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By Alameda County Environmental Health 2:38 pm, Apr 27, 2016

April 26, 2016

Alameda County Health Care Services Agency
Department of Health Services
1131 Harbor Bay Parkway
Alameda, CA 94502

Subject: AMG & Associates, LLC: Case File RO0003195

To Whom It May Concern:

My consultant in this case who is acting on my behalf is: Mr. Stuart G. Solomon of Phase-1 Environmental Services.

I declare under penalty of perjury that the information and/or recommendations contained in the attached documents; RO3195_Interim Update and Report_2016-04-25 and; RO3195_Site Management Plan_2016-04-25 are true and correct to the best of my knowledge.

Alexis M. Gevorgian

April 25, 2015

SITE MANAGEMENT PLAN – RO#3195
RESIDENTIAL DEVELOPMENT

Property Identification:

9 contiguous parcels at 10550 and 10552 International Boulevard, and 1424, 1500,1510, 1520, 1528, 1536, 1544, 1548/50, 1560/70 105th Avenue, Oakland, Alameda County, California.

PES Project No. P-6-05-2015

Prepared For:
AMG & Associates, LLC
16633 Ventura Blvd, Suite 1014
Encino, California 91436

Prepared By:
Phase-1 Environmental Services
5216 Harwood Road
San Jose, California 95124

Table of Contents – Site Management Plan – RO#3195 – April 2016

1) INTRODUCTION

On behalf of AMG & Associates, LLC (the Client) Phase-1 Environmental Services (P-1ES) has prepared this Site Management Plan (SMP) for the property consisting of 9 contiguous parcels located at 10550 and 10552 International Boulevard (formerly E. 14th Street), and 1424, 1500,1510, 1520, 1528, 1536, 1544, 1548/50, 1560/70 105th Avenue in the City of Oakland, Alameda County, California, subsequently referred to in this report as the "Property" or "Site". The site is currently under the regulatory oversight of the Alameda County Environmental Health Services (ACEH) (Alameda County Case No. RO3151), and is in the process of being developed for mixed commercial/residential occupancy. Please refer to **Figures 1 through 6** for the site and parcel information.

Due to past historic uses there is a potential to encounter residual contamination at the parcels included in this redevelopment. In the event that residual contamination, including newly discovered tanks or piping are encountered during site redevelopment, this SMP has been developed to provide a framework to manage the contamination should it be found at the Property during construction activities, in a manner that is; (1) satisfactory to ACEH and other regulatory agencies, (2) protective of human health and the environment, and (3) complies with residential land use standards.

ACEH will be notified within 24 hours if soil is encountered during construction that is suspected of being contaminated, or any other environmental conditions are discovered which may require action.

The purpose of this SMP is to provide an agenda for appropriately addressing environmental impacts that might be encountered during development construction. The SMP includes the following:

1. A description of the Site and planned development project;
2. A summary of known and potential environmental conditions;
3. Guidelines for testing, managing, and disposing of lead-based paint if encountered;
3. Guidelines for managing soil, and/or vapors that may be encountered, and;
4. Mitigation measures for discovered environmental conditions that may be encountered.

The project involves the decommissioning and destruction of existing buildings and surface coverings on the Property, and the construction of a multi-story, high density residential complex and its associated parking. Several phases of environmental assessment and remediation activities have taken place that identified the presence of hazardous substances released from historic site activities - primarily limited to petroleum hydrocarbons. An overview of the site history and results of these assessments and remediation is presented in Section 2.2) below. This is summarized in more detail in the WellTest, Inc; ***Excavation Documentation Report (Report 4409)*** *Batarse Redevelopment, 10550 International Blvd. Oakland, California, dated April 3, 2015 - ACHSA Site Cleanup Program Case # R0003151; Global ID T0000006347.* This document is on file at the ACEH.

2) SMP BACKGROUIND

2.1) Site Description, Historic Uses, and Planned Development

The multiple parcel Property has a history of sparse residential dwellings starting in the late 1930's with commercial activities beginning in the about the early 1950's ranging from a candy factory, photo lab, to

Roller Derby school. Automotive related uses began in about the early 1960's, and included dealerships, auto body shops, and auto repair facilities dating to present time.

The Client intends to demolish buildings that exist behind (to the northeast) of the existing 10500 International Blvd. parcel and behind the frontage building at 10550 (see Figure 6). A 6 inch concrete ground soil floor slab will be laid over all of the demolished parcel areas. This will be the parking area of the facility. At 13 ft. above the floor slab, a 13 inch thick concrete podium deck will be built, over which four stories of residential apartments will be constructed. The proposed structures are shown in **Attachment C.**

2.2) Summary of Environmental History and Conditions

The area of the residential development had an extensive soil and groundwater investigation performed in 2001 as part of a redevelopment plan for the Oakland Unified School (OUSD). The OUSD was considering purchasing the Property for school expansion. This work was performed by Levine-Fricke Recon (LFR) under the oversight of the Department of Toxic Substances Control (DTSC). The investigation revealed soil contamination – primarily by petroleum hydrocarbons, in a number of areas of the Property. Elevated Lead, Zinc, Chromium, and Arsenic were also detected in some areas. Some groundwater samples also contained constituents above MCL's. A risk study and analysis, including Human Exposure risks, was performed as part of the LFR Preliminary Site Assessment. Excerpted Tables from the LFR PSA relative to Values and Exposure Risk Estimates of COCs detected in soil and groundwater on the site are contained in **Attachment A.** The Levine-Fricke PEA Appendix H "Screening Level Evaluation" is also contained in this Attachment. This documents how each COC and its potential for human exposure was determined in their recommendations.

As a result of the study, the DTSC prescribed six areas on the Property to be excavated or remediated to meet their school occupancy requirements. Shortly thereafter, the Oakland School District curbed their school expansion plans due to financial constraints. Under Commercial zoning and current land use, the Property did not require any clean-up. Copies of the LFR 2001 PSA and Remedial Action Work plan documents are on file with Alameda County Health Care under 10500-10550 International Blvd.

In 2014, the developer (our Client) entered into an agreement with the owner to purchase the Property and develop it for a combination residential and commercial occupancy. The current Property owner subsequently opened a Voluntary Clean-up case with the ACHD, proposing to perform remediation at the site in accordance with the plan that was previously prescribed by the DTSC for school occupancy. The Plan was approved, and the work executed in March, 2015. Excavation of five of the six areas of concern was performed by WellTest, Inc. Extremity samples were collected and analyzed for the specific COC's in each of those areas. Sample testing determined that constituents of concern in soils in those five areas that had been above the DTSC clean-up levels required for school occupancy were effectively removed. **Attachment B** contains excerpted tables and drawings from the WellTest, Inc. Excavation Report showing the areas excavated, along with tables displaying the extremity sample analytical results. The sixth area that had been prescribed by the DTSC to be remediated was in Area 4 of the site, where elevated Total Chromium had been detected in LFR sample #BASB013. WellTest, Inc. collected a new soil sample from the exact location and depth the LFR sample had been taken.

That sample was analyzed for both Total Chromium, and Chromium VI in order to determine the ratio between Total and Hexavalent (IV) Chromium in the soil. The results can be viewed in Table 1-B of **Attachment B**. The sample ID is **4-B-1d3.0.** The ratio showed Cr VI and Total Cr to be well below residential ESL standards. This area, therefore, was not excavated.

2.3) Contaminants of Potential Concern

The primary constituents of concern at the Property are Total Petroleum Hydrocarbons (Oils, Diesel, Gasoline) in shallow soils resultant from spills or leakage from vehicles that were not found during the investigation and remediation activities. There is an existing oil/water separator positioned on the 1424 105th Ave. parcel as shown on **Figure 5**. The Site Environmental Consultant will be notified and present during its removal and attention given to potential contamination in its vicinity. Lead based paint from demolished buildings is of concern, as well as lead in shallow soils that could have been impacted by lead paint from those buildings. There is also a possibility that heating oil tanks and/or their piping associated with past residences could be encountered during demolition and excavation activities.

2.4) Site Hydrology

The direction of groundwater flow in the Property vicinity is assumed to be to the southwest to northwest, towards San Francisco Bay, and consistent with the slope of the regional topography. Groundwater flow measured in 1995 on site and surrounding sites indicated the gradient was southwesterly. According to Helley et. al. (1979), the Property and vicinity are underlain by Late Pleistocene alluvium. These sediments are described as weakly consolidated, slightly weathered, poorly soiled irregular inter-bedded clay, silt, sand and gravel that is at least 150 feet thick. This material grades progressively from coarse-grained stream deposits toward higher elevations to fine-grained alluvial fan and fresh-water marsh deposits nearest the present shore of the bay.

3) SOIL AND GROUNDWATER MANAGEMENT

Groundwater at the Property is at depths greater than 20 ft. BGS, and with the exception of a recently closed well at the 1510 105th Ave. parcel, there are no known remaining wells on the Property. Development plans are limited to surface and shallow soils excavation, and no contact with groundwater anticipated by the development. This SMP is, therefore, limited to soil management.

3.1) SMP Applicability

As noted above, soil impacted with concentrations of COPCs may be present at various on-site locations. This SMP presents protocol for the following construction activities that may encounter COPCs:

- Demolition of the buildings and existing concrete and asphalt surfaces;
- Shallow excavation, and grading;
- Subsurface utility installation, maintenance, or repair, and;
- Building slab construction and other subsurface work.

Contractors and their Subcontractors shall follow the soil management protocols presented in this SMP anywhere on-Site. In addition, if Contractors or their Subcontractors observe conditions indicative of contamination anywhere on-Site, they will follow the protocols presented in this document. Any observed or suspected contamination shall be reported to the Environmental Consultant immediately.

3.2) Risk Management

This section presents the risk management procedures to be followed during the above described construction activities during the on-site development, including worker training and impact mitigation measures.

3.2.1) Pre-Construction Lead Characterization, Planning and Notification

Prior to the start of building demolition, a lead paint inspection will be performed by a certified professional on all buildings on the Property constructed prior to 1977. Substrates that test positive for lead paint will be sampled in accordance with EPA waste disposal guidelines and if applicable, laboratory analyzed by STLP to determine leaching potential. Any substrate that exceeds the EPA's 5.00 mg/ltr. limit will be treated as hazardous, and at the discretion of the Developer, either treated on site to non hazardous levels, or disposed of as hazardous material. If on-site treatment is elected, it will be performed using an EPA recognized product and method such as Lead Out® Lead Paint Stripper. If hazardous disposal is elected, all Lead-affected substrates shall be separated from other non hazardous waste materials, and if stockpiled on site, shall be placed on plastic sheeting and covered. As part of the lead inspection, and after building demolition and debris disposal, a Tube Based DELTA Handheld XRF (or equivalent) will be used to screen surface soils in the vicinity of the previous building walls on the site to determine lead impact to surface soils. Representative soil sample(s) will be collected from area(s) where the XRF screening detected lead above the residential ESL of 80 mg/kg, and sent to an analytical laboratory for leach testing by Method TCLP. The number of samples collected and submitted shall be negotiated with the ACHD. The results of the screening shall be documented by the Inspector and a report written by the Environmental Consultant on the results of the screening. This document will be submitted to the ACHD for their review. Actions required to address the lead issues discovered (if any) will be negotiated with the ACHD.

Prior to the start of any construction activity (ie; building demolition, grading, slab construction, excavating or utility trenching), information regarding Site risk management procedures (a copy of this SMP) will be provided to the Contractors for their review and each contractor shall provide such information to its Subcontractors.

3.2.2) Site-Specific Worker Health & Safety

Each Contractor shall be responsible for the health and safety of their own workers, as required by Cal-OSHA, including but not limited to preparation of their own health and safety plan (HSP) and injury and illness prevention plan (IIPP). The purpose of these documents is to provide general guidance to the work hazards that may be encountered during each phase of Site construction activities. Contractors are also required to determine the requirements for worker training, based on the level of expected contact to soil, and soil vapor, associated with the contractor's activities and locations with respect to COPCs described in Section 2.3. The HSP will contain provisions for limiting and monitoring chemical exposure to construction workers, chemical and non-chemical hazards, emergency procedures, and standard safety protocols.

3.2.3) Construction Impact Mitigation Measures

During construction, measures will be taken by Contractors to minimize dust generation, and appropriately manage storm water runoff, and tracking of soil off-site. The construction impact mitigation measures are described below.

3.2.3.1) Site Control

Site control procedures will be implemented by the Contractor to control the flow of personnel, vehicles, and materials in and out of the site while working with potentially contaminated materials. In addition, Site control measures will help control the spread of COPCs from the Site, if they are present. The Site perimeter will be fenced by the Contractor. Access and egress will be controlled at selected locations. Signs will be posted by the Contractor at all Site entrances instructing visitors to sign in at the project support areas.

3.2.3.2) Equipment Decontamination

Because potentially impacted soil may be present at the site, precautions to limit the off-Site transfer of soil are warranted. These precautions also are applicable if during any construction, impacted soil is expected or confirmed to be encountered. Decontamination procedures will be established and implemented by the Contractor to reduce the potential for construction equipment and vehicles to release contaminated soil onto public roadways or other inadvertent off-Site transfer. At a minimum, gravel will be placed by the Contractor at all Site access points and excess soil will be removed from construction equipment using dry methods (e.g., brushing or scraping) prior to moving the equipment off-Site.

3.2.3.3) Personnel Protective Equipment

Personal Protective Equipment (PPE), including appropriate clothing are used to isolate workers from COPCs and physical hazards. The minimum level of protection for workers coming into direct contact with potentially contaminated materials is Level D, listed below. The level of PPE will be evaluated by the contractor and modified if warranted based upon conditions encountered at the Site and/or type of work activity in accordance with their own HSP (see Section 3.2.2).

- Coveralls or similar construction work clothing;
- Reflective safety vests; Steel-toed boots;
- Hard hat;
- Work gloves, as necessary;
- Safety glasses, as necessary, and;
- Hearing protection, as necessary

3.2.3.4) Dust Control

Mitigation measures will be conducted during soil handing and earthwork to minimize the creation and dispersion of dust in accordance with BAAQMD Rule 403 as outlined in the Western Regional Air Partnership Handbook Chapter 3 “Construction and Demolition” Pages 3-1 through 3-25 (**Attachment D**) and will include the following measures:

- Application of water while grading, excavating, and loading, as needed;
- Limiting vehicle speeds to 5-miles per hour on unpaved portions of the Property;
- Minimizing drop heights while loading/unloading soil; and,
- Additional measures as may be identified and implemented by Contractors, as necessary, especially if dry and windy conditions persist during periods of earthwork.

During grading activities and depending upon Site conditions, the Environmental Consultant will set up dust monitors to document airborne concentrations at upwind and downwind Property boundaries. The monitoring will be performed using DataRAM PDR-1000 particulate monitors or their equivalent. The locations of the monitoring stations will be determined by the environmental geologist or engineer in the field. The wind direction and time of observation will be recorded in the field and the sampling location will be modified during the day if significant changes in wind direction are readily observed. The particulate meters will be monitored by the field geologist or engineer to evaluate if excessive dust is migrating off-site. Each time the monitors are checked, the differences between the average upwind dust concentration and the average downwind concentration will be compared to ambient air quality standard of 150 micrograms per cubic meter over an averaging time of 8-hours for respirable dust. If this standard is exceeded, increased dust control measures will be implemented. Results of the air monitoring, if performed, will be summarized for the Developer and Contractor in daily reports.

3.2.3.5) Storm Water Pollution Controls

The Civil Engineer will prepare a storm water pollution prevention plan (SWPPP) for the Site. Contractors and their Subcontractors shall comply with the provisions and protocols of the SWPPP. Storm water pollution controls will be based on best management practices (BMPs), such as those described in "Information on Erosion and Sediment Control for Construction Projects: A Guidebook" (Water Board 1998) and "Erosion and Sediment Control Field Manual, Third Edition (Water Board 1999). The California Stormwater Best Management Practice Handbooks published by the California Stormwater Quality Association (CASQA) (http://www.casqa.org) also reflect current practices and storm water management standards. Sediment and erosion control procedures may include, but are not limited to the following:

- Constructing temporary berms or erecting silt fences around exposed soil;
- Placing straw bale barriers or sediment traps around catch basins or other entrances to storm drains;

- Covering soil stockpiles with plastic sheeting or tarps during rainfall events, and;
- Implementing other appropriate BMPs.

3.3) Soil Management Protocols

3.3.1) Soil Monitoring and Screening

If soil is encountered that is suspected of being contaminated (e.g., if soil discoloration or odors are noted), or any other environmental conditions are encountered which may require action during construction, the potentially impacted soil will be field screened by the Environmental Consultant. It is expected that the Environmental Consultant will only be used on an as-needed basis (whenever potentially contaminated soil is encountered) and will not be onsite during the entire duration of construction activities. The Environmental Consultant and ACEHD will be notified within 24 hours by the Contractor in the event that potentially impacted soil is encountered, and the Environmental Consultant will be onsite to perform field screening and possible sample collection as discussed below.

The Environmental Consultant will perform the field screening. In general, the field screening protocol will consist of using a hand-held photo-ionization detector (PID) instrument. Field screening of soil will be performed using the headspace analysis method of placing a small volume of soil into a plastic baggie, sealing the baggie, and placing the PID probe tip into the baggie after a minimum waiting period of 30 seconds. Field screening PID readings will be written in a bound project-dedicated log book along with notable field observations, if any. The PID instrument will be an Ion Science Phocheck+PID, a MiniRae 3000 PID or functionally similar instrument. The instrument will be capable of quantifying total VOCs in air and include features to minimize interference from high relative humidity which may be encountered during the headspace analysis. Each instrument will have a standard 10.6eV lamp, capable of ionizing VOCs. Each instrument will be field calibrated using isobutylene.

A field screening value of 10 ppmv above background using the headspace analysis method will be used as an action level to trigger follow-up soil sampling for laboratory analysis. Each day field screening is performed; a series of three background readings will initially be generated using on-site soil from locations away from potential source areas. Those values will be averaged to form a background value for that day. Headspace field readings consistently above 10 ppmv plus background would trigger collection of at least one soil sample for laboratory analysis of TPH using EPA Method 8015 and VOCs using EPA Method 8260B. Soil samples submitted for laboratory analysis may be analyzed on a rush basis, as appropriate based on the data turn-around requirements of the day's activities. Laboratory results will be documented and submitted to the Developer.

The field screening trigger level of 10 ppmv plus background will also be used to determine whether 40-hour HAZWOPER trained construction workers and equipment operators are needed in areas showing potential soil impact, until conditions are verified with laboratory data. If field instrument readings of 10 ppmv plus background are consistently recorded in an area, then the Contractor will be notified by the Environmental Consultant and the Contractor, in consultation with the Environmental Consultant, will determine whether 40-hour trained HAZWOPER personnel will be used for working in that area. In such a case, only work being performed in that particular area will be suspended and the area will be cordoned off until 40-hour trained personnel are available.

It is noted that soil moisture and other factors can influence field instrument readings resulting in false positive results. If readings are unusually high in the absence of other indications of soil impact, suggesting excess moisture or other factors, a replacement instrument will be obtained and locations with high readings will be confirmed. Also, if only one or two field screening readings slightly exceed 10 ppmv plus background and other readings collected in the same general area do not, then a soil sample may not be collected for laboratory analysis at the discretion of the Environmental Consultant. In the event field monitoring PID readings trigger soil sampling, the Contractor will be notified to temporarily stop work at the location and the Consultant will perform a limited assessment in the area of potential soil impact. One or more soil samples may be collected for laboratory analysis in the area showing elevated PID readings.

Upon receipt of analytical results, the ACEHD may direct the Developer to investigate the extent of the potential hydrocarbon impacted area. Such investigation may include the use of a backhoe, hand auger equipment, or drill rig, as circumstances may dictate for additional soil screening or the collection of soil or soil gas samples. Other COPCs may be investigated, as may be appropriate. Such investigation and any subsequent characterization or remediation work, will be coordinated between the ACEHD, the Developer, the Environmental Consultant, and Contractor.

3.3.2) Management of Impacted Soils

During construction activities, if soil is encountered that is suspected of being contaminated (e.g., if soil discoloration or odors are noted), or if buried structures (such as sumps, tanks, drain systems), debris or un-abandoned wells are encountered, earthwork in the suspect area will be immediately stopped and worker access to the suspect area will be restricted. The area will be cordoned off using delineators and caution tape, or similar materials by the Contractor and the Environmental Consultant and ACEHD will be notified. The quality of soil suspected to be contaminated will be evaluated through field screening and/or analytical testing by the Environmental Consultant so that appropriate handling and disposal alternatives can be determined. If on-site re-use of the contaminated soil is desired, soil samples shall be collected from the stockpile and analyzed for COPCs (Section 2.3).

If COPCs are detected, whether above or below regulatory agency screening levels, further investigation of the area may be performed as determined by the Developer in coordination with the Environmental Consultant. For soil considered for re-use, if COPCs are detected below applicable screening levels, re-use of the soil may be appropriate, at the discretion of the Environmental Consultant and Developer.

If COPCs are detected above the applicable ESLs, the results will be communicated to the ACEHD and soils will be profiled into a landfill facility for proper disposal under appropriate waste manifest. Prior to off-Site disposal, soil samples will be collected and analyzed in accordance with the requirements of the selected disposal facility.

Cleanup/remediation activities may be required at the Site if impacted soils are encountered or a previously unknown release is identified in order to meet applicable federal, state and local laws, regulations and requirements. If impacted soil is identified at the Site, earthwork activities in contaminated areas will be performed by licensed hazardous materials contractors and personnel trained in hazardous waste operations (40-hour OSHA training), if warranted based on COPC concentrations. The soil management procedures described in this document and the contractor's HSP will be followed. The scope of such removal action will be determined by the Developer in coordination with the Environmental Consultant and approved by the ACDEH. The clean-up levels for impacted soils on site shall be in accordance with the current San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESL) database, or as determined through an Exposure Risk Analyses and Assessment conducted by a licensed Professional, and based on residential occupancy standards. Extremity soil samples shall be collected from each area where excavation is required in accordance with standard practices, and as approved by the ACDEH. In general, at least one sample per sidewall and one from the bottom of the excavation will be required; however, the number and frequency of samples required will be subjected to field observations and the environmental Professional's judgment. Samples will be analyzed at a State Certified laboratory using analytical methods that are appropriate and approved for the particular Chemicals of Concern in each of the excavated areas.

Soil suspected of being contaminated that is excavated during construction shall be stockpiled separately from "clean" soil. Stockpiled soil that is suspected to be contaminated shall be stockpiled on-Site on top of and covered by an "impermeable" liner (i.e., 6 mil plastic sheeting) by the Contractor to reduce infiltration by rainwater and contamination of underlying soil. The soil shall be managed for erosion and sediment control by surrounding the base with straw wattles or other methods consistent with SWPPP BMPs. Stockpiles shall be checked daily by the Contractor to verify that they are adequately covered. The affected soil stockpiles shall be profiled for disposal by a licensed Professional using the soil sample collection protocols and analytical test methods prescribed and required by the selected disposal facility.

3.3.3) Management of Soils During Construction

Surplus soil generated during development may be transported from the Site. If no impact is identified during the monitoring procedures outlined in Section 3.3.1, such surplus soil will either be transported to an appropriate landfill facility or to another project that accepts the soil. If transported to another project, soil samples will be collected and analyzed in accordance with the requirements of that project in consultation with the Environmental Consultant. If transported to a landfill facility, the soil samples will be collected and analyzed according the profiling requirements of that facility. The Contractor will coordinate with the Environmental Consultant regarding all off-Site soil disposal activities. As outlined in Section 3.3.2, the ACEHD shall be contacted if potentially impacted soil is discovered. As stated in Section 3.3.2, surplus soils with detectable concentrations of hydrocarbons above the applicable screening level will not be re-used onsite; such soils will be properly disposed of at an offsite landfill. Disposal documentation and manifests will be provided to the ACEHD.

3.3.4) Import Fill

The Environmental Consultant, Geotechnical Engineer, and ACEHD will be notified prior to importing fill soil to the Site. An evaluation of import fill materials will be conducted to ensure such fill meets the geotechnical and environmental requirements. To minimize the potential introduction of contaminated fill onto the Site, all selected sources of import fill will have adequate documentation to verify that the fill source is appropriate for the Site. Documentation will include detailed information on previous land use of the fill source, any Phase I Environmental Site Assessments performed and the findings, and the results of any analytical testing performed (Phase II Investigations).

If no documentation is available or the documentation is inadequate or if no analytical testing has been performed, samples of the potential fill material will be collected and analyzed prior to delivery of such soil to the site. The analyses selected will be based on the fill source and knowledge of the previous land use as determined by the Environmental Consultant. The sample frequency for potential fill material will be in accordance with that outlined in the technical document titled, "Information Advisory on Clean Imported Fill Material" (DTSC, October 2001). A copy of this document is contained in **Attachment E**. The Environmental Consultant will provide guidance to the Contractor regarding acceptability of imported fill; no fill material will be accepted if contaminant levels exceed current residential environmental screening goals (unrestricted re-use criteria) and/or regional background concentrations. No recycled concrete fill shall be used in this project.

4.0) NOTIFICATION AND DOCUMENTATION

4.1) Key Contacts

Company	Role	Contact	Telephone
AMG & Associates, LLC	Developer	Alexis M. Gevorgian	(818) 380-2600 Ext. 14 (o)
Alameda County Health Care Agency	ACHC Case Manager	Mark Detterman	(510).567.6876 (o)
To be Determined	Environmental Consultant		
To be Determined	General Contractor		
To be Determined	Project Engineer		
To be Determined	Geotechnical Engineer		
To be Determined	Civil Engineer		

4.2) Notifications

Notifications of the discovery of COPCs in field screening, observations, or analytical results or other conditions of potential environmental concern are to be made immediately to the Developer, the Environmental Consultant, and ACEHD. The Developer will determine the need for other required notifications. If such discovery or conditions require notification to the Contractor and/or Sub-Contractors, such notification will be determined by the Developer and the Environmental Consultant.

4.3) Documentation

The Environmental Consultant will prepare a report(s) containing all documentation of conditions, including observations, screening results, findings, analytical laboratory results, contingency measures taken, dust control analytical, disposal manifests, and all other measures taken to comply with provisions of this SMP, including HSP requirements, work practices, and material handing requirements. This report(s) will be submitted to the ACEH as a condition for closure.

