



Cal/EPA

◆ Groundwater Protection ◆



**INTERIM  
SITE ASSESSMENT &  
CLEANUP GUIDEBOOK**

May 1996  
California Regional Water Quality  
Control Board  
Los Angeles and Ventura Counties  
Region 4



**PREVENTING GROUNDWATER  
POLLUTION:  
ASSESSING YOUR SITE FOR  
CHEMICAL CONTAMINANTS**

## **EXECUTIVE SUMMARY of CLEANUP GUIDEBOOK**

In December 1994, the staff of the Los Angeles Regional Water Quality Control Board, assisted by its Technical Review Committee, developed an Interim Site Assessment and Cleanup Guidebook to serve the regulated community in the Region.

The guidebook offers a new approach to the site cleanup process: one that reduces time, cuts costs, and establishes a defined endpoint for investigations and cleanup actions. Formerly, the process involved case-by-case decisions on a site-by-site basis, a process that took too long, cost too much, and had an uncertain outcome. Concerns expressed by property owners, consultants, attorneys, lenders' real estate brokers, insurance companies and others led the Board to reexamine and reinvent its procedures.

Specifically, the guidebook:

- identifies the role of the involved agencies and their oversight responsibilities to help avoid confusion and duplication.
- streamlines the investigation and cleanup process and offers a standard approach to developing work plans.
- expedites the review and decision-making process throughout all of the Regional Board's groundwater protection programs.
- answers the questions "How clean is clean?" for both petroleum and solvent impacted sites.
- defines investigation endpoints and criteria for issuing a "no further action" determination by the Board.
- is "user friendly" and "service oriented" to promote a better understanding of the assessment and cleanup process, foster cooperation among all parties involved in a site, and accelerates cleanup of contaminated sites to the benefit of both the environment and the local economy.

Scattered among the Board's well investigation, underground tanks, site cleanup, and other programs are over 3,500 site assessment and cleanup cases which will benefit from this guidebook. For example, the guidebook will make it easier for a property owner, a prospective buyer, or lender to predict the estimated cost of cleanup.

Using the procedures and standards contained in the guidebook owners will know ahead of time what level of cleanup must be achieved to obtain closure from the Board and at what cost. A gas station owner or consultant now has in one document the tools to determine the extent of the problem, clean up the contamination, and obtain closure, often with less oversight by Regional Board staff along the way.

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## FOREWORD

This guidebook has been prepared in response to a recommendation contained in the 1993 Final Report of the Regional Board's Water Quality Advisory Task Force. During its deliberations, the Task Force heard numerous comments from the regulated community that the site assessment and cleanup process was slow, confusing and seemingly never ending. In response to those concerns, this guidebook provides in layman's terms a clear picture of the goals, procedures, and requirements associated with the site assessment and cleanup process. The appendixes contain supporting documents and detailed information that are intended to assist a responsible party in complying with the Regional Board's requirements.

This guidebook is consistent with the applicable provisions of governing statutes, regulations and State Board policies. However, it is the Regional Board's intent to make this a dynamic document that will improve with age. Comments and suggestions for making it more "user friendly" are welcomed and encouraged. Board staff plans to distribute the guidebook to a broad audience and to incorporate constructive comments into future revisions.

Written comments regarding the guidebook should be sent to:

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## ACKNOWLEDGMENTS

Several members of the Regional Board's staff were instrumental in the development of this Guidebook. The key contributors were: Alex Carlos, Arthur Heath, Kwang Lee, Gay Norris, Al Novak, Eric Nupen, Yue Rong, and Mark Smythe. Draft versions of the document were reviewed, critiqued, and augmented by the Technical Review Committee (TRC), whose current members are listed below. Other governmental organizations, business persons and technical consultants contributed their comments on earlier drafts of this guidebook. We would like to thank all of the involved entities for their input.

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# **ASSESSMENT AND CLEANUP**

## **SECTION I**

# CHAPTER 1.0

## Introduction

### *California State and Regional Water Boards*

The California State Water Resources Control Board (State Board) and the nine Regional Boards work together to protect the quality of water (California Water Code, Sections 13000 and 13001) in waters such as lakes, estuaries, rivers, streams, ground waters, etc. By protecting water quality, these regulatory Boards seek to protect the "beneficial uses" or the many activities, uses and habitats that waters can support. Examples of "beneficial uses" include such things as boating, fishing, swimming, wildlife habitats, drinking water sources, and navigation.

In order to protect the many beneficial uses associated with our waters in California, Regional Boards often require that "actual (leaking underground fuel tanks) and potential threats" (soil contaminated with chemicals such as benzene and toluene) to water quality be assessed, and eliminated or removed, if needed. Additional water quality threats include chemical spills into the ocean, lakes or streams. In most instances, the person or entity responsible for the chemical release (Responsible Party - RP) will be required to stop the chemical release or discharge. If cleanup is determined to be needed, then the RP is required to eliminate or remove the released pollutant(s). This guidebook discusses the assessment and cleanup procedures that are needed to eliminate threats to ground waters in Los Angeles and Ventura counties.

The regulatory Boards operate under the Porter-Cologne Water Quality Control Act, which assigns overall responsibility for water quality protection to the State Board, and directs the Regional Boards to establish and enforce water quality standards within their respective boundaries. Each Regional Board is governed by nine members, all of whom are appointed by the Governor and confirmed by the State Senate. Figure 1-1 shows the organizational chart for the Los Angeles/Ventura Regional Board (Regional Board). This Regional Board is responsible for protecting the beneficial uses of surface and ground waters within the watersheds shown in Figure 1-2.

### *The Need for a Guidebook*

In December 1992, the Los Angeles Regional Board created a Water Quality Advisory Task Force (Task Force) to identify and recommend ways to reduce the costs incurred by businesses and public agencies as they strive to meet clean water laws without compromising water quality and public health. Task Force members included representatives of local government, environmental groups, businesses and public agencies.

To carry out this assignment, the Task Force conducted workshops to receive written and oral testimony from representatives of small businesses, government officials, corporate leaders, environmental groups and interested citizens. In the course of its meetings and workshops, representatives voiced a common concern -- that cities, governmental agencies and the business community face enormous

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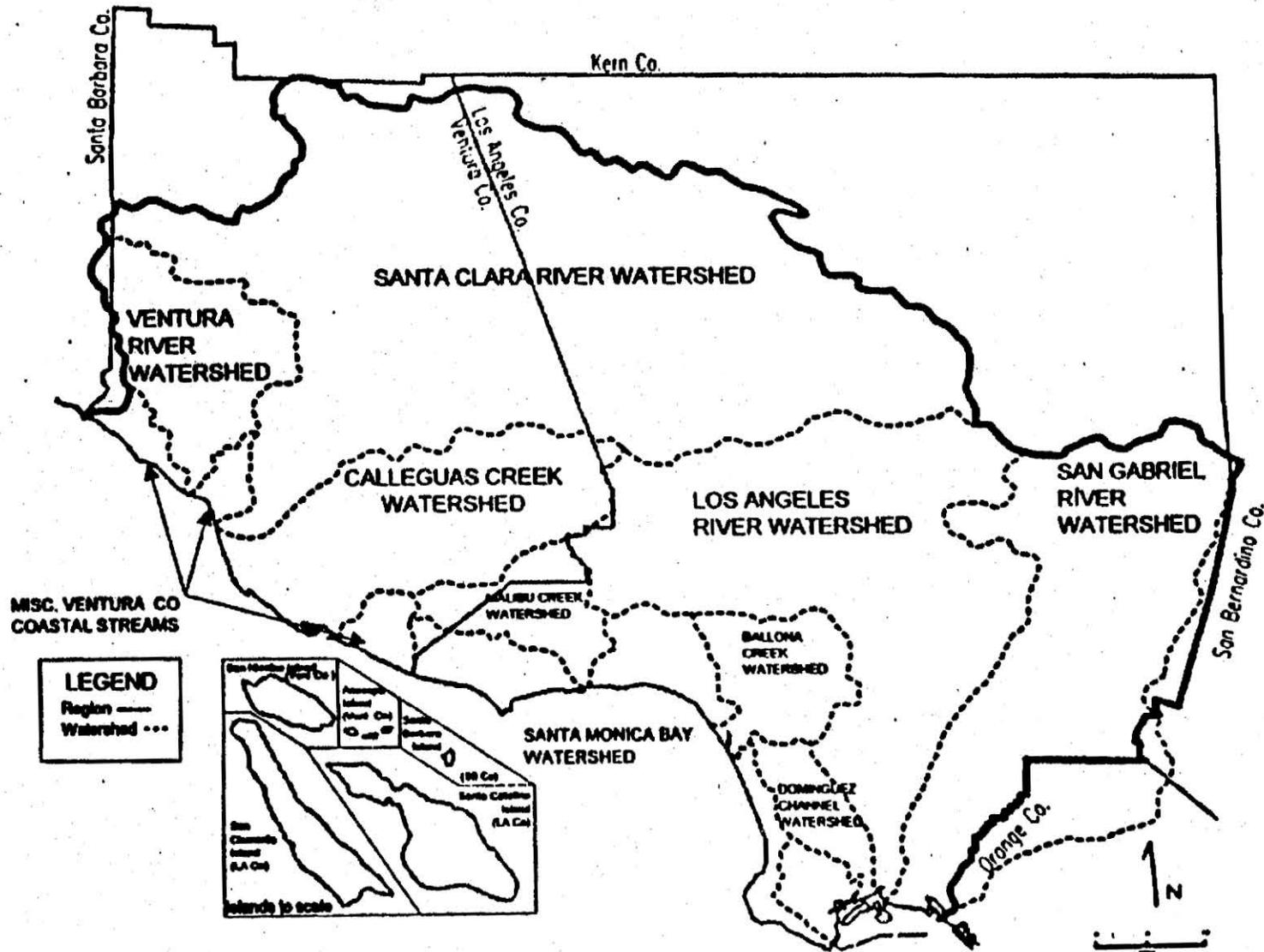


Figure 1-2: Map of the Region with Watershed Management Areas.

## Introduction

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costs when complying with water quality rules and regulations.

Frustrated property owners expressed the following complaints:

- ☞ the work plan development, review and approval process was costly, time consuming, needs streamlining and has an uncertain outcome,
- ☞ requirements are unclear,
- ☞ no certainty or finality to the assessment and cleanup process,
- ☞ the small businessperson must often resort to costly technical and legal assistance to settle any disputes that may arise due to the lack of a clear understanding of the appeals process, and
- ☞ no clear delineation of agency roles and responsibilities.

Based in part on the feedback from the regulated community, the Task Force concluded that "no clear and consistent work plan procedures guided the site assessment and cleanup process." To address this need, the Task Force recommended among other things that a site assessment and cleanup guidebook be developed.

The Task Force envisioned that the guidebook would promote the concept of a "total work plan" that takes into account the needs of Regional Board staff, the site owner plus his/her consultants and attorneys, lenders,

insurers, and others with an interest in the site. This "total work plan" approach helps to streamline work plan preparation, expedite review and lead to more timely processing of work plans through the Regional Board.

### *Purpose of the Guidebook*

This guidebook has been compiled to meet the specific charges of the Task Force, which were:

1. Describe the steps involved in the site assessment and cleanup process.
2. Identify the involved agencies and their oversight responsibilities.
3. Define what is needed to obtain a final sign-off or determination of "no further action" from the Regional Board when the work is completed as required.
4. Provide a concise description of the "appeals process".

Moreover, the guidebook and its appendices represent a compendium of technical information and guidance that already have been used successfully by the Regional Board in the "San Gabriel and San Fernando Valleys Cleanup Program" (formerly Well Investigation), "Underground Tank," and other programs. To assist readers, many of the technical terms, acronyms, abbreviations and regulations are explained in the text as well as listed in the glossary and appendices.

Most of the guidebook is written in plain English to serve as a road map through the

# Introduction

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process. Chapters 4 and 5 are somewhat more technical, however, as they are geared for readers with technical knowledge of the site assessment and cleanup process.

## *Protection of Water Quality*

The Regional Board protects water quality by regulating pollutants that are released or discharged into surface and ground waters. In turn, this helps to protect the beneficial uses (e.g., fishing, swimming, drinking water supply, boating, etc.) of the receiving waters.

To protect water quality, sources of pollutants must be identified, eliminated or cleaned up when necessary. Under Water Code Section 13304 (State Resolution No. 92-49, "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges" in Appendix E), policies and procedures are specified in terms of addressing the investigation, cleanup and abatement of discharges (i.e., pollutants or contaminants). As indicated below, pollutants may enter surface and ground waters by way of the following:

### *Sources of Pollutants:*

- Above/Underground Tanks
- Drum storage areas
- Sewer leaks
- Chemical spills
- Contaminated soil
- Clarifiers
- Septic tanks/Leach fields/cesspools
- Underground piping
- Vapor degreasers
- Landfills
- Paint booths
- Toxic pits

- Percolation sumps
- Contaminated run-off
- Any structure containing and/or transporting chemicals, wastes, etc.
- Illegal or unpermitted disposal or dumping.
- Waste water treatment plants/publicly owned treatment works.

Various federal and state regulations have been created to assist regulatory agencies, consultants, and RPs (i.e., individuals who are held responsible for a particular environmental problem) with the protection of water quality. A partial list of regulations that are applicable to the protection of water quality, including assessment and cleanup activities, are listed below:

### *State regulations:*

- Porter-Cologne Water Quality Control Act
- Hazardous Substance Cleanup Bond Act
- Toxic Injection Well Control Act
- Hazardous Waste Control Act
- California Code of Regulations, Title 22, Division 4 Environmental Health
- California Code of Regulations, Title 23, Chapters 15 and 16

### *Federal regulations:*

- Clean Water Act
- Safe Drinking Water Act
- Toxic Substances Control Act
- Resource Conservation and Recovery Act
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA - SUPERFUND)

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Additional information regarding state and federal regulations is contained in the Regional Board's Basin Plan. ☎ Contact our Business Assistance Office at (800) 500-8008 or (213) 266-7660/7671 for Basin Plan information.

### Programs

The Los Angeles/Ventura Regional Board addresses threats to water quality through several formalized programs that are listed in Table 1-1. These programs are designated to assist with the identification and elimination of pollution. An RP is required to adhere to the requirements of the applicable Regional Board program(s) that pertain to his/her site. To facilitate compliance and to simplify the process, it is suggested that face-to-face discussions between RPs and Regional Board staff begin as soon as possible. The following suggestions may assist an RP in the early stages of a project.

1. ☎ For general information, contact the Regional Board's Business Assistance Office at (213) 266-7660/7671, (800) 500-8008 or a representative listed in Table 1-1 at (213) 266-7500.
2. ☎ For bulletin board information, call (213) 266-7663.
3. Retain a consultant. Under State Board Resolution No. 92-49 (see Appendix E), appropriate qualified professionals must prepare reports

required by the state.

4. Provide staff with relevant evidence as specified in State Resolution No. 92-49, and any additional information that might assist the Regional Board:

- Known and potential sources of chemical releases on the subject property.
- Chemical usage and storage practices.
- Property photographs and maps.
- Type & nature of manufacturing operations.
- Names and addresses of prior owners & nature of businesses
- Prior & future land uses of the property.
- Financial situation for meeting requirements.
- Copies of technical reports, such as Phase I and Phase II environmental assessments, soil and groundwater assessments, foundation investigations, etc.

The above information will provide Regional Board staff with much of the data which it needs to guide you efficiently through the initial investigation.

What follows is a brief listing and summary of Regional Board programs. More detailed information regarding the programs is available in our Basin Plan. Information regarding the Regional Board's surface water programs is available through our Business Assistance office and/or bulletin board.

# Introduction

Beginning 1996, the Regional Board will oversee underground tank cases that were once regulated through the Local Oversight Program at the Los Angeles Department of Public Works, Waste Management Division. The Ventura Environmental Health Division continues to oversee underground tank cases within their jurisdiction.

<b>Table 1-1: Regional Board Programs</b>		
<b>PROTECTION OF GROUNDWATER</b>	<b>Unit Chief - area(s)</b>	
<b>SAN FERNANDO and SAN GABRIEL VALLEYS: CLEANUP PROGRAM</b>	Support and Computer Network	<b>Jonathan Bishop</b>
	San Gabriel Valley	<b>Arthur Heath - Azusa; El Monte; Richwood; Monrovia; La Puente; City of Industry; South El Monte; Whittier Narrows</b>
	San Fernando Valley	<b>Eric Nupen - Burbank; Glendale; North Hollywood</b>
<b>UNDERGROUND TANK PROGRAM</b>	UST I Admin.	<b>Al Novak - Groundwater Cases</b>
	UST II Closure Unit	<b>Gregg Kwey - Site Closures</b>
	UST III	<b>Dave Bacharowski - Ventura Co./LIA</b>
<b>GROUNDWATER PROTECTION</b>	Landfills and Solid Waste Water Quality Assessment Test (SWAT)	<b>Rod Nelson - region wide</b>
	Site Cleanup	<b>Jim Ross - Spills, Leaks, Investigations and Cleanups (SLIC); Aboveground Petroleum Storage Tanks (AGST); U.S. Department of Defense (DOD) and Department of Energy (DOE) Sites; Resource Conservation and Recovery Act (RCRA); and Superfund (CERCLA)</b>
	Subsurface Investigations	<b>Hubert Kang - region wide</b>

**☎ For an updated listing of telephone numbers for the unit chiefs mentioned above, please call the Regional Board's receptionist at (213) 266-7500.**

San Gabriel and San Fernando Valleys Cleanup Program

Targeted Area: San Fernando and San Gabriel Valley Groundwater Basins - designated as Superfund sites.

Potential Responsible Party(ies): Property owners/operators suspected of using or storing targeted chemicals.

Targeted Chemicals: Volatile organic compounds (VOCs) - tetrachloroethylene (PCE), trichloroethylene (TCE), etc.

Potential Source(s): Leaking solvent tanks, clarifiers, degreasers, sumps, paint booths, inadequate handling, storage, and disposal practices, etc.

Participating Agencies:

- 1) USEPA: Administers Superfund and RCRA sites; oversees groundwater cleanup; Regional Board has a cooperative agreement with USEPA for site investigations.
- 2) Regional Board: Oversees site investigations, on-site soil and groundwater cleanups.
- 3) DTSC: Lead agency for RCRA, and DoD (e.g., hazardous waste TSD facilities, and federally owned facilities).
- 4) County of Los Angeles, Public Works, UST: Oversees tank construction standards, monitoring requirements, unauthorized release reporting and closure requirements.

Pertinent Regulations and Policies: CERCLA; RCRA; State Board Resolution No. 92-49; Porter-Cologne Water Quality Control Act.

Underground Storage Tanks (UST)

Targeted Area: Region wide

Responsible Party(ies): Owners/operators of underground petroleum product tanks.

Targeted Chemicals: Gasoline and diesel fuel products, waste oil.

Potential Source(s): Leaking underground tanks and/or associated piping.

Participating Agencies:

- 1) Regional Board: Lead over investigations of groundwater pollution, corrective actions and closure requirements.
- 2) Ventura Environmental Health Division, Luft Program: Oversee some groundwater pollution and corrective actions; Lead over tank construction standards, monitoring requirements, unauthorized release reporting, initial soil and groundwater assessment and abatement procedures, and closure requirements.
- 3) Local Implementing Agencies: Lead over tank construction standards, monitoring requirements, unauthorized release reporting, initial soil assessment and abatement procedures, and closure requirements.

Pertinent Regulations and Policies: California Code of Regulations, Title 23, Division 3, Chapter 16; State Board Resolutions No. 92-49 and 68-16; Porter-Cologne Water Quality Control Act..

Pertinent Information, Assessment and Cleanup Documents: Self-Directed Process  
County of Los Angeles, Department of Public Works, Industrial Waste Planning and Control Environmental Programs' Guidelines for Report Submittals; Ventura Environmental Health Division's Guidebook.

Spills, Leaks, Investigation and Cleanup (SLIC)

Targeted Area: Region wide

Responsible Party(ies): Property owners/operators of major tank farms, oil refineries, metal drum storage facilities, and etc..

Targeted Chemicals: Miscellaneous chemicals, heavy metals, solvents, and petroleum hydrocarbons.

Potential Source(s): Surface spills, metal storage drums, leaking storage facilities and/or associated piping, aboveground (e.g., tank farms) and underground solvent storage facilities.

Participating Agencies:

- 1) Regional Board: Oversees site investigation and corrective action involving sites not overseen by other programs.
- 2) DTSC: Lead agency for RCRA, state and Federal Superfund, DoD (e.g., hazardous waste storage facilities, federally owned facilities) under contract from USEPA and DoD.
- 3) USEPA: Administers Superfund and RCRA sites.

Pertinent Regulations and Policies: CERCLA; RCRA; State Board Resolution No. 92-49; Porter-Cologne Water Quality Control Act; California Code of Regulations, Title 22, Division 4, Environmental Health; California Code of Regulations, Title 23, Chapters 15 and 16.

U.S. Departments of Defense (DoD) and Energy (DoE)

Targeted Area: Region wide

Responsible Party(ies): Federal government - military bases and energy facilities.

Targeted Chemicals: Hazardous wastes, solvents, gasoline and diesel fuel products, heavy metals, and low level nuclear waste.

Potential Source(s): Surface spills, metal storage drums, leaking storage facilities and/or associated piping, aboveground and underground petroleum storage facilities, unlined pits, holding ponds, drying beds.

Participating Agencies:

- 1) Regional Board: Oversees site water quality investigation and corrective action under DTSC's lead for DoD sites and under Department of Health Services' (DHS) lead at DoE sites.
- 2) DTSC: Administers DoD, federally owned facilities and sites under contract with DoD.
- 3) USEPA: Lead on Superfund and RCRA sites.
- 4) DHS: Lead on DoE sites under contract with DoE.

Pertinent Regulations and Policies: CERCLA; RCRA; State Board Resolution No. 92-49; Porter-Cologne Water Quality Control Act; California Code of Regulations, Title 23, Chapters 15 and 16.

Aboveground Petroleum Storage Tanks (AGST)

Targeted Area: Region wide

Responsible Party(ies): Owners/operators with aboveground petroleum storage tanks.

Targeted Chemicals: Gasoline, diesel and jet fuel products.

Potential Source(s): Leaking gasoline storage facilities and/or associated piping, aboveground petroleum storage facilities (e.g., tank farms and refineries).

Participating Agencies:

- Regional Board: Lead over site investigation and corrective action and SPCC inspections.

Pertinent Regulations and Policies: Health and Safety Code 25270.2 (Spill Prevention Control and Countermeasure Plan); State Board Resolution No. 92-49; Porter-Cologne Water Quality Control Act.

Resource Conservation and Recovery Act (RCRA)/Superfund (CERCLA)

Targeted Area:	Region wide
Responsible Party(ies):	Hazardous waste generators, transporters, and facilities that treat, store and dispose of hazardous wastes.
Targeted Chemicals:	Hazardous wastes.
Potential Source(s):	Hazardous waste generators, transporters, and facilities that treat, store and dispose of hazardous waste.
Participating Agencies:	
1) DTSC:	Administers the RCRA Program in California.
2) Regional Board:	When requested, Regional Board reviews water quality issues related to RCRA sites.
3) County of Los Angeles Fire Department, Health Hazardous Materials Division (HHMD):	Primary agency performing compliance inspections of hazardous waste generators (including overseeing corrective actions) under CAH&SC Division. 20, Chapter 6.5 (state RCRA); 22 CCR; and designation/MOU with DTSC.
Pertinent Regulations and Policies:	California Code of Regulations, Title 22; Porter-Cologne Water Quality Control Act.

Landfills

Targeted Area: Region wide

Responsible Party(ies): Property owners/operators of land disposal sites.

Targeted Chemicals: Hazardous wastes and solvents, heavy metals, leachate.

Potential Source(s): Wastes disposed at landfills.

Participating Agencies:

- 1) Regional Board: Lead agency.
- 2) County or City Planning Department: Oversees conditional use permit, flood control.
- 3) California Integrated Waste Management Board (CIWMB): Lead agency for solid waste facility permit.
- 4) County, City Health Departments: Local Enforcement Agencies (LEA) for CIWMB, oversee solid waste facility permit at the local level.
- 5) South Coast Air Quality Management District (SCAQMD): Lead agency for air emissions.

Pertinent Regulations, Policies and Assessment Test: California Code of Regulations, Title 23, Division 3, Chapter 15, 2524; California Code of Regulations, Title 14, Division 7; Porter-Cologne Water Quality Control Act, Section 13273; Solid Waste Water Quality Assessment Test<sup>1</sup>.

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<sup>1</sup> CIWMB provided funding (AB 1220) for Regional Boards to review all unreviewed in-house SWAT Reports through Rank 5. No SWAT sites beyond Rank 5 (i.e., 6 through 16) will be noticed. Program funding expires at the end of the fiscal year July 95/July 96.

### Subsurface Investigations

Targeted Area:	Region wide
Responsible Party(ies):	Owners/operators of septic disposal systems.
Targeted Chemicals:	Sewage wastes and nitrates.
Potential Source(s):	Septic tank disposal systems.
Participating Agencies:	
1) Regional Board:	Oversees multiple-dwelling units, some non-domestic septic tank systems, and large developments.
2) Local Health and Public Works Departments:	Permit and regulate most single-family dwellings and certain commercial septic tank disposal systems.
Pertinent Regulations and Policies:	Porter-Cologne Water Quality Control Act, Chapter 4, Article 5,.

# CHAPTER 2.0

## Overview of the Assessment and Cleanup Process

### Cleanup Goals

The Regional Board's main goal is to protect the existing and potential beneficial uses of state waters. Ideally, this entails the cleanup of soil and groundwater contamination to "background levels", (see acceptable screening levels shown in Tables 4-1 and 5-1) which are presumed to be non-detect for man-made chemicals.

This cleanup approach stems from an interpretation of the "Statement of Policy with Respect to Maintaining High Quality of Waters in California", commonly referred to as the antidegradation policy" (see State Board Resolution 68-16 in Appendix E). The approach also follows recommendations in "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges under Water Code Section 13304" (State Board Resolution 92-49). In practice, the Regional Board will afford the highest possible and practical level of protection to all sources, depending on their use.

Under Water Code Sections 13267 and 13304 (Porter-Cologne Water Quality Control Act), the Regional Board is authorized to require soil and groundwater investigations, site inspections, monitoring, and to request work plans from an RP for an assessment and/or cleanup project. The Regional Board may assess fines in cases of noncompliance.

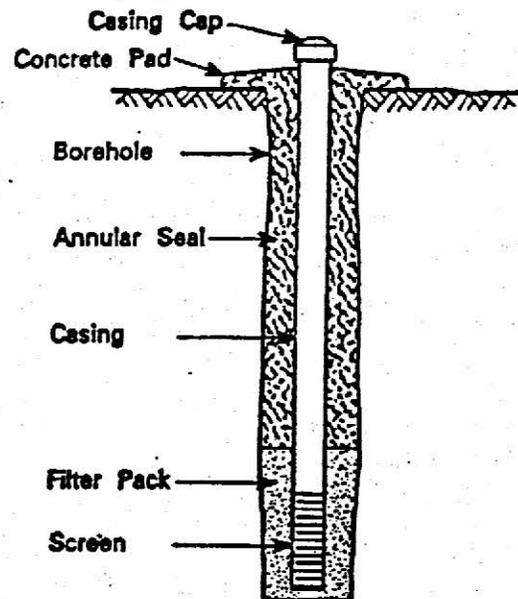
Please note that penalties potentially can be high, and, depending on the violations, may run into the tens of thousands of dollars.

Detailed enforcement information is discussed in our Basin Plan. Call Regional Board's Business Assistance Office at (213) 266-7671 or 266-7660 for Basin Plan information.

### General Report Requirements

All reports, documents, and plans that contain engineering, geologic, and/or geophysics evaluations and judgments must be prepared

Figure 2-1: Simplified Drawing of a Monitoring Well



Source: State of California, 1991. California Well Standards. California Dept. of Water Resources, Bulletin 74-90.

by, or under the direction of, a registered civil engineer, registered geologist, or certified engineering geologist licensed in the State of

## Overview of the Assessment and Cleanup Process

California (Sections 6735, 7835, and 7835.1 of the California Business and Professions Code).

All records of soil samples obtained from bore holes (holes drilled to a particular depth - see Figure 2-1 above) and water samples from groundwater monitoring wells (wells built with piping to draw water which can be sampled and analyzed - see Figure 2-1 above), monitoring well logs, as well as excavation procedures and soil/groundwater sampling must be reviewed, approved, and signed by a qualified professional. The registered or certified professional must indicate responsibility for the technical information by his/her signature and stamp or seal.

Sample collection and laboratory analyses of the samples are critical activities that occur during the site investigation, cleanup, and closure phases of a project. Analyze all soil and water samples using a laboratory that is certified by the California State Department of Health Services, for the United States Environmental Protection Agency (USEPA) analytical methods.

Prior to conducting any field work, prepare a site-specific health and safety plan complying with the California Occupational Safety and Health Agency, Health and Safety Code, Title 8, California Code of Regulations, Section 5192, and other appropriate sections.

The Regional Board may require soil and/or groundwater monitoring (collection and analysis of soil and/or groundwater samples referred to as "monitoring data") to evaluate site conditions during the site investigation and cleanup, and to verify that the corrective

action is effective. The responsible party must develop a monitoring program for an appropriate period of time based on the technical data and the site-specific conditions. In addition, the RP must collect monitoring data according to a regular schedule.

### *Monitoring Well Permit Requirements*

Well construction permits are required for all groundwater monitoring wells - wells built to sample and test groundwater quality, and to measure water elevation. General standards for well construction, reconstruction or repair, and abandonment, must comply with California Department of Water Resources Bulletins 74-81 and 74-90, and Chapter 16 Regulations, section 2649.

RPs must submit completed permit applications to the appropriate agency, and receive approval before drilling activities can begin. In Los Angeles County, the permitting agency is Los Angeles County Department of Health Services Water and Sewage Program (except in the cities of Long Beach, Pasadena, and Vernon). In Ventura County the permitting agency is Ventura County Environmental Health.

### *Other Permits*

You should obtain all other necessary permits (e.g., building, zoning, electrical, right of way encroachment, etc.) required by any agency prior to the start of work. Table 2-1 shows a partial list of permitting agencies within the region.

## Overview of the Assessment and Cleanup Process

Table 2-1: Permitting Agencies

REQUIRED PERMITS	AGENCY
Installation and Abandonment of ground water wells.	Los Angeles County Department of Health Services; Ventura County Environmental Health Division
Discharges to surface waters - NPDES Permit.	Regional Water Quality Control Boards
Discharges to land or ground water.	Regional Water Quality Control Boards
Discharges to municipal sewer system.	Local sewerage agency.
Emissions to air.	South Coast Air Quality Management District; Ventura County Air Pollution Control District.
System construction.	Local building or planning department.
Treatment of hazardous or RCRA regulated wastes.	Department of Toxic Substances Control.
Removal or installation of USTs.	Local tank permitting agency or Los Angeles County Department of Public Works or Ventura County Environmental Health Division.

## Overview of the Assessment and Cleanup Process

### *Waste Discharge Requirements*

It is the policy of the State Board and the Regional Boards to protect the surface waters and groundwaters of the State (Water Code Section 13263; California Code of Regulations, Title 23, Chapter 15) through developing Water Quality Control Plans (Basin Plans) and issuing Waste Discharge Requirements (WDRs). WDRs include National Pollutant Discharge Elimination System (NPDES) permits and non-NPDES permits.

The release of contaminants and other substances into surface waters (surface water "discharges") are subject to NPDES permits while discharges to land and groundwaters are subject to "non-NPDES" WDRs. Therefore, any discharge to groundwater, surface water, or a stormwater drain, is regulated by the Regional Board.

If a proposed corrective action (e.g., groundwater cleanup) involves a discharge to soil or water, you must obtain a waste discharge application from the Regional Board. Upon review of the discharge application by Regional Board staff, payment of fees (if any) and all other pertinent information (including comments received at a public hearing in some cases), the Regional Board may issue WDRs that include appropriate measures and limitations to protect public health and water quality. Detailed information regarding waste discharge applications and general WDRs (discussed below) can be obtained by calling either (213) 266-7660 or 266-7671, or (800) 500-8008 for assistance.

This Regional Board receives numerous discharge applications for the treatment and disposal of hydrocarbon-contaminated soil and groundwater. In order to expedite the processing and issuing of WDRs, the Regional Board has adopted several general NPDES permits and non-NPDES WDRs to cover specific cases. These general WDRs may be applied to specific sites, and typically are issued by the Regional Board's executive officer in less time than it takes to issue formal permits or WDRs, which must be adopted individually by the Regional Board. The following examples are general WDRs that may be appropriate for cleanups:

- Land Treatment of Petroleum Hydrocarbon Contaminated Soil in Los Angeles and Santa Clara River Basins (Order No. 90-148).
- General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Groundwater to Surface Waters in Los Angeles and Santa Clara River Basins (Order No. 91-92).
- General Waste Discharge Requirements for Discharge of Non-Hazardous Contaminated Soils and Other Wastes in Los Angeles and Santa Clara River Basins (Order No. 91-93).
- General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharges of Hydrostatic Test Water to Surface Waters in Los Angeles and Santa Clara River Basins (Order No. 91-111).
- General National Pollutant Discharge Elimination System Permit and Waste Discharge Requirements for Discharge of Groundwater from Investigation and/or Cleanup of Petroleum Fuel Pollution to Surface Waters in Los Angeles and Santa Clara River Basins (Order No. 92-091).

**Table 2-2: Collaborating Agencies**  
(a partial list - March 1996)

<b>STATE and FEDERAL</b>	
<b>California Environmental Protection Agency</b> Sacramento, CA Help Desk 1 (800) 808-8058	<b>Department of Toxic Substances Control</b> Glendale Office (Region 3): (818) 551-2800 Long Beach Office (Region 4): (310) 590-4868
<b>United States Environmental Protection Agency, Region IX, 75 Hawthorne Street, San Francisco, CA 94105 (415) 744-1500</b>	
<b>State Water Resources Control Board</b> Sacramento, CA (916) 657-2390	<b>Department of Water Resources</b> Glendale, CA (818) 543-4600
<b>California Integrated Waste Management Board, Sacramento, CA (916) 255-2200</b>	<b>Air Resources Board</b> El Monte, CA (818) 575-6888
<b>Regional Water Quality Control Board</b> Los Angeles Region 4 (213) 266-7500 Help Desk 1 (800) 500-8008 Bulletin Board Service 266-7663	<b>Department of Health Services</b> Southern California Laboratory: Los Angeles (213) 580-5795
<b>COUNTY</b>	
<b>Los Angeles Department of Public Works</b> Environmental Programs Division, Underground Tanks (818) 458-3539	<b>Sanitation Districts</b> Los Angeles (213) 685-5217
<b>Los Angeles Department of Health Services</b> Water & Sewage Program (well permits) (213) 881-4147	<b>Ventura County Environmental Health Division</b> Luft Program (805) 654-3519
<b>Los Angeles County Fire Department</b> Health Hazardous Materials Division (213) 890-4089	
<b>CITY AND REGIONAL</b>	
<b>City Fire Department:</b> Burbank (818) 238-3473; Glendale (818) 548-4030; Long Beach (310) 570-2560; Los Angeles (213) 485-7543; Pasadena (818) 405-4115; Torrance (310) 618-2973; Ventura (805) 654-7794.	<b>Health Departments: City of Vernon (213) 583-8811; City of Long Beach Health Human Health Services (310) 520-4000</b>
<b>South Coast Air Quality Management District</b> Permitting Section (909) 396-2000	<b>Department of General Services:</b> Santa Monica (310) 458-8228  <b>Watermaster:</b> San Gabriel Valley (818) 815-1300 Upper Los Angeles River Area (213) 367-1020

## Overview of the Assessment and Cleanup Process

- General Waste Discharge Requirements for Specified Discharges to Groundwater in Santa Clara River and Los Angeles River Basin (Order No. 93-010).

### *Other Agencies' Requirements*

Based on the location and nature of the contamination, investigation activities and cleanup actions, more than one regulatory agency may be involved in a case. Refer to Table 2-2 for a partial list of the agencies and telephone numbers. The RP must comply with applicable regulatory requirements and must obtain the necessary permits or variances from the appropriate agencies. It is strongly recommended that you coordinate these regulatory requirements through Regional Board staff to limit the potential for redundant requirements or inappropriate responses.

For example, the South Coast Air Quality Management District regulates the emission of vapors from contaminated soils, transfer facilities, accidental spillage or other deposition of contaminants. Any party who wishes to excavate or treat soils that are contaminated with petroleum hydrocarbons and/or solvents must obtain the appropriate permit before beginning the field work. The California Department of Toxic Substances Control (DTSC) regulates the transport of toxic wastes or hazardous materials, including contaminated soil. Therefore, the RP should contact DTSC when transporting toxic or hazardous materials. Also, the RP should check with the local zoning and other permitting agencies, within the city or county where the work is being performed, to ensure compliance with local regulations.

### *Summary of the Process*

To determine whether contaminants are impacting or threatening groundwater, an RP typically must undertake a progressive sequence of investigations. They are:

- 1) Initial Site Evaluation
- 2) Soil and Groundwater Assessment
- 3) Corrective Action Plan (including cleanup)
- 4) Verification Monitoring Data and Closure Report

It is strongly recommended that an RP seek site-specific guidance from Regional Board staff before beginning work on each of these tasks or phases. Written Regional Board staff approvals are mandatory (especially when an "No Further Action" letter is requested by the responsible party before beginning required work) for Soil and Groundwater Assessment work plans and reports, Corrective Action Plans, and Closure Reports, which conclude the investigation. For the UST Self-directed Process, please contact UST staff for details regarding Regional Board approvals. Key points of the assessment and cleanup process are provided in Figures 2-2 through 2-4.

The four basic tasks are discussed in detail in Chapter 3, "Assessment and Cleanup Guidance," and are summarized below.

### *Initial Site Evaluation*

The first step in the process is a preliminary site assessment. The goal of this initial

## Overview of the Assessment and Cleanup Process

evaluation is to confirm the absence or presence of discharge(s) from potential sources of contamination, such as underground and aboveground tanks, sumps, spills, etc., on the property, and to identify the

**Figure 2-2: Initial Site Evaluation**

Perform Site Evaluation ⇒ If no Potential Sources are found ⇒ request **No Further Action**, or

If Potential Sources are found ⇒ Complete Site Evaluation:

- No contamination detected ⇒ request **No Further Action**, or
- Contamination detected ⇒ Assess the soil

responsible party(ies). RPs can include site owners, tenants, and even prospective owners, if they are willing to accept liability for the contamination.

The assessment also identifies affected or threatened state waters. The RP should collect relevant information regarding the nature, and vertical and horizontal extent of the contamination. During this assessment phase, the RP should make every effort to eliminate, remove or abate any immediate threat to health, safety or the environment.

Site inspections, soil borings (for soil sampling), soil gas/vapor surveys (used to measure contaminant vapors in soil) and groundwater wells may be used during the preliminary assessment phase to confirm a discharge. If soil contamination is not found

during this phase, the RP should request an NFA letter from the Regional Board. Please refer to appendices for details regarding requirements for assessment and monitoring.

### *Soil and GroundWater Assessment*

When contamination is found after completing the initial site evaluation, the RP must conduct soil and groundwater assessment(s) to determine the source of contamination, nature and extent of the contamination. These

**Figure 2-3: Soil Assessment**

Complete soil assessment ⇒ If contaminants are **DETECTED** in soil ⇒ Consider soil cleanup - Refer to Chapters 4 and 5 for details:

- If soil contaminants are at or below "soil cleanup screening levels", request **No Further Action**, or
- If soil contaminants are above "soil cleanup screening levels", perform soil cleanup or "risk assessment/chemical fate transport modeling".
- If necessary, assess the groundwater quality - Refer to Chapter 3 for details.

assessments should delineate the site's geology and hydrogeology in sufficient detail. The Site Assessment Report should include, but is not limited to, such information as:

1. Site background information including a facility map drawn to scale showing

## Overview of the Assessment and Cleanup Process

- all significant site features;
2. Identification of the contaminant(s) of concern (e.g., benzene, trichloroethylene, etc.) and the source of contamination (e.g., underground storage tanks);
  3. Descriptions of site-specific and regional geology plus hydrogeology;
  4. Delineation of the vertical and lateral extent of soil and groundwater contamination, as identified through, but not limited to, appropriate soil borings, soil gas investigations,

Figure 2-4: Groundwater Assessment

Complete groundwater assessment:

- If contaminants are not detected, or detected at maximum contaminant levels (MCLs), request No Further Action.
- If contaminants are detected and above MCLs, consider monitoring or cleanup and off-site assessment - Refer to Chapter 3 for details.

groundwater monitoring wells, and the analytical data generated during this work, and other means;

5. Generation of all technical data necessary to develop cleanup options.

This work will produce a Site Assessment

Report, which must be submitted to Regional Board staff for review and approval. Site Assessment Reports must address the specific requirements of the program(s) (e.g., underground tanks, etc.) which dictate actions needed for a site assessment. The appendices list these requirements, which RPs should discuss with their consultants.

### *Corrective Action Plan*

To advance to the remediation phase, the Corrective Action Plan must include an evaluation of cleanup alternatives that are feasible at the site. The RP must select a cleanup alternative which best suits their site, based on the nature and extent of the contamination, site conditions, site limitations, cost effectiveness of the various cleanup options, and the current or potential beneficial uses of the involved groundwater.

Developing a Corrective Action Plan involves the following major activities:

1. Reviewing the site history, as well as the soil and groundwater analytical data.
2. Reviewing the regional hydrogeology and evaluating the site-specific hydrogeology.
3. Evaluating the water quality of nearby surface water or groundwater, and the current and potential beneficial uses.
4. Evaluating the nature of the contaminants, including the toxicity, persistence, and potential for spreading in soil and groundwater.

## Overview of the Assessment and Cleanup Process

5. Defining the extent of contamination in soil and groundwater.
  6. Evaluating if the contaminants are treatable based on bench tests, pilot studies, or other means.
  7. Defining the cleanup objectives of the corrective action.
  8. Identifying the technologies that can achieve the objectives, based on whether the technology has been applicable, feasible, reliable and has proven effective when used at similar sites.
  9. Evaluating the cleanup alternatives, including the "no action alternative", and at least two cleanup alternatives which are able to treat the contamination at the site.
  10. Recommending and justifying a cleanup alternative.
  11. Estimating the cost involved in construction, operation and maintenance, and shutting down the treatment system.
  12. Developing a sampling and analysis plan to monitor cleanup progress, and to verify that the cleanup measures are effectively reducing contaminant concentrations.
  13. Proposing cleanup levels acceptable to the Regional Board. [Note: Cleanup Goals, Soil Screening Level Guidance, and Cleanup Performance Criteria are discussed in the following pages.]
  14. Identifying the regulatory agencies and any permits or variances necessary to do the work.
  15. Developing a time schedule for putting the plan into effect.
  16. Developing a health and safety plan.
- As an RP, you must submit a Corrective Action Plan to Regional Board staff for approval, before you can proceed with cleanup. The Regional Board allows exceptions for interim corrective actions which the RP takes on to ease an imminent threat to human health and the environment, or to remove continuing sources of contamination.

### *Verification Monitoring Data and Closure Report*

The RP must submit a "Closure Report" to show that he/she has met the cleanup goals (see Cleanup Goals section on the next page). This is achieved through a process called "verification monitoring," typically conducted at the end of a cleanup project to verify the absence of contaminants or an acceptable level of contaminants (see Chapters 4 and 5 for details). "Verification monitoring" shows whether remediation has occurred and whether the investigation can be closed.

In general, the "Closure Report" must contain, but is not limited to, the results of the cleanup (including "verification monitoring" data) and summary data collected through the Initial Site Evaluation, the Soil and Groundwater

## Overview of the Assessment and Cleanup Process

### Assessment, and Corrective Action Plan.

The "verification monitoring" process may include data from soil gas and/or soil matrix sampling and analysis, groundwater level measurements, and groundwater sampling and analysis. If the RP seeks to close the investigation, "verification monitoring" must show the following:

#### "Soil Verification" Monitoring Conditions: Investigation Closure Requirements

1. Non-detectable levels of contaminants in the soil, or
2. Detectable levels of contaminants are present in the soil, at concentrations that are less than the "soil screening levels" (Chapters 4 and 5) or other "site-specific levels" as set forth in the Corrective Action Plan, or required by the Regional Board. These indicate whether the levels of contaminants at a particular site require cleanup. Or, an RP may use a mathematical model that predicts and describes where chemicals are moving in soil and/or groundwater (known as "risk assessment/chemical transport modeling") to show that remaining contaminants won't threaten groundwater quality, or
3. Detectable levels of contaminants remain in the soil and pose a threat to the groundwater. However, measures of the effectiveness of the treatment method, or "treatment performance measures", show that additional cleanup will not reduce contaminant

levels. Under these conditions, groundwater monitoring might be required.

#### "Groundwater Verification" Monitoring Conditions: Investigation Closure Requirements

1. Groundwater has not been impacted/contaminated, or
2. Groundwater has been impacted, however, contaminant levels are below "maximum contaminant levels" (MCLs), or
3. Groundwater has been impacted and contaminant levels exceed MCLs; however, treatment performance criteria show that additional cleanup will not reduce contaminant levels. You may need to do groundwater monitoring to ensure that contaminant levels are not increasing.

