Chevron

June 4, 1997

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6001 Bollinger Canyon Road
Building L
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P.O. Box 6004
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Marketing – Sales West
Phone 510 842 9500

Mr. Hugh Murphy
City of Hayward Fire Department
25151 Clawiter Road
Hayward, CA 94545

Re: Chevron Service Station #9-0260
21995 Foothill Blvd., Hayward, CA

Dear Mr. Murphy:

Enclosed is the ***Interim Remediation Work Plan***, that was prepared by our consultant Terra Vac for the above noted site. This ***Work Plan*** describes interim remediation associated with the former Chevron Service Station # 9-0260 as the primary source of concern and with the former Standard Service Station # 9-1230 as secondary and under evaluation.

The Problem Assessment Report of this ***Work Plan*** includes a summary of previous investigations which describes the site geology and hydrogeology, delineates the hydrocarbon impact, describes any interim remedial action, discusses any salient remedial concerns and presents an evaluation of human health risk to determine the appropriate from of remediation.

The appropriate remedial approach and the overall strategy for interim remediation is discussed in this ***Work Plan*** with removing the hydrocarbon source and reducing the dissolved benzene concentrations to specific goals. Once these goals are met a ***Final Remedial Plan*** will be prepared to select the most appropiate approach to complete site restoration.

If you have any questions, comments or would like to set up a meeting to discuss this ***Work Plan***, please call me at (510) 842-9136. Mr. Robert Dahl of Terra Vac is also available to answer your questions at (510) 351-8900.

Sincerely,
CHEVRON PRODUCTS COMPANY

Philip R. Briggs
Site Assessment and Remediation Project Manger

Enclosure

cc. Ms. Bette Owen, Chevron

Mr. Kevin Graves
RWQCB-San Francisco Bay Region
2101 Webster Street, Suite 500
Oakland, CA 94612

Ms. Madhulla Logan
Alameda County Health Care Services
Department of Environmental Health
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502-6577

Mr. Jim Perkins
Divison Manager
Terra Vac Corporation
1651 Alvarado Street
San Leandro, CA 94577 (No Report Included)

TERRA VAC

INTERIM REMEDIATION WORK PLAN
FORMER CHEVRON STATION 9-0260
21995 FOOTHILL BOULEVARD
HAYWARD, CALIFORNIA

PROJECT 30-0236

6/97

TERRA VAC

INTERIM REMEDIATION WORK PLAN
FORMER CHEVRON STATION 9-0260
21995 FOOTHILL BOULEVARD
HAYWARD, CALIFORNIA

Prepared For:

Chevron Products Company
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San Ramon, California 94583-0804

Prepared By:

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10/97
№ 4472
STATE OF CALIFORNIA

June 3, 1997

INTERIM REMEDIATION WORK PLAN
FORMER CHEVRON STATION 9-0260
21995 FOOTHILL BOULEVARD
HAYWARD, CALIFORNIA

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FORMER CHEVRON STATION 9-0260
21995 FOOTHILL BOULEVARD
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INTERIM REMEDIATION WORK PLAN
FORMER CHEVRON STATION 9-0260
21995 FOOTHILL BOULEVARD
HAYWARD, CALIFORNIA

1.0 INTRODUCTION

This interim remediation work plan describes environmental work to be conducted at former Chevron Station No. 9-0260, located in Hayward, California (Figure 1). The work plan was prepared at the request of Chevron Products Company for submittal to the Hayward Fire Department (HFD) and San Francisco Bay Regional Water Quality Control Board (RWQCB). Upon completion of interim remediation, a Final Remediation Plan (FRP) will be submitted to the HFD and RWQCB describing activities necessary to complete site restoration.

Chevron (Standard) has operated service stations on both the northwest and southeast corners of Foothill Boulevard and Rex Road. This work plan describes interim remediation associated with the former Chevron Station 9-0260 as the primary source of concern, and remediation associated with the former Standard Station #1230 as secondary and under evaluation. During the course of remedial activities, Terra Vac will provide an evaluation of hydrocarbon mass associated with the former Standard Station based on remediation wells located between the two properties, as described in the following plan. This document not only details the remediation plan, but also describes background information in the form of a Problem Assessment Report.

2.0 PROBLEM ASSESSMENT REPORT

The Problem Assessment Report is a summary of previous investigations which describe the site geology and hydrogeology, delineate the hydrocarbon impact, describe any interim remedial action, discuss any salient remedial concerns, and present an evaluation of human health risk to determine the appropriate form of remediation.

2.1 Site Description

Numerous site characterization studies have been conducted to provide information on the magnitude and extent of soil and groundwater impact beneath the two subject sites (former Chevron 9-0260 and former Standard #1230). Salient site characteristics that affect remediation activities are outlined below.

- Subsurface soils generally consist of silt and clay from grade to a depth of approximately 15 feet. A five-foot thick relatively permeable sand unit is present below the silt and clay. Silt or clay again is present below

the permeable sand unit. Locally, a second sand unit is present below the silt/clay layer.

- In general, static groundwater has occurred at between 10 and 15 feet below grade. The groundwater flow direction is generally toward the west/southwest; toward San Lorenzo Creek (Figure 3).

- The extent of gasoline-impacted soil is not known, however, both the former Chevron and Standard Stations are known source areas (Figure 2). Soil collected from borings drilled in Rex Road (between the former Standard Station and the Chevron Station) show greater than 1,000 ppm hydrocarbon and 55 ppm benzene. Onsite soil contained fuel hydrocarbon at concentrations up to 5,600 ppm along the northwestern part of the site and 11,000 ppm along the southwestern part of the site. Soil collected from the boring drilled for well MW-10 (located in the median of Foothill Boulevard) contained 320 ppm hydrocarbon.

- The free-phase hydrocarbon plume for the former Chevron Station appears to currently be restricted to the area about wells MW-7 and MW-9 (Figure 4). However, past monitoring events has shown measurable free-phase hydrocarbon in wells MW-5, MW-8, MW-11, MW-12, and MW-13 (Figure 5). The southern limits of this former Standard Station source area are not known.

- The dissolved gasoline plume is defined upgradient by well MW-10, and downgradient by San Lorenzo Creek (Figures 4 & 5). The plume appears to be relatively stable, but insufficient data exist to fully characterize the plume, particularly in the southeast direction.

- On the basis of site investigation and groundwater monitoring data, it is estimated that approximately 15,000 pounds of hydrocarbon are present beneath the former Chevron site and adjacent to the site beneath Rex Road. Due to insufficient data, no estimates have been made concerning the hydrocarbon mass that is associated with the former Standard Station. The environmental impact of the former Standard Station operations may have been addressed at the time of site demolition; however, due to the age of station activities, pertinent documentation could not be located. Although elevated dissolved levels are present downgradient of the two sites, from a mass perspective, this amount is less significant.

2.2 Site Activities

The remediation work plan for this site was developed based on documentation of previous site investigations included in the following reports:

- *Water Supply Well Survey*, Weiss Associates, June 3, 1988.
- *Interim Remediation Work Plan*, Weiss Associates, July 2, 1990.
- *Results of Soil-Vapor Extraction Pilot Test and Preliminary Design of a Soil-Vapor Extraction System*, Weiss Associates, November 10, 1993.
- *Underground Storage Tank Removal and Sampling Report*, Touchstone Developments Environmental Management, October 31, 1996.
- *First Quarter Groundwater Monitoring & Sampling Report*, Gettler Ryan Inc., March 26, 1997
- *Soil Vapor Survey/RBCA Calculations*, Weiss Associates, April 7, 1997.

2.3 Remedial Concerns

The dissolved gasoline plume situated downgradient of the site, and the lack of definition of gasoline-impacted soil makes site remediation very difficult. Difficulties arise not only from logistically addressing the offsite gasoline impact, but also with unknown onsite residual sources of hydrocarbon in the soil and smear zone. The proposed remediation approach evaluated the existing health risk to local residents, to derive the most appropriate remedial method to provide Chevron with unencumbered developability.

2.4 Remediation Goals

The goal for the former Chevron Station is to actively remediate the subsurface hydrocarbons to levels that do not pose adverse human health or environmental risks in addition to providing appropriate levels conducive to property redevelopment.

2.4.1 Weiss Associates Vapor Survey

On March 18, 1997, Weiss Associates, under contract to Chevron, performed a soil vapor survey and vapor pathway risk analysis in the southwestern portion of the site adjacent to the residential properties. During the vapor survey, four soil vapor samples were collected from the sample locations at depths of approximately 3 feet. Samples were attempted from two other depths (6 and 9 feet), however, this was unsuccessful due to "..the lack of vapor flow in the damp clay sediments." A copy of this soil vapor survey and RBCA calculations report is included (Appendix A).

The maximum vapor-phase benzene concentration encountered was 0.008 ppm from sample location SV-2. Utilizing these data to calculate the human health risk in a residential situation due to indoor air volatilization, produced a health risk of 6.9×10^{-7}. "This indoor air risk is more than an order of magnitude lower than the acceptable 10^{-5} risk level."

Based on this assessment, Weiss concluded that, "...there is no significant risk to residential receptors from hydrocarbon vapors originating in the subsurface."

2.4.2 Tier 2, Remediation Assessment

Chevron is committed to source removal activities with remediation goals based on property developability. Terra Vac performed a Risk Based Corrective Action (RBCA), TIER 2 evaluation using known site specific parameters to determine the acceptable concentrations of benzene that can remain in groundwater without producing a human health risk for future site conditions. The RBCA spreadsheets and backup information are included as Appendix B. The RBCA evaluation was conducted for residential groundwater and soil volatilization to both indoor and outdoor air. Other pathways, such as ingestion of soil and groundwater, are not likely pathways and were not evaluated based on the known location of the hydrocarbons and an assumed future commercial usage. Although the Weiss report concluded that no significant risk is associated with the current situation, Chevron is committed to the more conservative risk calculations performed by Terra Vac.

RBCA modeling of existing benzene levels beneath and adjacent to the former Chevron site, indicates an unacceptable health risk due to gasoline impacted groundwater. The exposure of concern is volatilization from groundwater to indoor air. The resulting applicable SSTL (site specific target level) for dissolved benzene in groundwater that allows an acceptable health risk for residential development (1.0×10^{-6}) is 150 parts per billion (Appendix B, Section 1). The 150 ppb benzene concentration is considered the primary remediation goal based on residential development. If the primary goal cannot be achieved cost effectively or by best available technologies, then a secondary goal based on commercial development will be utilized. This secondary remediation goal was also based on a Tier 2 RBCA for commercial development, and the acceptable health risk for benzene was calculated to be 460 ppb.

The proposed remediation goals for soil, are an average of 3.3 ppm benzene based on the RBCA (Appendix B, Section 2), or the documented Tri-Regional Guideline goal of a 100 ppm TPHg average. Natural attenuation in conjunction with appropriate monitoring will continue until the dissolved hydrocarbons are below MCLs or at a level acceptable to the RWQCB. Terra Vac and Chevron request that these active remediation goals be accepted by the HFD and RWQCB prior to the commencement of any onsite remediation activities. These concentrations are considered the remediation goal for onsite and offsite remediation, and are protectant of human and environmental health.

In addition to the above criteria, attainment of remediation goals for this site will be supported by:

- remediation system operating data (including asymptotic remediation rates),
- soil permeability,

- groundwater monitoring data,
- the use of cost effective, best available technology.

The procedures to verify attainment of acceptable soil remediation goals are described in Section 4.0, Task 5.

3.0 REMEDIAL APPROACH

The human health risk evaluation conducted by Terra Vac, indicates that onsite remediation is necessary for site development. Modeling site specific parameters to an acceptable health risk for dissolved benzene, produced a target groundwater concentration of 150 ppb, and the remediation goal for soil, is an average of 100 ppm TPHg or 3.3 ppm benzene (benzene goals were derived from the TIER 2 RBCA for soil volatilization to indoor air).

Terra Vac will conduct interim remediation onsite and beneath Rex Road (adjacent to the former Standard Station), and evaluate its effect on the known offsite dissolved hydrocarbon levels downgradient and east of the site (the former Standard Station). The evaluation will be conducted during the first three months of operation. Wells MW-8, MW-9, and MW-13 (Figure 2) will be used to evaluate the area about the former Standard Station in addition to a new well, MW-18 (Figure 2). If significant reductions in benzene are observed, performance data will be used to evaluate the length of time required for the existing operation to attain the 150 ppb benzene level throughout the plume.

Due to the uncertainty in water production and distribution of dissolved hydrocarbons below 15 feet, the initial DVE system may need to be augmented with either downhole pumps or air injection to obtain the remediation goals. These options are discussed in Section 4, Task 4.

The DVE system will initially consist of 16 new wells and 8 existing wells (MW-4, -5, -6, -7, -8, -9, -11, &-12), associated above and below grade piping, vapor/liquid separator, and a 600 scfm Retox regenerative oxidizer. The proposed remediation system is shown on Figure 6. The DVE system may be augmented with up to an additional five onsite wells after about 10 weeks of operations, if necessary. The DVE system performance goals are: (1a) an extraction rate decrease of greater than 90 percent, and (1b) speciation data that indicate few low boiling point hydrocarbon remain in the subsurface or (2) dissolved benzene levels average less than 150 ppb in onsite monitoring wells. We anticipate DVE operations to continue for 26 weeks to attain remediation goals. Interim wells may be installed to assist the initial DVE system in providing complete coverage of the hydrocarbon plume. If water production rates are excessive (greater than 15 gpm), downhole pumps may be installed in select wells to augment

lowering of the water table or air injection will be used to address the lower saturated zone.

We anticipate that six months of DVE operations will be required to reduce the average dissolved benzene level to less than 150 ppb over the target area. The six-month projection is dependent upon the offsite hydrocarbon mass. Due to inaccessibility, the hydrocarbon mass beneath the former Standard Station is unknown. Hydrocarbon reductions in wells MW-8, MW-9, and MW-13 will be interpreted to reflect successful source removal beneath the former Standard Station.

In March 1997, Weiss Associates performed a soil vapor survey onsite to evaluate the human health risks associated with currently existing hydrocarbons in the soil and groundwater, described in Section 2.4.1. Weiss Associates stated that, "Based on the results of the soil vapor survey and indoor air risk calculation, there is no significant risk to residential receptors from hydrocarbon vapors originating in the subsurface."

4.0 SCOPE OF WORK

Outlined in the Section are the various Tasks to be conducted on this project.

Task 1: Work Plan and Regulatory Negotiations

The overall strategy for interim remediation is removing the hydrocarbon source and reducing the dissolved benzene concentrations to below 150 ppb for residential development (primary goal), or 460 ppb for commercial development (secondary goal). Once dissolved levels of benzene are reduced to an average of less than the above goals, a FRP will be prepared to select the most appropriate approach to complete site restoration.

This Interim Remediation Work Plan was prepared for submittal to the HFD and RWQCB and describes proposed remediation efforts at the site. At the heart of this Work Plan is a justification of remediation goals. All data related to the RBCA evaluation Terra Vac conducted for this work plan is included as Appendix A. Additional site specific data collected during system installation and operations will be used to reevaluate appropriateness of the goals. Terra Vac will meet with the HFD and RWQCB to expedite approval of this work plan and address concerns they may have on the proposed work.

Task 2: Permitting, Installation, Startup, & One Month Operations

Task 2.1: Engineering & Permitting

Terra Vac will provide all the engineering to install and operate the remediation system. The system will include a dual vacuum extraction and treatment system with options to

include down-hole pumps or an air sparging system. The proposed design of the system is shown in Figure 6, and a process flow diagram is shown as Figure 7.

The equipment compound will be located in the northwest part of the site (Figure 6). The compound will be fenced providing visual screening and to mitigate any excessive noise. Electrical and sewer hookups will be provided to the compound in accordance with all appropriate requirements. All onsite piping will be routed to the compound and be placed above grade, while below grade piping will be utilized to connect the remediation well located in Rex Road. All trenching and below grade piping activities will conform with State and Local regulations. The foot print of the equipment compound will be approximately 30 by 30 feet. All permits will be obtained by Terra Vac. Terra Vac will be responsible for all reporting requirements to the applicable agencies for compliance.

Task 2.2 Remediation System Installation

Once all permits have been obtained, Terra Vac will proceed with the system installation. Terra Vac will subcontract portions of the installation. Outlined below are system components.

Remediation Wells

The dual vacuum extraction system will require new wells, as the existing wells are not spaced adequately for complete remediation. Initially, 16 DVE wells will be installed according to the proposed system design shown on Figure 6. Exact well locations and screened intervals will be determined in the field by a Terra Vac geologist. We anticipate that DVE wells will be completed to a depth of approximately 15 feet below grade. Up to five interim borings/wells will be installed in the same manner. Interim boring/well locations will be determined on the basis of operating data and discussed with the HFD and RWQCB prior to installation.

Select soil samples will be collected during well installation and analyzed at a State-Certified laboratory. A minimum of 16 soil samples will be collected and analyzed using modified EPA Method 8015/8020. In addition, approximately three samples will be collected from differing geologic strata for petrophysical analysis to confirm expected air permeability and other parameters. These tests will provide vital information during interim and confirmatory evaluations including future risk based assessments.

Process Equipment and Piping

Terra Vac will be utilizing the following equipment to perform remediation at this site.

- *Vapor/liquid separator* - Centrifugal separator with a capacity of 150 gallons. The separator will have high and low water level controls that

operate a water pump. A high-high level control will shut the system down in the event of a water pump failure.

- *Vacuum extraction unit* - A positive displacement blower (Turbotron) with a 30 HP motor capable of 12 inches of mercury vacuum at 600 scfm. The unit will be equipped with explosion-proof motor and motor controls. The unit will be enclosed for noise suppression.
- *Regenerative oxidizer* - In accordance with regulations of the BAAQMD, a regenerative oxidizer capable of 600 scfm will be used for vapor abatement.
- *Activated carbon* - Two 1,000-pound vessels of activated carbon will be used for polishing of treated discharge water.
- A 500-gallon settling tank for removal of suspended sediment in the process stream.
- *Bag filter* - A four bag filter assemblage will be used to capture fine suspended sediment prior to carbon filtration.

Once all permits have been received, Terra Vac will install all of the necessary components of the system. A process flow diagram is shown as Figure 7. All DVE piping will consist of schedule 40 PVC. If air sparging is utilized, schedule 80 PVC piping will be used. Discharge piping from the groundwater treatment system will be constructed of schedule 40 PVC pipe, or as directed by the HFD. Piping onsite will be placed above grade (Figure 6). Extraction equipment will be mobilized to the site and placed in an equipment compound. The existing equipment compound and various components will be removed.

Soil cuttings from well installation will be placed on, and covered with, visqueen. Terra Vac will sample the soil per Chevron protocol and coordinate disposal using a Chevron contractor. Soil from trenching will remain onsite and be disposed of with the drill cuttings.

Task 2.3: Startup & One Month Operations

All equipment and control systems will be checked for proper operation prior to startup. Testing shall include electrical continuity checks, tests of all safety shut-downs, verification of system set points, pressure testing of positive pressure water line, and testing of the remote monitoring system.

Startup will consist of the first week of DVE operations. During this time the system will be closely monitored to provide baseline remediation data. Each well will be brought on-line individually and evaluated for flow rate and hydrocarbon vapor concentration. Individual sampling will identify areas of high hydrocarbon impact and of low permeability soils. These data will document initial conditions, determine mass

extraction, overall system effectiveness, flow rates, vacuum influence, and air and water permit compliance. The system will then be optimized to effectively remediate the targeted area.

The water treatment system will be sampled and the required analytical testing conducted prior to discharge. If the first monitoring event shows compliance, the system will be operated and sampled again as required by the permit.

Site visits will be performed on the most cost-effective basis. Weekly site visits will be conducted throughout the first month of operation. Vacuum and flow rates will be evaluated during each site visit. Vapor samples will be collected at the system inlet and outlet of the regenerative oxidizer for compliance purposes as well as to calculate the mass extraction. A complete wellhead speciation survey will be completed at week four. Speciation will include detailed analyses of the various constituents of gasoline.

Task 3: Operations and Maintenance

The operation and maintenance plan in place during the first month will continue until DVE operations are terminated. Weekly site visits will document system compliance and optimize extraction. A complete wellhead survey will be conducted each month and evaluated to determine diffusion limited zones and potential sources removed from the target area. Oxygen uptake rates (OUR's) may be conducted periodically during operations to evaluate the reduction of hydrocarbons due to biologic processes.

Task 4: Interim System Performance Evaluation

Terra Vac will monitor the performance of the extraction system by evaluating the total extraction rate, changes in extraction rates from individual wells, and changes in the speciation of the vapor stream of individual wells and the entire system. These data collectively will allow identification of any areas onsite where extraction is being controlled by diffusion. The diffusion limited areas will be addressed by installation of up to five additional wells and system modification or enhancements such as pneumatic fracturing or hydrogen peroxide injection.

Interim borings will be drilled and evaluated approximately 10 weeks after startup. Soil samples will be collected and analyzed by modified EPA Method 8015/8020. If warranted by PID readings, the boring will be completed as a DVE well and added to the remediation system. The interim borings will be located based on operating and site characterization data. The borings will be used as confirmatory if the hydrocarbon concentrations meet remediation goals. Boring locations will be selected after discussion with the agencies.

Quarterly groundwater sampling will continue as required and be performed by others. Data on groundwater quality will be used to determine trends in the speed and effectiveness of groundwater remediation.

Task 4.1: Remediation System Augmentation

In the event that further remediation is required, Terra Vac will propose and appropriately augment the existing remediation system to address the remaining hydrocarbons based on the operational data and analysis from soil and groundwater investigations.

If water production rates during interim remedial action exceeds 15 gpm or the lower saturated zone is not adequately addressed by the DVE system, then select wells may be augmented with downhole pumps or air injection may be applied to materials below 15 feet. Air injection is the preferred option as it will allow biodegradation of the high boiling point constituents of gasoline. If air injection is requested, Terra Vac will install eight air injection wells to a depth of between 20 and 25 feet. Six of the wells will be installed onsite, two will be installed in Rex Road, or as determined through the course of remediation. The wells will be manifolded to an air injection unit in the equipment compound capable of 35 scfm at 15 psi. If required this system will be installed at about week 10, concurrent with any interim DVE wells.

The air injection or downhole pump systems will be brought online at about week 12. It is anticipated that the air injection system, if necessary, will operate for a total of 24 weeks. The air injection unit will operate for an additional 10 weeks past termination of DVE operation.

Downhole pumps can be installed in boundary wells along the northwest and southeast boundary of the site. Extracted water will be routed to a second air/water separator for stripping of volatile constituents and discharged to the activated carbon vessels. The control panel for the pumps will be placed in the equipment compound. All pressure piping will be double contained.

Task 5: Confirmatory Borings and Demobilization

Prior to completion of site remediation, Terra Vac will prepare and submit a soil boring and sampling plan to the HFD and RWQCB for vadose zone closure. Soil samples will be collected and analyzed by a state certified laboratory. Select soil samples will be analyzed following the procedures described below.

- Each primary sample will be analyzed for TPHg using modified EPA Method 8015/8020. If all samples have an average concentration less than 100 ppm or 3.3 ppm benzene, the remediation goal for soil will have been achieved.

- If an average of 100 ppm or 3.3 ppm benzene is not achieved using primary samples, then each sample that exceeds 100 ppm will be analyzed using the toxicity characteristic rules (Title 22) to demonstrate that benzene levels are less than 0.5 ppm in deionized water leachate. The test result will provide evidence whether any residual hydrocarbon in soil will impact groundwater.

- The primary results will be discounted if the secondary sample meets the remediation objective.

Dissolved levels of benzene will be used to evaluate the progress of groundwater remediation that will be considered complete when onsite benzene levels average less than 150 ppb (primary goal), or 460 ppb (secondary goal).

Upon confirmation that interim remediation goals onsite have been achieved, a final comprehensive report will be submitted to the HFD and RWQCB. Quarterly groundwater monitoring will continue as requested by the RWQCB.

All equipment will be removed from the site and utilities for equipment will be disconnected at completion of remediation work. The equipment compound will be dismantled. Extraction wells will be abandoned as required by the HFD and RWQCB. All underground piping will be abandoned in place, above grade piping will be removed.

5.0 FINAL REMEDIAL PLAN

Upon completion of the interim remedial action, Terra Vac will prepare and submit a Final Remedial Plan (FRP), in compliance with Tri-Regional Guidelines. The FRP will outline a natural biodegradation and monitoring plan for complete site restoration if no adverse human or environmental health risks exist.

Following installation of the confirmatory borings and documentation of attainment of interim remediation goals for soil, Terra Vac will demobilize all remediation equipment and submit a FRP that will address monitoring of the residual hydrocarbons during natural attenuation. If dissolved hydrocarbons are not detected, a residual monitoring plan will not be required. This report will include documentation of active remediation operations.

The FRP will include:

- a risk based assessment for the final remedial option,
- a description of the most appropriate remedial option to obtain site restoration,
- a summary of source removal through active interim remediation,
- an estimate of residual hydrocarbon mass in soil and groundwater,

- a projection of the rate of natural attenuation of residual hydrocarbon beneath the site,
- identification of wells to be included and monitoring frequency under the FRP, and
- a tabulation of "trigger" levels for groundwater monitoring and a contingency plan for handling trigger conditions.