5.0) LIMITATIONS

Contractors and Subcontractors are responsible for review of this SMP prior commencing work at the Site and for the health and safety of their own employees and subcontractors. The Developer is responsible for review of the provisions of this SMP and for incorporating its guidelines into their project planning and specifications. This document was prepared for the sole use and benefit of AMG & Associates, LLC, its project subsidiary, and its Contractors and Consultants at the Site. Neither this report, nor any of the information contained herein shall be used or relied upon for any purpose by any person or entities. P-1 ES relied on information prepared by others however P-1 ES cannot be responsible for its accuracy or completeness or for the availability of all information that may be relevant to the preparation of this document.

If there are any questions, please do not hesitate to contact Phase-1 Environmental Services at 831-422-2290.

Respectfully Submitted,

Phase-I Environmental Services

Stuart G. Solomon
Environmental Consultant/ Professional
Sr. Project Manager

FIGURES

1) Site Location Map
2) Parcel Overview Map
3) Parcel Map 1
4) Parcel Map 2
5) Existing Site Plan
6) Planned Demolition

ATTACHMENTS

A) LFR Values and Exposure Risk Estimates of COCs – Soil
B) WellTest, Inc. Excavation Locations, Extremity Sampling & Results Tables
C) DG Group Structural and Plans Submittal
D) Western Regional Air Partnership – Demo and Construction Dust Control -Chapter 3
E) DTSC Information Advisory on Clean Imported Fill

Legend

FIGURE 1

Project Number: P6-06-05-2015

N

SITE LOCATION MAP

Current Addresses: 10550, 10552 International Blvd & 1424, 1500, 1510, 1520, 1528, 1536, 1544, 1548, 1560/1570 105th Ave, Oakland, CA 94603

Parcel #'s: 47-5509-10, 47-5509-9-1, 47-5509-7, 47-5509-6, 47-5509-5, 47-5509-4, 47-5509-3, 47-5509-1-1, 47-5519-5-2

PES PARTNER

Legend

FIGURE 2

Project Number: P6-06-05-2015

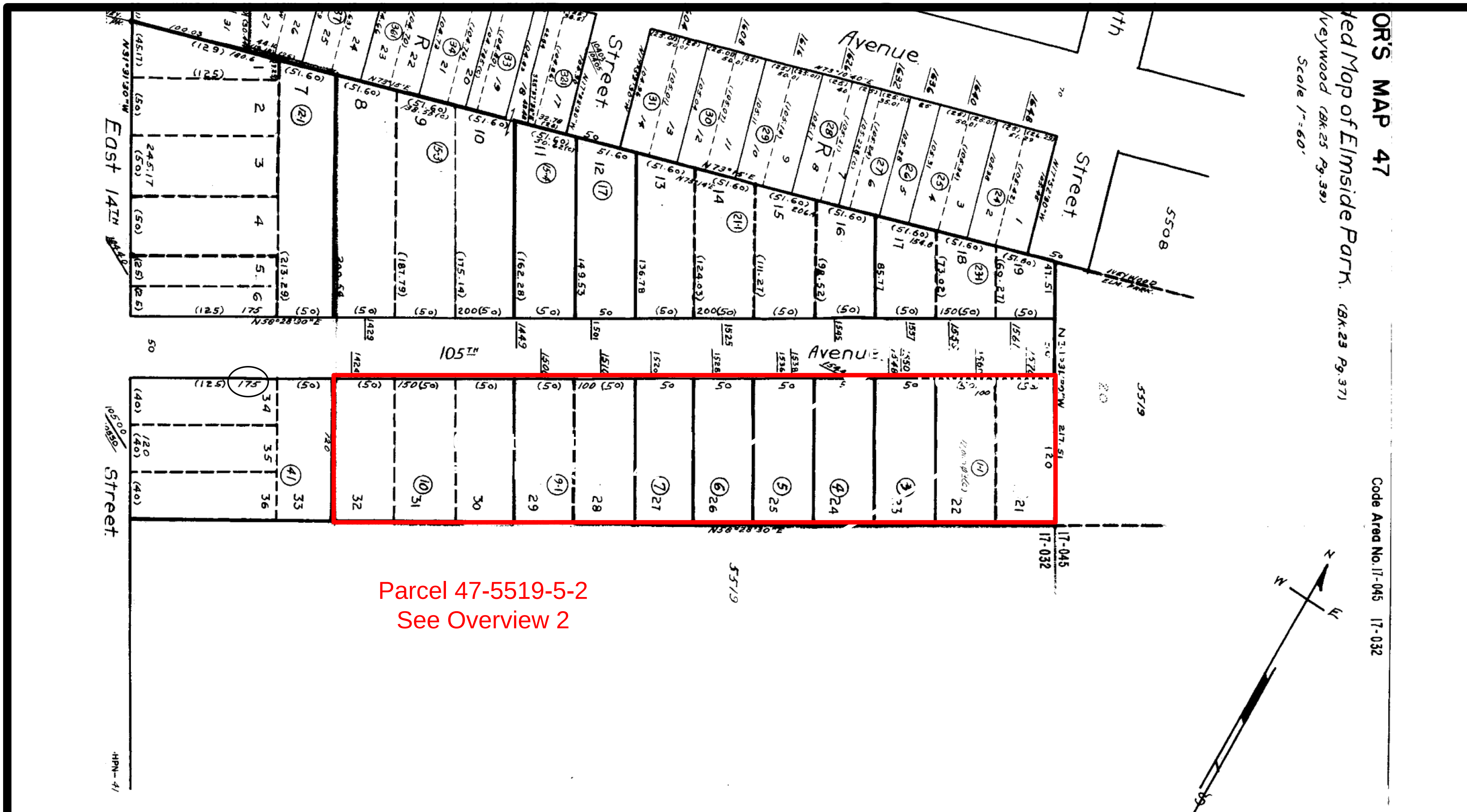
N

PARCEL OVERVIEW MAP

Current Addresses: 10550, 10552 International Blvd & 1424, 1500, 1510, 1520, 1528, 1536, 1544, 1548, 1560/1570 105[th] Ave, Oakland, CA 94603

Parcel #'s: 47-5509-10, 47-5509-9-1, 47-5509-7, 47-5509-6, 47-5509-5, 47-5509-4, 47-5509-3, 47-5509-1-1, 47-5519-5-2

P E S PARTNER



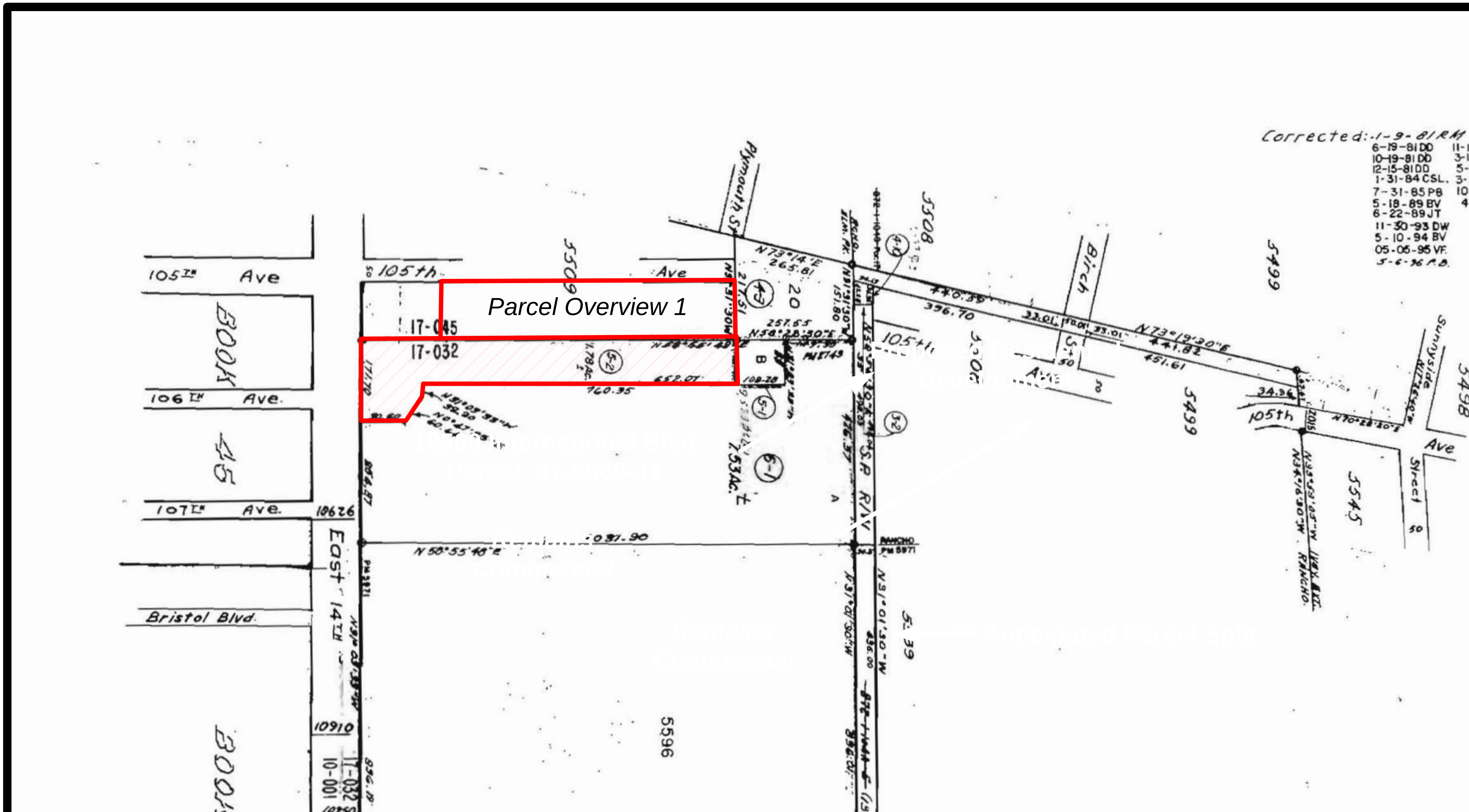
Legend

Property Border

N

Figure 3
PARCEL MAP OVERVIEW 1

Parcel #'s: 47-5509-10, 47-5509-9-1, 47-5509-7, 47-5509-6, 47-5509-5, 47-5509-4, 47-5509-3, 47-5509-1-1



Legend

Property Border

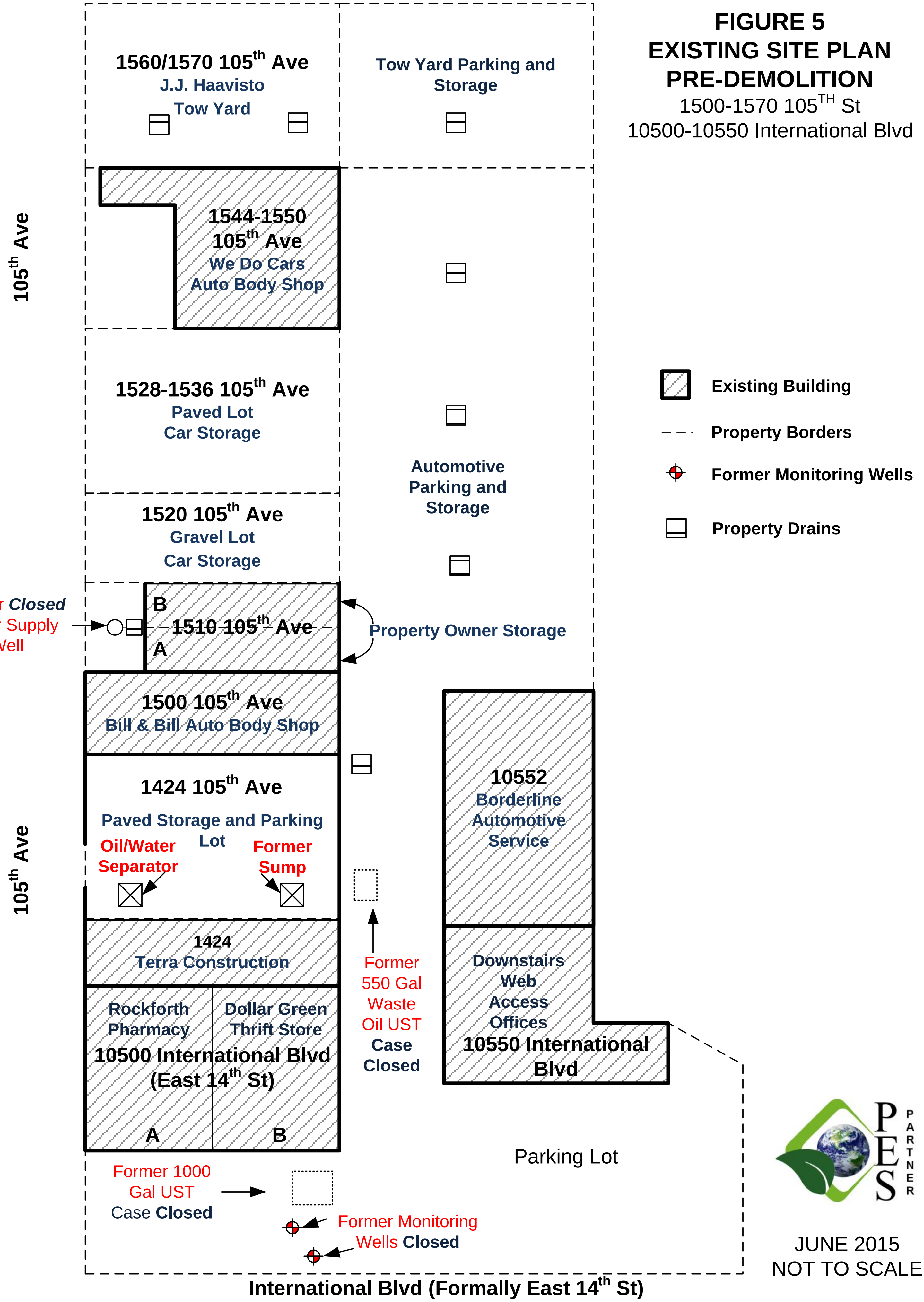
N

Figure 4
PARCEL MAP OVERVIEW 2

Parcel #: 47-5519-5-2

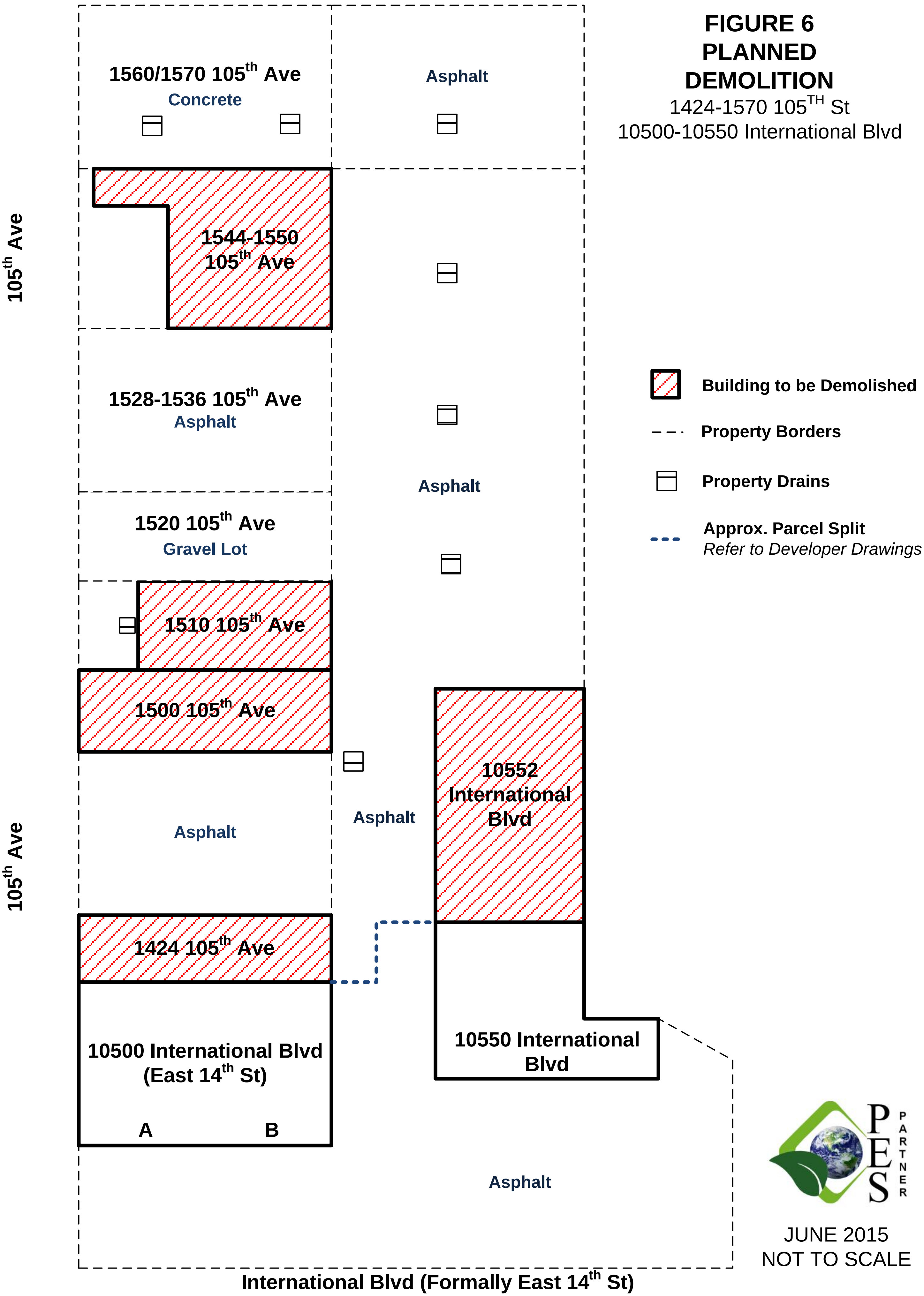
FIGURE 5
EXISTING SITE PLAN
PRE-DEMOLITION

1500-1570 105TH St
10500-10550 International Blvd



JUNE 2015
NOT TO SCALE

FIGURE 6
PLANNED DEMOLITION
1424-1570 105TH St
10500-10550 International Blvd



JUNE 2015
NOT TO SCALE

ATTACHMENT A

LFR Values and Exposure Risk Estimates of COCs – Soil &

LFR Appendix H: Screening Level Evaluation

Extracted pages from Levine-Fricke Recon Preliminary Environmental Assessment of 10-3-2001

Table 15
Title 22 Metals Detected in Groundwater
Batarse Site, Oakland, California

Concentrations in micrograms per liter (µg/l)

Location ID	Date Sampled	As	Ba	Co	Cu	Mo	Ni	Pb	Sb	Zn

Data prepared by: TIH. Data QA/QC by: LDF.

Notes:

DUP = Duplicate sample

J = Reported value is estimated.

Samples were analyzed by Curtis and Tompkins Analytical Laboratories Ltd. for metals using EPA test method 6020A.

As = Silver Ba = Barium Co = Cobalt Cu = Copper Mo = Molybdenum
Ni = Nickel Pb = Lead Sb = Antimony Zn = Zinc

Table 16
Total Petroleum Hydrocarbons in Soil - Concentrations Above 100 mg/kg
Batarse Site, Oakland, California
Concentrations in milligrams per kilogram (mg/kg)

Location ID	Date Sampled	Depth (feet bgs)	Chemical	Result	Comparison Value
Area 1					
BASB027	27-Mar-01	(3.50-4.00)	TPHmo	120 YH	100
BASB031	26-Mar-01	(6.50-7.00)	TPHg	440 JYH	100
BASB031	26-Mar-01	(6.50-7.00)	TPHms	480 JYL	100
BASB031	26-Mar-01	(6.50-7.00)	TPHss	220 J	100
BASB031	26-Mar-01	(9.50-10.00)	TPHg	490 JYH	100
BASB031	26-Mar-01	(9.50-10.00)	TPHms	530 JYL	100
BASB031	26-Mar-01	(9.50-10.00)	TPHss	250 J	100
BASB031	26-Mar-01	(14.50-15.00)	TPHg	180 JYH	100
BASB031	26-Mar-01	(14.50-15.00)	TPHms	190 JYL	100
BASB032-DUP	26-Mar-01	(4.50-5.00)	TPHmo	360	100
BASB033	26-Mar-01	(3.50-4.00)	TPHmo	240	100
BASB036	22-Mar-01	(3.50-4.00)	TPHd	160 YH	100
BASB036	22-Mar-01	(3.50-4.00)	TPHmo	630	100
BASB073	02-Apr-01	(2.50-3.00)	TPHmo	120 Y	100
BASB077	30-Mar-01	(3.50-4.00)	TPHd	270 YH	100
BASB077	30-Mar-01	(3.50-4.00)	TPHmo	2200 Y	100
Area 5					
BASB022	04-Apr-01	(1.50-2.00)	TPHd	220 YL	100
BASB022	04-Apr-01	(1.50-2.00)	TPHmo	1300	100
BASB022	04-Apr-01	(4.50-5.00)	TPHd	970 YL	100
BASB022	04-Apr-01	(4.50-5.00)	TPHmo	490	100
BASB022	04-Apr-01	(9.50-10.00)	TPHd	600 YL	100
BASB022	04-Apr-01	(9.50-10.00)	TPHmo	300	100
BASB023	04-Apr-01	(20.50-21.00)	TPHmo	150	100
Area 6					
BASB001	02-Apr-01	(22.50-23.00)	TPHmo	140 Y	100
BASB002	31-Mar-01	(2.50-3.00)	TPHd	150 YH	100
BASB002	31-Mar-01	(2.50-3.00)	TPHmo	1000 Y	100
Area 7					
BASB018	05-Apr-01	(11.50-12.00)	TPHmo	130	100
BASB019	05-Apr-01	(2.00-2.50)	TPHmo	330	100
BASB052	02-Apr-01	(3.50-4.00)	TPHmo	290 Y	100
BASB052	02-Apr-01	(24.50-25.00)	TPHmo	480	100
BASB053	03-Apr-01	(1.50-2.00)	TPHmo	460 YH	100

Table 16
Total Petroleum Hydrocarbons in Soil - Concentrations Above 100 mg/kg
Batarse Site, Oakland, California

Concentrations in milligrams per kilogram (mg/kg)

Location ID	Date Sampled	Depth (feet bgs)	Chemical	Result	Comparison Value
Area 7					
BASB054	03-Apr-01	(1.50-2.00)	TPHmo	290	100
BASB054	03-Apr-01	(21.50-22.00)	TPHmo	170	100
BASB056	30-Mar-01	(3.50-4.00)	TPHmo	120 Y	100
BASB058	21-Mar-01	(3.50-4.00)	TPHmo	310 Y	100
Area 8					
BASB061	05-Apr-01	(0.00-0.50)	TPHmo	120	100
Area 9					
BASB090	09-Jul-01	(2.00-2.50)	TPHmo	360	100
BASB090-DUP	09-Jul-01	(2.00-2.50)	TPHmo	310	100

Data prepared by: TIH. Data QA/QC by: LDF.

Notes:

bgs = below ground surface
DUP = Duplicate sample
H = Heavier hydrocarbons contributed to the quantitation.
J = Reported value is estimated.
L = Lighter hydrocarbons contributed to the quantitation.
Y = Sample exhibits fuel pattern which does not resemble standard.
TPHd = total petroleum hydrocarbons as diesel
TPHg = total petroleum hydrocarbons as gasoline
TPHmo = total petroleum hydrocarbons as motor oil
TPHms = total petroleum hydrocarbons as mineral spirits
TPHpt = total petroleum hydrocarbons as paint thinner
TPHss = total petroleum hydrocarbons as stoddard solvent
Samples were analyzed by Curtis and Tompkins Analytical Laboratories Ltd. for all compounds using EPA test method 8015 modified.