### *Guidance for Remediation (Cleanup) of Soils: Soil Screening Levels*

The Regional Board recently developed two approaches for soil remediation that are intended to simplify and clarify the site assessment and cleanup process. They are:

- 1) Remediation Guidance for Petroleum-Impacted Sites (March 1996). *See Chapter 4 for details.*
- 2) Remediation Guidance for Volatile Organic Compounds (VOC)-Impacted

## Overview of the Assessment and Cleanup Process

Sites (March 1996). See Chapter 5 for details.

These procedures, explained in Chapters 4 and 5, contain numerical screening levels to help an RP determine if site cleanup is needed. You should use Tables 4-1 and 5-1 to determine the acceptable cleanup levels for your site. These approaches to cleaning up petroleum- or VOC-impacted sites seek to simplify the remediation process by making it easier to select site-specific soil cleanup levels for most impacted sites in a way that both protects water resources yet is cost effective. In addition, the approaches strive to achieve the Regional Board's cleanup goals and to promptly return the sites to their intended uses.

### Cleanup Performance Criteria

During remediation, an RP might determine that it is physically, economically and technically impractical to remove, for example, the last 1%, 5%, 10%, etc, of the estimated contaminant mass in the soils (see Figure 2-5) and/or groundwater due to significant challenges such as time, costs, and even bankruptcy.

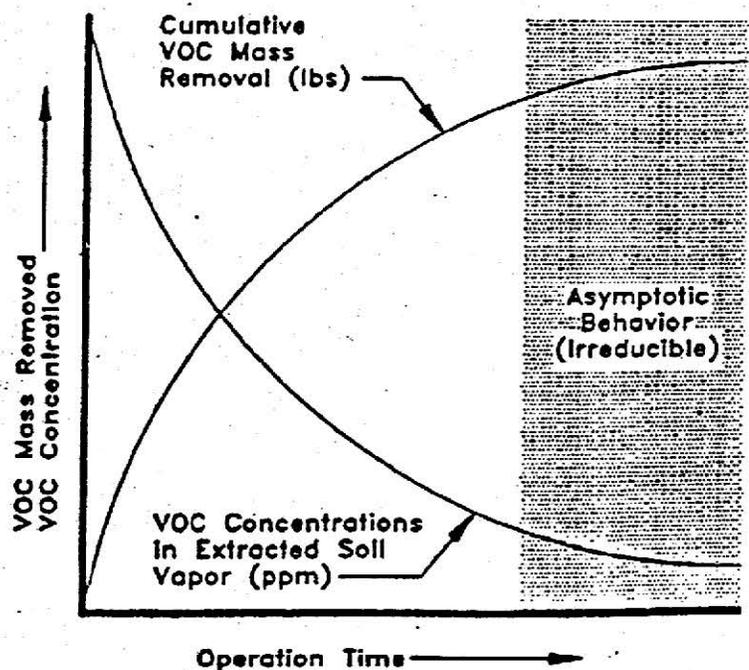
Here is one example of this situation:

*A mass of heavy petroleum waste oil is located beneath an occupied building. Further remediation/removal (i.e., excavation of contaminated soil) is not practical because it could structurally compromise the building's foundation.*

*Occupants, however, are not at risk and there is no risk to the groundwater based on a valid "risk assessment/chemical transport model." In this case, further remediation would not be cost effective nor expedient based on the modeling data.*

In such cases, the Regional Board recognizes that it might be more expedient to stop cleanup and determine, using a valid "risk assessment/chemical transport model," whether the remaining contaminants pose further threat to groundwater. If the site poses a threat to groundwater, you might need to do

Figure 2-5: Relationship Between Concentration Reduction and Contaminant Mass Removal



Source: USEPA, 1995. How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Sites. Solid Waste and Emergency Response 5403W, EPA 510-B-95-007.

groundwater monitoring to determine whether soil contaminants will impact the groundwater

## Overview of the Assessment and Cleanup Process

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in the near future.

### *"No Further Action" (NFA) Letters*

The Regional Board issues a "No Further Action" letter to indicate that the responsible party's site does not pose a threat to groundwater quality; therefore, further regulatory work such as soil and groundwater assessments, remediation, etc., will not be required. Examples of NFA letters are provided in Appendix D.

In general, several scenarios for issuing an NFA letter are possible. They are discussed below and depicted in Table 2-3:

- Scenario #1 involves properties that are not found to be impacted/contaminated.

The RP should submit relevant site information (please refer to Initial Site Evaluation Section for site evaluation information) so that the Regional Board can issue an NFA letter.

- Scenario #2 represents properties in which the soil is impacted; however, neither soil nor groundwater cleanup is required. Based on soil screening levels or "risk assessment/chemical transport modeling," the site poses no threat to groundwater quality.

In this situation, the RP should submit relevant site information and request an NFA letter.

- In Scenario #3, the soil is impacted and only soil cleanup is required.

An NFA will be issued when the soil cleanup results ("Soil Verification Monitoring" data) are submitted, reviewed and approved by the Regional Board.

- In Scenario #4, only soil cleanup and groundwater monitoring are required.

The Regional Board issues an NFA letter when the soil cleanup and groundwater monitoring results ("Soil and Groundwater Verification Monitoring" data) demonstrate that the site poses no further threat to the groundwater quality or when treatment performance measures demonstrate that additional cleanup will not reduce contaminant levels. Submit the results to the Regional Board for review and approval.

- In Scenario #5, both soil and groundwater assessments and cleanups are required.

The Regional Board issues an NFA letter when it receives, reviews and approves the soil cleanup and groundwater results. An NFA letter for completion of soil cleanup phase can be issued while groundwater is being monitored or cleaned to allow use of the site's surface area.

In conclusion, it is extremely difficult to determine initially whether cleanup will be required. The step-by-step or phased approach to soil and groundwater assessments helps to determine whether cleanup is needed. The challenge is to require only those assessment activities that will provide adequate data to evaluate the need for cleanup. If disputes and/or conflicts arise during assessments and cleanups, the Regional Board recommends the following conflict resolution process.

### *Conflict Resolution Process*

The conflict resolution process seeks to resolve conflicts and disputes regarding technical decisions, as mentioned in Section V of the State Board Resolution 92-49 included in Appendix E. In general, every effort should be made to resolve the matter with both the

## Overview of the Assessment and Cleanup Process

project manager (i.e., person handling the case) and immediate supervisor(s). This initial step may require a meeting with both the project manager and immediate supervisor(s) of the Regional Board staff.

If a conflict/dispute cannot be resolved at the project manager and immediate supervisor levels, the disputing party should submit a written statement to the Regional Board within thirty (30) days. The written "statement of dispute" should include: 1) the nature of the dispute; 2) the work affected by the dispute; 3) the disputing party's position with respect to the dispute; 4) an explanation of all the steps taken to resolve a dispute; and 5) the technical, legal, or factual information upon which the disputing party is relying to support their position. The written statement should be addressed to both the immediate supervisor(s) and executive officer. Upon receipt, the executive officer will issue a response (i.e., meeting and/or written statement) to the disputing party's statement within two weeks.

A disputing party may ask the Regional Board to consider conflicts and disputes that were not resolved at the executive officer level. This request should be made in writing to the executive officer of the Regional Board.

Within 30 days of any action or failure to act by the Regional Board, the disputing party may petition the State Board to review such action or failure to act. In case of failure to act, the 30-day period begins upon the Regional Board's refusal to act, or 60 days after the Regional Board has been asked to act. In a public hearing, the State Board may direct the Regional Board to take the

appropriate action, take the action itself or do any combination of the above.



B) Alice Fu (10)  
RW GCB

# Overview of the Assessment and Cleanup Process

## "No Further Action" (NFA) Determination Scenarios

**TABLE 2-3  
SOIL AND GROUNDWATER ASSESSMENT AND SCENARIOS**

S C E N A R I O	Soil	Soil Cleanup	Ground Water	Ground Water Cleanup
1	Not Impacted  Issue NFA	Not Required	Not Impacted	Not Required
2	Impacted	Not Required  Issue NFA	Not Impacted	Not Required
3	Impacted	Required	Not Impacted  Issue NFA AFTER CLEAN-UP	Not Required
4	Impacted	Required	Impacted	Monitor Ground Water Quality
5	Impacted	Required	Impacted	Required

<sup>1</sup> NFA will be issued when soil cleanup and monitoring data are submitted, reviewed and approved.

<sup>2</sup> NFA will be issued when cleanup data are submitted, reviewed and approved.

# CHAPTER 3.0

## Assessment and Cleanup Guidance

This portion of the guidebook serves as a road map through the assessment and cleanup process, and includes the major steps that were described in Chapter 2. It is not a detailed description of the procedures that are needed to perform assessment and cleanup work. Please refer to the appendices, and Chapters 4 and 5 for detailed assessment and cleanup procedures.

### *Initial Site Evaluation:*

<b>STEP 1:</b>	Locate and identify potential sources on-site, if not known.
<b>STEP 2:</b>	Confirm absence or presence of discharge.
<b>STEP 3:</b>	Submit initial findings to the Regional Board.

**STEP 1:** Locate and identify "potential sources of contamination" on your property, if not known.

If the "potential source of contamination" (structure where the chemical(s) is leaking from) is known, as in the case of aboveground tanks, drum storage areas, etc., go to STEP 2

and confirm whether a chemical discharge or release has taken place at the potential source in question.

The key areas of concern for an assessment and/or cleanup are primarily limited to potential sources of contamination, which include facilities, equipment or materials that may be leaking chemicals, wastewater, solvents, gasoline, etc., into the soil or have leaked these types of substances into the soil in the past.

### Examples of potential sources of contamination:

- Above/Underground Tanks
- Drum storage areas
- Sewer leaks
- Chemical spills
- Contaminated soil
- Clarifiers
- Septic tanks/Leachfields/cesspools
- Underground piping
- Vapor degreasers
- Landfills
- Paint booths
- Toxic pits
- Percolation sumps
- Contaminated run-off
- Illegal or unpermitted disposal or dumping.
- Any structure containing and/or transporting chemicals, wastes, etc.

The following site evaluation information or relevant evidence (State Board Resolution 92-49 in Appendix E) can be used to assist the RP

## Assessment and Cleanup Guidance

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in finding out whether there are "potential sources of contamination" on his/her property:

### Site Evaluation Information:

- Use information regarding chemical, waste, solvent, gasoline, usage and storage, etc., to help establish whether substances of interest were used and discharged into the soil. Descriptions of business or manufacturing operations (e.g., solvent manufacturer) may help to clarify usage and storage practices.
- Visual inspections may be very useful to spot potential sources and/or discharges to soil.
- Historical photographs and maps showing the locations of former potential sources (e.g., aboveground tanks) may be necessary if the facility no longer exists or has been modified structurally.
- Use groundwater quality information from nearby sites with monitoring wells. If groundwater quality has been impacted beneath your property or adjacent properties, activities on your property may have contributed to the problem. This determination will depend on the types of pollutants found in groundwater and used or stored on your property.
- Perform preliminary soil and groundwater assessments that may be needed on property where you cannot accurately locate suspected potential sources. This task will require laboratory testing of soil and/or groundwater samples.
- In some cases, it is not possible to locate or identify former potential sources on your property even though the soil has been contaminated. This sometimes happens if potential sources were removed without regulatory oversight. Therefore, it is important to consult with Regional Board staff before completing this investigation phase.

If potential sources of contamination do not now or have never existed on your property, you may not need to perform an investigation. However, this finding requires sufficient documentation and should be discussed with Regional Board staff.

**STEP 2: Confirm whether contaminants have been discharged into the soil.**

Table 3-1 lists several methods to use in assessing whether a "potential source of contamination" (e.g., underground gasoline tank) has discharged its contents into the soil. Initially, you should assess the soil surrounding the "potential source" to confirm the absence or presence of suspected contaminants. After the soil investigation has been completed, the RP can then perform groundwater assessment, if warranted. For some properties, especially those sites where the groundwater is shallow (e.g., 25 feet or less), think about the possibility of assessing both the soil and groundwater quality at the same time. Such an approach typically proves to be more timely and cost-effective.

**STEP 3: Submit initial findings of the assessment results to the Regional Board for review and approval.**

After Regional Board staff has reviewed the results collected during the initial site evaluation, the staff generates a response and submits it to the RP(s) within about two weeks. Table 3-2 contains the possible evaluation outcomes and the appropriate Regional Board responses.

## Assessment and Cleanup Guidance

Table 3-1: Methods used to confirm Contaminants in Soil

STEP 2: Methods	Criteria to Consider
<p><b>ON-SITE INSPECTIONS.</b> Visual inspections should be performed to spot surface spills, chemical storage areas, poor housekeeping practices, etc.</p>	<ul style="list-style-type: none"> <li>• Have all <b>POTENTIAL SOURCES</b> of Contamination been identified?</li> <li>• Perform a site inspection/evaluation to locate all <b>POTENTIAL SOURCES</b>.</li> <li>• Check for past and present surface spills.</li> </ul>
<p><b>SOIL ASSESSMENT.</b> Soil matrix and/or soil gas sampling (shallow &amp; deep) to detect the historical or current use of chemicals.</p>	<ul style="list-style-type: none"> <li>• Lateral and vertical migration of the soil contamination.</li> </ul>
<p><b>GROUNDWATER SAMPLING.</b> Use monitoring wells or hydropunch (which is a method that can be used to sample groundwater one time without actually installing a well).</p>	<ul style="list-style-type: none"> <li>• How deep is the soil contamination?</li> <li>• Soil contaminant concentrations.</li> <li>• Depth to groundwater table.</li> </ul>

# Assessment and Cleanup Guidance

**Table 3-2: Initial Site Evaluation**

Possible Outcomes	Regional Board Response to Property Owner or RP
No soil contamination is detected.	An "No Further Action" (NFA) letter is issued to RP.
Soil contamination is detected and the extent of the contamination is defined.	Determine whether soil contaminants have entered the groundwater beneath your site. See Groundwater Assessment Section.
Soil contamination is detected, but the extent of contamination is not defined.	Define extent of soil contamination and determine whether the soil contaminants have entered the groundwater. See Soil and Groundwater Assessment Section.

## *Soil and Groundwater Assessment:*

**STEP 1:** Submit Assessment Work Plan to Regional Board staff for approval.

**STEP 2:** Define extent of soil contamination.

**STEP 3:** Determine whether groundwater quality has been impacted.

**STEP 4:** Submit assessment results to Regional Board staff.

**STEP 1:** Submit Assessment Work plan for approval.

The Assessment Work Plan should include: Detailed background site information, descriptions of the proposed assessment tools (e.g., soil borings, soil gas survey, groundwater monitoring wells, etc.), a discussion on defining the extent of the contamination, etc.

*Requirements for developing Assessment Work Plans are discussed in Chapter 2, "Overview of the Assessment and Cleanup Process."*



# Assessment and Cleanup Guidance

Table 3-4: GROUNDWATER ASSESSMENT

STEPS	CRITERIA to Consider
<p>Consider the listed criteria prior to conducting GROUNDWATER ASSESSMENT.</p>	<ul style="list-style-type: none"> <li>• Types of soil contaminants, soil type and contaminant levels, fate and transport of soil contaminants.</li> <li>• Groundwater quality in nearby drinking and/or monitoring wells.</li> <li>• Beneficial uses of the groundwater, distance to drinking water wells.</li> </ul>
<p>If GROUNDWATER ASSESSMENT is necessary, submit a work plan to the Regional Board for approval. Once the work plan is approved, collect groundwater samples. If contaminated, define extent of the contamination beneath your property. At least three (3) wells are needed to determine groundwater flow direction. But, one (1) well initially may suffice to establish groundwater quality.</p>	<ul style="list-style-type: none"> <li>• Lateral extent of groundwater contamination.</li> <li>• Direction of groundwater flow.</li> <li>• Hydraulic properties of the aquifer.</li> </ul>
<p>Has the extent of groundwater contamination been defined?</p>	<ul style="list-style-type: none"> <li>• Have groundwater contaminants migrated off-site?</li> <li>• Compare analytical data to maximum contaminant levels (MCLs) and action levels (ALs).</li> <li>• Contaminant levels upgradient and downgradient of property.</li> </ul>

## Assessment and Cleanup Guidance

**STEP 4:** Submit the assessment results to the Regional Board for review and approval. When the assessment results are submitted, Board staff will respond as shown in Table 3-5.

Table 3-5: SOIL AND GROUNDWATER SITE ASSESSMENT	
Possible Outcomes	Regional Board Response to Property Owner
Extent of soil contamination is defined.	<ol style="list-style-type: none"> <li>1) Based on soil screening levels, soil cleanup is not required. Regional Board will issue an NFA letter, assuming groundwater has not been impacted, or,</li> <li>2) Based on soil screening levels, soil cleanup is required. See section regarding Corrective Action for Soil.</li> </ol>
Extent of soil contamination is not defined.	Complete soil assessment.
Contaminants are found in the groundwater (groundwater is impacted).	<ol style="list-style-type: none"> <li>1) Groundwater contaminant concentrations exceed maximum contaminant levels (MCLs). See Corrective Action for Groundwater Section, or,</li> <li>2) Groundwater contaminants are below MCLs. See Corrective Action for Groundwater Section.</li> </ol>
Groundwater is not impacted.	Stop assessing the groundwater. Regional Board will issue an NFA letter, if soil cleanup is not required.

# Assessment and Cleanup Guidance

## **CORRECTIVE ACTION FOR SOIL:**

<b>STEP 1:</b>	Determine whether soil cleanup will be required.
<b>STEP 2:</b>	If required, select the most appropriate soil cleanup option.
<b>STEP 3:</b>	Prepare and submit a Corrective Action Plan for Board approval.

**STEP 1:** Determine whether soil cleanup is needed, based on the Regional Board's guidance plan for soil remediation or "risk assessment/chemical transport modeling" (see Chapters 4 and 5).

As noted below in Table 3-6, deciding to clean up contaminated soil depends on many factors. Here is the Regional Board stance on soil cleanup:

A. If detected soil contaminants are found to be a threat (based on the Regional Board remediation guidance for soil) to the underlying groundwater, then soil cleanup is required (see Chapters 4 and 5 for details) as follows:

Groundwater (which is used as a drinking water source) is 40 feet below the ground surface in sandy soil. Benzene has been detected at 100 ppb (the Maximum Contaminant Level (MCL) allowable in drinking water is 1 part per billion - ppb) at 20 feet below the ground surface. Based on the soil screening levels for benzene and the groundwater level being 20 feet below the source, only 11 ppb of benzene is allowed to remain in the soil. Although the benzene contamination, in this example, is located 20 feet above the groundwater table, soil cleanup would be required because the measured concentration is 9 times the allowable level.

Groundwater (in this case, drinking water) is 40 feet below the ground surface in silty soil. Benzene has been detected at 10 ppb (the MCL is 1 ppb) and is 20 feet below the ground surface. Based on the soil screening levels for benzene, 11 ppb of benzene is allowed to remain in the soil. Although the benzene contamination, in this example, is located 20 feet above the groundwater table, soil cleanup would not be required.

B. If detected soil contaminants are not found to be a potential threat to underlying groundwaters (i.e., using the Regional Board's procedures for soil remediation and/or "risk assessment/chemical transport modeling"), then soil cleanup is not

## Assessment and Cleanup Guidance

required. However, leaving detectable levels of contaminants on your property might dictate how it can be used in the future. For example, if contaminants are left in place, your ability to refinance, sell or develop the property for other than the current land uses might be restricted.

In short, it may be in your best interest to remediate as much of the soil contamination as possible.

- C. If soil contamination is detected on your property but contaminant levels are below cleanup guidance screening levels, you should consult with Regional Board staff regarding an NFA letter.

**Table 3-6: Is Soil Cleanup necessary?  
Criteria to Consider:**

- Threat to groundwater.
- Soil screening levels.
- Type of soil identified beneath the property, e.g., sand versus clay.
- Types of soil contaminants.
- Beneficial uses of the groundwater.
- Future land uses.
- Potential health effects associated with contaminants.
- Costs associated with treatment methods.
- Best available technology (BAT).

**STEP 2: Determine the best soil cleanup options for your property.**

When detected soil contaminants exceed the Regional Board's screening levels, soil cleanup may be required. Consult with Regional Board staff and your consultant before beginning a cleanup. As noted in Table 3-7 and Figure 3-1, soil cleanup options will depend on several factors. Thus, please critically review the types of contaminants, soil type (e.g., sand versus clay) and the beneficial uses of the groundwater should be examined critically with your consultant(s).

**STEP 3: Prepare and submit a Corrective Action Plan for Agency approval.**

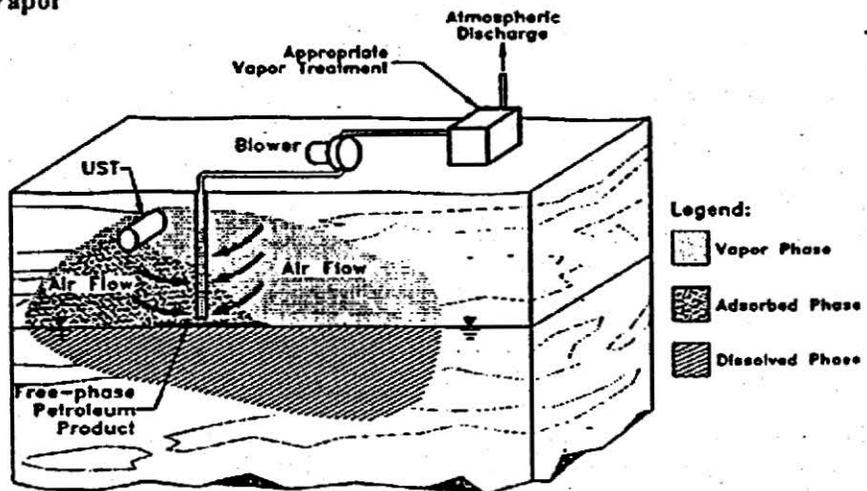
*Details on how to prepare and submit a Corrective Action Plan are discussed in Chapter 2, "Overview of the Assessment and Cleanup Process," and in the appendices.*

# Assessment and Cleanup Guidance

Table 3-7: SOIL Cleanup Options	
<p><b>STEP 2a:</b></p> <p>Once the soil contamination has been fully defined at each <b>POTENTIAL SOURCE</b>, a decision must be made regarding the <b>SOIL CLEANUP</b>. Consider <b>CLEANUP</b> options and consult with Regional Board staff.</p>	<p><b>CLEANUP Options (examples):</b></p> <ul style="list-style-type: none"> <li>• Leave in place and monitor for potential threat to groundwater.</li> <li>• Capping - control and contain.</li> <li>• Soil fixation.</li> <li>• Source removal and/or isolation.</li> <li>• Soil vapor extraction, venting, washing.</li> <li>• Bioremediation.</li> </ul>
<p><b>STEP 2b:</b></p> <p>Before finalizing your <b>SOIL CLEANUP</b> option, consider the listed criteria. These criteria will assist you in choosing the most cost effective and efficient <b>CLEANUP</b> method. See Figure 3-1 below.</p>	<p><b>Criteria to consider under CLEANUP Options:</b></p> <ul style="list-style-type: none"> <li>• Types of soil contaminants.</li> <li>• Soil type</li> <li>• Depth to groundwater.</li> <li>• Future land uses.</li> <li>• Soil screening levels.</li> <li>• Potential health effects related to contaminants.</li> </ul>

**Figure 3-1: Typical Soil Vapor Extraction System**

Source: USEPA, 1995. How to Evaluate Alternative Cleanup Technologies for Underground Tank Sites. Solid Waste and Emergency Response 5403W, EPA 510-B-95-007.



## Assessment and Cleanup Guidance

**STEP 4: Complete the soil cleanup phase.**

Soil cleanup can be terminated when one of the following conditions are met:

- A. Soil contaminant concentrations are reduced to non-detectable levels, or
- B. Soil contaminant concentrations are reduced to levels that do not pose a threat to groundwater quality, based on soil screening levels (see Chapters 4 and 5) or "risk assessment/chemical transport modeling," or groundwater quality, based on soil screening levels (see Chapters 4 and 5) or "risk assessment/chemical transport modeling," or
- C. Soil contaminant concentrations are reduced to levels that pose a threat to groundwater quality; however, cleanup performance measures reveal that additional cleanup will not reduce contaminants levels. Therefore, think about other soil treatment options or groundwater monitoring.

### ***CORRECTIVE ACTION FOR GROUNDWATER:***

**STEP 1: Determine the need for groundwater cleanup and/or monitoring.**

In some cases, groundwater cleanup guidelines levels (e.g., maximum contaminant and action levels - MCLs and ALs) are used as a basis for considering the need for groundwater cleanup.

**STEP 1:** Determine whether groundwater cleanup will be required.

**STEP 2:** If required, select the most appropriate groundwater cleanup options.

**STEP 3:** Prepare and submit a Corrective Action Plan for Agency approval.

**STEP 4:** Complete groundwater cleanup.

Additional factors (please refer to Table 3-8) may include the beneficial uses of the contaminated groundwater, and the proximity of the groundwater contamination to drinking water wells in the area. In the event that groundwater cleanup and/or monitoring are not required, request an NFA letter if all other required work is completed.

**STEP 2: Select the most appropriate treatment option.**

Groundwater treatment can be a time consuming and expensive process.

# Assessment and Cleanup Guidance

Table 3-8: GROUND WATER CLEANUP/MONITORING

STEPS	CRITERIA to Consider
<p>Consult with Regional Board staff and consider the listed criteria before deciding whether <b>GROUND WATER CLEANUP</b> or <b>MONITORING</b> is necessary.</p>	<ul style="list-style-type: none"> <li>• Depth of the soil contamination and groundwater.</li> <li>• Nature and extent of groundwater contamination.</li> <li>• Hydraulic properties of aquifer.</li> <li>• Type of soil contaminants and levels.</li> <li>• Soil type.</li> <li>• Compare ground water contaminant levels to MCLs and ALs.</li> <li>• Potential of the contaminants to migrate.</li> <li>• Location of drinking water wells in the area.</li> <li>• BAT.</li> <li>• Cleanup and monitoring costs.</li> </ul>
<p><b>GROUNDWATER MONITORING</b> may be appropriate in lieu of <b>GROUND- WATER CLEANUP</b></p>	<ul style="list-style-type: none"> <li>• Compare groundwater contaminant levels to MCLs and ALs.</li> <li>• Groundwater quality in nearby wells.</li> <li>• Regional cleanup/control strategies.</li> </ul>

# Assessment and Cleanup Guidance

Table 3-9: TREATMENT Options for GROUNDWATER CLEANUP

<p><b>STEP 2a:</b> Once the extent of groundwater contamination has been fully defined, a decision must be made regarding <b>GROUNDWATER CLEANUP</b>. Consider all <b>TREATMENT</b> options and consult with Regional Board staff.</p>	<p><b>TREATMENT Options (examples):</b></p> <ul style="list-style-type: none"> <li>• Air sparging with vapor extraction.</li> <li>• Pump and treat using carbon adsorption and/or air stripping.</li> <li>• Ion-exchange for nitrates.</li> <li>• Free product removal + pump and treat</li> <li>• Bioremediation.</li> </ul>
<p><b>STEP 2b:</b> Before finalizing your <b>GROUNDWATER TREATMENT</b> options, consider the listed criteria. These criteria will assist you in choosing the most cost effective and efficient <b>TREATMENT</b> method.</p>	<p><b>CRITERIA to consider under TREATMENT Option:</b></p> <ul style="list-style-type: none"> <li>• Soil type.</li> <li>• Hydrology of the site.</li> <li>• Types of groundwater contaminants.</li> <li>• Groundwater contaminant levels.</li> <li>• Cleanup levels, BAT, treatment costs.</li> </ul>

## Assessment and Cleanup Guidance

Therefore, you should do a considerable amount of planning before selecting the most appropriate treatment technology (Please refer to Table 3-9). Please consult with Regional Board staff before making your final choice(s).

**STEP 3:** Prepare and submit Corrective Action Plan for Agency approval.

*Details on preparing and submitting Corrective Action Plans are discussed in Chapter 2, "Overview of the Assessment and Cleanup Process," and in the appendices.*

**STEP 4:** Complete groundwater cleanup.

Groundwater cleanup can be terminated when one of the following conditions are met:

A. Groundwater contaminant concentrations are reduced below MCLs, or,

B. Groundwater contaminant concentrations are reduced and still exceed MCLs; however, cleanup performance measures show that additional cleanup will not reduce contaminant levels. Groundwater monitoring might be required.

### *Closure Report and Verification Monitoring Data:*

To obtain an NFA letter, the property owner must document that the site does not pose a threat to groundwater quality. Or, if there is a continuing threat to groundwater quality, the property owner must demonstrate that further

cleanup/treatment will not reduce the contaminant levels. The "closure report" should include the following:

- Preliminary site assessment results;
- soil and groundwater assessment results;
- results of the cleanup, including any "risk assessment/chemical transport modeling," and
- verification monitoring data.

After reviewing the "closure report," Regional Board staff will issue the RP one of the following:

- 1) An NFA letter indicating that no further investigatory or cleanup work is required, or
- 2) a letter that indicates the case requires further Regional Board evaluation or cleanup/remediation, monitoring or other action, or
- 3) a letter indicating that the case is no longer eligible for the particular Regional Board program and that it will be referred to the appropriate local, county, state, federal, or another jurisdiction program.

In some cases, the closure letter may state that more work may be required at a later time if water quality is found to be contaminated or becomes a public health problem.

**REMEDIATION GUIDANCE**  
**FOR**  
**PETROLEUM AND VOC IMPACTED**  
**SITES**

**SECTION II**

# CHAPTER 4.0

## Guidance for Petroleum-Impacted Sites: Soil Screening Levels - May 1996

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### *Summary*

This chapter explains an interim approach, or "guidance," using numerical soil screening levels, to evaluate the need for remediation of soils contaminated by petroleum hydrocarbons. Use this approach to find out when a site requires remedial action or what level of remediation you must reach to conclude the environmental study and cleanup, thus reaching "site closure."

This approach defines the differences in requirements between types of certain chemicals, or "constituents," in petroleum hydrocarbons and between drinking and non-drinking water aquifers – underground water-saturated formations from which water flows into wells and springs. You can still use "risk analysis" (determining the long-term effect of residual contaminants on groundwater and their potential hazard for people) for particular sites and/or "fate and transport models" (the mathematical models that show what happens to chemicals as they move through soil or water) that consider groundwater protection, to propose alternate soil cleanup levels. This guidance also includes "Closure Criteria for Low Risk Fuel Contamination Sites".

The approach in this guidance does *not* replace any site assessment requirements of the Regional Board. This "interim guidance," or amendments to it, will be in effect until the State Water Resources Control Board finishes a new field guide – the "Leaking Underground Fuel Tanks" (LUFT) manual

– for cleaning up contamination from leaking underground tanks. Then the Board will review the "interim guidance" for further use.

### *Background*

The Regional Board created the Water Quality Advisory Task Force to identify and recommend ways to reduce the cost of meeting existing clean water laws without compromising water quality and public health. The Task Force focused its deliberations on certain problem areas, one of which was site cleanup. In reviewing this area, the Task Force found that "there is no clear definition of what is clean," and that cleanup expectations were not consistent across all Regional Board programs.

The Task Force also recommended forming a Technical Review Committee (TRC), composed of representatives from the private and public sectors, to discuss existing and proposed programs, and to devise cleanup standards in concert with Regional Board staff. The Task Force stated:

*"Establishing a set of clear and consistent standards for site cleanup should be the first task undertaken by the Regional Board staff and its Technical Review Committee. The Regional Board should establish standards for identifying when a threat or probable threat to groundwater has occurred and when a site has been adequately remedied. ... the Regional Board should make every effort to ensure that the standards are consistent*

## Guidance for Petroleum-Impacted Sites

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*across all programs under its jurisdiction, and, whenever possible, consistent with those of other agencies in the Region. The standards should allow the community to use more cost-effective methods, such as risk-assessment approaches, and fate and transport models where appropriate, as means to determine if soil contamination poses a risk to ground water".*

### Objective

The following guidelines aim to simplify the remediation process by making it easy to choose levels of screening for contaminants at a certain site ("site-specific soil screening levels"). This works for most petroleum-impacted sites in a way that both protects water resources and is still cost effective. Through this approach, the Board seeks to encourage prompt cleanups that restore sites to their intended uses.

The approach relates only to the evaluation of petroleum-impacted soils and does not address groundwater directly. Before using the approach, however, you must complete a thorough site characterization and assessment. This should be a highly detailed review and sampling, providing information about the types of contaminants and how far they spread into the soil.

The Regional Board intends to close investigations of petroleum-impacted sites based on this "guidance." The closure is subject to land-use changes or gaining new information about the site. However, the Board may require groundwater monitoring if it confirms that soil contamination has

impacted groundwater.

The attached Table 4-1 provides the basis for the "guidance" procedures. Table 4-1 defines the soil screening levels above drinking water aquifers; below it are footnotes which explain the concentration screening levels of chemical components and clarify the procedures, as well as the screening levels to be used for sites above non-drinking water aquifers.

Since there is no adequate measure of risk or toxicity for total petroleum hydrocarbons (TPHs) per se, the screening levels for TPHs in Table 4-1 are based on the carbon range numbers of the TPHs. These ranges reflect the mobility of the material; the shorter carbon-chain TPHs (C4-C12) move more easily in soil than the longer carbon-chain TPHs (C23-C32). The table is organized into a matrix of screening "levels", based on distance of constituents above groundwater and carbon chain ranges.

At most petroleum-impacted sites, the main constituents which cause concern are benzene, toluene, ethylbenzene, and xylenes (BTEX). In addition, methyl tertiary butyl ether (MTBE) is also required for analysis. Analyze lead, other fuel additives and polycyclic aromatic hydrocarbons (PAHs) where needed, based on the product (gasoline, diesel, fuel oil, etc.) that was discharged into soil.

The screening levels for BTEX in Table 4-1 are generated based on the attenuation factor method developed by this Regional Board for volatile organic compounds (VOCs) (see Appendix A). Because of BTEX mobility and toxicity, the screening levels are determined based on distance from groundwater and soil

## Guidance for Petroleum-Impacted Sites

material type within the distance. The table values for BTEX can be interpolated between distance and proportional to fraction of each lithological thickness (see Appendix A for detail).

The screening level values in Table 4-1 are geared to protect groundwater. They also are intended to protect people from exposure when they come in contact with the chemicals, through such means as direct contact with soil, dust particles or gaseous compounds in the air. These "direct human health exposure pathways" are defined by the USEPA methodology (referenced in the ASTM Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites (E1739-95)). The screening levels also fall below the preliminary remediation goals (PRGs) published by the USEPA, Region IX.

As a responsible party, you can use the attached "Closure Criteria for Low Risk Fuel Contamination Sites" to obtain a site closure. And you can also propose alternative soil screening cleanup levels which are supported by "risk assessment approaches" and/or "fate and transport modeling" if they also address groundwater protection (i.e., groundwater in this case is considered a receptor rather than as a pathway). Discuss use of alternative approaches with the Regional Board staff. Any cleanup values derived under this guidance or alternative approaches are generally recommended to be below the health risk-based screening threshold values, such as PRGs.

### *Procedures*

To use Table 4-1, you will need to do the following:

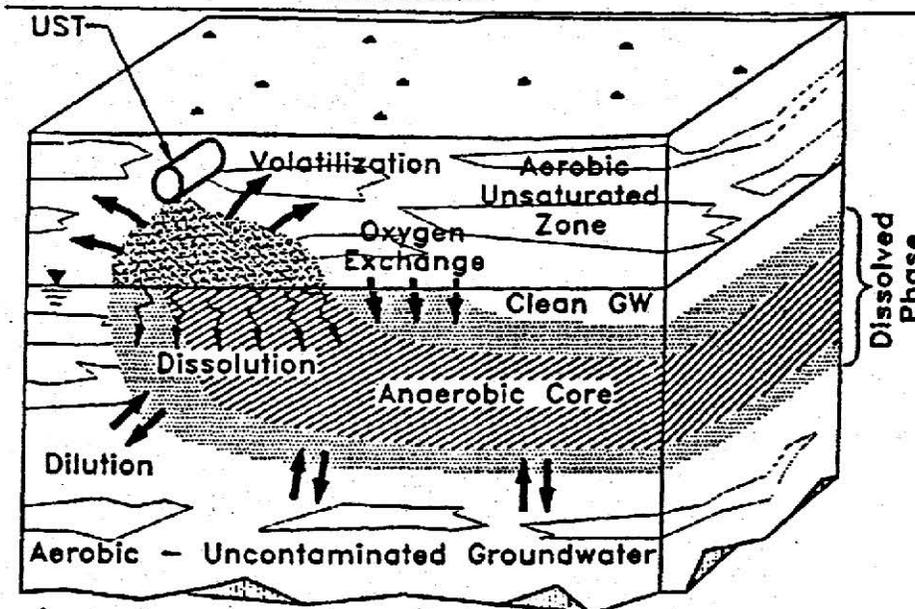
- 1) A thorough site characterization/assessment that shows the type of contaminants of concern, the lateral and vertical extent of the contamination, and the existence of a "clean zone" above groundwater. The clean zone generally consists of at least a 20-foot interval in which multiple consecutive samples (including soil matrix and/or soil gas) cannot be traced above a required detection limit (see Appendices B and C for required detection limits);
- 2) An analysis of beneficial uses for groundwater underlying the site. All Los Angeles Region's groundwaters are considered drinking water, unless they are excluded under the criteria specified in State Water Resources Control Board (SWRCB) Resolution 88-63 (i.e., TDS > 3,000 mg/l, deliverability of < 200 gal/day, or existing contamination that cannot be reasonably treated). However, Regional Board staff shall determine the water use for a specific site based on Regional Board's Water Quality Control Plan (Basin Plan) objectives; and
- 3) Use of appropriate analytical methods. Use EPA Method 8020 for BTEX and MTBE components and confirm positive results above the screening level with EPA Method 8260 to prevent possible false identification by EPA Method 8020. Measure TPH levels using EPA Methods 418.1 and 8015 (DHS Modified). Method 418.1 measures the total TPHs, therefore, Method 8015 (or Method 8260) is needed to identify carbon ranges. If

## Guidance for Petroleum-Impacted Sites

the total TPH from either test are below the applicable screening level for the C4-C12 range, no other TPH screening is necessary. TPH levels greater than the C4-C12 screening level should be differentiated using Gas Chromatograph/Mass Spectrometry (GC/MS) carbon range methods for hydrocarbon screening or speciation or EPA Method 8015 (DHS Modified). EPA Method 8310 shall be used for PAH analysis to achieve a detection limit of 0.2 ppb for individual constituent of PAHs.

Discuss the site assessment results, proposed screening levels, and confirmation testing results with Regional Board staff. If the findings are below applicable Table 4-1 values, cleanup of the soil is not required. If findings are above the required values, soil cleanup should take place to levels which are at or below the screening values, or certain values derived by any alternative method which is acceptable to Regional Board staff. Consideration should be given to historically high water levels at sites of concern.

A Typical Hydrocarbon Plume Undergoing Natural Bioremediation;  
Cross-section



Legend:

- |   |  |
|---|--|
|  Aerobic Margins |  Residual Phase |
|  Anaerobic Core  |  Water Table    |

Cross Section

Source: U.S. EPA

# Guidance for Petroleum-Impacted Sites

## Examples

### Example 1:

An underground storage tank was removed at a gasoline station. Gasoline contamination in soil has been confirmed and the lateral and vertical extent of the contamination has been adequately defined. Site lithology consists of 60% sand and 40% silt. Depth to groundwater is 40 feet from the surface. Soil samples obtained at 10, 15, and 20 feet below ground surface showed the following results (Table E1). TPH as gasoline (C4-C12) was identified by EPA Method 8015 (Modified).

From Table 4-1, the soil screening level for TPH (C4-C12) is 500 mg/kg at 20 to 30 feet above the groundwater table. By interpolating the table values, soil screening levels for a lithology of 60% sand and 40% silt are calculated as follows. The screening level for benzene in sandy soil, 30 feet above groundwater, is  $[(30-20)/(80-20)] \times (0.033-0.011) + 0.011 = 0.015$ . In the same way, the screening level for silty soil is 0.02. Given the site lithological composition of 60% sand and 40% silt, the final screening level for benzene at 30 feet above groundwater is  $(0.015 \times 0.6) + (0.02 \times 0.4) = 0.017$ . Results for other constituent and depth are in Table E2.

Table E1:

Sample Depth (ft)	Distance Above Groundwater (ft)	TPH (C4-C12)	mg/kg (ppm)			
			B	T	E	X
10	30	1500	1.6	9.1	ND	63
15	25	210	0.01	0.4	ND	ND
20	20	100	0.005	ND	ND	ND

ND=non-detected. Detection limit=0.005 mg/kg for BTEX.

Table E2:

Distance Above Groundwater	Sand	Silt	60% sand / 40% silt
30	B=0.015	B=0.02	0.017
	T=0.58	T=1	0.75
25	B=0.013	B=0.016	0.014
	T=0.44	T=0.75	0.56

The analytical results at 10 feet (30 feet above groundwater) definitely call for soil cleanup action since all concentrations are above the screening levels as defined above for TPH, benzene, toluene, and xylene. All other results are below the screening levels; therefore, cleanup does not need to extend beyond 15 feet below surface.

## Guidance for Petroleum-Impacted Sites

### EXAMPLE 2:

A property located in L.A. central basin earmarked for redevelopment was found to be impacted by petroleum product. The source had been determined and removed. Several soil borings were drilled around the source area and soil samples were obtained at different depths. Laboratory analyses of the soil samples revealed that the concentrations C4-C12 = 1000 mg/kg, C13-C22 = 7000 mg/kg, and C23-C32 = 25000 mg/kg extended to a depth of 18 feet below ground surface. A shallow "perched" groundwater was first encountered at 35 feet below grade, and found to be not impacted yet. However, information obtained from the RWQCB Basin Plan shows that the regional drinking water aquifer is at about 170 feet below ground surface.

In this example, if the perched groundwater is determined to be non-drinking water, TPH screening level for ">150 feet" category in Table 4-1 applies. Since all soil concentrations are less than the table values, no soil cleanup is required. The same would apply to the regional groundwater aquifer, that is, no soil cleanup is required and case could be closed.

Table 4-1: Maximum Soil Screening Levels (mg/kg) for TPH and BTEX above Drinking Water Aquifers

T P H	Distance Above Groundwater	Carbon Range		
		C4-C12	C13-C22	C23-C32
	>150 feet	1,000	10,000	50,000
	20-150 feet	500	1,000	10,000
<20 feet	100	100	1,000	

B T E X	Distance Above Groundwater	Lithology			
		Gravel	Sand	Silt	Clay
	150 feet	B=0.044 T=2 E=8 X=23	B=0.077 T=4 E=17 X=48	B=0.165 T=9 E=34 X=93	B=0.8 T=43 E=170 X=465
	80 feet	B=0.022 T=1 E=4 X=11	B=0.033 T=2 E=7 X=20	B=0.066 T=4 E=15 X=40	B=0.34 T=18 E=73 X=200
20 feet	B=0.011 T=0.15 E=0.7 X=1.75	B=0.011 T=0.3 E=0.7 X=1.75	B=0.011 T=0.45 E=2 X=5.3	B=0.044 T=2.3 E=9 X=24.5	

- TPH = Total petroleum hydrocarbons.
- BTEX = benzene, toluene, ethylbenzene, and xylenes, respectively. MCLs (ppm): B=0.001, T=0.15, E=0.7, X=1.75.
- MTBE (methyl tertiary butyl ether) must be included in BTEX analyses.
- BTEX screening concentrations determined per the attenuation factor method as described in RWQCB Guidance for VOC Impacted Sites (March 1996), with a natural degradation factor of 11 for benzene. Table values for BTEX can be linearly interpolated between distance above groundwater and are proportional to fraction of each lithological thickness.
- Values in Table 4-1 are for soils above drinking water aquifers. All groundwaters are considered as drinking water resources unless exempted by one of the criteria as defined under SWRCB Resolution 88-63 (TDS>3000 mg/L, or deliverability <200 gal/day, or existing contamination that cannot be reasonably treated). Regional Board staff will make a determination of potential water use at a particular site considering water quality objectives and beneficial uses. For non-drinking water aquifers, regardless of depth, TPH for ">150 feet" category in the table should be used; BTEX screening levels are set at 100 times respective MCLs as preliminary levels determined to be protective of human health and the environment.
- Distance above groundwater must be measured from the highest anticipated water level. Lithology is based on the USCS scale.
- For BTEX, each component is not to exceed the specified screening level.
- For TPH, the total allowable for each carbon range is not to be exceeded. In areas of naturally-occurring hydrocarbons, Regional Board staff will make allowance for TPH levels.
- BTEX to be analyzed by EPA Method 8020 or EPA Method 8260 (usually for confirmation).
- TPH to be analyzed by EPA Methods 418.1 plus 8015 (Modified). Ranges of TPH to be analyzed by GC/MS carbon range methods (EPA Method 8260) or EPA Method 8015 (Modified).

