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I. INTRODUCTION TO SAM MANUAL 2009

The Site Assessment and Mitigation (SAM) Manual 2009 is a compilation of guidelines designed to aid responsible parties (RPs), their consultants, and others who perform environmental investigations and remedial actions at contaminated sites in the County of San Diego (Figure 1-1). Because they are not laws, regulations, or ordinances, these guidelines have no legal status. They do, however, provide a framework to improve the communication process among regulators, RPs, and consultants, and to provide a clear and uniform direction to the environmental site investigation and remediation process. These guidelines are the standard of care for site assessment and remediation work in San Diego County.

These guidelines have been developed with the cooperation of the consulting industry, organized technical work groups, the military, the Regional Water Quality Control Board (RWQCB) staff, and Department of Environmental Health (DEH), Site Assessment and Mitigation Program (SAM) staff.

II. GOALS

SAM's primary goal is to protect public health, water resources, and the environment from releases of petroleum products from underground storage tanks (USTs) by providing oversight of assessments and clean-ups in accordance with the California Health and Safety Code and the California Code of Regulations (CCR). The secondary goal is to address these concerns in a cost efficient manner, for both the RP and the State Reimbursement Fund (Fund). A third goal is to provide third party review of voluntary environmental reports to allow property transactions to be completed and to ensure the protection of public health, water resources, and the environment. Strategies used to implement the program to attain these goals include advocating preventive and corrective measures and assuming an education/consultation role with industry. An open line of communication is encouraged so the highest level of customer service can be provided to the public. For SAM to be able to protect public health and the environment, comprehensive, accurate reports must be submitted for evaluation. These reports must be signed by a registered professional and must contain conclusions and recommendations obtained from the results.

III. ORGANIZATION

The SAM organizational chart is available on our web page.

The SAM office is located at the County Operations Center at:

5500 Overland Avenue, Suite 210
San Diego, CA 92123

However, written correspondence should be sent to:

Department of Environmental Health
Attn: _____
P.O. Box 129261
San Diego, CA 92112-9261

General phone number for DEH: (858) 505-6700 or (800) 253-9933.
Phone number for SAM duty line: (858) 505-6808.
Fax number: (858) 505-6891.
Web Site: http://www.sdcounty.ca.gov/deh/water/sam_homepage.html

IV. REGULATORY AUTHORITY

Federal, state, and local laws and regulations regarding hazardous substances have been developed with the intent of protecting public health, the environment, surface water, and groundwater resources. Over the years the laws and regulations have evolved to deal with different aspects of the handling, treatment, storage and disposal of hazardous substances. The overlapping of laws and regulations make them difficult to understand and implement. The laws and regulations that guide SAM include, but are not limited to:

- California Health and Safety Code (CHSC)
  Division 20, Chapter 6.5, Hazardous Waste Control
  Division 20, Chapter 6.7, Underground Storage of Hazardous Substances
  Division 20, Chapter 6.75, Petroleum Underground Storage Tank Cleanup
  Division 101, Part 3, Chapter 4, Article 5, (Section 101480 - 101490), Administration of Public Health, Local Health Departments

- California Water Code
  Division 7, Water Quality (Porter-Cologne Water Quality Control Act)

- California Code of Regulations (CCR)
  Title 22, Division 4, Chapter 30, Hazardous Wastes
  Title 23, Division 3, Chapter 16, Underground Storage Tanks

- San Diego County Code
  Title 6, Division 5, Permit Fees
  Title 6, Division 7, Chapter 4, Wells
  Title 6, Division 8, Chapter 10, Underground Storage of Hazardous Substances.

V. COUNTY'S SITE ASSESSMENT AND MITIGATION PROGRAM

The Site Assessment and Mitigation Program (SAM), within the Land and Water Quality Division of the County of San Diego's Department of Environmental Health, consists of project managers, field technicians, supervisors, and support staff, whose primary purpose is to protect human health, water resources, and the environment within San Diego County (Figure 1-1). SAM programs include:

- Local Oversight Program (LOP) (site assessment and remediation review of petroleum UST related cases)
- Voluntary Assistance Program (VAP) (consultation, overview, and report concurrence on sites with potential contamination from various sources)
- Site Designation
- Environmental Aspects of Property Redevelopment
- Monitoring Well Program (MWP) (permits and inspection of monitoring wells and borings)
- Methamphetamine Program

DEH public records, where files can be reviewed, are also associated with SAM. Files available for public review include site assessment-related correspondence and reports, UST compliance information, permits, complaints, and industrial compliance inspection files.

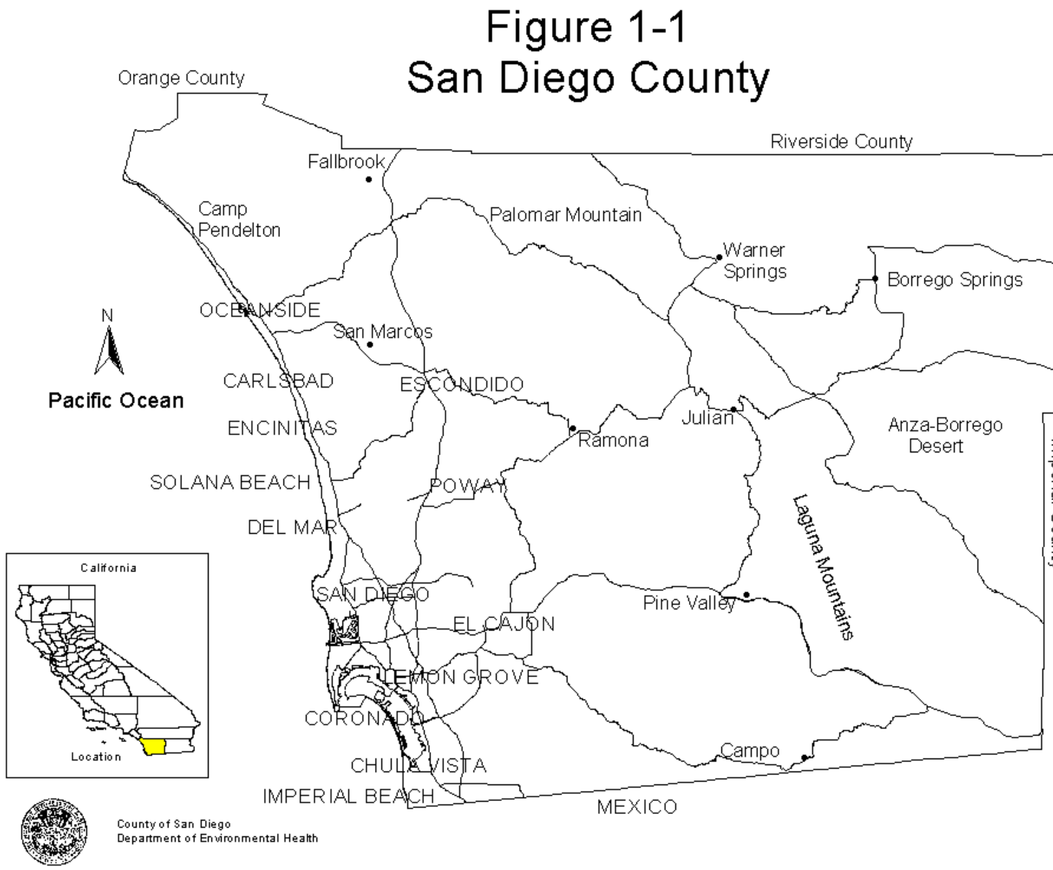


Figure 1-1
San Diego County
Orange County
Riverside County
Fallbrook
Camp Pendelton
Palomar Mountain
Warner Springs
Borrego Springs
OCEANSIDE
San Marcos
N
Pacific Ocean
CARLSBAD
ESCONDIDO
ENCINITAS
Julian
Ramona
Anza-Borrego Desert
SOLANA BEACH
POWAY
Imperial County
Laguna Mountains
DEL MAR
California
SAN DIEGO
Pine Valley
EL CAJON
LEMON GROVE
CORONADO
Location
Campo
CHULA VISTA
IMPERIAL BEACH
MEXICO
County of San Diego
Department of Environmental Health

VI. LOCAL OVERSIGHT PROGRAM

SAM has entered into a contract agreement with the State Water Resources Control Board (SWRCB) to oversee remedial actions for leaks from petroleum-containing USTs in San Diego County. Under state authority, SAM operates the LOP for the oversight of petroleum UST-related projects in the County. The Contract is renewable upon mutual consent of the parties for the life of the Federal Underground Storage Tanks Trust Fund Corrective Action Program. This contract provides the revenue for SAM to conduct its oversight activities. All reports and correspondence in this program are public record, and are available for public review.

VII. VOLUNTARY ASSISTANCE PROGRAM

SAM provides consultation, project oversight, report review, concurrence, and site closure letters on projects pertaining to properties contaminated with hazardous substances. SAM can provide third-party review of environmental reports to allow completion of property transactions and to ensure the protection of public health, water resources, and the environment. This assistance can be customized to meet the needs of the applicant.

The California Water Code and the California Health and Safety Code require those responsible for the release of hazardous substances to take all necessary corrective action to remedy (clean up) a release. The California Health and Safety Code Section 101480 through 101490 authorizes a local agency to provide oversight of environmental assessment and remediation activities if requested.

The following individuals and entities may apply and enter into the VAP:

- Present and past property owners,
- Lessees, renters, or operators of property or owners of equipment where a hazardous substance was located or used, and/or
- Present and past dischargers, generators, storers, treaters, transporters, disposers, and handlers of hazardous substances.

On sites contaminated by sources other than USTs, and where DEH has agreed to provide regulatory review, the corrective action process should be similar in principle to that defined by Article 11 for USTs. VAP applicants and their consultants should consult with DEH, as early in their project as possible, concerning any site-specific corrective action requirements. In general, DEH/SAM requires that all corrective actions be conducted in accordance with the policies, guidelines, and procedures contained in this manual (refer to Section 3.II).

A “Voluntary Assistance Program Application for Assistance” form must accompany an initial request for DEH assistance. A copy of this application is provided in Appendix C.II. This form is an agreement and notifies the requester of DEH’s charge for cost recovery.

DEH/SAM is required to notify the California Department of Toxic Substances Control (DTSC) and the RWQCB before beginning review of a VAP project. SAM can also refuse to accept a VAP application or may withdraw from a VAP agreement.

Costs for DEH staff time expended on oversight of the site assessment and remediation activities (including report review) will be billed to the applicant. The current fee for such work is $119.00 per hour (Section 65107(h), San Diego County Code). An initial payment of $238.00 (2 hours of time) will be required at the time the “Voluntary Assistance Program Application for Assistance” form is submitted. Additional staff review time will be billed quarterly. The cost of recovery hourly rate is subject to change.

VIII. SITE DESIGNATION PROGRAM

DEH/SAM can be designated by the Cal-EPA Site Designation Committee as the Administering Agency for overseeing environmental investigations and remediation of hazardous waste releases on properties in San Diego County. When appointed by the Cal-EPA Site Designation Committee, SAM will be authorized to supervise all aspects of site cleanup activities up to completion and is required to verify compliance with all applicable state and local laws and requirements. For this purpose, SAM will be granted sole jurisdiction over all activities necessary to respond to hazardous material releases according to California Health and Safety Code, Section 25264 (a). This oversight is conducted through our VAP and as such guidelines can be tailored to address tasks associated with Site Designation. As the Administering Agency, SAM will consult with other appropriate agencies and will maintain communications among agencies to provide consistencies in the progress of the projects and in the issuance of permits and concurrence letters, etc. VAP is a streamlined program that can easily fulfill the requirements of the Cal-EPA Site Designation Committee.

IX. ENVIRONMENTAL ASPECTS OF PROPERTY REDEVELOPMENT

For large-scale and complex environmental projects, where several parcels and/or a variety of sources of contamination are involved, the VAP can be utilized to address site investigation and remediation actions. In these cases, there is usually a voluntary effort that involves property owners, property developers, governmental agencies, and the community in implementing a corrective action to promote long-term productive reuse of the properties. The guideline has been prepared to facilitate site investigation and remediation actions in a more streamlined fashion.

The focus of this guidance on property redevelopment is to first briefly describe the redevelopment process in general and then to further describe how the services of the Department of Environmental Health, Site Assessment and Mitigation Programs (DEH-SAM) can be used in the process. These programs include the Local Oversight Program (LOP), the Voluntary Assistance Program (VAP) and the Site Designation Program (SDP). This guideline can be used to implement property development projects, including Brownfield projects, in San Diego County when DEH-SAM is the local agency.

Property redevelopment based on the historic activities and future plans for any given site can involve many issues. The issues related to environmental contamination are the primary focus of this guidance. Contaminated surface water, groundwater, soil, marine sediments, and air emissions can all be significant issues at a given site. Contamination issues range from leaking USTs that held petroleum products to complex issues that may include metals, volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), and other contaminants of concern.

If the primary environmental issues on a given site are related to water quality, human health impacts, or proper management of contaminated soils and groundwater, it is important to consider with which regulatory agency to work. Decisions cannot be made without first undertaking a sound evaluation of the environmental impacts (or indicators of potential impacts), reporting requirements, and desired agency action.

A. Phases of Property Redevelopment

The property redevelopment process generally involves four phases of activity: initiation, evaluation, transaction, and implementation. This process requires the involvement of numerous stakeholders that may include buyers, sellers, developers, redevelopment agencies, lenders, community groups, and government and regulatory agencies.

The redevelopment process is not linear, and not every project requires full use of all phases of the process for effective implementation. The process works best when the interests of all stakeholders are addressed early in the process and stakeholders work together to resolve any outstanding issues.

1. Initiation

The redevelopment process begins with a vision of reuse and/or restoration of a property or properties based on a public need or business opportunity. One or several of the following potential stakeholders can initiate this process.

Sellers, Developers, and Buyers may initiate the redevelopment process by identifying a property or properties for redevelopment based upon their belief that the project will yield an appropriate return on investment and provide economic benefits to the community.

Redevelopment Agencies may initiate the redevelopment process through dialogue with potential buyers, sellers, developers, or government agencies. A governmental redevelopment agency may initiate the process and act as a facilitator, investor, or partner with a developer in the redevelopment of a particular property or properties.

Lending Institutions will likely become involved in a redevelopment project as part of the necessary funding and accept a portion of the financial risk associated with the project. Many lenders condition their financing of a project upon the receipt of a concurrence letter or closure letter from the lead regulatory agency.

Community groups, local residents, workers, organizations, and institutions often have a vision, plan, and expectations for redevelopment of areas where they live and work.

Early in this process it is important to identify the various regulatory issues that will apply to the redevelopment project. This can include regional issues such as planning, building, and zoning and local issues such as water, sewer, and fire infrastructure. Since land is being redeveloped, there can be numerous environmental issues related to chemical and/or material used on the properties.

2. Evaluation

At the initial evaluation phase, the project proponents need to evaluate the acceptable financial and legal risks as well as the needed level of assurances related to liability and indemnification from chemically contaminated soil and/or groundwater. Identifying these issues up front is critical to the timeliness of the redevelopment process.

During the evaluation phase, the viability of proceeding with the redevelopment project will be evaluated and resolved. In addition to real estate issues, a number of environmental and legal issues must also be evaluated. A comprehensive evaluation and analysis may be undertaken to determine the viability of the envisioned redevelopment project.

The successful implementation of the redevelopment process is dependent on a clear understanding of the environmental conditions and identification of the environmental risks associated with the property or properties. Environmental issues can range from chemical contamination to archeological issues.

Identifying environmental risks on a site may include performing Phase I and Phase II environmental site assessments, evaluating the risk to potential receptors, and evaluating corrective action alternatives. The success of a redevelopment project is often dependent on how effectively current and future risks posed by the property are communicated to the community and other interested parties. It is important to note that risk communication should take place throughout the redevelopment process.

The three programs, discussed in Sections 1.VII through 1.IX, provide regulatory oversight for redevelopment projects when DEH-SAM is the lead agency. These programs are the Local Oversight Program (LOP), Voluntary Assistance Program (VAP), and Site Designation Program (SDP). The specific procedures for the LOP are outlined in Section 1.VII of the SAM Manual. Specific procedures for the VAP and SDP are outlined in Sections 1.VIII and 1.IX, respectively, and Appendix C of the SAM Manual under the VAP.

3. Transaction

Property ownership can change during any part of the redevelopment process. Planning and communication between all parties is critical to ensure a smooth redevelopment process. Commonly, buyers and sellers may seek protections such as:

- Preliminary and pre-closing agreements,
- Representation and warranties,
- Environmental covenants,
- Indemnification, and
- Environmental insurance.

4. Implementation

Demolition, renovation, and corrective action will likely occur during the implementation phase. Key issues during the implementation phase are:

- Implementation of the approved corrective action,
- Achieving the target cleanup levels for the property,
- Implementation of the monitoring, remedial operation, and/or engineering controls,
- Regulatory compliance on all environmental issues, and
- Successful completion of the project within schedule and budget.

Figure 1-2 shows the process discussed above, along with detailed steps and/or information needed within each phase. Table 1-1 provides additional details on the overall involvement and needs of the various stakeholders. Table 1-2 provides a listing of the various regulatory agencies that may be involved at the local, state, and federal levels.

FIGURE 1-2
THE REDEVELOPMENT PROCESS

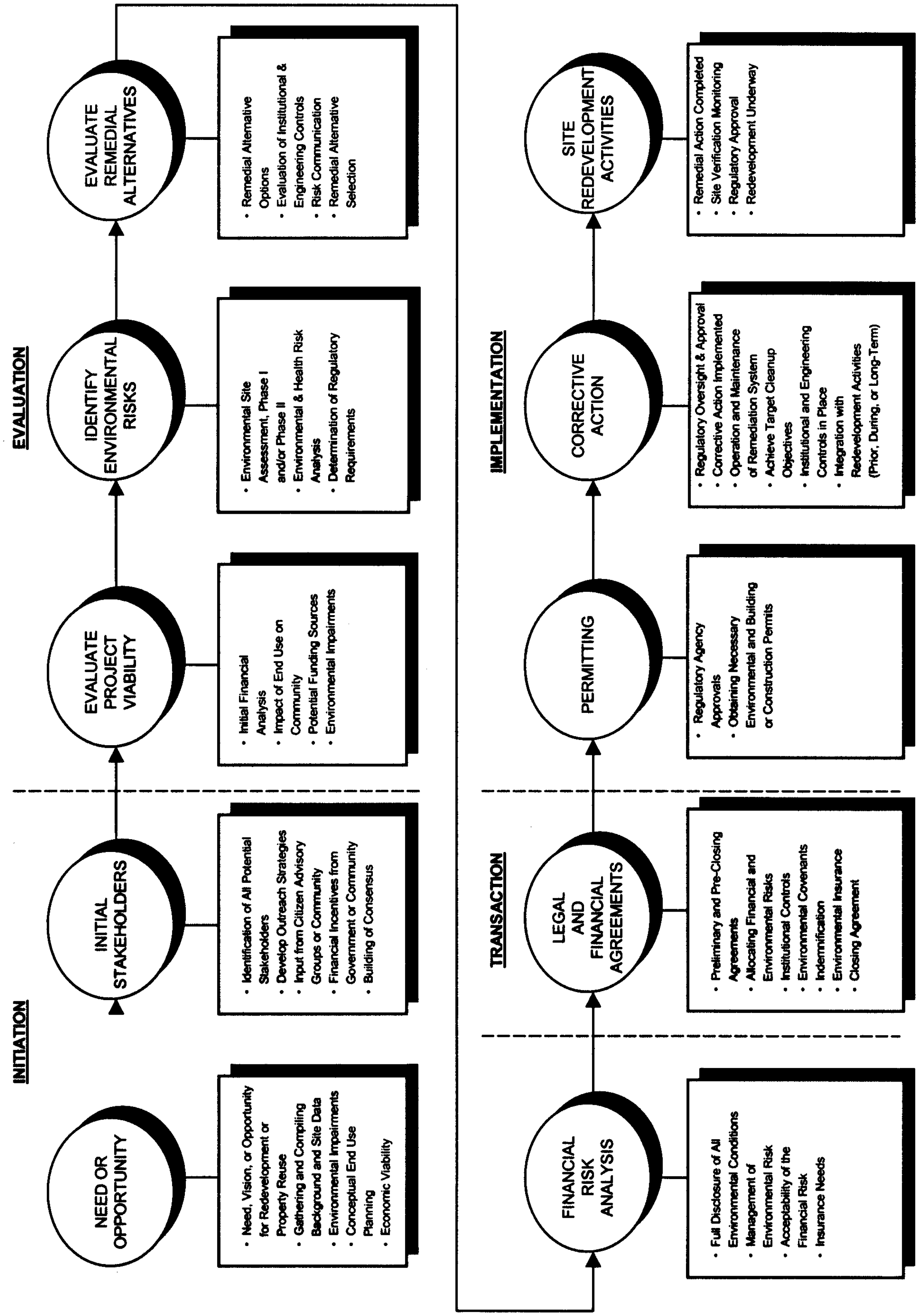


TABLE 1-1: STAKEHOLDERS GOALS AND OBJECTIVES

STAKE-HOLDERS	GOALS AND OBJECTIVES			
	INITIATION PHASE	EVALUATION PHASE	TRANSACTION PHASE	IMPLEMENTATION PHASE
Seller	• Enhancement of property value and least costly and effective technical approaches for the corrective action. • Identifying options to transfer risk and reduce liability.	• Finding a solution that enhances the property value. • Achieving least costly and effective technical solutions for the corrective action. • Identifying options to transfer risk and reduce liability.	• Meeting the financial and liability goals. • Implementing a cost-effective and timely corrective action with limited long-term liability.	• Timely completion of the project and acceptable return on investment.
Developer	• Opportunity to add value to the property and return on investment. • Management of liabilities for environmental conditions caused by others.	• Understanding the opportunities and barriers and reducing the uncertainty associated with time and costs for completion.	• Meeting the project requirements and anticipated return on investment.	• Timely completion of the project and acceptable return on investment. • Institutional and engineering controls in place.
Buyer	• Understanding the opportunities and barriers. • Purchase of a property with potential return on investment and benefit to the community. • Management of liabilities for environmental conditions they did not cause.	• Understanding the opportunities and barriers. • Understanding the financial/liability risk management options.	• Meeting the financial and liability goals. • Implementing a cost-effective and timely corrective action with limited long-term liability.	• Timely completion of the project and acceptable return on investment.
Redevelopment Agencies	• Economic revitalization. • Increased tax base.	• Incorporation of community feedback on the community redevelopment and revitalization goals for the property.	• Ensuring community understanding of the economic considerations and planned use of the property.	• Achieving the redevelopment goals including economic revitalization and increased tax base. • Meeting the environment and public health requirements. • Institutional and engineering controls in place.
Lenders		• Understanding the factors that influence the financial and environmental risks.	• Meeting acceptable financial objectives.	• Meeting the established financial objectives.
Insurer		• Understanding the factors that influence the financial and environmental risks.	• Meeting acceptable risk management objectives.	• Ensuring that the redevelopment is consistent with the insured conditions.
Community Groups	• Improvement of physical and aesthetic conditions. • Community and economic revitalization.	• Participation in the evaluation process and development of appropriate alternatives for restoration of the redevelopment or Brownfield property.		
City/County Government		• Evaluation of the proposed end use. • Initiation of the process to modify the land use designations that will be consistent with the redevelopment goals and requirements of the community.		• Establishing the land use designations that are consistent with the redevelopment project. • Meeting the planning and end use goals. • Monitoring the proper implementation of grading and construction requirements.
Environmental Regulatory Agencies	•	• Ensuring that the corrective actions are protective of human health and the environment. • Ensuring community understanding of the environmental objectives. • Ensuring that the requirements of multiple regulatory agencies are satisfied.		• Meeting the environment and public health requirements. • Institutional and engineering controls in place.

TABLE 1-2: REGULATORY AGENCIES INVOLVED IN REDEVELOPMENT PROCESS

LOCAL	STATE OF CALIFORNIA	FEDERAL
County Department of Environmental Health (DEH)	Department of Toxic Substances Control (DTSC)	Environmental Protection Agency (EPA)
Air Pollution Control District (APCD)	Regional Water Quality Control Board (RWQCB), San Diego Region	U.S. Fish and Wildlife Department
City/County Fire Departments	CA Department of Fish and Game	U.S. Coast Guard
City/County Planning Departments	Office of Environmental Health and Hazard Analysis (OEHHA)	Occupational Safety and Health (OSHA)
City/County Building Departments	CA Occupational Safety and Health (Cal-OSHA)	
City/County Department of Public Works	CA Environmental Protection Agency (Cal-EPA)	
County Department of Agriculture/Weights and Measures	CA Integrated Waste Management Board (CIWMB)	
	CA Coastal Commission	
	CA Department of Health Services	

Note: Website addresses for regulatory agencies are cited in Appendix G.

B. Selection of Lead Agency

In selecting the lead agency one must consider the end result desired from the regulatory community. There is a range of potential conclusions to regulatory oversight, from the relatively simple concurrence letter that can take several forms, to a closure letter, to the comprehensive "Certificate of Completion." If the developer needs a Prospective Purchaser Agreement (PPA), it may be impossible to obtain unless the Regional Water Quality Control Board (RWQCB) or Department of Toxic Substances Control (DTSC) is lead at the site. Even then, the process could be involved and lengthy.

The project proponent or the redevelopment agency should select a lead agency that will be able to provide a coordinated and appropriate level of oversight to resolve the chemical impacts associated with the project. The selection of a lead agency depends on the needs of the redevelopment project, or legal or financial requirements. Generally, one of the following agencies will function as the lead agency.

1. County of San Diego Department of Environmental Health (DEH)

DEH-SAM has three programs available to provide regulatory oversight of the investigation and cleanup of contaminated soil and groundwater in San Diego County. These programs are:

- **Local Oversight Program (LOP)** – This program is for known releases from USTs. The LOP is limited to USTs that contain or formerly contained petroleum products. This program is handled through contracting with the State Water Resources Control Board for regulatory oversight and through state funding for the oversight. Work performed under the LOP can, in certain circumstances, qualify for reimbursement from the California UST Fund. There are policy limitations to this program and reimbursement requires close coordination with DEH-SAM.

- **Voluntary Assistance Program (VAP)** – This program, with a few exceptions, covers all other types of contamination sources. The VAP is administered locally by DEH-SAM and all oversight costs are covered under a cost agreement between the agency and the project coordinator. This program uses a local fee-for-service cost recovery.

  Current regulations designate the RWQCB and the California DTSC as the lead agency over water quality and hazardous waste respectively. Under the Authority of Section 101480 or Section 252641 of the California Health and Safety Code, DEH-SAM can be selected as the lead agency upon approval from these agencies or by the DTSC Site Designation Program as defined in Sections 25260 through 25268.

  <u>Section 101480 (Remedial Action Agreement)</u> - DEH-SAM performs oversight and agrees to comply with the regulations of the RWQCB and DTSC. All work is completed to the standards of both RWQCB and DTSC; however, the decisions by DEH-SAM do not supersede the authority of the RWQCB or DTSC.

  Prior to commencing oversight, DEH-SAM will notify the RWQCB and the California DTSC of initiation of a remedial action agreement. This will allow these agencies to notify DEH-SAM of their concerns.

  Under the VAP, DEH-SAM provides consultation, review, and report concurrence on projects pertaining to properties that are suspected to be contaminated with hazardous substances. DEH-SAM provides third-party review of environmental reports to allow property transactions to be completed and to ensure the protection of public health, water resources, and the environment. This assistance can be customized to meet the needs of the applicant. This assistance is voluntary on the part of DEH-SAM and any concurrence letter or closure letter received from the VAP is not binding on any other agency.

  DEH-SAM can refuse to accept a VAP application or withdraw from a VAP agreement when sufficient technical staff is not available or when it recognizes that other more qualified agencies should address the specific environmental issues of concern.

- **Site Designation Program (SDP) -** The Site Designation Program is administered by the California Environmental Protection Agency (Cal-EPA) and is outlined in Section 25260-25268 of the California Health and Safety Code. The SDP provides regulatory authority to other agencies that are found to be more appropriate to oversee the investigation and/or cleanup of chemically impacted sites. Projects completed under the SDP are managed and funded under the VAP.

  DEH-SAM performs oversight and agrees to comply with the regulations of the RWQCB and DTSC. All work is completed to the standards of the RWQCB, DTSC, and other interested agencies (e.g., Department of Fish and Game, U.S. Fish and Wildlife). The process followed is more formal in structure than the remedial action agreement process. Decisions made by DEH-SAM are processed through the various agencies and are equivalent of the final decision for those agencies.

  Site Designation is a consultative process, whereby DEH-SAM takes the responsibility of coordinating the distribution of information and collection of recommendations from various California agencies, and concludes, if successful, with a Certificate of

Completion. This process can be combined with action under the Polanco Act if a redevelopment agency, as recognized under the Health and Safety Code, is involved. It is recommended that consultation with any agency whose jurisdiction is triggered by site conditions be undertaken before attempting to file a petition for "lead agency" with the DTSC.

2. California Regional Water Quality Control Board (RWQCB)

The RWQCB is responsible for enforcing regulations to protect the water quality of the waters of the State. This includes the protection of both groundwater and surface waters. The RWQCBs have developed Basin Plans for their regions, which outline the water quality goals and standards that they enforce. San Diego County covers two RWQCB Regions: the San Diego Region (Region 9) and the Colorado River Basin Region (Region 7).

Within each region, the RWQCB has regulatory authority over any discharger to the land or water. Commonly, the RWQCB oversees water quality issues through their various program areas.

These areas are:

- Underground Storage Tanks (USTs),
- Above Ground Storage Tanks (ASTs),
- Department of Defense (DOD) and Site Cleanup Programs (SCP),
- Recycled/Reclaimed Water Program and Subsurface Disposal/Onsite Wastewater Treatment (Septic Systems) Programs,
- Land Disposal Program (Landfills), and
- Storm water, NPDES, 401, CEQA.

Like DEH-SAM, the RWQCB can be designated as the lead agency. Not only are concurrence letters and Certificates of Completion available options with the RWQCB, but a prospective purchaser agreement (PPA) may also be an alternative option. A PPA typically offers a covenant not to sue by the regulatory agency.

3. California Department of Toxic Substance Control (DTSC)

The Site Mitigation Program within the DTSC oversees the investigation and remediation of hazardous substance releases in California. The DTSC program identifies and assesses potential releases. Additionally, they provide oversight of remedial actions. The DTSC Site Mitigation Program's regional operations provide project management oversight at:

- Federal National Priority List sites (Federal Superfund Sites),
- Federal military installations,
- Responsible Party lead sites, and
- State-funded sites (State Superfund Sites).

The DTSC has several programs designed to assist at Brownfield sites, which include the Voluntary Cleanup Program (similar to the DEH-SAM VAP program); the Expedited Remedial Action Program (SB 923); and the Private Site Management Program (AB 1876). For further information about DTSC programs check the Internet at http://calepa.ca.gov.

4. Redevelopment Agency Participation

A governmental redevelopment agency can participate in many diverse ways with the redevelopment of properties. The redevelopment agency may initiate the process and act as a facilitator, investor, or partner with a developer in the redevelopment process. The redevelopment agency may also assist the developer in compelling the cleanup of the property and adjacent properties by responsible parties. Redevelopment agency assistance under the Polanco Redevelopment Act provides immunities for the redevelopment agency. These immunities may be transferable to developers and their lenders.

The redevelopment agency may provide:

- Overall planning for community or area-wide redevelopment.
- Financial and tax incentives for developers and financial institutions to participate in the project.
- Federal and state grants, loans, or funding for Brownfield redevelopment projects.
- Coordination among governing and regulatory agencies.
- Implementation of community outreach programs.

The Polanco Redevelopment Act (Health and Safety Code Section 33459.1 et seq.) is a tool available only through the offices of a redevelopment agency. The Act requires a redevelopment agency to enter into an agreement with one of the regulatory agencies described above, compelling the assessment and, potentially, the remediation of hazardous substance releases. Responsible parties are liable to the redevelopment agency for costs incurred in the process, under conditions stated in the statute. Upon completion, Polanco immunities (potentially coupled with a Certificate of Completion) are granted to the agency and its successors and assigns. In other words, the redeveloper can be held immune and harmless from pre-existing environmental conditions that are remediated pursuant to an agreement with DEH-SAM or one of the other environmental agencies noted in the Act.

C. When DEH-SAM Is Selected as Lead Agency

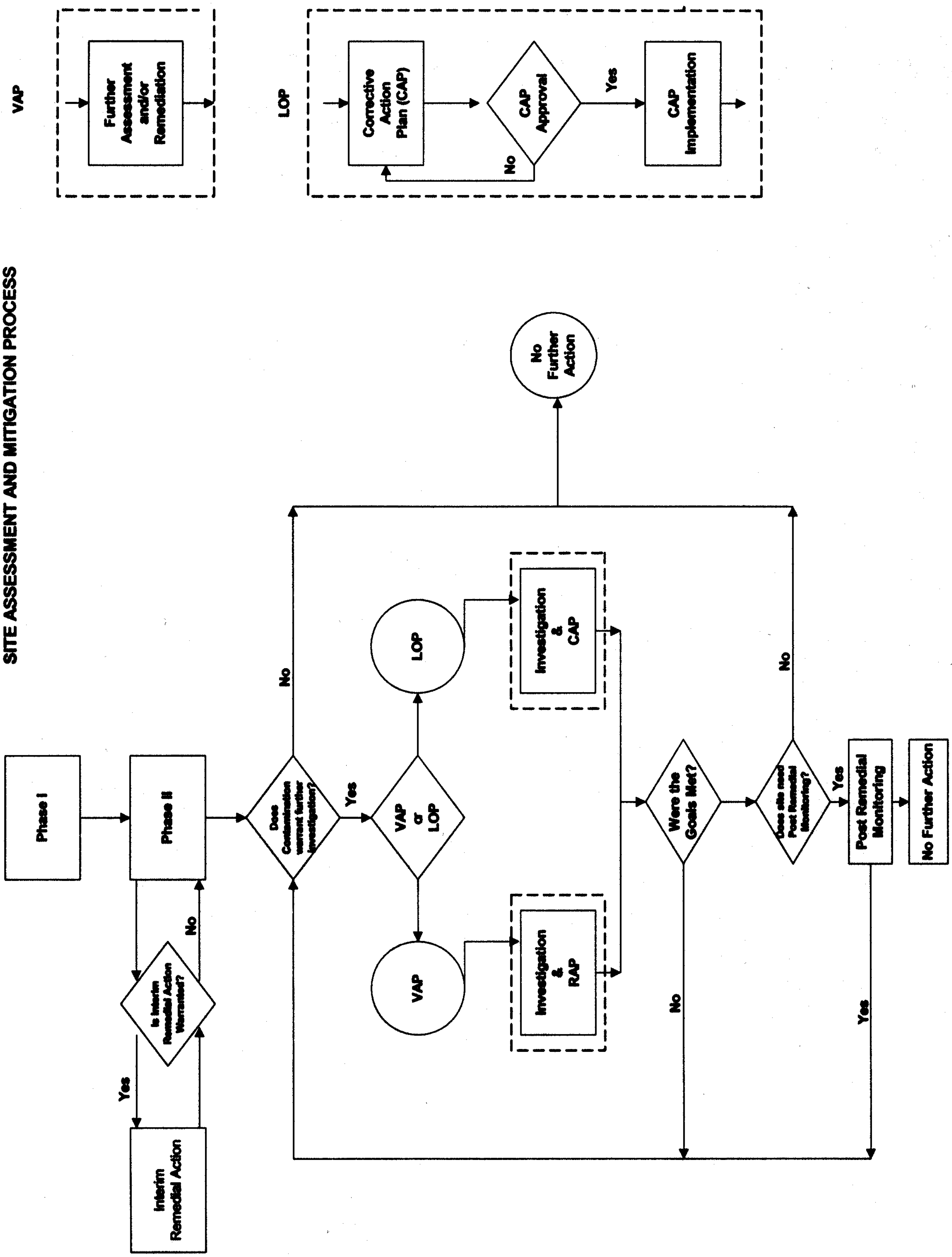
The site assessment and mitigation process used by DEH-SAM is outlined in Figure 1-3.

The VAP, LOP, and SDP are similar in that DEH-SAM reviews the investigations for completeness and adequacy of assessment and remediation. The investigation and remedial actions need to follow the procedures outlined within the SAM Manual.

The LOP is more structured and stepwise due to state regulations while the VAP and SDP allow a multitask approach. In LOP cases the source of the release is known. In VAP and SDP cases, it is common that the source of the release or releases is not known or multiple sources are represented. Due to the complexity of VAP and SDP cases, use of a multitask approach is commonly more appropriate.

The differences in these programs are described in Section 1.IX.B above.

Figure 1-3
SITE ASSESSMENT AND MITIGATION PROCESS



X. MONITORING WELL PROGRAM

DEH/SAM's Monitoring Well Program is the agency designated to administer and enforce state standards and local ordinances pertaining to the construction, alteration, maintenance, and destruction of monitoring wells. The goals of the San Diego County DEH Monitoring Well Program are:

- To permit the drilling, installation, and destruction of borings and wells,
- To educate the public regarding potential monitoring well hazards, and
- To minimize any risks to public health by bringing deficient monitoring wells to proper standards.

For information regarding monitoring well permitting, design, and construction standards, please see Section 5 and Appendix B.

XI. METHAMPHETAMINE PROGRAM

DEH's Methamphetamine Program is responsible for the regulatory oversight of methamphetamine-contaminated properties in San Diego County. If DEH determines that a property is contaminated with methamphetamine residue, the property is "unfit for occupancy," in accordance with Assembly Bill 1078, and the owner is responsible for assessing the level of contamination and remediating the property. Subsequently, a Preliminary Site Assessment (PSA) report is prepared. The PSA report shall be stamped and signed by the contractor responsible for the completion of the PSA and by a Certified Industrial Hygienist (CIH) for sufficiency and completeness per section 25400.38 of the Health and Safety Code. If soil and groundwater investigation is required, the document must also be signed by a State of California Professional Geologist (PG) or Registered Civil Engineer (RCE).

An effective remediation process requires coordination and cooperation between the property owner, the property owner's environmental consultant and remediation contractor, local Law Enforcement, Code Enforcement personnel, and DEH. DEH's role is to provide technical assistance regarding public health and contamination issues to the public and other agencies. Once the remediation process is complete, DEH issues the property owner a case closure letter.

Information regarding the Methamphetamine Program can be found at:

http://www.sdcounty.ca.gov/deh/hazmat/hmd_meth.html

XII. SERVICES PROVIDED

SAM oversees the closure of USTs; the installation, repair, reconstruction, and destruction of borings, monitoring wells, and cathodic protection wells; and investigation and remediation of UST-related sites. Any activities involving the closure of USTs and the installation, repair, reconstruction, and destruction of borings, monitoring wells, and cathodic protection wells must be completed under permit in accordance with DEH guidelines. The DEH Hazardous Materials Division (HMD) oversees the installation, repair, monitoring and operation of existing UST facilities.

SAM staff are assigned LOP and VAP projects based upon major RP groups and on a rotating basis to manage site assessment and remediation projects. If you have a question regarding a particular site, you will be directed to contact the SAM staff person assigned to the project.

Please refer to the SAM organizational chart or SAM web page for the phone numbers of the applicable departments/personnel to contact. Copies of boring/monitoring well and UST removal permit applications are contained in Appendix B.II.

A. Duty Desk

SAM has a staff person dedicated to answering public questions on a weekly rotating basis. For general SAM-related questions, call (858) 505-6808. The Duty Specialist will try to answer your questions or direct you to the correct person to contact.

B. Web Page

SAM maintains several web pages within the County of San Diego's web site. The web pages provide information of all aspects of the various programs. The web page can be accessed at:

http://www.sdcounty.ca.gov/deh/water/sam_homepage.html

C. Review of Public Records

Several types of files are available for public review at DEH offices, including site assessment related correspondence and reports, UST compliance information, permits, complaints, and industrial compliance inspection files. DEH must receive a written request prior to the file review. A copy of the public records review request form is included in Appendix D.V. Once the written request to review files has been received, the DEH Public Records Manager will contact the requestor to set up an appointment. Files cannot be taken apart, rearranged, or removed from the file review area. Copies of files or portions of files can be requested, and are available for a nominal per page copying fee. For file review questions, contact the Public Records Manager at (858) 505-6891 or access the web page for Public Records at:

http://www.co.san-diego.ca.us/deh/doing_business/records.html

D. SAM Manual

The SAM Manual is periodically updated, based upon input from quarterly Forum meetings, technical work groups, and the Steering Committee, as described below. As mentioned previously, the SAM Manual and updates are available on the SAM web page.

E. Forum Meetings

Forum meetings provide the opportunity for interaction between industry, government regulators, and consultants. These meetings take place periodically throughout the year. This interaction often takes the form of panel discussions concerning specific topics or informal question and answer periods. Suggestions for new work group topics are solicited at the Forum meetings through group discussions. The formation of new technical work groups (TWGs) is announced at the Forum meetings, and prospective work group members are given an opportunity to volunteer.

F. Technical Work Groups

The real work of guideline development and most of the industry/agency interaction takes place in TWGs. Experience has shown that TWGs generally require about six months to one year to complete work on a guideline. Members are asked to commit to monthly meetings for that time period, and sporadic participation is greatly discouraged. Leadership of TWGs is selected by the Steering Committee and consists of a chair and a co-chair. The committees are generally chaired by an industry representative and co-chaired by an agency representative. Usually, one of the TWG chairs provides an update of the TWG's progress at the Forum meeting.

After initial formation, the TWGs are asked to prepare a scope of work for the Steering Committee. The scope of work is intended to keep the TWG from getting sidetracked and to keep the TWG tasks to a manageable size. Draft guidelines are provided for comment at the TWG Forum meetings. The TWG will review any comments received and incorporate appropriate changes into a preliminary-final draft guideline. SAM and RWQCB staff will review and comment on the preliminary-final draft. Before the final guidelines are published, the Steering Committee will incorporate any additional comments. During the progression of the TWG, many new topics for additional TWGs are suggested. The TWG is asked to submit these new topics for Steering Committee and Forum consideration.

G. Steering Committee

The Steering Committee is comprised of representatives of SAM, the RWQCB, environmental attorneys, local industry, major oil companies, the military, and members of the consulting and analytical laboratory communities.

The Steering Committee is responsible for ensuring that the goals set for the TWGs are obtainable and are met in a timely manner. The Steering Committee is also responsible for preparing the agenda for the TWG Forum meetings, selecting topics for new TWGs, and selecting leadership of the TWGs.

The Steering Committee also makes the final decision as to when draft guidelines will be published as final guidelines. As soon as these guidelines are published, they are formally incorporated into the next update of the SAM Manual.

H. Annual "SAM Update" Meeting

A meeting called the "SAM Update" is hosted annually by the DEH. At this meeting DEH, RWQCB, and State Fund staff make presentations that are intended to highlight new guidelines and clarify issues that will help the regulated community better understand SAM guidelines.

XIII. OTHER AGENCIES AND PROGRAMS

A. Regional Water Quality Control Board (RWQCB)

The mission of the RWQCB 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." The RWQCB is responsible for protecting and enforcing the many uses of water, including the needs of industry, agriculture, municipal districts, and the environment. The

RWQCB develops the "basin plan" for its hydrologic areas, issues waste discharge requirements, takes enforcement action against violators, and monitors water quality. In addition, Regional Boards maintain computerized databases covering an array of regulatory activities.

The RWQCB has a stringent enforcement program. Legislation now authorizes Regional Boards to impose substantial civil liability on polluters. When enforcement problems arise, the RWQCB can determine which enforcement measures to adopt. Decisions are based on the nature of the violation, the discharger's record, and input received at public hearings. Decisions of the Regional Boards may be appealed to the State Board.

Other programs overseen by the RWQCB include water quality assessment programs, storm water discharge programs, bay protection and toxic cleanup programs, non-point source programs, and a watershed management program.

1. The San Diego RWQCB (Region 9) is located at:

    9174 Sky Park Court, Suite 100
    San Diego, CA 92123-4340
    (858) 467-2952

    The San Diego RWQCB web site is located at:

    http://www.waterboards.ca.gov/sandiego/

2. The Colorado River Basin RWQCB (Region 7) is located at:

    73-720 Fred Waring Dr., Suite 100
    Palm Desert, CA 92260
    (760) 346-7491
    (760) 341-6820

    The Colorado RWQCB web site is located at:

    http://www.waterboards.ca.gov/coloradoriver/

B. Department of Toxic Substances Control (DTSC)

The Site Mitigation Program within the DTSC oversees the investigation and remediation of hazardous substance release sites in California. The DTSC identifies, assesses, and carries out or oversees removal or remedial actions at sites where uncontrolled releases or potential releases of hazardous substances have occurred. If the DTSC determines that it is not the appropriate agency to address the problem, it will refer the case to the appropriate local, state or federal agency. The DTSC Site Mitigation Program's regional operations provide project management oversight at federal National Priority List sites (the federal Superfund Program), federal military installations, other RP-lead sites, and state-funded sites.

The local DTSC field office is located at:

5796 Corporate Avenue
Cypress, CA 90603
(714) 484-5300

The DTSC web site is located at:

http://www.dtsc.ca.gov

C. State Tank Funds

Federal regulations require owners and operators of USTs to demonstrate financial responsibility for cleanup of contamination and for third-party damages resulting from UST leaks. Financial responsibility means that owners or operators of USTs must ensure, through insurance coverage and/or other means, that there will be money available to help pay for the cost of corrective action and third party liability resulting from a leak from a UST.

1. The UST Cleanup Fund

The California UST Cleanup Fund (Reimbursement/Pre-Payment Fund) provides cost reimbursement to eligible UST owners, operators, or other RPs for the cleanup of petroleum hydrocarbon contamination. The Fund also helps UST owners or operators meet their federal and state financial responsibility requirements. The Fund is administered by the State Water Resources Control Board and is financed by the owners of petroleum USTs through a per gallon storage fee. The fee is based on gallons delivered to the UST and is collected by the State Board of Equalization.

For a more detailed description of the UST Cleanup Fund, refer to Appendix L.

Fund applications can be obtained by calling 1-800-813-FUND, or by writing to:

State Water Resources Control Board
Division of Financial Assistance
UST Cleanup Fund Program
P.O. Box 944212
Sacramento, CA 94244-2120

Information about the Fund can also be obtained on the web at:

http://www.waterboards.ca.gov/water_issues/programs/ustcf/

2. Small Home Heating Fuel Tanks

Residential owners of fuel oil tanks with capacities of 1,100 gallons or less for small home heating are eligible to participate in the Fund. Eligible small home heating fuel oil tanks are defined as a UST located at a residence (owner-occupied, single family dwelling or duplex at the time of the unauthorized release), that has a capacity of 1,100 gallons or less, that has stored home heating fuel oil for consumptive use on the property since January 1, 1985, and that is not located on property used for agricultural purposes after January 1, 1985.

3. The UST Loan Program

A second portion of the UST Cleanup Fund includes a loan program for the upgrade, replacement, or removal of USTs. The State Department of Commerce, not the SWRCB, is administering this at the state level. This portion of the Fund will not pay for corrective action. For further information, contact the Trade and Commerce Agency or a local administrator of the loan program.

California Trade and Commerce Agency
RUST Loan Program
801 K Street, Suite 1600
Sacramento, CA 95814
(916) 323-9879

California Southern Small Business Financial Development Corp.
600 B Street, Suite 2450
San Diego, CA 92101
Phone: (619) 232-7771
Fax: (619) 232-6743

XIV. COMMON DEFINITIONS

Aquifer. Rock or sediment in a formation, group of formations, or part of a formation, which is saturated and sufficiently permeable to transmit water to wells or springs.

Boring. A hole advanced into the ground by means of a drilling apparatus. In San Diego County, a permit is required if a boring is deeper than 20 feet, is cased, or encounters groundwater.

Brownfield. Abandoned, idle, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination.

Capillary fringe. The unsaturated zone immediately above the water table where water is drawn upward by capillary action.

Chemicals Of Concern (COC). Specific chemical constituents and their breakdown products that are identified for evaluation in the assessment and risk analysis process. They may include, but are not limited to, petroleum fuel products, chlorinated solvents, pesticides, and other chemicals and metals related to industrial and commercial operations.

Closure Letter. Letter or document issued by a governmental agency, possessing regulatory authority, concurring with the completion of corrective action including, but not limited to, environmental assessment and remediation activities. Most closure letters are conditional.

Comfort Letter. A letter from a regulatory agency stating the status of the site and the agency's enforcement intentions.

Corrective Action. A sequence of actions that includes the assessment of a property or facility, investigation and analysis of a release of a hazardous substance, the preparation of a plan, and the implementation of a solution to protect human health and the environment, and/or restore the current and future beneficial use of the property.

Engineering Controls. Engineered designs or structures that will be or have been incorporated into the designed development to reduce the exposure to chemicals of concern to acceptable levels. Examples can include vapor barriers, air gaps, ventilation systems etc.

Ex Situ. Means "outside place" and is often used to refer to location of activities outside the original place of origin.

Groundwater Table. Refer to Water Table.

Hazardous Substance. Any substance or chemical product for which one of the following applies:

- The manufacturer or producer is required to prepare a Material Safety Data Sheet (MSDS) for the substance or product pursuant to the Hazardous Substances Information and Training Act (Chapter 2.5 [commencing with Section 6360] of Part 1 of Division 5 of the Labor Code) or pursuant to any applicable federal law or regulation.
- The substance is listed as a radioactive material in Appendix B of Chapter 1 of Title 10 of the Code of Federal Regulations, maintained and updated by the Nuclear Regulatory Commission.
- The substance is listed pursuant to Title 49 of the Code of Federal Regulations.
- The material is listed in subdivision (b) of Section 6382 of the Labor Code.

Hazardous Waste. A hazardous waste means either of the following:

- A waste, or combination of wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may either:
  - Cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness.
  - Pose a substantial present or potential hazard to human health or environment when improperly treated, stored transported, or disposed of, or otherwise managed.

- A waste, which meets any of the criteria specified in CHSC, Chapter 6.5, Section 25141.
  - "Hazardous waste" includes, but is not limited to, a Resource Conservation and Recovery Act (RCRA) hazardous waste.
  - Unless expressly provided otherwise, the term "hazardous waste" is understood to also include extremely hazardous waste and acutely hazardous waste.

In Situ. In place.

Institutional Controls. Legal or physical restrictions on the property relative to the future use of a site. These restrictions are to minimize exposure to chemicals of concern to acceptable levels. Examples include deed restrictions, environmental covenants, zoning variances, notices, and advisories.

Lead Agency. The regulatory agency providing primary oversight for the process involving site cleanup, and/or Brownfield redevelopment.

Leak. Refer to Release.

Local Oversight Program (LOP). A state program that the County of San Diego administers within San Diego County to oversee the investigation and cleanup of contamination associated with USTs.

No Further Action Letter. See Closure Letter

Non-Hazardous Waste Manifest. A bill of lading.

Non-Tank Site. A site with contamination source(s) other than USTs.

Perched Water. Unconfined groundwater separated from an underlying main body of groundwater by an unsaturated zone.

Phase I Environmental Site Assessment (ESA). An inquiry and evaluation of historical and current ownership/use of real estate that typically involves records review, interviews, site observations, and preparation of a report.

Phase II ESA. A follow-up investigation to the Phase I ESA that includes work plan development, completion of needed environmental work, chemical analysis, and documentation of the findings with interpretations and recommendations in a report.

Phase-Separated Product. Refer to Section 5.VI.A.

Polanco Development Act. An act of the California Legislature that provides authority for redevelopment agencies to expedite environmental action in a redevelopment area.

Preliminary Remediation Goals (PRGs). Human health risk-based action levels provided by USEPA Region 9 for screening and evaluating contaminated sites (does not address groundwater or ecological receptors).

Primary Containment. The first level of containment, such as the portion of a UST that comes into immediate contact on its inner surface with the hazardous substance being contained.

Prospective Purchaser Agreement (PPA). An agreement and/or covenant not to sue, made between a regulatory agency and a prospective purchaser, addressing contamination that existed prior to the purchase.

Project Coordinator. The person or persons who have applied for regulatory oversight and who have taken financial responsibility of oversight activities. This person or persons may not necessarily be the responsible party for the site.

Purging. Refer to Section 5.VI.A.

Redevelopment Agency. A body of five to seven resident electors appointed by the mayor or the chairman of the board of supervisors, with the approval of the legislative body, to function in the community according to Part 1, Division 24 of the Health and Safety Code. The functions of the redevelopment agency may include the planning, development, replanning, redesign, clearance, reconstruction, or rehabilitation of a survey area related to residential, industrial, public, or other structures in the interest of the general welfare of the community.

Redevelopment Project. This may include any project where the site use is changing and there is a real or perceived environmental contamination associated with hazardous material or waste. Included in this definition are all sites meeting the criteria for a Brownfield.

Release. Any spilling, leaking, emitting, discharging, escaping, leaching, or disposing of a hazardous substance into or on the waters of the state, the land, or the subsurface soils.

Remediation. An action for cleaning up a site or achieving site-specific target values for site cleanup. Target values are established based on protection of human health and/or the environment. These actions may include, but are not limited to, excavation; source or product removal; soil vapor extraction; natural attenuation; pump and treatment systems; and other physical, chemical, and thermal biodegradation technologies and engineering controls.

Responsible Party (RP). An RP is one or more of the following:

- Any person who owns or operates a UST used for the storage of any hazardous substance;
- In the case of any UST no longer in use, any person who owned or operated the UST immediately before the discontinuation of its use;
- Any owner of property where an unauthorized release of a hazardous substance from a UST has occurred; and
- Any person who had or has control over a UST at the time of or following an unauthorized release of a hazardous substance.

Note: Authorities cited are Sections 25299.77 and 25299.37, Health and Safety Code; and 40 CFR Section 280.12.

In addition, an RP is any person, except for an independent contractor, who agrees to carry out a site investigation and remedial action at a hazardous materials release site for one of the following reasons:

- The person is liable under state or local law, ordinance, or regulation.
- The site investigation and remedial action is required by state or local law, ordinance, or regulation.

Remedial Action Agreement. A voluntary agreement between the project coordinator and the local agency to investigate and remediate the site. Both DTSC and the RWQCB are provided written notification prior to implementation of the remedial action agreement.

Risk Assessment. A quantitative/qualitative analysis of the potential adverse human health effects caused by exposure to chemicals of concern. This can include impacts to soil, groundwater, surface water and/or air. In some cases, an evaluation of ecological risk may be required that addresses the potential effects on plants and animals rather than on human health.

Risk-Based Corrective Action. A framework in which exposure and risk assessment practices are integrated with site assessment activities and remedial action selection to ensure that the chosen action is protective of human health and the environment.

Secondary Containment. The level of containment external to, and separate from, the primary containment.

Site Assessment. Collection, analyses, and evaluation of environmental data (e.g., soil, soil vapor, or groundwater samples) to determine the horizontal and vertical extent of contamination and its impact, if any, on human health and safety and/or the environment.

Site Designation. A California Environmental Protection Agency (Cal-EPA) process where the administering agency (state or local) is appointed to coordinate other agency requirements for a given site.

Stakeholders. Individuals, organizations, governmental agencies, and other entities that have an interest in or are directly affected by a Brownfield property and its redevelopment. Stakeholders include, but are not limited to, owners, buyers, developers, lenders, insurers, government and regulatory agencies, and community groups.

Unauthorized Release. Any release of any hazardous substance that does not conform to CHSC, Chapter 6.7, Section 25295, 25295.5, and 29296.

UST. UST is any one or combination of tanks, including pipes and dispensers connected thereto, which is used for the storage of hazardous substances and which is substantially or totally beneath the surface of the ground.

The following USTs or structures are exempt from the monitoring and tank closure requirements. To establish that a UST meets the exemption requirements, the UST owner/operator must submit an exemption form for DEH review. Written concurrence or disapproval will be provided after review of the application and a site investigation by DEH.

<u>Farm and Home Heating Fuel Tanks</u>
Two types of farm and home heating fuel tanks are considered exempt from the monitoring requirements of CCR, Title 23. These tanks are defined as follows.

- Farm tanks of less than 1,100 gallons which are located on a farm and which store motor vehicle fuel used primarily for agricultural purposes and not for resale.
- On-site home heating fuel tanks of less than 1,100 gallons used for heating purposes on the premises.
- When a farm or home heating fuel tank changes from an exempt use to a regulated use it becomes subject to UST regulation.

<u>Process Flow-Through Tanks</u>
Tank systems in which a waste stream is treated through a series of compartments, and the final effluent is discharged to the sewer under permit, are generally exempt from the UST regulations. An example would be an oil/water separator tank. Single tanks below the surface of the ground in which hazardous wastes or materials are treated or stored, and where solids may collect and settle, or tanks which store an alkaline or acidic compound, are not exempt and are regulated by DEH. These include tanks used for metal plating and finishing.

<u>Sumps, Pits, Ponds, or Lagoons</u>
A sump, pit, pond, or lagoon, defined as a depression in the ground that depends solely on its surrounding earthen material for structural support and containment of fluids, is generally exempt from UST regulations. However, a sump that is composed of concrete or other similar materials, and relies on these materials for independent structural support, is not exempt from UST regulation. The definition of a sump is very broad; therefore, DEH will review sump closures on a case-by-case basis. In general, if the sump is regulated under the Clean Water Act, it is exempt from UST regulation. All other sumps or field-constructed tanks that hold or previously held a hazardous substance will be subject to UST requirements.

<u>Vaulted Tanks</u>
Vaulted tanks are tank systems that are located in a below-grade structure (vault). To be exempt, the entire tank system, including piping, must be accessible for direct viewing.

Waste-Water Treatment Tanks/Septic Tank
Waste-water treatment tanks are defined as USTs located inside a public or private waste-water treatment facility. The definition includes holding tanks, separators, clarifiers, and filtration tanks that do not continuously contain hazardous substances.

Liquefied Petroleum Gas Tanks
USTs that contain butane, isobutane, propane, butylene, or mixtures of the above, in a liquid or gaseous state, are exempt from UST regulations.

Hydraulic Lift Tanks
USTs that hold hydraulic fluid used for operational purposes and that have a capacity of 110 gallons or less are exempt from UST regulations.

Liquid Asphalt Tanks
USTs that contain steam-refined asphalt are exempt from UST regulations.

Tanks Containing Radioactive Substances
The Nuclear Regulatory Commission regulates tanks containing radioactive material.

Emergency Containment Tanks
Emergency spill/overflow containment structures or UST systems that are kept empty to receive accidental spills are exempt from UST regulations.

Drums Located in Basements
Drums that contain 55 gallons or less of a hazardous substance stored in basements are exempt from UST regulations.

Treatment, Storage and Disposal Facilities Tanks
To be considered exempt, USTs that contain hazardous substances and are located at Treatment, Storage, and Disposal facilities must be directly regulated by the California EPA as part of the Treatment, Storage, and Disposal Facility permit.

Tanks Containing Heat Transfer Fluids
USTs containing heat-transfer fluids (such as ethylene glycol, propylene glycol, and inorganic salts) for use in a closed-loop cooling system may be exempt from UST regulations. DEH will evaluate facilities wishing to store heat-transfer fluids in UST systems on a case-by-case basis.

Unsaturated Zone. The zone between the land surface and the water table, also known as the zone of aeration or the vadose zone. It includes the root zone, intermediate zone, and the capillary fringe.

Vadose Zone. The zone containing water under pressures less than that of the atmosphere, including soil water, intermediate vadose zone, and capillary water. This zone is limited above by the land surface and below by the surface of the zone of saturation (the water table).

Voluntary Assistance Program. A County of San Diego voluntary program that provides consultation and overview on Brownfield and other projects associated with environmental contamination.

Water Table. The surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric.

Well Development. Refer to Section 5.VI.

Wells. Wells are borings, hydropunches, cone penetrometer testing (CPT) test tubes, Site Characterization and Analysis Penetrometer System (SCAPS) test holes, groundwater monitoring wells, vadose monitoring wells, groundwater recovery wells, vapor extraction or inlet wells, observation wells, inclinometers, soil vapor probes, air sparge wells and piezometers.

In This Section:

Section 2 Underground Tank Program

I. INTRODUCTION

The San Diego County Department of Environmental Health (DEH) oversees the inspection, monitoring, and plan review of all underground storage tank (UST) facilities. The Hazardous Materials Division (HMD) performs annual inspections of all regulated USTs and the plan review for new installation, repair, upgrade, and closure of USTs. In addition, HMD is responsible for the inspections of all UST closures, the review of post tank removal workplans, all sampling analyses, and makes the determination whether further site assessment is required after review of laboratory reports. San Diego County Code, Title 6, Division 8, Chapter 10, Underground Storage of Hazardous Substances, gives DEH the authority to inspect all regulated USTs in San Diego County.

II. PERMIT REQUIREMENTS

Permits are required for installation, repair, and/or closure of all regulated USTs. UST permitting is divided into five (5) categories

- UST installation
- UST closure
- UST interior lining, repair, or bladder installation
- UST re-piping, piping repairs, or island extensions
- UST installation in vaults

Please refer to Section 1.X1V for the definition of a UST.

III. PERMIT APPLICATION

Submit one (1) original and two copies of a complete permit application, three (3) copies of a detailed site plan, and the appropriate fees to DEH UST Plan Check Desk, 1255 Imperial Avenue, 3rd floor, San Diego, CA, 92101 or phone (619) 237-8451 if you need additional information. A copy of the UST permit application is located in Appendix A.I or can be obtained from our web site, http://www.sdcounty.ca.gov/deh/hazmat/hmd_ust_construction.html. Please allow seven to ten (7 to 10) working days for processing and review.

An approved permit is required before field activities can begin. If an incomplete application is submitted, a plan correction sheet and the disapproved application will be returned to the applicant for correction and resubmission. DEH will not process the permit application until all fees are submitted. Permit application fees are as outlined in Part I on Page 2 of the permit application. Any activity related to this section that may affect stormwater discharges must include best management practices (BMPs) per Appendix N.

The contact person indicated on the application will be notified when the application is approved or disapproved. At the time of approval, arrangements will be made to have the permit picked up at the DEH office or mailed to the address on the application.

Please note that issuance of a permit to install new USTs at a site does not imply that any unauthorized release at the site has been remediated to the satisfaction of DEH or any other regulatory agency. Prior to the installation of new USTs, the responsible party (RP) must evaluate the proper site placement of the new USTs so that they will not prevent the successful completion of site assessment and remediation activities at the site.

A. Application Form

The permit application is divided into six activities related to USTs. All applicable parts of the application must be completed as follows:

- **Part I** For any activities related to UST system installation, closure, repair, or modification; and for installation of vaulted USTs
- **Part II** For new UST installations
- **Part III** For UST closures
- **Part IV** For UST repairs or UST interior lining and bladder installations
- **Part V** For re-piping, piping repairs, or island extensions
- **Part VI** For USTs installed in vaults

B. Site Plan

The plan must show the site's property lines, all existing structures on the site and the location of all existing and proposed UST systems, including all piping; and underground utility lines and vaults on the site. The plan must also show storm drains and BMPs that will be utilized for UST closures, post tank removal work, and sampling. See Appendix N.

C. Permit Extension

A permit is valid for one year from the date of approval. Permit extensions will be granted on a case by case basis.

D. Other Permits

Submit copies of all current permits or approved applications from the Air Pollution Control District (APCD), local fire departments, and local building/planning departments.

E. Community Health and Safety

The form titled "Workplan for Underground Storage Tank Closure" (Appendix A.II) must be completed for all UST closures. This form is intended to describe the measures that will be taken to protect the community from the activities at the site during the UST closure process.

F. Post-Tank Removal Investigation Workplans

Following the removal of a UST, an RP may choose to use the available contractor/excavation equipment and initiate the subsurface investigation of a suspected or confirmed unauthorized release. DEH considers the Post-Tank Removal Investigation to be an effective method of subsurface investigation only in situations where the volume of excavated soil is limited (approximately 50 to 75 cubic yards or a volume that can be properly managed and not result in nuisance conditions) and minimum stormwater requirements must be met according to Appendix N.

The RP or UST removal contractor must have an approved Post-Tank Removal Investigation Workplan, prior to UST removal. Please refer to Appendix A.III for details on Post-Tank Removal Investigations and the Post-Tank Removal Investigation Workplan.

G. Health and Safety at Underground Storage Tank Sites

The form titled "Health and Safety at Underground Storage Tanks Sites" (Appendix A.IV) describes contractor requirements, which must be complied with to maintain the site in a safe and secure manner to protect worker safety as well as other individuals including responsible parties, regulatory officials, and the public.

H. UST Contractor Certification

All contractors performing the installation, closure, repair, re-piping or modification of a UST system must provide evidence of the following:

- A valid State Contractor's License
- A valid Hazardous Substance Removal Certificate
- Workman's Compensation insurance

Permits for UST work in San Diego County will not be approved unless these three documents are on file with DEH.

I. UST Closure Options

Owners and operators of UST systems containing hazardous substances who discontinue use of the USTs must either close or replace them. DEH permits and oversees these processes.

1. Closure by Removal

Most UST owners/operators elect to close their UST by removal. A DEH specialist witnesses and provides written documentation of a UST removal. The laboratory results from initial mandatory soil samples are reviewed by DEH to determine if contamination exists and if further work is necessary.

2. Closure-in-Place

UST system closure-in-place will be considered only if the removal could damage a building, its foundation, or adjacent structures. A letter detailing why the UST system should be considered for closure in place must be submitted for review and approval. The letter shall also include a site plan with proposed sampling locations.

3. Temporary Closure

This alternate method of UST closure will be considered when the storage of a hazardous substance has ceased but when the owner/operator desires to reuse the UST within one year. Before DEH will consider temporary UST system closure, the UST owner/operator must demonstrate to the satisfaction of DEH that the UST system has not experienced an unauthorized release. Soil sampling and/or UST system integrity testing may be required. If temporary closure is approved, UST operating permit fees are still required.

4. USTs Closed in Place Prior to 1984

USTs and piping that are to be removed, but were closed in place (sand/slurry filled) prior to 1984, are subject to current closure requirements (40 CFR, Section 280.73, Chapter 6.7 Health and Safety Codes, Sections 25280.5, 25298, and 25299.7).

A permit for UST and piping removal is required from DEH. In addition, a site investigation may be necessary to determine if contamination is present. A permit for removal will not be required if the owner or operator of the UST can demonstrate to DEH, through documentation, that the UST was properly decontaminated, that the hazardous substances were properly manifested, and that no environmental contamination is present.

IV. INSPECTION

The UST owner/operator is responsible for ensuring that the inspection procedure requirements are met. Additionally, the UST owner/operator is responsible for all activities related to worker and community health and safety.

A. Inspection Scheduling

Once a permit has been issued, it is the responsibility of the permittee to notify DEH at least two (2) working days in advance to schedule each required inspection. Please call the UST Inspection Scheduling Line at (619) 237-8451 to schedule an appointment.

B. Inspection Procedures

1. New UST Construction

a. First Inspection

This inspection is to observe the pressure test of the UST and its primary piping system and to obtain copies of the UST manufacturer's certification. DEH does not witness the testing of the secondary containment. The testing of the secondary containment is completed and certified by the contractor.

b. Second Inspection

This inspection is to examine the UST leak detection system and to obtain copies of the contractor's certification of installation, certification of the monitoring equipment, integrity test report, and monitoring and response plan.

2. UST Closure

A UST closure inspection can include the closure of a UST by removal or closure in-place.

a. Closure by Removal

Prior to scheduling an inspection, the UST with associated piping must be exposed and properly decontaminated to facilitate DEH inspection. The UST owner/authorized representative on-site must:

- Provide a copy of the uniform hazardous waste manifest demonstrating the UST has been decontaminated, and
- Have on-site, a functioning, combustible gas indicator (CGI). This equipment is to be used to ensure worker safety, to demonstrate that the UST(s) has been properly decontaminated and purged, and that the sampling protocol for closure of USTs and piping has been completed. Please refer to the CGI Policy in Appendix E.I.

At the time of removal the DEH inspector will identify sampling locations and complete the sampling chain-of-custody on-site. Sampling results must be provided within 30 days.

Closure-in-Place (see Section 2.III.I.2)

If DEH approves the alternative closure plan:

(1) A registered geologist or civil engineer will witness and document the soil sampling activities. Sampling results must be provided within 30 days. Soil sample results must be submitted to DEH for review before scheduling the filling of the UST.

(2) The DEH inspector will verify that the UST has been properly emptied and observe the filling of the UST with an approved inert substance. The owner/authorized representative on-site must provide a copy of the uniform hazardous waste manifest

demonstrating that the UST has been decontaminated and a bill of lading for the material used to fill the UST.

3. UST Repair or Interior Coating

a. First Inspection - Repair Evaluation

DEH performs an inspection of the UST to verify the completion of the abrasive blasting to expose the UST's interior surfaces. At this inspection the UST owner/representative must provide documentation of the structural integrity of the USTs*, copies of the manifests indicating proper disposal of the wastes generated from the UST cleaning, and soil sample results.

***Please Note:** The UST system must be closed in accordance with CCR Title 23, Article 7, if the structural integrity does not meet the criteria set in CCR Title 23, Section 2663(B).

b. Second Inspection - Repair/Lining Verification

This inspection is performed upon completion of the repair and/or lining of the UST. At this time the UST owner/representative provides copies of the integrity test data, certification of monitoring, cathodic protection certification, laboratory results, and hazardous waste manifests for the sandblast waste, holiday test, and thickness and hardness tests.

4. Re-pipe, Piping Repair, or Island Extension

All piping trenches must be exposed to facilitate inspection and sampling before an inspection is scheduled.

a. First Inspection

This inspection is to obtain soil samples from the trench excavations. The DEH inspector will select sampling locations. For piping to be closed in place, all pipes must be drained and capped according to an approved alternate closure plan.

b. Second Inspection

During this inspection the new or repaired piping is pressure tested in the presence of the DEH inspector. Additionally, the inspector will verify the presence of leak detection devices, secondary containment, and overfill prevention.

c. Third Inspection

This is a monitoring system verification inspection. If product piping is new, a line integrity test will be required prior to scheduling this inspection.

5. Vaulted UST

This inspection is to verify that the UST system was completed in accordance with the approved plans.

V. OTHER REQUIREMENTS

A. UST Decontamination and Purging

For USTs that are to be closed, the UST system must be decontaminated (cleaned) and the resulting waste properly disposed of by a licensed hazardous waste hauler. This decontamination must be done prior to the scheduled inspection. A California Uniform Hazardous Waste Manifest is issued to the UST owner after the decontamination. A copy of the manifest must be provided to the DEH inspector at the time of the scheduled UST system closure inspection. The USTs must be purged of flammable vapors just prior to the scheduled inspection. Purging means that the flammable vapors have been displaced by an inert gas such as Carbon Dioxide (dry ice). Fifteen (15) pounds of dry ice is required for every 1,000 gallons of UST capacity.

B. Combustible Gas Indicator (CGI)

Contractors responsible for UST closure, repair, or re-piping work must have a Combustible Gas Indicator (CGI) at the work site at all times. Please refer to Appendix E.I. for DEH Combustible Gas Indicator Guidelines.

C. Sampling at UST Removals

When a UST is closed, repaired, or modified, the California Health and Safety Code (Division 20, Chapter 6.7, Section 25298) requires the UST owner/operator to "demonstrate to the local agency that there has been no significant soil contamination resulting from a discharge in the area surrounding the UST or facility." DEH has established guidelines for routine soil sampling and analyses for UST closure, repairs and modifications. Please refer to Appendix E.II for the UST Soil Sampling Guideline and to Section 5.IX for laboratory testing requirements. In addition, if groundwater is present, the DEH inspector may require that groundwater samples are collected and analyzed.

D. Community Health and Safety Planning for UST Closures

The closure of a UST system can be dangerous because of the potential for fire or explosion. Section 2.IV.B.2 and Section 2.V. discuss several of the required tasks involved in closing a UST system. These tasks were designed to minimize those risks inherent to UST system closure.

The information in this section should be reviewed before planning for community health and safety relevant to closing a UST system. Contractors are required to complete the "Underground Storage Tank Closure Workplan" form as part of the plan check process. A copy of this form is supplied in Appendix A.II. A portion of the "UST Closure Workplan" form includes requirements for Community Health and Safety Planning.

Community health and safety planning for closure of an UST system should consider the following.

1. Physical Hazards

a. Utility Location and Identification

Evaluate the potential hazards relative to the location of utilities at the site. Underground utilities (electrical, gas, water, sewer, phone) should be located and marked out prior to removing a UST system. Overhead utilities should also be identified and assessed as possible hazards. Backhoes, excavators, and cranes can impact electrical lines and water pipes.

b. Site Security

Exclude public access using warning signs, fencing, barricades, safety tape, or a combination thereof. In case of equipment failures, the isolated area should be large enough to accommodate the lengths of cables, chains, straps, or other equipment used to remove the UST. Always inspect equipment for signs of wear and weakness prior to removing or securing the UST system. Worn cables and chains have caused injury and death.

c. Site Safety and Maintenance

(1) Community Health and Safety

The UST owner/operator is responsible for maintaining the site in a safe and secure manner. The excavation may be backfilled for safety reasons until site assessment and remediation activities commence. Open excavations and stockpiled contaminated soil should be secured from the public. Some facilities have used fencing and security guards to secure an area. Berms should be provided during site activities to prevent runoff from stockpiles and flooding of trenches.

Notify the local fire department and DEH <u>immediately</u> whenever a fire hazard or explosion hazard is present. This would include circumstances in which 20% or greater of the Lower Explosion Limit (LEL) is detected in an excavation, surface area or enclosed space.

(2) Product Removal

Remove the hazardous substance from the system's components. When removing product from a UST, give careful consideration to proper tank ballast in areas of high groundwater.

(3) Management of Soil and Water

All excavated soil and purged well water must be managed to avoid presenting a hazard to the community or the environment.

(a) Drums: Soil or groundwater placed in drums should be labeled with their actual contents (see Section 5.II.E.).

All drums should be labeled as follows:

- Description of Contents (e. g., soil, water)
- Boring Identification
- Date of Boring
- Consulting Company Name
- 24-Hour Contact Phone Number

(b) Stockpiles: Measures should be taken to ensure that no run-off occurs from the stockpile (e.g., berms around the stockpile). In the event that vapors are determined to be a problem, an effective vapor barrier must be used to control them. The necessity for such vapor control is site-specific and must be determined as part of the overall community health and safety considerations. If such control measures are used on the site, the RP should ensure that the vapor barrier remains secured in place, is not compromised due to physical damage, and otherwise continues to be effective in controlling vapor.

(c) Minimum stormwater requirements must be met according to Appendix N.

7. Flammable Hazards

When a UST system that held a flammable substance is being removed, every precaution should be taken to prevent flammable and explosive conditions that may endanger the public. Flammable or explosive conditions could develop during any phase of the UST system removal activities, including venting, rinsing, and purging/inerting.

a. UST Removal Equipment

Non-sparking tools should be used during removal activities because explosive conditions can exist outside of the UST. You must obtain the approval of the local fire department if the UST needs to be cut open to remove the waste, and/or be cleaned.

b. Monitoring Equipment

Select the proper equipment to monitor flammable and explosive conditions. Refer to Section 2.V.B for a discussion of monitoring equipment that must be used during removal of a UST system. Precautions should be taken to eliminate ignition sources. Ignition sources include sparking equipment, static electricity, open flame, and smoking.

8. Precautions

DEH has witnessed many UST system closure activities and can provide the following observations.

a. When removing a UST system that previously held a flammable product, always be aware that the UST excavation may trap flammable gases and/or liquids. If the UST system leaked flammable liquids during its use, the backfill or native soil below or next to the UST system may be contaminated (even saturated) with the flammable liquid. After the UST system is removed, flammable liquids or gases may accumulate in the excavation and result in explosive and/or flammable conditions. Several excavations in

San Diego County have caught on fire in this situation. Pump the flammable liquids from the excavation with a vacuum truck if potentially explosive or flammable conditions exist in an excavation that contains either ponded flammable liquid or contaminated soil that is releasing flammable gases.

b. When a UST system that held a flammable liquid is removed from inside a building or structure, flammable gases may be trapped in the structure and create flammable or explosive conditions. The facility should be well ventilated during the UST removal activities. If potentially explosive or flammable conditions exist in a building or structure despite the precautions taken, evacuate the structure and notify the local fire department.

In This Section:

Section 3
Contaminant Discovery and Release Reporting

I. CONTAMINANT DISCOVERY

Numerous contaminated sites exist in San Diego County. Regulations requiring the upgrade and replacement of underground storage tank (UST) systems and regulatory inspections of businesses and industrial facilities that use hazardous materials and generate hazardous wastes continue to be strengthened. Lenders and potential buyers, prior to a real estate transfer, now commonly require environmental property assessments.

The most common ways that DEH learns about sites contaminated by hazardous substances are as follows:

- Test results of soil or groundwater samples collected during UST removal operations
- During subsurface investigations and through test results of soil and groundwater samples from soil borings and monitoring wells installed during such investigations
- During business or industry compliance inspections and emergency response operations
- Through site inspections or surficial sampling conducted as part of environmental assessments
- Through referrals and complaints from other government agencies, industry, and the public
- Through failed UST integrity tests
- Through releases from exempted USTs

Note: If a release is identified at any point in time during the operation or closure of an exempt UST, the UST owner or UST operator must follow the reporting requirements outlined in Section 3.II.A.

A. Contamination Sources

The following are brief descriptions of the contamination sources.

1. Industrial Process

Assessment and remediation of industrial process releases require a thorough understanding of the process line and the chemistry of the materials used and wastes produced. This information should be discussed in the site assessment report submitted to DEH. The site assessment report needs to be completed in accordance with Section 4 and Section 5 of this Manual.

Layouts of plumbing/sewer lines (past and present), associated plant process lines, chemical inventory used, wastes produced, waste storage areas, methods of waste disposal, and permitted sewer discharge limitations should all be discussed, if applicable. The site assessment report should discuss thoroughly the past site usage and any impacts suspected to have been caused by them. Discussion should distinguish between impacts caused by past and present site activities.

In addition to investigation of soil and groundwater, it may be necessary to determine if building materials, containers, sumps, and/or basins are contaminated. An evaluation of the integrity of any concrete flooring should be made to determine if any visible deterioration exists. Cracks, joints, exposed aggregate, and holes, for example, may suggest that chemicals have contaminated the soil beneath the flooring. A determination must be made as to whether solutions have leached or leaked through the concrete slab.

Contaminants may be present that are characteristic of the unique chemicals and processes used at a site. Depending on the type of business (e.g., plating shop, dry cleaner), metals contamination or dense non-aqueous phase liquids (DNAPL) beneath the water table may be present and should be investigated.

The following is a list of common issues that pertain to hazardous substances at industrial releases.

a. Hazardous waste determinations for unknown wastes
b. Disposition of chemicals (e.g., permitted sewer discharge, copies of hazardous waste manifests or shipping documents)
c. USTs and piping decontamination
d. Sump clean-out and decontamination
e. Condition of concrete flooring (deterioration/leaching)
f. Wall and berm decontamination
g. Complete inventory of chemicals and wastes used and/or produced on-site
h. Waste-water treatment system leakage and/or decontamination
i. Rinsate disposal from shop cleanup
j. On-site waste storage and management areas

2. Agricultural Practices

Agricultural activities include the application of fertilizers, herbicides, and pesticides. Soils contaminated by past agricultural activities have been of growing concern, generally because of land use changes involving proposed housing developments on former agricultural lands. *In situ* residues in soil, resulting from legally applied fertilizers, herbicides, and pesticides are not regulated as hazardous waste. However, it is necessary to conduct both a site assessment and a risk assessment to adequately evaluate the risk to human health and the environment posed by the presence of these residual materials.

3. Above Ground Storage Tanks

Contact the County of San Diego Hazardous Materials Division (HMD) regarding the requirements for reporting, investigation, cleanup, and closure of operating or closed above ground storage tank (AST) systems.

4. Burn Ash

Burn ash refers to the debris, refuse, ash, and ash-contaminated soil that is produced from the open burning of municipal solid waste. In San Diego County, numerous burn ash sites exist from the time when open burning was the primary method used to dispose of solid waste. This was common from 1940 to the late 1960s.

Ash from the open burning of municipal solid waste is the most common, but not the only, source of burn ash. Historically, some open burning and low temperature incineration did occur with specific commercial wastes streams, often disposed of on-site. Ash from these sites could have very different characteristics from those of municipal solid waste. Burn ash is often commingled with other solid wastes, including incompletely burned refuse. These sites can have complicated mixtures of contaminants.

There are many environmental issues and concerns regarding the management of burn ash sites. Contact DEH's Local Enforcement Agency (LEA) regarding the requirements for investigation, cleanup and closure of these types of sites.

5. Illegal or Abandoned Landfill Sites

Contact DEH's LEA regarding the requirements for reporting, investigation, cleanup, and closure of illegal or abandoned landfill sites.

6. Closed Sites or Operating Landfill Sites

Contact DEH's LEA regarding the requirements for reporting, investigation, cleanup, and closure of closed or operating landfill sites.

B. Investigations to Determine if Contamination Is Present

Environmental assessments are now commonly performed on many sites where there is no obvious contamination, or where contamination is suspected but has not yet been discovered, in order to address various legal, technical, or real estate appraisal issues. For example, they may be performed as part of due diligence surrounding a property transfer, to determine the technical feasibility of a proposed site use, or to estimate the market value of a real estate parcel. Environmental assessments are also commonly called Phase I site assessments, preliminary site assessments (PSAs), and real estate assessments.

An environmental assessment is basically an investigation of current and past site uses to determine if contamination is present, likely, or suspected. It typically involves a thorough review of public records, a site visit, and possibly minor soil or groundwater sampling and analyses. In general, the information from the environmental assessment is evaluated to assess the current status of a property, and to determine if additional soil and groundwater investigations and testing are warranted. These investigations do not constitute a complete site assessment as defined in this Manual, since their purpose is only to establish the presence or absence of contamination. If contamination is known, discovered, or suspected, a complete site assessment should be performed in accordance with requirements in this Manual to determine the nature and extent of contamination. Section 4 and Section 5 of this Manual provide further information concerning site assessments and soil and water investigations.

If an environmental assessment is to be used as a decision-making tool in a property transaction, DEH strongly suggests that the environmental assessment be conducted in the early planning phases. An environmental assessment begins with a good request for proposal (RFP). Buyers, sellers, and lenders sometimes want to have a regulatory agency review and comment on reports that have been prepared following an environmental assessment of a property. This work is typically done prior to the sale of real estate. Many of these reports are submitted to DEH for review, although there is no legal requirement to do so. As part of the Voluntary Assistance Program (VAP), DEH may elect to review these documents for full cost recovery of the staff time expended. If contamination is known or discovered, it should be reported to DEH and/or the RWQCB, Department of Toxic Substances Control (DTSC), or other regulatory agencies with oversight authority.

The sections below, titled "An Environmental Assessment Task List" and "Environmental Assessment (Phase I) Report Checklist", present DEH's opinion on completing an environmental assessment. DEH is aware that there are several other published documents available that provide guidance for conducting an environmental assessment. DEH will continue to present guidance on conducting such assessments. In addition to the information below, DEH recommends that you consider the guidance presented by the American Society for Testing and Materials (ASTM) in their Standard Practices for Environmental Site Assessments. The ASTM Standards are more specifically referred to as *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process, designation E 1527-05*, and *Standard Practice for Environmental Site Assessments: Transaction Screen Process, designation E 1528-06*.

Environmental Assessment Task List

Environmental assessments should make use of existing documentation and historical information regarding site uses that may have created conditions leading to contamination of soil/groundwater. Environmental assessments may be conveniently divided into tasks as follows.

1. Historical Review

Review existing documents, including agency files, geotechnical reports, aerial photos, title documents, insurance documents, etc.

2. Site Reconnaissance

Conduct a site visit and look for existing evidence of surficial contamination. Document current storage, management, and disposal practices concerning hazardous substances.

3. Identification of Suspect Areas of Contamination

Identify and discuss potential areas of on-site contamination based upon the results of the historical review and site reconnaissance tasks from above. Evaluate the potential of contamination from "documented" nearby sites.

4. Report Preparation

Prepare a report that contains an analysis of all the pertinent data collected during the historical review and the site reconnaissance. The report shall include appropriate plot plans, tables, and potential areas of the site to be targeted for further studies (Phase II Investigation). Include conclusions and recommendations concerning the current site status and the need for further work at the site.

C. Environmental Assessment (Phase I) Report Checklist

DEH has prepared the following Environmental Assessment Report Checklist to ensure that reports submitted to DEH for review and comment are complete. The level of scrutiny warranted for an environmental investigation at any particular site may vary considerably, depending on the goals of the investigation and the potential for existing contamination.

1. Site Identification

a. Site address
b. County tax assessor's parcel number (APN)
c. Name and address of property owner
d. Contact name and phone number for property owner
e. Name of any business(es) on-site
f. Contact name and phone number for business(es) on-site
g. Location map (e.g., Thomas Brothers page indicating site vicinity)

2. Site Plot Plan(s) (maps)

a. Drawn to scale with key to map features and north arrow (or other directional indicators)
b. Roads, structures, pertinent utilities, and features shown
c. Storage areas and facilities/improvements of any type (e.g., sheds, concrete pads, fenced enclosures, ASTs, USTs, etc.) shown
d. Wells (drinking water supply or groundwater monitoring wells) shown
e. Location(s) of known or suspected contamination on the subject and adjacent sites (based on current and previous investigations)
f. Locations of any samples collected during current and previous investigations
g. Geotechnical modification location(s) of any geotechnical modifications made to the site, such as major areas of cut and fill, installed subsurface drainage structures, borings, and trenches. Reference the geotechnical reports from which such information is compiled.

3. Geology/Hydrology

Include any known geological information (list sources for all information).

a. Local (regional) geology
b. Site-specific geology
c. Topography and surface drainage
d. Surface water bodies in the vicinity
e. Groundwater occurrence (if known)

   (1) Depth to groundwater
   (2) Groundwater flow direction (gradient)
   (3) Groundwater quality

      (a) Local (designated by the state as beneficial or non-beneficial)
      (b) Site-specific (clean or contaminated)

4. Site Use

a. Current site use
b. Whether the site itself appears on a government environmental records list
c. Which list(s) and reason(s) for listing
d. Case "open" or "closed”
e. Chemical(s) of concern
f. Contamination of concern (soil/groundwater/both), if any
g. The extent of contamination (if known)
h. Dates of listing, of contamination, of discovery, if any

5. Activities involving hazardous materials occurring on site (use, storage, treatment, and/or disposal, whether proper or improper)

a. Specific activities, chemicals involved, potential for site contamination resulting from activities
b. The types of contaminants generally associated with a particular site use
c. Length of time these activities were performed

6. Activity requiring an EPA identification number or permit(s) from regulatory agencies for discharges to air, water, or sewer

7. Violations of permits or other environmental regulations and the nature and outcome of the violation

8. Environmental contamination observed or suspected in aerial photographs or during site reconnaissance

9. Structures or features on-site suggesting chemical use, storage, treatment, or disposal (tanks, sumps, clarifiers, ponds, etc.), including the materials stored/handled and a review of monitoring records

10. Equipment for monitoring or controlling the release or migration of waste or contamination (such as monitoring wells)

11. Activity involving non-hazardous materials occurring on-site that may impact proposed site use or increase liability (e.g., solid waste such as refuse, tires, automobiles, construction debris)

12. Pesticide application

d. Specific chemicals used
e. Method, rate, and frequency of application
f. Carrier agents (solvents), if any
g. Identify storage and mixing areas

13. Document known environmental contamination

14. Type of land use in the vicinity of site (industrial, commercial, residential, rural, etc.)

a. Previous site uses

(1) As with current site use above, review title documents, fire insurance records, lease or rental agreements, permits, geotechnical reports, land use maps, outdated phone books, etc., for information on sources or potential sources of environmental contamination.
(2) Tabulate a chronology of ownership and significant site use changes. Reference the source(s) of the information.

b. Adjacent site use

(1) Both current and past adjacent site use(s)
(2) As with current site use, but with added emphasis on distance to subject property, and on extent of or potential for off-site migration onto or towards subject property
(3) Impact(s) on site usability of any known off-site contamination or chemical emission

15. Sampling Data and Evaluation

a. Rationale for sampling (suspected sources of contamination)
b. Specific contaminants analyzed for (e.g., gasoline, waste oil, asbestos)
c. Sample collection procedures, equipment used, and chain-of-custody forms
d. Tabulation of results from laboratory analyses (data) for current and previous investigations. For the current investigation, provide a copy of the laboratory report in the assessment report. Data presented from past reports must be appropriately referenced.
e. Evaluation of sample data

(1) From the current and previous investigation
(2) In light of laws, regulations, or other regulatory guidance
(3) In light of proposed site use
(4) Recommendations for additional samples or analyses

16. Summary/Conclusions/Recommendations

a. Findings

(1) From the current investigation

(2) From previous investigations

b. Impacts (if contamination or potential sources are identified)

(1) Possible exposure concerns
(2) Potential for on-site or off-site contaminant migration

c. Recommendations

(1) Need for further assessment
(2) Possible restrictions for the proposed site use
(3) Possible restrictions for other site uses

17. Signatures

a. Signature(s) of the authors and reviewer(s)
b. Authorized signature for the company preparing the report (DEH does not accept "Draft" or unsigned reports.)

Request the signature of an appropriately registered or certified professional (the reports including geologic or engineering evaluations, interpretations, or judgments on crucial elements, especially those elements which affect ownership liability, cleanup feasibility and costs, property usability, or the appraisal value).

18. Attachments/Enclosures

Copies of pertinent records, historic and current aerial photographs, and photographs from the site reconnaissance should be included in the report.

II. RELEASE REPORTING AND AGENCY OVERSIGHT

Once contamination has been discovered, specific laws and regulations require reporting and corrective action depending on the constituents of the substance released and the source of the release. A release for the purposes of this Manual is defined as any spill, leak, discharge, or disposal of a hazardous substance into the waters of the state, the land, and surface or subsurface soils.

DEH provides regulatory oversight for corrective action at sites contaminated with petroleum products or hazardous substances from USTs. DEH is authorized to provide this oversight as a participant in the State Water Resources Control Board's Local Oversight Program (LOP) and by the County Board of Supervisors. For most other contaminated sites (other than with petroleum impacts from USTs) where contamination may threaten the waters of the County, the RWQCB has regulatory authority. The DTSC may have regulatory authority over a smaller number of contaminated sites, including Resource Conservation and Recovery Act (RCRA) treatment, storage, and disposal (TSD) facilities.

In many cases, the source, rather than the contaminant substance, determines which agency has regulatory oversight. An example is petroleum. When petroleum is stored in an AST, the County of San Diego Hazardous Materials Division has jurisdiction; however, when petroleum is stored in a UST, SAM has jurisdiction. Because of limited staff at the RWQCB and DTSC, DEH frequently provides oversight on many contaminated sites at the request of the Responsible Party (RP), and with the concurrence of the RWQCB and/or the DTSC as part of the Voluntary Assistance Program (VAP).

A. UST Sites

California law divides USTs into two groups. (1) USTs that are regulated by the UST regulations in the California Health and Safety Code (HSC) Chapter 6.7 for the monitoring and closure of USTs, and (2) USTs that are exempt from the monitoring and closure requirements. When a release is identified from an exempt UST, HSC Chapter 6.75 requires an investigation and cleanup.

For sites where soil and groundwater have been contaminated by a release of petroleum product from a UST, the corrective action process and the reporting requirements are specifically defined in the California Code of Regulations (CCR), Title 23, Division 3, Chapter 16, Article 11. According to Chapter 6.7 of the HSC, a UST is defined as a tank or a combination of tanks, including dispensers and connecting piping, which is used to contain regulated hazardous substances, with 10% or more of its capacity beneath the surface of the ground. Chapter 6.7 defines a release as any spilling, leaking, emitting, discharging, escaping, leaching, or disposing from a UST into or on the waters of the state, the land, or the subsurface soils.

A release from a UST is called an unauthorized release. Once contamination has been discovered at a petroleum UST site, the unauthorized release must be reported in accordance with CCR, Title 23, Division 3, Chapter 16, Article 5, and the corrective action process defined under Article 11 must be followed. California law requires the UST owner or operator to report an unauthorized release, spill, or overfill condition to DEH within 24 hours of discovery. The following section outlines the reporting requirements.

1. 24-Hour Notification

An unauthorized release may occur while a UST is in operation. In these instances, DEH requires notification within 24 hours. The five conditions that trigger the 24-hour reporting requirements are the following:

a. The UST owner or operator must report an unauthorized release that escapes from the secondary containment of the UST system, or from the primary containment if no secondary containment exists, to DEH within 24 hours of the discovery or detection of the release. Releases that do not escape the UST secondary containment and are cleaned up within 8 hours of release detection do not require 24-hour notification, but must be described in the UST operator's monitoring record.

b. Any unauthorized release that increases the hazard of fire or explosion must be reported within 24 hours.

c. Failed integrity tests are considered potential unauthorized releases and must be reported to DEH within 24 hours.

d. Unusual UST operation conditions or the sudden loss of product are considered suspected unauthorized releases and must be reported to DEH within 24 hours.

e. An unauthorized release that causes any deterioration to the secondary containment of the UST must be reported to DEH within 24 hours.

2. Integrity (Precision) Test Reporting

A tank integrity test determines the physical integrity of a UST. It is one of the monitoring alternatives available for detecting leakage from an UST. A tank tester who is licensed by the State of California must conduct all tank integrity tests. Integrity test methods must have third-party verification, and must be among those approved by the State Water Resources Control Board. The test method can be either volumetric or non-volumetric, and must be able to detect a leak rate of 0.10 gallon per hour (gph), with a probability of detection of at least 95%, and a probability of false reading of 5% or less. The leak rate can be no greater than 0.10 gallon per hour: however, it is also dependent upon the threshold limit value established for each particular test method. For example, if a threshold limit for a particular test is 0.05 gallon per hour, then any test result equal to or greater than 0.05 gallon per hour indicates a failed integrity test.

A failed integrity test is one in which the leak rate equals or exceeds the leak threshold limit established for that particular test method. Currently, in San Diego County, the threshold limit for all state-approved volumetric integrity test methods is 0.05 gph. A failed integrity test is considered a suspected unauthorized release.

a. Release Report

An integrity test with a leak rate greater than or equal to the leak threshold limit for that particular method is evidence of an unauthorized release. The UST owner/operator, or his agent, must notify DEH within 24 hours or on the next working day (CCR, Title 23, Section 2652). The UST owner/operator, or his agent can call DEH at (619) 338-2207 between 8:00 a.m. and 5:00 p.m., Monday through Friday. DEH encourages consultants to advise their clients of this requirement in advance of performing an integrity test. To protect their clients from possible enforcement action for neglecting to make the proper notifications as required by law, consultants can, on behalf of their clients, make the initial notification to DEH.

b. Five-Day Report

Upon receipt of the 24-hour notification of the unauthorized release, DEH will send an Official Notice to the UST owner/operator requiring submittal of a written report to DEH within five (5) working days (Form HSC-05). The five-day report must address the points specified in CCR, Title 23, Section 2652. Additionally, the owner/operator must provide a copy of all UST test results, the cause of the test failure, a time line for identifying the location of the suspected leak, and the measures for preventing further loss of hazardous substance from the UST system. The report should indicate any necessary repairs (a repair permit may be required) and the reschedule date for the integrity test, if applicable.

c. Loss Prevention

It is very important to identify the cause of the integrity test failure as soon as possible to minimize the cost and extent of any necessary cleanup. Any component of the tank system which is identified as having a leak, or is a source of product loss to the environment, shall have all product removed from that component and/or be maintained in such a state so as to preclude further product loss. Consideration must be given to the proper tank ballast in areas of high groundwater.

d. Additional Requirements

If it can be clearly demonstrated to DEH in the five-day report, or at a later date, that an unauthorized release did not occur, no further investigation or cleanup will be required. Such a case may exist when, for example, the integrity test failure is shown to be due to a loose fitting on a vent line. All other failed integrity tests will be handled as unauthorized releases.

5. Preliminary Site Assessment Phase

The first phase of corrective action as defined under CCR Title 23, Article 11, is the Preliminary Site Assessment Phase. The requirements of this phase include, at a minimum, initial site investigation, initial abatement actions, and initial site characterization in accordance with Sections 2652, 2653, and 2654 of Article 5 (Release Reporting and Initial Abatement Requirements), and any interim remedial actions taken in accordance with Section 2722(b) of Article 11.

The UST owner or operator should implement the following initial abatement actions, as applicable, in response to an unauthorized release.

a. Initial Site Characterization

(1) Visually inspect the site for impacts of the release.
(2) Investigate to determine if non-aqueous phase liquid (NAPL) is present.
(3) Evaluate the fire or safety hazards posed by vapors or NAPL.
(4) Assemble information on the nature and estimated quantity of the unauthorized release and information from available sources concerning applicable environmental and land use conditions.

b. Initial Abatement Actions

(1) Take all necessary and appropriate measures to stop the release.
(2) Remove any remaining stored substance from the UST.
(3) Remove NAPL from wells and/or the UST excavation to the maximum extent practical.
(4) Prevent further migration of the released substance into surrounding soil and groundwater.
(5) Mitigate any fire or safety hazards posed by vapors or NAPL that has migrated from the release area to subsurface structures, such as sewers, utilities, or basements.
(6) Remedy hazards posed by contaminated soils that are excavated or exposed as a result of release confirmation, investigation, or abatement.

6. Written Reporting Requirements

Within five working days of detecting an unauthorized release, the UST owner or operator must submit a written report to DEH that describes the nature and volume of the release and any corrective measures taken to control the release. At unauthorized release sites where

NAPL is removed from the subsurface soil or groundwater, a NAPL removal report should be prepared in accordance with CCR, Title 23, Article 5, Section 2655, and submitted to DEH.

DEH evaluates all available reports and information concerning a reported unauthorized release and determines the need for further corrective action. If DEH finds that further corrective action is necessary, the UST owner and/or operator, as well as other identified RPs, is issued a Notice of Responsibility letter. This letter specifies the financial and corrective action responsibilities of each RP. Along with the Notice of Responsibility, the "UST Unauthorized Release Report/Contamination Site Report" (State of California Form HSC 05) (see Appendix D.I) is sent with a request that this report be completed and submitted to DEH within five working days of receipt. Additional reports will be required at intervals specified by DEH.

7. Responsible Party

Title 23, Article 11, Section 2720 of the CCR defines responsible party (RP) to mean one or more of the following:

a. Any person who owns or operates a UST used for the storage of any hazardous substance

b. In the case of a UST no longer in use, any person who owned or operated the UST immediately before the discontinuation of its use

c. Any owner of property where an unauthorized release of a hazardous substance from a UST has occurred

d. Any person who had or has control over a UST at the time of or following an unauthorized release of a hazardous substance

8. Soil and Water Investigation

A soil and water investigation is required where there is evidence that surface water or groundwater resources have been or may be affected, where NAPL has been found, where there is an increased risk of fire or explosion, or when the regulatory agency requests an investigation based on these factors. This investigation begins the second phase of the corrective process defined in Article 11 as the Soil and Water Investigation Phase. For further information concerning the requirements for site assessments and soil and water investigations, see Section 4 and Section 5 of this Manual.

B. Non-UST Sites

Contamination of soil and groundwater resulting from sources other than a UST must be reported to the San Diego RWQCB. The RWQCB will provide regulatory oversight and direct corrective action at these sites, unless the RP requests assistance from DEH, and the RWQCB agrees to transfer oversight responsibility to DEH. Because of staff limitations, the RWQCB commonly authorizes DEH to oversee corrective action at certain sites on their behalf. To request DEH oversight assistance, including review of workplans and reports, the RP must complete a Voluntary Assistance Program application and agree to reimburse DEH for staff time expended. The “Voluntary Assistance Program Application for Assistance” must be approved by the

RWQCB. This application can be found at DEH's website at http://www.sdcounty.ca.gov/deh/water/sam_voluntary_assistance_program.html.

Knowing and complying with all reporting and disclosure requirements can be a challenge for those involved. Some reporting and disclosure requirements are summarized below. These requirements are not intended to be a substitute for applicable laws and regulations, and may not be complete.

The following agencies should be contacted immediately whenever a spill or release of a hazardous substance has occurred that has the potential for off-site public health and safety and/or environmental consequences:

- State Office of Emergency Services (OES)
- Local Fire Department (Ask for Fire Marshall)
- Department of Environmental Health (DEH)
- Regional Water Quality Control Board (RWQCB)

The following reporting requirements should be considered by RPs, property owners, business owners, and anyone who causes or threatens to cause a release or discharge of a hazardous substance, as well as those who discover contamination on property they control.

1. Federal Reporting Requirements

Contact Federal EPA for current reporting requirements.

2. State Reporting Requirements

Contact CAL EPA for current reporting requirements.

3. Local Reporting Requirements

a. Regional Water Quality Control Board (RWQCB)

The California Water Quality Control Act (California Water Code), Division 7, Chapter 4, Article 5, Section 13304(a) requires anyone who causes or threatens to cause a waste to be discharged into the waters of the state to take all necessary remedial action to clean up that waste. Additionally, Section 13305(f) of the California Water Code makes the owner of the property on which the condition exists responsible for all reasonable costs incurred by the RWQCB or any city, county, or public agency in abating that discharge.

Additionally, Section 13271(b) of the Water Quality Control Act states that:

"Any person who, without regard to intent or negligence, causes or permits a hazardous substance or sewage to be discharged or deposited where it is, or probably will be, discharged in or on any waters of the state, shall, as soon as (1) that person has knowledge of the discharge, (2) notification is possible, and (3) notification can be provided without substantially impeding cleanup or other emergency measures, immediately notify the Office of Emergency Services of the discharge in accordance with the spill reporting provision of the state toxic disaster contingency plan adopted pursuant to Article 3.7 (commencing with Section 8574.7) of Chapter 7 of Division 1 of Title 2 of the Government Code and immediately notify the state board or the appropriate regional board of the discharge. The state board or the regional board shall list all notifications received by them pursuant to this section in the minutes of the next business meeting and shall provide a copy of the minutes to the appropriate local health officials."