Table 17
Title 22 Metals in Soil - Concentrations Above Background Levels
Batarse Site, Oakland, California

Concentrations in milligrams per kilogram (mg/kg)

Location ID	Date Sampled	Depth (feet bgs)	Chemical	Result	Background Level
Area 1					
BASB026	28-Mar-01	(4.00-4.50)	Pb	22.0	16.1
BASB027	27-Mar-01	(4.00-4.50)	Pb	74.0	16.1
BASB027	27-Mar-01	(4.00-4.50)	Zn	140.0	106.1
BASB027	27-Mar-01	(15.00-15.50)	Hg	1.1	0.4
BASB028	27-Mar-01	(1.00-1.50)	Pb	83.0	16.1
BASB028	27-Mar-01	(1.00-1.50)	Zn	120.0	106.1
BASB033	26-Mar-01	(4.00-4.50)	Ba	340.0	323.6
BASB033	26-Mar-01	(4.00-4.50)	Pb	160.0	16.1
BASB033	26-Mar-01	(4.00-4.50)	Zn	430.0	106.1
BASB034	27-Mar-01	(4.00-4.50)	Pb	24.0	16.1
BASB036	22-Mar-01	(4.00-4.50)	Cd	3.1	2.7
BASB070	03-Apr-01	(3.50-4.00)	Pb	27.0	16.1
BASB071	03-Apr-01	(2.00-2.50)	Pb	130.0	16.1
BASB071	03-Apr-01	(2.00-2.50)	Zn	240.0	106.1
BASB072	05-Apr-01	(2.50-3.00)	Pb	44.0	16.1
BASB072	05-Apr-01	(2.50-3.00)	Zn	110.0	106.1
BASB077	30-Mar-01	(4.00-4.50)	Pb	30.0	16.1
BASB078	05-Apr-01	(4.00-4.50)	Pb	20.0	16.1
Area 2					
BASB008	21-Mar-01	(4.00-4.50)	Pb	26.0	16.1
Area 3					
BASB041	28-Mar-01	(4.00-4.50)	Pb	28.0	16.1
BASB041	28-Mar-01	(5.00-5.50)	Pb	49.0	16.1
Area 4					
BASB012	19-Mar-01	(4.00-4.50)	Pb	17.0	16.1
BASB013	20-Mar-01	(3.00-3.50)	Cr	160.0	99.6
BASB016	04-Apr-01	(2.50-3.00)	Pb	60.0	16.1
Area 5					
BASB022	04-Apr-01	(2.00-2.50)	Pb	31.0	16.1
BASB022	04-Apr-01	(5.00-5.50)	Pb	63.0	16.1
BASB022	04-Apr-01	(10.00-10.50)	Pb	23.0	16.1
BASB023	04-Apr-01	(2.00-2.50)	As	33.0	19.1
BASB023	04-Apr-01	(2.00-2.50)	Pb	130.0	16.1
BASB023	04-Apr-01	(2.00-2.50)	Zn	400.0	106.1
BASB023	04-Apr-01	(21.00-21.50)	Pb	33.0	16.1

Table 17
Title 22 Metals in Soil - Concentrations Above Background Levels
Batarse Site, Oakland, California

Concentrations in milligrams per kilogram (mg/kg)

Location ID	Date Sampled	Depth (feet bgs)	Chemical	Result	Background Level
Area 5					
BASB023	04-Apr-01	(21.00-21.50)	Zn	120.0	106.1
BASB024	04-Apr-01	(2.00-2.50)	Pb	17.0	16.1
BASB025	04-Apr-01	(4.00-4.50)	Pb	18.0	16.1
BASB025	04-Apr-01	(4.00-4.50)	Zn	110.0	106.1
BASB086	04-Apr-01	(2.00-2.50)	Cd	3.0	2.7
BASB087	04-Apr-01	(4.00-4.50)	Cd	2.8	2.7
Area 6					
BASB002	31-Mar-01	(3.00-3.50)	Pb	24.0	16.1
BASB021	29-Mar-01	(1.00-1.50)	Pb	19.0	16.1
Area 7					
BASB019	05-Apr-01	(2.50-3.00)	Pb	54.0	16.1
BASB019	05-Apr-01	(2.50-3.00)	Zn	130.0	106.1
BASB052	02-Apr-01	(4.00-4.50)	Zn	130.0	106.1
BASB052	02-Apr-01	(25.00-25.50)	Zn	150.0	106.1
BASB055	29-Mar-01	(8.50-9.00)	Pb	20.0	16.1
BASB056	30-Mar-01	(25.00-25.50)	Ba	410.0	323.6
BASB057	28-Mar-01	(4.00-4.50)	Pb	140.0	16.1
BASB057	28-Mar-01	(4.00-4.50)	Zn	140.0	106.1
Area 8					
BASB050	20-Mar-01	(2.50-3.00)	Pb	38.0	16.1
BASB060	05-Apr-01	(0.00-0.50)	Pb	36.0	16.1
BASB061	05-Apr-01	(0.00-0.50)	Pb	130.0	16.1
BASB062	05-Apr-01	(0.00-0.50)	Pb	18.0	16.1
BASB063	05-Apr-01	(0.00-0.50)	Pb	110.0	16.1
BASB065	22-Mar-01	(0.00-0.50)	Pb	31.0	16.1
Area 9					
BASB090	09-Jul-01	(2.50-3.00)	Pb	66.0	16.1
DUP	09-Jul-01	(2.50-3.00)	Pb	43.0	16.1

Data prepared by: TIH . Data QA/QC by: LDF .

Notes:

Metals background concentrations from Oakland Urban Land Development.

bgs = below ground surface

DUP = Duplicate sample

Samples were analyzed by Curtis and Tompkins Analytical Laboratories Ltd. for mercury using EPA test method 7470 and EPA test method 7470A and all other metals were analyzed by EPA test method 6010B.

As = Arsenic Ba = Barium Cd = Cadmium Cr = Chromium

Table 17
Title 22 Metals in Soil - Concentrations Above Background Levels
Batarse Site, Oakland, California

Concentrations in milligrams per kilogram (mg/kg)

Location ID	Date Sampled	Depth (feet bgs)	Chemical	Result	Background Level

Hg = Mercury   Pb = Lead   Zn = Zinc

Table 18
Total Petroleum Hydrocarbons in Water - Concentrations Above SNARLs
Batarse Site, Oakland, California

Concentrations in micrograms per liter (µg/l)

Location ID	Date Sampled	Chemical	Result	SNARL value
Area 1				
BASB026	28-Mar-01	TPHd	130 Y	100
DUP	28-Mar-01	TPHd	140 Y	100
BASB031	26-Mar-01	TPHd	800 YL	100
BASB031	26-Mar-01	TPHg	610 YH	5
BASB031	26-Mar-01	TPHms	920 YLb	5
BASB031	26-Mar-01	TPHss	320	5
BASB032	26-Mar-01	TPHd	61 Y	100
BASB036	22-Mar-01	TPHd	73 Y	100
BASB037	22-Mar-01	TPHd	100 Y	100
BASB071	03-Apr-01	TPHd	150 YL	100
BASB071	03-Apr-01	TPHg	320 Y	5
BASB071	03-Apr-01	TPHpt	240	5
BASB072	05-Apr-01	TPHd	80 Y	100
BASB073	02-Apr-01	TPHd	73 Y	100
BASB076	30-Mar-01	TPHd	530 Y	100
BASB076	30-Mar-01	TPHmo	530	100
BASB077	30-Mar-01	TPHd	52 Y	100
Area 2				
BASB007	31-Mar-01	TPHd	70 Y	100
BASB008	21-Mar-01	TPHd	150 YZ	100
Area 3				
BASB041	28-Mar-01	TPHd	120 Y	100
Area 4				
BASB012	19-Mar-01	TPHd	61 Y	100
BASB016	04-Apr-01	TPHd	71 Y	100
DUP	04-Apr-01	TPHd	61 Y	100
Area 5				
BASB022	04-Apr-01	TPHd	110 Y	100
BASB023	04-Apr-01	TPHd	310 YH	100
BASB023	04-Apr-01	TPHmo	1100	100
Area 6				
BASB001	02-Apr-01	TPHd	360 YH	100
BASB001	02-Apr-01	TPHmo	1200 Y	100
BASB021	29-Mar-01	TPHd	66 Y	100

Table 18
Total Petroleum Hydrocarbons in Water -
Concentrations Above SNARLs
Batarse Site, Oakland, California
Concentrations in micrograms per liter (µg/l)

Location ID	Date Sampled	Chemical	Result	SNARL value
Area 6				
BASB051	02-Apr-01	TPHd	20000 Y	100
BASB051	02-Apr-01	TPHg	19000	5
BASB051	02-Apr-01	TPHpt	14000 Y	5
BASB081	05-Apr-01	TPHd	210000 Y	100
BASB081	05-Apr-01	TPHg	7700	5
BASB081	05-Apr-01	TPHpt	5800 Y	5
DUP	05-Apr-01	TPHd	90000 Y	100
DUP	05-Apr-01	TPHg	7200	5
DUP	05-Apr-01	TPHpt	5400 Y	5
Area 7				
BASB018	05-Apr-01	TPHd	160 YH	100
BASB052	02-Apr-01	TPHd	100 YH	100
BASB052	02-Apr-01	TPHmo	360 YH	100
BASB055	29-Mar-01	TPHd	51 Y	100
BASB058	21-Mar-01	TPHd	57 Y	100
Area 8				
BASB050	20-Mar-01	TPHd	65 Y	100

Data prepared by: TIH. Data QA/QC by: LDF.

Notes:

SNARLs = Suggested No-Adverse-Response Levels, Regional Water Quality Control Board, Central Valley Region, A Compilation of Water Quality Goals, August 2000

SNARLs only exist for TPHg and TPHd but were applied to similiar TPH fractions.

bgs = below ground surface

b = Continuing calibration verification percent difference was slightly above acceptance limits in batch.

DUP = Duplicate sample

H = Heavier hydrocarbons contributed to the quantitation.

L = Lighter hydrocarbons contributed to the quantitation.

Y = Sample exhibits fuel pattern which does not resemble standard.

Z = Sample exhibits unknown single peak or peaks.

TPHd = total petroleum hydrocarbons as diesel

TPHg = total petroleum hydrocarbons as gasoline

TPHmo = total petroleum hydrocarbons as motor oil

TPHms = total petroleum hydrocarbons as mineral spirits

TPHpt = total petroleum hydrocarbons as paint thinner

TPHss = total petroleum hydrocarbons as stoddard solvent

Samples were analyzed by Curtis and Tompkins Analytical

Table 18
Total Petroleum Hydrocarbons in Water - Concentrations Above SNARLs
Batarse Site, Oakland, California

Concentrations in micrograms per liter (µg/l)

Location ID	Date Sampled	Chemical	Result	SNARL value

Laboratories Ltd. for all compounds using EPA test method 8015 modified.

Table 20
Selection of Chemicals of Potential Concern in Soil
Batarse Site, Oakland, California

Chemical	Detection Frequency	Minimum Reporting Limit [1] (mg/kg)	Maximum Reporting Limit [1] (mg/kg)	Minimum Detected Value [1] (mg/kg)	Maximum Detected Value [1] (mg/kg)	Background Values [2] (mg/kg)	Selected as COPC	Rationale for Selection or Exclusion
Indeno(1,2,3-cd)pyrene	1 / 15	0.0033	0.050	0.0059	0.0059	NA	Yes	Detected
Pyrene	2 / 15	0.0067	0.050	0.0091	0.0097	NA	Yes	Detected
SVOCS								
bis(2-Ethylhexyl)phthalate	1 / 15	0.33	3.3	0.87	0.87	NA	Yes	Detected
Phenol	1 / 15	0.33	3.3	0.82	0.82	NA	Yes	Detected
VOCS								
Acetone	1 / 95	0.019	0.022	0.025	0.025	NA	Yes	Detected
Methylene Chloride	8 / 95	0.019	0.022	0.020	0.060	NA	Yes	Detected

Notes:

[1] Minimum and maximum reporting limits and detecteds value from LFR sampling program.

[2] Metal background concentrations from Oakland Urban Land Development.

[3] Arsenic maximum detected value of 33 mg/kg is anomalous and considered an outlier; the other 278 arsenic results are below the background level of 19.1 mg/kg.

mg/kg = Milligrams per kilogram
NA = Not applicable
OCPs = Organochlorine Pesticides
PAH = Polynuclear Aromatic Hydrocarbons
SVOCs = Semivolatile organic compound
VOCs = Volatile organic compound

Table 21
Selection of Chemicals of Potential Concern in Groundwater
Batarse Site, Oakland, California

Chemical	Detection Frequency	Minimum Reporting Limit [1] (µg/l)	Maximum Reporting Limit [1] (µg/l)	Minimum Detected Value [1] (µg/l)	Maximum Detected Value [1] (µg/l)	Selected as COPC	Rationale for Selection or Exclusion
Metals							
Antimony	2 / 58	1.0	20	1.3	490	Yes	Detected
Arsenic	2 / 58	5.0	5.0	9.1	9.4	Yes	Detected
Barium	58 / 58	10	200	28	2000	Yes	Detected
Cobalt	3 / 58	20	20	37	50	Yes	Detected
Copper	2 / 58	10	10	15	16	Yes	Detected
Lead	3 / 58	3.0	3.0	12	100	Yes	Detected
Molybdenum	3 / 58	20	410	20	36	Yes	Detected
Nickel	11 / 58	20	20	23	130	Yes	Detected
Zinc	3 / 58	20	20	26	44	Yes	Detected
SVOCs							
2-Methylnaphthalene	2 / 14	9.4	4800	570	15000	Yes	Detected
Naphthalene	1 / 14	9.4	4800	7000	7000	Yes	Detected
bis(2-Ethylhexyl)phthalate	1 / 28	3.0	4800	3.1	3.1	Yes	Detected
VOCs							
1,2,4-Trimethylbenzene	3 / 58	0.50	8.3	580	2600	Yes	Detected
1,3,5-Trimethylbenzene	3 / 58	0.50	8.3	110	820	Yes	Detected
Bromodichloromethane	1 / 58	0.50	8.3	1.2	1.2	Yes	Detected
Bromoform	1 / 58	1.0	17	7.3	7.3	Yes	Detected
Carbon Disulfide	3 / 58	0.50	8.3	0.60	0.80	Yes	Detected
Chloroform	2 / 58	0.50	8.3	1.3	11	Yes	Detected
cis-1,2-Dichloroethene	4 / 58	0.50	8.3	2.3	10	Yes	Detected
Dibromochloromethane	1 / 58	0.50	8.3	0.60	0.60	Yes	Detected
Ethylbenzene	3 / 58	0.50	8.3	31	210	Yes	Detected
Isopropylbenzene	3 / 58	0.50	8.3	89	190	Yes	Detected
m,p-Xylenes	4 / 58	0.50	8.3	0.50	390	Yes	Detected
MTBE	4 / 58	0.50	8.3	0.50	16	Yes	Detected
n-Butylbenzene	3 / 58	0.50	8.3	93	550	Yes	Detected

Table 21
Selection of Chemicals of Potential Concern in Groundwater
Batarse Site, Oakland, California

Chemical	Detection Frequency	Minimum Reporting Limit [1] (μg/l)	Maximum Reporting Limit [1] (μg/l)	Minimum Detected Value [1] (μg/l)	Maximum Detected Value [1] (μg/l)	Selected as COPC	Rationale for Selection or Exclusion
Naphthalene	3 / 58	1.0	17	68	180	Yes	Detected
para-Isopropyl Toluene	3 / 58	0.50	8.3	14	65	Yes	Detected
Propylbenzene	3 / 58	0.50	8.3	240	700	Yes	Detected
sec-Butylbenzene	3 / 58	0.50	8.3	31	140	Yes	Detected
Styrene	2 / 58	0.50	8.3	0.60	1.4	Yes	Detected
Tetrachloroethene	1 / 58	0.50	8.3	1.3	1.3	Yes	Detected
Toluene	5 / 58	0.50	8.3	0.50	2.3	Yes	Detected
Trichloroethene	4 / 58	0.50	8.3	5.2	15	Yes	Detected
Trichlorofluoromethane	1 / 58	0.50	8.3	0.50	0.50	Yes	Detected
Vinyl Chloride	2 / 58	0.50	8.3	4.4	5.7	Yes	Detected

Notes:

[1] Minimum and maximum reporting limits and detecteds value from LFR sampling program.

μg/l =Micrograms per liter

NA = Not applicable

SVOCs = Semivolatile organic compound

VOCs = Volatile organic compounds

Table 22
Chemical Properties for Chemicals of Potential Concern
Batarse Site, Oakland, California

Chemical	CAS Number	Vapor Pressure[1] (mmHg @ 20-30C)	Solubility[1] (mg/l @ 20-30C)	Henry's Law [1] (atm-m^3/mol)
Metals				
Antimony	7440-36-0	1.00E+00	---	NA
Arsenic	7440-38-2	0.00E+00	---	NA
Barium	7440-39-3	---	---	NA
Cadmium	7440-43-9	0.00E+00	---	NA
Chromium	7440-47-3	0.00E+00	---	NA
Cobalt	7440-48-4	---	---	NA
Copper	7440-50-8	0.00E+00	---	NA
Lead	7439-92-1	0.00E+00	---	NA
Mercury	7439-97-6	2.00E-03	---	NA
Molybdenum	7439-98-7	0.00E+00	---	NA
Nickel	7440-02-0	0.00E+00	---	NA
Zinc	7440-66-6	0.00E+00	---	NA
OCPs				
4,4'-DDT	50-29-3	5.50E-06	5.00E-03	5.13E-04
alpha-Chlordane	5103-71-9	1.00E-05	5.60E-01	9.63E-06
gamma-Chlordane	5103-74-2	1.00E-05	5.60E-01	9.63E-06
PAHs				
2-Methylnaphthalene	91-57-6	---	---	---
Benzo(a)anthracene	56-55-3	2.20E-08	5.70E-03	1.16E-06
Benzo(a)pyrene	50-32-8	5.60E-09	1.20E-03	1.55E-06
Benzo(b)fluoranthene	205-99-2	5.00E-07	1.40E-02	1.19E-05
Benzo(g,h,i)perylene	191-24-2	1.03E-10	7.00E-04	5.34E-08
Chrysene	218-01-9	6.3E-09	1.80E-03	1.05E-06
Dibenz(a,h)anthracene	53-70-3	1.00E-10	5.00E-04	7.33E-08
Indeno(1,2,3-cd)pyrene	193-39-5	1.00E-10	5.30E-04	6.86E-08
Naphthalene [2]	91-20-3	8.50E-02	3.10E+01	4.40E-04
Pyrene	129-00-0	2.50E-06	1.32E-01	5.04E-06
SVOCs				
bis(2-Ethylhexyl)phthalate [2]	117-81-7	1.42E-07	2.70E-01	2.70E-07
Phenol	108-95-2	3.41E-01	9.30E+04	4.54E-07
VOCs				
1,2,4-Trimethylbenzene [2]	95-63-6	2.10E+00	5.70E+01	6.16E-03
1,3,5-Trimethylbenzene [2]	108-67-8	2.48E+00	4.82E+01	8.77E-03
Acetone	67-64-1	2.70E+02	1.00E+06	2.06E-05

Table 22
Chemical Properties for Chemicals of Potential Concern
Batarse Site, Oakland, California

Chemical	CAS Number	Vapor Pressure[1] (mmHg @ 20-30C)	Solubility[1] (mg/l @ 20-30C)	Henry's Law [1] (atm-m^3/mol)
Bromodichloromethane [2]	75-27-4	5.00E+01	3.03E+03	2.12E-03
Bromoform	75-25-2	5.00E+00	3.01E+03	5.52E-04
Carbon Disulfide	75-15-0	3.60E+02	2.94E+03	1.23E-02
Chloroform	67-66-3	1.51E+02	8.20E+03	2.87E-03
cis-1,2-Dichloroethene	156-59-2	2.08E+02	3.50E+03	7.58E-03
Dibromochloromethane [2]	124-48-1	5.54E+00	2.70E+03	7.83E-04
Ethylbenzene	100-41-4	7.00E+00	1.52E+02	6.43E-03
Isopropylbenzene [2]	98-82-8	4.50E+00	6.13E+01	1.15E-02
m,p-Xylenes	1330-20-7	1.00E+01	1.98E+02	7.04E-03
Methylene Chloride	75-09-2	4.31E+03	6.50E+03	4.40E-02
MTBE [2]	1634-04-4	2.50E+02	5.10E+04	5.87E-04
n-Butylbenzene [2]	104-51-8	1.06E+00	1.18E+01	1.59E-02
para-Isopropyl Toluene [2]	99-87-6	1.46E+00	2.34E+01	1.10E-02
Propylbenzene [2]	103-65-1	3.42E+00	5.22E+01	1.05E-02
sec-Butylbenzene [2]	135-98-8	1.75E+00	1.76E+01	1.76E-02
Styrene [2]	100-42-5	6.40E+00	3.10E+02	2.75E-03
Tetrachloroethene	127-18-4	1.78E+01	1.50E+02	2.59E-02
Toluene	108-88-3	2.81E+01	5.35E+02	6.37E-03
Trichloroethene	79-01-6	5.79E+01	1.10E+03	9.10E-03
Trichlorofluoromethane [2]	75-69-4	8.03E+02	1.10E+03	9.70E-02
Vinyl Chloride	75-01-4	2.66E+03	2.67E+03	8.19E-02

Notes:

[1] Values from Exhibit A-1, U.S.EPA Superfund Public Health Evaluation Manual, October 1986.

[2] Values from Environmental Science Center Database; http://esc.syrres.com/interknow/physdemo.htm

mg/l = Milligrams per liter

atm-m^3/mol = atmosphere-cubic meter per mole

NA = Not applicable

--- = Not available

OCPs = Organochlorine Pesticides

PAH = Polynuclear Aromatic Hydrocarbons

SVOCs = Semivolatile organic compound

VOCs = Volatile organic compound

Table 23
Carcinogenic Toxicity Information for Chemicals of Potential Concern
Batarse Site, Oakland, California

Chemical	Oral Cancer Slope Factor (Sfo) $(mg/kg\text{-}day)^{-1}$	Inhalation Cancer Slope Factor (Sfi) $(mg/kg\text{-}day)^{-1}$	Weight-of Evidence Classification	Toxicity Information Reference Source[1]
Metals				
Antimony	NA	NA	---	IRIS 2001
Arsenic	1.5E+00	1.2E+01	A	CAL/EPA 2001, IRIS 2001
Barium	NA	NA	D	IRIS 2001
Cadmium	3.8E-01	1.5E+01	B1	CAL/EPA 2001, IRIS 2001
Chromium	NA	NA	D	IRIS 2001
Cobalt	NA	NA	---	IRIS 2001
Copper	NA	NA	D	IRIS 2001
Lead	NA	NA	B2	IRIS 2001
Mercury	NA	NA	D	IRIS 2001
Molybdenum	NA	NA	---	IRIS 2001
Nickel	NA	9.1E-01	A	CAL/EPA 2001, IRIS 2001
Zinc	NA	NA	D	IRIS 2001
OCPs				
4,4'-DDT	3.4E-01	3.4E-01	B2	CAL/EPA 2001, IRIS 2001
alpha-Chlordane	1.3E+00	1.2E+00	B2	CAL/EPA 2001, IRIS 2001
gamma-Chlordane	1.3E+00	1.2E+00	B2	CAL/EPA 2001, IRIS 2001
PAHs				
2-Methylnaphthalene	NA	NA	---	IRIS 2001
Benzo(a)anthracene	1.2E+00	3.9E-01	B2	CAL/EPA 2001, IRIS 2001
Benzo(a)pyrene	1.2E+01	3.9E+00	B2	CAL/EPA 2001, IRIS 2001
Benzo(b)fluoranthene	1.2E+00	3.9E-01	B2	CAL/EPA 2001, IRIS 2001
Benzo(g,h,i)perylene	NA	NA	---	IRIS 2001
Chrysene	1.2E-01	3.9E-02	B2	CAL/EPA 2001, IRIS 2001
Dibenz(a,h)anthracene	4.1E+00	4.1E+00	B2	CAL/EPA 2001, IRIS 2001
Indeno(1,2,3-cd)pyrene	1.2E+00	3.9E-01	B2	CAL/EPA 2001, IRIS 2001
Naphthalene	NA	NA	C	IRIS 2001
Pyrene	NA	NA	D	IRIS 2001
SVOCs				
bis(2-Ethylhexyl)phthalate	3.0E-03	8.4E-03	B2	CAL/EPA 2001, IRIS 2001
Phenol	NA	NA	D	IRIS 2001
VOCs				
1,2,4-Trimethylbenzene	NA	NA	---	IRIS 2001
1,3,5-Trimethylbenzene	NA	NA	---	IRIS 2001
Acetone	NA	NA	D	IRIS 2001
Bromodichloromethane	1.3E-01	1.3E-01	B2	CAL/EPA 2001, IRIS 2001
Bromoform	7.9E-03	3.9E-03	B2	IRIS 2001
Carbon Disulfide	NA	NA	---	IRIS 2001
Chloroform	3.1E-02	1.9E-02	B2	CAL/EPA 2001, IRIS 2001
cis-1,2-Dichloroethene	NA	NA	D	IRIS 2001
Dibromochloromethane	9.4E-02	9.4E-02	C	CAL/EPA 2001, IRIS 2001
Ethylbenzene	NA	NA	D	IRIS 2001

Table 23
Carcinogenic Toxicity Information for Chemicals of Potential Concern
Batarse Site, Oakland, California

Chemical	Oral Cancer Slope Factor (Sfo) $(mg/kg\text{-}day)^{-1}$	Inhalation Cancer Slope Factor (Sfi) $(mg/kg\text{-}day)^{-1}$	Weight-of Evidence Classification	Toxicity Information Reference Source[1]
Isopropylbenzene	NA	NA	D	IRIS 2001
m,p-Xylenes	NA	NA	D	IRIS 2001
Methylene Chloride	1.4E-02	3.5E-03	B2	CAL/EPA 2001, IRIS 2001
MTBE	1.8E-03	1.8E-03	---	CAL/EPA 2001, IRIS 2001
n-Butylbenzene	NA	NA	---	IRIS 2001
para-Isopropyl Toluene	NA	NA	---	IRIS 2001
Propylbenzene	NA	NA	---	IRIS 2001
sec-Butylbenzene	NA	NA	---	IRIS 2001
Styrene	NA	NA	---	IRIS 2001
Tetrachloroethene	5.1E-02	2.1E-02	---	CAL/EPA 2001, IRIS 2001
Toluene	NA	NA	D	IRIS 2001
Trichloroethene	1.5E-02	1.0E-02	---	CAL/EPA 2001, IRIS 2001
Trichlorofluoromethane	NA	NA	D	IRIS 2001
Vinyl Chloride	2.7E-01	2.7E-01	A	CAL/EPA 2001, IRIS 2001

Notes:

[1] California EPA OEHHA Cancer Potency Values, March 2001;
U.S. EPA Integrated Risk Information System (IRIS) database, May 2001.

mg/kg-day = Milligrams per kilogram per day

OCPs = Organochlorine Pesticides

PAH = Polynuclear Aromatic Hydrocarbons

SVOCs = Semivolatile organic compound

VOCs = Volatile organic compound

NA = Not applicable

--- = Not available

Weight-of Evidence Classification:

- A - Human carcinogen
- B1 - Probable human carcinogen - indicates that limited human data are available
- B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans
- C - Possible human carcinogen
- D - Not classifiable as to human carcinogenicity

Table 24
Noncarcinogenic Toxicity Information for Chemicals of Potential Concern
Batarse Site, Oakland, California

Chemical	Oral Reference Dose (RfDo) (mg/kg-day)	Inhalation Reference Dose (RfDi) (mg/kg-day)	Primary Target Organs	Toxicity Information Reference Source[1]
Metals				
Antimony	4.0E-04	---	Blood	NCEA
Arsenic	3.0E-04	---	Skin	NCEA
Barium	7.0E-02	1.4E-04	Blood Pressure	NCEA
Cadmium	5.0E-04	---	Kidney	NCEA
Chromium	3.0E-03	---	Liver	NCEA
Cobalt	6.0E-02	---	---	
Copper	3.7E-02	---	GI	NCEA
Lead	---	---	Neurotoxicity	NCEA
Mercury	---	2.6E-05	Neurotoxicity	CAL/EPA OEHHA 2001
Molybdenum	5.0E-03	---	---	NCEA
Nickel	2.0E-02	---	Weight Loss	NCEA
Zinc	3.0E-01	---	Blood	NCEA
OCPs				
4,4'-DDT	5.0E-04	5.0E-04	Liver	IRIS 2001
alpha-Chlordane	5.0E-04	2.0E-04	Liver	IRIS 2001
gamma-Chlordane	5.0E-04	2.0E-04	Liver	IRIS 2001
PAHs				
2-Methylnaphthalene	---	---	---	---
Benzo(a)anthracene	---	---	---	---
Benzo(a)pyrene	---	---	---	---
Benzo(b)fluoranthene	---	---	---	---
Benzo(g,h,i)perylene	---	---	---	---
Chrysene	---	---	---	---
Dibenz(a,h)anthracene	---	---	---	---
Indeno(1,2,3-cd)pyrene	---	---	---	---
Naphthalene	2.0E-02	2.6E-03	Body Weight, Respiratory System	IRIS 2001, CAL/EPA OEHHA 2001
Pyrene	3.0E-02	3.0E-02	Kidney	IRIS 2001
SVOCs				
bis(2-Ethylhexyl)phthalate	2.0E-02	2.0E-02	Liver	IRIS 2001
Phenol	6.0E-01	6.0E-01	Fetal Body Weight	IRIS 2001
VOCs				
1,2,4-Trimethylbenzene	5.0E-02	1.7E-03	---	NCEA
1,3,5-Trimethylbenzene	5.0E-02	1.7E-03	---	NCEA
Acetone	1.0E-01	1.0E-01	Liver, Kidney	IRIS 2001
Bromodichloromethane	2.0E-02	2.0E-02	Kidney	IRIS 2001
Bromoform	2.0E-02	2.0E-02	Liver	IRIS 2001
Carbon Disulfide	1.0E-01	2.0E-01	Fetal Toxicity, PNS	IRIS 2001