## **Guidance for Petroleum-Impacted Sites**

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### ***CLOSURE CRITERIA FOR LOW RISK FUEL CONTAMINATION SITES - April 1996 Fact Sheet***

The following fact sheet and Table 4-1 (closure criteria) have been prepared in response to recent studies reevaluating the management of fuel contamination cases related to leaking underground tanks in California. These closure criteria apply to fuel contamination sites only, and are intended for use by the regulated community, other regulators, and consultants. If a site has non-fuel related contamination, it is not a candidate for closure under these criteria.

#### ***BACKGROUND***

In October 1995, The Lawrence Livermore National Laboratory presented "Recommendations to Improve the Cleanup Process for California's Leaking Underground Fuel Tanks" to the State Water Board. That report, endorsed in part by the Executive Director of the State Water Board, recommended that natural biological processes (passive bioremediation) and monitoring be used at the majority of low risk fuel contamination sites in California. The use of passive bioremediation instead of active cleanup would dramatically increase the number of fuel contamination sites eligible for closure in California.

In order to apply the recommendations of the State Water Board, it is critical that low risk sites be defined. The definition of low risk sites and a soil screening table (criteria) were developed by this Regional Board's staff and Groundwater Technical Review Committee to identify fuel contamination sites that do not

pose a significant threat to groundwater and would therefore qualify for closure as low risk fuel contamination cases. The criteria are consistent with similar information issued by other Regional Boards and with this Regional Board's "Interim Site Assessment and Cleanup Guidebook" (1996).

These criteria are issued for the purpose of expediting the closure of low risk fuel contamination cases. If a site meets the closure criteria, including the soil screening levels in the attached table, and does not require groundwater monitoring, that site will be closed without further requirements. Many sites that do not meet all of the criteria may also be considered low risk, and may be eligible for closure after additional data are submitted. Soil screening levels in Table 4-1 are reasonable, yet protective of water quality, and should ensure that there will be minimal impacts to groundwater from contaminated soil.

#### ***USE OF PASSIVE BIOREMEDIATION AT LOW RISK SITES***

Passive bioremediation is a complex natural process that reduces the petroleum hydrocarbon mass in the soil and groundwater. Petroleum hydrocarbons are generally biodegradable as long as naturally-occurring bacteria are present, have an adequate supply of oxygen and nutrients, and have a favorable environment.

While passive bioremediation is an appropriate cleanup method for many fuel contamination sites, and is frequently approved by this Regional Board, it is not appropriate at all

## **Guidance for Petroleum-Impacted Sites**

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sites. It is also important to note that as the rate of passive bioremediation is typically very slow, fuel concentrations may not reach closure levels for many years. Regional Board staff evaluate proposed cleanup methods on a case-by-case basis and determine when passive bioremediation and monitoring, instead of an active cleanup, are appropriate. When groundwater has been contaminated, monitoring will usually be required to demonstrate that the contamination plume is stable and that the contaminant concentrations are decreasing.

A checklist, developed by the U.S. EPA, should be used to evaluate whether passive bioremediation in groundwater is appropriate at a specific site. The checklist is included, and the supporting documentation can be obtained by calling Sandra Kelley, of Regional Board staff, at (213) 266-7521, or by downloading it from our electronic bulletin board at (213) 266-7663. The checklist will assist in: 1) determining if passive bioremediation in groundwater is appropriate for a site, 2) identifying where additional information may be required, and 3) evaluating the completeness of a corrective action plan, if required.

### ***HOW TO APPLY LOW RISK CRITERIA TO A FUEL CONTAMINATION SITE***

A site is eligible for closure as a low risk fuel contamination site if it meets the following definitions, and soil contaminant concentrations (for each constituent) are lower than the screening levels in Table 4-1.

### **DEFINITIONS**

#### **A. LOW RISK SOIL CONTAMINATION - sites are ready for closure when:**

1. **The leak has been stopped and ongoing sources, including fuel-saturated soil and soil which contains mobile fuel components, have been removed or remediated.** "Sources" include tanks and associated piping, gasoline-saturated soil, and soil with mobile gasoline components (e.g., leachate or vapor) that can degrade groundwater quality or pose a significant threat to human health or the environment. "Significant threat" is a long-term adverse effect on groundwater quality, including causing the non-localized exceedance(s) of maximum contaminant levels (MCLs) in the groundwater and/or posing a potential hazard to human health.
2. **The site has been adequately characterized and the soil contamination appears stable.** The vertical and horizontal extent of the soil contamination has been defined, and data demonstrate that it is stable. It is recognized that subsurface conditions are highly variable and that there is always some uncertainty associated with evaluating data at a site.
3. **Detectable levels of contaminants in the soil are lower than the soil screening levels in the attached Table 4-1.**

#### **B. LOW RISK GROUNDWATER CONTAMINATION - sites are ready for closure when:**

1. **The leak has been stopped and ongoing sources, including free product, have been removed or remediated.** "Sources" include tanks and associated piping, free-floating gasoline, gasoline-saturated soil, and soil which contains mobile gasoline components (e.g., leachate or vapor) that can degrade groundwater quality or pose a significant threat to human health or the environment.

## Guidance for Petroleum-Impacted Sites

"Significant threat" is a long-term adverse effect on groundwater quality, including causing the non-localized exceedance of maximum contaminant levels (MCLs) in the groundwater and/or posing a potential hazard to human health.

2. **The site has been adequately characterized, and the groundwater contamination plume is stable.** The vertical and horizontal extent of the groundwater contamination plume has been defined and data demonstrate that the plume is stable. Potential horizontal and vertical conduits, which could act as preferential pathways for the dissolved plume, must also be evaluated.

A stable groundwater plume is characterized by decreasing or stable concentrations of hydrocarbons in groundwater, and no MTBE is detected. Evidence of biodegradation can be demonstrated by a comparison of background and hydrocarbon plume concentrations of site-specific indicators (e.g., oxygen, nitrate, redox potential, and bacteria concentrations). These data may be necessary to supplement other site-specific information when utilizing passive bioremediation as a cleanup method. Groundwater monitoring may be required.

3. **No drinking water wells or aquifers, or surface waters have been or are likely to be affected.**
4. **Groundwater has been impacted, but contaminant levels are below MCLs, or**

**Groundwater has been impacted and contaminant levels exceed MCLs; however, treatment performance criteria demonstrate that a significant reduction of the contaminant levels cannot be achieved.** The groundwater plume must be stable, and continued groundwater monitoring may be required.

Low risk groundwater contamination sites that require additional monitoring will be issued pre-closure letters stating that the case may be eligible for closure when groundwater monitoring is completed.

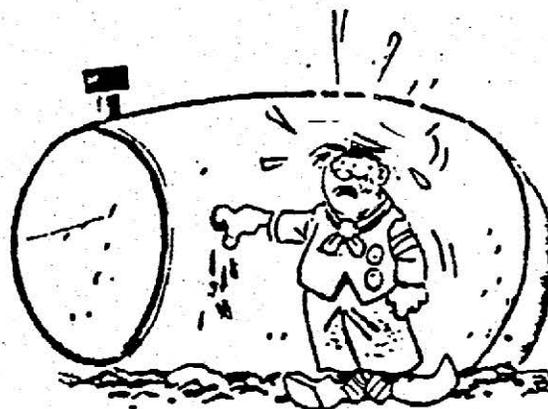
Many fuel contamination sites with both soil and groundwater contamination may be eligible for separate soil closure while the groundwater cleanup/monitoring is ongoing.

### **WHAT CAN A RESPONSIBLE PARTY DO TO EXPEDITE REVIEW OF A LOW RISK CASE?**

If a responsible party believes that a site meets the low risk criteria, we recommend that the responsible party provides the oversight agency with a summary of the Site Investigation and Cleanup History (form attached) to expedite staff review of the closure request.

The Regional Board believes that these closure criteria will expedite low risk case closures while maintaining a high degree of water quality protection.

All responsible parties, regulators, and consultants are encouraged to use the criteria to evaluate their sites and determine if they are considered to be low risk and ready for closure. If you have any questions concerning this fact sheet, or if you believe that your site can be considered a low risk site that does not meet the criteria, please contact Elijah Hill at (213) 266-7558, Harry Patel at (213) 266-7575, or Jack Price at (213) 266-7622.



# CHAPTER 5.0

## GUIDANCE FOR VOC-IMPACTED SITES: SOIL SCREENING LEVELS - May 1996

### *Summary*

This interim approach, or "guidance," is designed to protect groundwater quality. The methodology contained in this guidance calculates soil cleanup screening levels for volatile organic compounds (VOCs) when they are found in the subsurface zone that extends from the ground surface to the top of the water table. This area, known as the "vadose zone," is not saturated by groundwater, but can have a high moisture content and local areas of saturation.

This guidance also spells out performance standards for "vapor extraction system," which is a method of drawing air containing gaseous contaminants out of the vadose zone by a vacuum system. "Vapor extraction" has not only become a popular but also an effective cleanup process for VOCs.

The soil cleanup screening levels for vadose zones are calculated from "attenuation factors" (AFs), which refer to a potential ratio of the contaminants found in soil versus the contaminants in the groundwater. The AF Method (defined in Appendix A) derives from equations based on chemical and physical parameters, using data obtained by Regional Board staff.

After a complete site assessment, a responsible party may use these soil cleanup screening levels as: 1) screening criteria below which no remediation is required, 2) proposed soil cleanup targets, and/or 3) performance criteria to evaluate the effectiveness of remedial

actions. If desired, you may also propose site-specific soil cleanup criteria using health-based risk assessment and/or fate and transport models which contain measures for groundwater protection.

This approach provides a set of soil cleanup screening levels for VOC-impacted sites to encourage prompt soil remediations to a level of concentration that both protects ground water quality and is cost effective. However, this approach does not exempt any site assessment required by the Regional Board, and should not be used to define the extent of soil contamination, or substituted for any sophisticated site-specific fate and transport study and/or risk assessment. Any cleanup values derived under this guidance or other alternative approaches shall be below the health risk-based screening threshold values, such as the Preliminary Remediation Goals (PRGs).

### *Background*

When the Regional Board created a Water Quality Advisory Task Force in December 1992, the Task Force's mission was to evaluate and provide recommendations to regulatory agencies on how to reduce costs to businesses while still meeting clean water laws and without compromising water quality and public health. One of the Task Force's recommendations was to establish cleanup standards for all programs of the Regional Board.

## Guidance for VOC-Impacted Sites

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There have been many attempts in the past to provide cleanup standards, and, currently, there are many documents published under various titles and from several sources providing cleanup guidance which are primarily health based. The California Department of Toxic Substances Control (DTSC), through its Office of Scientific Affairs, issued a draft Technical Directive in January 1994 concerning Health-Based Soil Screening Levels. These tabulated levels are not to be used for contaminants that move between soil and water. They are also not intended to protect groundwater. When the document is finished, it will replace the USEPA Region IX's Preliminary Remediation Goals (PRGs) for screening sites where chemicals have been released. USEPA's PRGs are based on available toxicity values (but not Cal/EPA toxicity values for carcinogens) and are not considered by the DTSC to protect health in all situations. You can use PRG tables for general risk screening purposes but they do not take into account impact on groundwater or address ecological concerns.

You can use these health risk-based cleanup values for soil remediations where surface or groundwater is not affected. These values are not to be used for vadose zones affecting municipal or domestic use groundwater and will not be discussed further in this document.

### *VOC Cleanup Process*

#### **1. Vadose Zones Above Drinking Water Aquifers**

Under the State Board Resolution 68-16 (the Anti-degradation Policy), no degradation of

water quality of this State is permitted. The level of soil cleanup required to protect health and water quality depends on many site-specific factors, such as the type and distribution of soil contaminants, land use, ground cover, distance to the water body, use of the water body (drinking, industrial use, serving as a barrier to protect clean water from ocean water, etc.), hydrogeology of the area, site lithology, cleanup procedures, etc.

The subsurface investigation, as conducted at this region, involves tracing a discharge of VOCs from the vadose zone to groundwater and to define the lateral and vertical extent of contamination in both the vadose and saturated zones. This investigation can at a minimum: (1) evaluate the potential threat of soil contamination to groundwater quality, and (2) determine the need for soil cleanup.

Use of the following process requires the RP to conduct a thorough site assessment and characterization to determine the type of VOCs, its concentration and the vertical and lateral extent of contamination, depth to ground water, and the type of soils encountered from ground surface to groundwater.

To find out the vertical extent of contamination, a minimum "clean zone" should be established. The clean zone is the area in which contaminants in multiple consecutive samples (including soil matrix and/or soil gas) cannot be detected above a required detection limit. The depth of the clean zone depends upon site-specific factors such as type of VOCs, depth to groundwater, or vadose zone materials. Analytical methods used to detect the concentration of contaminants are EPA

## Guidance for VOC-Impacted Sites

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Methods 8010, 8020, 8260 and/or soil gas analytical protocols specified in the Regional Board's "Requirements for Active Soil Gas Investigation (March 96)".

State Board Resolution 92-49 (as amended in 1994) requires follow-up groundwater monitoring at soil cleanup sites where contaminants are left in place at higher concentration values than computed from either the following guidance or an acceptable "fate and transport" study, or at which VOCs in soil has been confirmed to cause ground water contamination.

### *VOC Cleanup Screening Level*

You can estimate target VOC soil cleanup screening levels as a function of physical and chemical properties of the impacted site and the contaminant. The model for creating a site-specific attenuation factor (AF) is based on an equation describing VOCs existing in "multi-phase equilibrium" in the vadose zone. Multi-phase refers to the various forms of VOC contaminants; they can be gaseous, liquid, or adsorbed onto solid particles. The AF is a measure of the concentration of contaminants that can be retained in the soils above the water table as a function of both distance above the water and the composition of soils and sediment, or "lithology," encountered between the point of discharge and the water.

The equations developed were used to calculate AF values based on soil physical property data collected in this region and chemical property data for 29 common VOCs, and modified by the factors of distance above

groundwater and the vadose zone lithology. The detailed calculation procedures are described in Appendix A of this document.

Soil cleanup screening levels determined through the AF method allow the RP to meet less stringent soil cleanup goals in situations where groundwater is deep and/or the vadose zone consists of fine grained materials such as silt or clay.

To simplify AF application and calculation processes, Table 5-1 offers total average attenuation factors,  $AF_T$ , in terms of distance above groundwater and the vadose zone lithology.  $AF_T$  can be applied directly from the table (e.g.,  $AF=11$  given groundwater at 80 feet and sandy soil condition); or can be interpolated between table values for distances above groundwater less than 150 feet (e.g.,  $AF=9$  given distance above ground water 70 feet and sandy soil condition). For a site of combined lithological composition,  $AF_T$  values should be proportional to the fraction of each lithological thickness in total distance of the vadose zone between the contaminant and groundwater. The caption of Table 5-1 provides an example.

To use Table 5-1 directly, minimum data required include contaminant concentrations at various depths, depth to groundwater, and vadose zone lithology between the point of VOC detection and water. Use the 150-foot values for  $AF_T$  for distances greater than 150 feet above groundwater. Use the table values of  $AF_T$  to determine total VOC concentrations for soil cleanup.

As a final step, multiply the selected table value  $AF_T$  by the water quality standard

## Guidance for VOC-Impacted Sites

concentration. The end product is the soil cleanup screening level (CSL):

$$\text{CSL} = \text{AF}_T \times (\text{water quality standard})$$

Use the water quality standard in the formula in three situations:

(1) If the aquifer to be protected is a drinking water aquifer, the water quality standard shall be the MCLs if set, or applicable federal or state water quality standards if the MCLs are not set (e.g., tap water criteria of USEPA PRGs).

(2) If the aquifer is designated as a drinking water aquifer but now contaminated, the water quality standard shall consider criteria and requirements for water treatment and water usage after remediation, such as well-head treatment, pump and treat, re-injection, etc., which may require less stringent standards than MCLs.

(3) If the aquifer is used for non-drinking water, other criteria, such as aquatic life

respective MCL. In this case, the most stringent screening level is applied as the target level for cleanup.

As addressed in Appendix A, the AF method has limitations, such as: (1) Non-aqueous Phase Liquids (NAPLs) are not considered; (2) VOC gaseous phase is assumed as lost mass. If VOC gaseous phase transport in the vadose zone is considered to be a major threat to groundwater, more vapor phase studies are needed; (3) the method is not a form of vadose zone transport model; and (4) the method is not a substitute for human health risk assessment.

### *Vapor Extraction of Volatile Organic Compounds*

Since it is effective and is one of the least costly processes for removing VOCs, "vapor extraction system" (VES) - system of using piping underground to create a vacuum to draw out gaseous material - is being used increasingly for remediation of VOC-impacted sites. The following steps must be taken to

When MCL is to be used in a situation of multiple VOC contamination, use the lowest MCL among the VOCs and their degradation products where they are detected. For example, MCL for 1,1,1-TCA is 200 µg/L (ppb) but its degradation compound could be 1,1-DCA, which has a MCL of 5 µg/L (ppb). Soil cleanup screening levels may also be set for each individual compound based on each

should include at least one deep soil boring to find out the vadose zone lithology at the site, with samples collected from fine-grained soil layers for VOC analysis.

## Guidance for VOC-Impacted Sites

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- B) Conduct a feasibility study to determine if VES is applicable to the site.
- C) Measure soil physical properties to determine operating parameters of VES.
- D) Collect soil gas samples at various locations and depths to provide a baseline data of soil vapor concentrations.
- E) Conduct a pilot test to determine the zone of influence and the best locations of extraction wells and associated soil vapor monitoring probes.
- F) Remove VOCs by using the VES specifically designed for the site. Once installed and operating, VES must continue until there is no further drop in VOC concentration over time at the extraction wells and in strategically placed vapor monitoring wells.
- G) Measure the "rebound concentrations." This begins at the point when no decrease in vapor concentration is observed. The VOC is then monitored after specified periods of time, with no extraction, to measure the concentrations as they "rebound" over time. If the "rebound" upon successive tests exceeds 50 percent of the targeted screening concentration, restart the VES and repeat the cycle. If the "rebound" does not exceed 50 percent of the targeted screening concentration over a period of one year, shut down the VES. Soil matrix sampling at "fine-grained horizons" - analyzing the VOC content in soil samples rather than in vapor forms - generally will be required to confirm the cleanup.

Initially, elevated detection limits may be used to monitor the VOC concentrations. However, as extraction progresses the analytical detection limit must be lowered to below the soil cleanup screening level. This is to assure that the concentration attained is not a function of elevated detection limits. For example, 1 ppm may be the initial detection limit. Unless the detection limit is lowered as extraction proceeds, it would appear that the VOC concentration has reached its minimum level at 1 ppm.

If the targeted cleanup levels cannot be attained, the Regional Board staff will use one or more of the following performance criteria or additional requirements to clear the site from further vadose zone remediation by VES:

- 1) Reduce overall VOC concentrations at all extraction and monitoring points as compared to the baseline level.
- 2) Verify that concentration reached an "asymptotic level" - in which concentration gradually decreases to a constant level - by monitoring concentration rebounds after extraction shut downs.

## Guidance for VOC-Impacted Sites

- 3) Check if there is reduction of concentrations in soil matrix samples at selected "fine-grained horizons" in the vadose zone.
- 4) Apply "transport modeling" to show that any residual contaminants will not pose further threat to groundwater quality.
- 5) Implement groundwater monitoring if contaminants exceeding target screening levels are to be left in the vadose zone.

In case of coarse materials in the vadose zone, where most VES is applied, you can compare soil gas concentration in  $\mu\text{g/L}$  with soil cleanup screening levels calculated in this guidance process to determine the effectiveness of the remediation and when to terminate it. See Appendix A for further explanation.

### 2. Vadose Zones above Non-Drinking Water Aquifers

Non-drinking water aquifers are not usable for municipal or domestic supply, as defined in State Water Resources Control Board (SWRCB) Resolution 88-63 (i.e., TDS > 3000 mg/L, deliverability < 200 gal/day, or existing contamination that cannot be reasonably treated). Regional Board staff shall make site-specific water use determinations based on the Basin Plan objectives.

VOCs are usually toxic; some of them even carcinogenic. They cannot be rapidly broken down in the natural subsurface environment

and are very mobile in the vadose zone, thus posing a threat to groundwater quality. Although not supplied for municipal or domestic use, non-drinking waters shall not be contaminated any more than their "background" levels. They also shall not adversely impact an underlying usable drinking water aquifer by discharging VOCs into the drinking water.

When soil cleanup standards above non-drinking water aquifers are to be determined, criteria other than drinking water standards, such as aquatic life habitat, ecological impact, economic importance of the aquifer, water beneficial use requirements, availability of reuse in other water bodies, etc., will be considered. However, the cleanup standards should normally not be as stringent as required for usable drinking water bodies.

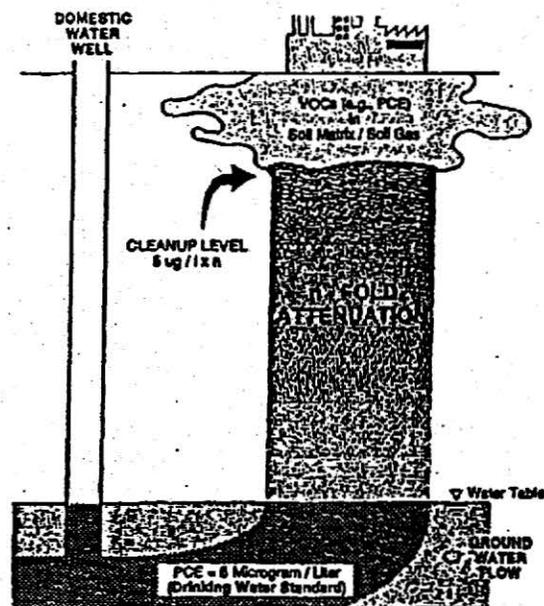


Illustration of Attenuation Effect

**Table 5-1: AVERAGE ATTENUATION FACTOR FOR DIFFERENT DISTANCE ABOVE GROUND WATER AND LITHOLOGY\***

DISTANCE ABOVE G.W.	LITHOLOGY			
	GRAVEL	SAND	SILT	CLAY
150	13	26	51	255
120	10	19	39	193
100	8	15	30	151
80	5	11	22	109
60	3	7	13	67
40	1	3	5	26
20	1	1	3	13
10	1	1	1	7

Distance (ft) Between Ground Water (G.W.) and the Measured Point;  
Lithology (USCS Standard) Between Ground Water and the Measured Point.

\*= See Section 5 of Appendix A

**EXAMPLE:**

A manufacturing factory used PCE in its degreasing process. Soil data are shown in table below. Ground water at the site is about 80 feet below ground surface. Lithology is about 50 percent gravel and 50 percent sand. Use Table 5-1 to determine the attenuation factor (AF) for different depths as follows:

At surface level (i.e., 80 feet above ground water):  $AF_{80} = 5 \times 50\% + 11 \times 50\% = 8$

At 20 feet level (i.e., 60 feet above ground water):  $AF_{60} = 3 \times 50\% + 7 \times 50\% = 5$

At 40 feet level (i.e., 40 feet above ground water):  $AF_{40} = 1 \times 50\% + 3 \times 50\% = 2$

Calculate the soil cleanup screening levels at respective depths by multiplying AF by MCL for PCE (5 ppb), and compare the results with the soil data at the site as shown below. Because soil concentrations are equal to or smaller than the cleanup screening levels, no soil cleanup is required.

Depth (ft)	Soil Data ( $\mu\text{g}/\text{kg}$ )	Cleanup Level (ppb)
1	40	40
20	20	25
40	10	10

# **GLOSSARY**

## GLOSSARY OF ABBREVIATIONS AND ACRONYMS

The terms and definitions in this glossary have been compiled from existing documents. The documents consulted in the assembly of the glossary are listed at the end of the glossary.

**Aboveground tank (AGT)** - Any containment device and associated piping made of non-earthen material which is situated partially or substantially above ground.

**Acid** - Any chemical compound containing hydrogen capable of being replaced by positive elements or radicals to form salts. In terms of the dissociation theory, it is a compound which, on dissociation in solution, yields excess hydrogen ions. Acids lower the pH. Examples of acids or acidic substances are hydrochloric acid, tannic acid, and sodium acid pyrophosphate.

**Acre-foot** - Enough water to cover 1 acre to a depth of 1 foot; equal to 43,560 cubic feet or 325,851 gallons.

**Activated carbon** - A granular material usually produced by the roasting of cellulose base substances, such as wood or coconut shell, in the absence of air. It has an extremely porous structure and is used in water conditioning as an adsorbent for organic matter and certain dissolved gases.

**Active soil gas investigation** - The act of withdrawing or pumping soil gas samples from the ground and analyzing such samples using an on-site mobile laboratory with laboratory-grade certifiable instrumentation and procedures for real-time analysis of volatile organic compounds.

**Adsorption** - The adherence of ions or molecules in solution to the surface of solids.

**Advection** - The process by which solutes are transported by the bulk motion of flowing fluid.

**Aeration** - The process of bringing air into intimate contact with water, usually by bubbling air through the water to remove dissolved gases like carbon dioxide and hydrogen sulfide or to oxidize dissolved materials like iron compounds.

**Air sparging** - A remedial technique whereby air injected below the area of contamination in the saturated zone travels vertically and horizontally to form an oxygen-rich zone in which adsorbed and dissolved VOCs are volatilized. As vapors rise from the saturated zone to the unsaturated soils above, VOCs are captured by a soil vapor extraction system, which also removes adsorbed solvents from the unsaturated soils.

**Air stripping** - A mass transfer process in which a substance in solution in water is transferred to solution in a gas, usually air.

**Alluvium** - A general term for clay, silt, sand, gravel, or similar unconsolidated material deposited during comparatively recent geologic time by a stream or other body of running water as a sorted or semisorted sediment in the bed of the stream or on its floodplain or delta, or as a cone of fan at the base of a mountain slope.

**Anisotropic** - Having some physical property that varies with direction.

**Annulus** - The space between the drill string or casing and the wall of the borehole or outer casing.

**Appeal process** - Under Section 13320 of the Porter-Cologne Act, a party may petition any action (enforcement action, permits, basin plan amendments, prohibitions) or inaction (refusal, after request, to take a requested action on any issue) of the Regional Board within 30 days of action or within 60 days of inaction. Title 23, CCR, Section 2050 provides the required contents of the petition.

**Applied Action Levels (AALs)** - These values are based on maximum acceptable exposure of biological receptors to substances associated with hazardous waste sites and facilities. AALs are derived by considering health effects without dealing with technical feasibility, economic concerns, or other factors. California DOHS AALs are not enforceable drinking water standards in the same sense as MCLs are, but are levels at which DOHS strongly urges water purveyors to take corrective action to reduce the level of contamination the water they supply. AALs cease to exist when State MCLs are promulgated.

**Aquiclude** - A body of relatively impermeable rock that is capable of absorbing water slowly but functions as an upper or lower boundary of an aquifer and does not transmit groundwater rapidly enough to supply a well or spring.

**Aquifer** - An underground water-bearing (saturated) geological formation that is capable of yielding a significant amount of water to wells or springs.

**Aquifer test** - A test involving the withdrawal of measured quantities of water from, or the addition of water to a well and the measurement of resulting changes in head in the aquifer both during and after the period of discharge or addition. Performed for the purpose of determining the aquifer characteristics of transmissivity and/or storativity.

**Aquitard** - An underground geological formation of low permeability. A water-bearing formation of low yield.

**ARAR** - Applicable or Relevant and Appropriate Requirements

**Artesian well** - A well deriving its water from a confined aquifer in which the water level stands above the top of the aquifer.

**Artificial recharge** - Recharge at a rate greater than natural resulting from deliberate actions of man.

**ASTM** - American Society for Testing and Materials

**atm** - Atmosphere

**Backwash (Well Development)** - The surging effect or reversal of water flow in a well. Backwashing removes fine-grained material from the formation surrounding the borehole and, thus, can enhance well yield.

**Barrier horizon** - A relatively impermeable layer of significant thickness and areal extent.

**Beneficial uses** - Beneficial uses of the waters of the state that may be protected against quality degradation include, but are not necessarily limited to, domestic, municipal, agriculture and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves.

**Bentonite grout** - An aluminum silicate clay which, when a small amount of magnesium oxide is added, swells and forms a viscous suspension when mixed with water. Dried, it forms a hard cement-like material.

**Best Available Technology (BAT)** - The best technology, treatment techniques, or other means which after examination for efficacy under field conditions and not solely under laboratory conditions, are available (taking cost into consideration). For the purposes of setting MCLs for synthetic organic chemicals, any BAT must be at least as effective as granular activated carbon.

**Biodegradation** - The breakdown of chemical constituents through the biological processes of naturally occurring organisms.

**Bioremediation** - Process which involves the use of microorganisms to convert contaminants to less harmful substances in order to remediate contaminated soil or groundwater.

**Biotransformation** - Refers to chemical alteration of organic compounds brought about by microorganisms.

**BNA - Base neutral acids**

**Borehole (boring)** - A hole created by a drilling device.

**Borehole log (geologic log)** - The record of geologic units penetrated, drilling progress, depth, water level, sample recovery, volumes and types of materials used, and other significant facts regarding the drilling of a borehole.

**Bridging** - The development of gaps caused by obstructions in either grout or filter pack materials during emplacement. Also refers to blockage of particles in natural formation materials or artificial filter pack materials that may occur during well development.

**BTEX** - An acronym for Benzene, Toluene, Ethylbenzene, and Xylenes, which are volatile aromatic compounds present in tar, petroleum products, and various organic chemical formulations.

**CAA** - Clean Air Act

**CAL-EPA** - The California Environmental Protection Agency

**Calibration** - The evaluation of the accuracy of an instrument. Calibration is accomplished by measuring acceptable standards and determining any difference between the standard known value and the reading of the instrument.

**Calibration standard (CAL)** -- A solution prepared from the primary dilution standard solution and stock standard solutions of the internal standards and surrogate analytes. The CAL solutions are used to calibrate the instrument response with respect to analyte concentration.

**Capillary fringe** - The area that is between the saturated zone and the unsaturated (vadose) zone, where water is held by surface tension. The zone may be only one-half inch thick in gravels, but up to 40 feet thick in clays.

**Casing** - Stainless steel or plastic (PVC) tubing placed in a boring.

**CERCLA** - The Comprehensive Environmental Response, Compensation, and Liability Act of 1980. also known as Superfund implements USEPA emergency and long-term

**CERCLIS** - CERCLA Information System

**Cesspool** - A covered hole or pit for receiving drained sewage.

**CFR - Code of Federal Regulations**

**Chain-of-custody (COC)** - Document designed to track samples from the point of collection to delivery at the laboratory. All persons that have physical custody of the samples must sign and date acceptance and/or relinquishment. Samples are invalidated by an improper or broken chain-of-custody.

**Clarifier** - Underground concrete structure generally with 2 or 3 chambers designed to separate solids from a waste water before it enters the sewer system.

**Clean Water Act** - Enacted in 1972, is the principal federal water quality protection statute which requires states to adopt water quality standards for approval by the EPA for all surface waters in the U.S.; establishes a federal permit (NPDES) scheme for surface water regulation. A permit is needed when a pollutant is discharged to a surface water of the U.S. from a "point source". The permits incorporate technology-based effluent limitations and any more stringent limits necessary to achieve surface water quality standards.

**Cleanup** - Actions taken to deal with a release or threat of release of a hazardous substance that could affect humans and/or the environment. The term cleanup is sometimes used interchangeably with the terms remedial action, removal action, response action, or corrective action.

**Cleanup criteria** - A standard on which a decision on the effectiveness of a cleanup action can be based.

**Closure** - Refers to the conclusion of environmental site investigation and remediation.

**CLP - Contract Laboratory Program**

**COD - Chemical Oxygen Demand**

**Coefficient of permeability** - An obsolete term that has been replaced by the term hydraulic conductivity.

**Coefficient of storage** - The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head.

**Coefficient of transmissivity** - See Transmissivity.

**Cone of depression** - A depression in the groundwater table or potentiometric surface that has the shape of an inverted cone and develops around a well from which water is being withdrawn. It defines the area of influence of a well.

**Confined aquifer** - Geological formation capable of storing and transmitting water in usable quantities overlain by a less permeable or impermeable formation, confining layer, placing the aquifer under pressure.

**Confining bed** - A body of "impermeable" or low permeability material stratigraphically above or below one or more aquifers.

**Consultant** - Any California licensed engineer or geologist who is involved in the assessment or cleanup of a facility. The consultant is hired by the Responsible Party.

**Contamination** - The impairment of the quality of the waters of the state by waste to a degree which creates a hazard to the public health through poisoning or through the spread of disease. "Contamination" shall include any equivalent effect resulting from the disposal of waste, whether or not waters of the state are affected.

**Darcy's law** - A derived equation for the flow of fluids on the assumption that the flow is laminar and that inertia can be neglected.

**Decontamination** - A variety of process used to clean equipment that has contacted formation material or groundwater that is known to be or suspected of being contaminated.

**Density** - Matter measured as mass per unit volume expressed in pounds per gallon (lb/gal), pounds per cubic ft (lb/ft<sup>3</sup>), and kilogram per cubic m (kg/m<sup>3</sup>).

**Depth to ground water** - Distance from the ground surface to the water table.

**Detection Limit** - The lowest concentration of a chemical that can be reliably reported to be different from zero concentration.

**Discharge** - A release of a substance(s) such as liquid waste, wastewater, solvents, gasoline, chemicals, etc., into the soil and/or ground water.

**Discharge Area** - An area in which subsurface water, including both ground water and water in the unsaturated zone, is discharged to the land surface, or to surface water.

**Dispersion** - The spreading and mixing of chemical constituents in groundwater caused by diffusion and mixing due to microscopic variations in velocities within and between pores.

**Dissolved product** - The water soluble components of hydrocarbon or other chemicals.

**DNAPL** - An acronym for denser-than-water nonaqueous phase liquid

**DO** - Dissolved oxygen

**Downgradient** - In the direction of decreasing hydrostatic head.

**Downgradient well** - A well that has been installed hydraulically downgradient of a site and is capable of detecting the migration of contaminants from a site. RCRA regulations require the installation of three or more downgradient wells, depending on the site-specific hydrogeological conditions and potential zones of contaminant migration.

**DQO** - data quality objectives; statements that specify the data needed to support decisions regarding response activities.

**Drawdown** - The distance between the static water level and the surface of the cone of depression.

**DRI** - Direct Reading Instruments

**Drum storage area** - A storage area for either virgin or waste chemicals generally contained in 55-gallon barrels. It is the most common method of chemical storage at industrial sites. A well designed storage area should be fenced and constructed with a containment system, such as a berm, and a surface sealant to contain any discharge and prevent it from impacting the soils.

**Duplicate Sample** - An additional sample taken near the field sample, co-located to determine total within-batch measurement error variance.

**Eh** - Oxygen-reduction potential

**EP** - Extraction procedure

**Equipotential line** - A contour line on the water table or potentiometric surface; a line along which the pressure head of groundwater in an aquifer is the same. Fluid flow is normal to these lines in the direction of decreasing fluid potential.

**ER** - Electrical resistivity

**Extent of contamination** - The depth and distance to which contaminants have respectively migrated vertically and laterally in the soil

**eV** - electron volt

**Evapotranspiration** - Loss of water from a land area through transpiration of plants and evaporation from the soil.

**Fault** - A fracture or a zone of fractures along which there has been displacement of the sides relative to one another parallel to the fracture.

**Field duplicates (FD1 and FD2)** – Two separate samples collected at the same time and place under identical circumstances and treated exactly the same throughout field and laboratory procedures. Analyses of FD1 and FD2 give a measure of the precision associated with sample collection, preservation and storage, as well as with laboratory procedures.

**Field reagent blank (FRB)** – Reagent water placed in a sample container in the laboratory and treated as a sample in all respects, including exposure to sampling site conditions, storage, preservation and all analytical procedures. The purpose of the FRB is to determine if method analytes or other interferences are present in the field environment.

**Filter pack** - Sand or gravel that is smooth, uniform, clean, well-rounded and siliceous. It is placed in the annulus of the well between the borehole wall and the well screen to minimize formation material from entering the screen.

**Floaters** - Lighter-than-water fluids, generally petroleum hydrocarbons or other organic liquids, capable of forming an immiscible layer that can float on the water table.

**Flow line** - Lines indicating the direction followed by groundwater toward points of discharge. Flow lines are perpendicular to equipotential lines.

**Fracture** - A break in a geological formation.

**Free product** - Liquid hydrocarbons or other chemical that accumulate on top of groundwater (capillary fringe).

**FS** - Feasibility Study

**Gaining stream** - A stream or reach of stream whose flow is being increased by inflow of ground water (an effluent stream).

**Gas chromatography (GC)** - An instrumental method for separating and identifying organic compounds, and measuring their concentrations. The various compounds pass through the chromatographic column at different rates; this time of travel through the column (called retention time) forms the basis for compound identification.

**Gas chromatography/mass spectroscopy (GC/MS)** - A tandem instrumental method for separating, identifying, and quantifying organic compounds. The GC separates the compounds. Compound identification is based on the compound retention time in the GC and on the mass spectral pattern. Compound quantification is normally done by measuring peak heights in the mass spectra.

**General notice** - A written statement from USEPA to a party notifying the party of its potential liability for the investigation and remediation of contamination at the party's facility.

**gpm** - Gallons per minute

**GPR** - Ground Penetrating Radar

**Grab sample** - Soil sample obtained without a coring device.

**Graded** - An engineering term pertaining to a soil or an unconsolidated sediment consisting of particles of several or many sizes or having a uniform or equable distribution of particles from coarse to fine.

**Ground water** - Water beneath the land surface contained in interconnected pores in the saturated zone that is under hydrostatic pressure. The water that enters wells and issues from springs.

**Ground water divide** - A high in the water table or other potentiometric surface from which ground water moves away in both directions normal to the ridge line.

**Ground water elevation** - The elevation of the water table at a particular place, as represented by the level of water in wells or other natural or artificial openings or depressions communicating with the zone of saturation.

**Ground water flow direction** - The direction of groundwater movement and any contaminants it contains; governed primarily by the hydraulic gradient.

**Ground water monitoring** - The periodic sampling and analysis of groundwater to determine the changes in concentration of chemical constituents in groundwater.

**Groundwater monitoring well** - A well that is constructed by one of a variety of techniques for the purpose of extracting ground water for physical, chemical, or biological testing, or for measuring water levels.

**Ground water quality** - Refers to chemical, physical, biological, bacteriological, radiological, and other properties and characteristics of water which affect its use.

**Ground water sampling** - The collection and subsequent chemical analysis of ground water samples.

**Grout** - Fluid mixture of cement and water (neat cement) of a consistency that can be forced through a pipe and placed as required. Various additives, such as sand, bentonite, and hydrated lime, may be included in the mixture to meet certain requirements. Bentonite and water are sometimes used for grout.

**Grouting** - The operation by which grout is placed between the casing and the sides of the well bore to a predetermined height above the bottom of the well. This secures the casing in place and excludes water and other fluids in the well bore

**HASP** - Health and Safety Plan (see also Site Safety Plan)

**Head** - Combination of elevation above datum, and pressure energy imparted to a column of water. (Velocity energy is ignored due to low velocities of ground water.) Measured in length units i.e. feet or meters.

**Head loss** - That part of head energy which is lost because of friction as water flows.

**Head space** - The air space at the top of a water or soil sample.

**Heterogeneous** - Nonuniform in structure or composition throughout.

**HNU** - Indicates a photolization device for measuring aromatic compounds (e.g., benzene, toluene, xylene - petroleum hydrocarbons).

**HSL** - Hazardous Substance List (previous term for Target Administration Compound List)

**HSO** - Health and Safety Officer

**NPDES** - National Pollution Discharge Elimination System

**HSWA** - Hazardous and Solid Waste Amendments

**Hydraulic conductivity** - The rate of flow of water in gallons per day through a cross section of one square foot under a unit hydraulic gradient, at the prevailing temperature (gpd/ft<sup>2</sup>). In the SI System, the units are m<sup>3</sup>/day/m<sup>2</sup> or m/day.

**Hydraulic containment** - Refers to modification of hydraulic gradients, usually by pumping groundwater, injecting fluids, and/or cur-off-walls, to control (contain) the movement of contaminants in the saturated zone.

**Hydraulic gradient** - The inclination of the groundwater surface measured as the degree of deviation from horizontal in unconfined aquifers, which may be highly variable. Change in head per unit distance in a given direction, typically in the principal flow direction.

**Hydrocarbon** - Any compound which contains only atoms of carbon and hydrogen, e.g., benzene or toluene.

**Hydrogeologic** - Those factors that deal with subsurface waters and related geologic aspects of surface waters.

**Hydrogeology** - The study of the physical earth properties that control the distribution and occurrence of subsurface fluids and gases and the medium in which they occur.

**Hydrograph** - Graph that shows the groundwater surface as a function of time.

**Hydropunch** - A soil and water sampling tool that is forced to a depth of about five to 10 feet below the water table in order to retrieve a water sample through a one-way valve.

**IDL** - Instrument Detection Limit

**IDLH** - Immediately dangerous to life and health

**Impermeable** - Having a texture that does not permit water to move through it perceptibly under the head difference that commonly occurs in nature.

**Industrial Hygienist** - A qualified person who is responsible for: recognition of hazards, identification of controls, calibration of equipment, interpretation of standards, collection of samples, and preparation of Health and Safety Plans.

**Interface** - In hydrology, the contact zone between two different fluids.

**Internal standard** -- A pure analyte(s) added to a solution in known amount(s) and used to measure the relative responses of other method analytes that are components of the same solution. The internal standard must be an analyte that is not a sample component

**Intrinsic Permeability** - Pertaining to the relative ease with which a porous medium can transmit a liquid under a hydrostatic or potential gradient. It is a property of the porous medium and is independent of the nature of the liquid or the potential field.

**IP** - Ionization potential

**Isoconcentration lines** - Lines of equal contaminant concentrations.

**Isotropic** - Said of a medium whose properties are the same in all directions.

**Laboratory duplicates (LD1 and LD2)** -- Two sample aliquots taken in the analytical laboratory and analyzed separately with identical procedures. Analyses of LD1 and LD2 give a measure of the precision associated with laboratory procedures, but not with sample collection, preservation, or storage procedures.

**Laboratory performance check solution (LPC)** -- A solution of one or more compounds used to evaluate the performance of the instrument system with respect to a defined set of method criteria.

**Laboratory reagent blank (LRB)** -- An aliquot of reagent water that is treated exactly as a sample including exposure to all glassware, equipment, solvents, reagents, internal standards, and surrogates that are used with other samples. The LRB is used to determine if method analytes or other interferences are present in the laboratory environment, the reagents, or the apparatus.

**LACDOHS** - Los Angeles County Department of Health Services.

**LACDPW** - Los Angeles County Department of Public Works.

**LACFD** - Los Angeles County Fire Department

**Laminar flow** - Water flow in which the stream lines remain distinct and in which the flow direction at every point remains unchanged with time. It is characteristic of the movement of groundwater.

**Landfill** - A waste management unit at which waste is discharged in or on land for disposal. It does not include surface impoundment, waste pile, land treatment, or soil amendments.

**LDP** - Leak Detection Program.

**Leachate** - The solution produced by the movement or percolation of liquid through soil or solid waste, and the subsequent dissolution of certain constituents in the water.

**Leaching** - Percolation of liquid or gases through soil or other materials.

**LEL** - Lower explosive limit

**LEL** - Lower explosive limit.

**Lithology** - The composition and texture of sediment or rock.

**Local Implementing Agency (LIA)** - County or city who regulates operations of underground storage tanks (USTs) and is the first contact when contamination is discovered.

**Local Oversight Program (LOP)** - Unit established in the Ventura County Environmental Health Division, in charge of overseeing cleanup of leaking USTs in Ventura County. Under contract with the State Water Resources Control Board.

**Losing stream** - A stream or reach of a stream that is losing water to the subsurface (also called influent stream).

**LUFT** - Leaking underground fuel tanks.

**LUFT Manual** - A State of California field manual to provide practical guidance to regulatory agencies with regard to the cleanup of contamination from underground fuel tanks.

**LUST** - Leaking underground storage tank

**Manifest (soil, rinseate)** - Documents hazardous material hauled away to a landfill or other disposal facility with generating, hauling and receiving facility operator's signature.

**Maximum Contaminant Level Goal (MCLG)** - The maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. Maximum contaminant level goals are nonenforceable health goals.

**Maximum Contaminant Level (MCL)** - The maximum contaminant levels for contaminants in drinking water, established by the U.S. Environmental Protection Agency and the California Department of Health Services.

**mg/Kg** - Milligrams per kilogram

**mg/L** - Milligrams per liter

**Molecular diffusion** - Dispersion of a chemical caused by the kinetic activity of the ionic or molecular constituents.

**Naturally developed well** - A well in which the screen is placed in direct contact with the aquifer materials; no filter pack is used.

**ND** - Non-detect.

**Nested well** - A set of multiple level wells constructed in the same borehole.

**NPDES** - National Pollutant Discharge Elimination System.

**NPL** - National Priorities List

**NTU** - Nephelometric Turbidity Unit.

**Observation well** - A well drilled in a selected location for the purpose of observing parameters such as water levels and pressure changes.