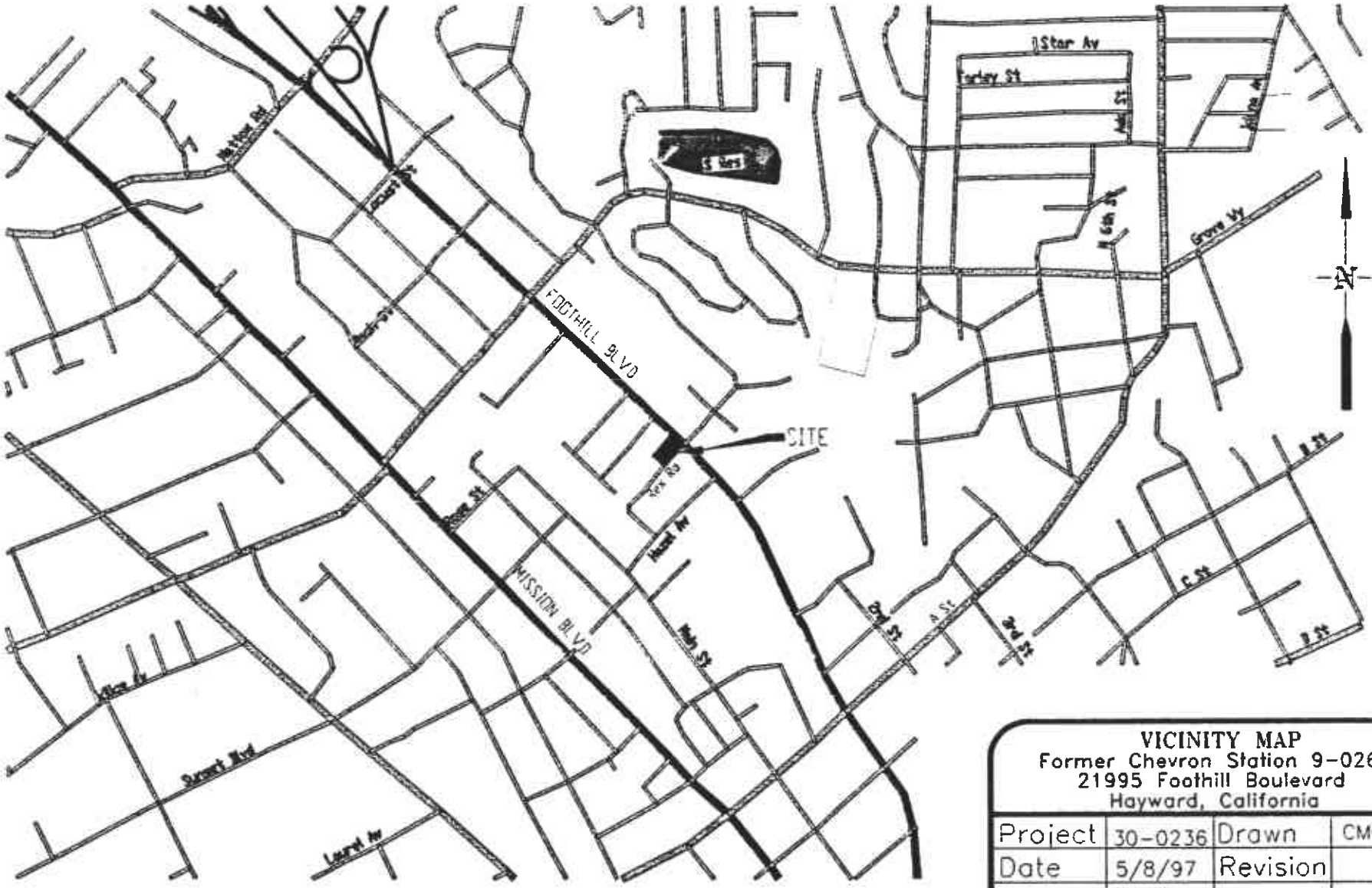
6.0 APPROXIMATE SCHEDULE AND DELIVERABLES

The following table shows the approximate schedule and deliverables.

ITEM	SCHEDULE
Equipment Installation	June 1997
Remediation Well Installation	June - July 1997
Rex Road Trenching and Piping	July 1997
Implementation of Dual Vacuum Extraction	July- August 1997
Interim Sampling/Well Installation	October 1997
Termination of Vacuum Extraction	February 1998
Confirmatory Sampling	February 1998
System Evaluation	February - March 1998
Preparation of the Final Remedial Plan	February - March 1998
System Augmentation (if necessary)	March 1998
System Demobilization	Once NFAR status is granted
Implementation of Residual Management Plan	Once NFAR status is granted

7.0 COMPLIANCE WITH STANDARDS, SPECIFICATIONS, AND LAWS

Terra Vac will perform all tasks associated with remediation of this site in a professional manner and in compliance with all codes, standards, permits, regulations and laws applicable to the project. All work performed by Terra Vac according to Terra Vac's Quality Assurance, Quality Control Plan (Appendix C). Remediation projects require safety and health measures to assure the protection of Terra Vac employees, subcontractors, and other authorized field personnel. All Terra Vac employees involved in remediation work undergo safety training which meets or exceeds the requirements of 29 CFR 1910.120. The Health and Safety Plan for this project is included as Appendix D.



VICINITY MAP
Former Chevron Station 9-0260
21995 Foothill Boulevard
Hayward, California

Project	30-0236	Drawn	CMG
Date	5/8/97	Revision	
Scale	N.T.S.	Checked	

TERRA VAC
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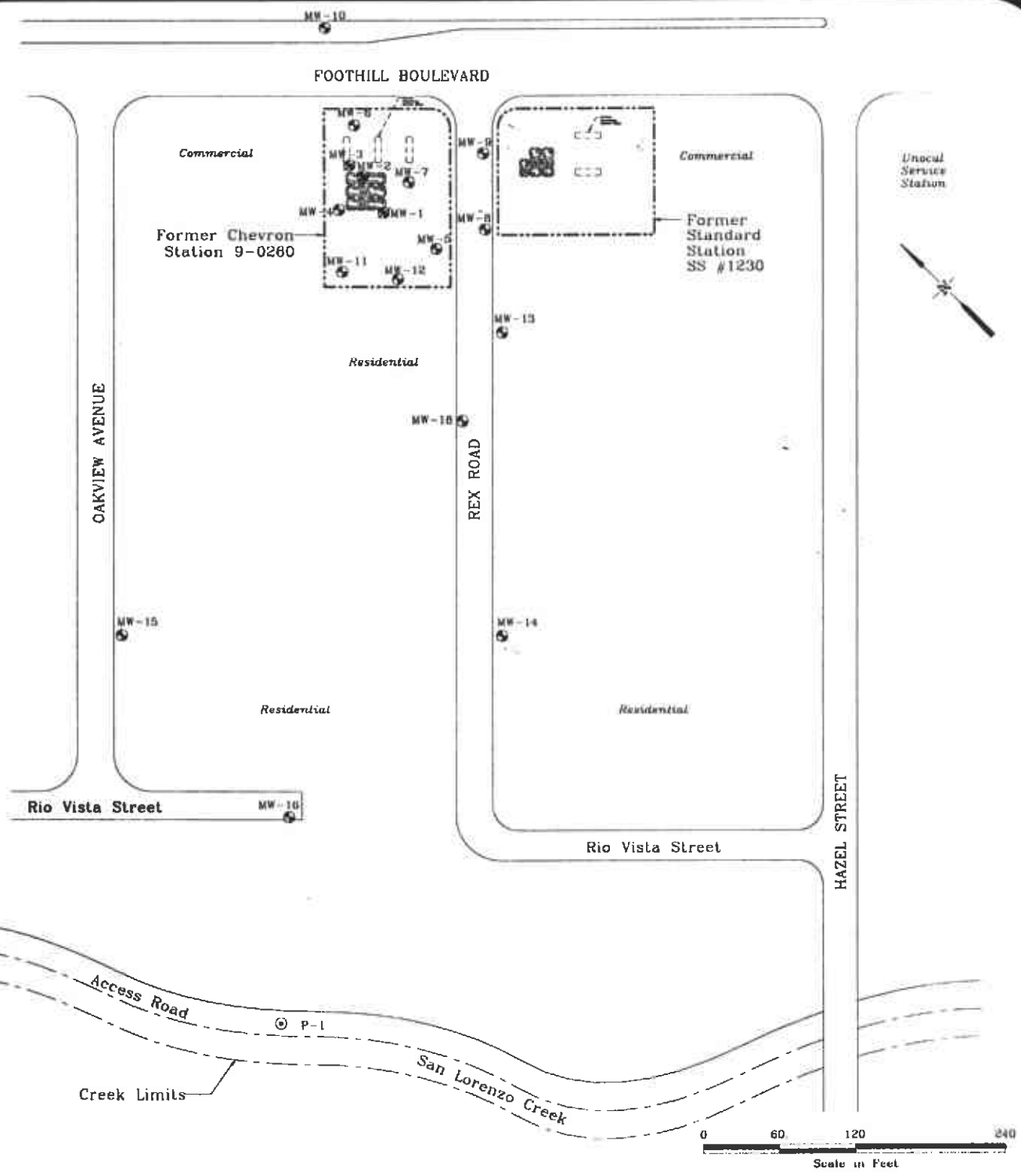
San Leandro, CA 94577
(510) 351-8900 Fax: -0221

Figure 1



Note. Base map adopted from Weiss Associates, Figure 3, titled "TPH G Concentrations in Groundwater December 3, 1992", dated January 21, 1993

Extended Site Plan
Former Chevron Station 9 0260
21995 Foothill Boulevard
Hayward, California

Project	30-0236	Drawn	JLN
Date	5/13/97	Revision	
Scale	1"=120'	Checked	

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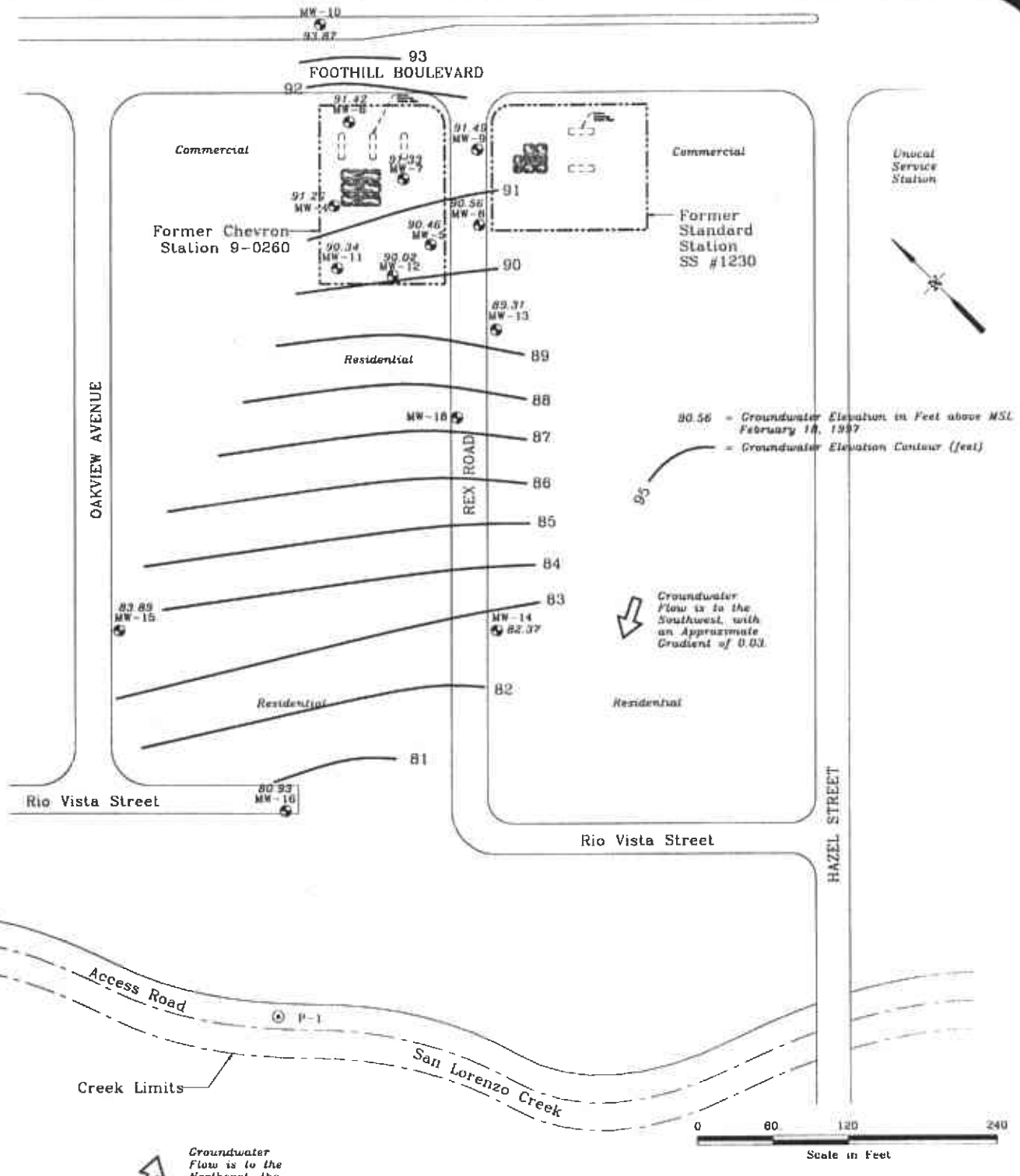
Figure 2



Note: Base map adopted from Weiss Associates, Figure 3, titled "TPH G Concentrations in Groundwater - December 3, 1992", dated January 21, 1993.

Groundwater Elevations, 2/18/97
Former Chevron Station 9-0260
21995 Foothill Boulevard
Hayward, California

Project	30-0236	Drawn	JLN
Date	5/13/97	Revision	
Scale	1"=120'	Checked	

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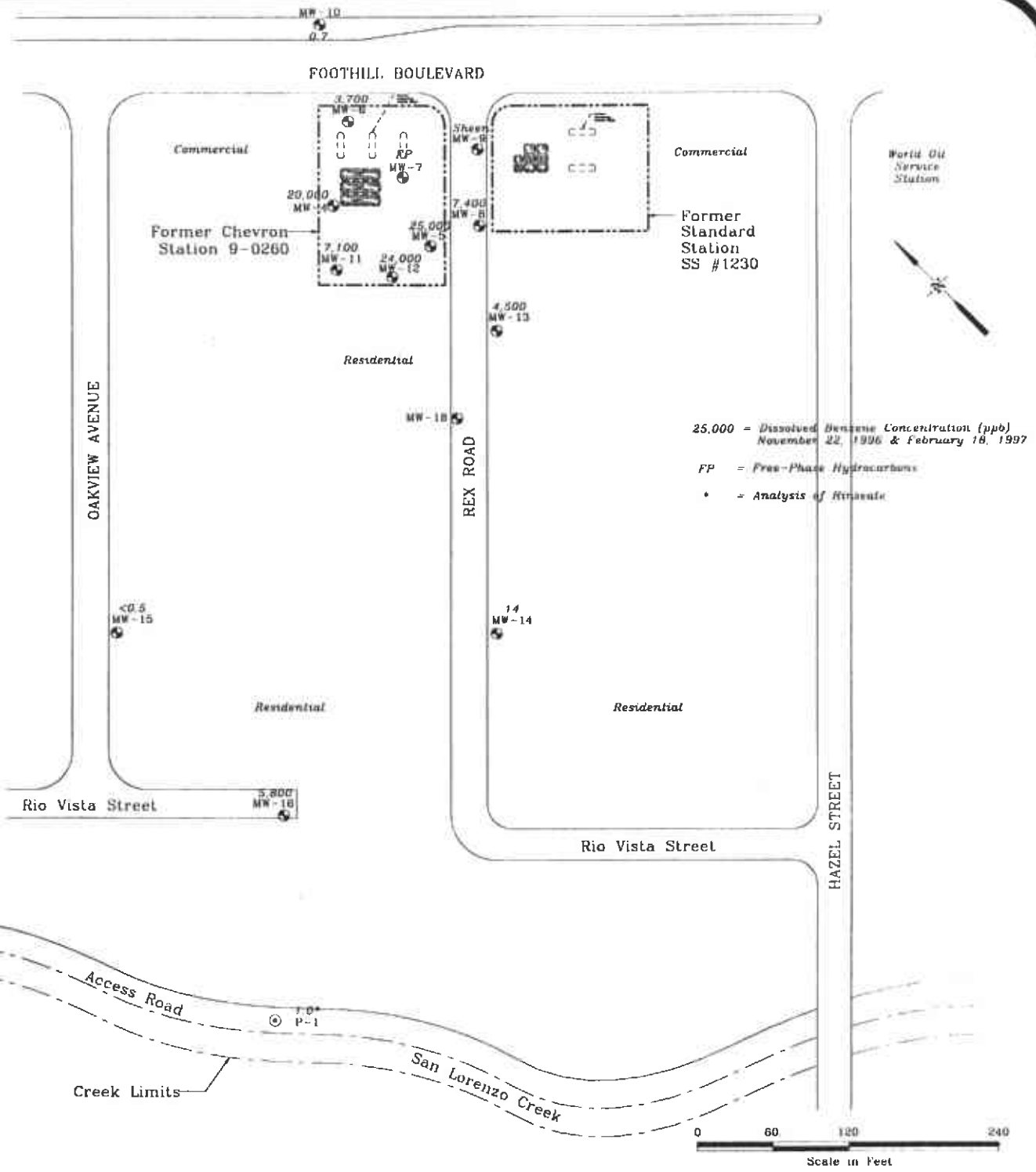
Figure 3



Note: Base map adopted from Weiss Associates, Figure 3, titled "TPH G Concentrations in Groundwater - December 3, 1992", dated January 21, 1993.

Dissolved Benzene Concs., 2/18/97
Former Chevron Station 9 0260
21995 Foothill Boulevard
Hayward, California

Project	30-0236	Drawn	JLN
Date	5/13/97	Revision	
Scale	1"=120'	Checked	

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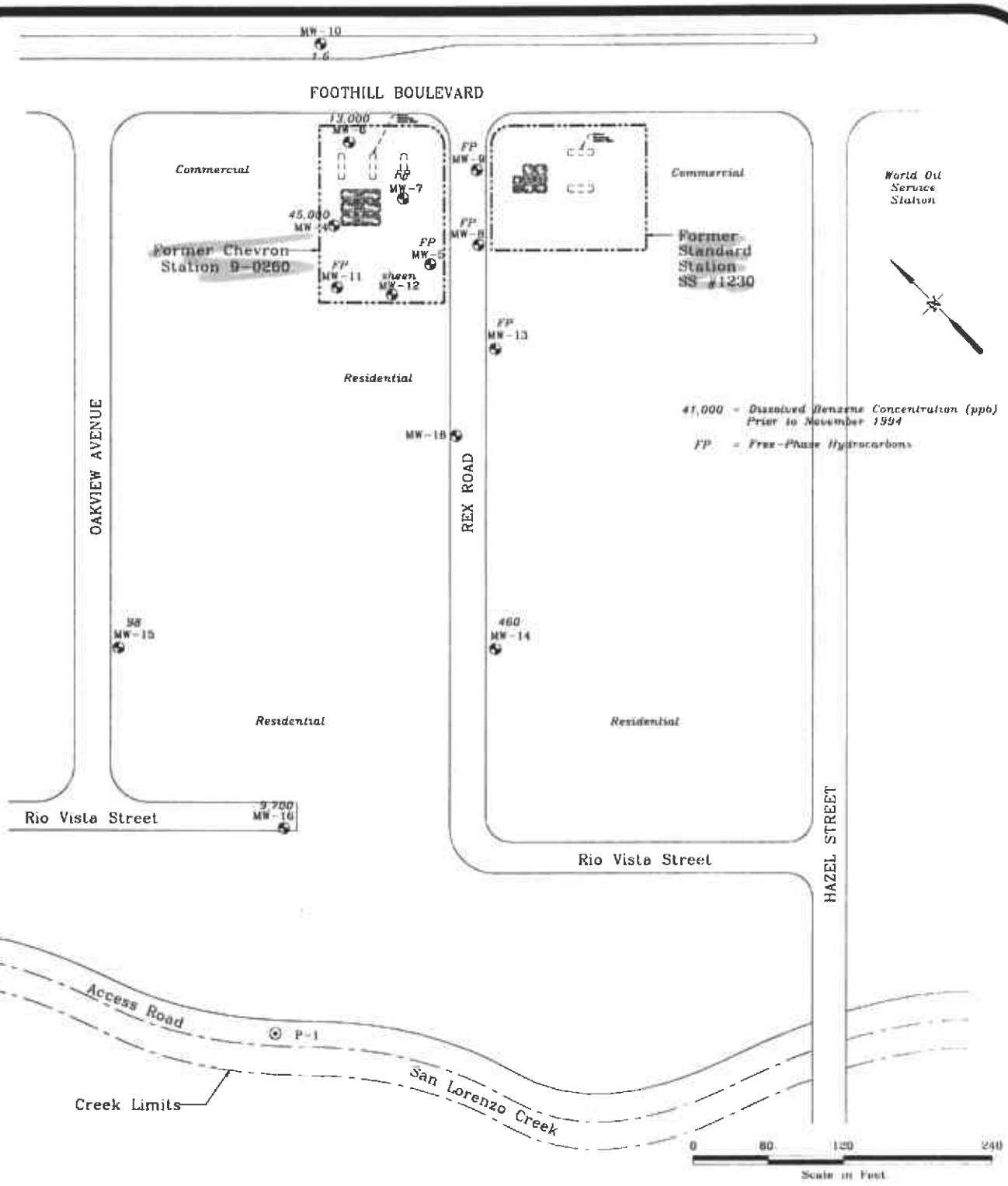
(510) 351-8900 Fax: (510) 351-1...

Figure 4



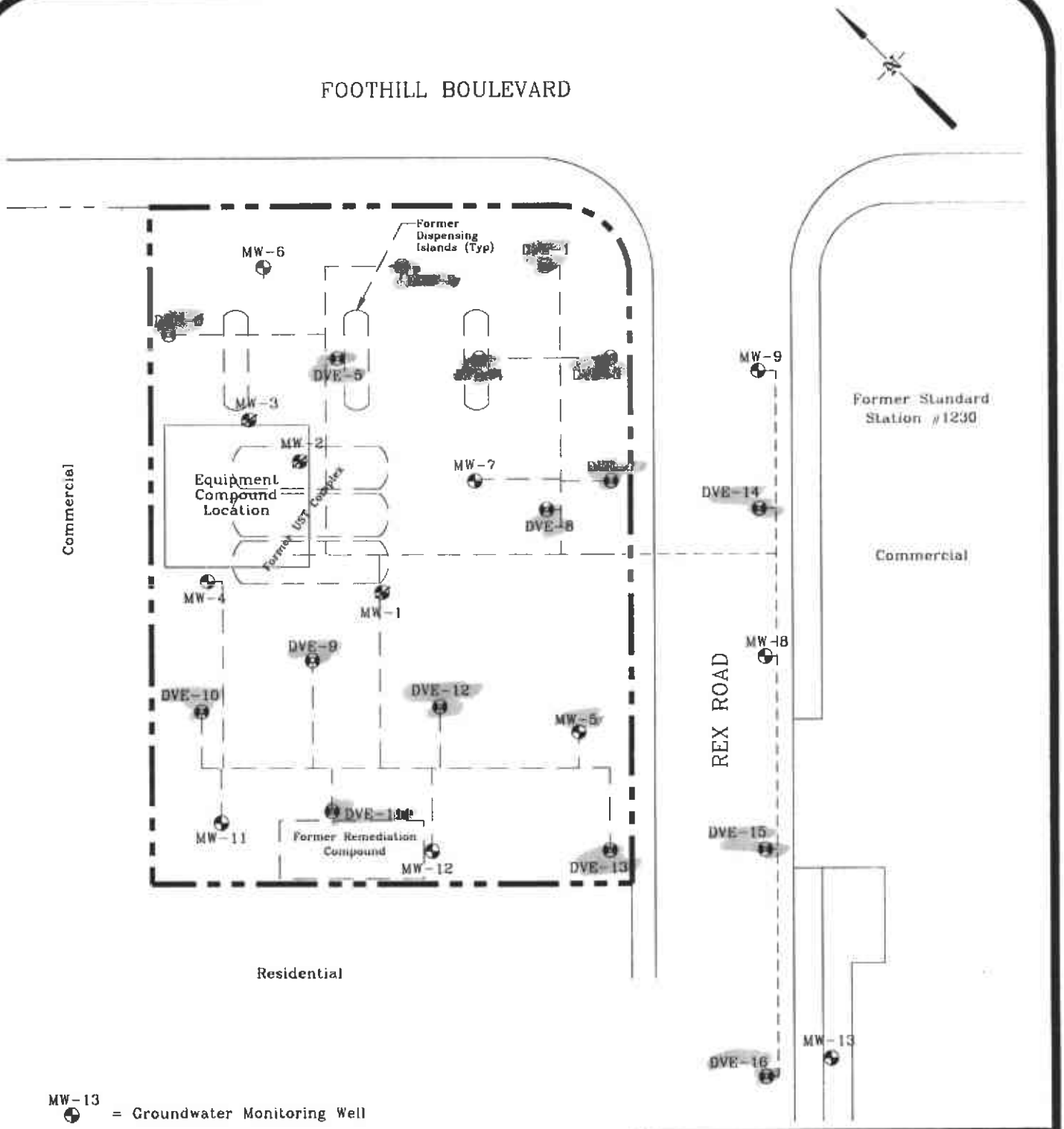
Note: Base map adopted from Weiss Associates, Figure 3, titled "TPH-G Concentrations in Groundwater - December 3, 1992", dated January 21, 1993

Dissolved Benzene Concs., Historic
Former Chevron Station 9 0260
21995 Foothill Boulevard
Hayward, California