Table 24
Noncarcinogenic Toxicity Information for Chemicals of Potential Concern
Batarse Site, Oakland, California

Chemical	Oral Reference Dose (RfDo) (mg/kg-day)	Inhalation Reference Dose (RfDi) (mg/kg-day)	Primary Target Organs	Toxicity Information Reference Source[1]
Chloroform	1.0E-02	1.0E-02	Liver	IRIS 2001
cis-1,2-Dichloroethene	1.0E-02	1.0E-02	Blood	HEAST 1997
Dibromochloromethane	2.0E-02	2.0E-02	Liver	IRIS 2001
Ethylbenzene	1.0E-01	5.7E-01	Liver, Kidney, Fetus	IRIS 2001, CAL/EPA OEHHA 2001
Isopropylbenzene	1.0E-01	1.1E-01	Kidney	IRIS 2001
m,p-Xylenes	2.0E+00	2.0E-01	Body weight, CNS, Whole Body	IRIS 2001, CAL/EPA OEHHA 2001
Methylene Chloride	6.0E-02	1.1E-01	Liver	IRIS 2001, CAL/EPA OEHHA 2001
MTBE	8.6E-01	2.2E+00	Liver, Kidney	IRIS 2001, CAL/EPA OEHHA 2001
n-Butylbenzene	1.0E-02	1.0E-02	---	NCEA
para-Isopropyl Toluene	---	---	---	---
Propylbenzene	1.0E-02	1.0E-02	---	NCEA
sec-Butylbenzene	1.0E-02	1.0E-02	---	NCEA
Styrene	2.0E-01	3.0E-01	Blood, Liver, CNS	IRIS 2001
Tetrachloroethene	1.0E-02	1.1E-01	Liver	IRIS 2001, NCEA
Toluene	2.0E-01	8.6E-02	Liver, Kidney, CNS, PNS	IRIS 2001, CAL/EPA OEHHA 2001
Trichloroethene	1.0E-02	1.0E-02	---	IRIS, withdrawn value
Trichlorofluoromethane	3.0E-01	3.0E-01	---	IRIS 2001
Vinyl Chloride	3.0E-03	2.9E-02	CNS/PNS, GI System	IRIS 2001

Notes:

[1] National Center for Environmental Assessment (NCEA) as cited in U.S. EPA Region 9 Preliminary Remedial Goals, November 2000.
U.S. EPA Integrated Risk Information System (IRIS) database, May 2001.
U.S. EPA Heath Effects Assessment Summary Tables (HEAST), Annual Update, FY 1997.
CAL/EPA Office of Environmental Heath Hazard Assessment (OEHHA) database, August 2001.

mg/kg-day = Milligrams per kilogram per day
NA = Not applicable
--- = Not available
OCPs = Organochlorine Pesticides
PAH = Polynuclear Aromatic Hydrocarbons
SVOCs = Semivolatile organic compound
VOCs = Volatile organic compound
PNS = Peripheral Nervous System
CNS = Central Nervous System

Table 25
Carcinogenic Risk Estimate for Chemicals of Potential Concern
Batarse Site, Oakland, California

Chemical	Oral Cancer Slope Factor (Sfo) (mg/kg-day)$^{-1}$	Inhalation Cancer Slope Factor (Sfi) (mg/kg-day)$^{-1}$	Dermal Permeability Coefficient (Kp) (cm/hr)		Dermal Absorption Fraction (ABS) (dimensionless)	Concentration in Water[1] (Cw) (mg/l)			Concentration in Soil[1] (Cs) (mg/kg)			Concentration in Air (Ca) (mg/m^3)	RISK for Water Pathway	RISK for Soil Pathway	RISK for Air Pathway
Metals															
Antimony	NA	NA	0.00016	a	0.01	0.0011	U	L	NA			NA	NA	NA	NA
Arsenic	1.5E+00	1.2E+01	0.00016	a	0.03	0.0028	U	L	NA	U	L	NA	NA	NA	NA
Barium	NA	NA	0.00016	a	0.001	0.13	U	L	131	U	L	6.6E-06	NA	NA	NA
Cadmium	3.8E-01	1.5E+01	NA		0.001	NA			1.7	U	L	8.5E-08	NA	**1.0E-06**	**1.9E-07**
Chromium	NA	NA	NA		0.01	NA			32	U	L	1.6E-06	NA	NA	NA
Cobalt	NA	NA	0.00016	a	0.01	0.012	U	L	NA			NA	NA	NA	NA
Copper	NA	NA	0.00016	a	0.01	0.0056	U	L	NA			NA	NA	NA	NA
Lead	NA	NA	0.00016	a	0.01	0.0026	U	L	10	U	L	5.0E-07	NA	NA	NA
Mercury	NA	NA	NA		0.01	NA			0.071	U	L	3.6E-09	NA	NA	NA
Molybdenum	NA	NA	0.00016	a	0.01	0.014	U	L	NA			NA	NA	NA	NA
Nickel	NA	9.1E-01	0.00016	a	0.01	0.020	U	L	NA			NA	NA	NA	NA
Zinc	NA	NA	0.00016	a	0.01	0.012	U	L	47	U	L	2.4E-06	NA	NA	NA
OCPs															
4,4'-DDT	3.4E-01	3.4E-01	NA		0.05	NA			0.012	M	N	6.0E-10	NA	**1.0E-08**	**3.0E-11**
alpha-Chlordane	1.3E+00	1.2E+00	NA		0.05	NA			0.012	M	N	6.0E-10	NA	**3.9E-08**	**1.1E-10**
gamma-Chlordane	1.3E+00	1.2E+00	NA		0.05	NA			0.0075	M	N	3.8E-10	NA	**2.4E-08**	**6.7E-11**
SVOCs															
2-Methylnaphthalene	NA	NA	0.069	b	NA	9.1	U	L	NA			6.7E-05	NA	NA	NA
Benzo(a)anthracene	1.2E+00	3.9E-01	NA		0.1	NA			0.0036	M	L	1.8E-10	NA	**1.5E-08**	**1.0E-11**
Benzo(a)pyrene	1.2E+01	3.9E+00	NA		0.1	NA			0.0081	M	L	4.1E-10	NA	**3.3E-07**	**2.4E-10**
Benzo(b)fluoranthene	1.2E+00	3.9E-01	NA		0.1	NA			0.0067	M	L	3.4E-10	NA	**2.8E-08**	**1.9E-11**
Benzo(g,h,i)perylene	NA	NA	NA		0.1	NA			0.0071	M	L	3.6E-10	NA	NA	NA
Chrysene	1.2E-01	3.9E-02	NA		0.1	NA			0.057	U	L	2.9E-09	NA	**2.4E-08**	**1.7E-11**
Dibenz(a,h)anthracene	4.1E+00	4.1E+00	NA		0.1	NA			0.016	M	L	8.0E-10	NA	**2.3E-07**	**4.9E-10**
Indeno(1,2,3-cd)pyrene	1.2E+00	3.9E-01	NA		0.1	NA			0.0059	M	L	3.0E-10	NA	**2.4E-08**	**1.7E-11**
Naphthalene	NA	NA	0.069		0.1	0.0046	U	L	NA			3.4E-08	NA	NA	NA
Pyrene	NA	NA	NA		0.1	NA			0.0097	M	L	1.3E-11	NA	NA	NA
SVOCs															
bis(2-Ethylhexyl)phthalate	3.0E-03	8.4E-03	0.033		0.1	0.0031	M	L	0.43	U	L	2.2E-08	**1.5E-07**	**4.4E-09**	**2.7E-11**
Phenol	NA	NA	NA		0.1	NA			0.42	U	L	2.1E-08	NA	NA	NA

APPENDIX H

Screening Level Evaluation

INTRODUCTION

A human health screening evaluation was performed for the Site, in conformance with the PEA Guidance Manual. Analytical data from the sampling events conducted by LFR were used for this evaluation.

The purpose of the screening evaluation was to provide the risk manager with an estimate of the potential chronic health risk/hazard from affected soils identified at the Site. The screening evaluation was used to assist in evaluating whether further site characterization, risk assessment, or remediation was necessary. The risk/hazard estimates are calculated for exposure pathways most frequently encountered in a residential setting.

Under the residential scenario, the receptors are assumed to be exposed 24 hours a day, 350 days per year for 30 years for the reasonable maximum exposure (RME) case (i.e., 6 years for a child and 24 years for an adult; Cal/EPA Department of Toxic Substances Control [DTSC] 1994). The residents are assumed to be exposed via inhalation of airborne particulate and vapor emissions from the Site. Inhalation rates of 0.83 cubic meter per hour (m^3/hr) for a 24-hour day (i.e., 20 cubic meter per day, m^3/day) for an adult resident and of 0.43 m^3/hr for a 24-hour day (i.e., 10 m^3/day) for a child resident were used for the residents evaluations as recommended by Cal/EPA for the RME case. Residents are also assumed to use the shallow groundwater as a domestic source. Groundwater ingestion rates of two liters per day for adult residents and one liter per day for child residents are used in the evaluation. To add a level of conservatism, volatile organic compounds (VOCs) are assumed to migrate into the indoor air. Inhalation of VOCs during bathing is also considered.

The residents are also assumed to be exposed via incidental ingestion and direct dermal contact with soils at the Site. Ingestion rates of 100 milligrams per day (mg/day) for an adult resident and of 200 mg/day for a child resident were used for the residents evaluations, as recommended by Cal/EPA for the RME case. The exposed skin surface areas of 5,800 square centimeters per day (cm^2 /day) for an adult resident and of 2,000 cm^2 /day for a child resident were used for the residential evaluations as recommended by Cal/EPA for the RME case. The default value for soil-to-skin adherence factor of 1 milligram per square centimeter (mg/cm^2) was used in the residential evaluations for direct dermal exposure. The adult resident was assumed to be exposed to soils via the direct dermal route two times per week or 100 days per year. The child resident was assumed to be exposed to soils via the direct dermal route seven times per week or 350 days per year. The average body weights of an adult resident and a child resident were assumed to be 70 kilograms (kg) and 15 kg, respectively.

The DTSC-modified Johnson and Ettinger vapor transport model was used to estimate VOC concentrations in indoor air. Silty clay soils are assumed to best represent the Site, and appropriate model parameters were selected. The results of the modeling are presented in Attachment 1 and summarized in Tables 25 and 26.

Figure 11 presents a conceptual site model for the Site. The conceptual site model is the tool used to identify the complete exposure pathways for the screening level evaluation of chronic health risks. The model for the Site was developed based on the following assumption:

- The Site will be developed into a school and covered with buildings and pavement.

Soil chemicals of potential concern (COPCs) used in the evaluation of chronic health risk from the ingestion, dermal contact, and inhalation pathways included metals, organochlorine pesticides (OCPs), polynuclear aromatic hydrocarbons (PAHs), semivolatile organic compounds (SVOCs), and VOCs and are summarized in Table 20.

Groundwater COPCs used in the evaluation of chronic health risk from inhalation of vapors and domestic use include metals, PAHs, SVOCs, and VOCs and are summarized in Table 21.

The conceptual site model shows that exposure to affected soils and groundwater may be possible along the inhalation, ingestion, and dermal absorption pathways.

Ingestion of and bathing in groundwater was considered as a complete pathway, even though individuals at the school would be unlikely to drink groundwater from the Site. The evaluation was performed for risk management information purposes. The inhalation of VOCs in groundwater migrating through the soil column and into indoor air was also considered as a complete exposure pathway.

The screening evaluation presented herein is intended to be a health-conservative preliminary evaluation of potential risk and hazard and represent a reasonable maximum exposure as defined by the U.S. EPA to the identified COPCs. In establishing screening evaluation assumptions and exposure factors, LFR considered those factors described in the PEA Guidance Manual, which include (but are not limited to) the following:

- land use (residential)
- exposure pathways and media of exposure (inhalation, ingestion, and dermal absorption)
- chemicals of potential concern (metals, OCPs, PAHs, SVOCs, and VOCs)
- exposure point concentrations (the higher value of the COPC 95% upper confidence limit [UCL] or maximum detected concentration for both soil and groundwater

EXPOSURE PATHWAYS AND MEDIA OF CONCERN

The exposure pathways for soil, groundwater, and air include inhalation, ingestion, and dermal absorption. The conceptual site model diagram is included as Figure 11. The PEA soil results indicate that affected soils are distributed throughout the Site. VOCs were identified in the shallow groundwater. Modeling was performed to estimate the air concentration of the VOCs migrating from the groundwater, through the soil column and into the breathing zone. Direct contact to groundwater was considered. The risk/hazard was calculated for the soil, groundwater, and air media of concern.

EXPOSURE POINT CONCENTRATIONS AND CHEMICAL GROUPS

All chemicals detected above laboratory detection limits in soil and groundwater samples were initially selected as COPCs. Maximum detected metal concentrations were compared to the range of background levels for soils in the local regional area (Oakland Urban Land Development). Metals with maximum detected concentrations below background levels (i.e., antimony, beryllium, cobalt, copper, molybdenum, nickel, selenium, silver, thallium, and vanadium) were excluded as soil COPCs.

Metals with maximum concentrations in discrete soil samples (i.e., arsenic, barium, cadmium, chromium, lead, mercury, and zinc) above background levels were selected as COPCs.

The final soil COPCs selected for the human health screening evaluation also included OCPs, PAHs, SVOCs, and VOCs in soil. No background metal concentration in groundwater was available for the Site. Metals detected in groundwater (i.e., antimony, arsenic, barium, cobalt, copper, lead, molybdenum, nickel, and zinc) were selected as groundwater COPCs. SVOCs and VOCs were also selected as COPCs in groundwater. The selection of COPCs in soil and groundwater is summarized in Tables 20 and 21, respectively.

As authorized by DTSC, 95% UCLs of the mean were considered to represent exposure point concentrations in soil and groundwater based on the robust data set (personal communication, Ms. Janet Naito of DTSC, August 16, 2001). In addition, DTSC's representatives agreed with LFR that the concentration of chromium at 160 milligrams per kilogram (mg/kg) in the soil sample collected at the 3-foot depth from boring BASB013, and the concentration of arsenic at 33 mg/kg in the soil sample collected at the 2-foot depth at boring BASB023, could be considered outliers of the data set and could be excluded from the risk assessment. COPC distributions in both soil and groundwater were evaluated using either the Shapiro-Wilk W-test for samples size less the 50 or the D'Agostino Y-Test for sample size greater than 50. The distribution and 95% UCL concentrations are presented in Tables 25 and 26. The 95% UCL concentrations for COPCs are used in the groundwater vapor transport modeling. The DTSC-modified Johnson and Ettinger vapor transport model provided via e-mail by Ms. Naito was used in this evaluation to estimate indoor air VOC concentrations. For non-volatile COPCs in soils, the air exposure point concentrations are calculated using the equations presented in Figure 2.8 in the PEA Guidance Manual.

ATTACHMENT 1

Modeling Results

DATA ENTRY SHEET FOR TRICHLOROFLUOROMETHANE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
75694	0.35	Trichlorofluoromethane

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR TRICHLOROFLUOROMETHANE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
8.70E-02	1.30E-05	3.98E+00	25	6,424	299.70	471.20	1.60E+02	1.10E+03	0.0E+00	7.0E-01

INTERMEDIATE CALCULATIONS SHEET FOR TRICHLOROFLUOROMETHANE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625.00	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	6,574	2.71E+00	1.14E+02	1.77E-04	5.76E-04	4.39E-04	5.26E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625.00	15	4.01E+04	0.10	4.60E-02	5.76E-04	3.84E+02	2.26E+01	8.05E-07	3.22E-02	NA	7.0E-01

DATA ENTRY SHEET FOR para-ISOPROPYL TOLUENE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
99876	0.73	para-Isopropyl Toluene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR para-ISOPROPYL TOLUENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.50E-02	7.10E-06	4.92E+01	25	11,039	449.70	651.00	2.20E+02	6.10E+01	0.0E+00	3.9E-01

INTERMEDIATE CALCULATIONS SHEET FOR para-ISOPROPYL TOLUENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm³/cm³)	Vadose zon effective total fluid saturation, S_{te} (cm³/cm³)	Vadose zone soil intrinsic permeability, k_i (cm²)	Vadose zone soil relative air permeability, k_{rg} (cm²)	Vadose zone soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
625.00	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)
5.63E+04	9.24E+05	4.16E-04	15	13,933	2.18E+01	9.20E+02	1.77E-04	4.97E-04	3.79E-04	4.53E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m³)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m³)
625.00	15	6.72E+05	0.10	4.60E-02	4.97E-04	3.84E+02	3.73E+01	7.84E-07	5.27E-01	NA	3.9E-01

DATA ENTRY SHEET FOR PROPYLBENZENE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
103651	2.6	Propylbenzene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR PROPYLBENZENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.50E-02	7.80E-06	5.37E-01	25	10,424	432.30	638.20	2.83E+03	1.38E+01	0.0E+00	3.5E-02

INTERMEDIATE CALCULATIONS SHEET FOR PROPYLBENZENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625.00	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	12,789	2.54E-01	1.07E+01	1.77E-04	4.97E-04	3.79E-04	4.53E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
625.00	15	2.79E+04	0.10	4.60E-02	4.97E-04	3.84E+02	3.73E+01	7.84E-07	2.19E-02	NA	3.5E-02

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
135988	1.0	sec-Butylbenzene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR sec-BUTYLBENZENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.50E-02	7.80E-06	7.67E-01	25	11,069	446.00	664.00	2.15E+03	1.70E+01	0.0E+00	3.5E-02

INTERMEDIATE CALCULATIONS SHEET FOR sec-BUTYLBENZENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625.00	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	13,623	3.45E-01	1.46E+01	1.77E-04	4.97E-04	3.79E-04	4.53E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625.00	15	1.46E+04	0.10	4.60E-02	4.97E-04	3.84E+02	3.73E+01	7.84E-07	1.14E-02	NA	3.5E-02

DATA ENTRY SHEET FOR n-BUTYLBENZENE

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26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
104518	1.8	n-Butylbenzene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR n-BUTYLBENZENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.50E-02	7.80E-06	5.37E-01	25	11,052	456.00	660.50	2.83E+03	1.38E+01	0.0E+00	3.5E-02

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm³/cm³)	Vadose zon effective total fluid saturation, S_{te} (cm³/cm³)	Vadose zone soil intrinsic permeability, k_i (cm²)	Vadose zone soil relative air permeability, k_{rg} (cm²)	Vadose zone soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
625.00	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)
5.63E+04	9.24E+05	4.16E-04	15	14,003	2.37E-01	1.00E+01	1.77E-04	4.97E-04	3.79E-04	4.53E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m³)	Unit risk factor, URF (μg/m³)⁻¹	Reference conc., RfC (mg/m³)
625.00	15	1.80E+04	0.10	4.60E-02	4.97E-04	3.84E+02	3.73E+01	7.84E-07	1.41E-02	NA	3.5E-02

DATA ENTRY SHEET FOR ISOPROPYLBENZENE

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

VERSION 1.5
26-Jan-01
DTSC / HERD

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
98828	1.4	Isopropylbenzene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR ISOPROPYLBENZENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.50E-02	7.10E-06	4.92E+01	25	10,335	425.80	631.10	2.20E+02	6.10E+01	0.0E+00	3.9E-01

INTERMEDIATE CALCULATIONS SHEET FOR ISOPROPYLBENZENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625.00	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	12,582	2.35E+01	9.96E+02	1.77E-04	4.97E-04	3.79E-04	4.53E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625.00	15	1.39E+06	0.10	4.60E-02	4.97E-04	3.84E+02	3.73E+01	7.84E-07	1.09E+00	NA	3.9E-01

DATA ENTRY SHEET FOR 1,2,4-TRIMETHYLBENZENE

VERSION 1.5
26-Jan-01

DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
95636	4.8	1,2,4-Trimethylbenzene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR 1,2,4-TRIMETHYLBENZENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
7.50E-02	7.10E-06	2.34E-01	25	10,782	449.10	664.50	3.72E+03	5.70E+01	0.0E+00	6.0E-03

INTERMEDIATE CALCULATIONS SHEET FOR 1,2,4-TRIMETHYLBENZENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625.00	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	13,359	1.07E-01	4.52E+00	1.77E-04	4.97E-04	3.79E-04	4.53E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625.00	15	2.17E+04	0.10	4.60E-02	4.97E-04	3.84E+02	3.73E+01	7.84E-07	1.70E-02	NA	6.0E-03

DATA ENTRY SHEET FOR 1,3,5-TRIMETHYLBENZENE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
108678	2.0	1,3,5-Trimethylbenzene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR 1,3,5-TRIMETHYLBENZENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.50E-02	7.10E-06	3.16E-01	25	10,517	437.70	637.30	8.19E+02	4.80E+01	0.0E+00	6.0E-03

INTERMEDIATE CALCULATIONS SHEET FOR 1,3,5-TRIMETHYLBENZENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625.00	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	13,096	1.47E-01	6.21E+00	1.77E-04	4.97E-04	3.79E-04	4.53E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625.00	15	1.24E+04	0.10	4.60E-02	4.97E-04	3.84E+02	3.73E+01	7.84E-07	9.73E-03	NA	6.0E-03

DATA ENTRY SHEET FOR VINYL CHLORIDE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
75014	0.43	Vinyl chloride (chloroethene)

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR VINYL CHLORIDE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3$)$^{-1}$	Reference conc., RfC (mg/m^3)
1.06E-01	1.23E-06	2.71E-02	25	5,250	259.25	432.00	1.86E+01	2.76E+03	7.8E-05	0.0E+00

INTERMEDIATE CALCULATIONS SHEET FOR VINYL CHLORIDE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	4,944	2.03E-02	8.58E-01	1.77E-04	7.02E-04	5.36E-04	6.41E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
625	15	3.69E+02	0.10	4.60E-02	7.02E-04	3.84E+02	1.29E+01	8.41E-07	3.10E-04	7.8E-05	NA

DATA ENTRY SHEET FOR TOLUENE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
108883	0.46	Toluene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR TOLUENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
8.70E-02	8.60E-06	6.63E-03	25	7,930	383.78	591.79	1.82E+02	5.26E+02	0.0E+00	3.0E-01

INTERMEDIATE CALCULATIONS SHEET FOR TOLUENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm³/cm³)	Vadose zone effective total fluid saturation, S_{te} (cm³/cm³)	Vadose zone soil intrinsic permeability, k_i (cm²)	Vadose zone soil relative air permeability, k_{rg} (cm²)	Vadose zone soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)
5.63E+04	9.24E+05	4.16E-04	15	9,100	3.89E-03	1.65E-01	1.77E-04	5.80E-04	4.43E-04	5.30E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m³)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m³)
625	15	7.57E+01	0.10	4.60E-02	5.80E-04	3.84E+02	2.22E+01	8.06E-07	6.10E-05	NA	3.0E-01

DATA ENTRY SHEET FOR STYRENE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
100425	0.38	Styrene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR STYRENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.10E-02	8.00E-06	2.76E-03	25	8,737	418.31	636.00	7.76E+02	3.10E+02	0.0E+00	9.0E-01

INTERMEDIATE CALCULATIONS SHEET FOR STYRENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	10,395	1.50E-03	6.35E-02	1.77E-04	4.79E-04	3.68E-04	4.38E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
625	15	2.41E+01	0.10	4.60E-02	4.79E-04	3.84E+02	4.28E+01	7.80E-07	1.88E-05	NA	9.0E-01

DATA ENTRY SHEET FOR MTBE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
1634044	0.52	Methyl tert-butyl ether

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR MTBE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
8.10E-02	9.41E-05	5.87E-04	25	6,678	328.00	497.00	1.17E+01	4.80E+04	2.6E-07	8.0E+00

INTERMEDIATE CALCULATIONS SHEET FOR MTBE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	7,226	3.84E-04	1.63E-02	1.77E-04	9.22E-04	8.47E-04	8.98E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
625	15	8.45E+00	0.10	4.60E-02	9.22E-04	3.84E+02	7.03E+00	9.15E-07	7.74E-06	2.6E-07	8.0E+00

DATA ENTRY SHEET FOR M,P-XYLENES

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
108383	1.4	m-Xylene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR M,P-XYLENES

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.00E-02	7.80E-06	7.34E-03	25	8,523	412.27	617.05	4.07E+02	1.61E+02	0.0E+00	7.0E-01

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	10,197	4.04E-03	1.71E-01	1.77E-04	4.67E-04	3.57E-04	4.26E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625	15	2.39E+02	0.10	4.60E-02	4.67E-04	3.84E+02	4.71E+01	7.77E-07	1.86E-04	NA	7.0E-01

DATA ENTRY SHEET FOR ETHYLBENZENE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
100414	1.1	Ethylbenzene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR ETHYLBENZENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.50E-02	7.80E-06	7.88E-03	25	8,501	409.34	617.20	3.63E+02	1.69E+02	0.0E+00	2.0E+00