**Operable Unit** - A subset of a larger Superfund site, typically the subject of an investigation and cleanup. An operable unit may be defined by geographic area, type of contamination, or location of the contamination (soil, groundwater, etc.)

**Optimum Yield** - The best use of ground water that can be made under the circumstances; a use dependent not only upon hydrologic factors but also upon legal, social, and economic factors.

**Organic compound** - Chemicals containing carbon, with the exception of carbon dioxide and carbonates (such as calcium carbonate).

**OVA** - Organic Vapor Analyzer, gives a preliminary indication of the presence of certain volatile contaminants.

**Overdraft** - The average annual decrease in the amount of fresh ground water in storage that occurs during a long-time mean water supply period, under a particular set of physical conditions affecting the supply, use, and disposal of water in the ground water basin.

**Paint booth** - An enclosed or semi-enclosed area used for paint spraying operation.

**Partial penetration** - When the intake portion of the well is less than the full thickness of the aquifer.

**Partitioning** - Refers to a chemical equilibrium condition where a chemical's concentration is apportioned between two different phases according to the partition coefficient, which is the ratio of a chemical's concentration in one phase to its concentration in the other phase.

**Perched water** - Unconfined groundwater separated from a underlying main body of groundwater by an unsaturated zone.

**Percolate** - The movement of liquid through openings (interconnected voids) within soil, sediment, or the fractures in a rock.

**Perforated casing** - Well casings with holes or slots permitting the passage of fluids or vapors

**Permeability** - The property or capacity of a porous rock sediment, or soil for transmitting a fluid; it is a measure of the relative ease of fluid flow under unequal pressure.

**pH** - A designation for the degree of acidity or alkalinity of any material.

**PID** - Photo Ionization detector

**Piezometer** - A nonpumping well, generally of small diameter, which is used to measure the elevation of the water table or potentiometric surface. A piezometer generally has a short well screen, five feet or less, through which water can enter.

**Plume** - A mass of contamination extending outward from a source.

**Pollution** - An alteration of the quality of the waters of the state by waste to a degree which unreasonably affects such waters for beneficial uses, or facilities which serve such beneficial uses. "Pollution" may include "contamination".

**Porosity** - The percentage of the bulk volume of a rock or soil that is occupied by interstices, whether isolated or connected.

**Porter-Cologne Water Quality Control Act (Water Code)** - Enacted in 1969, the Act passed by the California Legislature provides a broad authority to the State and Regional Boards to regulate discharges to waters of the state. The Act establishes a permit program for discharges to land, surface waters, or ground water; provides enforcement authority and procedures; and provides authority to prepare Basin Plans and Statewide Plans.

**Post remedial monitoring** - Activities performed after completing cleanup operation to evaluate the effectiveness of the cleanup.

**Potential sources** - Sources of pollution including chemical spills, sumps, clarifiers, etc.

**Potentially responsible parties (PRPs)** - Individuals or companies who may be liable for the investigation and cleanup costs.

**Potentiometric surface** - An imaginary surface representing the total head of groundwater in a confined aquifer that is defined by the level to which water will rise in a well.

**POTWs** - Publically owned treatment works

**ppb** - Part per billion, ug/Kg, ug/L

**PPE** - Personal protective equipment

**ppm** - Part per million, mg/Kg, mg/L

**Pump test** - A test to determine aquifer characteristics. (See Aquifer Test).

**PVC** - Polyvinyl chloride

**QA/QC** - Quality assurance/quality control

**QAPP** - Quality Assurance Project Plan; A plan that describes protocols necessary to achieve the data quality objectives defined for an RI. (See SAP.)

**Quality control sample (QCS)** -- A sample matrix containing method analytes or a solution of method analytes in a water miscible solvent which is used to fortify reagent water or environmental samples. The QCS is obtained from a source external to the laboratory, and is used to check laboratory performance with externally prepared test materials.

**Radius of influence** - The horizontal distance from the center of a well to the outer limit of the cone of depression or to the limit of effective vacuum pressure.

**RCRA** - Resource Conservation and Recovery Act of 1978 which regulates monitoring, investigation, and corrective action activities at all hazardous treatment, storage, and disposal facilities.

**RD** - Remedial design

**Recharge** - The addition of water to the zone of saturation; also, the amount of water added.

**Recharge area** - The area where replenishment of an aquifer occurs by a natural process, such as rainfall, lakes, or streams, or by an artificial system such as a spreading ground, leaky pipe, or injection well.

**Regional Boards (RWQCB)** - The nine Regional Boards together with the California State Water Resources Control Board operate collectively to protect water quality within the State.

**Remedial action** - Activities taken to correct a problem such as fuel contamination of soil or groundwater.

**Residual drawdown** - The difference between the original static water level and the depth of water at a given instant during the recovery period.

**Risk analysis** - Relating residual contaminants with their long-term effect on groundwater quality and potential hazard to human life.

**RI** - Remedial Investigation

**ROD** - Record of Decision

**RPM** - EPA Remedial Project Manager

**Runoff** - That part of precipitation flowing to surface streams.

**Safe yield** - The amount of naturally occurring groundwater that can be withdrawn from an aquifer on a sustained basis, economically and legally, without impairing the native groundwater quality or creating an undesirable effect such as environmental damage. Similar to sustained yield.

**SAP** - Sample and analysis plan; Consists of a quality assurance project plan (QAPP) and a field sampling plan (FSP).

**SARA** - Superfund Amendments and Reauthorization Act of 1986

**Saturated zone** - A subsurface zone in which all the pore space or interstitial spaces in the zone are filled with water under pressure equal to or greater than atmospheric pressure.

**SCAQMD** - South Coast Air Quality Management District.

**SCBA** - Self-contained breathing apparatus

**SDWA** - Safe Drinking Water Act

**SIC** - Standard industrial classification

**Sieve analysis** - Determination of the particle-size distribution of a soil, sediment, or rock by measuring the percentage of the particles that will pass through standard sieves of various sizes.

**Site assessment** - Activities taken to determine the nature and extent of contamination and the physical properties of the soil and water in which it occurs.

**Site inspection (SI)** - The act of examining carefully a site to locate sources of contaminants.

**Slug-test** - An aquifer test made by either pouring a small instantaneous charge of water into a well or by withdrawing a slug of water from the well. A synonym for this test, when a slug of water is removed from the well, is a bail-down test.

**Slurry** - A thin mixture of liquid, especially water, and any of several finely divided substances, such as cement or clay particles.

**Soil assessment** - Activities taken that involve soil and soil gas sampling and analyses and the subsequent evaluation of the results to determine the presence or absence of contaminants as well as the nature and extent of contamination and the physical properties of the soil in which it occurs.

**Soil gas** - Vapors (gas) that occupy the small spaces between soil particles above the saturated zone.

**Solvent** - Any substance that can dissolve another substance.

**SOPs** - standard operating procedures

**SP** - Spontaneous potential

**Special notice letters** - Special notice letters are sent to potentially responsible parties to offer them an opportunity to enter into negotiations with USEPA for conducting specific remedial activities such as RI/FS or the implementation of a remedial action. The Notice may also contain a demand for payment of past costs.

**Specific capacity** - The rate of discharge of a water well per unit of drawdown, commonly expressed in gpm/ft or m<sup>3</sup>/day/m. It varies with duration of discharge.

**Specific gravity** - The weight of a particular volume of any substance compared to the weight of an equal volume of water at a reference temperature.

**Specific retention** - The ratio of the volume of water that a given body of rock or soil will hold against the pull of gravity to the volume of the body itself. It is usually expressed as a percentage.

**Specific yield** - The ratio of the volume of water that a given mass of saturated rock or soil will yield by gravity to the volume of that mass. This ratio is stated as a percentage.

**SSC** - Site Safety Coordinator

**State Board (SWRCB)** - California State Water Resources Control Board.

**Static water level** - The level of water in a well that is not being affected by withdrawal of groundwater.

**Stock standard solution** - A concentrated solution containing a single certified standard that is a method analyte, or a concentrated solution of a single analyte prepared in the laboratory with an assayed reference compound. Stock standard solutions are used to prepare primary dilution standards.

**Storage coefficient** - See Coefficient of storage.

**Storativity** - See Coefficient of storage.

**Stratigraphy** - The arrangement of sediment in layers or strata.

**Subsurface contamination** - Any type of contamination located below the ground surface.

**Superfund** - Commonly-used name for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a federal law enacted in 1980 and amended in 1986. CERCLA enables USEPA to respond to hazardous sites that threaten the public health and the environment where owners or operators are either unwilling or unable to address the contamination themselves.

**Surrogate analyte** - A pure analyte(s), which is extremely unlikely to be found in any sample, and which is added to a sample aliquot in known amount(s) before extraction and is measured with the same procedures used to measure other sample components. The purpose of a surrogate analyte is to monitor method performance with each sample.

**Sustained yield** - Continuous long-term ground water production without progressive storage depletion or other undesirable result. See also safe yield.

**TDS** - Total dissolved solids

**TEGD** - The RCRA groundwater monitoring Technical Enforcement Guidance Document, (Sept. 1986) handbook addressing EPA's regulatory approach to hydrogeologic investigations at a RCRA hazardous waste facility.

**Threshold limit** - A chemical concentration above which adverse health or environmental effects may occur.

**TLV** - Threshold limit value

**TOC** - Total organic carbon

**TOH** - Total Organic Halides

**Tortuosity** - Sinuosity of the actual flow path in porous medium; it is the ratio of the length of the flow path divided by the length of the sample.

**Total dissolved solids (TDS)** - A term that expresses the quantity of dissolved material in a sample of water, either the residue on evaporation, dried at 356°F (180°C), or, for many waters that contain more than about 1,000 mg/l, the sum of the chemical constituents.

**TPH** - Total petroleum hydrocarbon.

**Transition seal** - A layer of sodium bentonite placed above the filter pack and below the annular seal in a monitoring well in order to prevent contamination from entering the filter pack.

**Transmissivity** - The rate at which water is transmitted through a unit width of an aquifer under a unit hydraulic gradient. Transmissivity values are given in gallons per minute through a vertical section of an aquifer one foot wide and extending the full saturated height of an aquifer under a hydraulic gradient of 1 in the English Engineering system; in the International System, transmissivity is given in cubic meters per day through a vertical section of an aquifer one meter wide and extending the full saturated height of an aquifer under a hydraulic gradient of 1.

**Transpiration** - The process by which water absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface.

**Treatment** - When used in connection with hazardous waste, any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or to recover energy or material resources from the waste, or to render such waste nonhazardous, or less hazardous; safer to transport, store, or dispose of; or amenable for recovery, amenable for storage, or reduced in volume.

**TSCA** - Toxic Substances Control Act

**TSDF** - Treatment, Storage, and Disposal Facility

**Turbulent flow** - Water flow in which the flow lines are confused and heterogeneously mixed. It is typical of flow in surface-water bodies.

**UEL** - Upper explosive limit

**µg/L** - Micrograms per liter

**Unconfined aquifer** - An aquifer where the water table is exposed to the atmosphere through openings in the overlying materials.

**Underground Storage Tank (UST)** - Any containment device and associated piping made of non-earthen material which is situated partially or substantially below ground.

**Unique site feature** - Natural or man-made physical characteristic of the site which could influence the movement and direction of contaminants through the subsurface.

**Upgradient** - In the direction of increasing static head.

**Upgradient well** - One or more wells placed hydraulically upgradient of a site, that are capable of yielding ground water samples representative of regional conditions, and that are not affected by activities at the site.

**USCS** - Unified Soil Classification System

**USEPA** - The Federal Environmental Protection Agency.

**USGS** - U.S. Geological Survey

**UV** - Ultraviolet

**Vadose zone (unsaturated zone)** - A zone that is not saturated by groundwater, but may have high moisture content and local areas of saturation (perched zones). This zone extends between the ground surface and the water table and includes the capillary fringe overlying the water table.

**Vapor degreasers** - An open-top aboveground tank where metal parts can be dipped into liquid or vaporized chlorinated solvents for removing oil and grease.

**Vapor extraction** - A remedial action involving the forced extraction of gas (with volatile contaminants) from the vadose zone,

**Viscosity** - The property of a substance to offer internal resistance to flow. Specifically, the ratio of the shear stress to the rate of shear strain.

**VOA** - Volatile organic analysis

**Volatile organic compounds (VOCs)** - Organic compounds (carbon-containing) that evaporate readily at room temperature, which are commonly used in dry cleaning, paint stripping, metal plating, electronics manufacturing and machine degreasing.

**Waste** - Includes sewage and any and all other waste substances, liquid, solid, gaseous, or radioactive, associated with human habitation, or of human or animal origin, or from any producing, manufacturing, or processing operation of whatever nature, including such waste placed within containers of whatever nature prior to, and for purposes of disposal.

**Water table** - The surface of an unconfined groundwater at which the pressure is equal to that of the atmosphere.

**WDR** - Waste Discharge Requirements

**Well development** - The act of restoring the hydraulic conductivity of the formation and removing all foreign sediment after constructing the monitoring well to ensure turbid-free groundwater samples.

**Well purging** - The removal of water from a well to bring representative groundwater into the casing during sample collection activities.

**Well seal** - The seal placed from the top of the filter pack to the ground surface. The preferred design is a seal of three to four feet thick sodium bentonite placed directly on top of the filter pack with the remaining annular space sealed with a cement grout from the top of the bentonite to the ground surface.

**Well yield** - The volume of water discharged from a well in gallons per minute or cubic meters per day.

**WIP** - Well Investigation Program; Regional Board program, under authority of the California Water Code, Section 13304, which locates and abates the sources of pollutants affecting public drinking water wells and oversees the remediation of the pollution.

**WRR** - Water Reclamation Requirements

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for  
Site Characterizations/Remedial Actions  
in the  
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  - EXAMS II - Surface water model
  - PRZM2 - Pesticide root zone model
  - MINTEQ - Geochemical equilibrium speciation model

**INFORMATION PROVIDED BY M/B&A: 12/95**

# **APPENDIX A**

**ATTENUATION FACTOR METHOD**

**FOR**

**VOCS**

# **APPENDIX A**

## **ATTENUATION FACTOR METHOD FOR VOCS**

**(February 14, 1996)**

**By**

**Yue Rong and Roy Sakaida**

**California Regional Water Quality Control Board**

**Los Angeles Region**

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## ATTENUATION FACTOR METHOD FOR VOCs

Soil cleanup criteria for volatile organic compounds (VOCs) that are protective of groundwater quality should depend on physical properties of the impacted site and chemical properties of the VOC contaminants. The attenuation factor to be derived as follows is a measure of VOC contaminants that can be retained in the soil above ground water as a function of retention of chemical by the distance and lithology of soils encountered during its transport to ground water. Attenuation factors were calculated using physical and chemical data collected or available in the Los Angeles area.

### 1. Attenuation Factor (AF)

We have derived an attenuation factor (AF) based on an assumption of attenuation (retention) of chemicals in the vadose zone as illustrated in Figure 1. Considering a vadose zone unit as shown in Figure 2, volatile organic compounds (VOCs) can partition into three phases: sorbed, gaseous, and dissolved (liquid). Jury et al. (1983) suggested that the total soil concentration of a VOC in all three phases can be calculated as:

$$C_T = \rho_b \cdot C_s + (n - \theta_w) \cdot C_g + \theta_w \cdot C_l \quad (1)$$

Where:

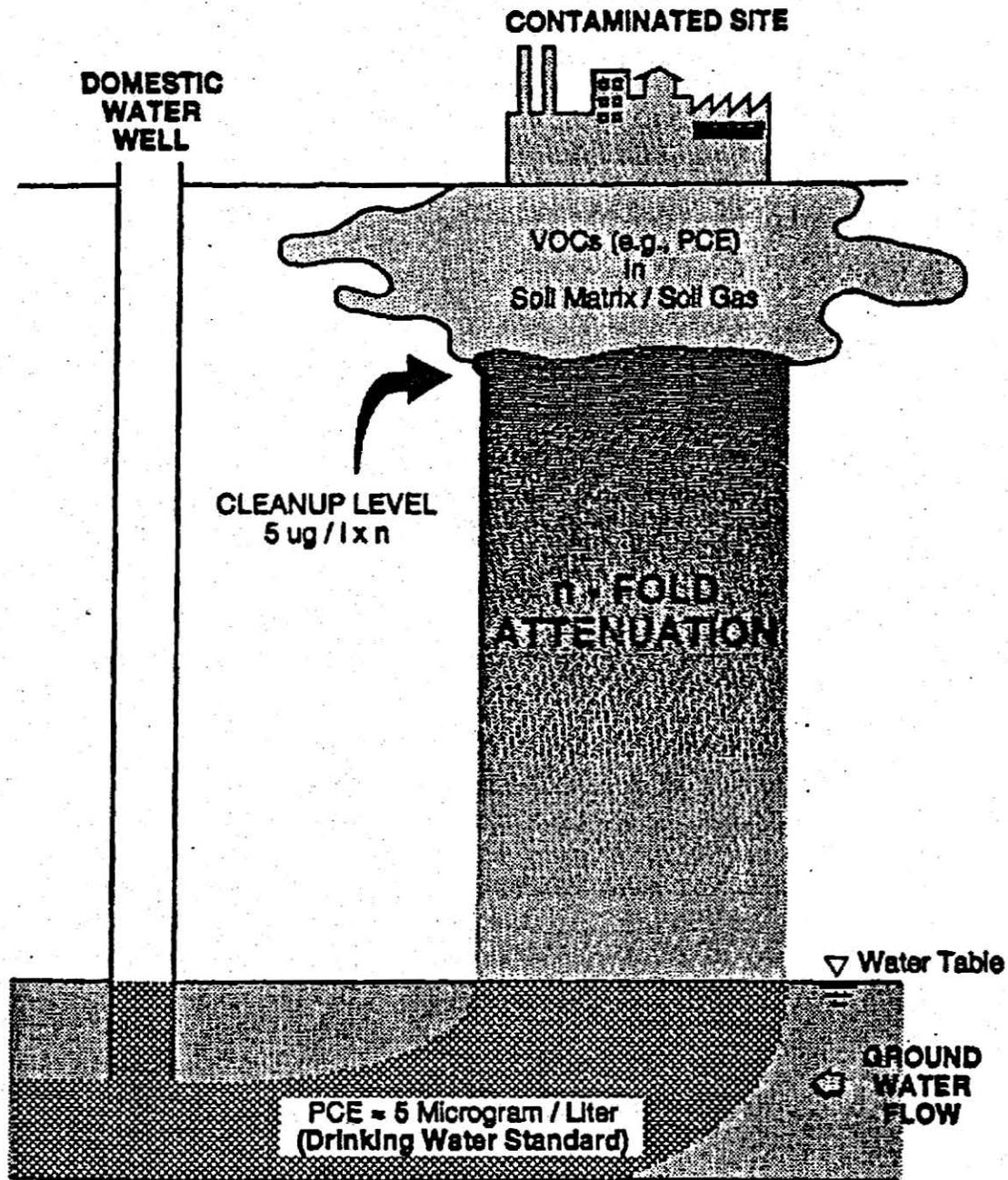
- $C_T$  = Total soil concentration (g/ml)
- $C_s$  = Concentration in sorbed phase (g/g)
- $C_g$  = Concentration in gaseous phase (g/ml)
- $C_l$  = Concentration in liquid phase (g/ml)
- $\rho_b$  = Soil bulk density (g/ml)
- $\theta_w$  = Soil water content by volume (dimensionless (--))
- $n$  = Soil porosity (dimensionless (--))

Substituting the two partition coefficients between the sorbed and liquid phases  $K_d = C_s/C_l = f_{oc} \cdot K_{oc}$ , and between the gaseous and liquid phases  $K_H = C_g/C_l$ , into equation (1), we have:

$$C_T = C_l [\theta_w + \rho_b \cdot f_{oc} \cdot K_{oc} + (n - \theta_w) \cdot K_H] \quad (2)$$

Where:

- $f_{oc}$  = Soil organic carbon content (dimensionless (--))
- $K_{oc}$  = Organic carbon partition coefficient (ml/g)
- $K_H$  = Henry's law constant (dimensionless (--))



**Figure 1: Illustration of Attenuation Effect**

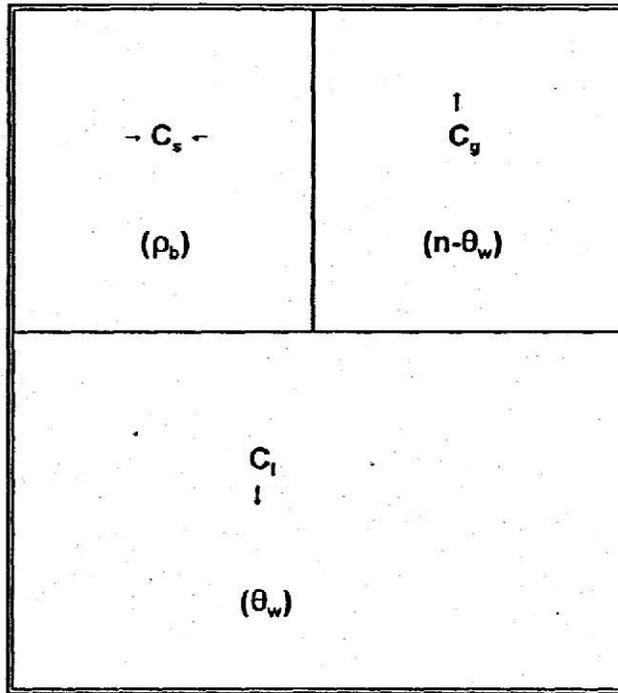


Figure 2: VOC Concentration Partition Distribution in a Conceptual Vadose Zone Unit [All parameters defined in equation (1)]

We also assume that VOC in the liquid phase is the only one moving downward to impact ground water quality and VOC in sorbed and gaseous phases is considered as lost mass in the subsurface for the moment. AF is then defined as the ratio of total soil concentration and the leachate concentration in the soil pores:

$$AF = C_T / (C_l \cdot \theta_w) \quad (3)$$

Hence, substituting (2) into (3), AF becomes:

$$AF = 1 + (\rho_b / \theta_w) \cdot f_{oc} \cdot K_{oc} + (n - \theta_w) \cdot K_H / \theta_w \quad (4)$$

By definition, AF is always greater than or equal to 1, at which there is no attenuation. The larger the AF is, the larger the attenuation effect is, i.e., the larger retention potential of VOC in soils.

Database is established based upon 55 soil samples obtained in the Los Angeles area (38 samples from San Fernando Valley, 6 samples from San Gabriel Valley, and 11 samples from Carson area). The physical parameters required for equation (4) are provided in Table 1 as follows:

Table 1: Statistics of 55 Soil Physical Parameters

	$\rho_b$ (g/ml)	$\theta_w$ (—)	$f_{oc}$ (—)	$n$ (—)
Distribution	Normal	Normal	Log-Normal	Normal
Minimum	1.2	0.031	0.0002	0.143
Maximum	2.27	0.4	0.015	0.54
Mean	1.746	0.167	0.00247	0.364
Std Deviation	0.242	0.103	0.00324	0.093
Median			0.00138	

The following values of soil physical property parameters are then selected to produce the maximum attenuation factor,  $AF_{MAX}$ :

$$\rho_b = 2.27(\text{g/ml}), \theta_w = 0.031(—), f_{oc} = 0.015(—), n = 0.143(—).$$

Table 2 tabulates the  $AF_{MAX}$  for 29 common VOCs, which are calculated using equation (4), along with California MCLs and chemical property parameters  $K_{oc}$  and  $K_H$ . These 29 VOCs are grouped into four brackets based on the  $AF_{MAX}$  values. Rounded average numbers for  $AF_{MAX}$  are provided to simplify calculations. To be used under site-specific soil physical conditions,  $AF_{MAX}$  should be modified by the following factors to generate soil screening levels for VOC impacted sites.

## 2. Modification Factor Due to Distance above Ground Water ( $AF_D$ )

We assume a general linear relationship between AF and vertical distance above ground water. Based upon the definition of AF, the closer the distance to ground water, the smaller the AF should be.

Hydrogeological information in the San Fernando Valley Superfund area, Los Angeles County, indicates that groundwater elevation fluctuation has been  $\pm 20$  feet for the last decade or so. Therefore, 40 feet above ground water table is chosen as a "smear zone" where ground water needs more protection and the AF values should be more stringent (i.e., smaller). The average ground water depth in the northwestern portion of the San Fernando Valley Superfund area is about 150 feet above the high concentration plume area. Hence, 150 feet is taken as a depth of concern for the AF modification, which is considered to be reasonable, compared with ground water depth in other areas in the Los Angeles County. We have also assumed no change in AF for distances greater than 150 feet above the ground water table.

A study of VOC downward transport by using an one-dimensional vadose zone transport model, VLEACH (Ravi 1994) indicates that the VOC transport rate can increase an order of magnitude in the "smear zone" immediately above the ground water table. In other words, AF should be reduced to one-tenth of the original value ( $AF/10$ ) at that point.

We then interpolate linearly between the distance from ground water to the vadose zone point of interest to calculate an AF modification factor. Since two zones above ground water table have been distinguished so far: from ground water table to 40 feet above the table and from 40 feet up to 150 feet above the table, we have two segments in the relationship of distance above ground water table and attenuation factor: [150, 40] versus [AF,  $AF/10$ ] and [40, 0] versus [ $AF/10$ , 1], where the datum point (zero) of the coordinate is at the ground water table and distance is measured up from the water table. Hence, attenuation factor modified by distance above ground water,  $AF_D$ , can be determined by the linear interpolation:

$$\begin{aligned} (AF_D - 0.1 \cdot AF) / (AF - 0.1 \cdot AF) &= (D - 40) / (150 - 40) & 40 < D \leq 150 \\ (AF_D - 1) / (0.1 \cdot AF - 1) &= D / 40 & 0 \leq D \leq 40 \end{aligned}$$

TABLE 2: MCL, K<sub>oc</sub>, K<sub>ow</sub>, MAXIMUM VALUES OF ATTENUATION FACTOR FOR COMMON VOCs

Compound	MCL(µg/l) <sup>a</sup>	K <sub>oc</sub> (ml/g) <sup>b</sup>	K <sub>ow</sub> (-) <sup>b</sup>	AF <sub>max</sub>
Acetone	610 <sup>c</sup>	2	0.0009	3.2
Methyl Ethyl Ketone (MEK)	1900 <sup>c</sup>	5	0.0011	6.5
Chloroethane		3	0.387	5.7
ROUNDED AVERAGE				6
Benzene	1	65	0.229	73
Chloroform	100	31	0.158	36
Cis-1,2-dichloroethylene (c-1,2-DCE)	6	59	0.274	67
Dichlorodifluoromethane (Freon 12)	390 <sup>c</sup>	58	4.158	80
1,1-Dichloroethane (1,1-DCA)	5	30	0.179	35
1,2-Dichloroethane (1,2-DCA)	0.5	14	0.05	17
Dichloromethane (Methylene Chloride)	5	9	0.11	11
1,1,1,2-Tetrachloroethane	1	54	0.016	60
Trans-1,2-dichloroethylene (t-1,2-DCE)	10	59	0.274	67
1,1,2-Trichloroethane (1,1,2-TCA)	5	56	0.05	63
ROUNDED AVERAGE				50
Carbon Tetrachloride	0.5	110	0.998	125
Chlorobenzene	30	160	0.146	177
1,1-Dichloroethylene (1,1-DCE)	6	65	6.237	95
Ethylbenzene	700	220	0.328	244
1,1,1,2-Tetrachloroethane	1	220	0.021	243
Tetrachloroethylene (PCE)	5	660	0.956	729
Toluene	150	260	0.274	288
1,1,1-Trichloroethane (1,1,1-TCA)	200	150	0.116	166
Trichloroethylene (TCE)	5	130	0.371	145
Trichlorofluoromethane (Freon 11)	150	160	4.03	191
1,1,2-Trichloro-trifluoroethane (Freon 113)	1200	160	2.41	185
Vinyl chloride (VC)	0.5	57	29.1	169
o,m,p - Xylene	1750	240	0.22	265
ROUNDED AVERAGE				200
1,2-Dichlorobenzene	600	1100	0.079	1210
1,3-Dichlorobenzene	600	1200	0.079	1319
1,4-Dichlorobenzene	5	1200	0.066	1319
ROUNDED AVERAGE				1200
OVERALL AVERAGE:				255

Reference:

- a = California MCL From CCR Title 22.
- b = USEPA (1994) Region IX Preliminary Remediation Goals (PRGs) Second Half 1994. (August). (except value for chloroethane from Montgomery (1990))
- c = PRG values for tap water (USEPA 1994)

By the assumptions and reorganizing above equations, the linear segment functions of  $AF_D$  can be expressed as:

$$\begin{aligned}
 AF_D &= AF & D > 150 & \quad (5) \\
 AF_D &= [0.9 \cdot (D-40)/110 + 0.1] \cdot AF & 40 < D \leq 150 & \quad (6) \\
 AF_D &= D \cdot [0.1 \cdot AF - 1]/40 + 1 & D \leq 40 & \quad (7)
 \end{aligned}$$

Where:  $AF_D$  = Attenuation factor modified by distance above ground water ( $\geq 1$  always)  
 $D$  = Distance from ground water to point of interest (ft).

If an individual VOC is of interest, the individual  $AF_{MAX}$  or rounded average  $AF_{MAX}$  from the corresponding bracket in Table 2 can be substituted for  $AF$  value in equations (5) through (7). If total VOC concentrations should be concerned, the 29 VOC overall average  $AF_{MAX}$  equal to 255 can be used. When  $AF=AF_{MAX}=255$ , equations (5), (6), and (7) become:

$$\begin{aligned}
 AF_D &= 255 & D > 150 & \quad (8) \\
 AF_D &= 2.09 \cdot (D-40) + 25.5 & 40 < D \leq 150 & \quad (9) \\
 AF_D &= 0.61 \cdot D + 1 & D \leq 40 & \quad (10)
 \end{aligned}$$

Here  $AF_D$  is only a function of  $D$ . The function is illustrated in Figure 3.

### 3. Total Modification Factor Due to Distance above Ground Water and Lithology ( $AF_T$ )

Soil types can affect the rate of transport due to infiltration and further retention of VOCs. In general, fine grained soils with relatively slow infiltration have a higher retention ability than coarse materials. Therefore, VOC retention should be different in each lithological layer. Assume  $AF$  is different in each lithologic layer and proportional to fractions of each lithologic thickness of gravel, sand, silt, and clay layers within  $D$ . Then the relationship can be expressed by the following equation:

$$AF_L = (TGR/D) \cdot AF_{GR} + (TSA/D) \cdot AF_{SA} + (TSI/D) \cdot AF_{SI} + (TCL/D) \cdot AF_{CL} \quad (11)$$

Where:  $AF_L$  = Attenuation factor modified by lithology ( $\geq 1$  always)

TGR = Total thickness of gravel layer within D (ft)

TSA = Total thickness of sand layer within D (ft)

TSI = Total thickness of silt layer within D (ft)

TCL = Total thickness of clay layer within D (ft)

$AF_{GR}$ ,  $AF_{SA}$ ,  $AF_{SI}$ ,  $AF_{CL}$  = Attenuation factor for gravel, sand, silt, and clay, respectively.

The data on steady infiltration rate of different soil types in Hillel (1982) indicate that water infiltration rate of gravel/sand materials can be 2 fold greater than sand/silt, 4 fold than silt/clay, and 20 fold than clayey materials. We assume VOC retention rate is inversely proportional to the steady infiltration rate. If only VOC in dissolved phase is of concern as defined in AF, we can determine attenuation factors for gravel, sand, silt, and clay, based upon VOC retention ratio between each lithological class, as shown in Table 3. The ratio between each lithological class in Table 3 is further supported by data in Carsel et al. (1988), which suggest the ratio in Table 3 is more conservative with respect to ground water protection.

Table 3: AF for Different Lithology

Lithology Class	Steady Infiltration Rate (mm/hr)*	AF
Gravel/Sand (GR)	20	$AF_{GR} = (1/20)(AF_D)$
Sand/Silt (SA)	10	$AF_{SA} = (1/10)(AF_D)$
Silt/Clay (SI)	5	$AF_{SI} = (1/5)(AF_D)$
Clay (CL)	1	$AF_{CL} = AF_D$

\* = Hillel (1982).  $AF_D$  is calculated in (5), (6), or (7).

Substituting values of  $AF_{GR}$ ,  $AF_{SA}$ ,  $AF_{SI}$ ,  $AF_{CL}$  in Table 3, equation (11) becomes:

$$AF_T = (AF_D/D) \cdot (TGR/20 + TSA/10 + TSI/5 + TCL) \quad D > 0 \quad (12)$$

Where:  $AF_T$  = Attenuation factor with total modification for distance above ground water and lithology  
 $AF_D \geq 1$  always.

Hence,  $AF_T$  is a function of  $AF_D$ ,  $D$ , and total thickness of each lithological class. Equation (12) represents the overall AF modified for distance above ground water and lithology within  $D$ .

#### 4. Use of Attenuation Factor for VOC Soil Cleanup Screening Levels

AF as defined in equation (4) incorporates site-specific physical parameters and chemical parameters of VOC mobility.  $AF_{MAX}$ , a best case scenario, is then modified by two factors: distance above ground water and lithology. Each modification reduces AF values, which tends toward a conservative estimate. Based on the modified  $AF_T$ , the following equation is used to determine VOC soil cleanup screening levels.

$$C = AF_T \times MCL \quad (13)$$

Where:  $C$  = Concentration of soil cleanup screening level (ppb)  
 $AF_T$  = Attenuation factor modified by distance above ground water and lithology ( $\geq 1$ ) (dimensionless)  
 $MCL$  = Maximum contaminant levels for drinking water (CCR Title 22) if set; or applicable Federal or State water standards if MCLs are not set (ppb)

California MCL values are summarized in Table 2. If soil contaminant is a single VOC, the individual MCL is applied. If total VOCs are of concern, use the lowest MCL among VOCs and their degradation products where they are detected. For example, MCL for 1,1,1-TCA is 200  $\mu\text{g/l}$  (ppb) but its degradation compound could be 1,1-DCA, which has a MCL of 5  $\mu\text{g/l}$  (ppb). In this case, MCL equal to 5 ppb should be used instead of 200 ppb. If soil contamination is a multiple VOCs problem and there is no predominant compound among the multiple VOCs, soil cleanup screening levels may be set for each individual compound based on each respective MCL.

If the aquifer to be protected is a drinking water aquifer, MCL shall be used in equation (13); if the MCLs are not set, applicable Federal or State water quality standards, e.g., tap water criteria of USEPA PRGs shall be considered. If the aquifer is designated as a drinking water aquifer but contaminated at present, the water quality standard shall consider criteria and requirements for water treatment and water usage after remediation, such as well-head treatment, pump and treat, reinjection, etc., which may require less stringent standards than MCLs. If the aquifer is used for non-drinking water, other criteria, such as aquatic life habitat, ecological impact, water beneficial use requirements, etc., may apply (refer to State Water Resources Control Board Resolution 88-63 for criteria to determine a "non-drinking aquifer").

## 5. Average Attenuation Factor Table

To simplify the calculation, a table for average attenuation factors is prepared. Given the overall average  $AF_{MAX}$  for 29 VOCs equal to 255 (Table 2) and using equations (8), (9), (10), and (12),  $AF_T$  is calculated for each depth interval and lithological class in Table 4. Distance above ground water (D) in Table 4 is first used to calculate  $AF_D$  and then let D in equation (12) equal to TGR, TSA, TSI, and TCL, respectively, to obtain  $AF_T$  under each lithological class. Table 4 suggests that AF should be 1 at a primary gravel site with ground water at 40 feet or shallower; and on the other hand, AF should be 255 at a site with all clay and ground water at 150 feet or deeper.

Table 4: Attenuation Factors ( $AF_T$ ) for Different Distance above Ground Water and Lithology

DISTANCE ABOVE G.W.	LITHOLOGY			
	GRAVEL	SAND	SILT	CLAY
150	13	26	51	255
120	10	19	39	193
100	8	15	30	151
80	5	11	22	109
60	3	7	13	67
40	1	3	5	26
20	1	1	3	13
10	1	1	1	7

Distance (ft) Between Ground Water (G.W.) and the Measured Point;  
Lithology (USCS Standard) Between Ground Water and the Measured Point.

For distance greater than 150 feet above ground water, the 150 feet values of  $AF_T$  are to be used.  $AF_T$  can be interpolated between depth intervals and proportional to fraction of each lithological thickness at the site. For instance, when  $D = 70$  feet,  $AF_T = 4, 9, 17.5,$  and  $88$  for gravel, sand, silt, and clay, respectively. If a site lithology consists of 20% gravel, 50% sand, 15% silt, and 15% clay,  $AF_T = 0.2 \cdot 4 + 0.5 \cdot 9 + 0.15 \cdot 17.5 + 0.15 \cdot 88 = 21$ . Table 4 is designed to provide a quick primary screening benchmark for total VOC soil cleanup levels.

## 6. Limitations of Attenuation Factor Method

From a perspective of ground water protection, VOC soil cleanup levels should be a function of physical properties of the site and chemical properties of the VOCs. Attenuation factor method formulates such a function, especially emphasizing distance to ground water and site lithology. It lays out a foundation for further quantification of the function as more data become available. However, the limitations of this method must be acknowledged, some of which are discussed as follows.

- a) Non-aqueous phase liquid (NAPL) is not considered in equations (1) and (4). If the cleanup site is a NAPL case, NAPL must be removed or remediated prior to applying attenuation factor method for the NAPL residuals of VOCs.
- b) Attenuation factor method is not a form of vadose zone transport model and cannot predict any change of concentrations over time in the subsurface. Therefore, any estimate of VOC transport with time and depth should be directed to site-specific fate and transport studies.
- c) VOC gaseous phase is assumed as lost mass in the attenuation factor method. If VOC gas transport in the vadose zone is considered to be a major mechanism of threat to ground water quality at a site, more vapor phase fate and transport studies need to be done prior to applying the method.
- d) The attenuation factor method is not a substitute for human health-based risk assessment. Any cleanup screening values derived by this method shall be less than the health risk threshold values, such as USEPA PRGs, above which a formal risk assessment may be required.
- e) The screening numbers calculated by the attenuation factor method should not be used to define the extent of soil contamination in site assessment. The screening numbers should not be applicable until the site is fully characterized.
- f) Ground water historical high level shall be taken into account with attenuation factor calculation in order to protect ground water quality in the long term.

## 7. Conversion of Soil Gas Concentrations ( $\mu\text{g/L}$ ) to Total Soil Concentrations ( $\mu\text{g/kg}$ )

In many soil cleanup cases, a vapor extraction system (VES) is often used to remove VOCs. Therefore, soil gas concentrations are usually obtained for cleanup monitoring. When soil gas data are available, HydroGeoChem (1989) proposes a method to calculate total concentrations in soil from soil gas concentrations, or vice versa.

$$C_T = C_g \cdot [\theta_w + (n - \theta_w) \cdot K_H + \rho_b \cdot f_{oc} \cdot K_{oc}] / (\rho_b \cdot K_H) \quad (14)$$

Where:  $C_T$  = Total soil concentration in  $\mu\text{g/kg}$   
 $C_g$  = Soil gas concentration in  $\mu\text{g/L}$   
Other parameters defined in equations (1) and (2).

Rosenbloom et al. (1993) indicated that soil gas concentrations were found to be more meaningful than soil matrix data for estimating total soil concentrations at an Arizona Superfund site. Data obtained from San Gabriel Valley and San Fernando Valley Superfund Sites in Los Angeles County also support this assertion.

Let CO be the coefficient between  $C_T$  and  $C_g$  in equation (14), hence  $CO = [\theta_w + (n - \theta_w) \cdot K_H + \rho_b \cdot f_{oc} \cdot K_{oc}] / (\rho_b \cdot K_H)$ . Therefore,  $C_T = CO \times C_g$ . CO values are calculated using equation (14) given soil physical property parameters presented in Table 1 for all 29 VOCs listed in Table 2. Results indicate that in general CO value is relatively small for highly volatile compounds in coarse material soil and CO value tends to be large for less volatile compounds in fine-grained soil. Therefore, in a subsurface investigation where volatile contaminants are in coarse soil such as sand or gravel, soil gas samples could be better choice. When less volatile contaminants are in fine-grained soil such as silt or clay, soil matrix samples should be analyzed. In the former case, soil gas concentration in  $\mu\text{g/L}$  can be compared directly with soil cleanup screening levels.

## 8. Evaluation of Attenuation Factor Method Results

### (a) Comparison of Attenuation Factor Method Results with USEPA Preliminary Remediation Goals (PRGs)

To evaluate a worst case scenario for the attenuation factor method, the largest AF value in Table 4, 255, is used to generate results of equation (13) by multiplying each corresponding MCLs listed in Table 2. The preliminary remediation goals (PRGs) for the

category of residential soil designated by the USEPA Region IX (1994) are then used for comparison with these worst case scenario values. As a result, 24 of the 29 VOCs compared show that the attenuation factor method values are much smaller than the corresponding PRG values. Therefore, the soil cleanup screening values calculated by attenuation factor method are generally safe as far as human health risk concerns. In any case, the maximum value used as the soil cleanup screening level should not exceed regulatory threshold values for protection of human health.

(b) Comparison of Attenuation Factor Method Results with Vadose Zone Transport Model (VLEACH)

Attenuation factor method has been compared with a one-dimensional finite difference vadose zone transport model, VLEACH (Version 2.1) (Ravi 1994) at two sites with site-specific soil physical property parameters. Under very conservative assumptions, VLEACH is used to calculate PCE concentrations in dissolved phase at each discrete depth. These concentrations would not result in liquid phase concentrations exceeding MCL for PCE (5 ppb) at historical ground water high level by downward migration.

The comparison is shown in Table 5. Attenuation factor method is within an order of magnitude of VLEACH model. The numerical levels determined by attenuation factor method are a factor of two or three below the VLEACH results. Results from a further uncertainty study by Monte Carlo Simulation based on VLEACH indicate that the 75 percentile concentration can be a factor of three above the resulting median value (Rong 1995). Therefore, this study supports attenuation factor method to be three-fold below VLEACH results. Such a safety factor may be necessary at this time as VOC fate and transport in the vadose zone could not be quantitatively predicted or verified by field data.

Table 5: Comparison Between AF Method and VLEACH

	Depth (ft)	Soil Cleanup Concentration for PCE (ppb)	
		AF	VLEACH
Case 1	30	34	100
	45	19	50
	65	6	25
Groundwater at 95			
Case 2	40	90	275
	50	75	160
Groundwater at 140			

## 9. Case Study

### 9.1 Example 1

Ground water depth is 70 feet at a subject site. Use Table 4 to calculate attenuation factor at surface level and 30 feet depth, given lithology of 50 percent gravel and 50 percent sand. Then compare the calculated attenuation factors with the ones under lithology of 60 percent silt and 40 percent clay.

At surface level (i.e., D=70 feet above ground water), from Table 4:

$$\begin{aligned} \text{AF}(\text{gravel, 70 feet}) &= 3+(5-3)/2 = 4, & \text{AF}(\text{sand, 70 feet}) &= 7+(11-7)/2 = 9 \\ \text{AF}(\text{silt, 70 feet}) &= 13+(22-13)/2 = 17.5, & \text{AF}(\text{clay, 70 feet}) &= 67+(109-67)/2 = 88. \end{aligned}$$

At 30 feet depth (i.e., D=70-30=40 feet above ground water), directly from Table 4:

$$\text{AF}(\text{gravel, 40 feet})=1, \text{AF}(\text{sand, 40 feet})=3, \text{AF}(\text{silt, 40 feet})=5, \text{AF}(\text{clay, 40 feet})=26.$$

Scenario 1: Lithology = 50% gravel / 50% sand

$$\begin{aligned} \text{AF}_{70} &= \text{AF}(\text{gravel, 70 feet}) \times 50\% + \text{AF}(\text{sand, 70 feet}) \times 50\% \\ &= 4 \times 50\% + 9 \times 50\% = 6.5 \\ \text{AF}_{40} &= \text{AF}(\text{gravel, 40 feet}) \times 50\% + \text{AF}(\text{sand, 40 feet}) \times 50\% \\ &= 1 \times 50\% + 3 \times 50\% = 2 \end{aligned}$$

Scenario 2: Lithology = 60% silt / 40% clay

$$\begin{aligned} \text{AF}_{70} &= 17.5 \times 60\% + 88 \times 40\% = 45.7 \\ \text{AF}_{40} &= 5 \times 60\% + 26 \times 40\% = 13.4 \end{aligned}$$

Table 6: AF Results under Different Lithology

Distance Above Ground Water (D)(ft)	Depth below Surface (ft)	AF with 50% gravel 50% sand	AF with 60% silt 40% clay
70	0	7	46
40	30	2	13

## 9.2 Example 2

Ground water at a VOC impacted site is at about 95 feet. Primary soil contaminants are PCE, TCE, and 1,1-DCE. Use Table 2 and equations given in the text to calculate step by step attenuation factors given site-specific lithological information. Then determine soil cleanup screening levels for PCE, TCE, and 1,1-DCE, respectively, and also for total VOCs for this site.