Project	30 0236	Drawn	JLN
Date	5/13/97	Revision	
Scale	1"=120'	Checked	

TERRA VAC
1651 Alvarado Street
San Leandro, CA 94577
(510) 351-8900 Fax: 0221

Figure 5

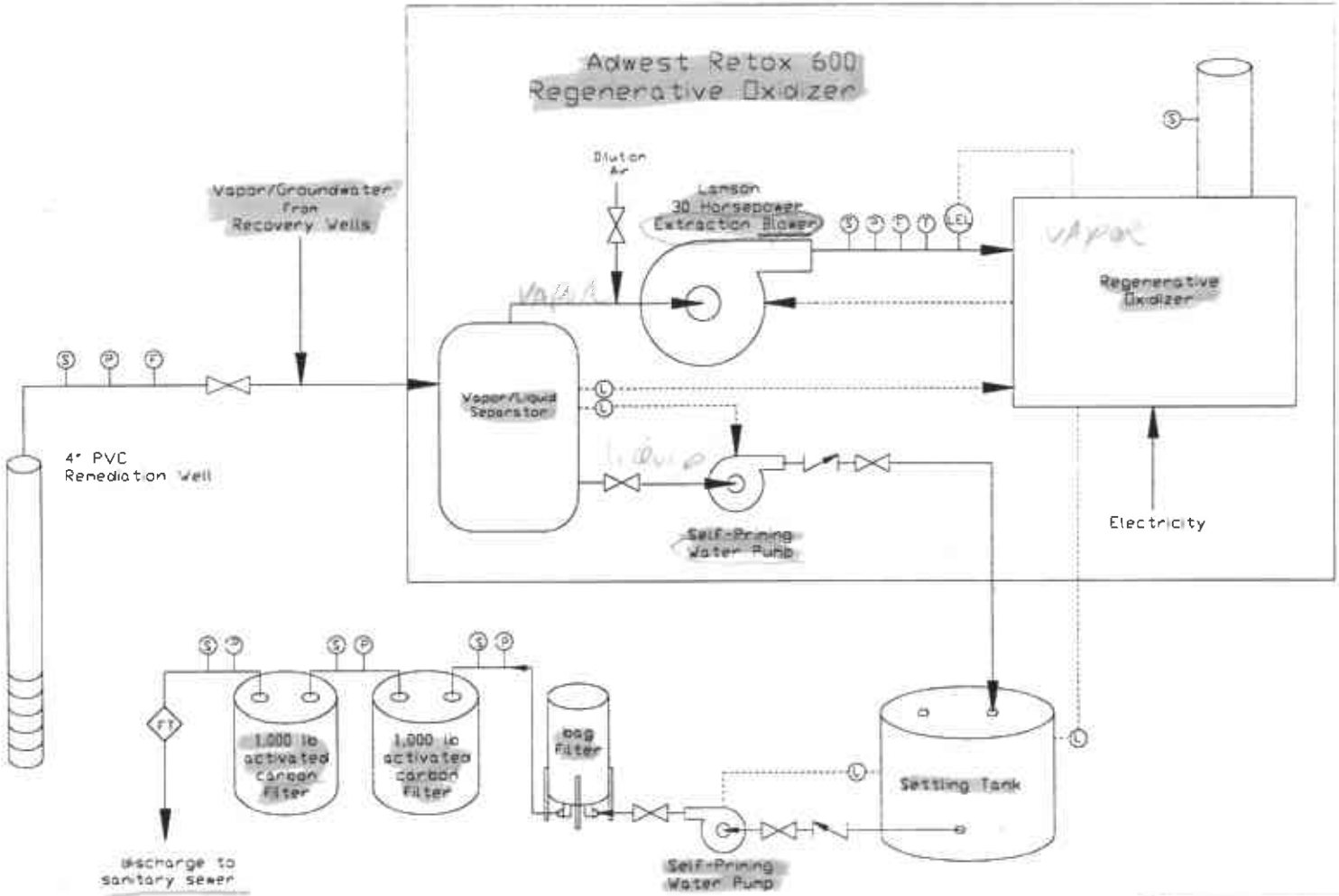


Proposed Remediation System
Former Chevron Station 9 0260
21995 Foothill Boulevard
Hayward, California

Project	30-0236	Drawn	JLN
Date	5/13/97	Revision	
Scale	1"=30'	Checked	

TERRA VAC 1651 Alvarado Street San Leandro, CA 94577 (510) 351-8900 Fax: 0221

Figure 6



FT = Flow Totalizer

---- = Lines of Control

F = Flow Rate Indicator

P = Pressure/Vacuum Indicator

LEL = LEL Monitor

= Check Valve

= Ball Valve

L = Water Level Sensor

S = Sample Port

T = Temperature Indicator

Process Flow Diagram
Former Chevron 9-0260
21995 Foothill Boulevard
Hayward, California

Project	30-0236	Drawn	JLN
Date	5/14/97	Revision	
Scale	None	Checked	

TERRA VAC
14798 Wicks Boulevard
San Leandro, CA 94577
(510) 351-8900 Fax: -0221

Figure 7

APPENDIX A

SOIL VAPOR SURVEY/RBCA CALCULATIONS
Former Chevron Station 9-0260
dated April 28,1 997
by
Weiss Associates

Weiss Associates Environmental and Geologic Services

5500 Shellmound Street, Emeryville, CA 94608-2411 Fax: 510-547-5043 Phone: 510-450-6000

April 28, 1997

Philip R. Briggs
Chevron Products Company
6001 Bollinger Canyon Road, Building L
P.O. Box 5004
San Ramon, CA, 94583-0804

RE: **Soil Vapor Survey/RBCA Calculations**
Former Chevron Service Station #9-0260
21995 Foothill Blvd
Hayward, California
WA Job #4-0310-70

Dear Phil:

Weiss Associates (WA) is pleased to present Chevron Products Company (Chevron) with the results of the soil vapor survey and vapor pathway risk calculations for the above referenced site. On March 18, 1997, WA and Inter Phase Inc (Inter Phase) collected soil vapor samples at the former Chevron service station located on the northwest corner of Foothill Boulevard and Rex Road in Hayward, California (Figure 1). The concentrations of hydrocarbons in the soil vapor samples were used in conjunction with the standard equations presented in the Risk Based Corrective Action[1] (RBCA) guidance document to calculate carcinogenic risk and toxicological hazard quotients for vapor intrusion to buildings. The risk assessment calculations indicate there is no significant risk to residential receptors from the low concentrations of hydrocarbon vapors detected in the subsurface. The soil vapor survey activities and results are described below followed by a description of the risk calculations.

Soil Vapor Survey

On March 18, 1997, WA collected four soil vapor samples at a depth of 3 feet below ground surface (bgs) from locations SV-1, SV-2, SV-3 and SV-4 at the subject site (Figure 2). Vapor samples were collected by advancing a vapor sampling rod to a specified depth with a hydraulically powered GeoProbe, inserting post run tubing (PRT) and connecting the tubing to the vapor sample collection assembly. Inter Phase operated the GeoProbe equipment and vapor sampling rod and connected the PRT. WA collected the samples with the vapor sample collection assembly. The PRT was connected to the vapor sample collection configuration as depicted in Figure 3. The vapor sample lines were purged by opening the ball valve and actuating the vacuum pump (hand operated Nalgene Mityvac air pump) to fill the 1-liter Tedlar bag approximately 1/4 full (250 ml). The ball

[1] ASTM 1995. Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

valve was closed and the sample collection valve on the 1 liter Summa canister was opened while monitoring the vacuum gauge. The Summa canister valve was closed after a three-minute sample collection time. After sample collection, the configuration was disconnected and the summa canister was labeled and stored for shipment. Before collecting the next vapor sample, the tubing and tee were replaced, the probe rod assembly cleaned, the vacuum gauge and ball valve purged with ambient air and a new Summa canister was connected.

WA attempted to collect soil vapor samples at 6 and 9 foot depths bgs from sample locations SV-2 and SV-3. Vapor sample collection was not successful at these depths due to a lack of vapor flow in the damp clay sediments.

Vapor samples were shipped under chain-of-custody to Air Toxics Ltd. of Folsom, California for analysis of benzene, toluene, ethylbenzene, and xylenes by Modified California Air Resources Board Method 410A. The maximum benzene concentration in pore vapor was 0.008 parts per million by volume (ppmv) from sample location SV-2 at 3 ft bgs. Toluene, ethylbenzene and xylene concentrations in vapor from sample location SV-2 were 0.004, 0.006 and 0.031 ppmv respectively. The maximum toluene concentration in pore vapor was 0.012 ppmv from sample location SV-1 at 3 ft bgs. The vapor sample analytical results are summarized in Table 1 and the laboratory analytic results are presented in Attachment A.

Lithological logging of soil cores collected from the 4 sample locations indicate that shallow soil (<3 feet bgs) consist primarily of silts and clays with a small percentage of 1/2 inch to 1 inch size gravel. Soil cores collected from sample location SV-2 indicate a layer of silt to 6 feet bgs and a layer of clay to 8 feet bgs, the total depth explored. Previously prepared boring logs indicate similar lithology at the subject site. Lithological logs for the four sample locations are included in Attachment B.

RBCA Calculations

The risk level determined by this analysis for benzene in the indoor air exposure pathway is 6.9×10^{-7} based on exposure parameters for children ages 1 through 16 years. This indoor air risk level for benzene is more than an order of magnitude lower than the acceptable 10^{-5} risk level. In addition, toluene, ethylbenzene and xylenes hazard quotients were approximately four orders of magnitude below the acceptable hazard quotient of 1.0. Table 2 summarizes risk calculation results for both child and adult receptors.

The risk and hazard quotients for vapor intrusion to buildings were calculated from the maximum detected concentrations of benzene, toluene, ethylbenzene and xylenes in soil vapor. The standard vapor transport equations presented in table X3.1 (pg. 31-33) of the RBCA guidance document were used. Attenuation of vapor flux due to the presence of a building foundation or ventilated sub floor crawl space was not used in the calculations. Subsurface vapors were conservatively assumed to transport directly into the receptor building with no barrier or losses. The risk calculations are presented in spreadsheet form in Attachment C.

Based on the results of the soil vapor survey and indoor air risk calculations, there is no significant risk to residential receptors from hydrocarbon vapors originating in the subsurface.

We appreciate this opportunity to assist Chevron Products Company. Please call either of the undersigned if you have any questions.

Sincerely,
Weiss Associates

Tim Utterback, P.E.
Senior Staff Engineer

Mike Cooke
Project Geologist

Enclosures:
Figure 1: Site Location Map
Figure 2: Soil Vapor Sample Locations
Figure 3: Vapor Sample Collection Configuration
Table 1: Analytic Results for Vapor Samples
Table 2: Summary of Indoor Air Risk Calculations
Attachment A - Laboratory Analytic Results
Attachment B - Lithological Logs
Attachment C - Risk Calculations

TRU/MC:all
J:\chevron\0310\rbca\04bril1.doc

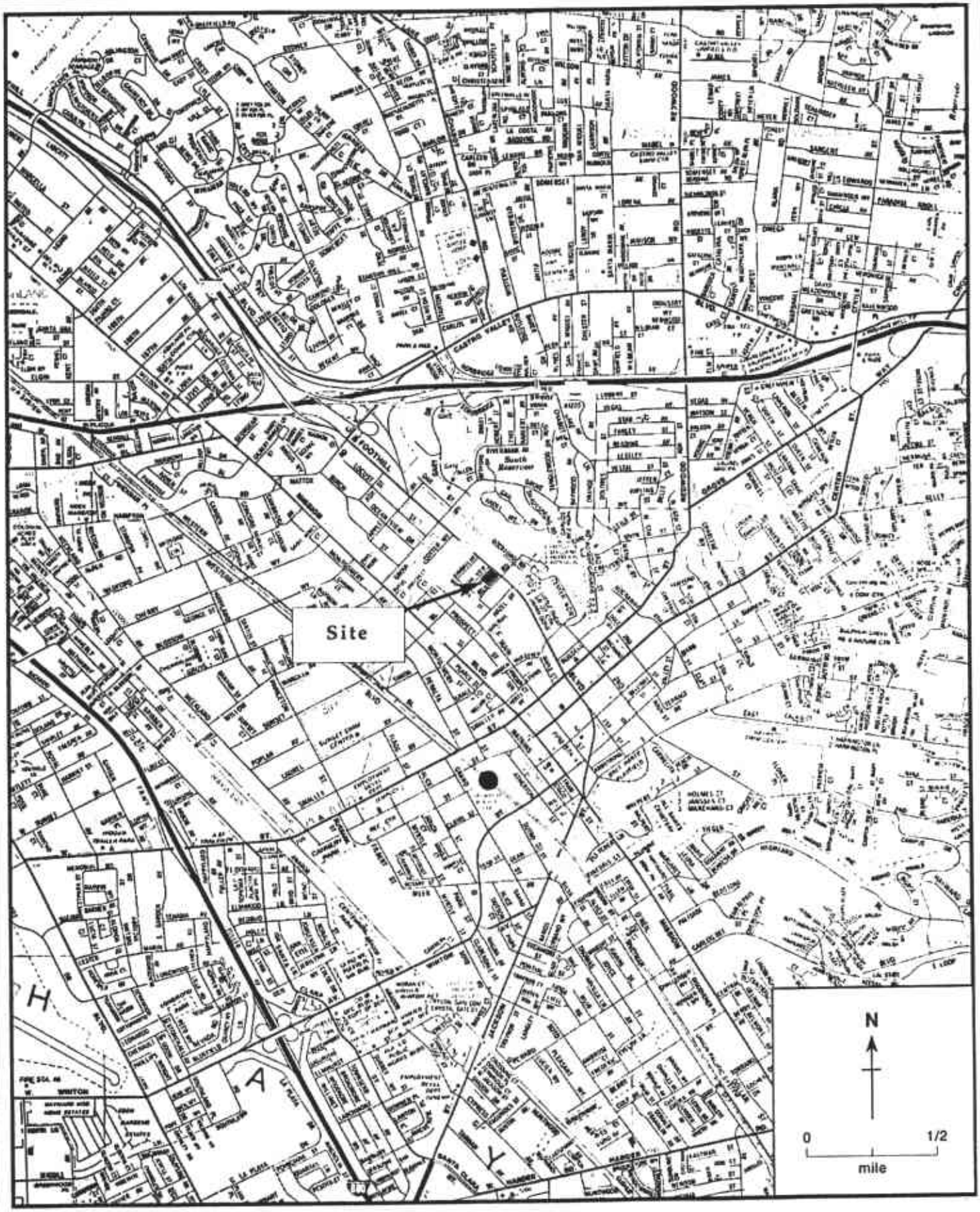


Figure 1. Site Location Map, Former Chevron Service Station #9-0260, 21995 Foothill Blvd, Hayward, California

C310-009.AI

04/02/97

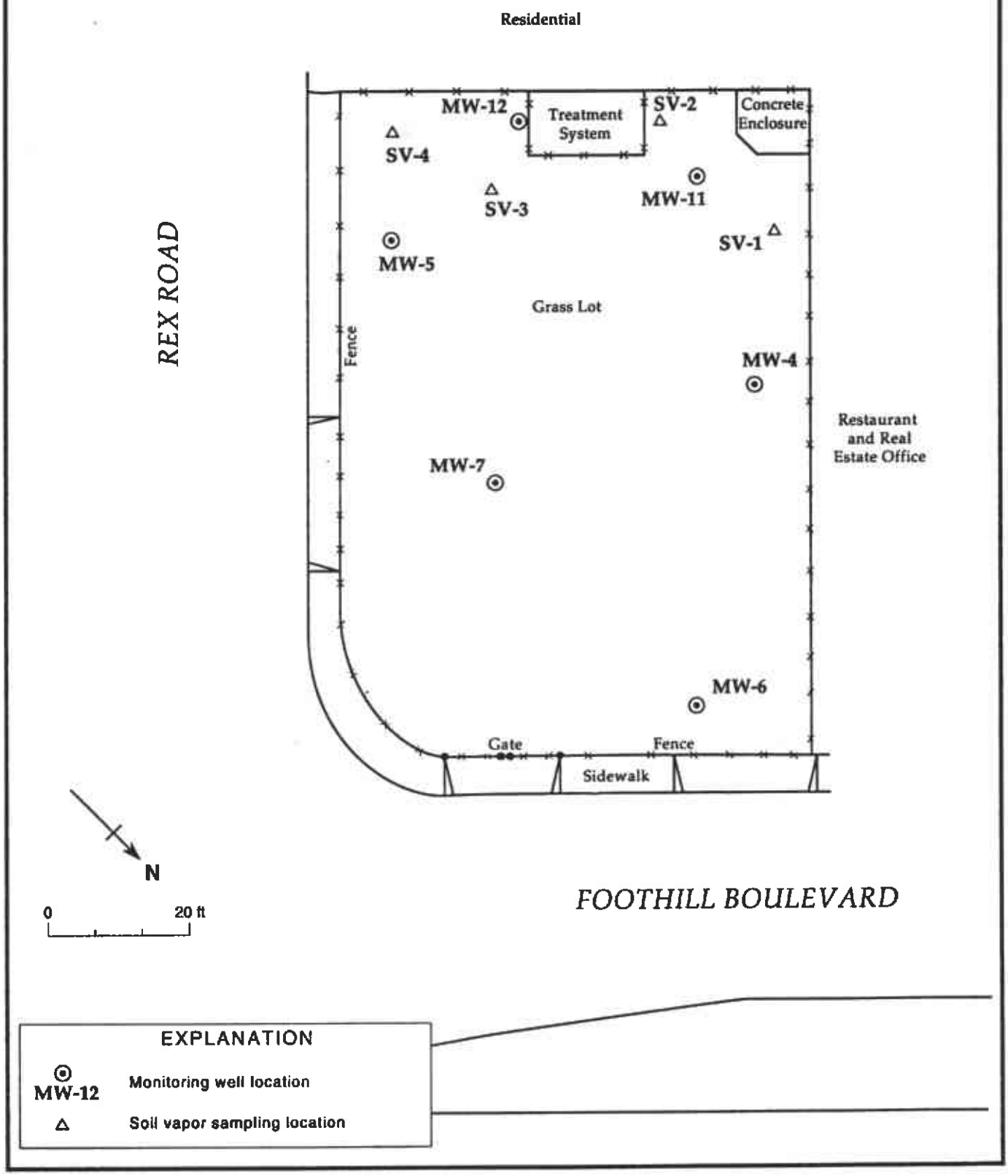


Figure 2. Soil Vapor Sample Locations - Former Chevron Service Station #9-0260, 21995 Foothill Boulevard, Hayward, California

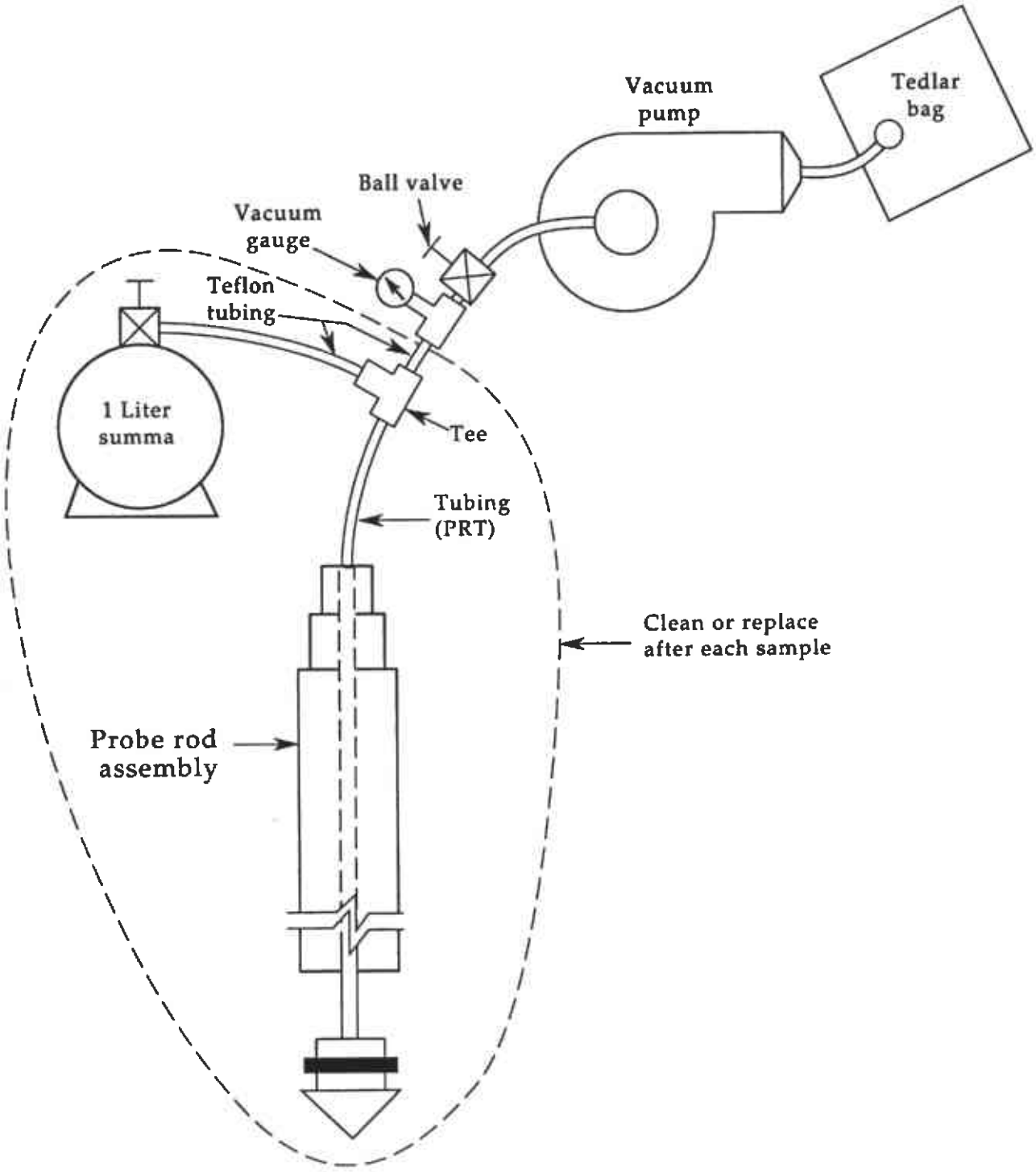


Figure 3. Vapor Sample Collection Configuration - Former Chevron Service Station #9-0260, 21995 Foothill Blvd., Hayward, California

Table 1. Analytic Results for Vapor Samples – Chevron Service Station #9-0260, 21995 Foothill Boulevard, Hayward, California.

Sample ID	Sample Depth (ft)	B	T	E	X
		parts per million by volume (ppmv)			
SV-1	3	0.007	0.012	0.004	0.020
SV-2	3	0.008	0.004	0.006	0.031
SV-3	3.5	<0.002	0.003	0.006	0.018
SV-4	3	0.004	<0.002	<0.002	0.005

Abbreviations:

B = Benzene by Modified CARB Method 410A.
E = Ethylbenzene by Modified CARB Method 410A.
T = Toluene by Modified CARB Method 410A.
X = Xylenes by Modified CARB Method 410A.
<n = Not detected at detection limit of n ppmv

Notes:

Samples collected on 3/18/97 by Weiss Associates and analyzed by Air Toxics, Folsom, California

Table-2. Summary of Indoor Air Risk Calculations - Residential Receptors - Former Chevron Service Station #9-0260, 21995 Foothill Boulevard, Hayward, California

Source Medium	Exposure Pathway	Potentially Complete Pathway?	Benzene		Toluene		Ethylbenzene		Xylenes	
			Representative Risk[a]	Acceptable Risk[b]	Representative Hazard Quotient[a]	Acceptable Hazard Quotient[c]	Representative Hazard Quotient[a]	Acceptable Hazard Quotient[c]	Representative Hazard Quotient[a]	Acceptable Hazard Quotient[c]
Soil Vapor	Vapor Intrusion to Buildings	Yes	6.91×10^{-7}[d] 6.48×10^{-7}[e]	10^{-5}	0.00044[d] 0.00022[e]	1.0	0.000087[d] 0.000043[e]	1.0	0.000062[d] 0.000031[e]	1.0

Notes:

a = Representative risk and representative hazard quotients calculated from the maximum detected benzene, toluene, ethylbenzene and xylenes concentrations in soil vapor. Maximum concentrations of benzene, ethylbenzene and xylenes in soil vapors were detected in sample SV-2 collected on March 18, 1997 from 3 foot depth. The maximum concentration of toluene in soil vapor was detected in sample SV-1 collected on March 18, 1997 from 3 foot depth.

b = Acceptable risk is based on a carcinogenic risk of 1 in 100,000 (10^{-5}) and California's standard cancer slope factor of 0.1 mg/kg-day.

c = Acceptable hazard quotients are based on a chronic hazard quotient of 1.0.

d = Representative risk and representative hazard quotient values based on exposure parameters for children ages 1 through 16 years.

e = Representative risk and representative hazard quotient values based on exposure parameters for adults ages 16 through 70 years.

ATTACHMENT A

LABORATORY ANALYTIC RESULTS

@ AIR TOXICS LTD.

AN ENVIRONMENTAL ANALYTICAL LABORATORY

WORK ORDER #: 9703166

Work Order Summary

CLIENT: Mr. Tim Utterbach
Weiss Associates
5500 Shellmound Street
Emeryville, CA 94608

BILL TO: Same

PHONE: 510-450-6147
FAX: 510-547-5043
DATE RECEIVED: 3/19/97
DATE COMPLETED: 3/24/97

INVOICE # 13652
P.O. # 4-0310-70
PROJECT # 4-0310-70 Chevron Hayward

FRACTION #	NAME	TEST	RECEIPT VAC./PRES.
01A	SV-1 at 3 ft.	Mod. CARB 410A	0 "Hg
02A	SV-2 at 3 ft.	Mod. CARB 410A	0.5 "Hg
03A	SV-3 at 3 ft.	Mod. CARB 410A	2.0 "Hg
04A	SV-4 at 3 ft.	Mod. CARB 410A	0 "Hg
05A	Lab Blank	Mod. CARB 410A	NA

CERTIFIED BY: Linda D. Furman
Laboratory Director

DATE: 3/24/97

Certification numbers: CA ELAP - 1149, NY ELAP - 11291, UT ELAP - E-217

180 BLUE RAVINE ROAD, SUITE B FOLSOM, CA 95630
(916) 985-1000 • (800) 985-5955 • FAX (916) 985-1020

AIR TOXICS LTD.

SAMPLE NAME: SV-1 at 3 ft.
ID#: 9703166-01A

STATE OF CALIFORNIA "LUFT"
(Modified CARB Method 410A - Low Level Aromatics in Air)

GC/PID

File Name: 6032012
Dil. Factor: 2.02

Date of Collection: 3/18/97
Date of Analysis: 3/20/97

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.002	0.007	0.007	0.023
Toluene	0.002	0.008	0.012	0.046
Ethyl Benzene	0.002	0.009	0.004	0.018
Total Xylenes	0.002	0.009	0.020	0.088

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: SV-2 at 3 ft.
ID#: 9703166-02A

STATE OF CALIFORNIA "LUFT"
(Modified CARB Method 410A - Low Level Aromatics in Air)

GC/PID

File Name: 6032013
Dil. Factor: 2.05

Date of Collection: 3/18/97
Date of Analysis: 3/20/97

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.002	0.007	0.008	0.026
Toluene	0.002	0.008	0.004	0.015
Ethyl Benzene	0.002	0.009	0.006	0.026
Total Xylenes	0.002	0.009	0.031	0.14

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: SV-3 at 3 ft.
ID#: 9703166-03A

STATE OF CALIFORNIA "LUFT"
(Modified CARB Method 410A - Low Level Aromatics in Air)

GC/PID

File Name: 6032014
Dil. Factor: 2.16

Date of Collection: 3/18/97
Date of Analysis: 3/20/97

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.002	0.007	Not Detected	Not Detected
Toluene	0.002	0.008	0.003	0.011
Ethyl Benzene	0.002	0.01	0.006	0.026
Total Xylenes	0.002	0.01	0.018	0.079

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: SV-4 at 3 ft.
ID#: 9703166-04A

STATE OF CALIFORNIA "LUFT"
(Modified CARB Method 410A - Low Level Aromatics in Air)

GC/PID

File Name: 6032015
Dil. Factor: 2.02

Date of Collection: 3/18/97
Date of Analysis: 3/20/97

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.002	0.007	0.004	0.013
Toluene	0.002	0.008	Not Detected	Not Detected
Ethyl Benzene	0.002	0.009	Not Detected	Not Detected
Total Xylenes	0.002	0.009	0.005	0.022

Container Type: 1 Liter Summa Canister

AIR TOXICS LTD.