DEH and the San Diego RWQCB work closely on most contamination cases in San Diego County. The discovery of any discharge of a hazardous substance to surface water and/or groundwater must be reported to the RWQCB.

b. Local Building/Planning Department Requirements

In many cases construction activity and building occupancy can proceed concurrently with corrective action and cleanup verification. However, appropriate concern for public health and safety needs to be evaluated. Experience has shown that construction activities often interfere with adequate site investigation, corrective actions, and cleanup verification. Consequently, DEH will recommend disapproval of present or future site usage involving building/construction, and will recommend disapproval of any City building/planning permits, until the following items have been addressed:

- The proposed construction activity and structures must not interfere with the necessary site investigation, corrective action, and cleanup verification;

- Existing or residual contaminated soil and/or groundwater must not pose a threat to public health during construction activities, nor to occupants of proposed structures once complete.

c. Real Estate Transfer

Various laws and regulations require the disclosure of known contamination and/or hazardous conditions that are known to exist prior to any transfer of property. Section 25359.7(a) of the California Health and Safety Code states in part that:

"Any owner of a non residential real property who knows or has reasonable cause to believe, that any release of a hazardous substance has come to be located on or beneath that real property shall prior to sale, lease, or rental of the real property by that owner, give written notice of that condition to each buyer, lessee, or renter of the real property."

In This Section:

Section 4 Site Assessment Process

I. INTRODUCTION

A site assessment is a comprehensive environmental investigation. Site assessments typically include contaminant characterization, sampling of soil and groundwater, investigation of the site's lithologic and hydrogeologic conditions, and identification of man-made subsurface structures and sensitive environmental receptors. Sufficient knowledge of the site's history and existing uses provides an essential framework for conducting a comprehensive environmental investigation. Ultimately, the information gathered during a site assessment is presented in a site conceptual model, which is also known as a site assessment report.

II. SITE ASSESSMENT OBJECTIVES

A site assessment should accomplish the following objectives:

- Characterize the types of contaminants present at the site
- Develop a comprehensive understanding of site geology and hydrogeology
- Delineate the extent and distribution of contamination within the subsurface environment
- Characterize the actual and potential migration paths of the subsurface contamination
- Identify and assess the actual and potential adverse effects to public health and the environment

For sites contaminated by an unauthorized release from an underground storage tank (UST), the site assessment and corrective action process that is defined in the California Code of Regulations (CCR), Title 23, Division 3, Chapter 16, Article 11, must be followed. According to Article 11, a "soil and water investigation" must be completed where there is evidence that surface water or groundwater has been or may be affected by an unauthorized release from a UST system. The soil and water investigation phase includes the following activities:

- Collecting and analyzing data necessary to assess the nature and the horizontal and vertical extent of the release, as well as determining a cost-effective method of cleanup, and

- Using the information obtained during the investigation to propose a Corrective Action Plan (CAP). A CAP consists of activities that are determined to be cost-effective, that will protect human health, safety, and the environment, and that will restore or protect current or potential beneficial uses of water.

The site assessment requirements and guidelines herein apply to investigations at all contaminated sites where the San Diego County Department of Environmental Health (DEH) is providing oversight for site assessment and site cleanup. For UST unauthorized release sites, the requirements of the soil and water investigation phase will be met by following the site assessment requirements and by completing and submitting to DEH a comprehensive Site Assessment Report and a CAP.

In general, DEH recommends that sites contaminated by something other than UST releases should follow the corrective action process outlined in Article 11 referenced above. Figure 4-1 on the next page provides a general overview of the corrective action process.

III. WORKPLANS

DEH requests that a workplan be submitted for review and comment prior to initiation of the site investigation work at any contaminated site where DEH is providing oversight. This practice will streamline the investigation by making sure the Responsible Party (RP), consultant, and regulator understand the information required in that phase of work.

All corrective action in San Diego County should to be completed under an approved workplan. Workplans are required for the following activities:

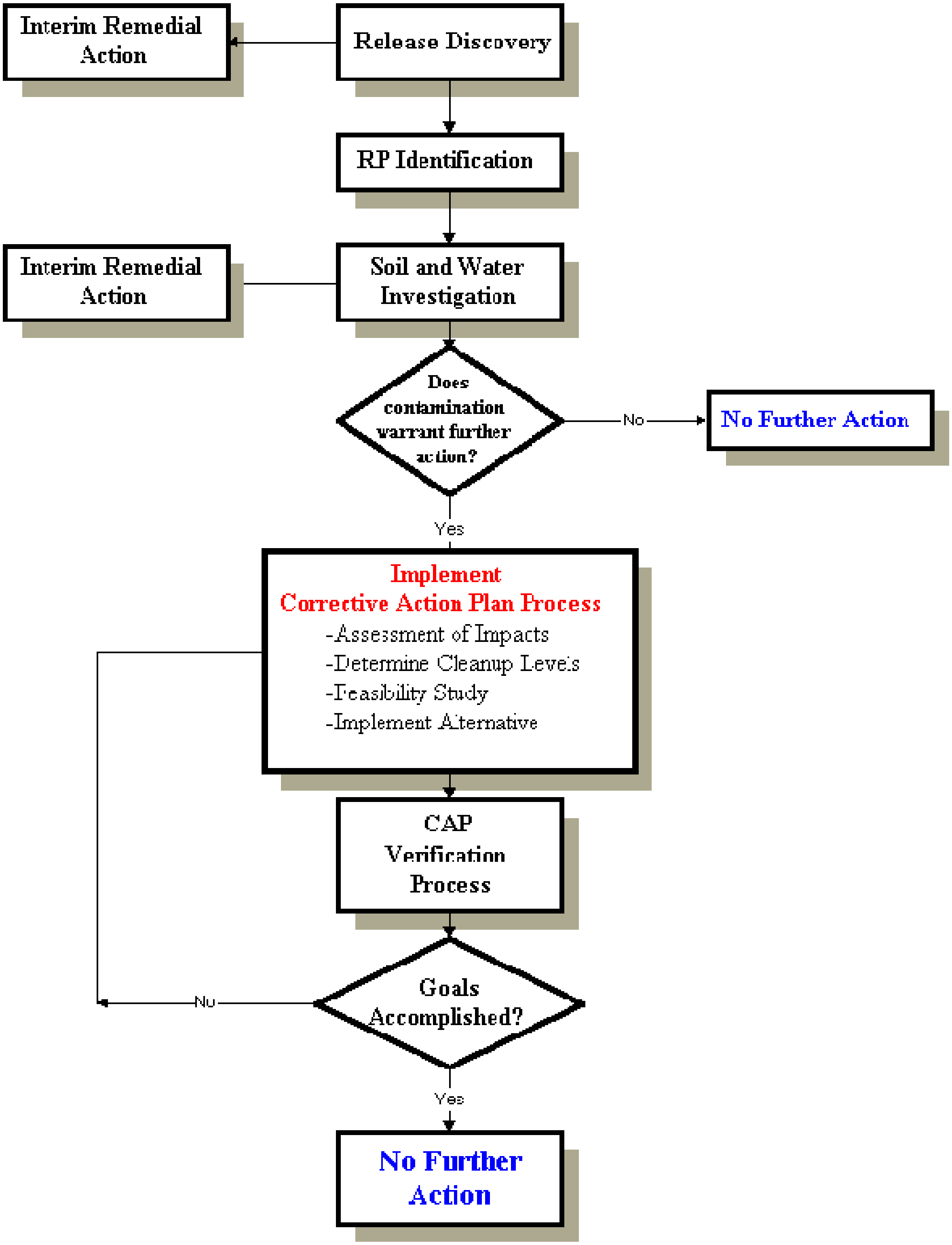
- Post tank removal corrective actions
- Interim remedial actions
- Preliminary site assessments
- Soil and groundwater investigations
- Corrective action plans
- Verification monitoring programs

A workplan must be submitted for review and comment prior to initiation of site investigation or remediation work at any contaminated site. Section 2722 of Article 11, CCR Title 23, requires that a workplan be submitted to the local regulatory agency (DEH) prior to implementing any phase of corrective action associated with regulated UST systems. DEH staff will respond to workplans in writing within 60 days after receipt or the workplan is automatically approved. A workplan that is disapproved must be modified as necessary at the direction of DEH staff.

Where possible, workplans should reference relevant sections of this Manual rather than restating information from the existing guidelines. A workplan should address the items discussed below. A Community Health and Safety Plan may also be a necessary part of the workplan. Refer to Section 4.IV for a discussion of community health and safety issues which may be appropriate. Depending on the type of activity planned, modification of an existing Stormwater Pollution Prevention Plan (SWPPP) or preparation of a new SWPPP may also be required. Information regarding SWPPP requirements is provided in Appendix N. Contact the DEH specialist assigned to the specific case to discuss proposed work that may require a Community Health and Safety Plan.

FIGURE 4-1

CORRECTIVE ACTION PROCESS



A. Purpose and Scope of Proposed Work

1. Narrative

The narrative section includes site identification, DEH case number, and current site conditions. Provide a brief description of the objective(s) of the proposed work and how the proposed work will accomplish the objective(s).

2. Illustrations

Provide clear illustrations to document the location and area of the site, current site conditions, and the proposed work. Include locations of existing features (e.g., utilities, wells, excavations, UST systems, adjacent property uses) location of proposed work (monitoring wells, borings, trenches, and/or excavations), and the horizontal/vertical extent of known contamination as determined from previous site investigation work.

B. Description of Proposed Work

The following information is required in the description of proposed work.

1. This is a description of the work to be performed (soil excavation/trenching, installation of soil borings and/or monitoring wells, etc.). Provide the following specific information as appropriate.

   a. Drilling method, soil sampling interval, and anticipated total depth of soil boring(s)

   b. Anticipated total depth and screened interval of monitoring well(s)

   c. The estimated extent of proposed excavation(s) and/or exploratory trenches, and the estimated volume of soil to be excavated

   (Note: Well permits must be obtained prior to drilling on-site.)

2. Include a description of the sampling strategy and protocol to be followed in the field. Indicate the laboratory analyses (along with federal/state method number) to be performed on the soil and/or groundwater samples collected. For soil samples, also indicate the sample extraction procedure followed by the laboratory. Regulatory acceptance of the analytical results from proposed laboratory methods not included in US EPA SW-846, or sanctioned by the California EPA, must have prior approval of DEH.

3. Include a description of the protocol to be followed for preservation and transport of soil and/or groundwater samples (Section 5.VI). Discuss procedures to be used for decontamination of sampling equipment.

   (Note: Items 4, 5, and 6 below should be used as needed)

4. Include a description of how contaminated soil and/or groundwater will be managed on-site and off-site. If stockpiled containerized soils and/or drums of contaminated liquid are to be

stored on-site, identify the storage locations on a site plot plan and describe how these materials will be marked/labeled and safely managed at the site (Section 5.XI).

5. Provide the name, address, telephone number, and contact name for the site where contaminated soils and/or liquids will be transported for treatment/disposal. Provide a time schedule for removal of waste(s) and contaminated media. Wastes must be properly disposed at off-site treatment/disposal facilities. Documentation (manifests, receipts) must be provided to DEH to demonstrate proper treatment and disposal of any contaminated wastes.

6. Provide a description of the protocol used to sample and characterize contaminated soil stockpiles for disposal (Section 5.XI). Alternative on-site uses of contaminated soils, which will not impact public health or the environment, may also be proposed to DEH staff.

7. Provide a description of the stormwater management practices to be implemented on-site. If a stormwater pollution prevention plan (SWPPP) has been prepared for the site, attach it to the workplan. If a SWPPP has not been prepared complete the Stormwater Management Practices Standard Project Form (Table N-3) included in Appendix N and attach it to the workplan. Ensure that at a minimum the stormwater management practices information provided includes a description of the activities to be addressed (drilling, soil stockpiles, etc.); best management practices (BMPs) to be implemented; and monitoring to be implemented to ensure proper application and maintenance of BMPs. Include the location of BMPs on a site map or other illustrations used in the site workplan as appropriate. Common stormwater symbols for use on site maps are included as Figure N-2 at the end of the Appendix N. See Appendix N for more detailed information.

IV. Schedule of Proposed Work

Provide a detailed schedule for implementation and completion of proposed work.

V. Interim Remedial Actions

Appropriate methods for interim remedial actions are specified in the regulations for corrective action (CCR Title 23, Division 3, Chapter 16, Article 11, Section 2722). The minimum information that must be included for a description of any proposed interim remedial action(s) is listed in Section 7.V.

IV. COMMUNITY HEALTH AND SAFETY PLAN

DEH has the responsibility to promote a safe and healthy environment for the public in areas where soils and other materials contaminated with hazardous substances are excavated, removed, or handled. It is the legal responsibility of property owners, RPs, contractors, and consultants to conduct all on-site activities so as not to create public health and safety hazards or nuisances. Every precaution must be taken to prevent impacts to the surrounding community. RPs (and their consultants and contractors) are expected to comply with applicable fire, health and safety, building, and construction laws and regulations.

To promote public health and safety, corrective actions must be performed in accordance with a site-specific Community Health and Safety Plan (Plan) that has been approved by DEH. A Plan must be submitted as part of any workplan.

The primary objective of the Plan is to promote a safe and healthy environment for the public by:

- Minimizing community exposures to hazards from site activities and/or releases which may migrate off-site, and
- Assuring community awareness.

The Plan should be developed in close coordination with the RPs. All persons conducting on-site activities should be familiar with the content and responsibilities described in the Plan. The community (or public) refers to anyone who is not an RP for the release and/or is not conducting specific activities relative to the site investigation or remediation.

DEH is committed to reviewing and commenting on Plans in a timely manner. Other agencies, such as local fire departments, may also require review and approval of a Plan prior to starting any site activities.

Please be advised that DEH has no authority to regulate worker health and safety. While there are similarities between a "worker health and safety plan" and a Community Health and Safety Plan, one should not be substituted for the other, and both should be kept separate. Do not submit "worker health and safety plans" to DEH. They are not required by DEH and will not be reviewed by DEH.

A Plan should adequately address the following topics. If any of the following informational requirements are not relevant to the work being proposed, please state that fact clearly in the Plan. While this section discusses a Plan as though it were a stand-alone document, it may actually be incorporated into a workplan, depending on the scope of work performed.

A. Site Identification and Location

Provide the DEH case number, site name, address, and assessor's parcel number (APN).

B. Plot Plan

Provide a detailed plot plan that identifies all on-site and surrounding structures, topography, prevailing wind directions, all surrounding land uses, nearby populations, and environments and/or receptors of special concern.

C. Evaluation of Potential Public Exposure to Hazards

Provide a description of the potential public health hazards and exposure pathways resulting from site activities, including vapors, dust, noise, fires, explosions, and physical hazards. Consider both immediate and long-term hazards.

D. Monitoring Equipment

Provide a description of site monitoring equipment and protocol to be used. Choose equipment that is capable of detecting the hazard of concern within an acceptable margin of error. In general, DEH suggests that fugitive organic chemical vapors be monitored with an Organic Vapor Analyzer (OVA) or equivalent along the entire site perimeter at 15-minute intervals. At most

UST sites involving petroleum, a reading of 25 parts per million (ppm) or greater on an OVA or equivalent device at the down-wind perimeter of the site is the recommended level for taking corrective measures. The OVA, or equivalent device, must be calibrated in accordance with manufacturer specifications. Monitoring records must be maintained and made available for on-site review at the request of DEH or other local agencies.

E. Control Methods

Provide a discussion of the administrative and/or engineering controls that will be implemented to prevent or minimize public exposure to hazards. Control methods are necessary to prohibit public access, prevent fugitive dust and vapors, and reduce noise.

1. Site Security

Describe the method(s) that will be used to exclude the public from, or limit public access to, the work area and the site in general.

2. Vapors

Describe the method(s) that will be used to minimize public exposure to potential vapor emissions resulting from the proposed activities. Engineering and construction practices can typically reduce such emissions. Acceptable control methods include pumping out non-aqueous phase liquids (NAPL), covering off-gassing excavations or stockpiles, backfilling off-gassing excavations, using off-gassing stockpiles as backfill, misting excavations or stockpiles with water, covering excavations or stockpiles with foam or other vapor suppressing agents, locating stockpiles away from and/or downwind of public receptors, and stopping work.

3. Dust

Describe the method(s) that will be used to minimize potential public exposure to dust generated as a result of the proposed activities. Control methods include covering sources, misting sources with water, reducing the pace of site activities, and halting activities altogether.

4. Noise

List the hours during which site activities will be performed or during which equipment will be operating. Every effort should be made to minimize noise. Noise standards are generally enforced from 7 p.m. to 7 a.m. weekdays, depending on the city and zoning. Noise standards may be even stricter during the weekend.

5. Open Excavations

Discuss the management of any excavations that may result from the proposed activities. Open excavations present a clear risk to the community. It is important to have adequate site security. Even with the best site security, DEH recommends that excavations be backfilled at the end of the workday. If not immediately backfilled, open excavations should be completely and securely fenced off to prevent public access. If the excavation is filled with waste liquid (petroleum or a combination of petroleum and water), the liquid must be pumped out before the excavation is backfilled.

6. Stockpiled Soil

Discuss the soil management procedures. Discuss the proposed disposition of the soil and the time frame during which final disposition will occur. Stockpiled soil should be handled and stored in accordance with Section 7.VI. Stockpiled soil should be contained within berms and covered to prevent runoff and vapor and dust exposures. Stockpiled soil should be stored in a secured area of the site to prevent public access.

7. BMPs

Describe what controls will be implemented at the site to prevent or minimize the transport of pollutants to receiving waters. Also describe how the controls will be maintained during active or inactive phases of the proposed work.

F. Site Safety Manager

Provide the name and telephone number of a site safety manager who will be available 24 hours a day and who will have the knowledge and authority necessary to shut down all on-site activities in the event of an emergency. In the event of a sudden release of a substance, the site safety manager must initiate the immediate cessation of all site activity contributing to the release. The site safety manager is also responsible for notifying the appropriate emergency response agencies as well as DEH.

G. Emergency Planning

Provide a description of the methods and equipment that will be used to address possible community emergency situations. The ponding of a flammable or combustible substance, and the build-up of explosive concentrations of vapors, are two examples of community emergency situations that must be addressed.

H. Public Notification

Provide a description of the Public Notification Program. The program should include the preparation and distribution of notices to residences and businesses adjacent to, or in the vicinity of, potential impacts from the site or area where work is being performed. Notices must also be posted around the perimeter of the site. At a minimum, the notification should contain the following information:

1. List the name and 24-hour telephone number of the site safety manager. Also list the name(s) and 24-hour phone number(s) of the person(s) to contact regarding problems (i.e., odors, dust, and noise). The consultant or RP is typically listed as the primary contact.

2. Provide a brief description of the proposed activities.

3. Provide the dates and times that the work will be conducted and an estimate of when the work will be completed.

4. Include any requisite Proposition 65 warnings. Proposition 65 (Section 25249.6 of the Health and Safety Code) requires that a warning be given to any individual who is exposed to a chemical known to cause cancer. Check the current Proposition 65 list for chemicals requiring such warnings.

V. SITE INVESTIGATIONS

The primary goal in a site investigation is to characterize a site or release to assess the extent, concentration, and mass of contamination; to assess the human health and environmental risk resulting from the contamination; and to provide recommendations for any further investigation or remedial actions.

It is important to identify likely receptors that may be impacted by the release. These receptors should be considered early on in the investigation planning process. The probable scenarios would include the migration of light non-aqueous phase liquid (LNAPL), dense non-aqueous phase liquid (DNAPL), and/or dissolved phase contamination into various receptors, such as the capture zone of a commercial or domestic water supply well, or an environmental receptor such as a creek or the ocean. The potential for vapor phase migration from soil or groundwater into an overlying structure should also be assessed.

Workplans should include provisions to collect information that will be required to properly implement a remedial plan, to perform a risk-based closure, or to recommend no further action. Site assessments should consider the most probable remedial options and provide for the collection of sufficient geotechnical and other samples/analyses to provide information to implement the desired remedial option and/or risk-based decision option.

For some sites, the appropriate remedial action may consist of natural attenuation if sensitive receptors are not threatened, if remediation options are excessively expensive, and if there is a high probability of reaching target cleanup levels in a reasonable time. The monitoring-only option, if applicable, must be supported with sufficient site characterization to:

- Assess the site stratigraphy and hydrogeologic setting,
- Assess receptors and pathways, and
- Conduct fate and transport modeling.

Site assessment efforts to define the extent of immiscible liquid contamination (LNAPL and/or DNAPL) may or may not be required, depending on the nature of the release, site conditions, receptors, and pathways. If it is impracticable to remediate the entire site, selected contaminant removal actions in LNAPL- and/or DNAPL-contaminated areas may be the preferred approach. In any event, the goal of site activities is to implement a comprehensive plan that will allow for an appropriate assessment of the extent of contamination and the identification and mitigation of future risk to the public and the environment.

When modeling programs are used, sensitive model output parameters should be identified before the data are collected. A few analyses that can be useful are grain-size distribution, porosity, degree of saturation, bulk density, total organic carbon, and permeability. Analyzing soil and groundwater samples for physical properties can reduce the need for additional site investigation.

Site characterization is an ongoing, iterative process. The investigation approach is dependent on the type of contamination being investigated. Since a chemical's behavior in the environment can vary significantly, we have provided a summary on the investigative approach for fuel, chlorinated solvents, metals, pesticides, and burn ash-contaminated sites.

A. Fuel-Contaminated Sites

Petroleum hydrocarbons are the most commonly used group of chemicals in society today. Petroleum hydrocarbons encompass a wide range of compounds including, but not limited to, fuels, oils, paints and non-chlorinated solvents. These compounds are used in all facets of modern life.

The investigation of sites that are suspected to be or that have been impacted by petroleum hydrocarbons should focus on what are considered to be the source areas at the site. The investigation needs to address both soil and groundwater contamination.

Due to the physical properties of petroleum hydrocarbons, contamination is commonly limited to shallow groundwater aquifers and generally has limited vertical impacts. Since petroleum hydrocarbons have a specific gravity that is less than that of water, they tend to float as an immiscible liquid (LNAPL) on the water table and/or on the capillary fringe of an unconfined aquifer. The vertical migration of dissolved contamination is uncommon except on sites located in groundwater recharge areas or where production wells are located.

Traditionally, an inside-out strategy has been used for the investigation of most fuel-contaminated sites. Drilling is typically done in source areas first, and then the lateral extent of contamination is determined. This type of strategy should not be used when dealing with chlorinated hydrocarbon releases.

B. Chlorinated Hydrocarbon Contaminated Sites

The most prevalent groundwater contamination problems with waste disposal sites in the United States are caused by a specific subset of halogenated hydrocarbons, known as chlorinated hydrocarbon compounds (CHCs). CHCs are uncharged, non-polar compounds that are good solvents for similar substances such as oils, greases, and paints. CHCs are commonly used in many commercial businesses, such as factories, storage operations, transport operations, electronics manufacturers, metal products manufacturing, and dry cleaners.

CHC releases to the environment behave differently than petroleum hydrocarbon releases due to their different physical properties. Because of this, an investigation of a site that is potentially impacted by CHCs is generally more complex than a typical petroleum hydrocarbon release site, and requires careful design. A thorough knowledge of the historical use of CHCs on and around the site is critical for a sound site investigation. The investigation should focus on those areas where materials were used, treated, stored and/or disposed. However, the determination of a contaminant source can be difficult, as the age and location of releases may not be well defined or documented.

1. Behavior in the Environment

Given the physical properties of CHCs, the conventional approaches to investigate petroleum hydrocarbon sites are not appropriate. Since CHCs have specific gravity values greater than water, they tend to sink through the groundwater column as a dense non-aqueous phase liquid (DNAPLs) and may vertically impact more than one aquifer. In addition to the individual chemical's physical characteristics, the physical properties and continuity of subsurface soil and geologic materials also govern subsurface migration. Recognizing the higher potential for migration, particularly vertical migration, the development of a comprehensive understanding of site stratigraphy and hydrogeology is essential.

Continuous coring and careful geologic logging are important aspects of identifying the locations of lithologic changes and determining their continuity. Due to the mobility of CHCs, the coring activities should include soils and geologic materials above and below the water table. Grain-size analyses should also be performed on representative samples to confirm field identification of lithologic units. Where layers of low permeability are encountered, it is important to identify their horizontal extent and continuity as well as their direction of dip, when possible. Because CHC migration can be driven more by gravity than by groundwater flow, dipping low permeability lithologies can cause DNAPL to migrate in unexpected directions. In this way, dipping discontinuities can create migration pathways that do not follow the groundwater flow patterns.

Investigations in fractured igneous or metamorphic rock terrain, which is common in San Diego County, are even more complex. Fractured subsurface materials provide conduits for direct and rapid groundwater and contaminant movement. Fractured rock aquifers are among the most difficult to characterize. As a result, they require more intensive investigations. Consequently, the focus of any investigation should be to obtain sufficient site information to make informed decisions on any risk assessment or remedial strategy that might be applied to the site.

2. Investigative Precautions

When the source area is being investigated, appropriate precautions should be taken to prevent the investigation process from causing a vertical mobilization of DNAPL contamination. Non-intrusive methods should be used first to develop and improve the site conceptual model and the probability of the presence of DNAPL. For investigating groundwater impacts at CHC-impacted sites, the best approach is the “outside-in” strategy. This strategy consists of drilling outside of source areas first to evaluate the site's geology and its stratigraphic relationships.

The drilling of exploratory borings or installation of monitoring wells in the DNAPL-impacted zones can exacerbate the migration of DNAPL in the environment. The drilling method used and the construction of the wells can increase the potential for downward migration of DNAPL or dissolved CHCs. Appropriate drilling techniques and well construction must be used to prevent this from occurring. Improper destruction of wells or borings may also provide vertical conduits. Without adequate precautions, the site characterization activities that include drilling, well construction, groundwater sampling, aquifer testing, and packer testing may cause DNAPL migration, thus increasing remediation costs (Mercer and Cohen, 1993).

Actual observation of DNAPL in monitoring wells has been relatively rare. Monitoring wells must be specifically located and designed to retain DNAPL that flows into the well. The determination of the presence of DNAPL should be based on core analyses, groundwater concentrations, and observation of DNAPL in monitoring wells. Since DNAPL can desiccate clay minerals, the exclusive use of clay seals is not recommended. Additionally, the use of plastic (polyvinyl chloride or PVC) well casing is not recommended, as PVC breaks down in the presence of DNAPL.

The workplan for investigation of areas where DNAPL is suspected should specify the drilling techniques and grouting methods that will be used to prevent downward migration of DNAPL. Drilling in DNAPL-impacted areas should be discontinued when DNAPL is first encountered or when a low permeability unit is encountered. If deeper drilling is required, cased wells should be installed to prevent downward migration of DNAPL. Specially designed monitoring wells should be installed to facilitate accumulation and collection of DNAPL (Niemeyer et al., 1993).

3. Site Investigation

A number of aspects of conducting an investigation of a CHC release differ markedly from those of a petroleum hydrocarbon investigation. Many of these differences stem from the behavior of CHCs in the subsurface. The migration patterns of CHCs vary significantly in the saturated zone. CHC releases tend to have poorly defined sources and result in less predictable soil contamination plumes.

The investigation of sites in San Diego County generally has shown low concentrations of CHCs in soil, and erratic distribution of contamination. This has been primarily because sampling has been done in areas away from the source and CHCs tend to move in narrowly defined paths through porous soil. Due to the difficulty in obtaining reliable soil samples, it is unclear how much sampling is adequate to accurately characterize soil impacts. Due to the variability of soil data, most of the time it is best to define the soil impacts qualitatively as “present” or “absent.”

At sites that were initially investigated because of a petroleum hydrocarbon release, soil sampling for CHCs is not recommended. Efforts should instead focus on the investigation of groundwater by using both the existing wells installed for the petroleum hydrocarbon investigation and wells tailored for a CHC assessment. Once the groundwater impact is characterized sufficiently to allow for speculation about the source of the impact at the site, attempts to backtrack soil contamination to a source may be useful.

For the sites where a known or suspected source exists, limited soil sampling should be performed to verify if any significant residual soil contamination exists in the vadose zone below the known or suspected source. Sampling would not necessarily follow the same frequency or distribution as in a petroleum hydrocarbon investigation, because of the smaller signature CHCs tend to leave behind in soil. Additionally, in the absence of a groundwater impact, extensive vertical sampling may not be required.

If groundwater contamination is suspected, a “qualitative” assessment of groundwater conditions (use of depth-discrete sampling devices [e.g., Hydropunch™-type devices]) should precede a more comprehensive approach. This approach is best used at sites where there are no previously confirmed CHC impacts to groundwater. During installation of the wells and/or exploratory borings, continuous cores should be obtained to assist in defining site lithology and aid in the final well construction design.

Assuming that contamination in the vadose zone will eventually reach groundwater, it may be necessary to install one or more monitoring well(s). If the groundwater has not been impacted, it may be necessary to continue monitoring for an extended period of time to ensure that CHCs do not reach the groundwater. Fate and transport studies may help define how long such monitoring is necessary. Caution should be exercised in using transport models for the vadose zone, since they have been unreliable.

If the groundwater is contaminated with CHCs, this does not necessarily indicate that the CHCs originated from the suspect site. Groundwater is often found impacted with CHCs at low concentrations in urbanized areas. Groundwater samples may have to be obtained up-gradient of the site to determine if the contamination originates on- or off-site. A thorough site history, as in Phase I reports, can help to locate potential CHC release areas. A detailed history should be obtained at the start of a CHC site investigation. Secondary inputs to groundwater, such as from sewer line leaks, must also be considered.

Technology to effectively clean up most CHC releases to current regulatory levels, such as the maximum contaminant levels (MCLs), is limited. Consequently, investigation of the extent of the release showing where CHCs are present and where possible future receptors are located may be necessary to predict where/when point source treatment might be required. A detailed assessment, beyond simply finding and monitoring the boundaries of the plume, provides the ability to manage and perhaps contain the spread of contamination, even if the site cannot be remediated to a final solution (e.g., MCLs).

C. Metal Contaminated Sites

The investigation of a suspected metal contamination site needs to be designed to identify and address all areas where these materials were stored, handled, and/or processed. Attention should be given to historic uses and processes on the site. The investigation should include the full spectrum of materials used so that potential impacts are understood.

The most complicated issue relative to investigation of metal contamination is the analysis of metals for the Total Threshold Limit Concentration (TTLC) or the Soluble Threshold Limit Concentration (STLC). These are described in CCR, Title 22, Article 2. In general, an STLC analysis should be completed when the TTLC result is 10% greater than the STLC action level.

D. Pesticide Contaminated Sites

The investigation of suspected pesticide contamination should be designed to identify and address all areas where the materials were stored, handled, and mixed. In addition, the historic methods of application used on the fields and the type of crops that were grown should be identified. The investigation must include the full spectrum of chemicals used so the potential impacts are well understood.

Investigation of pesticide impacts on properties has become common due to the change of agricultural lands to residential use. The investigation and any remedial actions related to pesticide contamination should focus on elimination of human or environmental exposure.

The most complicated issue relative to pesticide-contaminated sites is the definition of a hazardous waste. Even though the concentrations in soil may exceed the Title 22 levels for a hazardous waste, legally applied pesticides, and the resulting in situ residues in soil, are not regulated as hazardous waste unless transported off the subject property (Calif. H&S Code Section 25117).

It is often necessary to conduct both a site assessment and a risk assessment to adequately evaluate the risk to human health from pesticide impacts.

E. Burn Ash Contaminated Sites

Numerous burn sites exist in San Diego County. These sites are from the time when open burning was the primary method used to dispose of solid waste. This method was used mostly from 1940 to the late 1960s. Unfortunately, the records on these sites and their existence are poor at best.

Burn ash residues exist at many of these sites and at sites where ash was ultimately moved and disposed. Without appropriate care, burn ash and burn ash-contaminated soil have a potential for causing public health and environmental impacts. The primary pathways for public health and environmental impacts include dust migration, surface erosion, and groundwater and surface water contamination.

Ash from the open burning of municipal solid waste is the most common, but not the only, source of burn ash. Historically, most solid waste was burned at municipal burn dumps; however, open burning and low temperature incineration did occur with specific commercial waste streams, which were often disposed at the business location. Ash from these sites could have very different characteristics from ash from municipal solid waste. It was common for the burn ash to be commingled with other solid wastes, including incompletely burned refuse.

Environmental issues and concerns about the management of burn ash sites are numerous. Certain chemical constituents become absorbed and/or chemically bonded to ash particles and, if disturbed, have the potential for dust migration. These chemical contaminants commonly include metals and various organic contaminants including polychlorinated dibenzodioxins and polychlorinated dibenzofurans. The organic compounds are typically low in concentration, but metals can exceed California criteria for hazardous waste. Additionally, where solid waste is commingled with burn ash, biological decomposition may result in the generation of flammable and toxic gases, as well as liquid leachate containing organic and inorganic contaminants.

Burn ash sites and other solid waste issues are regulated by DEH's Local Enforcement Agency (LEA), the Regional Water Quality Control Board (RWQCB), and the California Integrated Waste Management Board (CIWMB). Please refer to Appendix E.III for the most recent guidance developed by the CIWMB. Contact the LEA (619-338-2222) for further information.

VI. SITE ASSESSMENT REPORT CHECKLIST

Site assessment results must be documented in a comprehensive site conceptual model, also known as a site assessment report. This report is not simply a written description of the field and analytical work performed at the site; it must provide complete documentation of the environmental investigation work and a comprehensive evaluation of the findings relevant to the aforementioned site assessment objectives. In addition to a narrative form, the investigation findings should also be presented in maps and cross sections that show the geologic and hydrogeologic conditions and the distribution of contaminants (examples are provided in Appendix F.I). All reports should summarize and interpret the findings as conclusions, and also provide recommendations as to what steps should be taken for future assessment and/or mitigation of the contamination at the site.

> Note: All reports that include geologic, hydrogeologic, contaminant flow, or contaminant migration interpretation must be prepared by, or under the direct supervision of, a California Professional Geologist, Certified Hydrogeologist, Certified Engineering Geologist, or Registered Civil Engineer. This professional must take full responsibility for the content of the report by signing and/or stamping it with his/her professional seal. Registered Environmental Assessors are not qualified to prepare site assessment reports, because proper interpretation of geological and/or hydrological data is required.

Each of the topics outlined below must be addressed in a site assessment report. If a topic is not applicable, provide an explanation. The report does not have to follow the order of the checklist. Reports must be "stand-alone" documents written in a narrative form; do not use the checklist as a "fill-in-the-blanks" form.

A. Site Identification

1. Site address (street name and number, city, state, zip code)
2. Name of business at site
3. Assessor's parcel number (APN)
4. DEH Case Number (e.g., H21042-001)
5. Responsible parties (property owner UST owner, and UST operator) (name and mailing address)
6. Contact persons for responsible parties and consultant (name, mailing address and phone number)
7. Location maps

B. Site History/Development/Usage

1. Historical site use (including potential sources of contamination and dates)
2. Current site use (including potential sources of contamination and dates)
3. Future site use and development plans (type of use, new construction, below-grade structures, proposed excavation work, elevator shafts, vaults, utility trenches)
4. Adjacent site uses
5. Description of release
   a. Substance(s) released
   b. Contaminant characterization
   c. Quantity of substance(s) released (estimate)
   d. How and when release occurred
   e. Location of release on site

C. Site Plot Plan

1. Drawn to scale (indicate scale used)
2. North direction arrow
3. Streets, structures, and utilities
4. Excavation and stockpile locations
5. UST and piping locations (past, existing, proposed)

6. Well, boring, and sample locations
7. Legend for symbols and abbreviations

D. Geology

1. Local geology description
2. Site geology description
3. Topography

E. Hydrology

1. Surface drainage and surface-water bodies in vicinity
2. RWQCB basin plan hydrographic unit and subunit identification

F. Hydrogeology

1. Groundwater elevation measurements and depth to groundwater
2. Groundwater gradient and direction of groundwater flow
3. Description of all groundwater aquifers
4. Known or probable contaminant migration patterns (consider hydrogeology, groundwater gradient, utility trenches location and depth, etc.)
5. Source of information

G. Delineation of Contamination

1. Summary table(s) of analytical data with sample identification, depth, location, analysis method(s), and results
2. Map(s) showing horizontal extent of soil contamination, probable contamination sources, contaminant migration pathways, well and boring locations, sample locations, and sample results
3. Cross sections showing vertical and horizontal extent of soil contamination, contamination source(s), lithology, water table, sample locations, sample results, and underground structures
4. Map(s) showing horizontal extent of groundwater contamination, well locations, sample results, product thickness in wells, groundwater elevation in wells, groundwater elevation contours, and groundwater flow directions
5. Environmental parameters or man-made features which may affect the spread of contamination
6. Estimated volume of contaminated soil and/or water
5. Estimated mass of contaminant in soil and/or water

H. Exposure Concerns

1. Contaminant migration pathways description
2. Man-made pathways (conduits, utilities, vaults, piping, storm drains, etc.)
3. Natural pathways (air, soil, surface water, bedrock fractures, groundwater, etc.)
4. Impact on biological receptors (people, plants, animals)
5. Potential nuisance complaints (odors, eyesore)
6. Risk assessment concepts and calculations

7. Identify all production and potable water supply wells within 2250 feet of the site by means of area site reconnaissance, California Department of Water Resources (DWR) records, Land and Water Quality Division permit review, GeoTracker website and other pertinent sources.

I. Sampling

1. Protocol description (basis for sampling)
2. Methods
3. Preservation and transport
4. Analyses performed
5. Chain-of-custody forms
6. Sample matrix description (clay, sand, water)
7. Laboratory analytical reports
6. Quality assurance/quality control data
7. Interpretation of analytical results with respect to previous and current understanding of site

J. Stockpiled Soil Management

1. Volume
2. Location
3. Methods used to prevent aeration, run-off, and public access
4. Disposal methods
5. Copies of manifests

K. Site Safety

1. Site safety/security description
2. Community health and safety issues addressed
3. Monitoring equipment
4. Protective equipment
5. Public agency notifications
6. Utility notifications

L. Stormwater Pollution Prevention Plan (SWPPP)

Describe what controls will be implemented at the site to prevent or minimize the transport of pollutants to receiving waters. Also describe how the controls will be maintained during active or inactive phases of the proposed work.

M. Summary/Conclusions/Recommendations

1. Horizontal and vertical extent of soil and groundwater contamination defined
2. Recommendations for additional assessment
3. Recommendations for mitigation alternatives

N. Signature/Registration

1. Signature(s) of report preparer(s)

2. Signature(s) and registration number(s) of the registered professional(s) who supervised and is responsible for designated portions of the report
3. Authorized signature for the company preparing the report (original signatures required; no draft or unsigned reports)

O. Appendices

1. Well/boring logs
2. Hazardous waste manifests and disposal receipts
3. Permits (Air Pollution Control District, fire department, wells, etc.)
4. Laboratory data sheets
5. Chain-of-custody forms
6. Backup supporting documentation, including calculations, notes, photographs, etc., as appropriate

In This Section:

Section 5 Site Investigation Techniques

I. INTRODUCTION

Consistent and appropriate site investigation techniques must be used to ensure that accurate, reliable, and representative data are collected during the site assessment process. The following guidance is provided to establish standardized methods and procedures for the investigation, testing, and interpretation of geology, hydrogeology, and contaminant mobility. This section is not intended to duplicate well-established methods and procedures, but to establish minimum standards for proper investigation techniques at a contaminated site.

The investigation techniques include soil and rock sampling, soil vapor sampling, direct measurement of vapor flux, groundwater sampling, laboratory analysis, and stockpile sampling. Additional guidance on standard field and laboratory methods can also be found in many textbooks, government agency documents, and professional society publications.

II. BORING AND WELL PERMITS

Permits are required for all groundwater, vadose wells, cathodic protection wells, and for many exploratory borings (San Diego County Code, Title 6, Division 4). Standards for well construction, destruction, reconstruction, or repair are as stated in California Department of Water Resources Bulletins 74-81 and 74-90. More specific boring and well construction standards are presented in Appendix B.IV. An explanation of permit requirements is provided below. Completed permit applications must be submitted to the San Diego County Department of Environmental Health (DEH), Monitoring Well Program (MWP) and approval must be received before drilling can begin.

In San Diego County, wells include:

- Community supply wells,
- Individual domestic wells,
- Commercial supply wells,
- Industrial supply wells,
- Agricultural supply wells,
- Cathodic protection wells,
- Groundwater monitoring wells (observation wells and piezometers),
- Groundwater remediation wells,
- Vadose monitoring wells, (vapor wells, gas monitoring wells, vapor probes),
- Vapor extraction/inlet wells, and

- Borings (test holes, auger holes, driven test holes, cone penetrometer test holes, Site Characterization and Analysis Penetrometer System [SCAPS] test holes, geotechnical borings, etc.).
- Geothermal Heat Exchange Wells
- Enhanced Leak Detection (ELD) Probes

A. Permit Requirements

1. Groundwater, Vadose, and Cathodic Protection Wells

Well permits are required for any groundwater, vadose, or cathodic protection well installation regardless of how the well is installed. Dewatering wells require a permit if they will be used beyond the initial construction phase. Information on the construction and destruction methods and specific permitting requirements for cathodic protection wells can be found on the San Diego County website at the MWP webpage:

http://www.sdcounty.ca.gov/deh/water/sam_monitoring_well_page.html

2. Enhanced Leak Detection (ELD) Probes

ELD is used to monitor new and existing underground and above ground storage tanks and associated pipelines for vapor and liquid leaks. All vertical vapor probes installed after underground and above ground tanks and pipelines are in operation require a permit. For details about permitting and construction requirements, refer to Appendix B.

3. Exploratory or Test Borings and Geotechnical Borings

Well permits are required on all sites for:

- Any boring in which a casing will be installed
- Any boring that has a monitoring device installed
- Any soil boring greater than 20 feet in depth
- Any soil boring, 20 feet or less in depth, where the groundwater table is anticipated to be encountered

A permit for geotechnical borings may be waived after review of information on the location of the borings by the MWP. Waivers are considered only for areas where hazardous waste or hazardous materials have not been stored, are not now stored, are not proposed to be stored or areas where soil and groundwater contamination is not known or suspected. Submit a waiver request (available at the above referenced webpage) along with a detailed site map and a description of the proposed work to assist the MWP in the evaluation.

4. Well Destruction

Well permits are required for the destruction of any groundwater, vadose, or cathodic protection well unless the well is destroyed within the life of the permit.

5. Well Reconstruction

Well permits are required for reconstruction of any groundwater, vadose, or cathodic protection well. A reconstruction is defined as an alteration to a well beyond minor modifications to the surface completion above the bentonite layer. Minor modifications may be completed without a permit but must be approved by the MWP before work begins.

B. Permit Application

Submit one original complete “Permit Application for Groundwater and Vadose Monitoring Wells and Exploratory or Test Borings” (well/boring application), detailed site plan, additional supporting documents (if required), and the appropriate fees to the Monitoring Well Permit Desk. A copy of the well/boring application is available in Appendix B.II and on the above webpage. The MWP will not process the application until all fees are submitted. The application must have original signatures of both the driller and the Professional Geologist (PG), Registered Civil Engineer (RCE), Certified Engineering Geologist (CEG), or Certified Hydrogeologist (CHG) in responsible charge of the work. Please allow seven to ten (7 to 10) working days after a complete application package is received for processing and review.

If an incomplete application is submitted, the permit application may be returned. The approved permit will be emailed to the contact person indicated in the application and the driller.

1. Application for Groundwater Monitoring Well Construction, Destruction, and Borings

Complete the “Permit Application for Groundwater and Vadose Monitoring Wells and Exploratory or Test Borings.” The following information must be included on the application.

a. Assessor’s parcel number (APN)
b. Current property owner
c. C57 driller's information (all work must be done by a properly California licensed driller with a bond to work in San Diego County.)
d. Licensed Geologist or Civil Engineer on project
e. Number of wells (or borings) to be constructed or destroyed
f. Well type
g. Drilling method
h. Proposed materials to be used
i. Proposed well construction or for well destructions, a copy of the well “as built” diagram or well construction permit number(s)
j. Driller’s signature (must have original signature)
k. Original signature of Professional Geologist (PG), Registered Civil Engineer (RCE), Certified Engineering Geologist (CEG), or Certified Hydrogeologist (CHG) for wells and borings. The driller’s signature must be provided for well destructions.
l. Evidence of a $7,500 bond, posted with the County of San Diego, Department of Environmental Health
m. Detailed site plan (drawn to scale) showing the location of the proposed well(s) and/or boring(s) and the location of existing wells. The plan must show the location of existing improvements, such as structures, underground storage tanks (USTs), and underground utilities. An adequate vicinity map is also required to show the site location in relation to the surrounding area.

n. Supporting documents:
- Applications for traffic control permits, and encroachment/excavation permits for work in the public right-of-way
- A Property Owner Consent (POC) form is required on applications for all work except: onsite, open LOP site assessment cases (SAM is lead agency), Caltrans property and Military property.

2. Application for Cathodic Protection Wells and ELD Probes

All of the above information is required with the exception that only a driller's signature is required.

3. Fees

To be accepted by the MWP, a well/boring application must be submitted with the appropriate fees. The current permit fees are detailed on page three of the application that is provided on the monitoring well webpage.

4. Refund of Permit Fees

If you did not complete the original scope of work for the permit issued, submit a written request to the Monitoring Well Permit Desk for a refund of the appropriate portion of the unused fees. Your request must be received within 30 days after the expiration date of the permit. A fee will be deducted from the refund to cover the processing and the technical review of the permit.

2. Permit Extensions

A permit is valid for 120 days. It may be extended for an additional 120 days for the purpose of completing the original scope of work. Two extensions may be requested for 120 days each for the purpose of completing the original scope of work.

Submit a written request for an extension to the Monitoring Well Permit Desk before the expiration date, along with an extension fee. Contact the Monitoring Well Desk for the amount of the fee as it is based on the Environmental Health Technician hourly rate. The maximum term of a permit cannot exceed 360 days.

3. Permit Modifications

Permit modifications will be granted if the Monitoring Well Permit Desk is notified at the time of initial drilling activities that further work is needed. We will require a written request for a modification, including the additional fees and a revised site map to be submitted to our office within five (5) business days. If it is determined after the initial drilling that additional work is necessary, a new application must be submitted.

C. Inspections

1. Drilling Inspections

The Monitoring Well Permit Desk must be given 48 hours notice prior to commencement of drilling activity. MWP staff conduct random on-site drilling inspections. These inspections are to observe field activities and to ensure that all work is being completed in compliance with the current local and state requirements.

2. Well Completion Inspections

a. MWP staff will perform inspections of all sites that have groundwater, vadose, or cathodic protection wells, or where these wells have been destroyed, to determine if the wells were completed or destroyed in accordance with current local and state standards and to observe the long- term maintenance of the well(s).

b. Inspection reports will be issued when it is observed that monitoring wells or cathodic protection wells are not being maintained and/or they present a potential public health hazard or environmental hazard.

3. Re-inspections

While inspecting drilling sites, DEH staff may discover that the scheduled drilling operations were cancelled. If the DEH Monitoring Well Permit Desk has not been properly notified of a drilling cancellation, and staff travels to a site to conduct an inspection, a re-inspection fee may be required. Contact the Monitoring Well Permit Desk at (619) 338-2339 for any drilling activity, including cancellations.

No additional fees are charged for the initial inspection. A re-inspection fee will be required for each subsequent re-inspection unless satisfactory proof of compliance, such as photos, has been provided to MWP staff. Subsequent non-compliance will result in an Official Notice to attend an office conference and further enforcement action.

D. Drilling Bond

Prior to obtaining a permit to drill, the licensed driller must have a $7,500 bond posted with DEH. This bond can either be a cash bond or an insurance performance bond. For details concerning drilling bonds, call (858) 565-5173.

E. Permit Conditions

1. Workplans

An approved drilling permit application does not constitute an approved workplan as defined in CCR Title 23, Article 11, Section 2722.

2. DEH Notification

The consultant/driller must notify the Monitoring Well Permit Desk 48 hours before the date of drilling. Additionally, the consultant/driller must also notify the Monitoring Well Permit Desk of any cancellation or rescheduling of drilling. Call (619) 338-2339 for all scheduled drilling, cancellations, or rescheduling.

3. 60-Day Drilling Report Submission

Within 60 days after construction or destruction of wells, or drilling of borings, a drilling report with the following information must be submitted to the MWP. The drilling report must be sent directly to the County of San Diego, Department of Environmental Health, Site Assessment and Mitigation Program, Monitoring Well Permit Desk, P. O. Box 129261, San Diego, CA 92112-9261.

a. For wells and borings, provide:

(1) Location and identification of property by:

- Site name and address
- Assessor's parcel number
- Establishment number (H#), if any
- Well permit number

(2) A detailed plot plan drawn to scale showing location of site and nearest cross streets, property boundary lines, existing improvements such as USTs, piping, and/or utilities, and the location of all wells and borings, both existing and proposed.

(3) A detailed log for each well/boring describing the density, moisture content, color, grain size distribution, and character of all lithologic units penetrated. The log must include:

- Depth of first groundwater
- Static water level in the completed well(s)
- Date of measurement
- Field vapor readings
- Dates of drilling initiation and completion

(4) A detailed "as-built" well construction diagram with well/boring diameter, type of casing, screened interval, screen slot size, type of filter pack, location and type of seals, surveyed well elevations and locations, and volumes of materials used (cubic feet) for each well/boring or a statement that they were sealed in accordance with State and Local guidelines. Surveying must be performed by an appropriately licensed professional and meet the accuracy requirements of CCR Title 12, Section 2729-2729.1.

(5) A grain-size analysis of the lithologic unit or units that represent soils adjacent to the perforated portion of the well, if performed.

(6) All laboratory analysis data and chain of custody if there is no current DEH, RWQCB or DTSC site assessment case.

(7) All well construction and boring reports must have the original signature of the registered professional and/or their seal as required by the Business and Professions Code. The PG, CEG, RCE, or CHG, who signed the permit application, is responsible for the accuracy and completeness of the logs and accompanying data

(8) The name of the drilling company who completed the work

b. For Well Destruction

(1) Provide a detailed site plan, as outlined in Section 5.II.E.4.a. (2), drawn to scale, and giving accurate locations of all wells and borings with well identification numbers.

(2) Include the location of the site by:

- Site name and address
- Assessor's parcel number
- Well permit number and/or establishment number

(3) Documentation of well destruction includes:

- Description of the method of destruction including auger size
- Description of the type of sealing materials and volume of materials used (cubic feet)
- Date the work was started and the date the work was completed
- The name of the drilling company who completed the work.

4. Storage of Drill Cuttings and Groundwater

a. Drum Labeling

Temporary drum storage of contaminated drill cuttings (soil) or groundwater requires proper labeling.

(1) If the drill cuttings or groundwater is a hazardous waste, a hazardous waste label must be properly completed and affixed to drums. All hazardous waste must be managed, stored, and disposed in accordance with all applicable hazardous waste laws and regulations.

(2) If the drill cuttings (soil) or the groundwater is not suspected of being contaminated (e.g., awaiting laboratory results), the drums must be clearly marked with the following information.

- Description of contents (e.g., soil, water)
- Boring identification
- Date of boring
- Consulting company name
- 24-Hour contact phone number

b. Drum Storage

All drums must be labeled and stored within a secure area. Drums containing hazardous waste must be removed within 90 days. Minimum stormwater requirements must be met according to Appendix N.

F. Well and Boring Standards

Please refer to Appendix B.II for local standards on well construction, well reconstruction, and well and boring destruction. Additionally, San Diego County requires all work to comply with the Department of Water Resources Bulletins 74-81 and 74-90.

III. SOIL AND ROCK SAMPLING

A. Geologic Observations and Interpretations

Understanding the geology at a site is critical in designing and implementing site assessment and remediation programs. Observations of soil and rock types encountered during site investigations should be integrated with all site findings and correlated with the local geologic environment.

Consider the following items to improve your understanding of the site.

- Review of existing geologic information from all available sources such as:

  - Published geologic maps and reports,
  - Personal or company experience in the site vicinity,
  - Reference material at local university libraries,
  - Site investigation and assessment reports prepared by environmental consultants on file with governmental agencies such as DEH, RWQCB, building departments, GeoTracker or others.

- Review of aerial photographs
- Review of topographic maps
- Observation of road cuts, excavations, and other exposures in the site vicinity
- Drilling one or more soil boring(s) using continuous coring methods

It is important to understand the local geologic environment to interpret the significance of changes in soil and rock types encountered in excavations and boreholes at the site.

Field observations, chemical analytical data, presence of groundwater, and presence of free product should be detailed in boring logs and trench logs. The depth and thickness of perched water or zones with non-aqueous phase liquid (NAPL) above the water table should be logged, sampled, and reported on the boring logs. Drilling generates cuttings that can be logged and interpreted to describe the underlying rock type and geologic structure. An interpretation should be made between fill and native soil, and should include an identification of the fill and native soil contact. Furthermore, all soil and fill materials should be described by using a soil classification system. Rocks and geologic formations should be described by using an appropriate rock classification system, such as ASTM.

A list of the observations that should be made and noted on field logs is presented in Table 5-1. Note that additional field descriptions for soils may be made depending on grain size. A key must be submitted with all boring logs. A list of field description guides is available in Appendix I.II, under *Technical References*.

An PG, CEG, RCE, or CHG who is registered with, or certified by, the State of California must log all soil and rock materials. A trained and experienced technician working under the direct supervision and review of one of these registered professionals shall be deemed qualified, provided this professional assumes responsibility for the accuracy and completeness of the logs. In addition, all work and reports that require geologic or engineering evaluations and/or judgments must be performed under the direction of an appropriately registered or certified professional. The registered professional must sign all reports containing such information.

TABLE 5-1: FIELD DESCRIPTIONS FOR SOIL AND ROCK

DESCRIPTIONS	(1) SOIL	(2) SEDIMENTARY
Classification System	USCS	List system used
Classification	ML, SW, CL, etc. Specify fill or native soil.	Sandstone, siltstone, conglomerate
Distribution/Abundance of Grain Size	Relative (include maximum Particle size)	Relative (include maximum particle size)
Minerals	Optional	List most abundant to least abundant
Color	Munsell Color Chart	Munsell Color Chart
Moisture Content/Saturation	Relative	Relative
Odor	Optional	Optional
OVA Readings	Optional	Optional
Contaminant Discoloration	As present	As present
Natural Organics	As present	As present
Plasticity	Degree of	Degree of
Visible Porosity	As applicable	As applicable
Blow Counts	As applicable	As applicable
Density (field)	Relative	Relative
Induration	Optional	Relative
Cementation	As present (type and degree)	As present (type and degree)
Weathering	Not applicable	Degree of
Fossil Assemblages or Trace Fossils	As present	As present
Texture/Structure	Grain shape(s) layers/laminations	Bed thickness, laminations, sorting, packing, grain shape(s), fracturing or folding, etc.
Other Observations	As present	As present

TABLE 5-1 (cont.): FIELD DESCRIPTIONS FOR SOIL AND ROCK

DESCRIPTIONS	(3) IGNEOUS	(4) METAMORPHIC
Classification System	List system used	List system used
Classification	Diorite, monzonite, gabbro, dacite, basalt, etc.	Schist, gneiss, quartzite, mylonite, etc.
Minerals	List most abundant to least abundant	List most abundant to least abundant
Particle/Grain Size Distribution	Relative (include maximum particle size)	Relative (include maximum particle size)
Color	Munsell Color Chart	Munsell Color Chart
Moisture Content/Saturation	Relative	Relative
Odor	Optional	Optional
OVA Readings	Optional	Optional
Contaminant Discoloration	As present	As present
Natural Organics	Not applicable, unless in fractures	Not applicable, unless in fractures
Visible Porosity	As applicable	As applicable
Blow Counts	As applicable	As applicable
Density (field)	Relative	Relative
Induration	Relative	Relative
Weathering	Degree of	Degree of
Fossil Assemblages or Trace Fossils	Not applicable	As present (remnant)
Texture	Euhedral to anhedral, equigranular to porphyritic, vesicular to scoriaceous, crystalline or glassy, etc.	Lineations, foliation, cleavage, cataclastic to mylonitic, etc.
Structure	Size and density of fractures, faulting, folding, cleavage, etc.	Size and density of fractures, faulting, folding, cleavage, etc.
Other Observations	As present	As present

Site geology controls the migration of contaminants. An understanding of soil and rock types within their geologic framework allows for better determination of the location of additional soil borings and monitoring wells, should further assessment or monitoring of subsurface contamination be necessary. Graphical presentations such as geologic cross sections are essential to illustrate interpreted changes in soil and rock types (refer to Appendix F.I for examples of site maps and geologic cross sections). Site-specific geologic information is necessary to evaluate and design remediation programs and to perform fate and transport studies.

B. Sample Collection

The goal of the site assessment is to determine the nature and extent of contamination. The quality and integrity of samples, sample locations, and other field observations will strongly influence interpretation of site conditions. Sample collection, management, and analysis must be done in accordance with the procedures specified in:

- CCR Title 22, Division 4.5, Chapter 11, Article 3, Section 66261.20(c), and
- U.S. Environmental Protection Agency document, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Sixth Edition (2007).

Many container types are available for contaminant sampling and/or storage. The contaminant class determines the type of container that is selected. Follow the protocols outlined in EPA SW-846 for selecting the appropriate containers and for determining proper handling and storage requirements. Sleeves or liners are generally used when volatile compounds are present or suspected. Their use, however, may be limited by certain geologic conditions in San Diego County. Non-clear sleeves and liners also limit observations of lithology and the presence or absence of contamination. For these reasons, glass jars with Teflon-lined lids are commonly used. When glass jars are used they should be filled completely to minimize headspace.

C. Sampling to Delineate Contamination

Subsurface sample locations should be guided by the underlying geology, contaminant characteristics, and field conditions to determine the extent and magnitude of contamination. Discrete samples are required to demonstrate delineation of contamination; <u>composite samples will not be accepted</u>. Delineation is generally complete when successive nondetectable levels of contaminants are observed.

Samples have historically been collected at intervals of 5 feet. However, since thin distinct layers of contaminated soil may exist, or changes in lithology that affect contaminant distribution may occur within a 5-foot interval, soil and rock samples should be collected at significant changes in lithology and other locations as necessary, based on field observations of contamination.

Within the capillary fringe and the saturated zone, samples should generally be collected at 1- to 2-foot intervals in order to delineate the "smear zone." For the purpose of this manual, the "smear zone" is defined as soil or rock in the vicinity of the capillary fringe, and below the water table, which contains contaminants in a sorbed or free product phase (light non-aqueous phase liquid or LNAPL). The smear zone develops when the water table fluctuates or is depressed by NAPL. The smear zone will provide a continuing source of groundwater contamination and must be delineated for an effective remediation program to be designed.

Site-specific sampling protocol and sampling strategy must be presented in a workplan (Section 4.III), and should be discussed with DEH staff. Sampling plans often need to be modified during field operations; therefore, details of the sampling and analyses actually performed must be described in the site assessment report.

D. Drilling Techniques for Sample Collection

A number of sample collection techniques are used in subsurface investigations. Determining a suitable approach to sampling will depend upon the site accessibility, underlying lithology, and contaminant type. Driven sampling methods that utilize split-spoon samplers, probe/push-sampling techniques, and continuous coring techniques are preferred because these methods allow collection of samples at precise depths. Samples should be collected at least 6 to 18 inches in advance of the drill bit or auger to ensure that undisturbed native material is obtained.

Because the original borehole depth of grab samples collected from auger flights is uncertain, this sampling technique should only be used when driven-sampler and continuous-coring methods are not feasible. When grab samples are being collected, they should be obtained from the lowest flight of the auger and close to the auger stem. Caving or sloughing of the sides of the borehole in softer sediments may further complicate identification of grab sample depths and should be noted on field logs.

Drilling methods that add water, drilling fluids, or other substances into the boring during drilling may contaminate samples, spread contamination, and interfere with analysis for target compounds. A Material Safety Data Sheet (MSDS) must be obtained from the manufacturer for each drilling fluid or additive used at the site. For percussion drilling and other down-hole devices that require lubrication, a pure vegetable oil or other petroleum-free hydrocarbon lubricant must be used. Any substance introduced into the boring or drilling environment should be sampled for comparison analysis of target compounds if cross-contamination is suspected.

The most common drilling and auguring methods are presented in Table 5-2. Actual site conditions may affect the suitability of these methods. Alternative approaches must be discussed with DEH staff.

TABLE 5-2: SAMPLING TECHNIQUES

METHOD	BEST RESULTS IN	NOT GOOD FOR	OTHER REMARKS
Hollow Stem Auger	Fill, soil, most sediments	Larger cobbles, boulders, hard rock	Good for discrete, in situ samples
Solid Stem Auger (18-24 inch diameter)	Fill, soil, cobbles, consolidated sediments	Cohesionless or saturated soil, boulders, hard rock	Large quantities of spoils; difficult sampling below water table; poor sample integrity
Bucket Auger	Cobble-rich strata, consolidated sediments	Cohesionless or saturated soil, boulders, hard rock	Large quantities of spoils; difficult sampling below water table; poor sample integrity
Probe/Push Samplers (CPT, Strataprobe, Geoprobe or like samplers)	Fill, soil, most sediments, weathered decomposed granite	Gravelly soil, cobbles, boulders, hard rock	Limited sample volume for analysis; limited depth. Doesn't penetrate consolidated soils.
Air Rotary	Any soil or rock	----	Air may volatilize contaminants; air stream must be dual filtered
Air Percussion	Cemented strata, conglomerate, boulders, cobbles, hard rock	Unconsolidated soils and sediments	Air may volatilize contaminants; air stream must be dual filtered
Mud Rotary	Any soil or rock	----	Use only appropriate drilling fluids
Rock or Diamond Coring	Hard rock	Gravels, cobbles, unconsolidated soils	Use face-discharging drill bit designed for environmental purposes
Casing Hammer	Soil, unconsolidated river wash, gravel, cobbles, conglomerate	Hard rock	----
Vibracores	Soft mud and other saturated, unconsolidated or benthic sediments	Consolidated sediments, hard rock	----
Hand Auger	Fill, soil, most sediments	Cobbles, boulders, hard rock	Limited depth
Sonic	Fill, soil, sediments, cobbles, consolidated or cemented strata	Cobbles, boulders, hard rock, or cobbles	Heat generated from drilling may volatilize contaminants

IV. SOIL VAPOR SAMPLING

The following guidelines are for conducting soil vapor sampling in San Diego County. The references used to develop these guidelines are presented in Appendix I.II.E. Other vapor survey standards (e.g. DTSC) may be applicable for a particular application. For cases under DEH jurisdiction, a work plan must be submitted and approved prior to initiation of fieldwork in accordance with Section 6 of this document.

A. Field Data Collection

This section does not provide guidance on indoor air sampling. For such guidance, the reader is referred to the DTSC vapor intrusion guidance, and the ITRC vapor intrusion guidance (www.itrcweb.org).

1. Introduction

Soil vapor surveys can be used for a number of purposes, including the following:

- ***Initial Site Screening***, where the objective is to assess if volatile organic chemicals (VOCs) are present;
- ***Site Assessment/Characterization***, where the objective is to assess the source, extent, and magnitude of impacted soil, groundwater and/or vapor;
- ***Risk Assessments***, where the objective is to assess the risk to public health; safety and the environment;
- ***Remediation and Post-Remediation Monitoring***, where the objective is to assess remediation progress or completion; and
- ***Ongoing Monitoring*** for risk assessment, remediation monitoring, landfill gas monitoring and background methane monitoring.

These guidelines provide information on the following:

- Acceptable methods of sample collection;
- Analysis methods
- Transient and other environmental factors that could affect the outcome of a vapor survey;
- Vapor survey design for a variety of sites including petroleum-related sites, dry cleaners and industrial facility sites, methane testing sites; and
- Documentation, including work plans, field notes and reporting.

2. Overview of Soil Vapor Survey Methods

Three principle methods exist for collecting soil vapor data:

- Active
- Passive
- Flux Chambers

Each method offers advantages and disadvantages that are briefly described below. The design and protocols of a soil vapor survey program are dependent upon the objectives of the program, the types of contaminants anticipated to be present, and the site conditions. There are a variety of sampling methods and equipment designs for collecting soil vapor samples that can potentially yield different values.

Active: The active approach consists of the withdrawal of an aliquot of soil vapor from the subsurface, typically with a sampling probe, followed by analysis of the withdrawn vapor. Analysis is often performed on-site using a variety of analytical instruments. Alternatively, soil vapor samples can be stored in gas-tight containers and analyzed at an off-site laboratory. The active method is quantitative and values are reported in gas concentration units (e.g., parts per million by volume [ppmv], micrograms per liter [μg/L] -vapor). This approach is the most common soil vapor collection method for a number of reasons, including ease of sample collection, opportunity for real-time data to direct further sampling, and the ability to acquire quantitative measurements.

Passive: There are two basis kinds of passive sampling: qualitative and quantitative. Both rely on passive adsorption of VOC vapors from soil over time, which is latter quantified by a laboratory and the mass adsorbed is proportional to the level of contamination. If the uptake rate has been experimentally measured and reported in a scientific publication, the mass adsorbed can be used to calculate a concentration (i.e., quantitative passive sampling): otherwise, the data are either qualitative or semi-quantitative, which can still be useful for delineation, but will generally require verification prior to use in estimating exposure point concentration for a risk assessment.

Flux Chambers: Flux chambers consist of an enclosed chamber that is placed on the surface for a specific period of time. Vapor concentrations are measured in the chamber after a period of time. This method is also quantitative and yields both concentration data in the chamber and flux data (mass/area-time). Flux chambers are the least common soil vapor survey method, and are typically used only for risk-based applications when direct vapor fluxes out of the subsurface are desired.

3. Procedures Which Influence Reported Soil Vapor Data

Soil gases can travel long distances from the contamination source and can potentially be representative of the “general area of contamination.” However, soil gas surveys should be used cautiously. Due to chemical specific characteristics, geologic conditions, and atmospheric influences, soil gas surveys can provide misleading results. Reported soil vapor data can depend greatly upon the collection protocols that are used to generate the data. For this reason, it is important to understand the factors that may influence the reported data. This section presents a description of a number of various factors that influence the reported data for different sampling methods.

a. Active Soil Vapor Surveys

Active Soil Gas Collection Methods

1.1 Probe Installation

Prior to installing soil gas probes care must be taken to locate potential subsurface structures of features such as buried pipes, tanks and electrical lines.

Two techniques are most commonly used to install soil gas probes:

(1) Insertion of a hard rod (probe) to a target depth, collection of soil gas through the rod while it is in the ground and subsequent removal of the rod (Figure 1). This method is commonly referred to as the probe-rod method or sometimes as the temporary probe method (since the probe rods are temporarily in the ground).

(2) Burial of an inert pipe or tube (typically 1/8" to ¼" OD) to a target depth with subsequent sampling of the soil gas. Tubing can be buried in holes created with hand driven rods, direct-push systems, hand-augers, or drill rigs (Figure 2). This method is referred to by several names such as soil vapor monitoring wells, soil gas implants, semi-permanent method (if the tubes are removed after a short period of time) or permanent probe method (if the tubing is left in the ground for a longer period of time).

Both methods have been shown to give reliable, reproducible data (DiGiulio et. al., 2006). The choice of which method to use should depend upon the site, access, and the project goals. Typically, sampling through the probe rod is faster and less likely to disturb the in-situ soil gas, especially for small diameter rods (<0.5" OD). For limited-access areas, a hand-driven probe may be all that is applicable. For deeper depths, probes inserted by direct-push methods are more convenient. If the probe-rod methods are used, samples should be collected through small-diameter inert tubing that runs down the probe rod so the sample does not contact the inside of the probe rod.

For repeated sampling or in low permeability soils, burial of soil gas implants offers advantages (Figure 2). Multiple tubes can be buried in the same hole and are commonly referred to as nested, multi-depth vapor wells (Figure 3). Please note, the shallow probes (3 feet of shallower) should be placed in a separate adjacent hole from the deeper probes. Section 5.3.2 contains an SOP for constructing nested vapor wells.

For both methods, a competent surface seal should be installed to prevent ambient air from infiltrating into the soil gas sample through the insertion hole, especially at shallow sampling depths (<3 feet bgs or below foundation). Detailed protocols for both methods can be found in the standard operating procedures listed in §5.3, in CA-USEPA (2003), API (2005), DiGiulio et al. 2006, and USEPA (2007).

Sample Tubing Type: Three studies have been done to evaluate different types of tubing. Air Toxics (Hayes et. al, 2006) conducted tests of three tubing types (Teflon®, nylon, PEEK) that showed little difference in the tubing type. Low-level blanks were detected in nylon, but the values were far below required soil-gas risk-based screening levels. An earlier study presented at a conference in 2004 (Ouellette, 2004) compared the adsorption of a hydrocarbon standard by five tubing types (Teflon®, nylon, polyethylene, vinyl and flexible tygon). Nylon and Teflon® showed insignificant losses (<10%), but the others showed higher losses, especially the flexible tubing, where losses were up to 80 percent. The EPA (2008) tested 5 types of tubing (Teflon®, nylon, PEEK, polyethylene, & stainless steel). All gave similar results except for polyethylene which was consistently lower.

Polyethylene and flexible tubing (e.g., tygon) should be avoided. For rigid-wall tubing, in practice, the type of tubing is not nearly as important as where the tubing is stored and how it is handled. Any type of tubing can become contaminated and contribute to false positives if it is stored in the back of a truck unsealed or near the truck exhaust.

Sample Spacing: The selection of sampling locations is strongly dependent upon the objectives of the program and the need for adequate coverage. Predetermined and widely spaced grid patterns are most commonly used for reconnaissance work, while closely spaced, irregularly situated locations are commonly used for covering specific source areas. Guidelines on sample spacing for various applications are summarized in Section 5.IV.A.5. of this guidance.

Collection Depth: Collection depths should be chosen to maximize the chances of detecting contamination, yet minimize the effects due to vapor movement, changes in barometric pressure, and surface temperature, or breakthrough of atmospheric air from the surface (refer to Section 5.IV.A.4 for further discussion of these factors). In general, the effects due to these processes are considered to be minimized at depths 3 to 5 feet below the ground surface (bgs) or building foundation. However, some processes such as bioattenuation, oxygen replenishment, and sub-structure flushing will occur primarily in the upper few feet of the vadose zone, so sampling in this zone should not necessarily be precluded. If soil gas data from depths less than 3 feet bgs or below the foundation are collected, additional sampling events may be appropriate to ensure representative values, especially if the measured values yield risks that are near acceptable levels. In such cases, burial of permanent vapor tubes is advised. Guidelines on collection depth for various applications are summarized in Section 5.IV.A.5.

Purge Volume: The sample collection equipment used for active soil vapor surveys has an internal volume that is filled with air or some other inert gas prior to insertion into the ground. This internal volume, often called the dead volume, must be completely purged and filled with soil vapor to ensure that a representative soil vapor sample is collected.

If soil gas implants are installed and probes are sampled the same day as installation, the air volume of the sand pack should also be included in the total system volume.

Different opinions exist on the optimum amount of vapor to be purged. Several published studies are now out that compare soil-gas concentrations collected with purge volumes ranging from 0.5 L to 100 L (DiGiulio et. al, 2006; McAlary & Creamer, 2006, USEPA 2007). The results of these studies, done in relatively coarse-grained soils, show no significant difference in concentrations. However, in finer-grained soils, large volumes are often not possible or difficult to collect. If larger sample volumes are attempted, the potential for leaks around fittings increases and the samples can be less representative.

Since soil vapor data are often interpreted in a relative fashion, it is important that the purge volume be consistent for all samples collected from the same site.

While it is important to collect enough vapor to purge the system, collecting too much vapor can also have drawbacks. The larger the quantity of soil vapor withdrawn, the greater the uncertainty in the location of the collected sample, and in turn, the greater the potential that atmospheric air might have been drawn down the outside of the probe body.

In addition, large purge volumes can create vacuum conditions that cause contaminant partitioning from the soil into the gas phase, which is not representative of in situ soil vapor conditions. Thus, sampling equipment with small internal dead volumes offers advantages over systems with larger dead volumes because the former systems require significantly less vapor to be withdrawn when purging the system.

At a minimum, enough vapor should be withdrawn prior to sample collection to purge the probe and collection system of all ambient air or purge gas (1 purge volume). One to three total system purge volumes are recommended as a minimum default value.

Sample Flow Rate & Applied Vacuum: Many US agencies and DTSC have put a limit on sample flow rate (typically <200 ml/min) because they are concerned that excessive flow might create turbulent flow at the probe tip and influence the soil-gas concentrations. The USEPA (USEPA 2007) actually measured soil-gas concentrations over different flow rates ranging from 100 ml/min to 5000 ml/min in soil gas probes. There was no significant difference in measured soil gas concentration. This suggests that for relatively coarse-grained soils, flow rate does not appear to be an important variable on soil-gas concentrations.

Higher vacuums increase the potential for leaks in the sampling system and for potential desorption of COCs off the soil. Most US agencies & DTSC are requiring applied vacuums at the probe to be less than 10 inches of Hg. A qualitative method to quickly estimate if there is little permeability and too much vaccum is likely to be applied is to hook up a 20cc to 50cc gas-tight, plastic syringe to the probe and pull on the plunder. If the plunger is hard to pull (compare to pulling outside air) or if the plunger is pulled back towards the probe after released, then there is likely too little permeability to get an uncompromised sample.

Equilibration Time: When probes are installed, the in-situ soil gas can be displaced and a period of time is required for the soil gas to re-equilibrate. A recent USEPA study (need reference) showed the following equilibration times were required:

- Sampling through probe rod installed by hand: 30 minutes
- Sampling through probe rod installed with direct push methods: 1 hour
- For probes where tubes are buried in a sandpack in the ground: 8 hours

If rotary drilling or percussion methods are used to emplace the tubes, or if air knifes are used to clear the sample locations, longer periods of time are required for the sand pack to equilibrate with the soil gas. To determine the equilibration time, a test of concentration vs. time can be used to determine when values stabilize. Another method is to purge the soil gas and monitor the soil gas concentration with a portable meter. When the concentrations stabilize, equilibrium is assumed and a sample can be collected for analysis.

Probe Seals: For collection systems with large purge volumes or designed to collect large sample volumes, it is often necessary to seal the probe at the surface. Seals may also be necessary for small volume systems if the soils are extremely porous and the sampling depth close to the surface (less than 3 feet). Most common sealing techniques are to pack the upper contact of the probe and the soil with grout or to use an inflatable seal.

Testing for Leaks : To ensure that valid soil gas samples are collected with no breakthrough of air down the probe rod or through leaks in the sampling train, a tracer compound can be applied at the base of the probe rod or at the top of the buried probe tubing where it contacts the surface and near all connections in the sampling train. Seal integrity is then confirmed by analyzing collected soil gas samples for the applied tracer compound. . Common tracer compounds are gases (e.g., helium, carbon dioxide, SF6, butane) or liquids (freons, isopropanol, hexane). With both methods, an enclosure/ shroud is placed over the probe at the surface, the compound is introduced into the shroud, the concentration in the shroud is measured, and the concentration in the collected soil gas sample is measured. If the tracer compound concentration in the soil gas sample is less than 15% of the concentration of the tracer compound measured in the shroud, the sample is considered leak-free.

The concentration in the shroud and soil gas sample can be measured with portable meters (He, CO2, etc.), or with an on-site lab, or with an off-site lab. Measuring the tracer compound on-site is recommended since it gives the ability to recognize a compromised sample in real-time and re-collected the sample, rather than finding out the sample was compromised after you leave the field.

An alternative method to the shroud method is to apply liquid tracers using paper towels or clean rags. The tracers are easily and quickly supplied at multiple locations (probe, sampling rod, and sampling train) simultaneously.. This method is particularly more suited for sampling through the probe rod since it can be easily applied at the base and top of the rod. However, since the starting concentration under the towel or rag is typically not known, an arbitrary maximum value of 10 ug/L of the tracer compound in the collected soil gas sample is considered as the leak-free threshold (assuming the tracer compound was at it's vapor pressure below the towel, this value would represent <0.1 % of a leak). Values this low can not be easily measured with portable meters so analysis is either done with a mobile laboratory or by an off-site lab. Another disadvantage of this approach is that small leaks (as low as 10 μg/L) can cause a lab to raise their detection levels depending on the tracer compound used, especially if the toxic organic (TO) methods are being used.

Leak Testing the Sampling Train. The sampling train should be tested for leaks by applying a vacuum on to the system from the top of the probe to the location of the ***sampling container. The applied vacuum should hold steady for at least 60 seconds. Alternatively, the sampling train can be put under the sample shroud containing tracer leak compound during sample collection as described previously.***

Probe Decontamination: All external parts should be wiped clean and washed as necessary to remove any soil or contaminant films. The internal vapor pathway should be purged with a minimum of five volumes of air or an inert gas, or replaced, or washed if contamination or water is present in the probe. Probes fitted with internal tubing offer advantages because the internal tubing can simply be replaced.

Systems with Vacuum Pumps: Soil vapor samples from collection systems employing vacuum pumps should be collected on the intake side of the pump to prevent potential contamination from the pump. Further, because the pressure on the intake side of the pump is below atmospheric, soil vapor samples must be collected with appropriate collection devices, such as gas-tight syringes and valves, to ensure that the samples are not diluted by outside air.

Sample Containers & Storage of Samples: While on-site analysis is advantageous to ensure sample integrity, soil vapor samples can be collected and analyzed off-site. To minimize potential effects on the sample integrity, it is recommended that:

- Do not chill samples during storage as is common with soil and water samples. The temperature should not be lower than 40˚ unless ambient temperature fall below 40˚.

- Samples and sample storage should not be left in the direct sunlight.

- For petroleum-hydrocarbons (aliphatics and aromatics) and biogenic gases (methane, carbon dioxide and oxygen), allowable containers include tedlar bags, gas tight vials (glass or stainless steel), polished or passivated steel canisters (Summa), and adsorbant tubes. Recommended maximum storage time in tedlar bags is approximately 2 to 3 days. Storage time in canisters is 14 to 30 days depending upon the COC. If samples are going to be shipped, do not fill a tedlar bag more than 2/3 full.

- For halogenated compounds (e.g., TCE, TCA, PCE), allowable containers include tedlar bags, gas tight vials (glass or stainless steel), polished or passivated steel canisters (Summa), and adsorbant tubes. Storage time in tedlar bags is compound specific but is typically 3 or more days for most of the common halogenated compounds (TCE, TCA, PCE). Recommended maximum storage time in canisters is 14 to 30 days depending upon the COC.

- For samples collected on adsorbants, storage times may be up to 15 days after sample collection depending upon the adsorbant used and COC.

Collection of Soil Vapor Samples with Summa Canisters: Because Summa Canisters generally are large volume containers (1 to 6 liters) under high vacuum, extra care should be exercised during sample collection to ensure that air from the surface is not being inadvertently sampled or that desorption of contaminants from the soil does not take place. To minimize the potential of surface breakthrough, seals around the probe rod at the surface should exist. To minimize the potential desorption of contaminants from the soil, Summa Canisters should between 500 to 1000 ml in size and should be filled at a rate less than 0.2 liters (200 cc) per minute.

b. Passive Soil Vapor Surveys

Sample Spacing: The selection of sampling locations for passive sampling is based upon the same considerations as active soil vapor methods: program objectives and the need for adequate coverage. Predetermined and widely spaced grid patterns are most commonly used for reconnaissance work, while closely spaced, irregularly situated locations are commonly used for covering specific source areas. Guidelines on sample spacing for various applications are summarized in Section 5.IV.A.5.

Collection Depth: Passive surveys are nearly always conducted by burying the collector close to the surface (6 inches to 3 feet). This protocol was developed not for technical reasons, but for convenience in deploying and retrieving the collector. Ideally, similar to active surveys, collectors should be deployed as close to the suspected contamination source as practically possible to minimize the effects of vapor movement. In addition, collectors buried within a couple feet of the surface will be very susceptible to air infiltration due to changes in barometric pressure and surface temperature. If the outside air is contaminated, for example at an active gasoline station or inside of an active dry-cleaning operation, the passive collectors could conceivably adsorb more contamination from infiltration of the surface air than from subsurface contamination. In this situation, it is advisable to bury the collector to deeper depths (greater than 3 feet).

Exposure Period: As with collection depth, the exposure period for passive collectors is generally selected more for convenience factors than for technical reasons. The key assumption that is made when interpreting passive soil vapor data is that each collector is exposed to the same quantity of soil vapor. Thus, passive collectors are typically deployed for the same period of time on a site or the data is normalized based upon the exposure time. Typical exposure times are a few days to two weeks.

In practice, the exposure period for a passive collector should depend upon the concentration of the contaminant of interest and desired detection levels. In areas of suspected high concentration, collectors can be left in the ground for shorter periods (1 to 5 days). In areas of suspected low concentrations, collectors are often left in the ground for two or more weeks. For areas of unknown concentration, the optimum approach is to determine the deployment time by burying a number of collectors in the same location and measuring them over a period of time.

Method Blanks: Since the passive soil vapor method does not enable real-time data, analysis of blanks is extremely important to verify that detected contamination was not from another source, such as the passive collector itself or handling and storage during transport from the site to the laboratory. The only way to evaluate this possibility is to include a method blank and trip blank as part of the sample batch. A method blank consists of an unused collector picked at random from the collector batch. A trip blank is an unused collector that is kept sealed, and accompanies the other collectors to and from the site and to the laboratory for analysis.

c. Surface Flux Chamber Surveys

Sample Spacing: The primary motive of flux chamber surveys is to measure the upward flux of vapor out of the ground or into a room for risk-based purposes. A minimum of three chambers should be deployed in the room or on the ground surface to provide representation of the area of interest and to demonstrate reproducibility. Chambers should preferably be located in areas where surface features suggest possible conduits to the subsurface (e.g., cracks, drains, electrical conduits, etc.). At least one chamber should be deployed in the area of anticipated maximum subsurface contaminant concentration, if identified, from a previous subsurface investigation.

Insertion Depth or Seals: Valid measurements require that the bottom of the chamber be sealed from exchange with atmospheric air. On soil surfaces, chambers are either inserted into the ground to a depth of one or more inches or the chamber flange covered with native soil or sealant. On finished surfaces such as floors, an airtight seal must be made between the chamber bottom and the surface, typically using a gasket or sealant.

Covers: Reflective coverings are sometimes necessary in outside locations to protect against temperature extremes that could create advective flow. Opaque coverings are required to minimize the potential of photo destruction of compounds.

Exposure Period: Chambers should be deployed for a minimum of eight (8) hours, with the exposure period during normal occupancy conditions. Longer exposure times, on the order of 24 hours, are preferred since they give a time-integrated result that is more representative of the actual flux into a surface enclosure.

Number of Samples per Exposure Period: Collection and analysis of multiple samples from a chamber at regular intervals over the deployment period (e.g., every 4 hours) is advised since it allows estimates of precision, allows identification of spurious measurements, and allows any variability in the measured fluxes to be detected.

Sample Containers & Storage of Samples: Refer to Section 5.IV.A.3.a for a description of applicable containers and storage considerations.

4. Temporal Variations and Other Environmental Effects

There have been a number of recent studies on the temporal variation of soil gas concentrations due to common meteorological parameters (Luo et. al., 2006; USEPA 2007;). The results of these studies show that variations in soil gas concentrations at depths 2 feet bgs or deeper due to temperature changes, barometric pressure, and wind speed are typically less than a factor of 2). Seasonal variations in cold climates are generally less than a factor of 5. Concentration variations will be greater the closer the samples are to the surface. For shallower sampling depths (< 2 feet), larger variations can be expected in areas of greater temperature variation and during heavy periods of precipitation.

a. Temperature

Effects on soil gas concentrations due to actual changes in the vadose zone temperature are minimal (USEPA 2007). For sub-foundation soil gas samples, the concentrations may be affected by changes in an overlying building's heating system in cold winters and/or Heating, Ventilation and Air-Conditioning (HVAC) system during the hot summers creating advective flow beneath the foundations.

Seasonal temperature variations are also minimal in southern California, and except for special environments such as the desert and the mountains, are unlikely to create a significant effect on soil vapor concentrations in the vadose zone.

b. Barometric Pressure

Changes in barometric pressure can lead to a pressure gradient between the soil vapor and atmosphere creating a flow of soil vapors out of the vadose zone during barometric lows and into the vadose zone during barometric highs. The potential effects decrease with increasing sampling depth. Recent published studies have shown that variations in soil gas concentrations due to barometric pressure are insignificant (USEPA EPA/600/R-07/141, December 2007)

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d. Precipitation (Rainfall)

Infiltration from rainfall can potentially impact soil vapor concentrations by displacing soil vapor, dissolving volatile organic compounds, and by creating a "cap" above the soil vapor. In practice, infiltration from large storms only penetrates into the soil on the order of inches. Hence soil vapor samples collected at depths greater than 3 feet bgs are unlikely to be significantly affected. Soil vapor samples collected closer to the surface (less than 3 feet) without surface cover may be affected. If the wetting front has penetrated to the sampling zone, it typically can be recognized by difficulty in collecting soil gas samples. If high vacuum readings are encountered when collecting a sample, or drops of moisture are evident in the sampling system or sample a soil gas sample should not be collected. Measurement of % moisture of the soil may also be useful if shallow sampling is performed during or shortly after significant rainfall (e.g., greater than 1 inch).

Soil gas concentrations have been shown to change drastically during periods of extreme precipitation creating a rise in the water table with contaminated water or by creating a clean water lens that prohibits oxygen transport from the atmosphere into the vadose zone. In general, soil vapor sampling should be completed greater than one week following any significant rainfall event.

5. Soil Vapor Survey Design For Specific Types of Sites

This section gives specific guidelines for designing soil vapor surveys for common types of sites.

a. Petroleum Related Sites, Including Underground Storage Tanks

(1) Chemical Specific/Analytical Considerations

Because petroleum products, such as gasoline and diesel, are complex mixtures containing a wide variety of different hydrocarbons, the appropriate analytical measurements depend upon the product type as follows:

- Aromatics (BTEX) and naphthalene: Method 8260, TO-15, or TO-17.
- MTBE and Oxygenates: Method 8260, TO-15, or TO-17
- Methane: The use of gas chromatography method with a flame detector, such as 8015 modified.
- Carbon Dioxide, Oxygen and Nitrogen: The use of gas chromatography (GC) method with a thermal conductivity detector, such as ASTM Method 1945-96. Portable GC meters, if calibrated correctly on day of use, are also allowed for these compounds.
- PAHs: Due to low vapor pressures, these compounds cannot be detected by active soil gas methods (except for naphthalene) and only the lightest ones can be detected by passive soil gas methods.

(2) Site Assessment/Characterization Applications

Certain components of an UST system are more likely to fail than others. For example, the tops of USTs where bungholes or man ways are present, seams in the UST, seams in asphalt or concrete surfaces, and elbows in the piping runs, and dispensers are typical sources of leaks. In addition, the base of the tank pit and associated piping can often be source zones due to the pooling of leaked substances. The sampling program should cover the most likely sources.

Soil Vapor Method: The active soil vapor method is most typically employed. The passive soil vapor method can also be used, especially in locations with limited access and at sites where relatively low concentrations of VOCs are expected.

Sample Location & Spacing: The sampling grid spacing should be sufficiently small to encounter areas of former USTs, piping, dispensers, etc. and any areas of gross contamination. When historical data regarding the layout of a UST system are unavailable, a useful strategy is to collect samples in a grid pattern. For a typical service station, a grid spacing of ~50 feet may be reasonable. For more detailed site assessment/characterization, a sample spacing of 10 to 20 feet is reasonable in the source area.

Collection Depth: Soil vapor samples are typically collected from 5 to 15 feet bgs to assess surface and UST releases. The chosen depth will be dependent upon the suspected source and what is being assessed: soil and/or groundwater. To assess the vertical extent of contamination, collect samples every 5 feet to 10 feet depending upon the depth to groundwater at the location of highest concentration. Typically sample depths shallower than 5 feet will be evaluated on a case-by-case basis.

(3) Health Risk Assessment Program Design

Soil Vapor Method: The active method is most commonly used. Passive soil vapor methods are not applicable since they are non-quantitative. Permanent probes/implants offer the advantage of assessing transient effects that could affect contaminant vapor flux rates. Surface flux chambers may also be used.

Sample Location & Spacing: Enough samples should be collected to allow a representative estimate of the average flux to the base of the existing or future structure. At a minimum, samples should be collected at the location of highest vadose zone contamination near or under the structure and at each corner of the structure (inside if possible, immediately outside if not).

Collection Depth: For active soil vapor programs, samples should initially be collected from 5 feet bgs unless there is reason to suspect shallower contamination. If the calculated risk exceeds allowable levels, a vertical profile of the soil vapor at shallower depths may be appropriate. Samples from shallower depths are more subject to infiltration of surface air and variability due to transient effects. If soil vapor data from depths less than 3 feet bgs are collected, additional sampling events may be appropriate to ensure representative values.

Sample Frequency: Typically, one to twosampling events following installation of the probes are sufficient to assess the risk pathway. In some situations additional sampling events may be appropriate (e.g., for shallow sampling depths).

Use of Tracers and Measurement of the Tracer, Oxygen and Carbon Dioxide is Soil Gas: All samples collected from a depth of 5 feet or shallower should have a tracer applied at the surface to verify that there is a good annular seal. In addition, both oxygen and carbon dioxide should be measured to provide an indication of aerobic/anaerobic conditions.

(4) Post-Remediation Assessment & Contaminant Monitoring

Sample spacing and collection depth will be dependent upon the objective of the monitoring and upon the size of the remediation area. For risk assessment and remediation monitoring, use the respective protocols described previously, but using semi-permanent probes/implants that are sampled multiple times over the course of the project.

(5) Special Considerations for Fuel Sites

Vapor Leaks*:* Subsurface vapor leaks are possible from USTs and piping associated with them (vent pipes, pipe joints, vapor recovery lines, and tank bungs). Such leaks can create situations with no corresponding detectable soil contamination. Soil vapor located near or at the leak may contain concentrations of these compounds. Soil vapor further from the source may contain only some of these compounds due to differences in their physical properties.

Potential Impact of Vapor Contamination on Groundwater*:* Leaking gasoline vapors from a UST are a likely contaminant pathway to groundwater for both MTBE and ethanol due to their high concentrations in the tank vapor and extremely low Henry's Law constants. In contrast, leaking gasoline vapors are an unlikely contaminant pathway to groundwater for the aromatics due to their lower concentrations in the tank vapor and moderate Henry's Law constants. The potential importance of this contaminant pathway increases with decreasing groundwater depth and is particularly acute in locations where the water table is near or above the UST and where the vadose zone is dry. Sampling programs assessing this contaminant pathway should focus on the collection of soil vapor samples vertically through the vadose zone at regular intervals down to groundwater. The concentration profile down to groundwater and concentration at the groundwater interface may enable an estimate of the importance of this pathway.

b. Dry Cleaners & Industrial Facilities with Non-Petroleum VOCs

At industrial facilities, a variety of contaminants, conditions, and potential sources can exist. Many industrial sites contain above ground solvent sources, such as degreasers, clarifiers, storage tanks, ink presses, spray booths, which can leak into the vadose zone. Subsurface sources can include leakage from drains, sumps, pipelines and manufacturing lines. Consequently, a soil vapor survey at an industrial facility should be performed only after a comprehensive historical site review and a thorough site reconnaissance have been performed to establish the potential sources and types of contamination. At dry cleaners sites, soil vapor contamination commonly exists under the washer unit; and soil contamination with corresponding soil vapor contamination commonly exists near liquid release sources such as sumps, drains, storage areas, and other disposal areas.

Vapor Clouds*:* Due to their high vapor pressures and high vapor densities, vapors may emanate from containers or pipes holding gaseous or liquid chlorinated compounds, collect on the floor, penetrate through the slab, and create a zone of contaminated vapor in the vadose zone. Such leaks can create soil vapor contamination with no corresponding detectable soil contamination. Such vapor clouds are commonly found under the washer unit at dry cleaners, under vapor degreasers, and in other above ground confined spaces containing solvents.

Potential Impact of Vapor Contamination on Groundwater*:* Due to their relatively low Henry's Law constants, the potential for vapors leaking from the surface to significantly impact groundwater is low, except in cases of very high soil vapor concentrations (typically greater than 100 μg/L-vapor at the groundwater interface) or in the presence of contaminated soil. Sampling programs assessing this contaminant pathway should focus on the collection of soil vapor samples vertically through the vadose zone down to groundwater. The concentration profile down to groundwater and concentration at the groundwater interface will enable an estimate of the importance of this contaminant pathway.

(1) Chemical-Specific/Analytical Considerations

Chemicals associated with industrial facilities vary depending upon the type of facility, but typically include chlorinated solvents and degreasers, such as methylene chloride, TCA, TCE, PCE, acetone, and methyl ethyl ketone. Not all compounds at a facility may be detectable by soil vapor methods depending upon their vapor pressures. At dry cleaners sites, the primary compound is PCE and its breakdown products/adulterants: vinyl chloride, dichloroethylene (cis & trans 1,2 DCE), and TCE. For quantitative programs, the appropriate analytical methods are 8021, 8260, TO-15, or TO-17. The detection limits, calibration procedures, and other QA/QC criteria should meet the requirements presented in Section 5.IV.B.

(2) Site Assessment/Characterization Applications

Soil Vapor Method: The active soil vapor method is most typically employed. The passive soil vapor method can also be used for site characterization of large areas to isolate smaller areas for active soil vapor sampling.

Sample Location, Spacing, & Depth: A soil vapor survey performed as part of a site assessment and characterization would ideally be performed in a phased approach, starting with a wide spacing between sampling points (50 feet to 100 feet) to obtain an overall assessment of the site (and off-site if necessary) then focusing the sampling in areas of higher contamination to better define its limits (10 feet to 25 feet). Vapor samples should be collected from all potential source areas. Initial sampling depths should be determined by the type of release anticipated:

- Surface and near surface releases: 3 to 5 feet bgs
- Deep releases (e.g., tanks, pipelines): at bottom of tank or pipeline.
- To assess the vertical extent of contamination, collect samples every 5 feet to 10 feet depending upon the depth to groundwater at the location of highest concentration.

(3) Health Risk Assessment

The collection method, sample location, sample spacing, and collection depth criteria are the same as described for fuel sites, with the following exception. For health risk assessments at adjoining rooms/businesses to a dry cleaners active soil gas samples should also be collected either within 1 foot of the base of the slab or subslab to test for the presence of higher soil vapor concentrations caused by preferential transport at the bottom of the slab. Procedures used to collect samples at this shallow depth should ensure that no ambient air is collected.

Sample Frequency: Typically, two to three sampling events following installation of the probes are sufficient to assess the risk pathway. In some situations additional sampling events may be appropriate (e.g., for shallow sampling depths).

Use of Tracers and Measurement of the Tracer, Oxygen and Carbon Dioxide is Soil Gas: All samples collected from a depth of 5 feet or shallower should have a tracer applied at the surface to verify that there is a good annular seal. In addition, both oxygen and carbon dioxide should be measured to provide an indication of aerobic/anaerobic conditions.

(4) Post-Remediation Assessment & Contaminant Monitoring

Sample spacing and collection depth will be dependent upon the objective of the monitoring and upon the size of the remediation area. For risk assessment and remediation monitoring, use the respective protocols described previously, but using semi-permanent probes/implants that are sampled multiple times over the course of the project.

c. Methane Testing

(1) Chemical Specific/Analytical Considerations

Methane is a colorless, odorless gas existing naturally in atmospheric air at a concentration of approximately 2 to 3 ppmv. It is commonly formed in the subsurface from the anaerobic breakdown of organic matter and can reach concentrations in the soil gas exceeding 50% in areas with abundant sources of organic carbon. Sources for methane generation include landfills, swamps and bogs, petroleum reservoirs (oil & gas), farmlands, and areas contaminated by organic matter sources (sewage, petroleum spills, etc.). Methane may also originate from non-biogenic, thermal origins, such as from volcanic sources. Because petroleum reservoirs are unknown in San Diego County, the most likely sources of high methane on a site will be from the degradation of organic matter or from a leak from an existing methane or natural gas line. In areas of known volcanic rocks or thermal activity (e.g., Jacumba), thermogenic sources of methane may contribute. If natural gas lines exist on a site, the local gas company (SDGE) will send personnel to test for leaks.

Analysis Methods: Methane is most commonly measured with either a flame ionization detector (FID) or thermal conductivity detector (TCD). FIDs are approximately 10,000 times more sensitive than a TCD and can detect methane in the low parts per million range. TCDs typically measure methane at concentrations exceeding 1 part per thousand (greater than 1,000 ppmv). Both portable and laboratory-grade instruments exist with these detectors. For applications where quantitative results are desired, the analytical methodology employed is typically gas chromatography (GC). A variety of gas chromatographic methods using the FID & TCD have been developed by the petroleum industry and may be used. EPA Method 8015 modified for methane may also be used. Regardless of the actual analytical method used, the detection limits, calibration procedures, and other QA/QC criteria should meet the requirements presented in Section 5.IV.B.

Soil Vapor Method: Active soil vapor surveys and flux chamber surveys are applicable to methane investigations. Passive soil vapor surveys are not used for methane investigations since methane is not quantitatively absorbed on the passive collector.

(2) Site Assessment/Characterization

Sample spacing: The selection of sampling points is strongly dependent upon the need for adequate coverage and budget. General grid patterns with 50 feet to 100 feet centers are typical for reconnaissance work, while closer spaced, irregularly situated locations (10 feet to 50 feet) are commonly used for covering potential source areas.

Collection depth**:** A nominal collection depth of five (5) feet bgs is generally considered to maximize the chances of detecting contamination yet minimizing the effects due to changes in barometric pressure, temperature, or breakthrough from the surface. Methane is generated under anaerobic conditions, which typically exist at deeper depths in the vadose zone. For source determination, samples should be collected at various depths at the same location to determine the depth of the methane source.

(3) Health Risk Assessment (Upward Vapor Migration)

Potential Risk: The principal health and safety risk posed by methane is the risk of explosion due to concentration build-up in confined spaces such as underground public utility structures (sewage lines, utility trenches & vaults) or above ground structures. The lower explosive limit (LEL) for methane is 5% (50,000 ppmv). The County of San Diego is concerned if concentrations exceeding 10% of the LEL (5,000 ppmv) are detected in the shallow soil gas near existing or proposed aboveground structures.

Sample Location & Spacing*:* Enough samples should be collected to allow a representative estimate of the average flux into the existing or future structure. For commercial sites, a minimum of 4 locations, one on each corner of the footprint, should be initially collected. For larger proposed residential developments, one location per lot is sufficient initially. Additional locations on the footprint or lot are advised if elevated levels (greater than 1,000 ppmv) are found. .

Collection depth: For active soil vapor programs, samples should initially be collected from 5 feet bgs. If significant levels (greater than 1,000 ppmv) are found at this depth, collection of a sample closer to the surface (1 foot to 2 feet) at the same location is advised to document if elevated levels approach the surface. It is also advisable to do vertical profile sampling at deeper depths if significant levels are detected to determine if there is a potential methane source zone below the proposed structure.

(4) Post-Development Assessment and Contaminant Monitoring

For contaminated sites, monitoring of the methane levels immediately below existing or proposed aboveground structures is advised. Refer to the existing County ordinance for specific requirements.

6. Documentation

a. Workplan

A comprehensive workplan should be prepared and submitted for review and approval to the lead agency prior to implementation. Revisions to the work plan may be requested prior to approval. If the work is completed without a workplan or prior to agency involvement, additional investigation may be required to render regulatory decisions related to adequacy of any health risk evaluation or regulatory closure.

The workplan should provide sufficient details, description of site conditions, and identify project objectives so that the lead agency can fully evaluate the proposed work. The work plan should reference the applicable section(s) of the SAM Manual or other guidance documents, rather than restating existing technical guidelines. The work plan should contain the main sections, and address specific issues, pertaining to:

- Health and safety
- Purpose and scope of work planned
- Background information (site history, existing analytical data, etc.)
- Current site conditions, depicting surface features and known buried structures
- Site conceptual model
- Description of proposed work (e.g., sampling strategy and protocol, including sampling technique and analytical methodology, purge rate, sampling frequency)
- Description of the methods to be used to evaluate the integrity of the vapor samples including biogenic gas monitoring, and tracer testing.
- Schedule of proposed work

The type of equipment to be used and/or the contractor planned for the work should be identified. The needed information in the work plan should be presented in a succinct and accurate manner to facilitate the review process, using existing tabular data and clear illustrations as deemed necessary. Existing analytical data should also be presented in tabular form and/or graphically on maps.

b. Field Data

Data acquisition and good field notes are important to document site-specific conditions observed and encountered during the actual vapor sampling and related field work. Such information can/should be used to prepare the written report and other work products (e.g., data tables, maps, etc. as described in Section 5c. below). Accurate and clear field notes, maintained on special forms and work sheets, could be used to further assess site conditions and the findings of the vapor survey. The site-specific types of information that should be acquired in the field and documented include, but should not be limited to:

- Sampling locations (detailed map at an appropriate scale to illustrate the data points)
- Sampling methods and devices, including QA/QC procedures
- Field equipment calibration, detection limits, quantification, and unusual conditions
- Sample identification/designation
- Date and time of sample collection
- Identification of sampling personnel
- Sampling depth (including obstructions encountered), or sampling height
- Known or encountered stratigraphic/lithologic conditions, as applicable
- Apparent soil moisture conditions encountered, as applicable
- Weather conditions
- Sample purge volumes
- Volume of vapor sample extracted
- Analytical method(s)
- Chain of custody records
- Tracers and biogenic gas monitoring

It is recognized that some of the information may be documented/maintained by the contractor (field technician) actually conducting the vapor sampling, if an outside company is used. The field work should be supervised by an appropriately trained and experienced professional.

c. Report Preparation

The components of the summary report should include the items listed in Section 4.VI of this Manual. Some of the items may not be applicable to the particular (site-specific) vapor survey to be performed. For example, information may not be available or understood regarding the lithologic/stratigraphic conditions beneath the concrete slab while conducting a building ventilation survey to assess potential volatile compounds within the enclosed space.