Step 1: to determine AF.

From Table 2,  $AF_{MAX}$  for PCE is 729,  $AF_{MAX}$  for TCE is 145, and  $AF_{MAX}$  for 1,1-DCE is 95. The average  $AF_{MAX}$  value for all 29 VOCs is equal to 255 in Table 2.

Step 2: to calculate  $AF_D$ , given  $AF_{MAX}$  values.

Distance above ground water (D) can be subjectively selected based on site-specific contamination and lithological information, or any point of interest, e.g., around a silt/clay layer or the highest concentration of soil contaminant vertical distribution, etc. Here, we select D=30 feet (65 feet below ground surface (bgs)), D=65 feet (30 feet bgs), and D=90 feet (5 feet bgs), respectively.

a) When D = 30 ft, since  $D \leq 40$ , use equation (7):  $AF_D = D \cdot [0.1 \cdot AF - 1] / 40 + 1$

i.e.,  $AF_{D=30} = 30 \cdot [0.1 \cdot AF - 1] / 40 + 1$

When AF for PCE = 729,  $AF_{D=30}$  (PCE) =  $30 \cdot [0.1 \cdot 729 - 1] / 40 + 1 = 55$

Similarly,  $AF_{D=30}$  (TCE) =  $30 \cdot [0.1 \cdot 145 - 1] / 40 + 1 = 11$   
 $AF_{D=30}$  (1,1-DCE) =  $30 \cdot [0.1 \cdot 95 - 1] / 40 + 1 = 7.4$   
 $AF_{D=30}$  (Total VOCs) =  $30 \cdot [0.1 \cdot 255 - 1] / 40 + 1 = 19$

b) When D = 65 ft, since  $40 < D < 150$ , use equation (6):  $AF_D = [0.9 \cdot (D-40) / 110 + 0.1] \cdot AF$

i.e.,  $AF_{D=65} = [0.9 \cdot (65-40) / 110 + 0.1] \cdot AF = 0.3 \cdot AF$

When AF for PCE = 729,  $AF_{D=65}$  (PCE) =  $0.3 \cdot 729 = 219$

Similarly,  $AF_{D=65}$  (TCE) =  $0.3 \cdot 145 = 44$   
 $AF_{D=65}$  (1,1-DCE) =  $0.3 \cdot 95 = 29$   
 $AF_{D=65}$  (Total VOCs) =  $0.3 \cdot 255 = 77$

c) When D = 90 ft, since  $40 < D < 150$ , use equation (6):  $AF_D = [0.9 \cdot (D-40) / 110 + 0.1] \cdot AF$

i.e.,  $AF_{D=90} = [0.9 \cdot (90-40) / 110 + 0.1] \cdot AF = 0.5 \cdot AF$

When AF for PCE = 729,  $AF_{D=90}$  (PCE) =  $0.5 \times 729 = 365$

Similarly,  $AF_{D=90}$  (TCE) =  $0.5 \times 145 = 73$   
 $AF_{D=90}$  (1,1-DCE) =  $0.5 \times 95 = 48$   
 $AF_{D=90}$  (Total VOCs) =  $0.5 \times 255 = 128$

Step 3: to calculate  $AF_T$ .

Lithology information can be obtained from site boring logs.

a) Given D = 30 ft and the following lithology:

TGR (Gravel) = 25 ft  
TSA (Sand) = 5 ft  
TSI (Silt) = 0 ft  
TCL (Clay) = 0 ft

Use equation (12):  $AF_T = (AF_{D=30}/D) \cdot (TGR/20 + TSA/10 + TSI/5 + TCL)$

$AF_T$  (PCE) =  $(55/30) \cdot [(25/20) + (5/10)] = 3$   
 $AF_T$  (TCE) =  $(11/30) \cdot [(25/20) + (5/10)] = 1$  (by definition)  
 $AF_T$  (1,1-DCE) =  $(7.4/30) \cdot [(25/20) + (5/10)] = 1$  (by definition)  
 $AF_T$  (Total VOCs) =  $(19/30) \cdot [(25/20) + (5/10)] = 1.1$

b) Given D = 65 ft and the following lithology:

TGR (Gravel) = 35 ft  
TSA (Sand) = 22 ft  
TSI (Silt) = 8 ft  
TCL (Clay) = 0 ft

Use equation (12):  $AF_T = (AF_{D=65}/D) \cdot (TGR/20 + TSA/10 + TSI/5 + TCL)$

$AF_T$  (PCE) =  $(219/65) \cdot (35/20 + 22/10 + 8/5) = 19$   
 $AF_T$  (TCE) =  $(44/65) \cdot (35/20 + 22/10 + 8/5) = 4$   
 $AF_T$  (1,1-DCE) =  $(29/65) \cdot (35/20 + 22/10 + 8/5) = 2.5$   
 $AF_T$  (Total VOCs) =  $(77/65) \cdot (35/20 + 22/10 + 8/5) = 7$

c) Given D = 90 ft and the following lithology:

TGR (Gravel) = 35 ft  
TSA (Sand) = 31 ft  
TSI (Silt) = 24 ft  
TCL (Clay) = 0 ft

Use equation (12):  $AF_T = (AF_{D=90}/D) \cdot (TGR/20 + TSA/10 + TSI/5 + TCL)$

$$AF_T (\text{PCE}) = (365/90) \cdot (35/20 + 31/10 + 24/5) = 39$$

$$AF_T (\text{TCE}) = (73/90) \cdot (35/20 + 31/10 + 24/5) = 8$$

$$AF_T (1,1\text{-DCE}) = (48/90) \cdot (35/20 + 31/10 + 24/5) = 5$$

$$AF_T (\text{Total VOCs}) = (128/90) \cdot (35/20 + 31/10 + 24/5) = 14$$

Step 4: to determine soil cleanup screening levels.

MCLs for PCE, TCE, and 1,1-DCE are 5 µg/l, 5 µg/l, and 6 µg/l, respectively. Since the lowest MCL among these three compounds detected is 5 µg/l, this value is used in equation (13) to calculate soil cleanup screening levels for total VOCs. The soil cleanup screening levels at different depths for different compounds are summarized in Table 7.

Table 7: Soil Cleanup Screening Levels for Different Compounds

Distance above Ground Water (D)(ft)	Depth below Surface (ft)	PCE (MCL=5ppb)			TCE (MCL=5ppb)			11DCE (MCL=6ppb)			Total VOCs (use MCL=5ppb)		
		AF <sub>D</sub>	AF <sub>T</sub>	C	AF <sub>D</sub>	AF <sub>T</sub>	C	AF <sub>D</sub>	AF <sub>T</sub>	C	AF <sub>D</sub>	AF <sub>T</sub>	C
90	5	365	39	195	73	8	40	48	5	30	128	14	70
65	30	219	19	95	44	4	20	29	2.5	15	77	7	35
30	65	55	3.2	16	11	1	5	7.4	1	6	19	1.1	6

C=Soil Cleanup Concentration (ppb)

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# **APPENDIX B**

**GENERAL REQUIREMENTS**

**FOR**

**SITE INVESTIGATIONS**

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**STATE OF CALIFORNIA**  
**California Regional Water Quality Control Board**  
**Los Angeles Region**

**GENERAL REQUIREMENTS**  
For  
**SUBSURFACE INVESTIGATIONS**

Objectives of subsurface soil/groundwater investigations are to evaluate historic and current waste discharges and to mitigate them as potential sources of groundwater contamination. In addition to the general requirements provided herein, work plans must be submitted for each investigation to be conducted. Specific requirements for Subsurface Soil Investigation, Active Soil Gas Investigation, and Groundwater Investigation are provided separately. Site-specific modification to these requirements may be allowed upon consultation with the Regional Board staff. Work should not be initiated without pre-approval.

**WORK PLAN:** Submit required number of copies of the work plan with a minimum time schedule for submitting a final technical report.

**SITE INFORMATION:** Characterize past and present specific business activities. Describe storage, handling, use, and disposal procedures for chemicals and waste materials, primarily chlorinated solvents, aromatics and petroleum-based hydrocarbons. Give name, address, and phone number of any landlord/lessor. Complete the Site Audit Questionnaire. Submit the results of any previous subsurface investigations conducted at the site and any report(s) generated for site assessment.

**FACILITY MAP:** Draw a facility map to scale including a north arrow, property lines and adjacent street(s). Identify all past and present potential sources for soil and/or groundwater contamination, such as chemical and waste storage, transfer, and use areas including drum storage, tanks and piping, clarifiers, sumps, pits, septic tank/cesspool systems, and sewer lines. Indicate dates of completion of buildings or pavings where possible.

**SITE HEALTH AND SAFETY PLAN:** Submit a site-specific health and safety plan for subsurface investigation, commensurate with the scope and nature of work to be completed.

**PERSONNEL:** ASSURE THAT A CALIFORNIA REGISTERED GEOLOGIST OR ENGINEER OR CERTIFIED ENGINEERING GEOLOGIST BE ON-SITE TO DIRECT OR CONDUCT SUBSURFACE INVESTIGATIONS FOR CERTAIN PERIODS OF TIME PROPORTIONAL TO THE SCOPE AND COMPLEXITY OF THE WORK AND SIGN THE FINAL TECHNICAL REPORT.

**FIELD WORK:** Do not proceed with field work without prior approval. Notify Regional Board staff at least 10 days prior to initiating field work to permit observation of field activities and/or to take duplicate samples as needed.

**REPORTS:** Submit required number of copies of a final technical report within 4 weeks after completion of field activities. Include a description of all field drilling and sampling activities, summary of sample analytical results and related QA/QC data, conclusions based upon the analytical results and investigation findings, and recommendations for additional work as needed. Report all analytical results and QA/QC data on the LabForm 10A/10B (for volatile organics and petroleum hydrocarbons).

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**STATE OF CALIFORNIA**  
**California Regional Water Quality Control Board**  
**Los Angeles Region**

**REQUIREMENTS**  
**For**  
**SUBSURFACE SOIL INVESTIGATIONS**

These requirements are to be used when conducting initial and any supplementary engineering/geologic soils investigation to evaluate:

1. Waste discharges to soils at potential point sources areas,
2. Lateral and vertical extent of soil contaminants,
3. Soil properties which affect contaminant mobility and transport in the vadose zone.

**WORK PLAN:** A work plan must be submitted to meet the General Requirements For Subsurface Investigation and shall also include, but not be limited to, the following:

1. Indicate the number, location, and depth of soil borings and justify. Plot on facility map.
2. Take soil samples at 5-foot intervals, and each change in lithology or changes in observed contamination.
3. Take samples from the middle of low permeability or high moisture content units if the units are thicker than five feet.
4. Explain proposed drilling method, equipment, and procedures for borings.
5. Describe equipment and procedures for collecting and handling of geologic materials.
6. Identify borehole backfill materials, procedures, and disposal method for soil cuttings.

**FIELD PROCEDURE:** The following investigation procedures must also be addressed in the work plan at a minimum.

1. Extend boring depth if groundwater is encountered or if there is obvious contamination at the bottom of the borehole.

2. Do not use soil samples obtained by any air or fluid drilling methods for volatile, semi-volatile or petroleum hydrocarbon chemical analyses.
3. Provide complete and legible boring logs including:
  - a) Description of earth materials, conditions (moisture, color, etc.), and classifications per Unified Soil Classification System (USCS);
  - b) Lithographic column with USCS abbreviations and symbols;
  - c) Sample depth in feet;
  - d) Penetration in blows per foot (blow counts) and inches (or percent) of sample recovered;
  - e) Vapor readings of samples using Organic Vapor Analyzer.
4. Use soil sample rings at least 2" (diameter) by 3" (length).
5. Take, seal, and transport discrete and undisturbed samples with no headspace to the laboratory for analysis. Do not use samples to be submitted for laboratory analyses for field screening or classification.
6. Comply with chain of custody procedures. Samples must be handled and analyzed per the Laboratory Requirements For Soil and Water Sample Analyses and QA/QC Guidance Document (11/92).
7. Sample and analyze water, if ground water is encountered, only after converting to a monitoring well or piezometer per the Requirements For Groundwater Investigation.

**OPTIONAL REQUIREMENTS:** Additional soil physical data collection may be considered during site assessment and/or remediation phases to perform site-specific risk assessment and/or fate and transport modeling.

Soil samples shall be collected from different lithological units at various locations and depths, and sent to laboratory for determining the following parameters:

- a) Water-Solid adsorption/distribution coefficient (Kd)
- b) Fraction of organic carbon content (foc)
- c) Grain-size distribution
- d) Effective soil porosity
- e) Bulk density
- f) Soil moisture content
- g) Plasticity index for clayey and silty materials
- h) Gas permeability (if possible).

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**STATE OF CALIFORNIA**  
**California Regional Water Quality Control Board**  
**Los Angeles Region**

**REQUIREMENTS**  
**For**  
**GROUNDWATER INVESTIGATIONS**

These requirements are to be used for hydrogeologic assessments and groundwater monitoring programs to determine:

1. Impacts of discharges on groundwater quality,
2. Lateral and vertical extent of contaminant plume(s),
3. Groundwater gradient and direction of flow, and
4. Specific aquifer properties as required.

**WORK PLAN:** A work plan must be submitted to meet the General Requirements For Subsurface Investigation and shall also include, but not be limited to, the following:

1. Provide a map, to scale, showing the location(s) of the proposed well(s) and nearby existing well(s).
2. Provide well design, specifications and construction details including casing and screen materials, screen length and placement with respect to water table, depth and type of annular seal.
3. Propose and explain drilling method(s) to be used and decontamination procedures.
4. Provide disposal plans for soil cuttings and development water.

**FIELD PROCEDURE:** The following investigation procedures must also be addressed in the work plan at a minimum.

**MONITORING WELL CONSTRUCTION/DEVELOPMENT:**

1. Use a minimum of 4" diameter, stainless steel wire-wrapped screen.

2. Do not penetrate a competent clay layer below the saturated zone. Conduct physical and hydraulic tests to determine competency of any confining zone materials. Take a sample of the confining clay at the end of borehole for chemical analysis.
3. Suspend and centralize casing such that it is not resting against the sides nor bottom of the hole prior to fixing in place.
4. Place grout of either cement, bentonite or mixture in an appropriate manner to avoid bridging.
5. Characterize aquifer materials based upon sieve analysis for proper selection of filter pack and screen. Less than 10% of the filter pack should enter the well.
6. Provide geophysical logging for all well boreholes by qualified personnel to confirm the geologic logging per USCS during the drilling.
7. Establish benchmark relative to mean sea level. Provide benchmark location and survey date. Measure water levels to 0.01 foot. Provide well location using UTM Coordinates.
8. Wait no less than 48 hours for well seal materials to set before well development. Develop well such that the waters sampled are representative of the formation water. Obtain water sample with less than 5 NTUs of turbidity measurement to be acceptable for volatile organic compound (VOC) analysis.

### WATER SAMPLING

1. Wait a minimum of seven days after well development.
2. Describe details of water sampling and provide:
  - a) Water level measurement procedures;
  - b) Purge techniques, purge volumes, and parameters (pH, temperature, conductivity, and turbidity) to assure the collection of a representative water sample;
  - c) Water sampling device(s);
  - d) Procedures to minimize loss of samples by adsorption and/or volatilization.
3. Describe methods for sample handling and preservation.
4. Comply with chain of custody procedures. Samples must be handled and analyzed per the Laboratory Requirements For Soil and Water Sample Analyses and QA/QC

Guidance Document (11/92).

**REPORTING:**

1. Have final technical report signed by a California Registered Geologist or Engineer or Certified Engineering Geologist with five years hydrogeologic experience to be accepted.
2. Incorporate all boring logs, geophysical logs, and sieve analysis results with interpretation in final report.
3. Illustrate the groundwater contaminant plume(s) by plan view and cross section (to scale), including direction of section lines, scale, legend, constituent concentrations, and lithology.
4. Recommend additional assessment requirements and plans for site remediation as needed.

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**STATE OF CALIFORNIA**  
**California Regional Water Quality Control Board**  
**Los Angeles Region**

**LABORATORY REQUIREMENTS**  
**For**  
**SOIL AND WATER SAMPLE ANALYSES**

This document serves as a portion of the requirements for soils and groundwater investigation and site assessment and/or cleanup, and is complementary to the QA/QC Guidance Document (11/92), Requirements For Subsurface Soil Investigation and Requirements For Groundwater Investigation.

**GENERAL:**

1. Employ a laboratory certified by the State Department of Health Services, Environmental Laboratory Accreditation Program (ELAP) for each analytical testing method to be used.
2. Quantify method detection limits (MDLs) for low level testing. Report concentrations for constituents identified above MDLs. Otherwise, indicate as trace and provide estimated concentration.
3. Report an analytical result as "non-detected" (ND) only for constituents from samples analyzed without dilution.
4. Take appropriate corrective actions for any laboratory contamination or matrix interference problems and report the corrective actions in support of the analytical results. Do not have results blank adjusted.
5. Include laboratory QA/QC procedures and performance as follows:
  - a) Calibration check standards including the most recent initial calibration range (the lowest to the highest injected concentrations) and average response factors (RF), %RSD, daily RF from continuing (mid-point) calibration and its percent difference from the initial calibration average RF;
  - b) Method blanks (daily);
  - c) Laboratory quality control check samples (LCS) and spiking concentrations (daily). LCS chemical standards and calibration standards must be obtained from different supply sources;
  - d) Surrogate samples and spiking concentrations (each sample);
  - e) Matrix spike and matrix spike duplicates (MS/MSD) (every batch of samples). If more than 10 samples are obtained for the subsurface investigation project, spike at least one of them.

6. Report all analytical results and QA/QC sample results on the LabForm 10A (for volatile organics and petroleum hydrocarbons). Run all QA/QC items specified above on the same dates when samples were actually analyzed.

#### SOIL SAMPLES:

1. Analyze samples by EPA Methods 8010/8020 or 8260 for volatile organic compounds (VOCs) and EPA Method 418.1 and/or EPA Method 8015 (Modified) for total petroleum-based hydrocarbons (TPH). Use supplementary EPA Method(s) as necessary for any past and/or present site chemicals (e.g., metals, phenols, PCBs, etc.).
2. Achieve MDLs of 1 - 2 µg/kg for select VOCs as specified in RWQCB LabForm 10A. Achieve 5 mg/kg for EPA Method 418.1. Achieve MDLs of 500 - 5000 µg/kg for EPA Method 8015 (Modified), depending upon type of hydrocarbons to be tested (gasoline, jet fuel, diesel, etc.).
3. Complete initial calibration consisting of a minimum of three points.
4. Analyze VOC samples within seven days and prior to other analyses (TPH, metals, etc.) unless separate samples are obtained at the site. Results for VOCs analyzed after seven days are considered to be low estimates of actual concentrations.
5. Specify and explain extraction method(s) and procedures to be used to prepare samples for hydrocarbon analyses based upon soil type and hydrocarbon characteristics. Fine-grained soils (clay or silt) or long-chain hydrocarbons require sufficient extraction time, which must be identified in the workplan and verified in the laboratory report.

#### WATER SAMPLES:

1. Analyze samples by EPA Methods 502.1/503.1 or 524.2 for VOCs. Use EPA Method 418.1 or EPA Method 8015 (Modified) for TPH analysis. Use supplementary EPA Method(s) as necessary for any past and/or present site chemicals. During the baseline groundwater monitoring, analyze general minerals and nitrogens (nitrate, nitrite, and ammonia).
2. Achieve MDLs of 0.5 - 1 µg/L for select VOCs as specified in RWQCB LabForm 10A. Achieve 2 mg/L for EPA Method 418.1. Achieve MDLs of 100 - 500 µg/L for EPA Method 8015 (Modified), depending upon type of hydrocarbons to be tested (gasoline, jet fuel, diesel, etc.).
3. Complete initial calibration consisting of a minimum of five points.

4. Analyze trip blanks, equipment blanks, and duplicate samples in addition to QA/QC items specified above.
5. Submit a separate sample for turbidity analysis and report result.

WIP/L02 0295

## **INSTRUCTIONS FOR RWQCB-LA LABORATORY REPORT FORM COVER PAGES (6/00)**

These instructions assist in completion of the report format required by the Regional Water Quality Control Board, Los Angeles Region. Other agencies or regulatory bodies may also require the use of this reporting format. The report format is to be applied to all stationary laboratories and mobile laboratories that undertake analyses under RWQCB-LA's jurisdiction. Failure to report in the format required may result in rejection of the analytical results.

Laboratories can use their available software to duplicate the reporting formats. The format and terminology shall be kept the same as this format with the exception of column widths and font types. The shading and grid lines are optional, however they help the reader to locate data easily.

Cover pages 1 and 2 can be used for all RWQCB LabForms. RWQCB LabForm 10A is designed for reporting all organics analyses. RWQCB LabForm 10C is for metal analyses. Do not try to amend the report forms to fit in analyses other than specified.

### Page 1: Laboratory and Project Information

1. Complete the top section of page one with the laboratory information. The laboratory name, address, telephone and facsimile (FAX) numbers, California ELAP Certification number and expiration date are required. The actual expiration date must be entered. If renewal is in the process, enter the expiration date and enter "Renewal in process" under the date.
2. Under "AUTHORIZED SIGNATURE", print or type the name and title of the authorized person who has reviewed the report. This person must sign and date the following line. The authorized person must be the laboratory director, QA/QC officer, or the person who is in charge of reviewing the data.
3. After "CLIENT NAME", enter the full name of the company or agency that submitted the samples to the laboratory for analysis.
4. After "PROJECT No.", enter the number, name and/or site of the project as identified by the client.
5. After "DATE(S) SAMPLED", "DATE(S) RECEIVED", and "DATE(S) REPORTED", enter the date, or range of dates, that the samples were collected and submitted to the laboratory and the sample results were reported to the client (e.g., Date Sampled: 6/2/94 to 6/3/94; Date Received: 6/3/94; Date Reported 6/10/94). The dates sampled and received should correspond to the dates on the chain of custody forms. The date reported is when the results were first released to the client.
6. Circle either "YES" or "NO" to indicate whether or not a Chain of Custody form was received with the samples. Attach a copy of Chain of Custody form.
7. The Comments section is used to describe any problem which occurred with the samples or analysis which may potentially affect the technical or legal defensibility of the data. Examples of problems may include sample head-space, insufficient sample volume, exceeded holding time, and QA/QC outside of acceptance limits. To avoid rejection of data

by regulatory agencies, efforts should be made to resolve any of these problems prior to the analysis and release of sample results.

Page 2: Sample Summary

1. Page 2 contains four different analysis sections: ORGANICS (VOCs, TPH, Pesticides, Herbicides, PCBs, etc.), INORGANICS (Metals), MICROBIOLOGICAL, and OTHER TYPES OF ANALYSES. In each applicable section, list EPA method used, the number of samples analyzed by that method at the laboratory listed on page 1 and the number of samples, if any, subcontracted to another laboratory which must also be certified by ELAP.
2. After "SAMPLE CONDITION" at the bottom of each analysis section, indicate the condition of the samples upon receipt at the laboratory. If the sample condition meets all of the necessary criteria, then enter "Acceptable". If the sample condition does not meet the criteria, enter the deficiency (e.g., no preservative, head-space present, unchilled samples).

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION**

LABORATORY REPORT FORM (COVER PAGE 1)

Laboratory Name: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

Telephone/Fax: \_\_\_\_\_

ELAP Certification No./  
Expiration Date \_\_\_\_\_

Authorized Signature  
Name, Title (print) \_\_\_\_\_

Signature, Date \_\_\_\_\_

Client Name \_\_\_\_\_

Project No. \_\_\_\_\_

Date(s) Sampled: (from – to) \_\_\_\_\_

Date(s) Received: (from – to) \_\_\_\_\_

Date(s) Reported: (from – to) \_\_\_\_\_

Chain of Custody Received: Yes \_\_\_\_\_ No \_\_\_\_\_

Comments \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION**

LABORATORY REPORT FORM (COVER PAGE 2)

Organic Analyses                      # of Samples                      # of Samples Subcontracted

Sample Condition:

Inorganic Analyses                      # of Samples                      # of Samples Subcontracted

Sample Condition:

Microbiological Analyses                      # of Samples                      # of Samples Subcontracted

Sample Condition:

Other Types of Analyses                      # of Samples                      # of Samples Subcontracted

Sample Condition:

This form can be used for reporting analyses of volatile organic compounds, semi-volatile, petroleum hydrocarbons, PCBs, pesticides, herbicides, and other organics.

Page 1 of 3: Analytical Result

A. Header Information

1. After "Project No:", enter the client's project number (from cover page 1). This number is required on every page of the report.
2. After "METHOD", enter the analytical method used. (e.g., EPA 8260, or EPA method 8021).
3. After "REPORTING UNIT", enter the appropriate reporting unit. The units ug/L for water samples and ug/Kg for soil samples are recommended for volatile analyses. The units mg/L and mg/Kg are recommended for TPH/semi-volatile analyses.
4. After "DATE ANALYZED", enter the date on which the sample is analyzed.
5. After "DATE EXTRACTED", enter the date on which the sample is extracted with solvent. If no solvent is used (e.g., purge and trap without organic solvent extraction), enter "N/A" (Not Applicable).
6. After "LAB SAMPLE I.D.", enter the I.D. number the laboratory assigned to each sample.
7. After "CLIENT SAMPLE I.D.", enter the I.D. number the client used when the sample was collected.
8. After "EXTRACTION SOLVENT", enter the type of solvent used for extraction before purge and trap or injection into instrument.
9. After "EXTRACTION METHOD", enter EPA Method used for extraction. (e.g., EPA 3550). For VOC sample which is extracted with methanol, enter the method used. (e.g., EPA 5030 for EPA 8021, EPA 8260 for the GC/MS methods.)
10. After "DILUTION FACTOR", enter the dilution factor for each sample. If a sample is not diluted (e.g., direct purge and trap of water sample), enter "1" as dilution factor.
11. If more than one page is needed, complete the header information for all samples analyzed on the subsequent pages. The method blank does not need to be repeated on each subsequent page. If more than one method blank is analyzed, report each method blank with the samples to which it applies for validation purposes. The column widths may be changed to put analysis results for more samples on each page.

## B. Analytical Results

1. Under "COMPOUND", list each analyte which the samples were tested for. List the analytes (alphabetical order or elution order is recommended). EPA Methods analyzed in series (e.g., EPA 8015 (modified) may be listed on the same results page. For hydrocarbons which cannot be positively identified as a specific product, indicate the type of hydrocarbons detected (e.g., hydrocarbons in the range of C23-C32).
2. Under "CRDL" (Contract Required Detection limit), list the detection limit used for reporting each analyte. If sample has to be diluted for one constituent, do not automatically adjust the CRDL for other constituents by the same dilution factor, and report results of other constituents under the CRDL without dilution.
3. In each column for the method blank and the samples, report all analytes detected above the CRDL. Do not subtract blank or adjust sample results for blank contamination. Any analyte not detected above the CRDL should be reported as "<CRDL value" (whatever the CRDL value is after taking into account dilution factor, e.g., <0.5). Samples must show the final results calculated with dilution factor. (e.g., sample after 10 times dilution gives analysis result of 10 ppb. Then the final result reported for this sample should be 100 ppb.) The CRDL for some analytes may be at or near the laboratory method detection limit. However, do not flag any data as estimated or below certain confidence levels.
4. If the list of analytes continues on to the second page, repeat the analytical method, reporting unit, laboratory sample identification and client sample identification on the second page in the spaces provided. Continue with the reporting of detection limits and analytical results as on the first page.
5. If samples are analyzed under different dilution factor, use separate column to report. Report a result as "non-detected" (ND) only for samples analyzed without dilution.
6. For SURROGATE, list surrogate compounds added to blank and samples. Report Spike Concentration (SPK CONC) of added surrogate, Acceptable % Limits (ACP%) for each surrogate, and % Recovery (%RC) of each surrogate in blank and each sample. If the analyte list lasts only one page, place the surrogate box at the bottom of the first page. If the analyte list continues on to other pages, place the surrogate box at the bottom of the last page.

Page 2 of 3: QA/QC Report

## I. Calibration Standard

## A. Initial Calibration (IC)

1. The initial calibration format provided or direct printouts from analytical instruments can be

used as an alternative of the IC format.

2. No matter which IC format (RWQCB form or direct instrument printouts) is used, provide the following data:

<u>Date performed:</u>	Date the IC was performed most recently and applied in calculation of the sample results.
<u>Standard Supply Source:</u>	Source of the standard used in IC.
<u>Instrument I.D.:</u>	ID or name of the instrument used for IC, QA/QC, and sample analyses.
<u>Analytical Method:</u>	EPA method used in IC, all QA/QC, and sample analyses.
<u>Date of source:</u>	Date when standard for IC was received or prepared in-house.
<u>Lot Number:</u>	The lot number of the standard used for IC.
<u>Compound:</u>	Name of compounds in IC.
<u>Detector:</u>	Detector used for analysis of the listed compound.
<u>RT:</u>	Retention time of listed compound.
<u>Mass/Conc:</u>	Injected mass or concentration of the listed compound. List all five masses or concentrations. Unit must be given (e.g., ng for mass and ug/L for concentration). If concentration is used, volume of standard injected must be reported.
<u>Area:</u>	Area count of each concentration level.
<u>RF:</u>	Response factor of each concentration level.
<u>RF(ave):</u>	Average RF.
<u>SD(n-1):</u>	Standard deviation with (n-1) degree of freedom.
<u>%RSD:</u>	% relative standard deviation.

B. Continuing Calibration (CC) (Daily Mid-point Calibration)

1. The CC format provided or direct printouts from analytical instruments can be used as an alternative of the CC format.
2. No matter which CC format (RWQCB form or direct instrument printouts) is used, provide the following data:

<u>Compound:</u>	Names of compounds in CC.
<u>Detector:</u>	Same as above in (A) Initial Calibration.
<u>RT:</u>	Same as above in (A) Initial Calibration.
<u>Mass/Conc:</u>	Same as above in (A) Initial Calibration.
<u>Area:</u>	Same as above in (A) Initial Calibration.
<u>RF:</u>	Same as above in (A) Initial Calibration.
<u>%DIFF:</u>	Percent difference between RF of continuing calibration and RF(ave) of initial calibration.

ACP RGE

%DIFF: Acceptable range for %DIFF.

Page 3 of 3: QA/QC Report (Continued)

II. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

1. Under "DATE PERFORMED", enter the date that MS/MSD is performed, which must be the same as the batch of samples that are analyzed.
2. Under "BATCH #", enter laboratory batch number associated with samples.
3. Under "LAB SAMPLE I.D.", enter the name or number of laboratory sample which is used for MS/MSD analyses.
4. Under "Analytical Method", enter the EPA Method and circle a reporting unit. The EPA Method and reporting unit must be the same as that reported for the samples.
5. Circle one to indicate unit.

Provide the following data in the table:

<u>Analyte:</u>	The spiking analytes in sample.
<u>Sample</u>	
<u>Result:</u>	The original sample result associated with the spiking analytes.
<u>Spike Conc:</u>	MS concentration of added analyte in sample.
<u>MS:</u>	Result of MS.
<u>%MS:</u>	% recovery for MS.
<u>Spike Conc</u>	
<u>(Dup):</u>	MSD concentration of added analyte in sample.
<u>MSD:</u>	Result of MSD.
<u>%MSD:</u>	% recovery for MSD
<u>RPD:</u>	Relative percent difference between MS and MSD
<u>MS/MSD</u>	
<u>LIMIT:</u>	Acceptance % limit for MS
<u>RPD LIMIT:</u>	acceptance limit for RPD

If the original sample results are "<CRDL" without dilution, enter "0" for sample result on this MS/MSD table.

III. Laboratory Control Sample (LCS)

1. After "DATE PERFORMED", enter the date LCS is analyzed, which must be the same as the batch of samples that are analyzed.

2. After "ANALYTICAL METHOD", enter EPA method used in LCS, which must be the same method used in QA/QC and sample analyses.
3. After "STANDARD SUPPLY SOURCE", enter source of the LCS standard.
4. After "DATE OF SOURCE", enter date when standard is used for LCS is received or prepared in-house.
5. After "INSTRUMENT I.D.", enter lab instrument I.D. for the LCS run.
6. After "LOT NUMBER", enter the lot number of the LCS standard.
7. After "LAB LCS I.D.", enter the laboratory ID number assigned to LCS.
8. Circle one to indicate unit.

Provide the following data in the table:

<u>Analyte:</u>	The LCS analyte.
<u>Spike Conc:</u>	Concentration of LCS analyte.
<u>Result:</u>	Result for each analyte.
<u>%Recovery:</u>	% recovery for LCS.
<u>ACP %REC</u>	
<u>LIMIT:</u>	Acceptance limit for LCS % recovery.

#### IV. General Reporting Requirements

1. Chromatograms, raw data on analysis, copy from logbooks, extraction logs, and other laboratory data relating to sample results are not required with report, but must be submitted upon request.
2. Workplan or monitoring program for a specific project may require additional site-specific analytes and/or conditions.
3. Use a separate sheet for more information for date of standard supply source, date of preparation, instrument I.D., lot number, etc.

#### V. General Requirements For Organics

The following requirements are not a replacement or substitution of the EPA method requirements which must be followed by the laboratories. These requirements serve as a specific emphasis or clarification to LARWQCB's QA/QC objectives in addition to EPA method requirements. Laboratories must comply with these requirements.

#### Sample Condition

The criteria for acceptable sample condition is determined by the method(s) which the samples will be analyzed. The laboratory should try to resolve any sample condition problems before the samples are accepted for analysis. If the problems are beyond being resolved, the samples should be rejected and resampling should be requested.

### Subcontracted Samples

Samples subcontracted to another laboratory, which must be certified by ELAP, must also conform to the requirements of this program and results must be submitted by the subcontracted laboratory on this report format.

### Target Compounds

The target compounds should be those specified in the method or as required by the LARWQCB.

Volatile organic compounds (VOCs) analysis must include the following compounds as target compounds at a minimum. If other compounds are also expected or detected in samples, they must be included in the target list. GC/MS method (e.g., EPA 8260) and ELCD (electronic conductivity detector)/PID (photoionization detector) in series method (e.g., EPA 8021) must include all target compounds. ELCD method (e.g. EPA 8021) must include all target halogenated compounds. PID method (e.g., 8021) must include all target aromatics.

#### **Halogenated compounds**

Bromodichloromethane	cis-1,2-Dichloroethene (c-1,2-DCE)
Bromoform	trans-1,2-Dichloroethene (t-1,2-DCE)
Bromomethane	1,2-Dichloropropane
Carbon tetrachloride	cis-1,3-Dichloropropene
Chlorobenzene	trans-1,3-Dichloropropene
Chloroethane	Methylene chloride (Dichloromethane)
Chloroform	1,1,2,2-Tetrachloroethane
Chloromethane	1,1,1,2-Tetrachloroethane
Dibromochloromethane	Tetrachloroethene (PCE)
1,2-Dichlorobenzene	1,1,1-Trichloroethane (1,1,1-TCA)
1,3-Dichlorobenzene	1,1,2-Trichloroethane (1,1,2-TCA)
1,4-Dichlorobenzene	Trichloroethene (TCE)
1,1-Dichloroethane (1,1-DCA)	Trichlorofluoromethane (Freon 11)
1,2-Dichloroethane (1,2-DCA)	Dichlorodifluoromethane (Freon 12)
1,1-Dichloroethylene (1,1-DCE)	Vinyl chloride (VC)

#### **Aromatics**

Benzene	m,p-Xylenes
Ethyl benzene	o-Xylene
Toluene	

CRDL

The detection limits should be those required by the LARWQCB, as specified in the assessment workplan/monitoring program or as specified in EPA methods used. Lower detection limits than these specified below can be required based on site-specific needs. If CRDL cannot be achieved due to matrix problem, laboratory must provide a written explanation and propose a reasonable CRDL under the situation.

CRDLs for VOCs must be 1 ug/L or 2 ug/Kg except for the following compounds. This low CRDLs are applicable to the samples with no detectable VOCs or low levels of VOCs. If sample needs to be diluted due to high contamination, see section concerning dilution in sample analysis requirements.

CRDL of 0.5 ug/L or 1.0 ug/Kg is required for these following compounds because MCLs or Action limits (AL) for these compounds are low as shown.

	MCL	AL
Benzene	1.0	
Carbon tetrachloride	0.5	
1,2-Dichloroethane	0.5	
1,3-Dichloropropene	0.5	
Dichlorodifluoromethane(Freon 12)		1.0
Vinyl chloride	0.5	

CRDL of 100 ug/L or 100 ug/Kg will be acceptable for following compounds.

Acetone  
 Acrolein  
 Acrylonitrile  
 Methyl Ethyl Ketone (2-butanone)  
 Methyl Isobutyl Ketone (4-Methyl-2-pentanone)

CRDL shall be 100-500 ug/L or 500-5000 ug/Kg for petroleum hydrocarbons depending on type of hydrocarbons to be tested (e.g., gasoline, jet fuel, diesel, etc.).

Analysis Methods

- For VOCs, if the samples have never been analyzed before (the type of compounds present is unknown), at least 10 % of samples from each site (or a minimum one sample if total samples are less than 10) should be analyzed using GC/MS method (e.g., EPA 8260B) first. The rest of samples can then be analyzed with non-GC/MS methods (e.g., EPA 8021) if desired.

2. Laboratory must report the number of tentative identified compounds and estimated results if possible for those samples analyzed by GC/MS method as required by Item 1 above.
3. If the GC/MS method analysis shows the presence of compounds that cannot or will not be detected by non-GC/MS method, then all the samples shall be analyzed by GC/MS method.
4. If the compounds present are known from previous analyses, the samples can be analyzed by either non-GC/MS or GC/MS method.
5. If the PID/ELCD in series method (e.g., EPA 8021) is used, the method must be reported as such (e.g., not reported as 8010/8020).
6. For other organic analyses (e.g., pesticides), confirmation must also be done by GC/MS. If GC/MS cannot confirm the compound due to low level, use second column for confirmation.

#### Initial Calibration

1. Initial 5 point calibration must be performed for all compounds in the above target list and any expected, required, or detected compound.
2. %RSD must be calculated for each compound and must not exceed 20%.
3. For GC/MS analyses, the %RSD of the Calibration Check Compounds (CCC) must be less than or equal to 30%. The CCC are: 1,1-dichloroethene, chloroform, 1,2-dichloropropane, toluene, ethylbenzene, and vinyl chloride.
4. Average Calibration Factor (CF) or Average Response Factor (RF(ave)) must be used for calculation of all sample results and QA/QC analyses.
5. In terms of practicality during compliance with the above requirements, for GC analyses, the percent relative standard deviation (%RSD) must not exceed 20% for 80% of all analytes calibrated. The %RSD for any analyte must not exceed 35%. However the %RSD for all compounds detected in samples must not exceed 20%.

#### Continuing Calibration (CC) (Daily mid-point calibration)

1. In terms of practicality during compliance with the requirement, for GC analyses, the percent difference (%DIFF) from initial calibration must not exceed 15% for 80% of all analytes calibrated. The compounds that meet the 15% difference requirement must be the same compounds which meet the %RSD in the initial calibration. The %DIFF for any analyte calibrated must not exceed 35%. However, the %DIFF for all compounds detected

in samples must not exceed 15%.

2. For GC/MS analyses, the %DIFF of CCC must not exceed 20%.

### Surrogate

The surrogate(s) used and surrogate recovery acceptance limits should be determined by the EPA Method guidelines. If there are no EPA guidelines, the laboratory can use the appropriate surrogate(s) and the recovery limits should be in a range determined by in-house laboratory control charts. Data for the control charts must be submitted upon request.

### Method Blank

The method blank should not show any concentration more than five times (5X) the CRDL for any single target compound. If exceeded, the laboratory should investigate the source of contamination and take corrective actions before proceeding with further sample analysis. Any disclaimer statement such as the following example concerning the blank and interpretation of result will not be acceptable and should not be included in report.

"Results should not be considered reliable unless the sample result exceeds five times (5X) the CRDL or ten times (10X) the blank concentration."

### MS/MSD

MS/MSD analyses should be performed for every project (for each site) at a minimum rate of one per 20 samples or per batch, whichever is more often. The spiking analytes used for the MS/MSD analyses should be those required by the LARWQCB. When the spiking analytes are not specified by LARWQCB, the ones specified in EPA methods should be used. If EPA method does not specify, then appropriate ones chosen by the laboratory can be used. If MS/MSD is not required by the method used, MS/MSD may not be required unless specified in workplan.

For VOCs analysis, the following compounds must be included in the spiking for MS/MSD.

#### **Halogenated Compounds:**

Chloroform  
1,1-Dichloroethane (1,1-DCA)  
1,2-Dichloroethane  
1,1-Dichloroethylene (1,1-DCE)  
Tetrachloroethylene (PCE)  
Trichloroethylene (TCE)

#### **Aromatics:**

Benzene  
Toluene  
MTBE

The acceptance limit should agree with EPA guidelines for each method used. If there are no EPA guidelines, it may be determined in a range by in-house laboratory control charts. Data for the control charts must be submitted upon request. Trace levels of analyte may be used in

MS/MSD calculations even if reported as non-detected on the report form.

#### Laboratory Control Sample (LCS)

The LCS analysis must be performed each day that samples are analyzed. The LCS must be obtained from a different supplier or a different lot from the calibration standards. If prepared in-house, it must be prepared from a stock solution different from calibration standards. The LCS should be analyzed in reagent water. It does not have to be matrix matched like the MS/MSD analyses.

The spiking analytes used for the LCS analyses should be those required in the target compound list or those required by the LARWQCB.

The acceptance limits for the LCS for volatile organic analyses are 80%-120%. LCS acceptance limits for other organic analyses should be determined by EPA Method guidelines, or in-house laboratory control charts if there are no EPA Method guidelines for this compound. Data for the control charts must be submitted upon request.

#### Sample Analysis

All samples must be analyzed to comply with CRDL requirements above. If sample dilution is required due to high concentrations of some compounds, the initial run must be used to calculate the results for constituents that are not affected by the high concentrations so that CRDL can be met for these compounds.

If concentrations of compounds present in samples are known to be high (outside the calibration range) from previous analyses or confirmative information, the samples can be directly diluted and then analyzed. Low CRDL will not be applicable for these samples if they are found to be high. If not, an undiluted sample must be reanalyzed to meet the CRDL requirements.

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### **ACKNOWLEDGEMENTS**

The following staff of the California Regional Water Quality Control Board - Los Angeles Region involved to finalize this document: David Bacharowski, Alex Carlos, Rebecca Chou, Yue Rong, Hiam Tan. During the reporting form development and revision, representatives from many regulated laboratories, especially the Association of California Testing Laboratories (ACTLabs), and the California Health Department Environmental Laboratory Accreditation Program (ELAP), provided valuable comments that make the improvement of the form possible.