SAMPLE NAME: Lab Blank

ID#: 9703166-05A

STATE OF CALIFORNIA "LUFT"

(Modified CARB Method 410A - Low Level Aromatics in Air)

GC/PID

File Name: 6032008
Dil. Factor: 1.00

Date of Collection: NA
Date of Analysis: 3/20/97

Compound	Det. Limit (ppmv)	Det. Limit (uG/L)	Amount (ppmv)	Amount (uG/L)
Benzene	0.001	0.003	Not Detected	Not Detected
Toluene	0.001	0.004	Not Detected	Not Detected
Ethyl Benzene	0.001	0.004	Not Detected	Not Detected
Total Xylenes	0.001	0.004	Not Detected	Not Detected

Container Type: NA

AIR TOXICS LTD.
AN ENVIRONMENTAL ANALYTICAL LABORATORY

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX: (916) 985-1020

CHAIN-OF-CUSTODY RECORD

№ 010217

Page 1 of 1

Contact Person: Tim Utterback
Company: Weiss Associates
Address: 5500 Shellmound St City: Emeryville State: CA Zip: 94608
Phone: (510) 450-6193 FAX: (510) 547-5043
Collected By: Signature: T. Utterback

Project info:
P.O. # 4-0310-70
Project # 4-0310-70
Project Name: Chevron Hayward

Turn Around Time:
☒ Normal
☐ Rush ____ Specify

Lab I.D.	Field Sample I.D.	Date & Time	Analyses Requested	Canister Pressure / Vacuum Initial	Final	Receipt
01A	SV-1 at 3 ft	3/18/97 10:00	Carb 410A, BTEX only	-30	-1	0"Hg
02A	SV-2 at 3 ft	3/18/97 10:30	" " " "	-30	-1	0.5"Hg
03A	SV-3 at 3.5 ft	3/18/97 11:37	" " " "	-30	-1	2.0"Hg
04A	SV-4 at 3 ft	3/18/97 10:56	" " " "	-30	-1	0"Hg
						3/19/97

Relinquished By: (Signature) Date/Time: T. Utterback 3/18/97
Print Name: Tim Utterback
Relinquished By: (Signature) Date/Time:
Received By: (Signature) Date/Time:
Relinquished By: (Signature) Date/Time:
Received By: (Signature) Date/Time: Jacob Cunningham 3/19/97 937

Notes:

Lab Use Only

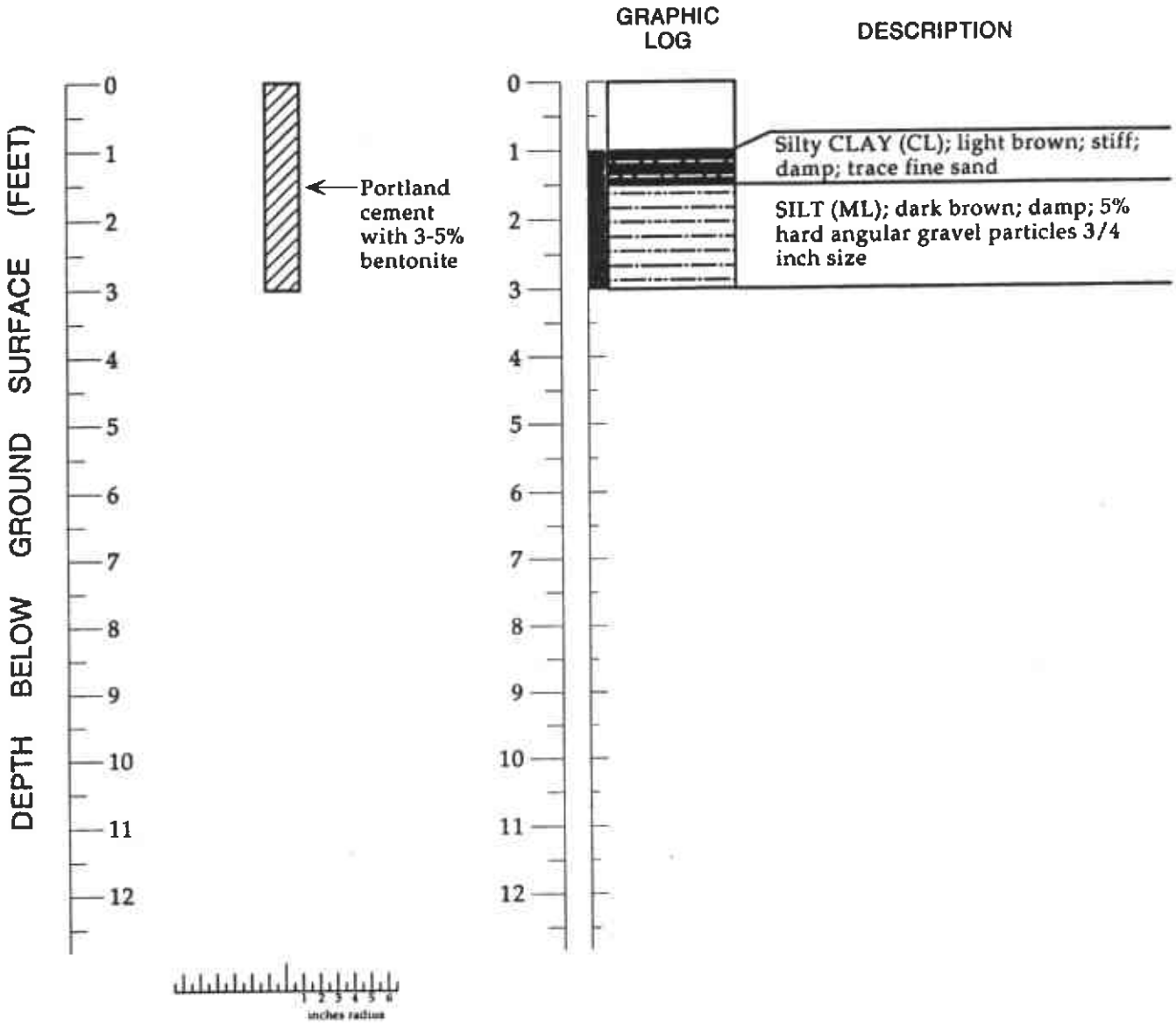
Shipper Name	Air Bill #	Opened By:	Date/Time	Temp. (°C)	Condition	Custody Seals Intact?	Work Order #
FEDEX	866744962	JC	3/19/97 937	AMBIENT	GOOD	Yes No (None) N/A	9703166

Form 1293 rev. 06

ATTACHMENT B

LITHOLOGICAL LOGS

SAMPLE LOCATION SV-1



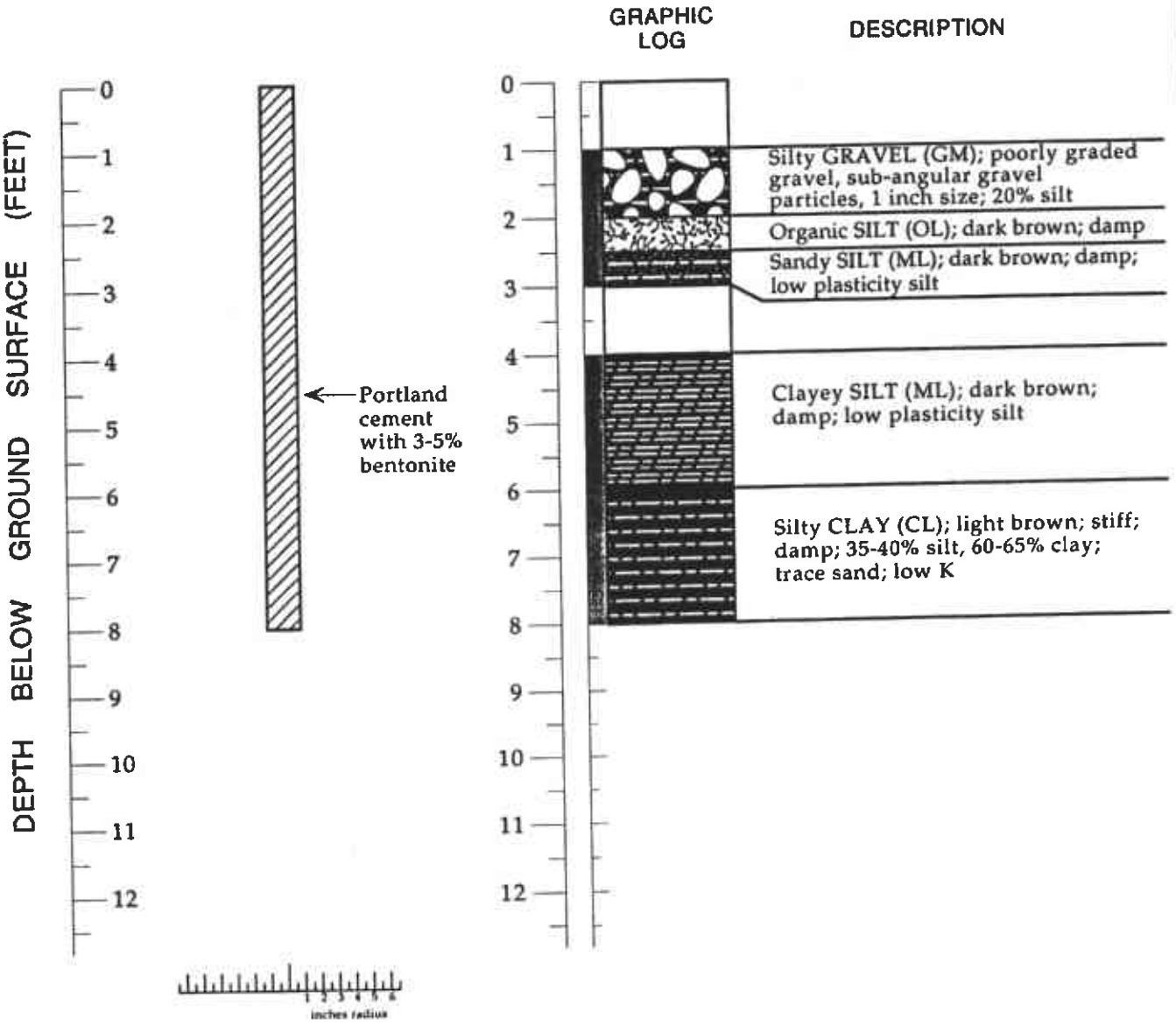
EXPLANATION

- Water level during drilling (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: Tim Utterback
Supervisor: Mike Cooke
Drilling Company: Weiss Associates, Emeryville, CA
License Number: C57-606481
Driller: Inter Phase Inc.
Drilling Method: Geoprobe
Date Drilled: March 18, 1997
Type of Sampler: Geoprobe sampler
Ground Surface Elevation: N/A

Borehole Log - Borehole Location SV-1 - Former Chevron Service Station #9-0260, 21995 Foothill Boulevard, Hayard, California

SAMPLE LOCATION SV-2



EXPLANATION

- ▼ Water level during drilling (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

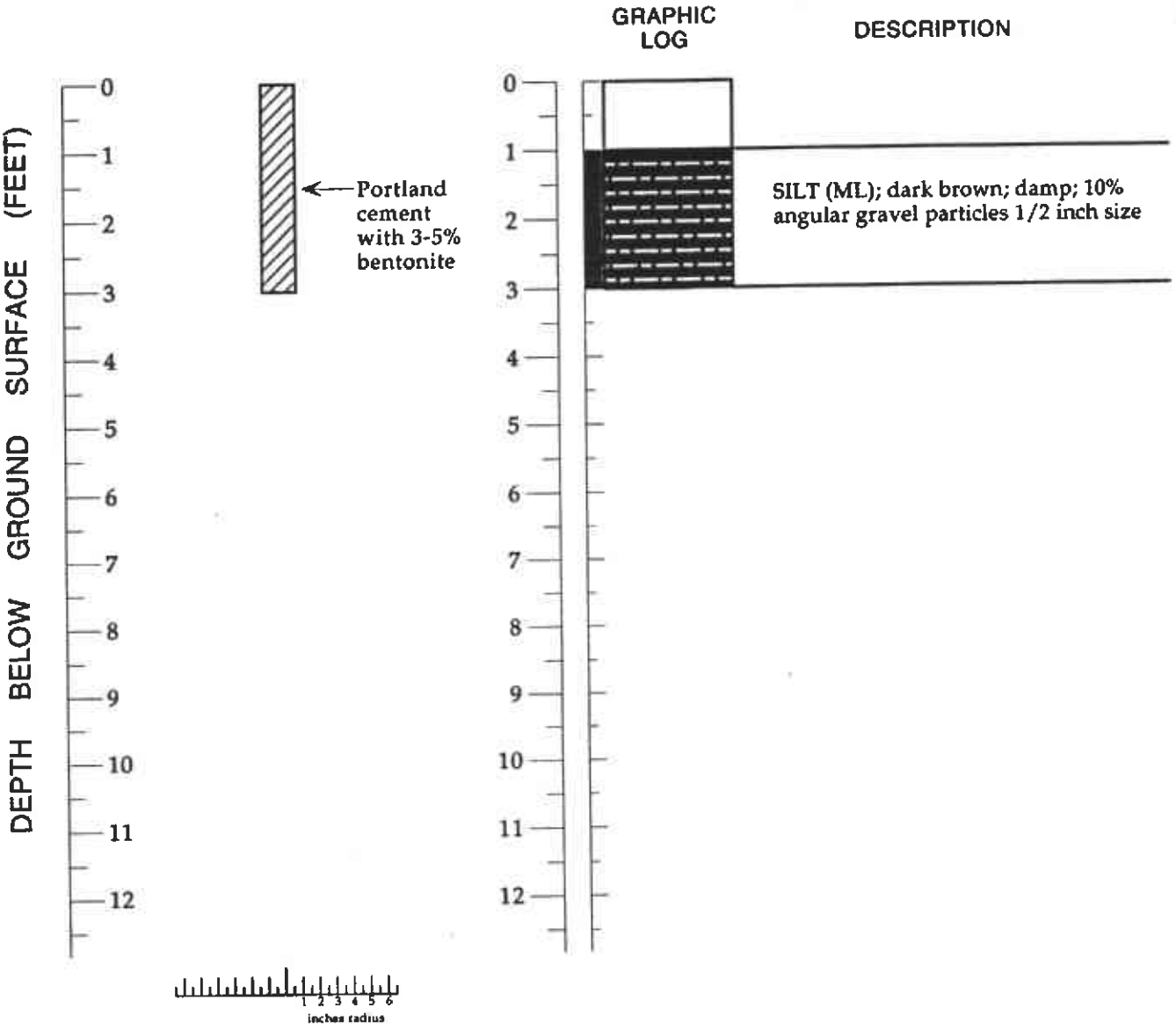
Logged By: Tim Utterback
Supervisor: Mike Cooke
Drilling Company: Weiss Associates, Emeryville, CA
License Number: C57-606481
Driller: Inter Phase Inc.
Drilling Method: Geoprobe
Date Drilled: March 18, 1997
Type of Sampler: Geoprobe sampler
Ground Surface Elevation: N/A

Borehole Log - Borehole Location SV-2 - Former Chevron Service Station #9-0260, 21995 Foothill Boulevard, Hayard, California

04/02/97

C310-02.AI

SAMPLE LOCATION SV-3



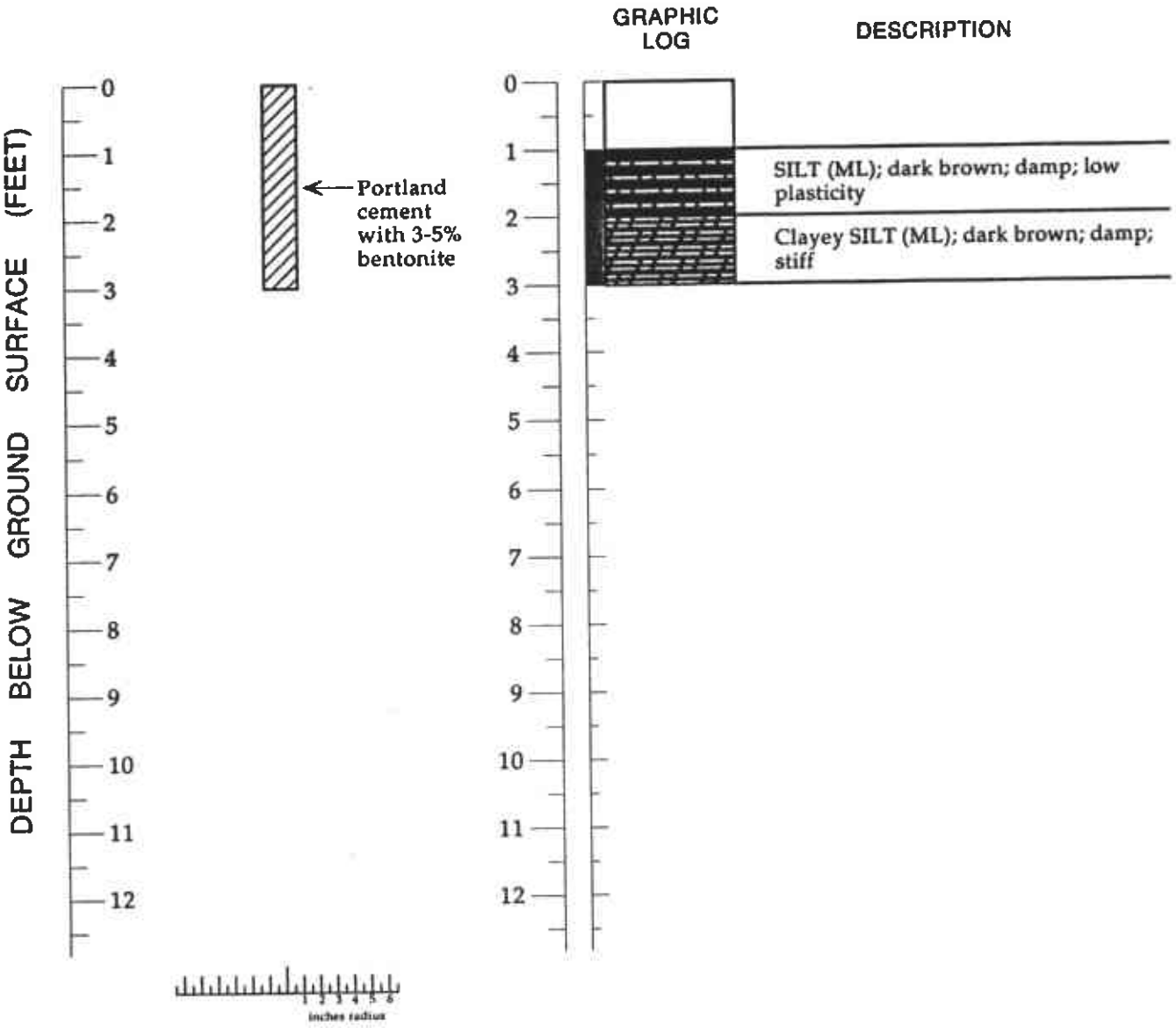
EXPLANATION

- Water level during drilling (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: Tim Utterback
Supervisor: Tim Utterback
Drilling Company: Weiss Associates, Emeryville, CA
License Number: C57-606481
Driller: Inter Phase Inc.
Drilling Method: Geoprobe
Date Drilled: March 18, 1997
Type of Sampler: Geoprobe sampler
Ground Surface Elevation: N/A

Borehole Log - Borehole Location SV-3 - Former Chevron Service Station #9-0260, 21995 Foothill Boulevard, Hayard, California

SAMPLE LOCATION SV-4



EXPLANATION

- Water level during drilling (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: Tim Utterback
Supervisor: Mike Cooke
Drilling Company: Weiss Associates, Emeryville, CA
License Number: C57-606481
Driller: Inter Phase Inc.
Drilling Method: Geoprobe
Date Drilled: March 18, 1997
Type of Sampler: Geoprobe sampler
Ground Surface Elevation: N/A

Borehole Log - Borehole Location SV-4 - Former Chevron Service Station #9-0260, 21995 Foothill Boulevard, Hayard, California

ATTACHMENT C

RISK CALCULATIONS

Indoor Air Risk Calculation - Benzene in Vapor

Residential Receptor - Child Ages 1 Through 16 Years

	Soil Specific Parameters		
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.26	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_t	0.38	Porosity (v/v)
Actual	d	91	**Depth to (location of) vapor sample (cm) - 3 foot depth**
	Diffusivity Parameters		
ASTM 95	H	0.22	Henry's Constant for Benzene
ASTM 95	D^{air}	9.30E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	1.10E-05	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.007258	Effective Diffusion Coefficient soil (cm^2/s)
	Prediction of Flux From Benzene Concentration in Soil Vapor		
Lab Analysis	$C_{v,max}$	8	**Maximum Detected Benzene Concentration in Vapor (ppbv)**
Unit Conv	$C_{v,max}$	0.026	Maximum Detected Benzene Concentration in Vapor (ug/L)
Calculated	F_{max}	2.06E-09	Maximum Diffusive Vapor Flux Predicted by Benzene Concentration in Soil Vapor (ug/cm^2-sec)
	Indoor Air Concentration		
ASTM 95	Lb	200	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	ER_{air}-indoor	0.00014	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	7.35E-08	Enclosed Space Air Concentration (ug/cm^3)
	Dose		
ASTM 95	IR_{air}-indoor	15	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	350	Exposure Frequency (days/year)
USEPA 1989	ED	16	Child Exposure Duration (years)
Calculated	Dose	6.17696	Dose (mg)
	Risk		
CAL EPA	SF_i	0.1	California Cancer Slope Factor for Benzene (kg-day/mg)
USEPA 1989	BW	35	Child Body Weight (kg)
ASTM 95	AT_c	70	Averaging Time for Carcinogens (years)
Calculated	**Risk**	**6.91E-07**	**Risk (unitless)**

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{v,max}}{d}$$

$$C_{indoor} = \frac{F_{max}}{ER_{air-indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air-indoor} \times EF \times ED$$

$$Risk = \frac{Dose \times SF_i}{BW \times AT}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

USEPA 1989 = Environmental Protection Agency, December 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington DC 20460.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and risk calculations from ASTM 95 guidance. Formulas presented above.

Maximum detected benzene concentration in soil vapor: Soil vapor sample SV-2, 3 feet below ground surface, collected March 18, 1997.

Indoor Air Risk Calculation - Benzene in Vapor

Residential Receptor - Adult

	Soil Specific Parameters		
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.26	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_t	0.38	Porosity (v/v)
Actual	d	91	**Depth to (location of) vapor sample (cm) - 3 foot depth**
	Diffusivity Parameters		
ASTM 95	H	0.22	Henry's Constant for Benzene
ASTM 95	D^{air}	9.30E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	1.10E-05	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.007258	Effective Diffusion Coefficient soil (cm^2/s)
	Prediction of Flux From Benzene Concentration in Soil Vapor		
Lab Analysis	$C_{v,max}$	8	**Maximum Detected Benzene Concentration in Vapor (ppbv)**
Unit Conv	$C_{v,max}$	0.026	Maximum Detected Benzene Concentration in Vapor (ug/L)
Calculated	F_{max}	2.06E-09	Maximum Diffusive Vapor Flux Predicted by Benzene Concentration in Soil Vapor (ug/cm^2-sec)
	Indoor Air Concentration		
ASTM 95	Lb	200	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	ER_{air}-indoor	0.00014	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	7.35E-08	Enclosed Space Air Concentration (ug/cm^3)
	Dose		
ASTM 95	IR_{air}-indoor	15	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	350	Exposure Frequency (days/year)
ASTM 95	ED	30	Adult Exposure Duration (years)
Calculated	Dose	11.5818	Dose (mg)
	Risk		
CAL EPA	SF_i	0.1	California Cancer Slope Factor for Benzene (kg-day/mg)
ASTM 95	BW	70	Adult Body Weight (kg)
ASTM 95	AT_c	70	Averaging Time for Carcinogens (years)
Calculated	**Risk**	**6.48E-07**	**Risk (unitless)**

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{v,max}}{d}$$

$$C_{indoor} = \frac{F_{max}}{ER_{air-indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air-indoor} \times EF \times ED$$

$$Risk = \frac{Dose \times SF_i}{BW \times AT}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and risk calculations from ASTM 95 guidance. Formulas presented above.

Maximum detected benzene concentration in soil vapor: Soil vapor sample SV-2, 3 feet below ground surface, collected March 18, 1997.