INTERMEDIATE CALCULATIONS SHEET FOR ETHYLBENZENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm³/cm³)	Vadose zone effective total fluid saturation, S_{te} (cm³/cm³)	Vadose zone soil intrinsic permeability, k_i (cm²)	Vadose zone soil relative air permeability, k_{rg} (cm²)	Vadose zone soil effective vapor permeability, k_v (cm²)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm³/cm³)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm³/cm³)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm³/cm³)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm³/s)	Area of enclosed space below grade, A_B (cm²)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m³/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm²/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm²/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm²/s)
5.63E+04	9.24E+05	4.16E-04	15	10,098	4.36E-03	1.84E-01	1.77E-04	5.00E-04	3.82E-04	4.56E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m³)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm³/s)	Crack effective diffusion coefficient, D^{crack} (cm²/s)	Area of crack, A_{crack} (cm²)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m³)	Unit risk factor, URF (μg/m³)⁻¹	Reference conc., RfC (mg/m³)
625	15	2.03E+02	0.10	4.60E-02	5.00E-04	3.84E+02	3.65E+01	7.85E-07	1.59E-04	NA	2.0E+00

DATA ENTRY SHEET FOR CHLORODIBROMOMETHANE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (µg/L)	Chemical
124481	0.36	Chlorodibromomethane

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR CHLORODIBROMOMETHANE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H (atm-m^3/mol)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.96E-02	1.05E-05	7.83E-04	25	8,000	416.14	678.20	6.31E+01	2.60E+03	2.7E-05	0.0E+00

INTERMEDIATE CALCULATIONS SHEET FOR CHLORODIBROMOMETHANE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	9,151	4.58E-04	1.94E-02	1.77E-04	1.66E-04	1.40E-04	1.57E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
625	15	6.97E+00	0.10	4.60E-02	1.66E-04	3.84E+02	5.07E+04	6.82E-07	4.75E-06	2.7E-05	NA

DATA ENTRY SHEET FOR CHLOROFORM

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
67663	0.47	Chloroform

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR CHLOROFORM

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (°C)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (°K)	Critical temperature, T_C (°K)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.66E-03	25	6,988	334.32	536.40	3.98E+01	7.92E+03	5.3E-06	3.0E-01

INTERMEDIATE CALCULATIONS SHEET FOR CHLOROFORM

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	7,502	2.36E-03	9.97E-02	1.77E-04	6.95E-04	5.33E-04	6.36E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
625	15	4.69E+01	0.10	4.60E-02	6.95E-04	3.84E+02	1.33E+01	8.39E-07	3.93E-05	5.3E-06	3.0E-01

DATA ENTRY SHEET FOR CARBON DISULFIDE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
75150	0.38	Carbon disulfide

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR CARBON DISULFIDE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
1.04E-01	1.00E-05	3.02E-02	25	6,391	319.00	552.00	4.57E+01	1.19E+03	0.0E+00	7.0E-01

INTERMEDIATE CALCULATIONS SHEET FOR CARBON DISULFIDE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	6,644	2.05E-02	8.65E-01	1.77E-04	6.90E-04	5.26E-04	6.29E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625	15	3.29E+02	0.10	4.60E-02	6.90E-04	3.84E+02	1.36E+01	8.37E-07	2.75E-04	NA	7.0E-01

DATA ENTRY SHEET FOR BROMOFORM

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
75252	0.80	Bromoform

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR BROMOFORM

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
1.49E-02	1.03E-05	5.34E-04	25	9,479	422.35	696.00	8.71E+01	3.10E+03	1.1E-06	0.0E+00

INTERMEDIATE CALCULATIONS SHEET FOR BROMOFORM

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	10,826	2.83E-04	1.20E-02	1.77E-04	1.56E-04	1.40E-04	1.51E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625	15	9.58E+00	0.10	4.60E-02	1.56E-04	3.84E+02	1.01E+05	6.77E-07	6.49E-06	1.1E-06	NA

DATA ENTRY SHEET FOR BROMODICHLOROMETHANE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
75274	0.37	Bromodichloromethane

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR BROMODICHLOROMETHANE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
2.98E-02	1.06E-05	1.60E-03	25	7,000	363.15	585.85	5.50E+01	6.74E+03	3.7E-05	0.0E+00

INTERMEDIATE CALCULATIONS SHEET FOR FOR BROMODICHLOROMETHANE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	7,732	1.02E-03	4.30E-02	1.77E-04	2.14E-04	1.69E-04	1.98E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625	15	1.59E+01	0.10	4.60E-02	2.14E-04	3.84E+02	4.48E+03	7.06E-07	1.12E-05	3.7E-05	NA

DATA ENTRY SHEET FOR 2-METHYLNAPHTHALENE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
91576	9074	2-Methylnaphthalene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

INTERMEDIATE CALCULATIONS SHEET FOR 2-METHYLNAPHTHALENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zon effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	12,861	2.27E-04	9.62E-03	1.77E-04	4.43E-04	3.57E-04	4.12E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625	15	8.73E+04	0.10	4.60E-02	4.43E-04	3.84E+02	5.80E+01	7.72E-07	6.74E-02	NA	9.0E-03

DATA ENTRY SHEET FOR NAPHTHALENE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
91203	4.6	Naphthalene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR NAPHTHALENE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
5.90E-02	7.50E-06	4.83E-04	25	10,373	491.14	748.40	2.00E+03	3.10E+01	0.0E+00	9.0E-03

INTERMEDIATE CALCULATIONS SHEET FOR NAPHTHALENE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	12,861	2.27E-04	9.62E-03	1.77E-04	4.43E-04	3.57E-04	4.12E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625	15	4.42E+01	0.10	4.60E-02	4.43E-04	3.84E+02	5.80E+01	7.72E-07	3.41E-05	NA	9.0E-03

DATA ENTRY SHEET FOR CIS-1,2-DCE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (μg/L)	Chemical
156592	0.57	cis-1,2-Dichloroethylene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vadose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR CIS-1,2-DCE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
7.36E-02	1.13E-05	4.07E-03	25	7,192	333.65	544.00	3.55E+01	3.50E+03	0.0E+00	3.5E-02

INTERMEDIATE CALCULATIONS SHEET FOR CIS-1,2-DCE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	7,684	2.59E-03	1.10E-01	1.77E-04	4.94E-04	3.80E-04	4.52E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625	15	6.26E+01	0.10	4.60E-02	4.94E-04	3.84E+02	3.80E+01	7.84E-07	4.90E-05	NA	3.5E-02

DATA ENTRY SHEET FOR PCE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
127184	0.37	Tetrachloroethylene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR PCE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.20E-02	8.20E-06	1.84E-02	25	8,288	394.40	620.20	1.55E+02	2.00E+02	5.9E-06	3.5E-02

INTERMEDIATE CALCULATIONS SHEET FOR PCE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	9,502	1.05E-02	4.46E-01	1.77E-04	4.78E-04	3.65E-04	4.37E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
625	15	1.65E+02	0.10	4.60E-02	4.78E-04	3.84E+02	4.29E+01	7.79E-07	1.29E-04	5.9E-06	3.5E-02

DATA ENTRY SHEET FOR TCE

VERSION 1.5
26-Jan-01
DTSC / HERD

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

YES [ ]

OR

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

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	**ENTER** Initial groundwater conc., C_W (μg/L)	Chemical
79016	0.62	Trichloroethylene

ENTER Depth below grade to bottom of enclosed space floor, L_F (15 or 200 cm)	**ENTER** Depth below grade to water table, L_{WT} (cm)	**ENTER** SCS soil type directly above water table	**ENTER** Average soil/ groundwater temperature, T_S (°C)
15	640	SIC	15

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	**ENTER** User-defined vadose zone soil vapor permeability, k_v (cm^2)	**ENTER** Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	**ENTER** Vadose zone soil total porosity, n^V (unitless)	**ENTER** Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
SIC			1.5	0.36	0.24

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

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET FOR TCE

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.10E+03	2.0E-06	6.0E-01

INTERMEDIATE CALCULATIONS SHEET FOR TCE

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
625	0.120	0.586	7.48E-11	0.643	4.81E-11	192.31	0.36	0.111	0.249	3,844

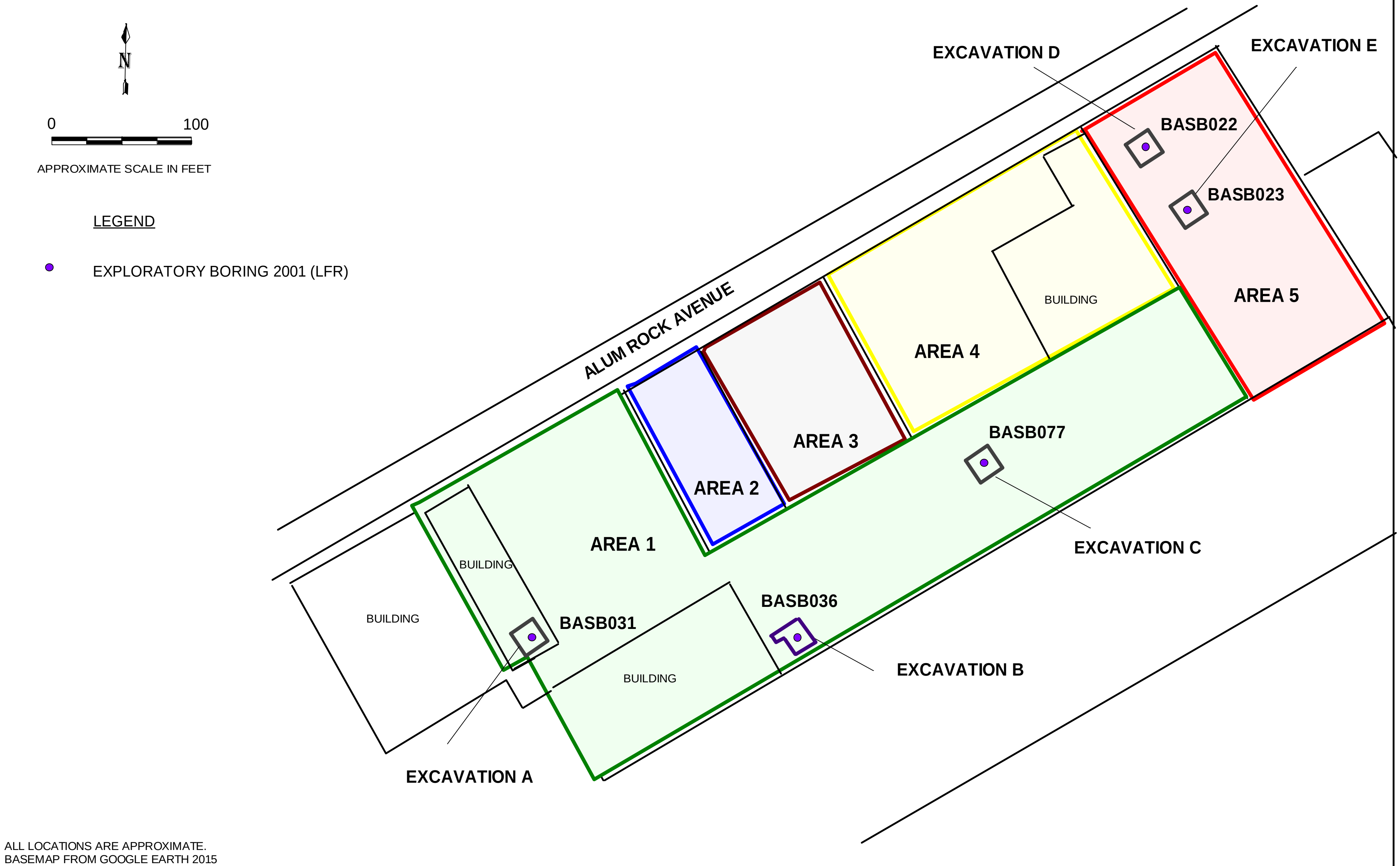
Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
5.63E+04	9.24E+05	4.16E-04	15	8,495	6.26E-03	2.65E-01	1.77E-04	5.26E-04	4.02E-04	4.80E-04

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} (μg/m^3)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ (μg/m^3)	Unit risk factor, URF (μg/m^3)$^{-1}$	Reference conc., RfC (mg/m^3)
625	15	1.64E+02	0.10	4.60E-02	5.26E-04	3.84E+02	3.06E+01	7.91E-07	1.30E-04	2.0E-06	6.0E-01

ATTACHMENT B

WellTest Excavation Locations, Extremity Sampling

& Results Tables



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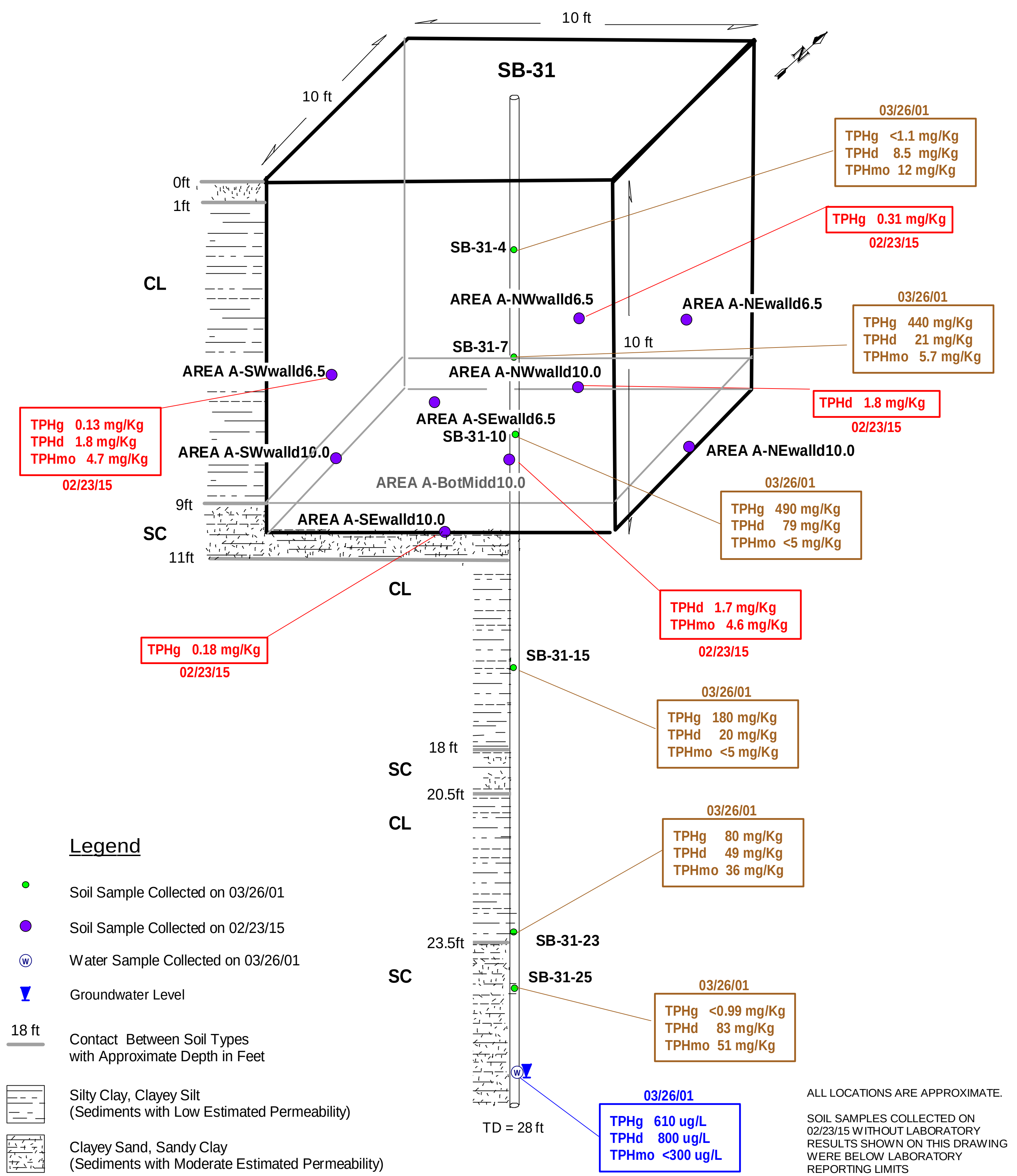
EXTENDED SITE MAP SHOWING STUDY AREAS 1 THROUGH 5 AND EXCAVATIONS A THROUGH E

BATARSE PROPERTY
10550 INDUSTRIAL AVENUE
OAKLAND, CALIFORNIA

FIGURE 3

File: 4409/Figure 3



ALL LOCATIONS ARE APPROXIMATE.

SOIL SAMPLES COLLECTED ON 02/23/15 WITHOUT LABORATORY RESULTS SHOWN ON THIS DRAWING WERE BELOW LABORATORY REPORTING LIMITS

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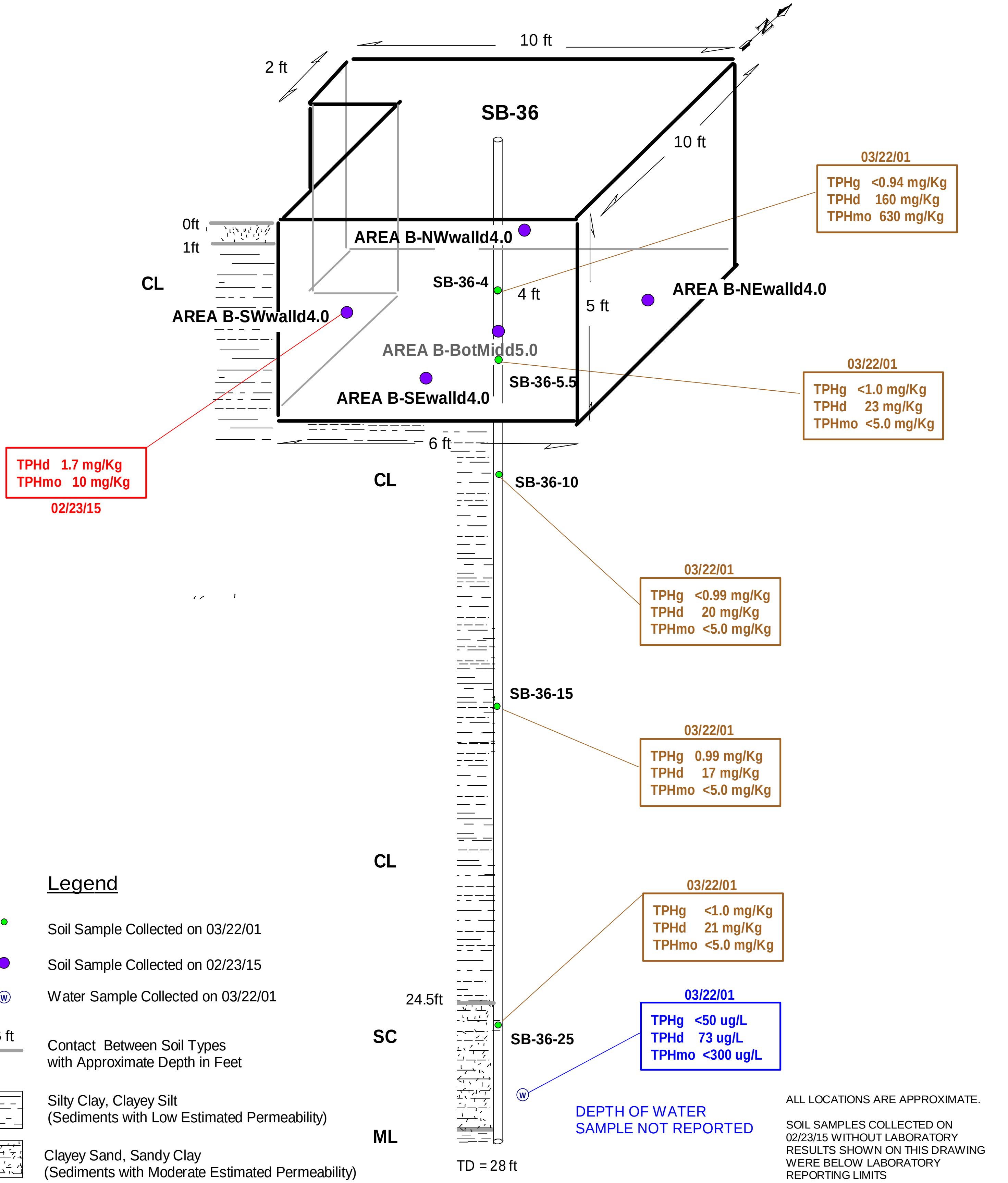
AREA "A" EXCAVATION DIAGRAM AND SOIL SAMPLE LOCATIONS (2001 AND 2015)

BATARSE PROPERTY
10550 INDUSTRIAL AVENUE
OAKLAND, CALIFORNIA

FIGURE 4

File: 4409/Figure 4



Legend

- Soil Sample Collected on 03/22/01
- Soil Sample Collected on 02/23/15
- Water Sample Collected on 03/22/01
- 6 ft — Contact Between Soil Types with Approximate Depth in Feet
- Silty Clay, Clayey Silt (Sediments with Low Estimated Permeability)
- Clayey Sand, Sandy Clay (Sediments with Moderate Estimated Permeability)

ALL LOCATIONS ARE APPROXIMATE.

SOIL SAMPLES COLLECTED ON 02/23/15 WITHOUT LABORATORY RESULTS SHOWN ON THIS DRAWING WERE BELOW LABORATORY REPORTING LIMITS

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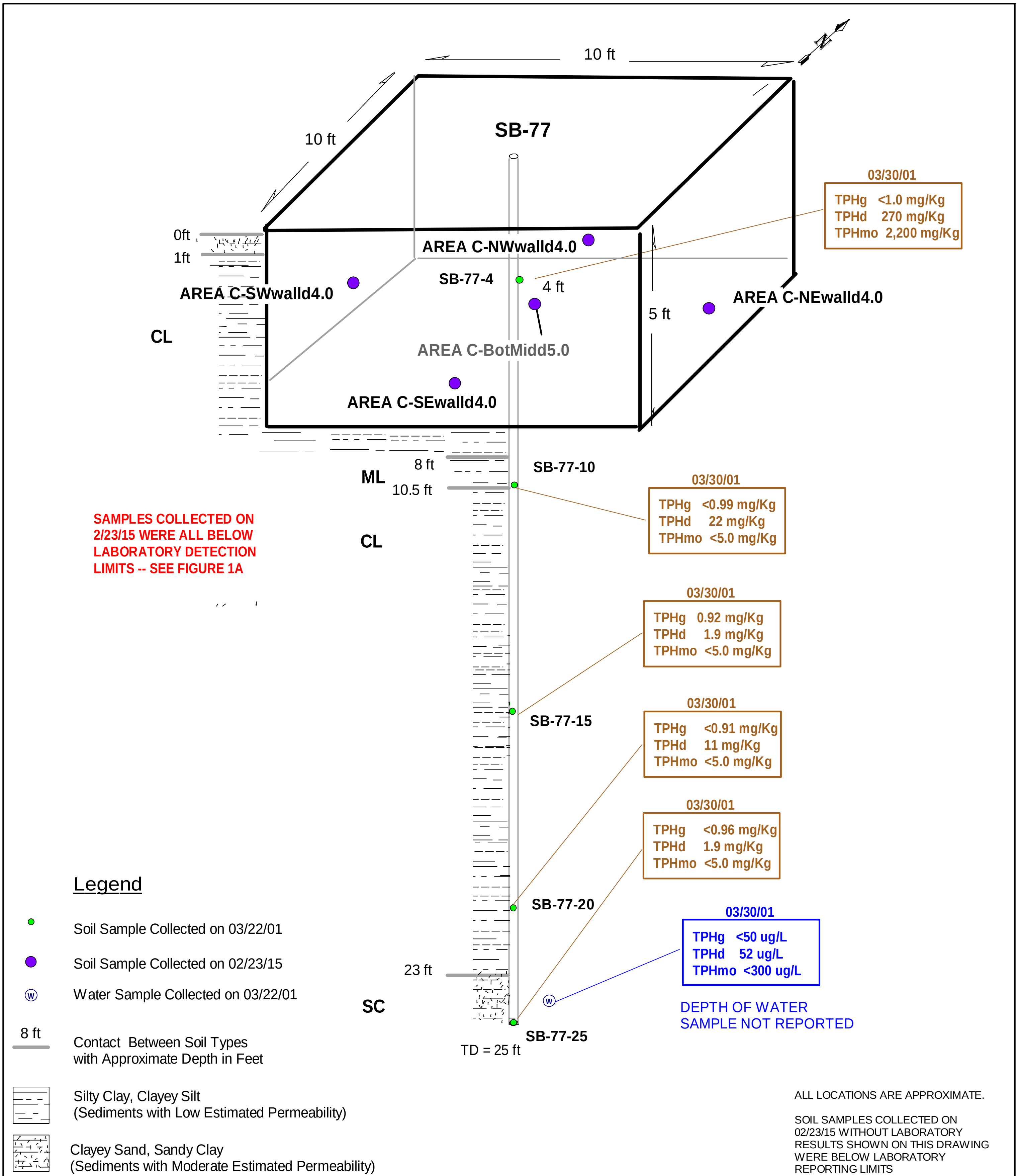
AREA "B" EXCAVATION DIAGRAM AND SOIL SAMPLE LOCATIONS (2001 AND 2015)