Project No: \_\_\_\_\_

(RWQCB LabForm10A;Ver6/00)

**QA/QC REPORT**

**I. Calibration Standard**

**(A). Initial Calibration**

DATE PERFORMED: \_\_\_\_\_

ANALYTICAL METHOD: \_\_\_\_\_

STANDARD SUPPLY SOURCE: \_\_\_\_\_

DATE OF SOURCE: \_\_\_\_\_

INSTRUMENT I.D.: \_\_\_\_\_

LOT NUMBER: \_\_\_\_\_

COMPOUND	DETECTOR	RT	MASS/CONC UNIT:	AREA	RF	RF <sub>ave</sub>	SD <sub>n-1</sub>	%RSD
Compound 1			1st conc					
			2nd conc					
			3rd conc					
			4th conc					
			5th conc					
Compound 2 . . .			.					
			.					
			.					
			.					
			.					
Compound k			1st conc					
			2nd conc					
			3rd conc					
			4th conc					
			5th conc					

**(B). Continuing Calibration (Mid-Point)**

COMPOUND	DETECTOR	RT	MASS/CONC UNIT:	AREA	RF	%DIFF	ACP RGE %DIFF
Compound 1							
Compound 2							
.							
.							
Compound k							

Project No: \_\_\_\_\_

(RWQCB LabForm10A;Ver6/00)

**QA/QC REPORT (Continued)**

**II. Matrix Spike (MS)/Matrix Spike Duplicate (MSD)**

DATE PERFORMED: \_\_\_\_\_

ANALYTICAL METHOD: \_\_\_\_\_

BATCH #: \_\_\_\_\_

LAB SAMPLE I.D.: \_\_\_\_\_

UNIT: (Circle one)  $\mu\text{g}/\text{kg}$   $\mu\text{g}/\text{l}$

ANALYTE	SAMPLE RESULT	SPIKE CONC	MS	%MS	SPIKE CONC (DUP)	MSD	%MSD	RPD	MS/MSD LIMIT	RPD LIMIT

**III. Laboratory Quality Control Check Sample (LCS)**

DATE PERFORMED: \_\_\_\_\_

ANALYTICAL METHOD: \_\_\_\_\_

STANDARD SUPPLY SOURCE: \_\_\_\_\_

DATE OF SOURCE: \_\_\_\_\_

INSTRUMENT I.D.: \_\_\_\_\_

LOT NUMBER: \_\_\_\_\_

LAB LCS I.D.: \_\_\_\_\_

UNIT: (Circle one)  $\mu\text{g}/\text{kg}$   $\mu\text{g}/\text{l}$

ANALYTE	SPIKE CONC	RESULT	%RECOVERY	ACP %REC LIMIT

**.. INSTRUCTION FOR LARQWCB LABORATORY REPORT FORM FOR METALS  
(12/94; Revised 2/96)**

Page 1 of 3: Analytical Result

1. After "Project No:", enter the client's project number (from cover page 1). This number is required on every page of the report.
2. For "DATE ANALYZED", enter the date on which the sample is analyzed.
3. For "LAB SAMPLE I.D.", enter the I.D. number the laboratory assigned to each sample.
4. For "CLIENT SAMPLE I.D.", enter the I.D. number the client used when the sample was collected.
5. For "DILUTION FACTOR", enter the dilution factor for each sample. If a sample is not diluted (e.g., direct purge & trap of water sample), enter "1" as dilution factor.
6. For "PREP:TM/DM/CAL-WET/TCLP", enter the appropriate type of analysis preparation: TCLP = Toxicity Characteristic Leaching Procedure, CAL-WET = California Waste Extraction Test (STLC), TM = Total Metal (TTLC), DM = Dissolved Metal.
7. For "SAMPLE MATRIX", enter water, soil, sludge, etc.
8. For "REPORTING UNIT", enter the appropriate reporting unit. The unit mg/L or ug/L for water samples and mg/Kg or ug/Kg for soil samples are typically used. The reporting unit must be the same for all standards, sample results, contract required detection limits (CRDLs), and QA/QC data.
9. Under "METAL", list each element analyzed.
10. Under "METHOD", enter the EPA Method number used for each element, including the sample preparation method if applicable.
11. Under "CRDL", list the detection limit used for reporting each element. Do not adjust the CRDL by the dilution factor for the samples. Any sample dilution which may affect the detection limits for that sample shall be indicated in the sample dilution factor.
12. In each column for the method blank and the samples, report all analytes detected above the CRDL. Do not subtract blank or adjust sample results for blank contamination. Any analyte not detected above the CRDL should be reported as "<CRDL value" (Whatever the CRDL value is after taking into account dilution factor, e.g., <1). Samples must show the final results calculated using appropriate dilution factor (e.g., sample after 10 times dilution gives analysis result of 10 ppb. Then the final result reported for this sample should be 100 ppb). Do not flag any data as estimated or below certain confidence levels.
13. There are two type of formats: one for multiple element analysis in each sample and the other for single element for multiple samples. Choose the appropriate format to report results.
14. If more than one page is needed, complete header information for all samples

analyzed on subsequent pages. The method blank does not need to be repeated on each subsequent page. If more than one method blank is analyzed, report each method blank with the samples to which it applies for validation purpose. The column width may be adjusted to put analysis results for more samples on each page.

Page 2 of 3: QA/QC Report

I. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

1. Under "LAB SAMPLE I.D.", enter name or number of laboratory sample used for MS/MSD analyses.
2. For "REPORTING UNIT", enter appropriate reporting unit. The unit mg/L or ug/L for water samples and mg/Kg or ug/Kg for soil samples are typically used. The reporting unit must be the same for all standards, sample results, CRDLs, and QA/QC data.

Metal: The spiking analytes in sample.

Date: The date that MS/MSD is performed, which must be the same as the batch of samples that are analyzed.

Sample

Result: The original sample result associated with the spiking analytes.

Spike Conc: Analyte concentration of MS added to sample.

MS: Result of MS.

%MS: Percent recovery for MS.

Spike Conc

(Dup): Analyte concentration of MSD added to sample.

MSD: Result of MSD.

%MSD: Percent recovery for MSD

RPD: Relative percent difference between MS and MSD

MS/MSD

LIMIT: Acceptance Percent limit for MS

RPD LIMIT: acceptance limit for RPD

If the original sample results are "<CRDL" without dilution, enter "0" for sample result on this MS/MSD table.

II. Calibration, CRDLs, and Laboratory Control Sample (LCS)

1. Under "Date Received/Prepared:", enter date that calibration standard and LCS are received from supplier or prepared in-house.
2. Under "Lot Number:", enter lot number for calibration standard and LCS.
3. Under "Supply Source:", enter supplier's name for calibration standard and LCS.

<u>Metal:</u>	List each element that is analyzed.
<u>Date:</u>	The date that calibration, CRDLs, and LCS are performed, which must be the same day that samples are analyzed.
<u>Calibration</u>	
<u>Range:</u>	List the calibration concentration range (lowest - highest) for each element.
<u>LCS @ CRDL:</u>	LCS analyzed at CRDL concentration.
<u>Result:</u>	Result of LCS @ CRDL
<u>%RC:</u>	Percent recovery of LCS @ CRDL
<u>LCS @ Mid-</u>	
<u>Level Conc:</u>	LCS analyzed at mid-range concentration of calibration range.
<u>Result:</u>	Result of LCS at mid-range.
<u>%RC:</u>	Percent recovery of LCS at mid-range.

Page 3 of 3: QA/QC Report (Continued)

III. Inductively Coupled Plasma(ICP) Interference Check Sample (ICS)

Under "Reporting Unit:", enter appropriate reporting unit.

<u>Metal:</u>	List each interfering element that was analyzed.
<u>Date Analyzed:</u>	Date ICS was analyzed.
<u>True Conc:</u>	True concentration of each interfering element.
<u>Result:</u>	Enter the result from the instrument.
<u>%RC:</u>	Enter the percent recovery for each interfering element.

IV. Serial Dilution Result (Required for Flame A.A., Graphite Furnace A.A., and ICP Method, for evaluating matrix interference only)

1. Under "Lab Sample I.D.:", enter the I.D. of the sample which was used for series dilution.
2. Under "Reporting unit:", enter appropriate reporting unit.

<u>Metal:</u>	List each element that was analyzed.
<u>Date Analyzed:</u>	Date series dilution was analyzed for each element.
<u>Series Dilution</u>	
<u>Result:</u>	Enter the result of each element after series dilution.
<u>%Diff:</u>	Enter the percent different of series dilution result from the original sample result.

## V. General Reporting Requirements

1. The analysis report must be submitted using the reporting format and all QA/QC requirements must be complied. Failure to do so may result in rejection of the analysis report.
2. Raw data on analysis, copy from logbooks, and other laboratory data relating to sample results are not routinely required with report, but must be submitted upon request.
3. Workplan or monitoring program for a specific project may require additional site-specific analytes and/or conditions.

## VI. General Requirements For Metals

The following requirements are not a replacement or substitution of the EPA Method requirements which must be followed by the performing laboratories. These requirements serve as a specific emphasis or clarification to LARWQCB's QA/QC objectives in addition to EPA method requirements. Laboratories must comply with these requirements as well.

### Sample Condition

The criteria for acceptable sample conditions are dictated by the method(s) to be employed for sample analysis. The laboratory shall strive to resolve any sample condition problems before the samples are accepted for analysis. If the problems are beyond resolution, the samples should be rejected and resampling should be requested.

### Subcontracted Samples

Samples subcontracted to another laboratory, which must be certified by ELAP, must also conform to these requirements and results must be submitted by the subcontracted laboratory using this report format.

### Target Elements

The target metals should be those specified in assessment workplan or monitoring program, contract request or as required by the LARWQCB.

### CRDL

The detection limits should be those required by the LARWQCB, as specified in the assessment workplan/monitoring program or as specified in EPA methods used. Detection limits higher or lower than these specified below can be required based on site-specific needs.

The required CRDLs for each element are specified below. If the sample showed

high contamination and required dilution, the low CRDLs are not required for those samples.

<u>Element</u>	<u>For Water</u> (mg/L)	<u>For Solid</u> (mg/Kg)
Aluminum	0.2	10
Antimony	0.005	0.25
Arsenic	0.005	0.25
Barium	0.2	10
Beryllium	0.002	0.1
Boron	0.1	5
Cadmium	0.001	0.05

<u>Element</u>	<u>For Water</u> (mg/L)	<u>For solid</u> (mg/Kg)
Calcium	1	50
Chromium, Total	0.01	0.5
Chromium, Hexavalent	0.01	0.5
Cobalt	0.2	10
Copper	0.1	5
Iron	0.1	5
Lead	0.005	0.25
Magnesium	1	50
Manganese	0.03	1.5
Mercury	0.001	0.05
Molybdenum	2	100
Nickel	0.02	1
Potassium	2	100
Selenium	0.005	0.25
Silver	0.01	0.5
Sodium	1	50
Thallium	0.001	0.05
Vanadium	2	100
Zinc	0.5	25

### Analysis Methods

Use the appropriate approved EPA methods and report the actual method used. The procedures must be the same for initial calibration, initial calibration verification, continuing calibration verification, laboratory control samples, environmental samples,

MS/MSD, and all other QA/QC tests.

### Calibration

1. Calibrate the instrument according to method requirements and manufacturer's guidelines.
2. The initial calibration must be verified and documented for every analyzed element by analysis of initial calibration verification (ICV) solution using laboratory control sample (LCS) or EPA ICV solution. All ICVs must be within 90-110% of the true values regardless of which method is used. For ICV purpose, the LCS is analyzed under the same conditions as initial standards.
3. Continuing calibration verification (CCV) must be performed and documented for every analyzed element and must be within 90-110% of the true value regardless of which method is used.

### Laboratory Control Sample (LCS)

LCS analysis must be performed each day that samples are analyzed. The LCS must be obtained from a different supplier or a different lot from the calibration standards. If prepared in-house, it must be prepared from a stock solution different from calibration standards. The LCS shall be analyzed under the same conditions as the samples were analyzed (i.e., processed in the same manner as a sample).

The concentration of LCS for each element must not be higher than the mid-level concentration of the calibration range (preferably no greater than 10 times the CRDL). The acceptance limits for the LCS for metal analyses are 80-120%:

### CRDL Check Standard

In order to demonstrate that the CRDLs can be achieved and any "Not Detected (ND)" results are actually "ND", a standard or series of standards are required to be analyzed at the CRDL levels for each element analyzed.

The percent recovery of LCS at CRDL level must be at least 50%. If the percent recovery is below 50%, the laboratory must investigate and solve the problems, and reanalyze all the samples which showed "ND" results prior to the investigation.

If none of the samples from the same project showed "ND" results (i.e., they all showed results higher than CRDLs), analysis of LCS at CRDL level for that element is not required. A note should be included in the report.

### Blanks

Results of the method blank, initial calibration blank (ICB) and continuing calibration blank (CCB) must be below CRDL for every element. If exceeded, the laboratory shall investigate the source of contamination and take corrective actions prior to proceeding with further sample analysis. Any disclaimer statement such as the following example

concerning the blank and interpretation of result will not be acceptable and should not be included in report:

"Results should not be considered reliable unless the sample result exceeds five times (5X) the CRDL or ten times (10X) the blank concentration."

### MS/MSD

MS/MSD analyses should be performed for every project (for each site) at a minimum rate of one per 20 samples or per batch, whichever is more often. If the project consists of both liquid and solid samples, MS/MSD should be performed for each matrix. The spiking concentration for the MS/MSD analyses should be within the calibration range. MS/MSD is not required for the following elements: calcium, magnesium, potassium, and sodium.

When the element concentration in the sample turned out to be very high compared to the spiking level of MS/MSD and thus making the MS/MSD result unusable, an explanation should be included in the report.

The acceptance limit should agree with EPA guidelines for each method used. If there are no EPA guidelines, it may be determined in a range by in-house laboratory control charts. Data for the control charts must be submitted upon request. Trace levels of analyte may be used in MS/MSD calculations even if reported as non-detected on the report form.

### Sample Analysis

All samples must be analyzed to comply with CRDL requirements shown above. If concentrations of elements present in samples are known to be high (outside the calibration range) from previous analyses or confirmative information, the samples can be directly diluted and then analyzed. Low CRDL will not be applicable for these samples if they are found to be high. If not, an undiluted sample must be reanalyzed to meet the CRDL requirements.

### Inductively Coupled Plasma (ICP) Interference Check Sample (ICS)

1. ICS must be analyzed according to the EPA method used, at the beginning and end of each analysis run but not before initial calibration verification and daily calibration check.
2. ICS solution must consist of the analytes mixed with the interferents.
3. The ICS results must fall within the control limit of  $\pm 20\%$  of the true values for each analyte. If not, terminate analysis, take corrective actions, recheck the calibration and reanalyze the affected samples.

### Serial Dilution (SD)

Serial dilution analysis on one representative sample must be performed for every project (for each site). If the project consists of both liquid and solid samples, SD should be performed for each matrix. Blanks cannot be used for SD analysis.

If the percent difference is greater than 20%, the laboratory shall ensure that the problem is confined only to the sample matrix.

### **ACKNOWLEDGEMENTS**

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Project No: \_\_\_\_\_

(CRWQCB LabForm10C;Ver12/94)

**ANALYTICAL RESULT FOR METALS  
(FOR MULTIPLE METAL ANALYSES)**

DATE ANALYZED							
LAB SAMPLE I.D.							
CLIENT SAMPLE I.D.							
DILUTION FACTOR							
PREP: TCLP / CAL-WET / TM / DM							
SAMPLE MATRIX							
REPORTING UNIT: MG/KG MG/L							
METAL	METHOD	CRDL	RESULTS				

**ANALYTICAL RESULT FOR METALS  
(FOR SINGLE METAL ANALYSIS)**

METHOD:		DATE ANALYZED:		
PREP (TCLP, CAL-WET, TM, DM):		CRDL:		
METAL ELEMENT:		REPORTING UNIT:		
LAB SAMPLE I.D.	CLIENT SAMPLE I.D.	SAMPLE MATRIX	DILUTION FACTOR	RESULT

Project No: \_\_\_\_\_

(RWQCB LabForm10C;Ver12)

**QA/QC REPORT**

**I. Matrix Spike (MS)/Matrix Spike Duplicate (MSD)**

LAB SAMPLE I.D.: \_\_\_\_\_  
REPORTING UNIT: \_\_\_\_\_

METAL	DATE	SAMPLE RESULT	SPK CONC	MS	%MS	SPK CONC (DUP)	MSD	%MSD	RPD	MS/MSD LIMIT	RPD LIMIT

**II. CALIBRATION, CRDL, AND LABORATORY CONTROL SAMPLE (LCS)**

DATE RECEIVED/PREPARED: \_\_\_\_\_  
LOT NUMBER: \_\_\_\_\_  
SUPPLY SOURCE: \_\_\_\_\_

CALIBRATION  
STANDARD LCS

METAL	DATE	CALIBRATION RANGE	LCS @ CRDL	RESULT	%RC	LCS @ MID-LEVEL CONC	RESULT	%RC

**QA/QC REPORT (CONTINUED)**

**III. INDUCTIVELY COUPLED PLASMA (ICP) INTERFERENCE CHECK SAMPLE  
(AS SPECIFIED IN EPA METHODS 200.7/6010)**

REPORTING UNIT: \_\_\_\_\_



# **APPENDIX C**

**INTERIM GUIDANCE**

**FOR**

**ACTIVE SOIL GAS INVESTIGATIONS**

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**STATE OF CALIFORNIA**  
**California Regional Water Quality Control Board**  
**Los Angeles Region**

**INTERIM GUIDANCE FOR ACTIVE SOIL GAS INVESTIGATION**  
**(February 25, 1997)**

**Introduction**

Volatile organic compounds (VOCs) within the unsaturated zone partition into the adsorbed, dissolved, free liquid, and vapor phases. Measurement of VOCs through an active soil gas investigation allows: 1) evaluation of whether waste discharges of VOCs have occurred which may impact groundwater, 2) determination of spatial pattern and extent of vapor phase soil contamination, 3) establishment of vapor distribution for the design of soil vapor extraction (SVE) system, and 4) determination of the efficiency of reduction in threat to groundwater from any cleanup action, including SVE. The work plan should include, but not be limited to, the following:

**1.0 Survey Design**

**1.1**

Provide a scaled facility map depicting potential sources and proposed sampling points. Include locations and coordinates of identifiable geographic landmarks (e.g., street center-line, benchmark, street intersection, wells, north arrow, property line).

**1.2**

Locate initial sampling points in potential source areas and areas with known soil contamination using an adjustable 10 to 20 foot grid pattern. Provide rationale for the number, location and depth of sampling points. Screen the remainder of the site with a 100-foot or less grid pattern.

**1.3**

Conduct a close interval (10 to 20 foot grid pattern) and multi-level sampling (5 to 10 feet vertical distance between points) in areas with known or relatively high VOC concentrations.

**1.4**

Use an on-site mobile laboratory with laboratory-grade certifiable instrumentation and procedures for real-time analysis of individual VOCs. Non-specific portable organic vapor analyzers and/or GC-based handheld detectors may not be used for analysis, except for daily or weekly vapor monitoring during SVE.

**1.5**

Maintain flexibility in the sampling plan such that field modifications (grid pattern density, location and depth) can be made as real-time evaluation of analytical test results occurs. Include in the work plan decision-making criteria for these adjustments and explain decisions in the report. Field decisions shall be made in consultation with Regional Board staff.

## **1.6**

Re-sample at any sampling point if anomalous data (i.e., 2 to 3 orders of magnitude difference from surrounding samples) are obtained. Board staff may require additional points to resolve the spatial distribution of the contaminants within the interval in question.

## **2.0 Sample Collection**

### **2.1**

Obtain samples at an adequate depth (nominally 5 feet) below ground surface (bgs) to minimize potential dilution by ambient air.

### **2.2**

Conduct a site-specific purge volume versus contaminant concentration test at the start of the initial soil gas survey and vapor monitoring well sampling. The purpose of the test is to purge ambient air in the sampling system with minimal disturbance of soil gas around the probe tip. Conduct this test based on soil type and where VOC concentrations are suspected to be highest. Describe specific method and equipment to determine optimal purge rates and volumes. Take into account the potential sorption of target compounds to the tubing and adjust the purge rate and time to achieve the optimal purge volume. Limit the sampling vacuum to collect proper samples. Optimum purge volume may be compound specific. "Lighter" early eluting VOCs, such as vinyl chloride, may reach their highest concentration with less purging than "heavier" late eluting VOCs like PCE. Therefore, optimize the purge volume for the compound(s) of greatest concern.

### **2.3**

Explain the expected zone of influence for sample points, taking into consideration soil types, land cover, drive point construction and sample purge rate/time/volume. The vertical zone of influence for purging and sampling must not intersect the ground surface.

### **2.4**

Discuss soil gas sample collection and handling procedures. Discuss the procedures to prevent collection of samples under partial vacuum and the methods to minimize equipment cross-contamination between sampling points.

### **2.5**

Avoid making a pilot hole (e.g., using a slam bar) prior to inserting the probe rod, except to drill through asphalt or concrete. The process of making a pilot hole may promote vapor contaminant aeration and result in lower sample concentration.

### **2.6**

Specify that the sampling equipment (e.g., gas tight syringe, sorbent trap) will not compromise the integrity of the samples. Tedlar bags may only be used for qualitative analysis.

### **2.7**

Assure that the probe tip, probe and probe connectors have the same diameter to provide a good seal between the formation and the sampling assembly. If a space develops between the probe and the formation, as a result of probe advancement, seal (e.g., with bentonite) the area around the probe at the surface to minimize the potential for ambient air intrusion.

## 2.8

Some sampling systems (e.g., Geoprobe) utilize the probe rod as a conduit for the tubing that connects to the probe tip. Assure a tight fit between the tubing and probe tip to minimize potential for leakage and dilution of the sample.

## 2.9

Follow the sampling method specified in the soil gas consultant's standard operating procedure (SOP). Discuss with Board staff any deviations from the SOP before it is implemented in the field.

## 3.0 Laboratory Analysis of Soil Gas Samples

### 3.1 Primary Target Compounds

1. Carbon tetrachloride
2. Chloroethane
3. Chloroform
4. 1,1-Dichloroethane
5. 1,2-Dichloroethane
6. 1,1-Dichloroethene
7. cis-1,2-Dichloroethene
8. trans-1,2-Dichloroethene
9. Dichloromethane (methylene chloride)
10. Tetrachloroethene
11. 1,1,1,2-Tetrachloroethane
12. 1,1,2,2-Tetrachloroethane
13. 1,1,1-Trichloroethane
14. 1,1,2-Trichloroethane
15. Trichloroethene
16. Vinyl chloride
17. Benzene
18. Toluene
19. Ethylbenzene
20. Xylenes
21. Trichlorofluoromethane (Freon 11)
22. Dichlorodifluoromethane (Freon 12)
23. 1,1,2-Trichloro-trifluoroethane (Freon 113)

### 3.2 Other Target Compounds

Analyze for other VOCs (e.g., methyl ethyl ketone, methyl isobutyl ketone, ethylene dibromide, petroleum hydrocarbons, etc.) based upon site history and conditions.

### 3.3 Detection Limit (DL)

Attain a DL of not more than 1 µg/L for all target compounds. A higher DL is acceptable only for the compound(s) whose concentration exceeds the initial calibration range.

### **3.4 Detectors**

Use the following detectors in appropriate combinations:

Electrolytic conductivity detector (ELCD) (e.g., Hall) Photoionization detector (PID)

Flame ionization detector (FID)

Mass spectrometer (MS)

Electron capture detector (ECD)

### **3.5.0 Identification of Calibration Standards & Laboratory Control Sample (LCS)**

#### **3.5.1**

Properly and clearly identify all calibration standards and LCS. The identification must agree with the data on record for the standards and LCS.

#### **3.5.2**

Prepare LCS from a second source standard that is totally independent from the standards used for the initial calibration. Second source means a different supplier (whenever possible) or a different lot from the same supplier.

### **3.6.0 GC Conditions**

#### **3.6.1**

Use a type of column that can separate all the target compounds. Coelution of the target compounds is not acceptable unless the compounds are distinguished and quantified by two different types of detectors in use at that time.

#### **3.6.2**

Analyze the initial calibration and daily mid-point calibration check standards, LCS, blank, and samples using the same GC conditions (i.e., detector, temperature program, etc.).

#### **3.6.3**

Use a GC run time that is long enough to identify and quantify all the target compounds.

### **3.7.0 Initial Calibration (Record in Table 1)**

#### **3.7.1**

Perform an initial calibration:

1. for all 23 compounds listed in Section 3.1;
2. when the GC column type is changed;
3. when the GC operating conditions have changed;
4. when the daily mid-point calibration check cannot meet the requirement in Section 3.8.3; and
5. when specified by Regional Board staff based on the scope and nature of the investigation.

### 3.7.2

Include at least three different concentrations of the standard in the initial calibration, with the lowest one not exceeding 5 times the DL for each compound.

### 3.7.3

Calculate the response factor (RF) for each compound and calibration concentration prior to analyzing any site samples. Calculate the average RF for each compound. The percent relative standard deviation (%RSD) for each target compound must not exceed 20% except for the following compounds which must not exceed 30%:

Trichlorofluoromethane (Freon 11)  
Dichlorodifluoromethane (Freon 12)  
Trichlorotrifluoromethane (Freon 113)  
Chloroethane  
Vinyl chloride

### 3.7.4

Verify the true concentration of the standard solutions used with the LCS after each initial calibration. Conduct the verification using a LCS with a mid-point concentration within the initial calibration range. The LCS must include all the target compounds. The RF of each compound must be within  $\pm 15\%$  difference from the initial calibration, except for freon 11, 12 and 113, chloroethane, and vinyl chloride which must be within  $\pm 25\%$  difference from the initial calibration.

## 3.8.0 Daily Mid-point Calibration Check (Record in Table 1)

### 3.8.1

Check the calibration using the calibration standard solution with a mid-point concentration within the linear range of the initial calibration before any sample is analyzed.

### 3.8.2

Include in the daily mid-point calibration check standard the following compounds and every compound expected or detected at the site:

1. 1,1-Dichloroethane
2. 1,2-Dichloroethane
3. 1,1-Dichloroethene
4. cis-1,2-Dichloroethene
5. trans-1,2-Dichloroethene
6. Tetrachloroethene
7. 1,1,1-Trichloroethane
8. 1,1,2-Trichloroethane
9. Trichloroethene
10. Benzene
11. Toluene
12. Xylenes

### **3.8.3**

Assure that the RF of each compound (except for freons 11, 12 and 113, chloroethane, and vinyl chloride) is within  $\pm 15\%$  difference from the initial calibration's average RF. The RF for freons 11, 12 and 113, chloroethane, and vinyl chloride must be within  $\pm 25\%$ .

## **3.9.0 Blank**

### **3.9.1**

Analyze field blank(s) to detect any possible interference from ambient air.

### **3.9.2**

Investigate and determine the source(s) and resolve any laboratory contamination problem prior to analyzing any samples if the blank shows a measurable amount ( $\geq 1 \mu\text{g/L}$ ) of the target compound(s).

## **3.10.0 Sample Analysis**

### **3.10.1**

Assure that the requirements for initial calibration, daily mid-point check, blank, and LCS are met before any site samples are analyzed.

### **3.10.2**

Analyze samples within 30 minutes after collection to minimize VOC loss. Longer holding time may be allowed if the laboratory uses a special sampling equipment (e.g., sorbent trap, glass bulb) and demonstrates that the holding time can exceed 30 minutes with no decrease in results.

### **3.10.3**

Assure that the concentrations of constituent(s) in a sample do not exceed 50% of the highest concentration in the calibration range. Reanalyze the sample using a smaller volume or dilution if the detected concentration exceed 50% of the highest concentration in the calibration range.

### **3.10.4**

Attain DL of not more than  $1 \mu\text{g/L}$  for all target compounds. If lesser sample volumes or dilutions are used to off-set possible high concentration of constituents in the initial run, use the initial run to calculate the results for constituents that are not affected by the high concentration so that DL of  $1 \mu\text{g/L}$  for these compounds can be achieved.

### **3.10.5**

Quantify sample results using the average RF from the most recent initial calibration.

### **3.10.6**

Add surrogate compounds to all samples. Assure that the surrogate compound concentration is within the initial calibration range. Two to three different surrogate compounds [one aromatic hydrocarbon and two chlorinated compounds (early and middle eluting, except gases)] should be used to cover the different temperature programming range for each GC run.

### **3.10.7**

Calculate the surrogate recovery for each GC run. Surrogate recovery must not exceed  $\pm 25\%$  difference from the true concentration of the surrogate, as the sample result would be considered questionable and may be rejected by this Regional Board.

## **3.11.0 Compound Confirmation**

### **3.11.1**

Conduct compound confirmation by GC/MS whenever possible. Use second column confirmation with surrogate for compound confirmation if GC/MS is not used.

### **3.11.2**

Add surrogate compounds to standards and site samples for second column confirmation to monitor the relative retention time (RRT) shift between GC runs. This is required for better compound identification when ELCD, PID, ECD, and FID are used for analysis.

### **3.11.3**

Usually one sample is adequate and quantitation is not required for second column confirmation. Second column confirmation can be done with a different GC. The representative sample can be collected in Tedlar bag and confirmation can be done off site.

### **3.11.4**

Second column confirmation is not necessary if the compounds present have been confirmed from previous soil gas investigations.

## **3.12.0 Samples with High Concentration**

### **3.12.1**

DL may be raised above 1  $\mu\text{g}/\text{L}$  for compounds with high results (i.e., the limit as specified in Section 3.10.3) and those closely eluting compounds for which quantitation may be interfered by the high concentrations.

### **3.12.2**

Quantify sample results according to Section 3.10.4 for analytes which are not affected by the high concentration compounds.

### **3.12.3**

If high VOC concentration in an area is known from previous soil gas analysis, Sections 3.12.1 and 3.12.2 are not necessary when analyzing samples from the area in question.

### **3.12.4**

When dilution with ambient air is used for samples with high results, dilute and analyze in duplicate each day at least one sample to verify the dilution procedure. Ambient air should be checked periodically during each day of analysis.

### **3.13.0 Shortened Analysis Time**

#### **3.13.1**

Shorten the GC run time under the following conditions only:

1. The exact number and identification of compounds are known from previous soil and soil gas investigations; and
2. The consultant has been given permission by Regional Board staff to analyze only for specific compounds.

#### **3.13.2**

Meet the following requirements when shortening GC run-time:

1. Regional Board staff must approved the shortened run time;
2. The compounds must not coelute;
3. Perform initial calibration and daily mid-point calibration check and analyze LCS and samples under the same conditions as the shorter GC run-time;
4. Quantitate using the average RF from the initial calibration utilizing the shorter run-time; and
5. Perform a normal run-time analysis whenever peaks are detected within retention time windows where coelution, as indicated by the calibration chromatograms, is likely.

### **3.14.0 Last GC Test Run Per Day of Analysis** (Record in Table 1)

#### **3.14.1**

A LCS as the last GC run of the day is not mandatory, except under conditions in Section 3.14.2. Include the same compounds used in the daily mid-point calibration check analysis, as listed in Section 3.8.2. Attain RF for each compound within  $\pm 20\%$  difference from the initial calibration's average RF, except for freons 11, 12, 113, chloroethane, and vinyl chloride which must be within  $\pm 30\%$ .

#### **3.14.2**

Analyze a LCS at the detection limit concentration instead of the mid-point concentration if all samples from same day of analysis show non-detect (ND) results. The recovery for each compound must be at least 50%. If it is less than 50%, all the ND results of the samples become questionable.

### **3.15.0 On-site Evaluation Check Sample**

#### **3.15.1**

Analyze on-site the evaluation check sample as part of the QA/QC procedures when presented

with such a check sample by Regional Board staff. Provide preliminary results on-site.

### **3.15.2**

If the results show that the soil gas consultant has problems with the analysis, all the results generated during the same day may be rejected. Correct all problems before any more samples are analyzed.

## **3.16.0 Site Inspection**

### **3.16.1**

Unannounced, on-site inspection by Regional Board staff is routine. Provide upon request hard copies of the complete laboratory data, including raw data for initial calibration, daily mid-point check, LCS and blank results. Failure to allow such inspection or to present these records or field data may result in rejection of all sample results.

### **3.16.2**

The soil gas consultant must understand the instruments, analytical and QA/QC procedures and must be capable of responding to reasonable inquiries.

## **3.17.0 Recordkeeping in the Mobile Laboratory**

Maintain the following records in the mobile laboratory:

1. A hard copy record of calibration standards and LCS with the following information:
  - a. Date of receipt
  - b. Name of supplier
  - c. Lot number
  - d. Date of preparation for intermediate standards (dilution from the stock or concentrated solution from supplier)
  - e. ID number or other identification data
  - f. Name of person who performed the dilution
  - g. Volume of concentrated solution taken for dilution
  - h. Final volume after dilution
  - i. Calculated concentration after dilution
2. A hard copy of each initial calibration for each instrument used for the past few months.
3. The laboratory standard operating procedures.

## **4.0 Reporting of Soil Gas Sample Results and QA/QC Data (Record in Table 1 and 2)**

### **4.1**

Report all sample test results and QA/QC data using the reporting formats in Appendix A. Compounds may be listed by retention time or in alphabetical order. Include in the table of sample results all compounds in the analyte list. Report unidentified or tentatively identified peaks. Submit upon request all data in electronic format and raw data, including the chromatograms. Identify the source(s) of the contaminants detected in the investigation, as indicated by the data.

## 4.2

Report the following for all calibration standards, LCS and environmental samples:

1. Site name
2. Laboratory name
3. Date of analysis
4. Name of analyst
5. Instrument identification
6. Normal injection volume
7. Injection time
8. Any special analytical conditions/remark

## 4.3

Provide additional information, as specified, for different types of analyses. Tabulate and present in a clear legible format all information according to the following grouping:

### 1. Initial calibration

- a. Source of standard (**STD LOT ID NO.**)
- b. Detector for quantitation (**DETECTOR**)
- c. Retention time (**RT**)
- d. Standard mass or concentration (**MASS/CONC**)
- e. Peak area (**AREA**)
- f. Response factor (**RF**)
- g. Average response factor (**RF<sub>ave</sub>**)
- h. Standard deviation (**SD<sub>n-1</sub>**) of RF, i.e.,

$$\frac{n}{\left[ \sum_{i=1}^n (RF_{ave} - RF)^2 / (n - 1) \right]^{1/2}}$$

n = number of points in initial calibration

- i. Percent relative standard deviation (**% RSD**), i.e.,  $(SD_{n-1} / RF_{ave}) \times 100$  (%)
- j. Acceptable range of %RSD (**ACC RGE**)

### 2. Daily calibration check sample

- a. Source of standard
- b. Detector
- c. Retention time (**RT**)
- d. Standard mass or concentration
- e. Peak area
- f. Response factor (**RF**)
- g. Percent difference between RF and RF<sub>ave</sub> from initial calibration (**% DIFF**)
- h. Acceptable range of %DIFF (**ACC RGE**)

### 3. LCS. Same format as daily calibration

### 4. Environmental sample

- a. Sample identification
- b. Sampling depth
- c. Purge volume

- d. Vacuum pressure
  - e. Sampling time
  - f. Injection time
  - g. Injection volume
  - h. Dilution factor (or concentration factor if trap is used)
  - i. Detector for quantitation
  - j. Retention time (RT)
  - k. Peak area
  - l. Concentration in µg/L (CONC)
  - m. Total number of peaks found by each detector
  - n. Unidentified peaks and/or other analytical remarks
5. Surrogate and second column confirmation

Mark RT and compound name on: a) second column chromatogram of standard and b) second column chromatogram of confirmation sample.

#### 4.4

Discuss the method(s) to be used for data interpolation (contouring). Provide isoconcentration maps for each VOC detected, total chlorinated volatile organics, total aromatic hydrocarbons, and petroleum-based hydrocarbons for each sampling depth, as applicable. Provide cross-section(s) depicting the geology and changes in contaminant concentration with depth, as justified by the data.

### 5.0 Companion Soil Sampling

#### 5.1

Discuss soil boring locations with Regional Board staff. Locate borings and sampling depths based on all available information including soil gas test results.

#### 5.2

Conduct the soil sampling and analysis per this Regional Board's **Well Investigation Program General Requirements for Subsurface Investigations, Requirements for Subsurface Soil Investigation and Laboratory Requirements for Soil and Water Sample Analyses.**

### 6.0 Soil Vapor Monitoring Well/Vertical Profiling

Install soil vapor monitoring wells for vertical profiling in areas where significant VOC concentrations were identified during the vapor investigation. The objectives of vertical profiling are to: 1) assess the vertical distribution of VOCs in the vapor phase within the unsaturated zone, 2) determine the spatial pattern of vapor phase soil contamination at different depths within the unsaturated zone, 3) identify migration pathways at depth along which VOCs may have migrated from sources, and 4) serve as discrete monitoring points to evaluate the efficiency of a cleanup action. Soil vapor monitoring wells offer the opportunity to resample as many times as necessary to monitor soil vapor changes over time.

Address appropriate items in the following sections when conducting vertical profiling.

#### 6.1

Install nested, cluster, and/or multi-port vapor monitoring wells to obtain discrete multi-depth soil vapor data in the unsaturated zone. Provide a schematic diagram of the well design and a cross-section of the site showing the major lithologic units and zones for vapor monitoring.

## 6.2

Collect undisturbed soil samples if fine-grained soils are encountered during drilling of the boring for the probes. Due to air-stripping effect, VOC analysis of soil samples is not acceptable if air drilling method is used. Refer to Section 5.2 for sampling and testing requirements.

## 6.3

Use all available information (e.g., geologic log, organic vapor concentration reading) to select appropriate depths for vapor monitoring. Install probes at depths with elevated vapor readings (headspace) and/or slightly above fine-grained soils which can retard the migration of VOCs. The deepest probe should be installed above the capillary fringe.

## 6.4

Consider installing nested vapor probes in the annular space of the groundwater monitoring well to serve as a dual-purpose well if both vapor and groundwater monitoring are required. This design saves costs by installing vapor and groundwater monitoring wells in a single borehole.

## 6.5

Use small-diameter (e.g.,  $\leq 1/4$ -inch) continuous tubing attached from the vapor probe to the ground surface to minimize purge volume.

## 6.6

Design and construct the vapor wells to serve as long-term monitoring points to evaluate the efficiency of a cleanup action and soil vapor changes over time. Protect the tubing from being damaged or clogged by subsurface soil materials especially in deep installations (e.g., place inside a PVC casing) or consider using  $1/2$ -inch PVC pipe in place of the tubing. If a tubing is used, consider attaching a weight at the probe tip and/or attaching the tubing onto a supporting pipe or rod to ensure that the probe tip remains in-place during installation.

Properly cap the top end of each tubing/pipe (e.g., control valve) and label each tubing/pipe with the correct sampling depth.

## 6.7

Attach the bottom-end of the tubing to an appropriate vapor probe (e.g., PVC screen, stainless steel wire screen, stainless steel probe, or brass elbow, etc). If a vacuum pump is used for purging and sampling, include a wire screen around the probe to prevent soil particles from blocking the probe's airways. Ensure that the connection between the tubing and the vapor probe is tight to prevent leakage.

## 6.8

Place the filter pack (e.g., sand or pea gravel) around each vapor probe and isolate each monitoring zone with bentonite seals. Use an appropriate method (e.g., tremie method) to avoid bridging or segregation during placement of the filter packs and bentonite seals.

Extend the filter pack to a sufficient distance above the probe to allow for settling of backfill materials. In general, the filter pack should not exceed 3 feet in thickness. In deep borings, the filter pack should extend about four feet above the probe to allow for settling of backfill materials and to reduce the potential for the bentonite seal settling around the probe.

Consider placing fine sand above the filter pack to prevent the bentonite seal from entering the filter pack. Place a minimum of two feet thick bentonite seal above and below the filter pack. Allow sufficient time (e.g., one-half to one hour) for bentonite seal to properly hydrate before placing filter pack or cement-based sealing materials.

#### **6.9**

Prevent infiltration of surface runoff and unauthorized access (e.g., use a locking subsurface utility vault).

#### **6.10**

Specify the schedule for sampling the vapor probes. In general, soil vapor monitoring is required a minimum of one and two months after installation. Due to the VOC stripping caused by air drilling methods, conduct soil vapor monitoring at least two and four months following well completion. Regional Board staff may require a different sampling schedule and additional sampling based upon site conditions and test results.

#### **6.11**

Specify the procedures to properly decommission vapor wells that are no longer needed. The decommissioning activity should achieve an effective and long-term seal of subsurface geologic materials and prevent cross contamination in the subsurface.

### **7.0 Soil Gas Consultants**

This Regional Board reserves the authority to review any soil gas consultant's work to assure compliance with all applicable statutes, regulations, orders, and guidelines. It is your responsibility to ascertain that the individual directing the field investigation is professionally qualified and conducts the field work in accordance with the Board's guidance for active soil gas investigations.

### **Acknowledgements**

This guideline was prepared under the direction of Roy R. Sakaida by David Bacharowski, Alex Carlos, Wayne Chiou, Keith Elliott, Jack Price, Yue Rong, Hiam Tan and Ruen Fang Wang of the California Regional Water Quality Control Board-Los Angeles Region (CRWQCB-LA) Soil Gas Committee. Special thanks go to the staff of the CRWQCB-LA for reviewing the information contained in this document. In addition, discussions and written comments received from soil gas consultants have greatly improved its content. Former CRWQCB-LA staff Philip Chandler and Samuel Yu assisted in preparing previous versions of this guideline.

e 1  
SOIL GAS INITIAL CALIBRATION

SITE NAME: \_\_\_\_\_ LAB NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

ANALYST: \_\_\_\_\_ STD LOT ID NO.: \_\_\_\_\_ INSTRUMENT ID: \_\_\_\_\_

NORMAL INJECTION VOLUME: \_\_\_\_\_ INJECTION TIME: \_\_\_\_\_

COMPOUND	DETECTOR	1st CONC	2nd CONC	3rd CONC	RF <sub>ave</sub>	SD <sub>n-1</sub>	%RSD	ACC RGE
		RT/RRT MASS/CONC	RT MASS/CONC	RT/RRT MASS/CONC				
		AREA RF	AREA RF	AREA RF				

OR

COMPOUND	DETECTOR	RT/RRT	MASS/CONC	AREA	RF	RF <sub>ave</sub>	SD <sub>n-1</sub>	%RSD	ACC RGE
Compound 1		_____	1st conc _____	_____	_____				
		_____	2nd conc _____	_____	_____				
Compound 2 (Surrogate)		_____	3rd conc _____	_____	_____				

SOIL GAS DAILY MID-POINT CALIBRATION STANDARD

AND

SOIL GAS LABORATORY CONTROL SAMPLES (LCS)

SITE NAME: \_\_\_\_\_ LAB NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

ANALYST: \_\_\_\_\_ STD LOT ID NO.: \_\_\_\_\_ INSTRUMENT ID: \_\_\_\_\_

NORMAL INJECTION VOLUME: \_\_\_\_\_ INJECTION TIME: \_\_\_\_\_

COMPOUND (SURROGATE)	DETECTOR	RT/RRT	MASS/CONC	AREA	RF	%DIFF	ACC RGE
-------------------------	----------	--------	-----------	------	----	-------	---------

**Table 2**  
**SOIL GAS SAMPLE RESULTS**

SITE NAME: \_\_\_\_\_ LAB NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

ANALYST: \_\_\_\_\_ COLLECTOR: \_\_\_\_\_ INSTRUMENT ID: \_\_\_\_\_

NORMAL INJECTION VOLUME: \_\_\_\_\_

Sample ID	Sample 1	Sample 2	Sample 3 .....
Sampling Depth			
Purge Volume			
Vacuum			
Sampling Time			
Injection Time			
Injection Volume			
Dilution Factor			

COMPOUND	DETECTOR	RT	AREA	CONC	RT	AREA	CONC	RT	AREA	CONC
----------	----------	----	------	------	----	------	------	----	------	------

Compound 1  
Compound 2  
Compound 3  
.  
.  
.  
.

Surrogate 1  
Surrogate 2

Total Number of Peaks  
by Detector 1 (specify)  
by Detector 2 (specify)

Unidentified peaks and/or other analytical remarks

**ALTERNATIVE FORMAT FOR REPORTING SOIL GAS SAMPLE RESULTS**

SITE NAME: \_\_\_\_\_ LAB NAME: \_\_\_\_\_ DATE: \_\_\_\_\_

Sample ID \_\_\_\_\_  
 Sampling Depth \_\_\_\_\_  
 Sample 1 Sample 2 Sample 3 ...

COMPOUND                      CONC                      CONC                      CONC

Compound 1  
 Compound 2  
 Compound 3

SITE NAME: \_\_\_\_\_ LAB NAME: \_\_\_\_\_ DATE: \_\_\_\_\_  
 ANALYST: \_\_\_\_\_ COLLECTOR: \_\_\_\_\_ INSTRUMENT ID: \_\_\_\_\_  
 NORMAL INJECTION VOLUME: \_\_\_\_\_

Sample ID \_\_\_\_\_                      Sample 1    Sample 2                      Sample 3 ...  
 Sampling Depth \_\_\_\_\_  
 Purge Volume \_\_\_\_\_  
 Vacuum \_\_\_\_\_  
 Sampling Time \_\_\_\_\_  
 Injection Time \_\_\_\_\_  
 Injection Volume \_\_\_\_\_  
 Dilution Factor \_\_\_\_\_

COMPOUND    DETECTOR                      RT    AREA    RT    AREA                      RT    AREA

Compound 1  
 Compound 2  
 Compound 3

Surrogate 1  
 Surrogate 2

Total Number of Peaks  
 by Detector 1 (specify)  
 by Detector 2 (specify)

Unidentified peaks and/or other analytical remarks

(Page 2 of 2, Analytical Raw Data)

(Page 1 of 2, Results Summary)

# **APPENDIX D**

## **EXAMPLES OF "NO FURTHER ACTION " LETTERS**

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION**

CENTRE PLAZA DRIVE  
MONTEREY PARK, CA 91754-2156  
(213) 266-7500  
FAX: (213) 266-7600



April 10, 1995

Ms. Kathy Emerson  
Chevron Chemical Company  
Environmental & Health Protection  
6001 Bollinger Canyon Road  
San Ramon, CA 94583

**REMEDIATION CLOSURE, H. KRAMER AND COMPANY SITE, EL SEGUNDO  
(CAO ORDER NO. 92-094, FILE NO. 92-57)**

You indicated in our telephone conversation on March 21, 1995, that the cap work has been completed at the site in accordance with your engineering design at the subject site.

On March 29, 1995, staff performed a final inspection of the cap and the remediation activities for the slag material at the site.

Based upon this and all previous inspection, we have determined that the remediation has been successfully completed in accordance with the approved cap design and this Water Board's requirements. Therefore, we have determined that no further action will be required for soil and slag remediation at the site. Please provide a summary report along with all sampling and testing results and as-built drawings to us on or before May 15, 1995.

Also, we will require proof that a "Deed Restriction" has been put in place, which clearly delineates this cap location, and which provides public notice that no penetration or disruption of the cap may occur without the prior written approval of this Board.

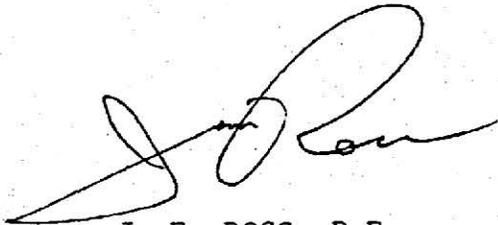
Order No. 92-094, prescribes certain requirements pertaining to post-closure maintenance of the cap and groundwater monitoring.

