274 65TH STREET
Emeryville, California

FIGURE 2
1424-4

LOWNEYASSOCIATES
Environmental/Geotechnical/Engineering Services