BATARSE PROPERTY
10550 INDUSTRIAL AVENUE
OAKLAND, CALIFORNIA

FIGURE 5

File: 4409/Figure 4



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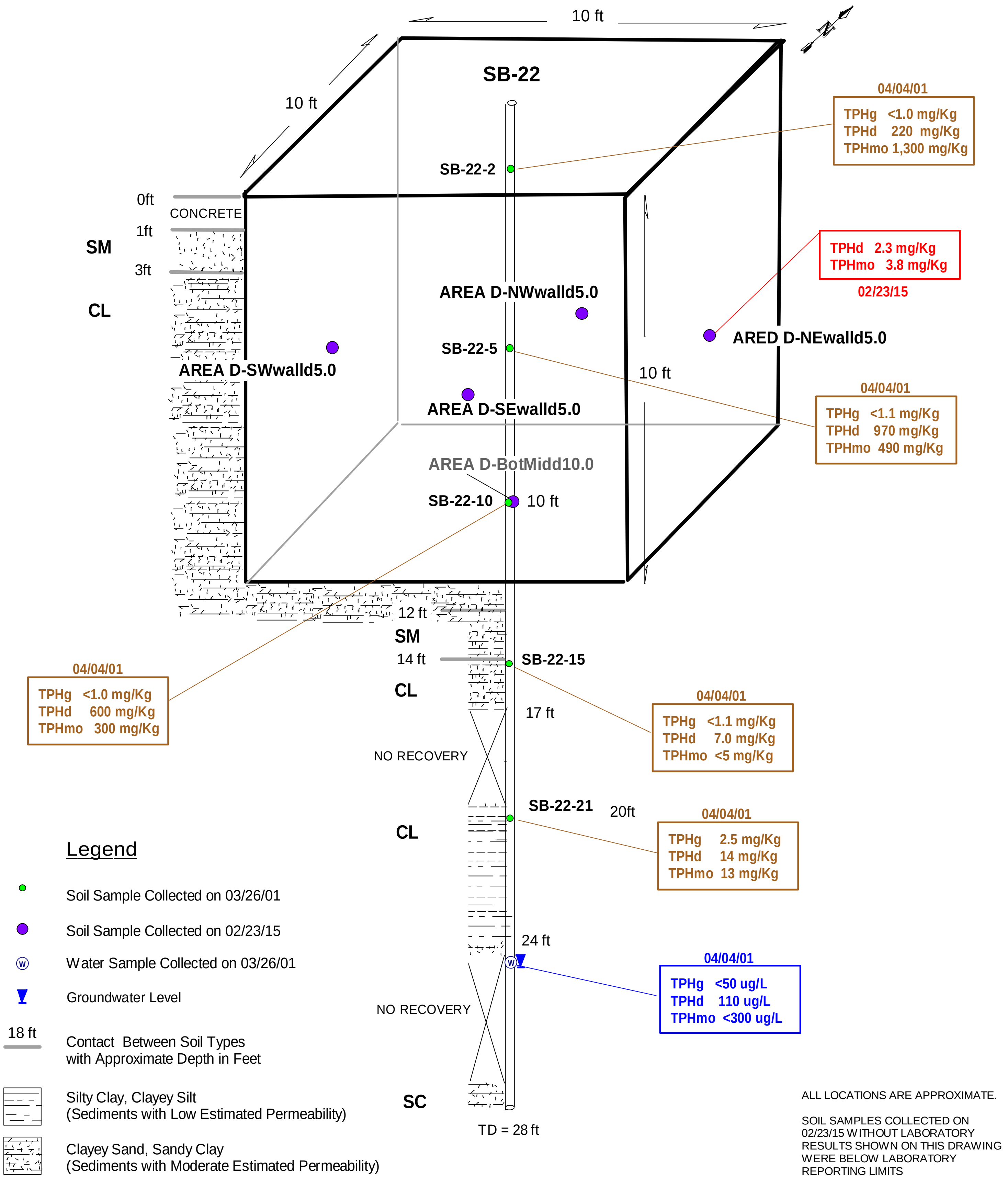
AREA "C" EXCAVATION DIAGRAM
AND SOIL SAMPLE LOCATIONS (2001 AND 2015)

BATARSE PROPERTY
10550 INDUSTRIAL AVENUE
OAKLAND, CALIFORNIA

FIGURE

6

File: 4409/Figure 6



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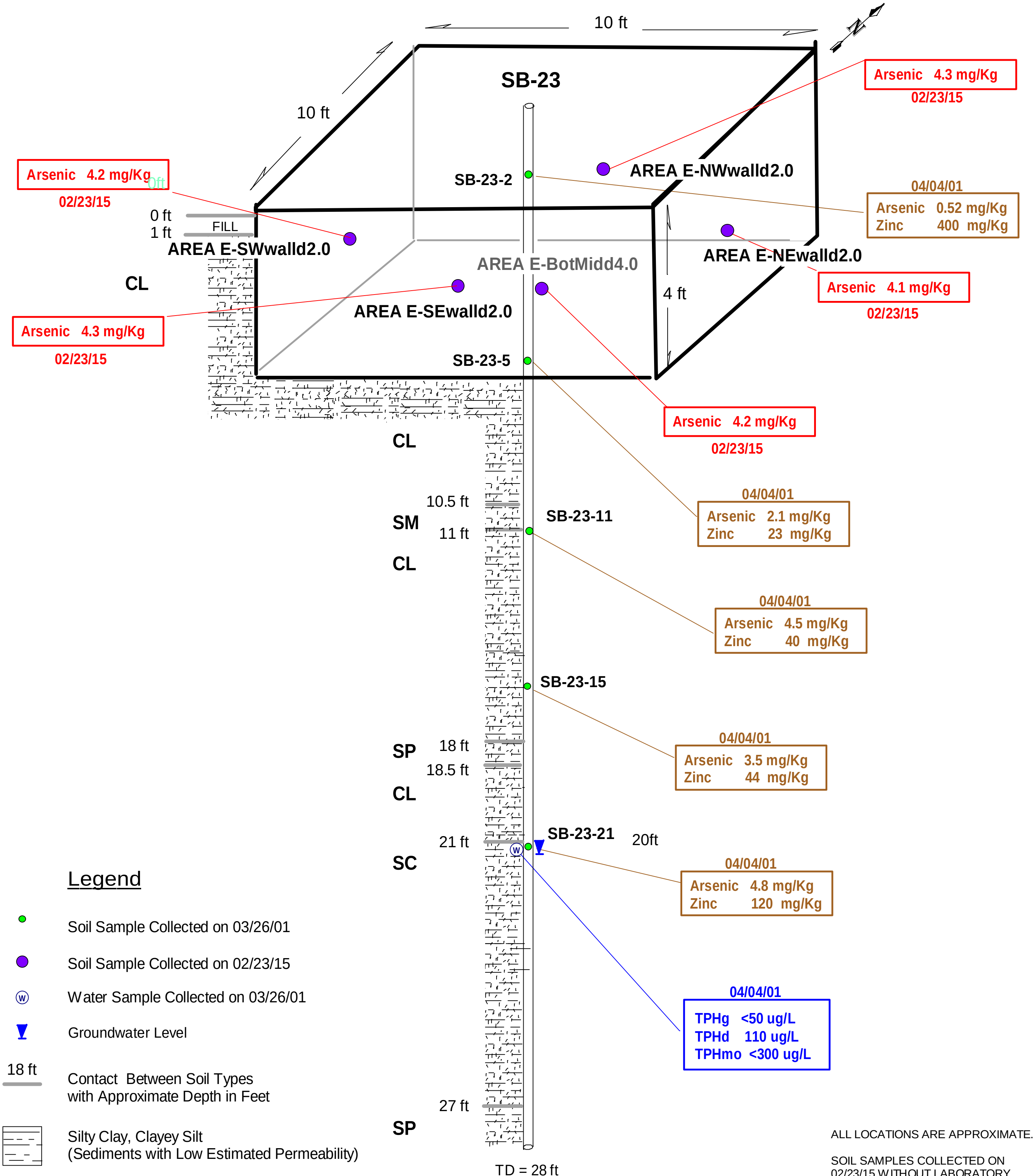
AREA "D" EXCAVATION DIAGRAM
AND SOIL SAMPLE LOCATIONS (2001 AND 2015)

BATARSE PROPERTY
10550 INDUSTRIAL AVENUE
OAKLAND, CALIFORNIA

FIGURE

7

File: 4409/Figure 7



Legend

- Soil Sample Collected on 03/26/01
- Soil Sample Collected on 02/23/15
- Water Sample Collected on 03/26/01
- Groundwater Level
- 18 ft — Contact Between Soil Types with Approximate Depth in Feet
- Silty Clay, Clayey Silt (Sediments with Low Estimated Permeability)
- Clayey Sand, Sandy Clay (Sediments with Moderate Estimated Permeability)

ALL LOCATIONS ARE APPROXIMATE.

SOIL SAMPLES COLLECTED ON 02/23/15 WITHOUT LABORATORY RESULTS SHOWN ON THIS DRAWING WERE BELOW LABORATORY REPORTING LIMITS

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AREA "E" EXCAVATION DIAGRAM AND SOIL SAMPLE LOCATIONS (2001 AND 2015)

BATARSE PROPERTY
10550 INDUSTRIAL AVENUE
OAKLAND, CALIFORNIA

FIGURE 8

File: 4409/Figure 8

TABLE 1A
SUMMARY OF CURRENT HYDROCARBON SOIL ANALYTICAL DATA
BATARSE PROPERTY
10550 INTERNATIONAL BLVD. AND 1424 & 1560 105th AVE.
OAKLAND, CALIFORNIA

Sample ID	Sample Depth (ft.)	Sample Date	TPHg (mg/Kg)	TPHd (mg/Kg)	TPHmo (mg/Kg)	B (mg/Kg)	T (mg/Kg)	E (mg/Kg)	X (mg/Kg)	MtBE (mg/Kg)
AREA A-NEwalld6.5	6.5	02/23/15	ND<0.20	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA A-NEwalld10.0	10.0	02/23/15	ND<2.0	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA A-NWwalld6.5	6.5	02/23/15	**0.31**	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA A-NWwalld10.0	10.0	02/23/15	ND<2.0	**1.8**	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA A-SWwalld6.5	6.5	02/23/15	**0.13**	**1.8**	**4.7**	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA A-SWwalld10.0	10.0	02/23/15	ND<2.0	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA A-SEwalld6.5	6.5	02/23/15	ND<2.0	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA A-SEwalld10.0	10.0	02/23/15	**0.18**	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA A-BotMidd10.0	10.0	02/23/15	ND<2.0	**1.7**	**4.6**	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA B-NWwalld4.0	4.0	02/23/15	ND<1.0	ND<2.0	ND<10.0	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA B-NEwalld4.0	4.0	02/23/15	ND<1.0	ND<2.0	ND<10.0	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA B-SWwalld4.0	4.0	02/23/15	ND<1.0	**1.7**	**10**	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA B-SEwalld4.0	4.0	02/23/15	ND<1.0	ND<2.0	ND<10.0	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA B-BotMidd5.0	5.0	02/23/15	ND<1.0	ND<2.0	ND<10.0	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA C-NWwalld4.0	4.0	02/23/15	ND<2.0	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA C-NEwalld4.0	4.0	02/23/15	ND<1.0	ND<2.0	ND<10.0	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA C-SWwalld4.0	4.0	02/23/15	ND<1.0	ND<2.0	ND<10.0	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA C-SEwalld4.0	4.0	02/23/15	ND<1.0	ND<2.0	ND<10.0	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA C-BotMidd5.0	5.0	02/23/15	ND<1.0	ND<2.0	ND<10.0	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA D-NWwalld5.0	5.0	02/23/15	ND<2.0	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA D-NEwalld5.0	5.0	02/23/15	ND<1.0	**2.3**	**3.8**	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
AREA D-SWwalld5.0	5.0	02/23/15	ND<2.0	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA D-SEwalld5.0	5.0	02/23/15	ND<2.0	ND<2.0	ND<10.0	ND<0.005	ND<0.005	ND<0.005	ND<0.010	ND<0.005
AREA D-BotMidd10.0	10.0	02/23/15	ND<1.0	ND<2.0	ND<10.0	ND<0.025	ND<0.025	ND<0.025	ND<0.050	ND<0.025
Residential ESL			**100**	**100**	**500**	**0.044**	**2.9**	**3.3**	**2.3**	**0.023**
Comm./Industrial ESL			**500**	**500**	**2,500**	**0.044**	**2.9**	**3.3**	**2.3**	**0.023**
Residential LTCP (0 to 5 ft)			**NA**	**NA**	**NA**	**1.900**	**NA**	**21**	**NA**	**NA**

Notes:

<0.5 / ND = Not present at or above reporting detection limit
mg/Kg = micrograms per kilogram = parts per million = ppm
ESLs = Environmental Screening Levels shallow soil (potential source of drinking water): Summary Table A, May 2013
TPHg =Total Petroleum Hydrocarbons as gasoline
TPHd = Total Petroleum Hydrocarbons as diesel (with Silica Gel cleanup)
TPHmo = Total Poetroleum Hydrocarbons as moto oil (with Silica Gel Cleanup)
B = Benzene T = Toluene
E = Ethylbenzene X = Xylenes (total)
MtBE = Methyl t-butyl ether LTCP = Low Threat Closure Policy

TABLE 1B
SUMMARY OF CURRENT METALS SOIL ANALYTICAL DATA
BATARSE PROPERTY
10550 INTERNATIONAL BLVD. AND 1424 & 1560 105th AVE.
OAKLAND, CALIFORNIA

Sample ID	Sample Depth (ft.)	Sample Date	Lead (mg/Kg)	Arsenic (mg/Kg)	Chrom VI (mg/Kg)	Total Chrom (mg/Kg)	Zinc (mg/Kg)
AREA A-NEwalld6.5	6.5	02/23/15	7.3	---	---	---	---
AREA A-NEwalld10.0	10.0	02/23/15	8.3	---	---	---	---
AREA A-NWwalld6.5	6.5	02/23/15	8.8	---	---	---	---
AREA A-NWwalld10.0	10.0	02/23/15	8.0	---	---	---	---
AREA A-SWwalld6.5	6.5	02/23/15	7.6	---	---	---	---
AREA A-SWwalld10.0	10.0	02/23/15	7.8	---	---	---	---
AREA A-SEwalld6.5	6.5	02/23/15	7.8	---	---	---	---
AREA A-SEwalld10.0	10.0	02/23/15	8.1	---	---	---	---
AREA A-BotMidd10.0	10.0	02/23/15	8.6	---	---	---	---
AREA E-NEwalld2.0	2.0	02/23/15	66	4.1	---	---	100
AREA E-NWwalld2.0	2.0	02/23/15	14	4.3	---	---	78
AREA E-SWwalld2.0	2.0	02/23/15	11	4.2	---	---	43
AREA E-SEwalld2.0	2.0	02/23/15	25	4.3	---	---	70
AREA E-BotMidd4.0	4.0	02/23/15	6.9	4.2	---	---	43
AREA 4-B-1d3.0	3.0	02/23/15	---	---	0.88	32	---
Residential ESL			80	0.39	8.0	NA	600
Comm./Industrial ESL			320	0.96	8.0	NA	600
Residential CHHSL			150	0.07	17	NA	23,000
Comm./Industrial CHHSL			3500	0.24	37	NA	100,000

Notes:
--- = Parameter not analyzed
<0.5 / ND = Not present at or above reporting detection limit
mg/Kg = micrograms per kilogram = parts per million = ppm
ESLs = Environmental Screening Levels shallow soil (potential source of drinking water): Summary Table A, May 2013
CHHSL California Human Health Screening Level - January 2005.

ATTACHMENT C

DG Group Structural Submittal

March 13, 2015

Alameda County Health Care Services Agency
Department of Health Services
1131 Harbor Bay Parkway
Alameda, CA 94502

Attn: Mark Detterman

Subject: Batarse Property; case file RO0003151

Dear Mr. Detterman

Re: Oakland CA. International Blvd Apartments

This letter is in reference to that certain proposed apartment project located in the City of Oakland on International Blvd. and 105th Street. The project will have approximately 4 elevators. The elevator "pit" will be submerged up to 4 feet below the existing grade with a complete concrete encasement. No area of the area below grade will have access to soils. These "pits" will be the only part of the project that will be built below grade.

Should you have any questions please do not hesitate to contact me.

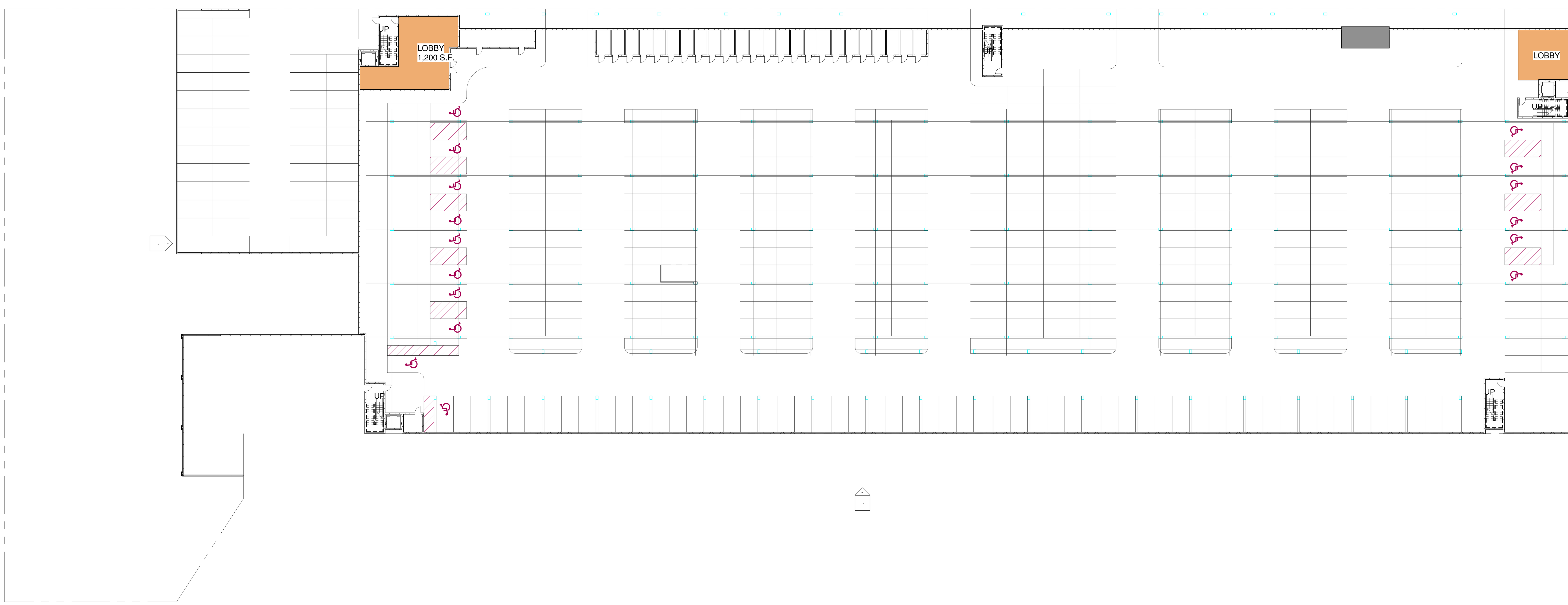
Sincerely,

Douglas L. Gibson, A.I.A.

LICENSED ARCHITECT DOUGLAS L. GIBSON C-29792 REN. 09-30-15 STATE OF CALIFORNIA

430 East State Street, Ste. 100 ● Eagle, ID 83616 ● 208-908-4871 ● 208-392-1269 Fax
Licensed Architect: Idaho ● Utah ● Nevada ● Wyoming ● Montana ● Washington ●Oregon ● California ● Hawaii ● Alaska Arizona ● Colorado ● South Dakota● North Dakota ● Louisiana ● U.S. Virgin Islands ● New Mexico

1 2ND FLOOR PLAN
1" = 30'-0"



2 1ST FLOOR PLAN
1" = 30'-0"

REVISIONS

COPYRIGHT DATE
01/23/15
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AW
PROJECT #
AMG14-28

PACIFIC WEST ARCHITECTURE

Pacific West Architecture

430 E. STATE STREET, SUITE 100
EAGLE, IDAHO 83616
(208) 461-0022
fax (208) 461-3267

ALASKA - ARIZONA - CALIFORNIA - COLORADO - HAWAII - IDAHO - LOUISIANA - MONTANA - NEW MEXICO - NEVADA - NORTH DAKOTA - OREGON - SOUTH DAKOTA - U.S.V.I. - UTAH - WASHINGTON - WYOMING

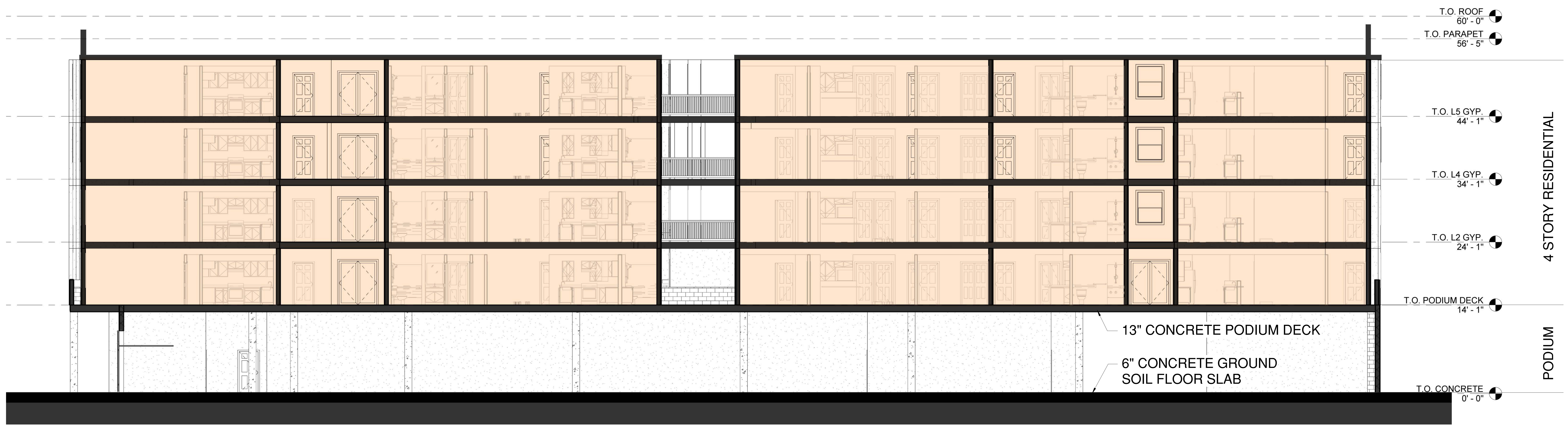
PROJECT

OAKLAND INTERNATIONAL

INTERNATIONAL BLVD.
CITY, STATE

A3.1

BUILDING PERMIT SUBMITTAL SET



1 SCHEMATIC BUILDING SECTION
6" = 1'-0"

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AMG14-28

PACIFIC WEST ARCHITECTURE

Pacific West Architecture
430 E. STATE STREET, SUITE 100
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PROJECT
OAKLAND INTERNATIONAL
INTERNATIONAL BLVD.
CITY, STATE

A5.3

BUILDING PERMIT SUBMITTAL SET

ATTACHMENT D

Western Regional Air Partnership Chapter 3

WRAP Fugitive Dust Handbook

Prepared for:

Western Governors' Association
1515 Cleveland Place, Suite 200
Denver, Colorado 80202

Prepared by:

Countess Environmental
4001 Whitesail Circle
Westlake Village, CA 91361
(WGA Contract No. 30204-111)

September 7, 2006

TABLE OF CONTENTS

Chapter 3. Construction and Demolition

3.1 Characterization of Source Emissions

Heavy construction is a source of dust emissions that may have a substantial temporary impact on local air quality. Building and road construction are two examples of construction activities with high emissions potential. Emissions during the construction of a building or road can be associated with land clearing, drilling and blasting, ground excavation, cut and fill operations (i.e., earth moving), and construction of a particular building or road. Dust emissions often vary substantially from day to day, depending on the level of activity, the specific operations, and the prevailing meteorological conditions. A large portion of the emissions results from construction vehicle traffic over temporary roads at the construction site.

The temporary nature of construction differentiates it from other fugitive dust sources as to estimation and control of emissions. Construction consists of a series of different operations, each with its own duration and potential for dust generation. In other words, emissions from any single construction site can be expected (1) to have a definable beginning and an end, and (2) to vary substantially over different phases of the construction process. This is in contrast to most other fugitive dust sources where emissions are either relatively steady or follow a discernable annual cycle. Furthermore, there is often a need to estimate areawide construction emissions without regard to the actual plans of any individual construction project. For these reasons, methods by which either areawide or site-specific emissions may be estimated are presented below.

The quantity of dust emissions from construction operations is proportional to the area of land being worked and to the level of construction activity. By analogy to the parameter dependence observed for other similar fugitive dust sources, one can expect emissions from construction operations to be positively correlated with the silt content of the soil (i.e., particles smaller than 75 micrometers [µm] in diameter), as well as with the speed and weight of the construction vehicle, and to be negatively correlated with the soil moisture content.

Table 3-1 displays the dust sources involved with construction. In addition to the on-site activities shown in Table 3-1, substantial emissions are possible because of material tracked out from the site and deposited on adjacent paved streets. Because all traffic passing the site (i.e., not just that associated with the construction) can resuspend the deposited material, this “secondary” source of emissions may be far more important than all the dust sources located within the construction site. Furthermore, this secondary source will be present during all construction operations. Persons developing construction site emission estimates must consider the potential for increased adjacent emissions from off-site paved roadways (see Chapter 5). High wind events also can lead to emissions from cleared land and material stockpiles. Chapters 8 and 9 present estimation methodologies that can be used for such sources at construction sites.

Table 3-1. Emission Sources for Construction Operations

Construction phase	Dust-generating activities
I. Demolition and debris removal	1. Demolition of buildings or other (natural) obstacles such as trees, boulders, etc. a. Mechanical dismemberment ("headache ball") of existing structures b. Implosion of existing structures c. Drilling and blasting of soil d. General land clearing 2. Loading of debris into trucks 3. Truck transport of debris 4. Truck unloading of debris
II. Site Preparation (earth moving)	1. Bulldozing 2. Scrapers unloading topsoil 3. Scrapers in travel 4. Scrapers removing topsoil 5. Loading of excavated material into trucks 6. Truck dumping of fill material, road base, or other materials 7. Compacting 8. Motor grading
III. General Construction	1. Vehicular Traffic 2. Portable plants a. Crushing b. Screening c. Material transfers 3. Other operations

3.2 Emissions Estimation: Primary Methodology[1-6]

This section was adapted from: Estimating Particulate Matter Emissions from Construction Operations, report prepared for USEPA by Midwest Research Institute dated September 15, 1999.[1]

Note that AP-42 Section 13.2.3, "Heavy Construction Operations," was not adopted for the primary emission estimation methodology because it relies on a single-valued emission factor for TSP of 1.2 tons/acre-month based on only one set of field tests.[2]

3.2.1 PM Emissions from Construction

Construction emissions can be estimated when two basic construction parameters are known: the acres of land disturbed by the construction activity, and the duration of the activity. A general emission factor for all types of construction activity is 0.11 tons PM10/acre-month and is based on a 1996 BACM study conducted by Midwest Research (MRI) Institute for the California South Coast Air Quality Management District (SCAQMD).[3] The single composite factor of 0.11 tons PM10/acre-month assumes that all construction activity produces the same amount of dust on a per acre basis. In other words, the amount of dust produced is not dependent on the type of construction but merely on the area of land being disturbed by the construction activity. A second assumption is that land affected by construction activity does not involve large-scale cut and fill operations. Factors for the conversion of dollars spent on construction to acreage disturbed, along with the estimates for the duration of construction activity, were originally developed by MRI in 1974.[4]

Separate emission factors segregated by type of construction activity provide better estimates of PM10 emissions that are more accurate estimate than are obtained using a general emission factor. The factors from the 1996 MRI BACM study[3] are summarized in Table 3-2. Specific emission factors and activity levels for residential, nonresidential, and road construction activities are described below.