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B. Laboratory Analysis of Soil Gas Samples

This guideline is intended for use whenever soil gas samples are collected for the purpose of conducting a health risk assessment for submittal to Site Assessment and Mitigation (SAM). SAM will not accept a health risk assessment if the associated soil gas samples have not been analyzed and reported in accordance with this guideline.

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 is an accepted site assessment practice. In San Diego County, soil gas concentrations of contaminants, such as benzene, are accepted as input into the SAM Vapor Risk 2000 assessment model for evaluation of potential increased risk to human health from vapor migration into buildings. The SAM Vapor Risk 2000 assessment model is described in the SAM Manual in Section 6 and in the SAM webpage at:

http://www.sdcounty.ca.gov/deh/water/sam_vapor_risk_assessment_2000.html

Since significant decisions are made based on the soil gas data collected at contaminated sites, it is imperative that the soil gas data reported to this agency are consistently of high quality. The following guideline will assist in producing results of high quality.

1. Laboratory Analysis of Soil Gas Samples

a. Primary Target Compounds

Group A - Fuels Target Compounds	
Benzene	Tert-amyl methyl ether (TAME)
Toluene	Ethyl tertiary butyl ether (ETBE)
Xylenes	Tertiary butyl alcohol (TBA)
Ethylbenzene	Tetrachloroethene added as indicator compound
Methyl tertiary butyl ether (MTBE)	Trichloroethene added as indicator compound
Di-isopropyl ether (DIPE)	
Group B - Volatile Halogenated Hydrocarbon Target Compounds	
Chloroform	1,1,1-Trichloroethane
1,1-Dichloroethane	1,1,2-Trichloroethane
1,2-Dichloroethane	Trichloroethene (TCE)
1,1-Dichloroethene	Vinyl chloride
Cis-1,2-Dichloroethene	Trichlorofluoromethane (Freon 11)
Trans-1,2-Dichloroethene	Dichlorodifluoromethane (Freon 12)
Dichloromethane (methylene chloride)	1,1,2-Trichloro-trifluoroethane (Freon 113)
Tetrachloroethene (PCE)	Naphthalene
Group C - Combined Group Target Compounds	
All compounds in Groups A & B	
Methane	

Deviation from these Target Compound Groups may be allowed with prior consultation and approval of the SAM project manager.

b. Other Target Compounds

Analyze for other VOCs based upon site history and conditions.

c. Reporting Limit (RL)

If the SAM vapor risk model is used, the following DLs are appropriate for the target compounds listed.

Compound	Detection Limit
Benzene	0.1 µg/l-vapor
Toluene, Ethylbenzene, and Xylenes	1 µg/l-vapor
MTBE, TAME, DIPE, and ETBE	1 µg/l-vapor
TBA	10 µg/l-vapor
VOCs (except vinyl chloride)	1 µg/l-vapor
Vinyl chloride	0.05 µg/l-vapor
Methane	10 ppmv

Note: these DLs are based on a sample collected at a depth of 1 foot below the interior floor slab of a structure. Determination of site-specific detection levels is allowed but it must be documented how they were determined. Higher DLs may be applicable when samples are collected at greater depths. Lower DLs may be necessary for a risk assessment if another model is used or if sub-slab soil gas samples are collected. In all cases, the DLs must clearly be below the concentration at which the risk is at, or below the one in one million health risk level. DLs in excess of this threshold may require additional testing.

d. Analytical Methods

Allowable methods are EPA Method 8021, 8260, TO-15, T0-17 and for SVOCs, any of the applicable NIOSH or Toxic-Organic (TO) sorbent methods for the compounds of interest. Refer to Table 5-12.

e. Identification of Calibration Standards and Laboratory Control Sample (LCS)

(1) Properly and clearly identify all calibration standards and the LCS.

(2) Prepare the LCS from a standard that is totally independent from the standards used for the initial calibration. A totally independent source means a different supplier (whenever possible) or a different lot from the same supplier. Note: an LCS is also required for method TO-15.

f. Gas Chromatography (GC) and Mass Spectrometry (MS)

(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. For MS detection, resolution of all compounds is not required.

(2) Analyze the initial calibration and daily mid-point calibration check standards, LCS, blank, and samples using the same GC conditions (or e.g., detector, temperature program, etc.).

(3) Use a GC run time that is long enough to identify and quantify all the target compounds.

g. Initial Calibration

The initial calibration must be recorded in Table 5-3.

(1) Perform an initial calibration:

- for all compounds listed in Group A, or B, or C in Section 5.IV.B.1.a;
- when the GC column type is changed;
- when the GC operating conditions have changed; and
- when the daily mid-point calibration check cannot meet the requirement in Section 5.IV.B.1.h.(3).

(2) Include at least five different concentrations of the standard in the initial calibration, with the lowest one not exceeding five times the RL for each compound.

For MS detection, make certain that the mass spectrometer is tuned in accordance with the laboratory's standard protocol prior to the analysis of standards or samples (e.g., a 50-ng injection of 1,4-bromofluorobenzene meets the requirements listed in EPA Method 8260B).

(3) Calculate the response factor (RF) for each compound and the 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 should not exceed 20% except for the following compounds, which should not exceed 30%:

Trichlorofluoromethane (Freon 11)
Dichlorodifluoromethane (Freon 12)
Trichlorotrifluoromethane (Freon 113)
Chloroethane
Vinyl chloride
Tertiary butyl alcohol (TBA)

All target compounds that exceed these requirements must be flagged. Note: for methods TO-15 & TO-17, the %RSD for all target compounds can be up to 30% with two analytes up to 40% RSD.

(4) Verify the true concentration of the standard solutions used with the LCS after each initial calibration. Conduct the verification using an LCS with a mid-point concentration within the initial calibration range. The LCS must include all the target compounds. The RF of each compound should be within ±20% of the initial calibration, except for Freon 11, 12, and 113; chloroethane; vinyl chloride; and TBA; which should all be within ±30% of the initial calibration. Note: for methods TO-15 & TO-17, the %RSD for all target compounds can be up to 35%. All target compounds that exceed these requirements must be flagged. Any compound that exceeds these requirements may be considered invalid for use in health risk evaluations.

TABLE 5-3: SOIL GAS CALIBRATION TABLE

SITE NAME: ____________________ LAB NAME: ________________________________ DATE:

ANALYST: _____________________ INSTRUMENT ID: ______

INITIAL CALIBRATION

STD LOT ID NO.: ________________ NORMAL INJECTION VOLUME: ____________ INJECTION TIME: ___________________

COMPOUND	DETECTOR	1st CONC				2nd CONC				3rd CONC				RF_{ave}	SD_{n-1}	%RSD	ACC RGE
		RT/RRT	MASS/CONC	AREA	RF	RT/RRT	MASS/CONC	AREA	RF	RT/RRT	MASS/CONC	AREA	RF				

-- OR --

COMPOUND	DETECTOR	RT/RRT	MASS/CONC	AREA	RF_{ave}	SD_{n-1}	%RSD	ACC RGE
Compound 1	________	1st Conc .	________	______	______	______	______	______
		2nd Conc	________	______	______	______	______	______
		3rd Conc .	________	______	______	______	______	______
Compound 2	________	1st Conc .	________	______	______	______	______	______
		2nd Conc	________	______	______	______	______	______
		3rd Conc.	________	______	______	______	______	______
(Surrogate)								

DAILY MID-POINT CALIBRATION STANDARD, SOIL GAS LABORATORY CONTROL SAMPLES (LCS) AND CLOSING CALIBRATION.

ANALYST: ______________________________ STD LOT ID NO.: __________________

NORMAL INJECTION VOLUME: _____________ INJECTION TIME: __________________

COMPOUND (SURROGATE)	DETECTOR	RT/RRT	MASS/CONC	AREA	RF	%DIFF	ACC RGE
________	________	______	______	______	______	______	______

h. Daily Mid-point Calibration Check

The daily mid-point calibration check is required before analyses start in the morning. The daily calibration check results should be included in the lab report sent to the client.

(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.

(2) Include the following compounds and **every** compound expected or detected at the site in the daily mid-point calibration check standard:

Group A	**Group B**	**Group C**
Benzene	1,1-Dichloroethane	All of Group A and B & methane
Toluene	1,2-Dichloroethane	
Xylenes	1,1-Dichloroethene	
Methyl tertiary butyl ether (MTBE)	Cis-1,2-Dichloroethene	
Tetrachloroethene	Trans-1,2-Dichloroethene	
	Tetrachloroethene	
	1,1,1-Trichloroethane	
	1,1,2-Trichloroethane	
	Trichloroethene	

(3) Ensure that the RF of each compound (except for Freon 11, 12, and 113, chloroethane, vinyl chloride, and TBA) is within ±20% of the initial calibration's average RF. If detected, the RF for Freon 11, 12, 113, chloroethane, vinyl chloride, and TBA should be within ±30%. Note: for methods TO-15 & TO-17, the (RF) for all target compounds can be 30%.

i. Blank

(1) Analyze field blank(s) to detect any possible interference from ambient air.

(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 of the target compound(s).

j. Sample Analysis

(1) Ensure that the requirements for the initial calibration, the daily mid-point check, the blank, and the LCS are met before any site samples are analyzed. If they are not, all reported values must be flagged with a footnote describing the deviance. Depending upon the project goals, the sample result may be considered inadequate and need to be resampled.

(2) Analyze samples within 30 minutes after collection to minimize VOC loss. Longer holding time may be allowed if the laboratory uses 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) If the concentrations of constituents(s) in a sample exceed 10% of the highest concentration in the calibration range, either reanalyze the sample using a smaller volume and dilution, or flag the result and provide a narrative justifying the validity of the result. Be advised that depending upon the explanation and project goals, the sample result may be considered inadequate and need to be resampled.

(4) Attain a DL as indicated in Section 5.IV.B.1.c If lesser sample volumes or dilutions are used to offset possible high concentrations 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 a DL referenced in Section 5.IV.B.1.c can be achieved.

(5) Quantify sample results using the average RF from the most recent initial calibration.

(6) Add surrogate compounds to all samples. Ensure 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. Note: this requirement also applies to methods TO-15 & TO-17.

(7) Calculate the surrogate recovery for each GC run. Surrogate recovery should not exceed ±25% of the true concentration of the surrogate. If recoveries fall outside these limits, all reported values must be flagged with a footnote describing the deviance. **Depending on the preponderance of data, samples with data outside the limits may be required to be resampled and analyzed. For EPA TO-15 and TO-17, the acceptance ranges for surrogate recoveries are to be statistically determined by the laboratory.**

(8) Analyze duplicate samples at a minimum of 1 every 20 samples (5%).

k. Compound Confirmation

(1) Conduct compound confirmation by GC/MS whenever possible. Use second column confirmation with surrogate(s) for compound confirmation if GC/MS is not used.

(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 and FID are used for analysis.

(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 a Tedlar™ bag and confirmation can be done off-site. The maximum holding time for samples in a Tedlar™ bag taken to an off-site laboratory is compound specific. For benzene, the maximum holding time is 4 hours. Please refer to the time frames outlined by the National Institute of Occupational Safety and Health (NIOSH) for other compounds. For further information on the NIOSH Manual of Analytical Methods (NMAM), 4th ed. DHHS

(NIOSH) Publication 94-113 (August 1994), refer to the web site @ www.cdc.gov/niosh/nmam/order.html.

(4) Second column confirmation is not necessary if the compounds present have been confirmed from previous soil gas investigations.

l. Samples with High Concentration

(1) The DL may be raised above 1 µg/L for compounds with high results (i.e., the limit as specified in Section 5.IV.B.j.(3) and those closely eluting compounds for which quantitation may be interfered with by the high concentrations.

(2) Quantify sample results according to Section 5.IV.B.j.(4) for analytes that are not affected by the high concentration compounds.

(3) If high VOC concentrations in an area are known from previous soil gas analysis, Sections 5.IV.B.1.l.(1) and 5.IV.B.1.l.(2) are not necessary when analyzing samples from the area in question.

(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.

m. Shortened Analysis Time

(1) Shorten the GC run time only under the following conditions:

(a) The exact number and identification of compounds are known from previous soil and soil gas investigations; and
(b) The consultant has been given permission by an approved work plan by the lead agency to analyze only for specific compounds.

(2) The following requirements must be met when shortening GC run-time:

(a) Based on the previous site assessment work on-site, the compounds present are fully known.
(b) The compounds must not coelute;
(c) Perform the initial calibration and daily mid-point calibration check and analyze the LCS and samples under the same conditions as the shorter GC run time;
(d) Quantitate using the average RF from the initial calibration utilizing the shorter run time; and
(e) Perform a normal run time analysis whenever peaks are detected within retention time windows where coelution, as indicated by the calibration chromatograms, is likely.

n. Last GC Test Run Per Day of Analysis

The closing calibration analysis must be included in the lab report to the client.

(1) A closing calibration or LCS is required at the end of the day to verify that the calibration is still within limits. Include the same compounds used in the daily mid-point calibration check analysis, as listed in Section 5.IV.B.1.h.(2). Attain an RF for

each compound within ±20% difference from the initial calibration's average RF, except for Freon 11, 12, 113, chloroethane, vinyl chloride, and TBA, which should be within ±30%. All target compounds that exceed these requirements must be flagged. Any results that exceed these requirements may be considered invalid for use in health risk evaluations. Note: for methods TO-15 & TO-17 a closing CCV is not required.

(2) Analyze the closing calibration standard at the detection limit concentration instead of the mid-point concentration if all samples from the same day of analysis show non-detect (ND) results. The recovery for each compound must be at least 50%. If less than 50%, all the ND results of the samples may be considered questionable.

o. Site Inspection

(1) Unannounced, on-site inspection by the lead agency may occur. The inspector or case manager may request hard copies of the complete laboratory data, including raw data for the initial calibration, daily mid-point check, LCS, and blank results. Failure to provide this information may result in the data being considered inadequate and may require samples to be reanalyzed.

(2) The soil gas consultant must be able to answer reasonable inquiries on the use of the instruments, analytical procedures, and QA/QC procedures.

p. Record Keeping 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

2. Reporting of Soil Gas Sample Results and QA/QC Data

a. Reports for all sample test results should be presented in the preferred reporting formats outlined in Table 5-4. The QA/QC data should be presented in the preferred reporting formats that are provided in Table 5-3. 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 all data requested upon request. Identify the source(s) of the contaminants detected in the investigation, as indicated by the data.

b. Report the following for all calibration standards, LCS, and environmental samples:

(1) Site name / Project name
(2) Address
(3) Sample Date
(2) Laboratory name (3) Date of analysis
(4) Sample result
(5) QA/AC - Soil & Water
Method Blank
LCS/LCSD
MS/MSD
Soil Vapor
Method
LCS/second and/or LCSD

3. Acknowledgement

This guideline, although based on the State of California, California Regional Water Quality Control Board-Los Angeles Region *Interim Guidance for Active Soil Gas Investigation (*February 25, 1997*)*, has been modified to meet SAM requirements. At present, EPA SW846 does not address soil gas as a matrix for the analytical methods SAM typically uses. Also, there is no California accreditation process to review the methodology or require specific QA/QC when soil gas is the matrix.

SAM accepts soil gas data for input into the SAM Soil Gas Vapor Risk 2000 assessment model for evaluation of potential increased risk to human health from vapor migration into buildings. Because of this, a higher level of accuracy and precision of the data is required than that necessary for soil gas surveys for other purposes.

TABLE 5-4: 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

Note: Data for retention time and soil vapor results can be placed in separate tables.

V. DIRECT MEASUREMENT OF VAPOR FLUX

Due to site conditions it is sometimes necessary to directly measure the vapor flux though the floor of a structure. A flux chamber is used for this type of measurement. A flux chamber consists of an enclosed chamber that is placed on the surface to directly measure emissions. Flux chambers can be used to take either active or passive samples. Passive flux chambers have not been adequately tested under field conditions, and are therefore not recommended at this time and will not be discussed further. Active flux chambers measure vapor concentrations through time. This method is quantitative and yields both concentration data and flux data (mass/area-time). In general, numerous locations are tested to evaluate the varying conditions of the floor slab.

A. Active Flux Chamber

Equipment: The sampling equipment consists of an air-tight container open on the bottom, placed at least 2 centimeters (cm) into the soil with optional sample ports for temperature and pressure probes, an air distribution system for sweep gas, and an outlet gas line. To the outlet gas line, various sample trains can be attached to collect samples for later analysis, or instruments can be attached to analyze samples on-site.

Purge Volume: Before samples are taken, the chamber should be purged with at least 3 volumes of clean air (bottled "zero" air or ambient air that has been passed through a carbon filter).

Chamber Pressure and Temperature: Pressure and temperature should be kept as close to ambient as possible to minimize the possibility of losses to the atmosphere or addition of ambient air.

Sweep Air Flow Rate: The incorporation and selection of the sweep gas flow rate depend on the anticipated concentrations, the purpose of the sample program, and modeling considerations. If the purpose of the sampling program is to estimate health risk when the soil is open to the atmosphere, it may be desirable to model ambient wind conditions.

Sample System Pumps: Sample pumps should be upstream of inlet carbon filters or after all grab sample ports to minimize the possibility that lubricants in the pump could contaminate the sample, or use pumps specifically designed for air sampling. The design of the sampling system should ensure that samples are not contaminated by ambient air.

Sampling Techniques: Samples from the chamber can be taken either as discrete samples or by adsorbing the chamber vapors onto an adsorbent medium.

Discrete Sample Containers: Discrete samples can be taken in either Summa™ canisters or Tedlar™ bags. Summa™ canisters should be pre-evacuated. The vacuum should be measured before and after sampling.

Sorbed Samples: The laboratory that will analyze the sample should prepare the sorbent media.

Sampling Interval: Flux chambers should be sampled over a minimum of 3 time intervals.

B. Analysis of Samples

Refer to the previous section (Section 5.IV.B) for the discussion of methods.

VI. WELL DEVELOPMENT

The goal of well development is to improve hydraulic communication between the geologic formation and the well. Hydraulic communication is degraded when clay and silt in the formation (or in fractures), and/or drilling muds, are smeared on the borehole wall during the drilling process. Well development improves hydraulic communication by eliminating or reducing this smear. Development also improves the filtering action of filter pack that surrounds the well casing.

Most monitoring wells need to be developed after construction. The intensity of development depends on the purpose of the well and the nature of the water-bearing materials. There is no "cook book" formula for monitoring well development. Determining what constitutes acceptable development is a professional judgment that is left to the registered professional. SAM will consider the quality of development when evaluating data obtained from the well and when establishing the length of monitoring programs.

A. Important Terms

Non-aqueous phase liquid (NAPL): Immiscible liquids that are found on the surface of the water table, at the base of the well and in the formation's interstitial pore space in both the saturated and unsaturated zones. When NAPL is observed in a well, it is commonly referred to as phase-separated product, free product, floating product, liquid phase hydrocarbon, light non-aqueous phase liquid (LNAPL) or dense non-aqueous phase liquid (DNAPL).

Water-bearing materials: Term that is generally equivalent to aquifer. In San Diego County many water-bearing formations do not meet the textbook definition of an aquifer; nevertheless, these formations are subject to investigation and remediation.

Well development: The process by which hydraulic communication between the well and the surrounding material is improved.

Filter pack: Also known as sand pack or gravel pack. The filter pack consists of non-reactive granular material matched to the slot size of the well screen to prevent the movement of fines into the well.

B. Selection of Well Development Method

The quickest and possibly the only effective way to remove clay smear is to generate a strong back-and-forth flow of water between the well bore and the formation. Several development methods generate a back-and-forth flow. Method selection is influenced by the type of formation material, drilling method, well recovery rate, well depth, depth to water, contaminants, purpose of the well, and other factors that only an experienced professional can determine. The advantages and disadvantages of various well development methods are discussed in the National Water Well Association's document entitled *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells* (Aller et al., 1989, p. 228-245).

In general, block surging and airlifting are acceptable development methods. Over-pumping is commonly used for development but is not as effective as those methods mentioned above. The use of vacuum trucks has similar results as over-pumping and is discouraged. Other methods may be suitable but should be discussed with the regulatory agencies before implementation.

C. Considerations

The following items should be considered when using monitoring wells to obtain water quality data:

1. A well that has never been properly developed may be a questionable source of data. Documentation of well development is necessary for a well to be considered reliable.

2. A well should be redeveloped when its use changes, when the data become suspect, or when the well becomes "silted-in," bio-fouled, encrusted, or sits idle for an extended period.

3. NAPL sometimes appears in a well weeks to many months after construction. While this may indicate actual spreading of the product, it can also reflect insufficient initial well development or a formational material with low hydraulic conductivity. Unexplainable variation in groundwater sample results over a period of time may be the result of "delayed development" caused by repeated purging of the well.

4. The County of San Diego considers that reliable observation of static water level and NAPL thickness frequently cannot be made until at least 72 hours after well development. Therefore, samples should not be obtained until at least 72 hours after proper well development, or possibly longer if NAPL is expected.

5. Stability of field-measured turbidity has been used to indicate effectiveness of well development.

6. No specific values exist for duration of development activity, or the volume of water to be removed as part of the development process. The purpose of the well, type of contaminant, and geologic conditions must be considered when deciding on the appropriate level of development.

7. If water has been added during drilling, at a minimum, that volume of water must be removed in addition to the development water.

8. Well development will cause a filter pack to settle. It is recommended that partial development take place before any sealing material is placed above the filter pack. This will increase the long-term reliability of the annular seal and minimize bridging of well material. Complete the development process after seal installation.

D. Reporting

It is essential that the development process be clearly documented in the reports submitted to SAM. The following information must be reported:

- Description of development method used,
- Date and duration of development,
- Quantity of water removed,
- Type and quantity of anything (including water) added during drilling and development, and
- Qualitative description of well water throughout the development process (clear, cloudy, etc.).

VII. WELL PURGING AND SAMPLING

This guideline has been developed to provide consistent and representative sampling of groundwater monitoring wells. The well or wells to be sampled are assumed to be properly constructed and developed. This section focuses on sampling of groundwater for dissolved organic chemicals but can also be applied to sampling of inorganic compounds.

There has been considerable research and evaluation of the requirements for purging of wells and sampling methodologies. Sampling approaches can vary depending on the goal of the sampling program. In general there are four methods that have been accepted. These are high-flow purging and sampling, low-flow purging and sampling, no-purge discrete sampling, and non-purge grab sampling. It should be noted that consistency over time is very important. The same methods should be used each time the wells are purged and sampled unless a different purging method would improve sample quality and data precision.

A. Important Terms

Borehole volume: Volume of water that is contained in the well casing plus volume of water contained in the pore spaces of the filter pack.

Recovery: The measure of groundwater's return to its static level after purging.

Fast recovering well: A well is considered to be fast recovering if recovery to 80 percent or more of its static condition occurs within 2 hours when using the high-flow purging method.

Slow recovering well: A well is considered to be slow recovering if recovery to 80 percent of its static water level takes longer than 2 hours when using the high-flow purging method.

Purging: The act of evacuating (removing) water from a well. This includes water in the blank casing, screened casing, and filter pack.

Sample: A subset of a whole, which is representative of the whole.

Depth Discrete Sample: Distinguished from a grab sample by having a specific location in the well (i.e., depth).

Flow Sample: A sample collected from a pump.

Grab Sample: A sample obtained in a single aliquot or mass using a device specifically designed for the purpose. Grab samplers may include a bailer or other similar device(s).

Stability: Refers to the consistency of field water quality indicator parameters over a specified time interval. The most sensitive field parameters are dissolved oxygen, specific conductance, and temperature.

Purging and Sampling Methods: The following methods are currently approved by SAM.

High-flow Purging and Sampling: Purging using a pumping rate greater than 1 liter per minute (lpm) or 0.26 gallon per minute (gpm) (Barcelona and Puls, 1996). Traditionally, the high-flow purging method has been widely used. This method typically involves the removal of up to 3 borehole volumes prior to sampling. Samples are most often collected with a bailer or other device after completion of purging. This methodology provides a composite of the contaminant concentration within the well and will likely not be suitable for low yield wells.

Low-flow (Low Stress or Low Impact) Purging and Sampling: Purging using a pumping mechanism that produces low-flow rates (less than 1 lpm or less than 0.26 gpm), which causes minimal drawdown of the static water table and usually employs a flow cell in which geochemical parameters are continuously monitored. These parameters may include dissolved oxygen content, oxidation-reduction potential (redox), conductivity, turbidity, and/or pH. Samples are obtained when all chemical parameters have stabilized thus demonstrating qualitatively that the groundwater being purged is in equilibrium (refer to Table 5-7). Samples are collected directly from the pumping mechanism with minimum disturbance to the aquifer groundwater. The low-flow purging method (purging to parameter stability) tends to isolate the interval being sampled, provides more accurate water quality measurements, and reduces the volume of purge water generated. This method has an advantage in that it can limit vertical mixing and volatilization of volatile organic compounds in solution within the well casing or borehole as compared to high-flow purging and sampling.

No-purge Grab Sampling: The non-purge grab sampling method refers to the Western State Petroleum Association's (WSPA) sampling methodology that was proposed in 1996 for fuel releases and approved by the State Water Resources Control Board in 1997. This sampling methodology involves the collection of a grab sample taken from a well without purging. The sample is acquired using a grab-type-sampling device and is generally acquired at or near the air-water interface of a well. These samples may not be representative of the aquifer water quality. To date the studies on this method are limited and inconclusive. This method is allowed on a limited basis and generally a comparative testing plan is required prior to approval.

No-purge Discrete Sampling: This method includes discrete point-interval sampling (DPIS) devices and other devices that allow sampling from a discrete interval within a well without compromising the vertical stratification of water quality conditions in the well bore. A discrete sample is acquired without splitting and must be taken from a well that has been demonstrated to have a net flow, or a measured flow through the well.

Such sampling is useful for characterizing specific zones or intervals within a saturated well screen or borehole.

B. Purging and Sampling Methodology

This section outlines procedures for high-flow, low-flow, no-purge grab, and no-purge discrete interval sampling. For consistency and to help evaluate results over time, the use of one method of purging and sampling over time is highly recommended.

There has been significant discussion in the literature regarding shifting from the high-flow purge methodology to the low-flow purge methodology. The low-flow methodology has been demonstrated to minimize or overcome many of the limitations created by the high-flow purging method. These limitations include sample turbidity, alteration of sample chemistry, altered ambient flow conditions, and the need to purge excessive volumes of water to achieve stability.

In the high-flow purging method, low-yield wells have often been evacuated to dryness and allowed to recover prior to sampling. In many cases, wells that are considered to be "low yield" could readily be pumped continuously at sustained rates less than 1 lpm or 0.26 gpm. In these situations, the low-flow method is recommended provided that it is implemented in accordance with guidelines.

The evacuation of the well to dryness poses several problems:

- Cascading water as the well recovers results in changes to water chemistry due to aeration and volatilization,

- Draining water from the filter pack may result in air being trapped in the pore spaces, with lingering effects on water chemistry,

- Increased sample turbidity may result from the stress on the formation and stirring up of settled solids in the bottom of the well, and

- The excessive time required for sufficient recovery of the well may affect sample chemistry through prolonged exposure to the atmosphere.

Depending on the purging method to be used there are specific equipment limitations. Table 5-5 provides a description of the various methodologies and their applicability.

TABLE 5-5: PURGING METHODS

Method	Low-flow (< 1 lpm)	High-flow (> 1 lpm)
Peristaltic Pump	1	2
Centrifugal Pump	3	3
Submersible Impeller Pump	1	3
Bailer	X	2
Bladder Pump	3	3
Vacuum Truck	X	X

1 - Not recommended, better methods exist
2 - Useful with limitations
3 - Recommended method
X - Unacceptable

Proper selection of sampling devices or pumps is critical to the quality and representativeness of the sampling results. Table 5-6 provides a summary of the acceptable sampling methods for the various chemicals of concern.

TABLE 5-6: ACCEPTABLE SAMPLING METHODS FOR CHEMICALS OF CONCERN

	Analytical Sampling					
Method	VOCs	Semi VOCs	Metals and Inorganics	Petroleum Hydrocarbons C3-C16	Petroleum Hydrocarbons C16+	General Chemistry
Peristaltic Pump	X	1	3	X	1	2
Centrifugal Pump	2	3	3	2	2	3
Submersible Impeller Pump	2 3 if low-flow	3	3	2	3	3
Bailer	2	2	2	2	2	2
Bladder Pump	3	3	3	3	3	3
Vacuum Truck	X	X	X	X	X	X
DPIS	3	3	2	2	2	2
Diffusion Sampler	2	2	X	2	2	X
Grab Sampler	2	2	2	2	2	2

1 - Not recommended, better methods exist
2 - Useful with limitations
3 - Recommended method
X - Unacceptable

Notes: Centrifugal pump—assumed at a low-flow rate (no greater than 1 lpm)

1. High-flow Purging and Sampling Method

This method is widely used and involves the removal of water from the well at a rate in excess of 1 lpm (0.26 gpm) by a variety of methods, including pumps, bailers, etc. The following steps are necessary to collect representative samples. Well purging to "dryness" should be avoided for the reasons cited in Section 5.VII.B. Consideration should be given to the use of low-flow or passive purging methods in the future.

a. Measure for NAPL

LNAPL and DNAPL may be present in groundwater monitoring wells. If NAPL exists, the well sampling procedure described in this section will typically not apply. Special considerations may be necessary and should be discussed with the SAM project manager on a case-by-case basis.

b. Measure Water Level

The groundwater level in the monitoring well should be measured to an accuracy of 0.01 foot prior to purging and sampling activities.

c. Placement of Pump

The pump should be placed in the lower one-third of the well screen.

d. Calculation of Borehole Volume

The following equation can be used to calculate the borehole volume.

$$BV = \left(\frac{7.48\,\pi}{4}\right) [\, CD^2 + P\,(\, BD^2 - CD^2 \,)\,]\,(WD - GW)$$

Where:

Where:	BV	=	the borehole volume (gal)
	CD	=	the casing diameter (ft)
	P	=	the porosity of the filter pack (e.g., if porosity is 25% use 0.25 in the formula)
	BD	=	the borehole diameter (ft)
	WD	=	the well depth (ft)
	GW	=	the depth to groundwater (ft)

Note: The above equation, as written, applies to wells constructed straddling the water table. The equation may be modified for circumstances where the static water table is above the top of the filter pack.

e. Calculation of Percent Recovery

The following equation may be used to calculate the percent recovery after purging.

$$PR = \left(1 - \frac{RD}{MD}\right) \times 100$$

Where:	PR	=	the percent recovery (%)
	RD	=	the residual drawdown (ft) - the difference between the water level prior to purging and the measured water level at any time after purging
	MD	=	the maximum drawdown (ft) - the difference between the static water level prior to purging and the measured water level immediately after purging

f. Parameter Stability

It is assumed that parameter stability is achieved when the difference between successive measurements is less than 10 percent. Generally, measurements are made after one borehole volume is removed and then at one-half borehole volume intervals. Commonly, the measurement of temperature, specific conductance, and pH are used exclusively, but it has been found these parameters are less sensitive to field conditions. It is recommended that dissolved oxygen, turbidity, specific conductance, and temperature be monitored.

g. Purge Well

The well must be purged with a device that does not compromise the sample by cross-contamination, aeration, or other negative effects. Refer to Table 5-5 for the acceptable purging devices for this method.

(1) Fast Recovering Wells

DEH considers the following two options acceptable methods for properly purging fast recovering wells:

(a) Option I
  i. Remove 3 borehole volumes of water.
  ii. Allow the well to recover to 80% of its static condition prior to collecting the sample.

(b) Option II
  i. Remove 1 borehole volume of water.
  ii. Conduct field water-quality measurements (dissolved oxygen, turbidity, specific conductance, and temperature).
  iii. Remove an additional ½ borehole volume of water. Conduct field water quality measurements again. If the first and second measurements vary by less than 10%, purging is considered adequate. Proceed to step (v.) below.
  iv. Repeat step (iii) until the measurements vary by less than 10% or until 3 borehole volumes of water have been removed.
  v. Allow the well to recover to 80% of its static condition before collecting the sample.

(2) Slow Recovering Wells

(a) Remove 1 borehole volume of water.

(b) The well should be allowed to recover for 2 hours after purging has stopped. Then the well should be sampled as soon after 2 hours as possible. Note that if the well recovers to greater than 80% in less than 2 hours, it is a fast recovering well and the steps in Option I or II above must be implemented.

(c) Consider using the low-flow method for future sampling events (refer to Section 5.VII.B.2, below).

h. Collect Samples

After the monitoring well has been properly purged, the guidelines below for groundwater sample collection should be followed.

(1) In the case of a fast recovering well, samples should be collected when the well has recovered to 80%. In the case of a slow recovering well, samples should be collected as soon as possible after 2 hours have elapsed.

(2) Collect groundwater samples from wells with sampling equipment in accordance with Table 5-6.

(3) Sampling equipment must be compatible with the contaminant being analyzed.

(4) Sampling equipment should be decontaminated before use.

(5) Samples requiring organic analyses should not be filtered.

(6) Samples should be transferred from the sampling device to a container in a manner that minimizes aeration.

(7) Samples should be collected in approved sample containers appropriate for the type of analysis to be performed.

(8) Samples should not be transferred from one sample container to another.

(9) Headspace in sample containers should be avoided.

(10) EPA SW-846 sample preservation and holding times for specific analyses should be followed.

(11) Appropriate sample chain-of-custody procedures must be followed (refer to Section 5.X).

(12) Appropriate QA/QC procedures must be followed (refer to Section 5.X).

2. Low-flow Purging and Sampling Method

The low-flow purging and sampling method has been described in the literature since the mid-1980s with a defined methodology being accepted by the U.S. EPA in 1995. An overview of this methodology is presented in a U.S. EPA Ground Water Issue paper titled *"Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures"* by Robert Puls and Michael J. Barcelona dated April 1996.

Low-flow purging and sampling is appropriate for collection of groundwater samples for all groundwater contaminants, including inorganic compounds, metals, pesticides, polychlorinated biphenyls (PCBs), volatile and semi-volatile organic compounds (VOCs and SVOCs), other organic compounds, and radiochemical and microbiological constituents. This method is not applicable to the collection of LNAPL or DNAPL.

Low-flow refers to the velocity of the water entering the pump intake. Low-flow purging also results in limited drawdown. This method can be applied to wells that meet the following criteria:

- The well can be pumped at a constant low-flow rate of 0.1 to 1.0 lpm, with an overall **goal** of less than 0.10 meter or 0.33 foot of drawdown in the well during purging. This goal may be difficult to achieve under some circumstances due to geologic heterogeneities and may require adjustment based upon site-specific conditions. The goal is to minimize drawdown and achieve a stabilized pumping water level as soon as possible.
- The maximum well screen or open borehole intake length should be 20 feet when sampling from a single point within the intake.

- Where the screen or open zone is longer than 20 feet and a target zone cannot be identified based on either of the boring logs, it may be necessary to sample multi-levels to identify the target zone.

a. Pump Placement

Proper pump placement requires detailed knowledge of the site's lithology, the hydrogeologic properties, contaminant depths, and the well construction details, along with the specific goals and objectives of the monitoring program. The following is general guidance on pump placement. Following placement of the pump, the well needs to sit for a minimum of 2 hours prior to purging.

(1) Homogeneous Geologic Conditions

For a well screened or open across a single homogeneous geologic unit and where the saturated interval is not more than 20 feet long, the pump intake should be positioned adjacent to known soil impacts. Where the compounds of interest are known to concentrate near the top or the bottom of the screen zone, it may be desirable to locate the pump intake in the upper one-third or lower one-third of the interval, respectively.

(2) Heterogeneous Geologic Conditions

For a well screened or open across heterogeneous geologic conditions and where the saturated interval has layers of contrasting permeability, it may be necessary to locate the pump intake adjacent to any anticipated preferential flow pathways, zones of concern, or areas of known contamination.

b. Flow Rate

The flow rate used during purging must be low enough to avoid increasing the water turbidity. The following measures should be taken to determine the appropriate flow rate:

- The flow rate should be determined for each well, based on the hydraulic performance of the well.
- The optimum flow rate for each well should be established during well development or redevelopment, or, if possible, in advance of the actual sampling event.
- The flow must be adjusted to obtain stabilization of the water level in the well as quickly as possible.
- The maximum flow rate used should not exceed 1 lpm (0.26 gpm).
- Once established, this rate should be reproduced with each subsequent sampling event.
- If a significant change in initial water level occurs between events, it may be necessary to reestablish the optimum flow rate at each sampling event.

c. Measurement of Water Level and Drawdown

Measurement of the water level in the well during purging is important when establishing the optimum flow rate for purging. The goal is to achieve a stabilized pumping water level as quickly as possible with minimal drawdown, to avoid stressing the formation and mobilizing solids and to obtain stabilized indicator parameters in the shortest time possible.

d. Measurement of Indicator Parameters and Turbidity

Continuous monitoring of water quality indicator parameters is used to determine when purging is completed and sampling should begin. Stabilized values, based on selected criteria listed in Table 5-7, should be met prior to sampling. The use of an in-line flow cell (closed) system is recommended for measuring indicator parameters, except for turbidity. Indicator parameter collection is more important when low-flow purging is used and additional parameters are needed as compared to the high-flow purging method.

Generally, measurements are taken every 3 to 5 minutes and water chemistry parameters are considered to be stable when they are within the following ranges for three consecutive readings.

TABLE 5-7: STABILITY CRITERIA FOR LOW-FLOW PURGING

Constituent	Criteria
Dissolved Oxygen Content (DO)	± 0.2 mg/l
Oxidation-Reduction Potential (redox)	± 20 mv
Turbidity	± 10 %
Specific Conductance	± 3-5% of reading
Temperature	± 3% of reading (min. of ± 0.2°C)
pH	± 0.2 units

e. Equipment Requirements

Because the methodology requires that disturbance to the water column in the well be minimized, the same pumping device used for purging should be used for sampling (i.e., the pump should be left in place after purging). Refer to Table 5-5 and Table 5-6 for the proper pumping equipment for the low-flow method.

(1) Dedicated and Portable Systems

Studies have shown that installation of any device into a well disturbs the stratification typically exhibited in a well due to laminar flow of groundwater in the well. Insertion also potentially mobilizes suspended solids in the water column due to disturbance of settled and adhered solids in the casing and agitation of water in the filter pack. Therefore, low-flow purging and sampling techniques are more accurate when dedicated systems are used. Dedicated systems result in lower initial turbidity values and lower purge volumes to achieve stabilized indicator parameter readings and should be considered when a well will be sampled multiple times.

If portable systems are used, they must be placed carefully into the well and lowered into the screen zone as slowly as possible. Placement of the portable pump can disturb the groundwater flow conditions resulting in non-equilibrium conditions. Therefore, longer purge times and greater purge volumes may be necessary to achieve indicator parameter stabilization. After installation, the portable pump should remain in place at least 2 hours to allow settling of solids and re-establishment of horizontal flow through the screen zone. If initial turbidity readings are excessive (>50 nephelometric turbidity units [NTU]), pumping should cease and the well should rest for another 1 to 2 hours before re-initiating pumping. In wells set in very fine-grained formations, longer waiting periods may be required. If the well consistently produces high turbidity water (>50 NTU), even at low pumping rates, redevelopment of the well should be considered before further sampling.

(2) Water-Level Measurement Equipment

Continuous water-level measurement devices are preferred, such as down-hole pressure transducers, but electronic water-level tapes can be used. The devices used must be capable of measuring to 0.01-foot accuracy.

(3) Indicator Parameter Equipment

Measurement of indicator parameters (dissolved oxygen content, redox potential, specific conductance, temperature, and pH) is required. This is most easily performed using an in-line flow cell (closed) system attached directly to the pump discharge tubing. For turbidity measurement, a separate field nephelometer should be used.

f. Collect Samples

After the monitoring well has been properly purged using the low-flow method, use the guidelines outlined in Section 5.VII.B.1.h (where appropriate) for groundwater sample collection. However, when using this method it is of utmost importance to collect the groundwater samples using the same pump or device used for low-flow purging without moving it or causing disturbance to the well.

g. Well Specific Sampling Procedures

Due to the complexity of this sampling method, preparation of well specific sampling procedures is recommended for consistency and reproducibility. SAM may require either a workplan for low-flow sampling, submittal of well specific parameters or both. At the least, the registered professional's understanding of site specific conditions must be evident in reports or other submittals which provide low-flow sampling results.

3. Non-Purge Method

The San Diego RWQCB has concluded that use of the non-purge sampling method (as outlined in the California Groundwater Purging Study for Petroleum Hydrocarbons prepared for the Western States Petroleum Association (WSPA) in October 1996) can be considered for wells that meet the following minimum conditions:

- The only contaminants of concern are gasoline petroleum hydrocarbons,

- No NAPL exists in the well,
- The well construction details are known and documented,
- The well is screened across the water table, and
- The well is properly developed.

Prior to implementation of this method, SAM may request multiple monitoring events using the standard purging and sampling method in conjunction with the non-purge method to determine repeatability and variance of the methods.

A formal request must be submitted with a California registered professional (PG, PE, CEG, CHG) certifying the items listed above, and a statement that the non-purge method will provide representative water quality results for the compounds of concern.

4. Discrete Point-Interval Sampling (DPIS)

The purpose of DPIS is to collect groundwater samples from monitoring wells that represent groundwater conditions vertically in the well. This is accomplished by obtaining the samples at pre-determined depths within the screened interval of the well. The use of DPIS is effective for collecting zone-specific and vertical profile samples from a well. Vertical profiling can be used to identify zones of concern for future long-term sampling programs.

The DPIS has three primary benefits:

- Minimizes disturbance of sediment in the bottom of the well, thereby producing a sample with low turbidity,
- Eliminates aeration of groundwater during sample collection, and
- Eliminates the need to purge well (in wells that have demonstrated net flow or measured flow through the well).

This procedure addresses the collection of water samples and NAPL (if present).

a. Review Available Site Historical Data

If available, review the borehole logs and well construction diagrams to determine the geologic and hydrologic conditions associated with the well.

b. Measure Water Level

Measure the groundwater level in the monitoring well to an accuracy of 0.01 foot prior to sampling activities.

c. Prepare DPIS Sampling Device

Select an appropriate DPIS sampling instrument and prepare for sampling in accordance with the manufacturer's specifications. Make certain that the equipment has been properly decontaminated prior to use. All sampling equipment must be compatible with the contaminant being analyzed.

d. Well Purging

Well purging is not required for DPIS sampling instruments when used in accordance with the manufacturer's specifications.

e. Sample Collection

(1) After the monitoring well has been properly gauged and surveyed for NAPL, and the depth of the top of the screened interval has been determined, the following procedures should be followed for sample collection.

(2) Deliver the sampling instrument to a pre-determined depth that is a minimum of 6 inches below the top of the screened interval of the well:

(a) Discrete Interval Sampling

(i) Sample from the top of the well down to limit disturbance in the well.

(b) Routine Monitoring

(i) After proper vertical profiling of the well, routine sampling shall be taken from the zone of highest concentrations.

(ii) For closure (final phase) sampling, vertically profile the well in accordance with the original procedures used in the initial vertical profiling.

(iii) Where applicable, follow the sample handling guidelines outlined in Section 5.VII.B.1.h.

C. Groundwater Sampling from Excavations and Boreholes

DEH recognizes that groundwater samples collected from open excavations and boreholes can be useful as screening tools or for water disposal characterization; however, the consultant should confer with DEH before doing such sampling. In areas where groundwater has beneficial uses and where stringent cleanup standards apply, water samples from open excavations or boreholes are discouraged and DEH or the RWQCB may not accept the results. Groundwater samples collected from open excavations and boreholes may not be representative of groundwater present within adjacent formations for some of the following reasons:

- Open excavations may have a large water-surface area exposed to the atmosphere that allows the rapid loss of VOCs dissolved in the groundwater.
- The sloughing of contaminated soils from the sidewalls can contaminate groundwater within an open excavation.
- Open excavations may also collect surface water runoff, which would dilute any contaminants present in the groundwater and/or add other contaminants.
- Groundwater samples from open boreholes have similar limitations, as well as potential turbidity problems.

D. Groundwater Sampling from Wells Installed in Excavations

On some sites, well casings have been placed into former UST excavations and the excavation has been backfilled with sand or gravel. Most of these excavation wells have been intended for potential recovery of free product or contaminated groundwater, not water quality sampling. The use of UST excavation wells for groundwater elevations and groundwater quality may not be representative of conditions within the adjacent geologic formation. The consultant should confer with DEH prior to sampling from such wells.

If excavation wells are to be used to obtain groundwater samples, protocols for groundwater sampling from traditional monitoring wells should be followed in principle. Collection of groundwater samples from excavation wells should occur only after a sufficient volume of water has been removed in order to purge the well casing and the sand or gravel backfill in the former UST excavation. Purge volume includes water in the well casing plus the water within the pores of the sand or gravel filling the entire excavation.

An approved well/boring permit application from DEH is required prior to constructing or destroying a UST excavation well. These wells must be constructed in compliance with State and County well construction standards.

E. Groundwater Sampling Using Alternative Sampling Devices

Recent studies suggest that sampling devices other than the traditional monitoring well can be used to obtain representative groundwater samples for initial characterization to aid in the placement of permanent groundwater monitoring wells. Proposals to use alternative sampling devices (e.g., well points, direct push or BAT® samplers) will be considered on a case-by-case basis and will be reviewed within the context of the goals of the site assessment.

Unlike traditional monitoring wells, which are usually screened over several feet of the water-bearing formation, alternative sampling devices are typically more depth discrete. For petroleum hydrocarbon cases in which contaminants tend to be found near the water table, care must be taken to ensure that these sampling devices are positioned to collect a sample from this zone. It is also important to follow the manufacturer's instructions to ensure that valid samples are collected.

Correlation of groundwater sample results with those from adjacent monitoring wells, or collection of groundwater samples from multiple depths at each sampling point to determine the vertical distribution of contamination may be required. Some of these alternative sampling devices provide a one-time opportunity to obtain a sample; this could be a disadvantage if additional sampling and monitoring is necessary.

Groundwater elevation data can be obtained from some alternative sampling devices. Because of the slow recovery rate of some geologic formations, these data are generally not considered reliable for determining groundwater gradient or static water conditions.

F. Groundwater Monitoring and Reporting Checklist

The following guidelines provide a consistent format for a groundwater monitoring program. A groundwater monitoring program includes:

- Measurement of groundwater elevation,
- Measurement of NAPL thickness (if present),
- Analysis of dissolved chemical concentrations,
- Interpretation of results, and

- Reporting.

This information is incorporated into a monitoring report that is submitted to DEH. **The report must include interpretations of the data and be signed by an appropriately registered professional.** The monitoring frequency will be established by the lead agency (either DEH or the RWQCB). Monitoring frequency will vary depending on site-specific conditions.

The following checklist provides a general format to achieve consistent reporting of groundwater monitoring programs.

1. Monitoring Activities

a. Accurately survey all wells horizontally and vertically relative to a fixed point in accordance with State GeoTracker guidelines. The vertical measurement should be to an accuracy of 0.01 foot.
b. Measure depth to groundwater and NAPL (if present) in all wells to within 0.01 foot from a permanent reference mark on the well casing.
c. Follow the SAM Manual guidelines for well development, purging, and groundwater sampling.
d. Collect groundwater samples from designated wells. Generally, these wells will not contain NAPL.
e. Submit all samples to a State Department of Health Services-certified laboratory for the analyses requested.
f. Analyze water samples for the chemical constituents as described in this section or in accordance with the monitoring program established for the site by the lead agency. For contaminants not listed, contact the lead agency.

2. Reporting

a. Graphic Presentation

Include site maps (plot plans) that are drawn to a scale that remains constant from reporting period to reporting period. These maps must include the following information.

(1) Potential contaminant sources
(2) Well locations
(3) Groundwater elevation contours
(4) Groundwater flow direction(s)
(5) Extent of NAPL
(6) Extent of dissolved chemical constituents of concern
(7) Analytical results as appropriate

Line or bar graphs are helpful when illustrating variations in groundwater elevations, NAPL thickness, and dissolved chemical concentrations with time. Cross sections are recommended if the previous interpretation of subsurface conditions has changed.

b. Tabular Presentation

Present all of the following data in tables to show a chronological history and allow quick and easy reference of the most recent data.

(1) Well designations
(2) Well construction (including well casing elevation, total casing and screen length, and depth to top of screen)
(3) Groundwater depths
(4) Groundwater elevations
(5) NAPL elevations
(6) NAPL thickness
(7) Analytical results (current as well as historical)
(8) Measurement dates

c. Discussion

Provide a discussion of the field and laboratory results, which includes the following information:

(1) Conclusions
(2) Data anomalies
(3) Variations from protocols
(4) Conditions of wells, including vaults and seals
(5) Management of drill cuttings and purge water
(6) Trend analysis
(7) Data interpretation
(8) Recommendations

d. Appendices

Include the following information in appendices:

(1) Complete analytical laboratory reports
(2) Well purging and sampling documentation (including equipment used, date and time, and infield water quality measurement), which must include all information on the attached example purge log.
(3) Decontamination procedures
(4) Field QA/QC methods
(5) Sample preservation
(6) Documentation of quantities of product, well development and purge water, and drill cuttings recovered or generated during field activities, and documentation of their proper disposal or recycling (include copies of hazardous waste manifests and bills of lading)

VIII. Non-Aqueous Phase Liquids

Soil and groundwater impacts may include the presence of NAPL. Depending on the physical properties of the contaminant, the NAPL may be lighter or denser than water. In general, contaminants such as fuels (e.g., TPH) have densities that are lower than water and are commonly referred to as LNAPL. Chlorinated hydrocarbons (CHCs) have densities that are higher than water and are commonly referred to as DNAPL.

NAPL can occur in the subsurface, partially or completely saturating pore or fracture spaces. Because of the low solubility of these chemicals, the presence of NAPL can be an ongoing source of groundwater contamination. To properly evaluate the long-term impacts of a release to groundwater, and the environmental risk, it is important to determine if NAPL is present. The presence or absence of NAPL in the subsurface will influence how the site is managed with respect to the selection of site characterization methods, consideration of appropriate remedial technologies, and development of a viable risk assessment. The San Diego RWQCB has provided some guidance on the data collection requirements for the evaluation of NAPL (Appendix E.V).

A. Evaluation and Determination of Residual Saturation

Initial site characterization data used to evaluate the presence of DNAPL include:

- Visual identification of chemical product in soil
- Visual identification of chemical product in wells or excavations
- Comparison of measured chemical concentrations in groundwater to equilibrium partitioning concentrations
- Comparison of measured chemical concentrations in soil to equilibrium partitioning concentrations
- Anomalous concentrations of chemicals in groundwater, soil, or soil vapor

NAPL characterization needs to include some or all of the following elements:

- Detailed characterization of site stratigraphy
- Determination of capillary properties of key lithologies
- Determination of NAPL chemical composition and fluid properties
- Estimation of NAPL mobility
- Estimation of residual NAPL distribution (horizontally and vertically)
- Estimation of NAPL volumes

The presence of NAPL is of significant concern because it has the potential to cause explosions and vapor problems, and/or be a continuous source of groundwater contamination. Additionally, these compounds can move through geologic materials as a NAPL, as dissolved components in water, or as vapors in soil pores.

As a general practice, the presence of NAPL in the subsurface has been investigated by using wells screened through the capillary fringe and the water table. The presence or lack of NAPL in wells or excavations is due to a number of site-specific conditions that may change with time. Typical conditions can include, but may not be limited to, a fluctuating water table, residual NAPL saturation, and soil type. Due to these conditions, the use of wells to define the presence of NAPL has resulted in inconsistent and unreliable results.

The following guidance is provided to aid in determining if NAPL is present at the site in the unsaturated and saturated zones.

A percentage of a fluid that is introduced into a soil will be permanently captured within the porous structure of the soil and/or rock materials. This is due to surface tension characteristics and capillary forces. The maximum percentage by volume of the liquid retained after gravity drainage is the specific retention of that liquid for that specific soil. For liquids other than water, this is commonly called the **residual saturation**. Besides reporting residual saturation as a percentage or fraction of the pore space, it is also commonly reported by laboratories as mass of the hydrocarbon per unit mass of soil (e.g., mg/kg, micrograms per liter [ug/kg], parts per million [ppm], parts per billion [ppb]).

Work by Hoag and Marley (1986), Huntley et al. (1994a,b), Melrose and Brander (1974), Mercer and Cohen (1990), Rathmell et al. (1973), and Tyler and Finley (1991) evaluated residual saturation for various NAPLs and soil/rock types. These researchers demonstrated that a significant fraction of NAPL would remain in soil after gravity drainage. Parker (1991) provides a modification of the Brooks-Corey relative permeability function (Equation 5-3, below) to estimate residual NAPL as a function of soil hydraulic conductivity and NAPL type. The equation assumes that below some critical threshold (q_c), NAPL loses pore continuity and becomes trapped by soil capillary forces, and movement is considered insignificant:

$$S_{ro} = (1-S_{rw}) * [q_c \, \mu_{ro} / (\gamma_{ro} \, K_{swz})]^{0.25}$$ **Equation 5-3**

Where:
- S_{ro} = the residual NAPL saturation (dimensionless)
- S_{rw} = the residual water (dimensionless)
- q_c = the critical flow rate (centimeters per second [cm/sec])
- μ_{ro} = the relative NAPL viscosity to water (dimensionless)
- γ_{ro} = the relative NAPL specific gravity to water (dimensionless)
- K_{swz} = the vertical hydraulic conductivity of the soil (cm/sec)

A more accurate method of determining the residual saturation for a specific soil on a site is a laboratory test method that uses the Dean Stark Method (API RP40) described in Section 5.VIII.D.

Since Equation 5-3 provides residual saturation as a percentage or fraction of the pore space, it needs to be converted to units of mass of the hydrocarbon per unit mass of soil (e.g., mg/kg and ug/kg). This conversion makes it possible to compare the estimated residual saturation to laboratory data for the site. Equation 5-4 should be used to complete this conversion.

$$C_s = \frac{S_{ro} \; \theta \; \rho_o}{((\rho_w \, \theta_w) + \rho_b)\,(1 \times 10^{-6} \text{ kg/mg})}$$ **Equation 5-4**

Where:
- C_s = the concentration of compound in soil (mg/kg)
- S_{ro} = the residual NAPL saturation (dimensionless)
- ρ_o = the density of NAPL (gm/cm^3)
- ρ_w = the density of water (gm/cm^3)
- ρ_b = the dry bulk density of soil (gm/cm^3)
- θ = the total soil porosity (dimensionless)
- θ_w = the water filled porosity (dimensionless)

Equations 5-3

and 5-4 and conservative assumptions on soil type and petroleum-specific residual NAPL saturation were used to generate Table 5-3. DEH selected conservative saturated soil hydraulic conductivities, soil properties, and petroleum properties to provide the lowest expected residual saturation for a particular fuel and soil type. Other parameters such as the relative viscosity (μro) and the specific gravity (γro) are presented in Table 6-2(b) in Section 6. The water filled porosity (θ) is considered equal to the values for residual water (Srw) presented in Table 5-8.

TABLE 5-8

Petroleum Residual NAPL Saturation Based on Soil Type in Sedimentary Environments

Soil Type ASTM-D2487	Approx. Particle Size (mm)	K_{swz} (cm/sec)	θ (dim)	S_{rw} (dim)	ρ_b (gm/cm^3)	TPH Concentration (mg/kg)			
						Gasoline/ Naphtha (mg/kg)	Kerosene / JP-4 (mg/kg)	Diesel #2 (mg/kg)	Fuel Oil (mg/kg)
Gravel	76.2-4.75	100	0.30	0.001	2.00	560	780	1000	1400
Sandy Gravel	Based on % fines	5.0	0.36	0.005	1.86	1,500	2,100	2,800	3,800
M-Coarse Sand	4.75-0.425	1.0	0.37	0.007	1.83	2,300	3,200	4,400	5,900
Fine Sand	0.425-0.074	0.5	0.38	0.009	1.81	2,900	4,000	5,400	7,300
Silty Sand	Based on % fines	0.05	0.41	0.018	1.76	5,600	7,800	10,000	14,000
Silt	0.074-0.005	0.0005	0.48	0.10	1.65	19,000	27,000	36,000	49,000
Clay	<0.005	0.000005	0.56	0.39	1.56	44,000	61,000	82,000	110,000

1. The critical flow rate (q_c) used to calculate the above values was 1 x 10^{-7} cm/sec. This table does not apply in fractured crystalline rock environments
2. The TPH concentration values were determined by using Equations 5-3 and 5-4.

NAPL characterization requires an approach that is distinctly different from dissolved-phase characterization because immiscible flow is controlled by parameters not addressed in a dissolved-phase assessment. These parameters include the fluid properties of the NAPL and the capillary properties of the porous media.

There are many ways to determine the presence of NAPL. A more detailed discussion of the following techniques can be found in Cohen (1993) and Pankow (1996).

B. Visual Evidence

It is possible to identify NAPL visually in soil core samples. This is best accomplished when large quantities of NAPL have been detected or when there is dark colored NAPL such as creosote. More often than not, identifying NAPL visually is difficult because the NAPL may be clear or present near the soil's residual saturation.

C. Field Testing

Field testing methods can greatly increase the probability of determining NAPL presence. Laboratory tests have indicated that NAPL could be identified 80 percent of the time by using UV fluorescence or the soil-water-dye shake test (Cohen, 1993). The following describes the different types of field test methods:

- Ultraviolet Light (UV) Fluorescence: UV examination of soil cores can identify some contaminants such as trichloroethene (TCE) and perchloroethene (PCE). Uncontaminated soil should also be examined as a control since some soil minerals also fluoresce.

- Soil-water Shake Tests: If NAPL is suspected in a portion of a soil core, a soil-water shake test can be performed by mixing a small volume of soil with an equal volume of water in a clear vial. The presence of DNAPL can be determined by examining the sides and bottom of the tube. To enhance the test, a small amount of hydrophobic dye such as Red Sudan IV or Oil Red O can be placed in the vial. The dye, which is soluble in NAPL compounds but insoluble in water, will cause the NAPL to change color.

- Vapor Analysis: If volatile organic compound (VOC) readings from a head-space analysis are on the order of 1,000 to 2,000 ppm, NAPL may be present.

- Drilling Fluids: The presence of NAPL in drilling fluids can be determined by visual examination of the fluid for sheen.

- Soil Analytical Data: If the soil sample results are at or above the chemical's residual saturation, NAPL may be present.

- Groundwater Analytical Data: The presence of NAPL can also be determined by evaluation of water quality analytical results. If a particular compound is present at concentrations on the order of 1 to 10 % of the chemical solubility, NAPL may be present.

- Observation of NAPL in Well or Excavation: LNAPL will be observed floating on top of the groundwater in the well, whereas DNAPL will be observed at the bottom of the well or excavation. Please refer to Cohen (1993) or Pankow (1996) for a more detailed discussion of this topic.

D. Laboratory Testing

Currently, neither the EPA nor the ASTM has specified laboratory methods for determining the mobility of NAPL. Since there are no prescribed methods outlined, the following methodology can be used to evaluate product mobility in soil for sites located within San Diego County. The data derived from this laboratory test can be used to assess the potential mobility of NAPL under in situ conditions.

The following are the recommended procedures for this method:

1. Conduct product mobility testing on soil samples that represent in situ conditions in terms of soil compaction, soil structure, and contaminant concentrations.

2. Visually examine the geologic formations and/or soil structure in road cuts or trenches on or near the site to verify in situ conditions.

3. Evaluate subsurface soils for the potential of “finger flow” movement of contaminants. “Finger flow” is present to a degree in most cases. In those cases where fine-grained soils overlay uniform clean sands and/or coarse-grained sands, “finger flow” may pose a significant problem, and a groundwater monitoring well may be required to evaluate potential impacts to groundwater.

4. For those soils that need to be re-compacted (e.g., because of cobbles), make every effort to replicate the sample to in situ conditions.

5. Determine the residual saturation by using the following testing method: (Prior to collecting samples for this method contact your laboratory to determine sample size and preparation needed to complete the testing.)

   The soil sample is placed in a temperature-controlled centrifuge and subjected to increasing rotational speeds from 50-5000 revolutions per minute (rpm). Each rotational speed is maintained up to 24 hours or until fluid production stabilizes before the speed is increased to the next step. Volumes of water and hydrocarbons produced are determined by using calibrated collection tubes. Values are recorded at each step. Following the final step, the sample is removed from the centrifuge and residual fluids are extracted (Dean-Stark Method; API RP40). At the completion of the test the following items should be reported:

   - Initial hydrocarbon saturation (% and mg/kg)
   - Residual hydrocarbon saturation (% and mg/kg)
   - Fluid production vs. capillary pressure relationship
   - Sample petrophysical properties: effective porosity (%), grain and bulk density (gm/cc)

6. Compare the measured residual saturation values to the highest TPH concentration from the site. If the site value is <u>less than</u> the laboratory residual saturation value, the contaminant is considered to be below residual saturation. This will indicate that the contaminant is not mobile as a NAPL. If the site value is <u>greater than</u> the laboratory value, the contaminant is above the residual saturation and may be mobile. This indicates further investigation and/or remediation is necessary.

7. Review subsequent guidance sections regarding evaluation of soil leachability and potential impacts to groundwater.

IX. SOIL LEACHABILITY

To estimate the leaching potential of impacted soil, one of the following laboratory testing methods for leachability of a particular soil can be used:

- **EPA Method 1312**, Synthetic Precipitation Leaching Procedure (SPLP)
- **ASTM Method D4874-95**, Leaching Solid Material in a Column Apparatus

These tests are intended to aid in determining the maximum concentration of a contaminant that may remain in soil without potentially leaching to groundwater. A leachability study is not appropriate in materials where transport is primarily through fractures or if fractures are suspected.

A. Soil Sampling

For the majority of situations, obtain a minimum of three samples from each predominantly impacted soil type or geologic unit. These samples should encompass the full range of contaminant concentrations. One of the samples must represent the highest concentration of soil contamination; this is commonly located in or near the source. If the soil type or geologic unit varies in texture and composition, additional samples will need to be taken and analyzed to evaluate the leachability of the contaminant.

B. Analysis of Soil and Leachate

The following table is provided for guidance on the analyses to be performed. The soil analysis must be completed prior to running the SPLP analysis. The SPLP method should not be used to analyze soil samples with non-detect concentrations.

Substance	Soil	SPLP Leachate
Gasoline	EPA-8260	EPA-8260
Diesel	EPA-8260and/or 8270	EPA-8260 and/or 8270
JP-4	EPA-8260 and/or 8270	EPA-8260 and/or 8270
Kerosene	EPA-8270	EPA-8270
MTBE	EPA-8260B	EPA-8260B
Waste Oil**	Case-by-case	Case-by-case
Solvents**	Case-by-case	Case-by-case

** The specific analysis will be determined on a case-by-case basis. Selection of target compounds should be based on knowledge of the waste.

C. Leachate Testing Procedures

1. SPLP Testing (EPA Method 1312)

This method is a standard laboratory procedure designed to determine the leaching potential of organic and inorganic compounds present in soils and wastes. It provides a leachate for analysis from a disaggregated soil or waste sample. This method uses pH-adjusted deionized water for metals analysis, and deionized water for cyanide and organic compounds.

2. Leaching Solid Material in a Column Apparatus (ASTM Method D4874-95)

This method is a standard laboratory procedure for generating aqueous leachate from soil using a column apparatus. It provides a leachate suitable for organic and inorganic analyses from samples that are undisturbed. This method is less aggressive than the SPLP procedures outlined above and is considered to be more representative of field conditions.

Since method detection limits (MDLs) for the target analyses will vary between analytical laboratories, it is important to acquire a sufficient volume of pore water to achieve detection limits down to the required action level.

To provide results that are more representative of in situ field conditions, this method should be modified as follows:

a. Test only undisturbed samples to represent optimum field conditions of porosity, density, or moisture. <u>Do not disaggregate and repack columns</u>.

b. Use a flexible sleeve column loaded to in situ confining pressures to prevent channeling. The laboratory should be notified of the depth of the sample so that the proper confining pressure can be maintained. The flexible sleeve should be of Teflon or other relatively inert material to prevent contamination of the leachate.

D. Data Interpretation

The sample results should be plotted on log-log graph paper. The soil results are plotted on the x-coordinate and the leachate results are plotted on the y-coordinate. Separate graphs should be made for each soil type or geologic unit.

The following example is provided to demonstrate the interpretation of benzene SPLP data.

EXAMPLE:

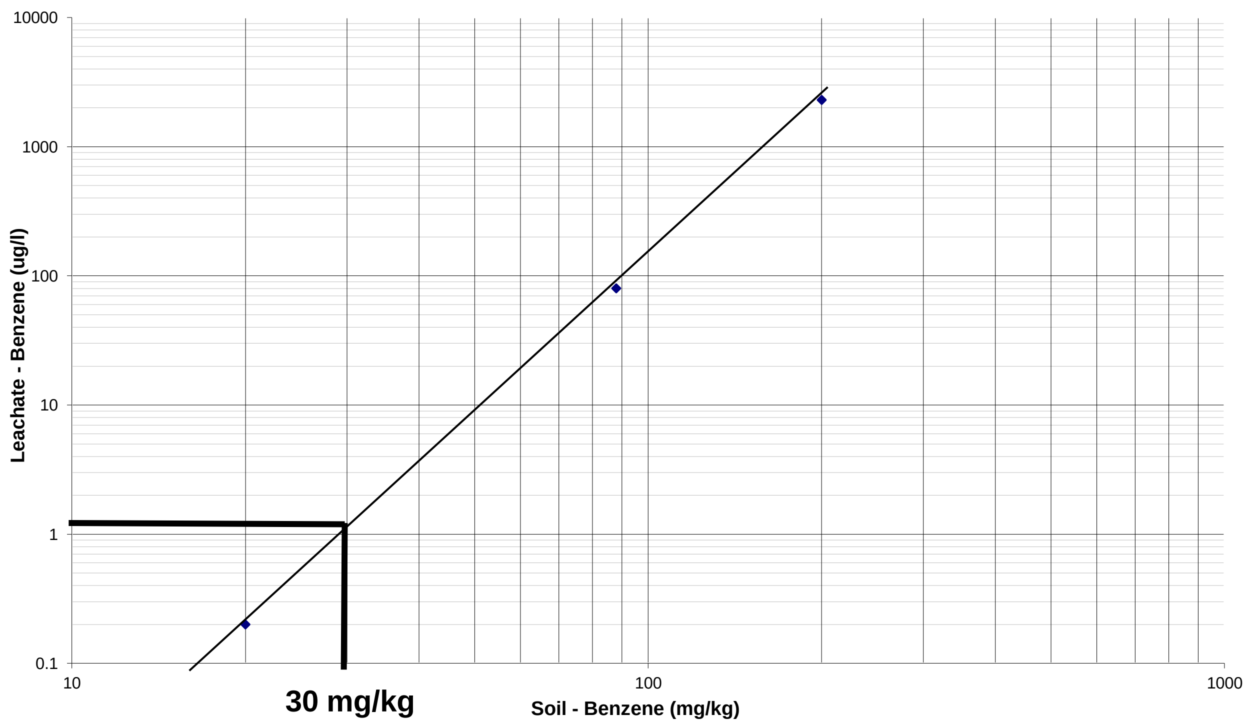
Three samples were obtained from a site in an area where groundwater was designated as having municipal and domestic uses. Torrey Sandstone, which was observed to be a light-brown, medium-grained, subangular, and moderately indurated arkosic sandstone, underlies the site. The following are the soil and SPLP results for benzene:

	Soil	Leachate
Sample 1	200 mg/kg	2,300 ug/l
Sample 2	82 mg/kg	80 ug/l
Sample 3	20 mg/kg	0.20 ug/l

Figure 5-1 is a graph of the data above. At the point on the plotted line where benzene is 1 ug/l in the leachate (the MCL for benzene), the corresponding benzene concentration in the soil sample is 30 mg/kg. Assuming no attenuation in the unsaturated zone, all soils greater than 30 mg/kg may impact groundwater in excess of the water quality goals for the area.

Figure 5-1

Soil Concentration vs. Leachate Concentration



X. LABORATORY ANALYSIS

Analytical reports and QA/QC data packages prepared for submittal to DEH must be in accordance with the sampling and analysis plan for a specific program, either UST Removal or Initial Site Assessment for contamination characterization. The analyses shall be performed by an Environmental Laboratory Accreditation Program (ELAP) certified laboratory granted by California Department of Health Services (DHS). All analyses shall be performed in accordance with laboratory certification criteria and the CCR, Title 22. A copy of all relevant laboratory data must be submitted to DEH.

A. Required Analytical Methods

For UST removals, the analyses in Table 5-9 must be performed. For site assessment purposes, the analyses in Table 5-10 must be performed. Additional analyses may be required for treatment, remediation, transport, or disposal purposes. EPAMethod 8015B or DHS-TPH analysis preparation methods for various fuels are provided in Table 5-11.

Regardless of which analytical method is used, EPA8015B or DHS-LUFT , or detector FID or GCMS, it is imperative that consistent results be obtained so that analytical data can be compared effectively from different laboratories. To accomplish this, gasoline and diesel must be evaluated using the same carbon ranges and quantitated in the same manner. The gasoline carbon range is to be determined from C6- C10 and the diesel range is to be determined from C10- C28. The retention time for C6 is to start after the elution of 2-methyl-pentane and the retention time for

C10 is to start after the elution of 1,2,4-trimethylpenatane. The response factors for gasoline and diesel are to be determined using a calibration curve from gasoline and diesel standards, respectively. Gasoline is to be integrated baseline to baseline, summing the total area responses across the specified carbon range. Diesel is to be integrated using a dropline integration whereby a horizontal baseline is drawn to obtain total area under the diesel "Hump". If heavy oil components alter the baseline near the C28 end, the dropline integration baseline should remain consistent to the method blank. The calibration factor (CF) is calculated as follows:

$$CF = \frac{\text{Total area within Carbon range}}{\text{Mass injected (nanograms)}}$$

Samples are to be prepared, analyzed and integrated in the same manner as the standards. If samples contain a significant concentration of chlorinated or other non-petroleum type analytes, the laboratory should remove their area responses from the total area determined. If this subtraction is not performed, at a minimum, the data should be flagged to indicate this.

Note: For samples collected at the time of UST removal, copies of chromatograms may be submitted with the laboratory report for all TPH analyses by the EPA Methodi 8015B and/or DHS-TPH Method. These chromatograms will be qualitatively evaluated to help determine if further site assessment is needed.

TABLE 5-9: REQUIRED ANALYSES FOR UST REMOVALS[1]		
SUBSTANCE	**COMPONENT**	**METHOD**
GASOLINE/DIESEL	Total Petroleum Hydrocarbons (TPH C_6-C_{28})[2]	EPA 8015B or DHS-LUFT
	BTEX and VOCs[3]	EPA 8260B
	MTBE, TBA, and related oxygenates[3]	EPA 8260B
WASTE OIL	Total Recoverable Petroleum Hydrocarbons (TRPH)	EPA 418.1
	BTEX and VOCs[3]	EPA 8260B
	MTBE, TBA, and related oxygenates[3]	EPA 8260B
	TPH extended	EPA 8015M
DRY CLEANING SUBSTANCE	Stoddard Solvent	EPA 8015B
	PCE	EPA 8021 or 8260B
OTHER	Submit a written plan to DEH with UST removal application	Various

[1] Analyses are most commonly performed on soil samples. Water samples in areas of shallow groundwater may be requested.

[2] Upon request, copies of chromatograms should be submitted on 8.5 x 11 format. These chromatograms will be used qualitatively to help determine if further site assessment is needed.

[3] The highest TPH or TRPH sample from each UST excavation should be analyzed fro BTEX, VOCs, MTBE, TBA and related oxygenates. In the event that there are diesel and gasoline USTs in the same excavation, the highest TPH sample from each UST type should be analyzed for BTEX, VOCs, MTBE, TBA and related oxygenates. In addition, for piping and dispensers, the highest TPH sample per piping run should be analyzed for BTEX, VOCs, MTBE, TBA and related oxygenates.

TABLE 5-10: LABORATORY ANALYSES FOR INITIAL CONTAMINANT CHARACTERIZATION

SUSPECTED SUBSTANCE	A. COMPONENT	B. METHOD
GASOLINE DIESEL JET A FUEL	Total Petroleum Hydrocarbons (TPH) [1, 4]	EPA 8015B or DHS-LUFT
	Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) [2, 4]	EPA 8260
	Volatile Organic Compounds [3]	EPA 8260
	Total Lead [2, 3, 4, 7]	EPA 6010
	Organic Lead (Soil Only) [3, 5]	DHS organic lead or EPA 3050 or 6010
	MTBE [2, 4]	EPA 8260B
	Other Oxygenates	EPA 8260
	Polynuclear aromatics (PNAs) (Diesel Fuel) [2, 4]	EPA 8310 or 8270 [7]
WASTE OIL	Total Recoverable Petroleum Hydrocarbons (TRPH)	EPA 418.1
	Benzene, Toluene, Ethylbenzene, and Xylene (BTEX)[2]	EPA 8260B
	MTBE	EPA 8260B
	Chlorinated Hydrocarbons [2]	EPA **8021,** 8260 or 8010
	PCBs [3]	EPA 8082
	Title 22 Metals [2, 3]	EPA 7000 or 6010
	Total Lead [2, 3, 4, 7]	EPA 6010 or 6020
	Organic Lead (Soil Only) [2, 3]	EPA 3050/6010
KEROSENE, HEATING FUEL, BUNKER FUEL	Total Petroleum Hydrocarbons (TPH) [1,4]	EPA 8015B
	PNAs [2, 4]	EPA 8310 or 8270 [6]
OTHER (e.g., plating facilities, agricultural sites)	Submit written plan to DEH	Various, per approved Workplan
DRY CLEANING SUBSTANCES	Stoddard Solvent	EPA 8015B
	Perchloroethylene (PCE)	EPA **8021 or** 8260
	Carbon Tetrachloride [3]	EPA 8260
	Volatile Organic Compounds [3]	EPA 8260

The above analyses are for initial site characterization. Preliminary screening should be based on historical use, operational process, and nature of substance used at the site. Further analyses and monitoring of site activities will depend on the results of the characterization.

1 The samples must be analyzed with an appropriate standard (Gas, Diesel, Jet Fuel, etc.) and the amount of **petroleum** hydrocarbons must be quantified between C_6 and C_{30}. Report all carbon ranges discovered.

2 The number of samples to be analyzed must be based on specific site conditions. At a minimum, analysis of the sample with the highest TPH or TRPH concentration will be required.

3 A written justification for omitting this analysis may be submitted for consideration.

4 Analyze for every water sample collected.

5 Analyze on the highest TPH gasoline sample only.

6 Use Method 8310 PNA list of compounds only.

7 If the Total Threshold Limit Value for lead is greater than 50 mg/kg, run the Soluble Threshold Limited Concentration test and screen for organic lead.

TABLE 5-11: PREPARATION METHODS

SUSPECTED SUBSTANCE	TPH METHOD
Gasoline, Diesel, Jet A Fuel, Kerosene	EPA 8015B or DHS-LUFT using a solvent extraction and EPA 5030 purge
Gasoline only	EPA 5030 using purge and trap followed by GC/MS
Diesel only	EPA 8015B using a solvent extraction
Lead	EPA 3050/6010
Stoddard Solvent	EPA 8015B using a solvent extraction

The following information should be discussed with an analytical laboratory for analyses criteria not listed in this manual. Identify the substances or chemicals of concern, the breakdown products or components to be analyzed, and the recommended analysis methods. DEH will consider alternative analysis methods on a site-specific basis only. Alternative methodology should provide results that are as good and/or more representative than standard method results. Such alternative plans must be included in the scope of a corrective action workplan and submitted to DEH for review and approval. Written approval of such plans is required if the results will be submitted to DEH.

Analytical reporting limits are presented in Table 5-12. It is recognized that high levels of contamination, dilution factors, or matrix interferences may result in higher detection limits. A written explanation should be provided to DEH upon request when the recommended minimum detection limits are exceeded. Use of these minimum detection limits is highly recommended. Analytical results will be evaluated in accordance with current technical information. For optimum representative results, consideration must be given to the method and extraction solvent selected.

TABLE 5-12: REPORTING LIMITS

Contaminant & Method	Matrix	Recommended Reporting Limit
Gasoline, Diesel, Jet A Fuel (EPA 8015B)	Soil	Gasoline & Jet A -10.0 mg/kg, Diesel 500 mg/kg
	Water	Gasoline & Jet A - 10 ug/l, Diesel 500 ug/l
	Vapor	NA
Benzene (EPA 8260)	Soil	0.05 mg/kg
	Water	0.5 ug/l
	Vapor	0.1 ug/l-vapor
Toluene (EPA 8260)	Soil	0.05 mg/kg
	Water	0.5 ug/l
	Vapor	1 ug/l-vapor
Xylene (EPA 8260)	Soil	0.05 mg/kg per isomer
		0.15 mg/kg isomer total
	Water	0.5 ug/l per isomer
		1.5 ug/l isomer total
	Vapor	1 ug/l-vapor
Ethylbenzene (EPA 8260)	Soil	0.05 mg/kg
	Water	0.5 ug/l
	Vapor	1 ug/l-vapor
Volatile Organic Compounds (EPA 8021 or 8260)	Soil	0.005 mg/kg to 0.5 mg/kg depending on compound
	Water	0.5 ug/l to 100 ug/l depending on compound
	Vapor	1 ug/l-vapor
Organic Lead (EPA 6010 or 3050)	Soil	0.5 mg/kg
Total Lead (EPA 6010 or 6020)	Water	5 ug/l (primary MCL for drinking water)
Total Recoverable Petroleum Hydrocarbons (EPA 418.1)	Soil	10.0 mg/kg
	Water	500 ug/l
MTBE, TAME, DIPE and ETBE (EPA 8260B)	Soil	0.1 mg/kg
	Water	1 ug/l
	Vapor	1 ug/l-vapor
TBA (EPA 8260B)	Soil	1 mg/kg
	Water	10 ug/l
	Vapor	10 ug/l-vapor
PNA/Naphthalene (EPA 8270 or 8260) and PNA (EPA 8270 or 8310)	Soil	200-400 ug/kg
	Water	10 ug/l
	Vapor	Site specific. Check with DEH representative.
PCBs/Pesticides (EPA 8082 or 8270)	Soil	SW-846 requirements/estimated quantitation limits
	Water	
Vinyl chloride	Soil	0.005 mg/kg
	Water	0.5 ug/l
	Vapor	0.05 ug/l-vapor.

TABLE 5-12: REPORTING LIMITS (Continued)		
Contaminant & Method	**Matrix**	**Recommended Reporting Limit**
Methane (EPA 8015 Mod)	Vapor	10 ppmv (0.001%)
Carbon Dioxide (CO_2) – Field Method	Water	Check with DEH representative.
	Vapor	1000 ppmv
Oxygen (O_2)	Water	Check with DEH representative.
	Vapor	1000 ppmv
Nitrogen (N)	Vapor	10000 ppmv

B. Laboratory Report

The complete laboratory report is typically attached as an appendix to the site assessment report. A summary table with field sample identifications, lab sample identifications, if different, and analytical results must be included in the main text of the site assessment report. All laboratory data submitted to DEH must include the following minimum information.

1. Site/job identification (e.g., site address, city)

2. Sample identification and laboratory identification

   Official laboratory letterhead paper must be used. Mobile laboratories must indicate a "mobile laboratory" (or equivalent) and the location where analyses were performed.

3. Quality assurance and quality control (QA/QC) data

   See Table E-1 in Appendix E.VIII.

4. Analysis method, extraction and preparation methods, units reported (e.g., mg/kg), and limits of detection

5. Copies of all analytical data

6. If appropriate, submit a copy of the chromatogram of the highest concentration of each contaminant found in the initial site assessment report. For example, if the results indicate only gasoline is present, you may want to provide a copy of the chromatogram of the highest gasoline result detected. If the results indicate gasoline in some samples and a mixture of gasoline and diesel in other samples, you may want to submit at least two chromatograms. Non-compliance with method procedure (i.e. holding times, temperature issues, etc.) must be explained in the laboratory report.

7. Chain-of-custody and sample analysis request documents must be submitted with all laboratory analyses data reports. The analysis request may be reflected on the chain-of-custody document. Date of sample collection must be clearly noted on the chain-of-custody document.

8. Remarks as necessary (e.g., condition of sample, appropriate container, excess holding times)

See Table E-1 in Appendix E.VIII for additional information.

9. Analytical results are expected to be within the laboratory's control limits. Written explanation will be required for analyses outside of these limits.

   Note: Additional information for some issues may be necessary. If DEH requires additional laboratory or analytical information not outlined in this Manual, the request will be made in writing to the responsible party (RP).

C. Laboratory QA/QC Reporting

In the laboratory, quality assurance and quality control (QA/QC) are a set of protocols designed to verify and maintain a desired level of quality in the analytical process. QA/QC requires careful planning, continued inspection, and appropriate corrective action.

The QA/QC requirements for analyses submitted to DEH are summarized in Table E-1 of Appendix E.VIII.

D. Field QA/QC

QA/QC in field work refers to field procedures that can affect sample results and methods used to check the quality of field techniques. The purpose of this guideline is to describe acceptable quality check procedures for use in routine environmental investigations carried out in San Diego County that are evaluated by DEH.

This guideline does not present detailed field procedures; these will be found in other sections of this manual and in published handbooks (e.g., EPA SW-846, RCRA Technical Enforcement Guidance Document [TEGD], SWRCB LUFT Manual). It is assumed that field workers will use their best professional practices when collecting samples. (Note: Do not assume that the procedures in this guideline are suitable for unusual cases, or that they will be accepted by other regulatory agencies.)

E. Blanks

A. Trip Blank

A trip blank is a sample container of matrix material prepared in the lab, carried into the field, and returned to the lab with the samples without being opened. The purpose of the trip blank is to pick up any cross contamination between sample containers, and to show if the container or the preservative has added contamination to the sample. It must be the same type of container, from the same batch of containers, as is used to store the samples. It must be prepared and sealed before arrival at the site. Preservation and packaging must match that of the field samples.

Trip blanks for water are straightforward to prepare and can be quite useful, since water cleanup levels are often close to the limits of analytical detection. One water trip blank for each unique combination of preservation and packaging should be carried during each groundwater-sampling event. The blank should be prepared with distilled water of known quality. Preparation must be done in an area free of airborne contamination.

Trip blanks for soil are difficult to prepare and of questionable value. The amount of contamination released from or adsorbed onto soil is dependent on the soil composition. Preparation of a functional soil blank requires detailed study of site soil characteristics. Therefore, no trip blank is necessary for soil.

To help avoid cross contamination during storage and transport, contaminated samples should be segregated from apparently clean samples, and water samples should be separated from soil samples. Blanks should travel with the clean(er) samples, since impact on those samples is more critical and detectable. Samples and blanks should be stored at the required temperature and preservatives used where required to prevent biologic degradation. These procedures are also to be followed even when mobile labs are utilized.

Equipment Blank

An equipment blank is prepared on site by passing clean matrix material through decontaminated or factory-sealed sampling equipment. The water used must be free of volatile organic contaminants. Presumably, this picks up contamination from the equipment, from the air, from the sample container, and through sample cross contamination during storage and transport.

An equipment blank is needed for water analysis. One water equipment blank should be prepared for each day of water sampling at a site; it should be prepared after sampling has been completed. No equipment blanks are needed for soil for the same reasons as for trip blanks. Some published protocols call for field blanks, which check for contamination via air at a sampling site. DEH does not consider these necessary for hydrocarbon investigations.

Analysis of Blanks

Analysis of blanks may or may not be needed. If some sample analysis results are "non-detect," inadvertent contamination is obviously not systematic and there is no need to analyze the blanks. If all samples are grossly contaminated and confirm field observations, analysis of the blanks is not needed. Analysis of blanks can be useful if:

- Unsuspected materials are detected in the samples,
- All samples yield nearly equal results, or
- Sample results are borderline for opening or closing a case.

Prompt consultation with DEH staff is essential if any of the above conditions are encountered. Blanks must be analyzed within the specified holding time. The decision on the need for blank analysis is the responsibility of the consultant and RP. If the quality of data is suspect and blank results have not been provided, DEH may require re-sampling. Results of blank analyses are not used to correct analytical values. Rather, they indicate a need to find the source of the problem and to take corrective action, including re-sampling if necessary.

F. Duplicate Samples

Duplicates are samples taken in sequence to show natural variability. Closely spaced soil or rock samples are expected to have variable contaminant chemistry. This can be caused by abrupt changes in soil characteristics that influence the amount of contamination retained. Knowing where a sample comes from in the geologic framework of the site is more valuable than arbitrarily taking a second sample adjacent to the first.

Sequential groundwater samples will vary in chemistry. This is influenced by sample collection method, well purging method, and well recharge characteristics. Because no acceptable difference between duplicates can be specified, and because trends over time and space are used to evaluate the condition of a contaminated site, duplicates are not required.

G. Background Samples (Required If Background Contamination Suspected)

If background contamination is suspected, the contaminant needs to be quantified and confirmed as background. The consultant must defend any case of suspected background contamination. Background soil or rock samples must be in the same geological material as the contamination. Background water samples must be taken upgradient of, but close to, the contaminated area; they must be from the same water-bearing zone as the contaminated samples. (NOTE: In San Diego County, naturally occurring metals in soil, contaminated imported fill, and chlorinated solvents in groundwater have caused background problems.)

H. Containers, Preservation and Holding Time

Correct handling of samples is needed to eliminate bias and cross contamination prior to laboratory analysis. See EPA SW-846 for correct handling procedures.

XI. WASTE CHARACTERIZATION AND SOIL REUSE

Soil that is disturbed and accumulated at a contaminated site through excavation, drilling, or other means must be characterized to determine the concentration of any contaminants for proper disposition. Examples of stockpiled soil include:

- Excavated soil from a UST removal
- Excavated soil placed back into a UST pit
- Graded soil
- Soil cuttings from borings or well construction
- Imported clean soil mixed with contaminated soil

All stockpiled soil that is associated with an unauthorized release, spill, or other release, and that is not intended to be transported off-site or is to be transported to an unregulated site, must be sampled and analyzed in accordance with the following statistical procedure. This procedure provides a uniform approach for demonstrating the contaminant level within a uniform soil mass. Prior approval must be obtained from DEH and/or the RWQCB for off-site transport or reuse on-site of any soil associated with an unauthorized release, or that is otherwise contaminated.

The RWQCB has adopted a resolution for the reuse of inert soil contaminated with Title 22 metals. RWQCB Resolution Number R9-2007-0104, Conditional Waiver Number 8 (Waiver) sets specific criteria for the reuse of soils contaminated with Title 22 metals. In order for inert soil to be considered eligible for this Waiver, a number of criteria must be met as outlined in the aforementioned Resolution. Soil Screening Levels are separated into two tiers depending on current or proposed site use with the primary distinction being allowable Title 22 metal concentrations. For more information on this Waiver, please reference RWQCB Resolution Number R9-2007-0104.

A. Soil Reuse Guidance

As indicated above, DEH must approve the sampling, handling, or reuse of contaminated or potentially contaminated soil. While no guidance can be comprehensive enough to address every site or situation, DEH offers the following general guidance for the reuse of contaminated or potentially contaminated soil.

1. Offsite Soil Reuse

   - Soil contaminated with Title 22 metals only, must be evaluated and conform to Tier 1 criteria in accordance with RWQCB Resolution Number R9-2007-0104, Conditional Waiver Number 8.

   - Soil potentially contaminated with constituents other than Title 22 metals must be below DEH approved laboratory reporting limits and must not appear to be impacted by visual inspection or odor.

   - Soil potentially contaminated with hydrocarbons must not contain hydrocarbon concentrations above a laboratory reporting limit of 10 milligrams per kilogram as identified by EPA Method 8015 – Extended Range. Reporting limits for VOCs, chlorinated hydrocarbons, and other compound specific contaminants must be approved by DEH in advance of soil excavation and export.

2. Onsite Soil Reuse

   - Soil contaminated with Title 22 metals only, must be evaluated and conform to Tier 1 criteria for residential use and Tier 2 criteria for commercial use in accordance with RWQCB Resolution Number R9-2007-0104, Conditional Waiver Number 8.

   - Concentrations and locations of constituents of concern must be shown to be protective of human health and the environment, including groundwater, as identified by a receptor pathway evaluation.

   - Soil contaminated with hydrocarbons must not exhibit concentrations greater than the residual NAPL saturation level as identified in Table 5-8.

   - Contaminants must be adequately assessed in order to determine if the aforementioned guidance has been satisfied.

B. Sampling Protocol for Stockpiled Soil

1. Stockpiled soil that is designated for disposal to a permitted hazardous waste or specified waste facility, or to a treatment/recycling facility, must be sampled and analyzed in accordance with the receiving facility's requirements. These facilities may have different

requirements than those presented below. Copies of all laboratory data and hazardous waste manifests, or other transportation documents generated for the soil treatment or disposal, must be submitted to DEH to demonstrate the proper handling and disposal of contaminated soil.

2. DEH will not accept composite soil samples for characterizing contaminated soil stockpiles. Only discrete samples will be accepted, because of the losses of volatile contaminants during sample handling and the dilution of non-volatile contaminants.

3. All stockpiled soil associated with an unauthorized release, spill, or other release that is not intended to be transported off site to a permitted facility, or has not been previously characterized through in situ sampling, must be sampled in accordance with the protocol outlined below. This protocol provides a uniform approach for demonstrating the contaminant level within a soil mass. Prior approval must be obtained from DEH and the RWQCB for off-site transport or reuse on-site of any soil associated with an unauthorized release, spill, or other release, including soil taken from areas of the site outside of the spill or release.

4. Procedures in EPA Publication SW-846 provide a method for determining the mean concentration of a given contaminant within a soil mass and the appropriate number of samples necessary to calculate this mean to within a specified confidence level. Initial sampling should generate a minimum number of samples/analyses as described below. Additional sample analyses may be required to meet the confidence levels given in SW846; therefore, archiving of samples may be appropriate. Archived samples must be appropriately preserved and analyzed within the maximum holding time specified in SW-846. The minimum number of discrete samples initially required is given below:

   - Stockpiles less than 10 cubic yards: a minimum of two (2) samples must be collected, one from each half of the stockpile. Select sample points randomly within each half.

   - Stockpiles from 10-20 cubic yards: a minimum of three (3) samples must be collected, one from each third of the stockpile. Select sample points randomly within each third.

   - Stockpiles from 20-100 cubic yards: a minimum of four (4) samples must be collected, one from each quarter of the stockpile. Select sample points randomly within each quarter.

   - Stockpiles from 100-500 cubic yards: a minimum of one (1) sample for each 25 cubic yards or portion must be collected (e.g., a 130-cubic yard stockpile would require 6 samples). Section the stockpile into 25 cubic yard portions and obtain a minimum of one (1) sample from each 25 cubic yard portion. Select sample points randomly within each 25 cubic yard portion of the stockpile.

   - Stockpiles over 500 cubic yards: contact DEH for guidance on the minimum samples necessary.

5. Random sample points must be selected from locations on a three-dimensional grid. The presence of materials such as boulders, debris, etc., may make strict application of this requirement impractical. In such cases, it is appropriate to obtain the sample as close as possible to the randomly selected point without altering the spirit of the random selection

process. For hydrocarbon contaminants, sample collection in either metal tubes or glass jars is acceptable, provided every effort is made to minimize the loss of volatile constituents. Metal tubes are preferred, since they will minimize aeration of the samples. Containers should be completely filled, capped, and placed on ice immediately.

6. Stockpiled soil is assumed to have a non-homogeneous distribution of contaminants. If a stockpile previously characterized by this protocol is split for any reason (such as to excise a portion expected to be highly contaminated from a non- or lesser-contaminated portion), the remaining mass must be re-sampled as a new stockpile per the previously described protocol to establish its mean contaminant concentration. Note that it is not necessary to consider each individual stockpile separately. At the discretion of the consultant, stockpiles expected to contain similar contaminant conditions can be considered part of the same soil mass for the purpose of SW-846 sampling.

7. Information on stockpiled soil evaluation must be submitted to DEH and must include the following:

   - An estimate of the volume of contaminated soil involved
   - A description of the contaminant (e.g., gasoline, diesel, aviation fuel)
   - A description of the sampling methodology and the sample location/selection process
   - A plot plan detailing the stockpile and sample locations
   - A copy of all sample results, chain of custody documents, and QA/QC supporting data
   - A one-page summary of the laboratory results for the stockpile sampling
   - Statistical calculations for all stockpiles greater than 20 cubic yards. Note: A Stockpile Statistics Worksheet (Table 5-13) and Tabulated Values of Students ‘t’ (Table 5-14) are provided as an aid in completing these calculations.
   - A statement by the RP or by a registered professional (e.g., PG, RCE, Registered Environmental Health Specialist, or equivalent) certifying the level of contamination as determined using the SW-846 statistical process.

8. Data generated by field instrument methodologies such as photo-ionization and flame ionization detectors are not acceptable for quantifying contaminant concentrations.

C. Sampling Protocol for Containerized Soil

The RP or consultant often chooses to manage soil by placing it in containers (e.g., storage bins, 55-gallon drums) for security or aesthetic reasons. The characterization of soil placed in storage bins will typically follow the same sampling protocol as described above for stockpiled soil. However, the characterization of soil placed in drums may require the review of boring logs and site sampling/analytical data, as well as the collection of soil samples from selected drums. Please contact the DEH caseworker for specific direction concerning the characterization of soil stored in drums.

TABLE 5-13: STOCKPILE STATISTICS WORKSHEET[1]

1	List sample results from laboratory Analytical Method: ____________ Units (e.g., mg/kg): ____________		1 | 2 | 3 4 | 5 | 6 7 | 8 | 9
2	Determine number of sample values	n	$n=$
3	Calculate sample mean with n = number of sample measurements	$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$	$\bar{x}=$
4	Calculate sample variance	$s^2 = \frac{\sum_{i=1}^{n} x_i^2 - \frac{(\sum_{i=1}^{n} x_i)^2}{n}}{n-1}$	$s^2=$
5	Calculate sample standard deviation	$s = \sqrt{s^2}$	$s=$
6	Calculate degrees of freedom	$df = n-1$	$df=$
7	Calculate standard error of the mean	$s_{\bar{x}} = \frac{s}{\sqrt{n}}$	$s_{\bar{x}}=$
8	Obtain *student's t value* corresponding to the degree of freedom value determined in #6 above	(See attached table of values on next page)	$t_{.20}=$
9	Calculate the confidence interval	$CI = \bar{x} \pm t_{.20}\, s_{\bar{x}}$	$CI=$
10	Obtain regulatory threshold for the contaminant of concern	RT	$RT=$
11	Calculate	$\Delta = RT - \bar{x}$	$\Delta=$
12	Estimate minimum number of samples	$n_{min} = \frac{t_{.20}^2\, s^2}{\Delta^2}$	$n_{min}=$

[1] In accordance with the California Code of Regulations, Title 22, Section 66694, DEH follows the sampling guidelines set forth in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition,* US Environmental Protection Agency, 1986. This worksheet is based on information found in Volume II, Part III, Chapter 9 of *"SW-846"* and is provided as an aid for stockpile characterization. For circumstances requiring data manipulation beyond that indicated on the worksheet, refer to *"SW-846."*

TABLE 5-14: TABULATED VALUES OF STUDENT'S *'t'* FOR EVALUATING SOLID WASTES

Degrees of Freedom[1] *df* (n-1)	Tabulated value[2] $t_{.20}$ (80% confidence interval)
1	3.078
2	1.886
3	1.638
4	1.533
5	1.476
6	1.440
7	1.415
8	1.397
9	1.383
10	1.372
11	1.363
12	1.356
13	1.350
14	1.345
15	1.341
16	1.337
17	1.333
18	1.330
19	1.328
20	1.325
21	1.323
22	1.321
23	1.319
24	1.318
25	1.316
26	1.315
27	1.314
28	1.313
29	1.311
30	1.310
40	1.303
60	1.296
120	1.289

[1] Degrees of freedom ***(df)*** are equal to the number of samples ***(n)*** collected less one.

[2]Tabulated ***'t'*** values are for a two-tailed confidence interval and a probability of 0.20 (80% confidence level). The same values are applicable to a one-tailed confidence interval and a probability of 0.10 (90% confidence level).

In This Section:

Section 6
Risk Based Decision Process

I. INTRODUCTION

After the soil and water investigation phase is complete and the extent of contamination or the release has been quantified, the following questions must be answered:

- Does the residual soil and groundwater contamination pose a threat to current and/or probable future beneficial uses of water resources?
- Does the contamination pose an immediate or long-term threat to public safety, human health, or the environment, based on current or future site use?
- What levels of contamination remaining in the soil and/or groundwater would be acceptable without impacting public safety, human health, and the environment?
- Is remedial action technically and economically feasible, or can engineering and institutional controls be used to effectively mitigate the risks to human health and the environment from residual contamination?

The responsible party (RP) and the RP's consultant must evaluate answers to these questions. The regulatory agency will determine if the evaluation is adequate.

The following narrative provides guidance on identifying and evaluating the risks at a site and the framework for conducting risk-based correction action. For more detailed description of the risk assessment process, please refer to the *Risk Assessment Guidance for Superfund* referenced below. The following are various documents that discuss risk-based corrective action.

- US-EPA, *Risk Assessment Guidance for Superfund (RAGS),* December 1989, EPA/540/1-89/002 (use the most current update)

- US-EPA, RAGS, January 2009, EPA/540/R/070/002, Part F: Supplemental Guidance for Inhalation Risk Assessment)

- US-EPA, *Region IX Regional Screening Levels (RSLs)*, May 2010 (formerly Preliminary Remediation Goals)

- Cal-EPA, Department of Toxic Substance Control, *Preliminary Endangerment Assessment Guidance Manual,* 1994

- American Society for Testing and Materials (ASTM*), Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites*, (ASTM/RBCA) 2002, E1739-95 (2002)

In this document the term RBCA is the abbreviation for risk-based corrective action. This term is used as a generic description of the process and is not confined to the ASTM methodology.

Risks include health risk related to carcinogenic risk and acute and chronic non-carcinogenic risk, ecological risk, and the threat to water quality. For many chemical compounds, information about human health risk is available. Currently, information on short-term (acute) and long-term (chronic) risk to ecological receptors is limited. The following documents are common references for ecological receptors:

- US-EPA, *Quality Criteria for Water*, 1986 (also known as the "Gold Book")

- US-EPA, *National Recommended Water Quality Criteria: 2002 Table*, and *Revised Human Health Water Quality Criteria* (EPA-822-F-03-012) 2002

- US-EPA *Quality Criteria for Water*, 1976, (also known as the "Red Book")

- US-EPA *Water Quality Criteria*, 1972, (also known as the "Blue Book")

- Department of Toxic Substances Control (DTSC*), Guidance on Ecological Risk Assessments*, July 4, 1996

- US-EPA, *Framework for Ecological Risk Assessment*, 1992, (EPA/630/R-92/001)

- US-EPA, *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments: Interim Final*, 1997, (EPA 540-R-97-006)

- US-EPA, *Guidance for Ecological Risk Assessments*, 1998, (EPA/630/R-95/002Fa)

Acceptable levels of risk to human health can vary significantly based on site land use, adjacent land uses, and the perspective of the property owner, the occupant, and/or the public. An estimate of risk must include all pathways that apply to the conditions at a site. US-EPA indicated the acceptable carcinogenic risk could range from $1x10^{-4}$ to $1x10^{-6}$ with $1x10^{-6}$ being a level of de minimums risk (assumed to be insignificant risk). As a regulatory default, DEH considers $1x10^{-6}$ for both residential and commercial use, as the acceptable risk level. Due to the lack of clear guidance on acceptable exposure levels to ecological receptors, action levels will be developed on a case-by-case basis.

Risk requires three elements: a source, a pathway, and a receptor. If one of these is missing, no risk exists. If all three of these elements are present, a risk may exist. To pose a human health or ecological risk, the source of contaminants must be linked to the receptors by a complete pathway. A pathway is a route a contaminant takes to expose the receptor. Pathways may include natural pathways and man-made pathways. The possible transport media include the air (vapors and/or particulates), soil vapor, soil, sediment, and water (surface and ground). A complete risk assessment must include a receptor pathway evaluation.

II. WATER QUALITY OBJECTIVES

The California Regional Water Quality Control Boards (RWQCB) established water quality objectives for surface water and groundwater throughout California. These objectives are applied to sites where groundwater has been impacted, and they may be more restrictive than health based risk levels.

The Colorado River Basin RWQCB and the San Diego Basin RWQCB have established the water quality objectives in San Diego County as identified below:

A. Beneficial Use Waters

The beneficial use designations for both groundwater and surface water are presented in the following documents:

1. *Water Quality Control Plan for the Colorado River Basin (7*), California Regional Water Quality Control Board, Colorado River Region, February 17, 1994

2. *Water Quality Control Plan for the San Diego Basin (9)*, California Regional Water Quality Control Board, San Diego Region, September 8, 1994

B. Non-Beneficial Use Waters

- **Colorado River RWQCB –** All basins identified in the Colorado River RWQCB Basin Plan for San Diego County are areas with designated beneficial uses.

- **San Diego RWQCB** - The San Diego RWQCB's Basin Plan identifies areas where groundwater has no designated beneficial uses. Cleanup levels in these areas will generally be defined by cleanup of NAPL, and risks to human health and the environment. Soil cleanups will be to a level that precludes the accumulation of non-aqueous phase liquid (NAPL) and ensures protection of human health and the environment. Removal of NAPL is the established groundwater remediation goal.

  Note: For sites within 1,000 feet of marine surface water, the San Diego RWQCB has issued interim cleanup goals for groundwater and criteria for mitigation of low-risk sites (April 1, 1996; revised July 23, 1996, Appendix E.IV).

III. RISK ASSESSMENT PROCESS

The completed evaluation of existing and potential risks at a site is called a "**risk assessment**." A risk assessment may range from a very simple evaluation to an extremely complex evaluation, which includes computer modeling.