To that end, the cap shall be maintained in accordance with the maintenance plan approved by the Board on August 15, 1994. Please provide the name of the party who has the financial responsibilities for performing the proposed cap and pavement maintenance and rehabilitation long term.

In addition, groundwater monitoring shall be performed for three consecutive years and the results submitted to us for review in accordance with the workplan approved by the Board on March 2, 1995.

Ms. Kathy Emerson  
Page 2

If you have any questions, please call David Hung at 213/266-7611.

A handwritten signature in black ink, appearing to read 'J. E. Ross', with a large, stylized initial 'J'.

J. E. ROSS, P.E.  
Chief, Site Cleanup Unit

cc: Lisa Neilson, USEPA, Region 9  
Steve Trumura, El Segundo Fire Department  
Bill O'Brien, H. Kramer & Company  
Linda Sutton  
Michael Brill, Alschler, Grossman & Pines

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD**  
**LOS ANGELES REGION**

CENTRE PLAZA DRIVE  
MONTREY PARK, CA 91754-2156  
TEL: (913) 266-7500  
FAX: (913) 266-7600

April 24, 1996

Mr. John C. Moore  
TELEDYNE ANALYTICAL INSTRUMENTS  
16830 Chestnut street  
City of Industry, CA 91749

SAN GABRIEL VALLEY CLEANUP PROGRAM - NO FURTHER REQUIREMENTS,  
TELEDYNE ANALYTICAL INSTRUMENTS, 16830 CHESTNUT STREET, CITY OF  
INDUSTRY, CALIFORNIA (FILE NO. 105.0275)

We are in receipt of the report entitled "Results of Soil Gas Investigation", received on February 13, 1996, submitted on your behalf by your consultant, PES ENVIRONMENTAL, INC. The subject report details the results of a recent soil gas survey at the subject site. This submission is in general compliance with requirements in our letters of October 25, 1995, and December 8, 1995. Upon review of the subject report, we have the following comments:

1. A total of 51, mostly shallow soil vapor samples were collected from soil vapor probes installed to depths ranging from 5' to 15' below ground surface (bgs) in seven potential source areas during this phase of assessment.
2. Maximum VOC concentrations were 28 µg/l PCE, 2 µg/l 1,1,1-TCA, 6 µg/l 1,1-DCE, and 3 µg/l TCE detected in shallow samples from the interior of the building and dumpster area. All deeper samples contained only traces of volatile organic compounds (VOCs) or were non-detect (ND). Ground water is estimated to be approximately 20' bgs in the site area.

PREVIOUS ASSESSMENT

Since 1981, the subject site has been occupied by a manufacturer of precision measurement and control instruments. A vapor degreaser, that used 1,1,1-TCA, was operated at the site to clean printed circuit boards before 1989. During the period of July 1988 through September 1989, a total of twenty-three soil matrix samples were collected from eight boreholes drilled to a maximum depth of 20' bgs over several areas of the facility. Maximum concentrations of VOCs detected were 26 µg/kg of PCE and 36 µg/kg of methylene chloride. On April 9, 1993, a self-directed soil gas survey was conducted over several areas of the subject facility. The highest concentrations of VOCs detected from vapor probes, installed to a maximum depth of 15' bgs, were 84.3 µg/l of PCE and 3.1 µg/l of 1,1-DCE at the vapor degreaser area at a depth of 5' bgs.

Based on the results of the subject report and previous information

John C. Moore  
Page 2

contained in our files, Board staff have determined that assessment is complete and we therefore have no further requirements with respect to the objectives of the San Gabriel Valley Cleanup Program at this site. According to Regional Board guidelines included in the "Interim Site Assessment and Cleanup Guidebook," February 1995 edition, the concentrations of VOCs detected at your facility do not represent a threat to ground water quality. If you have any questions, please contact Julio C. Lara at (213)266-7541 and address all correspondence to his attention.

  
Arthur G. Heath, Ph.D.  
Environmental Specialist IV

cc: Phillip Ramsey, U.S. EPA, Region IX, San Francisco  
Dennis Dickerson, Cal-EPA, DTSC, Region 3  
Carol Williams, San Gabriel Valley Watermaster  
James L. Jasperse, PES Environmental, Inc.

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION**

1 CENTRE PLAZA DRIVE  
MONTEREY PARK, CA 91734-2156  
266-7500  
FAX (213) 266-7600

June 12, 1995

Mr. Richard Dulmage  
Wheaton Plastics Containers  
2568 Channel Drive  
Ventura, CA 93003

Dear Mr. Dulmage:

**UNDERGROUND STORAGE TANK CASE CLOSURE  
WHEATON PLASTIC CONTAINERS  
2568 CHANNEL DRIVE, VENTURA (ID #930300361)**

This letter confirms the completion of the site investigation for the underground storage tank formerly located at the above-described location.

Based on the available information and with the provision that the information provided to this agency was accurate and representative of site conditions, no further action related to the underground storage tank release is required.

This notice is issued pursuant to a regulation contained in Title 23, California Code of Regulations, Division 3, Chapter 16, Section 2721(e).

Please contact Dr. Nancy Adin at (213) 266-7676, if you have any questions concerning this matter.

Sincerely,

*Robert P. Ghirelli*

ROBERT P. GHIRELLI, D.Env.  
Executive Officer

cc: Mr. Jorge Leon, State Water Resources Control Board, Office of Chief Counsel  
Mr. Douglas Beach, Ventura County Environmental Health Division  
Mr. Ricahard Botke, PW Environmental

**CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION**

101 CENTRE PLAZA DRIVE  
MONTEREY PARK, CA 91754-2156  
(213) 266-7500  
FAX: (213) 266-7600



April 27, 1995

Mr. Fred Burnett  
Department of General Services  
City of Los Angeles  
215 West 6th Street, Suite 1101  
Los Angeles, CA 90014-1830

**SOIL CLOSURE AND GROUNDWATER MONITORING  
LOS ANGELES CITY FIRE STATION #56  
2759 ROWENA STREET, LOS ANGELES (ID #900390125)**

We have reviewed the information contained in our file for the subject case. Based on our review of the information submitted, no further soil cleanup will be required at this time.

Because the groundwater quality data which we have in our files is more than six years old, you must collect and analyze one water sample from each onsite groundwater monitoring well before we can determine if further action is necessary. Prior to collecting samples, the depth to water must be measured, then the wells must be properly purged until the temperature, conductivity, and pH stabilize, and the water is free of suspended and settleable matter. The samples are to be analyzed for total petroleum hydrocarbons as gasoline and diesel using EPA method 8015 and aromatic hydrocarbons, using EPA method 8020. All analytical data are to be reported as shown in the enclosed laboratory report forms.

The report on this work is due by **May 25, 1995**. The report must include the analytical results, an isoconcentration map showing total aromatic hydrocarbons, the current groundwater elevation data, and a groundwater contour map based on those data. The report must also contain the measurements recorded during the purging of the well and the disposal point of the purged water.

If you have any questions concerning this matter, please call Dr. Nancy Adin at (213) 266-7676.

A handwritten signature in cursive script that reads "Albert E. Novak".

**ALBERT E. NOVAK**  
Environmental Specialist IV

Enclosure

cc: w/o enclosure:

Captain Jim Digrado, Los Angeles City Fire Department, Underground Tanks  
Law/Crandall & Associates

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION17 CENTRE PLAZA DRIVE  
JERREY PARK, CA 91754-2156  
266-7500  
(213) 266-7600

April 25, 1996

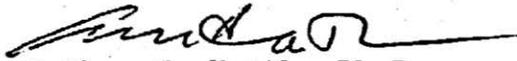
Mr. Ray Navarro  
CACIQUE, INC.  
14940 Proctor Avenue  
City of Industry, CA 91745SAN GABRIEL VALLEY CLEANUP PROGRAM - NO FURTHER ACTION, CACIQUE,  
INC. 14940 PROCTOR AVENUE, CITY OF INDUSTRY (FILE NO. 102.0184)

Since 1985, the subject site has been occupied by a food processing plant. Before 1985, the site was operated by a meat processing company. Reportedly no vapor degreaser was used on site. Upon review of records from the Los Angeles County Fire Department (LACFD), the City of Industry Building and Safety Department (CIBSD), and our file for the subject site, Board staff have the following comments:

1. A site inspection conducted by Board staff on October 17, 1990, confirmed the use of cleaning or sanitizing solutions, caustic soda, chlorine compounds, sulfuric acid, iodine, and ammonia. The use of chlorinated volatile organic compounds (VOCs) was not noted or declared.
2. Three underground storage tanks (UST) were removed during 1990 under the direction of Los Angeles County Department of Public Works (LACDPW). No significant impact to subsurface soil or ground water was encountered in the UST area and site closure was granted by the LACDPW in a letter dated July 18, 1990.
3. A 500-gallon waste oil UST was removed from the site on January 2, 1991. Analysis of soil matrix samples collected from the excavation resulted in the detection of maximum TPH concentrations of 1,950 mg/kg and chloroform of 30 µg/kg. To verify these results, on July 23, 1991, three soil matrix samples were collected from one borehole drilled to the maximum depth of 10' below the former tank invert which is approximately 18.5' below ground surface (bgs). No TPH or VOCs were detected in these samples.

Ray Navarro  
Page 2

Based on the information contained in the file, and after inspecting the site on March 20, 1996, Board staff have determined that no further action is required with respect to the San Gabriel Valley Cleanup Program at this site. If you have any questions, please contact Julio C. Lara at (213) 266-7541.



Arthur G. Heath, Ph.D.  
Environmental Specialist IV

cc: Phillip Ramsey, U.S. EPA, Region IX, San Francisco  
Dennis Dickerson, Cal-EPA, DTSC, Region 3  
Carol Williams, San Gabriel Valley Watermaster  
Carl Sjoberg, County of L.A., D.P.W., Industrial Waste Section  
George Salmas, Attorney At Law, Los Angeles, CA  
Kirk Thomson, Environmental Support Technologies, Inc.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION

1 CENTRE PLAZA DRIVE  
MONTEREY PARK, CA 91754-2156  
(213) 266-7500  
FAX: (213) 266-7600



October 16, 1995

Fred Tindall  
MOORE BUSINESS FORMS  
2275 Commerce Dr.  
Fremont, OH 43420

WELL INVESTIGATION PROGRAM - NO FURTHER REQUIREMENT, FORMER MOORE BUSINESS FORMS FACILITY, 3730 CAPITAL AVE. CITY OF INDUSTRY (FILE I-10116)

Regional Board staff have received the documents contained in the former Los Angeles County Department of Public Works (LACDPW) LOP file concerning former underground petroleum storage tanks (USTs) at the subject site. Upon review of the subject file and other information, we have the following comments:

1. According to the information contained in the subject file, two USTs (one 5,000 gallon gasoline tank and one 10,000 gallon diesel tank) were installed at the subject facility in 1968, and removed in 1985.
2. In March 1991, 3 boreholes were drilled to a maximum depth of 35' bgs in the UST area to determine if soil beneath the subject site was contaminated as a result of releases from the former USTs and associated piping. Analysis (in accordance with EPA Methods 418.1 for total recoverable petroleum hydrocarbons/TRPH and 8020 for BTEX) of soil matrix samples from these boreholes detected concentrations of 3,035 mg/kg TRPH (in a sample collected at 10' bgs); 43 mg/kg TRPH (in a sample collected at 30' bgs); and 0.021 mg/kg xylenes (in a sample from 10' bgs). No other compound was above detection limits in any of the other soil matrix samples.
3. On November 4, 1991, the LACDPW required, and subsequently approved a work plan to remediate the contaminated soil associated with the former USTs.
4. Excavation and hauling of approximately 550 cubic yards of predominantly diesel contaminated soil associated with the USTs commenced in January 1992. Laboratory results of confirmation soil samples collected in the bottom and sidewalls of the final excavation pit were ND for fuels.

Based on the results of the assessment work conducted at the subject facility, Board staff have determined that assessment and remediation have been completed and we therefore have no further requirements with respect to the former USTs at the site. A "no further requirements" letter for VOCs at the site was issued by

Board staff on August 8, 1995. The remaining TRPH soil contamination detected at 30' bgs in one of the boreholes does not represent a significant continuing threat to ground water quality, human or environmental health and therefore does not require cleanup. Considering the ND results analysis of confirmation soil matrix samples in the excavation pit, and therefore unlikelihood of ground water contamination associated with the USTs, we do not require the installation of ground water monitoring wells.

If you have any questions, please contact me at (213) 266-7531.

*for*  
*Hank H. Geoul*

ERIC NUPEN, R.G.  
Senior Engineering Geologist

cc: Jorge A. Leon, OCC, Sacramento  
Norman Dupont, (attorney for Moore Business Forms)  
Phillip Ramsey, USEPA, Region IX  
Steven Anderson, Erickson Inc., Richmond, CA  
Richard Montevideo, Rutan & Tucker, Costa Mesa, CA

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION

CENTRE PLAZA DRIVE  
SAN FRANCISCO, CA 94111-2156  
(415) 266-7500  
FAX: (415) 266-7600



October 10, 1995

Matthew A. Love  
EXIDE CORPORATION  
645 Penn Street  
Reading, PA 19601

WELL INVESTIGATION PROGRAM - NO FURTHER REQUIREMENTS, FORMER EXIDE CORPORATION FACILITY, 13110 LOUDEN LANE, CITY OF INDUSTRY CA (FILE No. 102.7209)

Board staff have received the "Second Round Semi-Annual Groundwater Monitoring Report", prepared by your consultant Dames & Moore, dated May 24, 1995 (received May 25, 1995). The report contains the results of biannual ground water sampling from the 3 on-site monitoring wells and is in general compliance with requirements stated in our letter of September 14, 1994. Upon review of the subject report, previous assessment work and other information, Board staff have the following comments:

1. Previous assessment work conducted at the subject facility included the removal of 7 sulfate solution underground storage tanks (USTs), and cleanup of associated sulfate contaminated soil, and on-site abandonment of 1 UST. A portion of the sulfate contaminated soil was left in place with the associated UST due to accessibility difficulties. This site was transferred from the County due to potential ground water impact from the leaking sulfate USTs. No potential sources of VOCs were identified on site.
2. A total of 7 ground water sampling events have been conducted at the subject facility. Most of the ground water samples contained concentrations of sulfate concentration below the RWQCB Basin Plan water quality objective of 300 mg/l and EPA's maximum contaminant level of 250 mg/l, except for a sample collected from MW-2 which reported a sulfate concentration of 350 mg/l. The average maximum sulfate concentration in ground water samples from the downgradient wells was 231 mg/l. The average from the upgradient wells was 130 mg/l.

Based on the results of the subject report and previous investigations, Board staff have determine that soil and ground water assessment and remediation have been completed where feasible and therefore we have no further requirements with regard to the objectives of the well investigation program. The continued ground water contamination from on-site sources evidenced by the monitoring data is apparently due to either incidental on-site surficial spills or leachate from the sulfate soil contamination that was abandoned in place with the remaining UST. Board staff

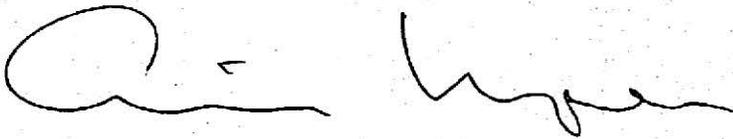
Matthew A. Love

Page 2

recommends that you attempt to control on-site surficial spills and continue periodic ground water sampling until sulfate levels decline. Although Board staff concur that soil remediation in the UST 7 area is unfeasible due to accessibility at this time, the remaining sulfate contaminated soil should be cleaned up if the building is removed from the affected area to prevent human and environmental exposure, and restore the full beneficial uses of the subject property.

The jurisdiction requirements of other agencies, such as the U.S. Environmental Protection Agency (USEPA), are not affected by the Board's "no further requirements" determination. Such agencies may choose to make their own determination concerning the site.

If you have any questions, please contact Walter Salas at (213) 266-7542 and address all correspondence to his attention.



Eric Nupen, R.G.  
Senior Engineering Geologist

cc: Phillip Ramsey, USEPA, Region IX  
Dennis Dickerson, Cal-EPA, DTSC, Region 3  
Carol Williams, San Gabriel Valley Watermaster  
William McConnell, property owner  
Karen J. Kinsella, Dames & Moore, Santa Ana  
Steven JI Oppenheimer, Morgan, Lewis & Bockius

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
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November 15, 1995

Alex Neria  
Valley Brass Co.  
3141 Maxson Road  
South El Monte, CA 91733

WELL INVESTIGATION PROGRAM - NO FURTHER REQUIREMENTS, VALLEY BRASS CO., 3141 MAXSON ROAD, SOUTH EL MONTE, CA (File No. 107.0386)

Upon review of our files, we have the following comments regarding the objectives of the Well Investigation Program for the subject site:

1. Valley Brass, Inc. has operated a brass foundry at the subject site since 1946. Kerosene, hydraulic oil, petroleum, grease, and gasoline were among chemicals used at this facility that may have contaminated the soil and ground water.
2. An inspection by Board staff on September 3, 1987, identified the following areas of concern: 1) a drum storage area in the northwest corner of the site; 2) two underground storage tanks (USTs) in the front parking lot area; 3) an oil storage area in the southern part of the site; and 4) a hazardous material storage area in the southern part of the site.
3. Two USTs were removed in August, 1987, in accordance with the Los Angeles County Department of Public Work requirements. No evidence of leaks from the USTs and associated piping were detected by confirmatory soil sampling and the inspectors observations.
4. An initial soil investigation was performed in December, 1987, under Board staff oversight which consisted of one 25-foot soil boring in the fuel drum storage area. Methylene chloride (1,500 ug/kg), PCE (1,100), toluene (170), and TPH (32,200 mg/kg) were detected to a depth of one foot below ground surface (bgs). TPH (35 mg/kg) was also detected in a sample collected at 5' bgs. Ground water is estimated to be approximately 45' bgs in this area.
5. Contaminated soil was excavated and hauled from the former drum storage area in June, 1988. Laboratory analysis of soil matrix samples from a confirmatory borehole drilled to a depth of 30' bgs were non-detect (ND) for BTEX, TPH, and Volatile organic compounds (VOCs).

Mr. Alex Neria  
Page 2

6. An additional soil investigation was performed in May, 1990, consisting of 10 boreholes to a maximum depth of 10' bgs in the hazardous material and fuel drum storage areas. No VOCs or TPH were detected in samples from these borings.
7. Additional subsurface investigations performed in February, 1991, consisted of 9 boreholes in the oil and hazardous material storage areas. No VOCs were detected in these samples. Samples from one borehole in the hazardous material storage area contained a maximum TPH concentration of 1,400 mg/kg. Samples collected in the other borings in the area contained no greater than 100 mg/kg TPH.

Based on the above information, Board staff concludes that the assessment work performed at the site adequately evaluate subsurface conditions beneath the site and we therefore have no further requirements regarding assessment. The remaining TPH soil contamination in the hazardous material storage area marginally exceeds allowable levels. However, considering the limited volume of soil and depth to ground water, we do not believe that this is a significant threat to human or environmental health, or to ground water quality, and therefore remediation is not required.

The jurisdiction requirements of other agencies, such as the United States Environmental Protection Agency, are not affected by this Board's "no further requirement" decision. Such agencies may choose to make their own decisions concerning soil and groundwater investigations at the region.

If you have any questions, please contact Mr. Yi Lu at (213)266-7642.



Eric Nupen, RG  
Senior Engineering Geologist

cc: Bella Dizon, U.S. EPA, Region IX

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
LOS ANGELES REGION

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(213) 266-7600

December 21, 1995

Phil Ramser, Sr.  
RAMSER PROPERTIES  
151 Kalmus Dr., Suite D 220  
Costa Mesa, CA 92626

WELL INVESTIGATION PROGRAM - NO FURTHER REQUIREMENTS, RAMSER PROPERTIES SITE AT 18525 RAILROAD STREET, CITY OF INDUSTRY, CALIFORNIA (FILE NO. 105.0234).

We are in receipt of the report entitled "Supplemental Soil Gas Survey to Reassess Vadose Zone Site Conditions and Evaluate Water Quality Findings", received November 16, 1995, submitted by your consultant, The Kendall/Adams Group. The subject report details the collection and analysis of soil vapor samples potential VOC sources at the facility. The subject soil gas survey was implemented to complement previous assessment work and is in general compliance with requirements in our letters of February 4, 1995, and May 15, 1995. Upon review of the subject report, we have the following comments:

1. A total of 46 soil vapor samples were collected from soil vapor probes installed to a maximum depth of 15' bgs in potential source areas on the site during this phase of assessment. Maximum VOC concentrations were 1  $\mu\text{g/l}$  PCE; 16  $\mu\text{g/l}$  TCE; and 79  $\mu\text{g/l}$  Freon 11.
2. These results correlate with data from a subsurface investigation conducted in October 1991. Laboratory analysis of shallow soil gas samples collected during this earlier phase of assessment resulted in maximum VOC concentrations of 56  $\mu\text{g/l}$  PCE; 15  $\mu\text{g/l}$  TCE; 128  $\mu\text{g/l}$  1,1,1-TCA; 1  $\mu\text{g/l}$  1,1-DCE; and 372  $\mu\text{g/l}$  Freon 113; and 1  $\mu\text{g/l}$  methylene chloride. Deeper soil vapor samples collected during the subject soil gas survey confirmed that the higher concentrations detected during the earlier assessment did not extend below 10' bgs.
3. Other previous assessment work at the subject site included passive soil sampler (using petrex tubes), drilling and sampling of 9 boreholes, collection and analysis of 57 soil vapor samples, and installation/sampling of three ground water monitoring wells. Maximum VOC concentrations in soil matrix samples were 43  $\mu\text{g/kg}$  PCE; 8  $\mu\text{g/kg}$  TCE; 45,000  $\mu\text{g/kg}$  methylene chloride (at 1' bgs); and 167  $\mu\text{g/kg}$  toluene. Deeper soil vapor samples collected during the subject soil gas survey confirmed that the higher concentrations detected during the

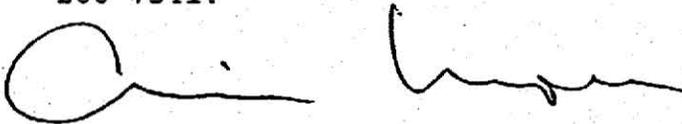
earlier assessment did not extend below 10' bgs.

4. Laboratory results of the latest ground water sampling and analysis indicate a reduction in concentrations of VOCs in ground water since monitoring began in June 1993. The highest VOC concentrations in the ground water samples were TCE at 59  $\mu\text{g}/\text{l}$ ; 1,1-DCE at 6  $\mu\text{g}/\text{l}$ ; and trichlorofluoromethane at 42  $\mu\text{g}/\text{l}$ . In general, the highest concentrations of contaminants were detected in ground water samples from downgradient well MW-3. Ground water is approximately 18' bgs.
5. The subject site has been used for the manufacture of polyurethane foam products since 1977. Potential sources of soil and ground water contamination included above ground storage tanks, process areas and numerous chemicals storage areas. The soil is predominantly clayey silts with interbedded silts, sands and gravels.

Based on the results of the subject reports and previous information contained our files, Board staff have determined that the data obtained at the site adequately evaluate subsurface conditions and we therefore have no further requirements with respect to the Well Investigation Program. Although VOCs that were detected in shallow soil matrix and vapor samples exceed allowable limits, the limited volumetric extent of the impacted soil and clayey nature of the soil limits the risk to human or environmental health, or ground water quality, and therefore remediation is not required.

The jurisdictional requirements of other agencies, such as the U.S. Environmental Protection Agency (USEPA), are not affected by the Board's "no further action" determination. Such agencies may choose to make their own determination concerning the site.

If you have any questions, please contact Julio C. Lara at (213) 266-7541.



ERIC NUPEN, R.G.  
Senior Engineering Geologist

cc: Phillip Ramsey, U.S. EPA, Region IX, San Francisco  
Dennis Dickerson, Cal-EPA, DTSC, Region 3  
Carol Williams, San Gabriel Valley Watermaster  
Charles C. Kendall, Kendall/Adams Group

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD  
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FAX: (213) 266-7600*Simple  
letter*

January 4, 1996

Eric Henn  
HENNS INVESTMENT  
c/o Edro Engineering, Inc.  
20500 Carrey Rd.  
Walnut, CA 91789WELL INVESTIGATION PROGRAM - NO FURTHER REQUIREMENTS, HENNS INVESTMENT (FORMER BECKER MANUFACTURING, INC.), 215 N. MASON WAY, CITY OF INDUSTRY (FILE NO. 102.0052)

At the request of your consultant, FERRO ENGINEERING, we have reconsidered our requirement for a hydrogeologic investigation at the subject site which was noted in our letter of September 21, 1995. The purpose of this requirement was to determine if a ground water plume was associated with on-site sources that needed cleanup to prevent further degradation of ground water quality. As noted in our letter, considering the extent of VOC soil contamination from ground surface to the water table, we believe that it is likely that ground water has been impacted as a result of releases from on-site sources. Although the levels of reported soil contamination were not high enough to indicate a likelihood of severe ground water contamination, we thought a confirmatory hydrogeologic investigation was justified due to the possibility that higher concentrations were present before the suspected preliminary cleanup that may have been conducted without Board staff knowledge or oversight in the most heavily contaminated portion of the site.

Upon review of data from the subject site and ground water data from adjacent sites, we have decided to rescind our requirement for a hydrogeologic investigation at the site. Although it is likely that ground water quality has been impacted as a result of releases from on-site sources, it is unlikely that the contamination is of such magnitude to require cleanup and does not warrant the cost of a hydrogeologic investigation. We therefore have no further requirements for assessment or remediation at the site.

The jurisdiction requirements of other agencies, such as the U.S. Environmental Protection Agency (USEPA), are not affected by the Board's "no further requirements" determination. Such agencies may choose to make their own determination concerning the site.

Eric Henn  
Page 2

If you have any questions, please contact the undersigned at (213) 266-7531 and direct all correspondence to his attention.

A handwritten signature in black ink, appearing to read "Eric Nupen". The signature is fluid and cursive, with a large initial "E" and "N".

Eric Nupen, R.G.  
Senior Engineering Geologist

cc: Phillip Ramsey, U.S. EPA, Region IX, San Francisco  
Dennis Dickerson, Cal-EPA, DTSC, Region 3  
Carol Williams, San Gabriel Valley Watermaster  
Carl Sjoberg, County of L.A., D.P.W., Industrial Waste Section  
Paul Mitchell, Fero Engineering

# **APPENDIX E**

**STATE BOARD**

**POLICES AND PROCEDURES**

**FOR**

**INVESTIGATIONS, CLEANUPS,**

**DRINKING AND HIGH QUALITY**

**WATERS**



OCT 08 1996



Pete Wilson  
Governor

Cal SW

State Water  
Resources  
Control Board

Division of  
Clean Water  
Programs

Mailing Address:  
P.O. Box 944212  
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95834-4212

14 T Street,  
Suite 130  
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95814  
(916) 227-4418  
(916) 227-4443

TO: INTERESTED PARTIES

AMENDED RESOLUTION NO. 92-49

Enclosed is a copy of the Amended Resolution No. 92-49 "Policies and Procedures for Investigation and Cleanup and Abatement Under Section 13304 of the Water Code" regarding the "Containment Zone Policy." This Amendment was adopted by the State Water Resources Control Board at its October 2, 1996 meeting.

Those sections that were amended on October 2 are indicated by underline and strikeout, and will not become effective until approved by the Office of Administrative Law. We anticipate a decision regarding approval in January 1997.

If you have any questions, please contact me at (916) 227-4418 or Christine Bailey at (916) 227-4525.

Sincerely,

*Christine Bailey*

for Elizabeth Babcock, Chief  
Land Disposal Section.

Enclosure



*Our mission is to preserve and enhance the quality of California's water resources, and ensure their proper allocation and efficient use for the benefit of present and future generations.*

STATE WATER RESOURCES CONTROL BOARD  
RESOLUTION NO. 96-079

ADOPTION OF  
CONTAINMENT ZONE POLICY  
AMENDMENT TO RESOLUTION NO. 92-49:  
POLICIES AND PROCEDURES FOR INVESTIGATION AND  
CLEANUP AND ABATEMENT OF DISCHARGES  
UNDER WATER CODE SECTION 13304

WHEREAS:

1. California Water Code (WC) Section 13140 provides that the State Water Resources Control Board (SWRCB) may formulate and adopt State Policy for Water Quality Control.
2. Water Code Section 13240 provides that Water Quality Control Plans shall conform to any State Policy for Water Quality Control.
3. The SWRCB adopted Resolution No. 92-49 "Policies and Procedures for Cleanup and Abatement of Discharges Under Water Code Section 13304" on June 17, 1992. Resolution No. 92-49 was amended on April 21, 1994, and became effective upon approval by the Office of Administrative Law on July 8, 1994.
4. SWRCB Resolution No. 92-49 is being amended to establish conditions under which a Regional Water Quality Control Board (RWQCB) may establish containment zones (specific portions of ground water bearing units where water quality objectives cannot be reasonably achieved). The SWRCB prepared and circulated a draft of the proposed amendment on January 20, 1995. In addition, a draft environmental document ("functional equivalent document" (FED)) was made available for public review on January 20, 1995, in accordance with the provisions of the California Environmental Quality Act (CEQA). The SWRCB conducted a public hearing in Sacramento on March 23, 1995 to solicit comments regarding a draft of the proposed amendment to Resolution No. 92-49.
5. Based on comments received by the SWRCB, the amendment was restructured, revised, and circulated for a second public comment period on September 14, 1996. In addition, the FED was revised and expanded and made available for a second public comment period on September 14, 1996. A second public hearing was held in Sacramento on November 8, 1996, regarding the second draft of the proposed amendment.

6. Based on comments received by the SWRCB, the amendment was revised circulated for a third public comment period on June 3, 1996. The draft Final FED was revised and made available for public comment on June 7, 1996. An SWRCB Workshop was held on July 3, 1996 regarding the third draft of the proposed amendment.
7. The SWRCB has reviewed and considered all comments and testimony received regarding the amendment.
8. A draft Final FED was prepared responding to written and oral comments received during the second public participation process and presented to the SWRCB on June 6, 1996. An Appendix to the FED was prepared (including responses to comments received during the third public participation process and changes to the draft Final FED made due to changes in the policy) and provided to the SWRCB on August 7, 1996. The SWRCB considered the information contained in the Final FED (draft Final FED and Appendix) prior to approval of the amendment to Resolution No. 92-49.
9. According to Government Code Section 11353(b)(5), this amendment shall not become effective until its regulatory provisions have been approved by the California Office of Administrative Law in accordance with Government Code Section 11349.3(a).
10. The regulatory provisions of this amendment comply with the standards of necessity, authority, clarity, consistency, reference, and nonduplication set forth in Government Code Section 11349.1(a).
11. CEQA requires adoption of a program for monitoring implementation of mitigation measures that are adopted as part of the project approval. This requirement applies to mitigation that is included as a part of each individual containment zone designation. The Appendix to the containment zone policy provides for such a program. It states that the management plan will set forth "...mitigation measures, an implementation schedule for mitigation, and reporting requirements for compliance with mitigation measures." The adequacy of the mitigation monitoring plan will be reviewed during the public proceedings regarding adequacy of the management plan.
12. The SWRCB makes the following specific findings regarding its CEQA responsibilities:
  - A. The Final FED (which includes responses to all comments regarding the September 1995 and June 1996 drafts of the amendment and environmental document) has been completed in compliance with the California Environmental Quality

Act (Public Resources Code Sections 21000, et seq.), the CEQA Guidelines, and the procedures of the State of California for Certified Regulatory Programs (Public Resources Code Section 21080.5, CEQA Guidelines Section 15250 - 15253); the Final FED reflects the independent judgment of the SWRCB; and the SWRCB has reviewed and considered the Final FED prior to its decision to approve the amendment to Resolution No. 92-49.

B. The Final FED identified potentially significant environmental effects from the proposed amendment and mitigation measures and provisions of the proposed amendment which would lessen or avoid each of those impacts, and with respect to each of those impacts and mitigations or policy provisions the SWRCB finds as follows:

1. Ground Water. The amendment acknowledges that some pollutants will remain within the containment zone for some period of time because it is unreasonable to cleanup to water quality objectives.

Mitigation measures incorporated into the amendment to reduce impacts to less than significant levels are: Where appropriate, discharger must provide for equivalent alternate water supplies, reimbursement for increased water treatment costs to affected users, and increased costs associated with well modifications. Additional mitigation measures may be proposed by the discharger including participating in regional ground water monitoring or contributing to ground water basin cleanup or management programs or research aimed at developing remedial technologies.

Implementation of these mitigation measures, as appropriate, for each individual containment zone designation will reduce these potentially significant impacts to less than significant levels.

The migration of polluted ground water to other areas of the subsurface could pose a significant adverse impact to ground water quality surrounding a containment zone. The proposed amendment provides that the discharger must contain pollutants within the area of the containment zone, and that containment zone designation will be revoked if water quality objectives are exceeded outside the containment zone as a result of migration of chemicals from inside the containment zone.

Application of these provisions of the policy at each individual containment zone designation site will reduce

this potentially significant impact to a less than significant level.

2. **Surface Water (Including Wetlands).** The migration of ground water pollutants to surface water outside the containment zone could pose a potentially significant adverse impact to surface water quality. The proposed amendment provides that the discharger must contain pollutants within the area of the containment zone, and that containment zone designation will be revoked if water quality objectives are exceeded outside the containment zone as a result of migration of chemicals from inside the containment zone.

Application of these provisions of the policy at each individual containment zone site will reduce this potentially significant impact to a less than significant level.

In some cases there is the potential that ground water pollutants could interface with surface waters overlying the containment zone. The proposed amendment provides that (1) a containment zone designation can not have significant adverse impacts on human health or the environment, and (2) mitigation must be provided for any significant adverse impacts.

Application of these provisions of the policy at each individual containment zone site will reduce this potentially significant impact to a less than significant level.

3. **Human Health.** Pollutants at levels above water quality objectives in ground water may pose adverse impacts to human health. The amendment provides that the discharger must propose and agree to implement a management plan to assess, cleanup, abate, manage, monitor, and mitigate any significant adverse impacts to human health. The amendment also prohibits designation of a containment zone if such designation would allow exposure levels of constituents of concern that could have an adverse impact on human health.

Application of these provisions of the policy at each individual containment zone site will reduce these potentially significant impacts to less than significant levels.

4. **Biological Resources.** Ground water pollutants may pose potentially significant impacts to biological receptors, especially when the ground water interfaces with surface water. The policy provides that the discharger must

propose and agree to implement a management plan to assess, cleanup, abate, manage, monitor, and mitigate any significant adverse impacts to the environment. The policy also prohibits designation of a containment zone if such designation would allow exposure levels of constituents of concern that could have an adverse impact on the environment.

Application of these provisions of the policy at each individual containment zone designation site will reduce these potentially significant impacts to less than significant levels.

5. Public Facilities and Utilities. Polluted ground water may pose the potential for adverse health impacts to workers at public facilities and utilities who must penetrate the subsurface for maintenance activities. The policy provides that the discharger must propose and agree to implement a management plan to assess, cleanup, abate, manage, monitor, and mitigate any significant adverse impacts to human health. The policy also prohibits designation of a containment zone if such designation would allow exposure levels of constituents of concern that could have an adverse impact on human health.

Application of these provisions of the policy at each containment zone site will reduce this potentially significant impact to a less than significant level.

Polluted ground water may have the potential to adversely affect local or regional water supplies. The amendment requires the discharger to provide reasonable mitigation measures to lessen or avoid any significant adverse environmental impacts.

Application of this provision of the policy at each containment zone site will reduce these potentially significant impacts to less than significant levels.

6. Taste and Odor. There may be potential for nuisance due to taste or odor from the residual pollutants remaining in the ground water in the containment zone. The amendment requires mitigation for any significant adverse impacts due to residual pollutants remaining in the containment zone.

Application of this provision of the policy at each individual containment zone site will reduce these potentially significant impacts to less than significant levels.

7. Land Use. Designation of a containment zone may allow a property owner to cease active remediation and put his property to active use such as construction of industrial or commercial facilities. If construction of a facility is able to proceed because of a designation of a containment zone, local governments and regulatory agencies are responsible for mitigating indirect impacts of land use in these communities.

With respect to these potentially significant impacts, appropriate changes, alterations, or mitigation are not within the responsibility and jurisdiction of the SWRCB or RWQCBs. Such changes, alterations, or mitigation should be adopted by other agencies.

8. Growth-Inducing Impacts. Designation of a containment zone may allow property to be redeveloped and thus create jobs and contribute to some growth in the community. This is not the regional growth that would have significant impacts to infrastructure, public services, and the environment that is envisioned in CEQA as a significant impact. However, avoiding or mitigating adverse impacts due to growth in the community falls within the jurisdiction of local governments and regulatory facilities when they are approving or amending general and specific plans and zoning maps and ordinances. The SWRCB and RWQCBs do not have the authority to mitigate such impacts.

With respect to potentially significant impacts due to growth, appropriate changes, alterations, or mitigation are not within the responsibility and jurisdiction of the SWRCB or RWQCBs. Such changes, alterations, or mitigation should be adopted by other agencies.

9. Secondary Impacts. Secondary impacts could occur from measures taken to comply with mitigation requirements for containment zone designation. Such measures could include construction of physical ground water barriers, hydrodynamic control systems, modification of water treatment facilities, or redevelopment of land overlying the containment zone.

It is too speculative to anticipate at this time what, if any, such projects would be proposed and what their impacts might be. These construction activities will be considered individually to determine whether CEQA review is required and are not addressed in the environmental document for the amendment.

- C. The Final FED concludes that with the implementation of feasible policy requirements and mitigation, that cumulative and long-term impacts are not foreseen. However, it is too speculative to make a determination that there will be no significant cumulative and long-term impacts.

Cumulative and Long-Term Impacts. It is not possible at this time to estimate the number of sites in California where dischargers will request and RWQCBs will grant containment zones. However, the following policy provisions and mitigation measures are required, where appropriate, for each containment zone designation.

-The RWQCB will determine whether water quality objectives can reasonably be achieved within a reasonable period considering what is economically and technologically feasible.

-Containment and storage vessels that cause water quality degradation must be removed, repaired, or closed; floating free product must be removed to the extent practicable; and other sources must be removed, isolated or managed.

-The discharger must take all actions necessary to prevent migration of pollutants beyond the boundaries of the containment zone in concentrations that exceed water quality objectives.

-The discharger must propose and agree to implement a management plan to assess, cleanup, abate, manage, monitor, and mitigate significant impacts to human health, water quality, and the environment.

-Containment zones will be no larger than necessary based on the facts of the individual designation. In no event shall the size of a containment zone or the cumulative effect of a containment zones cause a substantial decline in the overall yield, storage, or transport capacity of a ground water basin.

-The policy prohibits designation of a containment zone in a critical recharge area or if designation would be inconsistent with a local ground water management plan developed pursuant to Part 2.75 of Division 6 of the Water Code (commencing at Section 10750) or provisions of law or court order, judgment or decree.

-The RWQCB can designate a containment zone only after a 45-day public review period.

-Prior to designation of a containment zone the RWQCB must notify the California Department of Toxic Substances Control; the California Department of Health Services, Drinking Water Branch; the California Department of Fish and Game; the local health authority; the local water purveyor in the event ground water is used or planned to be used as a source of water supply; any local ground

water management agency; and the United States Environmental Protection Agency; and consider advice provided by these agencies regarding the designation.

-The containment zone designation will be revoked if the discharger(s) fails to fully implement the management plan or water quality objectives are exceeded outside the containment zone as a result of migration of chemicals from inside the containment zone.

D. Having reviewed and considered the information in the Final FED, the SWRCB finds the following regarding alternatives to the project:

1. No Action. Under this alternative, the existing framework for regulating ground water cleanup levels is unchanged. This framework consists of RWQCBs making cleanup-level decisions based on 1) site-specific characteristics, 2) applicable state and federal statutes and regulations, 3) applicable beneficial uses and water quality objectives from RWQCB basin plans, 4) SWRCB policies found in Resolutions No. 68-16 and No. 92-49, and 5) relevant standards, criteria, and advisories adopted by other state and federal agencies and organizations. In some cases, practical limitations arising from hydrogeologic factors, pollutant-related factors, remediation system inadequacies, and costs severely restrict remediation efforts. These limitations are discussed in detail in Section 3.3 of the FED. The existing framework does not provide procedures or criteria for the case where water quality objectives cannot be reasonably achieved. Consequently, the "no action" alternative is infeasible.
2. De-Designation of Beneficial Uses. Under this alternative Resolution No. 92-49 would be amended to establish a policy whereby beneficial use designations in areas of polluted ground water would be de-designated if it could be shown that cleanup to water quality objectives is unreasonable. This alternative has the following problems:
  - (a) Containment zones will be established on a case-by-case basis and will be limited in areal extent. However, de-designation of beneficial uses can only be accomplished through amendments to Basin Plans. Such amendments are accomplished through rule-making proceedings. As such, the quasi-legislative process is unsuitable for case-by-case decisions.

- (b) Designation and de-designation of beneficial uses ordinarily takes place on an aquifer or sub-aquifer basis. To require a Basin Plan amendment for each containment zone, many of which may be less than an acre in areal extent, is not appropriate or practicable.
- (c) To require amendment of a Basin Plan every time a containment zone is established is overly cumbersome. The notice requirements are greater than what is necessary. The process is very time consuming and would require more use of limited staff time. In addition, such amendments may have to be approved by the Office of Administrative Law, an agency that is set up to deal only with rule-making proceedings.
- (d) If beneficial uses are de-designated, then the relevant water quality objective would no longer apply. Such a de-designation would then limit future RWQCB authority over that water body. The RWQCB would not be required to protect the water body from future degradation relative to the de-designated beneficial use from other sources.

This alternative is infeasible for the above-listed reasons.

- 3. Relaxation of Water Quality Objectives. Water quality objectives are numerical or narrative limits of water quality constituents or characteristics established for the protection of designated beneficial uses and for the prevention of nuisance. Water quality objectives can only be changed through an amendment to a RWQCB Basin Plan.

This alternative is infeasible for the same reasons in the Alternative 2 - De-Designation of Beneficial Uses.

- 4. Establish Alternate Points of Compliance. Under this alternative, a procedure would be established to address cases where compliance with water quality objectives can not be achieved throughout the body of ground water. This approach would informally de-designate the beneficial use of ground water upgradient of the alternative point of compliance.

This alternative is infeasible because it would be inconsistent with Porter-Cologne and it is unworkable because it would require a Basin Plan amendment and, therefore, suffers from the same drawbacks as Alternatives 2 and 3. In addition, this alternative

conveys the impression that water quality objectives are being met when in fact they cannot be reasonably met.

- E. There are no feasible alternatives or additional feasible mitigation measures available to the SWRCB which would substantially lessen any potentially significant adverse environmental impacts.
- F. The SWRCB believes that this policy contains feasible mitigation measures that will substantially lessen or avoid significant impacts. To the extent that it can be argued that such impacts remain, the SWRCB issues the following statement of overriding considerations to address any unforeseen cumulative or long-term impacts that may potentially occur from designation of containment zones.
- The policy will establish a process and criteria for RWQCBs to address those sites where water quality objectives set forth in RWQCB Basin Plans cannot be reasonably achieved.
  - Establishment of this policy sets out requirements for protection of human health, water quality, and the environment at sites where it is unreasonable to cleanup to water quality objectives.
  - Establishment of this policy sets out requirements for public notice and participation, and consultation with expert agencies regarding the management and mitigation of sites where it is unreasonable to cleanup to water quality objectives.

The SWRCB has incorporated feasible requirements and mitigation into the policy which significantly reduce any potential cumulative and long-term impacts, and significant cumulative and long-term impacts are not foreseen. In fact, the provisions necessary to achieve containment zone status (e.g., source removal, containment, consultation with local water and ground water management agencies, and mitigation) may have beneficial cumulative and long-term impacts. In balancing the benefits of the policy against the potential for some undetermined cumulative or long-term impacts, the SWRCB determines that overriding economic benefits of the project outweigh any significant effects on the environment (which are not expected to occur), and the potential for effects is, therefore, acceptable.

- G. During the public comment period regarding the amendment, some interested parties recommended the incorporation of

risk assessment procedures into Resolution No. 92-49. The issue of risk based corrective action was not addressed in the FED for this amendment, nor were the issues raised regarding the use of risk resolved.

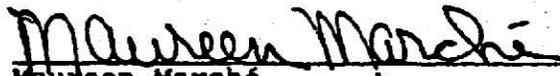
THEREFORE BE IT RESOLVED THAT

THE STATE WATER RESOURCES CONTROL BOARD:

1. Approves the environmental document for the amendment to Resolution No. 92-49 and the mitigation monitoring program.
2. Adopts the attached amendment to Resolution No. 92-49.
3. Directs the Containment Zone Review Committee established pursuant to Section III.H.11. of the amendment to review the implementation of this policy and the incorporation of risk assessment into this policy and provide recommendations to the SWRCB by May 1, 1997, on any further adjustments to the policy.
4. Expands the Containment Zone Review Committee to include other public officials and private individuals as determined by the State Board.