Table 3-2. Recommended PM10 Emission Factors for Construction Operations[1]

Basis for emission factor	Recommended PM10 emission factor
Level 1 Only area and duration known	0.11 ton/acre-month (average conditions) 0.42 ton/acre-month (worst-case conditions)[a]
Level 2 Amount of earth moving known, in addition to total project area and duration	0.011 ton/acre-month for general construction (for each month of construction activity) <u>plus</u> 0.059 ton/1,000 cubic yards for on-site cut/fill[b] 0.22 ton/1,000 cubic yards for off-site cut/fill[b]
Level 3 More detailed information available on duration of earth moving and other material movement	0.13 lb/acre-work hr for general construction <u>plus</u> 49 lb/scraper-hr for on-site haulage[c] 94 lb/hr for off-site haulage[d]
Level 4 Detailed information on number of units and travel distances available	0.13 lb/acre-work hr for general construction <u>plus</u> 0.21 lb/ton-mile for on-site haulage 0.62 lb/ton-mile for off-site haulage[c]

[a] Worst-case refers to construction sites with active large-scale earth moving operations.
[b] These values are based on assumptions that one scraper can move 70,000 cubic yards of earth in one month and one truck can move 35,000 cubic yards of material in one month. If the on-site/off-site fraction is not known, assume 100% on-site.
[c] If the number of scrapers in use is not knows, MRI recommends that a default value of 4 be used. In addition, if the actual capacity of earth moving units is known, the user is directed to use the following emission rates in units of lb/scraper-hour for different capacity scrapers: 19 for 10 yd^3 scraper, 45 for 20 yd^3 scraper, 49 for 30 yd^3 scraper, and 84 for 45 yd^3 scraper.
[d] Factor for use with over-the-road trucks. If "off-highway" or "haul" trucks are used, haulage should be considered "on-site."

3.2.2 Residential Construction

Residential construction emissions can be calculated for three basic types of residential construction:

- Single-family houses
- Two-family houses
- Apartment buildings

Housing construction emissions are calculated using an emission factor of 0.032 tons PM10/acre-month. Also required are: the number of housing units created, a units-to-acres conversion factor, and the duration of construction activity. The formula for calculating emissions from residential construction is:

$$\text{Emissions} = (0.032 \text{ tons PM10/acre-month})\ \ B \times f \times m$$

where, B = the number of houses constructed
f = building to acres conversion factor
m = the duration of construction activity in months

Following the California methodology, residential construction acreage is based on the number of housing units constructed rather than the dollar value of construction.

An alternative methodology is recommended for residential construction in areas in which basements are constructed or the amount of dirt moved at a residential construction site is known. The F.W. Dodge reports (www. fwdodge.com/newdodgenews.asp) give the total square footage of homes for both single-family and two-family homes. These values can be used to estimate the volume in cubic yards of dirt moved. Multiplying the total square footage of the homes by an average basement depth of 8 ft, and adding 10% additional volume to account for peripheral dirt removed for footings, space around the footings, and other backfilled areas adjacent to the basement, produces an estimate of the total volume in cubic yards of earth moved during residential construction.

The information needed to determine activity levels of residential construction may be based either on the dollar value of construction or the number of housing units constructed. Construction costs vary throughout the United States. The average home cost can vary from the low to upper $100,000s depending on where the home is located in the United States. Because residential construction characteristics do not show as much variance as the cost does, the number of units constructed is a better indicator of activity level. The amount of land impacted by residential construction is determined to be about the same on a per house basis. The number of housing units for the three types of residential construction (single family, two-family, and apartments) for a county or state are available from the F.W. Dodge's "Dodge Local Construction Potentials Bulletin."

A single-family house is estimated to occupy 1/4 acre. The "building to acres" conversion factor for a single-family house was determined by finding the area of the base of a home and estimating the area of land affected by grading and other construction activities beyond the "footprint" of the house. The average home is around 2,000 sq. ft. Using a conversion factor of 1/4 acre/house indicates that five times the base of the house is affected by the construction of the home. The "building to acres" conversion factor for two-family housing was found to be 1/3 acre per building. The 1/3 acre was derived from the average square footage of a two-family home (approximately 3,500 sq. ft.) and the land affected beyond the base of the house, about 4 times the base for two-family residences.

For comparison purposes, residential construction emission factor calculations are calculated below for BACM Level 1 and Level 2 scenarios. The PM10 construction emission factor for one single-family home is based on typical parameters for a single-family home:

- area of land disturbed 1/4 acre
- area of home 2,000 sq. ft.
- duration 6 months
- basement depth 8 ft.
- moisture level 6%
- silt content 8%

The BACM Level 1 emission calculation is estimated as follows:

0.032 tons PM10/acre-month x 1/4 acre x 6 months = 0.048 tons PM10 = 96 lb PM10

The BACM Level 2 emission calculation is estimated as follows:

Cubic yards of dirt moved = 2,000 ft^2 x 8 ft. x 110% = 17,600 ft^3 = 652 yd^3
PM10 = (0.011 tons/acre-month x 1/4 acre x 6 months) + (0.059 tons/1000 yd^3 dirt x 652 yd^3 dirt)
= 0.016 tons + 0.038 tons = 0.0545 tons PM10 = 109 lb PM10

The emission factor recommended for the construction of apartment buildings is 0.11 tons PM10/acre-month because apartment construction does not normally involve a large amount of cut-and-fill operations. Apartment buildings vary in size, number of units, square footage per unit, floors, and many other characteristics. Because of these variations and the fact that most apartment buildings occupy a variable amount of space, a “dollars-to-acres” conversion is recommended for apartment building construction rather than a “building-to-acres” conversion factor. An estimate of 1.5 acres/$\$10^6$ (in 2004 dollar value) is recommended to determine the acres of land disturbed by the construction of apartments. This “dollars-to-acres” conversion factor is based on updating previous conversion factors developed by MRI[4, 5] using cost of living adjustment factors.

3.2.3 Nonresidential Construction

Nonresidential construction includes building construction (commercial, industrial, institutional, governmental) and also public works. The emissions produced from the construction of nonresidential buildings are calculated using the dollar value of the construction. The formula for calculating the emissions from nonresidential construction is:

PM10 Emissions = (0.19 tons PM10/acre-month) x \$ x f x m

where, \$ = dollars spent on nonresidential construction in millions
f = dollars to acres conversion factor
m = duration of construction activity in months

The emission factor of 0.19 tons PM10/acre-month was developed by MRI in 1999 using a method similar to a procedure originated by Clark County, Nevada and the emission factors recommended in the 1996 MRI BACM Report.[3] A quarter of all nonresidential construction is assumed to involve active earthmoving in which the recommended emission factor is 0.42 tons PM10/acre-month. The 0.19 tons PM10/acre-month was calculated by taking 1/4 of the heavy emission factor, (0.42 tons PM10/acre-month) plus 3/4 of the general emission factor (0.11 tons/acre-month). The 1/4:3/4 apportionment is based on a detailed analysis of a Phoenix airport construction where specific unit operations had been investigated for PM10 emissions.[6] The proposed emission factor of 0.19 tons/acre-month for nonresidential building construction resulted in a total uncontrolled PM10 emissions estimate that was within 25% of that based on a detailed unit operation emissions inventory using detailed engineering plans and "unit-operation" emission factors.

Extensive earthmoving activities will produce higher amounts of PM10 emissions than the average construction project. Thus, a worst-case BACM "heavy construction emission factor" of 0.42 tons PM10/acre-month should provide a better emissions estimate for areas in which a significant amount of earth is disturbed.

The dollar amount spent on nonresidential construction is available from the U.S. Census Bureau (www.census.gov/prod/www/abs/cons-hou), and the Dodge Construction Potentials Bulletin (www. fwdodge.com/newdodgenews.asp). Census data are delineated by SIC Code, whereas the Potentials Bulletin divides activity by the types of building being constructed rather than by SIC Code. It is estimated that for every million dollars spent on construction (in 2004 dollars), 1.5 acres of land are impacted. The "dollars to acres" conversion factor reflects the current dollar value using the Price and Cost Indices for Construction that are available from the Statistical Abstract of the United States, published yearly. The estimate for the duration of nonresidential construction is 11 months.

3.2.4 Road Construction

Road construction emissions are highly correlated with the amount of earthmoving that occurs at a site. Almost all roadway construction involves extensive earthmoving and heavy construction vehicle travel, causing emissions to be higher than found for other construction projects. The PM10 emissions produced by road construction are calculated using the BACM recommended emission factor for heavy construction[1] and the miles of new roadway constructed. The formula used for calculating roadway construction emissions is:

$$\text{PM10 Emissions} = (0.42 \text{ tons PM10/acre-month}) \times M \times f \times d$$

where, M = miles of new roadway constructed
f = miles to acres conversion factors
d = duration of roadway construction activity in months

The BACM worst case scenario emission factor of 0.42 tons/acre-month is used to account for the large amount of dirt moved during the construction of roadways. Since most road construction consists of grading and leveling the land, the higher emission factor more accurately reflects the high level of cut and fill activity that occurs at road construction sites.

The miles of new roadway constructed are available at the state level from the *Highway Statistics* book published yearly by the Federal Highway Administration (FHWA; www.fhwa.dot.gov/ohim/hs97/hm50.pdf) and the Bureau of Census Statistical Abstract of the United States. The miles of new roadway constructed can be found by determining the change in the miles of roadway from the previous year to the current year. The amount of roadway constructed is apportioned from the state to the county level using housing start data that is a good indicator of the need for new roads.

The conversion of miles of roadway constructed to the acres of land disturbed is based on a method developed by the California Air Resources Board. This calculation is performed by estimating the overall width of the roadway, then multiplying the width by a mile to determine the acres affected by one mile of roadway construction. The California "miles to acres disturbed" conversion factors are available for freeway, highway and city/county roads. In the Highway Statistics book, roadways are divided into separate functional classes. MRI developed a "miles-to-acres" conversion factor in 1999[1] according to the roadway types found in the "Public Road Length, Miles by Functional System" table of the annual *Highway Statistics*. The functional classes are divided into four groups. Group 1 includes Interstates and Other Principal Arterial roads and is estimated to occupy 15.2 acres/mile. Group 2 includes Other Freeways and Expressways (Urban) and Minor Arterial Roads and is estimated at 12.7 acres/mile. Group 3 has Major Collectors (Rural) and Collectors (Urban) and a conversion factor of 9.8 acres/mile. Minor Collectors (Rural) and Local roads are included in Group 4 and converted at 7.9 acres/mile. Table 3-3 shows the data used to calculate the acres per mile of road constructed.

Table 3-3. Conversion of Road Miles to Acres Disturbed

	Group 1	Group 2	Group 3	Group 4
Lane Width (feet)	12	12	12	12
Number of Lanes	5	5	3	2
Average Shoulder Width (feet)	10	10	10	8
Number of Shoulders	4	2	2	2
Roadway Width* (feet)	100	80	56	40
Area affected beyond road width	25	25	25	25
Width Affected (feet)	125	105	81	65
Acres Affected per Mile of New Roadway	15.2	12.7	9.8	7.9

* Roadway Width= (Lane Width x # of Lanes) + (Shoulder Width x # of Shoulders).

The amount of new roadway constructed is available on a yearly basis and the duration of the construction activity is determined to be 12 months. The duration accounts for the amount of land affected during that time period and also reflects the fact that construction of roads normally lasts longer than a year. The duration of construction of a new roadway is estimated at 12 to 18 months.

3.3 Emission Estimation: Alternate Methodology for Building Construction

This section was adapted from Section 7.7 of CARB's Emission Inventory Methodology. Section 7.7 was last updated in September 2002.

The building construction dust source category provides estimates of the fugitive dust particulate matter caused by construction activities associated with building residential, commercial, industrial, institutional, or governmental structures. The emissions result predominantly from site preparation work, which may include scraping, grading, loading, digging, compacting, light-duty vehicle travel, and other operations. Dust emissions from construction operations are computed by using a PM10 emission factor developed by MRI during 1996.[3] The emission factor is based on observations of construction operations in California and Las Vegas. Activity data for construction is expressed in terms of acre-months of construction. Acre-months are based on estimates of the acres disturbed for residential construction, and project valuation for other non-residential construction.

3.3.1 Emission Estimation Methodology

Emission Factor. The PM10 emission factor used for estimating geologic dust emissions from building construction activities is based on work performed by MRI[3] under contract to the PM10 Best Available Control Measure (BACM) working group. For most parts of the state, the emission factor used is 0.11 tons PM10/acre-month of activity. This emission factor is based on MRI's observation of the types, quantity, and duration of operations at eight construction sites (three in Las Vegas and five in California). The bulk of the operations observed were site preparation-related activities. The observed activity data were then combined with operation-specific emission factors provided in AP-42[2] to produce site emissions estimates. These site estimates were then combined to produce the overall average emission factor of 0.11 tons PM10/acre-month. The PM2.5/PM10 ratio for fugitive dust from construction and demolition activities is 0.1 based on the analysis conducted by MRI on behalf of WRAP.[7]

The construction emission factor is assumed to include the effects of typical control measures such as routine watering. A dust control effectiveness of 50% is assumed from these measures, which is based on the estimated control effectiveness of watering.[8] Therefore, if this emission factor is used for construction activities where watering is not used, it should be doubled to more accurately reflect the actual emissions. The MRI document[3] lists their average emission factor values as uncontrolled. However, it can be argued that the activities observed and the emission estimates do include the residual effects of control. All of the test sites observed were actual operations that used watering controls as part of their standard industry practice in California and Las Vegas. So, even if in some cases watering was not performed during MRI's actual site visits, the residual decreases in emissions from the watering controls and raising the soil moisture are included in the MRI estimates.

The 1996 MRI report[3] also includes an emission factor for worst-case emissions of 0.42 tons PM10/acre-month. This emission factor is appropriate for large-scale construction operations, which involve substantial earthmoving operations. The South Coast Air Quality Management District (SCAQMD) estimated that 25% of their construction projects involve these types of operations. For the remainder of the state, such detailed information is not readily available, so the average emission factor of 0.11 tons PM10/acre-month is used by CARB for these other areas of California..

Activity Data. For the purpose of estimating emissions, it is assumed that the fugitive dust emissions are related to the acreage affected by construction. Because regionwide estimates of the acreage under construction may not be directly available, other construction activity data can be used to derive acreage estimates. Activity data are estimated separately for residential construction and the other types of construction (commercial, industrial, institutional, and governmental).

For residential construction, the number of new housing units estimated by the California Department of Finance[9] are used to estimate acreage disturbed. It is estimated that single family houses are built on 1/7 of an acre in heavily populated counties, and 1/5 of an acre in less populated counties.[10-12] It is also estimated that multiple living units such as apartments occupy 1/20 of an acre per living unit. For all of these residential construction activities, a project duration of 6 months is assumed.[10] Applying these factors to the reported number of new units in each county results in an estimate of acre-months of construction. This estimate of acre-months of construction combined with the construction emission factor is used to estimate residential construction particulate emissions.

For commercial, industrial, and institutional building construction, construction acreage is based on project valuations. Project valuations for additions and alterations are not included. According to the Construction Industry Research Board,[13] most additions and alterations would be modifications within the existing structure and normally would not include the use of large earthmoving equipment. Most horizontal additions would usually be issued a new building permit. The valuations are 3.7, 4.0 and 4.4 acres per million dollars of valuation for the respective construction types listed.[12] Valuations were corrected from 1999 values to 1977 values using the Annual Average Consumer Price Index (CPI-U-RS) provided by the U.S. Census Bureau.[14] The Census Bureau uses the Bureau of Labor Statistics' experimental Consumer Price Index (CPI-U-RS) for 1977 through 2000.[15] Valuations were corrected from 1999 values to 1977 values because the acres per dollar valuation values are based on 1977 valuations. For example, the CPI-U-RS for 1999 is 244.1 and the CPI-U-RS for 1977 is 100.0. The ratio of 1977 to 1999 dollars is 100.0/244.1 or 0.41. Inflation from 1999 to 2004 is estimated to be 12%. Thus, updating the 1977 valuation results to 2004 dollars produces a ratio of 1977 to 2004 dollars of 0.41/1.12 or 0.37. CARB assumes that each acre is under construction for 11 months for each project type.[10]

3.3.2 Assumptions and Limitations

1. The current methodology assumes that all construction operations in all parts of the state emit the same levels of PM10 on a per acre basis.
2. It is assumed that watering techniques are used statewide, reducing emissions by 50% and making it valid to apply the MRI emission factor without correction.
3. The methodology assumes that valuation is proportional to acreage disturbed, even for high-rise type building construction.
4. The methodology assumes that construction dust emissions are directly proportional to the number of acres disturbed during construction.
5. The estimates of acreage disturbed are limited in their accuracy. New housing units and project valuations do not provide direct estimates of actual acreage disturbed by construction operations in each county.
6. The methodology assumes that the Consumer Price Index (CPI-U-RS) provides an accurate estimate of 1977 and current values.

3.3.3 Temporal Activity

The temporal activity is assumed to occur five days a week between the hours of 8:00 AM and 4:00 PM. The table below shows the percentage of construction activity that is estimated to occur during each month. The monthly activity increases during the spring and summer months. Some districts may use a different profile that has a larger peak during the summer months.

JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
6.4	6.4	8.3	9.2	9.2	9.2	9.2	9.2	9.2	8.3	8.3	7.3

3.4 Emission Estimation: Alternate Methodology for Road Construction

This section was adapted from Section 7.8 of CARB's Emission Inventory Methodology. Section 7.8 was last updated in August 1997.

The road construction dust source category provides estimates of the fugitive dust particulate matter due to construction activities while building roads. The emissions result from site preparation work that may include scraping, grading, loading, digging, compacting, light-duty vehicle travel, and other operations. Dust emissions from road construction operations are computed by using a PM10 emission factor developed by MRI.[3] The emission factor is based on observations of construction operations in California and Las Vegas. Activity data for road construction is expressed in terms of acre-months of construction. Acre-months are based on estimates of the acres disturbed for road construction. The acres disturbed are computed based on: estimates of the annual difference in road mileage; estimates of road width (to compute acres disturbed); and an assumption of 18 months as the typical project duration.

3.4.1 Emissions Estimation Methodology

Emission Factor. The PM10 emission factor used for estimating geologic dust emissions from road construction activities is based on work performed by MRI under contract to the PM10 Best Available Control Measure working group.[3] For most parts of the State, the emission factor used is 0.11 tons PM10/acre-month of activity. This emission factor is based on MRI's observation of the types, quantity, and duration of operations at eight construction sites (three in Las Vegas, and five in California). The bulk of the operations observed were site preparation related activities. The observed activity data were then combined with operation specific emission factors provided in U.S. EPA's AP-42 (5th Edition)[2] document to produce site emissions estimates. These site estimates were then combined to produce the overall average emission factor of 0.11 tons PM10/acre-month. The PM2.5/PM10 ratio for fugitive dust from construction and demolition activities is 0.1 based on the analysis conducted by MRI on behalf of WRAP.[7]

The construction emission factor is assumed to include the effects of routine dust suppression measures such as watering. A dust control effectiveness of 50% is assumed from these measures, which is based on the estimated control effectiveness of watering.[8] Therefore, if this emission factor is used for road construction activities where watering is not used, it should be doubled to more accurately reflect the actual emissions. The MRI document[3] lists their average emission factor values as uncontrolled. However, it can be argued that the activities do include the effects of controls. All of the test sites were actual operations that used watering controls, even if in some cases they were not used during the actual site visits. It is believed that the residual effects of controls are reflected in the MRI emission estimates.

The MRI report[3] also includes an emission factor for worst-case construction emissions of 0.42 tons of PM10/acre-month. This emission factor is appropriate for large scale construction operations that involve substantial earthmoving operations. The South Coast Air Quality Management District (SCAQMD) estimated that a percentage of their construction projects involve these types of operations, and applied the larger emission factor to these activities. For the remainder of the state, such detailed information is not readily available, so the average emission factor of 0.11 tons PM10 per acre-month is used by CARB.

Activity Data. For the purpose of estimating emissions, it is assumed that the fugitive dust emissions are related to the acreage affected by construction. Regionwide estimates of the acreage disturbed by roadway construction may not be directly available. Therefore, the miles of road built and the acreage disturbed per mile of construction can be used to estimate the overall acreage disturbed.

The miles of road built are based on the annual difference in the road mileage. These data, from the California Department of Finance[9] and Caltrans[16], are split for each county into freeways, state highways, and city and county road. The acreage of land disturbed per mile of road construction is based on the number of lanes, lane width, and shoulder width for each listed road type. The assumptions used are provided in Table 3-4. Because most projects will probably also disturb land outside of the immediate roadway corridor, these acreage estimates are somewhat conservative.

The final parameter needed is project duration, which is assumed to be an average of 18 months.[10] Multiplying the road mileage built by the acres per mile and the months of construction provides the acre-months of activity for road building construction. This, multiplied by the emission factor, provides the emissions estimate.

Table 3-4. Roadway Acres per Mile of Construction Estimates

Road Type	Freeway	Highway	City & County
Number of Lanes	*5*	5	2
Width per Lane (feet)	12	12	12
Shoulder Width (feet)	10'x4 = 40'	20'x2 = 40'	20'x2 = 40'
Roadway Width* (feet)	100	76	64
Roadway Width* (miles)	0.019	0.014	0.012
Area per Mile** (acres)	12.1	9.2	7.8

*Roadway Width (miles) = [(Lanes x Width per Lane) + Shoulder Width] x (1 mile/5,280 feet)
**Area per Mile (acres) = Length x Width = 1 Mile x Width x 640 acres/mile^2

3.4.2 Temporal Activity

Temporal activity is assumed to occur five days a week between the hours of 8 AM and 4 PM. The table below shows the percentage of construction activity that is estimated to occur during each month. The monthly activity increases during the spring and summer months as shown below. Some districts use a slightly different profile that has a larger peak during the summer months.

ALL	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
100	7.7	7.7	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	7.7

3.4.3 Assumptions and Limitations

1. The current methodology assumes that all construction operations in all parts of the state emit the same levels of PM10 on a per acre basis.
2. It is assumed that watering techniques are used statewide, reducing emissions by 50% and making it valid to apply the MRI emission factor without correction.
3. The methodology assumes that the acreage disturbed per mile for road building is similar statewide, and the overall disturbed acreage is approximately the same as the finished roadway's footprint.
4. The methodology assumes that construction dust emissions are directly proportional to the number of acres disturbed during construction.

3.5 Supplemental Emission Factors

AP-42 lists uncontrolled TSP emission factors for specific activities at construction sites.[2] These TSP emission factors as well as references to the relevant chapters of this handbook that provide PM10 and/or TSP emission factors for similar activities are presented in Table 3-5.

Table 3-5. TSP Emission Factors for Specific Construction Site Activities

Construction Phase	Activity	TSP Emission Factor*
Demolition and Debris Removal	Drilling soil	1.3 lb/hole
	Land clearing with bulldozer	$5.7\ (s)^{1.2} / M^{1.3}$ lb/hr
	Loading debris into trucks and subsequent unloading	See Chapter 4
	Truck transport of debris on paved or unpaved roads	See Chapters 5 and 6
Site Preparation (earth moving)	Bulldozing and compacting	$5.7\ (s)^{1.2} / M^{1.3}$ lb/hr
	Scrapers unloading topsoil	0.04 lb/ton
	Scrapers in travel mode	See Chapter 6
	Scrapers removing topsoil	20.2 lb/mile
	Grading	$0.040\ (S)^{2.5}$ lb/mile
	Loading excavated material into trucks and subsequent unloading	See Chapter 4
General Construction	Vehicular traffic	See Chapters 5 and 6
	Crushing and screening aggregate	See Chapter 11
	Material transfer	See Chapter 4

* Symbols for equations: M = material moisture content (%), s = material silt content (%), S = mean vehicle speed (mph).

3.6 Demonstrated Control Techniques

Because of the relatively short-term nature of construction activities, some control measures are more cost-effective than others. Frank Elswick of Midwest Industrial Supply Inc. presented an extensive summary of control measures for construction activities and their associated costs at a WRAP sponsored fugitive dust workshop in Palm Springs, CA in May 2005.[17] Elswick concluded that dust suppressant methods fall into the following six categories:

1. **Watering**

* Watering works by agglomerating surface particles together.
* No negative environmental impacts from using water.
* Normally readily available.
* Evaporates quickly, therefore typically only effective for short periods of time.
* Frequency of application depends on temperature and humidity.
* Generally labor intensive due to frequent application.
* Costs associated with pre-watering and as needed watering are $55 to $80/hour.

2. **Chemical Stabilizers**

(a) Water absorbing products (e.g., calcium chloride brine or flakes, magnesium chloride brine, sodium chloride)

* These products work by significantly increasing surface tension of water between dust particles, helping to slow evaporation and further tighten compacted soil.
* Products ability to absorb water from the air is a function of temperature and humidity.
* These products work best in low humidity environments.
* Frequent re-application in dry climates.
* Must be watered to activate during dry months.
* Potential costly environmental impacts to fresh water aquatic life, plants and water quality
* Corrosive to metal and steel.
* Not suitable for non-traffic areas.
* Costs associated with traffic area program are $.03 - $.05 per square foot.

(b) Organic Petroleum Products (e.g. asphalt emulsions, cut/liquid asphalt, dust oils, petroleum resins)

* These products work by binding and/or agglomerating surface particles together because of asphalt adhesive properties.
* Potentially costly environmental due to presence of polycyclic aromatic hydrocarbons that are "hazardous air and water pollutants" that may be subject to reporting requirements.
* Can fragment under traffic conditions.
* Not suitable for non-traffic areas.
* Costs associated with traffic area program are $.05 - $.075 per square foot.