Indoor Air Risk Calculation - Toluene in Vapor

Residential Receptor - Child Ages 1 Through 16 Years

	Soil Specific Parameters		
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.26	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_t	0.38	Porosity (v/v)
Actual	d	91	**Depth to (location of) vapor sample (cm) - 3 foot depth**
	Diffusivity Parameters		
ASTM 95	H	0.26	Henry's Constant for Toluene
ASTM 95	D^{air}	8.50E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	9.40E-06	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.006633	Effective Diffusion Coefficient soil (cm^2/s)
	Prediction of Flux From Toluene Concentration in Soil Vapor		
Lab Analysis	$C_{v,max}$	**12**	**Maximum Detected Toluene Concentration in Vapor (ppbv)**
Unit Conv	$C_{v,max}$	0.05	Maximum Detected Toluene Concentration in Vapor (ug/L)
Calculated	F_{max}	3.33E-09	Maximum Diffusive Vapor Flux Predicted by Toluene Concentration in Soil Vapor (ug/cm^2-sec)
	Indoor Air Concentration		
ASTM 95	Lb	200	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	ER_{air}-indoor	0.00014	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	1.19E-07	Enclosed Space Air Concentration (ug/cm^3)
	Dose		
ASTM 95	IR_{air}-indoor	15	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	350	Exposure Frequency (days/year)
USEPA 1989	ED	16	Child Exposure Duration (years)
Calculated	Dose	9.988298	Dose (mg)
	Risk		
ASTM 95	RfD_i	0.11	Reference Dose for Inhalation Exposure (mg/kg-day)
USEPA 1989	BW	35	Child Body Weight (kg)
USEPA 1989	AT_n	16	Child Averaging Time for noncarcinogens (years)
Calculated	THQ	**0.00044**	**Calculated Hazard Quotient (unitless)**

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{v,max}}{d}$$

$$C_{indoor} = \frac{F_{max}}{ER_{air-indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air-indoor} \times EF \times ED$$

$$THQ = \frac{Dose}{BW \times AT \times RfD_i}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

USEPA 1989 = Environmental Protection Agency, December 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington DC 20460.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and hazard quotient calculations from ASTM 95 guidance. Formulas presented above.

Maximum detected toluene concentration in soil vapor: Soil vapor sample SV-1, 3 feet below ground surface, collected March 18, 1997.

Indoor Air Risk Calculation - Toluene in Vapor

Residential Receptor - Adult

	Soil Specific Parameters		
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.26	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_t	0.38	Porosity (v/v)
Actual	d	91	**Depth to (location of) vapor sample (cm) - 3 foot depth**
	Diffusivity Parameters		
ASTM 95	H	0.26	Henry's Constant for Toluene
ASTM 95	D^{air}	8.50E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	9.40E-06	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.006633	Effective Diffusion Coefficient soil (cm^2/s)
	Prediction of Flux From Toluene Concentration in Soil Vapor		
Lab Analysis	$C_{v,max}$	**12**	**Maximum Detected Toluene Concentration in Vapor (ppbv)**
Unit Conv	$C_{v,max}$	0.05	Maximum Detected Toluene Concentration in Vapor (ug/L)
Calculated	F_{max}	3.33E-09	Maximum Diffusive Vapor Flux Predicted by Toluene Concentration in Soil Vapor (ug/cm^2-sec)
	Indoor Air Concentration		
ASTM 95	Lb	200	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	ER_{air}-indoor	0.00014	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	1.19E-07	Enclosed Space Air Concentration (ug/cm^3)
	Dose		
ASTM 95	IR_{air}-indoor	15	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	350	Exposure Frequency (days/year)
ASTM 95	ED	30	Adult Exposure Duration (years)
Calculated	Dose	18.72806	Dose (mg)
	Risk		
ASTM 95	RfD_i	0.11	Reference Dose for Inhalation Exposure (mg/kg-day)
ASTM 95	BW	70	Adult Body Weight (kg)
ASTM 95	AT_n	30	Adult Averaging Time for noncarcinogens (years)
Calculated	THQ	**0.00022**	**Calculated Hazard Quotient (unitless)**

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{v,max}}{d}$$

$$C_{indoor} = \frac{F_{max}}{ER_{air-indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air-indoor} \times EF \times ED$$

$$THQ = \frac{Dose}{BW \times AT \times RfD_i}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and hazard quotient calculations from ASTM 95 guidance. Formulas presented above.

Maximum detected toluene concentration in soil vapor: Soil vapor sample SV-1, 3 feet below ground surface, collected March 18, 1997.

Indoor Air Risk Calculation - Ethylbenzene in Vapor

Residential Receptor - Child Ages 1 Through 16 Years

		Soil Specific Parameters	
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.26	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_t	0.38	Porosity (v/v)
Actual	d	91	**Depth to (location of) vapor sample (cm) - 3 foot depth**
		Diffusivity Parameters	
ASTM 95	H	0.32	Henry's Constant for Ethylbenzene
ASTM 95	D^{air}	7.60E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	8.50E-06	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.005931	Effective Diffusion Coefficient soil (cm^2/s)
		Prediction of Flux From Ethybenzene Concentration in Soil Vapor	
Lab Analysis	$C_{v,max}$	**6**	**Maximum Detected Ethylbenzene Concentration in Vapor (ppbv)**
Unit Conv	$C_{v,max}$	0.026	Maximum Detected Ethylbenzene Concentration in Vapor (ug/L)
Calculated	F_{max}	1.71E-09	Maximum Diffusive Vapor Flux Predicted by Ethylbenzene Concentration in Soil Vapor (ug/cm^2-sec)
		Indoor Air Concentration	
ASTM 95	Lb	200	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	ER_{air}-indoor	0.00014	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	6.12E-08	Enclosed Space Air Concentration (ug/cm^3)
		Dose	
ASTM 95	IR_{air}-indoor	15	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	350	Exposure Frequency (days/year)
USEPA 1989	ED	16	Child Exposure Duration (years)
Calculated	Dose	5.144838	Dose (mg)
		Risk	
ASTM 95	RfD_i	0.29	Reference Dose for Inhalation Exposure (mg/kg-day)
USEPA 1989	BW	35	Child Body Weight (kg)
USEPA 1989	AT_n	16	Child Averaging Time for noncarcinogens (years)
Calculated	THQ	**0.000087**	**Calculated Hazard Quotient (unitless)**

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{v,max}}{d}$$

$$C_{indoor} = \frac{F_{max}}{ER_{air-indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air-indoor} \times EF \times ED$$

$$THQ = \frac{Dose}{BW \times AT \times RfD_i}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

USEPA 1989 = Environmental Protection Agency, December 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington DC 20460.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and hazard quotient calculations from ASTM 95 guidance. Formulas presented above.

Maximum detected ethylbenzene concentration in soil vapor: Soil vapor sample SV-2, 3 feet below ground surface, collected March 18, 1997.

Indoor Air Risk Calculation - Ethylbenzene in Vapor

Residential Receptor - Adult

	Soil Specific Parameters		
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.26	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_t	0.38	Porosity (v/v)
Actual	d	91	**Depth to (location of) vapor sample (cm) - 3 foot depth**
	Diffusivity Parameters		
ASTM 95	H	0.32	Henry's Constant for Ethylbenzene
ASTM 95	D^{air}	7.60E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	8.50E-06	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.005931	Effective Diffusion Coefficient soil (cm^2/s)
	Prediction of Flux From Ethybenzene Concentration in Soil Vapor		
Lab Analysis	$C_{v,max}$	6	**Maximum Detected Ethylbenzene Concentration in Vapor (ppbv)**
Unit Conv	$C_{v,max}$	0.026	Maximum Detected Ethylbenzene Concentration in Vapor (ug/L)
Calculated	F_{max}	1.71E-09	Maximum Diffusive Vapor Flux Predicted by Ethylbenzene Concentration in Soil Vapor (ug/cm^2-sec)
	Indoor Air Concentration		
ASTM 95	Lb	200	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	ER_{air}-indoor	0.00014	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	6.12E-08	Enclosed Space Air Concentration (ug/cm^3)
	Dose		
ASTM 95	IR_{air}-indoor	15	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	350	Exposure Frequency (days/year)
ASTM 95	ED	30	Adult Exposure Duration (years)
Calculated	Dose	9.646571	Dose (mg)
	Risk		
ASTM 95	RfD_i	0.29	Reference Dose for Inhalation Exposure (mg/kg-day)
ASTM 95	BW	70	Adult Body Weight (kg)
ASTM 95	AT_n	30	Adult Averaging Time for noncarcinogens (years)
Calculated	THQ	**0.000043**	**Calculated Hazard Quotient (unitless)**

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{v,max}}{d}$$

$$C_{indoor} = \frac{F_{max}}{ER_{air-indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air-indoor} \times EF \times ED$$

$$THQ = \frac{Dose}{BW \times AT \times RfD_i}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and hazard quotient calculations from ASTM 95 guidance. Formulas presented above.

Maximum detected ethylbenzene concentration in soil vapor: Soil vapor sample SV-2, 3 feet below ground surface, collected March 18, 1997.

Indoor Air Risk Calculation - Xylenes in Vapor

Residential Receptor - Child Ages 1 Through 16 Years

	Soil Specific Parameters		
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.26	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_t	0.38	Porosity (v/v)
Actual	d	91	**Depth to (location of) vapor sample (cm) - 3 foot depth**
	Diffusivity Parameters		
ASTM 95	H	0.29	Henry's Constant for Xylenes
ASTM 95	D^{air}	7.20E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	8.50E-06	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.005619	Effective Diffusion Coefficient soil (cm^2/s)
	Prediction of Flux From Xylenes Concentration in Soil Vapor		
Lab Analysis	$C_{v,max}$	31	**Maximum Detected Xylenes Concentration in Vapor (ppbv)**
Unit Conv	$C_{v,max}$	0.137	Maximum Detected Xylenes Concentration in Vapor (ug/L)
Calculated	F_{max}	8.39E-09	Maximum Diffusive Vapor Flux Predicted by Xylenes Concentration in Soil Vapor (ug/cm^2-sec)
	Indoor Air Concentration		
ASTM 95	Lb	200	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	ER_{air}-indoor	0.00014	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	3E-07	Enclosed Space Air Concentration (ug/cm^3)
	Dose		
ASTM 95	IR_{air}-indoor	15	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	350	Exposure Frequency (days/year)
USEPA 1989	ED	16	Child Exposure Duration (years)
Calculated	Dose	25.18274	Dose (mg)
	Risk		
ASTM 95	RfD_i	2.0	Reference Dose for Inhalation Exposure (mg/kg-day)
USEPA 1989	BW	35	Child Body Weight (kg)
USEPA 1989	AT_n	16	Child Averaging Time for noncarcinogens (years)
Calculated	THQ	0.000062	**Calculated Hazard Quotient (unitless)**

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{v,max}}{d}$$

$$C_{indoor} = \frac{F_{max}}{ER_{air-indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air-indoor} \times EF \times ED$$

$$THQ = \frac{Dose}{BW \times AT \times RfD_i}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

USEPA 1989 = Environmental Protection Agency, December 1989. Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A). Office of Emergency and Remedial Response, Washington DC 20460.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and hazard quotient calculations from ASTM 95 guidance. Formulas presented above.

Maximum detected xylenes concentration in soil vapor: Soil vapor sample SV-2, 3 feet below ground surface, collected March 18, 1997.

Indoor Air Risk Calculation - Xylenes in Vapor

Residential Receptor - Adult

		Soil Specific Parameters	
ASTM 95	ρ_s	1.7	Bulk Density(g/cm^3) or (kg/L)
ASTM 95	θ_{as}	0.26	Air Content (v/v)
ASTM 95	θ_{ws}	0.12	Water Content (v/v)
ASTM 95	θ_t	0.38	Porosity (v/v)
Actual	d	91	**Depth to (location of) vapor sample (cm) - 3 foot depth**
		Diffusivity Parameters	
ASTM 95	H	0.29	Henry's Constant for Xylenes
ASTM 95	D^{air}	7.20E-02	Air Diffusion Coefficient (cm^2/s)
ASTM 95	D^{wat}	8.50E-06	Water Diffusion Coefficient (cm^2/s)
Calculated	D^{eff}_s	0.005619	Effective Diffusion Coefficient soil (cm^2/s)
		Prediction of Flux From Xylenes Concentration In Soil Vapor	
Lab Analysis	$C_{v,max}$	**31**	**Maximum Detected Xylenes Concentration in Vapor (ppbv)**
Unit Conv	$C_{v,max}$	0.137	Maximum Detected Xylenes Concentration in Vapor (ug/L)
Calculated	F_{max}	8.39E-09	Maximum Diffusive Vapor Flux Predicted by Xylenes Concentration in Soil Vapor (ug/cm^2-sec)
		Indoor Air Concentration	
ASTM 95	Lb	200	Enclosed Space Volume/Infiltration Area Ratio (cm)
ASTM 95	ER_{air}-indoor	0.00014	Enclosed Space Air Exchange Rate (sec^{-1})
Calculated	C_{indoor}	3E-07	Enclosed Space Air Concentration (ug/cm^3)
		Dose	
ASTM 95	IR_{air}-indoor	15	Daily Indoor Inhalation Rate (m^3/day)
ASTM 95	EF	350	Exposure Frequency (days/year)
ASTM 95	ED	30	Adult Exposure Duration (years)
Calculated	Dose	47.21764	Dose (mg)
		Risk	
ASTM 95	RfD_i	2.0	Reference Dose for Inhalation Exposure (mg/kg-day)
ASTM 95	BW	70	Adult Body Weight (kg)
ASTM 95	AT_n	30	Adult Averaging Time for noncarcinogens (years)
Calculated	THQ	**0.000031**	**Calculated Hazard Quotient (unitless)**

Formulas

$$D_s^{eff} = D^{air}\frac{\theta_{as}^{3.33}}{\theta_T^2} + D^{wat}\frac{1}{H}\frac{\theta_{ws}^{3.33}}{\theta_T^2}$$

$$F_{max} = D_s^{eff}\frac{C_{v,max}}{d}$$

$$C_{indoor} = \frac{F_{max}}{ER_{air-indoor} \times L_b}$$

$$Dose = C_{indoor} \times IR_{air-indoor} \times EF \times ED$$

$$THQ = \frac{Dose}{BW \times AT \times RfD_i}$$

Notes:

ASTM 95 = American Society for Testing and Materials, 1995. Standard Guide for Risk Based Corrective Action Applied at Petroleum Release Sites, E 1739-95.

Calculations: Effective diffusivity, diffusive vapor flux, enclosed space air concentration, dose and hazard quotient calculations from ASTM 95 guidance. Formulas presented above.

Maximum detected xylenes concentration in soil vapor: Soil vapor sample SV-2, 3 feet below ground surface, collected March 18, 1997.

APPENDIX B

TIER 2, RISK BASED ASSESSMENT
by
Terra Vac Corporation

Section 1
Residential Risk Assessment:
Subsurface Soils & Groundwater

RBCA SITE ASSESSMENT | **Tier 2 Worksheet 9.3**

Site Name: Chevron Station 9-0260 | Completed By: 586-4

Site Location: 21995 Foothill Boulevard, Hayward, CA | Date Completed: 11/6/1996

GROUNDWATER SSTL VALUES

Target Risk (Class A & B) 2.9E-7
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 3

SSTL Results For Complete Exposure Pathways ("x" If Complete)

CONSTITUENTS OF CONCERN		Representative Concentration		Groundwater Ingestion			X Groundwater Volatilization to Indoor Air		X Groundwater Volatilization to Outdoor Air		Applicable SSTL	Exceeded ?	Required CRF
CAS No.	Name	(mg/L)	Residential: (on-site)	Commercial: (on-site)	Regulatory(MCL): (on-site)	Residential: (on-site)	Commercial: (on-site)	Residential (on-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	6.8E+0	NA	NA	NA	1.5E-1	NA	4.1E+1	NA	1.5E-1	■	5.9E+01
100-41-4	Ethylbenzene	1.4E+0	NA	NA	NA	>Sol	NA	>Sol	NA	>Sol	☐	<1
108-88-3	Toluene	1.1E+0	NA	NA	NA	>Sol	NA	>Sol	NA	>Sol	☐	<1
1330-20-7	Xylene (mixed isomers)	6.3E+0	NA	NA	NA	>Sol	NA	>Sol	NA	>Sol	☐	<1

Software: GSI RBCA Spreadsheet Serial: G-337-YAX-542
Version: v 1.0

RBCA SITE ASSESSMENT | **Tier 2 Worksheet 9.2**

Site Name: Chevron Station 9-0260 | Completed By: 586-4

Site Location: 21995 Foothill Boulevard, Hayward, CA | Date Completed: 11/6/1996

SUBSURFACE SOIL SSTL VALUES (> 3 FT BGS)

Target Risk (Class A & B) 2.9E-7 ☐ MCL exposure limit?

Target Risk (Class C) 1.0E-5 ☐ PEL exposure limit?

Target Hazard Quotient 1.0E+0

Calculation Option: 3

SSTL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration		Soil Leaching to Groundwater				Soil Volatilization to Indoor Air	X	Soil Volatilization to Outdoor Air		Applicable SSTL	SSTL Exceeded ?	Required CRF
CAS No.	Name	(mg/kg)	Residential: (on-site)	Commercial: (on-site)	Regulatory(MCL): (on-site)	Residential: (on-site)	Commercial: (on-site)	Residential: (on-site)		Commercial: (on-site)		(mg/kg)	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.5E+0	NA	NA	NA	NA	NA	3.3E+0		NA		3.3E+0	☐	<1
100-41-4	Ethylbenzene	6.0E+0	NA	NA	NA	NA	NA	>Res		NA		>Res	☐	<1
108-88-3	Toluene	1.9E+0	NA	NA	NA	NA	NA	>Res		NA		>Res	☐	<1
1330-20-7	Xylene (mixed isomers)	3.3E+1	NA	NA	NA	NA	NA	>Res		NA		>Res	☐	<1

Section 2
Commercial Risk Assessment:
Subsurface Soils & Groundwater

RBCA SITE ASSESSMENT

Tier 2 Worksheet 9.3

Site Name: Chevron Station 9-0260
Site Location: 21995 Foothill Boulevard, Hayward, CA

Completed By: 586-4
Date Completed: 11/6/1996

GROUNDWATER SSTL VALUES

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 3

SSTL Results For Complete Exposure Pathways ("x" if Complete)

CONSTITUENTS OF CONCERN		Representative Concentration		Groundwater Ingestion			X Groundwater Volatilization to Indoor Air		X Groundwater Volatilization to Outdoor Air		Applicable SSTL	Exceeded ?	Required CRF
CAS No.	Name	(mg/L)	Residential: (on-site)	Commercial: (on-site)	Regulatory(MCL): (on-site)	Residential: (on-site)	Commercial: (on-site)	Residential (on-site)	Commercial: (on-site)	(mg/L	"■" If yes	Only if "yes" left
71-43-2	Benzene	4.4E+0	NA	NA	NA	NA	1.6E+0	NA	2.4E+2	1.6E+0	■	3.0E+00
100-41-4	Ethylbenzene	2.5E+0	NA	NA	NA	NA	>Sol	NA	>Sol	>Sol	☐	<1
108-88-3	Toluene	8.6E-1	NA	NA	NA	NA	>Sol	NA	>Sol	>Sol	☐	<1
1330-20-7	Xylene (mixed isomers)	4.1E+0	NA	NA	NA	NA	>Sol	NA	>Sol	>Sol	☐	<1

Software: GSI RBCA Spreadsheet
Version: v 1.0

Serial: G-337-YAX-542

RBCA SITE ASSESSMENT

Tier 2 Worksheet 9.2

Site Name: Chevron Station 9-0260
Site Location: 21995 Foothill Boulevard, Hayward, CA

Completed By: 586-4
Date Completed: 11/6/1996

SUBSURFACE SOIL SSTL VALUES (> 3 FT BGS)

Target Risk (Class A & B) 1.0E-6
Target Risk (Class C) 1.0E-5
Target Hazard Quotient 1.0E+0

☐ MCL exposure limit?
☐ PEL exposure limit?

Calculation Option: 3

SSTL Results For Complete Exposure Pathways ("x" If Complete)

CONSTITUENTS OF CONCERN		Representative Concentration		Soil Leaching to Groundwater			X	Soil Volatilization to Indoor Air		X	Soil Volatilization to Outdoor Air		Applicable SSTL	SSTL Exceeded ?	Required CRF
CAS No.	Name	(mg/kg)	Residential: (on-site)	Commercial: (on-site)	Regulatory(MCL): (on-site)		Residential: (on-site)	Commercial: (on-site)		Residential: (on-site)	Commercial: (on-site)	(mg/kg)	"■" If yes	Only if "yes" left
71-43-2	Benzene	1.5E+0	NA	NA	NA		NA	4.5E-1		NA	1.6E+1	4.5E-1	■	3.0E+00
100-41-4	Ethylbenzene	6.0E+0	NA	NA	NA		NA	>Res		NA	>Res	>Res	☐	<1
108-88-3	Toluene	1.9E+0	NA	NA	NA		NA	>Res		NA	>Res	>Res	☐	<1
1330-20-7	Xylene (mixed isomers)	3.3E+1	NA	NA	NA		NA	>Res		NA	>Res	>Res	☐	<1

Software: GSI RBCA Spreadsheet
Version: v 1.0

Serial: G-337-YAX-542

Risk Assessment:
Backup Data

RBCA TIER 1/TIER 2 EVALUATION

Output Table 1

Site Name: Chevron Station 9-0260 Job Identification: P-0043-30
Site Location: 21995 Foothill Boulevard, Hayw Date Completed: 11/6/96
Completed By: 586-4

Software: GSI RBCA Spreadsheet
Version: v 1.0

NOTE: values which differ from Tier 1 default values are shown in bold italics and underlined.

DEFAULT PARAMETERS

Exposure Parameter	Definition (Units)	Residential Adult	Residential (1-6yrs)	Residential (1-16 yrs)	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
ATc	Averaging time for carcinogens (yr)	70				
ATn	Averaging time for non-carcinogens (yr)	30	6	16	25	1
BW	Body Weight (kg)	70	15	35	70	
ED	Exposure Duration (yr)	30	6	16	25	1
EF	Exposure Frequency (days/yr)	350			250	180
EF.Derm	Exposure Frequency for dermal exposure	350			250	
IRgw	Ingestion Rate of Water (l/day)	2			1	
IRs	Ingestion Rate of Soil (mg/day)	100	200		50	100
IRadj	Adjusted soil ing. rate (mg-yr/kg-d)	1.1E+02			9.4E+01	
IRa.in	Inhalation rate indoor (m^3/day)	15			20	
IRa.out	Inhalation rate outdoor (m^3/day)	20			20	10
SA	Skin surface area (dermal) (cm^2)	5.8E+03		2.0E+03	5.8E+03	5.8E+03
SAadj	Adjusted dermal area (cm^2-yr/kg)	2.1E+03			1.7E+03	
M	Soil to Skin adherence factor	1				
AAFs	Age adjustment on soil ingestion	FALSE			FALSE	
AAFd	Age adjustment on skin surface area	FALSE			FALSE	
tox	Use EPA tox data for air (or PEL based)	TRUE				
gwMCL?	Use MCL as exposure limit in groundwater?	FALSE				

Matrix of Exposed Persons to Complete Exposure Pathways		Residential	Commercial/Industrial Chronic	Commercial/Industrial Constrctn
Groundwater Pathways:				
GW.i	Groundwater Ingestion	FALSE	FALSE	
GW.v	Volatilization to Outdoor Air	TRUE	FALSE	
GW.b	Vapor Intrusion to Buildings	TRUE	FALSE	
Soil Pathways				
S.v	Volatiles from Subsurface Soils	TRUE	FALSE	
SS.v	Volatiles and Particulate Inhalation	FALSE	FALSE	FALSE
SS.d	Direct Ingestion and Dermal Contact	FALSE	FALSE	FALSE
S.l	Leaching to Groundwater from all Soils	FALSE	FALSE	
S.b	Intrusion to Buildings - Subsurface Soils	FALSE	FALSE	

Matrix of Receptor Distance and Location on- or off-site		Residential Distance	Residential On-Site	Commercial/Industrial Distance	Commercial/Industrial On-Site
GW	Groundwater receptor (cm)	9.1E+03	FALSE	9.1E+03	FALSE
S	Inhalation receptor (cm)		TRUE		FALSE

Matrix of Target Risks		Individual	Cumulative
TRab	Target Risk (class A&B carcinogens)	***2.9E-07***	
TRc	Target Risk (class C carcinogens)	1.0E-05	
THQ	Target Hazard Quotient	1.0E+00	
Opt	Calculation Option (1, 2, or 3)	3	
Tier	RBCA Tier	2	

Surface Parameters	Definition (Units)	Residential	Commercial/Industrial Chronic	Commercial/Industrial Construction
t	Exposure duration (yr)	30	25	1
A	Contaminated soil area (cm^2)	***1.9E+06***		
W	Length of affected soil parallel to wind (cm)	***3.0E+03***		
W.gw	Length of affected soil parallel to groundwater (c	1.5E+03		
Uair	Ambient air velocity in mixing zone (cm/s)	2.3E+02		
delta	Air mixing zone height (cm)	2.0E+02		
Lss	Definition of surficial soils (cm)	***9.1E+01***		
Pe	Particulate areal emission rate (g/cm^2/s)	2.2E-10		

Groundwater	Definition (Units)	Value
delta.gw	Groundwater mixing zone depth (cm)	2.0E+02
I	Groundwater infiltration rate (cm/yr)	3.0E+01
Ugw	Groundwater Darcy velocity (cm/yr)	***7.6E+02***
Ugw.tr	Groundwater Transport velocity (cm/yr)	***2.5E+03***
Ks	Saturated Hydraulic Conductivity(cm/s)	1.2E-03
grad	Groundwater Gradient (cm/cm)	2.0E-02
Sw	Width of groundwater source zone (cm)	5.3E+03
Sd	Depth of groundwater source zone (cm)	3.0E+02
BC	Biodegradation Capacity (mg/L)	
BIO?	Is Bioattenuation Considered	TRUE
phi.eff	Effective Porosity in Water-Bearing Unit	3.0E-01
foc.sat	Fraction organic carbon in water-bearing unit	1.0E-03

Soil	Definition (Units)	Value	vadose	foundation
hc	Capillary zone thickness (cm)	***8.1E+01***		
hv	Vadose zone thickness (cm)	***3.0E+02***		
rho	Soil density (g/cm^3)	1.7		
foc	Fraction of organic carbon in vadose zone	***0.02***		
phi	Soil porosity in vadose zone	***0.3***		
Lgw	Depth to groundwater (cm)	***3.7E+02***		
Ls	Depth to top of affected soil (cm)	***9.1E+01***		
Lsubs	Thickness of affected subsurface soils (cm)	***2.1E+02***		
pH	Soil/groundwater pH	6.5		
		capillary	vadose	foundation
phi.w	Volumetric water content	***0.29***	***0.2***	***0.2***
phi.a	Volumetric air content	***0.01***	***0.1***	***0.1***