A risk assessment consists of three major elements:

- Toxicity Assessment
- Exposure Assessment
- Risk Characterization

The following text is a detailed discussion of each of the three major elements with specific references to those sections of the Manual that contain relevant guidance.

A. Toxicity Assessment

The purpose of the toxicity assessment is to characterize the relationship between the dose of the contaminant absorbed by an individual and the adverse consequences that may result.

Human health risks (carcinogenic and non-carcinogenic) are generally considered to be acceptable if the contaminant concentrations to which humans are exposed do not exceed health-based standards. The contaminant type and exposure route determine health-based standards. These standards include Applied Action Levels (AALs), Maximum Contaminant Levels (MCLs), and US-EPA Region IX Regional Screening Levels (RSLs), and US-EPA Region III Risk Based Concentration (RBCs) and Reference Doses (RfDs). Health-based standards for carcinogens can be calculated from Cal-EPA and US-EPA cancer potency slope factors (SF). Health-based standards for non-carcinogens are calculated using Cal-EPA and US-EPA RfDs.

- The Cal-EPA cancer potency SF and RfD values can be obtained by contacting the Office of Environmental Health Assessment (OEHHA) of the Cal-EPA.
- The US-EPA cancer potency SF values can be found in the US-EPA's Integrated Risk Information System (IRIS). Updates to US-EPA toxicity values can also be obtained from Health Effects Assessment Summary Table (HEAST), or the National Center for Environmental Assessment (NCEA).

Since the Cal-EPA cancer potency SFs are generally more stringent, the Cal-EPA SFs should be used.

For a quick reference, Table 6-1 provides the cancer SFs and RfDs for various compounds that are commonly encountered. Please be aware that these values may change with time. It is best to verify the most current values by accessing the OEHHA website and checking values in IRIS, HEAST, or NCEA.

The toxicity of an individual compound is typically established based on dose-response studies that estimate the relationship between different dose levels and the magnitude of their adverse effects. When evaluating exposures to multiple chemicals, preference is given to data on actual mixtures. Generally, the risks associated with individual constituents of a complex mixture are assumed to be additive and carcinogenic and non-carcinogenic risks are determined separately. For non-carcinogenic endpoints, it is appropriate to sum hazard quotients of compounds (hazard index) with similar toxicological endpoints and mechanisms of action.

Various chemical analysis methods such as for “Total Petroleum Hydrocarbons” (TPH) and "Total Volatile Hydrocarbons" (TVH) are often used during an initial site assessment to focus future investigations toward particular compounds and/or media. These measurements cannot be combined in a risk assessment because the general measure of TPH or TVH provides insufficient information about the amounts of individual compounds present to accurately characterize potential risk.

Carcinogenic

The primary index of cancer effects (i.e., quantitative expression of dose-response information) is the cancer potency SF. SF is a conservative estimate of the incremental probability of an individual developing cancer as a result of exposure over a lifetime. Another factor for carcinogens is the Weight of Evidence Class, which describes the quality and quantity of data that underlie their designation as a potential human carcinogen.

Non-Carcinogenic

The primary index of non-cancer effects (i.e., quantitative expression of dose-response information) is the hazard quotient for individual substances or the hazard index for multiple substances. The hazard index utilizes the reference dose (RfD), although reference concentrations (RfC) and acceptable daily intake (ADI) are also used. RfD is an estimate of the daily exposure to the human receptor that represents an acceptable risk of deleterious effects during a lifetime.

Ecological Receptors

Because current information regarding toxicity to ecological receptors is highly dependent on the environment, the ecological setting, and the species being protected, ecological receptors are evaluated on a case-by-case basis. An evaluation of ecological risk may involve input by DEH, RWQCB, US Coast Guard, US Army Corps of Engineers, California Department of Fish and Game and/or the US Fish and Wildlife Service.

TABLE 6-1

CANCER SLOPE FACTORS AND REFERENCE DOSES

CHEMICAL NAME	CAS #	Cancer SF 1/(milligrams per kilogram [mg/kg]-day)		RfD mg/kg-day	
		Oral	Inhalation	Oral	Inhalation
Benzene	71-43-2	1.0E-01 [1]	1.0E-01 [1]	4.0E-03 [2]	18.6E-03 [2]
Benzo(a)pyrene	50-32-8	1.2E+01 [1]	3.9E-00 [1]		
Carbon tetrachloride	56-23-5	1.5E-01 [1]	1.5E-01 [1]	7.0E-04 [2]	7.0E-04 [2]
Chlorobenzene	108-90-7			2.0E-02 [2]	1.7E-02 [2]
Chloroethane	75-00-3	2.9E-03 [2]	2.9E-03 [2]	4.0E-01 [2]	2.9E-00 [2]
Chloromethane (Methyl Chloride)	74-87-3			2.6E-02 [2]	2.6E-02 [2]
1,2-dichlorobenzene	95-50-1			9.0E-02 [2]	5.7E-02 [2]
1,3-dichlorobenzene	541-73-1			3.0E-02 [2]	3.0E-02 [2]
1,4-dichlorobenzene	106-46-7	5.4E-03 [1]	4.0E-02 [1]	3.0E-02 [2]	2.3E-01 [2]
1,1-dichloroethene (1,1-DCE)	75-35-4			5.0E-02 [2]	5.7E-02 [2]
1,1-dichloroethane (1,1-DCA)	75-34-3	5.7E-03 [1]	5.7E-03 [1]	1.0E-01 [2]	1.4E-01 [2]
1,2-dichloroethane (1,2-DCA)	107-06-2	4.7E-02 [1]	7.2E-02 [1]	2.0E-02 [2]	1.4E-03 [2]
Trans-1,2-dichloroethene	156-60-5			2.0E-02 [2]	2.0E-02 [2]
Dichloromethane	75-09-2	1.4E-02 [1]	3.5E-03 [1]	6.0E-02 [2]	8.6E-01 [2]
Ethylbenzene	100-41-4	1.1E-02 [1]	8.7E-03 [1]	1.0E-01 [2]	2.9E-01 [2]
Naphthalene	91-20-3	1.2E-01 [2]	1.2E-01 [1]	2.0E-02 [2]	8.6E-04 [2]
Methyl tertiary butyl ether (MTBE)	1634-04-4	1.8E-03 [1]	1.8E-03 [1]	8.6E-01 [2]	8.6E-01 [2]
1,1,1-trichloroethane	71-55-6			2.8E-01 [2]	6.3E-01 [2]
1,1,2-trichloroethane	79-00-5	7.2E-02 [1]	5.7E-02 [1]	4.0E-03 [2]	4.0E-03 [2]
Trichloroethene (TCE)	79-01-6	5.9E-03 [1]	7.0E-03 [1]	3.0E-04 [2]	1.7E-01 [2]
Trichloromethane	67-66-3	3.1E-02 [1]	1.9E-02 [1]	1.0E-02 [2]	8.6E-05 [2]
Tetrachloroethene (PCE)	127-18-4	5.4E-01 [1]	2.1E-02 [1]	1.0E-02 [2]	1.0E-02 [2]
Toluene	108-88-3			2.0E-01 [2]	1.1E-01 [2]
Vinyl chloride	75-01-4	2.7E-01 [1]	2.7E-01 [1]	3.0E-03 [2]	2.9E-02 [2]
Xylenes	1330-20-7			2.0E-01 [2]	2.9E-02 [2]

Note: [1] OEHHA Cancer Potency Values as of July 21, 2009
[2] US-EPA, Region 9 RSLs, October 2004

Exposure Assessment

An exposure assessment is a comprehensive evaluation of a site, identifying all existing and potential exposure pathways. This may involve contamination caused by a single release or a collection of problems from on-site and/or off-site sources. There are three main components of an exposure assessment: a site assessment, a pathway and receptor identification, and a contaminant fate and transport evaluation. For additional guidance on site assessments refer to Sections 4 and 5 of this manual.

1. Site Assessment

A complete site assessment adequately identifies the nature and extent of soil and groundwater contamination including its distribution, volume and mass. A complete site assessment must include the following information.

a. Chemical/Physical Properties of Contaminants

Determine the types, concentrations, and chemical/physical properties of individual contaminants and contaminant mixtures present at the site. These properties include, but are not limited to, aqueous solubility, vapor density, liquid density, cosolvency effects, organic carbon partition coefficient (K_{oc}), effective air diffusion coefficient (D_e), soil/water distribution coefficient (K_d), vapor pressure (VP), and Henry's Law Constant (H).

b. Contaminant Volume and Mass

Define the vertical and horizontal extent of soil and groundwater contamination. The distribution of contamination must be presented on maps and cross-sections. An estimate of the contaminant concentration, matrix mass, and volume must be provided.

c. Site Geology and Hydrogeology

Confirm the site geology and hydrogeology by field observation during drilling or excavation work at the site. The site geology must be interpreted in the context of regional geology. Soils must be described by using the accepted standards of the Unified Soil Classification System for soils. Descriptions must be consistent with the generally accepted geological classification of rocks. Please refer to Section 5.III for more detailed description of soil and rock classification.

d. Model Input Parameters

Use site-specific data as input for the most sensitive parameters in the fate and transport model. A sensitivity analysis should be conducted to identify the critical data required. Collection of the most sensitive data during the site assessment phase is recommended to minimize investigation costs incurred during multiple equipment mobilizations.

All physical and chemical analyses must be performed in accordance with documented and approved test methods (US-EPA, ASTM, Cal-EPA, etc.). The site-specific data required for input into fate and transport models vary depending on the model used. Models may use one or more of the parameters listed below. Not all parameters are necessary, but those used must be justified.

- Soil bulk density
- Soil particle density
- Soil moisture content
- Organic carbon content
- Soil porosity
- Unsaturated vertical and saturated horizontal hydraulic conductivity and transmissivity
- Soil suction, matric potential, capillary suction
- pH and redox potential
- Soil cation and anion exchange capacities
- Laboratory grain-particle size analysis
- Stratigraphic sequence and spatial distribution of geologic materials (soils and rocks)
- Identification and analysis of fractures and faults in the subsurface, including analysis of fracture orientation and density at the site
- Site topography and ground surface conditions
- Depth to groundwater (current and historic water level fluctuations, tidal fluctuations, locations of recharge and discharge areas, and groundwater flow directions and gradients)
- Distance to receptors (e.g., human, environmental, surface water, groundwater, utilities, adjacent properties)
- Annual climatic variables (e.g., annual rainfall, rainfall intensities, storm frequency, temperature, evapotranspiration)

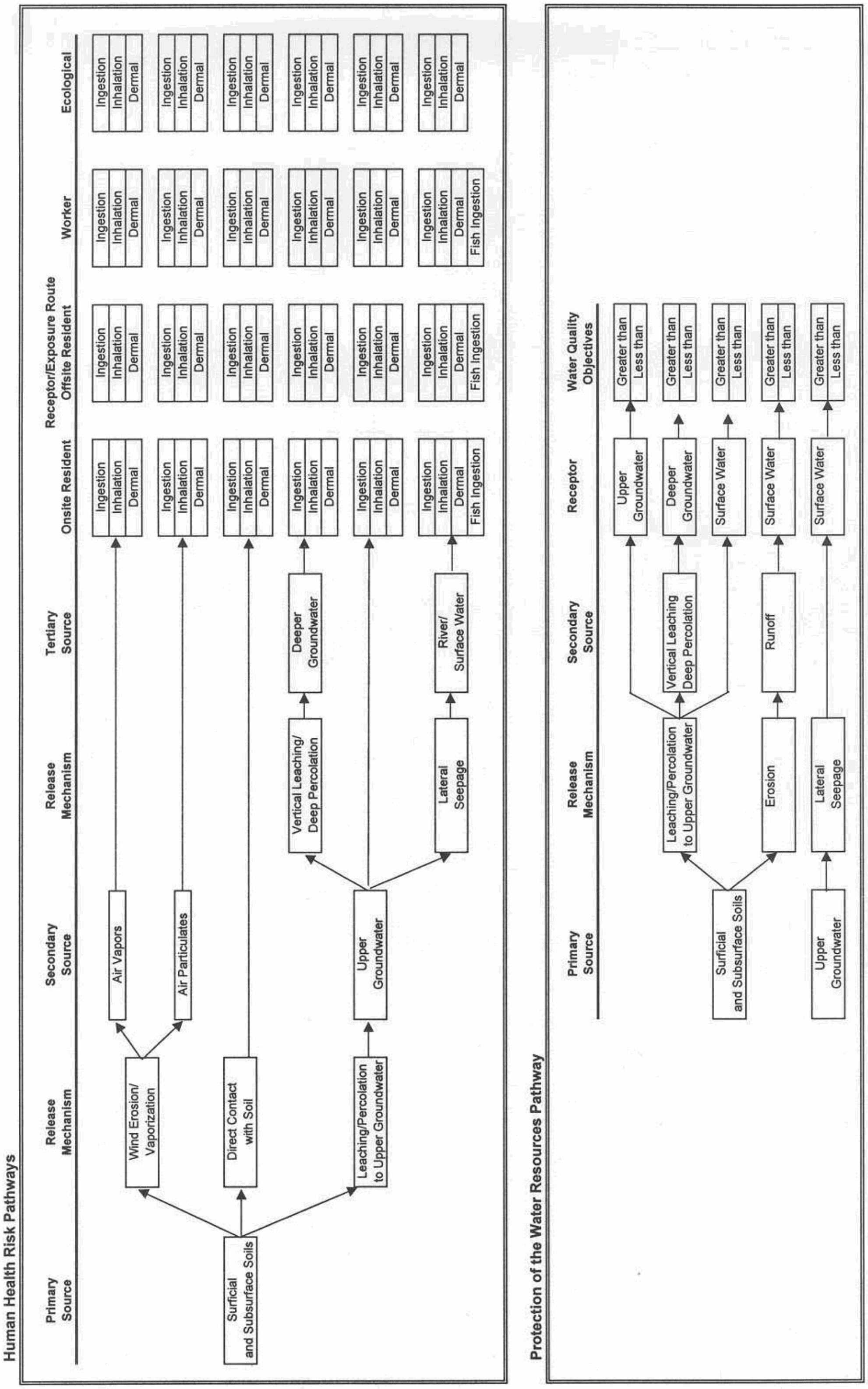
2. Pathway and Receptor Identification

There are many ways a contaminant may reach a receptor. A receptor may include humans, plants, animals, man-made structures, surface water, and/or groundwater resources. It is also important to consider the probability of a foreseeable land use change that may result in a future exposure to a receptor.

The first step in evaluating exposure pathways is to identify those pathways that are relevant to the conditions at the site (Figure 6.1). The first step in a pathway analysis is development of a site conceptual model in accordance with the example provided in the Site Assessment Report Checklist. In order to formulate a realistic and representative conceptual model and begin the fate and transport modeling process, a comprehensive site assessment must be completed.

FIGURE 6-1

PATHWAY & RECEPTOR MODEL



The exposure of a receptor to environmental contamination requires a pathway for the contaminant to travel to the receptor. Typical pathways for contaminated sites include:

- Non-aqueous phase liquid (NAPL) migration from source area into structures, utilities, surface water, and/or groundwater
- Vapor migration from soil, groundwater or NAPL into structures, utilities, and/or ambient air
- Solute migration from source area to a receptor (well, surface water, groundwater, etc.)

For humans and animals, exposure usually occurs by the following typical exposure routes:

- Ingestion of contaminated drinking water
- Inhalation of vapor from contaminated soil or groundwater
- Ingestion or inhalation of contaminated soil particles
- Dermal contact with contaminated soil particles

In areas where the groundwater and /or surface water are considered to be a receptor, the following are typical pathways that may apply:

- NAPL migration from source area into surface water and/or groundwater
- Solute migration from source area to surface water and/or groundwater

3. Contaminant Fate and Transport

Fate and transport analyses are procedures used to assess the mobility, migration potential, and persistence of contaminants in the environment. Due to the complexity of contaminant migration, computer simulations (models) are commonly used to estimate a contaminant's environmental fate and transport. Many different models are available. The user must have a thorough knowledge of the model's limitations and assumptions, and ensure that the model is appropriate for the conditions of the site being modeled. The approach and calculations presented in the following sections are limited to non-fractured geologic environments.

Fate and transport models are designed to provide a method to objectively estimate the effects of natural processes on the stability and the distribution of contaminants in the environment. The variability of geologic materials and/or the interactions between natural processes can be very complex. For this reason, fate and transport models must include many simplifying assumptions.

Therefore, the model results are treated as "estimates" rather than "absolutes". The reliability of the "estimate" is directly linked to the validity of the input parameters to accurately simulate conditions at the site.

Fate and transport modeling may be used at several points in the corrective action process.

4. Discussion with Regulatory Agencies

Prior to the initiation of a fate and transport-modeling program, the RP and consultant may choose to meet with the lead agency to discuss the appropriate level of effort required to evaluate a site.

It must be demonstrated that the chosen model(s) can adequately simulate the conditions of the site such that the conclusions drawn from the model(s) will be considered valid. The regulatory agencies reserve the right to decide whether a site is appropriate for a fate and transport modeling approach.

5. Level of Evaluation

DEH recommends a phased approach to fate and transport modeling as it relates to the risk assessment process. For some sites modeling may not be appropriate. The use of regulatory guidance, such as RSLs or other values, may be more appropriate when the resulting cleanup volume and cost would be small. However, if the impact is significant, it may be appropriate to consider simple models such as those presented in this chapter for evaluating risk due to vapor and solute movement.

In general, DEH recommends the use of the simplified fate and transport methods and calculations presented below. The four main pathways that a contaminant may reach a receptor are:

- NAPL Migration in Soil
- Leaching and Migration in Soil
- Vapor-Phase Migration
- Groundwater Contaminant Transport (to receptors, surface water)*

* Note: In areas where groundwater is designated as having beneficial uses, the water quality objectives are MCLs as indicated in Title 23.

For each pathway section there are three levels of evaluation provided.

- **Level 1 Evaluation –** This level of evaluation requires the use of minimal site-specific data. The use of conservative default values in the analytical models provided in the following sections will provide conservative estimates of the potential concentrations at the point of exposure. Typical default values are provided in Tables 6-2 through 6-4.

- **Level 2 Evaluation –** This level of evaluation requires the use of more site-specific data in the analytical model provided. Commonly, the site-specific data used are the most sensitive in the analytical model provided. This approach will generally provide conservative estimates of the potential concentrations at the point of exposure.

- **Level 3 Evaluation –** This level of evaluation requires the use of site-specific data in addition to more complex modeling programs. The most sophisticated approach may include multiphase numerical models based on detailed site-specific data. Only well-documented models that have been scientifically peer reviewed and validated should be used. DEH and the RWQCB may request copies of the model and model documentation.

6. Input Variables

Sections 6.III.7 through 6.III.9 provide simplified analytical equations to describe a contaminant's environmental fate and transport in the subsurface. For quick reference, the following list of terms is provided:

A	=	the room floor area (m^2)
A_v	=	the area of infiltration (cm^2)
C_f	=	the final concentration in soil pore water at water table (ug/l)
C_i	=	the indoor air concentration (mg/m^3)
C_s	=	the concentration of compound in soil (mg/kg)
$C_{s\ (TPH)}$	=	the concentration of TPH in soil (mg/kg)
C_{gw}	=	the calculated concentration in groundwater (ug/l)
C_w	=	the concentration in soil pore water (ug/l)
C_{sg}	=	the contaminant concentration in the soil vapor (mg/m^3)
d	=	the depth of groundwater mixing zone (cm)
D_a	=	the diffusion coefficient of compound in air (cm^2/sec)
D_e	=	the effective air diffusion coefficient (cm^2/sec)
D_f	=	the dilution factor (dimensionless)
E	=	the indoor air exchange rate per hour (air exchanges/hr)
Fx	=	the contaminant vapor flux (mg/hr-m^2)
f_{oc}	=	the weight fraction of organic carbon in soil = TOC/10,000
H	=	the Henry's Law Constant (dimensionless)
i	=	the gradient (dimensionless)
K	=	the saturated hydraulic conductivity (cm/sec)
K_{avg}	=	the average vertical hydraulic conductivity (cm/sec)
K_d	=	the soil/water distribution coefficient (cm^3/gm)
K_{oc}	=	the organic carbon partitioning coefficient (cm^3/gm)
K_{swz}	=	the vertical saturated hydraulic conductivity of the soil (cm/sec)
L	=	the distance of travel (cm)
MF	=	the mole fraction (dimensionless)
MW	=	the molecular weight of the compound of concern (mg/mole)
$MW_{(TPH)}$	=	the molecular weight of TPH (mg/mole)
q_z	=	the Darcy velocity (cm/sec)
Q_{gw}	=	the unit mass flux of groundwater (cm^3/sec)
R	=	the universal gas constant (atm-m^3/mole-K)
Rh	=	the room height (m)
S	=	the pure component aqueous solubility (mg/l-H_20)
Sb	=	the slab attenuation factor (dimensionless)
SF	=	the contaminant carcinogenic slope factor ($[mg/kg\text{-}day]^{-1}$)
S_r	=	the specific retention (dimensionless)
S_y	=	the specific yield (dimensionless)
T	=	the temperature in degrees Kelvin (^oK)
T_c	=	the time to reach groundwater (sec)
$t_{1/2}$	=	the biodegradation half life of contaminant (sec)
TOC	=	the total organic carbon content (mg/kg)
ν	=	the infiltration velocity (cm/sec)
V	=	the room volume (m^3)
VP	=	the contaminant vapor pressure at STP (atm)
X	=	the depth or distance to contamination in the vadose zone (m)
Z	=	the gravitation component (cm)

ρ_b	=	the dry bulk density of soil (gm/cm^3)
θ	=	the total soil porosity (dimensionless)
θ_a	=	the air filled porosity (dimensionless)
θ_w	=	the water filled porosity (dimensionless)
Ψ	=	the capillary suction component (cm)

Tables 6-2a and 6-2b are provided to summarize the chemical properties of the most common chemicals encountered. Table 6-3 provides typical ranges of soil properties that are found in San Diego County. Table 6-4 lists conservative default values for various physical properties.

TABLE 6-2 (a)

Summary of Chemical Properties

	Mol. Wgt mg/mole	Specific Gravity gm/cm3(T)	Boiling Point C	Vapor Pressure atm	Viscosity cP(T)	Solubility mg/l-H20(T)	Henry's Law Constant (dim-less)	Da cm2/sec	Koc cm3/gm
benzene	78,110 [1]	0.8787 (15) [1]	80 [1]	1.3E-01 (20) [3]	0.6468 (20) [2]	1,800 [5]	2.3E-01 [5]	8.8E-02 [5]	6.2E+01 [5]
benzo(a)pyrene	252,300 [1]	1.3510 (20) [1]	>360 [1]	1.3E-03 (20) [2]		0.00162 [8]	4.6E-05 [8]	4.3E-02 [8]	1.0E+06 [8]
carbon tetrachloride	153,840 [1]	1.5940 (20) [1]	76.54 [1]	1.2E-01 (20) [3]	0.9690 (20) [2]	790 [5]	1.2E+00 [5]	7.8E-02 [5]	1.5E+02 [5]
chlorobenzene	112,560 [1]	1.1058 (20) [1]	132 [1]	1.6E-02 (25) [2]	0.7900 (21) [2]	470 [5]	1.5E-01 [5]	7.3E-02 [5]	2.2E+02 [5]
chloroethane (ethyl chloride)	64,520 [1]	0.9214 (0) [1]	12 [1]	1.3E+00 (20) [2]	0.2790 (10) [2]	5,700 [5]	4.5E-01 [5]	1.0E-01 [5]	1.5E+01 [5]
chloromethane (methyl chloride)	50,490 [1]	0.9159 (20) [2]	-23.7 [1]	5.7E+00 (25) [2]	0.1834 (20) [2]	8,200 [5]	9.8E-01 [5]	1.1E-01 [5]	3.5E+01 [5]
1,2-dichlorobenzene	147,010 [1]	1.3059 (20) [1]	180.5 [1]	1.9E-03 (25) [2]	1.3240 (25) [2]	160 [5]	7.8E-02 [5]	6.9E-02 [5]	3.8E+02 [5]
1,3-dichlorobenzene	147,010 [1]	1.2880 (20) [1]	172 [1]	2.8E-03 (25) [2]	1.0450 (23) [2]	160 [5]	7.8E-02 [5]	6.9E-02 [5]	3.8E+02 [5]
1,4-dichlorobenzene	147,010 [1]	1.2480 (55) [1]	174 [1]	1.3E-03 (25) [2]	0.6680 (26) [2]	74 [5]	1.0E-01 [5]	6.9E-02 [5]	6.2E+02 [5]
1,1-dichloroethene (1,1-DCE)	96,940 [1]	1.2129 (20) [1]	31.7 [1]	7.8E-01 (25) [2]	0.3302 (20) [2]	2,300 [5]	1.1E+00 [5]	9.0E-02 [5]	6.5E+01 [5]
trans-1,2-dichloroethene	96,950 [1]	1.2700 (25) [1]	48 [1]	5.2E-01 (30) [2]	0.4100 (20) [2]	6,300 [5]	3.8E-01 [5]	7.1E-02 [5]	3.8E+01 [5]
1,1-dichloroethane (1,1-DCA)	98,970 [1]	1.1740 (20) [1]	57.3 [1]	2.5E-01 (20) [2]	0.3770 (20) [9]	5,100 [5]	2.3E-01 [5]	7.4E-02 [5]	5.3E+01 [5]
1,2-dichloroethane (1,2-DCA)	98,960 [1]	1.2600 (20) [1]	83.5 [1]	8.0E-02 (20) [4]	0.8400 (20) [2]	8,500 [5]	4.0E-02 [5]	1.0E-01 [5]	3.8E+01 [5]
dichloromethane (methylene chloride)	84,900 [1]	1.3300 (15) [1]	40 [1]	5.3E-01 (24) [2]	0.4490 (15) [6]	13,000 [5]	9.0E-02 [5]	1.0E-01 [5]	1.0E+01 [5]
ethylbenzene	106,000 [1]	0.8626 (25) [1]	136 [1]	1.5E-02 (26) [2]	0.6400 (25) [2]	170 [5]	3.2E-01 [5]	7.5E-02 [5]	2.0E+02 [5]
naphthalene	128,200 [1]	1.1450 (20) [1]	218 [1]	3.0E-04 (20) [2]	0.9670 (80) [6]	31 [5]	2.0E-02 [5]	5.9E-02 [5]	1.2E+03 [5]
methyl tertiary butyl ether (MTBE)	88,150 [1]	0.7405 (20) [1]	55 [1]	3.2E-01 (25) [7]		48,000 [1]	2.4E-02 [7]	8.0E-02 [7]	7.8E+02 [7]
tetrachloroethene (PCE)	166,000 [1]	1.6230 (20) [1]	121 [1]	1.9E-02 (20) [3]	0.8390 (25) [2]	200 [5]	7.5E-01 [5]	7.2E-02 [5]	2.7E+02 [5]
toluene	92,150 [1]	0.8660 (20) [1]	110.6 [1]	3.7E-02 (20) [3]	0.5900 (20) [2]	530 [5]	2.7E-01 [5]	8.7E-02 [5]	1.4E+02 [5]
1,1,1-trichloroethane	133,420 [1]	1.3376 (20) [1]	75 [1]	1.3E-01 (25) [2]	0.8580 (20) [2]	1,300 [5]	7.1E-01 [5]	7.8E-02 [5]	1.4E+02 [5]
1,1,2-trichloroethane	133,000 [1]	1.4416 (20) [1]	114 [1]	2.5E-02 (20) [4]	1.6900 (25) [2]	4,400 [5]	3.7E-02 [5]	7.8E-02 [5]	7.5E+01 [5]
trichloroethene (TCE)	131,400 [1]	1.4649 (20) [1]	87 [1]	7.6E-02 (20) [2]	0.5500 (25) [2]	1,100 [5]	4.2E-01 [5]	7.9E-02 [5]	9.4E+01 [5]
trichloromethane (chloroform)	119,000 [1]	1.4840 (20) [1]	61 [1]	2.6E-01 (25) [2]	0.0563 (20) [2]	7,900 [5]	1.5E-01 [5]	1.0E-01 [5]	5.3E+01 [5]
vinyl chloride	62,500 [2]	0.9106 (20) [2]	-13.37 [2]	3.5E+00 (20) [2]	0.0107 (20) [2]	2,800 [5]	1.1E+00 [5]	1.1E-01 [5]	1.9E+01 [5]
xylene (average)	106,160 [1]	0.8640 (20) [1]	137 [1]	1.1E-02 (25) [2]	0.6927 (20) [6]	180 [5]	2.7E-01 [5]	7.8E-02 [5]	2.5E+02 [5]

[1] Genium Publishing Corp, Mateirals Safety Data Sheets
[2] TOMES, 1998, HSDB - Hazardous Substance Data Bank
[3] Lyman et al, 1982, Handbook of Chemical Prpoerty Estimation Methods
[4] Verschueren,1983, Handbook of Evironmental Data on Organic Chemicals
[5] US-EPA Region 9, PRGs, 1998 (Physical properties table)
[6] CRC, 1971, Handbook of Chemistry and Physics
[7] Cal-EPA OEHHA, 04/1998 Draft, Public Health Goal for Methyll Tertary Butyl Ether (MTBE) in drinking water
[8] US-EPA Soil Screening Guidnace: User Guide, 1996
[9] PTS Laboratories, Inc. 1998, Personal communication

TABLE 6-2 (b)
SUMMARY OF CHEMICAL PROPERTIES
(MIXTURES)

Mixture	Molecular weight mg/mole[1] (MW)	Relative Viscosity (PSH to water)[2] (μ_{ro})	Specific Gravity (gm/cm^3)[2] (ρ_o)	Relative Specific Gravity (dimensionless)[2] (γ_{ro})
Gasoline	100,000	0.5	0.73	0.73
Kerosene	200,000	2.0	0.79	0.79
Diesel	200,000	7.0	0.83	0.83
Fuel Oil	200,000	25.0	0.90	0.90
Waste Oil	400,000	60.0	0.92	0.92

Note: The molecular weights for the fuel mixtures presented are assumed values based on average carbon chain length. If accurate values are available those values should be used.

1 Larry Kunkel, PTL Laboratories, 1998 Personal Communication

2 Gary Beckett, Aqui-Ver, 1998 Personal Communication

TABLE 6-3
REPRESENTATIVE RANGE OF VALUES FOR SOIL PHYSICAL PROPERTIES

Soil Type	Total Porosity θ (%)	Dry Bulk Density ρ_b (gm/cm^3)	Water Content* (% by weight)	Water Content* θ_w (% by volume)	Air-filled Porosity* θ_a (% by volume)	Hydr. Cond. K (cm/sec)	TOC (fraction)
Gravel	25-44	1.50-2.00	1-2	2-3	23-41	10^{-1}-10^{3}	0.01
Sandy Gravel	25-46	1.45-2.00	1-2	2-3	23-43	10^{-2}-10^{0}	0.01
M-C Sand	25-51	1.30-2.00	2-5	4-7	21-44	10^{-3}-10^{-0}	0.01
Fine Sand	25-51	1.30-2.00	5-8	10-11	15-40	10^{-4}-10^{-2}	0.01
Silty Sand	25-51	1.30-2.00	5-8	10-11	15-40	10^{-5}-10^{-3}	0.01
Silt	36-51	1.30-1.70	18-20	26-31	5-25	10^{-6}-10^{-4}	0.01
Clay	47-75	0.68-1.40	29-40	27-41	7-48	10^{-9}-10^{-6}	0.01

* Based on the soil's specific retention

TABLE 6-4
CONSERVATIVE DEFAULT VALUES FOR VARIOUS PHYSICAL PROPERTIES

VARIABLE	DESCRIPTION	DEFAULT VALUE	SOURCE
D	depth of groundwater mixing zone	100 cm	DEH
E	indoor air exchange rate	0.50 exchanges/hour (resid) 0.83 exchanges/hour (com)	ASTM, 1995 ASTM, 1995
f_{oc}	weight fraction of organic carbon in soil	0.01 (TOC/1,000,000)	DEH
$MF_{(benzene/TPH)}$ Fresh gasoline	mole fraction of fresh gasoline	0.01 to 0.03 (dimensionless)	LUFT, 1988
q_c	critical flow rate	1 x 10^{-7} cm/sec	DEH
R	universal gas constant	8.2 x 10^{-5} atm-m^3/mole-K	Lyman, 1989
Rh	room height	2.44 m	DEH
Sb	slab attenuation factor	1.0 no slab (dirt floor) 0.1 old slab 0.01 new/improved slab	DEH DEH DEH
T	temperature	293 ^{o}K (Stand. Temp. 20^{o}c)	DEH
θ	total soil porosity	0.3 (dimensionless)	DEH
θ_a	air filled porosity	0.2 (dimensionless)	DEH
θ_w	water filled porosity	0.1 (dimensionless)	DEH
ρ_b	dry bulk density	1.85 gm/cm^3	DEH
ρ_w	density of water	1.00 gm/cm^3	Lyman, 1989

7. NAPL Migration in Soil

An extensive discussion on the investigation and behavior of non-aqueous phase liquids (NAPL, free product) is provided in Section 5.VII. To evaluate the potential presence of NAPL in the soils at a site, the following three levels of evaluation can be used.

a. Level 1 Evaluation

The following procedure is recommended for a Level 1 evaluation to describe NAPL immobility (residual saturation).

(1) Identify the worst-case soil impacts at the site. This should include the highest permeability soil and the soil with the highest contaminant concentration. This may represent two separate soil types.

(2) Determine the soil characteristics. Soils must be described by using ASTM-D2487 (Unified Soil Classification System). If site-specific soil analysis is not available, contact the agency Project Manager on the applicability of using the visual soil description outlined in ASTM-D2488.

(3) Subsurface soils should be evaluated for the potential of "finger flow" movement of contaminants. It is recognized that "finger flow" is present to a degree in most cases. This condition is found frequently in cases where there are fine-grained soils overlaying uniform clean sands and/or coarse-grained sands. "Finger flow" may pose a significant problem, and installation of a groundwater monitoring well may be required to evaluate potential impacts to groundwater.

(4) Select the petroleum product that was released at the site. If the petroleum product is a mixture, assume the lighter product as the product of concern. If the product is not listed in Table 5-3 in Section 5, then proceed to Level 2 evaluation.

(5) Compare the residual saturation in Table 5-3 in Section 5 to the highest TPH concentration from the site. If the site value is **less than** the table value for residual saturation, the contaminant is considered to be below residual saturation. This will indicate that the contaminant is less likely to be mobile as an NAPL. If the site value is **greater than** the table value, the contaminant or petroleum hydrocarbon is above the residual saturation and may be mobile.

(6) Review subsequent guidance sections regarding evaluation of soil leachability and potential impacts to groundwater.

b. Level 2 Evaluation

The following procedure is recommended for a Level 2 evaluation. This procedure uses site-specific data in the analytical model provided. Commonly, the site-specific data used are the most sensitive variables in the analytical model. This can include the soil concentrations, soil properties, and NAPL characteristics.

(1) Identify the worst-case soil impacts at the site. These should include the highest permeability soil and the soil with the highest contaminant concentration. Two separate soil types may be represented.

(2) Determine the soil characteristics. All soils must be described using ASTM-D2487. If the saturated hydraulic conductivity of the soil is unknown, select the appropriate soil type from Table 5-3 in Section 5. Conductivity decreases logarithmically from gravel to clay. Laboratory measurement of hydraulic conductivity (or permeability) of the appropriate impacted soils can reduce uncertainty and justify a less conservative screening evaluation. The appropriate laboratory test for permeability or hydraulic conductivity is ASTM Method D2484 or D5084.

(3) Subsurface soils should be evaluated for the potential of "finger flow" movement of contaminants. It is recognized that "finger flow" is present to a degree in most cases. This condition is found frequently in cases where there are fine-grained soils overlaying uniform clean sands and/or coarse-grained sands. "Finger flow" may pose a significant problem, and installation of a groundwater monitoring well may be required to evaluate potential impacts to groundwater.

(4) Determine the petroleum characteristics by using Tables 6-2 (a) and (b). If the petroleum product is a mixture, assume the lighter, more refined product as the product of concern.

(5) Calculate the residual saturation for the site using Equations 5-3 and 5-4 in Section 5.VII.

(6) Compare the calculated residual saturation to the highest TPH concentration from the site. If the site value is **less than** the calculated value (C_s), the contaminant is likely considered to be below residual saturation. This will indicate that the contaminant is not mobile as a NAPL. If the site value is **greater than** the calculated value (C_s), the contaminant or petroleum hydrocarbon is above the residual saturation and may be mobile.

(7) Review subsequent guidance sections regarding evaluation of soil leachability and potential impacts to groundwater.

c. Level 3 Evaluation

Before proceeding with a Level 3 evaluation, it is important to discuss your approach with the agency Project Manager.

If the site does not pass the Level 1 or Level 2 evaluations as outlined above, a more detailed evaluation may be completed. This evaluation may include performing an NAPL mobility-screening test. Please refer to Section 5.VII.C for the recommended testing procedures.

8. Leaching and Migration in Soil

The next step in establishing site-specific soil cleanup goals to protect water quality is to determine how much of a contaminant will leach from the soil. The following equilibrium equations may be used to calculate a maximum concentration in the pore water of a soil.

When NAPL is present in the soil's pore space, Equations 6-1 and 6-2 should be used to calculate the maximum pore water concentration.

$$C_w = MF * S * \frac{1000\ ug}{1\ mg}$$ **Equation 6-1**

Where:

Where:	C_w	=	the concentration in pore water (ug/l)
	MF	=	the mole fraction (dimensionless)
	S	=	the pure component aqueous solubility (mg/l-$H_2$0)

$$MF = \frac{C_s / MW}{C_{s\,(TPH)} / MW_{(TPH)}}$$ **Equation 6-2**

Where:	MF	=	the mole fraction (dimensionless)
	C_s	=	the concentration of compound in soil (mg/kg)
	C_{sTPH}	=	the concentration of TPH in soil (mg/kg)
	MW	=	the molecular weight of the compound in soil (mg/mole)
	$MW_{(TPH)}$	=	the molecular weight of TPH (mg/mole)

When immiscible hydrocarbons are not present in the pore space, Equation 6-3 should be used to calculate the maximum leachate concentration.

$$C_w = \frac{C_s * \rho_b}{\theta_w + K_d * \rho_b + H * \theta_a} * \frac{1\ kg}{1000\ gm} * \frac{1000\ cm^3}{1\ l} * \frac{1000\ ug}{1\ mg}$$ **Equation 6-3**

Where:	C_w	=	the concentration in soil pore water (ug/l)
	C_s	=	the concentration of compound in soil (mg/kg)
	ρ_b	=	the dry bulk density of soil (gm/cm^3)
	θ_w	=	the water filled porosity (dimensionless)
	θ_a	=	the air filled porosity (dimensionless)
	K_d	=	the soil/water distribution coefficient (cm^3/gm)
		=	K_{oc}*f_{oc}
	K_{oc}	=	the organic carbon partitioning coefficient (cm^3/gm)
	f_{oc}	=	the weight fraction of organic carbon in soil = TOC/10,000
	H	=	the Henrys Law Constant (dimensionless)

A more accurate and preferred method of determining the leachability of a contaminant in a soil is by using one of the following laboratory testing methods.

- **EPA Method 1312**, Synthetic Precipitation Leaching Procedure (SPLP), or
- **ASTM Method D4874-95**, Leaching Solid Material in a Column Apparatus.

Details on the use of these methods are presented in Section 5.VIII of this manual.

One or more of the following three levels of evaluation can be used to determine the solubility of a contaminant in soil. The results can then be used to evaluate the potential impact to groundwater.

a. Level 1 Evaluation

The Level 1 evaluation assumes that the calculated pore water concentration from Equations 6-1 and 6-2 directly impacts groundwater without dilution or biodegradation. Tables 6-5 and 6-6 provide the maximum mole fraction of the contaminant of concern that can be in soil to achieve the designated water quality goals established in beneficial use areas and non-beneficial use areas located near surface waters. These tables were generated with relatively conservative input parameters.

TABLE 6-5
GROUNDWATER WITH DESIGNATED BENEFICIAL USE
MAXIMUM SOIL CONTAMINATION BASED ON SOLUBILITY (NO ATTENUATION)

COMPOUND	Water Quality Goal (ug/l)	Solubility (ml/l - H_20)	Mole Fraction (dimensionless)	TPH in Soil (mg/kg)	Concentration in Soil (mg/kg)
Benzene	1.0	1800	5.76×10^{-7}	1000	0.00045
Benzene	1.0	1800	5.76×10^{-7}	5000	0.00225
Benzene	1.0	1800	5.76×10^{-7}	10000	0.00450
Toluene	150	530	2.83×10^{-4}	1000	0.261
Toluene	150	530	2.83×10^{-4}	5000	1.30
Toluene	150	530	2.83×10^{-4}	10000	2.61
Ethylbenzene	700	170	4.12×10^{-3}	1000	4.36
Ethylbenzene	700	170	4.12×10^{-3}	5000	21.8
Ethylbenzene	700	170	4.12×10^{-3}	10000	43.6
Xylene	1,750	180	9.72×10^{-3}	1000	10.3
Xylene	1,750	180	9.72×10^{-3}	5000	51.6
Xylene	1,750	180	9.72×10^{-3}	10000	103
Naphthalene	20	31	6.46×10^{-4}	1000	0.414
Naphthalene	20	31	6.46×10^{-4}	5000	2.07
Naphthalene	20	31	6.46×10^{-4}	10000	4.14
Benzo(a)pyrene	0.2	0.00162	9.51×10^{-2}	1000	120
Benzo(a)pyrene	0.2	0.00162	9.51×10^{-2}	5000	600
Benzo(a)pyrene	0.2	0.00162	9.51×10^{-2}	10000	1,200
MTBE	13	48000	2.71×10^{-7}	1000	0.000239
MTBE	13	48000	2.71×10^{-7}	5000	0.00191
MTBE	13	48000	2.71×10^{-7}	10000	0.00239

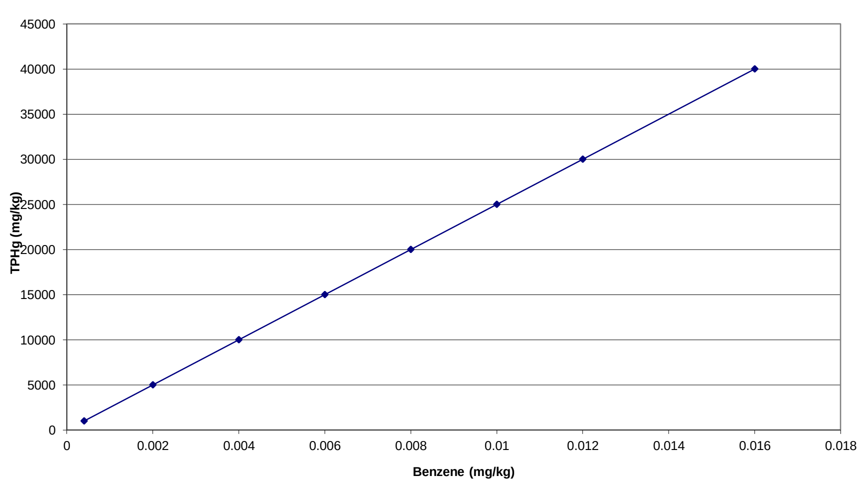
Note: ug/l = micrograms per liter

TABLE 6-6
GROUNDWATER WITH NO DESIGNATED BENEFICIAL USE
(<1000 FT FROM A SURFACE WATER)
MAXIMUM SOIL CONTAMINATION BASED ON SOLUBILITY (NO ATTENUATION)

COMPOUND	Water Quality Goal (ug/l)	Solubility (mg/l - H_20)	Mole Fraction (dimensionless)	TPH in Soil (mg/kg)	Concentration in Soil (mg/kg)
Benzene	400	1800	2.22×10^{-4}	1000	0.173
Benzene	400	1800	2.22×10^{-4}	5000	0.867
Benzene	400	1800	2.22×10^{-4}	10000	1.73
Toluene	5,000	530	9.43×10^{-3}	1000	8.69
Toluene	5,000	530	9.43×10^{-3}	5000	43.4
Toluene	5,000	530	9.43×10^{-3}	10000	86.9
Ethylbenzene	430	170	2.53×10^{-3}	1000	2.68
Ethylbenzene	430	170	2.53×10^{-3}	5000	13.4
Ethylbenzene	430	170	2.53×10^{-3}	10000	26.8
Xylene	10,000	180	5.56×10^{-2}	1000	58.9
Xylene	10,000	180	5.56×10^{-2}	5000	294
Xylene	10,000	180	5.56×10^{-2}	10000	589
Naphthalene	2,350	31	7.58×10^{-2}	1000	48.6
Naphthalene	2,350	31	7.58×10^{-2}	5000	243
Naphthalene	2,350	31	7.58×10^{-2}	10000	486
Benzo(a)pyrene	4.4	0.00162	2.73×10^{-0}	1000	3,450
Benzo(a)pyrene	4.4	0.00162	2.73×10^{-0}	5000	17,250
Benzo(a)pyrene	4.4	0.00162	2.73×10^{-0}	10000	34,500

The data presented in theses tables can be graphed with the compound of concern on the x-axis and TPH on the y-axis. The graph presented below shows benzene and a water quality goal of 1 ug/l.

BENZENE EQUILIBRIUM
SOIL PORE WATER
Line represents soil pore water equal to 1 ug/l



When the site-specific TPH and benzene concentrations plot below the 1 ug/l line on the graph, the residual soil contamination will not generate a leachate (pore water) that exceeds the water quality goal.

(1) Identify worse case soil impacts at the site. This should include the highest permeability soil and the soil with the highest contaminant concentration. This may represent two separate soil types.

(2) Determine the soil characteristics. All soils must be described by using ASTM-D2487. If site-specific soil analysis is not available, contact the agency Project Manager on the applicability of using the visual soil description outlined in ASTM-D2488.

(3) Exercise caution if a site is underlain predominantly by clay or silts.

(4) Determine the existing and potential beneficial uses of groundwater in addition to the actual and probable future uses in the proximity of the subject site.

(5) Compare the concentrations of the compounds detected at the site to the concentrations listed in Tables 6-5 and 6-6.

(6) If the site-specific soil concentrations are greater than the values in Tables 6-6 or 6-7, proceed to a Level 2 evaluation. If the subsurface soils or rock conditions are fractured, no attenuation should be considered and groundwater impacts need to be investigated and monitored. If the concentrations at the site are less than the values in Table 6-5 or 6-6, residual contamination levels pose no threat to groundwater.

b. Level 2 Evaluation

The Level 2 evaluation not only calculates pore water concentration of the contaminant in the soil; it also incorporates the transport processes of the pore water through the vadose zone to groundwater. The environmental fate of a contaminant through the vadose zone is controlled by a number of factors. These factors include volatilization, retardation, sorption, biodegradation, and dilution.

The following evaluation method takes into account the factors of biodegradation and dilution. Volatilization was not included in this analysis due to the required level of understanding needed to evaluate multiphase relationships at a site. Retardation and sorption were not included since these processes generally slow the contamination front rather than reduce the level of contamination.

(1) Under most field conditions, the effective unsaturated hydraulic conductivity is controlling the infiltration rate. Darcy's Law for vertical flow (Equation 6-4) defines this. The darcy velocity (q_z) is the average velocity of water over a cross-sectional area of porous material.

$$q_z = K_{avg} \frac{\Psi + Z}{Z}$$ **Equation 6-4**

Where: q_z = darcy velocity (cm/sec)
K_{avg} = average vertical unsaturated hydraulic conductivity (cm/sec)
Ψ = capillary suction component (cm)
Z = gravitation component (cm)

At later infiltration times the capillary suction component of the gradient will drop out and the gradient is reduced to a value of one. Equation 6-4 then can be rewritten as follows:

$$q_z = K_{avg}$$ **Equation 6-5**

Where: q_z = darcy velocity (cm/sec)
K_{avg} = average vertical unsaturated hydraulic conductivity (cm/sec)

To determine the effective unsaturated hydraulic conductivity for a soil, detailed laboratory testing needs to be completed. The effective vertical unsaturated hydraulic conductivity in reality is a value somewhere between the hydraulic conductivity at the wetting front (at low moisture content) and the hydraulic conductivity in the transmission zone (at or near saturation). It is conservative to assume the effective vertical unsaturated hydraulic conductivity is 50% of the saturated laboratory hydraulic conductivity. In most cases this assumption will result in an over estimation of the effective vertical unsaturated hydraulic conductivity. This assumption is not conservative in cases in which there are coarse sands and gravels.

(2) Determine the percolation velocity (ν).

The darcy velocity (q_z) calculated in Equation 6-5 is then divided by the change in volumetric moisture in the unsaturated zone to give the infiltration velocity. Generally the effective change in volumetric moisture is unknown and depends on the capillary characteristics of the soil. A conservative estimate may be made by using the calculated darcy velocity (q_z) and dividing it by the soils-specific yield.

$$\theta = S_r + S_y$$ **Equation 6-6**

Where: θ = the total porosity (dimensionless)
S_r = the specific retention (dimensionless)
S_y = the specific yield (dimensionless)

To obtain the infiltration velocity, use Equation 6-7.

$$\nu = \frac{q_z}{S_y}$$ **Equation 6-7**

Where: ν = the infiltration velocity (cm/sec)
q_z = the darcy velocity (cm/sec)
S_y = the specific yield (dimensionless)

(3) Determine the time to reach groundwater (T_c).

The following equation is used to calculate the number of seconds it will take the contaminant to reach groundwater.

$$T_c = \frac{L}{\nu}$$ **Equation 6-8**

Where: T_c = the time to reach groundwater (sec)
L = the distance of travel (cm)
ν = the infiltration velocity (cm/sec)

The distance of travel (L) is the minimum vertical distance between soil contamination and groundwater.

(4) Determine the pore water concentration at the water table interface prior to dilution (C_f).

Biodegradation is known to reduce the level of contamination. In an aerobic environment, biodegradation of fuels generally follows a first order decay relationship. The biodegradation rates ($t_{1/2}$) are not provided. Caution should be exercised when using first order decay rates ($t_{1/2}$) at high concentrations. Work by Bekins et al, 1998, suggests that the degradation rates for benzene tend to over-estimate biodegradation when leachate concentration (benzene) is greater than 1,000 ug/l. This is also true when the combination of benzene, toluene, ethylbenzene and xylene (BTEX) is greater than 5,000 mg/l.

The biodegradation rates ($t_{1/2}$) used in the following equation will have to be either obtained from the literature or from site data. At the request of the agency, copies of references used may be required.

The following equation is used to calculate the pore water concentration at the water table.

$$\log (C_f) = \log [C_w] - [(T_c / 2.3)^* (0.693/t_{1/2})]$$ **Equation 6-9**

Where: C_f = the final concentration in soil pore water at water table (ug/l)
C_w = the concentration in soil pore water (ug/l)
T_c = the time to reach groundwater (sec)
$t_{1/2}$ = the biodegradation half life of contaminant (sec)

(5) Determine the calculated impact to groundwater (C_{gw}).

The potential dilution of pore water in groundwater depends on the proportionality of the mass of input (pore water) and the background mass flux of the groundwater system. A simple dilution factor can be calculated as the ratio of the vertical recharge divided by the total discharge in the mixing zone.

To calculate the unit mass flux in the groundwater system, the vertical mixing zone is assumed to be approximately 3 feet (100 centimeters) in depth. This unit mass flux is calculated by using the following equation.

$$Q_{gw} = K * i * d * 1\ cm$$ **Equation 6-10**

Where:
- Q_{gw} = unit mass flux of groundwater (cm^3/sec)
- K = saturated hydraulic conductivity (cm/sec)
- i = gradient (dimensionless)
- d = depth of groundwater mixing zone (cm)

The following equation is used to calculate the effective dilution factor in the groundwater-mixing zone.

$$D_f = \frac{\nu * A_\nu}{(\nu * A_\nu) + Q_{gw}}$$ **Equation 6-11**

Where:
- D_f = the dilution factor (dimensionless)
- ν = the infiltration velocity (cm/sec)
- A_ν = the area of infiltration (cm^2)
- Q_{gw} = unit mass flux of groundwater (cm^3/sec)

The final calculations apply the dilution factor (D_f) to the pore water concentration (C_f) to calculate the concentration in groundwater (C_{gw}).

$$C_{gw} = C_f * D_f$$ **Equation 6-12**

Where:
- C_{gw} = the calculated concentration in groundwater (ug/l)
- C_f = the final concentration in soil pore water at water table (ug/l)
- D_f = the dilution factor (dimensionless)

(6) Compare the calculated impact to the water quality objectives as specified by the RWQCB Basin Plan. If concentrations are greater than the water quality objectives, soil remediation should be considered or a Level 3 evaluation should be undertaken. Alternatively, the calculated concentrations may be used as input parameters into a groundwater flow model to evaluate the potential impacts to a receptor.

c. Level 3 Evaluation*

* Discussion with DEH Project Manager prior to proceeding with a Level 3 evaluation is required.

This level of evaluation includes the use of more complex computer models that describe the environmental fate and transport of a contaminant in the subsurface. These models may be capable of modeling complex subsurface conditions such as multi-layered geologic conditions, anaerobic conditions, and fractured geologic environments. The computer model used should be available in the public domain, peer reviewed, and validated. DEH and the RWQCB may request copies of the model and model documentation.

If there is an impact to groundwater above established action levels, further investigation and/or remediation will need to be completed.

9. Vapor-Phase Migration

DEH has developed the VAPRISK 2000 Model, which can be found at:

http://www.sdcounty.ca.gov/deh/water/sam_vapor_risk_assessment_2000.html.

VAPRISK 2000 Model can be used to evaluate the risk to receptors from the vapor intrusion pathway. VAPRISK 2000 can also be used to develop proposed site-specific cleanup goals for specific constituents.

This section provides a narrative of the vapor diffusion process and the different methods used to calculate soil gas concentrations. In this discussion and the example calculations provided in Appendix F.II, benzene is used as the constituent of concern. This methodology may be used to estimate the potential exposure to any volatile compound of concern.

The calculations presented in this section represent a method to estimate vapor diffusion of benzene from subsurface gasoline-contaminated media to indoor air space. Benzene is considered the most toxic carcinogenic compound in gasoline and will serve as the indicator compound for this example. The exposure pathway of concern is the upward diffusion of benzene through soil gas and into indoor air. Buildings with basements or other subterranean structures may require more complex analyses that consider advective or pressure-driven flow.

A simplified environmental fate and transport analysis is used to evaluate the inhalation exposure pathway for benzene as shown in Figure 6-2. This process is divided into five components. The analysis considers diffusive flux, assuming a non-diminishing steady state source of benzene in the subsurface. Additionally, it assumes that the system is in dynamic equilibrium.

Default values used by DEH are presented in Tables 6-2 though 6-4. Should site-specific soil physical properties be used as input parameters, representative samples from the vadose zone should be collected. It is recommended that three representative soil samples be collected from each lithologic soil unit at the site. The site-specific soil physical properties should include:

- Bulk density
- Total porosity, water-filled porosity, air-filled porosity
- Soil moisture content
- Total organic carbon
- Grain size distribution and/or clay content

Samples should be taken in the unsaturated zone (only) and not in the capillary fringe or saturated zone. This is so that the samples are representative of the zone where vapor diffusion is occurring. Representative soil samples can be collected in three 3-inch to 6-inch rings. Collected samples should be relatively undisturbed where possible. Samples collected for soil moisture content are measured in a laboratory by using ASTM Method D2216-92. Samples for total organic carbon should be collected and analyzed in accordance with the Walkley Black method for soils (ASTM, 1995).

a. Calculation of Soil Gas Concentrations

The concentration of benzene in soil gas is calculated by one of the following methods, using samples collected from the area or zone where the source of contamination is located. DEH recommends that soil gas concentrations not be estimated by evaluating the partitioning of contaminants in soil to soil vapor.

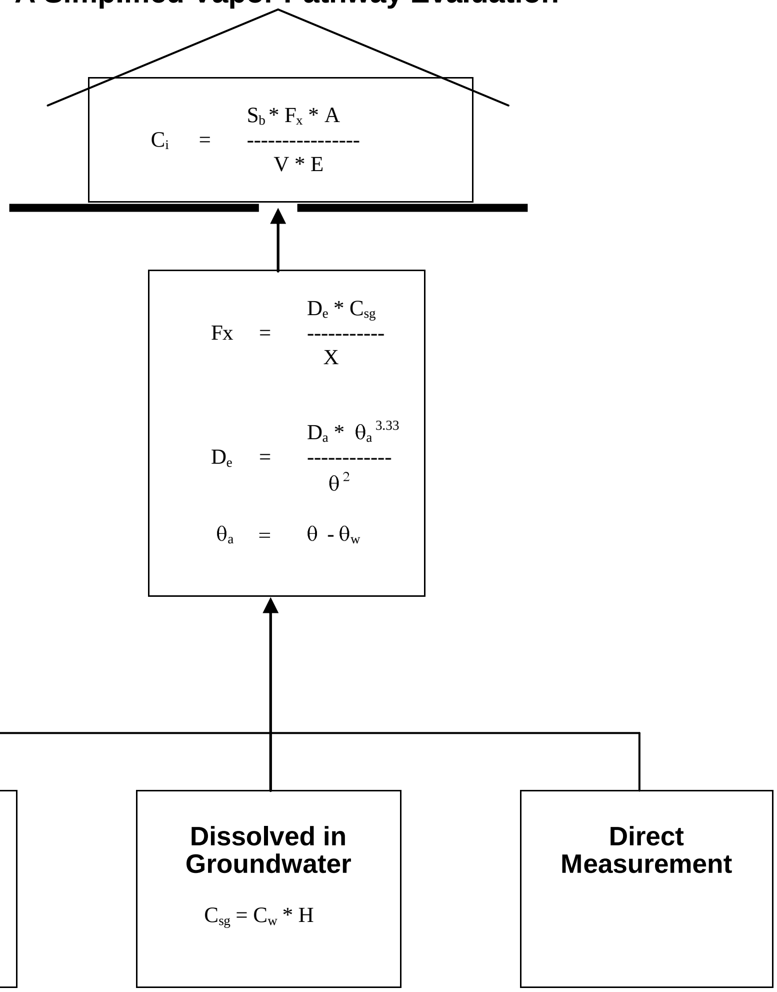
(1) Groundwater with NAPL

For sites where NAPL is present, the soil gas concentration in the area of the source is calculated by using the Ideal Gas Law and Raoult's Law as presented in Equation 6-13. The ***mole fraction*** **(MF)** of benzene in the NAPL is used. The mole fraction of benzene in fresh gasoline ranges from 0.01 to 0.03 (dimensionless). If the NAPL has been analyzed, the mole fraction of benzene can be calculated by dividing the benzene concentration by the TPH concentration multiplied by the ratio of the molecular weight of benzene to the average molecular weight of the mixture of gasoline. To calculate the mole fraction from available laboratory data, use Equation 6-2.

(2) Groundwater with Dissolved Contamination (No NAPL)

For sites where benzene is dissolved into either groundwater or soil pore water, the benzene concentration in soil gas is calculated by using the Henry's Law Constant as presented in Equation 6-14.

FIGURE 6-2
A Simplified Vapor Pathway Evaluation



A	=	the room floor area (m^2)
C_{sg}	=	the contaminant concentration in the soil vapor (mg/m^3)
C_w	=	the concentration in pore water (ug/l)
C_i	=	the indoor air concentration (mg/m^3)
D_a	=	the diffusion coefficient of compound in air (cm^2/sec)
D_e	=	the effective air diffusion coefficient (cm^2/sec)
E	=	the indoor air exchange rate per hour (hr^{-1})
F_x	=	the contaminant vapor flux ($mg/hr\text{-}m^2$)
H	=	the Henry’s law constant (dimensionless)
MF	=	the mole fraction (dimensionless)
MW	=	the molecular weight of the compound of concern (mg/mole)
R	=	the universal gas constant ($atm\text{-}m^3/mole\text{-}K$)
T	=	the temperature in degrees Kelvin (^oK)
S_b	=	the slab attenuation factor (dimensionless)
V	=	the room volume (m^3)
VP	=	the contaminant vapor pressure at STP (atm)
X	=	the depth or distance to contamination in the vadose zone (m)
θ	=	the total soil porosity (dimensionless)
θ_a	=	the air filled porosity (dimensionless)
θ_w	=	the water filled porosity (dimensionless)
ρ_b	=	the dry bulk density of soil (gm/cm^3)

(3) Direct Measurement of Soil Gas

Experience has shown the benzene concentration in soil gas can be overestimated by using the methods described above. These methods do not account for biodegradation and natural attenuation. These processes may account for the difference between the calculated soil gas and the direct measurement of soil gas. Direct measurements of soil gas can be used only if the system can be adequately characterized both spatially and temporally, and the samples collected are representative of exposure scenarios for the receptor. Furthermore, detection limits for soil gas survey must be sufficiently low to be used for risk analysis. Please refer to Section 5.IV for procedures on soil gas sampling.

b. Calculation of Flux

The simplified equation used in this section (Equation 6-15) describes soil gas flux from the source area to the base of a structure. The equation assumes diffusion as the driving force for mass transport. The equation is highly dependent on soil moisture. Soil moisture content values should preferably be measured in representative soil samples collected from the site.

c. Calculation of Indoor Air Concentration

The indoor air contaminant concentration is dependent on the "effective area" through which the flux occurs and the indoor air exchange rate with outdoor air. For residential buildings, the "effective area" must include the entire floor area of the building. For commercial and industrial buildings the “effective area” may be less than the entire floor area. Any reduction in the “effective area” must be justified. The indoor air exchange rate with outdoor air may be taken to be 0.5 exchanges per hour for residential construction. Rates for commercial buildings may be obtained from the architect or engineer, or the default value of 0.83 exchanges per hour should be used.

d. Equations Used to Model Migration of Vapors from Subsurface Contamination

This section presents the equations used to calculate soil gas, effective diffusion coefficients, diffusive mass flux, and indoor air concentration.

(1) Calculation of Soil Gas Concentrations

Soil gas concentrations can be determined based on one of the following methods. With the exception of direct measurement, the method used is a function of site conditions.

- For Groundwater with NAPL

It is assumed that the vapor immediately above the groundwater is in equilibrium with the NAPL present. The vapor concentration is a function of the contaminant's mole fraction and vapor pressure:

$$C_{sg} = \frac{VP * MW * MF}{R * T} \qquad \textbf{Equation 6-13}$$

Where:
- C_{sg} = the contaminant concentration in the soil vapor (mg/m^3)
- VP = the contaminant vapor pressure at STP (atm)
- MW = the molecular weight of the compound of concern (mg/mole)
- MF = the mole fraction (dimensionless)
- R = the universal gas constant ($atm\text{-}m^3/mole\text{-}K$)
- T = the temperature in degrees Kelvin (Standard temperature of 293°K)

- From Groundwater with no NAPL (No Liquid Phase Hydrocarbons)

It is assumed the vapor concentration immediately above the groundwater is in equilibrium with the groundwater. The concentration in soil gas is given by the water concentration times the dimensionless Henry's Law Constant:

$$C_{sg} = C_w * H \qquad \textbf{Equation 6-14}$$

Where:
- C_{sg} = the contaminant concentration in the soil vapor (mg/m^3)
- C_w = the concentration of compound in groundwater (ug/l)
- H = the Henry's Law Constant (dimensionless)

- Direct Measurement of Soil Gas

Data provided from soil gas surveys are typically reported in micrograms per liter-vapor (ug/l-vapor) or parts per million by volume (ppmV). The latter value should be converted to the proper units required for the flux equation (mg/m^3). Standard conversions are provided in Table 6-7.

TABLE 6-7
GAS CONCENTRATION UNITS – CONVERSION

UNITS	TO CONVERT TO:	MULTIPLY BY:
ug/l	mg/m^3	1
ug/m^3	mg/m^3	0.001
ppmv	mg/m^3	MW/24 (20^oc)
ppbv	mg/m^3	MW/24,000 (20^oc)
ug/l	ug/m^3	1000
ug/l	ppbv	24,000/MW (20^oc)
ug/l	ppmv	24/MW (20^oc)
ppbv	ppm	0.001
ppmv	ppbv	1000

Notes:
ug/l = micrograms per liter
mg/m^3 = milligrams per cubic meter
ug/m^3 = micrograms per cubic meter
ppmv = parts per million by volume
ppbv = part per billion by volume
MW = molecular weight of compound (g/mole). Values presented in Table 6-2(a) must be converted from mg/kg to g/mole

(3) Calculation of Indoor Air Concentration

The indoor air concentration is dependent upon the area through which the flux passes and the indoor air exchange rate with outdoor air. The flux is considered attenuated by the presence of a concrete slab. The default slab attenuation factors are provided in Table 6-4. For residential buildings, an indoor air exchange rate of one building volume every 2 hours (or 0.5 exchange per hour) is typically used. Commercial buildings typically have higher exchange rates, which can be obtained from the building architect or engineer. If site-specific air exchange rates are not available, the 0.83 exchanges per hour rate should be used.

$$C_i = \frac{S_b * F_x * A}{V * E} = \frac{S_b * F_x}{R_h * E} \qquad \textbf{Equation 6-17}$$

Where:

	C_i	=	the indoor air concentration (mg/m^3)
	S_b	=	the slab attenuation factor (dimensionless)
	F_x	=	the contaminant vapor flux ($mg/hr\text{-}m^2$)
	A	=	the room floor area (m^2)
	V	=	the room volume (m^3)
	E	=	the indoor air exchange rate per hour (hr^{-1})
	R_h	=	the room height (m)

10. Groundwater Contaminant Transport

A wide variety of analytical and numerical groundwater transport models can be used to evaluate contaminant transport. DEH recommends use of a peer-reviewed model that has been demonstrated in the literature to be conservative, accurate, and appropriate to the site conditions.

11. Fate and Transport Model Proposal

An appropriately detailed written proposal describing the model selection process and rationale must be submitted to the regulatory agencies for review. The proposal should discuss the following:

- Purpose and scope of the fate and transport modeling analysis
- A statement of qualifications
- Summary of site assessment data
- Conceptual model
- Model selection criteria
  - List the objectives of the fate and transport analysis.
  - Describe the concepts and calculations utilized by the models.
  - Summarize strengths, weaknesses, assumptions, and uncertainties of models.
- Data requirements for fate and transport modeling

Discuss the site-specific input parameters to be used in the model. Include a discussion on data availability and quality, and describe any biases in the data that may be attributed to methods of collection or analysis. Discuss, justify, and document the sources of all assumed values used for model input parameters. Correct the values that vary with temperature and pressure to the conditions found at the site being modeled.

Reasonable extrapolations of site-specific data are preferred to generic data from published literature sources. Commonly, fate and transport modeling is performed on one or more indicator compounds. Indicator compounds are typically chosen on the basis of mobility and toxicity.

Describe the methods (analytical, physical, experimental, etc.) that may be used to validate the results of the fate and transport model. If the model has been validated under similar conditions at another site, provide references and briefly outline the results. Discuss the applicability of the validation techniques used at another site to the site of concern.

Please note: In DEH's experience, the largest source of error in computer modeling is from using input parameters that are not in the correct units.

12. Fate and Transport Report

The fate and transport report must be complete and will be reviewed as a stand-alone document. The report may be included in the health risk assessment report. Data obtained from site assessment reports should be clearly presented. A single clear and concise interpretation of the data should be presented (include maps, plot plans, and cross-sections that clearly illustrate site conditions and contaminant distribution). The report must provide the model's predictions of future contaminant migration and distribution of contaminants in relation to receptors (include maps, plot plans and cross-sections). Include copies of model calibration runs and sensitivity analyses in an appendix.

Provide a detailed discussion of the results of the modeling analysis, which addresses the following items:

- Technical problems encountered and any new information concerning site conditions which resulted from the modeling analysis;
- Model input parameters which should be within the range of measured or expected site-specific values;
- Methods used to validate the model at the site;
- Conclusions of fate and transport modeling (include a synopsis of the important results with reference to the limitations and assumptions of the model used); and
- Discussion of the case status, additional work required, and recommendations for the future course of action at the site.

Since fate and transport modeling involves the interpretation of subsurface processes affecting contaminant migration, contaminant transformation and interpretations of geologic and hydrogeologic conditions, the fate and transport proposal needs to be reviewed and signed by a registered professional in the field of geology (a Professional Geologist [PG]).

C. Water Resource Impacts

In those areas designated in the RWQCB Basin Plan as having existing or potential beneficial uses for groundwater and surface waters, the water quality objectives are the MCLs for the compounds identified. In these areas the RWQCB considers the groundwater and surface water as receptors.

II. Risk Characterization

Risk characterization is the process of evaluating the level of human health or ecological risk at a site. This is accomplished by integrating the results of the exposure and toxicity assessments.

The complexity and expense of the risk assessment will vary considerably depending on the site conditions, the type and extent of contamination, and the proposed site use. In an effort to conserve resources, a risk assessment can be done in a phased approach. Available site data, simple calculations, and conservative assumptions can be used initially. If the risk is acceptable under these "worst case" conditions, there may be no need to continue the risk assessment. If the risk is not acceptable, additional site-specific data and/or more complex models using more realistic assumptions should be used to further characterize the risk.

In order to provide a more realistic characterization of risk, some projects may require collection of additional site-specific data. When the collection of site-specific data is too difficult or costly, contaminant removal or treatment may be the best alternative.

DEH recommends that risk assessments adhere to the format presented in the U.S. EPA's document entitled "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A, Interim Final (RAG), December 1989, EPA/540/1-89/002."

In summary, the calculation of risk is based on the summation of the calculated risk from each route of exposure. The routes of exposure to be considered are:

- Dermal
- Ingestion
- Inhalation

In most cases there are three exposure pathways that are relevant. These pathways are (1) inhalation from NAPL, (2) inhalation from residual soil contamination and groundwater contamination, and (3) ingestion of groundwater. These pathways are described in Section 6.III.B.2. Other pathways have not been described herein. If other pathways exist at the site, they need to be included in the analysis to evaluate exposure.

The results of the analytical calculation from the exposure assessment and the corresponding chemicals' cancer SFs and RfDs from the toxicity assessment are then used in the following exposure calculation to calculate the health risk.

It is important to understand that health risk calculations only estimate the incremental increase in risk resulting from residual contamination. Except for lead, risks from ambient sources are not estimated or considered in the methods presented.

The risk assessment report must contain objective and technically defensible conclusions. The report must include a discussion of the strengths and weaknesses of the model by describing uncertainties, making statements of assumptions and limitations, and providing the scientific basis and rationale for each assumption. Model validation must also be discussed as applicable. Conclusions regarding the potential risk to human health and/or the environment must be based on current federal, state, and local guidelines. Risk assessment reporting format is described beginning in Section 6.III.E.

1. List of exposure variables used in risk calculations.

   This following are provided for quick reference for Equations 6-18 through 6-26. Typical default values are presented in Table 6-8.

ABS	=	the absorption factor (dimensionless)
AD	=	the absorbed dose (mg/kg-day)
AF	=	the soil to skin adherence factor (mg/cm^2)
AT	=	the averaging time (days)
BW	=	the body weight (kg)
C_{gw}	=	the chemical concentration in groundwater (ug/l)
C_s	=	the chemical concentration in soil (mg/kg)
C_i	=	the indoor air concentration (mg/m^3)
PC	=	the chemical-specific dermal permeability constant (cm/hr)
ET	=	the exposure time (hr/24hr)
EF	=	the exposure frequency (days/yr)
EF_s	=	the exposure frequency (events/yr)
ED	=	the exposure duration (yr)
FI	=	the fraction of soil ingested from the contaminated source (dimensionless)
HI	=	the hazard index
HQ	=	the hazard quotient
IR	=	the inhalation rate (m^3/day)
IR_w	=	the ingestion rate (l/day-water)
IR_s	=	the ingestion rate (mg/day-soil)
IT	=	the chemical intake (mg/kg-day)
RfD	=	the reference dose (mg/kg-day)
Risk	=	the estimate of health risk (excess cancer risk)
SA_w	=	the skin surface area available for contact (cm^2)
SA_s	=	the skin surface area available for contact (cm^2/event)
SF	=	the contaminant carcinogenic slope factor ($[mg/kg\text{-}day]^{-1}$)

   Either a Certified Industrial Hygienist (CIH) or a Diplomat American Board of Toxicology (DABT) should evaluate use of values other than those presented in Table 6-8.

2. The following are the human health exposure calculations from U.S. EPA's document entitled "Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A, Interim Final (RAGS), December 1989, EPA/540/1-89/002" for the three main exposure routes:

   The following equations are used to calculate the risk to a receptor or individual from a specific exposure route. The intake or absorbed dose accounts for the specific route of exposure. Note that when the chemical of concern is a known carcinogen, the averaging time

(AT) is the number of days over a 70-year lifetime (25,500 days). Please note that for residential exposures, risk must include children and adult exposures.

a. Dermal

Dermal exposure can include exposure to either soil and/or water. The following equations are for dermal contact with a chemical of concern.

(1) Dermal contact with chemicals in water

Equation 6-18

$$AD = \frac{C_{gw} * SA_w * PC * ET * EF * ED * (1 \text{ x } 10^{-3} \text{ l/cm}^3) * (1 \text{ x } 10^{-3} \text{ mg/ug})}{BW * AT}$$

Where:

AD	=	the absorbed dose (mg/kg-day)
C_{gw}	=	the chemical concentration in groundwater (ug/l)
SA_w	=	the skin surface area available for contact (cm^2)
PC	=	the chemical-specific dermal permeability constant (cm/hr)
ET	=	the exposure time (hr/24hr-day)
EF	=	the exposure frequency (days/yr)
ED	=	the exposure duration (yr)
BW	=	the body weight (kg)
AT	=	the averaging time (days)

(2) Dermal contact with chemicals in soil **Equation 6-19**

$$AD = \frac{C_s * SA_s * AF * ABS * EF_s * ED * (1 \text{ x } 10^{-6} \text{ kg/mg})}{BW * AT}$$

Where:

AD	=	the absorbed dose (mg/kg-day)
C_s	=	the chemical concentration in soil (mg/kg)
SA_s	=	the skin surface area available for contact (cm^2/event)
AF	=	the soil to skin adherence factor (mg/cm^2)
ABS	=	the absorption factor (dimensionless)
EF_s	=	the exposure frequency (events/yr)
ED	=	the exposure duration (yr)
BW	=	the body weight (kg)
AT	=	the averaging time (days)

TABLE 6-8
CONSERVATIVE DEFAULT VALUES FOR HEALTH RISK EXPOSURE

VAR.	DESCRIPTION	DEFAULT VALUE	SOURCE
ABS	Absorption factor	Chemical–specific (literature)	EPA, 1989
AF	Soil to skin adherence factor	1.0 mg/m^3	DEH
AT	Averaging time	25,500 days (carcinogen) ED (non-carcinogen)	EPA, 1989
BW	Body weight	15 kg (child) 70 kg (adult)	EPA, 1991 EPA, 1989
ED	Exposure duration	25 years (commercial, adult only) 30 years (residential, adult only) 6 years / 19 years (commercial, child/ad.) 6 years / 24 years (residential, child/adult)	EPA, 1989 EPA, 1989 EPA, 1991 EPA, 1991
EF	Exposure frequency	250 days/year (commercial) 365 days/year (residential)	EPA, 1989 EPA, 1989
EF_s	Exposure frequency	Pathway specific	EPA, 1989
ET	Exposure time	0.5 days (commercial) - 12 hours/day 1.0 days (residential) – 24 hours/day	EPA, 1989 EPA, 1989
FI	Fraction of soil ingested	1 (100% for commercial & residential)	DEH
IR	Inhalation rate	10 m^3/day (child) 20 m^3/day (adult)	EPA, 1997 EPA, 1991
IR_s	Ingestion rate (soil)	100 mg/day (child) 200 mg/day (adult)	EPA, 1991 EPA, 1991
IR_w	Ingestion rate (water)	1 l/day (child) 2 l/day (adult)	EPA, 1989 DTSC,1994
PC	Dermal perm. Constant	Chemical-specific (literature)	EPA, 1989
SA_s	Skin surface area for contact (soil)	2,000 cm^2/day (child) 5,800 cm^2/day (adult)	DEH DEH
SA_w	Skin surface area for contact (water)	23,000 cm^2/day (adult/adult)	DEH

b. Ingestion

Chemicals in soil and/or water can be ingested. The following equations are to be used for ingestion.

(1) Ingestion of chemicals in drinking water

$$IT = \frac{C_{gw} * IR_w * EF * ED * (1 \times 10^{-3}\ mg/ug)}{BW * AT} \qquad \textbf{Equation 6-20}$$

Where:
- IT = the chemical intake (mg/kg-day)
- C_{gw} = the chemical concentration in groundwater (ug/l)
- IR_w = the ingestion rate (l/day-water)
- EF = the exposure frequency (days/yr)
- ED = the exposure duration (yr)
- BW = the body weight (kg)
- AT = the averaging time (days)

(2) Ingestion of chemicals in soil

$$IT = \frac{C_s * IR_s * FI * EF * ED * (1 \times 10^{-6}\ kg/mg)}{BW * AT} \qquad \textbf{Equation 6-21}$$

Where:
- IT = the chemical intake (mg/kg-day)
- C_s = the chemical concentration in soil (mg/kg)
- IR_s = the ingestion rate (mg/day-soil)
- FI = the fraction of soil ingested from the contaminated source (dimensionless)
- EF = the exposure frequency (days/yr)
- ED = the exposure duration (yr)
- BW = the body weight (kg)
- AT = the averaging time (days)

c. Inhalation

Inhalation of chemical vapors inside a structure can be evaluated by using the following equation.

$$IT = \frac{C_i * IR * ET * EF * ED}{BW * AT} \qquad \textbf{Equation 6-22}$$

Where:
- IT = the chemical intake (mg/kg-day)
- C_i = the indoor air concentration (mg/m^3)
- IR = the inhalation rate (m^3/day)
- ET = the exposure time (hr/24hr)
- EF = the exposure frequency (days/yr)
- ED = the exposure duration (yr)
- BW = the body weight (kg)

AT = the averaging time (days)

3. To calculate the carcinogenic risk, the intake (IT) or absorbed dose (AD) is applied to the cancer SF for the compound of concern. Accordingly, the risk is calculated as follows:

Risk = IT * SF **Equation 6-23**

Where:
Risk = the estimate of health risk (dimensionless)
IT = the chemical intake (mg/kg-day)
SF = the contaminant carcinogenic slope factor ($[\text{mg/kg-day}]^{-1}$)

and/or

Risk = AD * SF **Equation 6-24**

Where:
Risk = the estimate of health risk (dimensionless)
AD = the absorbed dose (mg/kg-day)
SF = the contaminant carcinogenic slope factor ($[\text{mg/kg-day}]^{-1}$)

4. To calculate the non-carcinogenic risk, the hazard quotient (HQ), the intake (IT) or absorbed dose (AD) is applied to the reference dose (RfD) for the compound of concern. Accordingly, the hazard index (hazard quotient) is calculated as follows:

$$HQ = \frac{IT}{RfD}$$ **Equation 6-25**

Where:
HQ = the hazard quotient
IT = the chemical intake (mg/kg-day)
RfD = the contaminant reference dose (mg/kg-day)

and/or

$$HQ = \frac{AD}{RfD}$$ **Equation 6-26**

Where:
HQ = the hazard quotient
AD = the absorbed dose (mg/kg-day)
RfD = the contaminant reference dose (mg/kg-day)

When there are multiple substances, the sum of the hazard quotients is considered to be the hazard index (HI).

5. The procedures for evaluation of ecological risks will be reviewed on a case-by-case basis.

III. **Risk Assessment Report Checklist**

A risk assessment report may be a stand-alone document or it may be incorporated into a comprehensive assessment report or Corrective Action Plan. The following format should be used.

1. Executive Summary

A brief and concise overview of information contained in the report. The executive summary should be limited to less than three pages in length and include:

a. A brief description of the receptors of concern (human, environmental, and water resources)
b. A detailed site parameter list (refer to Figure 6-3).
c. A summary of the findings, conclusions and recommendations of the risk assessment.
d. A brief description of the recommended cleanup/closure level(s).

2. Site History

a. Site Description

Include the following (where applicable):

(1) Site address (street name and number, city, state, and zip code)
(2) Name of business
(3) Assessor's Parcel Number (APN)
(4) DEH File No.
(5) Property owner (name and mailing address)
(6) Underground storage tank (UST) owner (name and mailing address)
(7) UST operator (name and mailing address)
(8) RP and contact person (name, mailing address and phone number)

b. Current and Past Site Ownership and Activity Record

Provide a chronological list of past and current owners and operators on the site. Include dates of occupancy, a description of the business operations, and chemical usage including handling/storage/disposal procedures.

c. Summary of Current and Future Property Uses

(1) Provide a summary of on-site use.
(2) Provide a summary of land usage on all adjacent and nearby properties (including those across the street or alley). Include locations of schools, day care centers, residential areas (including apartments, condominiums, single family residences), hospitals, surface water bodies, and aqueducts within one-quarter mile of the site.

d. History of Past Releases

(1) Substance(s) released and date
(2) How release occurred

(3) Contaminant characterization, including constituents and breakdown products
(4) Quantity of substance(s) released (estimate)
(5) Location of release on site

e. Summary of Current and Completed Site Assessment and Remedial Activities

(1) Summary tables of all analytical data with sample identification, depth, laboratory test method and results
(2) Site maps showing horizontal extent of soil and groundwater contamination (including NAPL plume), probable sources, contaminant migration pathways, surface drainage, subsurface utilities (i.e., water, sewer, electric, gas, telephone, storm drain), boring and monitoring well locations, sample locations, and laboratory test results
(3) Site map showing groundwater contour elevations and direction of groundwater flow
(4) Cross sections showing vertical and horizontal extent of soil and groundwater contamination, source of contamination, lithology, water table, sample locations, laboratory results, utilities, and well construction
(5) Estimated mass of contaminants in soil and/or groundwater
(6) Summary of remedial activities conducted to date, including maps, cross sections, mass of contaminants, and discussion of Corrective Action Plan, if applicable

f. Summary of Near-Term and Long-Term Site Remedial Activities

(1) Summary of the planned near-term environmental activities (remedial action, monitoring, no action) at the site
(2) Summary of the planned long-term environmental activities (remedial action, monitoring, no action) at the site

3. Site Information

a. Regional Geologic Conditions

Summary of the lithology in the site vicinity, as well as any geological features of significance, such as faults, landslides, or variable stratigraphy.

b. Site Geologic Conditions

Description of the soil/bedrock

(1) Soil properties that may affect the mobility of vapor, water, or contaminants.
(2) Site features which may influence the migration of contaminants or groundwater through the subsurface, including faults, stratigraphy, subsurface utility lines, abandoned or active wells, geotechnical borings, etc.

FIGURE 6-3
SITE PARAMETER LIST

Soil Parameters	**Information Value Used**	**Reference**
Soil Type		
Soil Porosity		
Soil Bulk Density		
Water Content (vadose zone)		
Air Content (vadose zone)		
Water Content (capillary fringe)		
Air Content (capillary fringe)		
Soil Particle Density		
Mass Fraction of Organic Carbon in Soil		
Depth To and Thickness of Contaminated Soil		
Thickness of Uncontaminated Vadose Zone Between Vadose Zone Plume and Groundwater		
Range of Depths to Groundwater		
Capillary Zone Thickness		
Vadose Zone Thickness		
Soil/Water pH		
Hydraulic Conductivity		
Groundwater Parameters	**Value Used**	**Reference**
Water Infiltration Rate		
Groundwater Mixing Zone Depth		
Aquifer Dilution Factor		
Surface Parameters	**Value Used**	**Reference**
Surface Conditions (paved or landscaped)		
Ambient Air Velocity in Mixing Zone		
Mixing Zone Height		
Contaminated Area		
Width of Contaminated Area		
Thickness of Surficial Soils		
Particulate Areal Emission Rate		
Building Parameters	**Value Used**	**Reference**
Foundation Crack Thickness		
Foundation Crack Fraction		
Building Volume/Foundation Area Ratio (res.)		
Building Volume/Foundation Area Ratio (com./ind.)		
Building Vapor Volume Exchange Rate (res.)		
Building Vapor Volume Exchange Rate (com./ind.)		
Depth of Utilities		
Foundation Type		

c. Regional Hydrologic/Hydrogeologic Conditions

(1) Provide the hydrologic unit, area, and subarea of the site (from the Water Quality Control Plan for the San Diego Region, September 8, 1994).
(2) Describe surface drainage and water bodies.
(3) Discuss historical low and high groundwater levels as well as any recharge/discharge areas within the basin. If multiple aquifer systems are present and known, describe the geometry and distribution of the aquifers. Note the regional groundwater flow direction.
(4) Indicate current or potential beneficial uses of groundwater in the site vicinity.
(5) Note any potential or pending changes in groundwater use.

d. Site Hydrogeologic Conditions

(1) Present a detailed description of the aquifer system(s) beneath the site, including perched groundwater, the capillary fringe zone, and the saturated zone. Provide a detailed description of the aquifer lithology. Any aquitards and aquicludes that could influence the migration of subsurface contaminants should be noted.
(2) Describe groundwater elevation, flow direction, and gradient. Determine whether off-site activities may be influencing flow direction or gradient. Note any on-site or near-site recharge areas.
(3) Provide a summary of any physical properties (grain-size, permeability, etc.) and aquifer tests.
(4) Provide available estimates for hydraulic conductivity, velocity, or other aquifer characteristics.
(5) Provide an evaluation of the current and probable future use of the surface and groundwater resources around the site.

e. Summary of Site Meteorology

(1) Prevailing wind direction.
(2) Average annual rainfall, temperature, etc.

f. Well Inventory Survey

Include a summary of all nearby wells (within one-quarter mile of the source) and plot them on the site map. Identify the well screen interval versus the subsurface zone of soil contamination at the subject site, and whether a well is currently impacted, potentially impacted, or not anticipated to be impacted. Include pertinent substantiation for this conclusion.

4. Compounds of Concerns (COCs)

The report should discuss the rationale for including or excluding potential COCs as well as a summary of the parameters used in the evaluation.

a. Site Contaminants

Discuss all reported contaminants on-site.

b. Table of COCs

Provide the physical characteristics and degradation aspects for each COC in a table format.

(1) Physical Characteristics:

- Solubility
- K_{oc}
- K_{ow}
- Vapor Pressure
- Molecular Weight
- Molecular Formula
- State at Room Temperature
- Oxidation/Reduction Potential
- Density (liquid/vapor)

(2) Degradation Compounds

- Degradation products
- Half life of products (provide reference)

c. Toxicity Assessment

(1) Carcinogenic

- Identify and list the cancer SF for each COC in a table

(2) Non-Carcinogenic

- Identify and list the RfD for each COC in a table

5. Exposure Assessment

The exposure assessment is divided into two sections. One is identification of human and environmental exposures, and the other is the protection of groundwater and surface water as a resource.

The purpose of the exposure assessment is to identify human and environmental populations exposed to contaminants, or the impacts to groundwater and surface water, and identify the pathways through which they would be potentially exposed or impacted.

a. Potential Receptors

(1) Humans and environmental populations

Describe the populations on or near the site. Identify the prevailing wind direction and direction of groundwater flow. Include the population locations, activity patterns, and the presence of sensitive subgroups (e.g., children, elderly people) within one-quarter mile or farther if potential exposure to contamination extends beyond one-quarter of a mile.

(2) Groundwater and Surface Water Resources

Describe the existing and potential beneficial uses of the groundwater and surface water at and near the site.

b. Exposure Pathway Analysis

An exposure analysis includes identification of potentially complete exposure pathways. An exposure pathway is complete if four elements are present:

- A source and mechanism of a chemical release to the environment (e.g., contaminated soil releases of chemicals by volatilization);
- An environmental transport medium (e.g., groundwater, surface water, air, soil or subsurface utilities);
- A point of potential contact between the receptor and the contaminated medium (the exposure point); and
- An exposure route at the contact point (e.g., inhalation, ingestion).

Based on the exposure analysis, summarize complete exposure pathways for the site using current and future anticipated land use.

c. Exposure Concentrations

Provide the exposure concentrations of COCs at the exposure point for completed pathways.

(1) Direct Use of Monitoring Data

Use of monitoring data to estimate exposure concentrations typically is applicable to the following potential exposure points (current use):

- Direct contact with contaminated soil or surface water (e.g., use 95% upper confidence level [UCL] concentration of soil or surface water concentrations in vicinity of likely exposure point).

- Drinking water (contaminated ground water and/or potable municipal water) piped through a zone of contaminated soil (e.g., use the UCL concentrations of the last four quarters of groundwater monitoring data from each well located within the plume).

- Direct use of the soil vapor concentrations as described in Section 5.VI. Use the 95% UCL concentration in soil gas measurements that are representative of the area of contamination.

(2) Fate and Transport Modeling

A combination of monitoring data and environmental fate and transport modeling may be used to estimate exposure point concentrations that vary temporally or spatially. Examples of where fate and transport modeling is used are:

- Future concentrations in contaminated groundwater that will be used for drinking water;

- Future concentrations in contaminated groundwater that may volatilize to the surface;

- Current air concentrations (indoor, outdoor, and offsite) from volatile chemicals in soil, shallow groundwater, and surface water; and

- Estimated concentrations in fish biota that uptake chemicals from water, sediment, or soil.

d. Estimated Intakes

Pathway-specific intakes are dependent on three types of variables:

- Chemical-related variable-exposure concentrations (chemical concentrations in media at exposure point);

- Variables that describe the receptor (e.g., exposure frequency and duration, and body weight); and

- Assessment-determined variable (e.g., averaging time of exposure based on land-use and activity patterns.

For non-carcinogens, the averaging time (AT) generally consists of a limited exposure duration. Non-carcinogenic intakes are referred to as the Chronic Daily Intake (CDI). For carcinogens, the AT is generally an individual's lifetime, assumed to be 70 years. The intake for a carcinogen is referred to as the Lifetime Average Daily Dose (LADD).

e. Risk Characterization

Carcinogenic risk
Determine the corresponding carcinogenic risk for each contaminant in each complete exposure pathway and the cumulative cancer risk for each exposure pathway. The acceptable risk is considered by DEH to be less than 1×10^{-6} (i.e., one theoretical excess cancer in a human population of one million).

Non-carcinogenic risk
Determine the corresponding hazard quotient for each contaminant in each complete exposure pathway. It is appropriate to sum the hazard quotients of compounds with similar toxicological endpoints. The sum of more than one hazard quotient is the hazard index. The hazard index for more than one substance or the hazard quotient for a single substance must not exceed a value of 1.0.

f. Cleanup/Closure Levels

Where applicable, calculate the cleanup/closure levels to achieve acceptable risk for cumulative exposure pathways.

6. Uncertainty

Discuss the uncertainties that have a bearing on contaminant fate and transport models used, the calculation of risk and the degree to which the uncertainty may tend to underestimate or overestimate the actual risk.

Frequently, the final values presented are very conservative. They may be based on the upper 95th confidence interval or the “maximally exposed population.” The “median value of excess” cancer risk may likely be several orders of magnitude lower. On the other hand, sensitive populations such as the elderly and children may be prone to higher rates of toxicity or cancer than the population at large. Identify the key site variables and assumptions that contribute most to the uncertainty. The end result of a risk assessment is a qualitative/semi-quantitative assessment that is useful to risk managers in evaluating and ranking risk—not determining absolute risk.

7. Findings, Conclusions, and Recommendations

Summarize the findings and conclusions. Provide recommendations for cleanup/closure levels. A registered professional must sign the final risk assessment report. Generally, this work requires geologic evaluation and interpretation, and the qualified professionals who have expertise in this field are Professional Geologists and Registered Civil Engineers.

If the default health risk exposure values (Table 6-8) are modified, the report will need to include a discussion providing the technical justification for the change and the report must be signed by the Certified Industrial Hygienist (CIH) or a Diplomat American Board of Toxicology (DABT) making the modification.

IV. RISK MANAGEMENT

DEH's role is to review the assumptions, calculations, and conclusions presented in the risk assessment and evaluate the risk management decisions proposed by the RP/consultant.

DEH requires risk management decisions be made if the risk assessment indicates an unacceptable level of risk. Examples of some risk management decisions are:

- Removal and/or treatment of contaminants,
- Creation of barriers to block migration or exposure pathways, or
- Other engineering controls to reduce or prevent exposure.

In This Section:

Section 7
Site Mitigation Process

I. INTRODUCTION

The remedial phase of an environmental investigation involves activities to eliminate contaminant impacts to receptors (human health, human safety, groundwater quality, or the environment).

Once the full extent of contamination has been determined, the elimination of existing contaminant impact to receptors requires the establishment of site-specific cleanup goals based on the following criteria:

- Regulatory standards
- Current or proposed site use
- Existing or potential use of ground and surface water
- Existing or potential contaminant impact to receptors

Remediation can include:

- Remedial (cleanup) activities, or
- Engineering controls (techniques used to eliminate existing or potential contaminant impacts)
- Natural attenuation

A. UST Sites

The California Code of Regulations (CCR), Title 23, Division 3, Chapter 16, Article 11, divides remedial actions into two types for sites with contamination related to underground storage tanks (USTs):

1. Interim Remedial Action

Interim remedial actions are necessary to abate immediate contaminant impacts to receptors, or to control the spread of contamination, and can occur any time during an environmental investigation.

Most common remedial technologies can be used as interim remedial actions (examples include non-aqueous phase liquid [NAPL] removal or excavation of contaminated soil). DEH concurrence is required prior to initiating interim remedial activities. Other regulatory agencies may require permits and/or approvals depending on the technology selected.

2. Corrective Action Plan Implementation

A Corrective Action Plan (CAP) presents a comprehensive summary of the findings of site assessment and characterization activities, identifies existing and potential receptors, proposes site specific cleanup goals, presents a remedial technology feasibility study, and proposes a remedial plan. Before a CAP is implemented, the extent of contamination must be completely assessed, and the contaminant and site must be characterized. CAPs must also undergo a public review period. The elements of a CAP can be reviewed in Article 11, provided in Appendix K. CAP guidelines are also described in Section 7.III.

If the RP is seeking reimbursement from the State UST Cleanup Fund, implementation of the most cost-effective remedial alternative is required.

B. Non-UST Sites

The remediation process for cleanup of non-UST related sites is technically identical to the remediation process for UST related cases. A formal CAP is not required by regulation. However, for consistency DEH may choose this same process for non-UST cases.

C. Remediation Alternatives

Following the review of the comprehensive site assessment report, the registered professional will decide if site conditions are protective of human health, human safety, groundwater quality, or the environment. If site conditions are not protective of receptors, the submittal of a CAP is required. All appropriate remediation alternatives should be evaluated in the CAP. Remediation alternatives include, but are not limited to:

- NAPL removal
- Soil excavation and off-site disposal
- Soil excavation and on-site treatment
- In situ soil treatment
- Groundwater treatment
- Natural attenuation

II. AGENCY PERMITTING

The following is a list of various agencies involved in the permitting of remediation systems. When considering a remediation approach, contact these agencies to verify their requirements, since they can vary significantly depending on the technology, the waste being treated, and the local laws and regulations.

- Regional Water Quality Control Boards (RWQCBs)
- San Diego County Air Pollution Control District (APCD)
- Local building /planning departments
- Local sewer agency
- Local storm water programs
- Local fire departments
- Cal-EPA

- Federal EPA, Region 9

III. CORRECTIVE ACTION PLANS

A CAP is a comprehensive approach to remediate the effects of an unauthorized release from a UST system in a cost-effective manner. A CAP is typically developed only after a complete site investigation has been performed. A CAP should be a stand alone document written with sufficient details that the public can understand the current site conditions and remedial approach. The following discussion outlines the information to be considered and documentation to be submitted by RPs preparing a CAP. RPs or their consultants must be prepared to present their CAP process to the public when necessary.

The complexity of the investigation, assessment, and feasibility study depends, in part, on the type of contaminant(s) and the extent of contamination. RPs and their consultants are advised to work closely with DEH staff throughout the entire CAP process to avoid unnecessary tasks. As always, DEH wants to encourage prompt cleanup. However, situations could exist where RPs and/or their consultants seek to obtain DEH concurrence at each step of the CAP process. DEH will review the proposed CAP and provide concurrence only after concluding that implementation of the CAP will adequately protect public health and safety and the environment, and will restore or protect current or potential beneficial uses of water.

These guidelines have been developed to comply with the UST regulations included in the CCRs, Title 23, Division 3, Chapter 16, Article 11, Sections 2720 and 2725 through 2728, and the California Health and Safety Code, Division 20, Chapter 6.7, Section 25280(b).

For those sites where contamination is not related to a UST and remediation is required, a remedial action plan (RAP) may be needed. At the request of DEH, a RAP is required for sites where significant remedial action is necessary. The RAP should follow the guidance for CAPs presented in this section.

A. Situations Requiring a CAP

A CAP is required when any of the following conditions exist:

1. NAPL is found at the site or in the surrounding area.
2. There is evidence that surface water or groundwater has been or may be affected by the unauthorized release.
3. There is evidence that contaminated soils are or could come in contact with surface water or groundwater.
4. DEH requests a CAP, based on actual or potential adverse effects of contaminated soil or groundwater on nearby surface waters or groundwater resources, or based on the potential risk of fire, explosion, or other potential public exposure.

B. Contents of a CAP

A CAP includes the following four basic elements, which are listed and then described in more detail below:

- Assessment of impacts
- Determination of applicable cleanup levels
- Feasibility study and corrective action workplan
- Plan to monitor and report the effectiveness of the corrective action

1. Assessment of Impacts

A CAP is based on adequate delineation of contamination. If DEH requests a CAP prior to the completion of a site investigation, the site investigation becomes a part of the CAP and must be completed before the remedial action is undertaken. Previous site assessment reports may be referenced in the CAP.

At a minimum, all of the following information should be included in an "Assessment of Impacts."

a. Hydrologic and Geologic Characteristics of the Site

(1) Indicate the current and potential beneficial uses of groundwater and nearby surface waters as designated by the RWQCB.

(2) Tabulate existing groundwater data for the site. Include existing monitoring well gauging data (e.g., depth to groundwater, groundwater elevation) and well construction details (e.g., total depth, depth to top of screen, screened intervals).

(3) Provide a narrative description of the topographic characteristics in the vicinity of the site (e.g., locations of surface waters, slope of site, drainage patterns and facilities, locations of subdrains, locations of grading work done at the site).

(4) Provide a map that illustrates the items described in (3) above, as well as the location of groundwater recharge zones and groundwater supply wells in the vicinity of the site.

(5) Provide a narrative description of the lithology of the site.

(6) Provide a cross section of the lithologies present at the site.

(7) Provide hydraulic contour maps to illustrate the groundwater flow direction and gradient.

(8) Provide a discussion of the groundwater data in a regional context and in consideration of regional climatic cycles. Discuss any trends or fluctuations observed from season to season, or from year to year.

b. Contaminant Characteristics and their Impacts

(1) Identify the contaminants of concern at the site. Tabulate all existing soil data. Tabulate the existing groundwater data and provide an analysis of trends in contaminant concentrations.

(2) Provide a narrative discussion of the chemical and physical characteristics of the contaminant(s). Discuss each contaminant's toxicity, persistence, and potential for migration through soil, water, and air.

(3) Describe impacts of the contamination at the site to soil, groundwater, surface water, and air. Describe impacts to utilities including water lines, storm drains, electrical and phone lines, etc. Include maps and cross sections depicting the contaminant plume(s). Include maps of all utility lines and indicate their depths.

(4) Describe potential impacts of contamination at the site to soil, groundwater, surface water, and air. Describe potential impacts to utilities including water lines, storm drains, electrical and phone lines, etc. Include maps and cross sections depicting the potentially impacted area(s). Prior to initiating a fate and transport study or risk assessment study, consult with DEH to determine if this level of analysis is necessary.

2. Determination of Applicable Cleanup Levels

Cleanup levels for groundwater, surface water, and soil are performance standards that need to be considered for the feasibility study. Strategies evaluated in the feasibility study should be technically capable of remediating contamination to the established cleanup levels. DEH concurrence with any proposed target cleanup levels must be obtained prior to implementing the corrective action, except as provided in Section 6.III.D. Cleanup levels are determined as follows.

a. Cleanup Levels for Groundwater or Surface Water in Areas with Designated Current or Potential Beneficial Uses

CCR Title 23, Article 11, Section 2725 (g) requires that in areas with designated current or potential beneficial uses of groundwater or surface water, the numerical objectives designated in the San Diego Water Quality Control Plan (as prepared by RWQCB) for any particular contaminant will constitute the Maximum Contaminant Level (MCL) for that contaminant in groundwater and surface water. In general, the numerical objectives (MCLs) will be adopted as specified in CCR Title 22, Chapter 15, Article 5.5, Section 64444.5, Table 5.

There are chemical compounds that have no numerical objective designated in the Water Quality Control Plans for either the San Diego Basin or the Colorado River Basin. The RP shall then propose target cleanup levels for groundwater and surface water that are consistent with the narrative of the Water Quality Control Plans for the San Diego Basin and the Colorado River Basin (see "Groundwater Cleanup Levels" section in the Water Quality Control Plan), and that are based on the information presented in Section 6.II.A. Proposed target cleanup levels are typically based on risks to public health and safety. Potential vapor migration of contaminants should be taken into account.

b. Cleanup Levels for Groundwater or Surface Water in Areas with No Designated Beneficial Uses (Non-Beneficial Use Areas)

In an area with no designated current or potential beneficial uses for groundwater or surface water (i.e., non-beneficial use areas), the RP shall propose target cleanup levels for groundwater and surface water. The target cleanup levels should be based on the information presented in Section 6.II.B. Proposed target cleanup levels are typically based on risks to public health and safety. Potential vapor migration of contaminants should also be taken into account.

When the RP or DEH is aware that water in a non-beneficial use area is in fact being used, cleanup levels for groundwater and surface water are as outlined in Section 6.II.A.

c. Cleanup Levels for Soil

The RP shall also propose soil cleanup levels. The target soil cleanup levels must ensure that remaining leachable/mobile constituents of concern do not threaten to cause groundwater or surface water to exceed applicable (water) target cleanup levels. The target soil cleanup levels must ensure that remaining constituents of concern do not threaten public health through exposure to soil vapors or the soil itself. The target soil cleanup levels must also ensure that remaining constituents of concern do not create fire or explosion hazards.