(c) Organic Non-Petroleum Products (e.g., ligninsulfonates, tall oil emulsions, vegetable oils)

* These products work by binding and/or agglomerating surface particles together.
* Surface binding for these product may be reduced or destroyed by rains.
* Generally limited availability of non-petroleum products.
* Ligninsulfonates can impact freshwater aquatic life due to high B.O.D. and C.O.D.
* Not suitable for non-traffic areas.
* Costs associated with traffic area program are $.04 - $.08 square foot.

(d) Polymer Products (e.g., polyvinyl acetates, vinyl acrylics)

* These products work by binding soil particles together because of the polymer's adhesive properties.
* Polymers also increase the load-bearing strength of all types of soils.
* Polymers are non-toxic, non-corrosive, and do not pollute ground water.
* Polymers dry virtually clear to create an aesthetically pleasing result.
* Polymers create a tough yet flexible crust to prevent wind and water erosion.
* Costs associated with traffic areas are $.05 - $.08 per square foot.
* Costs associated with disturbed non-traffic areas are $300 - $800 per acre depending on longevity desired.

* Costs associated with slopes and inactive stockpiles are $500 to $1,000 per acre.

(e) Synthetic Products (e.g., iso-alkane compounds)
* Synthetic fluids work as a dust suppressing ballasting mechanism, while also acting as a durable re-workable binder.
* Formulated with safe and environmentally friendly synthetic fluids; non-hazardous per OSHA, EPA and US DOT; contains no asphalt, oil or PAH's.
* Easy application; no water required.
* Costs associated with traffic area program are $.05 - $.10 per square foot.

3. **Sand Fences**
* Fabric on chain link fence.
* Redwood slat fence.
* Mylar sand fence.
* Most effective when used in conjunction with chemical stabilizers.

4. **Perimeter Sprinklers**
* Most effective when used in conjunction with other methods.

5. **Tire Cleaning Systems at Site Exit**
* Rumble strips to prevent track-out from site onto pavement.
* Washed rock 100' prior to exit onto pavement.

6. **On- Site Speed Control**
* Limiting on-site vehicle speed to 15mph.

Wet suppression and wind speed reduction are the two most common methods used to control open dust sources at construction sites because a source of water and material for wind barriers tend to be readily available on a construction site. However, several other forms of dust control are available. Table 3-6 displays each of the preferred control measures by dust source.[18, 19]

Table 3-6. Control Options for General Construction Sources of PM10

Emission source	Recommended control methods(s)
Debris handling	Wind speed reduction; wet suppression[a]
Truck transport[b]	Wet suppression; paving; chemical stabilization[c]
Bulldozers	Wet suppression[d]
Pan scrapers	Wet suppression of travel routes
Cut/fill material handling	Wind speed reduction; wet suppression
Cut/fill haulage	Wet suppression; paving; chemical stabilization
General construction	Wind speed reduction; wet suppression; early paving of permanent roads

[a] Dust control plans should contain precautions against watering programs that confound trackout problems.
[b] Loads could be covered to avoid loss of material in transport, especially if material is transported offsite.
[c] Chemical stabilization is usually cost-effective for relatively long-term or semipermanent unpaved roads.
[d] Excavated materials may already be moist and not require additional wetting. Furthermore, most soils are associated with an "optimum moisture" for compaction.

One of the dustiest construction operations is cutting and filling using scrapers, with the highest emissions occurring during scraper transit. In a 1999 MRI field study,[5] it was found that watering can provide a high level of PM10 control efficiency for scraper transit emissions. Average control efficiency remained above 75% approximately 2 hours after watering. The average PM10 efficiency decay rate for water was found to vary from approximately 3% to 14% hour. The decay rate depended upon relative humidity in a manner consistent with the effect of humidity on the rate of evaporation. Test results for watered scraper transit routes showed a steep increase in control efficiency with a doubling of surface moisture and little additional control efficiency at higher moisture levels. This is in keeping with past studies that found that control efficiency data can be successfully fitted by a bilinear function. In another recent MRI field study (MRI, 2001),[20] tests of mud and dirt trackout indicated that a 10% soil moisture content represents a reasonable first estimate of the point at which watering becomes counter productive. The control efficiencies afforded by graveling or paving of a 7.6 m (25 ft) access apron were in the range of 40% to 50%.

Table 3-7 summarizes tested control measures and reported control efficiencies for dust control measures applied to construction and demolition operation.

Table 3-7. Control Efficiencies for Control Measures for Construction/Demolition[20, 21]

Control measure	Source component	PM10 control efficiency	References/Comments
Apply water every 4 hrs within 100 feet of a structure being demolished	Active demolition and debris removal	36%	MRI, April 2001, test series 701. 4-hour watering interval (Scenario: lot remains vacant 6 mo after demolition)
Gravel apron, 25" long by road width	Trackout	46%	MRI, April 2001
Apply dust suppressants (e.g., polymer emulsion)	Post-demolition stabilization	84%	CARB April 2002; for actively disturbed areas
Apply water to disturbed soils after demolition is completed or at the end of each day of cleanup	Demolition Activities	10%	MRI, April 2001, test series 701. 14-hour watering interval.
Prohibit demolition activities when wind speeds exceed 25 mph	Demolition Activities	98%	Estimated for high wind days in absence of soil disturbance activities
Apply water at various intervals to disturbed areas within construction site	Construction Activities	61%	MRI, April 2001, test series 701. 3.2-hour watering interval
		74%	MRI, April 2001, test series 701. 2.1-hour watering interval
Require minimum soil moisture of 12% for earthmoving	Scraper loading and unloading	69%	AP-42 emission factor equation for materials handling due to increasing soil moisture from 1.4% to 12%
Limit on-site vehicle speeds to 15 mph (Scenario: radar enforcement)	Construction traffic	57%	Assume linear relationship between PM10 emissions and uncontrolled vehicle speed of 35 mph

3.7 Regulatory Formats

Fugitive dust control options have been embedded in many regulations for state and local agencies in the WRAP region. Regulatory formats specify the threshold source size that triggers the need for control application. Example regulatory formats downloaded from the Internet for several local air quality agencies in the WRAP region are presented in Table 3-8. The website addresses for obtaining information on fugitive dust regulations for local air quality districts within California, for Clark County, NV, and for Maricopa County, AZ, are as follows:

- Districts within California: www.arb.ca.gov/drdb/drdb.htm
- Clark County, NV: www.co.clark.nv.us/air_quality/regs.htm
- Maricopa County, AZ: www.maricopa.gov/envsvc/air/ruledsc.asp

3.8 Compliance Tools

Compliance tools assure that the regulatory requirements, including application of dust controls, are being followed. Three major categories of compliance tools are discussed below.

Record keeping: A compliance plan is typically specified in local air quality rules and mandates record keeping of source operation and compliance activities by the source owner/operator. The plan includes a description of how a source proposes to comply with all applicable requirements, log sheets for daily dust control, and schedules for compliance activities and submittal of progress reports to the air quality agency. The purpose of a compliance plan is to provide a consistent reasonable process for documenting air quality violations, notifying alleged violators, and initiating enforcement action to ensure that violations are addressed in a timely and appropriate manner.

Site inspection: This activity includes (1) review of compliance records, (2) proximate inspections (sampling and analysis of source material), and (3) general observations (e.g., whether an unpaved road has been paved, graveled, or treated; whether haul truck beds are covered ; whether water trucks are being used during construction activities). An inspector can use photography to document compliance with an air quality regulation.

On-site monitoring: EPA has stated that "An enforceable regulation must also contain test procedures in order to determine whether sources are in compliance." Monitoring can include observation of visible plume opacity, surface testing for crust strength and moisture content, and other means for assuring that specified controls are in place.

Table 3-9 summarizes the compliance tools that are applicable to construction and demolition.

Table 3-8. Example Regulatory Formats for Construction and Demolition

Source	Control measure	Goal	Threshold	Agency
Paved Roads-Public and Private Track-out and Carryout	Install track-out ctrl device	Prevent/remove track-out from haul trucks and tires	Paved roads within construction sites, where haul trucks traverse; with disturbed surface area >2 acres, with 100 cubic yards of bulk material hauled	Maricopa County Rule 310 04/07/2004
	Either immediately cleanup track-out (>50ft) and nightly clean-up of rest; install grizzly/wheel wash system; install gravel pad--30ftx50ft, 6" deep; pave intersection--100ftx20ft; route traffic over track-out ctrl devices; limit access to unprotected routes; pave construction roadways ASAP	Control track-out on paved construction roads	Immediate track-out clean-up after 50ft, at end of workday for less; gravel pad standards are min; paved intersection also min and must be accessible to public; limit access to unprotected routes with barriers	Maricopa County Rule 310 04/07/2004
	Track-out control device must be installed at all access points to public roads and there must be mud/dirt removal from interior paved roads with sufficient frequency	Allow mud/dirt to drop off before leaving site and prevent track-out	For sites greater than 5 acres or those with more than 100 yd3 of daily import/export	SJVAPCD Rule 8041 11/15/2001
	Removal of track-out within one hour or selecting a track-out prevention option and removing track-out at the end of the day		For sites greater than 5 acres or those with more than 100 yd3 of daily import/export and track-out is less than 50ft	SCAQMD Rule 403 12/11/1998
	Removing track-out ASAP		Track-out greater than 50 ft	SCAQMD Rule 403 12/11/1998
	Require road surface paved or chemically stabilized from point of intersection with a public paved road to distance of at least 100 ft by 20 ft or installation of track-out control device from point of intersection with a public paved road to a distance of at least 25 ft by 20 ft	Prohibits material from extending more than 25 ft from a site entrance	For sites greater than 5 acres or those with more than 100 yd3 of daily import/export	SCAQMD Rule 403 12/11/1998
Bulk Materials Transport	Establishes speed limits. Requires at least 6" freeboard when crossing paved public road, water applied to top of load. Haul trucks need tarp or suitable cover and truck interior must be cleaned before leaving site	Limit visible dust emissions to 20% opacity and prevent spillage from holes	Trucks entering paved public roads (6" freeboard); leaving work site; specific haul trucks need covering	SJVAPCD Rule 8031 11/15/2001
	Requires covering haul trucks or to use bottom-dumping if possible and maintain minimum 6" freeboard (in high winds)			SCAQMD Rule 403 12/11/1998
	Freeboard at least 3"; prevent spillage from holes; install track-out ctrl devices	Prevent/remove track-out onto paved roads	Within the work site; removes possible track-out from tires, exterior of trucks that traverse work site	Maricopa County Rule 310 04/07/2004
Construction and Demolition Earthmoving	Require water and chemical stabilizers (dust suppressants) be applied, in conjunction with optional wind barrier	Limit visible dust emissions to 20% opacity		SJVAPCD Rule 8021 11/15/2001
	Specifies Dust Control Plan must be submitted	Limit visible dust emissions to 20% opacity	For areas 40 acres or larger where earth movement of 2500 yd3 or more on at least 3 days is intended	SJVAPCD Rule 8021 11/15/2001

Table 3-8. Example Regulatory Formats for Construction and Demolition (Continued)

Source	Control measure	Goal	Threshold	Agency
	Requires implementation of Best Available Control Measures (BACM)	Prohibit visible dust emissions beyond property line and limit an upwind/downwind PM10 differential to 50 ug/m3. Limit visible dust emissions to 100 ft from origin		SCAQMD Rule 403 12/11/1998
Construction and Demolition Demolition	Application of dust suppressants	Limit visible dust emissions to 20% opacity		SJVAPCD Rule 8021 11/15/2001
	Application of best available control measures (BACM)	Prohibits visible dust emissions beyond property line. Limits downwind PM10 levels to 50 ug/m3	For projects greater than 5 acres or 100 yd3 of daily import/export	SCAQMD Rule 403 12/11/1998
Construction and Demolition Grading Operations	Requires pre-watering and phasing of work	Limit VDE to 20% opacity		SJVAPCD Rule 8021 11/15/2001
	Requires water application and chemical stabilizers	Increase moisture content to proposed cut	For graded areas where construction will not begin for more than 60 days after grading	SCAQMD Rule 403 12/11/1998
	Preapplication of water to depth of proposed cuts and reapplication of water as necessary. Also stabilization of soils once earth-moving is complete	Ensure visible emissions do not extend more than 100 ft from sources		SCAQMD Rule 403 12/11/1998

Table 3-9. Compliance Tools for Construction and Demolition

Record keeping	Site inspection/monitoring
Site map; description of work practices; duration of project activities; locations and methods for demolition activities; locations and amounts of all earthmoving and material (types) handling operations; dust suppression equipment (types) and maintenance; frequencies, amounts, times, and rates of watering or dust suppressant application; mud/dirt carryout prevention and remediation requirements; wind shelters; meteorological log.	Observation of earthmoving and demolition activities, considering timeframe of project; observation of operation of dust suppression systems, vehicle/ equipment operation and disturbance areas; surface material sampling and analysis for silt and moisture contents; observation of truck spillage onto adjacent paved roads; mud/dirt carryout prevention and remediation; inspection of wind sheltering; real-time portable monitoring of PM; observation of dust plume opacity exceeding a standard.

3.9 Sample Cost-Effectiveness Calculation

This section is intended to demonstrate how to select a cost-effective control measure for construction and demolition. A sample cost-effectiveness calculation is presented below for a specific control measure (gravel apron at trackout egress points) to illustrate the procedure. The sample calculation includes the entire series of steps for estimating uncontrolled emissions (with correction parameters and source extent), controlled emissions, emission reductions, control costs, and control cost-effectiveness values for PM10 and PM2.5. In selecting the most advantageous control measure for construction and demolition, the same procedure is used to evaluate each candidate control measure (utilizing the control measure specific control efficiency and cost data), and the control measure with the most favorable cost-effectiveness and feasibility characteristics is identified.

Sample Calculation for Construction and Demolition (Mud/Dirt Egress Points)

Step 1. Determine source activity and control application parameters.

Egress traffic rate (veh/day)	100
Number of egress points	2
Duration of construction activity (month)	24
Wet days/year	10
Number of workdays/year	260
Number of emission days/yr (workdays without rain)	250

Control Measure	Gravel apron 25 ft long by road width
Economic Life of Control System (yr)	2
Control Efficiency	46%
Reference	MRI, 2001[20]

The number of vehicles per day, wet days per year, workdays per year, and the economic life of the control are determined from climatic and industrial records. The number of emission days per year are calculated by subtracting the number of annual wet days from the number of annual workdays as follows:

Number of workdays/year – Wet days/year = 260 – 10 = 250

Gravel aprons at the two construction site egress points have been chosen as the applied control measure. The control efficiency was obtained from MRI, 2001.[19]

Step 2. Obtain PM10 Emission Factor. The PM10 emission factor for construction and demolition dust is 6 g/vehicle.[22]

Step 3. Calculate Uncontrolled PM Emissions. The PM10 emission factor, EF, (given in Step 2) is multiplied by the number of vehicles per day and by the number of emission days per year (both under activity data) and divided by 454 grams/lb and 2000 lb/ton to compute the annual PM10 emissions, as follows:

Annual PM10 emissions = (EF x Veh/day x Emission days/year)/(454 x 2,000)
Annual PM10 emissions = (6 x 100 x 250) / (454 x 2,000) = 0.165 tons/year

Annual PM2.5 emissions = 0.1 x PM10 emissions[7]
Annual PM2.5 emissions = (0.1 x 0.165 tons/year) = 0.0165 tons/year

Step 4. Calculate Controlled PM Emissions. The controlled PM emissions (i.e., the PM emissions remaining after control) are equal to the uncontrolled emissions (calculated above in Step 3) multiplied by the percentage that uncontrolled emissions are reduced, as follows:

Controlled emissions = Uncontrolled emissions x (1 – Control Efficiency).

For this example, we have selected gravel aprons at egress points as our control measure. Based on a control efficiency estimate of 46% for a gravel apron, the annual PM emissions are calculated to be:

Annual Controlled PM10 emissions = (0.165 tons/yr) x (1 – 0.46) = 0.089 tons/yr
Annual Controlled PM2.5 emissions = (0.0165 tons/yr) x (1 – 0.46) = 0.0089 tons/yr

Step 5. Determine Annual Cost to Control PM Emissions.

Capital costs ($)	500
Annual Operating/Maintenance costs ($)	3,150
Annual Interest Rate	5%
Capital Recovery Factor	0.54
Annualized Cost ($/year)	3,419

The capital costs, annual operating and maintenance costs, and annual interest rate (AIR) are assumed values for illustrative purposes. The Capital Recovery Factor (CRF) is calculated as follows:

Capital Recovery Factor = AIR x $(1+AIR)^{\text{Economic life}}$ / $(1+AIR)^{\text{Economic life}}$ – 1
Capital Recovery Factor = 5% x $(1+5\%)^2$ / $(1+5\%)^2$ – 1 = 0.54

The Annualized Cost is calculated by adding the product of the Capital Recovery Factor and the Capital costs to the annual Operating and Maintenance costs:

Annualized Cost = (CRF x Capital costs) + Annual Operating and Maintenance costs
Annualized Cost = (0.54 x $500) + $3,150 = $3,419

Step 6. Calculate Cost Effectiveness. Cost effectiveness is calculated by dividing the annualized cost by the emissions reduction. The emissions reduction is determined by subtracting the controlled emissions from the uncontrolled emissions:

Cost effectiveness = Annualized Cost / (Uncontrolled emissions – Controlled emissions)

Cost effectiveness for PM10 emissions = $3,420 / (0.165 - 0.089) = $44,991/ton
Cost effectiveness for PM2.5 emissions = $3,420 / (0.0165 - 0.0089) = $449,908/ton

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ATTACHMENT E

DTSC Information Advisory on Clean Imported Fill

Information Advisory
Clean Imported Fill Material

October 2001

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

It is DTSC's mission to restore, protect and enhance the environment, to ensure public health, environmental quality and economic vitality, by regulating hazardous waste, conducting and overseeing cleanups, and developing and promoting pollution prevention.

State of California

California Environmental Protection Agency

Executive Summary

This fact sheet has been prepared to ensure that inappropriate fill material is not introduced onto sensitive land use properties under the oversight of the DTSC or applicable regulatory authorities. Sensitive land use properties include those that contain facilities such as hospitals, homes, day care centers, and schools. This document only focuses on human health concerns and ecological issues are not addressed. It identifies those types of land use activities that may be appropriate when determining whether a site may be used as a fill material source area. It also provides guidelines for the appropriate types of analyses that should be performed relative to the former land use, and for the number of samples that should be collected and analyzed based on the estimated volume of fill material that will need to be used. The information provided in this fact sheet is not regulatory in nature, rather is to be used as a guide, and in most situations the final decision as to the acceptability of fill material for a sensitive land use property is made on a case-by-case basis by the appropriate regulatory agency.

Introduction

The use of imported fill material has recently come under scrutiny because of the instances where contaminated soil has been brought onto an otherwise clean site. However, there are currently no established standards in the statutes or regulations that address environmental requirements for imported fill material. Therefore, the California Environmental Protection Agency, Department of Toxic Substances Control (DTSC) has prepared this fact sheet to identify procedures that can be used to minimize the possibility of introducing contaminated soil onto a site that requires imported fill material. Such sites include those that are undergoing site remediation, corrective action, and closure activities overseen by DTSC or the appropriate regulatory agency. These procedures may also apply to construction projects that will result in sensitive land uses. The intent of this fact sheet is to protect people who live on or otherwise use a sensitive land use property. By using this fact sheet as a guide, the reader will minimize the chance of introducing fill material that may result in potential risk to human health or the environment at some future time.

Overview

Both natural and manmade fill materials are used for a variety of purposes. Fill material properties are commonly controlled to meet the necessary site specific engineering specifications. Because most sites requiring fill material are located in or near urban areas, the fill materials are often obtained from construction projects that generate an excess of soil, and from demolition debris (asphalt, broken concrete, etc.). However, materials from those types of sites may or may not be appropriate, depending on the proposed use of the fill, and the quality of the assessment and/or mitigation measures, if necessary. Therefore, unless material from construction projects can be demonstrated to be free of contamination and/or appropriate for the proposed use, the use of that material as fill should be avoided.

Selecting Fill Material

In general, the fill source area should be located in nonindustrial areas, and not from sites undergoing an environmental cleanup. Nonindustrial sites include those that were previously undeveloped, or used solely for residential or agricultural purposes. If the source is from an agricultural area, care should be taken to insure that the fill does not include former agricultural waste process byproducts such as manure or other decomposed organic material. Undesirable sources of fill material include industrial and/or commercial sites where hazardous ma-

Potential Contaminants Based on the Fill Source Area

Fill Source:	Target Compounds
Land near to an existing freeway	Lead (EPA methods 6010B or 7471A), PAHs (EPA method 8310)
Land near a mining area or rock quarry	Heavy Metals (EPA methods 6010B and 7471A), asbestos (polarized light microscopy), pH
Agricultural land	Pesticides (Organochlorine Pesticides: EPA method 8081A or 8080A; Organophosphorus Pesticides: EPA method 8141A; Chlorinated Herbicides: EPA method 8151A), heavy metals (EPA methods 6010B and 7471A)
Residential/acceptable commercial land	VOCs (EPA method 8021 or 8260B, as appropriate and combined with collection by EPA Method 5035), semi-VOCs (EPA method 8270C), TPH (modified EPA method 8015), PCBs (EPA method 8082 or 8080A), heavy metals including lead (EPA methods 6010B and 7471A), asbestos (OSHA Method ID-191)

**The recommended analyses should be performed in accordance with USEPA SW-846 methods (1996). Other possible analyses include Hexavalent Chromium: EPA method 7199*

Recommended Fill Material Sampling Schedule

Area of Individual Borrow Area	Sampling Requirements
2 acres or less	Minimum of 4 samples
2 to 4 acres	Minimum of 1 sample every 1/2 acre
4 to 10 acres	Minimum of 8 samples
Greater than 10 acres	Minimum of 8 locations with 4 subsamples per location

Volume of Borrow Area Stockpile	Samples per Volume
Up to 1,000 cubic yards	1 sample per 250 cubic yards
1,000 to 5,000 cubic yards	4 samples for first 1000 cubic yards +1 sample per each additional 500 cubic yards
Greater than 5,000 cubic yards	12 samples for first 5,000 cubic yards + 1 sample per each additional 1,000 cubic yards

terials were used, handled or stored as part of the business operations, or unpaved parking areas where petroleum hydrocarbons could have been spilled or leaked into the soil. Undesirable commercial sites include former gasoline service stations, retail strip malls that contained dry cleaners or photographic processing facilities, paint stores, auto repair and/or painting facilities. Undesirable industrial facilities include metal processing shops, manufacturing facilities, aerospace facilities, oil refineries, waste treatment plants, etc. Alternatives to using fill from construction sites include the use of fill material obtained from a commercial supplier of fill material or from soil pits in rural or suburban areas. However, care should be taken to ensure that those materials are also uncontaminated.

Documentation and Analysis

In order to minimize the potential of introducing contaminated fill material onto a site, it is necessary to verify through documentation that the fill source is appropriate and/or to have the fill material analyzed for potential contaminants based on the location and history of the source area. Fill documentation should include detailed information on the previous use of the land from where the fill is taken, whether an environmental site assessment was performed and its findings, and the results of any testing performed. It is recommended that any such documentation should be signed by an appropriately licensed (CA-registered) individual. If such documentation is not available or is inadequate, samples of the fill material should be chemically analyzed. Analysis of the fill material should be based on the source of the fill and knowledge of the prior land use.

Detectable amounts of compounds of concern within the fill material should be evaluated for risk in accordance with the DTSC Preliminary Endangerment Assessment (PEA) Guidance Manual. If metal analyses are performed, only those metals (CAM 17 / Title 22) to which risk levels have been assigned need to be evaluated. At present, the DTSC is working to establish California Screening Levels (CSL) to determine whether some compounds of concern pose a risk. Until such time as these CSL values are established, DTSC recommends that the DTSC PEA Guidance Manual or an equivalent process be referenced. This guidance may include the Regional Water Quality Control Board's (RWQCB) guidelines for reuse of non-hazardous petroleum hydrocarbon contaminated soil as applied to Total Petroleum Hydrocarbons (TPH) only. The RWQCB guidelines should not be used for volatile organic compounds (VOCs) or semi-volatile organic compounds (SVOCS). In addition, a standard laboratory data package, including a summary of the QA/QC (Quality Assurance/Quality Control) sample results should also accompany all analytical reports.

When possible, representative samples should be collected at the borrow area while the potential fill material is still in place, and analyzed prior to removal from the borrow area. In addition to performing the appropriate analyses of the fill material, an appropriate number of samples should also be determined based on the approximate volume or area of soil to be used as fill material. The table above can be used as a guide to determine the number of samples needed to adequately characterize the fill material when sampled at the borrow site.

Alternative Sampling

A Phase I or PEA may be conducted prior to sampling to determine whether the borrow area may have been impacted by previous activities on the property. After the property has been evaluated, any sampling that may be required can be determined during a meeting with DTSC or appropriate regulatory agency. However, if it is not possible to analyze the fill material at the borrow area or determine that it is appropriate for use via a Phase I or PEA, it is recommended that one (1) sample per truckload be collected and analyzed for all compounds of concern to ensure that the imported soil is uncontaminated and acceptable. (See chart on Potential Contaminants Based on the Fill Source Area for appropriate analyses). This sampling frequency may be modified upon consultation with the DTSC or appropriate regulatory agency if all of the fill material is derived from a common borrow area. However, fill material that is not characterized at the borrow area will need to be stockpiled either on or off-site until the analyses have been completed. In addition, should contaminants exceeding acceptance criteria be identified in the stockpiled fill material, that material will be deemed unacceptable and new fill material will need to be obtained, sampled and analyzed. Therefore, the DTSC recommends that all sampling and analyses should be completed prior to delivery to the site to ensure the soil is free of contamination, and to eliminate unnecessary transportation charges for unacceptable fill material.

Composite sampling for fill material characterization may or may not be appropriate, depending on quality and homogeneity of source/borrow area, and compounds of concern. Compositing samples for volatile and semivolatile constituents is not acceptable. Composite sampling for heavy metals, pesticides, herbicides or PAH's from unanalyzed stockpiled soil is also unacceptable, unless it is stockpiled at the borrow area and originates from the same source area. In addition, if samples are composited, they should be from the same soil layer, and not from different soil layers.

When very large volumes of fill material are anticipated, or when larger areas are being considered as borrow areas, the DTSC recommends that a Phase I or PEA be conducted on the area to ensure that the borrow area has not been impacted by previous activities on the property. After the property has been evaluated, any sampling that may be required can be determined during a meeting with the DTSC.

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