CERTIFICATION

The undersigned Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on October 2, 1996.

  
Maureen Marché  
Administrative Assistant to the Board

STATE WATER RESOURCES CONTROL BOARD  
RESOLUTION NO. 92-49  
(As Amended on April 21, 1994 and October 2, 1996)

POLICIES AND PROCEDURES  
FOR INVESTIGATION AND  
CLEANUP AND ABATEMENT OF  
DISCHARGES UNDER  
WATER CODE SECTION 13304

WHEREAS:

1. California Water Code (WC) Section 13001 provides that it is the intent of the Legislature that the State Water Resources Control Board (State Water Board) and each Regional Water Quality Control Board (Regional Water Board) shall be the principal state agencies with primary responsibility for the coordination and control of water quality. The State and Regional Water Boards shall conform to and implement the policies of the Porter-Cologne Water Quality Control Act (Division 7, commencing with WC Section 13000) and shall coordinate their respective activities so as to achieve a unified and effective water quality control program in the state;
2. WC Section 13140 provides that the State Water Board shall formulate and adopt State Policy for Water Quality Control;
3. WC Section 13240 provides that Water Quality Control Plans shall conform to any State Policy for Water Quality Control;
4. WC Section 13304 requires that any person who has discharged or discharges waste into waters of the state in violation of any waste discharge requirement or other order or prohibition issued by a Regional Water Board or the State Water Board, or who has caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged into the waters of the state and creates, or threatens to create, a condition of pollution or nuisance may be required to clean up the discharge and abate the effects thereof. This section authorizes Regional Water Boards to require complete cleanup of all waste discharged and restoration of affected water to background conditions (i.e., the water quality that existed before the discharge). The term waste discharge requirements includes those which implement the National Pollutant Discharge Elimination System;
5. WC Section 13307 provides that the State Water Board shall establish policies and procedures that its representatives and the representatives of the Regional Water Boards shall follow for the oversight of investigations and cleanup and abatement activities resulting from discharges of hazardous substances, including:
  - a. The procedures the State Water Board and the Regional Water Boards will follow in making decisions as to when a person may be required to undertake an investigation to determine if an unauthorized hazardous substance discharge has occurred;
  - b. Policies for carrying out a phased, step-by-step investigation to determine the nature and extent of possible soil and ground water contamination or pollution at a site;
  - c. Procedures for identifying and utilizing the most cost-effective methods for detecting contamination or pollution and cleaning up or abating the effects of contamination or pollution;
  - d. Policies for determining reasonable schedules for investigation and cleanup, abatement, or other remedial action at a site. The policies shall recognize the danger to public health and the waters of the state posed by an unauthorized discharge and the need to mitigate those dangers while at the same time taking into account, to the extent possible, the resources, both financial and technical, available to the person responsible for the discharge;
6. "Waters of the state" include both ground water and surface water;
7. Regardless of the type of discharge, procedures and policies applicable to investigations, and cleanup and abatement activities are similar. It is in the best interest of the people of the state for the State Water Board to provide consistent guidance for Regional Water Boards to apply to investigation, and cleanup and abatement;
8. WC Section 13260 requires any person discharging or proposing to discharge waste that could affect waters of the state, or proposing to change the character, location, or volume of a discharge to file a report with and receive requirements from the Regional Water Board;
9. WC Section 13267 provides that the Regional Water Board may require dischargers, past dischargers, or suspected dischargers to furnish those technical or monitoring reports as the Regional Water Board may specify, provided that the burden, including costs, of these reports, shall

- bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports;
10. WC Section 13300 states that the Regional Water Board may require a discharger to submit a time schedule of specific actions the discharger shall take in order to correct or prevent a violation of requirements prescribed by the Regional Water Board or the State Water Board;
  11. California Health and Safety Code (HSC) Section 25356.1 requires the Department of Toxic Substances Control (DTSC) or, if appropriate, the Regional Water Board to prepare or approve remedial action plans for sites where hazardous substances were released to the environment if the sites have been listed pursuant to HSC Section 25356 (state "Superfund" priority list for cleanup of sites);
  12. Coordination with the U.S. Environmental Protection Agency (USEPA), state agencies within the California Environmental Protection Agency (Cal/EPA) (e.g., DTSC, Air Resources Control Board), air pollution control districts, local environmental health agencies, and other responsible federal, state, and local agencies: (1) promotes effective protection of water quality, human health, and the environment and (2) is in the best interest of the people of the state. The principles of coordination are embodied in many statutes, regulations, and interagency memoranda of understanding (MOU) or agreement which affect the State and Regional Water Boards and these agencies;
  13. In order to clean up and abate the effects of a discharge or threat of a discharge, a discharger may be required to perform an investigation to define the nature and extent of the discharge or threatened discharge and to develop appropriate cleanup and abatement measures;
  14. Investigations that were not properly planned have resulted in increases in overall costs and, in some cases, environmental damage. Overall costs have increased when original corrective actions were later found to have had no positive effect or to have exacerbated the pollution. Environmental damage may increase when a poorly conceived investigation or cleanup and abatement program allows pollutants to spread to previously unaffected waters of the state;
  15. A phased approach to site investigation should facilitate adequate delineation of the nature and extent of the pollution, and may reduce overall costs and environmental damage, because: (1) investigations inherently build on information previously gained; (2) often data are dependent on seasonal and other temporal variations; and (3) adverse consequences of greater cost or increased environmental damage can result from improperly planned investigations and the lack of consultation and coordination with the Regional Water Board. However, there are circumstances under which a phased, iterative approach may not be necessary to protect water quality, and there are other circumstances under which phases may need to be compressed or combined to expedite cleanup and abatement;
  16. Preparation of written workplans prior to initiation of significant elements or phases of investigation, and cleanup and abatement generally saves Regional Water Board and discharger resources. Results are superior, and the overall cost-effectiveness is enhanced;
  17. Discharger reliance on qualified professionals promotes proper planning, implementation, and long-term cost-effectiveness of investigation, and cleanup and abatement activities. Professionals should be qualified, licensed where applicable, and competent and proficient in the fields pertinent to the required activities. California Business and Professions Code Sections 6735, 7835, and 7835.1 require that engineering and geologic evaluations and judgements be performed by or under the direction of registered professionals;
  18. WC Section 13360 prohibits the Regional Water Boards from specifying, but not from suggesting, methods that a discharger may use to achieve compliance with requirements or orders. It is the responsibility of the discharger to propose methods for Regional Water Board review and concurrence to achieve compliance with requirements or orders;
  19. The USEPA, California state agencies, the American Society for Testing and Materials, and similar organizations have developed or identified methods successful in particular applications. Reliance on established, appropriate methods can reduce costs of investigation, and cleanup and abatement;
  20. The basis for Regional Water Board decisions regarding investigation, and cleanup and abatement includes: (1) site-specific characteristics; (2) applicable state and federal statutes and regulations; (3) applicable water quality control plans adopted by the State Water Board and Regional Water Boards, including beneficial uses, water quality objectives, and implementation plans; (4) State Water Board and Regional Water Board policies, including State Water Board Resolutions No. 68-16 (Statement of Policy with Respect to Maintaining High Quality of Waters in California) and No. 88-63 (Sources of Drinking Water); and

- (5) relevant standards, criteria, and advisories adopted by other state and federal agencies;
21. Discharges subject to WC Section 13304 may include discharges of waste to land; such discharges may cause, or threaten to cause, conditions of soil or water pollution or nuisance that are analogous to conditions associated with migration of waste or fluid from a waste management unit;
  22. The State Water Board has adopted regulations governing discharges of waste to land (California Code of Regulations (CCR), Title 23, Division 3, Chapter 15);
  23. State Water Board regulations governing site investigation and corrective action at underground storage tank unauthorized release sites are found in 23 CCR Division 3, Chapter 16, in particular Article 11 commencing with Section 2720;
  24. It is the responsibility of the Regional Water Board to make decisions regarding cleanup and abatement goals and objectives for the protection of water quality and the beneficial uses of waters of the state within each Region;
  25. Cleanup and abatement alternatives that entail discharge of residual wastes to waters of the state, discharges to regulated waste management units, or leaving wastes in place, create additional regulatory constraints and long-term liability, which must be considered in any evaluation of cost-effectiveness;
  26. It is not the intent of the State or Regional Water Boards to allow dischargers, whose actions have caused, permitted, or threaten to cause or permit conditions of pollution, to avoid responsibilities for cleanup. However, in some cases, attainment of applicable water quality objectives for ground water cannot reasonably be achieved. In these cases, the State Water Board determines that establishment of a containment zone is appropriate and consistent with the maximum benefit to the people of the State if applicable requirements contained in the Policy are satisfied. The establishment of a containment zone does not limit or supersede obligations or liabilities that may arise under other laws;
  27. The Porter-Cologne Water Quality Control Act allows Regional Water Boards to impose more stringent requirements on discharges of waste than any statewide requirements promulgated by the State Water Board (e.g., in this Policy) or than water quality objectives established in statewide or regional water quality control plans as needed to protect water quality and to reflect regional and site-specific conditions; and
  28. Pursuant to Section 13320 of the Water Code, aggrieved persons may petition the State Water Board to review any decisions made under this policy.
- THEREFORE BE IT RESOLVED:**
- These policies and procedures apply to all investigations, and cleanup and abatement activities, for all types of discharges subject to Section 13304 of the WC.
- I. The Regional Water Board shall apply the following procedures in determining whether a person shall be required to investigate a discharge under WC Section 13267, or to clean up waste and abate the effects of a discharge or a threat of a discharge under WC Section 13304. The Regional Water Board shall:
    - A. Use any relevant evidence, whether direct or circumstantial, including, but not limited to, evidence in the following categories:
      1. Documentation of historical or current activities, waste characteristics, chemical use, storage or disposal information, as documented by public records, responses to questionnaires, or other sources of information;
      2. Site characteristics and location in relation to other potential sources of a discharge;
      3. Hydrologic and hydrogeologic information, such as differences in upgradient and downgradient water quality;
      4. Industry-wide operational practices that historically have led to discharges, such as leakage of pollutants from wastewater collection and conveyance systems, sumps, storage tanks, landfills, and clarifiers;
      5. Evidence of poor management of materials or wastes, such as improper storage practices or inability to reconcile inventories;
      6. Lack of documentation of responsible management of materials or wastes, such as lack of manifests or lack of documentation of proper disposal;
      7. Physical evidence, such as analytical data, soil or pavement staining, distressed vegetation, or unusual odor or appearance;
      8. Reports and complaints;

9. Other agencies' records of possible or known discharge; and
10. Refusal or failure to respond to Regional Water Board inquiries;

- B. Make a reasonable effort to identify the dischargers associated with the discharge. It is not necessary to identify all dischargers for the Regional Water Board to proceed with requirements for a discharger to investigate and clean up;
- C. Require one or more persons identified as a discharger associated with a discharge or threatened discharge subject to WC Section 13304 to undertake an investigation, based on findings of I.A and I.B above;
- D. Notify appropriate federal, state, and local agencies regarding discharges subject to WC Section 13304 and coordinate with these agencies on investigation, and cleanup and abatement activities.

II. The Regional Water Board shall apply the following policies in overseeing: (a) investigations to determine the nature and horizontal and vertical extent of a discharge and (b) appropriate cleanup and abatement measures.

A. The Regional Water Board shall:

1. Require the discharger to conduct investigation, and cleanup and abatement, in a progressive sequence ordinarily consisting of the following phases, provided that the sequence shall be adjusted to accommodate site-specific circumstances, if necessary:
  - a. Preliminary site assessment (to confirm the discharge and the identity of the dischargers; to identify affected or threatened waters of the state and their beneficial uses; and to develop preliminary information on the nature, and vertical and horizontal extent, of the discharge);
  - b. Soil and water investigation (to determine the source, nature and extent of the discharge with sufficient detail to provide the basis for decisions regarding subsequent cleanup and abatement actions, if any are determined by the Regional Water Board to be necessary);
  - c. Proposal and selection of cleanup and abatement action (to evaluate feasible and effective cleanup and abatement

actions, and to develop preferred cleanup and abatement alternatives);

- d. Implementation of cleanup and abatement action (to implement the selected alternative, and to monitor in order to verify progress);
  - e. Monitoring (to confirm short- and long-term effectiveness of cleanup and abatement);
2. Consider, where necessary to protect water quality, approval of plans for investigation, or cleanup and abatement, that proceed concurrently rather than sequentially, provided that overall cleanup and abatement goals and objectives are not compromised, under the following conditions:
    - a. Emergency situations involving acute pollution or contamination affecting present uses of waters of the state;
    - b. Imminent threat of pollution;
    - c. Protracted investigations resulting in unreasonable delay of cleanup and abatement; or
    - d. Discharges of limited extent which can be effectively investigated and cleaned up within a short time;
  3. Require the discharger to extend the investigation, and cleanup and abatement, to any location affected by the discharge or threatened discharge;
  4. Where necessary to protect water quality, name other persons as dischargers, to the extent permitted by law;
  5. Require the discharger to submit written workplans for elements and phases of the investigation, and cleanup and abatement, whenever practicable;
  6. Review and concur with adequate workplans prior to initiation of investigations, to the extent practicable. The Regional Water Board may give verbal concurrence for investigations to proceed, with written follow-up. An adequate workplan should include or reference, at least, a comprehensive description of proposed investigative, cleanup, and abatement activities, a sampling and analysis plan, a quality assurance project plan, a health and safety plan, and a commitment to implement the workplan;

7. Require the discharger to submit reports on results of all phases of investigations, and cleanup and abatement actions, regardless of degree of oversight by the Regional Water Board;
  8. Require the discharger to provide documentation that plans and reports are prepared by professionals qualified to prepare such reports, and that each component of investigative and cleanup and abatement actions is conducted under the direction of appropriately qualified professionals. A statement of qualifications of the responsible lead professionals shall be included in all plans and reports submitted by the discharger;
  9. Prescribe cleanup levels which are consistent with appropriate levels set by the Regional Water Board for analogous discharges that involve similar wastes, site characteristics, and water quality considerations;
- B. The Regional Water Board may identify investigative and cleanup and abatement activities that the discharger could undertake without Regional Water Board oversight, provided that these investigations and cleanup and abatement activities shall be consistent with the policies and procedures established herein.
- III. The Regional Water Board shall implement the following procedures to ensure that dischargers shall have the opportunity to select cost-effective methods for detecting discharges or threatened discharges and methods for cleaning up or abating the effects thereof. The Regional Water Board shall:
- A. Concur with any investigative and cleanup and abatement proposal which the discharger demonstrates and the Regional Water Board finds to have a substantial likelihood to achieve compliance, within a reasonable time frame, with cleanup goals and objectives that implement the applicable Water Quality Control Plans and Policies adopted by the State Water Board and Regional Water Boards, and which implement permanent cleanup and abatement solutions which do not require ongoing maintenance, wherever feasible;
  - B. Consider whether the burden, including costs, of reports required of the discharger during the investigation and cleanup and abatement of a discharge bears a reasonable relationship to the need for the reports and the benefits to be obtained from the reports;
- C. Require the discharger to consider the effectiveness, feasibility, and relative costs of applicable alternative methods for investigation, and cleanup and abatement. Such comparison may rely on previous analysis of analogous sites, and shall include supporting rationale for the selected methods;
  - D. Ensure that the discharger is aware of and considers techniques which provide a cost-effective basis for initial assessment of a discharge.
    1. The following techniques may be applicable:
      - a. Use of available current and historical photographs and site records to focus investigative activities on locations and wastes or materials handled at the site;
      - b. Soil gas surveys;
      - c. Shallow geophysical surveys;
      - d. Remote sensing techniques;
    2. The above techniques are in addition to the standard site assessment techniques, which include:
      - a. Inventory and sampling and analysis of materials or wastes;
      - b. Sampling and analysis of surface water;
      - c. Sampling and analysis of sediment and aquatic biota;
      - d. Sampling and analysis of ground water;
      - e. Sampling and analysis of soil and soil pore moisture;
      - f. Hydrogeologic investigation;
  - E. Ensure that the discharger is aware of and considers the following cleanup and abatement methods or combinations thereof, to the extent that they may be applicable to the discharge or threat thereof:
    1. Source removal and/or isolation;
    2. In-place treatment of soil or water:
      - a. Bioremediation;
      - b. Aeration;
      - c. Fixation;
    3. Excavation or extraction of soil, water, or gas for on-site or off-site treatment by the following techniques:
      - a. Bioremediation;

- b. Thermal destruction;
  - c. Aeration;
  - d. Sorption;
  - e. Precipitation, flocculation, and sedimentation;
  - f. Filtration;
  - g. Fixation;
  - h. Evaporation;
4. Excavation or extraction of soil, water, or gas for appropriate recycling, re-use, or disposal;
- F. Require actions for cleanup and abatement to:
- 1. Conform to the provisions of Resolution No. 68-16 of the State Water Board, and the Water Quality Control Plans of the State and Regional Water Boards, provided that under no circumstances shall these provisions be interpreted to require cleanup and abatement which achieves water quality conditions that are better than background conditions;
  - 2. Implement the provisions of Chapter 15 that are applicable to cleanup and abatement, as follows:
    - a. If cleanup and abatement involves corrective action at a waste management unit regulated by waste discharge requirements issued under Chapter 15, the Regional Water Board shall implement the provisions of that chapter;
    - b. If cleanup and abatement involves removal of waste from the immediate place of release and discharge of the waste to land for treatment, storage, or disposal, the Regional Water Board shall regulate the discharge of the waste through waste discharge requirements issued under Chapter 15, provided that the Regional Water Board may waive waste discharge requirements under WC Section 13269 if the waiver is not against the public interest (e.g., if the discharge is for short-term treatment or storage, and if the temporary waste management unit is equipped with features that will ensure full and complete containment of the waste for the treatment or storage period); and
    - c. If cleanup and abatement involves actions other than removal of the

waste, such as containment of waste in soil or ground water by physical or hydrological barriers to migration (natural or engineered), or in-situ treatment (e.g., chemical or thermal fixation, or bioremediation), the Regional Water Board shall apply the applicable provisions of Chapter 15, to the extent that it is technologically and economically feasible to do so; and

- 3. Implement the applicable provisions of Chapter 16 for investigations and cleanup and abatement of discharges of hazardous substances from underground storage tanks; and
- G. Ensure that dischargers are required to clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored, considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible; in approving any alternative cleanup levels less stringent than background, apply Section 2550.4 of Chapter 15, or, for cleanup and abatement associated with underground storage tanks, apply Section 2725 of Chapter 16, provided that the Regional Water Board considers the conditions set forth in Section 2550.4 of Chapter 15 in setting alternative cleanup levels pursuant to Section 2725 of Chapter 16; any such alternative cleanup level shall:
- 1. Be consistent with maximum benefit to the people of the state;
  - 2. Not unreasonably affect present and anticipated beneficial use of such water; and
  - 3. Not result in water quality less than that prescribed in the Water Quality Control Plans and Policies adopted by the State and Regional Water Boards; and
- H. Consider the designation of containment zones notwithstanding any other provision of this or other policies or regulations which require cleanup to water quality objectives. A containment zone is defined as a specific portion of a water bearing unit where the Regional Water Board finds, pursuant to Section III.H. of this policy, it is unreasonable to remediate to the level that achieves water quality objectives. The discharger is required to take all actions necessary to prevent the

migration of pollutants beyond the boundaries of the containment zone in concentrations which exceed water quality objectives. The discharger must verify containment with an approved monitoring program and must provide reasonable mitigation measures to compensate for any significant adverse environmental impacts attributable to the discharge. Examples of sites which may qualify for containment zone designation include, but are not limited to, sites where either strong sorption of pollutants on soils, pollutant entrapment (e.g. dense non-aqueous phase liquids [DNAPLS]), or complex geology due to heterogeneity or fractures indicate that cleanup to applicable water quality objectives cannot reasonably be achieved. In establishing a containment zone, the following procedures, conditions, and restrictions must be met:

1. The Regional Water Board shall determine whether water quality objectives can reasonably be achieved within a reasonable period by considering what is technologically and economically feasible and shall take into account environmental characteristics of the hydrogeologic unit under consideration and the degree of impact of any remaining pollutants pursuant to Section III.H.3. The Regional Water Board shall evaluate information provided by the discharger and any other information available to it:
  - a. Technological feasibility is determined by assessing available technologies, which have been shown to be effective under similar hydrogeologic conditions in reducing the concentration of the constituents of concern. Bench-scale or pilot-scale studies may be necessary to make this feasibility assessment;
  - b. Economic feasibility is an objective balancing of the incremental benefit of attaining further reductions in the concentrations of constituents of concern as compared with the incremental cost of achieving those reductions. The evaluation of economic feasibility will include consideration of current, planned, or future land use, social, and economic impacts to the surrounding community including property owners other than the discharger. Economic feasibility, in this Policy, does not refer to the discharger's ability to finance cleanup. Availability of financial resources should be considered in the establishment of reasonable compliance schedules;

5. The Regional Water Board may make determinations of technological or economic infeasibility after a discharger either implements a cleanup program pursuant to III.G, which cannot reasonably attain cleanup objectives, or demonstrates that it is unreasonable to cleanup to water quality objectives, and may make determinations on the basis of projection, modeling, or other analysis of site-specific data without necessarily requiring that remedial measures be first constructed or installed and operated and their performance reviewed over time unless such projection, modeling, or other analysis is insufficient or inadequate to make such determinations;

2. The following conditions shall be met for all containment zone designations:
  - a. The discharger or a group of dischargers is responsible for submitting an application for designation of a containment zone. Where the application does not have sufficient information for the Regional Water Board to make the requisite findings, the Regional Water Board shall request the discharger(s) to develop and submit the necessary information. Information requirements are listed in the Appendix to this section;
  - b. Containment and storage vessels that have caused, are causing, or are likely to cause ground water degradation must be removed or repaired, or closed in accordance with applicable regulations. Floating free product must be removed to the extent practicable. If necessary, as determined by the Regional Water Board, to prevent further water quality degradation, other sources (e.g., soils, nonfloating free product) must be either removed, isolated, or managed. The significance and approach to be taken regarding these sources must be addressed in the management plan developed under H.2.d.;
  - c. Where reasonable, removal of pollutant mass from ground water within the containment zone may be required, if it will significantly reduce the concentration of pollutants within the containment zone, the volume of the

containment zone, or the level of maintenance required for containment. The degree of removal which may be required will be determined by the Regional Water Board in the process of evaluating the proposal for designation of a containment zone. The determination of the extent of mass removal required will include consideration of the incremental cost of mass removal, the incremental benefit of mass removal, and the availability of funds to implement the provisions in the management plan for as long as water quality objectives are exceeded within the containment zone;

- d. The discharger or a group of dischargers must propose and agree to implement a management plan to assess, cleanup, abate, manage, monitor, and mitigate the remaining significant human health, water quality, and environmental impacts to the satisfaction of the Regional Water Board. Impacts will be evaluated in accordance with Section III.H.3. The management plan may include management measures, such as land use controls<sup>1</sup>, engineering controls<sup>2</sup>, and agreements with other landowners or agreements with the landlord or lessor where the discharger is a tenant or lessee.<sup>1</sup> The contents of the management plan shall be dependent upon the specific characteristics of the proposed containment zone and must include a requirement that the Regional Water Board be notified of any transfer of affected property to a new owner(s);
- e. The proposed management plan must provide reasonable mitigation measures to substantially lessen or avoid any significant adverse environmental impacts attributable to the discharge. At a minimum, the plan must provide for control of pollutants within the containment zone such that water quality objectives are not exceeded outside the containment zone as a result of the discharge. The plan must also provide, if appropriate, for equivalent alternative water supplies, reimbursement for increased water treatment costs to affected users, and increased costs associated with well modifications. Additional mitigation measures may be proposed by the discharger based on the specific characteristics of the proposed containment zone. Such measures must assist in water quality improvement efforts within the ground

water basin and may include participating in regional ground water monitoring, contributing to ground water basin cleanup or management programs, or contributing to research projects which are publicly accessible (i.e., not protected by patents and licenses) and aimed at developing remedial technologies that would be used in the ground water basin. Proposals for off-site cleanup projects may be considered by the Regional Water Board as a mitigation measure under the following criteria:

1. Off-site cleanup projects must be located in the same ground water basin as the proposed containment zone, and
2. Implementation of an off-site project must result in an improvement in the basin's water quality or protect the basin's water quality from pollution, and
3. Off-site projects must include source removal or other elements for which water quality benefits or water quality protection can be easily demonstrated, and
4. Off-site projects may be proposed independently by the discharger or taken from projects identified as acceptable by the Regional Water Board through a clearinghouse process, or
5. In lieu of choosing to finance a specific off-site project, the discharger may contribute moneys to the SWRCB's Cleanup and Abatement Account (Account) or other funding source. Use of such contributions to the Account or other source will be limited to cleanup projects or water quality protection projects for the basin in which the containment zone is designated. Contributions are not to exceed ten percent of the savings in continued active remediation that discharger will accrue over a ten-year period due to designation of a containment zone (less any additional costs of containment zone designation during this period, e.g.,

additional monitoring requirements, Regional Water Board application costs, etc.). Contributions of less than ten percent must be accompanied by a detailed justification as to why a lesser contribution would provide adequate mitigation.

Except where prohibited by Federal law, Federal agencies may be required, based on specific site conditions, to implement mitigation measures;

f. The proposed management plan must include a detailed description of the proposed monitoring program, including the location and construction of monitoring points, a list of proposed monitoring parameters, a detailed description of sampling protocols, the monitoring frequency, and the reporting requirements and frequency. The monitoring points must be at or as close as reasonable to the boundary of the containment zone so as to clearly demonstrate containment such that water quality objectives outside the containment zone are not violated as the result of the discharge. Specific monitoring points must be defined on a case-by-case basis by determining what is necessary to demonstrate containment, horizontally and vertically. All technical or monitoring program requirements and requirements for access shall be designated pursuant to WC Section 13267. The monitoring program may be modified with the approval of the Regional Water Board's Executive Officer based on an evaluation of monitoring data;

g. The management plan must include a detailed description of the method to be used by the discharger to evaluate monitoring data and a specific protocol for actions to be taken in response to evidence that water quality objectives have been exceeded outside the containment zone as a result of the migration of pollutants from within the containment zone;

3. In order for a containment zone to be designated, it shall be limited in vertical and lateral extent, as protective as reasonably possible of human health and safety and the environment, and should not result in violation of water quality objectives outside the containment zone. The following

factors must be considered by the Regional Water Board in making such findings:

a. The size of a containment zone shall be no larger than necessary based on the facts of the individual designation. In no event shall the size of a containment zone or the cumulative effect of containment zones cause a substantial decline in the overall yield, storage, or transport capacity of a ground water basin;

b. Evaluation of potentially significant impacts to water quality, human health, and the environment, shall take into consideration the following, as applicable to the specific factual situation:

1. The physical and chemical characteristics of the discharge, including its potential for migration;
2. The hydrogeological characteristics of the site and surrounding land;
3. The quantity of ground water and surface water and the direction of ground water flow;
4. The proximity and withdrawal rates of ground water users;
5. The patterns of rainfall in the region and the proximity of the site to surface waters;
6. The present and probable future uses of ground water and surface water in the area;
7. The existing quality of ground water and surface water, including other sources of pollution and their cumulative impact on water quality;
8. The potential for health impacts caused by human exposure to waste constituents;
9. The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents;
10. The persistence and permanence of any potential adverse effects;
11. Exposure to human or other biological receptors from the aggregate of hazardous constituents in the environment;

12. The potential for the pollutants to attenuate or degrade and the nature of the breakdown products; and
13. Potential adverse effects on approved local development plans, including plans approved by redevelopment agencies or the California Coastal Commission.
- c. No provision of this Policy shall be interpreted to allow exposure levels of constituents of concern that could have a significant adverse effect on human health or the environment;
- d. A containment zone shall not be designated in a critical recharge area. A critical recharge area is an artificial recharge area or an area determined by the Regional Water Board to be a critical recharge area after the consultation process required by Section III.H.9. Further, a containment zone shall not be designated if it would be inconsistent with a local ground water management plan developed pursuant to Part 2.75 of Division 6 of the WC (commencing at Section 10750) or other provisions of law or court order, judgment or decree;
4. After designation, no further action to reduce pollutant levels, beyond that which is specified in the management plan, will be required within a containment zone unless the Regional Water Board finds that the discharger(s) has failed to fully implement the required management plan or that violation of water quality objectives has occurred beyond the containment zone, as a result of migration of chemicals from inside the containment zone. If the required tasks contained in the approved management plan are not implemented, or appropriate access is not granted by the discharger to the Regional Water Board for purposes of compliance inspection, or violation of water quality objectives occurs outside the containment zone and that violation is attributable to the discharge in the containment zone, the Regional Water Board, after 45 days public notice, shall promptly revoke the zone's containment status and shall take appropriate enforcement action against the discharger;
5. The designation of a containment zone shall be accomplished through the adoption of a cleanup and abatement order as authorized by WC Section 13304. The Regional Water Board shall make a finding of fact with regard to each of the conditions which serve as a prerequisite for containment zone designation in the cleanup and abatement order. All applicable criteria of Section III.H. must be met as a prerequisite to designation. The Regional Water Board may reject an application for designation of a containment zone for failure to meet any applicable criteria without having to make findings with regard to each prerequisite. Such orders shall be adopted by the Regional Water Boards themselves and not issued by the Executive Officers of the Regional Water Boards. These orders shall ensure compliance with all procedures, conditions, and restrictions set forth in Section III.H. As authorized by WC Section 13308, time schedules issued as part of the establishment of a containment zone may prescribe a civil penalty which shall become due if compliance is not achieved in accordance with that time schedule;
6. A containment zone shall be implemented only with the written agreement of all fee interest owners of the parcel(s) of property containing the containment zone. Exceptions may be allowed by the Regional Water Board where opposition is found to be unreasonable. In such cases, the Regional Water Board may use the authority of WC Section 13267 to assure access to property overlying the containment zone;
7. Local agencies which are supervising cleanup under contract with the State Water Board or by agreement with the Regional Water Board pursuant to provisions of the Underground Storage Tank Program may propose containment zones for consideration by the Regional Water Board. The local agency will forward its files and proposal to the Regional Water Board for consideration. Regional Water Boards shall use the same procedures, processes, public notice, and criteria that are noted elsewhere in this policy. Approval of Technical Impracticability Waivers by the Department of Toxic Substances Control or

the United States Environmental Protection Agency under the requirements of the Federal Resource Conservation and Recovery Act or the Comprehensive Environmental Response, Compensation, and Liability Act are deemed to be equivalent to the actions outlined in Section H. of this Policy if:

- a. the substantive provisions of Sections III.H.2.b., e., f., and g. are met;
  - b. interested parties described in III.H.8.a. are included in the public participation process; and
  - c. site information is forwarded from the approving agency to the Regional Water Board so that sites for which Technical Impracticability Waivers have been approved can be included in the master listings described in Section III.H.10.;
8. The Regional Water Board shall comply with the following public participation requirements, in addition to any other legal requirements for notice and public participation, prior to the designation of a containment zone:
- a. Public notice of an intention to designate a containment zone shall be provided to all known interested persons, including the owner of the affected property(s), owners and residents of properties adjacent to the containment zone, and agencies identified in Section III.H.9, at least 45 days prior to the proposed designation of a containment zone;
  - b. Interested persons shall be given the opportunity to review the application, including the proposed management plan, and any other available materials and to comment on any proposed designation of a containment zone. These materials, which contain information upon which the proposed designation of a containment zone is based, must be available for review at least 45 days prior to the proposed designation of a containment zone;
  - c. The proposed designation of a containment zone shall be placed on the agenda for consideration at a Regional Water Board meeting;

9. At least 45 days prior to the proposed designation of a containment zone, the Regional Water Board shall invite a technical advisory committee to review any proposed designation and shall meet as a committee at the request of any committee member. The committee or any committee member shall provide advice to the Regional Water Board as to the appropriateness of the requested designation and such designation will become part of the public record. No person or agency shall be made a member of the committee who is employed by or has a financial interest with the discharger seeking the designation. The following agencies shall be invited to participate in the advisory committee:
- a. The California Department of Toxic Substances Control;
  - b. The California Department of Health Services, Drinking Water Branch;
  - c. The California Department of Fish and Game;
  - d. The local health authority;
  - e. The local water purveyor, in the event ground water is used or planned to be used as a source of water supply;
  - f. Any local ground water management agency including an appointed water master;
  - g. The United States Environmental Protection Agency; and
  - h. The California Coastal Commission if the site is located within the coastal zone of California.
10. The Regional Water Boards shall keep a master listing of all designated containment zones. The master listing shall describe the location and physical boundaries of the containment zone, the pollutants which exceed applicable water quality objectives, and any land use controls associated with the containment zone designation. The Regional Water Board shall forward the information on the master list to the State Water Board and to the local well permitting agency whenever a new containment zone is designated. The State Water Board will compile the lists from the

Regional Water Boards into a comprehensive master list;

11. To assure consistency of application of this Policy, the State Water Board will designate a "Containment Zone Review Committee" consisting of staff from the State Water Board and each of the Regional Water Boards. This review committee shall meet quarterly for two years and review all designation actions taken. The committee shall review problems and issues and make recommendations for consistency and improved procedures. In any event the State Water Board shall review the containment zone issue not later than five years after the adoption of Section III.H... and periodically thereafter. Such review shall take place in a public proceeding;
12. In the event that a Regional Water Board finds that water quality objectives within the containment zone have been met, after public notice, the Regional Water Board will rescind the designation of the containment zone and issue a closure letter; and
13. The Regional Water Board's cost associated with review of applications for containment zone designation will be recoverable pursuant to Section 13304 of the Water Code, provided a separate source of funding has not been provided by the discharger.
14. Designation of a containment zone shall have no impact on a Regional Water Board's discretion to take appropriate enforcement actions except for the provisions of Section III.H.4.

IV. The Regional Water Board shall determine schedules for investigation, and cleanup and abatement, taking into account the following factors:

- A. The degree of threat or impact of the discharge on water quality and beneficial uses;
- B. The obligation to achieve timely compliance with cleanup and abatement goals and objectives that implement the applicable Water Quality Control Plans and Policies adopted by the State Water Board and Regional Water Boards;

- C. The financial and technical resources available to the discharger; and
- D. Minimizing the likelihood of imposing a burden on the people of the state with the expense of cleanup and abatement, where feasible.

V. The State and Regional Water Boards shall develop an expedited technical conflict resolution process so when disagreements occur, a prompt appeal and resolution of the conflict is accomplished.

## Appendix to Section III.H.

### Application for a Containment Zone Designation

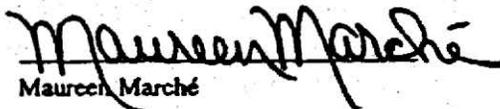
The discharger is responsible for submitting an application for designation of a containment zone. Supporting information which is readily available to the Regional Water Board and which would be cumbersome or costly to reproduce can be included in the application by reference. In order to facilitate the preparation of an acceptable application, the discharger may request that the Regional Water Board provide a preliminary review of a partial application. The partial application should be detailed enough to allow the Regional Water Board to determine if the site passes the threshold criteria for establishment of a containment zone (e.g., it is not reasonable to achieve water quality objectives at that site, plume management measures are likely to be effective, etc.). As appropriate, the application shall include:

- a) Background information (location, site history, regulatory history);
- b) Site characterization information, including a description of the nature and extent of the discharge. Hydrogeologic characterization must be adequate for making the determinations necessary for a containment zone designation;
- c) An inventory of all wells (including abandoned wells and exploratory boreholes) that could affect or be affected by the containment zone;
- d) A demonstration that it is not reasonable to achieve water quality objectives;
- e) A discussion of completed source removal and identification of any additional sources that will be addressed during implementation of the management plan;
- f) A discussion of the extent to which pollutant mass has been reduced in the aquifer and identification of any additional mass removal that will be addressed during implementation of the management plan;
- g) If necessary, information related to the availability of funds to implement the provisions of the management plan throughout the expected duration of the containment zone designation;
- h) The proposed boundaries for the proposed containment zone pursuant to Section III.H.3.a.;
- i) An evaluation of potential impacts to water quality, human health and the environment pursuant to Sections III.H.3.b. and c.;
- j) A statement that the discharger believes that the site is not located in a critical recharge area, as required by Section III.H.3.d.;
- k) Copies of maps and cross sections that clearly show the boundaries of the proposed containment zone and that show the locations where land use restrictions will apply. Maps must include at least four points of reference near the map corners. Reference points must be identified by latitude and longitude (accurate to within 50 feet), as appropriate for possible inclusion in a geographic information system (GIS) database; and
- l) A management plan for review and approval. The management plan must contain provisions for:
  - 1) source removal as appropriate;
  - 2) pollutant mass removal from the aquifer as appropriate;
  - 3) land use or engineering controls necessary to prevent the migration of pollution, including the proper abandonment of any wells within the vicinity of the containment zone that could provide a conduit for pollution migration beyond the containment zone boundary;

- 4) land use or engineering controls necessary to prevent water quality impacts and risks to human health and the environment;
- 5) mitigation measures, an implementation schedule for mitigation, and reporting requirements for compliance with mitigation measures;
- 6) a detailed description of the proposed monitoring program;
- 7) a detailed description of the method to be used by the discharger to evaluate monitoring data;
- 8) a specific protocol for actions to be taken if there is evidence that water quality objectives have been exceeded outside the containment zone as a result of the migration of pollutants from within the containment zone;
- 9) a detailed description of the frequency and content of reports to be submitted to the Regional Water Board;
- 10) detailed procedures and designs for well maintenance, replacement and decommissioning;
- 11) a protocol for submittal to and approval by the Executive Officer of minor modifications to the management plan as necessary to optimize monitoring and containment; and
- 12) a description of file and data base maintenance requirements.

#### CERTIFICATION

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on June 18, 1992, and amended at meetings of the State Water Resources Control Board held on April 21, 1994, and October 2, 1996.



Maurcen Marché

Administrative Assistant to the Board

(Note: The amendments adopted October 2, 1996 (shown by strikeout and underlining) will not be effective until approved by the Office of Administrative Law)

1. For the purposes of this section, "land use controls" means recorded instruments, proposed by the discharger and agreed to by the owner of the affected property, restricting the present and future uses of the affected property, including, but not limited to, recorded easements, covenants, restrictions or servitudes, or any combination thereof, as appropriate. Land use controls shall run with the land from the date of recordation, shall bind all of the owners of the land, and their heirs, successors, and assignees, and the agents, employees, and lessees of the owners, heirs, successors, and assignees. Such instruments shall provide for (a) amendment or rescission of the restriction upon application of the holder of fee interest in the property and upon the approval of the Regional Water Board if warranted by changed circumstances (e.g., new information demonstrates that a modification to land use restriction is appropriate, the containment zone designation has been rescinded because water quality objectives have been attained throughout the containment zone.

etc.), and (b) except for the restriction contained in the instrument, the establishment of a containment zone shall not prohibit the full use or enjoyment of the property.

2. For the purposes of this section, "engineering controls" means measures to prevent migration of pollutants and to prevent, minimize or mitigate environmental damage which may otherwise result from a release or threatened release, including, but not limited to, caps, covers, dikes, trenches, leachate collection systems, treatment systems, and ground water containment systems or procedures and decommissioning of wells.

3. For the purposes of this section, these agreements could be formal, private agreements between parties related to the property use, existing or potential water use, etc.

STATE WATER RESOURCES CONTROL BOARD  
RESOLUTION NO. 88-63

ADOPTION OF POLICY ENTITLED "SOURCES OF DRINKING WATER"

WHEREAS:

1. California Water Code Section 13140 provides that the State Board shall formulate and adopt State Policy for Water Quality Control; and,
2. California Water Code Section 13240 provides that Water Quality Control Plans "shall conform" to any State Policy for Water Quality Control; and,
3. The Regional Boards can conform the Water Quality Control Plans to this policy by amending the plans to incorporate the policy; and,
4. The State Board must approve any conforming amendments pursuant to Water Code Section 13245; and,
5. "Sources of drinking water" shall be defined in Water Quality Control Plans as those water bodies with beneficial uses designated as suitable, or potentially suitable, for municipal or domestic water supply (MUN); and,
6. The Water Quality Control Plans do not provide sufficient detail in the description of water bodies designated MUN to judge clearly what is, or is not, a source of drinking water for various purposes.

THEREFORE BE IT RESOLVED:

All surface and ground waters of the state are considered to be suitable, or potentially suitable, for municipal or domestic water supply and should be so designated by the Regional Boards with the exception of:

1. Surface and ground waters where:
  - a. The total dissolved solids (TDS) exceed 3,000 mg/L (5,000 uS/cm, electrical conductivity) and it is not reasonably expected by Regional Boards to supply a public water system, or
  - b. There is contamination, either by natural processes or by human activity (unrelated to a specific pollution incident), that cannot reasonably be treated for domestic use using either Best Management Practices or best economically achievable treatment practices, or
  - c. The water source does not provide sufficient water to supply a single well capable of producing an average sustained yield of 200 gallons per day.
2. Surface waters where:
  - a. The water is in systems designed or modified to collect or treat municipal or industrial wastewaters, process waters, mining wastewaters, or storm water runoff, provided that the discharge from such systems is monitored to assure compliance with all relevant water quality objectives as required by the Regional Boards; or,
  - b. The water is in systems designed or modified for the primary purpose of conveying or holding agricultural drainage waters, provided that the discharge from such systems is monitored to assure compliance with all relevant water quality objectives as required by the Regional Boards.
3. Ground water where:

The aquifer is regulated as a geothermal energy producing source or has been exempted administratively pursuant to 40 Code of Federal Regulations, Section 146.4 for the purpose of underground injection of fluids associated with the production of hydrocarbon or geothermal energy, provided that these fluids do not constitute a hazardous waste under 40 CFR, Section 261.3.

4. Regional Board Authority to Amend Use Designations:

Any body of water which has a current specific designation previously assigned to it by a Regional Board in Water Quality Control Plans may retain that designation at the Regional Board's discretion. Where a body of water is not currently designated as MUN but, in the opinion of a Regional Board, is presently or potentially suitable for MUN, the Regional Board shall include MUN in the beneficial use designation.

The Regional Boards shall also assure that the beneficial uses of municipal and domestic supply are designated for protection wherever those uses are presently being attained, and assure that any changes in beneficial use designations for waters of the State are consistent with all applicable regulations adopted by the Environmental Protection Agency.

The Regional Boards shall review and revise the Water Quality Control Plans to incorporate this policy.

**CERTIFICATION**

The undersigned, Administrative Assistant to the Board, does hereby certify that the foregoing is a full, true, and correct copy of a policy duly and regularly adopted at a meeting of the State Water Resources Control Board held on May 19, 1988.

Original signed by  
Maureen Marche  
Administrative Assistant to the Board

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<sup>1</sup> This policy does not affect any determination of what is a potential source of drinking water for the limited purposes of maintaining a surface impoundment after June 30, 1988, pursuant to Section 25208.4 of the Health and Safety Code.

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**STATE WATER RESOURCES CONTROL BOARD  
RESOLUTION NO. 88-16**

**STATEMENT OF POLICY WITH RESPECT TO  
MAINTAINING HIGH QUALITY OF WATERS IN CALIFORNIA**

WHEREAS the California Legislature has declared that it is the policy of the State that the granting of permits and licenses for unappropriated water and the disposal of wastes into the waters of the State shall be so regulated as to achieve highest water quality consistent with maximum benefit to the people of the State and shall be controlled so as to promote the peace, health, safety and welfare of the people of the State; and

WHEREAS water quality control policies have been and are being adopted for waters of the State; and

WHEREAS the quality of some waters of the State is higher than that established by the adopted policies and it is the intent and purpose of this Board that such higher quality shall be maintained to the maximum extent possible consistent with the declaration of the Legislature;

NOW, THEREFORE, BE IT RESOLVED:

1. Whenever the existing quality of water is better than the quality established in policies as of the date on which such policies become effective, such existing high quality will be maintained until it has been demonstrated to the State that any change will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water and will not result in water quality less than that prescribed in the policies.
2. Any activity which produces or may produce a waste or increased volume or concentration of waste and which discharges or proposes to discharge to existing high quality waters will be required to meet waste discharge requirements which will result in the best practicable treatment or control of the discharge necessary to assure that (a) a pollution or nuisance will not occur and (b) the highest water quality consistent with maximum benefit to the people of the State will be maintained.
3. In implementing this policy, the Secretary of the Interior will be kept advised and will be provided with such information as he will need to discharge his responsibilities under the Federal Water Pollution Control Act.

BE IT FURTHER RESOLVED that a copy of this resolution be forwarded to the Secretary of the Interior as part of California's water quality control policy submission.

**CERTIFICATION**

The undersigned, Executive Officer of the State Water Resources Control Board, does hereby certify that the foregoing is a full, true, and correct copy of a resolution duly and regularly adopted at a meeting of the State Water Resources Control Board held on October 24, 1968.

Dated: October 28, 1968

Original signed by  
Kerry W. Mulligan, Executive Officer  
State Water Resources Control Board

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