Building	Definition (Units)	Residential	Commercial
Lb	Building volume/area ratio (cm)	2.0E+02	3.0E+02
ER	Building air exchange rate (s^-1)	1.4E-04	2.3E-04
Lcrk	Foundation crack thickness (cm)	1.5E+01	
eta	Foundation crack fraction	0.01	

Dispersive Transport Parameters	Definition (Units)	Residential	Commercial
Groundwater			
ax	Longitudinal dispersion coefficient (cm)		
ay	Transverse dispersion coefficient (cm)		
az	Vertical dispersion coefficient (cm)		
Vapor			
dcy	Transverse dispersion coefficient (cm)		
dcz	Vertical dispersion coefficient (cm)		

SCREEN 7.3
SUBSURFACE SOILS
CONCENTRATION
CALCULATOR

UCL Percentile

0.95 (must be 0.9 or 0.95)

Analytical Data (Up to 50 Data Points)

	1	2	3	4	5	6	7	8	9	10
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Sample Name										
Date Sampled										
	1.6	1.7								
	10	1.9								
	5.4	0.7								
	5.4	1.2								

Calculated Distribution of Data	Default Detection Limit (mg/L)
Normal	0.005
Normal	0.005
Lognormal	0.005
Normal	0.005

SCREEN 7.1
GROUNDWATER
CONCENTRATION
CALCULATOR

Choose UCL Percentile
[redacted] (must be 0.9 or 0.95)

Analytical Data (Up to 50 Data Points)

	1	2	3	4	5	6	7	8	9	10	11
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)
Well Name	[redacted]										
Date Sampled	[redacted]										
	[redacted]										

Calculated Distribution of Data	Default Detection Limit (mg/L)
Normal	0.005
Normal	0.002
Lognormal	0.002
Normal	0.005

RBCA CHEMICAL DATABASE

Physical Property Data

CAS Number	Constituent	type	Molecular Weight (g/mole) MW	ref	Diffusion Coefficients in air (cm2/s) Dair	re	in water (cm2/s) Dwat	re	log (Koc) or log(Kd) (@ 20 - 25 C) (l/kg) Koc	ref	Henry's Law Constant (@ 20 - 25 C) (atm-m3/mol)	(unitless)	re	Vapor Pressure (@ 20 - 25 C) (mm Hg) Pure Component	ref	Solubility (@ 20 - 25 C) (mg/l) Pure Component	ref	acid pKa	base pKb	ref
71-43-2	Benzene	A	78.1	5	9.30E-02	A	1.10E-05	A	1.58	A	5.29E-03	2.20E-01	A	9.52E+01	4	1.75E+03	A			
100-41-4	Ethylbenzene	A	106.2	5	7.60E-02	A	8.50E-06	A	1.98	A	7.69E-03	3.20E-01	A	1.00E+01	4	1.52E+02	5			
108-88-3	Toluene	A	92.4	5	8.50E-02	A	9.40E-06	A	2.13	A	6.25E-03	2.60E-01	A	3.00E+01	4	5.15E+02	29			
1330-20-7	Xylene (mixed isomers)	A	106.2	5	7.20E-02	A	8.50E-06	A	2.38	A	6.97E-03	2.90E-01	A	7.00E+00	4	1.98E+02	5			

Site Name: Chevron Station 9-0 Site Location: 21995 Foothill Boul Completed By: 586-4 Date Completed: 11/6/1996

Software version: v 1.0

RBCA CHEMICAL DATABASE — Toxicity Data

CAS Number	Constituent	Reference Dose (mg/kg/day) Oral RfD_oral	ref	Inhalation RfD_inhal	re	Slope Factors 1/(mg/kg/day) Oral SF_oral	ref	Inhalation SF_inhal	ref	EPA Weight of Evidence	Is Constituent Carcinogenic ?
71-43-2	Benzene	-	R	1.70E-03	R	2.90E-02	A	2.90E-02	A	A	TRUE
100-41-4	Ethylbenzene	1.00E-01	A	2.86E-01	A	-	R	-	R	D	FALSE
108-88-3	Toluene	2.00E-01	A,R	1.14E-01	,	-	R	-	R	D	FALSE
1330-20-7	Xylene (mixed isomers)	2.00E+00	A,R	2.00E+00	A	-	R	-	R	D	FALSE

Site Name: Chevron Stati Site Location: 21995 Foothill Boulev Completed By: 586-4 Date Completed: 11/6/1996

Software version: v 1.0

APPENDIX C

QUALITY ASSURANCE/CONTROL PLAN

QUALITY ASSURANCE OBJECTIVES

Operation and evaluation for the vacuum extraction process throughout the remediation period requires the collection of operating data. The data will be obtained from chemical analyses of vapor samples. Quality assurance objectives for these analyses are summarized in this section. Samples will be collected and then tested by protocol guidelines set forth in: Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, Volume IB, USEPA SW-846, Third Edition, 1986.

Precision, Accuracy and Representativeness:

Critical review of all data acquisition and analyses with respect to specific quality indicators will enable the QA/QC objectives to be achieved. These indicators are:

Precision: Precision normally measures the reproducibility of measurements under a given set of conditions.

Accuracy: Accuracy is a measurement of the standard error or bias that is inherent in the analytical process.

Representativeness: This is a function of the sampling method used and the procedures for processing the sample. The objective is to demonstrate the degree of quality of the data and the degree to which it represents the actual environmental condition. This can be determined by a comparison of the quality control data for samples analyzed against other data for similar samples under the same circumstances.

Every attempt will be made to validate all data generated. However, some samples may be lost in laboratory and field accidents and some may be deemed questionable based on internal QC procedures. Terra Vac anticipates that some 5 to 10 percent of the recovery values will be outside the QC limits owing to matrix interferences. In the event of gross matrix interferences, revised QA objectives will be developed by the QA officer. The objective is to have more than 90 percent valid data.

Completeness and Comparability:

It is recognized that the usefulness of the data is also contingent upon meeting the criteria for completeness and comparability. Wherever possible, reference methods and standard sampling procedures will be used. The QA objective is that all measurements be comparable to the media and operation being evaluated. These specific objectives are summarized below:

Comparability: This is an expression of the confidence with which one data set can be compared to another. By using standard methodology and QA/QC procedures, the results of the analyses can be compared to other analyses by other laboratories.

Completeness: The indicator for completeness is the percent of samples judged to be valid compared to the total number of samples collected.

PLACEMENT OF WELLS

Remediation systems will be designed with extraction wells placed where there are high degrees of contamination. Each well will be tested shortly after installation. The purpose of the well testing procedure is to quantify the radius of influence, flow rates of vapors, and Volatile Organic Compounds (VOC) concentration at each location. This information will be evaluated by Terra Vac to adjust the location of subsequent wells in the area so that the spacing of the wells is consistent with the radius of influence actually measured in the wells.

After the system begins full scale remediation, wells will be monitored regularly so as to quantify the extraction rate of VOCs from each well. This data will be used to establish initial conditions from which the effectiveness of the vacuum extraction remedy will be evaluated by Terra Vac throughout the proposed period of operation. The parameters to be measured include flow rate, vacuum levels, temperature, and VOC concentration. Normally these four vital measurements are taken at the same time from selected locations throughout the vacuum extraction system. In general, these locations are in the following process areas:

1. Vacuum extraction wells
2. Field piping
3. Separators and condensate collectors
4. Vacuum pumping inlet
5. Ambient air
6. Outlet after vapor treatment

This information will then be transferred to a data base to be used in analytical computations.

SPECIFIC QA MEASURES TO ASSESS DATA QUALITY

Process Gas:

Vapor samples will be compared with an independently prepared standard that is traceable to National Bureau of Standards. These will also be compared to standards prepared on site as a reference. Syringe blanks will be performed 1 in 20 samples as long as blanks show to be clean. If not, then more frequent blanks will be analyzed or a better purge method will be employed. Standards will be analyzed 1 in 20 samples (or at least daily). Duplicate vapor samples will be analyzed 1 in 20 samples. Detection limits for this analysis are anticipated to be in the range of 0.1 to 0.5 ppm.

Pressure, Temperature and Flow:

Pressure gauges, thermometers and flow devices will be routinely cross-checked with a calibrated gauge and thermometer. A field audit of gauges will be conducted as necessary. Any gauge or measuring device that is suspected or found to be out of the accuracy range of the manufacturer specifications will be calibrated or replaced if necessary.

SAMPLING PLAN AND PROCEDURES

Sampling Objectives:

The planned sampling procedures to be used during all phases of the vacuum extraction remediation activities will include the collection of process vapors, and specific process operating data. Attachments 1 and 2 detail sampling protocol and standardization procedures for use in the Terra Vac laboratory.

SAMPLE LOCATIONS AND FREQUENCY

Vapor Samples:

During the remediation process, vapor samples will be collected at various locations and analyzed on a gas chromatograph to determine mass flow rates to the vapor treatment system. Each extraction header will be analyzed for mass flux as determined by the contract.

CALIBRATION PROCEDURES

In order that QA/QC objectives can be achieved it is imperative that the response of all analytical equipment be calibrated to known standards.

Calibration will be achieved by using an independently prepared gas standard that is National Bureau of Standards traceable. Initial calibration of the gas chromatograph will be performed at least three times to assure consistency before standardization. A calibration test shall be performed at least every 20 samples, or daily, whichever is more conservative. Recalibration

will occur if a standard is found to deviate more than 10 percent from the previous standard. No further samples will be analyzed until the instrument is calibrated.

The gas chromatograph and flame ionization detector (FID) will allow total petroleum hydrocarbon (TPH) and halogenated compounds to be analyzed. Typically the calibration is against propane.

DATA REPORTING, VALIDATION, AND REDUCTION

Analytical data are generated from two primary sources: field testing and laboratory testing. Terra Vac testing utilizes several instruments to obtain data. Field data is generated flow meter, temperature, pressure and vacuum gauges, and by gas chromatograph. Analytical data generated by the field gas chromatograph includes the chromatographic identification of compounds, concentrations, retention times and comparisons to standards.

Data production also includes internal records available for inspection during audits. These records include the following: laboratory notebooks, log book, worksheets, standards, records and associated quality control data. A complete record of each sample's history will be available to document the process from the field through the laboratory analysis.

Steps and checks used to validate the precision and accuracy of the analytical work performed and to support its representativeness, comparability and completeness include:

1. Documentation of analytical and QA/QC methodology.
2. Description of the controls for interfering contaminants (use of reference blanks and check standards for method accuracy and precision).
3. Description of the calibration of methods and instruments.

Validation of the analytical data will include review of the following:

1. Contaminants in syringe blanks and background analyses.
2. Agreement between samples and duplicates.
3. Agreement between calibration checks

Levels of contaminants in syringe blanks must be low enough so as not to have an impact on the validity of the data. If contaminants are found in significant levels in one of the field blanks, the sample data will be reviewed to determine if comparable levels are found in other samples obtained that same day.

Attachment 1

TERRA VAC CORPORATION

Sampling Techniques of Volatile Organic Compounds

I. SCOPE

Volatile Organic Compounds (VOC) are regulated, toxic chemicals and should be treated with care to avoid personal and environmental contamination. When sampling vapors from the vacuum system, it will be considered that the air stream is contaminated with VOC's. Care should be taken so that no contaminated air is discharged to atmosphere.

II. EQUIPMENT AND REAGENTS

1. Clean and well lighted work area
2. Hamilton Gastight Syringes 500μl size

III. PROCEDURE

1. Purge syringe with clean air
2. Insert syringe through sample port septum
3. Purge syringe with air stream to be sampled
4. Draw plunger back to desired volume
5. Withdraw needle from septum and stopper with a septum
6. Log time, location, wellhead vacuum and flow then return sample to GC

IV. PRECAUTIONS

Test syringe before use for leaking plunger and tight needle.

Attachment 2

TERRA VAC CORPORATION

Standards

I. SCOPE

The purpose of this procedure is to define the standardization of the gas chromatograph for reference in the quantitative analysis of samples containing unknown amounts of Volatile Organic Compounds. In this case, calibration is done with reference to site specific contaminants.

II. EQUIPMENT AND REAGENTS

1. Clean and well lighted work area
2. Gastight syringes 500 μl, 10 μl size
3. Pure liquid compounds (CAUTION: Some VOCs are known carcinogens and should be handled with care to avoid possible contamination or exposure.)
4. NBS traceable gas standards
5. Gas sampling bulb 500 ml size

III. PROCEDURES

For Liquid Standards

1. Run a blank of the syringe and gas sampling bulb to be used.
2. Inject a known volume (around 1 μl) of the standard into the 500 ml bulb (verify actual bulb volume beforehand).
3. Allow a few minutes for the liquid to evaporate in the bulb. Warm gently, then allow to return to room temperature.
4. Using a gastight syringe, withdraw a 500 μl sample from the bulb and inject it into the GC. Volume utilized should approximate expected field concentrations.
5. Calculation of concentration at sea level:

$$\text{mg/l} = \frac{\text{vol. injected } (\mu\text{l}) * \text{spec gravity } (\text{mg}/\mu\text{l})}{\text{bulb volume (l)}}$$

Note: Specific gravity for reagents are given in the Handbook of Environmental Data for Organic Chemicals, 2nd Ed.

6. If not within 10% of previous calibration, repeat steps 4&5, otherwise maintain calibration values established.
7. Calibration to new values when repeatability is shown. See precautions.

8. Establish retention times for indicator compounds by injecting headspace samples of pure compounds.

For NBS Traceable Gases

1. Run a blank of the syringe.
2. Using a gas tight syringe, withdraw a 500 μl sample directly from the gas cylinder of known concentration.
3. Inject immediately into GC.
4. Calculation of concentration at sea level:

   mg/l = conc given (ppm) / conversion factor

   Note: the conversion factor used will be air pollution factors from the Handbook of Environmental Data for Organic Chemicals, 2nd Ed., and are in units of ppm per mg/l.
5. If not within 10% of previous calibration, repeat steps 2&3, otherwise maintain calibration values established.
6. Calibrate to new values when repeatability is not shown, or a new cylinder of gas is used.
7. Establish retention times as needed by injecting headspace samples of pure compounds.

IV. PRECAUTIONS

1. In injecting headspace vapor from pure compound, care must be taken not to overload the column.
2. A wide change in calibration values indicates that troubleshooting of the system or procedures is necessary.

APPENDIX D

HEALTH AND SAFETY PLAN

RBCA CHEMICAL DATABASE

Miscellaneous Chemical Data

CAS Number	Constituent	Maximum Contaminant Level MCL (mg/L)	Maximum Contaminant Level reference	Permissible Exposure Limit PEL/TLV (mg/m3)	Permissible Exposure Limit PEL/TLV ref	Relative Absorption Factors Oral	Relative Absorption Factors Dermal	Detection Limits Groundwater (mg/L)	Groundwater ref	Detection Limits Soil (mg/kg)	Soil re	Half Life (First-Order Decay) (days) Saturated	Half Life (First-Order Decay) (days) Unsaturated	ref
71-43-2	Benzene	5.00E-03	52 FR 25690	3.20E+00	OSHA	1	0.5	0.002	C	0.005	S	720	720	H
100-41-4	Ethylbenzene	7.00E-01	6 FR 3526 (30 Jan 91	4.34E+02	ACGIH	1	0.5	0.002	C	0.005	S	228	228	H
108-88-3	Toluene	1.00E+00	6 FR 3526 (30 Jan 91	1.47E+02	ACGIH	1	0.5	0.002	C	0.005	S	28	28	H
1330-20-7	Xylene (mixed isomers)	1.00E+01	6 FR 3526 (30 Jan 91	4.34E+02	ACGIH	1	0.5	0.005	C	0.005	S	360	360	H

Site Name: Chevron Stati Site Location: 21995 Foothill Boulevard, Hayward, CA Completed By: 586-4 Date Completed: 11/6/1996

Software version: v 1.0

TERRA VAC

HEALTH AND SAFETY PLAN
FORMER CHEVRON STATION 9-0260
21995 FOOTHILL BOULEVARD
HAYWARD, CALIFORNIA

PROJECT 30-0236

Prepared For:

Chevron Products Company
6001 Bollinger Canyon Road
San Ramon, California 94583

Prepared By:

Terra Vac Corporation
1651 Alvarado Street
San Leandro, California 94577

May 15, 1997

HEALTH AND SAFETY PLAN
FORMER CHEVRON STATION 9-0260
21995 FOOTHILL BOULEVARD
HAYWARD, CALIFORNIA

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HEALTH AND SAFETY PLAN
FORMER CHEVRON STATION 9-0260
21995 FOOTHILL BOULEVARD
HAYWARD, CALIFORNIA

1.00 INTRODUCTION

The purpose of this Health and Safety Plan is to provide a basic framework for the safe performance of all tasks that may occur on-site. The procedures contained in this plan will apply to all Terra Vac employees and subcontractors, as well as any visitors to the site.

1.10 Site Description

The subject property, located at 21995 Foothill Boulevard, Hayward, California, is the site of the former Chevron Station 9-0260 (Figure 1 and Figure 2). The site is currently a vacant lot.

Petroleum hydrocarbons have been detected in the soil beneath the former service station facility. Some soil remediation activities have been undertaken at the site. It is estimated that approximately 15,000 pounds of petroleum hydrocarbons have impacted soil and groundwater beneath the site.

1.20 Project Description

The overall objective of this project is to remediate any remaining petroleum hydrocarbons in the soil beneath the site. Project tasks will include drilling, soil sampling, well installation, process piping installation, utility hook-up, and dual vacuum extraction/ air sparging system operations. Throughout all on-site activities it is required that Terra Vac employees, subcontractors and visitors to the site review and adhere to the Health and Safety Plan (HSP).

2.00 ORGANIZATION AND COORDINATION

2.10 Project Manager

The Project Manager (Tony Dahl) of Terra Vac is responsible for directing, coordinating and controlling all site activities and is solely responsible for enforcing onsite compliance with the provisions of the Health and Safety Plan. The Project Manager has the authority to stop work at the site if unsafe conditions exist.

2.20 Site Safety Officer

A Site Safety Officer (SSO), Tony Dahl, shall be designated to coordinate all aspects of site health and safety activities. The SSO will report directly to the Project Manager. In addition to ensuring the implementation and enforcement of the Site Health and Safety Plan, the SSO duties include:

- Monitoring for volatile petroleum hydrocarbon concentrations in the breathing zone of site personnel with a photoionization detector (PID) during soil drilling and intrusive work activities.
- Keeping a daily log of site activities, including type of activities, date, and location.
- Determining the level of respiratory protection required for the specific work activity.
- Conducting site safety meetings, which all onsite personnel shall be required to attend.
- Maintaining, inspecting and controlling an adequate inventory of safety equipment onsite.
- Monitoring all onsite hazards and conditions, including possible heat/cold stress situations.
- Monitoring any site decontamination procedures.

If Mr. Dahl is unavailable to perform onsite duties, another duly trained individual will be appointed. When only one Terra Vac employee is onsite, that employee will be designated the SSO.

2.30 Team Members

Team members shall consist of all personnel involved in the project who will be allowed onsite. All team members will be responsible for understanding and complying with the HSP requirements.

2.40 Subcontractors

All subcontractors performing work for Terra Vac will be provided with a copy of the HSP and are required to attend all site safety meetings. It will be the responsibility of each subcontractor to ensure that their work is performed in a safe manner and in accordance with the HSP.

3.00 MEDICAL MONITORING/TRAINING REQUIREMENTS

Terra Vac has established a medical surveillance program designed to monitor and reduce health risks for its employees who have potential to be exposed to hazardous materials. This program is based on the Occupational Safety and Health Administration (OSHA) requirements under the U.S. Department of Labor (29 CFR 1910.120). Medical examinations are administered on an annual basis. Each employee is issued a certificate to certify him/her for respirator use upon completion of all requirements.

All Terra Vac activities will be performed in accordance with OSHA Standards and with properly trained employees who have passed all medical requirements of 29 CFR 1910.120. In addition, site specific training will be given to all personnel expected to perform activities onsite. This training will address any potential hazards and associated risks, site operating procedures and emergency response procedures.

All subcontractors of Terra Vac whose personnel may be exposed to health and safety hazards will be responsible to insure their employees have received the proper training and medical tests as required by OSHA (29 CFR 1910.120).

4.00 ONSITE HAZARDS

4.10 Chemical Hazards

The primary hazard to workers at the site is the potential for release of hazardous levels of volatile organic compounds (VOCs) from soils as the result of soil disturbance activities. Drilling is the only intrusive activities anticipated on site.

Common symptoms of overexposure to gasoline compounds at the site are headache, dizziness, weakness, loss of coordination or irritation of the eyes, nose or throat. Air monitoring and associated action levels will be based on the exposure limits of gasoline/benzene with a margin of safety built into the action level. The chemical and physical properties of these materials, including exposure limits, are listed in Attachment A. Material Safety Data Sheets (MSDSs) for the hazardous materials found onsite are included in Attachment B.

4.20 Physical Hazards

Physical hazards typically found at construction sites will be of concern at this site. These hazards include slippery ground surfaces, uneven terrain, holes/trenches, operation of heavy equipment and traffic. The basic Level D safety apparel such as steel-toed shoes, hard hat and safety glasses will be worn during all onsite activities. Additionally, while work is being conducted in the public right of way, safety vest should be worn at all times. All work within the public right of way will be in strict accordance with the site traffic plan and encroachment permit.

Noise is not expected to be above 80 decibels within the equipment compound and 65 decibels at the perimeter of the site. However, it is standard practice for workers to wear hearing protection while performing routine maintenance on the operating equipment. A sound wall will be installed around the equipment compound to minimize noise levels.

4.30 Environmental Hazards

Environmental hazards may exist at the project site, such as exposure to heat, wind, rain and lightening. To avoid the possibility of heat stress, the work regime defined below will be followed. When weather conditions change, the Project Manager and the SSO will be responsible for determining if work procedures can be performed safely.

For workers not wearing protective clothing, the following applies:

Temperature*	Work	Rest	Comments
70-80° F	4.0 hr.	15 min.	Review heat stress symptoms in a safety meeting.
80-85° F	2.0 hr.	15 min.	Review heat stress in a safety meeting. Schedule a beverage break every 2 hours.
85-90° F	2.0 hr.	15 min.	Seated rest. Drink at least 8 ounces at each break.
Above 90° F	1.5 hr.	15 min.	As above. Rest area should be shaded.

For workers who are wearing protective clothing, pulse rate monitoring will be used to schedule work/rest in accordance with the following:

Temperature*	Action
72.5-77.5° F	Monitoring each 120 minutes of work
77.5-82.5° F	Monitoring each 90 minutes of work

Temperature*	Action
82.5-87.5° F	Monitoring each 60 minutes of work
87.5-90.0° F	Monitoring each 30 minutes of work
90.0° F or above	Monitoring each 15 minutes of work

If pulse rates are above 110 beats per minute, the length of the next work period will be shortened by 1/3.

* Temperature measured with a thermometer in the work area.

5.00 RISK ASSESSMENT

Exposure to chemical/physical hazards vary depending upon the work activity. The following is a summary of work activities and related exposure risks.

Activity	Chemical/Physical Risks	Assessment
Drilling/ Well installation	possible exposure to contaminated soils, heavy lifting, rotating equipment, heat stress	moderate-high
Construction	heavy lifting, heat stress	low-moderate
Start-up/ Operations	heat stress	low

Demobilization	heavy lifting, rotating equipment, heat stress	low-moderate

6.00 SITE MONITORING/ACTION LEVELS

Intrusive field activities associated with the installation and/or operation of the dual extraction remediation system may create potential hazardous conditions such as the release of hazardous substances, especially during drilling activities. Monitoring with a hand-held photoionization detector (PID) will be conducted in the work zone during intrusive work and sampling activities to ensure appropriate personal protective measures are employed. The PID will monitor total VOC levels and will be calibrated daily using 100 ppm Isobutylene.

6.10 Action Levels

During the course of any activity, if PID readings of 0 - 99 parts per million (ppm) are encountered in the breathing zone of the exclusion area, level D personal protective equipment shall be used. If concentrations exceed 100 ppm for a period of 5 minutes or longer, the level of PPE shall be upgraded to level C. These levels are based on the assumption that benzene is 1% of the volatile compounds encountered onsite. The action level for benzene shall be 1 ppm.

6.20 Personal Protective Equipment

Based on an evaluation of the hazards at the site, personal protective equipment (PPE) will be required for all personnel and visitors entering the controlled portion (exclusion zone) of the site. Protective clothing and respiratory protection for each level of protection are as follows:

Level D:

- Long trousers and shirt
- Steel-toed shoes
- Safety glasses (if necessary)
- Protective gloves (if necessary)
- Safety vest

Level C:

- Level D PPE
- Full or half face air purifying, organic vapor cartridge equipped respirator
- Disposable chemical resistant one-piece suit (tyvek)
- Inner and outer chemical resistant gloves

- Safety vest

The anticipated levels for the various work activities are as follows:

*	Drilling activities (well installation/soil sampling)	C or D
*	Installation of process piping and equipment	D
*	System operations	D
*	System sampling	D
*	Site demobilization	D

7.00 SITE CONTROL PLAN

Site safety zones will be established during site activities. These zones will be dynamic and the size and function of each zone will depend on the type of activity taking place. Only authorized personnel who comply with the training and medical requirements of 29 CFR 1910.120 may enter the exclusion zone of the site. The exclusion zone will be established around any intrusive activity, such as drilling.

7.10 Exclusion Zone (EZ)

The controlled portion of the site will be delineated to identify the exclusion zone, wherein a higher level of personal protective equipment may be required for entry. An EZ will be designated during intrusive activities such as drilling and soil sampling. The limits of the EZ will be defined by caution tape and barricades.

All personnel entering the EZ will be required to wear the level of protection (D or C) which has been selected by the SSO.

7.20 Decontamination Zone (DZ)

The DZ will be located immediately outside of the exclusion zone. Upon leaving the EZ, all personnel and equipment must follow appropriate decontamination procedures depending on the level of protection used within the EZ. This zone will also be delineated using barricades.

7.30 Support Zone (SZ)

The support zone is considered to be the areas at the site at background concentration of any volatile compounds. All equipment and materials are stored and maintained in this zone. During operations, this zone will include the equipment compound containing the remediation system. Access will be controlled to limit any potential dangers to untrained personnel.