3. Feasibility Study and Corrective Action Workplan

The CAP feasibility study is performed to evaluate alternative strategies for remediation and their appropriateness and cost effectiveness. Each recommended strategy must be capable of achieving the target cleanup goals established or proposed/approved for the site. Each strategy must also be designed to mitigate nuisance conditions and risk of fire or explosion.

In areas where the RWQCB has designated current or potential beneficial uses for groundwater or surface water, or where water is being used regardless of any particular designation, the feasibility study must evaluate at least two corrective action strategies. In areas where the RWQCB has not designated any current or potential beneficial uses for groundwater or surface waters**, t**he feasibility study must evaluate at least one corrective action strategies. At times, circumstances may be such that the "no action" or long-term "passive bioremediation" alternative might be considered suitable for evaluation in the feasibility study.

The elements of a feasibility study include, at a minimum, the following information:

a. A brief description of each proposed corrective action strategy.

b. A brief justification for the selection of each corrective action strategy as an appropriate method to restore or protect existing or potential beneficial uses and protect public health.

c. An estimate of the time required to attain proposed cleanup goals for each corrective action strategy.

d. A comparative analysis of the total costs of each corrective action strategy. Costs should be presented in terms of starting and operating costs. Unit costs and detailed activity lists are not required.

e. A selection of the "most cost-effective" strategy, as determined by the RPs.

f. Preparation of a detailed workplan describing the specific tasks to be performed in implementing the selected remediation alternative. The workplan should address all the relevant items in the SAM Manual "Site Remediation Check List" and contain sufficient detail so that a third party with no knowledge of the case could implement the workplan.

g. Preparation of a Community Health and Safety Plan. A detailed plan of community health and safety must be prepared according to the guidelines presented in Section 4.IV. This document must accompany the workplan.

Note: The workplan is requested to expedite the site cleanup process. However, circumstances may be such that the RPs and/or their consultants may seek DEH concurrence with the proposed corrective action strategy prior to the preparation of a workplan. Final CAP concurrence cannot be granted until the workplan has been approved.

4. Plan to Monitor and Report the Effectiveness of the Corrective Action

As an integral part of the CAP, the RPs must propose a strategy for monitoring and evaluating the effectiveness of the corrective action strategy.

- Describe the key indicators and the monitoring methods to be used in evaluating the effectiveness of the work.
- Describe the criteria to be used in determining when site cleanup is complete, or when the corrective action has become ineffective.
- Propose a schedule for reporting to DEH, in writing, the monitoring data and an evaluation of the results of such monitoring.

DEH concurrence with the proposed reporting schedule must be obtained before the corrective action is implemented, except as provided in Section C below. During implementation of the CAP, the verification and monitoring program may be modified after consultation with DEH if new conditions deem this necessary.

C. Regulatory Agency Concurrence

The RP must modify the CAP in response to DEH directives. DEH will concur with the final version of the CAP and will issue a "Conditional CAP Concurrence" letter after concluding that implementation of the CAP will adequately protect public health and safety and the environment, and will restore or protect the existing or potential beneficial uses of water. The RP, not DEH, is fully responsible for identifying the most cost-effective corrective action alternative for the site.

If DEH does not respond to the CAP proposal within 60 days of receipt, the RP may notify DEH of their intent to begin cleanup. The RP must comply with any conditions set by DEH at that time, including mitigation of adverse consequences from cleanup activities. DEH can, at any time, direct the RP to modify or suspend cleanup activities.

Before "Final CAP Concurrence" is provided for implementation of the CAP, the RP needs to notify the public of the proposed corrective actions.

D. Public Participation

DEH will require that the RP send a public notice to property owners and occupants of adjacent properties. Additionally, notifications must be sent to those in the vicinity of potential impacts from the site activities, the local planning agency, and other interested parties. The public notice is to describe the proposed CAP and invite interested parties to review the CAP at a local public library, at the offices of DEH, or on the GeoTracker database. The public participation process must provide a minimum 30-day period for the public to review the CAP and to comment directly to DEH. The public notice must include the information contained in the sample notice found in Appendix D.II.

Prior to initiating the public notice period, the RP will provide to the DEH Project Manager for approval a copy of the notice, the list of persons to be notified, and an additional copy of the CAP and workplan for public review at DEH offices. Upon approval from DEH, the public notices may be distributed. DEH must be notified when the Public Participation process has begun, and be provided, in writing, proof of service of the public notice.

If sufficient public interest is expressed during the public notice period, DEH has the option of holding a public meeting. During a public meeting, the RP and/or their consultants must be prepared to present the findings and conclusions of their site investigations, as well as their recommended remediation strategies. Based upon the public comments received, DEH may require modifications to the CAP proposal prior to providing final concurrence and allowing CAP implementation.

Note: Public notification is also required after CAP implementation whenever the target cleanup levels are not attained or if the remediation strategy has changed.

E. Verification Monitoring and Verification of Remediation

Verification samples must be obtained to demonstrate the effectiveness of site cleanup, both during and post remediation. The specifics of verification sampling are dependent upon the:

- Amount of investigation conducted during the site assessment phase,
- Remediation process used,
- Type of contaminant,
- Site geology and hydrogeology, and
- Site use.

A verification-sampling plan must be designed in cooperation with the DEH Specialist assigned to the case. For groundwater contamination, periodic samples will be required from monitoring wells. This must continue over a one-year period (at a minimum). Analytical criteria for cleanup verification are the same as those discussed in Section 5.

IV. REMEDIATION BY NATURAL ATTENUATION

Under certain circumstances, DEH will consider Remediation by Natural Attenuation (RNA) as a remediation alternative for petroleum contamination. RNA is a natural process by which contaminants in the environment are slowly degraded or reduced in concentration by various passive means including volatilization, adsorption, desorption, dispersion, dilution, diffusion, biodegradation, and abiotic degradation. With proper monitoring, an RP may use RNA when there is no existing threat to public health, public safety, groundwater quality, or the environment. The RWQCB's Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated Sites, dated April 1, 1996 (Appendix E.IV) should be consulted when considering RNA, because it outlines additional site mitigation criteria in relation to the groundwater basin use.

Aggressive remedial technologies can potentially yield more immediate mitigation of contaminated sites. This guideline is not intended to discourage the use of the best available control or treatment technologies, methods, or practices.

The following Applicability Section describes the conditions that must be shown to exist at a site in order for DEH to consider RNA a viable corrective action strategy, or a single phase of a multi-phase corrective action strategy. The Evaluation Section then outlines the data collection and data evaluation requirements that need to be addressed when RNA is proposed. Finally, the Workplan and Report of Natural Attenuation Processes Sections establish the scope and the content of the monitoring and reporting program.

A. Applicability

For RNA to be considered, the following conditions must be met:

- The release has been assessed to the satisfaction of the DEH Project Manager.
- Sensitive receptors are protected prior to and during the RNA process.
- The primary contaminants of concern are petroleum hydrocarbons that can be shown to attenuate under natural site conditions.
- Sources of existing or potential groundwater contamination have been removed or mitigated to the extent practicable. These include primary sources such as leaking USTs or product pipelines, and secondary sources such as NAPL and soil containing contaminant concentrations that exceed the established cleanup goals.
- Groundwater monitoring data demonstrate a stable or retreating contaminant plume to the satisfaction of the DEH Project Manager.

B. Evaluation

The site-specific data needed and the evaluation method must be proposed to DEH in the CAP to justify the use of RNA.

1. Data Collection

Site-specific data are required at all sites where RNA is proposed as a remedial technology. In addition to the Site Remediation Plan Checklist topics, the following information must be included to demonstrate the viability of RNA at a site.

a. General Site Parameters

- Soil type
- Soil contamination (type, magnitude, quantity, and distribution)
- Groundwater depth and gradient (include historical fluctuations)
- Groundwater contamination (type, magnitude, quantity, and distribution)
- Historical date and volume of release (if known)
- Porosity, hydraulic conductivity, transmissivity, groundwater velocity

b. Specific Site Parameters

Specific site parameters are measured to demonstrate the occurrence of RNA. If the primary parameters do not demonstrate the viability of RNA, secondary parameters will be required. It is recommended that the frequency and distribution of measurements allow for time series graphing, site profiles and/or contours.

Primary:

- Benzene, toluene, ethylbenzene, and xylene (BTEX) concentrations

Secondary:

- Dissolved oxygen

- Soluble iron, manganese, nitrate, sulfate, phosphate, bicarbonate, carbon dioxide, methane, pH, and redox

2. Data Evaluation

a. Trends in Site-Specific Data

Because hydrogeologic conditions, (water level, flow direction, gradient, etc.), sampling techniques (purge method, collection apparatus, etc.), and analytical methods may vary, established trends (both spatial and temporal) should be based on long-term monitoring. Possible approaches for evaluating data include cross sections that illustrate historic groundwater levels and analytical data relative to the contaminant source, historic graphs of contaminant concentrations and water levels versus time, and trend analyses of contaminant concentrations temporally and/or spatially.

(1) Temporal groundwater analytical and elevation data are to be plotted on a graph versus time to assess plume status.

(2) Spatial groundwater analytical data are to be plotted on a concentration versus distance graph and on site plot plans.

b. Trends in Indicators

Table 7.1 provides a partial list of chemical constituents and properties that have been used to evaluate the viability of RNA.

c. Models

If preliminary information does not adequately demonstrate that RNA is viable, additional information may be required and modeling may be necessary. Models may be used to evaluate the viability of RNA or to estimate the time required to achieve the cleanup goals.

All sensitive physical parameters required in the model construction and operation must be listed and be site-specific.

d. Innovative Alternative Data Evaluation

Proposals are encouraged that use new/innovative data evaluation methods to evaluate and monitor the effectiveness of RNA. Before an innovative method of data evaluation is begun at a site, the justification for the proposed methodology must be discussed with the regulatory agencies. A workplan for the use of an innovative data evaluation method must be submitted to the regulatory agencies for review and approval. The workplan must include the following minimum information:

(1) Technical basis and merits of proposed new/innovative data evaluation method

(2) Specific attenuation processes that the methodology is intended to monitor and evaluate

(3) Technical references to support the validity and sensitivity of the proposed data evaluation method(s).

C. Workplan

The workplan should propose a monitoring and reporting plan to evaluate the progress of RNA. Specifically, the plan should include:

- Compounds of concern
- Cleanup goals (specific concentration or trend as set in the CAP)
- Data evaluation methodology
- Specific data required to implement the proposed data evaluation methodology
- Site-specific sampling locations and media to be sampled
- Sampling and analytical protocols (including QA/QC limits) required by the proposed methodology
- Frequency of sampling and analysis
- Proposed frequency for the preparation and distribution of the reports and attachments
- Methodology to be used to estimate mass removal rate

TABLE 7-1
SELECTED INDICATORS OF RNA

Indicator	**Biodegradation Condition**	**Evaluation**
Dissolved Oxygen (D.O.)	Aerobic biodegradation	Monitor upgradient and in source area. Should see decrease in source area if being utilized.
Nitrate, sulfate, ferric iron, manganese	Anaerobic biodegradation	Instead of oxygen, under anaerobic conditions (no D.O. upgradient or <1 ppm D.O.) there are several possible electron acceptors. Nitrate and sulfate will decrease, as compared to upgradient if they are being used for biodegradation. It is difficult to measure ferric iron. Measure the end product, ferrous iron. In this case, the concentration of ferrous iron will increase in the source area if biodegradation is occurring. Manganese can also be used as an electron acceptor, although it is mostly associated with marine sediments.
Methane	Anaerobic biodegradation	Methane is the end product of the use of carbon dioxide as an electron acceptor. Can be measured by gas chromatography.
Carbon dioxide	Aerobic and anaerobic biodegradation	Carbon dioxide is made under both aerobic and anaerobic conditions. It is the major end product from the biodegradation. It can be measured by gas chromatography or chemical titration.
Eh (Redox potential)	Aerobic and anaerobic biodegradation	An Eh that is positive is indicative of aerobic conditions. An Eh that is negative is indicative of anaerobic conditions. The electron acceptor that is being used under anaerobic conditions can be predicted from the Eh measurement. The measurement of Eh can be difficult.
Ammonia (or nitrate) and phosphate (Nutrients)	Aerobic and anaerobic biodegradation	Biodegradation may be limited under some conditions due to insufficient nutrients for microbial growth. Phosphate and a nitrogen source (ammonia or nitrate) are needed for bacterial growth and can decrease in the source area.
pH	Aerobic and anaerobic biodegradation	Aerobic biodegradation will generally lead to carbon dioxide. Anaerobic biodegradation will lead to both carbon dioxide and other end products, such as volatile fatty acids (acetate, propionate, butyrate). Both can result in acidic conditions and a lower pH.

D. Report of Natural Attenuation Processes

A report must be submitted summarizing the evaluation of the RNA processes. The report should include at a minimum the following:

1. A complete site assessment report
2. Compilation of the data analysis activities to evaluate the RNA process
3. Calculations of the mass removal rate
4. A general estimate of the time it would take to reach the cleanup goal by RNA (if not reached)
5. Conclusions and recommendations.

The report must re-evaluate the efficacy of RNA. The report should summarize previous field and laboratory data and summarize data accumulated during the RNA monitoring period. The final report submitted to DEH must demonstrate that remediation has accomplished its stated goals (as set in the CAP).

A Registered Geologist or Registered Civil Engineer must sign the report.

V. SITE REMEDIATION WORKPLAN CHECKLIST

All remedial activities under the direction of DEH must be completed under an approved workplan. The workplan must contain the relevant items in the Site Remediation Workplan Checklist in this Section. Activities must be performed in accordance with the SAM Manual and in a manner that adequately protects public health and the environment. Additionally, most remediation activities require approval and/or permits from various agencies.

Each of the following topics should be addressed in the proposed workplan for remediation or be included as part of a CAP if the workplan is being submitted as an attachment to a CAP. If any of the topics do not apply to your situation, provide an explanation within the workplan.

A. Site Identification

1. Complete site address, contact and phone number
2. Name and type of business or description of current site use
3. Assessor's parcel number (APN)
4. Property owner's name, mailing address, and phone number
5. RP's name, mailing address, and phone number
6. Consultant's name, mailing address, and phone number
7. Contact person's name, mailing address, and phone number (if different than listed above)
8. DEH case number (i.e., H00000-000)
9. EPA identification/generator number

B. Summary of Site Assessment

1. Characterization of contamination and matrix (e.g., soil, sludge, groundwater)
2. Table of laboratory data
3. Cross sections showing the extent of contamination, sample locations, contaminant concentrations, water table elevation, lithology, location of USTs, piping, dispensers, and other possible contaminant sources
4. Map(s) showing the horizontal extent of contamination, sample locations, contaminant concentrations, groundwater gradient, location of entire UST system
5. Maximum and average concentration of contaminant(s)
6. Estimated volume of contaminant to be treated
7. Estimated volume of matrix to be treated
8. Description of past present and future property uses
9. Map showing adjacent land use(s) (e.g., residential, commercial) drawn to scale, noting schools, hospitals, and any other sensitive receptors within a 1-mile radius of the site
10. Location and use of all known water wells on the site and within a 1-mile radius of the site

C. Treatment System

1. Statement of qualifications of treatment system designer, including past experience(s) using the proposed system on similar contaminants and matrices
2. Treatment system design, type of equipment, and operation specifications
3. Treatment system flow chart and logic control flow diagram
4. Plot plan showing location and arrangement of treatment system on the site
5. Proposed treatment project schedule (time-line)
6. Description of monitoring method and schedule to evaluate treatment system effectiveness and to ensure receptors are protected
7. Hours of operation
8. Sound/noise attenuation, if necessary

D. Remedial Waste Determination

The RP is to evaluate whether the waste generated during remedial activities is a regulated waste.

E. Agencies That Require Permits or Notification

A list of agencies which require permits or notification must be provided.

1. For proposed discharges to the environment, contact:

    - RWQCB for all discharges, or potential or existing impacts to surface and/or groundwater
    - Air Pollution Control District (APCD) for all discharges to air
    - Local sewer agency for all discharges to sewer

2. If the proposed activities involve flammable or explosive materials or conditions, the RP should acquire input from the local fire department.

3. If the remedial system requires construction activities, the RP is required to contact local building and planning departments to determine if a building permit is required.

4. If the remedial activities involve the generation or treatment of material determined to be a California regulated or RCRA regulated hazardous waste, the RP is to contact the California EPA for direction.

5. If the remedial activities involve the generation or treatment of material determined to be a RCRA regulated hazardous waste, the RP is to contact the EPA for direction.

6. If the remedial activities involve the installation of wells, a DEH permit is required.

7. If pesticides are a contaminant of concern, the RP should contact the Department of Agriculture for direction.

8. If asbestos is a contaminant of concern, the RP should contact the APCD for direction.

9. Contact each municipality for grading permit requirements. See Appendix N for contact phone numbers."

F. Management of Remedial Wastes and On-Site Soil Treatment Stockpiles

Refer to Section 5.XI.

G. Verification Sampling Plan

Verification sampling plans may be included as part of the "Remediation Workplan." It should be understood, however, that such plans are preliminary and may need to be modified as a result of site-specific conditions, which may be discovered during remediation. A verification sampling workplan will be required prior to implementation.

H. Community Health and Safety Plan

DEH has the legal authority to halt any remediation project that adversely impacts the public health, public safety, or the environment. Other agencies can halt activities that create a nuisance or fire danger. A Community Health and Safety Plan must be submitted and approved prior to commencement of remediation activities. This will help ensure (but cannot guarantee) that the cleanup will continue uninterrupted. Please refer to Section 4.IV.

VI. MANAGEMENT OF PETROLEUM HYDROCARBON CONTAMINATED SOIL

The following discusses the proper on-site storage controls and the final management options for disturbed petroleum contaminated soils (excavated, graded, cuttings from boreholes, etc.).

A. Engineering Controls for Stockpiled Soil

When contaminated soil is being excavated and stockpiled, the main concerns are the impacts pto human receptors and to the environment. DEH recommends that creation of contaminated soil stockpiles be avoided whenever possible, but understands that there are situations in which these stockpiles are necessary. The following engineering controls should be implemented when contaminated soil stockpiles are created:

1. Place on a relatively impervious surface such as covered asphalt, concrete, or plastic sheeting.
2. Moisten to minimize dust emissions during stockpiling (no runoff is to be created during this process).
3. Construct and maintain the stockpile in a manner that prevents surface and rainwater from entering the stockpile and minimizes vapor emissions.
4. Secure covering with heavy plastic sheeting to minimize vapor emissions and prevent runoff from rain (sheeting must be maintained in good condition).
5. Remove stockpiled soil in a timely manner after excavation to avoid nuisance complaints. Any stockpiled soil demonstrated by sampling and laboratory analysis, or determined by the generator to be hazardous waste, must be stored in accordance with hazardous waste regulations, and removed within 90 days of excavation.
6. Minimum stormwater requirements must be met according to Appendix N.

B. On-Site Management

The RP for the unauthorized release may elect to manage the contaminated soil through on-site treatment and/or on-site disposal. The RP is required to follow the requirements of the RWQCB Resolution No. 95-63 (Appendix E.VII). Sampling should follow the guidance in Section 5.X.A. It is good practice to communicate closely with the assigned DEH Project Manager to avoid any unnecessary delays and/or expenses. Documentation of all implemented on-site soil treatment or disposal activities must be submitted to DEH and the RWQCB.

C. Disposal of Contaminated Soil Outside San Diego County

Contaminated soil to be disposed of or treated at a permitted facility outside of San Diego County must meet the acceptance requirements of that facility. Documentation of disposal of the soil (i.e., bill of lading, weigh tickets, manifests, etc.) must be submitted to DEH as evidence of proper soil disposal.

D. Disposal of Contaminated Soil at a Class III Landfill in San Diego County

Contaminated soil to be disposed at a Class III landfill in San Diego County must meet the acceptance requirements of that facility. Documentation of proper disposal of the soil (bill of lading, weigh tickets, manifests, etc.) must be submitted to DEH.

Appendix A
Underground Storage Tank Permit

Contents of Appendix A

I. Underground Storage Tank Permit Application

PERMIT APPLICATION
PART I
GENERAL PROJECT INFORMATION

OFFICE USE ONLY
PERMIT #:
PLAN CK#:
DATE RECEIVED:
FEE PAID:
PLAN APPROVAL:
HYDRO UNIT:
BENEF. USE:

UNDERGROUND HAZARDOUS MATERIALS STORAGE TANK FACILITY

A. SITE NAME: ____________________

SITE ADDRESS: ____________ City ____________ Zip ________

B. PROPERTY OWNER:

Assessors Parcel No. ____________

Company ____________ Contact ____________

Mailing Address ____________ City ____________ State ________ Zip ________

Phone ( ) ____________

24-Hour Emergency Contact ____________ Phone ( ) ____________

C. TANK OPERATOR:

Company ____________ Contact ____________

Mailing Address ____________ City ____________ Zip ________

Phone ( ) ____________

24-Hour Emergency Contact ____________ Phone ( ) ____________

D. CONTRACTOR PERFORMING WORK:

Primary Contractor ____________ Contract ____________

Mailing Address ____________ City ____________ Zip ________

Phone ( ) ____________

State Contractor License ____________

Hazardous Substances Certificate ____________

Worker's Compensation Insurance Company ____________

E. APPLICATION SUBMITTAL, PLAN APPROVAL, PERMIT ISSUANCE, AND REQUIRED INSPECTIONS

Submit one (1) original and two (2) copies of this application package, including plan drawings with the required fee to the Department of Environmental Health (DEH), Hazardous Materials Division, 1255 Imperial Avenue, San Diego, CA 92101; or mail to P.O. Box 129261, San Diego, CA 92112-9261. **Checks should be made payable to the County of San Diego.**

A permit will be issued by DEH upon review and approval of the application and plans. The required fees must be submitted with the application package. Information in addition to that presented in the application package may be needed in order to obtain final approval. No work is to begin on the proposed project until a permit has been issued. The required inspections cannot be scheduled until a permit is issued.

Once the permit has been issued, it is the responsibility of the permittee to notify DEH at least two (2) working days in advance to schedule each required inspection.

Construction stages at which inspections are required are indicated in each subpart of this application form (i.e., Part II, III, IV, & V).

DEH:HMD-9311 (Rev. 01/03) 1-1 County of San Diego
Department of Environmental Health

F. PROJECT WORK TO BE COMPLETED: Check Applicable Box	COMPLETE APPLICATION PARTS	FEE CODE TABLE G
☐ Installation/Construction of new tank(s) systems only (without closing any existing tanks)	I & II	1
☐ Closure of existing tank(s) systems with installation of new tanks (tank replacement)	I, II & III	1 & 2
☐ Closure of existing tank(s) systems with no new tank installation	I & III	2
☐ Interior coating/repair of an existing underground storage tank	I & IV	1
☐ Repipe/pipe-repair piping upgrade of an existing underground storage tank facility	I & V	3
☐ Installation/Construction of vaulted tanks	VI	4

G. FEES: The fees shown below cover plan review and the required field inspections. Use the appropriate Fee Code as determined in Section F above.

FEE CODE	Installation fee for first tanks $890.00 **(fee will apply to all tank installations, tank repairs, interior lining and bladder installations)**	Fee: $
1	Installation fee for each additional tank No. ______ X $90.00	Fee: $
	Establishment Base Fee $180.00 (Applies to establishments not currently under permit with DEH)	Fee: $
	Operating Permit Fee per tank No. ______ X $270.00 (Does not apply to replacement tanks if the existing tank to be replaced has paid current operating permit fees)	Fee: $
2	Closure fee for first tank $535.00	Fee: $
	Closure fee for each additional tank No. ______ X $90.00	Fee: $
3	**NOTE: Upgrades / Repair shall include but not limited to pipe repairs, repipes, and new monitoring system installations**	
	Upgrade /Repair – 2 inspections (including soil sampling) $755.00	Fee: $
	Upgrade /Repair – 1 inspection and no soil sampling $535.00	Fee: $
4	Consultation fee (e.g. vaulted tank: minimum 2 hours) ______ Hours X $90.00	Fee: $
5	Re-inspection fee $300.00	Fee: $
	Plan Re-Review $200.00	Fee: $
		TOTAL FEE: $

H. PERMITS REQUIRED BY OTHER AGENCIES:

FIRE DEPARTMENT __________ APCD __________ BUILDING DEPARTMENT __________ OTHER __________

Provide copies of approved applications from these departments and others if needed.

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PERMIT APPLICATION

PART II

APPLICATION FOR PERMIT TO CONSTRUCT UNDERGROUND STORAGE TANK FACILITY

BOARD OF EQUALIZATION UST STORAGE FEE ACCOUNT NUMBER-Call (916) 324-2300 for information

TY (TK) HQ	4	4	-							

NOTE: Application will be disapproved without this information

A. TOTAL NUMBER OF TANKS TO BE INSTALLED ______________

B. TYPE OF PRIMARY CONTAINMENT

TANK NO.	MANUFACTURER	COMPOSITION	CAPACITY	STORAGE MATERIAL

C. TYPE OF SECONDARY CONTAINMENT

☐ Multiple compartment double wall tanks

☐ Double wall tanks ☐ Concrete Vault

☐ Flexible liner (manufacturer) ______________________

Other, briefly describe ___________________________

D. DISPENSER CONTAINMENT

Manufacturer ____

Type of Monitoring:

☐ Mechanical Monitoring

☐ Electronic Monitoring ____________________________Model

E. UNDERGROUND STORAGE TANK LEAK DETECTION SYSTEM

☐ Continuous leak detection device within the secondary containment, connected to an audible/visual alarm system

Manufacturer/Model No. ____

☐ Other, briefly describe ____

F. UNDERGROUND STORAGE TANK PIPING MATERIALS AND CONSTRUCTION

PRODUCT PIPING: Primary containment ____

Secondary containment ____

VAPOR, VENT, FILL PIPING: Primary containment ____
(fittings and unused bungs)

Secondary containment ____

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G. TYPE OF PRODUCT DELIVERY/FILL SYSTEM (I.E., PRESSURIZED, SUCTION, REMOTE FILL)

Motor vehicle fuel tanks ______________________

Waste oil tanks ______________________

Other tanks, briefly describe ______________________

NOTE: MANIFOLDED PRODUCT DELIVERY SYSTEMS REQUIRE SECONDARY CONTAINMENT AND CONTINUOUS MONITORING

H. PIPING LEAK DETECTION SYSTEM

Continuous monitoring device within the secondary containment

Manufacturer ______________________

-AND-

☐ Leak detector on pressurized line (must shut down pump and activate alarm)*
Manufacturer ______________________

-OR-

☐ Continuous monitoring device shuts down pump and activates alarm*

***NOTE: not required for non-pressurized systems (i.e., suction, remote fill)**

I. CORROSION PROTECTION FOR UNDERGROUND PIPING

☐ Coated and Cathodically Protected Steel

☐ Fiberglass

J. UNDERGROUND STORAGE TANK SPILL/OVERFILL PREVENTION SYSTEM

Catchment Basin surrounding the product fill pipe.
Manufacturer ______________________

-AND-

☐ Product Level Sensing Device with High Level Alarm and Ball Float Valves
Manufacturer ______________________

-OR-

☐ Positive shutoff device in fill riser set at 95% of tank capacity
Manufacturer ______________________

-OR-

☐ Secondary containment for vent, vapor, and tank riser piping with Ball Float Valves <u>or</u> Product Level Sensing Device with High Level Alarm
Manufacturer ______________________

K. TYPE/MANUFACTURER OF VAPOR RECOVERY SYSTEM TO BE USED

Stage I Recovery System ______________________

Stage II Recovery System ______________________

L. DESCRIBE HOW YOU PROPOSE TO BALLAST THE TANKS FROM FLOTATION
(TANKS MUST BE BALLASTED IF HIGHEST ANTICIPATED GROUNDWATER IS AT LEAST 25' BELOW GROUND SURFACE)

☐ Anchor Straps per manufacturer's specification with deadman and/or slab

☐ Buoyancy Calculations (must be submitted)

☐ Depth of Groundwater: ____________ ft. (Provide documentation)

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M. CERTIFICATION

Attach certification from the manufacturer that the Hazardous Materials to be stored are compatible with the tank and piping materials.

N. ATTACH THREE COPIES OF PLANS SHOWING THE FOLLOWING:

1. Location of all existing and proposed structures.
2. Location of all existing underground tanks and piping (indicate if tanks are to be closed or replaced).
3. Location of all proposed tanks and piping.
4. Cross section of the tank and piping system(s). This drawing must show secondary containment of tank(s) and piping, spill/overfill prevention devices, leak detection equipment with the correct number of sensing probes and extension of all pipes and ancillary equipment to finish grade.
5. Location of underground utility vaults and lines.
6. Site plan showing site address, nearest cross street and property lines (scale and north arrow must be used).

O. REQUIRED INSPECTIONS - NEW UNDERGROUND STORAGE TANK INSTALLATIONS

EACH NEW TANK INSTALLATION MUST BE INSPECTED BY DEH. TWO INSPECTIONS ARE REQUIRED.

1. **FIRST INSPECTION: CERTIFICATION AND PRESSURE TEST INSPECTION**
   - pressure test of entire primary system (tank, product, vent, vapor, fill).

2. **SECOND INSPECTION: MONITORING EQUIPMENT AND INTEGRITY TEST VERIFICATION**
   - performance check of the monitoring system. Tank manufacturer's certification, DEH Certification of Tank System installation, Certification of Monitoring Equipment, Integrity Test Report, Form C, and Monitoring and Response Plans must be submitted to the inspector at the time of inspection. **All documents must be submitted before final operating permit will be issued.**

Note: Failure to meet any of the conditions of the permit may result in a reinspection and reinspection fee.

P. DECLARATION

I declare that to the best of my knowledge and belief the statements and information provided are correct and true. I understand that information, in addition to that provided above, may be needed in order to obtain a permit from the Department of Environmental Health (DEH), and that no work is to begin on this project until the permit is issued.

I understand that any changes in design, materials, or equipment will void my permit to construct if prior approval is not obtained. I further understand, that a permit to operate the underground storage tank(s) will not be issued until the DEH inspector approves all conditions of the permit.

I will notify the DEH at least two working days (48 hours) in advance to schedule each required inspection. I understand that site and worker safety are solely the responsibility of the property owner or his agent and that this responsibility is not shared or assumed by the County of San Diego.

SIGNATURE & TITLE: ______________________________

PRINT NAME: ______________________________

TELEPHONE: (   ) ____________________ DATE ____________________

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PERMIT APPLICATION
PART III
APPLICATION FOR PERMIT TO CLOSE UNDERGROUND STORAGE TANK SYSTEM

A. TOTAL NUMBER OF TANK SYSTEMS TO BE CLOSED:________________
NOTE: UST SYSTEMS INCLUDE TANK AND ALL ASSOCIATED PIPING.
B. DESCRIPTION OF TANKS TO BE CLOSED:

TANK NO.	CAPACITY	DATE INSTALLED	TANK COMPOSITION	TANK PRESENTLY IN USE?	MATERIALS STORED IN TANK

C. HAS THE TANK SYSTEM EVER FAILED OR LEAKED? YES ☐ NO ☐ UNKNOWN ☐

D. REASON FOR TANKS TO BE CLOSED:

DEH USE ONLY:
Project Manager: ________________
Type: ________________
Status: ________________

☐ Meet current state/federal requirements

☐ Replacement of existing tanks

☐ Tank system failure, briefly describe ________________

☐ Other, briefly describe ________________

E. PREVIOUS OWNERS AND OPERATORS OF THE TANKS:

Dates	Owner/Operator

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F. PROPOSED METHOD OF CLOSURE: ☐ **REMOVAL** ☐ **CLOSURE IN PLACE**

SAMPLING PROTOCOL Tank owner/authorized representative responsible for all sampling analyses and associated costs.

- For tank systems that are to be removed. The excavation shall be exposed prior to the scheduled inspection and sampling points identified by the Department of Environmental Health (DEH) inspector. Sampling is required for both tank and piping. **The tank and piping must remain in the excavation until the DEH Inspector approves the removal.**
- Tank systems to be closed in place. Submit an alternate plan which must include soil sampling, reason for closing the tank system in place and type of material to be used to fill the tank. Soil sampling and/or hydrostatic testing is also required for piping closures. Tank system closure in place will only be considered after evaluating the risks and hazards if the tank system

G. DISPOSAL SITE OF TANK: ______________________________

Note: You must inform DEH of the address of where the tank and piping is to be disposed. **Plans will be disapproved without this information.**

H. ATTACH THREE COPIES OF PLANS SHOWING THE FOLLOWING:

1. Property lines, site address, scale, north arrow.
2. Location of all existing structures.
3. Location of all existing underground storage tank facilities.
4. Location of underground storage tanks and piping to be closed.
5. Location of underground utility lines and vaults.

I. REQUIRED INSPECTION-PERMIT TO CLOSE

A representative from DEH must be on site at the time the tank(s) are closed.

1. TANK SYSTEM CLOSURE BY REMOVAL:

- The excavation shall be exposed prior to the scheduled inspection. The tank owner/authorized representative on site must submit a uniform hazardous waste manifest demonstrating that the tank has been properly decontaminated. A combustible gas instrument and soil sampling equipment must be on site. The DEH Inspector will identify sampling points. The tank and piping must remain in the excavation until DEH approves the removal.

2. TANK SYSTEM CLOSURE IN PLACE:

- Soil sampling for tank(s) and piping.
- After approval of the alternate plan, the tank owner/authorized representative on site shall submit a uniform hazardous waste manifest demonstrating that the tank has been properly decontaminated. The DEH Inspector shall verify that the tank system has been properly emptied and will witness the filling with an approved inert substance. Piping must be closed at the same time as the tank

J. DECLARATION

I declare that to the best of my knowledge and belief, the statements and information provided are correct and true. I understand that information in addition to that provided above may be needed in order to obtain final approval by the Department of Environmental Health (DEH).

I understand that tests and procedures that may be required by other departments and agencies to demonstrate adequate site safety or suitability for further development (e.g. soil compaction testing) are in addition to the requirements of the Department of Environmental Health (DEH).

I will notify the Department of Environmental Health (DEH) at least two working days (48 hours) before work is to begin in order to schedule the required inspections. I understand that site and worker safety are solely the responsibility of the property owner or his agent and that this responsibility is not shared or assumed by the County of San Diego.

SIGNATURE & TITLE ______________________________

PRINT NAME ______________________________

TELEPHONE ( ) ______________________ DATE ______________

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Department of Environmental Health

PERMIT APPLICATION

PART IV

APPLICATION FOR PERMIT TO INTERIOR LINE/COAT/REPAIR UNDERGROUND STORAGE TANK

The repair material and lining process shall be listed or certified by an independent testing organization based on voluntary consensus standards.

NOTE: Only motor vehicle fuel storage tanks may be repaired by the interior coating process. In accordance with Section 25296 of Chapter 6.7 of the California Health and Safety Code, such an underground storage tank may only be repaired once.

BOARD OF EQUALIZATION UST STORAGE FEE ACCOUNT NUMBER-Call (916) 324-2300 for information

TY (TK) HQ | 4 | 4 | - | | | | | | |

A. NUMBER OF UNDERGROUND STORAGE TANKS TO BE INTERIOR LINED/COAT/REPAIRED: ____________

B. DESCRIPTION OF UNDERGROUND STORAGE TANKS TO BE INTERIOR LINED/COAT/REPAIRED:

TANK NO.	CAPACITY	DATE INSTALLED	TANK COMPOSITION	TANK PRESENTLY IN USE	MATERIALS STORED IN TANK

C. REASON FOR TANKS TO BE INTERIOR LINED/COATED/REPAIRED:

☐ Upgrade to meet current state/federal requirements

☐ Tank system failure, please describe ____________

D. DESCRIBE WHAT TESTS WILL BE CONDUCTED TO DETERMINE THE STRUCTURAL INTEGRITY OF THE UNDERGROUND STORAGE TANK TO BE INTERIOR LINED/REPAIRED:

STEEL TANKS

☐ Ultrasonic Test **(Required in San Diego County)**

AND

Certification by a "Special Inspector" that the shell will provide structural support for the interior lining

NON-STEEL TANKS

☐ Certification in accordance with manufacturer's specifications

E. DESCRIBE THE TYPE OF CORROSION PROTECTION SYSTEM YOU PLAN TO INSTALL (Design must be certified and inspected by a registered corrosion engineer) ____________.

F. UNDERGROUND STORAGE TANK SPILL/OVERFILL PREVENTION SYSTEM

Catchment Basin surrounding the product fill pipe: Manufacturer ____________.

-AND-

☐ Secondary containment for vent, vapor, and tank riser piping with Ball Float Valves or Product Level Sensing Device with High Level Alarm Manufacturer ____________

-OR-

☐ Positive shutoff device in fill pipe at 95% full Manufacturer ____________

-OR-

☐ Product Level Sensing Device with High Level Alarm and Ball Float Valves Manufacturer ____________

G. CERTIFICATION: (Application will be disapproved without this information)

Attach detailed information as to the methods used to line the tank and a certification from the manufacturer, or his authorized representative, of the tank lining material's capability to store the proposed hazardous substances.

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H. ATTACH THREE COPIES OF PLANS SHOWING THE FOLLOWING:

1. Property lines, site address, scale, north arrow.
2. Location of all existing structures.
3. Location of all existing underground storage tank facilities.
4. Location of underground storage tanks to be lined/coated/repaired.
5. Location of underground utility lines and vaults.

I. DESCRIBE THE MONITORING ALTERNATIVE/PROPOSAL YOU PLAN TO IMPLEMENT AFTER THE REPAIRS ARE COMPLETED. ______________________________

____

J. REQUIRED INSPECTIONS-PERMIT TO INTERIOR LINE/COAT/REPAIR

All tests and evaluations required by Chapter 6.7 of the California Health and Safety Code, Section 25296, and CCR Title 23, Article 6 are subject to inspection and review by the Department of Environmental Health (DEH).

1. FIRST INSPECTION (INTERIOR LINING/REPAIR EVALUATION):

_ The first required inspection is of the tank upon completion of the soil sampling, abrasive blasting and vacuum procedure. Documents to determine the structural integrity of the tanks and manifests of proper disposal of the wastes must be received by the SAM inspector at this time.

2. SECOND INSPECTION (INTERIOR LINING/REPAIR VERIFICATION):

_ The second inspection is upon completion of repair/upgrade. Documents required at this time are: Integrity Test Data, Certification of Monitoring, Cathodic Protection Certification, Lab results/hazardous waste manifest for sandblast waste, holiday, thickness and hardness certification. The contractor shall certify that fill pipe striker plates have been installed and the tank lining process was conducted in accordance with CCR Title, Article 6, and NLPA 631 or equal. The DEH inspector shall witness the pressure test and verify installation of monitoring system, cathodic protection and overfill/spill protection

K. DECLARATION

I declare that to the best of my knowledge and belief the statements and information provided are correct and true. I understand that information in addition to that provided above may be needed in order to obtain a permit from the Department of Environmental Health (DEH), and that no work is to begin on this project until a permit has been issued.

I understand that any changes in design, materials, or equipment will void my permit to modify if prior approval is not obtained.

ANY UNAUTHORIZED RELEASE (LEAK) DISCOVERED DURING THE INTERIOR LINING COATING PROCESS MUST BE REPORTED TO HMD AND WILL BE SUBJECT TO SITE ASSESSMENT/ MITIGATION ACTIVITIES BY SAM AND OTHER RESPONSIBLE AGENCIES.

I will notify DEH at least two working days (48 hours) before work on this tank interior coating is to begin in order to schedule each required inspection. I understand that site and worker safety are solely the responsibility of the property owner or his agent and that the responsibility is not shared or assumed by the County of San Diego.

SIGNATURE AND TITLE: ______________________________

PRINT NAME: ______________________________

TELEPHONE: (   ) ______________________ DATE: ______________________

DEH:HM-9314 (Rev 01-03) IV-2 County of San Diego Department of Environmental Health

PERMIT APPLICATION
PART V

APPLICATION FOR REPIPE, PIPING UPGRADE OR PIPE REPAIR OF AN EXISTING TANK FACILITY

BOARD OF EQUALIZATION UST STORAGE FEE ACCOUNT NUMBER-Call (916) 324-2300 for information

TY (TK) HQ | 4 | 4 | - | | | | | | |

NOTE: Application will be disapproved without this information

A. TOTAL NUMBER OF TANKS WHERE PIPING IS TO BE REPIPED, REPAIRED OR UPGRADED ____________

B. DESCRIPTION OF TANKS WHERE PIPING IS TO BE REPIPED, REPAIRED OR UPGRADED

TANK NO.	TANK CAPACITY	PRODUCT TYPE	COMPOSITION

CHECK BELOW WHAT PIPING IS TO BE REPLACED, REPAIRED OR UPGRADED.

	PRODUCT	VAPOR	VENT	FILL LINES
TANK NO. 1				
TANK NO. 2				
TANK NO. 3				
TANK NO. 4				

C. REASON FOR TANKS TO BE REPIPED/REPAIRED/UPGRADED:

☐ Upgrade to meet current state/federal requirements
☐ Piping system failure
☐ Other, briefly describe ____________

D. PIPING MATERIALS AND CONSTRUCTION:

Primary Containment ____________ Manufacturer/model ____________
Secondary Containment ____________ Manufacturer/model ____________
Dispenser Containment ____________ Manufacturer/model ____________

E. TYPE OF PRODUCT DELIVERY/FILL SYSTEM:
☐ Pressurized ☐ Suction ☐ Gravity ☐ Direct Fill ☐ Manifolded System

F. PIPING LEAK DETECTION/MONITORING SYSTEM:
☐ Leak detector on pressurized line: Manufacturer ____________
☐ Continuous monitoring device within the secondary containment: Manufacturer ____________
☐ Leak detector on pressurized line (must shut down pump and activate alarm) (pressurized lines only)
☐ Continuous monitoring device shuts down pump and activates alarm (pressurized lines only)

G. DISPENSER CONTAINMENT MONITORING: (at a minimum must shut down dispenser)
☐ Mechanical monitoring
☐ Electronic monitoring ____________ Model

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Department of Environmental Health

H. TANK OVERFILL PREVENTION:

Catchment Basin surrounding the product fill pipe:
Manufacturer ____________________

-AND-

☐ Product Level Sensing Device with High Level Alarm and Ball Float Valves
Manufacturer ____________________

-OR-

☐ Positive shutoff device in fill pipe at 95% full
Manufacturer ____________________

-OR-

☐ Secondary containment for vent, vapor, and tank riser piping with Ball Float Valves or Product Level Sensing Device with High Level Alarm
Manufacturer ____________________

I. PIPING UPGRADE REQUIREMENT:

☐ Cathodic protection for all product piping in direct contact with backfill material, including turbine, flex connectors and all other appurtenances containing product

☐ Secondary containment of all product piping including turbines, dispenser piping, and all other appurtenances containing product

J. PROPOSED METHOD OF PIPE CLOSURE: ☐ **REMOVAL** ☐ **CLOSURE IN PLACE**

SAMPLING PROTOCOL Tank owner/authorized representative responsible for all sampling analyses and associated costs.

- For piping that is to be removed, the trenching shall be exposed prior to the scheduled inspection, sampling points will be identified by the DEH inspector and samples taken every 20 feet.
- Piping to be closed in place may be considered only if the removal might damage structures. Submit an alternate plan which must include soil sampling.

K. ATTACH THREE COPIES OF PLANS SHOWING THE FOLLOWING (Must be drawn to scale):

1. Location of existing and proposed structures.
2. Location of all existing underground tanks and piping. (Indicate what piping is to be closed in place or by removal)
3. Location of new piping, secondary containment, leak detection, and overfill prevention.
4. Cross section of piping, tank sumps, dispenser containment.

L. REQUIRED INSPECTIONS-PIPING REPAIR/REPLACEMENT/PIPING UPGRADE:
EACH PIPING REPAIR/REPLACEMENT AND/OR PIPING UPGRADE MUST BE INSPECTED BY DEH. THREE INSPECTIONS MAY BE REQUIRED.

1. **FIRST INSPECTION:**
   - Piping to be closed by removal. Trenching shall be exposed prior to the scheduled inspection and sampling points identified by the DEH inspector.
   - Piping to be closed in place. Piping shall be capped and drained and per alternate approved plan, samples collected by the DEH inspector.
2. **SECOND INSPECTION:**
   - Pressure test of all piping repaired, replaced, or upgraded - verification of cathodic protection.
3. **THIRD INSPECTION:**
   - Verification of leak detection devices/secondary containment.

M. DECLARATION

I declare that to the best of my knowledge and belief the statements and information provided are correct and true. I understand that information in addition to that provided above may be needed in order to obtain a permit from the Department of Environmental Health (DEH).

I understand that any changes in design, materials, or equipment will void my permit to construct if prior approval is not obtained.

I understand that tests and procedures that may be required by other departments and agencies to demonstrate adequate site safety or suitability for further development (e.g. soil compaction testing) are in addition to the requirements of the Department of Environmental Health (DEH).

I will notify the Department of Environmental Health (DEH) at least two working days (48 hours) before work is to begin in order to schedule the required inspection. I understand that site and worker safety are solely the responsibility of the property owner or his agent and that the responsibility is not shared or assumed by the County of San Diego.

SIGNATURE & TITLE ____________________

PRINT NAME ____________________

TELEPHONE (   ) ____________________ DATE ____________________

DEH:HM-9315 (Rev. 01-03) V-3 County of San Diego
Department of Environmental Health

PERMIT APPLICATION

PART VI

APPLICATION TO CONSTRUCT A VAULTED UNDERGROUND STORAGE TANK FACILITY

A. **TOTAL NUMBER OF TANKS TO BE INSTALLED** ______________________

B. **TYPE OF PRIMARY CONTAINMENT**

TANK NO.	MANUFACTURER	COMPOSITION	CAPACITY	STORAGE MATERIAL

C. **TYPE OF SECONDARY CONTAINMENT**

- ☐ CONCRETE VAULT
- ☐ Other, briefly describe ______________________

D. **TANK LEAK DETECTION SYSTEM**

- ☐ Visual monitoring of the primary and secondary containments **(NOTE: All exterior surfaces of the primary containment including the floor surface must be monitored by direct viewing.)**
- ☐ Other, briefly describe ______________________

E. **TANK PIPING MATERIALS AND CONSTRUCTION**

PIPING TYPE	PRIMARY CONTAINMENT	SECONDARY CONTAINMENT
PRODUCT		
VAPOR, VENT, FILL		

F. **TANK PIPING LEAK DETECTION SYSTEM**

- ☐ Leak detector on pressurized line
  Manufacturer ______________________
- ☐ Continuous monitoring within the secondary containment
  Manufacturer ______________________
- ☐ Other, briefly describe ______________________

DEH:HM-9316 (Rev. 01-03) VI-1 County of San Diego Department of Environmental Health

G. TYPE OF PRODUCT DELIVERY/FILL SYSTEM (CHECK ALL THAT APPLY)

☐ PRESSURIZED ☐ FUEL OIL SUPPLY (FOS)

☐ SUCTION ☐ FUEL OIL RETURN (FOR)

☐ REMOTE FILL ☐ Other, briefly describe ______________________________

H. TANK SPILL/OVERFILL PREVENTION SYSTEM

☐ Automatic Shutoff Device
Manufacturer ______________________________

☐ Product Level Sensing Device with high Level Alarm

☐ Ball Float Valves on vapor and vent lines

☐ Other, briefly describe ______________________________

I. ATTACH TWO COPIES OF PLANS SHOWING THE FOLLOWING:

1. Location of all existing and proposed structures (generator, boiler, etc.)
2. Location of all existing underground tanks and piping
3. Location of all proposed tanks and piping
4. Cross section of tank and piping system. All surfaces of the tank must be visible for direct viewing, including the secondary containment of tank and piping, and leak detect equipment.
5. Location of underground utility vaults and lines.
6. Site plan showing site address, nearest cross street and property lines **(SCALE AND NORTH ARROW MUST BE USED).**

J. REQUIRED INSPECTION

After plans have been reviewed, a field inspection shall be made to verify if the tank system submitted on the plans were completed on the job site. The actual plans that were stamped from our office must be on site for the inspector to sign and finalize the status of the tank in accordance to Section 25283.5 of the California Health and Safety Code.

K. DECLARATION

I declare that to the best of my knowledge and belief, the statements and information provided are correct and true. I understand that information, in addition to that provided above, may be needed in order to obtain final approval by the Department of Environmental Health (DEH).

I understand that that tests and procedures that may be required by other departments and agencies to demonstrate adequate site safety or suitability for further development (e.g. soil compaction testing) are in addition to the requirements of the Department of Environmental Health (DEH).

I will notify the Department of Environmental Health (DEH) at least two working days (48 hours) in advance before work is to begin in order to schedule the required inspections. I understand that site and worker safety are solely the responsibility of the property owner or his agent and that this responsibility is not shared or assumed by the County of San Diego.

SIGNATURE & TITLE: ______________________________

PRINT NAME: ______________________________

TELEPHONE: ( ) ____________________ DATE ____________________

DEH:HM-9316 (Rev. 01-03) VI-2 County of San Diego
Department of Environmental Health

PERMIT APPLICATION
PART VII
APPLICATION FOR PERMIT TO INSTALL A BLADDER IN AN UNDERGROUND STORAGE TANK

The bladder material and process shall be listed or certified by an independent testing organization based on voluntary consensus standards.

NOTE: Only motor vehicle fuel storage tanks may be retrofitted with a Bladder System.

BOARD OF EQUALIZATION UST STORAGE FEE ACCOUNT NUMBER-Call (916) 324-2300 for information

TY (TK) HQ | 4 | 4 | - | | | | | | |

A. NUMBER OF UNDERGROUND STORAGE TANKS TO BE RETROFITTED WITH A BLADDER: ___________
B. DESCRIPTION OF UNDERGROUND STORAGE TANKS TO BE RETROFITTED WITH A BLADDER:

TANK NO.	CAPACITY	TANK COMPOSITION	MATERIALS STORED IN TANK

C. REASON FOR TANKS TO BE INTERIOR LINED/COATED/REPAIRED:
☐ Upgrade to meet current state/federal requirements
☐ Tank system failure, please describe ___________________________

D. TYPE OF SECONDARY CONTAINMENT:
☐ Steel Tank(s)
☐ Concrete Tank(s)
☐ Other___________

E. DESCRIBE WHAT TESTS WILL BE CONDUCTED TO DETERMINE THE STRUCTURAL INTEGRITY OF THE UNDERGROUND STORAGE TANK TO BE RETROFITTED WITH A BLADDER:

STEEL TANKS
☐ Ultrasonic Test **(Required in San Diego County)**
AND
Certification by a "Special Inspector" that the shell will provide structural support for the Bladder.
NON-STEEL TANKS
☐ Certification by a "special inspector" that the shell will provide structural support for the Bladder.

F. DESCRIBE THE TYPE OF CORROSION PROTECTION SYSTEM YOU PLAN TO INSTALL (Design must be certified and inspected by a registered corrosion engineer) ___________________________

G. UNDERGROUND STORAGE TANK LEAD DETECTION SYSTEM.
☐ Continuous leak detection device within the secondary containment, connected to an audible/visual alarm system.
Manufacturer/Model No.___________________________

☐ Other, briefly describe___________________________
H. UNDERGROUND STORAGE TANK SPILL/OVERFILL PREVENTION SYSTEM

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Department of Environmental Health

Catchment Basin surrounding the product fill pipe: Manufacturer ______________________

-AND-

☐ Secondary containment for vent, vapor, and tank riser piping with Ball Float Valves **or** Product Level Sensing Device with High Level Alarm Manufacturer ______________________

-OR-

☐ Positive shutoff device in fill pipe at 95% full Manufacturer ______________________

-OR-

☐ Product Level Sensing Device with High Level Alarm and Ball Float Valves Manufacturer

I. CERTIFICATION: (Application will be disapproved without this information)
Attach detailed information as to the methods used to retrofit the tank with a bladder and a certification from the manufacturer, or his authorized representative, of the bladder material's capability to store the proposed hazardous substances.

J. ATTACH THREE COPIES OF PLANS SHOWING THE FOLLOWING:

1. Property lines, site address, scale, north arrow.
2. Location of all existing structures.
3. Location of all existing underground storage tank facilities.
4. Location of underground storage tanks to be retrofitted with a bladder.
5. Location of underground utility lines and vaults.

K. DESCRIBE THE MONITORING ALTERNATIVE/PROPOSAL YOU PLAN TO IMPLEMENT AFTER THE REPAIRS ARE COMPLETED.

L. REQUIRED INSPECTIONS-PERMIT TO INSTALL A BLADDER:
All tests and evaluations required by Chapter 6.7 of the California Health and Safety Code, Section 25296, and CCR Title 23, Article 6 are subject to inspection and review by the Department of Environmental Health.

1. FIRST INSPECTION: CERTIFICATION OF STRUCTURAL EVALUATION

- Provide documentation of structural certification and manifest for proper disposal of wastes generated during tank closure.

2. SECOND INSPECTION: CERTIFICATION OF BLADDER INSTALLATION

- The second inspection is upon completion of the bladder installation. Documents required at this time are: Integrity Test Data, Cathodic Protection Certification, Certification of Monitoring, Bladder Installation Certification. The Contractor shall certify that fill pipe striker plates have been installed and the Bladder installation process was conducted with the manufacturer's requirements and CCR Title 23, Article 6. The DEH Inspector shall verify the installation of the monitoring system, Cathodic protection and spill/overfill protection. All documents must be submitted before a final operating permit will be issued.

M. DECLARATION

I declare that to the best of my knowledge and belief the statements and information provided are correct and true. I understand that information in addition to that provided above may be needed in order to obtain a permit from the Department of Environmental Health (DEH) and that no work is to begin on this project until a permit has been issued.

I understand that any changes in design, materials, or equipment will void my permit to modify if prior approval is not obtained.

ANY UNAUTHORIZED RELEASE (LEAK) DISCOVERED DURING THE BLADDER INSTALLATION PROCESS MUST BE REPORTED TO DEH AND WILL BE SUBJECT TO SITE ASSESSMENT/MITIGATION ACTIVITIES BY SAM AND OTHER RESPONSIBLE AGENCIES.

I will notify DEH at least two working days (48 hours) before work on this tank interior coating is to begin in order to schedule each required inspection. I understand that site and worker safety are solely the responsibility of the property owner or his agent and that the responsibility is not shared or assumed by the County of San Diego.

SIGNATURE AND TITLE: ______________________

PRINT NAME: ______________________

TELEPHONE: (   ) ______________ DATE: ______________

DEH:HM-9317 (Rev. 01-03) VII-2 County of San Diego Department of Environmental Health

II. Workplan for UST Closure

EST. H# ____________________

PLAN CHECK # ________________

WORKPLAN
FOR
UNDERGROUND STORAGE TANK CLOSURE

1. Site Name ____

2. Site Address ____

   ____

3. Describe the existing land use in the surrounding area (residential, commercial, schools). Describe the locations of nearest receptors and the prevailing wind.

   ____

   ____

4. Explain how the excavation will be secured. Describe fencing/site security and other methods that ensure public safety.

   ____

   ____

5. If soil is to be stockpiled, describe the location on the Plan Check map. Describe method of soil containment (berming/covers, run-off control).

   ____

   ____

   ____

6. Do you plan to conduct site assessment or remedial work beyond what is necessary to remove the underground storage tank(s) and perform the mandory soil sampling required by the Site Assessment and Mitigation Program (SAM) of the Department of Environmental Health?

   ☐ Yes ☐ No

   If Yes, a Workplan for Post-Tank Removal Investigation must be completed under the direction of a registered professional.

Signature ____

Title ____

Telephone ______________________ Date ______________________

DEH:SAM-9176 (Rev. 6/99)

County of San Diego
Department of Environmental Health

III. Workplan for Post Tank Removal Investigations

INSTRUCTION SHEET
FOR A
POST-TANK REMOVAL INVESTIGATION

A Post-Tank Removal Investigation generally involves the use of a backhoe to conduct a subsurface site investigation of petroleum hydrocarbon contamination within 72 hours of underground storage tank (UST) removal. Department of Environmental Health (DEH) considers the Post-Tank Removal Investigation to be an effective method of subsurface investigation only in situations where the volume of excavated contaminated soil is limited (approximately 50 cubic yards or a volume that can be properly managed as per Section 7.VI of the Site Assessment & Mitigation (SAM) Manual and not cause a nuisance). A DEH guideline for conducting an acceptable post-tank removal investigation is attached for your reference.

Complete in detail the attached Workplan for Post-Tank Removal Investigation if you plan to commence a subsurface site investigation immediately after removal of the UST(s). Please note the following conditions.

- The Workplan must be submitted with the UST closure application. The field investigation cannot be started until the UST closure permit and Workplan are approved by DEH.
- The Workplan must be implemented under the direction of the project's Registered Geologist, Certified Engineering Geologist or Registered Civil Engineer.
- The Workplan must provide assurance that the public (neighbors, pedestrians, etc.) is protected from contact with the contaminated soil, fugitive vapors, and from risk of accidents resulting from the site investigation activities.
- A complete site assessment report, signed by the above referenced registered professional, must be submitted to DEH within 60 days of the investigation.
- The investigation must be implemented in accordance with the SAM Manual.

Completion of the attached Workplan is **not required** by DEH under the following circumstances:

- The contractor's plan for site excavation is limited to the removal of the UST and surrounding backfill material and the contractor has no plans to excavate into and/or remove native soil for site investigation closure purposes.
- The DEH inspector directs the excavation of native soil to obtain representative soil samples in support of the UST closure requirements.
- An "Unauthorized Release" of hydrocarbons has previously occurred at the UST removal site and a Workplan has been pre-approved by the DEH caseworker.
- Activities associated with immediate removal of free product from an open tank excavation. Reference Sections 3.II.A of the SAM Manual to review free product abatement and reporting requirements.

**** Office Use Only ****
Establishment No. #H
Plan Check #
DEH Inspector

WORKPLAN FOR POST-TANK REMOVAL INVESTIGATION

Complete this Workplan only if you intend to utilize a backhoe to investigate the extent of hydrocarbon contamination within 72 hours of the removal of an underground storage tank (UST). This site investigation work must be implemented in accordance with the DEH-SAM Manual and under the direction of an appropriately Registered Geologist (RG), Certified Engineering Geologist (CEG) or Registered Civil Engineer (RCE). A complete site assessment report, signed by the above referenced registered professional, must be submitted to DEH within 60 days of the date of the field investigation. This workplan must be signed by the above referenced registered professional.

1. Establishment Name/Address

____
____
____

2. Contractor, Contact & Phone No.

____

Environmental Consultant, Contact & Phone No.

____

Registered Professional (defined above) & Phone No.

____

3. Describe how the backhoe will be utilized to conduct the site investigation (ie. potholing, trenching, etc.) and estimate the maximum quantity of soil to be excavated.

____
____
____
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____
____
____

DEH:SAM-9227 (Rev. 1/03) -2- County of San Diego
Department of Environmental Health

4. Describe the soil sample collection methods and laboratory to be used (reference Section 5.III of the SAM Manual). Soil analysis must be performed by a California DTSC Certified Laboratory.

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5. Attach a site drawing (to scale) which includes at a minimum: site structures, subsurface utility lines and fuel lines, UST(s) location, site investigation area, stockpiled soil area, prevailing wind direction, adjacent street and property uses, surface water and wells.

____

6. Describe methods to monitor and control hydrocarbon vapor emissions at the excavation site.

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7. Describe the procedures for the management of excavated soil, i.e. soil, segregation, engineering controls for the stockpile soil (reference Section 7.VI of the SAM Manual), soil characterization, on-site soil management, off-site disposal, on-site treatment, etc. Describe the Best Management Practices (BMPs) to be used in the event of rainfall to control erosion from stockpiled soil.

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8. A Public Notification Program must be implemented prior to commencing the site investigation. Attach a copy of the public notice and provide a written description of the program (reference Section 4.IV of the SAM Manual). Identify the targeted population and the method of public notice distribution.

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Please Note:

- The investigation trench or excavation must be logged under the direction of a RG, CEG or RCE and include a complete description of the subsurface soil and/or rock.
- All contaminated soil should either be removed from the site or be treated on-site (with agency approval) within 45 days of site excavation.
- The site excavation must be secured with fencing, site security and other methods as required to ensure public safety. DEH recommends backfilling the excavation site for safety reasons within 72 hours of the post-tank removal investigation.

Prepared by:

____

(Name, print or type) (Company) (Signature) (date)

Approved by Tank/Property Owner:

____

(Name, print or type) (Signature) (date)

Approved by DEH, SAM Program:

____

(Name, print or type) (Signature) (date)

Stormwater Management Plan for Underground Storage Tank Permits

Stormwater Management Plan for Underground Storage Tank Permits

(Required for all Permits within the unincorporated County)

DEH

Under authority of the County of San Diego's Watershed Protection, Stormwater Management and Discharge Control Ordinance (No. 9424 and 9426) and Grading Ordinances, the County requires that construction proponents submit a Stormwater Management Plan in conjunction with all Underground Storage Tank Permits (installation, removal and modification) issued in the Unincorporated County. The Stormwater Management Plan is used to document basic project information, as well as certify that the project proponent is aware of the County's minimum Best Management Practices (BMPs) requirements. This will include the following:

Section 1: Required Information - Each of the items in this section must be completed. This section is used to provide the County with basic information necessary to evaluate and prioritize project activities. Please Note: Excavations greater than 200 cubic yards and cuts greater than 5 ft. in height require a Grading Permit from the County Department of Planning and Land Use (858-565-5920).

Section 2: Best Management Practices - BMPs must be selected and implemented to prevent erosion and construction-related materials, sediment, wastes and spills from entering stormwater conveyances and receiving waters.

Minimum Best Management Practice Requirements:

- Adequate perimeter protection BMPs must be installed and maintained. The perimeter of the cleared/graded area must be protected to prevent the discharge of stormwater pollutants. At least one of the following BMPs must be installed: Silt Fence; Straw Wattles; and/or Gravel Bags.
- Adequate BMPs to control off site sediment tracking must be installed and maintained. These BMPs include stabilized construction entrances/exits and construction road stabilization.
- Areas for material storage shall be either under roof or be able to be covered with plastic or tarp prior to a rain event.
- Waste materials must be properly managed to prevent discharge into stormwater. Each of the following BMPs shall be implemented and maintained if the waste is present on site: Concrete Waste Management; Solid Waste Management; Sanitary Waste Management; Hazardous Waste Management.
- All contaminated or potentially contaminated soil must be managed to prevent it from being discharged into a stormwater conveyance or receiving water. All contaminated soil must be placed on an impervious surface, bermed and completely covered with plastic sheeting.
- All storm drain inlets on site must be either sealed with an impervious material during construction activities or protected using inlet protection BMPs.

Note: It is the responsibility of project proponents to determine the types of BMPs that will be used, as well as the levels of application necessary to comply with the County's Stormwater and Grading Ordinances. Failure to prevent soil erosion and discharges of sediment and other pollutants from underground storage tank construction sites may result in enforcement by the County.

Section 3: Certification - The project proponents must sign this section. In doing so, they acknowledge the following:

- They understand the County's minimum requirements for stormwater management of underground storage tank construction activities,
- They will implement the selected BMPs to effectively minimize the potentially negative impacts of this project's construction activities on stormwater quality.
- They will monitor, maintain or revise these BMPs to ensure their effectiveness throughout the duration of the grading and/or construction activities, and
- They understand that non-compliance with the County's Stormwater and Grading Ordinances may result in enforcement by the County, including fines and/or cease and desist orders.

Compliance verification will occur during routine and/or unscheduled site visits by County inspection staff. County inspectors will use the information contained in the Stormwater Management Plan and supporting materials to verify compliance with the County's Stormwater and Grading ordinances.

HM: 9302 (09-02)

COUNTY OF SAN DIEGO

STORMWATER MANAGEMENT PLAN FOR UNDERGROUND STORAGE TANK PERMITS

(For All Permits Issued In The Unincorporated County)

DEH

SECTION 1. Required Information

Permit Number: ________________	Plan Check #________________
Site Name:	Name of project contact:
Site Address:	Phone # of project contact:

Estimated excavation area:__________ Cu. Yds. Please Note: Excavations greater than 200 cubic yards and cuts greater than 5 ft. in height require a Grading Permit from the County Department of Planning and Land Use (858-565-5920)

Grading Permit # ________________ (if applicable)

SECTION 2. Best Management Practices

The goal of stormwater management planning is to reduce pollution to the maximum extent practicable using Best Management Practices (BMPs). Erosion of disturbed soil must be prevented. Construction-related materials, sediment, wastes, spills, and residues must be retained on site to minimize transport from the site to streets, drainages, receiving waters, and adjacent properties by wind or runoff. It is the responsibility of project proponents to determine the types of BMPs that will be used, as well as the levels of application necessary to comply with the County's Stormwater and Grading Ordinances. For more information regarding BMPs, please call **(888) 846-0800.**

Minimum Best Management Practice Requirements.

1. Adequate perimeter protection BMPs must be installed and maintained. The perimeter of the cleared/graded area must be protected to prevent the discharge of stormwater pollutants. At least one of the following BMPs must be installed: Silt Fence; Straw Wattles; and/or Gravel Bags.
2. Adequate sediment control BMPs must be installed and maintained
3. Adequate BMPs to control off site sediment tracking must be installed and maintained. These BMPs include stabilized construction entrances/exits and construction road stabilization.
4. Areas for material storage shall be either under roof or be able to be covered with plastic or tarp prior to a rain event and also must be elevated to prevent contact with stormwater run-off.
5. Waste materials must be properly managed to prevent discharge into stormwater. Each of the following BMPs shall be implemented and maintained if the waste is present on site: Concrete Waste Management; Solid Waste Management; Sanitary Waste Management and Hazardous Waste Management.
6. All contaminated or potentially contaminated soil must be managed to prevent it from being discharged into a stormwater conveyance or receiving water. All contaminated soil must be placed on an impervious surface, bermed and completely covered with plastic sheeting.
7. All storm drain inlets on site must be either sealed with an impervious material during construction activities or protected using inlet protection BMPs.
8. Any minor slopes created incidental to construction and not covered by a major or minor grading permit shall be protected by covering with plastic or tarp prior to a rain event, and shall have vegetative cover reestablished within 180 days and prior to final building approval.

SECTION 3. Certification

You must read and sign the certification below before an Underground Storage Tank Construction Permit is issued in the Unincorporated County.

I have read and understand that the County of San Diego has adopted minimum requirements for stormwater management of underground storage tank construction activities. I certify that the BMPs I have selected will be implemented to effectively minimize the potentially negative impacts of this project's activities on stormwater quality. I am aware that the selected BMPs must be installed, monitored, maintained or revised to ensure their effectiveness. I understand that non-compliance with the County's Stormwater and Grading Ordinances may result in enforcement by the County, including fines and/or cease and desist orders.

________________________________ ____________

Contractor *Date:*

________________________________ ____________

Property owner *Date:*

HM: 9302 (09-02)

Appendix B
Monitoring Well/Boring Permit and Standards

CONTENTS OF APPENDIX B

I. GUIDELINE FOR COMPLETING MONITORING WELL PERMIT APPLICATIONS

INSTRUCTIONS FOR COMPLETING MONITORING WELL PERMIT APPLICATIONS

Submit one (1) original application package, including plan drawings with the required fee to the Monitoring Well Permit Desk, Department of Environmental Health, Site Assessment and Mitigation Program (SAM) at 1255 Imperial Avenue, 3rd Floor, San Diego, CA 92101 or mail the application package to P. O. Box 129261, San Diego, CA 92112-9261. All accompanying documentation must be included in each application package. Information in addition to that presented in the application package may be needed in order to obtain final approval. Any application that is missing information or documents may be returned to the submitter as incomplete. Allow seven to ten business days for processing. **Checks should be made payable to the County of San Diego.** The applications and associated forms can be found at:

http://www.sdcounty.ca.gov/deh/water/sam_monitoring_well_page.html

PLEASE PROVIDE ALL INFORMATION AS REQUIRED ON THE APPLICATION FORM

A. Responsible Party: the person, persons or company who has or who causes to have constructed, repaired, reconstructed, maintained and /or destroyed, the proposed borings and/or wells.

B. Site Assessment Project: If there is a Site Assessment and Mitigation (SAM) case (open or closed), please provide the lead agency and regulatory case number. EXAMPLE: H00011-002.

C. Consulting Firm: Well design, logging and construction must be supervised by a Geologist, Engineering Geologist or Civil Engineer who is licensed by the State of California.

D. Drilling Company: Well driller must have an active C-57 License and current $7,500 bond with the County.

E. Proposed Scope of Work: Provide all requested data concerning the proposed construction/destruction of wells and/or drilling of borings. Be sure that the licensed professional and the authorized person for the drilling company have both signed the application.

F. Site Location: Space is provided on the application for more than one site. If your application includes more than one parcel, the sites must be adjacent to one another or located within the same block. If not, a separate application may be required. If you are in doubt, please contact the Monitoring Well Permit desk. Please provide the correct Assessor's Parcel Number(s). Identify each parcel on the accompanying site map and provide accurate property owner information. You can verify the parcel number by accessing the Internet SANGIS site at:

http://files.sangis.org/interactive/viewer/viewer.asp

or by calling the Assessor's Office at (619) 236-3771. If the property in question is undeveloped or otherwise difficult to identify, the Mapping Division of the Assessor's office may be able to assist you. Their phone number is (619) 531-5588. In addition, if the work is to be done in the public right-of-way or other location that has no assessor's parcel identification, use the APN of the adjacent property closest to your proposed drilling location.

Military Sites: Some bases are divided into "areas". Since the bases are so large, please include only one "area" per application in addition to the parcel number. If you are in doubt about how a military site is designated, please check first with your military contact person. If it is still not clear how to proceed, call our office and we will assist you.

G. Fees: Please use the fee table included in the application to compute the appropriate fees for your project.

If you are in doubt, please visit the Monitoring Well Website:

http://www.sdcounty.ca.gov/deh/water/sam_monitoring_well_page.html

or contact the Monitoring Well Permit Desk (619 338-2339) for assistance.

H. Questions: Provide full and accurate answers to all applicable questions. For well destructions, complete only Question #1 and provide applicable supporting documents including requests for variances.

ADDITIONAL SUPPORTING DOCUMENTS:

Site Maps: All applications must include a site map giving location of property lines, existing improvements such as structures, underground tanks, underground utilities, underground piping, and the existing and proposed wells and borings. Please be sure the site map also shows the streets bounding your site property. Sometimes you can do it all with just one map and other times it may require one site-specific map and one more general area map. If you are in doubt, ask yourself: "If I were unfamiliar with this site/area, would I be able to locate the property and the wells using this map?"

Encroachment and Traffic Control Permits: If your proposed work will be located in a public right-of-way that requires permits from the city or County in which the work is being done, you must include a copy of the permit or the application for the encroachment/traffic control permit in your application package.

Property Owner Consent (**POC**): This document, completed and signed by the property owner[1], must accompany all applications **except** work proposed for on-site open LOP/SAM cases, Military property or Caltrans property:1

[1] The property owner may be an individual, several individuals or a company/corporation. If not a private individual(s), the signer must be an officer of the company. A "manager" may not sign for the property owner unless DEH receives written verification that the property owner has authorized this person to sign on his/her behalf.

II. SAN DIEGO COUNTY MONITORING WELL AND BORING CONSTRUCTION STANDARDS

Monitoring wells are normally constructed in conjunction with on-site corrective action, namely site investigation or remediation activities, or with water resource investigations. Proper design and construction of groundwater and vadose wells are essential for the acquisition of reliable subsurface data and representative samples as well as for protection of the groundwater aquifer. In such design and construction, site-specific geological, hydrogeological, physical, and geochemical conditions should be considered. It may even be appropriate to develop a conceptual hydrogeological model, prior to well design and construction, particularly for sites with relatively complex environments.

Groundwater or vadose well installation should be properly planned with the drilling activities, monitoring well construction materials, well specifications, and installation procedures addressed prior to the initiation of field work. Monitoring wells should be constructed as designed, except in situations where subsurface conditions warrant modifications, which should be clearly documented.

There are numerous publications that provide guidance for the design and construction of wells. This type of detail is beyond the scope of this manual. Please refer to Appendix I for several references on this subject.

A. General Considerations

1. Site

a. Monitoring well(s) for an initial site assessment should be located reasonably close to the known or suspected spill/leak or in areas know to be contaminated.

b. Generally, the well(s) should be located in the down-gradient direction, based on known or reasonably assumed conditions at the site. For complete site assessment, the monitoring well network should be capable of evaluating the groundwater gradient, extent of the contamination, and background conditions.

c. It may be feasible to use an in situ sampling device to sample groundwater and assist in determining the placement of groundwater monitoring wells.

2. Equipment and Materials

a. Drilling - The selection of an appropriate drilling method for constructing monitoring wells should be based on minimizing both the disturbance of penetrated geologic materials and the possibility of aquifer contamination by the introduction of air, fluids, muds, and contaminated soil. Where possible, the drilling method selected should allow detection of the saturated zones encountered during drilling.

(1) Wherever possible, drilling should be accomplished with a hollow-stem, continuous flight auger drill rig. Other types of drilling methods may be used if conditions warrant and are approved by DEH or the lead agency.

(2) No drilling fluids are to be used unless approved by DEH prior to drilling. Drilling fluid additives (if approved) should be limited to inorganic, non-hazardous materials that will not mask or alter the constituents being monitored. Use of all additives must be indicated on the boring log as to depth, quantity and type. Representative samples

of the additive should be retained for a period of 90 days and analyzed in the event contamination is identified.

b. Inspections, Maintenance, and Materials

(1) Drill rigs should be inspected prior to drilling to ensure that the rig is free of hydraulic oil and fuel leaks.

(2) Prior to drilling, the drill rig and equipment should be cleaned by an appropriate method to ensure that a contaminant is not introduced by drilling. The equipment should be cleaned between boreholes to prevent cross contamination.

(3) Prior to installation, well casings, casing fittings, screen, and all other components to be installed in the well should be thoroughly cleaned by an appropriate method. Well materials that are cleaned and wrapped by the factory are acceptable. Care should be taken to not contaminate the casing during installation.

c. Well Materials

(1) Soil sampling equipment, drilling equipment and materials used to construct a well should be compatible with the constituents being investigated, and should not donate to, capture, mask, or alter the constituents to be analyzed.

(2) The materials should be of sufficient durability to withstand deterioration by the suspected contaminants.

(3) The well screen should be commercially manufactured, corrosion resistant, and have sufficient column and collapse strength.

(4) Representative samples of all imported materials used for filter pack, annular seal, and bentonite seals should be retained for a period of 90 days. At the request of DEH or the lead agency, an evaluation of compatibility may be required.

d. Soil Descriptions/Sampling

(1) All soil and/or fill encountered during drilling shall be described in detail according to the Unified Soil Classification System.

(2) Rocks or geologic formations should be described by an appropriate rock classification system.

(3) A Professional Geologist, Registered Civil Engineer, or Certified Engineering Geologist, who is licensed or certified by the State of California, must log all soils and rock materials. A trained and experienced technician working under the direct supervision and review of one of the aforementioned professionals shall be deemed qualified, provided the aforementioned professional assumes responsibility for the accuracy and completeness of the logs.

B. Standards

1. Well Construction

a. Vadose and groundwater wells must be designed by a Professional Geologist, Registered Civil Engineer, or Certified Engineering Geologist.

b. The well identification number and well type should be permanently affixed to the exterior of the well security structure.

c. Well casing should be flush-threaded. Use of organic solvents or cements is not acceptable. All well casing should have a bottom cap or plug.

d. Monitoring well casing diameter should not be less than 2 inches or greater than 6 inches, unless specifically approved by DEH.

e. The casing must extend a minimum of three inches above the interior concrete seal.

f. The following are minimum boring diameters for the respective casing sizes:

Casing I.D.	**Minimum Boring Diameter**
2 inches	6 inches
4 inches	8 inches
6 inches	10 inches

In general, casing sizes must have a minimum borehole diameter 4 inches greater than the proposed casing. Under prescribed conditions, a small diameter well variance may be permitted, refer to D. in this appendix.

g. Well screen and blank casing should be suspended from the ground surface and not allowed to rest on the bottom of the hole during well construction. When casing is installed in a hollow-stem auger hole, centralizers are not required because the auger centers the screened casing. In borings that do not have the hollow-stem auger in the hole at the time of casing installation, centralizers should be placed from the bottom up, every 20 feet on screen sections greater than 20 feet in length and every 40 feet on the blank portion of the well casing. For well casing with a screened interval of less than 20 feet in length, centralizers should be placed on the top and bottom of the screened interval, and every 40 feet on the blank portion of the well casing.

h. Wells that are designed to evaluate water table conditions should be designed and constructed to provide sufficient length to accommodate expected seasonal or tidal groundwater fluctuations and should extend a minimum of 2 feet above the top of the saturated zone. Generally, the screened interval length should not exceed 10 to 15 feet into the saturated zone. If deeper sections of the aquifer will be investigated, or the well is going to be used for dewatering or remediation purposes, then design considerations should be discussed with DEH and the lead agency on a site-specific basis.

i. Groundwater wells should be constructed with a filter pack. The filter pack should extend to at least 2 feet above the top of the screened interval. Depending on site conditions, the filter pack may need to be tremied into place. When using a hollow-stem auger the augers may be used as a tremie. Care should be taken to prevent bridging of the filter pack during placement.

j. Groundwater wells being constructed in crystalline rock may be constructed as an open hole in the interval that is to be monitored. This type of construction will be evaluated on a case-by-case basis.

k. Sieve analyses performed on the actual aquifer formation material will allow for design of an effective filter pack and screen size. During initial drilling, formation material should be retained and sieve analyses performed to develop a proper well design.

l. Following placement of the filter pack and prior to placement of the bentonite transition seal, the well should be surged to ensure that the filter pack level has stabilized.

m. A minimum 3-foot-thick bentonite transition seal should be placed directly on top of the filter pack. Depending on site conditions, the bentonite may have to be tremied into place to prevent bridging when being placed. The bentonite seal should be placed and hydrated in accordance with manufacturer's specifications.

n. The depth of the annular seal should be in accordance with California Department of Water Resources Bulletins 74-81 and 74-90. For those cases where the annular seal is less than 20 feet in length, a variance must be reviewed and approved by DEH prior to construction.

o. The annular space from the top of the bentonite transition seal to the base of the surface seal shall be filled with either a cement, a cement-bentonite, or bentonite grout. The grout seal shall be an approved sealing material as specified in California Department of Water Resources Bulletins 74-81 and 74-90, and should be placed by using the tremie method.

p. The surface seal shall consist of concrete able to withstand the maximum anticipated load without cracking or deteriorating. The concrete should meet Class A specifications, which meet a minimum 4,000-pound compressive strength.

q. All wells must be constructed at the ground surface meeting the following criteria:

    (1) The surface completion of the security structure must use structural rated concrete that meets or exceeds the structural loads anticipated for the site.

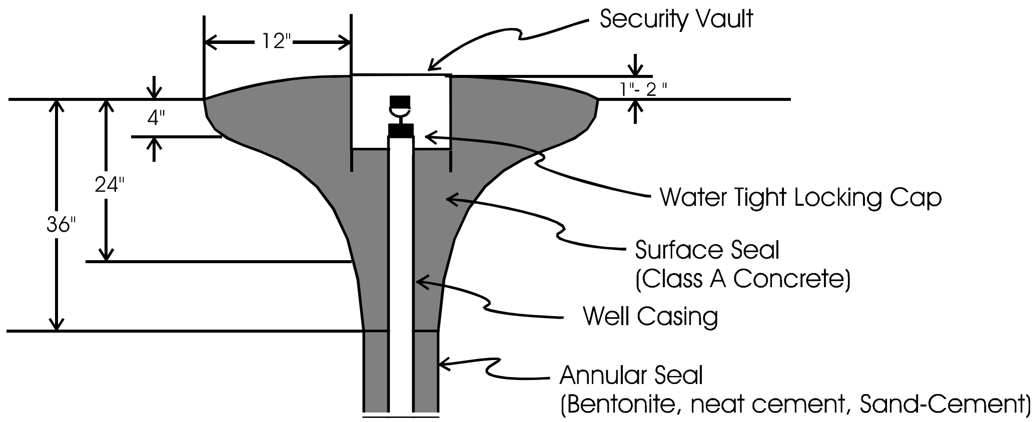
    (2) The security structure must be able to be properly secured to prevent access by unauthorized persons and vandalism.

    (3) Positive surface drainage away from the security structure must be provided to prevent water from entering the well vault.

    (4) The security structure must be designed for a monitoring well. Irrigation boxes are not acceptable. The casing must be fitted with a water-tight locking well cap. The use of a slip cap is not acceptable.

r. Figure B-1

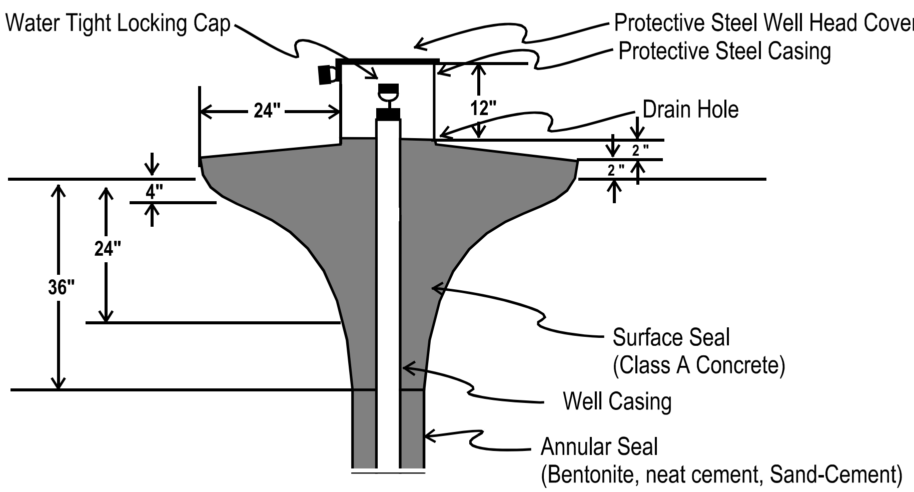
Flush - Grade Well Head Construction



The well head is completed below the surface grade in a vault. The following diagram provides minimum design standards for surface completion of a flush-grade well head security vault. This type of surface construction is only applicable in traffic areas, paved areas, and/or where the well will cause a safety problem. In traffic areas and sidewalks, the vertical well profile must not exceed 1/2 inch to minimize physical hazards and maintain a smooth, travelable surface. These wells must be constructed in an area where the wells will not become flooded or damaged. Drainage around the well must be maintained so that no ponding of water will occur around the well head. The security vault must be a traffic-rated, water tight, locking structure that can withstand the maximum traffic loads anticipated for the site. The surface seal must be extended a minimum of 12 inches around the perimeter of the security vault and extend a minimum 36” below ground surface. Any variation in these construction standards must be approved by DEH.

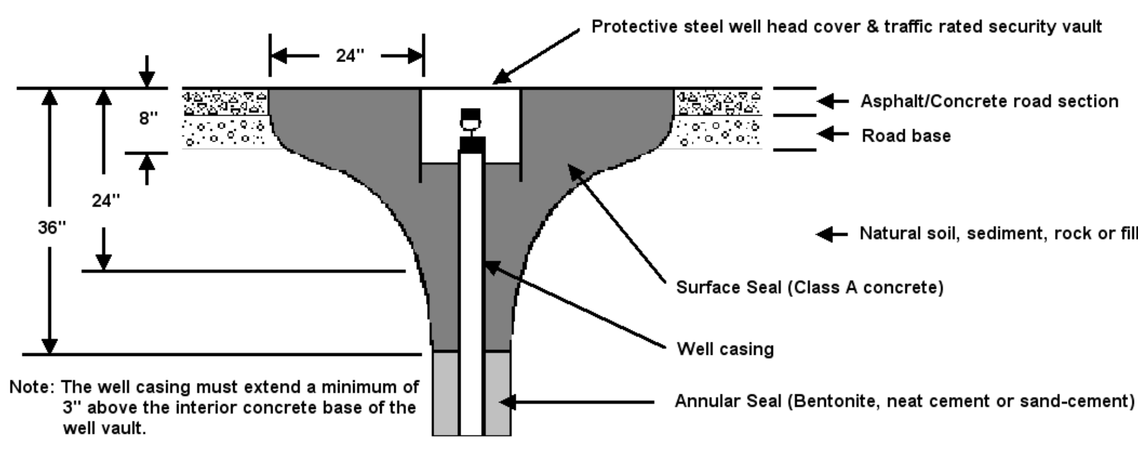
s. Figure B-2

Monument Well Head Construction



The well head is completed above the surface grade. The following diagram provides the minimum design standards for an above-grade surface completion of a well. This type of surface construction is required in all areas unless the well is located in traffic areas, paved areas, and/or where the well will cause a safety problem. The well pad must be designed and constructed so that it will have proper drainage away from the steel conductor casing. Drainage around the well must be maintained so that no ponding of water will occur around the well head. Protective steel posts may be required around the well to provide protection to the well structure. The surface seal must be extended a minimum of 24 inches around the perimeter of the protective steel casing and extend a minimum of 36" below surface grade. Any variation in these construction standards must be approved by DEH.

Flush - Grade Well Head Construction for Wells in Public Roadways



The well head is completed below the surface grade in a vault. The following diagram provides minimum design standards for surface completion of a flush-grade well head security vault in a public roadway. These wells must be constructed in an area where the wells will not become flooded or damaged. Drainage around the well must be maintained so that no ponding of water will occur around the well head. The security vault must be a traffic-rated, water tight, locking structure that can withstand the maximum traffic loads anticipated for the site. The surface seal must be extended a minimum of 12 inches around the perimeter of the security vault and extend a minimum 36” below ground surface. Any variation in these construction standards must be approved by DEH.

t. A properly licensed professional should survey the top of the well casing to an accurate datum.

u. Special considerations for vadose wells

(1) Design

(a) Vadose well(s) may be designed for monitoring or remedial action purposes.
(b) Vadose well(s) for monitoring purposes should be designed to detect the substances being monitored.
(c) The well(s) should be designed to reduce the potential for cross contamination.

(2) Construction - Vadose well(s) shall be constructed with a well seal. The depth of the well seal will be approved by DEH on a case-by-case basis.

2. Destruction of Wells and Exploratory Borings

a. Groundwater and Vadose Wells - A monitoring well shall be destroyed by removing all material within the original borehole, including the casing, filter pack, and annular seal, and filling the remaining borehole from the bottom of the borehole to the ground surface with an approved sealing material as specified in Bulletin 74-90.

b. Temporary wells can be permitted as borings but must be destroyed within 72 hours of construction. This allows for proper well development and sampling. A temporary well shall be destroyed by removing all material within the original borehole, including the casing, filter pack, and annular seal, with the remaining borehole being completely filled from the bottom of the borehole to the ground surface with an approved sealing material as specified in Bulletin 74-90.

c. Exploratory Borings - All exploratory borings, including direct push borings, shall be sealed from the bottom of the boring to the ground surface with an approved sealing material as specified in California Department of Water Resources Bulletins 74-81 and 74-90. Placement of any sealing material at a depth greater than 30 feet must be done using the tremie method.

d. Any proposed destruction variance, including pressure grouting or the filling of large diameter borings (>12 inches), must be submitted with the original application accompanied by a detailed description.

C. Procedures

1. Variances

Due to special site-specific geologic and hydrogeologic conditions, DEH may allow variances to the design of a groundwater or vadose monitoring well(s). This variance will be reviewed on a case-by-case basis and must be approved by DEH prior to construction of the well(s). Refer to D of this appendix for the Small Diameter Well Variance guideline.

2. Reporting, Notifications, and Inspections

a. A representative of DEH will, on a case-by-case basis, observe the installation of wells/borings. DEH requires a minimum notice of 48 hours prior to drilling.

b. Well owners are required to maintain their well(s) in good condition. All permitted wells will be inspected. The well owner will be notified of deficiencies and instructed to make associated repairs.

c. Reports concerning the construction, alteration, or destruction of vadose and groundwater wells and borings shall be filed with DEH within 60 days of completion. See Section 5.II.E.3 for reporting requirements.

D. Small Diameter Well Variance Guideline

1. Introduction

In recent years, direct push technology (DPT) has been used to investigate both soil and groundwater contamination. Technological advances have resulted in the ability to install small diameter groundwater monitoring wells using direct push technology. Published studies indicate that contaminant concentration data from direct push wells compare favorably to data from traditional drilled wells (Kram, et. al., 2001; BP and EPA Region 4, May, 2002). Direct push wells cost less than drilled wells, minimize or eliminate soil cuttings, and expose the workers to less chemical exposure during installation. Due to the convenience and the cost savings of using this technology, there has been increasing demand to use this method to install permanent small diameter wells.

In addition, this guideline will allow, in certain circumstances, a small diameter well to be installed in an open hole.

Pursuant to the current State of California Well Standards (Department of Water Resources, DWR, Bulletins 74-81 and 74-90), groundwater wells shall have a minimum annular space of two inches around the well casing and screen. The intent of the Standards to specify a minimum annular space is to minimize the potential of bridging during placement of the sand pack and seals and to increase the potential of a properly placed annular seal.

Small diameter wells cannot meet these prescribed construction standards because of the insufficient annular space created by the small diameter of the borehole. However, DEH has the authority to approve variance to the standards if the well design meets the intent of the State Well Standards. Therefore, DEH has established these guidelines to allow a variance for the construction of permanent small diameter wells having effective sand packs and annular seals following the intent of the Bulletins. Please be reminded that screen slot size and sand pack selection should follow the guidelines provided in Appendix B II. B.

Please be aware that nothing in this guideline relieves the driller and/or the registered professional from their responsibility for:

- Properly installing the well in accordance with applicable state and local regulations and guidelines.
- Preventing the well from being a potential environmental threat to water quality.
- Assuring that the well will be designed and constructed to yield representative samples, usable hydrologic data, and have a useful lifetime.

DEH, under its well permitting authority, reserves the right to modify or deny any variance.

2. General Considerations

a. Definition of Small Diameter Well

A “small diameter well” for the purpose of this document is a well with a borehole diameter of less than 6 inches and an annular space around the casing of less than 2 inches that cannot be constructed using conventional drilling methods.

The “small diameter well” must have an annular space of sufficient size to allow verifiable emplacement of sealing materials.

This variance guideline does not apply to other well geometries.

b. San Diego County Well and Boring Standards

The installation of small diameter wells shall follow all sections of the San Diego County Well and Boring Construction Standards in Appendix B II. B. except for specific variances allowed in this guideline. Unless otherwise specified in this section, all standards listed in the California Department of Water Resources Bulletins 74-81 and 74-90 will apply to small diameter wells.

A small diameter well is a "variation from the methods and or procedures presented in the requirements for the construction of Vadose and Ground Water Monitoring Wells (Current SAM Manual Requirements)" and, therefore, must be identified as such in answering Question 9 of the Permit Application for Ground Water and Vadose Monitoring Wells, Exploratory or Test Borings.

The purpose of this guideline is to help qualified professionals propose an acceptable construction of a small diameter well.

c. Site Selection

The ability to install small diameter wells depends on having favorable geologic and hydrologic conditions at the site. Additionally, this guideline specifies conditions where these technologies are permitted.

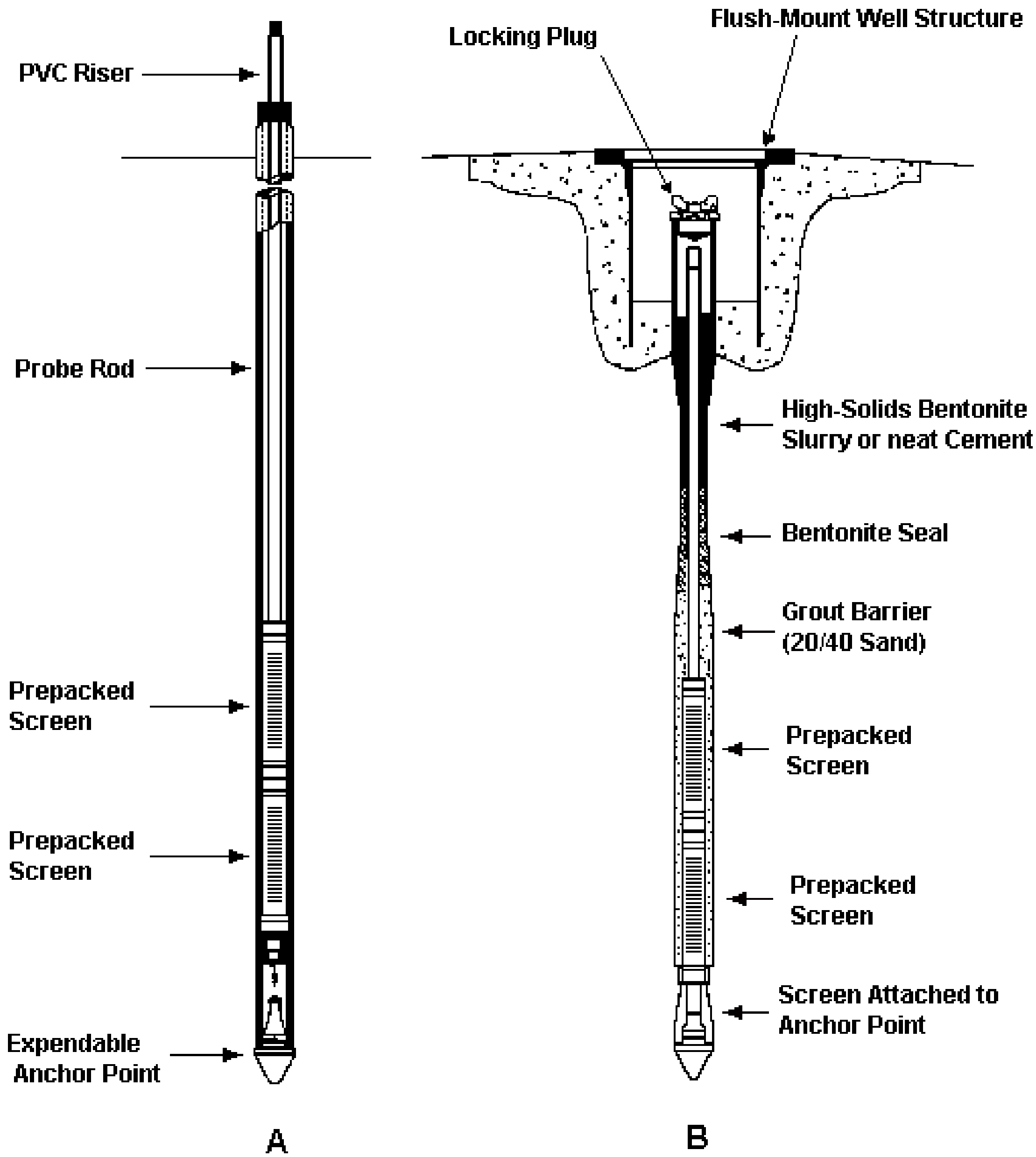
The subsurface geology and water table elevation at the site shall be sufficiently understood to allow the proper choice of a filter pack and selection of a screened interval before a small diameter well is constructed.

The subsurface geology must be verified by continuous logging during the installation of small diameter wells.

d. Well Design

Only professionals having the qualifications listed in Appendix B II. B. may design small diameter wells. The professional should review available well and boring logs for the site and immediate vicinity along with sample data to design the well. Design the wells in accordance with the standards in Appendix B II. B. Do not use pre-packed bentonite seals for transition or annular seals above the water level in the borehole because the proper expansion of the seal cannot be assured in unsaturated conditions.

Figure B-3 Example Small Diameter Well



e. Overview of DPT Well Installation

A DPT rig is a hydraulically powered machine that utilizes static force and hydraulic rams and/or percussion to advance small diameter sampling tools into the subsurface for making *in-situ* measurements or collecting soil core, soil gas, or groundwater samples. The DPT rig pushes tools into the ground using rods with a typical outside diameter of approximately two inches.

The components of a DPT well consist of the following:

- An expendable conical push point that the anchors the well.
- A bottom cap or plug.
- A length of manufactured well screen with attached filter pack, also known as a "prepacked well screen."
- Material to support a bentonite transition seal above the prepacked screen, such as a manufactured annular bridge attached to the well casing, or sand tremied into the annular space surrounding the prepacked screen, or collapse of natural formational material.
- A bentonite transition seal that prevents liquid grout from reaching the screened interval.
- Riser pipe.
- Properly installed annular seal materials.
- Standard surface seal and wellhead protection.
- If a portion of the annular seal is constructed below water level in the hole, prepacked bentonite seals are used for both the transition seal and the annular seal below water level in the hole.

For well construction, the push rods are advanced to the correct depth, then the prepacked well screen, optional annular bridge, prepacked bentonite seal (if appropriate), and riser pipe are assembled and lowered through the inside of the push rods.

The bottom of the well assembly is attached to an expendable anchor point that becomes the bottom cap of the well. After the well assembly is anchored, the push rods are retracted. As the rods are retracted above the prepacked screen, either natural formation collapses around the screen or (if no annular bridge or prepacked bentonite sleeve is used) sand of the appropriate size is poured through the rod annulus to a level six inches above the screen.

A bentonite transition seal six inches in thickness is placed above the filter pack to prevent grout from penetrating into the screened interval. Grout conforming to the requirements in Appendix B II. B. is then installed in the annulus to form an annular seal.

These procedures are presented in more detail in the following sections.

Once the well is set, the surface seal and well head completion is constructed in accordance with SAM Manual Appendix B II. B.

f. Overview of Open Hole Construction of Small Diameter Wells

Open hole construction is performed in small diameter boreholes created by equipment other than hollow-stem auger or DPT. For San Diego County, open hole construction is limited to wells no greater that 20 feet in depth from the ground surface. The walls of the borehole must be stable when unsupported.

All requirements in Appendix B II. B regarding the design and construction of groundwater monitoring wells apply to small diameter wells constructed in open holes, except for the characteristics unique to small diameter wells and techniques unique to open hole construction specified in this guideline.

Once the open borehole has been excavated, the well materials, consisting of a bottom cap, well screen, riser pipe, and centralizers, are assembled and lowered into the hole. Centralizers are required at the bottom, top, and at an appropriate location in the center of the well assembly.

Appropriate materials are then poured into the borehole to form the sand pack, transition seal, and annular seal, in accordance with San Diego County Standards for well construction in Appendix B II. B. In addition, as materials are added, the filling of the hole is monitored using a rigid device to measure the depth to the top of the material. If the measurements indicate bridging or other conditions that could create voids, corrective action is taken before adding more material. These procedures are presented in more detail in the following sections.

Once the well is set, the surface seal and well head completion is constructed in accordance with SAM Manual Appendix B II. B.

g. General Equipment and Materials

(1) Equipment

DPT equipment is manufactured by several companies and sold under various names. Similarly, there are a wide variety of small-diameter solid-stem auger and hand auger rigs available. Any of these rigs are suitable for the installation of small diameter wells. The equipment must be inspected and maintained in accordance with the requirements in Appendix B II. B. The operator of any of this equipment must meet the requirements for “Drilling Company” in Appendix B II. B.

A grout pump is required to install annular seals.

(2) Permits

An approved Groundwater Monitoring Well permit is needed prior to installation of the wells. A well construction diagram must be submitted for any permit application for a small diameter well. In the appropriate area on the permit application, identify that the proposed well will be a small-diameter well and, if applicable, identify if the well will be constructed in an open hole. Identify the type of equipment to be used (DPT, solid-stem auger, or hand auger). Identify any other proposed variances from the well standards or these guidelines. More information regarding how to complete the Groundwater Monitoring Well permit application is presented in Appendix B II. B.

(3) Well Materials

At a minimum, the following well materials are needed at the site to properly construct a DPT small diameter well:

- Pre-packed screen;
- Expendable drive/anchor point;
- Bottom cap or plug;
- PVC riser with 0-rings or a SAM-approved alternative between the riser pipe sections;
- PVC top cap;
- Well cover (aboveground or flush-mount);
- Annular bridge or sand, 20/40 grade or as appropriate for the lithology;
- Granular bentonite (passing #8 mesh);
- High-solids bentonite grout;
- Portland cement;
- Type I concrete mix (premixed cement and aggregate);
- A rigid measuring device that will fit down the small annular space;
- Clean water;
- Decontamination equipment for all down-hole rods and equipment.

All well materials must conform to the other requirements listed in Appendix B II. B.

h. Soil Description/Sampling

Soil descriptions, soil sampling, and documentation of depth to groundwater, must be performed in accordance with Appendix B IV. B. Because DPT does not inherently produce materials that can be logged, such as soil cuttings, the subsurface geology by continuous logging technique such as continuous coring or Cone Penetrometer Test (CPT). If CPT data is used, soil classification (using a referenced CPT classification system) must be provided as well as the raw strain gauge data. Depending on the level of information available, the degree of verifiability needed may be reduced on a case-by-case basis with a variance issued by DEH.

The geology and water table shall be depicted on a well log and submitted with the well log report in accordance with the requirements of the well permit. The source of the geologic data (continuous coring, CPT, etc.) shall be clearly stated on the well log.

i. Well Destruction

All failed or unsuccessful small-diameter well installations must be destroyed according to California Standards within 24 hours of construction. Small diameter wells shall be destroyed in the same manner as any groundwater or vadose well.