8.00 EMERGENCY PROCEDURES

Emergency communications at the site will be by means of a mobile phone or onsite telephone. A list of emergency telephone numbers will be posted along with maps showing emergency evacuation routes from the site and the route to the nearest hospital (see Figure 3, Hospital Location Map and Table 1, Emergency Telephone Numbers). A first aid kit will be located at or near the equipment area.

All injuries occurring onsite, no matter how minor, will be immediately reported to the SSO. The SSO shall evaluate the extent of the injury, arrange for appropriate medical attention, and investigate the cause of the injury.

The SSO and/or Project Manager are directly responsible for locating all personnel. When the site is evacuated due to an onsite emergency, personnel shall not re-enter until:

1) The conditions resulting in the emergency have been corrected.
2) The hazards have been reassessed.
3) The Health and Safety Plan has been reviewed
4) Site personnel have been briefed on any changes in safe work procedures.
5) A Terra Vac representative gives the all clear.

9.00 HAZARD COMMUNICATION PROGRAM

A hazardous chemical is broadly defined as a chemical that is either a health hazard, a physical hazard, or both. To insure that all employees and subcontractors receive the necessary information regarding the safe handling of chemicals and other substances that are normally

required in the execution of Terra Vac projects, a Hazard Communication Program has been established.

A list of hazardous chemicals will be maintained by the Project Manager or SSO. The master list will consist of all hazardous chemicals used or stored at the project site and will be updated whenever a new chemical is brought to the site. The Project Manager or SSO must be notified of any chemical substance being ordered for the first time so as to be able to add that chemical to the master list.

Material Safety Data Sheets (MSDSs) for each chemical used or stored at the site are found in Attachment B.

10.00 SITE RULES/PROHIBITIONS

The following is a list of rules and prohibitions required for Terra Vac job sites.

1. Personal protective equipment will be required for all onsite personnel dependent upon action level (Level D is required if no other level is specified).
2. Operating logs and health and safety logs will be onsite for review and daily entries beginning with the drilling activities.
3. Health and safety monitoring for chemical, physical and environmental risks will be performed as needed and by qualified personnel.
4. Workers will be properly trained for the various tasks performed during this project.
5. Personnel and equipment will be properly decontaminated prior to breaks and leaving the site.
6. All onsite personnel will review and understand the Health and Safety Plan.
7. All work will be performed in a professional and safe manner.
8. All accidents will be reported to the Project Manager and the SSO.
9. No smoking will be permitted in Terra Vac vehicles, offices or at job sites.
10. No Terra Vac employee will be under the influence of alcohol or controlled substances while conducting Terra Vac business.

TABLE 1

EMERGENCY TELEPHONE NUMBERS

Ambulance/Paramedics:	**emergency**	**911**

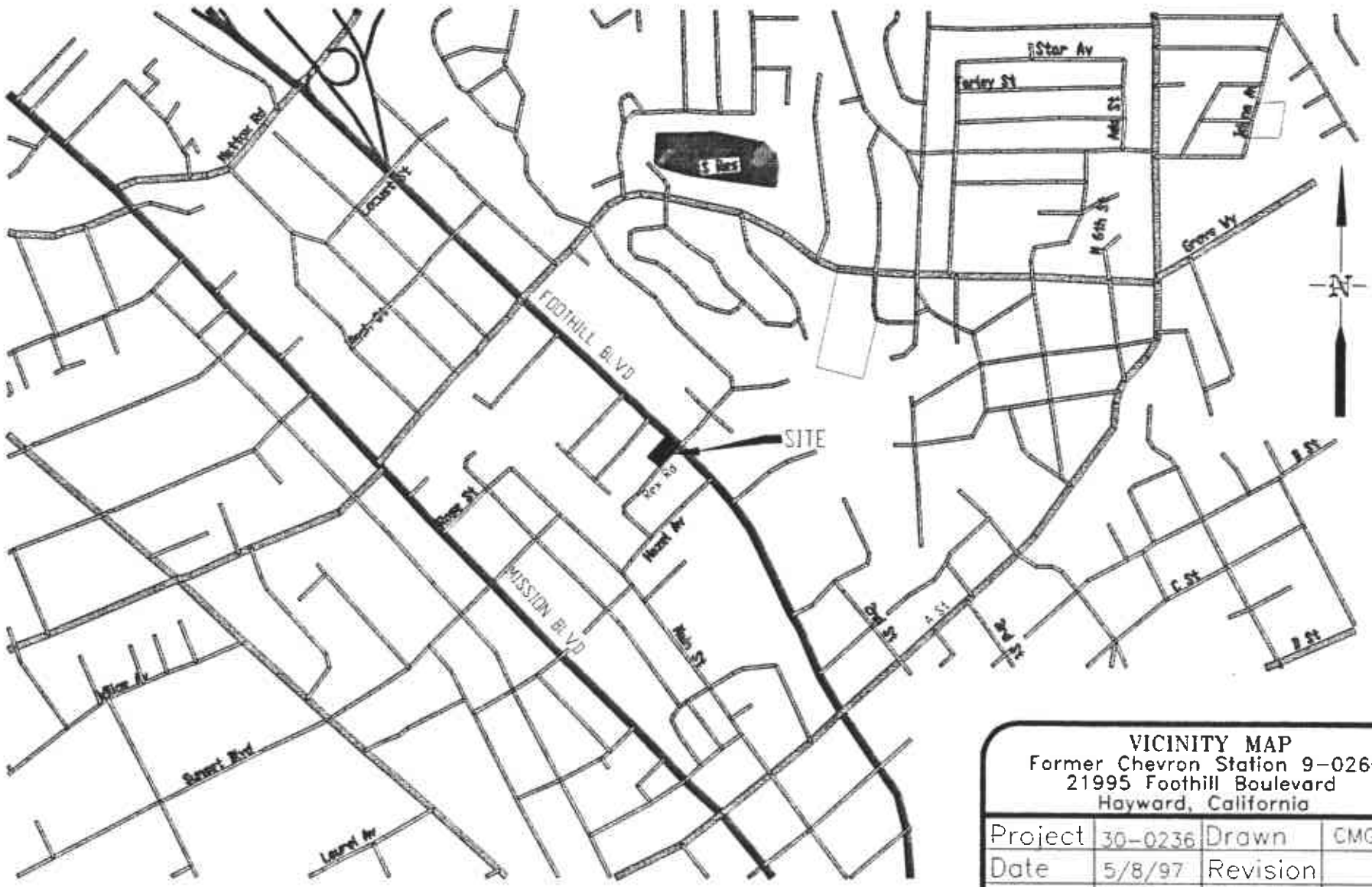
Hospital:

Eden Medical Center — emergency — (510) 889-5015
20103 Lake Chabot Rd.
Castro Valley, CA

Directions to the Hospital:

From site, left on Foothill Boulevard approximately 0.75 miles to Castro Valley Boulevard. Right on Castro Valley Boulevard to Lake Chabot Road, approximately 0.71 miles. Left on Lake Chabot Road approximately 0.02 miles, hospital will be on the left side of the street.

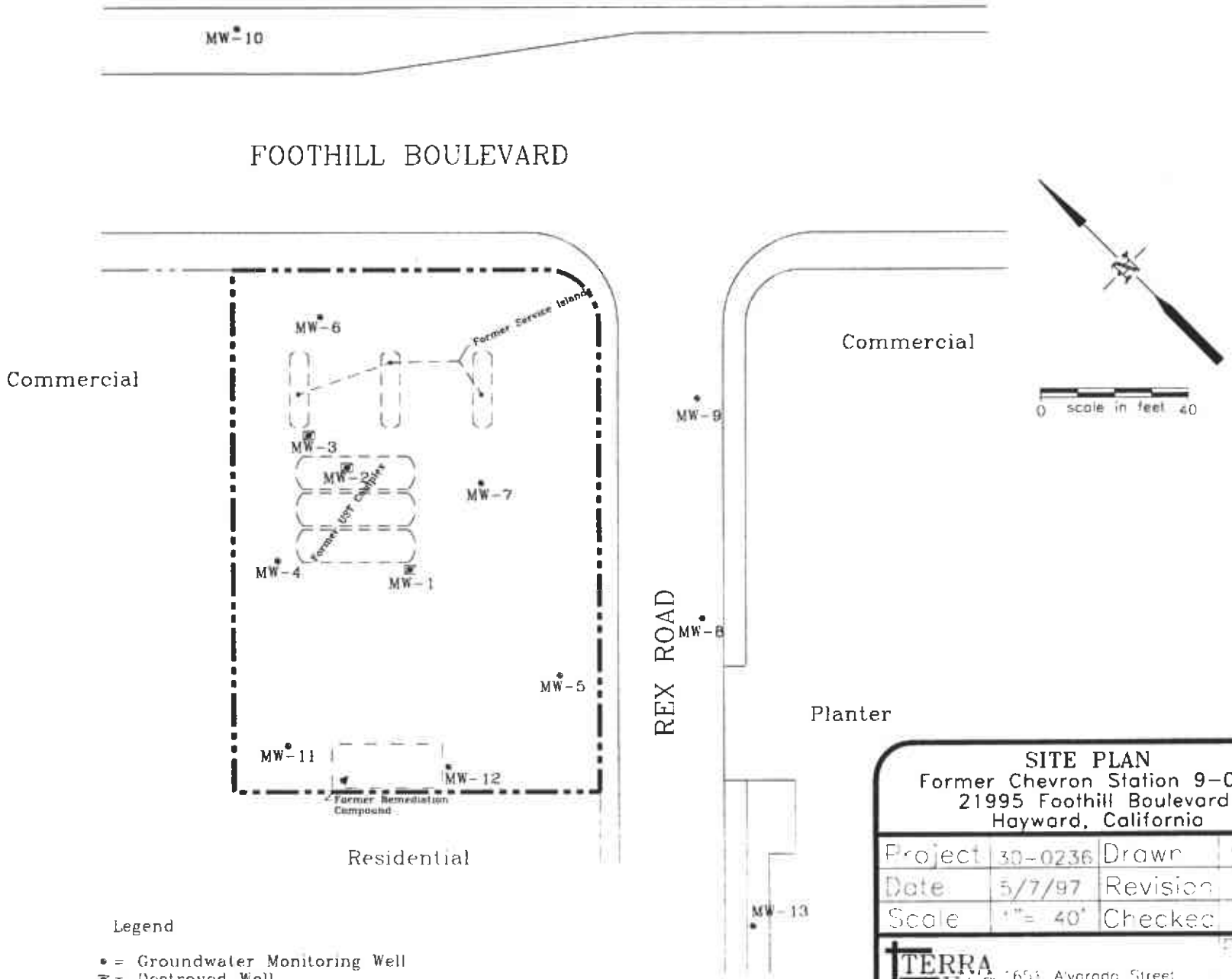
Fire Department:	**emergency** Business	**911** (510) 293-8690
Police Department:	**emergency** general	**911** (510) 293-7000
Poison Control Center: (San Francisco)	24 Hours	1 (800) 523-2222
Terra Vac Office:	office	(510) 351-8900



VICINITY MAP
Former Chevron Station 9-0260
21995 Foothill Boulevard
Hayward, California

TERRA VAC
1651 Alvarado Street
San Leandro, CA 94577
(510) 351-8900 Fax: -0221

Figure 1

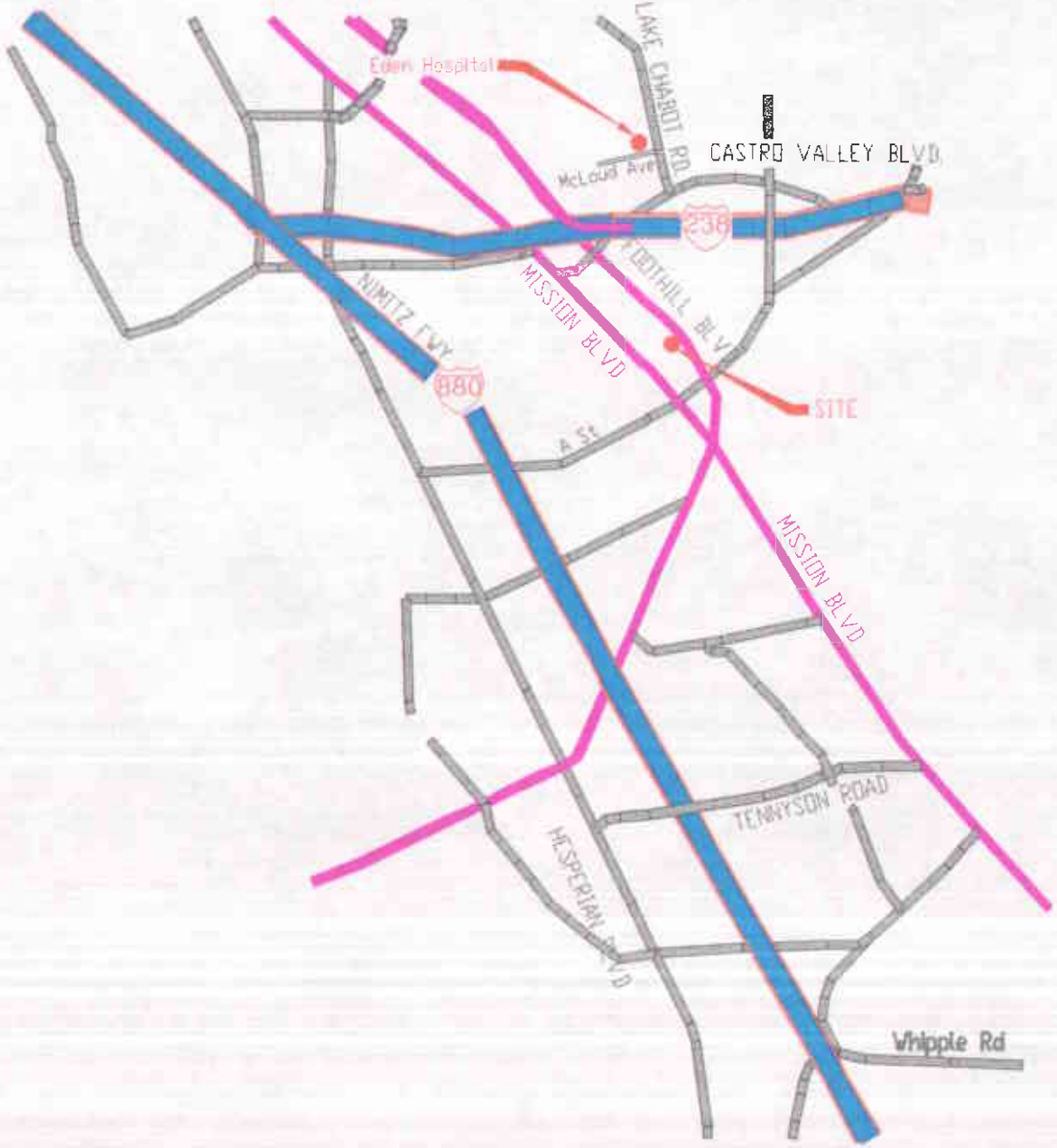


SITE PLAN
Former Chevron Station 9-0260
21995 Foothill Boulevard
Hayward, California

Project	30-0236	Drawn	CVG
Date	5/7/97	Revision	
Scale	1" = 40'	Checked	

TERRA VAC
1654 Alvarado Street
San Leandro, CA 94577
(510) 351-8900 Fax: (510) 351-0227

Figure 2



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ROUTE TO HOSPITAL
Eden Hospital
20103 Lake Chabot Road
Castro Valley, California

Project	30-0236	Drawn	CMG
Date	5/8/97	Revision	
Scale	N.T.S.	Checked	

TERRA VAC
1651 Alvarado Street
San Leandro, CA 94577
(510) 351-8900 Fax: -0221

Figure 3

ATTACHMENT A

CHEMICAL AND PHYSICAL PROPERTIES OF CONTAMINANTS

PROJECT 30-0236

MUST ADHERE TO LOWEST VALUE

CONTAMINANT	EXPOSURE LIMIT	IDLH LEVEL	PROPERTIES	
Benzene	1 ppm PEL	2000 ppm	MW: 78 BP: 176 F SOL: 0.18% IP: 9.25ev Flash Point: 12 F	VP: 75 mm MP: 42 F UEL: 7.1% LEL: 1.3%
Gasoline (Regular)	300 ppm TLV		MW: n/a BP: 25-225 F SOL: insoluble IP: n/a Flash Point: < -49 F	VP: 5-15 PSI MP: n/a UEL: 7.6% LEL: 1.4%
Gasoline (Unleaded)	300 ppm TLV		MW: n/a BP: 25-225 F SOL: insoluble IP: n/a Flash Point: < -49 F	VP: 5-15 PSI MP: n/a UEL: 7.6% LEL: 1.4%

PEL (permissible exposure limit) **set by:** Cal OSHA
TLV (threshold limit values) **set by:** ACGIH
REL (time weighted average (TWA) concentration for up to 10 hour workday during 40 hour work-week) **set by:** NIOSH (10hr TWA)

ATTACHMENT B

MATERIAL SAFETY DATA SHEETS

Chevron

Material Safety Data Sheet

CHEVRON Regular Gasoline

TERRA VAC
ATTN: TONY DAHL
P.O.BOX 1918
SAN LEANDRO, CA 94577

Print Date: December 21, 1990

This Material Safety Data Sheet contains environmental, health and toxicology information for your employees. Please make sure this information is given to them. It also contains information to help you meet community right-to-know/emergency response reporting requirements under SARA Title III and many other laws. If you resell this product, this MSDS must be given to the buyer or the information incorporated in your MSDS. Discard any previous edition of this MSDS.

Revised to update Sections 1, 10, 11 and 12.

1. PRODUCT IDENTIFICATION

CHEVRON Regular Gasoline

DANGER:
- HARMFUL OR FATAL IF SWALLOWED - CAN ENTER LUNGS AND CAUSE DAMAGE
- VAPOR HARMFUL
- LONG-TERM EXPOSURE TO VAPOR HAS CAUSED CANCER IN LABORATORY ANIMALS
- MAY CAUSE EYE AND SKIN IRRITATION
- EXTREMELY FLAMMABLE
- CONTAINS LEAD
- KEEP OUT OF REACH OF CHILDREN

PRODUCT NUMBER(S): CPS201305
PRODUCT INFORMATION: (800)582-3835

Prepared According to the OSHA Hazard Communication Standard (29 CFR 1910.1200) by the Chevron Environmental Health Center, Inc., P.O. Box 4054, Richmond, CA 94804.

2. FIRST AID - EMERGENCY NUMBER (800)457-2022 OR (415)233-3737

EYE CONTACT:
Flush eyes immediately with fresh water for at least 15 minutes while holding the eyelids open. Remove contact lenses if worn. No additional first aid should be necessary, however, if irritation persists, see a doctor.

SKIN CONTACT:
Remove contaminated clothing. Wash skin thoroughly with soap and water. See a doctor if any signs or symptoms described in this document occur. Discard contaminated non-waterproof shoes and boots. Wash contaminated clothing.

INHALATION:
If respiratory irritation or any signs or symptoms as described in this document occur, move the person to fresh air. If any of these effects continue, see a doctor.

INGESTION:
If swallowed, give water or milk to drink and telephone for medical advice. DO NOT make person vomit unless directed to do so by medical personnel. If medical advice cannot be obtained, then take the person and product container to the nearest medical emergency treatment center or hospital. Note to Physician: Ingestion of this product or subsequent vomiting can result in aspiration of light hydrocarbon liquid which can cause pneumonitis.

3. IMMEDIATE HEALTH EFFECTS - (ALSO SEE SECTIONS 11 & 12)

EYE CONTACT:
This substance is slightly irritating to the eyes and could cause prolonged (days) impairment of your vision. The degree of the injury will depend on the amount of material that gets into the eye and the speed and thoroughness of the first aid treatment. Signs and symptoms may include pain, tears, swelling, redness, and blurred vision. Eye contact with the vapors, fumes, or spray mist from this substance could also cause similar signs and symptoms. This hazard evaluation is based on the data from similar materials.

SKIN IRRITATION:
The skin irritation potential of this substance has not been determined. However, it may be a moderate skin irritant so contact with the skin could cause prolonged (days) injury to the affected area. The degree of injury will depend on the amount of material that gets on the skin and the speed and thoroughness of the first aid treatment. Signs and symptoms may include pain or a feeling of heat, discoloration, swelling, and blistering. Prolonged or frequently repeated contact may cause the skin to become cracked or dry from the defatting action of this material. This hazard evaluation is based on data from similar materials.

DERMAL TOXICITY:
If absorbed through the skin, this substance is considered practically non-toxic to internal organs. This hazard evaluation is based on data

from similar materials.

RESPIRATORY/INHALATION:

This substance is slightly toxic to internal organs if inhaled. The degree of injury will depend on the airborne concentration and duration of exposure. The target organ(s) is the nervous system. Inhalation of gasoline vapor at airborne concentrations exceeding 1000 ppm may cause signs and symptoms of central nervous system effects such as headache, dizziness, loss of appetite, weakness and loss of coordination. Vapor concentrations in excess of 5000 ppm may cause loss of consciousness, coma and death. Brief exposures to high vapor concentrations may also cause pulmonary edema and bronchitis. Intentional exposures to excessively high concentrations (e.g., when used as a drug of abuse) have been reported to result in clinical manifestations that may include convulsions, delirium, and hallucinations. These manifestations are not known to occur following accidental inhalation of gasoline vapor during normal operations. This hazard evaluation is based on data from similar materials.

INGESTION:

This substance is slightly toxic to internal organs if swallowed. The degree of injury will depend on the amount absorbed from the gut. The target organ(s) is the nervous system. Signs and symptoms of central nervous system effects may include one or more of the following: headache, dizziness, loss of appetite, weakness and loss of coordination. Because of the low viscosity of this substance, it can directly enter the lungs if it is swallowed (this is called aspiration). This can occur during the act of swallowing or when vomiting the substance. Once in the lungs, the substance is very difficult to remove and can cause severe injury to the lungs and death. This hazard evaluation is based on data from similar materials.

4. PROTECTIVE EQUIPMENT

EYE PROTECTION:

Do not get this material in your eyes. Eye contact can be avoided by wearing chemical goggles.

SKIN PROTECTION:

Avoid contact with skin or clothing. Skin contact should be minimized by wearing protective clothing including gloves.

RESPIRATORY PROTECTION:

No special respiratory protection is normally required. However, if operating conditions create airborne concentrations which exceed the recommended exposure standards, the use of an approved respirator is required. Refer to the OSHA Benzene Standard to determine what type of respirator is required based on exposure levels.

VENTILATION:

Use this material only in well ventilated areas.

5. FIRE PROTECTION

FLASH POINT: (P-M) < -49F (-45C)
AUTOIGNITION: NDA

FLAMMABILITY: 1.4 - 7.6%
EXTINGUISHING MEDIA:
CO2, Dry Chemical, Alcohol Foam and Water Fog.
NFPA RATINGS: Health 1; Flammability 3; Reactivity 0; Special NDA;
HMIS RATINGS: Health 2; Flammability 3; Reactivity 0; Other NDA;
(Least-0, Slight-1, Moderate-2, High-3, Extreme-4). These values are obtained using the guidelines or published evaluations prepared by the National Fire Protection Association or, if applicable, the National Paint and Coating Association, and do not necessarily reflect the hazard evaluation of the Chevron Environmental Health Center. Read the entire document and label before using this product.
FIRE FIGHTING PROCEDURES:
This product presents an extreme fire hazard. Liquid very quickly evaporates, even at low temperatures, and forms vapor (fumes) which can catch fire and burn with explosive violence. Invisible vapor spreads easily and can be set on fire by many sources such as pilot lights, welding equipment, and electrical motors and switches.

For fires involving this material, do not enter any enclosed or confined fire space without proper protective equipment. This may include self-contained breathing apparatus to protect against the hazardous effects of normal products of combustion or oxygen deficiency. Read the entire document.
COMBUSTION PRODUCTS:
Normal combustion forms carbon dioxide and water vapor; incomplete combustion can produce carbon monoxide.

6. STORAGE, HANDLING, AND REACTIVITY

HAZARDOUS DECOMPOSITION PRODUCTS:
NDA.
STABILITY:
Stable.
HAZARDOUS POLYMERIZATION:
Polymerization will not occur.
INCOMPATIBILITY:
May react with strong oxidizing agents, such as chlorates, nitrates, peroxides, etc.
SPECIAL PRECAUTIONS:
Never siphon gasoline by mouth. READ AND OBSERVE ALL PRECAUTIONS ON PRODUCT LABEL. Use only as a motor fuel. Do not use for cleaning, pressure appliance fuel, or any other such use. DO NOT USE OR STORE near flame, sparks or hot surfaces. USE ONLY IN WELL VENTILATED AREA. Keep container closed. DO NOT TRANSFER LIQUID TO AN UNLABELED CONTAINER. DO NOT weld, heat or drill container. Replace cap or bung. Emptied container still contains hazardous or explosive vapor or liquid.

7. PHYSICAL PROPERTIES

SOLUBILITY: Soluble in hydrocarbons; insoluble in water.

APPEARANCE: Orange to bronze liquid.
BOILING POINT: 25 - 225C (Variable)
MELTING POINT: NA
EVAPORATION: NDA
SPECIFIC GRAVITY: 0.7 - 0.8
VAPOR PRESSURE: 5 - 15PSI (max.) @ 100F (Variable)
PERCENT VOLATILE (VOLUME %): 99+%
VAPOR DENSITY (AIR=1): 3-4

8. ENVIRONMENTAL CONCERNS, SPILL RESPONSE AND DISPOSAL

CHEMTREC EMERGENCY PHONE NUMBER: (800) 424-9300 (24 hour).
SPILL/LEAK PRECAUTIONS:
Certain geographical areas have air pollution restrictions concerning the use of materials in work situations which may release volatile components to the atmosphere. Air pollution regulations should be studied to determine if this material is regulated in the area where it is to be used.

This material is considered to be a water pollutant and releases of this product should be prevented from contaminating soil and water and from entering drainage and sewer systems. Eliminate all sources of ignition in vicinity of spill or released vapor. Clean up small spills using appropriate techniques such as sorbent materials or pumping. Where feasible and appropriate, remove contaminated soil. Follow prescribed procedures for reporting and responding to larger releases.
DISPOSAL METHODS:
Place contaminated materials in disposable containers and dispose of in a manner consistent with applicable regulations. Contact local environmental or health authorities for approved disposal of this material.