3. Small Diameter Well Construction Guidelines

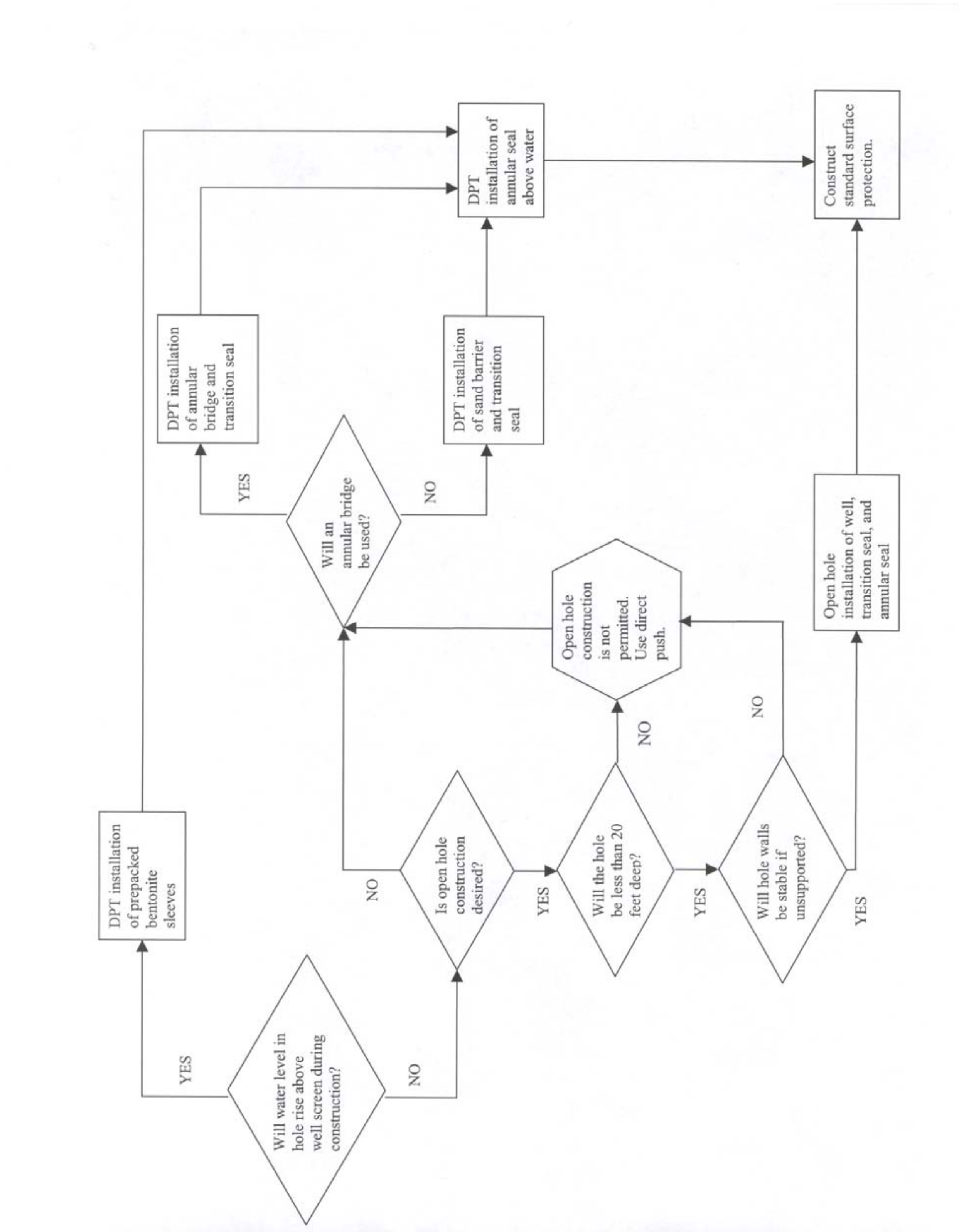
This section presents five separate procedures for use in the construction of small diameter wells:

The flowchart in Figure B-4 guides the decision of which procedure(s) are appropriate for the proposed well installation. Note that information about the subsurface is required in order to decide which procedures to use.

Information regarding the depth to water at the site must be known. Not only is this information required (as with any well) to properly design the well in accordance with the requirements of Appendix B II. B., this information is also needed to plan the special materials needed and procedures to be followed for a small diameter well. For example, if water level in the borehole rises completely above the screened interval during construction, and therefore sealing materials need to be installed below water in the borehole, prepacked bentonite sleeves should be used to seal the interval below water level in the borehole.

Also, if open hole construction is desired, the geologic materials must be of a type not given to caving, sloughing, expansion, heaving, flowing, or other characteristics that would cause closure or in-filling of an open borehole. The project site and subsurface geologic conditions must be evaluated by a qualified professional, and a certification be made that the site geologic conditions are suitable for open-hole construction of wells. Accompanying the application for a permit, a summary of the evaluation must be included to justify the use of this method.

Figure B-4 Flowchart



The following are details for the five procedures presented in the flow chart (Figure B-4).

a. DPT installation of sand barrier and transition seal.

<u>Overview</u>

- Shall be constructed with a prepacked well screen that is designed to span the water table.
- Shall have a sand barrier filling the annular space adjacent to the prepacked well screen and extending to six inches above the top of the screened interval. The purpose of the sand barrier is to prevent transition seal materials from reaching the depth of the screened interval.
- Shall have a transition seal six inches thick composed of properly hydrated granular bentonite used in accordance with manufacturer's specifications. The purpose of the transition seal is to prevent annular sealing materials from reaching the screened interval.
- The annular space from the top of the bentonite transition seal to the base of the surface seal shall be filled using the procedure for "DPT installation of annular seal above water level in well" below. A surface seal and well head shall be completed in accordance with Appendix B II. B.
- As with all well construction, all quantities of sealing materials used shall be measured in units of volume and reported in the well log report.

<u>Procedure for Anchoring Well Assembly</u>

An expendable anchor point is driven to depth on the end of the push rods. A prepacked well screen assembly is inserted into the inside of the rod with sections of PVC riser pipe. The screens and riser pipe are attached to the anchor point to stabilize the assembly for installation.

- Affix the expendable drive point to the bottom push rod and advance the push rods to the designed maximum depth of the well.
- Lower capped or plugged prepacked well screen down the push rod with the appropriate end pointing down, per manufacturer's instructions. Add pre-packed well screen sections as needed to achieve the designed screened interval.
- Attach sections of PVC Riser to the top of the screen assembly. Continue to add riser sections until the assembly hits the expendable drive point at bottom of rods. At least one foot of riser should extend past the top push rod. Plug the top riser to ensure that the inside of the well stays clean during construction.
- Attach the well assembly firmly to the expendable drive point in accordance with the manufacturer's instructions, ensuring that the bottom end of the screen is sealed. Gently pull up on the riser to ensure that the well assembly is firmly attached to the anchor.

- Begin retracting the push rods. While pulling the rods, observe whether the PVC risers stay in place or move up with the rods.

- If the PVC risers move up with the rod string, the well is not anchored. Stop and take corrective action. First, check to be sure the pre-packed screen is still attached to the expendable drive point. Next, use precautionary measures to safely hold the PVC risers in place while pulling up the rods. An additional section of PVC riser may be helpful. Once the push rods have cleared the anchor point and part of the screen, the screen and riser assembly should stop rising with the rods.

  If the PVC risers stay in place, the well is successfully anchored. Continue retracting the rods so that the bottom of the rods are no more than two feet above the top of the planned six-inch transition seal interval.

<u>Procedure for Installing the Sand Barrier</u>

The natural formation will sometimes collapse around and above the well screens as the push rod string is withdrawn. The collapse above the screens provides effective support for the transition seal. If the formation does not collapse, a sand barrier must be placed from the surface. This portion of the well installation procedure is important because an inadequate barrier will allow transition seal bentonite and perhaps grout to reach the well screens. Non-representative samples and retarded groundwater flow into the well result from bentonite or grout in the screened interval.

Using a water level sounder or flat tape measure, determine the depth from the top of the PVC riser to the bottom of the annulus between the riser and push rods. Two scenarios are possible:

- Measured depth is 2 to 3 feet less than riser length. This indicates that unstable conditions have resulted in formation collapse. A natural base for the transition seal was formed as material collapsed around the PVC riser when the probe rods were retracted. This commonly occurs in non-cohesive sands. A sand barrier cannot be installed due to the collapse of the formation. Proceed to the next section on installing the bentonite transition seal.
- Measured depth is equal to or greater than riser length. This indicates that stable conditions are present. The probe hole has remained open and void space exists between the riser (and possibly the screen) and formation material. Clean sand must be placed down hole to provide a suitable grout barrier.

Begin slowly pouring 20/40-grade (or as appropriate for the lithology) sand pack down the annulus between the PVC riser and push rod string. Measure and record the volume of sand added.

Measure the annulus depth while adding sand. The sand may not fall all the way past the screens due to the tight annulus and possible water intrusion. This is acceptable, since the pre-packed screens do not require the addition of sand. It is, however, important that support for the transition seal is provided above the screens.

Add sand until it extends six inches above the screen section.

Sand may bridge within the annulus between the risers and push rods and consequently fail to reach total depth. Wet probe rods contribute to sand bridging. If no bridging has occurred, proceed to the next step.

In case of a sand bridge above the screens, insert a clean rigid device into the well annulus to break up the sand. Simultaneously retracting the push rods usually helps. Check annulus depth again. If sand is no longer bridged, proceed to the next step.

If the sand bridge cannot be broken up with a rigid device, inject a small amount of clean water into the annulus. This is accomplished using grout machine and tubing. Insert the tubing down the well annulus until the sand bridge is contacted. Attach the tubing to the grout machine and pump up to one gallon of clean water while moving the tubing up and down. The jetting action of the water will loosen and remove the sand bridge. Check annulus depth again. The distance should be 2 to 3 feet less than the riser length.

In general, avoid any procedure that will cause the inside of the push rods to get wet. Moisture inside the push rods will greatly increase the chance of bentonite bridging in the rod annulus when the transition seal is installed.

<u>Procedure for Installing Bentonite Transition Seal</u>

Bentonite clay, when properly placed, prevents liquid grout and contaminants from moving down the annular space into the well screen. The seal is formed by placing granular bentonite into the annulus by gravity and hydrating in accordance with the manufacturer's instructions or by injecting high-solids bentonite slurry directly above the sand barrier. Bentonite chips should not be used. The bentonite transition seal must extend at least six inches above the sand pack.

<u>Stable Formation</u> - Granular bentonite is recommended if the following conditions are met:

- Formation remained open when probe rods were retracted.
- Bridging was not encountered while installing the sand pack and grout barrier.

  The following procedure should be used:

  - Withdraw the probe rod string another 3 to 4 feet. Ensure that the PVC riser does not rise with rods.
  - Measure the depth from the top of the riser to the bottom of the annulus. Pour granular bentonite between the probe rods and PVC riser as was done with the sand, measuring as the bentonite is added. Add bentonite to form a six-inch transition seal.

Verify the thickness of the transition seal by measure the depth from the top of the riser to the bottom of the annulus. The distance should now equal the installed riser length minus the minimum six inches of sand pack and six inches of bentonite seal. As was stated with the sand pack, if the measured depth is significantly less than expected, the bentonite has more than likely bridged somewhere along the rod string. A procedure similar to that identified for bridged sand may be used to dislodge the granular bentonite.

Once it has been determined that the bentonite seal is properly placed, use the grout pump and grout tube to pump sufficient water to the bentonite to hydrate it according to the manufacture's instructions.

Unstable Formation - A grout machine is required. The pump must be able to supply high-solids bentonite slurry under sufficient pressure to displace collapsing soil.

The high-solids bentonite grout (20 to 25 percent by dry weight) must be used and placed by using a grouting machine.

The grout must be delivered to the bottom of the annulus between the probe rods and well riser through a grouting tube.

While pumping the bentonite grout slowly pull the rod string approximately 3 feet. This procedure will place bentonite in the void left by the retracted rods before it is filled by the collapsing formation.

During this procedure measure the annulus depth to ensure that the bentonite was delivered.

Follow procedure for "DPT installation of annular seal above water level in well" below, and then construct surface completion in accordance with Appendix B II. B.

b. DPT installation of annular bridge and transition seal.

Overview

The well shall be constructed with a prepacked well screen that is designed to span the water table.

- The well shall have a manufactured device in the well assembly designed to bridge the annular space and prevent transition seal materials from reaching the well screen (i.e. an "annular bridge"). The annular bridge must meet all requirements in the General Considerations for Well Materials in Appendix B II. B.

- The well shall have a transition seal six inches thick composed of properly hydrated granular bentonite used in accordance with manufacturer's specifications. The purpose of the transition seal is to prevent annular sealing materials from reaching the screened interval.

- The annular space from the top of the bentonite transition seal to the base of the surface seal shall be filled using the procedure for "DPT installation of annular seal above water level in well" below. A surface seal and well head shall be completed in accordance with Appendix B II. B.

- As with all well construction, all quantities of sealing materials used shall be measured in units of volume and reported in the well log report.

Procedure for Anchoring Well Assembly

- Affix the expendable drive point to the bottom push rod and advance the push rods to the designed maximum depth of the well.

- Lower capped or plugged prepacked screen down the push rod with the appropriate end pointing down, per manufacturer's instructions. Add screen sections as needed to achieve the designed screened interval.

- Thread annular bridge onto the top of the pre-packed screen.

- Thread the riser pipe to the top of the annular bridge.

- Lower well assembly into push rods until the annular bridge is approximately three feet into the push rods.

- Calculate the volume of granular bentonite that is needed to fill the annular space between the borehole wall and the riser pipe for six vertical inches. Measure the granular bentonite into the annular space between the riser pipe and the push rod so that it rests on top of the annular bridge. Note that the insides of the push rods need to be dry for this method to succeed.

- While holding the grout tube to well casing, push the riser pipe and grout tube down the push rod, adding riser pipe until screen hits the expendable drive point at bottom of rod string. At least one foot of riser should extend past the top push rod. Plug the top riser to ensure that the inside of the well stays clean during construction.

- Release the grout tube and attach the well assembly firmly to the expendable drive point in accordance with the manufacturer's instructions, ensuring that the bottom end of the screen is sealed. Gently pull up on the riser to ensure that the well assembly and anchor are firmly attached.

- Begin retracting the push rods. While pulling the rods, observe whether the PVC risers stay in place or move up with the rods. If the PVC risers move up with the rod string, the well is not anchored. Stop and take corrective action. First, check to be sure the pre-packed screen is still attached to the expendable drive point. Next, use precautionary measures to safely hold the PVC risers in place while pulling up the rods. An additional section of PVC riser may be helpful. Once the push rods have cleared the annular bridge, the screen and riser assembly should stop rising with the rods.

  If the PVC risers stay in place, the well is successfully anchored. Continue retracting the rods so that the bottom of the rod string rod is just above the end of the grout tube. The length of retraction equals the total length of screen + the length of the annular bridge + the thickness of the bentonite + the distance between the bentonite and the bottom of the grout tube.

- Use the grout pump and grout tube to pump sufficient water to the bentonite to hydrate it according to the manufacture's instructions. Wait for the bentonite to absorb enough water to form a barrier to liquid grout.

- Follow procedure for "DPT installation of annular seal above water level in well" below, and then construct surface completion in accordance with Appendix B II. B.

c. DPT installation of wells using prepacked bentonite sleeves below water level in the borehole.

Overview

- The well shall be constructed with a prepacked well screen.

- The well shall be constructed with properly installed prepacked bentonite seals for all riser pipe installed beneath the water level in the borehole at the time of installation. When the well assembly is anchored, the prepacked seals are submerged under water. The prepacked seals are allowed to hydrate in accordance with the manufacturer's instructions.

- The annular space above water level in the borehole, from the top of the prepacked bentonite seal to the base of the surface seal, shall be filled using the procedure for "DPT installation of annular seal above water level in well" below (#4). A surface seal and well head shall be completed in accordance with Appendix B II. B.

- As with all well construction, all quantities of sealing materials used shall be measured in units of volume and reported in the well log report.

Procedure for Anchoring Well Assembly

- Affix the expendable drive point to the bottom push rod and advance the push rods to the designed maximum depth of the well.

- Lower capped or plugged pre-packed screen down the push rod with the appropriate end pointing down, per manufacturer's instructions. Add screen sections as needed to achieve the designed screened interval.

- Thread annular bridge onto the top of the pre-packed screen.

- Thread the prepacked bentonite sleeve to top of screen.

- Lower the well screen and seal into the push rods. Add additional pre-packed bentonite seals so that pre-packed seals will seal all of the annular space below the water level in the borehole. The pre-packed seals will function as an annular seal below the water table and as a transition seal/grout barrier for the annular seal installed above the water table.

- Do not use pre-packed seals above the water table because the proper expansion of the seal cannot be assured in unsaturated conditions. Add PVC riser pipe above the prepacked bentonite sleeves. Continue to add riser sections until the assembly hits the expendable drive point at bottom of rod string. At least one foot of riser should extend past the top push rod. Plug the top riser to ensure that the inside of the well stays clean during construction.

- Attach the well assembly firmly to the expendable drive point in accordance with the manufacturer's instructions, ensuring that the bottom end of the screen is sealed. Gently pull up on the riser to ensure that the well assembly and anchor are firmly attached.

- Retract the push rods so that the bottom push rod is approximately one foot above the top prepacked bentonite sleeve. Work quickly so that the sleeves do not swell inside the push rods and come up with the rod string. If the prepacked bentonite sleeves come up with the rod string, the well installation has failed and must be immediately destroyed and sealed by tremie grouting.

- Allow the prepacked bentonite seals to hydrate in accordance with manufacturer's instructions before proceeding with the next steps. This can take anywhere from minutes to several hours depending on the product used.

- Follow procedure for "DPT installation of annular seal above water level in well" below, and then construct surface completion in accordance with Appendix B II. B.

d. DPT installation of annular seal above water level in well.

- The annular space from the top of the bentonite transition seal to the base of the surface seal shall be filled using approved sealing materials and methods as specified in Appendix B II. B.

- Calculate the amount of grout expected for each foot of annulus that will be filled. Mix an appropriate amount of grout material and place it in the hopper on the grouting machine.

- Position the grout tube just above the bentonite transition seal.

- Retract two push rods (approximately six feet total length) while simultaneously pumping grout. Hold the grout tube down while retracting the rods. When pausing rod retraction to remove a rod, stop the grout pump to prevent flooding rods with grout.

- Continue retracting the push rods while simultaneously pumping grout until rods are out of ground. Stop the grout pump at each rod break and pull approximately one push-rod length of grout tube out of the hole or hold tube while retracting rods so that tube comes up with rods.

- Pull grout tube from hole until the end is above ground surface, pumping grout as needed to keep hole full.

- When level of grout in hole stabilizes, put end of grout tube in bucket and pump clear water through until clear water runs into the bucket. Shut off grout pump.

- Pull the remaining grout tube through the push rods.

- Cut or unthread casing approximately 6 inches above ground surface and remove excess casing. Cap well temporarily with slip cap.

- Construct a standard well surface completion in accordance with the specifications in Appendix B IV. B. of the SAM manual. Note that curing concrete can potentially generate enough heat to melt the riser pipe. Consider protecting the riser pipe from the curing concrete with a PVC conductor casing. The annular space between the riser pipe and conductor casing must be sealed with annular sealing material.

e. Open hole installation of well, transition seal, and annular seal.

Overview

This section provides criteria to be used for open-hole construction of groundwater monitoring wells in small-diameter soil borings. An open hole for the purpose of this guideline is a hole less than 20 feet deep with hole walls that will be stable if unsupported. Open-hole construction of wells in small diameter borings will be limited to borings and wells no greater than 20 feet in depth from the ground surface. The proper placement of the well casing and annular materials (sand pack, well seal, etc.) and an appropriate method of verifying the placement is a requirement of this method of well construction. Centralizers must be used at the bottom, top, and at an appropriate location in the middle of the well assembly. Following are criteria to be used for open-hole construction of wells in small diameter borings.

Subsurface Geologic Conditions

Because the borehole must remain open during construction of the well, geologic materials must be of a type not given to caving, sloughing, expansion, heaving, flowing, or other characteristics that would cause closure or in-filling of an open borehole. The project site and subsurface geologic conditions must be evaluated by the qualified professional (as specified in Appendix B IV. B.), and a certification be made that the site geologic conditions are suitable for open-hole construction of wells. Accompanying the application for a permit, a summary of the evaluation must be included to justify the use of this method.

Well Construction

With the exception of provision of a 2-inch annular space between the well casing and boring walls, wells constructed in small-diameter borings must meet the requirements of the State well standards and the SAM Program regarding the following:

- Placement and location of well screen relative to the water table;
- Placement of annular materials including sand filter pack, bentonite well seal, and surface seal;
- Construction of well surface completion; and
- Well development.

In addition to these requirements, centralizers are required at the bottom, top, and at an appropriate location in the center of the well assembly.

Verification of Well Construction

During placement of annular materials during typical well construction, depth to annular materials (sand filter pack, bentonite seal, grout backfill) is monitored or “tagged” usually with a weighted measuring tape or similar devise. The small annular space in wells constructed in small-diameter borings would not allow the use of similar methods for measuring the depth of emplacement of the annular materials. A rigid measuring device must be used for such measurements during well construction in small-diameter borings. The rigid device must not collapse or bend during the process of obtaining measurements, must be long enough to reach to the bottom of the borehole, and must be small enough to be inserted in the annular space between the well casing and borehole walls.

Definitions

Annular Bridge – A manufactured device designed to provide a bridge above the screened interval to prevent granular bentonite from reaching the screened interval during transition seal emplacement. This is a small device made of an expanding material such as foam.

Annular Space – The void space between an outer cylinder (such as a borehole wall or a push rod) and an inner cylinder (such as a well screen or riser pipe).

DEH – The County of San Diego, Department of Environmental Health.

DPT – Direct Push Technology. Equipment that drives tools into the ground without augering a borehole.

Expendable drive point – A sacrificial metal conical tip that is left in the ground to act as an anchor point and bottom cap for a direct-push well.

ID – Inside diameter; the diameter of a pipe or rod as measured from the inside edges.

OD – Outside diameter; the diameter of a pipe or rod as measured from the outside edges.

Prepacked bentonite seal – A commercially manufactured annular seal consisting of PVC riser pipe wrapped with material that temporarily encloses bentonite. The prepacked seal is designed to be installed through DPT push rods. When the rods are withdrawn and the seal comes in contact with groundwater, the bentonite expands, rupturing the enclosing material and filling the annular space between the riser pipe and the borehole wall. The prepacked bentonite seal must be certified by the manufacturer to completely seal the annular space created by the outside diameter of the push rods. Prepacked bentonite seals must be allowed to hydrate in accordance with manufacturer's specifications before an annular seal is installed in the unsaturated zone. **Prepacked bentonite seals are not to be used above the water table.**

Prepacked well screen – A commercially manufactured well intake device consisting of slotted PVC pipe wrapped with a sandwich of screen holding a layer of appropriately sized silica sand.

PVC – Polyvinyl chloride.

SAM – The County of San Diego, Department of Environmental Health, Site Assessment and Mitigation Program.

Schedule 40 -- Pipe manufactured to meet ASTM D1785 Schedule 40 specifications.

Small Diameter Well - A "small diameter well" for the purpose of this document is a well with a borehole diameter of less than 6 inches and an annular space around the casing of less than 2 inches that cannot be constructed using conventional drilling methods.

Well riser pipe - The non-perforated pipe inserted into the well borehole that connects the well screen with the ground surface.

References

ASTM International D: 6724-01, 2001. Standard Guide for Installation of Direct Push Ground Water Monitoring Wells.

ASTM International D: 6725-01, 2001. Standard Practice for Direct Push Installation of Prepacked Screen Monitoring Wells in Unconsolidated Aquifers.

BP Corporation North America Inc. and The Underground Storage Tank Programs of U.S. Environmental Protection Agency Regions 4, Atlanta GA and Region 5, Chicago, IL, May 1, 2002. Monitoring Well Comparison Study: An Evaluation of Direct-Push Versus Conventional Monitoring Wells.

California Department of Water Resources, 1991. Bulletin 74-90 (Supplement to 74-81), California Well Standards, Water wells, Monitoring wells, Cathodic protection wells.

County of San Diego, Department of Environmental Health, Land & Water Quality Division, Site Assessment and Mitigation Program (SD DEH), 2002. Site Assessment and Mitigation Manual.

Kram, M; Lorenzana, D; Michaelsen, J; and Lory, E; January, 2001. Performance Comparison: Direct-Push Wells Versus Drilled Wells. Naval Facilities Engineering Service Center Technical Report TR-2120-ENV.

Appendix C
Voluntary Assistance Program

Contents of Appendix C

I. APPLICATION INSTRUCTIONS

COUNTY OF SAN DIEGO
DEPARTMENT OF ENVIRONMENTAL HEALTH

VOLUNTARY ASSISTANCE PROGRAM

The Voluntary Assistance Program is designed to provide the applicant with staff consultation, project review, and public health assessment pertaining to properties suspected or known to be contaminated with hazardous substances. California Health and Safety Code Sections 101480-101490 authorize the County Department of Environmental Health (DEH) to enter into voluntary agreements for the oversight of remedial action at sites contaminated by wastes.

The DEH staff will review and manage all projects in accordance with applicable regulatory requirements, industry practices, and the current version of the DEH Site Assessment and Mitigation Manual. Our goal throughout project review is the protection of human health, water resources and the environment. Upon completion of a project, DEH will issue a letter addressing the applicant's specific project goals. Open lines of communication between DEH and the applicant provide the best opportunities for expedient review and successful project resolution.

Application Requirements

- Sections A, B, C, and D must be completed on the "Application for Assistance" form (Page 1 of 2), along with the applicant's original signature.
- Fully describe your project and your specific request(s) for DEH review and written response (Section D). As necessary, include a cover letter to clarify your project needs.
- Submit all relevant documentation/reports with the application. All documents containing geologic and/or contaminant migration interpretations must be signed by an experienced professional with the appropriate California registration or certification.
- An **initial fee of $210, payable to the <u>County of San Diego</u>,** is required at the time of application submittal. This fee covers two (2) hours of staff review time. Staff time in excess of two hours will be invoiced to applicant and must be paid within 30 days of receipt of the invoice. The staff billing rate is currently $105/hour. **Staff assistance will not be provided on delinquent accounts.**

Project Review Conditions

- Within five (5) workdays of DEH receipt of your <u>complete</u> application, the project is identified by a DEH Case No. and assigned to a DEH project manager.
- The DEH will notify the Department of Toxic Substances Control (DTSC) and the Regional Water Quality Control Board (RWQCB) that the project has been submitted for DEH review.
- A copy of all written DEH correspondence will be sent to the applicant and forwarded to the legal property owner. Project files will be available for public review.
- DEH has the option of referring the project to the DTSC or RWQCB at any time during the project review process. If the applicant ceases work, or requests DEH to cease work, on a project <u>prior</u> to resolving site contamination issues, then DEH would refer the project to the appropriate agency and/or identify the project as <u>unresolved</u> in the DEH database.

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II. Application for DEH Assistance

P.O. BOX 129261
SAN DIEGO, CA 92112-9261
ATTN: NASSER SIONIT
(619) 338-2239
(619) 338-2315 (FAX)
WEB SITE: www.co.san-diego.ca.us/deh/lwq/sam

FOR OFFICE USE:

Date Received ______________________

Submittal Fee Paid ____________________

Establishment #______________________

COUNTY OF SAN DIEGO
DEPARTMENT OF ENVIRONMENTAL HEALTH

VOLUNTARY ASSISTANCE PROGRAM
APPLICATION FOR ASSISTANCE

(PLEASE READ BOTH PAGES OF THIS APPLICATION PRIOR TO COMPLETION)

A. Site Name ______________________________ Assessors Parcel Number ______________

Site Address ____
Street City State Zip Code

B. Property Owner ____

Mailing Address ____
Street City State Zip Code

Contact Person ______________________________ Telephone ( ) ______________

C. Application Submitted By:
Contact Person ______________________________ Telephone ( ) ______________

Company Name ____

Mailing Address ____
Street City State Zip Code

Note: Invoices will be sent to the applicant at this address unless other arrangements are made.

D. Brief Project Description ____

____

____

____

Type of Assistance Requested ____

____

____

____

I accept the application requirements and project review conditions listed on Page 2 of 2 and I agree to pay all costs associated with DEH staff time and services within 30 days of receiving an invoice.

________________________ ________________________ ____________
Original Signature of Applicant Printed Name Date

DEH:SAM-990 (Rev. 12/02) **PAGE 1 OF 2**

Appendix D
Forms

CONTENTS OF APPENDIX D

I. Underground Storage Tank Unauthorized Release (Leak) Contamination Site Report

UNDERGROUND STORAGE TANK UNAUTHORIZED RELEASE (LEAK) / CONTAMINATION SITE REPORT

EMERGENCY ☐ YES ☐ NO

HAS STATE OFFICE OF EMERGENCY SERVICES REPORT BEEN FILED ? ☐ YES ☐ NO

FOR LOCAL AGENCY USE ONLY
I HEREBY CERTIFY THAT I HAVE DISTRIBUTED THIS INFORMATION ACCORDING TO THE DISTRIBUTION SHOWN ON THE INSTRUCTION SHEET ON THE BACK PAGE OF THIS FORM.

SIGNED ______ DATE ______

REPORT DATE M M D D Y Y

CASE #

REPORTED BY

NAME OF INDIVIDUAL FILING REPORT | PHONE ( ) | SIGNATURE

REPRESENTING ☐ OWNER/OPERATOR ☐ REGIONAL BOARD ☐ LOCAL AGENCY ☐ OTHER ______

COMPANY OR AGENCY NAME

ADDRESS
STREET | CITY | STATE | ZIP

RESPONSIBLE PARTY

NAME ☐ UNKNOWN | CONTACT PERSON | PHONE ( )

ADDRESS
STREET | CITY | STATE | ZIP

SITE LOCATION

FACILITY NAME (IF APPLICABLE) | OPERATOR | PHONE ( )

ADDRESS
STREET | CITY | COUNTY | ZIP

CROSS STREET

IMPLEMENTING AGENCIES

LOCAL AGENCY | AGENCY NAME | CONTACT PERSON | PHONE ( )

REGIONAL BOARD | PHONE ( )

SUBSTANCES INVOLVED

(1) NAME | QUANTITY LOST (GALLONS) ______ ☐ UNKNOWN

(2) ______ ☐ UNKNOWN

DISCOVERY/ABATEMENT

DATE DISCOVERED M M D D Y Y

HOW DISCOVERED ☐ INVENTORY CONTROL ☐ SUBSURFACE MONITORING ☐ NUISANCE CONDITIONS ☐ TANK TEST ☐ TANK REMOVAL ☐ OTHER ______

DATE DISCHARGE BEGAN M M D D Y Y ☐ UNKNOWN

METHOD USED TO STOP DISCHARGE (CHECK ALL THAT APPLY)
☐ REMOVE CONTENTS ☐ CLOSE TANK & REMOVE ☐ REPAIR PIPING
☐ REPAIR TANK ☐ CLOSE TANK & FILL IN PLACE ☐ CHANGE PROCEDURE
☐ REPLACE TANK ☐ OTHER ______

HAS DISCHARGE BEEN STOPPED ? ☐ YES ☐ NO IF YES, DATE M M D D Y Y

SOURCE/CAUSE

SOURCE OF DISCHARGE ☐ TANK LEAK ☐ UNKNOWN ☐ PIPING LEAK ☐ OTHER

CAUSE(S) ☐ OVERFILL ☐ RUPTURE/FAILURE ☐ SPILL ☐ CORROSION ☐ UNKNOWN ☐ OTHER ______

CASE TYPE

CHECK ONE ONLY
☐ UNDETERMINED ☐ SOIL ONLY ☐ GROUNDWATER ☐ DRINKING WATER - (CHECK ONLY IF WATER WELLS HAVE ACTUALLY BEEN AFFECTED)

CURRENT STATUS

CHECK ONE ONLY
☐ NO ACTION TAKEN ☐ PRELIMINARY SITE ASSESSMENT WORKPLAN SUBMITTED ☐ POLLUTION CHARACTERIZATION
☐ LEAK BEING CONFIRMED ☐ PRELIMINARY SITE ASSESSMENT UNDERWAY ☐ POST CLEANUP MONITORING IN PROGRESS
☐ REMEDIATION PLAN ☐ CASE CLOSED (CLEANUP COMPLETED OR UNNECESSARY) ☐ CLEANUP UNDERWAY

REMEDIAL ACTION

CHECK APPROPRIATE ACTION(S)
(SEE BACK FOR DETAILS)
☐ EXCAVATE & DISPOSE (ED) ☐ REMOVE FREE PRODUCT (FP) ☐ ENHANCED BIO DEGRADATION (IT)
☐ CAP SITE (CD) ☐ EXCAVATE & TREAT (ET) ☐ PUMP & TREAT GROUNDWATER (GT) ☐ REPLACE SUPPLY (RS)
☐ CONTAINMENT BARRIER (CB) ☐ NO ACTION REQUIRED (NA) ☐ TREATMENT AT HOOKUP (HU) ☐ VENT SOIL (VS)
☐ VACUUM EXTRACT (VE) ☐ OTHER (OT) ______

COMMENTS

HSC 05 (8/90)

II. Cap Public Notification and Request for Comment Form

SAMPLE

CAP PUBLIC NOTIFICATION LETTER

Date
Name, Address, City, State Zip

Dear :

CLEANUP OF ENVIRONMENTAL CONTAMINATION RESULTING FROM
LEAKING UNDERGROUND STORAGE TANKS LOCATED AT
(Site Name, Address, City, State and Zip Code).

The (RP Name) and their consultants, (Consulting Firm Name), have proposed a corrective action plan (CAP) to remediate the soil and groundwater contamination at the site referenced above. The County of San Diego Department of Environmental Health (DEH) must review the CAP prior to implementation of the plan. This notice is sent to advise you that the plan is available for review, and to advise you that DEH is accepting public comment on the plan through (use 30 day window).

The environmental contamination at the site resulted from a leaking underground fuel tank system. The leak was first discovered in (time of year, e.g., Spring of year). Since that time, the (RP Name) has instituted clean up efforts to control the adverse impacts to the public, while simultaneously investigating the size of the release. The (RP Name) now proposes a CAP to effectively clean up the contamination. The (RP's) activities have been overseen by DEH.

The CAP proposes to remediate soil contamination by (short description of activities to be implemented).

You may review a copy of the CAP (list exact title of report) for (Site Address, City, State, SAM Case #/H#) at the (location) Public Library, (address of library), or at the offices of the County DEH, 1255 Imperial Avenue, Suite 300, San Diego, CA.

Written comments on the CAP may be directed to (DEH/SAM Staff Person's Name) by Fax (619) 338-2377 or by mail to the County of San Diego Department of Environmental Health, P.O. Box 85261, San Diego, 92186-5261. Comments must be received by (use 30 day window).

Questions regarding the content of the CAP should be directed to one of the following:

1) (RP Representative, Telephone #, RP Name)
2) (Consultant Name, Telephone #, Consultant Firm's Name)
3) (DEH/SAM Staff Person's Name, Telephone #)

Sincerely,

III. Chain-of-Custody Form

County of San Diego

SAM Chain-of-Custody Record

Date ________ Page ____ of ______

Project Name ______________________________
Reference ______________________________
Address ______________________________
____
Samplers Signature ______________________________
Lab To Be Used ______________________________

COPY OF LAB RESULTS
MUST BE SENT TO:
Dept. of Environmental Health
Land and Water Quality Division
P.O. Box 129261
San Diego, CA 92112-9261

SAMPLE NO.	DATE	TIME	LOCATION	ANALYSIS REQUESTED: TPH METHOD	TRPH EPA 418.1	BTXE (8021/8260)	HALOGENATED (8010/601)	MTBE (8260)		SAMPLE TYPE: SOLID	LIQUID	GRAB	COMPOSITE	NO OF CONTAINERS	COMMENTS

1. RELINQUISHED BY	Date	2. RELINQUISHED BY	Date	3. RELINQUISHED BY	Date	TOTAL NO. OF CONTAINERS
Signature		Signature		Signature		Sample Conditions Received On Ice Yes/No Tape Seal Intact Yes/No
Printed Name	Time	Printed Name	Time	Printed Name	Time	Special Shipment/Handling Or Storage Requirements:
Company		Company		Company		
RECEIVED BY	Date	RECEIVED BY	Date	RECEIVED BY	Date	Split Sample Location
Signature		Signature		Signature		Site Identification
Printed Name	Time	Printed Name	Time	Printed Name	Time	H# ________ AT# ________ SAM ________
Company		Company		Company		

DEH:SAM-999 (Rev. 1/03) NCR

Distribution: White - Laboratory
Yellow - Contractor/Responsible Party
Pink - SAM

County of San Diego
Department of Environmental Health

IV. Groundwater Monitoring Results Reporting Form

GROUNDWATER MONITORING RESULTS

Site Name: ______________________

Address: ______________________

Case No: ______________________

		Well ID: Drill Date:		Well Diameter: Bore Diameter:		Total Well Depth:		Screen Interval:		Top of Casing Elevation:	
	Sample Date:										
	MCL										
Benzene (ug/l)	1 ug/l										
Toluene (ug/l)	100 ug/l										
Ethylbenzene (ug/l)	680 ug/l										
Xylenes (ug/l)	1,750 ug/l										
MTBE (ug/l)	13 ug/l										
TPH (mg/l)											
Free Product (ft)											
Depth to Product (ft)											
Depth to Water (ft)											
GW Elevation (ft)											

		Well ID: Drill Date:		Well Diameter: Bore Diameter:		Total Well Depth:		Screen Interval:		Top of Casing Elevation:	
	Sample Date:										
	MCL										
Benzene (ug/l)	1 ug/l										
Toluene (ug/l)	100 ug/l										
Ethylbenzene (ug/l)	680 ug/l										
Xylenes (ug/l)	1,750 ug/l										
MTBE (ug/l)	13 ug/l										
TPH (mg/l)											
Free Product (ft)											
Depth to Product (ft)											
Depth to Water (ft)											
GW Elevation (ft)											

V. File Review Request Form

OFFICE USE ONLY
File #________
Request#________
No Records ________

County of San Diego

GARY W. ERBECK
DIRECTOR

DEPARTMENT OF ENVIRONMENTAL HEALTH
P.O. BOX 129261, SAN DIEGO, CA 92112-9261
(619) 338-2222 FAX (619) 237-8447
1-800-253-9933

RICHARD HASS
ASSISTANT DIRECTOR

REQUEST TO REVIEW DEPARTMENT OF ENVIRONMENTAL HEALTH (DEH) RECORDS

A request is hereby made to review DEH records. You may also access information from the DEH website at www.sdcounty.ca.gov/deh/. Each request is limited to a MAXIMUM OF FIVE (5) addresses or Assessor's Parcels. A separate form must be completed for each address. Fax your completed form to File Review at (619-237-8447) or mail your request to address above Attn: File Review.

DEH complies fully with the California Public Records Act and the Federal Freedom of Information Act. Every properly completed request will be processed in the order it is received. After the files you have requested are retrieved from storage, an appointment will be scheduled so that you may review DEH records. Photocopies of file items may be requested. A fee of $.15 per page is charged to cover cost of copies.

Requestor Name: ________________
Phone: ( ) ________ FAX: ( ) ________
Company Name: ________________
Mailing Address: ________________
(You may attach a business card/overprint with business card if preferred.)

The following information is required so that our files may be accurately searched:

________________ or ________
Exact Address (Street, City and Zip Code) Assessor's Parcel Number

____
Optional information (Establishment Permit Number, business name, etc.)

To help us identify all the records you wish to review, please indicate the purpose of your search and if you know the program file you want to review, please check below:

- ☐ Environmental Assessment Phase I/II
- ☐ Hazardous Materials Permit
- ☐ Active business
- ☐ Site Assessment and Mitigation Release(s)
- ☐ Purchasing/Selling Property
- ☐ Underground Storage Tank(s)
- ☐ SAM Closure Letter/Report
- ☐ Other

OFFICE USE ONLY BELOW THIS LINE

# ____	# ____	# ____	# ____	# ____	Inactive File #____
# ____	# ____	# ____	# ____	# ____	Iron Mtn #____

Files reviewed by: ________ of ________ Date: ________
Files copied for: ________ of ________ Date: ________
Request cancelled by: ________ Date: ________
Photocopies ________ Cost ________ Paid ________
Photocopies picked up/mailed on ________ By ________
Date Name

A search for DEH records checked above has been conducted and NO RECORDS for the address you requested were found.

________ ________ ________
Signature Title Date

DEH-SAM-9096 (Rev.1/03)

Appendix E
Guidelines

CONTENTS OF APPENDIX E

I. COMBUSTIBLE GAS INDICATOR (CGI) GUIDELINE

Contractors responsible for underground storage tank (UST) closure, repair, or re-piping work, must have a Combustible Gas Indicator (CGI) at the work site at all times. This instrument must be used to ensure that 20% of the lower explosive limit (LEL) is not reached within the UST or work area surrounding the UST. It is also recommended that the level of oxygen be measured, in addition to the LEL, with either a separate oxygen meter or with a combination CGI/Oxygen meter. Primary authority for fire and explosion safety at a UST work-site rests with the local fire agency.

All DEH personnel will enforce the safety precautions outlined below during repair or removal of USTs. At the location of a UST removal or repair project, where flammable chemicals have been stored, DEH staff will require the contractor to demonstrate that the work site is safe. However, the local fire agency has primary authority over fire safety and this guideline is not intended to supersede that authority.

In order to prevent an explosion, the following minimum procedures shall be taken by an applicant for the removal of a UST:

A. The applicant or contractor shall have a CGI, capable of measuring LEL in percentages, present at the work site during all times when work is being conducted on or around USTs. The CGI must be maintained in good repair and calibrated in accordance with the manufacturer's specifications. The CGI must be calibrated so as to detect the LEL of the product in the UST, or the LEL of an indicator chemical that is a component of the product in the UST.

B. The contractor shall be responsible to ensure that flammable vapors around the work area and within the UST are not in explosive concentrations. Non-explosive conditions will normally be demonstrated by assuring that vapors within excavations, the work area, and the UST being removed, are less than 20% of the LEL. If the UST being removed cannot be evacuated and purged of vapors prior to the beginning of excavation work, then the UST may be maintained non-explosive by maintaining vapor concentrations (within the UST) above the upper explosive limit (UEL). The UST contractor must obtain concurrence from the local Fire Department and DEH before conducting excavation work using the UEL to maintain non-explosive conditions. A UST should not be moved until it has been "inerted" to less than 20% of the LEL.

C. The CGI and CGI calibration kits must meet the following minimum specifications:

   1. The CGI must have a direct readout that indicates the percentage of the LEL being measured.
   2. The CGI must be intrinsically safe.
   3. The CGI must have a probe capable of testing the interior of the UST.
   4. The CGI must be calibrated using substances that approximate the vapors being tested.
   5. The CGI may require a dilution fitting to be capable of giving an accurate LEL reading in the absence of oxygen.
   6. The CGI must be capable of being field calibrated.
   7. The CGI must be routinely calibrated as required by the manufacturer.

II. UNDERGROUND STORAGE TANK SOIL SAMPLING GUIDELINE

UNDERGROUND STORAGE TANK SOIL SAMPLING GUIDELINE

In San Diego County, the Department of Environmental Health (DEH) is the local oversight agency. DEH has established the following guidelines for routine soil sampling and analyses as a condition of all UST closure (removal) permits. Samples are required when soil appears to be clean. At sites with obvious contamination, a full assessment will be required; routine samples may not be required at the time of inspection.

A. UST Owner/Operator

The UST owner/operator is required to have the following items at the site and to have made the following arrangements prior to UST removal:

1. Person to take the samples - this does not need to be an environmental consultant.
2. Sample containers.
3. Labels for the containers.
4. Ice chest with dry ice or blue ice.
5. Backhoe, or similar excavating device, which can be used to remove backfill and native soil from the UST excavation in a safe manner.
6. Sample-taking device (trowel, hand auger, disposable gloves).
7. Materials for cleaning the sampling tools, if tools are to be reused (e.g., bucket, water, and cleaning agent).
8. Person and transportation to deliver sample to laboratory.
9. Advance arrangements with a State-certified hazardous waste laboratory to perform the analyses.
10. Submit copies of laboratory results and the chromatogram for the analysis to DEH.

B. DEH Hazardous Materials Specialist

The DEH inspector will be responsible for the following:

1. Documenting the UST removal.
2. Documenting conditions of the UST, piping, and soil.
3. Providing chain-of-custody form.
4. Identifying sampling locations.
5. Selection of analytical methods.
6. Evaluating laboratory analyses data upon receipt.

C. Required Sampling Supplies

The following chart (Table E-1) can be used to estimate the number of required samples based on the UST size and the length of piping. Knowing the approximate number of samples to be collected can help estimate the necessary sampling supplies and to ensure that these supplies are at the work site at the time of the UST removal. Refer to Table 5-4 in Section 5 for the required laboratory analysis. Final approval of a UST closure (removal) cannot be given by the DEH until all laboratory data and supporting information have been received and evaluated.

TABLE E - 1: APPROXIMATE NUMBER OF SAMPLES FOR UST REMOVAL

UST SIZE (GALLONS)	NUMBER OF SAMPLES FROM EXCAVATION PER UST	NUMBER OF SAMPLES FROM PIPING TRENCH PER 20 LINEAL FEET
1 - 10,000	Two	One
10,001 – 20,000	Three	One
20,001 – 30,000	Six	One
> 30,000	Contact DEH	One

III.BURN ASH INVESTIGATION GUIDELINES

LEA Advisory #56 November 4, 1998 **Publication #231-98-019**

Process for Evaluating and Remediating Burn Dump Sites

To All Local Enforcement Agencies:

This Local Enforcement Agency (LEA) Advisory covers the process for evaluating and remediating burn dump sites. The purpose of this LEA Advisory is to:

- Provide guidance on the appropriate procedures to follow in evaluating the risks to public health and safety and the environment posed by burn ash dump (burn dump) sites that contain non-Resource Conservation and Recovery Act (RCRA) waste.
- Identify the steps to take to control these risks.
- Describe the roles of other regulatory agencies in burn dump regulation.
- Address burn dump issues raised at the November 1997 Partnership 2000 Conference at Asilomar.

What Is a Burn Dump?

A burn dump is a site where solid waste has been burned at low temperature and the residual burn ash and debris have been landfilled or stockpiled. The burn ash referred to in this document is the residual ash that results from the low temperature combustion of solid waste. Ash from controlled incineration at a permitted facility, such as a waste-to-energy plant, is not included in this advisory.

Burn dumps typically contain little biodegradable organic material because of the combustion of waste materials and the age of the sites. Therefore, typically little or no landfill gas is being generated at burn dump sites.

Burn dumps were phased out in the early 1970s in response to federal and state air quality legislation. Most burn dumps are considered closed sites as their operations ceased prior to the development of regulations addressing the closure of disposal sites, provided that these sites were operated under applicable permits at the time. If these sites were not operated under applicable permits at the time they would be considered illegal disposal sites.

What Are the Problems and Hazards Associated with Burn Dumps?

An increasing number of burn dumps are identified in site assessments conducted by the LEAs and the California Integrated Waste Management Board (IWMB). Laboratory tests of ash from a number of burn dump sites show that the burning of nonhazardous household or municipal waste tends to concentrate certain metals to levels that are hazardous under California regulations and, on occasion, federal regulation. The potential threat from burn ash to public health and safety and the environment may be minimal if the sites are located in remote, less populated areas of the state where public contact is limited or nonexistent. However, in heavily developed areas where land is scarce and expensive there is increasing interest in developing burn dump sites. Before a burn dump site is developed the associated health and environmental risks should be addressed through a waste characterization study as described in Attachment 1.

Test results indicate the predominant metals of concern in burn ash (i.e., arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, and zinc) are not readily soluble in water; therefore, not readily leachable into ground water. However, burn ash does pose a risk if it becomes airborne, is eroded into surface water, or comes in contact with skin. The potential routes for human exposure to the contaminants in burn ash are inhalation, ingestion, and direct skin contact. Exposure to contaminants via any of these routes may result in adverse health effects. Attachment 2 briefly describes the adverse health effects of the metals most commonly found in burn ash. Burn dump problems and potential hazards result primarily from:

1. Improper cover contributing to hazardous burn ash becoming airborne and being inhaled by humans or animals.
2. Inadequate erosion protection contributing to transport of hazardous burn ash into surface waters and being ingested by humans and animals.

3. Improper site security allowing human or animal access to areas of hazardous waste and hazards from direct contact, inhalation, and ingestion.
4. Burn dumps not recorded at the local level allowing construction or other improper land use on or adjacent to hazardous burn ash and long term threats to public health and safety and the environment.

Burn Ash Characterization

The main concern when evaluating a burn dump is determining whether or not the burn ash and residues are hazardous. To determine whether or not a burn ash is hazardous a burn ash characterization study (i.e., waste characterization study) is performed. In a waste characterization study burn ash samples are taken and analyzed using a specified sampling methodology and set of test protocols. Each test protocol produces its own specific type of information for a given range of conditions. The waste characterization study is described in Attachment 1.

Who Regulates Burn Dumps?

LEA/IWMB Authority

The authority that allows LEAs and the IWMB to investigate and inspect burn dumps is contained in Public Resources Code (PRC) section 44100. This section states in part that:

> ....the enforcement agency, in issuing or reviewing any solid waste facilities permit or in connection with any action relating thereto or authorized by this division, may investigate the operation by any person of a ...disposal site....

"Disposal site" is defined in PRC section 40122 which states in part:

> "Disposal site" or "site" includes the place, location, tract of land, area, or premises in use, intended to be used, or which has been used, for the landfill disposal of solid wastes.

Solid waste is defined in PRC section 40191, which states that solid waste does not include hazardous waste or low level radioactive waste regulated under Chapter 7.6 of the Health and Safety Code. When burn ash is classified as a RCRA hazardous waste the IWMB and LEA do not have the authority to, and will not, regulate the site, even if the waste was derived from solid waste. However, when burn ash is classified as a California hazardous waste there are circumstances where the IWMB and LEA may regulate the burn dump site.

The burn ash at most burn dump sites in California meets the criteria to be classified as a California hazardous waste. However, because of the limited solubility of burn ash metals in water, the risk posed by these sites is effectively controlled when a few straightforward precautions are taken. To acknowledge this reduced risk under specified conditions IWMB and Department of Toxic Substances Control (DTSC) jointly developed a streamlined, coordinated regulatory approach for burn dump sites outlined in a memorandum dated March 3, 1995 (Attachment 5). Under this streamlined, coordinated regulatory approach the LEA and IWMB are given the responsibility to regulate burn dump sites, with limited DTSC involvement. Out of four scenarios in this streamlined approach DTSC involvement in required in only the fourth scenario. The approach is described in Attachment 3 and graphically represented in Figures A, B, C, and D.

Also, under some conditions the owner of a burn dump site may request from DTSC a nonhazardous determination or a blanket variance for closure. Under this scenario the IWMB and LEA may replace DTSC as the regulating agency. This is explained in more detail in following sections and attachments.

In the event that the waste characterization study demonstrates that the ash does not meet the criteria for being classified as a California or RCRA hazardous waste, DTSC involvement in any site activity, including removal of ash, would not be necessary. If the waste characterization study demonstrates that the ash contains a non-ash California hazardous waste fraction DTSC should be contacted to determine how to proceed. However, regardless of whether the ash is hazardous or not, the LEA should coordinate with the Regional Water Quality Control Board (RWQCB).

Also, California Code of Regulations, Title 27 (27 CCR) section 21100(d) allows the enforcement agency to apply closure regulations, on an as needed basis, to closed sites not having approved closure plans and to illegal or abandoned disposal sites. Section 21100(d) states that:

> Closed sites for which closure plans were not approved pursuant to §20164 or §21099, and illegal or abandoned disposal sites which pose a threat to public health and safety or the environment shall implement the provisions of these regulations as required by the EA.

DTSC Authority

If burn ash is classified as a RCRA hazardous waste DTSC is the lead agency and regulates the site in accordance with California Code of Regulations, Title 22 (22 CCR). If burn ash is classified as a California hazardous waste DTSC would normally be the lead agency and would regulate the site in accordance with 22 CCR. However, as discussed above, under some circumstances the authority to regulate burn dump sites is given to the LEA and IWMB.

Regional Water Quality Control Board Authority

The RWQCB has authority to regulate burn dumps regardless of whether the waste has been determined to be hazardous or non-hazardous. Regulations that the RWQCB use to govern burn dump sites are contained in 27 CCR.

Proposed Changes to Hazardous Waste Regulations

Currently, DTSC is proposing changes to 22 CCR through a process termed the "Regulatory Structure Update" (RSU). Where most hazardous wastes are now subject to the same management standards DTSC is proposing to create two hazardous waste tiers based on risk, fully regulated hazardous waste and special waste. The first tier is for the higher risk waste streams, which are fully regulated hazardous wastes. This tier is subject to all hazardous waste regulatory requirements. These Tier 1 wastes would be regulated in the same way all hazardous waste is currently regulated in California. The second lower-risk tier would be special wastes. Tier 2 will be a more comprehensively defined waste category that includes a broader range of wastes. These Tier 2 wastes are lower-risk wastes than those in Tier 1 and have fewer regulatory requirements. Although special wastes would have fewer requirements there would be no reduction in protection of public health and safety and the environment. One possible result of DTSC's RSU on the regulation of burn dump sites may be that some of these sites will fall into a lower category of risk; therefore, regulated at a lower level. Once DTSC completes the RSU process this advisory will be reviewed to determine if a revised/updated advisory is necessary.

What Procedures Should Be Followed to Regulate Burn Dumps?

Since most burn dumps can be classified as closed, illegal, or abandoned sites their identification and initial assessment should be accomplished using the Site Identification Process (SIP) or similar procedure. The guidance for the SIP is contained in LEA Advisory Numbers 3 and 9. The assessment in the SIP would determine whether there is an imminent threat to the environment or public health and safety. It is important that at a minimum the investigator evaluates the following:

1. Degree of burn ash exposure.
2. Adequacy of erosion control.
3. Site security including fencing and signage.
4. Whether the condition of the property is recorded showing the location of the burn dump, possible hazardous constituents present, excluded postclosure land uses (PCLU), and procedures for the development of the property for excluded land uses.

Additional areas of concern might include burning waste and underground fires.

Once this initial assessment has been completed, refer to Attachment 3 to determine the appropriate procedure to follow for the specific site. These procedures are intended to provide guidance for properly remediating burn dump sites.

Because site conditions will vary, some or part of the procedures or the level of detail may not be applicable in all cases. For example, in rural areas where there may be fewer sensitive receptors and a lower risk to human health and safety a less rigorous waste characterization may be appropriate. In urban areas, because of the higher concentration of sensitive receptors and higher human health and safety risks, a more rigorous waste characterization may be necessary. **However, it is important that coordination occurs between all regulatory agencies to assure that the appropriate mitigation measures are implemented.**

If you should have any questions regarding the regulation of burn dumps please contact the Remediation, Closure and Technical Services Branch staff person assigned to assist your jurisdiction.

Sincerely,

Julie Nauman, Acting Deputy Director
Permitting and Enforcement Division

Attachments:

Attachment 1

Characterizing Burn Dumps in California

Background

Based on several burn dump investigations California Integrated Waste Management Board (IWMB) staff have determined that there may be elevated levels or hazardous levels of arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, and zinc in the soil/ash. Also, low levels of total recoverable petroleum hydrocarbons and/or low to nondetectable levels of semivolatile organic compounds, polychlorinated biphenyls (PCB), dioxins, and furans may be present in burn ash. The pH in the burn ash is expected to range from 6.0 to 9.0. When waste characterization of a burn dump is necessary an investigation must be performed to delineate the nature and extent of the waste and to determine if the burn ash is a Resource Conservation and Recovery Act (RCRA) hazardous waste, a non-RCRA hazardous waste (designated California hazardous waste), or a nonhazardous solid waste. Once the waste classification is established, the appropriate and effective remediation measures can be determined. To accomplish this objective the burn ash should be sampled and analyzed using one or more of the testing protocols describe below.

The IWMB’s Solid Waste Cleanup Program (SWCP) has developed a waste characterization methodology and actively evaluated burn dumps throughout California. The SWCP considers a variety of factors in assessing burn dumps and recommends the following procedures for the waste characterization. The components of the waste characterization include:

1. Developing a sampling plan.
2. Performing discrete sampling following a recommended sampling procedure.
3. Analyzing samples using recommended analytical procedures and testing methodologies.
4. Comparing sampling results with regulatory limits.

The use of SWCP's waste characterization methodology is only a recommendation. Depending on site conditions other city, county, State, or federal agencies may require additional sampling, analyses, and assessments.

Waste Characterization Methodology

Sampling Plan

A sampling plan is necessary to document the procedural and analytical requirements to collect soil samples to characterize areas of potential contamination from a burn dump. The intent of the plan is to provide the necessary documentation to characterize the burn dump ash. At a minimum the plan should discuss: site location and background, project purpose, project tasks, methodology, equipment, sampling procedures and locations, decontamination, sample containers and preservation, disposal of residual materials, analyses of concern, analytical procedures, quality control, chain of custody, and health and safety issues. The number of samples will vary depending on the size, location, and site conditions.

Sampling Methodology

The SWCP staff use authoritative discrete sampling to assess the burn ash and surrounding soils. Authoritative sampling is based on the subjective judgement of the investigator regarding the location of potential contamination and serves as a valuable investigative tool in ascertaining if a hazardous substance is or is not present.

Sampling Procedures

The SWCP uses appropriate sampling, collecting, decontamination, and storage techniques. All environmental samples are sent to a state-certified hazardous waste laboratory for analyses using chain-of-custody protocols.

Testing Protocols

In a waste characterization study burn ash samples are analyzed using one or more test protocols. Each test protocol produces its own specific type of information for a given range of conditions.

Four test protocols that are widely used are:

Protocol 1: Totals Test. The "totals test" is a chemical digestion test developed by the Department of Toxic Substances Control (DTSC) to determine the total amount of a specific constituent in the soil. A sample is digested chemically to obtain its soluble and insoluble fractions. The total of the soluble and insoluble fractions of the sample is then compared to the total threshold limit concentration (TTLC). The results of the Totals Test are reported in milligrams per kilogram of sample (mg/kg).

Protocol 2: Waste Extraction Test (WET). The WET is a leaching test developed by DTSC. Results of the WET are compared to the Soluble Threshold Limit Concentration (STLC). The WET determines the amount of a specific constituent that can be leached from the soil using a solution designed to simulate landfill leaching. It is therefore a useful test for situations where a soil would be exposed to landfill leachate, such as disposal of ash together with uncombusted organic wastes in a solid waste landfill. However, the WET may not be very representative of the conditions at a site where all organic material has been completely burned. Because of the aggressive nature of the leaching in this test samples may exceed the STLC. The results of the WET are reported in milligrams per liter (mg/l).

Protocol 3: Toxicity Characteristic Leaching Procedure (TCLP). The TCLP was developed by the federal Environmental Protection Agency (U.S. EPA) to determine if a waste is a RCRA waste subject to regulation under Subtitle C. The TCLP is a leaching procedure that uses a slightly less aggressive leaching agent than is used by the WET. The TCLP ensures that any volatile constituents present in the sample are collected and measured. However, few volatile constituents are likely to be found in completely combusted burn ash. Therefore, when compared to the WET results it is likely that TCLP results will indicate lower metals concentrations and less elevated levels of volatile constituents. Chromium is one of the few constituents that may be present in higher concentrations in TCLP results than in WET results. Chromium concentrations are higher because the TCLP results do not differentiate between the 3+ and 6+ chrome species, but report the two species combined. In contrast, the WET reports the 3+ and 6+ species separately. The results of the TCLP are reported in milligrams per liter (mg/l). Temperatures reached during open burning are usually not high enough to completely combust all waste materials in the burn ash. Therefore, in a worst case situation, incomplete combustion may create dioxins and other organic compounds.

Protocol 4: Deionized Water Waste Extraction Test (DI WET). The DI WET is used to characterize the amount of metals that would leach from ash under the conditions most likely to be encountered at burn dump sites. This test is essentially the same test as the WET, but uses deionized water as the leaching agent. At most burn dump sites the primary liquid that will come in contact with burn ash is water, not landfill leachate. Results of tests done on samples of burn ash from a variety of burn dump sites indicate that very few samples release any metals when tested under the DI WET protocol.

Analytical Procedures

Typically, all samples are analyzed for California Assessment Manual (CAM) 17 metals using the Totals Test procedure by EPA Method 6010/7000 and pH by EPA Method 9040. Samples (i.e., at least three) with the highest concentration of lead based on the Totals Test are also analyzed for CAM-5 metals using the WET procedure and RCRA Eight Metals using the TCLP. Also, if the WET results for any other metal not in the CAM-5 analysis exceeds 10 times the STLC regulatory level a separate WET analysis for that metal must be performed. In addition, the IWMB use the highest lead samples and analyze again for lead using the DI WET extraction procedure. Sampling for PCBs, total recoverable petroleum hydrocarbons (TRPH), and semi-volatile organic compounds may be necessary if visual observation or records indicate possible contamination.

At minimum the SWCP staff recommends all soil/ash samples be analyzed for:

- *CAM 17 Metals (Sb, As, Ba, Be, Ce, Cr, Co, Cu, Pb, Hg, Mo, Ni, Se, Ag, Tl, V, Zn) Totals Test, EPA Method 6010/7471*
- *pH, EPA Method 9040*

And the three samples containing the highest lead be analyzed for:

- *CAM 5 Metals (Cd, Cr, Ni, Pb, Zn), WET, EPA Method 6010*
- *TCLP RCRA Metals (Ag, As, Ba, Cd, Cr, Hg, Pb, Se), EPA Method 1311*

Additionally, the LEA may request the following sampling procedures:

- *PCBs, EPA Method 8080*
- *Total Recoverable Petroleum Hydrocarbons (TRPH), EPA Method 418.1*
- *Semi-Volatile Organic Compounds, EPA Method 8270*
- *Lead DI-WET, WET, EPA Method 6010*

In addition, testing for dioxins and furans may be appropriate if evidence suggests that these constituents would likely be present from the type of waste combusted, and/or the site is located in an urban area with a number of sensitive receptors nearby and where there is a higher risk to human health and safety.

Regulatory Limits

To characterize the ash, SWCP staff use regulatory limits established from the California Code of Regulations, Title 22, section 66261.10 et seq. and the Code of Federal Regulations, Title 40, Section 261.24. The sample results are compared to the TTLC and STLC, and the federal RCRA Standards. This comparison provides the basis for classifying the burn ash as either a RCRA hazardous waste, a non-RCRA hazardous waste (designated California hazardous waste), or a non-hazardous solid waste. Burn ash that contains concentrations of metals that exceed the TTLC or STLC limits, or established health based levels that the DTSC has determined to be protective of human health and the environment, may be considered hazardous waste as defined in Title 14, California Code of Regulations, section 17225.32. In addition, wastes that exceed the TCLP concentration limits would be considered a RCRA hazardous waste.

Examples of Burn Ash Analytical Test Results in California

Table 1 shows the highest concentrations from the totals test data of nine common metals found in ash sampled at 12 sites throughout California. These numbers represent the total amount of certain metals that are present in the soil. These results show that ash commonly contains lead in excess of the California standard for hazardous waste, with nickel and zinc also found at elevated levels. Some of the tested sites also showed elevated levels of arsenic and chromium.

Table 2 compares the results of testing of a single sample using the Totals Test, WET, TCLP, and DI WET test protocols. Samples tested under the Totals Test protocol that exceed the TTLC hazardous threshold for lead also will likely exceed the STLC hazardous threshold for lead. However, a sample tested under the TCLP protocol, with its less aggressive leaching agent, will probably not exceed the hazardous threshold concentration associated with the TCLP test. If the sample is tested under the DI WET protocol the sample again probably will not exceed the STLC hazardous threshold concentration limits.

Table 1

Summary of Highest Totals Test Values of Selected Metals at Burn Dump Sites within California Compared to TTLC Limits

(Concentrations in excess of DTSC hazardous waste levels shown in bold italics)

(NA = Not Available; ND = Non Detected)

Site Name	**As (mg/kg)**	**Be (mg/kg)**	**Cd (mg/kg)**	**Cu (mg/kg)**	**Cr (mg/kg)**	**Hg (mg/kg)**	**Ni (mg/kg)**	**Pb (mg/kg)**	**Zn (mg/kg)**
Amador City Burn Dump	220	0.77	7.9	1260	101	1.2	102	***2180***	2240
Davenport Burn Dump	18	0.41	24	502	81	1.42	104	***1310***	1970
Drum Canyon Burn Dump	204	***240***	22	670	53	3.6	81	***2830***	2620
(Old)Grass Valley Burn Dump	16		19		2300	ND	***2100***	***4900***	200
Humboldt Road Disposal Site	NA		NA		NA	NA	NA	***4920***	NA
Los Banos Bottle Dump/Mercey Springs Road Burn Dump Site	19.6		7.8		96.8	NA	NA	***3750***	2200
Morro Bay Burn Dump	14	0.73	16	504	115	0.20	217	***6080***	1790
Mountain Meadows Illegal Disposal Site	17.5		3.9		85.6	1.5	83.7	***1110***	3320
Nevada City Burn Dump (A)	NA		12		73	NA	20	***2200***	***5500***
Nevada City Burn Dump (B)	ND		11.1		7.08	0.61	39.9	***1904***	3040
Tehachapi Burn Dump #2	7.1		NA		26.9	<0.1	11.9	16.7	NA
Wilder Ranch Burn Dump	***1420***	0.32	12.0	496	96	0.09	196	779	***5410***
Hazardous Waste Level TTLC	**500**	**75**	**75**	**2500**	**2500**	**20**	**2000**	**1000**	**5000**

Table 2

Comparsion of Burn Dump Ash Test Results

	Lead (Pb)				Cadmium (Cd)				Arsenic (As)				Mercury (Hg)			SAMPLE
Site Name	TTLC	STLC	TCLP	DI WET	TTLC	STLC	TCLP	DI WET	TTLC	STLC	TCLP	DI WET	TTLC	STLC	DI WET	ID
Hazardous Threshold Level	1000	5	5		100	1	1		500	5	5		20	2		
Amador City Burn Dump	2180	26		0.077	7.9	0.35			133				0.32			SS3
	1490	14		0.11	6.5	0.27			155				1.2			SS2
Drum Canyon Burn Dump	2830	74		0.23	18	0.33		ND	204				0.09			2AS
	1660	248		ND	22	0.42		ND	23				0.45			3AS
	966	50		0.15	12	0.42		0.07	10				3.6			4AS
		95	0.82													DCASH1
		61	4.2													DCASH2
		84	0.89													DCASH3
(Old) Grass Valley Burn Dump	4900				19				16				ND			E-1 (2/11/92)
	2980	5.1			12	ND			14	ND			ND	ND		E-2 (2/11/92)
Humboldt Road Burn Dump	4620	104														#I2
	4920	51.9														#F2
	4390			<0.50												#K2-1
Los Banos Bottle Dump/ Mercey Springs Road Dump	1160		<0.5	0.017	5.9		0.059	<0.005	14.2		<0.5	<0.005				PRS*
	1950			0.035	5.6			<0.005	19.6			<0.005				MSRBD**
Hanford School Site	240	33			1				4				0.3			B-3@1FT
	280	4.1			ND				2				0.2			LA-3@1FT
	430	10			ND				4				0.5			B5@1FT
	Lead (Pb)				Cadmium (Cd)				Arsenic (As)				Mercury (Hg)			SAMPLE
Site Name	TTLC	STLC	TCLP	DI WET	TTLC	STLC	TCLP	DI WET	TTLC	STLC	TCLP	DI WET	TTLC	STLC	DI WET	ID
Morro Bay Burn Dump	6080	605		ND	16				14				0.12			1-BA
	1170	46		ND	16				14				0.2			2-BA
Nevada City Burn Dump	1904				11.12				ND				0.61			NCM10
	1000				6.12				ND				0.34			NCM8

TTLC = mg/kg

STLC, TCLP, DI WET =mg/L

ND = below detection limit

* Composite of 18040, 180421, 18042, 18043

** Composite of 18044, 18045, 18046, 18047

Attachment 2

Health Effects of Seven Metals Commonly Found in Burn Ash[1]

Arsenic (As)

Arsenic is listed by the Environmental Protection Agency (EPA) as one of 129 priority pollutants. Arsenic is also listed among the 25 hazardous substances thought to pose the most significant potential threat to human health at priority superfund sites.

Potential Hazards to Fish, Wildlife, and Other Non-Human Biota: Plants can take up arsenic in a variety of ways, including from fly ash, sludge, and by manure dumped on the land. However, it has been found that the edible portions of plants grown on contaminated sources seldom accumulate dangerous levels of arsenic. Animals are generally less sensitive to arsenic than plants. Arsenic is one of the most toxic elements to fish.

Potential Hazards to Humans: Arsenic has long been a concern to man because small amounts can be toxic to humans. Relatively high doses of arsenic have been reported to cause bone marrow suppression in humans. Inorganic arsenic in high amounts has been known for centuries as a fast acting human poison.

Brief Summary of Carcinogenicity/Cancer Information: Arsenic is often thought of as a carcinogenic priority pollutant. Recent reviews indicate arsenic has been implicated in numerous types of cancer, including skin, bladder, kidney, liver, prostate, and nasal cavity.

Brief Summary of Developmental, Reproductive, Endocrine, and Genotoxicity Information: Recent reviews indicate arsenic has been associated with genotoxic, fetotoxic, mutagenic, and teratogenic impacts. Arsenic does not seem to directly impact DNA but may inhibit some DNA repair.

Beryllium (Be)

Beryllium is listed by the EPA as one of 129 priority pollutants, and is considered one of the 14 most noxious heavy metals.

General Hazard/Toxicity Summary: All beryllium compounds are potentially harmful or toxic. However, the probability of beryllium occurring at significantly toxic levels in ambient natural waters is minimal.

Potential Hazards to Fish, Wildlife, and Other Non-Human Biota: In those cases in which it is elevated in water beryllium is extremely toxic to warm water fish in soft water.

Potential Effects of Beryllium Upon Humans: Human impacts of beryllium include severe lung inflammation. Acute exposure to high concentrations of the more soluble compounds of beryllium can cause chemical pneumonitis, the symptoms of which include cough, substernal burning, shortness of breath, anorexia, and increasing fatigue.

Brief Summary of Carcinogenicity/Cancer Information: Beryllium is a Class B2 carcinogen, (i.e., a probable human carcinogen). Beryllium has been shown to induce lung cancer via inhalation in rats and monkeys and to induce osteosarcomas in rabbits.

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[1] Information in Attachment 2 was compiled from the following document taken from web site address: www.aqd.nps.gov/toxic/list.html *Environmental Contaminants Encyclopedia*, July 1, 1997, Roy J. Irwin, National Park Service

Brief Summary of Developmental, Reproductive, Endocrine and Genotoxicity Information: Beryllium has been shown to be teratogenic in snails, and to cause developmental problems in salamanders. Impacts on humans are unknown.

Cadmium (Cd)

Cadmium is listed by the EPA as one of 129 priority pollutants. Cadmium is also listed among the 25 hazardous substances thought to pose the most significant potential threat to human health at priority superfund sites.

General Hazard/Toxicity Summary: Cadmium ions are extremely poisonous; their action is similar to those of mercury. Cadmium acts as a cumulative poison. All cadmium compounds are potentially harmful or toxic.
Potential Hazards to Fish, Wildlife, and Other Non-Human Biota: Cadmium is very toxic to a variety of species of fish and wildlife. Cadmium causes behavior, growth, and physiological problems in aquatic life at sublethal concentrations. Cadmium is the only metal that clearly accumulates with increasing age of the animal, and the kidneys are the preferred site of cadmium accumulation.
Potential Effects of Cadmium Upon Humans: All cadmium compounds are potentially harmful or toxic. It has been implicated as a cause of human deaths. Kidney and/or liver damage have followed respiratory exposures in industry. Inhalation of cadmium dusts, salts, and fumes over a number of years can cause kidney and bone marrow diseases and emphysema.
Brief Summary of Carcinogenicity/Cancer Information: Cadmium is listed by EPA as a Class B1 carcinogen (i.e., a probable human carcinogen by inhalation).
Brief Summary of Developmental, Reproductive, Endocrine and Genotoxicity Information: Cadmium is listed as having some endocrine disruptive activities. Cadmium has been shown to cause birth defects in mammals.

Chromium, General (Cr)

Chromium (Cr) is listed by the EPA as one of 129 priority pollutants. Chromium is considered one of the 14 most noxious heavy metals. Chromium is also listed among the 25 hazardous substances thought to pose the most significant potential threat to human health at priority superfund sites.
General Hazard/Toxicity Summary: The EPA regards all chromium compounds as toxic. Hexavalent chromium causes cellular damage via its role as a strong oxidizing agent, whereas trivalent chromium can inhibit various enzyme systems or react with organic molecules.
Potential Hazards to Fish, Wildlife, and Other Non-Human Biota: In plants chromium interferes with uptake translocation and accumulation by plant tops of calcium, potassium, magnesium, phosphorus, boron, copper, and aggravates iron deficiency chlorosis by interfering with iron metabolism. In mammalian species chromium is considered one of the least toxic trace elements, as normal stomach pH converts hexavalent chromium to trivalent chromium.
Potential Hazards to Humans: Hexavalent chromium is associated with cancer risk and kidney damage. Certain hexavalent chromium compounds when administered via inhalation at high doses have the potential to induce lung tumors in humans and experimental animals. However, at low levels of exposure hexavalent chromium ions are reduced in humans bodily.
Brief Summary of Carcinogenicity/Cancer Information: Chromium in general is listed by EPA as a Class A human carcinogen. Some salts of chromium are carcinogenic and humans exposed to chromium fumes have an increased risk for lung cancer.
Brief Summary of Developmental, Reproductive, Endocrine, and Genotoxicity Information:
Hexavalent chromium is associated with cancer risk and kidney damage, and may cause damage to DNA and many other tissue structures.

Copper (Cu)

Copper is listed by the EPA as one of 129 priority pollutants.
General Hazard/Toxicity Summary: Although copper in water is a hazard to many aquatic organisms minute amounts of copper in the diet are needed for human, plant, and animal enzymes.
Potential Hazards to Fish, Wildlife, and Other Non-Human Biota: Elevated concentrations of copper in water are particularly toxic to many species of algae, bacilli, fungi, crustaceans, annelids, cyprinids, and salmonids. Most adult fish are able to tolerate relatively high concentrations of copper for short periods of time. The critical effect of copper is its greater toxicity to younger fish.
Potential Hazards to Humans: Copper poisoning or deficiency problems are rare in humans.
Brief Summary of Carcinogenicity/Cancer Information: Copper is not classifiable as to human carcinogenicity. There is inadequate animal carcinogenicity data on copper.

***Brief Summary of Developmental, Reproductive, Endocrine, and Genotoxicity Information**:* Reproductive effects on animals are noted at low levels of copper. Incubation of human spermatozoa with metallic copper is found to bring about a significant fall in the percentage of motile sperm in humans.

Lead (Pb)

Lead is listed by the EPA as one of 129 priority pollutants. Lead is also listed among the 25 hazardous substances thought to pose the most significant potential threat to human health at priority superfund sites.

General Hazard/Toxicity Summary: All measured effects of lead on living organisms are adverse, including those related to survival, growth, learning, reproduction, development, behavior, and metabolism.

Potential Hazards to Fish, Wildlife, and Other Non-Human Biota: Lead is a heavy metal that is very toxic to aquatic organisms, especially fish. In fish lead deposits in active calcification areas such as scales, fin rays, vertebrae, and opercula. In vertebrates sublethal lead poisoning is characterized by neurological problems, kidney dysfunction, enzyme inhibition, and anemia.

***Potential Hazards to Humans**:* Lead poisoning is particularly dangerous in young children (who may ingest lead by eating lead-containing chips of paint); it may result in anorexia and--in severe cases--permanent brain damage. Women in the workplace are more likely to experience adverse effects from lead exposure than men because their hematopoietic system is more lead sensitive than men's.

Brief Summary of Carcinogenicity/Cancer Information: Lead is listed by EPA as a Class B2 carcinogen. There is sufficient evidence to be classed as an animal carcinogen.

Brief Summary of Developmental, Reproductive, Endocrine, and Genotoxicity Information: Adverse effects of lead on living organisms include those negatively affecting reproduction and development. Effects of sublethal concentrations of lead include delayed embryonic development, suppressed reproduction, inhibition of growth, and fin erosion.

Mercury (Hg)

Mercury is listed by the EPA as one of 129 priority pollutants.

General Hazard/Toxicity Summary: Major sources to atmosphere include incineration of municipal waste, landfills, Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) sites, sewage sludge burning, and medical waste incinerators.

Potential Hazards to Fish, Wildlife, Invertebrates, Plants, and Other Non-Human Biota: Mercury is one of the few metals which strongly bioconcentrates and biomagnifies and has only harmful effects with no useful physiological functions when present in fish and wildlife. The most sensitive target of low-level exposure to metallic or organic mercury following short- or long-term exposures appear to be the nervous system. The most sensitive target of low-level exposure to inorganic mercury appears to be the kidneys.

Potential Hazards to Humans: Human exposure to methyl mercury is almost entirely due to consumption of fish. Potential impacts to human health are real and potentially great. Mercury deposits in human kidneys may lead to renal failure. Children and persons with a history of allergies or known sensitization to mercury, chronic respiratory disease, nervous system disorders, or kidney disorders are at increased risk to mercury poisoning. Many mercury compounds are irritating to skin and may produce dermatitis with or without vesication. Contact with eyes cause ulceration of conjunctiva and cornea. Mercury deposits in the brain cause many disorders and sometimes dementia in humans.

Brief Summary of Carcinogenicity/Cancer Information: Mercury is not classifiable as to human carcinogenicity, based on inadequate human and animal data.

Brief Summary of Developmental, Reproductive, Endocrine, and Genotoxicity Information: Methyl mercury can denature DNA and can otherwise interact with both DNA and RNA to alter their structures.

Nickel (Ni)

Nickel is listed by the EPA as one of 129 priority pollutants, and is considered to be one of the 14 most noxious heavy metals. Nickel is also listed among the 25 hazardous substances thought to pose the most significant potential threat to human health at priority superfund sites.

General Hazard/Toxicity Summary: Low absorption from the GI tract causes nickel compounds to be essentially nontoxic after ingestion.

Potential Hazards to Fish, Wildlife, Invertebrates, Plants, or Other Non-Human Biota: Mixtures of nickel, copper, and zinc produced additive toxicity effects on rainbow trout.

Potential Hazards to Humans: Nickel is toxic to humans as a dust or powder. The organs that are affected by exposure to nickel, metal, and soluble compounds (as Ni) are nasal cavities, lungs, and skin.

Brief Summary of Carcinogenicity/Cancer Information: Nickel, in general, is not considered a carcinogen.

Brief Summary of Developmental, Reproductive, Endocrine, and Genotoxicity Information: Study results indicate that nickel is a developmental toxicant in animals, but it is not known whether occupational or environmental exposure to nickel could result in developmental effects in humans.

Zinc (Zn)

Zinc is listed by the EPA as one of 129 priority pollutants.

General Hazard/Toxicity Summary: Zinc in low to moderate amounts is of very low toxicity in its ordinary compounds and in low concentrations is an essential element in plant and animal life.

Potential Hazards to Fish, Wildlife, Invertebrates, Plants, or Other Non-Human Biota: Elevated concentrations of zinc in water are particularly toxic to many species of algae, crustaceans, and salmonids. In mammals excess zinc can cause copper deficiencies, affect iron metabolism, and interact with the chemical dynamics of lead and drugs.

Potential Hazards to Humans: In humans, prolonged excessive dietary intake of zinc can lead to deficiencies in iron and copper, nausea, vomiting, fever, headache, tiredness, and abdominal pain. Zinc is a human skin irritant.

Brief Summary of Carcinogenicity/Cancer Information: There are no reports on the possible carcinogenicity of zinc and compounds per se in humans.

Brief Summary of Developmental, Reproductive, Endocrine, and Genotoxicity Information: The risk associated with maternal ingestion of large amounts of zinc in human pregnancy is unknown.

Attachment 3

Procedures to Follow When Remediating Burn Dumps

The four scenarios that will typically be encountered when regulating burn dumps are:

5. Minimal action required.
6. Leave burn ash in place and cap.
7. Consolidate burn ash on site or on another adjacent parcel that already contains burn ash and cap.
8. Clean closure of the burn dump site.

Scenario 1, Minimal Action Required

(Refer to Figure A*, "Leave Ash in Place with Minimal Action Required")*

Under this scenario a determination is made through the Site Investigation Process (SIP) that at the site in question there is no exposed burn ash, no proposed postclosure land use (PCLU), and that the current land use does not pose an immediate threat to public health and safety and the environment. If the site is located in an area that is accessible to the public the owner may be required to fence and post the site to limit access and to warn the public that a burn dump is present. For sites that fit this scenario there would likely be no other mitigation measures or actions proposed for managing the burn ash at the site. The procedure shown on Figure A would then be followed.

Generally, waste characterization will not be required for sites under this scenario because there are no proposed actions at the site. In the future, if site conditions were to change (e.g., erosion of the cover or PCLU), waste characterization may be warranted.

The primary concerns for sites that fit this scenario are changes in site conditions that might pose a threat to public health and safety and the environment or changes in land use. The following actions can be taken to identify and minimize the risk of such changes:

- A determination should be made of whether erosion control is needed to protect the cover at the site.
- If it has not already been done the Local Enforcement Agency (LEA) should determine whether the owner should provide site security and limit public access by fencing the site and posting a sign warning the public that a burn dump is present. This determination should be based on current relative risk to human health and safety and the environment (e.g., increase in adjacent population).
- The owner should be notified in writing by the LEA that future development of the property will be subject to the PCLU requirements contained in California Code of
- Regulations, Title 27 (27 CCR), section 21190 and that any proposed change in land use must be approved by the appropriate regulatory agencies.
- A deed notification or restriction should be placed on the title of the property to limit the types of PCLU that are allowed on the site and to also notify the appropriate agencies when a PCLU is being proposed for construction on the site. A deed restriction will also notify prospective buyers that the property contains a burn dump and the buyer will assume all responsibility for managing it should they purchase the property. Lastly, it would require that the owner notify the LEA of changes in ownership. The procedure to follow in recording a typical deed restriction for a burn dump is contained in Attachment 4..

Scenario 2, Leave Burn Ash in Place and Cap

(Refer to Figure B, "Leave Ash in Place and Cap")

Under this scenario it has been determined through the SIP process that there is exposed burn ash or potential exposure of burn ash at the site in question but no proposed PCLU. The primary human health threat associated with burn dump sites under this scenario is exposure through direct contact with the burn ash or exposure to windblown particulates that have been contaminated with burn ash. Therefore, the best mitigation might be to simply cap the exposed burn ash. The procedure shown on Figure B should be followed to mitigate the sites that fit this scenario.

The first step under this scenario is to determine whether the site poses an immediate threat to public health and safety and the environment. To determine the immediate threat to public health and safety and the environment the owner is required to perform waste characterization on the burn ash material. To ensure a proper waste characterization the owner should submit a waste characterization workplan to the LEA for approval. Waste characterization is necessary to define the limits of the waste and to determine whether the waste is hazardous. This information will ensure that all exposed burn ash is properly capped and that appropriate measures are incorporated into the site health and safety plan and properly implemented during the capping activities.

A waste characterization of the burn ash will likely show that it is a hazardous waste and would therefore be subject to the hazardous waste regulations and Department of Toxic Substances Control (DTSC) oversight and approval. However, in a memorandum dated March 3, 1995, DTSC states that if there is no active management of the burn ash material (i.e., the burn ash will be left in place and capped) the "...regulations regarding the management of hazardous waste do not apply". In other words, DTSC does not require that the owner of the burn dump site obtain DTSC approval of on-site activities to consolidate and cover the ash, nor is the owner required to obtain a DTSC variance in order for the LEA to oversee these capping activities.

It should be noted that even though DTSC has made the policy decision that the burn ash does not need to be managed as a hazardous waste under this scenario, the LEA must still make the necessary notifications as required under the Safe Drinking Water & Toxic Enforcement Act of 1986 (Proposition 65), Health and Safety Code sections 25249.5 et. seq.

In the event that the analyses show that the burn ash cannot be classified as a hazardous waste DTSC coordination would not be necessary. Regardless of whether the waste is hazardous or not, the LEA should coordinate with the Regional Water Quality Control Board (RWQCB).

After the burn dump site is capped (e.g., covered with two feet of compacted earthen material) the owner should provide site security (e.g., fencing and posting the area where burn ash remains). This will limit public access to the site.

Next, a deed notification or restriction should be placed on the title of the property to limit the types of PCLU that can be constructed on the site and to also notify the appropriate agencies when a PCLU is being proposed for construction on the site. It will also notify any prospective buyers that the property contains a burn dump and the buyer will assume all responsibility for managing it should they purchase the property. Lastly, it would require that the owner notify the LEA of changes in ownership. The procedure to follow in recording a typical deed restriction for a burn dump is contained in Attachment 4.

Lastly, the LEA should notify DTSC of the location and actions taken at the burn dump site and should also continue to monitor the site for illegal dumping, PCLU, or erosion of the cap.

Scenario 3, Consolidate Burn Ash on Site or on a Contiguous Parcel That Already Contains Burn Ash

(Refer to Figure C, "Consolidate Ash, Either On Site or on a Contiguous Parcel that Already Contains Ash")

Under this scenario there are multiple burn dump sites on one property or the burn ash is shallow and spread over a large area. There may or may not be exposed burn ash on the site. There is no existing or proposed PCLU that would pose a threat to public health and safety and environment. Under these conditions one possible mitigation would be to consolidate these sites into fewer sites or even one site. The primary human health threat associated with burn dump sites is exposure through direct contact with the burn ash or exposure to windblown particulates that have been contaminated with burn ash. Therefore, appropriate health and safety measures should be implemented during excavation and movement of the burn ash material. If the owner does not want to develop the property the site can be remediated in place and maintained by the owner. The procedure shown on Figure C should be followed.

Because the burn ash will be excavated and moved under this scenario a waste characterization is necessary to define the limits of the waste and to determine whether the waste is hazardous. This information will ensure that 1) all exposed burn ash is identified and properly capped, and 2) appropriate measures are incorporated into the site health and safety plan and are properly implemented.

A waste characterization of the burn ash will likely show that it is a hazardous waste. However, as long as the burn ash material is only moved and consolidated on site or onto a contiguous pre-contaminated parcel DTSC would not consider this active management of hazardous waste. Therefore, the hazardous waste regulations would not apply under this scenario and the LEA could use 27 CCR regulations to regulate these sites. As stated previously in Scenario 2 the LEA must still make the necessary notifications as required under Proposition 65.

Since excavation of the burn ash will occur during the consolidation of the burn dump sites, the excavation activities should follow guidance contained in LEA Advisory Number 26, Excavation Permit.

Lastly, the purpose of consolidation of one or more burn dumps is clean closure of the portions of the site from which burn ash is removed. Therefore, guidance contained in LEA Advisory Number 16, Clean Closure, is recommended to be followed to ensure that the clean closure is complete and documented.

Once the consolidation activities are complete the burn ash can be covered with at least two feet of earthen material and graded to drain. If the finished grades are relatively steep the owner should provide erosion protection. In many cases more than two feet of cover material are necessary. The owner should also provide confirmation sampling of the "clean closed" areas to verify all burn ash materials have been removed.

After the burn ash is capped the owner should provide site security to limit public access (e.g., fencing and posting the area where burn ash remains).

Next, a deed notification or restriction should be placed on the title of the property to limit the types of PCLU that can be constructed on the site and to also notify the appropriate agencies when a PCLU is being proposed for construction on the site. The deed notification or restriction will also notify any prospective buyers that the property contains a burn dump and the buyer will assume all responsibility for managing it should they purchase the property. It would require that the owner notify the LEA of changes in ownership. The procedure to follow in recording a typical deed restriction for a burn dump is contained in Attachment 4.

Lastly, the LEA should notify DTSC of the location and actions taken at the site and they should also continue to monitor the site for illegal dumping, PCLU, or erosion of the cap.

Scenario 4, Clean Closure

(Refer to Figure D, "Clean Closure for a Site that Contains Ash")

Under this scenario the burn dump site, or a portion of the site if consolidation has occurred, will be clean closed. This means that all the burn ash at the site is removed and transported off-site to an appropriate disposal site.

The primary human health threat associated with burn dump sites is exposure through direct contact with the burn ash or exposure to windblown particulates that have been contaminated with burn ash. Therefore, appropriate health and safety measures should be implemented during excavation of the ash material. The procedure shown on Figure D should be followed for sites that fit this scenario.

Since the burn ash will be excavated and moved waste characterization is necessary to determine the proper disposal site for the burn ash and to also ensure that appropriate measures are incorporated into a health and safety plan and properly implemented during the excavation of the burn ash material.

A waste characterization of the burn ash will likely show that it is a hazardous waste. But as long as the waste is not a Resource Conservation and Recovery Act (RCRA) hazardous waste and passes the Deionized Water Waste Extraction Test (DI WET) it can be regulated using 27 CCR regulations. However, the LEA must still make the necessary notifications as required under Proposition 65. Also, as stated in a memorandum dated March 3, 1995, DTSC must first issue a variance for the burn ash before it is allowed to be disposed of at a non-Class I disposal facility.

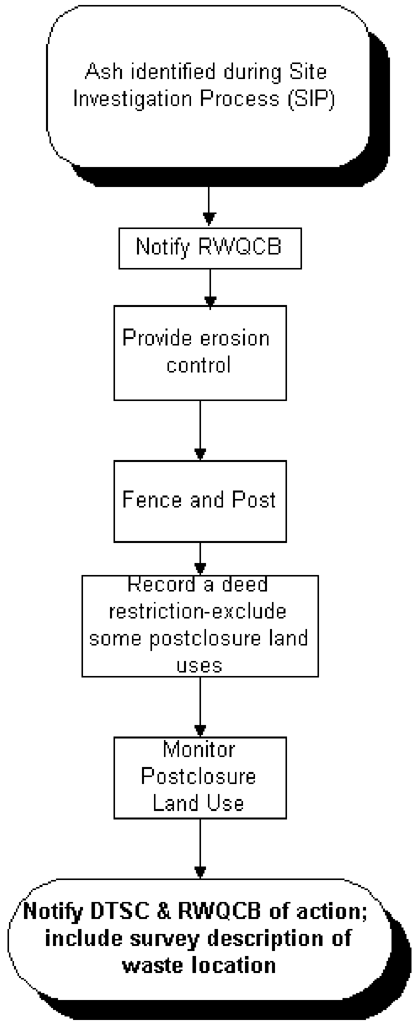
Guidance contained in LEA Advisory Number 16, Clean Closure, should be followed to ensure clean closure is complete and documented.

Also, once clean closure of the burn dump site is achieved and certified clean by the LEA, DTSC, and the RWQCB the owner would be free to develop the site without any additional land use restrictions or postclosure maintenance requirements.

Figure A

Leave Ash in Place with Minimal Action Required

June 29, 1998



Notes:

- No Characterization required since there is no exposed ash

-The initial CEQA document, if necessary, will be drafted either to reflect burn ash remediation, if burn ash is known to be on site, or to incorporate the possibility that burn ash may be discovered during remediation activities.

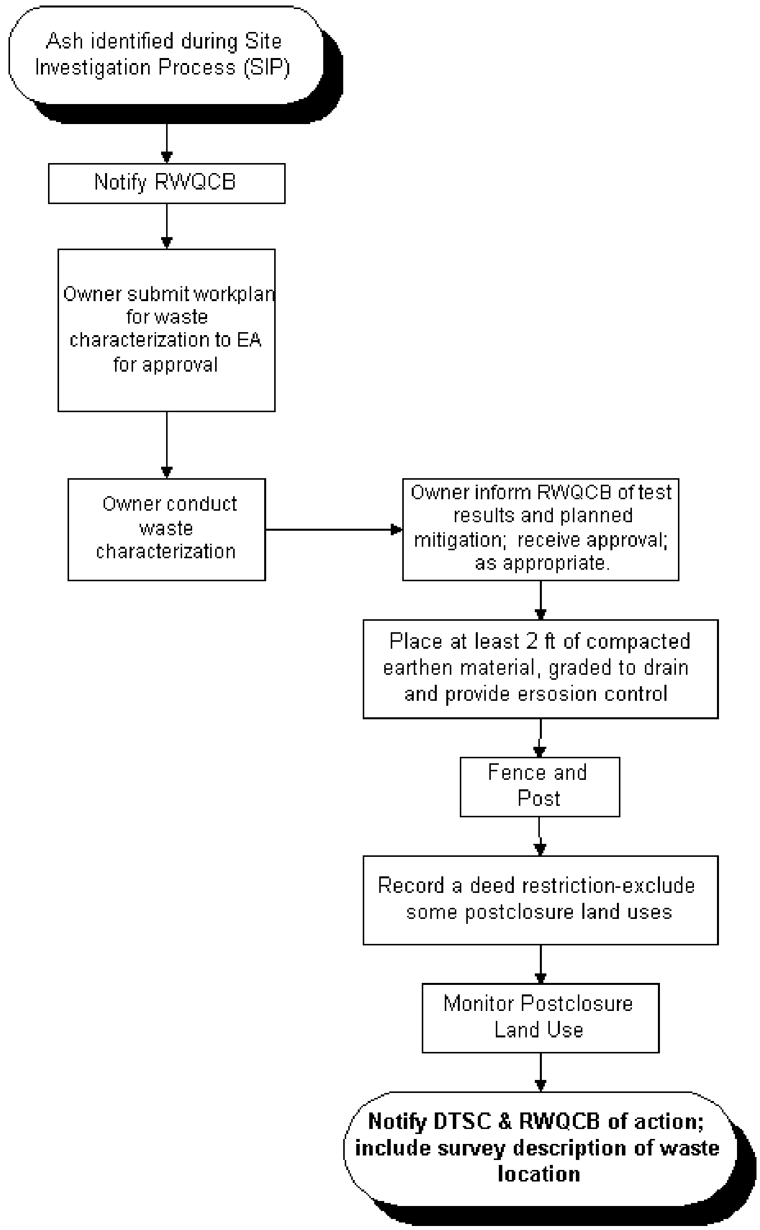
- The health and safety plan for the remediation will be drafted either to reflect appropriate precautions for burn ash handling, if burn ash is known to be on site, or will be revised to incorporate appropriate precautions once burn ash is discovered.

- The intended PCLU is nonirrigated open space. If another PCLU is intended, the site owner must notify the regulatory agencies (DTSC, RWQCB, and LEA).

A3-5

Figure B
Leave Ash in Place and Cap

July 3, 1998



Notes:

-The initial CEQA document, if necessary, will be drafted either to reflect burn ash remediation, if burn ash is known be on site, or to incorporate the possibility that burn ash may be discovered during remediation activities.

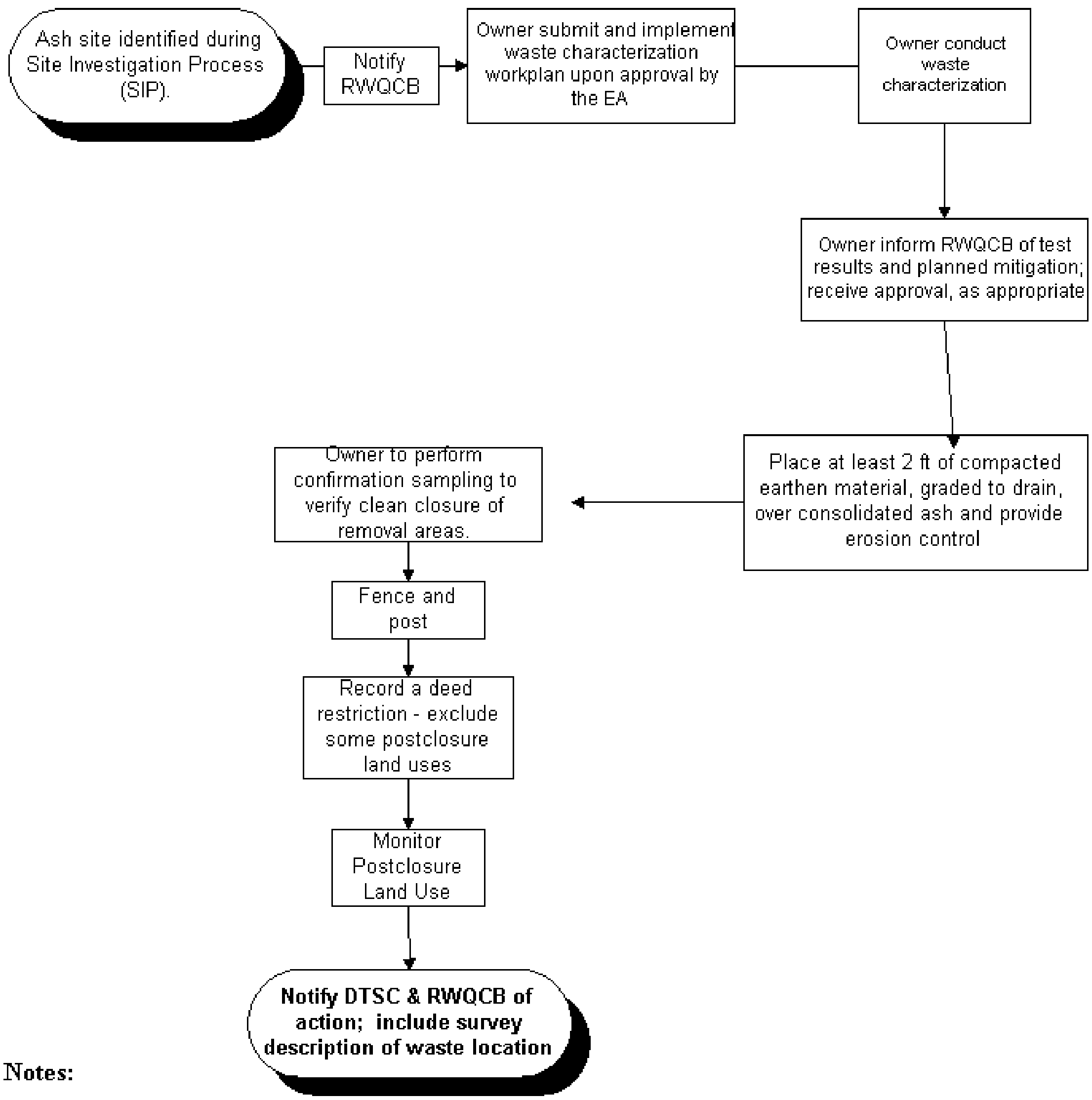
-The health and safety plan for the remediation will be drafted either to reflect appropriate precautions for burn ash handling, if burn ash is known to be on site, or will be revised to incorporate appropriate precautions once burn ash i discovered.

-The intended postclosure land use is nonirrigated open space. If another PCLU is intended, the site owner must no the regulatory agencies (DTSC, RWQCB, and LEA).
-The LEA will perform Proposition 65 notification on receipt of TTLC, STLC, or TCLP results, if necessary.

A3-6

Figure C
Consolidate Ash, Either on Site or on a Contiguous Parcel that Already Contains Ash

July, 3, 1998



Notes:

-The initial CEQA document, if necessary, will be drafted either to reflect burn ash remediation, if burn ash is known to be on site, or to incorporate the possibility that burn ash may be discovered during remediation activities.

- The health and safety plan for the remediation will be drafted either to reflect appropriate precautions for burn ash handling, if burn ash is known to be on site, or will be revised to incorporate appropriate precautions once burn ash is discovered.

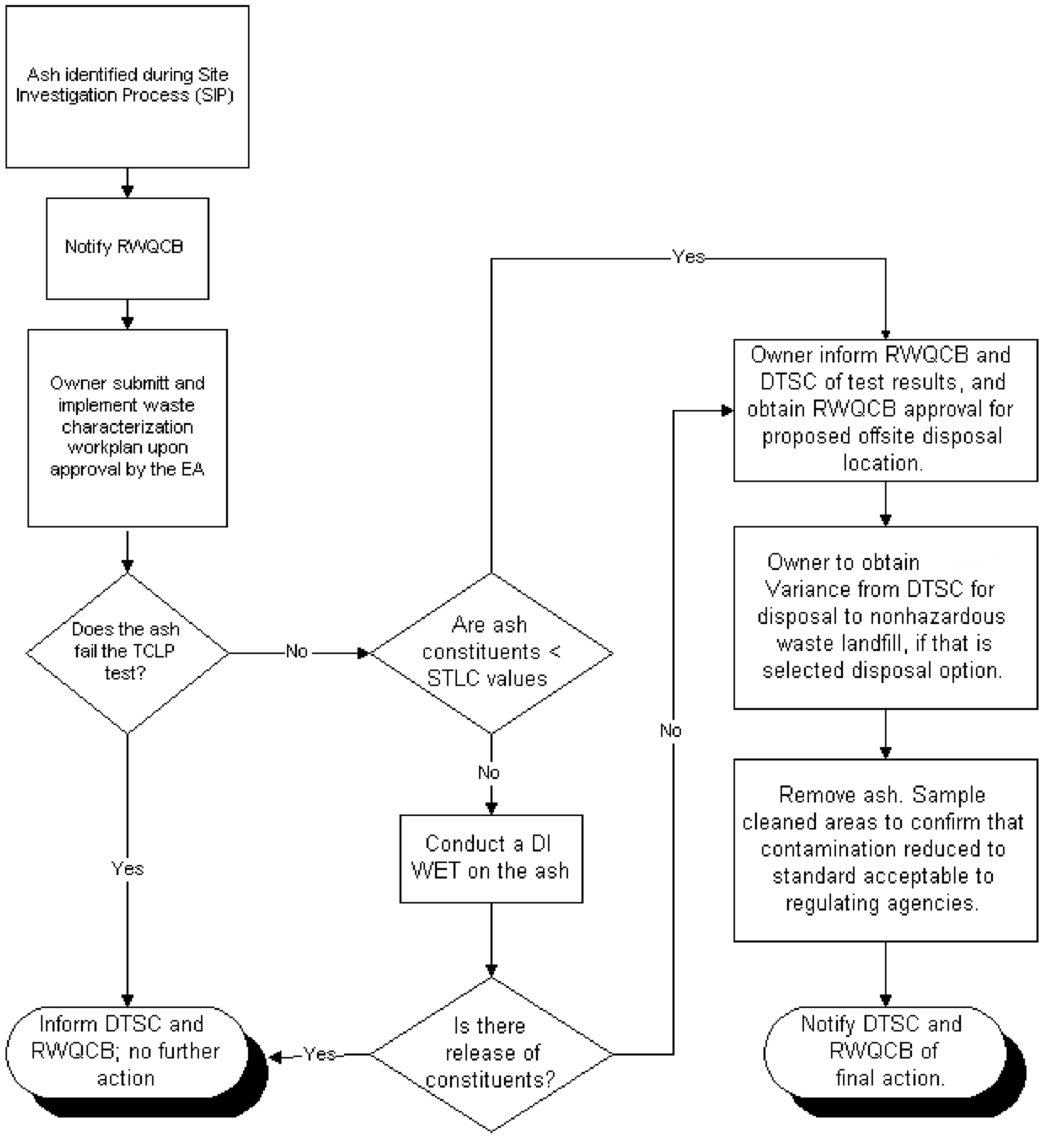
- The intended postclosure land use is nonirrigated open space. If another PCLU is intended, the site owner must notify the regulatory agencies (DTSC, RWQCB, and LEA).

- The LEA will perform Proposition 65 notification on receipt of TTLC, STLC, or TCLP results, if necessary.

A3-7

July 3, 1998

Figure D
Clean Closure for a site that contains ash



Notes:

-The initial CEQA document, if necessary, will be drafted either to reflect burn ash remediation, if burn ash is known to be on site, or to incorporate the possibility that burn ash may be discovered during remediation activities.

-The health and safety plan for the remediation will be drafted either to reflect appropriate precautions for burn ash handling, if burn ash is known to be on site, or will be revised to incorporate appropriate precautions once burn ash is discovered.

-The LEA will perform Proposition 65 notification on receipt of TTLC, STLC, or TCLP results, if necessary.

A3-8

Attachment 4

Recording Deed Restrictions for Burn Dumps Remediated in Place

Section 25220 of the Health and Safety Code is used by the Department of Toxic Substances Control (DTSC) for recording restrictions for hazardous waste sites and section 21170 of Title 27 of the California Code of Regulations (27 CCR) is used by Local Enforcement Agencies (LEA) for recording deed restrictions for landfills. Based on procedures in these sections and the procedures contained in this advisory the following guidelines have been developed for remediation of burn dumps in place and recording deed restrictions.

Site Investigation

- Obtain the assessor's parcel number, address, legal description of the parcel, owner's name and address, and a boundary survey map.
- Determine the extent, thickness, and constituents of the burn ash. (Use existing investigations and/or perform field surveying, drilling, sampling and analysis.)
- Prepare a record map that includes boundary survey information (or modify the existing boundary survey map). Map scale should not be more than 1"=200'. Show the existing areas of burn ash tied to property boundaries and provide topographical/drainage information on and around the site needed to estimate grading and construction permit requirements.
- Note the assessor's parcel number on the record map.
- Incorporate the above information and map in the Site Investigation Report.

Construction Completion

- Update the Record Map to show the as-built location of the burn ash tied to property boundaries, type and thickness of the soil cover, final topography and drainage (including new/modified drainage structures), fencing plan and type, and other pertinent details.
- Include on the Record Map the date of remediation and a brief summary of remediation performed (e.g., tons of solid waste recycled or landfilled, description of burn dump remediation, erosion control, and fencing).
- Make known on the Record Map the hazardous properties of the burn ash and the postclosure land use (PCLU) restrictions necessary to maintain the integrity of the soil cover. For example, the following language might be used if the burn ash is classified as a hazardous waste:

> The covered burn ash contains metal substances classified as hazardous in California Code of Regulations, Title 22 (see [*fill in the name of the Report*] dated [*fill in the date*] for laboratory analysis of burn ash). Postclosure land use shall be restricted to activities that will not result in penetration of the soil cover or exposure of the burn ash (e.g., non-irrigated open space), and shall exclude construction of buildings and structures over the burn dump area. Proposed land uses that violate these restrictions shall require the proponent to apply to the [*fill in the name of the Local Enforcement Agency*] for removal of land use restrictions, and to the Department of Toxic Substances Control for a variance or removal of land use restrictions pursuant to section 25233 or 25234 of the California Health and Safety Code.

If the burn ash is classified as a non-hazardous waste the following language might be used:

> The covered burn ash contains metal substances classified as non-hazardous in California Code of Regulations, Title 22 (see [fill in the name of the Report] dated [fill in the date] for laboratory analysis of burn ash). Postclosure land use shall be restricted to activities that will not result in penetration of the soil cover or exposure of the burn ash (e.g., non-irrigated open space), and shall exclude construction of buildings

and structures over the burn dump area. Proposed land uses that violate these restrictions shall require the proponent to apply to the [fill in the name of the Local Enforcement Agency] for a removal of land use restrictions.

- Notify the appropriate city/county planning and building department to file the Record Map and require any proponent requesting a land use differing from the filed PCLU to apply to DTSC.
- Include a copy of the notification to the Planning and Building Department and the Record Map in the Construction Completion Report.

Attachment 5

Attachment

STATE OF CALIFORNIA—CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY

PETE WILSON, Governor

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

400 P STREET, 4TH FLOOR
P.O. BOX 806
SACRAMENTO, CA 95812-0806
(916) 324-7193

M E M O R A N D U M

Doug

TO: Doug Okumura, Deputy Director
Permitting and Enforcement Division
California Integrated Waste Management Board
8800 Cal Center Drive
Sacramento E-10

FROM: [illegible], Deputy Director
Hazardous Waste Management Program

DATE: March 3, 1995

SUBJECT: REGULATION OF BURN DUMP ASH

This memo is in response to your memo concerning the regulation of burn dump ash. In your memo, you outline two categories of problems that you anticipate encountering when dealing with burn dump ash during remediation under the AB 2136 program: remediation of sites known to contain burn dump ash and remediation of ash found unexpectedly during clean-up of a site. In your memo, you express uncertainty regarding the position of the Department of Toxic Substances Control (DTSC) relative to regulation of burn ash sites. We hope that our response to your memo will clearly lay out options for the California Integrated Waste Management Board (CIWMB) during remediation of burn ash sites.

Your memo includes three flow charts that DTSC understands are meant to represent how CIWMB thinks coordination between DTSC and CIWMB for various waste management scenarios should be accomplished in order to keep the CIWMB burn dump ash projects on schedule. The first flow chart addresses leaving the ash in place and capping the burn ash area. Since no active management of the burn ash will occur under this scenario, the regulations regarding the management of hazardous waste do not apply. No permitting action from DTSC is necessary; however, in order to provide some assurance that the remaining ash does not pose a threat, we recommend that incompatible land uses be precluded from areas containing ash. For example, your flow chart shows a one-foot compacted earthen cap, fencing, and posting, plus deed restrictions. One foot of cap, depending on its design, may not be adequate. Restrictions prohibiting vegetable gardens, swimming pools, or other land uses should be in place. Roadways,

A5-1

Doug Okumura
March 3, 1993
Page 2

open areas, parking, or commercial land uses are preferred over residential uses for these reasons. Generally, with these precautions in place, DTSC involvement should not be necessary.

The second flow chart addresses consolidating ash, either on site or on a contiguous parcel that already contains ash. Burn ash that is moved within an area that is considered an area of contamination does not constitute active management; therefore, hazardous waste management requirements do not apply. For clarification, an area of contamination is an area of contiguously contaminated soil. The contaminants and the concentrations of the contaminants may vary. A variance from DTSC is not required for movement of burn ash within the area of contamination.

The third flow chart addresses clean closure for a site that contains ash. This flow chart would also apply for sites where the ash cannot be maintained within the area of contamination. CIWMB will not need to obtain a variance from DTSC if the ash does not fail the Total Threshold Limit Concentration (TTLC) or the Soluble Threshold Limit Concentration (STLC) using the Waste Extraction Test (WET), assuming the ash does not fail any other hazardous waste criteria. DTSC needs to issue a variance for ash that must be removed from the area of contamination that fails either the STLC or the TTLC using the WET if (1) CIWMB wishes to use de-ionized water as the extracting solution in order to determine if the ash is nonhazardous and may be disposed in a monofill, or (2) CIWMB wishes to dispose the ash that fails the hazardous waste criteria using the WET in a non-Class I disposal facility. DTSC cannot issue a "blanket variance"; however, CIWMB can request a variance from DTSC for multiple sites where it is known that the ash will need to be removed from the area of contamination. DTSC staff can work with CIWMB to structure a variance that meets the needs of CIWMB to the extent possible.

In your memo you state that there has been no evidence of any burn dump ash exceeding the RCRA hazardous waste criteria. The above discussion assumes that the burn dump ash is not a RCRA hazardous waste. DTSC does not have the jurisdiction to issue a variance from the RCRA hazardous waste requirements.

DTSC suggests, as you note in your flow charts, that a deed restriction and monitoring of post-closure land use be implemented for any ash left in place and capped. One alternative might be that, based on a characterization of the burn dump ash, DTSC can perform a health risk assessment of the

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Doug Okumura
March 3, 1993
Page 3

burn dump ash. Depending on the results of the health risk assessment, disposal or leaving in place of the ash that doesn't exceed the health-based concentrations could be allowed without a deed restriction or monitoring of post-closure land use.

For your information, a copy of the Interagency Agreement between DTSC and Caltrans is attached. The intent of this interagency agreement is to establish a mechanism for Caltrans to provide funding to DTSC for DTSC to provide professional staff services to Caltrans.

Please feel free to call either Watson Gin, Chief of the Permitting Division, at 322-3501 or Peggy Harris, Chief of the Standardized Permitting Section, at 324-7663 if you have any questions.

Attachment

cc: Paul Blais
Special Assistant to the Secretary
California Environmental Protection Agency

Stan Phillippe
Acting Deputy Director
Site Mitigation Program

Watson Gin, P.E., Chief
Permitting Division
Hazardous Waste Management Program

Peggy Harris, P.E., Chief
Standardized Permitting Section
Permitting Division
Hazardous Waste Management Program

A5-3

IV. INTERIM GUIDANCE ON REQUIRED CLEANUP AT LOW RISK FUEL CONTAMINATED SITES, APRIL 1, 1996

STATE OF CALIFORNIA - CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY PETE WILSON, *Governor*

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
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April 1, 1996

MEMORANDUM

To: UST Local Oversight Program Agencies and Other Interested Parties Overseeing UST Cleanup

Subject: Regional Board Supplemental Instructions to State Water Board December 8, 1995, Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated Sites (Replaces February 29, 1996 version)

This supplemental guidance is intended for the regulatory and technical audience[1] to expand on the interim guidance provided in the December 8, 1995, letter from Mr. Walt Pettit, Executive Director of the State Water Resources Control Board regarding the findings of the report entitled "Recommendations to Improve the Cleanup Process for California's Leaking Underground Fuel Tanks (LUFTs)" issued by the Lawrence Livermore National Laboratory (LLNL). Mr. Pettit's letter urges cleanup agencies to proceed aggressively to close low risk soil only cases and not to require active remediation of low risk groundwater cases.

The LLNL report concludes that natural attenuation of petroleum is an important factor in stabilizing plumes and may be the only remedial activity necessary in the absence of the source. After a review of existing literature, white papers submitted to the SB1764 committee, and a study of selected UST leak cases primarily from Coastal Range sedimentary or valley alluvium hydrogeochemical provinces, the LLNL report found that petroleum plumes tend to stabilize close to the source, generally occur in shallow groundwater and rarely impact drinking water wells in the state.

It is in light of these findings and the "lessons learned" over the past ten years in San Diego Region that the attached supplemental Interim Guidance was developed. This interim guidance document describes what constitutes a "low risk soils only case" and "low risk groundwater case". Strategies are presented for closing "low risk soil only cases" and managing "low risk groundwater impact cases" through natural attenuation as the preferred remedial alternative.

These two classes of sites, low risk soils and low risk ground water, are not intended to include the whole universe of petroleum contaminated sites. There are higher risk sites that may require immediate action and active remediation to protect human health and the environment. The responsibility still lies with the responsible party for investigation of the subsurface to gather the data necessary to make these decisions. It remains the responsibility of the regulator to request that information which is required to make the necessary regulatory decisions regarding the site.

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1 Additional information is also provided from the Regional Board in the form of a Fact Sheet in a "Question and Answer" format.

It is the responsibility of everyone in the process, particularly consultants and regulators, to keep up with current research on site investigation, fate and transport of contaminants, analytical methods, and other topics that affect the decision making process. Training and education should be a high priority for all parties participating in the site cleanup process. The State and Regional Boards will be providing guidance to the local agencies and others affected.

INTRODUCTION

Subsurface conditions are highly variable and there is always some uncertainty associated with evaluating data for a site. However, the cost of obtaining additional site assessment data must be weighed against the benefit from obtaining that additional data and the effect the data may have on the certainty of decisions made for the site.

The following RWQCB guidance concerning the investigation and management of "low risk" leaking petroleum underground storage tank (UST) sites assumes that the following factors apply:

1) The tank or appurtenant structure that leaked has been repaired or permanently closed per requirements of Article 7, Section 2670 et seq. of Chapter 16 (CHAPTER 16), Title 23, CCR.

2) Free product has been removed to the extent practicable per requirements of Article 5, Section 2655 of CHAPTER 16.

LOW RISK SOILS ONLY CASE

Criteria:

1) **The leak has been stopped and ongoing sources of pollution are removed or remediated to the extent practicable.**

   Sources of pollution may include soil which contains sufficient mobile constituents (e.g., leachable pollutants, vapors, or residual fuel product) to degrade surface or ground water resources in excess of water quality objectives as defined in the RWQCB Basin Plan. Residual fuel contaminated soils which are eroded and transported to storm drains, abandoned or active wells, surface waters, or lands beyond control of the discharger or which create exposures or hazardous conditions, and may pose a significant threat to human health or the environment should also be considered a source.

   For older releases, the absence of current groundwater impact is often a good indication that residual concentrations present in the soil are not a potential source of future pollution. In general, if pollutants within fuel contaminated soil are not in contact, or expected to come in contact, with groundwater, it is unlikely that it is a significant source of pollution.

2) **The site has been adequately characterized.**

   The extent of the subsurface impact should be defined to the degree that is necessary to determine if the site poses a threat to human health, the environment, or other nearby sensitive receptors. The level of detailed data required from a specific site will depend upon the anticipated depth to groundwater, the presence or absence of potential receptors, and exposure pathways. Delineation and characterization of environmental contamination needs to be completed to a sufficient level to accurately document conditions at the site. Delineating environmental contamination to non-detect levels may not be required at all sites.

3) **No groundwater impact currently exists.**

By definition, soils only cases do not have groundwater impacts. Results from contaminant leachability testing (e.g., U.S. EPA Method 1311 - modified TCLP or EPA Method 1312--SPLP) may be useful for responsible parties wishing to make a technical demonstration that residual soluble fuel contaminants do not pose a significant threat to groundwater resources.

4) **No groundwater, surface water, or other sensitive receptors are likely to be impacted.**

5) **The site presents no significant risk to human health.**

Site mitigation strategies which include elements of *"Risk Based Corrective Action"* (RBCA) may provide an acceptable methodology to perform a tiered risk analysis at petroleum release sites. RBCA methodologies usually incorporate elements of U.S. EPA risk assessment practices to determine non-site specific (e.g., generic risk based screening levels) and site specific clean up levels that are protective of human health and environmental resources. The responsible party may wish to propose a RBCA approach for consideration by the regulatory agencies.

Significant risks to human health may also include the creation of fire and explosion hazards from the migration and accumulation of fuel vapors in subsurface utilities (e.g., storm drains, sewer systems, utility vaults, etc) as well as excess lifetime cancer risk due to benzene vapor migration. Further corrective actions at some UST sites maybe necessary to mitigate these hazards as well.

6) **The site presents no significant risk to the environment.**

RBCA methodologies have no specific guidance for evaluating environmental risk although the basic framework is appropriate if site specific exposure pathways and ecological receptors are included. If the site has a potential to create fire and explosion hazards, significantly impact surface water, wetlands, or other sensitive receptors, it should not be considered "low risk."

Management Strategy

Low risk soils cases should be closed when it is determined that site conditions conform to the above criteria. Further remediation or monitoring is not required. If the most sensitive permitted use (e.g., residential) is not protected by the site cleanup levels which are protective of human health and water resources, then engineering (e.g., vapor barriers, caps, etc.) and/or administrative (land use restrictions or notifications) controls may be appropriate for the site. The site status should be re-evaluated when property transfers result in a change in land use (e.g., changes from commercial to residential uses). If fuel contaminated soils are subsequently disturbed, additional remedial or mitigative measures may be necessary and appropriate at the site.

LOW RISK GROUNDWATER CASE

Criteria:

1) **Groundwater has been impacted, the leak has been stopped and ongoing sources (as defined in LOW RISK SOIL ONLY CASE DEFINITION #1), including free product have been removed or remediated to the extent practicable.**

2) **The site has been adequately characterized (see Low Risk Soils Case Definition #2).**

3) **The site is located in a Basin <u>without</u> designated Municipal / Domestic Beneficial Use**

   A site should <u>not</u> be considered "low risk" if current uses of water resources are known to exist but are not identified in the RWQCB Basin Plan.

4) **The site is located in a Basin <u>with</u> Municipal / Domestic Beneficial Use (Outside of a Sensitive Aquifer Boundary).**

   Leaking UST sites located within the San Diego County Water Authority (CWA) service area footprint, not including sensitive aquifer areas, will be considered low risk ground water areas. Designation of "low risk" groundwater sites also depend upon the status of the site with regard to the other criteria discussed in this section. The CWA service area extends approximately 18 miles inland from the coast and from the southern boundary of MCB Camp Pendleton to the U.S./Mexican border. The sensitive aquifer areas are the alluvial groundwater basins as defined by the Department of Water Resources (DWR) within the service area footprint of the CWA. Areas located outside the CWA service area footprint will generally not be considered low risk groundwater areas (see Q&A supplement for further discussion). Sites within a sensitive aquifer boundary and sites located in Riverside and southern Orange Counties will be evaluated on a case-by-case basis.

5) **The dissolved hydrocarbon plume is not migrating.**

   Chemical concentrations of hydrocarbons in groundwater that decrease or do not change with time are the best indicators of a stable plume. Comparison of background and hydrocarbon plume concentrations of dissolved oxygen, iron, nitrate, sulfate, methane, and others, can provide evidence that in-situ biodegradation may be reasonably effective at a given site. These data may or may not be required to determine plume stability but can supplement other lines of evidence.

   Stable or decreasing plumes often display short-term variability in groundwater concentrations. These effects are due to changes in groundwater flow, degradation rates, sampling procedures, and other factors which are inherently variable. This behavior should not necessarily be construed as evidence of an unstable plume but may be the natural variations of a stable plume in the environment.

6) **No water wells, deeper drinking water aquifers, surface water, or other sensitive receptors are likely to be impacted.**

No water wells (e.g., domestic supply, agricultural supply, construction related dewatering wells) located within 1,000 feet of a source or where the source is within the capture zone influenced by the well.

7) **The site presents no significant risk to human health.**

Until the State Water Resources Control Board (SWRCB) policies are modified to give RWQCB staff clear guidance on how to incorporate risk-based corrective action (RBCA) elements into the California corrective action process, RWQCB staff will require ground water clean up to restore beneficial uses and protect future beneficial uses of water resources. For low-risk groundwater cases, RWQCB staff will continue to allow natural attenuation to be considered on a site specific basis, along with other cost effective remedial technologies. In addition, various methods of evaluating contaminant transport may also be acceptable in determining residual levels of contaminants which are protective of human health and the environment.

Other factors to consider in evaluating this criteria include threats to human health (e.g., fire and explosion hazards, exposure to fugitive vapors, see Low Risk Soils Case Definition #5).

8) **The site presents no significant risk to the environment.**

The site specific evaluation must also include consideration of risks to sensitive environmental and ecological receptors as well. If the site has a potential to create fire and explosion hazards, or significantly impact beneficial uses of water resources, wetlands, or other sensitive environmental or ecological receptors, it should not be considered "low risk" (see Low Risk Soils Case, Definition No. 6).

Management Strategy

In general, sites located in "low risk" groundwater areas may cease active remediation (with agency approval) and natural attenuation (passive bioremediation, etc.) should be the preferred remedial alternative unless there is a compelling reason to do otherwise. A partial list of reasons that may justify active remediation are listed below:

- Groundwater within an impacted aquifer is likely to be used before natural attenuation is projected to complete the cleanup.
- Sensitive aquifers and/or sensitive receptors have been identified and are anticipated to be adversely impacted.
- The plume is migrating significantly.

Generally, if any of these conditions or others deemed to be compelling are met, a more aggressive remedial approach may be appropriate. The following criteria further refine the goals and objectives for managing "low risk" sites:

1) **Sites located in a Basin <u>without</u> designated Municipal / Domestic Beneficial Use.**

a.) *Groundwater impacted sites which are located more than 1,000 feet from a marine surface water (e.g., bay, coastal lagoon, or ocean).* These sites can be closed when adequate information is presented to demonstrate that site conditions are protective of human health and the environment and that natural attenuation is effectively controlling and reducing the spread of dissolved fuel contaminants from the site.

b.) *Groundwater impacted sites which are located less than 1,000 feet from a marine surface water (e.g., bay, coastal lagoon, or ocean).* Sites located in these areas may be closed when adequate information is presented to demonstrate that existing site conditions are protective of human health and the environment and the contaminant concentrations in groundwater have been reduced to those levels listed in Table 1.

2) **Sites located in a Basin <u>with</u> designated Municipal / Domestic Beneficial Use.**

a.) Dischargers with sites located within the service area footprint of the CWA and which do not overlie sensitive aquifers (e.g., recharge areas, probable future ground-water use aquifers) may request the lead regulating agency to allow implementation of a natural attenuation remedial strategy. Long-term ground water monitoring will be required to verify the effectiveness of the natural attenuation site mitigation strategy at these sites. The specific wells to be included in the monitoring program and the frequency of sampling will be determined on a site by site basis.

b.) Due to the reliance of inland communities on the use of groundwater resources for municipal/domestic water supplies, sites with fuel contaminated groundwater resources in areas outside the service area footprint of the CWA are **not** classified as "low risk" by the RWQCB. Sites which meet the criteria for "low risk" for inland communities will be evaluated on a case-by-case basis.

c.) Sites in Orange County under the jurisdiction of the San Diego Regional Water Quality Control Board that do not overlie sensitive aquifers are generally considered to be low-risk groundwater cases. However, in addition to the location of contaminated sites with respect to sensitive aquifers, the sites will be rigorously evaluated with regard to the following: current and future water use plans of the water districts, potential for hydrocarbon plumes to contaminate sensitive aquifers (including sites that may contaminate surface waters that may recharge sensitive aquifers), ecological concerns, as well as health and safety concerns. Further evaluation of factors other than groundwater protection may indicate that the site does not qualify as being low risk.

3) **Monitor the site to determine plume stability and the site-specific effectiveness of the natural attenuation remedial strategy.**

Ground water monitoring is necessary to determine if site conditions will remain stable or improve over time. One hydrologic cycle (four quarters) of monitoring data is usually considered to be the minimum necessary to determine site conditions. This assumes depth to groundwater has significant seasonal variation and that no longer term variation occurs. If little seasonal fluctuation is expected, then one year of monitoring may not be required. Conversely, if depth to groundwater is expected to change significantly from year to year due to droughts, adjacent pumping, or other factors, then one year of monitoring may not be adequate.

Data from adjacent or nearby sites may be useful in determining groundwater fluctuations and other regional aquifer characteristics. Frequency of monitoring and the number of monitoring points may be adjusted after site characterization is completed. At many existing sites, these data may already have been collected.

This Interim Guidance document may be modified as additional recommendations become available from the State Board through the overall UST regulation review process (SB1764 Committee) and may be further refined to specifically address portions of Orange and Riverside Counties.

Coordinated &
Prepared by: Corey Walsh, Associate Engineering Geologist
John Odermatt, R.G., Associate Engineering Geologist
John Anderson, R.G., Senior Engineering Geologist
Karen Zachary, WRC Engineer

Table 1

The table in the 1996 low-risk guidance was removed by RWQCB due to the specific numerical concentrations being obsolete and not fully protective of all beneficial uses.

V. SAN DIEGO REGIONAL BOARD SUPPLEMENTAL INSTRUCTIONS AND INTERIM GUIDANCE ON REQUIRED CLEANUP AT LOW RISK FUEL CONTAMINATED SITES: APPENDIX A - GUIDANCE ON DATA COLLECTION REQUIREMENTS FOR THE EVALUATION OF RESIDUAL FREE PRODUCT OR LIGHT NON-AQUEOUS PHASE LIQUID (LNAPL) ON GROUNDWATER, JULY 22, 1998

California Regional Water Quality Control Board

San Diego Region

Peter M. Rooney
Secretary for
Environmental
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Pete Wilson
Governor

July 22, 1998

Interested Parties

SUBJECT: **Regional Board Supplemental Instructions and Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated Sites: Appendix A - Guidance on Data Collection Requirements for the Evaluation of Residual Free Product or Light Non-Aqueous Phase Liquid (LNAPL) on Groundwater.**

This appendix is intended for the regulatory and technical audience as an addendum to the San Diego Regional Water Quality Control Board ("RWQCB") Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated sites (dated April 1, 1996). The RWQCB Interim Guidance was developed to expand the interim guidance for leaking underground fuel tank (LUFT) sites provided in the December 8, 1995 letter from Mr. Walt Petit, Executive Director of the State Water Resources Control Board. Mr. Pettit's letter urges cleanup agencies to proceed aggressively to close low risk soil only cases and not require active remediation of low risk groundwater cases.

State statutes and regulations specifically require corrective actions at leaking underground storage tank sites to be consistent with all applicable state policies for water quality control adopted pursuant to Article 3 (commencing with Section 13140) of Chapter 3 of Division 7 of the Water Code, and all applicable water quality control plans adopted pursuant to Section 13170 of the Water Code and Article 3 (Commencing with Section 13240) of Chapter 4 of Division 7 of the Water Code [CH&S, Chapter 6.75, Article 4, Section 25299.37(b) and 23 CCR, Chapter 16, Article 11, Section 2721].

The California Water Code (CWC) specifically requires that, state offices, departments, and boards shall comply with state policy for water quality control (CWC Section 13147) and water quality control plans (CWC Section 13247) unless otherwise directed or authorized by statute. These statutory requirements direct the State and Regional Boards to make regulatory decisions which are consistent with state policy regarding cleanup and abatement of wastes (SWRCB Resolution No. 92-49) and the local water quality control plans ("RWQCB Basin Plans"). Further, the state law requires that implementation of cleanup, abatement, or other action by the local agencies to be "... based upon cleanup standards specified by the board or regional board" [CH&S, Chapter 6.7, Section 25297.1(b)].

The California Code of Regulations, Title 23, Chapter 16, Articles 5 and 11 gives requirements for the investigation and removal of free product or light non-aqueous phase liquids (LNAPLs) from groundwater. Under Section 2655, the responsible party is required to "... remove free product to the maximum extent practicable, as determined by the local agency,...." In

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considering the definition of "maximum extent practicable" the RWQCB and local agencies must incorporate requirements from SWRCB Resolution No. 92-49 "*Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304*" (Section III.G) and references to 23 CCR, Chapter 15, Section 2550.4. The referenced section of Chapter 15 (also see CCR Title 27, Section 20400) provides a series of "factors" which must be evaluated before a groundwater cleanup level greater than background (or "CLGB") can be established by the Regional Board.

At some low-risk LUFT sites, it may be possible to make a determination that remediation of free product has proceeded to the maximum extent practicable in compliance with 23 CCR, Article 5, Section 2655. In the absence of specific technical guidance from the SWRCB on this issue, the guidance contained in Appendix A to the San Diego RWQCB Interim Guidance is designed to facilitate the collection of site-specific data needed to evaluate the factors which are necessary for this Regional Board to make a determination that free product removal has proceeded to the "maximum extent practicable." Wherever possible, these data should be provided within the impact assessment portion of a site-specific corrective action plan (or "CAP") as required by state regulations (23 CCR, Chapter 16, Article 11, Section 2725). While providing these data does not guarantee that a site will close with no further action required; it does give the Regional Board the data required to more objectively evaluate current and potential impacts to water quality associated with low-risk groundwater sites where residual free product remains in situ.

If you have any questions, or if my staff or I can be of any assistance, please call us at (619) 467-2952.

Sincerely,

John P. Anderson

JOHN P. ANDERSON, Senior Engineering Geologist
UST Program Manager
Site Mitigation and Cleanup Unit

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cc: Mr. Allan Patton, SWRCB Program Manager
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Regional Board UST Program Managers (via e-mail)
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Mr. Dan Diehr, San Diego County Water Authority

California Environmental Protection Agency

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Governor

APPENDIX A
Guidance on Data Collection Requirements for the Evaluation of Residual Free Product or Light Non-Aqueous Phase Liquid (LNAPL) on Groundwater (July 1998)

This guidance is an appendix to the RWQCB "*Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated Sites*" dated April 1, 1996. There are a number of issues which should be adequately addressed before the San Diego Regional Water Quality Control Board (RWQCB) staff can properly evaluate a request to cease removal of "*free product*" or "*light non-aqueous phase liquids*" (or ***LNAPL***) from the groundwater at petroleum contaminated sites. The specific answers to the questions listed below will help address the issues of technical and economic feasibility of site remediation, and allow the RWQCB staff to make an informed decision regarding actual risks to human health and environmental receptors posed by the environmental pollution remaining at sites. The following minimum information should be included in corrective actions plans (CAPs), where LNAPL is present at the site:

1. *Identify the beneficial uses of groundwater and surface water for the hydrologic basin where the site is located (RWQCB, 1994).* Complete the information on FORM 1 (attached) to answer the appropriate questions.

2. *Evaluate the extent and impacts of the LNAPL pool on and off-property.* Provide an estimate of the total volume of LNAPL present on groundwater and estimate the age of the release at the site. Provide a list of assumptions and the calculations in the text (also see discussion of methodologies by USEPA, 1996).

   Provide a map clearly illustrating the estimated footprint of the LNAPL pool, on-site and adjacent land uses, locations of surface improvements, buildings, and subsurface utilities (and estimated depth of subsurface utilities) located on-site and adjacent to the site. The text should also provide an evaluation of general plan designations, land use zoning categories, and potential adverse impacts on projected land uses.

3. *Evaluate the historical observations of free product.* Provide a table of observed maximum thickness (in ft) of LNAPL over time. The narrative should include an evaluation of effects of water table fluctuations on the history of LNAPL occurrence in groundwater wells. A graph of variations in depth to water and LNAPL thickness with time, for each affected well, should be included in the report. Include the well number, date of observation, depth to top of well screen, depth to top of LNAPL, depth to water, and calculated/measured thickness of observed LNAPL.

4. *Evaluate hydrogeological characteristics affecting advective contaminant transport and attenuation mechanisms, and plume stability at the site.* For all basins, the minimum information shall include: estimates of the direction of groundwater flow and the proximity and withdrawal rates of groundwater users and dewatering projects. For sites located in basins with designated beneficial uses of groundwater (RWQCB, 1994), or within 1,000 feet of a sensitive receptor *(e.g., surface waters)* in basins where designated beneficial uses of groundwater do not exist, the evaluation shall include estimates of the range of site-specific soil pore-water velocity(ies) (in feet per year) for the aquifer at the site (see FORM 2 attached). The associated discussion shall include a comparison of the estimated site-specific rate(s) of contaminant transport and contaminant attenuation rates to evaluate potential impacts to the nearest sensitive receptor(s). Provide a list of assumptions, references, and calculations with the text.

5. *Provide an evaluation of technical feasibility of removing all LNAPL from groundwater at the site.* This analysis should include a reasonable estimated rate of LNAPL removal. This may be based upon observed site-specific LNAPL recovery rates and/or derived from historical operation of the LNAPL recovery system (if present) at the site. For example, the time frame for removal of free product may be estimated as:

$$\frac{\text{Volume of LNAPL (gallons)}}{\text{LNAPL Removal Rate (gal/day)}} = \text{No. of days to remove}$$

These data should be converted to appropriate units of time (*e.g.*, years, days, *etc*) for convenience. Also see discussion of this topic provided by USEPA (1996). Provide a list of assumptions and the associated calculations with the text.

6. *Provide an estimate of the economic feasibility of removing all LNAPL from groundwater at the site.* The estimate should include data from past operations of free product removal systems at the site, if available. Future
capital improvements and O&M costs should be estimated for completion of free product removal at the site. Provide a list of assumptions and a table of itemized estimated costs with the text.

7. *Tabulate the characteristics of the waste(s) left in-situ , including the type of LNAPL (e.g., gasoline, diesel fuel, etc), and the chronology of past efforts to remove LNAPL from groundwater at the site.* The information provided should include the following:

    a) Solubility of the fresh product *versus* on-site LNAPL.
    b) Estimated/measured content of fuel constituents in the fresh product and residual concentrations observed in LNAPL currently at the site.
    c) Vapor pressure of the fresh product *versus* on-site LNAPL.
    d) A chronology of attempts to remove LNAPL from the site, including a short description of limitations encountered and an estimated total volume recovered to date.

    Some of these data may be derived from a combination of site-specific measurements and data cited from available technical references, as appropriate.

8. *Provide an evaluation of the environmental persistency of water quality impairment at the site.* Provide an estimate for the length of time (in years) the residual LNAPL (concentrations of product above solubility limit) will remain at the site. This may be done by modeling explicit attenuation processes and/or using site-specific chemical parameters (*e.g.,* ratios of constituents, *etc.*) indicative of LNAPL attenuation. Provide a list of rationale, assumptions, and associated calculations with the text.

9. *Provide an evaluation of risks to human health from exposure to product and/or vapors from the residual LNAPL.* Provide results and map from a vapor survey(s) of soils and/or utilities located at/adjacent to the site. Provide a list of assumptions and any associated calculations with the text (*e.g.*, USEPA, 1989). The discussion in the text should also include an evaluation of potential impacts to water resources in basins where groundwater development projects are planned (for examples see SDCWA, 1997), persistence and permanence of potential adverse effects on surface water/groundwater quality, and beneficial uses of water resources.

10. *Provide an evaluation of risk from fire and explosion hazards associated with residual LNAPL and/or associated vapors from the site.* Provide specific narrative rationale, tabulated on-site measurements, and a site plot plan with vapor survey results (for utilities) to support the stated conclusions in the text.

11. *Provide an evaluation of risks to environmental (including ecological) receptors from exposure to product and/or vapors from residual LNAPL.* Discuss the proximity of the wastes at the site to surface waters and potential/actual hydraulic connections between groundwater and surface water resources. Provide a list of assumptions and any associated risk calculations with the text.

The responsible party(ies) should provide the requested information in a corrective action plan (CAP) or a *"short and concise"* letter with the limited number of attachments (or appendices) containing the information requested above. The attached references section includes a short list of references of current State requirements for water quality protection and technical references which may help with preparation of the information requested above.

sdrwqcb:s:\site\guidance\lnapl.doc

REFERENCES

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RWQCB, 1994, Water Quality Control Plan for the San Diego Basin (9), dated September 8, 1994.

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State Water Resources Control Board, 1996, Resolution No. 92-49: Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304, dated October 2, 1996.

US Environmental Protection Agency (USEPA), 1996, How to Effectively Recover Free Product at Leaking Underground Storage Tank Sites: A Guide for State Regulators. EPA 510-R-96-001, dated September 1996.

US Environmental Protection Agency (USEPA), 1993, Guidance for Evaluating Technical Impracticability of Ground-Water Restoration. Directive 9234.2-25, dated September 1993.

US Environmental Protection Agency (USEPA), 1989, Risk Assessment Guidance for Superfund, Volume 1: Human Health Evaluation Manual (Part A). EPA/540/1-89/002, dated December 1989.

BENEFICIAL USES OF WATER RESOURCES
Data Entry Form

Site **NAME:** ______________________________

Site **ADDRESS:** ______________________________

CITY/COUNTY/ZIP: ______________________________

Nearest Major Cross-Streets: ______________________________

____

Hydrologic Unit **NAME** and **BASIN NUMBER:** ______________________________
(*e.g.* San Diego Mesa, HU 8.20)

Nearest Surface Water (**NAME**): ______________________________

Approximate distance to Surface Water (in feet): ______________________________

Ground Water Exempted from MUN (RWQCB, 1994 [1]): ☐ YES ☐ NO

Sensitive Aquifer (RWQCB, 1996[2]): ☐ YES ☐ NO

Designated Existing or Potential Beneficial Uses of Surface Water (check all that apply [1])

☐ MUN ☐ AGR ☐ IND ☐ PROC ☐ GWR ☐ FRSH ☐ POW ☐ SPWN

☐ REC1 ☐ REC2 ☐ BIOL ☐ WARM ☐ COLD ☐ WILD ☐ RARE

☐ NAV ☐ EST ☐ MAR ☐ COMM ☐ AQUA ☐ MIGR ☐ SHELL

Designated Existing or Potential Beneficial Uses of Ground Water (check all that apply [1])

☐ MUN ☐ AGR ☐ IND ☐ PROC ☐ FRSH ☐ GWR

San Diego RWQCB LNAPL FORM 1: May 1998

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[1] RWQCB, 1994, Water Quality Control Plan for the San Diego Basin (9), dated September 8, 1994.

[2] RWQCB, 1996, Regional Board Supplemental Instructions to State Water Board December 8, 1995, Interim Guidance on Required Cleanup at Low-Risk Fuel Contaminated Sites, dated April 1, 1996.

Groundwater Velocity Calculations

Estimate velocity of groundwater from Darcy Equation:

$$V_W = K_h (I) / \theta$$

V_W = velocity of groundwater

K_h = hydraulic conductivity

I = groundwater gradient

θ = saturated porosity

Saturated porosity (%):
(list the source of this information: laboratory measurement, reference text, other - provide explanation)

Hydraulic conductivity (also specify units):
(list the source of this information: laboratory measurement, aquifer pump test, aquifer slug test, reference text, other - provide explanation)

Groundwater gradient (unitless):
(list the source of this information: site-specific measurement, reference text, other - provide explanation)

Groundwater velocity - V_{YR} (ft/year):

Distance to nearest sensitive receptor (e.g., water well(s), surface water, habitat area)(in ft):

Estimated time of travel to nearest receptor (Distance / V_{YR}) in years:

Provide an evaluation of mitigating attenuation factors, if any at this site. Include a list of assumptions and associated calculations as necessary to support the analysis. Attached other sheets as necessary.

San Diego RWQCB LNAPL FORM 2: May 1998

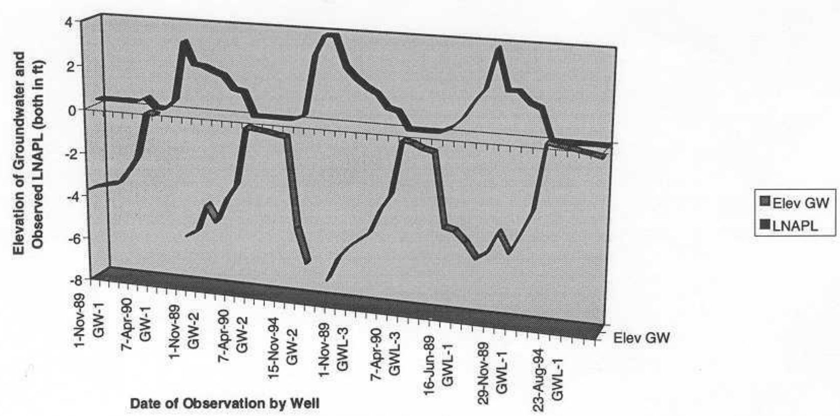

Figure 1

San Diego RWQCB LNAPL GUIDANCE Figure 1: May 1998

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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.

VI. SAN DIEGO REGIONAL BOARD NON-PURGE GUIDANCE

I/EPA

San Diego
Regional Water
Quality Control
Board

9771 Clairemont Mesa
Blvd., Suite A
San Diego, CA 92124
(619) 467-2952
FAX (619) 571-6972
BBS (619) 467-2958

Pete Wilson
Governor

June 20, 1997

To: Interested Parties

SUBJECT: USE OF NONPURGE METHOD FOR SAMPLING OF GROUND WATER MONITORING WELLS AT GASOLINE IMPACTED SITES.

It has been suggested that there may not be a need to purge ground water wells prior to sampling. Under certain circumstances, reliable and representative ground water data from gasoline contaminated underground storage tank (UST) sites can be obtained without purging. Well purging can increase costs due to labor, time, equipment needs, and purge water disposal. Significant cost savings could be realized if representative ground water samples could be collected without prior purging of the well(s).

In October 1996, a report entitled "The California Groundwater Purging Study for Petroleum Hydrocarbons," was prepared for the Western States Petroleum Association (WSPA) by SECOR International Incorporated. This report presented the results of an evaluation of the necessity for purging wells prior to ground water sampling. The report provided an extensive literature review of well purging principles and a historical perspective of well purging. Ground water samples were collected from contaminated sites from various regions in California. Based on the comparison of 4,808 selected nonpurge/post-purge data pairs from 556 wells, the authors concluded that there was no statistically significant difference between the nonpurge and post-purge concentration results for gasoline constituents. Copies of this report can be obtained through WSPA in Sacramento at (916) 498-7753.

The State Water Resources Control Board UST Program Manager, Mr. Allan Patton, issued a guidance letter to the Local Oversight Program (LOP) agencies and Local Implementing Agencies (LIAs) on March 26, 1997, regarding "California Groundwater Purging Study for Petroleum Hydrocarbons." The letter acknowledged the results of the WSPA report, stated that there were limitations to the nonpurge sampling method, and concluded that a nonpurge sampling method, where applicable and appropriate, should be implemented in order to reduce costs whenever possible.

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San Diego Regional Water Quality Control Board (RWQCB) staff has reviewed the WSPA report and concludes that a nonpurge sampling method is applicable if the following minimum conditions described below are met:

1. The only contaminants of concern are gasoline petroleum hydrocarbons (e.g. TPHg, benzene, toluene, ethylbenzene, total xylenes, and MTBE); and
2. No free phase petroleum hydrocarbon exists in the well; and
3. All pertinent well construction details are known to the lead regulatory agency; and
4. The well has been appropriately developed; and
5. The ground water monitoring well is screened across the water table in an unconfined aquifer (no submerged well screen).

Prior to implementation of the nonpurge sampling method, the responsible party must notify the lead regulatory agency, in writing, of the intent to implement this sampling protocol and receive concurrence from the lead regulatory agency. This notification must include a signature of a California registered professional (RG, PE, CEG, RH) certifying that the above conditions have been met.

A site-specific nonpurge/post-purge ground water monitoring study may be used to evaluate wells <u>not</u> meeting the above minimum criteria. On a case by case basis, should the results of a site-specific nonpurge/post-purge study show that no statistically significant variance in the petroleum hydrocarbon concentrations exist, and the report has been submitted and approved by the lead regulatory agency, then a nonpurge sampling method may be applicable and appropriate for the site.

When a responsible party requests site closure, the lead regulatory agency may require that a final round of purged ground water samples be collected from the monitoring well(s).

If you have any questions, please contact the Regional Board staff assigned to your UST case (619) 467-2952 or the staff of the appropriate local oversight agency.

John H Robertus

JOHN H. ROBERTUS
Executive Officer

cc: Regional Board Members
Allan Patton, SWRCB UST Program Manager
Regional Board UST Program Managers
San Diego County LOP
Orange County LOP
Riverside County LOP

Recycled Paper

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VII. SAN DIEGO REGIONAL BOARD ORDER R9-2002-342: WASTE DISCHARGE REQUIREMENTS FOR THE DISPOSAL AND/OR REUSE OF PETROLEUM FUEL CONTAMINATED SOILS (FCS) IN THE SAN DIEGO REGION

California Regional Water Quality Control Board

San Diego Region

Winston H. Hickox
Secretary for Environmental Protection

Internet Address: http://www.swrcb.ca.gov/rwqcb9/
9174 Sky Park Court, Suite 100, San Diego, California 92123-4340
Phone (858) 467-2952 • FAX (858) 571-6972

Gray Davis
Governor

December 13, 2002

To: Interested/Affected Parties

Dear Representatives:

RE: ORDER R9-2002-342: "WASTE DISCHARGE REQUIREMENTS FOR THE DISPOSAL AND/OR REUSE OF PETROLEUM FUEL CONTAMINATED SOILS (FCS) IN THE SAN DIEGO REGION."

On December 11, 2002, the Regional Board adopted Order R9-2002-342 and Monitoring and Reporting Plan No. R9-2002-342. This Order contains waste discharge requirements (WDRs) that will replace the conditional waiver Resolution No. 95-63: *"A Resolution Conditionally Waiving Adoption of Waste Discharge Requirements for Disposal/Reuse of Petroleum Hydrocarbon Fuel Contaminated Soils (FCS)."* Resolution No. 95-63 (and addenda thereto) will expire on January 1, 2003.

The following are some of the requirements included in the attached Order R9-2002-342:

1. Order R9-2002-342 requires that dischargers file the following application materials with the RWQCB: a.) an application (Form 200) for Waste Discharge Requirements (WDRs), b.) a filing fee, and c.) a completed Fuel Contaminated Soil (FCS) Certification form (and supporting information). The RWQCB staff will review the application materials to determine if the proposed discharge is eligible to enroll for coverage by the Order R9-2002-342. As of the date this Order was adopted, the filing fee was set at $1,500 as established by the State Water Resources Control Board pursuant to California Code of Regulations Title 23, Section 2200. The fee payment should be submitted to the RWQCB, but made payable to the "State Water Resources Control Board."

2. Order R9-2002-342 covers discharges of soil wastes containing only petroleum hydrocarbon fuel constituents, including gasoline, aviation gasoline, diesel fuel, jet fuels (Jet A, JP-4, and JP-5), kerosene, and fuel oils.

3. Order R9-2002-342 prohibits discharges of FCS wastes that contain "waste oil" or "waste oil constituents" or hazardous wastes as defined by California Code of Regulations (CCR), Title 22, Division 4.5.

4. Order R9-2002-342 establishes that waste characterization criteria that discharges FCS wastes must meet in order to be consistent with the definition of "inert wastes" included in CCR, Title 27, §20230.

5. Order R9-2002-342 sets specific minimum site and waste reuse criteria to identify sites that are eligible to receive discharges of FCS wastes for purposes of reuse/disposal as engineered fill.

California Environmental Protection Agency

Recycled Paper

Interested/Affected Parties - 2 - December 13, 2002
Order R9-2002-342: General WDRs
for Reuse/Disposal of Fuel Contaminated
Soils (FCS) in the San Diego Region

6. Order R9-2002-342 sets site-specific criteria and establishes waste discharge requirements for management of temporary waste piles of FCS wastes.

7. Order R9-2002-342 requires that dischargers report to the RWQCB all waste characterization results for each separate source of FCS wastes discharged at the site.

8. Order R9-2002-342 requires that dischargers conduct public notification and periodic inspections to ensure the discharge(s) of FCS wastes do not create a condition of pollution or nuisance.

9. Order R9-2002-342 requires the dischargers to provide the RWQCB with a technical report that details the final reuse/disposal conditions at the site.

10. Order R9-2002-342 requires the dischargers to properly manage any temporary waste piles created under this Order. The dischargers are required to develop and implement site-specific Best Management Practices (BMPs) for control of erosion and conveyance of storm water.

11. Order R9-2002-342 requires that new construction and maintenance activities comply with the applicable requirements of State Board General Order 99-08-DWQ "Waste Discharge Requirements for Discharges of Storm Water Associated with Construction Activity."

You are being sent a copy of this Order because the RWQCB has identified you or your organization as an Interested or Affected Party for Order No. R9-2002-342. Electronic copies of Order R9-2002-342 and Monitoring and Reporting Program R9-2002-342 are also available from our web site at:

http://www.swrcb.ca.gov/rwqcb9/orders/orders.html

Should you have any questions concerning Order R9-2002-342, please contact Mr. Brian McDaniel at (858) 627-3927 or by email at mcdab@rb9.swrcb.ca.gov or Mr. John Odermatt at (858) 637-5595 or by email at oderj@rb9.swrcb.ca.gov.

Sincerely,

John H. Robertus

JOHN H. ROBERTUS
Executive Officer

Enclosures: Order R9-2002-342
Fuel Contaminated Soil (FCS) Certification Form – Order R9-2002-342
Monitoring and Reporting Plan R9-2002-342

Cc: Interested Parties List (see attached) with Enclosure

California Environmental Protection Agency

Recycled Paper

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340
Attention: Land Discharge Unit

FCS Disposal Certification Form
In Accordance With Order No. R9-2002-342

I. Generator of Contaminated Soil

Generator Name:					
Mailing Address:					
City:	County:	State:	Zip:	Phone:	FAX:
Contact:			Title:		

II. Present Status of Contaminated Soil

Site Location:				
Property Owner Name:				
City:	County:	State:	Zip:	APN No.:
DEH/RWQCB Case No.:	Date Gen.:	Quantity (Cu. Yds.):		Method of Containment:

Soil Contaminants

Contaminant Type:
- ☐ Unleaded Gasoline
- ☐ Leaded Gasoline
- ☐ Diesel
- ☐ Kerosene
- ☐ Jet Fuel

Additives:
- ☐ MTBE
- ☐ None
- ☐ Other

No. of Samples:

Primary Analyses	Second. Analyses

Contaminant Concentrations

TPH-Gas		TPH- Diesel		Leachable Diesel		Other:	
Mean	Mean + 80% C.I.	Mean	Mean + 80% C.I.	Mean	Mean + 80% C.I.	Mean	Mean + 80% C.I.

Benzene		Toluene		Ethylbenzene		Xylenes	
Mean	Mean + 80% C.I.	Mean	Mean + 80% C.I.	Mean	Mean + 80% C.I.	Mean	Mean + 80% C.I.

Leach. Benzene		Leach. Toluene		Leach. Ethylbenzene		Leach. Xylenes	
Mean	Mean + 80% C.I.	Mean	Mean + 80% C.I.	Mean	Mean + 80% C.I.	Mean	Mean + 80% C.I.

III. Disposal Site Information

Site Conditions Met
- ☐ Ground Water Separation
- ☐ Surface Water Separation
- ☐ Flood Plain Protection
- ☐ Cover of Stockpiled Soil
- ☐ Ground Water Dependent Area
- ☐ Land Use Restriction

Site/Property Information

Property Owner:			
Property Address:			
City:	County:	State:	Zip:
Contact:		Phone:	

Property Owner Acknowledgement

I hereby acknowledge receipt of the waste described in this notice, and acknowledge that I have reviewed any associated reports. By signing this form I acknowledge that the Generator of this waste has certified that all the conditions of Order No. R9-2002-342 have been met.

Print Name: ______________________ Title: ______________________

Signature: ______________________ Date: ______________________

IV. Generator Certification

I hereby certify that the information provided regarding soil characterization is a complete and accurate representation of the subject soil, and that the soil is not hazardous waste as defined by the California Code of Regulations, Title 22, and by the United States Environmental Protection Agency, and that all conditions of Order No. R9-2002-342 have been met.

Print Name: ______________________ Title: ______________________

Signature: ______________________ Date: ______________________

For Agency Use Only RWQCB Regulatory Program:
☐ LDU ☐ DoD/SLIC ☐ UST/AGT/LOP County ____________

Version: 9/20/02a

California Regional Water Quality Control Board, **San Diego Region**

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

ORDER NO. R9-2002-0342

WASTE DISCHARGE REQUIREMENTS
FOR THE DISPOSAL AND/OR REUSE OF
PETROLEUM FUEL CONTAMINATED SOILS (FCS)
IN THE SAN DIEGO REGION

The California Regional Water Quality Control Board, San Diego Region (hereinafter the RWQCB) finds that:

1. California Water Code Section 13260(a) requires that any person discharging waste or proposing to discharge waste within any Region, other than to a community sewer system, that could affect the quality of the waters of the State, file a Report of Waste Discharge (RWD).

2. Under authority of Water Code Section 13263(d), the RWQCB may prescribe waste discharge requirements although no report of waste discharge has been filed.

3. California Water Code Section 13263(a) requires that California Regional Water Quality Control Board prescribe requirements for existing and proposed discharges in their respective areas of jurisdiction.

4. California Code of Regulations, Title 27 (27 CCR), Article 1, commencing with Section 20080 contains requirements governing discharges of nonhazardous solid wastes to land.

5. The issuance of this Order establishing general waste discharge requirements is consistent with the State Water Resources Control Board Strategic Plan and its goal to provide water resources protection, enhancement and restoration while balancing economic and environmental impacts.

6. Pursuant to Water Code Section 13263(i), the RWQCB finds that:

   a. For the purposes of this Order, petroleum fuel contaminated soils *("FCS wastes")* are defined as soils containing elevated concentrations, above natural background concentrations, of constituents from the following fuel sources: gasoline, aviation gasoline ("av-gas"), diesel fuel, jet fuels (Jet A, JP-4 and JP-5), kerosene, and fuel oils. FCS wastes are commonly created as a result of unauthorized releases (leaks) of petroleum fuel constituents from a number of similar fuel containment systems, including leaking underground storage tank systems, leaking fuel pipelines, and leaking above ground storage tank systems. FCS wastes are categorically classified as "designated wastes" pursuant to Water Code Section 13173.

b. Unauthorized releases of gasoline and diesel fuel constituents into soils from fuel containment systems identified in Finding 6.a. result in the same or similar types of wastes (*i.e.*, fuel contaminated soils).

c. FCS wastes used as engineered fill must be consistent with the criteria for "inert wastes" as identified in California Code of Regulations, Title 27, § 20230. Therefore, FCS wastes require the same or similar treatment standards for disposal and/or reuse as engineered fill.

d. The dischargers are more appropriately regulated under general discharge requirements than individual discharger requirements because:

   i. The regulated reuse of FCS wastes in redevelopment projects is an effective alternative to disposing of those wastes in existing municipal solid waste landfills.

   ii. Projects involving disposal and/or reuse of FCS wastes commonly require the implementation of the same or similar waste characterization protocols, waste management/containment criteria, and site-specific criteria for the protection of water quality.

   ii. These General WDRs would reduce RWQCB time expended on preparing and considering individual waste discharge requirements for each project.

   iii. These General WDRs would significantly simplify and expedite the application process for the dischargers.

   iv. These General WDRs would allow the RWQCB to more effectively and efficiently regulate discharges of FCS wastes for disposal and/or reuse in the San Diego Region.

7. The RWQCB finds that the uncontrolled discharge of FCS wastes may adversely affect the waters of the state.

8. On May 16, 1995 this RWQCB adopted Resolution No. 95-63: "A Resolution Conditionally Waiving Adoption of Waste Discharge Requirements for Disposal/Reuse of Petroleum Hydrocarbon Fuel Contaminated Soils (FCS)."

9. On February 13, 1997, the RWQCB adopted Addendum No. 1 to Resolution No. 95-63. Addendum No. 1 placed additional use restrictions upon the reuse/disposal of FCS wastes.

10. On October 10, 1999, Senate Bill 390 was signed into law amending Water Code Section 13269 and 13350. As a result of those amendments, all of the RWQCB's existing conditional waivers will expire on January 1, 2003.

11. The RWQCB has notified interested parties of its intent to adopt Order No. R9-2002-0342, superseding Resolution No. 95-63 and addenda thereto.

12. Because there is a potential impact to water quality from the uncontrolled discharge (reuse/disposal) of FCS wastes to land, the RWQCB finds that the discharges of FCS wastes are of category III-C as defined Title 23, Section 2200. Category "III" – include those discharges of waste that could degrade water quality without violating water quality objectives, or could cause a minor impairment of designated beneficial uses. A complexity rating of "C" is assigned to any discharge for which waste discharge requirements have been prescribed pursuant to Section 13263 of the Water Code not included as a Category "A" or Category "B". Included would be discharges having no waste treatment systems or that must comply with best management practices.

CEQA COMPLIANCE

13. On November 15, 1993, the RWQCB adopted a Negative Declaration (Resolution No. 93-103) for three types of discharges, including the disposal and reuse of petroleum hydrocarbon fuel contaminated soils. This action complies with the requirements of the California Environmental Quality Act (Public Resources Code, Section 21000, et seq.) and State guidelines. In adopting the Negative Declaration, the RWQCB determined that discharges wastes meeting the specified conditions would not result in any significant adverse water quality impacts.

OTHER LEGAL REFERENCES

14. The **Water Quality Control Plan Report, San Diego Basin (9)** (hereinafter Basin Plan), was adopted by this RWQCB on September 8, 1994, and subsequently approved by the State Water Resources Control Board (State Board) on December 13, 1994. The Basin Plan designates beneficial uses and narrative and numerical water quality objectives, and discharge prohibitions applicable to the discharges regulated under this Order.

15. The Basin Plan designates the following beneficial uses for ground waters resources within the San Diego Region:

a.	Muncipal and domestic water supply	(MUN)
b.	Agricultural water supply	(AGR)
c.	Industrial service supply	(IND)
d.	Industrial process supply	(PROC)

16. The Basin Plan designates some or all of the following beneficial uses of surface water resources located within the San Diego Region:

a.	Municipal and domestic supply	(MUN)
b.	Agricultural supply	(AGR)
c.	Industrial service supply	(IND)
d.	Industrial process	(PROC)
e.	Groundwater recharge	(GWR)
f.	Freshwater replenishment	(FRSH)
g.	Navigation	(NAV)
h.	Hydropower generation	(POW)
i.	Water contact recreation	(REC1)
j.	Noncontact water recreation	(REC2)
k.	Commercial and sport fishing	(COMM)
l.	Warm freshwater habitat	(WARM)
m.	Cold freshwater habitat	(COLD)
n.	Preservation of areas of special biological significance	(BIOL)
o.	Inland saline water habitat	(SAL)
p.	Wildlife habitat	(WILD)
q.	Preservation of rare and endangered species	(RARE)
r.	Marine habitat	(MAR)
s.	Migration of aquatic organisms	(MIGR)
t.	Spawning, reproduction, and/or early development	(SPWN)
u.	Shellfish harvesting	(SHELL)
v.	Esturine habitat	(EST)
w.	Aquacultural	(AQUA)

17. Discharges (i.e., for reuse/disposal) of FCS wastes may occur in areas that overlie ground water basins designated as suitable for uses including municipal and domestic public water supplies. Applicable numeric and narrative water quality objectives for groundwater resources are promulgated in Chapter 3 of the Water Quality Control Plan for the San Diego Region.

18. Discharges (i.e., for reuse/disposal) of FCS wastes may occur in areas located in proximity to surface waters that support beneficial uses including recreation (REC1 and REC2) and support of fish and wildlife (COLD, WARM, WILD, RARE). Applicable numeric and narrative water quality objectives for surface water resources are promulgated in Chapter 3 of the Water Quality Control Plan for the San Diego Region.

19. Additional State water quality criteria for beneficial uses of water resources as a public drinking water supply are promulgated in California Code of Regulations (CCR), Title 22, Division 4,Chapter 15, Article 4, §64431 (Primary MCLs for inorganic chemicals), §64443 (MCLs for man-made radioactivity), §64444 (Primary MCLs for organic

chemicals), §64449 (Secondary MCLs), and Chapter 17.5, Article 1, §64672.3 (copper and lead action levels).

20. Additional State and Federal water quality criteria for protection of beneficial uses of surface water resources are promulgated by the U.S. Environmental Protection Agency as the California Toxics Rule (CTR) as implemented by State Water Resources Control Board Resolution Nos. 2000-015 and 2000-030.

21. The San Diego Region contains a number of impaired water bodies identified on the on the statewide 303-d list published in 1998. Environmental pollutants/stressors associated with the impairment of water bodies in the San Diego Region include: sediments, metals (*e.g.*, cadmium, copper, lead, nickel, thallium, and zinc) and sediment toxicity. Discharges of FCS wastes could occur within hydrologic subareas that contain impaired water bodies, as identified on the 303-d list, in the San Diego Region.

22. This Order does not preempt or supersede the authority of other State and local agencies to prohibit, restrict, or control discharges of waste subject to their jurisdiction.

23. The RWQCB finds that a variety of approaches may be effective as Best Management Practices (BMPs) for control of surface water runoff and erosion of soils/sediments and FCS wastes. Deployment of bonded fiber matrix materials, anchored fiber rolls, and fiber blankets, among other measures, can be effective BMPs for erosion control and conveyance of surface water runoff if designed and applied as appropriate for site-specific conditions.

24. For applicable projects, it is appropriate for the discharger to file the required notice of intent (NOI) and application fee for coverage under State Board Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, "Waste Discharge Requirements for Discharges of Storm Water Associated Construction Activity."

25. Under the conditions of this Order, dischargers may find it necessary to establish and maintain temporary waste piles of FCS wastes. Therefore, it is appropriate for this Order to include waste discharge requirements for regulating the discharges of FCS wastes into temporary waste piles.

26. The RWQCB has considered all water quality related environmental factors associated with the category of waste discharges (reuse/disposal) covered by this order.

27. The RWQCB has notified potential dischargers and all other known interested parties of the intent to prescribe WDRs as described in this order.

28. The RWQCB, in a public meeting, heard and considered all comments pertaining to the proposed discharge.

IT IS HEREBY ORDERED, that each person enrolled in this Order (hereinafter the "discharger"), meet the provisions contained in Division 7 of the California Water Code and regulations adopted therein and shall comply with the following:

A. ENROLLMENT PROCEDURE

1. In order to enroll for coverage under this Order, the discharger shall submit the FCS certification from (attached to this Order) and appropriate filing fee for each location/property proposed to receive a discharge of FCS wastes. The Report of Waste Discharge (RWD) shall include the following:

   a. Application/Report of Waste Discharge general information form (Form 200) filled out in accordance with the instructions.

   b. Completed FCS certification form filled out in accordance with the instructions.

   c. Copies of all analytical results, associated laboratory data sheets, including QA/QC data and chain of custody documents.

   d. A discussion of the discharge site and petroleum hydrocarbon FCS (waste) characteristics including:

      i. Identification of the period during which waste is to be disposed of at the site;

      ii. Description of disposal methods, operation and maintenance activities;

      iii. Description of types and quantities of waste to be disposed of;

      iv. Present and future land use.

   e. The discharger shall file a notice of intent (NOI) and application fee, as applicable, for coverage under State Board Order No. 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No. CAS000002, "Waste Discharge Requirements for Discharges of Storm Water Associated Construction Activity."

   f. Documentation of how the discharger will comply with all applicable requirements of this Order and Monitoring and Reporting Program R9-2002-0342.

g. A topographic map at an appropriate scale and other information clearly illustrating the location, owners, and uses of all wells located within one mile of the site.

h. Any other information pertinent to the protection of water quality or public health and prevention of nuisance.

2. Discharges of FCS waste (for reuse/disposal) may be enrolled through the procedure identified in **Section A** of this Order or by the RWQCB under the authority cited in **Finding 2**. In either case, the discharger may receive written notification from the RWQCB stating whether it is appropriate to regulate the inactive landfill under these general waste discharge requirements (WDRs), or that individual WDRs are required.

3. It may be necessary for a discharger authorized under this Order to apply for and obtain an individual waste discharge requirements (WDRs) with more discharge- specific requirements. When individual WDRs are issued to a discharger, the applicability of this general permit to the individual enrollee shall be terminated on the effective date of the individual WDRs.

4. Notwithstanding the conditions specified above, individual cases may be brought to the RWQCB for consideration of waste discharge requirements when deemed appropriate.

B. DISCHARGE PROHIBITIONS

1. Discharges of wastes to land for treatment, storage, or disposal are prohibited; unless the RWQCB has issued valid Waste Discharge Requirements for that discharge.

2. The acceptance or discharge of "hazardous waste" is prohibited. For the purposes of this Order, the term "hazardous waste" is as defined in California Code of Regulations (CCR) Title 22, Division 4.5, § 66261 *et seq.*

3. The acceptance or discharge of soils containing "waste oil", under the definition of California Health and Safety Code Section 25250.4, is prohibited.

4. The acceptance or discharge of FCS wastes containing waste constituents, other than those listed in Table 1, above natural background concentrations is prohibited.

5. The disposal/reuse of FCS wastes to land is prohibited unless the required application (From 200), application fee, and FCS certification report for the discharge has been submitted to the RWQCB.

6. The discharge of solid waste containing free liquid or moisture, in excess of the waste's moisture holding capacity, is prohibited.

7. The dumping, deposition, or discharge of waste directly into waters of the state, or adjacent to such waters in any manner, under which wastes may be transported into the waters, is prohibited unless authorized by the RWQCB.

8. The discharge of waste or waste constituents to ground water or surface waters at, beneath, or adjacent to the facility is prohibited.

9. The discharge of wastes in a manner that creates nuisance conditions (from odors, vectors, and other nuisances) is prohibited.

10. The discharge of waste to waters of the state in a manner causing, or threatening to cause a condition of pollution, contamination or nuisance as defined in California Water Code Section 13050, is prohibited.

11. Basin Plan discharge prohibitions shall not be violated.

C. DISCHARGE SPECIFICATIONS

Discharges of FCS wastes shall comply with all of the following specifications:

1. DOCUMENTATION FOR SOURCE(S) OF FCS WASTE

Provide the RWQCB with a completed FCS certification form and supporting analytical data (per **Section A.1.** of this Order) for each individual source of FCS waste discharged at the site.

2. SITE CONDITIONS

The proposed disposal site shall meet the following minimum conditions:

a. **Groundwater Dependent Area Protection**: The disposal site shall not be located in an area that is dependent on groundwater for the sole source of drinking water.

b. **Industrial Reuse Restriction**: The disposal site shall only have an industrial or commercial use such as a road bed, commercial fill site or other use that limits potential human exposure. Residential properties shall not to be used as disposal sites. If a structure is to be constructed over the disposal site an approval must be obtained from the appropriate local agencies

c. **Separation from Ground Water**: The FCS waste shall be placed at least five feet above the highest anticipated level of ground water. The soil that separates the FCS waste from groundwater shall have a significant clay content (greater than 5% clay-sized material) or a permeability of less than 10^{-5} cm/sec.

d. **Separation from Surface Water**: The waste shall be placed at least 100 feet from the nearest surface water.

e. **Flood Plan Protection**: The waste shall be protected against 100 year peak stream flows as defined by the County flood control agency.

f. **Cover**: The waste shall be covered by either 1) engineered materials (e.g. used as road base, fill beneath buildings, bridge abutments), or 2) not less than 2 feet of noncontaminated, clean fill. The cover shall either provide a permeability of 10^{-5} cm/sec, or it shall be soil compacted to maximum 90% relative maximum compaction. Placement of a cover on the waste shall be completed with 30 days of revising/discharging the final load of wastes at the site.

g. **Property Owner Acknowledgment**: By signature on the attached FCS certification form written correspondence to the RWQCB, the property owner shall approve the placement of the FCS waste at the site.

3. FUEL CONSTITUENT CONCENTRATION LIMITS

The results of sampling and analyses of FCS wastes shall be subject to either the primary level (a) **and/or** the secondary level (b) conditions listed below.

a. *Primary Level Conditions (First Tier):* The upper 80% confidence interval value of the mean concentrations resulting from the primary analyses of the samples shall not exceed the concentration limits for the primary constituents of concern listed in **Table 1**. If the primary level conditions are not met, the FCS waste samples exhibiting the highest concentrations as a result of the primary analyses (**a minimum of 4 samples for all parameters tested**) shall be further analyzed for the secondary constituents of concern (**Table 2**).

Table 1. Primary Concentration Limits for Fuel Constituents in FCS wastes

Type of Contaminant	Constituent of Concern	Carbon Range	Concentration Limit
Gasoline/Av-Gas	TPH-Gasoline	C_6-C_{12}	≤10 mg/kg
Diesel Fuel/ kerosene/ jet fuel/ bunker fuel	TPH-Diesel	C_{10}-C_{30}	≤100 mg/kg
ALL	Benzene		≤1 μg/kg
ALL	Toluene		≤150 μg/kg
ALL	Ethylbenzene		≤700 μg/kg
ALL	Xylenes		≤1,750 μg/kg
Gasoline	MTBE		≤ 13 μg/kg

KEY to TABLE 1:

Gas/Av-Gas = concentration limit required for FCS containing gasoline and aviation gasoline constituents

Gasoline = concentration limit required for FCS containing only gasoline constituents

Diesel Fuel/ kerosene/ jet fuel/ bunker fuel = concentration limit required for FCS containing the listed fuel constituents

ALL = analyses required for FCS containing any fuel constituent identified in this Order.

b. *Secondary Level Conditions (Second Tier):* The upper 80% confidence interval value of the mean concentrations resulting from the secondary analyses shall not exceed the concentration limits for the secondary constituents of concern listed in **Table 2.**

Table 2. Secondary (Leachable) Concentration Limits for Fuel Constituents in FCS Wastes

Type of Contaminant	Constituent of Concern	Carbon Range	Concentration Limit
Gas/Av-Gas	TPH-Gas	C_6-C_{12}	≤ 100 mg/kg
Diesel Fuel/ kerosene/ jet fuel/ bunker fuel	TPH- Diesel	C_{10}-C_{30}	≤ 500 mg/kg
Diesel Fuel/ kerosene/ jet fuel/ bunker fuel	TPH-Diesel	C_{10}-C_{30}	≤50 μg/L
ALL	Benzene		≤0.5 μg/L
ALL	Toluene		≤75 μg/L
ALL	Ethylbenzene		≤350 μg/L
ALL	Xylenes		≤900 μg/L
Gasoline	MTBE		≤ 7 μg/L

KEY to TABLE 2:

Gas/Av-Gas = concentration limit required for FCS containing gasoline and aviation gasoline constituents

Gasoline = concentration limit required for FCS containing only gasoline constituents

Diesel Fuel/ kerosene/ jet fuel/ bunker fuel = concentration limit required for FCS containing the listed fuel constituents

ALL = analyses required for FCS containing any fuel constituent identified in this Order.

4. EROSION CONTROLS AND STORMWATER PROTECTION

The discharger shall develop and implement best management practices (BMPs) for effective control of erosion and discharges of wastes from the site. Sites receiving discharges of FCS wastes for reuse/disposal, under this Order, shall comply with the requirements of Order 99-08-DWQ, National Pollutant Discharge Elimination System (NPDES) General Permit No.

CAS000002, "Waste Discharge Requirements for Discharges of Storm Water Associated Construction Activity."

5. DISCHARGES OF WASTES TO TEMPORARY WASTE PILES

Any discharger who creates one or more temporary waste piles of FCS wastes that do not qualify for a conditional waiver of WDRs, pursuant to either a site-specific conditional waiver issued by the RWQCB or the RWQCB waiver policy, shall comply with the following requirements:

a. **Site Conditions**: All parcels of land/property receiving a temporary discharges of FCS wastes (i.e., temporary waste piles) under this Order, shall meet the following minimum general site conditions:

   i. <u>Runon/Runoff Protection</u>: Surface drainage shall be diverted from the temporary waste piles. For all waste piles, the dischargers shall implement effective Best Management Practices (BMPs) to prevent surface water runon and runoff from contacting wastes and to prevent erosion and transport of wastes by surface runoff.

   ii. <u>Groundwater Protection:</u> All waste piles shall be placed at least five feet above the highest anticipated level of groundwater.

   iii. <u>Surface Water Protection:</u> All waste piles established under this waiver shall be located not less than 100 feet from any surface water identified in the Basin Plan.

   iv. <u>Flood Plain Protection:</u> All waste piles shall be protected against 100-year peak stream flows as defined by the County flood control agency.

b. **Inspection and Maintenance:** The discharger shall regularly inspect and maintain wastes discharged to temporary waste piles established under this Order. Inspections shall be conducted at a frequency that will ensure the discharge of FCS wastes does not create conditions of pollution or nuisance. The discharger shall report on the disposition of all temporary waste piles at the time of the final inspection conducted pursuant to **Section E (INSPECTION RESULTS)** of this Order.

c. **Clean Closure Required:** The discharger shall properly dispose of the following in accordance with all applicable requirements and regulations: all waste piles established under this Order, together with any materials used to contain the temporary waste piles, underlying geologic materials contaminated by the discharge, treatment facilities, and related equipment.

d. **Management of Return or Ponded Water:** If return water or ponded water contained within the treatment or storage area of the temporary waste pile will be disposed of at a location other than to a sanitary sewer system, then the discharger shall submit written notification to the RWQCB prior to initiating the discharge and either: 1) obtain waste discharge requirements; 2) obtain a waiver of waste discharge requirements or 3) obtain a written determination from the RWQCB Executive Officer that the disposal of the return water or ponded water is not subject to regulation by the RWQCB.

e. **Property Owner Acknowledgment:** By written correspondence to the RWQCB, the property owner shall approve the placement of the waste (temporary waste piles) at the site.

f. **Public Notification Requirement:** The discharger shall post at least one clearly visible, sign (in english) listing the following minimum information: a.) project name, b.) name and address of discharger, c.) brief project description, and d.) 24-hour contact information – name, address, facsimile, and telephone number for the project. The discharger shall post additional signs as necessary (in languages other than english) to more effectively communicate the minimum contact information (listed above) to the local community. The sign(s) shall be maintained as required to keep them legible and remain in place while temporary waste piles remain on site.

g. **Obligation to Comply:** Compliance with this Order does not relieve discharger of the obligation to comply with any other applicable local, state and federal requirements.

h. **Maximum Time Limit.** Temporary waste piles established under this Order shall be limited to a maximum time period of **30-days** after the RWQCB receives the final technical report required in **Section F (FINAL DISPOSITION OF WASTE**) of this Order.

i. **Source(s) of FCS Waste:** The discharger shall provide the RWQCB with complete information, for each source of FCS wastes, as required by **Section C.1 (DISCHARGE SPECIFICATIONS**) of this Order.

j. **Cover:** All waste piles shall be overlain by plastic sheeting (not less than 10 mils thick) to adequately prevent infiltration of rainwater, control fugitive dust, and other nuisances.

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k. **Liner:** All waste piles shall be underlain by either plastic sheeting (not less than 10 mils thick) or a liner of low permeability approved by the RWQCB.

D. REPORTING REQUIREMENTS

1. GENERAL REPORTING REQUIREMENTS

The discharger is required to comply with the following minimum reporting requirements:

a. Submit to the RWQCB a FCS certification report (form attached to this Order) at least **30 days** prior to reuse or disposal of FCS wastes at a site, other than a Classified waste management unit. Comments received in response to the public notification are to be forwarded to the RWQCB with the certification report.

b. Pursuant to Section 13260(a) of the California Water Code, prior to disposal, submit a Report of Waste Discharge (RWD) for site specific waste discharge requirements if both the primary **and** secondary level conditions listed above (**Discharge Specification C.3.a and C.3.b**) are not met.

c. Other Constituents: The discharger shall report leachable concentrations of any other waste constituents, not listed in **Discharge Specification C.3.b.** (Table 2), that may be present in concentrations that could pose a threat to water quality at the proposed disposal site.

d. Furnish to the RWQCB, within a reasonable time, any information which the RWQCB Executive Officer may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this Order. The discharger shall also furnish to the RWQCB upon request, copies of all records required to be kept under this Order.

2. CHANGE IN OWNERSHIP

The discharger shall notify the RWQCB, in writing, **at least 30 days** in advance of any proposed transfer of ownership or responsibility for maintenance of a site/facility subject to this Order. The discharger shall include with such notification, written acknowledgement by the prospective purchaser or successor in responsibility executed under penalty of perjury under the laws of the state of California, that such purchaser or successor has read and understood the requirements contained herein and will accept responsibility for compliance therewith as of the date of transfer of ownership or responsibility.

3. INCOMPLETE REPORTS

Where the discharger becomes aware that it failed to submit any relevant facts in a Report of Waste Discharge (RWD) or submitted incorrect information in a RWD or in any report to the RWQCB, it shall promptly submit such facts or information.

4. ENDANGERMENT OF HEALTH AND ENVIRONMENT

The discharger shall report any noncompliance, which may endanger health or the environment. Any such information shall be provided orally to the RWQCB **within 24 hours** from the time the owner becomes aware of the circumstances. A written submission shall also be provided **within five days** of the time the owner becomes aware of the circumstances, provided that no written report need be submitted if the RWQCB waives the requirement for such written report upon timely receipt of a satisfactory oral report. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected; the anticipated time it is expected to continue, and steps taken or planned to reduce, eliminate, or prevent recurrence of the noncompliance.

5. OTHER INFORMATION

When the discharger becomes aware of a failure to submit any relevant facts in an application for Waste Discharge Requirements or submitted incorrect information in a permit application, or in any report to the RWQCB, the facts of information shall be promptly submitted.

6. FALSE REPORTING

Any person who knowingly makes any false statement, representation, or certification any record or other document submitted or required to be maintained under this Order, including monitoring reports or reports of compliance or noncompliance shall be subject to enforcement procedures as identified in the **Provision G.9.** of this Order.

7. ANTICIPATED NONCOMPLIANCE

Provide advance notice to the RWQCB of any planned changes in the facility or discharge activity that may result in noncompliance with the waste discharge requirements.

8. MONITORING AND REPORTING PROGRAM

Monitoring and analytical results shall be reported to the RWQCB as specified in the attached **Monitoring and Reporting Program No. R9-2002-0342.**

9. REPORT DECLARATION

All applications, reports, or information submitted to the RWQCB shall be signed and certified as follows:

a. The Report of Waste Discharge (RWD) shall be signed as follows:

 1. **For a corporation** - by a principal executive officer of at least the level of vice-president.

 2. **For a partnership or sole proprietorship** - by a general partner or the proprietor, respectively.

 3. **For a municipality, state, federal or other public agency** - by either a principal executive officer or ranking elected official.

 4. **For a military installation** - by the base commander or the person with overall responsibility for environmental matters in that branch of the military.

b. All other reports required by this Order and other information required by the RWQCB shall be signed by a person designated in paragraph (a) of this provision, or by a duly authorized representative of that person. An individual is a duly authorized representative only if:

 1. The authorization is made in writing by a person described in paragraph (a) of this provision;

 2. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity; and

 3. The written authorization is submitted to the RWQCB.

c. Any person signing a document under this Section shall make the following certification:

" I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."

10. RWQCB ADDRESS

The discharger shall submit reports required under this Order, and other information requested by the RWQCB, to:

Executive Officer
California Regional Water Quality Control Board
San Diego Region
9174 Sky Park Court, Suite 100
San Diego, California 92123-4340
Attn: Land Discharge Unit Supervisor

E. SITE INSPECTION RESULTS

1. The discharger shall perform **a final site inspection** after the discharge of waste has been completed at the site. The results of that inspection, and any supporting documentation, shall be submitted to the RWQCB in an appendix to the final summary report required by **Section F** of this Order and Monitoring and Reporting Program R9-2002-0342. The report shall contain a discussion of any significant findings regarding:

   a) General site condition;

   b) FCS waste piles and the condition thereof;

   c) Disposition of FCS wastes reused/disposed at the site;

   d) Storm water conveyance and erosion control BMPs located on and immediately off the site;

   e) Maintenance activities at the site.

F. FINAL DISPOSITION OF WASTE

For each discharge of waste to an unclassified waste management unit the discharger shall report all information that is necessary for the RWQCB to assess compliance with the **Discharge Specifications Section C** of this Order. This information shall be reported as an appendix pursuant to **Reports To Be Filed With the RWQCB, Section C** in compliance with the schedule required in Monitoring and Reporting Program R9-2002-0342.

G. PROVISIONS

1. OBLIGATION TO COMPLY

The discharger shall comply with all conditions of this Order. Any noncompliance with this Order constitutes a violation of the California Water Code and is grounds for: (a) enforcement action; or (b) termination, revocation and reissuance, or modification of this Order.

2. CORRECTION OF ADVERSE IMPACTS

The discharger shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this Order, including such accelerated or additional monitoring as may be necessary to determine the nature and impact of the noncompliance.

3. PROPER OPERATION AND MAINTENANCE

The discharger shall, at all times, properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the discharger to achieve compliance with conditions of this Order. Proper operation and maintenance includes effective performance, adequate laboratory and process controls including appropriate quality assurance procedures.

4. PROPERTY RIGHTS

This Order does not convey any property rights of any sort or any exclusive privileges, including any authorization to discharge solid waste or maintain an inactive landfill. The requirements prescribed herein do not authorize the commission of any act causing injury to persons or property, nor protect the discharger from liability under federal, state, or local laws, nor create a vested right for the owner and operator to continue the regulated activity.

5. ENTRY AND INSPECTION

The discharger shall allow the RWQCB, or an authorized representative upon the presentation of credentials, to:

a. Enter upon the discharger premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this Order;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this Order;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order; and

d. Sample or monitor at reasonable times, for the purposes of assuring compliance with this Order or as otherwise authorized by the California Water Code, any substances or parameters at any location.

6. REPOSITORY FOR WASTE DISCHARGE REQUIREMENTS

A copy of this Order shall be maintained at the local offices of the discharger and shall be available to operating personnel at all times.

7. SEVERABILITY

The provisions of this Order are severable, and if any provision of this Order or the application of any provision of this Order to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this Order, shall not be affected thereby.

8. PUBLIC NOTIFICATION

Public notification shall be completed at least **30 days** prior to the discharge (for disposal or reuse) of FCS wastes at the site. Adjacent property owners and other interested parties are to be notified of the plans for the disposal/reuse of FCS wastes. The discharger shall provide the RWQCB with written documentation of the required public notification.

9. ENFORCEMENT

In the case of an enforcement action, the following provisions shall apply:

a. The provisions in this enforcement section shall not act as limitation on the statutory or regulatory authority of the RWQCB.

b. Any violation of this Order constitutes violation of the California Water Code and is basis for enforcement action, termination of the order, revocation and reissuance of the Order, denial of an application for reissuance of the Order or a combination thereof.

c. It shall not be a defense for a discharger in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this Order.

d. The California Water Code provides that any person who intentionally or negligently violates any waste discharge requirements issued, reissued, or amended by this RWQCB is subject to administrative civil liability of up to five thousand (5,000) dollars per day of violation. The Superior Court may impose civil liability of up to fifteen thousand (15,000) dollars per day of violation.

e. The California Water Code provides that any person failing or refusing to furnish technical or monitoring program reports, as required under this Order, or falsifying any information provided in the monitoring reports is guilty of a misdemeanor.

10. DEVELOPMENT AND IMPLEMENTATION OF BEST MANAGEMENT PRACTICES

The discharger shall develop and implement effective best management practices (BMPs) to comply with **Discharge Specifications Sections C.4** of this Order.

H. NOTIFICATIONS

1. Definitions of terms used in this Order shall be as set forth in California Code of Regulations, Title 27.

2. This Order becomes effective on the date of adoption by the RWQCB and will supercede Resolution Order No. 95-63.

I, John H. Robertus, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Water Quality Control Board, San Diego Region on December 11, 2002.

John H Robertus

JOHN H. ROBERTUS
Executive Officer

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
SAN DIEGO REGION

MONITORING AND REPORTING PROGRAM NO. R9-2002-0342
FOR THE DISPOSAL AND/OR REUSE OF
PETROLEUM FUEL CONTAMINATED SOILS (FCS)
IN THE SAN DIEGO REGION

A. MONITORING PROVISIONS

1. Samples and measurements taken as required herein shall be representative of the volume and nature of the monitored discharge.

2. Monitoring must be conducted according to United States Environmental Protection Agency test procedures approved under the most current version of Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, U.S. Environmental Protection Agency.

3. All analyses shall be performed in a laboratory certified to perform such analyses by the California Department of Health Services.

4. If the discharger monitors any pollutants more frequently than required by this Order, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the discharger's monitoring report. The increased frequency of monitoring shall also be reported.

5. The discharger shall retain records of all monitoring information, including all calibration and maintenance records, copies of all reports required by this Order, and records of all data used to complete the application for this Order. Records shall be maintained for a minimum of five years from the date of the sample, measurement, report or application. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the San Diego Regional Water Quality Control Board (RWQCB).

6. All monitoring instruments and devices that are used by the discharger to fulfill the prescribed monitoring program shall be properly maintained and calibrated as necessary to ensure their continued accuracy.

7. The discharger shall report all instances of noncompliance, not reported under the **Reporting Requirement D.4.** of Order No. R9-2002-0342, at the time the final report is submitted (see **Final Disposition of Wastes, Section F** of Order No. R9-2002-0342).

8. Records of monitoring information shall include:

a. The date, identity of sample monitoring point from which it was taken, weather conditions at time of sampling, and time of sampling or measurement;

b. The names and qualifications of individual(s) who performed the sampling or measurements;

b. Date and time that analyses were started and completed, and the name of the personnel performing each analysis;

c. The analytical techniques or method(s) used, including method of preserving the sample and the identity and volumes of reagents used;

d. Calculation of results;

e. Results of analyses and the practical quantitation limit (PQL) and method detection limit (MDL) for each parameter; and

g. Laboratory quality assurance results (*e.g.* percent recovery, response factor)

6. Technical reports shall be signed by an authorized person as required by the **Reporting Requirement D.9.** of Order No. R9-2002-0342.

B. WASTE MONITORING

The discharger shall ensure that all FCS wastes are discharged in compliance with the requirements of **Sections B (Discharge Prohibitions)** and **Section C (Discharge Specificiations)** of Order R9-2002-0342. The characterization of FCS wastes shall be performed as required below:

1. The discharger shall monitor the wastes from each source using the following parameters and report results to the RWQCB as required in **Eligibility, Section A** of Order R9-2002-0342.

2. Each source of petroleum hydrocarbon fuel contaminated soil *("FCS waste")* disposed of or reused at the facility shall be sampled and analyzed as follows:

a) **Sampling:** All samples of FCS wastes shall be collected in accordance with sampling guidelines set forth in the test procedures approved under the most current version of "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846", U.S. Environmental Protection Agency.

b) **Analysis:** The minimum detection levels for the methods prescribed in this Order are listed in **Table 1** of this Monitoring and Reporting Program.

Table 1. Test Methods and Minimum Detection Levels for Fuel Constituents in FCS Wastes

Type of Contaminant	Constituent of Concern	Ext. Method SPLP	Carbon Range	Prep. Method	DHS/EPA Method of Analysis	Minimum Detection Level
Gasoline/Av-Gas	TPH-Gasoline		C_6-C_{12}	5035	8015M/DHS	10 mg/kg
Diesel Fuel/ kerosene/ jet fuel/ bunker fuel	TPH-Diesel Fuel		C_{10}-C_{30}	5035	8015M/DHS	10 mg/kg
Gasoline	MTBE			5035	8260B	5 µg/kg
All	BTEX			5035	8021	0.5 µg/kg
Diesel Fuel/ kerosene/ jet fuel/ bunker fuel	Leachable Diesel Fuel	Method 1312	C_{10}-C_{30}	5035	8015M/DHS	50 µg/L
All	Leachable BTEX	Method 1312		5035	8021	0.5 µg/L
Gasoline	Leachable MTBE	Method 1312		5035	8260B	5 µg/L

KEY to TABLE 1:

Gas/Av-Gas = concentration limit required for FCS containing gasoline and aviation gasoline constituents

Gasoline = concentration limit required for FCS containing only gasoline constituents

Diesel Fuel/ kerosene/ jet fuel/ bunker fuel = concentration limit required for FCS containing the listed fuel constituents

ALL = analyses required for FCS containing any fuel constituent identified in this Order.

3. All FCS wastes discharged under this Order must be sampled and analyzed using the following minimum requirements:

   a) **Sampling:** For quantities of FCS waste less than or equal to 500 cubic yards, **a minimum of four samples per 100 cubic yards** will be taken. For quantities of FCS waste above 500 cubic yards, an additional sample shall be collected for every 500 cubic yards. In all cases, **a minimum of four samples** shall be analyzed for either primary and/or secondary level analyses as set forth in **Discharge Specifications C.3.a. and C.3.b.** of Order R9-2002-0342.

b) **Primary Level Conditions:** The waste samples shall be analyzed for the primary constituents of concern as listed in **Discharge Specification (Section C.3.a. - Table 1**) of Order R9-2002-0342.

i) Primary Level Conditions-Gas/Av-Gas.
FCS wastes containing gasoline or aviation gasoline constituents shall be analyzed using the DHS method or EPA Method 8015 modified to quantify the concentration of total petroleum hydrocarbons (TPH) through the carbon range C_6 to C_{12}. The minimum detection limit for TPH using these criteria shall be no greater than 10 mg/kg. Additionally, the FCS wastes shall be analyzed using EPA Method 8021 to quantify the concentrations of benzene, toluene, ethylbenzene, and total xylenes (BTEX) and EPA Method 8260B to quantify concentrations of MTBE (for gasoline only). The minimum detection limits shall be as follows: for BTEX analyses by EPA Method 8021 detection limits shall be no greater than 0.5 μg/kg and for MTBE by EPA Method 8260B detection limits shall be no greater than 0.5 μg/kg.

ii) Primary Level Conditions –Diesel fuel/kerosene/jet fuels/bunker fuel. FCS Wastes containing diesel fuel, kerosene, jet fuels, or bunker fuel constituents shall be analyzed using the DHS/EPA Method 8015 modified to quantify the concentration of total petroleum hydrocarbons through the carbon range C_{10} to C_{30}. The minimum detection limit for TPH using these criteria in FCS wastes shall be no greater than 10 mg/kg. Additionally, the FCS wastes shall be analyzed using EPA Methods 8021 to quantify the concentrations of BTEX. The minimum detection limits for BTEX analyses by EPA Method 8021 shall be no greater than 0.5 μg/kg.

c) Secondary Analysis: If the primary level conditions (**Discharge Specification C.3.a** - **Table 1** of Order R9-2002-0342) are not met, the samples of FCS wastes exhibiting the highest concentrations as a result of the primary analyses (**a minimum of 4 samples** for all parameters tested) shall be further analyzed for the secondary constituents of concern conditions (**Discharge Specification C.3.b. - Table 2** of Order R9-2002-0342).

i) Secondary-Gasoline/Av-Gas.
For secondary analysis, samples of FCS wastes containing gasoline or aviation gasoline constituents shall be extracted using the Synthetic Precipitation Leaching Procedure (SPLP) using a zero

headspace extractor. Procedures for the SPLP are described in EPA method 1312 of "Test Methods for Solid Waste, SW 846". The SPLP waste extract shall be analyzed for BTEX using Method 8021 and analyzed for MTBE using Method 8260B (for gasoline only). The minimum detection limit for BTEX in waste extract, using Method 8021, shall be no greater than 0.5 μg/L. The minimum detection limit for MTBE in the SPLP waste extract, using Method 8260B, shall be no greater than 5 μg/L.

ii) Secondary- Diesel fuel/kerosene/jet fuels/bunker fuel.
For secondary analysis, samples of FCS wastes containing diesel fuel, kerosene, jet fuel, or bunker fuel constituents shall be extracted using the Synthetic Precipitation Leaching Procedure (SPLP) using a zero headspace extractor. Procedures for the SPLP are described in EPA method 1312 of "Test Methods for Solid Waste, SW 846". The SPLP waste extract shall be analyzed for diesel fuel constituents using DHS/EPA Method 8015 modified to quantify the concentration of total petroleum hydrocarbons (TPH) through the carbon range C_{10} to C_{30}, and BTEX using Method 8021. The minimum detection limit for TPH analyses in the waste extract (8015M) shall be no greater than 50 μg/L. The minimum detection limit for BTEX in waste extract, using Method 8021, shall be no greater than 0.5 μg/L.

4. The RWQCB Executive Officer may consider alternative analytical methods and protocols proposed by the discharger. However, discharger must provide the RWQCB with acceptable justification to support proposed alternatives to protocols set forth in this Monitoring and Reporting Program.

5. Under authority of Water Code Section 13267(a), the discharger may be required to submit additional analyses for other waste constituents (*e.g.*, for other fuel additives or degradation products thereof) or additional monitoring reports as deemed appropriate by the RWQCB Executive Officer.

C. REPORTS TO BE FILED WITH THE RWQCB

Under authority of Water Code Section 13267(a), all reports shall be submitted no later than **60 days** following final discharge of FCS waste at the site. The report shall be comprised of the following in addition to the specific contents listed below:

1. Transmittal Letter

A letter summarizing the essential points shall be submitted with each report. The transmittal letter shall include:

a. A discussion of any requirement violations found and actions taken or planned for correcting the violations. If no violations have occurred, this shall be stated in the transmittal letter; and

b. A statement certifying that, under penalty of perjury, that to the best of the signer's knowledge the report is true, complete, and correct as required in in **Reporting Requirements (Section D.9.c.)** of Order R9-2002-0342. An individual that meets the requirements contained in **Reporting Requirements (Section D.9.a. or D.9.b.** of Order R9-2002-0342) shall sign the required statement.

2. Waste Monitoring Report

The discharger shall submit to the RWQCB a final summary technical report. The final report shall include, but not be limited to the following:

a. A completed FCS certification form (attached to Order R9-2002-0342) for each separate source (*i.e.*, unauthorized release case) of petroleum hydrocarbon fuel contaminated soils (FCS wastes) discharged at the site.

b. The following information shall be attached to each completed FCS certification form:

   i. Copy of the laboratory data sheets for analytical results from the waste

   ii. Complete copy of applicable laboratory quality assurance/quality control (QA/QC) data.

   iii. The discharge shall provide the information in 2.b.i and 2.b.ii (above) as an appendix to the Final Summary Report pursuant to **Section F (Final Disposition of Wastes**) of Order R9-2002-0342.

c. Where the reuse of FCS wastes is part of an individual site redevelopment project (involving only one parcel/property), the discharger shall provide the RWQCB with an estimated completion date for the site-specific redevelopment work.

d. Where the reuse of FCS wastes is part of a larger redevelopment project, involving multiple properties/parcels/sites, the discharger shall also provide the RWQCB with an estimated completion date for the final redevelopment project.

D. REPORTING SCHEDULE

Under authority of Water Code Section 13267(a), the discharger is required to comply with the following minimum reporting schedule:

Reporting Frequency	Report Period	Report Due
One Time	Duration of Project	Within **60 days** after discharge of FCS waste is completed.

Reports shall be submitted to the RWQCB Executive Officer:

Executive Officer
California Regional Water Quality Control Board
San Diego Region
9174 Sky Park Court, Suite 100
San Diego, California 92123-4340
Attention: Supervisor Land Discharge Unit

Ordered by: John H Robertus
JOHN H. ROBERTUS
Executive Officer
December 11, 2002

VIII. LABORATORY QA/QC REPORTING GUIDELINES

In the laboratory, QA/QC is protocol designed to verify and maintain a desired level of quality in the analytical process. OA/QC requires careful planning, continued inspection, and appropriate corrective action.

A. Definitions

The commonly used laboratory QA/QC terms are described for the purpose of consistency in San Diego County. It is recognized that other terminology is used in other geographical areas.

1. Calibration Standard (CS)

A standard containing known quantities of target analyses, prepared from traceable stock materials of known, certified quality obtained from a reliable source or sources. Used to calibrate analytical instrument response.

2. Calibration Verification Standard (CVS)

A standard containing known quantities of target analyses, prepared from traceable stock materials of known, certified quality obtained from a reliable source or sources independent from those associated with the corresponding calibration standards. Often obtained as a Quality Control (QC) Check Standard prepared by an outside source. Used to verify the accuracy of the analytical instrument calibration. (See also *Laboratory Control Standard*.)

3. Instrument Detection Limit (IDL)

The smallest quantity of an analyte that can be statistically differentiated from the baseline noise level of an instrument without regard to sample matrix characteristics or to the specific sample preparation and analysis methods employed.

4. Laboratory Control Sample/Blank Spike (LCS)

A "clean," analyte-free matrix sample (e.g., organic-free or deionized water) spiked with known concentrations of target analyses and carried through the same, entire sample preparation and analysis procedure used for samples. LCS spiking stocks are normally prepared from traceable standard materials of known, certified quality obtained from a reliable source or sources independent from those associated with the corresponding calibration standards. (Note: For those methods that treat all standards and samples alike except perhaps for sample aliquot size, the Calibration Verification Standard also qualifies as a Laboratory Control Sample/Blank Spike.) LCS recoveries are used to estimate overall analytical method accuracy independent of sample matrix effects. Also used to demonstrate overall routine method performance. (See also: *Calibration Verification Standard; Method Blank*.)

5. Matrix

The combination of physical and chemical properties of a group of samples which are similar enough to be analyzed together and evaluated by the same quality control criteria. Air, water, soil, tissue, etc., are some general terms typically used to refer to different matrix types.

6. Matrix Spike (MS)

An aliquot of sample spiked with known concentrations of target analyses. Matrix spike recoveries are used to estimate overall sample matrix-dependent analytical method accuracy, and to characterize matrix interference effects.

7. Matrix Spike Duplicate (MSD)

Separate sample aliquot spiked with known concentrations of target analyses. Results of the analysis of matrix spike duplicates are used to estimate overall method precision.

8. Method Blank

A "clean", analyte-free matrix sample (e.g., organic-free or deionized water) carried through the same, entire sample preparation and analysis procedure used for samples. Measures the overall levels of contamination for the method.

9. Method Detection Limit (MDL)

The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero, as determined by a specific method. The MDL takes into account the effects of reagents and preparation and analysis steps.

10. Percent Recovery

Calculated for Matrix Spike, Surrogate, and LCS data, and used to estimate the accuracy of all or part of a measurement process. Matrix Spike Percent Recovery (MSPR) is usually calculated from the results of analyses of samples and their respective sample matrix spikes, according to the following general equation:

$$MSPR = \frac{SSR - SR}{SA} \times 100$$ **Equation E-1**

where:

	MSPR	=	Matrix Spike Percent Recovery
	SSR	=	Spike Sample Result
	SR	=	Sample Result
	SA	=	Spike Added

Surrogate and LCS recoveries are calculated in a similar manner.

11. Relative Percent Difference

Calculated for sample duplicate and matrix spike duplicate data, and used to estimate overall method precision. Relative Percent Difference (RPD) of the results of analyses of sample duplicates is normally calculated according to the following general equation:

$$RPD = \frac{S - D}{} \times 100$$ **Equation E-2**

(S + D) / 2

where:	RPD	=	Relative Percent Difference
	S	=	First Sample Value (original)
	D	=	Second Sample Value (duplicate)

RPD for matrix spike duplicate results is calculated in a similar manner

12. Reporting Detection Limit (RDL)

The minimum concentration of a substance in a specific sample that can be measured and reported with a known and specified level of confidence that the analyte concentration is greater than zero, as determined by a specific method. Typically determined as the corresponding Method Detection Limit (MDL) to which the appropriate adjustments and qualifiers for sample matrix type, aliquot size, sample dilutions of pre-concentrations, and observed interferences have been applied and appended.

13. Sample Duplicates

Separate sample aliquot taken through the entire preparation and analysis procedure. Results of the analyses of sample duplicates are used to estimate overall method precision.

14. Surrogate

An organic compound similar in compositional, extraction, and chromatographic character and behavior to one or more target analyses but not normally found in environmental samples. In GC/MS methods, sample aliquots are spiked with surrogates, and surrogate recoveries are used to indicate method efficiency and can, with qualifications, be used to estimate overall method accuracy.

TABLE E-2: LABORATORY QA/QC REPORTING GUIDELINES

QA/QC Parameters	Indicator of	Required for	Description
Sample duplicate; Matrix Spike duplicate	Precision	All sample analyses	The results of all sample duplicate and/or matrix spike duplicate (MS/MSD) analyses, together with the derived Relative Percent Differences (RPD), should be reported for analytes detected to provide the requisite estimates for precision. Minimum frequency; 5% per batch.
Sample Matrix Spike & Surrogate Recovery Results	Accuracy	All sample analyses. For exceptions, see description note.	The results of all sample matrix spike analyses, together with the derived Matrix Spike Percent Recoveries (MSPR), should be reported for spiked analytes to provide the requisite estimates for accuracy. Minimum frequency; 5% per batch. For mass spectrometric analyses, surrogate spike recoveries may be reported in lieu of matrix spike recoveries unless otherwise directed by DEH.
Reporting Detection Limit	Sample specific limit of detection	All sample analyses	Sample-based, matrix-dependent and method-specific Reporting Detection Limits (RDL) should be reported for all target analytes. A detailed derivation of these RDL, including all statistical formulas and all method- and sample-specific pre-concentration and dilution terms should be made available upon request.
Method blanks	In-house lab contamination	All sample analyses	Either report the results of all method blank analyses for target analytes or provide a statement indicating that target analytes are within laboratory control limits. Any out of control conditions should be explained. Minimum frequency; 5% per batch.
Laboratory Control Sample/Blank Spike	Method Control and Method Accuracy	Required whenever sample matrix spike is outside Control limits or when matrix spiking is not appropriate.	The results of any relevant Laboratory Control Sample/Blank Spike (LCS) analyses, together with the derived Laboratory Control Standard Recoveries (LCSR), should be reported whenever sample matrix spike recoveries are found to be outside the appropriate control limits or whenever matrix spiking is not appropriate for the particular method or sample conditions. If both matrix spike and LCS recoveries are within control limits, a summary statement to the effect that all LCSR and MSPR results are within the specified control limits may be substituted for a detailed report of LCS and MSPR results.
Control Limits	Individual Lab Method Dependent Performance	All sample analyses	Appropriate method-derived or laboratory-defined control limits for reporting RPD, LCSR and MSPR should be provided with the QC report to facilitate the interpretation and evaluation of precision and accuracy estimates. Alternatively, a **current** copy of laboratory control limits should be on file with DEH or made available to the consultant upon request.
Chain of Custody	Sample integrity	All sample analyses	Copies of the completed chain-of-custody forms should accompany the report. The condition (temperature, seals, etc.) of the sample(s) upon receipt by the laboratory should be noted.

Supplemental Information:

1) A complete listing of correlated laboratory sample codes and their respective field sample identifiers should be included in the report.
2) The dates of sample acquisition, receipt, preparation, extraction, and analysis, including all QC samples for which detailed reporting is required (e.g., sample duplicates, sample matrix spikes, laboratory control samples), should be included in the report.
3) The report should supply any supplemental information needed for the interpretation of QC data and the evaluation of data quality, including commentary on out-of-control conditions, sample matrix effects, observed laboratory contamination, anomalies associated with the samples or their analyses, and any other factors that could affect data quality.
4) Calibration, calibration verification, and method blank analytical data need not be reported in detail but should be retained for possible future need. A summary statement to the effect that all such results are within the specified control limits may be substituted for a detailed report of the results.
5) All raw data, chromatograms, laboratory logs, analyst notebooks, and other pertinent documentation should also be retained and should be made available for inspection upon request.