9. EXPOSURE STANDARDS, REGULATORY LIMITS AND COMPOSITION

COMPOSITION COMMENT:
All the components of this material are on the Toxic Substances Control Act Chemical Substances Inventory.

The percent compositions are given to allow for the various ranges of the components present in the whole product and may not equal 100%.

PERCENT/CAS#	COMPONENT/REGULATORY LIMITS
100.0 %	CHEVRON Regular Gasoline
CONTAINING	
100.0 %	GASOLINE (GENERIC) 300ppm ACGIH TLV 500ppm ACGIH STEL

300ppm OSHA PEL
500ppm OSHA STEL

1.4 % ETHYLBENZENE
CAS100414 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
100ppm ACGIH TLV
125ppm ACGIH STEL
100ppm OSHA PEL
125ppm OSHA STEL
CERCLA 302.4 RQ=1000 POUNDS

0.9 % XYLENE-P
CAS106423 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
CERCLA 302.4 RQ=1000 POUNDS

4.6 % XYLENE-M
CAS108383 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
100ppm ACGIH TLV
150ppm ACGIH STEL
100ppm OSHA PEL
150ppm OSHA STEL
CERCLA 302.4 RQ=1000 POUNDS

6.5 % TOLUENE
CAS108883 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
100ppm ACGIH TLV
150ppm ACGIH STEL
100ppm OSHA PEL
150ppm OSHA STEL
CERCLA 302.4 RQ=1000 POUNDS

3.0 % HEXANE
CAS110543 50ppm ACGIH TLV
50ppm OSHA PEL

2.4 % CYCLOHEXANE
CAS110827 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
300ppm ACGIH TLV
300ppm OSHA PEL
CERCLA 302.4 RQ=1000 POUNDS

15.0 % METHYL TERT BUTYL ETHER
CAS1634044 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and

Reauthorization Act of 1986 and 40 CFR Part 372.

1.4 % BENZENE
CAS71432 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
10ppm ACGIH TLV
1ppm OSHA PEL
5ppm OSHA STEL
CERCLA 302.4 RQ=10 POUNDS

Refer to the OSHA Benzene Standard (29 CFR 1910.1028) for detailed training, exposure monitoring, respiratory protection and medical surveillance requirements before using this product.

< 0.2 G/GAL TETRAETHYL LEAD
CAS78002 0.1mg/m3 ACGIH TLV
.075mg/m3 OSHA PEL
SARA 302/304 RQ=10 POUNDS TPQ=100 POUNDS
CERCLA 302.4 RQ=10 POUNDS

2.2 % XYLENE-O
CAS95476 A toxic chemical subject to the reporting requirements of Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR Part 372.
100ppm ACGIH TLV
150ppm ACGIH STEL
100ppm OSHA PEL
150ppm OSHA STEL
CERCLA 302.4 RQ=1000 POUNDS

TLV - Threshold Limit Value PEL - Permissible Exposure Limit
STEL - Short-term Exposure Limit TPQ - Threshold Planning Quantity
RQ - Reportable Quantity CPS - CUSA Product Code
CC - Chevron Chemical Company CAS - Chemical Abstract Service Number

10. REGULATORY INFORMATION

DOT SHIPPING NAME: GASOLINE
DOT HAZARD CLASS: FLAMMABLE LIQUID
DOT IDENTIFICATION NUMBER: UN1203

SARA 311 CATEGORIES:
1. Immediate (Acute) Health Effects; YES
2. Delayed (Chronic) Health Effects; YES
3. Fire Hazard; YES
4. Sudden Release of Pressure Hazard; NO
5. Reactivity Hazard; NO

WHEN A COMPONENT OF THIS MATERIAL IS SHOWN IN THIS SECTION, THE REGULATORY LIST ON WHICH IT APPEARS IS INDICATED.

ETHYLBENZENE 01,02,10,11,14,15,17,18,26,28,

P-XYLENE(1,4-DIMETHYL BENZENE)	01,02,10,11,26,28,
M-XYLENE	01,02,10,11,14,15,17,18,26,28,
TOLUENE	01,02,10,11,14,15,17,18,26,28,
HEXANE	02,10,11,14,17,28,
CYCLOHEXANE	01,02,10,11,14,17,26,28,
METHYL TERT BUTYL ETHER	01,10,11,24,26,
BENZENE	01,02,03,04,06,10,11,14,17,18,20,28,
TETRAETHYLLEAD	02,10,11,14,17,28,
O-XYLENE(1,2-DIMETHYL BENZENE)	01,02,10,11,14,15,17,18,26,28,
GASOLINE (GENERIC)	04,08,14,15,17,18,20,

REGULATORY LISTS:

01=SARA 313	02=MASS RTK	03=NTP Carcinogen
04=CA Prop. 65	05=MI 406	06=IARC Group 1
07=IARC Group 2A	08=IARC Group 2B	09=SARA 302/304
10=PA RTK	11=NJ RTK	12=CERCLA 302.4
13=MN RTK	14=ACGIH TLV	15=ACGIH STEL
16=ACGIH Calculated TLV	17=OSHA PEL	18=OSHA STEL
19=Chevron TLV	20=EPA Carcinogen	21=TSCA SECT 4
22=TSCA SECT 5 SNUR	23=TSCA SECT 6 RULE	24=TSCA SECT 12 EXPORT
25=TSCA SECT 6A CAIR	26=TSCA SECT 8D REPORT	27=TSCA SECT 8E
28=Canadian WHMIS		

11. PRODUCT TOXICOLOGY DATA

EYE IRRITATION:
NDA. The hazard evaluation was based on data from similar materials.
SKIN IRRITATION:
This material was not a skin sensitizer in the modified Buehler Guinea Pig Sensitization Test.
DERMAL TOXICITY:
NDA. The hazard evaluation was based on data from similar materials.
RESPIRATORY/INHALATION:
NDA. The hazard evaluation was based on data from similar materials.
INGESTION:
NDA. The hazard evaluation was based on data from similar materials.
ADDITIONAL TOXICOLOGY DATA:
Lifetime inhalation of whole gasoline vapor has caused increased liver tumors in female mice. The mechanism of this response is still being investigated but it is thought to be an epigenetic process unique to the female mouse. Inhalation exposure to whole gasoline vapor also caused kidney damage and eventually kidney cancer in male rats.

No other animal model studied has shown these adverse kidney effects and there is no physiological reason to believe that they would occur in man. The cause of the kidney toxicity is thought to be due to the interaction of isoparaffin hydrocarbons in the product with a specific serum protein, alpha-2-microglobulin. Male rats synthesis large amounts of this protein which is filtered, reabsorbed, and degraded by their kidneys. Isoparaffins or their metabolites combine with this protein and make it "undigestable" by the kidney proteases. With repeated exposure, the

protein-isoparaffin complex accumulates in the kidney tubules causing significant cell death and regrowth. It is thought that this continuous kidney injury may contribute to the eventual development of the tumors.

The data above is obtained from studies sponsored by the American Petroleum Institute (API).

12. ADDITIONAL HEALTH DATA

ADDITIONAL HEALTH DATA COMMENT:
This product contains benzene. The OSHA Benzene Standard (29 CFR 1910.1028) contains detailed requirements for training, exposure monitoring, respiratory protection and medical surveillance triggered by the exposure level. Refer to the OSHA Standard before using this product. Repeated or prolonged breathing of benzene vapors has been associated with the development of chromosomal damage in experimental animals and various blood diseases in humans ranging from aplastic anemia to leukemia (a form of cancer). All of these diseases can be fatal. No birth defects have been shown to occur in pregnant laboratory animals exposed to doses not toxic to the mother. However, some evidence of fetal toxicity such as delayed physical development has been seen at such levels. The available information on the effects of benzene on human pregnancies is inadequate but it has been established that benzene can cross the human placenta.

This product contains n-hexane. Prolonged or repeated skin contact or breathing of vapors may cause nerve damage characterized by progressive weakness and numbness in the arms and legs. Recovery ranges from no recovery to complete recovery depending upon the severity of the nerve damage.

This product contains toluene. Toluene has been reported to decrease immunological responses in test animals. It has also been reported that when young rats were exposed to 1000 ppm toluene for 14 hours daily, for two weeks, irreversible hearing loss was detected. The same daily exposure to 700 ppm for as long as 16 weeks was without effect. Since the level necessary to produce hearing loss is greater than 7 times the 1987-88 ACGIH TLV for toluene, worker exposures at or below 100 ppm is not expected to cause any adverse effect. There are also reports that chronic abusers (glue sniffers, solvent huffers) of solvents containing toluene have suffered liver, kidney and brain damage. Scientific studies on toluene have failed to demonstrate birth defects in rats and mice. However, toluene has been shown to cause delayed growth and extra ribs in the offspring of rats and mice at inhaled doses (266-399 ppm) that were non-toxic to the mother. Toluene has not conclusively been shown to cause adverse reproductive effects in humans.

This product contains xylene, a chemical that has been reported to cause developmental toxicity in rats and mice exposed by inhalation during pregnancy. The effects noted consisted of delayed development and minor skeletal variations; additionally, when pregnant mice were exposed by ingestion to a level that killed nearly one-third of the test group, lethality (resorptions) and malformations (primarily cleft palate)

occurred. Malformations have not been reported following inhalation exposure. Because of the very high levels of exposure used in these studies, we do not believe that their results imply an increased risk of reproductive toxicity to workers exposed to xylene levels at or below the exposure standard.

Xylene has given negative results in several mutagen testing assays including the Ames assay. In a cancer study sponsored by the National Toxicology Program (NTP), technical grade xylene gave no evidence of carcinogenicity in rats or mice dosed daily for two years.

Whole gasoline exhaust was reviewed by the International Agency for Research on Cancer (IARC) in their Monograph Volume 46 (1989). Evidence for causing cancer was considered inadequate in animals and inadequate in humans. IARC placed this material in Category 2B, considering it possibly carcinogenic to humans.

****

The above information is based on the data of which we are aware and is believed to be correct as of the date hereof. Since the information contained herein may be applied under conditions beyond our control and with which we may be unfamiliar and since data made available subsequent to the date hereof may suggest modification of the information, we do not assume any responsibility for the results of its use. This information is furnished upon condition that the person receiving it shall make his own determination of the suitability of the material for his particular purpose.

IPS
WELD-ON

MATERIAL SAFETY DATA SHEET

Date Revised: AUG 1995
Supersedes: MAR 1994

Information on this form is furnished solely for the purpose of compliance with the Occupational Safety and Health Act and shall not be used for any other purpose. IPS Corporation urges the customers receiving this Material Safety Data Sheet to study it carefully to become aware of the hazards, if any, of the product involved. In the interest of safety, you should notify your employees, agents and contractors of the information on this sheet.

SECTION I

MANUFACTURER'S NAME
IPS Corporation
ADDRESS
17109 S. Main St., P.O. Box 379, Gardena, CA. 90248

Transportation Emergencies:
CHEMTREC: (800) 424-9300
Medical Emergencies: (213) 222-3212
(L.A. Poison Center 24 Hour No.)
Business: (310) 366-3300

CHEMICAL NAME and FAMILY
Mixture of Organic Solvents

TRADE NAME:
WELD-ON P-70 Primer for PVC and CPVC Plastic Pipe

FORMULA: Proprietary

SECTION II - HAZARDOUS INGREDIENTS

None of the ingredients below are listed as carcinogens by IARC, NTP or OSHA	CAS#	APPROX %	ACGIH-TLV	ACGIH-STEL	OSHA-PEL	OSHA-STEL
Tetrahydrofuran (THF)	109-99-9	45-55	200 PPM	250 PPM	200 PPM	250 PPM
Methyl Ethyl Ketone (MEK)	78-93-3	37*	200 PPM	300 PPM	200 PPM	300 PPM
Cyclohexanone	108-94-1	5-15	25 PPM Skin		25 PPM Skin	

* Title III Section 313 Supplier Notification: This product contains toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 and of 40CFR372. This information must be included in all MSDS's that are copied and distributed for this material.

SHIPPING INFORMATION FOR GALLON CONTAINERS OR ABOVE
DOT Shipping Name: Flammable Liquid, N.O.S.
Contains: (Tetrahydrofuran, Methyl Ethyl Ketone)
DOT Hazard Class: 3
Identification Number: UN 1993
Packaging Group: II
Label Required: Flammable Liquid

SHIPPING INFORMATION FOR CONTAINERS LESS THAN ONE GALLON
DOT Shipping Name: Consumer Commodity
DOT Hazard Class: ORM-D

SPECIAL HAZARD DESIGNATIONS

	HMIS	NFPA	HAZARD RATING
HEALTH:	2	2	0 - MINIMAL
FLAMMABILITY:	3	3	1 - SLIGHT
REACTIVITY:	0	1	2 - MODERATE
PROTECTIVE EQUIPMENT:	H		3 - SERIOUS
			4 - SEVERE

SECTION III - PHYSICAL DATA

APPEARANCE
Purple or clear, thin liquid

ODOR
Ethereal

BOILING POINT (°F/°C)
151°F Based on first boiling component: THF

SPECIFIC GRAVITY @ 73 ± 2°F
Typical 0.860 ± 0.040

VAPOR PRESSURE (mm Hg.)
143 mm Hg. based on first boiling component, THF @ 20°C

PERCENT VOLATILE BY VOLUME (%)
100%

VAPOR DENSITY (Air = 1)
2.49

EVAPORATION RATE (BUAC = 1)
> 1.0

SOLUBILITY IN WATER
Completely soluble in water.

VOC STATEMENT: VOC as manufactured: 860 Grams/Liter. Maximum VOC emission per SCAQMD Rule 1168, Test Method 316A: 650 Grams/Liter.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT
6°F T.C.C. Based on THF

FLAMMABLE LIMITS (PERCENT BY VOLUME)	LEL	UEL
	2.0	11.8

FIRE EXTINGUISHING MEDIA
Ansul "Purple K" potassium bicarbonate dry chemical, carbon dioxide, National Aer-O-Foam universal alcohol resistant foam, water spray.

SPECIAL FIRE FIGHTING PROCEDURES
Evacuate enclosed areas, stay upwind. Close or confined quarters require self-contained breathing apparatus, positive pressure hose masks or airline masks. Use water spray to cool containers, to flush spills from source of ignition and to disperse vapors.

UNUSUAL FIRE AND EXPLOSION HAZARDS
Fire hazard because of low flash point and high volatility. Vapors are heavier than air and may travel to source of ignition.

SECTION V - HEALTH HAZARD DATA

PRIMARY ROUTES OF ENTRY: X Inhalation X Skin Contact ___ Eye Contact ___ Ingestion

EFFECT OF OVEREXPOSURE
ACUTE: Inhalation: Severe overexposure may result in nausea, dizziness, headache. Can cause drowsiness, irritation of eyes and nasal passages.
Skin Contact: Skin irritant. Liquid contact may remove natural skin oils resulting in skin irritation. Dermatitis may occur with prolonged contact.
Skin Absorption: Prolonged or widespread exposure may result in the absorption of harmful amounts of material.
Eye Contact: Overexposure may result in severe eye injury with corneal or conjuctival inflammation on contact with the liquid. Vapors slightly uncomfortable.
Ingestion: Moderately toxic. May cause nausea, vomiting, diarrhea. May cause mental sluggishness.
CHRONIC: Symptoms of respiratory tract irritation and damage to respiratory epithelium were reported in rats exposed to 5000 ppm THF for 90 days. Elevation of SGPT suggests a disturbance in liver function. The NOEL was reported to be 200 ppm.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Individuals with pre-existing diseases of the eyes, skin or respiratory system may have increased susceptibility to the toxicity of excessive exposures.

EMERGENCY AND FIRST AID PROCEDURES
Inhalation: If overcome by vapors, remove to fresh air and if breathing stopped, give artificial respiration. If breathing is difficult, give oxygen. Call physician.
Eye Contact: Flush eyes with plenty of water for 15 minutes and call a physician.
Skin Contact: Remove contaminated clothing and shoes. Wash skin with plenty of soap and water for at least 15 minutes. If irritation develops, get medical attention.
Ingestion: Give 1 or 2 glasses of water or milk. Do not induce vomiting. Call physician or poison control center immediately.

SECTION VI - REACTIVITY

STABILITY	UNSTABLE		CONDITIONS TO AVOID Keep away from heat, sparks, open flame and other sources of ignition.
	STABLE	X	

INCOMPATIBILITY
(MATERIALS TO AVOID) Caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocyanates.

HAZARDOUS DECOMPOSITION PRODUCTS
When forced to burn, this product gives out carbon monoxide, carbon dioxide, hydrogen chloride and smoke.

HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID Keep away from heat, sparks, open flame and other sources of ignition
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Eliminate all ignition sources. Avoid breathing of vapors. Keep liquid out of eyes. Flush with large amount of water. Contain liquid with sand or earth. Absorb with sand or nonflammable absorbent material and transfer into steel drums for recovery or disposal. Prevent liquid from entering drains.

WASTE DISPOSAL METHOD
Follow local, State and Federal regulations. Consult disposal expert. Can be disposed of by incineration. Excessive quantities should not be permitted to enter drains. Empty containers should be air dried before disposing. Hazardous Waste Code: 214.

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION (Specify type)
Atmospheric levels should be maintained below established exposure limits contained in Section II. If airborne concentrations exceed those limits, use of a NIOSH-approved organic vapor cartridge respirator with full face-piece is recommended. The effectiveness of an air purifying respirator is limited. Use it only for a single short-term exposure. For emergency and other conditions where short term exposure guidelines may be exceeded, use an approved positive pressure self-contained breathing apparatus.

VENTILATION
Use only with adequate ventilation. Provide sufficient ventilation in volume and pattern to keep contaminants below applicable exposure limits set forth in Section II. Use only explosion proof ventilation equipment.

PROTECTIVE GLOVES PVA coated	EYE PROTECTION Splashproof chemical goggles

OTHER PROTECTIVE EQUIPMENT AND HYGIENIC PRACTICES
Impervious apron and a source of running water to flush or wash the eyes and skin in case of contact.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING
Store in the shade between 40°F - 110°F. Keep away from heat, sparks, open flame and other sources of ignition. Avoid prolonged breathing of vapor. Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Train employees on all special handling procedures before they work with this product.

OTHER PRECAUTIONS
Follow all precautionary information given on container label, product bulletins and our solvent cementing literature. All handling equipment should be electrically grounded.

Prepared by George Blanco of PS

IPS WELD-ON

MATERIAL SAFETY DATA SHEET

DATE PREPARED OR REVISED: JUNE 1990

Information on this form is furnished solely for the purpose of compliance with the Occupational Safety and Health Act and shall not be used for any other purpose. IPS Corporation urges the customers receiving this Material Safety Data Sheet to study it carefully to become aware of the hazards, if any, of the product involved. In the interest of safety, you should notify your employees, agents, and contractors of the information on this sheet.

SECTION I

MANUFACTURER'S NAME
IPS Corporation

ADDRESS
17109 S. Main St, P.O. Box 379, Gardena, CA 90248

TRANSPORTATION EMERGENCIES:
CHEMTREC: (800) 424-9300
Medical Emergencies: (213) 484-5151
(L.A. Poison Center 24 Hr. No.)
Business: (213) 321-6515

CHEMICAL NAME AND FAMILY
Solvent Cement for Plastic Pipe
Mixture of PVC Resin and Organic Solvents

TRADE NAME
Weld-On 711 for PVC Plastic Pipe

FORMULA Proprietary

SECTION II - HAZARDOUS INGREDIENTS

NONE OF THE INGREDIENTS BELOW ARE LISTED AS CARCINOGENS BY IARC, NTP, OSHA.	CAS #	APPROX %	ACGIH-TLV	OSHA-PEL
Polyvinyl Chloride Resin	9002-86-2	10-20	N/A	N/A
Tetrahydrofuran (THF)	109-99-9	55-70	200 ppm	200 ppm
Methyl Ethyl Ketone (MEK)	78-93-3	15*	200 ppm	200 ppm
Cyclohexanone	108-94-1	5-15	25 ppm Skin	50 ppm (Trans) 25 ppm Skin

*Title III Section 313 Supplier Notification: This product contains toxic chemicals subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-To-Know Act of 1986 and of 40CFR372. This information must be included in all MSDS's that are copied and distributed for this material.

SHIPPING INFORMATION
DOT HAZARD CLASS: FLAMMABLE LIQUID
DOT SHIPPING NAME: CEMENT FLAMMABLE LIQUID
IDENTIFICATION NUMBER: UN/NA 1133

SPECIAL HAZARD DESIGNATIONS	HMIS	NFPA	HAZARD RATING
HEALTH:	2	2	0 - MINIMAL
FLAMMABILITY:	3	3	1 - SLIGHT
REACTIVITY:	0	1	2 - MODERATE
PROTECTIVE EQUIPMENT:	H	—	3 - SERIOUS
			4 - SEVERE

SECTION III - PHYSICAL DATA

APPEARANCE White or opaque gray, medium syrupy liquid	ODOR Ethereal	BOILING POINT (°F / °C) 151°F based on first boiling component THF
SPECIFIC GRAVITY @ 73±2°F Typical 0.946 ± 0.012	VAPOR PRESSURE (mm Hg.) 143 mm Hg. based on first boiling component, THF @ 20°C	PERCENT, VOLATILE BY VOLUME (%) Approximately 80-85%
VAPOR DENSITY (Air = 1) 2.49	EVAPORATION RATE (BUAC = 1) Approx. 5-8	SOLUBILITY IN WATER Solvent portion completely soluble in water. Resin portion precipitates

VOC STATEMENT: This cement contains 780 grams of VOC per liter as manufactured. More than 60 percent of the VOC acts as a reactive diluent and remains in the pipe joint.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT	FLAMMABLE LIMITS (PERCENT BY VOLUME)	LEL	UEL
T.C.C. 6°F Based on THF		1.8	11.8

FIRE EXTINGUISHING MEDIA
Ansul "Purple K" potassium bicarbonate dry chemical, carbon dioxide, National Aer-O-Foam universal alcohol resistant foam, water spray.

SPECIAL FIRE FIGHTING PROCEDURES
Evacuate enclosed areas, stay upwind. Close or confined quarters require self-contained breathing apparatus, positive pressure hose masks or airline masks. Use water spray to cool containers, to flush spills from source of ignition and to disperse vapors.

UNUSUAL FIRE AND EXPLOSION HAZARDS
Fire hazard because of low flash point and high volatility. Vapors are heavier than air and may travel to source of ignition.

SECTION V - HEALTH HAZARD DATA

PRIMARY ROUTES OF ENTRY: [X] Inhalation [X] Skin Contact [ ] Eye Contact [ ] Ingestion

EFFECT OF OVEREXPOSURE ACUTE: Inhalation: Severe overexposure may result in nausea, dizziness, headache. Can cause drowsiness, irritation of eyes and nasal passages. Skin Contact: Skin irritant. Liquid contact may remove natural skin oils resulting in skin irritation. Dermatitis may occur with prolonged contact. Skin Absorption: Prolonged or widespread exposure may result in the absorption of harmful amounts of material. Eye Contact: Overexposure may result in severe eye injury with corneal or conjuctival inflammation on contact with the liquid. Vapors slightly uncomfortable. Ingestion: Moderately toxic. May cause nausea, vomiting, diarrhea. May cause mental sluggishness.
CHRONIC: None currently known.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE None currently known.

EMERGENCY AND FIRST AID PROCEDURES
Inhalation: If overcome by vapors, remove to fresh air and if breathing stopped, give artificial respiration — preferably mouth-to-mouth. If breathing is difficult, give oxygen. Call physician.
Eye Contact: Flush eyes with plenty of water for 15 mins. and call a physician.
Skin Contact: Remove contaminated clothing and shoes. Wash skin with plenty of soap and water for at least 15 mins. If irritation develops, get medical attention.
Ingestion: Give 1 or 2 glasses of water or milk. Do not induce vomiting. Call physician or poison control center immediately.

SECTION VI - REACTIVITY DATA

STABILITY			CONDITIONS TO AVOID
	UNSTABLE		Keep away from heat, sparks, open flame and other sources of ignition.
	STABLE	X	

INCOMPATABILITY (MATERIALS TO AVOID) Caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocynates.

HAZARDOUS DECOMPOSITION PRODUCTS When forced to burn, this product gives out carbon monoxide, carbon dioxide, hydrogen chloride and smoke.

HAZARDOUS POLYMERIZATION			CONDITIONS TO AVOID
	MAY OCCUR		Keep away from heat, sparks, open flame and other sources of ignition.
	WILL NOT OCCUR	X	

SECTION VII - SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Eliminate all ignition sources. Avoid breathing of vapors. Keep liquid out of eyes. Flush with large amount of water. Contain liquid with sand or earth. Absorb with sand or nonflammable absorbent material and transfer into steel drums for recovery or disposal. Prevent liquid from entering drains.

WASTE DISPOSAL METHOD
Follow local, State and Federal regulations. Consult disposal expert. Can be disposed of by incineration. Excessive quantities should not be permitted to enter drains. Empty containers should be air dried before disposing. Hazardous Waste Code: 214

SECTION VIII - SPECIAL PROTECTION INFORMATION

RESPIRATORY PROTECTION *(Specify type)*
In situations where vapor concentrations exceed the recommended exposure limits, a NIOSH-approved organic vapor cartridge respirator with full face-piece is recommended. Use only SCBA for emergencies.

VENTILATION Explosion-proof general mechanical ventilation or local exhaust is recommended to maintain vapor concentrations below recommended exposure limits.

PROTECTIVE GLOVES PVA coated

EYE PROTECTION Splashproof chemical goggles

OTHER PROTECTIVE EQUIPMENT AND HYGIENIC PRACTICES
Impervious apron and a source of running water to flush or wash the eyes and skin in case of contact.

SECTION IX - SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Store in the shade between 40°F-110°F. Keep away from heat, sparks, open flame and other sources of ignition. Avoid prolonged breathing of vapor. Use with adequate ventilation. Avoid contact with eyes, skin and clothing. Train employees on all special handling procedures before they work with this product.

OTHER PRECAUTIONS
Follow all precautionary information given on container label, product bulletins and our solvent cementing literature. All handling equipment should be electrically grounded.

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof.
Prepared by: George Blanco of IPS