Note: These guidelines apply to site assessment and mitigation work only. For all other purposes, contact DEH.

Appendix F
Examples

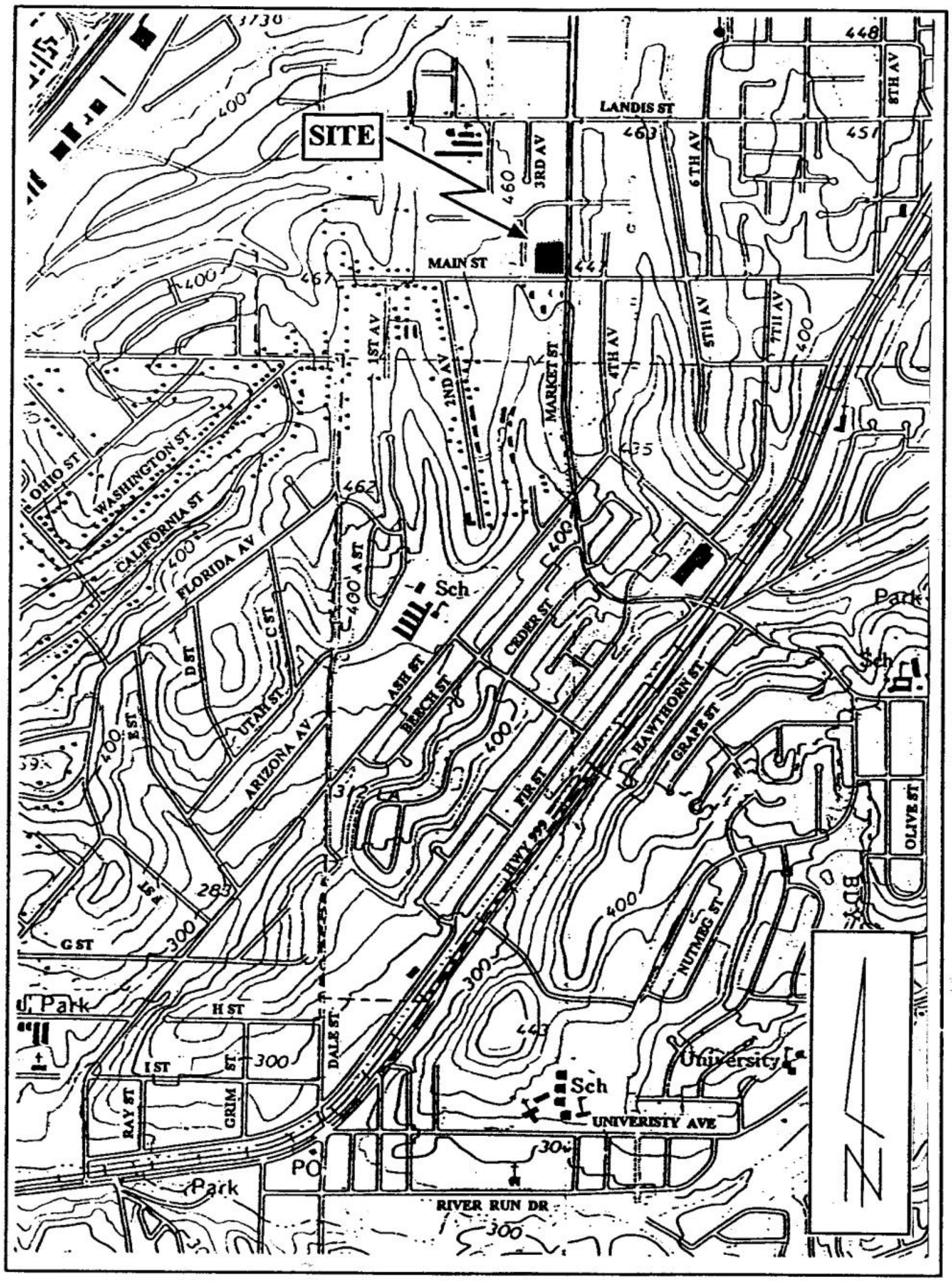
CONTENTS OF APPENDIX F

I. MAPS AND CROSS SECTIONS PRESENTATION OF DATA

All work related to site assessment and mitigation must be documented in a clear and concise manor. In geological and engineering activities, the use of maps and cross sections is a valuable tool in presenting simple-to-very-complex issues.

All site investigations and monitoring reports should incorporate maps and cross sections, including, but not limited to, the following information:

- Site location/vicinity map
- Adjacent land use map
- Utilities site map
- Site map
- Geological cross sections
- Groundwater gradient maps
- Groundwater sampling results map
- All sample locations and relevant sample results



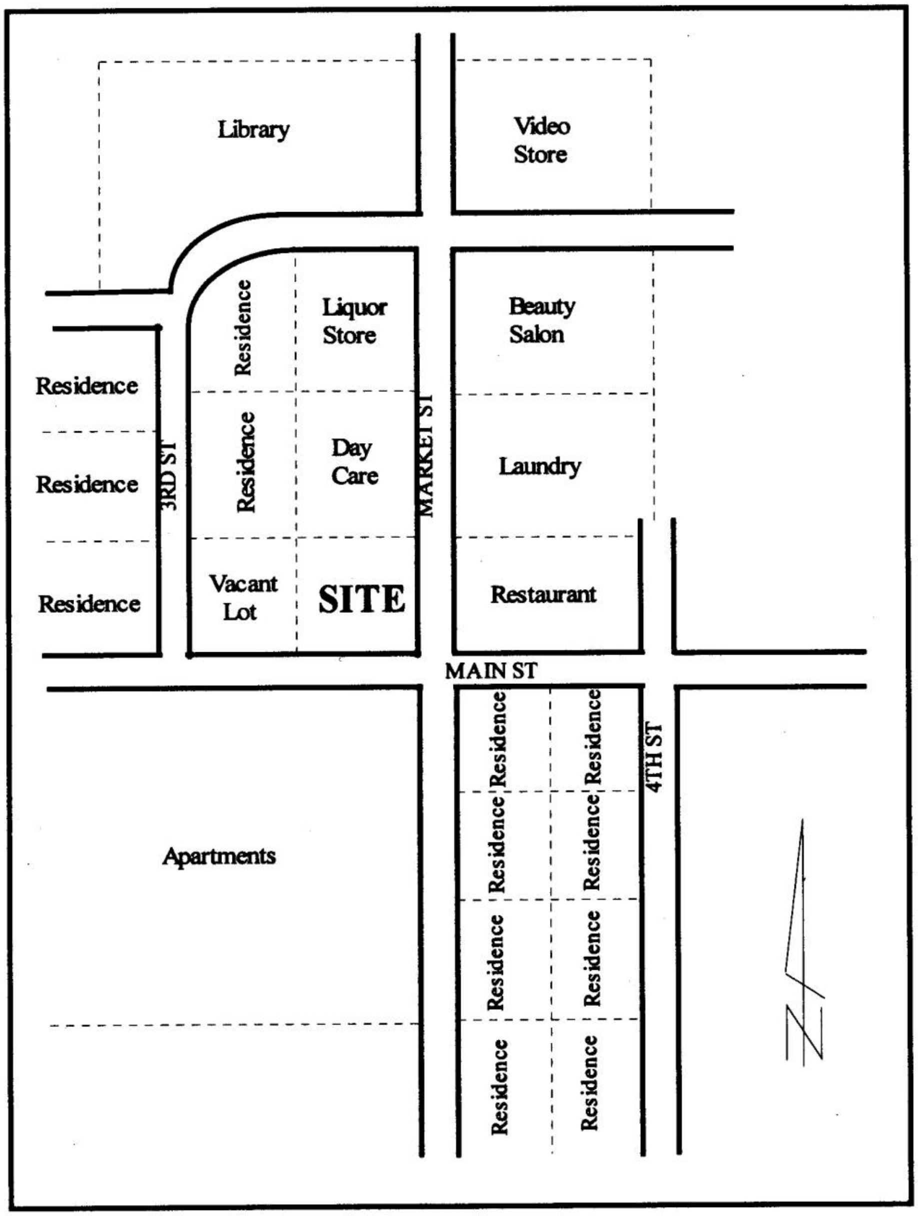
VICINITY MAP

FIGURE 1

Scale (miles)

0 .25 .50

Date: June 4, 1995



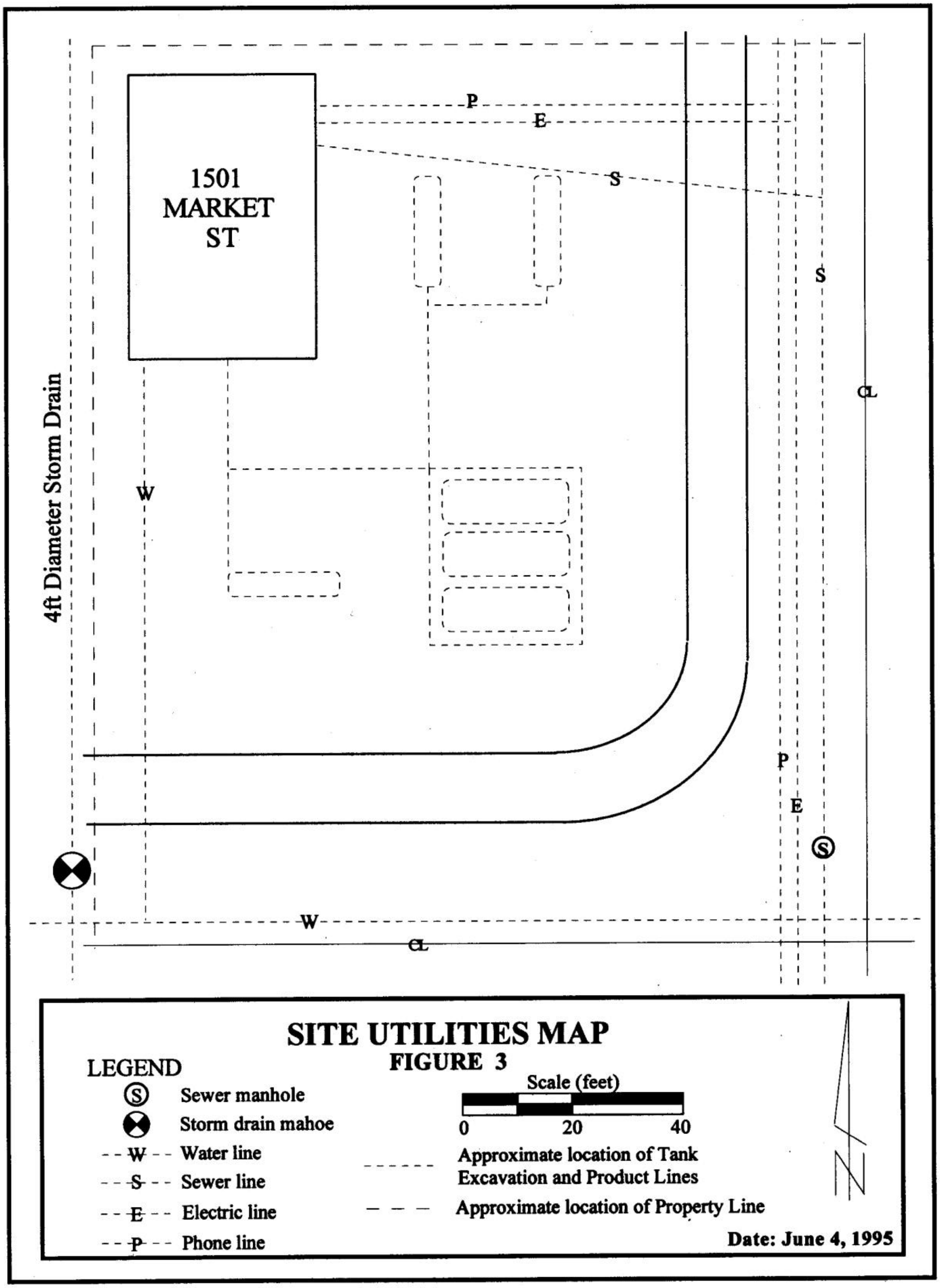
SITE MAP AND SURROUNDING LAND USE

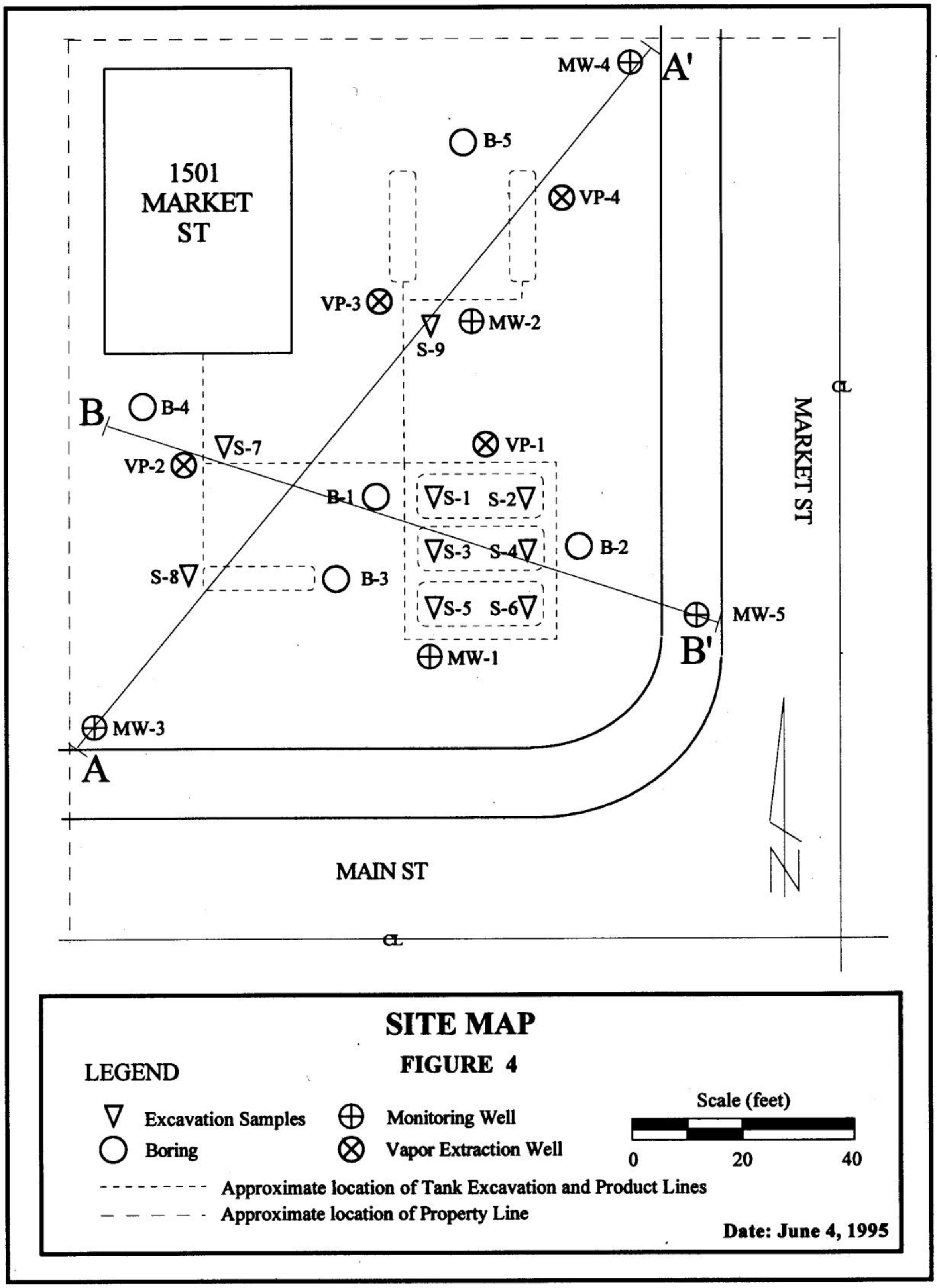
FIGURE 2

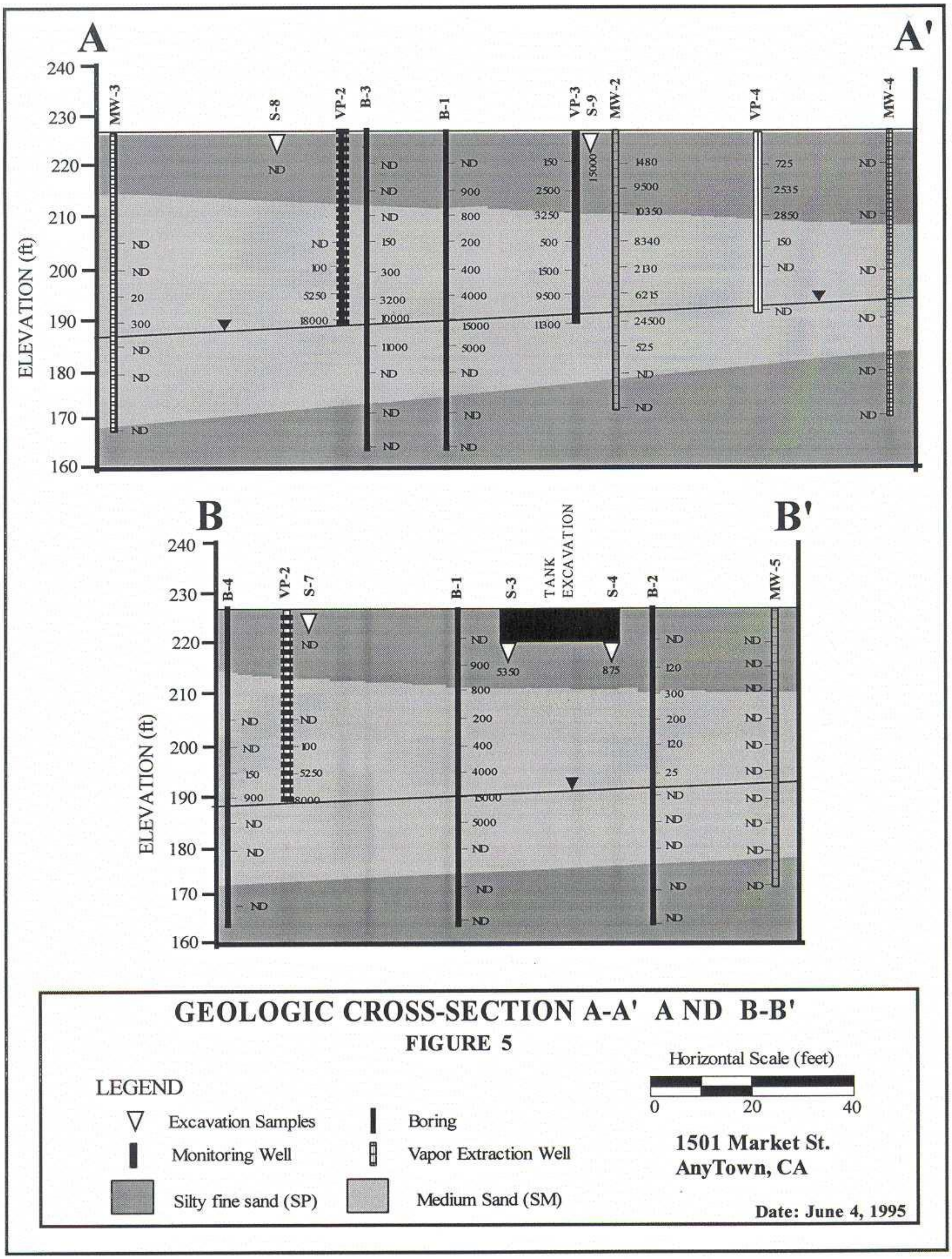
Scale (feet)

0 100 200

Date: June 4, 1995

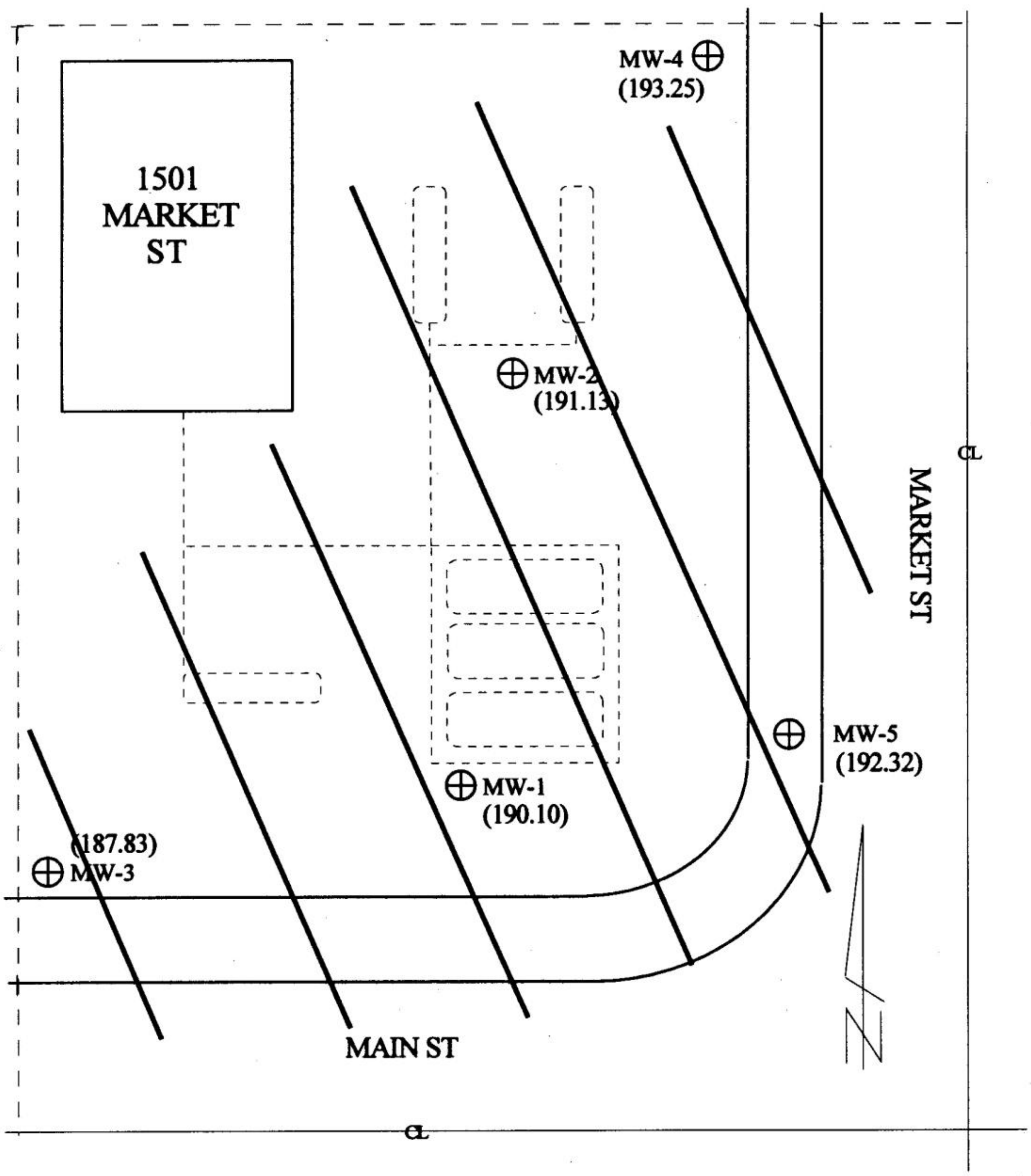

1501
MARKET
ST
4ft Diameter Storm Drain
P
E
S
S
CL
W
P
E
W
CL
SITE UTILITIES MAP
FIGURE 3
LEGEND
Sewer manhole
Storm drain mahoe
W Water line
S Sewer line
E Electric line
P Phone line
Scale (feet)
0
20
40
Approximate location of Tank Excavation and Product Lines
Approximate location of Property Line
N
Date: June 4, 1995


1501
MARKET
ST
MW-4
A'
B-5
VP-4
VP-3
MW-2
S-9
B
B-4
S-7
VP-1
VP-2
B-1
S-1
S-2
B-2
S-3
S-4
S-8
B-3
S-5
S-6
MW-5
B'
MW-1
MW-3
A
MARKET ST
MAIN ST
SITE MAP
FIGURE 4
LEGEND
Excavation Samples
Boring
Monitoring Well
Vapor Extraction Well
Scale (feet)
0
20
40
Approximate location of Tank Excavation and Product Lines
Approximate location of Property Line
Date: June 4, 1995



GEOLOGIC CROSS-SECTION A-A' A ND B-B'

FIGURE 5



GROUNDWATER GRADIENT -- March 23, 1995

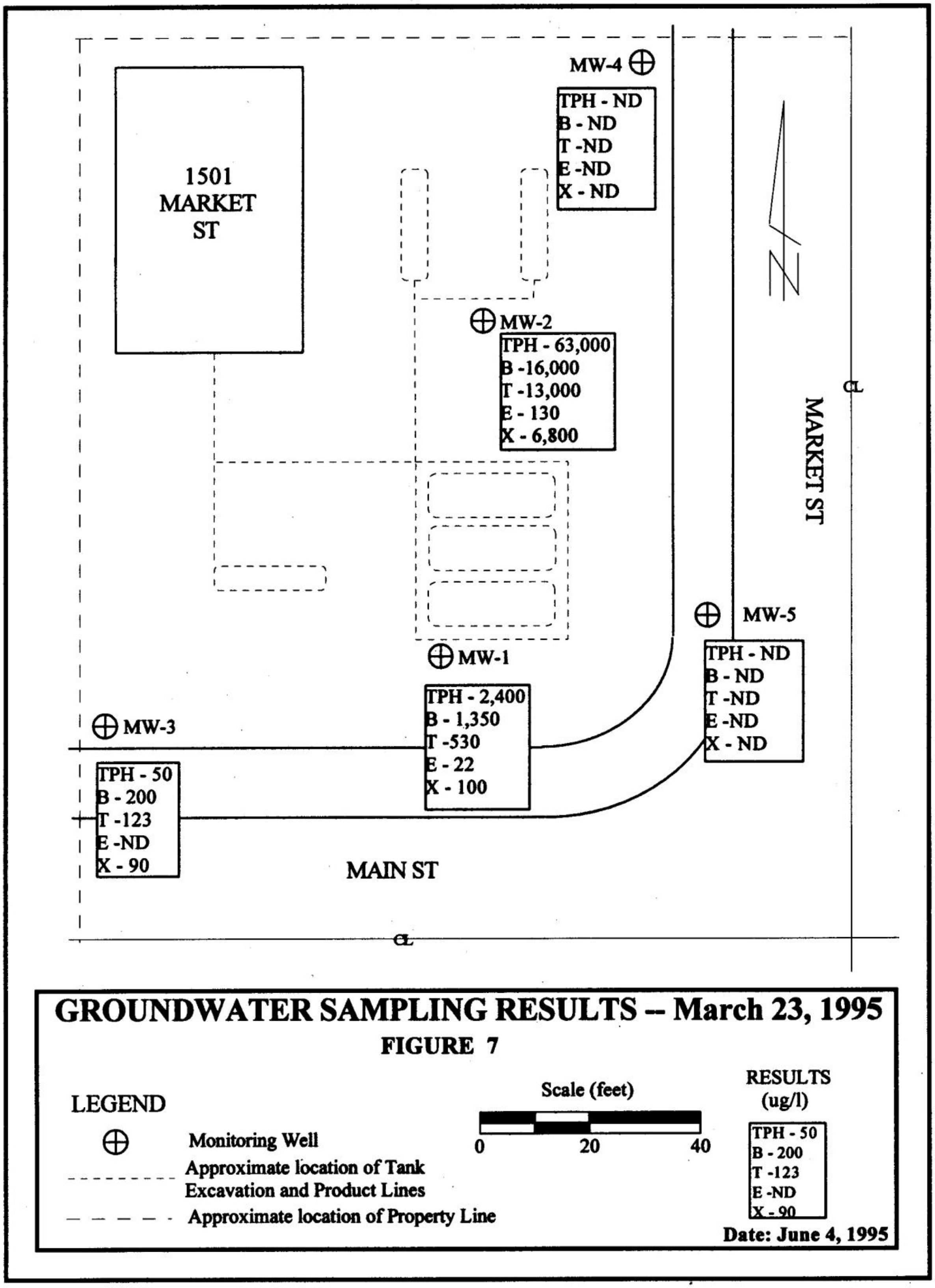
FIGURE 6

LEGEND

MW-1 (190.50)	Monitoring Well Groundwater Elevation
- - - - - - - -	Approximate location of Tank Excavation and Product Lines
— — — —	Approximate location of Property Line

Scale (feet): 0, 20, 40

Date: June 4, 1995


MW-4
TPH - ND
B - ND
T -ND
E -ND
X - ND
1501
MARKET
ST
MW-2
TPH - 63,000
B -16,000
T -13,000
E - 130
X - 6,800
MARKET ST
MW-5
TPH - ND
B - ND
T -ND
E -ND
X - ND
MW-1
TPH - 2,400
B - 1,350
T -530
E - 22
X - 100
MW-3
TPH - 50
B - 200
T -123
E -ND
X - 90
MAIN ST
GROUNDWATER SAMPLING RESULTS -- March 23, 1995
FIGURE 7
LEGEND
Monitoring Well
Approximate location of Tank
Excavation and Product Lines
Approximate location of Property Line
Scale (feet)
0
20
40
RESULTS
(ug/l)
TPH - 50
B - 200
T -123
E -ND
X - 90
Date: June 4, 1995

II. SAMPLE VAPOR PHASE RISK CALCULATIONS

EXAMPLES - VAPOR-PHASE MIGRATION AND RISK EVALUATION

The vapor-phase migration and risk evaluation are discussed in detail in Section 6. All the equations and tables referenced in this appendix can also be found in Section 6. Consultants are encouraged to use the VAPRISK 2000 Model (http://www.sdcounty.ca.gov/deh/water/sam_vapor_risk_assessment_2000.html) which is programmed with each of the equations provided in the following examples.

LEVEL 1 ANALYSIS

Site Description:

The site under evaluation is a neighborhood gasoline station that is surrounded by residential homes. This site experienced a release of gasoline from the underground storage tank system that was replaced in 1990. The site investigation identified the extent of soil and groundwater contamination. Contamination extends off-site with free product extending below a residential home that was built in the late 1960s.

Due to the presence of free-product beneath the residence, a preliminary vapor phase evaluation was warranted. The following are typical steps that should be taken to do a Level 1 Evaluation of the potential health risk.

VAPOR TRANSPORT

Step 1 – Review of site data

A review of the site investigation data indicated that in the area of the residence the subsurface soils were primarily medium to coarse sands. Free product ranging form 0.05 to 0.2 feet in thickness was observed in the area of the residence.

Step 2 – Field verify site conditions

Initially the consultant visited the site and performed a detailed visual evaluation of the residence and its construction. This inspection identified the residence was a structure built with a concrete slab on-grade and the house was ventilated passively with only a forced air heating system. The concrete slab was inspected to verify its condition. Field observations identified the building slab as being in good condition with no observed deterioration or cracking. Based on these observations it was concluded that the use of the 0.01 slab attenuation factor was acceptable for use in the health risk evaluation. Additionally, the residence had an interior room height of 8 feet (2.44 meters).

Step 3 – Calculation of soil gas concentration

Since free-product is present appropriate method to calculate the level of benzene in soils gas is using Equation 6-13 presented below:

$$C_{sg} = \frac{VP * MW * MF}{R * T}$$

Where:	C_{sg}	=	the contaminant concentration in the soil vapor (mg/m^3)
	VP	=	the contaminant vapor pressure at STP (atm)
	MW	=	the molecular weight of the compound of concern (mg/mole)
	MF	=	the mole fraction (dimensionless)
	R	=	the universal gas constant (atm-m^3/mole-K)
	T	=	the temperature in degrees Kelvin (Standard temperature of 293°K)

Using the default values presented in Table 6-4 the soil gas concentration is calculated as follows.

$$C_{sg} = \frac{0.13 \text{ atm} * 78{,}110 \text{ mg/kg} * 0.03}{0.000082 \text{ atm-m}^3\text{/mole-°K} * 293 \text{ °K}} = 12{,}700 \text{ mg/m}^3$$

Step 4 – Calculate Effective Diffusion Coefficient

To calculate the effective diffusion coefficient Equation 6-16, presented below, is used.

$$D_e = \frac{D_a * \theta_a^{3.33}}{\theta^2}$$

Where:	D_e	=	the effective air diffusion coefficient (cm^2/sec)
	D_a	=	the diffusion coefficient of compound in air (cm^2/sec)
	θ_a	=	the air filled porosity (dimensionless)
	θ	=	the total soil porosity (dimensionless)

Since the soils identified in the area of concern (medium to coarse sands) have not been tested to determine the soils porosity and moisture content the default values for porosity and air filled porosity were used (Table 6-4). In reviewing Table 6-3

$$D_e = \frac{0.088 \text{ cm}^2\text{/sec} * 0.20^{3.33}}{0.30^2} = 0.0046 \text{ cm}^2\text{/sec}$$

Step 5 – Calculate Vapor Flux

To calculate vapor flux Equation 6-15 presented below is used.

$$Fx = \frac{D_e * C_{sg} * 3{,}600 \text{ sec/ hr}}{X * 10{,}000 \text{ cm}^2/\text{m}^2}$$

Where:

Fx	=	the contaminant vapor flux (mg/hr-m^2)
D_e	=	the effective air diffusion coefficient (cm^2/sec)
C_{sg}	=	the contaminant concentration in the soil vapor (mg/m^3)
X	=	the depth or distance to contamination in the vadose zone (m)

$$Fx = \frac{0.0046 \text{ cm}^2/\text{sec} * 12{,}700 \text{ mg/m}^3 * 3{,}600 \text{ sec/ hr}}{4.6 \text{ m} * 10{,}000 \text{ cm}^2/\text{m}^2} = 4.56 \text{ mg/hr-m}^2$$

Step 6 – Calculation of Indoor Air Concentration

To calculate the indoor air concentration Equation 6-17 presented below is used.

$$C_i = \frac{S_b * F_x * A}{V * E} = \frac{S_b * F_x}{R_h * E}$$

Where:

C_i	=	the indoor air concentration (mg/m^3)
S_b	=	the slab attenuation factor (dimensionless)
F_x	=	the contaminant vapor flux (mg/hr-m^2)
A	=	the room floor area (m^2)
V	=	the room volume (m^3)
E	=	the indoor air exchange rate per hour (hr^{-1})
R_h	=	the room height (m)

$$C_i = \frac{0.01 * 4.56 \text{ mg/hr-m}^2}{2.44 \text{ m} * 0.5 \text{ hr}^{-1}} = 0.0374 \text{ mg/m}^3$$

VAPOR RISK

Steps 1 though 6 have calculated the indoor air concentration in overlaying residence. This is the vapor transport portion of the evaluation. This indoor air concentration, 0.0374 mg/m^3, is the air concentration that the occupants are exposed to through inhalation. The following steps calculate the human exposure and the potential health risk to these individuals. Since in this evaluation we are evaluating residential exposure then the default values for health risk exposure (Table 6-9) need to be used.

Step 7 – Calculating Human Exposure

To calculate human exposure through inhalation Equation 6-22, presented below, is used

$$IT = \frac{C_i * IR * ET * EF * ED}{BW * AT}$$

Where:

	IT	=	the chemical intake (mg/kg-day)
	C_i	=	the indoor air concentration (mg/m^3)
	IR	=	the inhalation rate (m^3/day)
	ET	=	the exposure time (hr/24hr)
	EF	=	the exposure frequency (days/yr)
	ED	=	the exposure duration (yr)
	BW	=	the body weight (kg)
	AT	=	the averaging time (days)

$$IT = \frac{0.0374 \text{ mg/m}^3 * 20 \text{ m}^3\text{/day} * 24\text{hr/24hr} * 365 \text{ days/yr} * 70 \text{ yr}}{70 \text{ kg} * 25500 \text{ days}} = 0.0107 \text{ mg/kg-day}$$

Step 8 – Calculation of Carcinogenic Risk

To calculate the carcinogenic risk Equation 6-23, presented below, is used.

$$Risk = IT * SF$$

Where:

	Risk	=	the estimate of health risk (dimensionless)
	IT	=	the chemical intake (mg/kg-day)
	SF	=	the contaminant carcinogenic slope factor ($[\text{mg/kg-day}]^{-1}$)

$$Risk = 0.0107 \text{ mg/kg-day} * 0.1 [\text{mg/kg-day}]^{-1} = 1.07 \times 10^{-3}$$

Based on this analysis, the incremental cancer risk is the inverse of the risk calculated above. This result indicates that there is a cancer risk of one in a population of 934 people. This result represents an unacceptable health risk. The acceptable level or risk is one in a population of 1,000,000 (one in a million).

Based on this result, the responsible party should either proceed with remediation or complete a higher level of investigation to collect site-specific information to support a Level 2 risk evaluation.

LEVEL 2 ANALYSIS

Site Description:

The site under evaluation is a commercial property that historically was operated as a dry cleaning business. Site investigation included the collection of soil and vapor data from beneath the concrete floor slab in the area of the former dry cleaning equipment. The investigation identified only tetrachloroethene (PCE) at a maximum concentration of 10 mg/kg in soil and 365 ug/l in soil vapor at approximately 1 foot below the floor slab.

Due to the elevated levels of PCE contamination, a vapor phase evaluation was warranted. The following are typical steps that should be taken to do a Level 2 Evaluation of the potential health risk.

VAPOR TRANSPORT

Step 1 – Review of site data

A review of the site investigation data indicated that the maximum soil vapor concentration was 265 ug/l at 1 foot below (0.33 meters) the floor slab. During the site investigation, the soils at the site were identified as Lindavista Formation-derived fill soils consisting of silty fine sands. Due to fine grained nature of the fill soils, the consultant obtained samples and did site-specific physical testing to determine the in situ soil porosity, moisture content and organic carbon content.

This additional testing provided the following physical properties:

Bulk density	1.9 gm/cm^3
Total porosity	0.255 dimensionless
Water filled porosity	0.135 dimensionless
Air filled porosity	0.120 dimensionless
Total organic carbon content	0.01 dimensionless

Step 2 – Field verify site conditions

Additionally the consultant performed a detailed visual evaluation of the commercial space under consideration, in addition to the adjacent units, to evaluate the building construction and current condition. This inspection identified that the structure was built with an on-grade concrete slab within the past 10 years and the commercial unit was designed with a ventilation system that provided 1.0 air exchange per hour with the outside air.

The concrete slab was inspected to verify its condition. Field observations identified the building slab as being in good condition with no observed deterioration or cracking. Based on these observations, it was concluded that the use of the 0.01 slab attenuation factor was acceptable for use in the health risk evaluation. Additionally, the commercial space had a ceiling height of 8 feet (2.44 meters).

Step 3 – Calculation of soil gas concentration

Based on the site investigation, the maximum soil vapor concentration identified was 265 ug//l.

Since the vapor risk model must use units of mg/m^3 for the soil gas, the maximum soil gas concentration needs to be converted from ug/l. The conversion table is presented in Section 6, Table 6.7.

In this example, the unit of ug/l is equal to that of mg/m^3

$C_{sg} = 265\ mg/m^3$

Step 4 – Calculate Effective Diffusion Coefficient

To calculate the effective diffusion coefficient, Equation 6-16, presented below, is used.

$$D_e = \frac{D_a * \theta_a^{3.33}}{\theta^2}$$

Where:

D_e	=	the effective air diffusion coefficient (cm^2/sec)
D_a	=	the diffusion coefficient of compound in air (cm^2/sec)
θ_a	=	the air filled porosity (dimensionless)
θ	=	the total soil porosity (dimensionless)

Since the soils were tested, the site-specific values presented in Step 1 are used along with the diffusion coefficient obtained from Table 6-2a.

$$D_e = \frac{0.072\ cm^2/sec * 0.120^{3.33}}{0.255^2} = 0.00095\ cm^2/sec$$

Step 5 – Calculate Vapor Flux

To calculate vapor flux, Equation 6-15 presented below is used.

$$Fx = \frac{D_e * C_{sg} * 3{,}600\ sec/\ hr}{X * 10{,}000\ cm^2/m^2}$$

Where:

Fx	=	the contaminant vapor flux ($mg/hr\text{-}m^2$)
D_e	=	the effective air diffusion coefficient (cm^2/sec)
C_{sg}	=	the contaminant concentration in the soil vapor (mg/m^3)
X	=	the depth or distance to contamination in the vadose zone (m)

$$Fx = \frac{0.00095\ cm^2/sec * 265\ mg/m^3 * 3{,}600\ sec/\ hr}{0.33\ m * 10{,}000\ cm^2/m^2} = 0.275\ mg/hr\text{-}m^2$$

Step 6 – Calculation of Indoor Air Concentration

To calculate the indoor air concentration, Equation 6-17 presented below is used.

$$C_i = \frac{S_b * F_x * A}{V * E} = \frac{S_b * F_x}{R_h * E}$$

Where:

	C_i	=	the indoor air concentration (mg/m^3)
	S_b	=	the slab attenuation factor (dimensionless)
	F_x	=	the contaminant vapor flux (mg/hr-m^2)
	A	=	the room floor area (m^2)
	V	=	the room volume (m^3)
	E	=	the indoor air exchange rate per hour (hr^{-1})
	R_h	=	the room height (m)

$$C_i = \frac{0.01 * 0.275 \text{ mg/hr-m}^2}{2.44 \text{ m} * 1 \text{ hr}^{-1}} = 0.00113 \text{ mg/m}^3$$

VAPOR RISK

Steps 1 though 6 have calculated the indoor air concentration in overlaying commercial space. This is the vapor transport portion of the evaluation. This indoor air concentration, 0.000113 mg/m^3, is the air concentration that the occupants are exposed to through inhalation. The following steps calculate the human exposure and the potential health risk to these individuals. Since in this evaluation we are evaluating commercial exposure, the default values for health risk exposure (Table 6-9) need to be used.

Step 7 – Calculating Human Exposure

To calculate human exposure through inhalation, Equation 6-22, presented below, is used

$$IT = \frac{C_i * IR * ET * EF * ED}{BW * AT}$$

Where:

	IT	=	the chemical intake (mg/kg-day)
	C_i	=	the indoor air concentration (mg/m^3)
	IR	=	the inhalation rate (m^3/day)
	ET	=	the exposure time (hr/24hr)
	EF	=	the exposure frequency (days/yr)
	ED	=	the exposure duration (yr)
	BW	=	the body weight (kg)
	AT	=	the averaging time (days)

$$IT = \frac{0.00113\ mg/m^3 * 20\ m^3/day * 12hr/24hr * 250\ days/yr * 25\ yr}{70\ kg * 25500\ days}$$

$$IT = 3.94 \times 10^{-5}\ mg/kg\text{-}day$$

Step 8 – Calculation of Carcinogenic Risk

To calculate the carcinogenic risk, Equation 6-23, presented below, is used. The slope factor for PCE is presented in Table 6-1.

$$Risk = IT * SF$$

Where:
- Risk = the estimate of health risk (dimensionless)
- IT = the chemical intake (mg/kg-day)
- SF = the contaminant carcinogenic slope factor ($[mg/kg\text{-}day]^{-1}$)

$$Risk = 3.94 \times 10^{-5}\ mg/kg\text{-}day * 2.10 \times 10^{-2}\ [mg/kg\text{-}day]^{-1} = 8.28 \times 10^{-7}$$

Based on this analysis, the incremental cancer risk is the inverse of the risk calculated above. This result indicates that there is a cancer risk of one in a population of 1,209,190 people. This result represents an acceptable health risk. The acceptable level or risk is one in a population of 1,000,000 (one in a million).

Appendix G
Agency Directory

CONTENTS OF APPENDIX G

I. LOCAL

A. Department of Environmental Health (DEH), Site Assessment and Mitigation Program (SAM)

Department of Environmental Health

Mailing address: P.O. Box 129261
San Diego, CA 92112-9261

Office address: 1255 Imperial Ave., third floor
San Diego, CA 92101
General Phone: (619) 338-2222, (800) 253-9933 (toll free)

- Concerned with impact on soil/groundwater and public health issues
- Local enforcement agency for Underground Storage Tank (UST) regulations (CCR Title 23) and Hazardous Waste Regulations (CCR Title 22)
- Primary contact for 24 hour unauthorized release reporting and 5 day written report (Underground Storage Tank Unauthorized Release [Leak] Contamination Site Report)
- Coordinates contact with the Regional Water Quality Control Board and other appropriate agencies
- Oversee site assessment/mitigation activities to ensure compliance with state/local regulations
- Issues permits for hazardous waste generators, USTs, UST removals, and USTinstallations
- Issues permits for borings and monitoring wells

B. Air Pollution Control District (APCD)

9150 Chesapeake Dr.
San Diego, CA 92123-1096
General Phone: (858) 694-3307, Enforcement: (858) 694-3340, Meteorology: (858) 694-3355

- Concern with air emissions/air quality.
- Issue Permits for certain types of equipment/treatment processes.

C. Fire Department

Routine calls - Refer to Government listings in the telephone book
Emergency calls - Dial 911

- May issue permits for remediation - varies with jurisdiction.

D. Utilities

- Sewer District
- Water District
- Storm Drain
- San Diego Gas and Electric
- Pacific Bell/AT&T
- Cable TV

Contact as applicable to situation:

- Underground Service Alert, USA (800) 422-4133 for underground utilities location.
- SDG&E (619) 237-2000 (Environmental)
- Pacific Bell (619) 574-4300 (Right of Way-Liaison Office)
- Sewer District (varies) refer to Government Listings
- Water District (varies) refer to Government Listings

E. Public Works/Planning/Building/Code Enforcement

- Refer to Government Listings
- Concerns and requirements vary with jurisdiction

F. San Diego County Department of Agriculture/Weights and Measures

(858) 694-2739

- Concerned with Pesticides

II. STATE

A. REGIONAL WATER QUALITY CONTROL BOARD (RWQCB)

1. **Regional Water Quality Control Board San Diego Region (Region 9)**
   9174 Sky Park Court, Suite 100
   San Diego, CA 92123-4340
   (858) 467-2952

2. **Regional Water Quality Control Board Colorado River Basin Region (Region 7)**
   73-720 Fred Waring Drive, Suite 100
   Palm Desert, CA 92260
   (760) 346-7491

- Enforces Water Code Requirements.
- Coordinates efforts with DEH.
- Joint jurisdiction with DEH overseeing site assessment/mitigation.
- May issue Cleanup and Abatement Order.

- Issues National Pollutants Discharge Elimination System (NPDES) permits.

B. California Environmental Protection Agency (CAL-EPA)
555 Capital Mall, Suite 235
Sacramento, CA 95814
(916) 445-3846

1. **Department of Toxic Substances Control (DTSC)**
   Long Beach Office
   245 West Broadway, Ste. 350
   Long Beach, CA 90802
   (310) 590-4868

2. **Department of Toxic Substances Control (DTSC)**
   P.O. Box 806
   Sacramento, CA 95812-0806
   (916) 323-2679

3. **Department of Toxic Substances Control (DTSC)**
   Waste Evaluation Unit
   P.O. Box 806
   Sacramento, CA 95812-0806
   (916) 322-7676

4. **Department of Toxic Substances Control (DTSC)**
   Environmental Laboratory Accreditation Program
   2151 Berkeley Way, Annex 2
   Berkeley, CA 94704
   (510) 540-2800

C. Office of Environmental Health Hazard Assessment
601 No. 7th St.
Box 942732
Sacramento, CA 94234-7320
(916) 324-7572

D. State Water Resources Control Board (SWRCB)
Underground Tanks
P.O. Box 944212
Sacramento, CA 94244-2120

E. California Department of Fish and Game
(619) 525-4215
- Concerned with impact on fish/wildlife.
- Regulates efforts in wildlife preservation areas.

F. Occupational Safety and Health Administration (OSHA)
(619) 279-3771 - California Consultation
- Concerned with worker/site safety.

- Consider also, Private Industrial Hygienist (CIH).

III. FEDERAL

A. U.S. Coast Guard (USCG)
(619) 683-6505 (Port Operations)

- Concerned with impact on navigable waterways.
- Jurisdiction over Pacific Ocean, San Diego Harbor

B. Occupational Safety And Health Administration (OSHA)
(619) 569-9071 - Federal

- Concerned with worker/site safety.
- Consider also, Private Industrial Hygienist (CIH).

C. Environmental Protection Agency (EPA) (Region 9)
(415) 744-1500 – General
EPA ID# (California) (916) 324-1781 (DTSC), (800) 618-6942

Appendix H
Listings

CONTENTS OF APPENDIX H

LISTINGS

I. CONTAMINATED SITE / ENVIRONMENTAL INVESTIGATION LISTINGS

A. Local Lists

1. SAM CASE LISTING - (Site Assessment and Mitigation Case Listing)

San Diego County Department of Environmental Health (DEH) publishes this list of known environmental assessment cases. The list includes sites with leaking underground storage tanks (USTs) and environmental contamination from sources other than USTs (including soil and groundwater contamination identified during real estate Phase 1 Assessments). Both open and closed cases are listed. This list was recently published on the Internet at:

http://www.sdcounty.ca.gov/deh/lwq/sam

Source: Site Assessment and Mitigation
Contact: San Diego County Department of Environmental Health (DEH)
DEH Records/Information Clerk
Address: 1255 Imperial Avenue, 3rd Floor
P.O. Box 129261
San Diego, CA 92112-9261
(619) 338-2268

B. State Lists

Many state lists may only be of historical interest. Contact the agencies for specific information regarding the frequency of updates and the status of the currently distributed lists.

1. HWP - (Hazardous Waste Property)

California Department of Toxic Substances Control (DTSC) list of sites with deed restrictions that limit land use. Hazardous Waste Properties have not yet (1992) been designated by DTSC. Hazardous Waste Property is land at which hazardous waste has been deposited. A Border Zone Property is any property within 2,000 feet of a hazardous waste deposit.

Source: Properties with Deed Restrictions.
Contact: Department of Toxic Substances Control (DTSC)
Environmental Science Support Unit
Address: P. 0. Box 806
Sacramento, CA 95812-0806

2. CAL-SITES

CAL-EPA list of known and potential hazardous waste sites based on a variety of information sources including ASPIS, Bond Expenditure Program and Annual Workplan). Most of the information is preliminary. Many sites identified as requiring no further action based on determination that either release was of insignificant public or environmental concern, or that no release occurred (Includes Abandoned Site Program- ASPIS, Bond Expenditure Program 1984-BEP, Annual Workplan).

Source: CAL-SITES Program

Contact: CAL-EPA - Department of Toxic Substance Control Site Mitigation Program
Address: P.O. Box 806
Sacramento, CA 95812-0806

Other: Over 26,000 sites in the database. Computer searches of the CAL-SITES database are available through DTSC for a minimal charge ($5.00 per search address) call for information.

Regional: Xerox copy of partial database available through the regional office of DTSC:

Department of Toxic Substances Control
245 West Broadway, Suite 350
Long Beach, CA 90802
(310) 590-4868

3. LUST - (Leaking Underground Storage Tanks)

California State Water Resources Control Board list of sites at which there has been at least one leak of a hazardous substance from a UST.

Source: San Diego Region Leaking Underground Tanks List
Contact: San Diego Regional Water Quality Control Board
Address: 9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340
(858) 467-2952

4. SLIC - (Spills, Leaks, Investigations and Clean-ups)

California State Regional Water Quality Control Board list of sites at which there has had a spill, leak, investigation, and/or clean-up of a hazardous substance.

Source: San Diego Region Spills, Leaks, Investigation and Clean-up List
Contact: San Diego Regional Water Quality Control Board
Address: 9174 Sky Park Court, Suite 100
San Diego, CA 92123-4340
(858) 467-2952

C. Federal Lists

1. CERCLA

US-EPA list of contaminated properties under the federal Superfund program. Maintained since 1982 in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. US-EPA obtains information from reporting requirements; routine inspections of hazardous waste generators and treatment, storage, and disposal facilities; and citizen reports.

Source: Federal Superfund Sites - US-EPA
Contact: US Environmental Protection Agency, Region IX
Attn.: Ms. Sharon Jang, E-1
Address: 75 Hawthorne Street
San Francisco, CA 94105
TEL: (415) 744-1592 (List)
FAX: (415) 744-1604 (Fax)

Other: State that this is a "Freedom of Information Act Request" for this document.

2. NPL - (National Priority List)

US-EPA list of those CERCLA sites that present the greatest potential risk to human health and the environment. US-EPA ranks the sites using its Hazard Ranking System. These sites qualify to receive funding for cleanup under CERCLA.

Source: National Priorities List Sites - US-EPA
Contact: Public Information Center
Address: 401 M Street - South West
Washington, DC 20460
(202) 260-2080

3. LIENS - (Federal Super Fund Liens)

US-EPA list of sites against which they have filed "statutory liens" to recover cleanup, response, or other cost incurred by the agency under CERCLA.

Source: Field Notes of Superfund Liens - US-EPA
Contact: US Environmental Protection Agency
Address: 75 Hawthorne Street
San Francisco, CA 94105
(415) 744-1500 (General)
(415) 744-1593 (List)

Other: State that this is a "Freedom of Information Act Request" for this document.

II. REGULATED BUSINESS LISTINGS

A. Local List

1. HE58 LISTING

San Diego County Department of Environmental Health list of sites that have obtained a permit from HMMD to handle hazardous materials.

Source: San Diego County Department of Environmental Health, Permitted Sites in San Diego County
Contact: DEH Records/Information Clerk
Address: 1255 Imperial Avenue, 3rd Floor
P.O. Box 85261
San Diego, CA 92186-5261
(619) 338-2268

2. APCD PERMIT LISTING

San Diego Air Pollution Control District list of sites that have obtained a permit to operate.

Source: San Diego Air Pollution Control District
Contact: San Diego Air Pollution Control District
Address: 9150 Chesapeake Dr.
San Diego, CA 92123-1096
(858) 694-3307

3. San Diego County Department of Agriculture Weights and Measures Listing

County of San Diego Department of Agriculture list of operators who are licensed and/or are permitted to use controlled substances in San Diego County.

Source: San Diego County Department of Agriculture Weights and Measures
Contact: San Diego County Department of Agriculture Weights and Measures
Address: 5555 Overland Av., Building 3
San Diego, CA 92123
(858) 694-2739

B. State Listings

1. CORTESE

California Governors Office of Planning and Research list of potential and confirmed hazardous waste sites throughout the state. Based on input from Cal-EPA, Department of Health Services, Water Resources Control Board, and Integrated Waste Management Board.

Source: Hazardous Waste and Substances Site List - OPR
Contact: Cal-EPA Office of Environmental Information
Address: P.O. Box 2815, 555 Capitol Mall, Suite 235
Sacramento, CA 95819
(916) 327-1848

Other: DTSC-LA will copy up to 25 pages out of the database for distribution ($2.50). They will fax up to 4 pages at $0.25 per page.

2. HWIS (Hazardous Waste Information Systems)

Cal-EPA list of hazardous waste generators and hazardous waste treatment, storage, and disposal facilities. Information is obtained from manifest reports required from hazardous waste generators.

Source: Hazardous Waste Information System
Contact: Department of Toxic Substance Control
Address: 400 P Street, 4th Floor
Sacramento, CA 95814
(916) 323-6556

Other: DTSC maintains a catalog of other data resources concerning hazardous waste sites, that can be obtained from this office.

3. SWIS (Solid Waste Information Systems)

California Integrated Waste Management Board list of open and closed, as well as inactive, solid waste disposal or transfer facilities.

Source: Active and Inactive Sanitary Landfills and Disposal Facilities - CIWMB
Contact: California Integrated Waste Management Board
Address: 1001 "I" Street
P. O. Box 4025
Sacramento, CA 95812-4025

(916) 255-2296 (General Information)
(800) 553-2962 (Hotline)

Other: California Integrated Waste Management Board Enforcement Division
1752 Orange Tree Lane
Redlands, CA 92374

4. NPDES (National Pollution Discharge Elimination System)

   California State Regional Water Quality Control Board list of sites that have obtained a permit to discharge to surface water.

   Source: San Diego Regional Water Quality Control Board
   Contact: San Diego Regional Water Quality Control Board NPDES Section
   Address: 9174 Sky Park Court, Suite 100
   San Diego, CA 92123-4340
   (858) 467-2952

5. Soil Treatment Facilities

   California State Regional Water Quality Control Board list of sites that have obtained a permit to operate a soil treatment facility.

   Source: San Diego Regional Water Quality Control Board
   Contact: San Diego Regional Water Quality Control Board Solid Waste Disposal Section
   Address: 9174 Sky Park Court, Suite 100
   San Diego, CA 92123-4340
   (858) 467-2952

Appendix I
References

CONTENTS OF APPENDIX I

I. GENERAL REFERENCES

A. California Health and Safety Code (HSC)

Division 20, Chapter 6.5, Hazardous Waste Control
Division 20, Chapter 6.7, Underground Storage of Hazardous Substances
Division 20, Chapter 6.75, Petroleum Underground Storage Tank Cleanup

B. California Code of Regulations (CCR)

Title 22, Div. 4, Chapter 30, Hazardous Wastes
Title 23, Chapter 3, Subchapter 16, Underground Tank Regulations

C. San Diego County Code

Title 6, Div.7, Chapter 4, Wells

D. Water Code

Porter-Cologne Water Quality Control Act.
Division 7 Water Quality

II. TECHNICAL REFERENCES

A. General References

1. State of California, Department of Health Services, Environmental Laboratory Accreditation / Registration: Environmental Laboratory, California Department of Health Services, 2151 Berkeley Way, Berkeley, CA 94704, (415) 540-3105.

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3. State of California, State Water Resources Control Board, 1989, Leaking Underground Fuel Tank Manual, Guidelines for Site Assessment, Cleanup, and Underground Storage Tank Closure: Underground Tanks, P.O. Box 944212, Sacramento, CA 94244-2120, (916) 739-2421.

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D. Soil and Rock Sampling Guideline References

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7. U.S. Environmental Protection Agency, 1988, Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA: October 1988, EPA/540/G-89/004.

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Appendix J
Acronyms and Abbreviations

ACRONYMS AND ABBREVIATIONS

APCD	Air Pollution Control District
APN	Assessors Parcel Number
ASTM	American Society for Testing and Materials
BTEX	Benzene, Toluene, Ethylbenzene, and total Xylenes
Cal-EPA	California Environmental Protection Agency
CAO	Corrective Action Order
CAP	Corrective Action Plan (as defined by Article 11)
CIWMB	California Integrated Waste Management Board
CCR	California Code of Regulations
CEG	Certified Engineering Geologist
CFR	Code of Federal Regulations
CHG	Certified Hydrogeologist
CHSC	California Health and Safety Code
COC	Chemical Of Concern
DEH	Department of Environmental Health
DHS/ELAP	Department of Health Services/Environmental Laboratory Accreditation Program
DHS	State Department of Health Services (in Cal-EPA)
DIPE	Di-Isopropyl Ether
DL	Detection Limit
DNAPL	Dense Non-Aqueous Phase Liquid
DPIS	Discrete Point-Interval Sampling
DTSC	Department of Toxic Substances Control (in Cal-EPA)
DWR	Department of Water Resources
ELCD	Electrolytic Conductivity Detector
ESA	Environmental Site Assessment
ETBE	Ethyl Tertiary Butyl Ether
FID	Flame Ionization Detector
GC	Gas Chromatography
GC/FID	Gas Chromatography/Flame Ionization Detector
GC/MS	Gas Chromatography/Mass Spectrometry
IRA	Interim Remedial Action
LCS	Laboratory Control Sample

LEA	Local Enforcement Agency
LNAPL	Light Non-Aqueous Phase Liquid
LOP	Local Oversight Program
LUFT	Leaky Underground Fuel Tank
MCL	Maximum Contaminant Level
MS	Mass Spectometry
MSDS	Material Safety Data Sheet
MTBE	Methyl Tertiary Butyl Ether
NAPL	Non-Aqueous Phase Liquid
ND	Non-Detect
NFA	National Fire Association
NFA	No Further Action
NIOSH	National Institute of Occupational Safety and Health
NMAM	NIOSH Manual of Analytical Methods
OEHHA	Office of Environmental Health and Hazard Analysis
OSHA	Occupational Safety and Health Administration
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photoionization Detector
PNA	Poly-Nuclear Aromatic Hydrocarbon (also known as PAH)
PPA	Prospective Purchaser Agreement
PRG	Preliminary Remediation Goal
QA/QC	Quality Assurance/Quality Control
RCE	Registered Civil Engineer
RCRA	Resource Conservation and Recovery Act
RF	Response Factor
RG	Registered Geologist
RP	Responsible Party
RRT	Relative Retention Time
RSD	Relative Standard Deviation
RWQCB	Regional Water Quality Control Board
SAM	Site Assessment and Mitigation
SDP	Site Designation Program
STLC	Soluble Threshold Limit Concentration (CCR Title 22)
SVOC	Semi-Volatile Organic Compound
SW-846	Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, Third Edition (1986), U.S. Environmental Protection Agency
TAME	Tert-Amyl Methyl Ether
TBA	Tertiary Butyl Alcohol
TPH	Total Petroleum Hydrocarbons (as determined by DHS-TPH analytical method)
TRPH	Total Recoverable Petroleum Hydrocarbons (as determined by EPA Test Method 418.1)
TTLC	Total Threshold Limit Concentration (CCR Title 22)
USCS	Unified Soil Classification System
UST	Underground Storage Tank
VAP	Voluntary Assistance Program
VOC	Volatile Organic Compound
WSPA	Western States Petroleum Association

Appendix K
Article 11

ARTICLE 11, CALIFORNIA CODE OF REGULATIONS, TITLE 23, CHAPTER 16

The most current copy of these regulations can be found at the following State Water Resources Internet web site: http://www.swrcb.ca.gov/~cwphome/ust/caustreg.htm

Article 11. Corrective Action Requirements (12/20/99)

2720. Additional Definitions

Unless the context clearly indicates otherwise, the following definition shall apply to terms used in this Article.

"Corrective action" means any activity necessary to investigate and analyze the effects of an unauthorized release; propose a cost-effective plan to adequately protect human health, safety, and the environment and to restore or protect current and potential beneficial uses of water; and implement and evaluate the effectiveness of the activity(ies). Corrective action does not include any of the following activities:

(1) Detection, confirmation, or reporting of the unauthorized release; or

(2) Repair, upgrade, replacement or removal of the underground storage tank.

"Cost effective" means actions that achieve similar or greater water quality benefits at an equal or lesser cost than other corrective actions.

"Federal act" means Subchapter IX (commencing with Section 6991) of Chapter 82 of Title 42 of the United States Code, as added by the Hazardous and Solid Waste Amendments of 1984 (P.L. 98-616), or as it may subsequently be amended or supplemented, and the regulations adopted pursuant thereto.

"Regulatory agency" means the Board, regional board, or any local, state, or federal agency which has responsibility for regulating underground storage tanks or which has responsibility for overseeing cleanup of unauthorized releases from underground storage tanks.

"Responsible party" means one or more of the following:

(1) Any person who owns or operates an underground storage tank used for the storage of any hazardous substance;

(2) In the case of any underground storage tank no longer in use, any person who owned or operated the underground storage tank immediately before the discontinuation of its use;

(3) Any owner of property where an unauthorized release of a hazardous substance from an underground storage tank has occurred; and

(4) Any person who had or has control over an underground storage tank at the time of or following an unauthorized release of a hazardous substance.

Authority: H&SC 25299.77
Reference: H&SC Section 25299.37 and 40 CFR Section 280.12

2721. General Applicability of Article

(a) Responsible parties for an underground storage tank shall comply with the requirements of this article whenever there is any reportable unauthorized release pursuant to Section 25295 of Chapter 6.7.

(b) Responsible parties shall take corrective action in compliance with the following requirements:
(1) all applicable waste discharge requirements or other order issued pursuant to Division 7, commencing with section13000 of the Porter-Cologne Water Quality Control Act (Water Code);

(2) all applicable state policies for water quality control adopted pursuant to Article 3 (commencing with Section 13140) of Chapter 3 of Division 7 of the Water Code;

(3) all applicable water quality control plans adopted pursuant to Article 3 (commencing with Section 13240) of Chapter 4 of Division 7 of the Water Code;

(4) all applicable requirements of Chapter 6.7 (commencing with Section 25280) and the regulations (Chapter 16, Title 23 CCR) promulgated thereto; and

(5) all applicable requirements of Article 4 of Chapter 6.75 of the Health and Safety Code, the applicable provisions of this Chapter, and the Federal act.

(c) When acting as the regulatory agency, the Board or regional board shall take appropriate action pursuant to Division 7, commencing with Section 13000 of the California Water Code, to ensure that corrective action complies with the applicable policies for water quality control and applicable water quality control plans.

(d) The regulatory agency responsible for overseeing corrective action at an underground storage tank site shall comply with the applicable public participation provisions of Section 2728 of this Article.

(e) Upon completion of required corrective action, the regulatory agency shall inform the responsible party in writing that no further work is required at that time, based on available information. This written notice shall constitute agency concurrence on the completed corrective action.

Authority: H&SC Section 25299.77
Reference: H&SC Sections 25299.37, 25299.54, 25295, and 25298 and 40 CFR Section 280.67

2722. Scope of Corrective Action

(a) Corrective action includes one or more of the following phases:

(1) Preliminary Site Assessment Phase

(2) Soil and Water Investigation Phase;
(3) Corrective Action Plan Implementation Phase; and
(4) Verification Monitoring Phase.

(b) The responsible party shall take or contract for interim remedial actions, as necessary, to abate or correct the actual or potential effects of an unauthorized release. Interim remedial actions can occur concurrently with any phase of corrective action. Before taking interim remedial action, the responsible party shall notify the regulatory agency of the proposed action and shall comply with any requirements that the regulatory agency sets. Interim remedial actions include, but are not limited to, the following:

(1) removal of free product. Free product removal must comply with the applicable provisions of Section 2655 of Article 5;

(2) enhanced biodegradation to promote bacterial decomposition of contaminants;

(3) excavation and disposal of contaminated soil;

(4) excavation and treatment of contaminated soil;

(5) vacuum extraction of contaminants from soil or groundwater; and

(6) pumping and treatment of ground water to remove dissolved contaminants.

(c) The responsible party shall submit a workplan to the regulatory agency responsible for overseeing corrective action at the underground storage tank site, under the conditions listed below. If no regulatory agency has assumed responsibility for overseeing corrective action, the responsible party shall submit the workplan to the regional board with jurisdiction for the site where the underground storage tank is or was located:

(1) for proposed activities under the Preliminary Site Assessment Phase, if directed by the regulatory agency; and

(2) before initiating any work in accordance with Sections 2725 and 2727 of this Article.

(d) The workplan shall include the proposed actions and a proposed schedule for their completion. The responsible party shall modify the workplan, as necessary, at the direction of the regulatory agency.

(e) In the interest of minimizing environmental contamination and promoting prompt cleanup, the responsible party may begin implementation of the proposed actions after the workplan has been submitted and before it has received agency concurrence. Implementation of the workplan may begin sixty (60) calendar days after submittal, unless the responsible party is otherwise directed in writing by the regulatory agency. Before beginning these activities, the responsible party shall:

(1) notify the regulatory agency of the intent to initiate the proposed actions included in the workplan submitted; and

(2) comply with any conditions set by the regulatory agency, including mitigation of adverse consequences from cleanup activities.

Authority: H&SC Section 25299.77

Reference: H&SC Sections 25295, 25297, 25299.14, 25299.37, 25299.78, and 40 CFR Sections 280.53, and 280.60 through 280.66, and Section 13267 of the Water Code

2723. Preliminary Site Assessment Phase

(a) The Preliminary Site Assessment Phase includes, at a minimum, initial site investigation, initial abatement actions and initial site characterization in accordance with Sections 2652, 2653, and 2654 of Article 5 and any interim remedial actions taken in accordance with Section 2722(b) of this Article.

(b) Implementation of any of the interim remedial actions or any of the activities included in the Preliminary Site Assessment Phase shall constitute initiation of corrective action.

Authority: H&SC Section 25299.77
Reference: H&SC Sections 25295, 25298, 25299.37, and 40 CFR Sections 280.61 and 280.62

2724. Conditions That Require Soil and Water Investigation

The responsible party shall conduct investigations of the unauthorized release, the release site, and the surrounding area possibly affected by the unauthorized release, if any of the following conditions exists:

(1) There is evidence that surface water or ground eater has been or may be affected by the unauthorized release;

(2) Free product is found at the site where the unauthorized release occurred or in the surrounding area;

(3) There is evidence that contaminated soils are or may be in contact with surface water or ground water; or

(4) The regulatory agency requests an investigation, based on the actual or potential effects of contaminated soil or ground water on nearby surface water or ground water resources or based on the increased risk of fire or explosion.

Authority: H&SC Section 25299.77
Reference: H&SC Sections 25299.37 and 40 CFR Sections 280.61 through 280.64

2725. Soil and Water Investigation Phase

(a) The Soil and Water Investigation Phase includes the collection and analysis of data necessary to assess the nature and vertical and lateral extent of the release and to determine a cost-effective method of cleanup.

(b) Using information obtained during the investigation, the responsible party shall propose a Corrective Action Plan. The Corrective Action Plan shall consist of those activities determined to be cost-effective.

(c) The responsible party shall submit the Corrective Action Plan to the regulatory agency for review and concurrence. The regulatory agency shall concur with the Corrective Action Plan after determining that implementation of the plan will adequately protect human health, safety and the environment and will restore or protect current or potential beneficial uses of water. The responsible party shall modify the Corrective Action Plan in response to a final regulatory agency directive.

(d) The Corrective Action Plan shall include the following elements:

(1) an assessment of the impacts listed in subsection (e) of this Section;

(2) a feasibility study, in accordance with subsection (f) of this Section; and

(3) applicable cleanup levels, in accordance with subsection (g) of this Section.

(e) An assessment of the impacts shall include, but is not limited to, the following:

(1) The physical and chemical characteristics of the hazardous substance or its constituents, including their toxicity, persistence and potential for migration in water, soil, and air;

(2) The hydrogeologic characteristics of the site and the surrounding area where the unauthorized release has migrated or may migrate;

(3) The proximity and quality of nearby surface water or ground water, and the current and potential beneficial uses of these waters;

(4) The potential effects of residual contamination on nearby surface water and ground water; and

(f) The responsible party shall conduct a feasibility study to evaluate alternatives for remedying or mitigating the actual or potential adverse effects of the unauthorized release. Each alternative shall be evaluated for cost-effectiveness, and the responsible party shall propose to implement the most cost-effective corrective action.

(1) For all sites, each recommended alternative shall be designed to mitigate nuisance conditions and risk of fire or explosion;

(2) For sites where the unauthorized release affects or threatens waters with current or potential beneficial uses designated in water quality control plans, the feasibility study shall also identify and evaluate at least two alternatives for restoring or protecting these beneficial uses;

(3) For sites where the unauthorized release affects or threatens waters with no current or potential beneficial uses designated in water quality control plans, the feasibility study shall identify and evaluate at least one alternative to satisfy paragraph (1) of this subsection.

(g) Cleanup levels for ground or surface waters, affected or threatened by the unauthorized release, shall comply with the requirements of Section 2721(b) and shall meet the following requirements:

(1) For waters with current or potential beneficial uses for which numerical objectives have been designated in water quality control plans, the responsible party shall propose at least two alternatives to achieve these numerical objectives;

(2) For waters with current or potential beneficial uses for which no numerical objectives have been designated in water quality control plans, the responsible party shall recommend target cleanup levels for long-term corrective actions to the regulatory agency for concurrence. Target cleanup levels shall be based on the impact assessment, prepared in accordance with subsection (e) of this Section.

Authority: H&SC Section 25299.77
Reference: H&SC Sections 25299.37, 25299.57

2726. Corrective Action Implementation Phase

(a) The Corrective Action Plan Implementation Phase consists of carrying out the cost-effective alternative selected during the Soil and Water Investigation Phase for remediation or mitigation of the actual or potential adverse effects of the unauthorized release.

(b) Upon concurrence with the Corrective Action Plan or as directed by the regulatory agency, the responsible party shall implement the Corrective Action Plan. The responsible party shall monitor, evaluate, and report the results of implementation of the Corrective Action Plan on a schedule agreed to by the regulatory agency.

(c) In the interest of minimizing environmental contamination and promoting prompt cleanup, the responsible party may begin cleanup of soil and water after the Corrective Action Plan has been submitted and before it has received agency concurrence. Implementation of the Corrective Action Plan may begin sixty (60) calendar days after submittal, unless the responsible party is otherwise directed in writing by the regulatory agency. Before beginning this cleanup, the responsible party shall:

(1) notify the regulatory agency of its intention to begin cleanup; and

(2) comply with any conditions set by the regulatory agency, including mitigation of adverse consequences from cleanup activities.

(d) The responsible party shall modify or suspend cleanup activities when directed to do so by the regulatory agency.

Authority: H&SC Section 25299.77
Reference: H&SC Section 25299.7 and 40 CFR Sections 280.65 and 280.66

2727. Verification Monitoring Phase

(a) The Verification Monitoring Phase includes all activities required to verify implementation of the Corrective Action Plan and evaluate its effectiveness.

(b) The responsible party shall verify completion of the Corrective Action Plan through sampling or other monitoring of soil and/or water for such period of time and intervals agreed to by the regulatory agency. Using the monitoring results obtained pursuant to this Section and any other relevant data obtained pursuant to this Article, the responsible party shall evaluate the effectiveness of the site work.

(c) The responsible party shall submit monitoring data and an evaluation of the results of such monitoring in writing on a schedule and for a duration agreed to by the regulatory agency.

Authority: H&SC Section 25299.77
Reference: H&SC Section 25299.37 and 40 CFR Section 280.65

2728. Public Participation

(a) For each confirmed unauthorized release that requires a Corrective Action Plan, the regulatory agency shall inform the public of the proposed activities contained in the Corrective Action Plan. This notice shall include at least one of the following:

(1) publication in a regulatory agency meeting agenda;

(2) public notice posted in a regulatory agency office;

(3) public notice in a local newspaper;

(4) block advertisements;

(5) a public service announcement;

(6) letters to individual households; or

(7) personal contacts with the affected parties by regulatory agency staff.

(b) The regulatory agency shall ensure that information and decisions concerning the Corrective Action Plan are made available to the public for inspection upon request.

(c) Before concurring with a Corrective Action Plan, the regulatory agency may hold a public meeting when requested by any member of the public, if there is sufficient public interest on the proposed Corrective Action Plan.

(d) Upon completion of corrective action, the regulatory agency shall file public notice that complies with subsection (a) of this Section, if both of the following conditions apply:

(1) Implementation of the Corrective Action Plan does not achieve the cleanup levels established in the Corrective Action Plan; and

(2) The regulatory agency does not intend to require additional corrective action, except for monitoring in accordance with Section 2727.

(e) The regulatory agency shall comply with all applicable provisions of the California Environmental Quality Act, Public Resources Code, commencing with Section 21000.

Authority: H&SC Section 25299.77
Reference: H&SC Sections 25299.37 and 25299.78 and 40 CFR Sections 280.65 through 280.67

Appendix L
UST Cleanup Fund

CALIFORNIA UNDERGROUND STORAGE TANK CLEANUP FUND

A. History

The Barry Keene Underground Storage Tank Cleanup Fund Act of 1989 created the Underground Storage Tank Cleanup Fund Program to help owners and operators of underground storage tanks (USTs) satisfy federal and state financial responsibility requirements and to assist with the costs of cleanup of contaminated soil and groundwater caused by leaking petroleum USTs. The Fund also provides coverage for third-party liability due to releases.

Established by SB 299 in 1989, modified by SB 2004 in 1990, and extended by SB 989 in 1999, the funding is collected by the State Board of Equalization and ends on January 1, 2011.

To be eligible to file a claim against the Fund, a person must be a current or past owner or operator of a petroleum UST that has released petroleum and which is subject to state regulation. Owners of small home heating oil tanks that have released petroleum are also eligible. Other eligibility conditions include compliance with applicable state permit requirements and regulatory agency cleanup orders. Claimants may receive reimbursements up to $1,500,000. A deductible applies to all claimants except those who qualify for Priority A.

The Fund is administered by the State Water Resources Control Board (SWRCB). On September 26, 1991, the SWRCB adopted emergency regulations implementing the program, and the regulations became effective on December 2, 1991.

B. Claim Priority System

The implementing legislation sets forth a claim priority system that is based on claimant characteristics. The highest priority, Class A, is given to residential UST owners; the second priority, Class B, is given to small California businesses, governmental agencies and nonprofit organizations with gross receipts below a specified maximum; the third priority, Class C, is given to California businesses, governmental agencies and nonprofit organizations having fewer than 500 employees; and the fourth priority, Class D, is given to all other claimants.

Under statute, the Priority List must be updated at least once a year to include new claims. Since fall 1993, the Fund has been updating the list monthly. Claims from previous updates retain their relative ranking within their priority class with new claims ranked in their appropriate class below those carried over from the previous list. New claims in a higher priority class must be processed before older claims in a lower priority class.

There is one major exception to the priority system. Legislation passed in 1993 requires the Fund to award approximately 15 percent of its funds annually to any lower priority classes that would not otherwise be funded (i.e., "C" and "D" claimants each receive at least 15 percent of the annual funding).

C. Letters of Commitment

When a claim is activated from the Priority List, the eligibility requirements are verified with the appropriate regulatory agency, and a Letter of Commitment (LOC) is issued. The LOC is the mechanism by which the program awards or encumbers funds for reimbursement of cleanup costs. A claim is removed from the Priority List when the claimant is issued an LOC. Initial LOCs are issued in an amount adequate to cover the actual eligible costs incurred to date. LOC amounts are administratively increased as necessary to insure sufficient funding of eligible costs.

D. Reimbursements

Once an LOC is issued, claimants may submit payment requests. Eligible costs include reasonable and necessary corrective action costs incurred after January 1, 1988, and amounts awarded in third-party compensation against the claimant. Only costs paid by or on behalf of the claimant may be reimbursed.

E. Financial Responsibility

Federal EPA regulations (Section 280.90, Subpart H-Financial Responsibility, Part 280, 40 CFR) published on October 16, 1988, require owners and operators of USTs to demonstrate through insurance coverage or other acceptable mechanisms that they can pay for cleanup and third-party damages resulting from leaks that may occur from their USTs.

On June 9, 1993, the United States Environmental Protection Agency (EPA) approved California's Fund as a mechanism for meeting the federal financial responsibility requirements for USTs containing petroleum.

In order for the Fund to be used as a financial responsibility mechanism, the law requires that the claimant must (a) be the owner or operator of a petroleum UST as defined in Section 25281 (x) of the H&SC; (2) be in compliance with applicable financial responsibility requirements; and (3) be in compliance with UST laws and regulations.

F. Appeals

Claimants who fail to reach agreement with the Fund on any Fund decision may appeal that decision. The appeal process is found in Article 5, Chapter 18 of the UST Cleanup Fund regulations. In addition, a recently adopted Senate Bill (SB 562) allows for a review of all sites which have an existing Letter of Commitment which is 5 years or older. SB 562 also provides for <u>any</u> owner or operator who has a Fund claim to request a case review by the Fund Manager. For those owners or operators who have not applied to the Fund, they may petition the State Board for review of their case. All case reviews are specific to those sites where the owner or operator believes that the corrective action plan has been satisfactorily implemented.

1. General Information

Fund Overview: who are we, what do we do
How to Contact the Fund: addresses and phone numbers
Fund's Status: how many applications, LOCs, Reimbursement Requests

2. Bulletins, News Releases, and Special Notices

New 1996 Regulations Available
Final Cost Guidelines Available
Lawrence Livermore Report recommends dramatic changes to UST corrective actions
Fund issues no new LOCs for remainder of 95/96 fiscal year
Walt Pettit's February 16, 1996 letter to regional EOs and LOP Directors.

3. Technical Guidance

Cost Guidelines: Fund's Cost Guidelines for corrective action work in California
Guidance #4: pre-approving corrective action costs, assisting claimants, and improving California's UST Cleanup Process
Guidance #3: assisting claimants with hiring of consultants and contractors
Guidance #2: Contractor's State Licensing Laws as they pertain to work with the USTCF
Guidance #1: Fund's Three Bid Requirement (see updated version in Cost Guidelines Policy section)

RMICB: Recommended Minimum Invoice Cost Breakdown

4. UST Update Newsletters

UST Update #8: UST Update Newsletter #8, Spring 1996
Previous UST Updates: UST Update Newsletter Back Issues

5. Available Documents to Download

Cost Guidelines: in HTML or PDF format for printing or viewing off-line
1996 Regulations: in HTML or PDF format for printing or viewing off-line
Application: instructions and forms to apply to the Fund
Reimbursement Request(s): instructions and forms for completing a reimbursement request
Spreadsheets: example copies of spreadsheets for Reimbursement Requests
Financial Responsibility Guide: instructions and forms
1996 Fund Regulations: the fine print

6. Financial Responsibility

Financial Responsibility Guide: how it works, dated 1995
Financial Responsibility Long Term Study: report, dated January 1995
USTCF Regulations pertaining to financial responsibility

7. Legislative Reports

Legislative Annual Report: September 1994
Financial Responsibility Long Term Study: January 1995

Blythe Environmental Remediation demonstration Project: May 1995

8. Regulations

1996 USTCF Regulations: the "fine print" for your reading enjoyment

Preview of Coming Attractions

USTCF Corrective Action Guide (CAG)
USTCF Searchable Databases
(Note: All Documents can be found on the Fund's web site at:
http://www.swrcb.ca.gov/-cwphome/fundhome.htm)
For technical problems or questions: cwphome@swrcb.ca.gov

State of California
Division of Clean Water Programs
UST Cleanup Fund
(USTCF)

How to Contact the Fund....

Call our 800 number and leave a message.

1-800-813-FUND (3863)

Our fax number is: **(916) 227-4530**

Send mail through the U.S. Postal Service to:

UST Cleanup Fund
P.O. Box 944212
Sacramento, CA 94244-2120

Send parcels and packages (UPS, FedEx, etc.) to:

UST Cleanup Fund
UST Cleanup Fund
1001 "I" Street, 17th Floor
Sacramento, CA 95814-2828

Appendix M
State MTBE Draft Guidelines

FINAL DRAFT – 3/27/2000
Guidelines for Investigation and Cleanup of MTBE and Other Ether-Based Oxygenates

Overview

This document has been developed in response to Executive Order D-5-99 and Senate Bill 989 (Sher -- Chapter 812, Statutes of 1999). It is intended to assist managers and staff at state and local regulatory agencies with the task of overseeing the investigation and cleanup of sites where there have been or may have been releases of MTBE-laden petroleum. This document will serve as a basis for reporting to Cal/EPA and the legislature regarding progress made on cleaning up MTBE.

The essence of this document is the understanding that the standard approach for dealing with petroleum releases employed over the past decade will not suffice for MTBE, because unlike traditional petroleum constituents such as benzene, MTBE moves quickly to pollute water and is slow to degrade in the subsurface environment. Response time is critical for MTBE. A quick response to a release greatly increases the ability to check the spread of the MTBE and to clean up the mass of the release. Because time is critical, regulators will need to prioritize their cases and give first attention to those that pose the greatest risk to groundwater. It is also expected that there will be more need for vertical definition of MTBE plumes and more reliance on active cleanup technologies, such as soil vapor extraction, in situ groundwater remediation, and groundwater pump and treat systems, than there has been for non-MTBE petroleum.

Lead agencies are expected to understand the extent of MTBE releases in their jurisdiction, the proximity of those plumes to nearby receptors (ie. drinking water wells and surface water supplies), and the approximate travel time for the plume to reach the receptor. With this information, lead agencies will be able to direct resources to those sites where the plumes are most likely to impact a nearby receptor. A two-phase priority classification system to allocate resources during investigation and cleanup is presented to help accomplish that task. Technical references are included.

This document does not address the question of when to cease corrective action at an MTBE site. Existing SWRCB policies and resolutions provide guidance for determining the appropriate conditions for site closure.

Introduction

Executive and Legislative Mandates

Governor Davis issued Executive Order D-5-99 on March 25, 1999, and signed Senate Bill 989 on October 8, 1999. These documents recognize that if not managed properly, MTBE can cause significant adverse impacts to current and future beneficial uses of ground and surface water.

The Executive Order contains eleven items that include tasks for various state departments and boards. Among these, item 8 directs the State Board to proceed to identify areas that are most vulnerable to MTBE, prioritize resources, and to provide guidelines for the cleanup of MTBE in groundwater.

> *8. The State Water Resources Control Board (SWRCB), in consultation with the Department of Water Resources and the Department of Health Services (DHS), shall expeditiously prioritize groundwater recharge areas and aquifers that are most vulnerable to contamination by MTBE*

> *and prioritize resources towards protection and cleanup. The SWRCB, in consultation with DHS, shall develop a clear set of guidelines for the investigation and cleanup of MTBE in groundwater at these sites."*

Senate Bill 989, introduced by Senator Sher, also directs the State Board to identify areas most vulnerable to groundwater contamination, prioritize resources, and to develop investigation and cleanup guidelines.

> … "the State Water Resources Control Board, in consultation with the Department of Water Resources and the State Department of Health Services, shall identify areas of the State that are most vulnerable to groundwater contamination by MTBE or other ether based oxygenates. The State Water Resources Control Board shall direct resources to those areas for protection and cleanup on a prioritized basis." …

> … "The Board, in consultation with the State Department of Health Services, shall develop guidelines for the investigation and cleanup of MTBE and other ether-based oxygenates in groundwater. The guidelines shall include procedures for determining, to the extent practicable, whether the contamination associated with an unauthorized release of MTBE is from the tank system prior to the system's most recent upgrade or replacement or if the contamination is from an unauthorized release from the current tank system." …

Applicability
These guidelines are intended for use by Regional Water Quality Control Boards and local agencies to assist in the investigation and cleanup of MTBE impacted sites. The document identifies areas most vulnerable to groundwater contamination, provides a priority ranking of MTBE sites, outlines a decision making framework for determining appropriate actions at sites, and proposes a timeframe for completing site management milestones.

Regulatory Authority
The authority for requiring investigation and cleanup exists in the Porter-Cologne Water Quality Control Act, Health and Safety Code, Underground Storage Tank Regulations, Regional Board Basin Plans, and State Board Policies. These guidelines are not intended to create any new authority, but rather, to help regulators direct resources and manage cases to maximize water quality restoration and protection when faced with widespread MTBE impacts. If the lead agency believes that action other than that described in these guidelines is appropriate, the agency may provide an alternative course of action. These guidelines may not be used by a responsible party to argue that any investigation or cleanup activity should proceed At a slower rate than ordered by the lead agency.

The guidelines are also not intended to set cleanup levels or other closure criteria. Existing SWRCB and RWQCB plans and policies provide guidance for determining the appropriate conditions for site closure. These include SWRCB Resolution 92-49, SWRCB decisions on UST appeal cases, and RWQCB Basin Plans.

Background
Methyl Tertiary Butyl Ether (MTBE) has been added to gasoline to enhance octane and to comply with clean air act mandates. It was approved by the USEPA for use in 1979 and was added to gasoline during the 1980s at approximately 2-5% by volume as an octane booster. In 1992, it was blended at 10-15% by volume for use in some areas in the wintertime oxygenated fuel program. In 1996, it began to be used year round at 11% by volume in the statewide reformulated gasoline program.

Relative to other fuel hydrocarbons, MTBE has a high solubility in water. The compound has low retardation in groundwater aquifers, and is slow to biodegrade. These properties, combined with a high percentage in gasoline, cause the potential for high source area concentrations, long plumes in groundwater, and long residence times in the subsurface. It also has taste and odor characteristics that can impair water supplies at very low concentrations.

There have been impacts on drinking water wells at dozens of sites in California, most notably in Santa Monica and South Lake Tahoe. In addition, there are thousands of underground storage tank (UST) sites with MTBE detected in the groundwater. Other sources of MTBE release to the environment include above ground storage tanks, spills, pipelines, etc.

Other Oxygenates and Breakdown Products
Tertiary butyl alcohol (TBA) is often present as a by-product of MTBE production and is also suspected to be a primary breakdown product of MTBE in the environment. In addition, several other ethers have been used as oxygenates in gasoline such as tertiary amyl methyl ether (TAME) and ethyl tertiary butyl ether (ETBE). Because their use has not been as widespread, it is unlikely that they will prove to be as great a threat as MTBE at most sites. However, it is prudent to analyze for these additional compounds during the initial investigation to determine if they are present. If other oxygenates are determined to be present in sufficient quantities to adversely affect beneficial uses, these compounds should be included in the remediation plan for the site. For screening purposes, it may be useful to add the concentration of other ether oxygenates to the concentration of MTBE and treat the sum as “MTBE equivalents”.

The currently accepted analytical protocol for groundwater samples suspected of containing ether oxygenates and TBA is EPA Method 8260B. EPA Method 8020/8021 may be used for MTBE analysis if EPA Method 8260B is used to confirm positive detections. Significant interference and false detections can occur when MTBE is analyzed in the presence of petroleum hydrocarbons using EPA Method 8020/8021. When other hydrocarbons are present in the sample, EPA Method 8260B is the preferred method. The ether oxygenates and TBA are not included in the standard list of analytes for EPA Method 8260B or 8020/8021 and therefore must be specifically requested when submitting samples to a laboratory for analysis. Selected physical properties of MTBE and other oxygenates are presented in Appendix A.

Early Detection of MTBE Releases
Early detection and quick response are key to successful remediation of MTBE releases. Agencies providing investigation and cleanup oversight should work closely with local UST permitting agencies. Appendix D provides a list of actions that may be taken at a site to determine if a UST system is leaking. An effective leak prevention and response plan includes at a minimum:

- UST leak detection systems
- Periodic inspections of UST systems
- Reporting known spills

Role of the Cleanup Fund
The UST Cleanup Fund (Fund) administered by the Division of Clean Water Programs will play a crucial role in implementation of these guidelines. In order for tank owners and operators to meet the time frames specified for higher priority MTBE cases, the Fund will need to process claim applications, letters of commitment, cost approvals and payments in a timely manner. This will likely require the Fund to identify MTBE claims and modify procedures to quickly turn-around approvals and payments for these claims. Fund management should consult with claimants, contractors, and regulators to identify needs, and make any necessary procedural changes consistent with Fund statutes.

Definition of Areas Most Vulnerable to Groundwater Contamination

For the purposes of these guidelines, a site is in a most vulnerable area if it has one or more of the following characteristics:

1) Located within a 1000 ft radius of a drinking water well or surface water body used as a source of drinking water.

2) Located on near-surface fractured bedrock geology that is a source of water supply for a community.

3) Located above an aquifer that is a source of water supply for a community.

4) Located in an area designated as having a high degree of hydrogeologic susceptibility to contamination as shown on the statewide map compiled from Department of Water Resources (DWR) and United States Geological Survey references by the SWRCB in consultation with DWR, the Department of Health Services, and Regional Water Quality Control Boards.

Tracking and Reporting Progress

Tracking the progress of investigations and cleanups is an important aspect of case management. The SWRCB will be creating and distributing a variety of reports based upon data submitted by Regional Boards and local agencies to track the progress of MTBE investigation and remediation in response to the Governor's executive order and SB 989. To accomplish this, accurate and timely data will need to be submitted to the SWRCB by RWQCBs and local agencies who are conducting LUST regulatory oversight through the Geographic Environmental Information Management System maintained by the SWRCB. Some of the questions that will be addressed by these reports are as follows:

- How many sites are in each threat classification?
- Which sites are actively remediating MTBE in soil or groundwater?
- How many pounds of MTBE have been removed?
- Which sites have not received regulatory direction?
- Which sites are delinquent in responding to a regulatory directive?
- Which sites are in enforcement?
- How many sites have been closed?

Site Investigation and Remediation Decision-Making Framework

These guidelines provide a framework for prioritizing resources to work on sites with MTBE or other oxygenates. Lead agencies are in the best position to understand the extent of MTBE releases in their jurisdiction, the proximity of those plumes to nearby receptors, and the approximate travel time for the plume to reach the receptor. With this information, lead agencies can direct resources to those sites where the plumes are most likely to impact a nearby receptor. The site investigation and remediation decision-making framework presented in this section provides a method to accomplish that task.

The decision-making framework centers around the development and continual modification of the site conceptual model (SCM). The SCM is the progressive assemblage of information regarding the distribution of chemicals at a site and its hydrologic setting. The SCM describes the release scenario, surrounding land use, geology, well locations, and the likely distribution of chemicals at the site, existing and projected water use patterns, and other factors considered when making decisions about a case. It functions as the framework for the investigation, remediation, and ultimately the closure of the site and serves as the basis for communication between responsible parties, regulators, and other interested parties.

Always ready to be changed to better reflect real-world conditions, the SCM is checked and updated when new data become available.

If MTBE is detected in the groundwater at a site, the regulatory caseworker should develop a preliminary SCM, identify the appropriate investigation priority classification, and require the responsible party to conduct the appropriate investigation or interim remediation. The responsible party conducts any required investigation and submits a more detailed SCM to the regulatory agency along with the investigation report. Each subsequent investigation requirement seeks to fill a data gap to clarify the SCM. After the source area and pathways to receptors have been adequately characterized, an appropriate remedial alternative can be selected and implemented. Some sites, however, may require expedited interim remedial action prior to completion of the site investigation. Subsequent reports from responsible parties describe how the information submitted confirm or change the SCM. A suggested format for the SCM is included in Appendix C.

The investigation priority classifications presented below in Step 2 are intended to be *initial* classifications for prioritization of investigation resources. As more detailed information becomes available, the site should be reevaluated and, if appropriate, the investigation priority class changed. When enough information has been collected during the investigation to adequately determine the travel time of the plume to the receptor, a cleanup priority class is assigned and resources directed appropriately. Resources should be directed to those sites that pose the greatest and most immediate threat to nearby receptors.

For further information regarding site investigation, remediation, and the development of site conceptual models, please see the references in Appendix B. A description of the 7-step decision-making framework is included below. It should be noted that the steps listed need not be completed sequentially but may occur whenever the lead agency determines is appropriate.

1) Initial Investigation/Scoping
2) Develop Initial Conceptual Model/Assign Investigation Priority Class
3) Interim Remedial Action
4) Site Characterization/Investigation
5) Update Conceptual Model/Assign Cleanup Priority Class
6) Corrective Action/Remediation
7) Verification Monitoring

Step 1. Initial Investigation/Scoping

The basic data necessary to classify the site is collected during this initial step. These data include the distance to receptors (drinking water wells and surface water supplies) in the vicinity and the concentration of MTBE present in the subsurface at the site.

To determine if MTBE is present at the site, the responsible party should be directed to collect representative groundwater samples for MTBE analysis. If the site is not conducive to groundwater sampling, the lead agency may allow other methods to be substituted during this initial investigation to determine the presence or absence of MTBE. These methods may include collection of soil samples or soil vapor samples beneath areas of suspected release. Expedited site assessment techniques may be useful during this step. Further information on expedited site assessment is contained in the references in Appendix B.

It is assumed that a search of the state GIS mapping database will be the minimum level of effort used to determine the location of wells in the vicinity of the site. A more thorough well search should be completed during the investigation phase and the results reflected in the cleanup priority classification. If wells are suspected to be in the area but their exact locations are unknown, the site should be given a higher investigation priority classification rather than differing classification until more information is available. The investigation priority classification may be changed later if warranted.

Step 2. Develop Preliminary Site Conceptual Model/Assign Investigation Priority Classification
Each agency should examine their portfolio of cases and classify them based on the estimated travel time to the nearest receptor or other factors (such as geology) that the agency feels is pertinent to their jurisdiction. Many sites may have additional information beyond that collected in the initial scoping phase. All relevant site data should be used in this step to obtain the most accurate preliminary SCM and investigation priority classification. Sites which are determined to pose the greatest threat should be given the greatest share of resources and be tracked more closely to assure a timely and effective investigation.

Figure 1. represents an initial estimation of the MTBE travel time to the nearest receptor (drinking water well or surface water source). The curved portion of the two lines separating sections A, B, and C, represent the theoretical contaminant travel time generated by a computer model (the A/B line corresponds to a travel time of 1 year and the B/C line corresponds to a travel time of 20 years). The computer model used is a statistical simulation of a three-dimensional transport equation. The model uses a conservative set of assumptions (groundwater velocities, source area, dispersivity, constant concentration, constant source, and constant velocity). Since the preferred gradient direction (ie. direction of plume travel) is unknown, the model projects that the plume forms an expanding circle around the site. These graphs may be used to screen sites and assign initial investigation priorities, but should not be used as a predictor of actual travel times for plumes.

When a new site is added to the portfolio of active cases, it can be classified according to the criteria listed below. The agency should review the classifications and priorities at least annually to determine if new information has been received that would change the priority of sites. The following is a recommended initial investigation classification system:

Class A:
Criteria: See Figure 1
Regulatory Response Timing: Conduct case review and send directive letter within 30 days after notification of MTBE release. Determine cleanup priority classification as soon as possible, not later than one year after notification or discovery of MTBE release.

Class B:
Criteria: See Figure 1
Regulatory Response Timing: Determine cleanup priority classification within two years after notification or discovery of MTBE release.

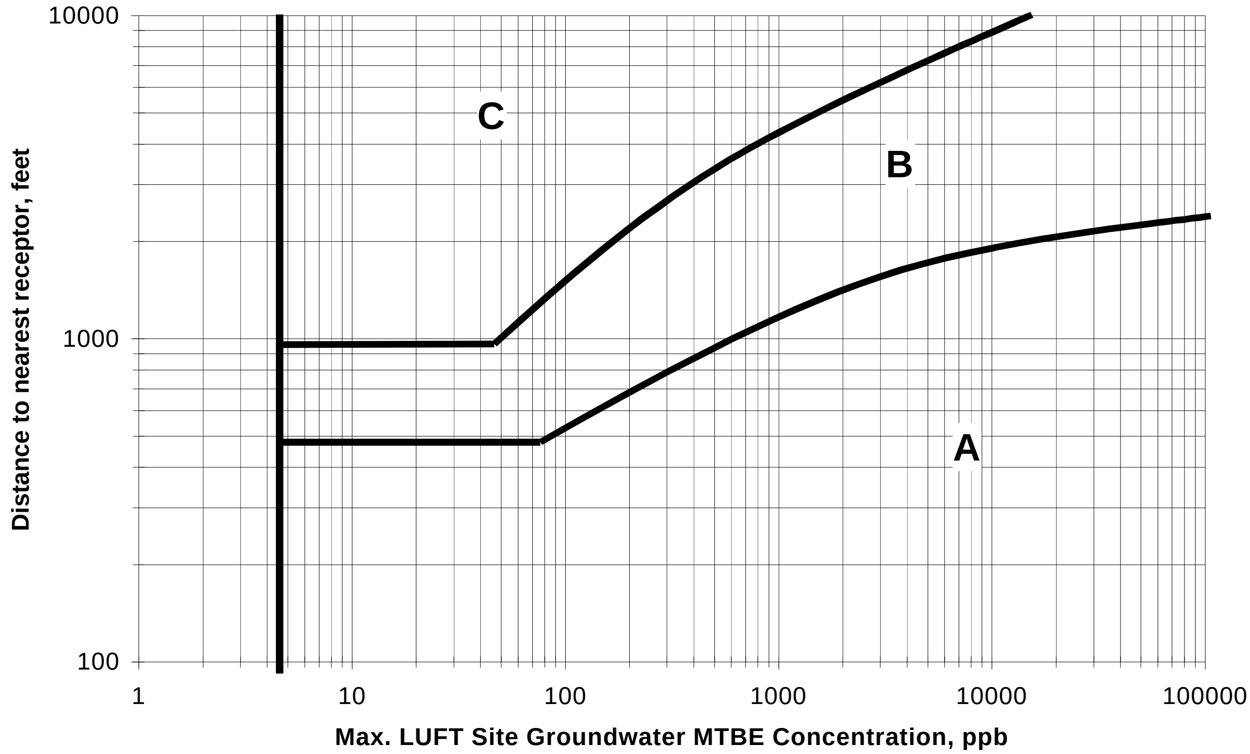
Class C:
Criteria: See Figure 1
Regulatory Response Timing: Determine cleanup priority classification within three years after notification or discovery of MTBE release.

Class D:
Criteria: Not located in an area that is most vulnerable to contamination and has concentrations of MTBE in groundwater over 5 ppb.
Regulatory Response Timing: Determine cleanup priority classification within five years after notification or discovery of MTBE release.

Figure 1. - Investigation Priority Class (A, B, or C)

(Sites Located in Most Vulnerable Areas)

note: log/log scale



Step 3. Interim Remedial Action

Sites with high concentrations and a large release mass should have those concentrations and mass reduced before the plume can spread regardless of their priority classification. For example, sites with free product or persistent concentrations over 10,000 ppb MTBE in the groundwater are candidates for source area remediation as an interim remedial action. Long-term impacts to water quality and financial resources are likely to be reduced if interim remediation is performed in these situations. If the MTBE plume imminently threatens a well, interdiction wells to contain the plume may be necessary. Conversely, if the investigation data indicate a low potential threat, either because the mass of MTBE released is small, migration to drinking water wells is highly unlikely, or other relevant factors exist, then this interim remedial action would not be necessary. The SCM is updated with any new data that is collected while taking interim remedial actions.

It is extremely important for the agency providing cleanup oversight and the tank permitting agency to work together to identify the source of the MTBE in the subsurface (tank, pipe joint, spill bucket, surface spill, etc.) when an ongoing release is suspected at an operating UST. If this step is not completed and an ongoing leak is allowed to continue, the potential success of any attempted remediation will be reduced. A summary of suggested methods for determining the source of leaks in tank systems is included in Appendix D.

Step 4. Site Characterization/Determine Plume Travel Time

In this step, additional data is gathered regarding the distribution of contaminants in the subsurface, the location of any nearby receptors (drinking water wells or surface water sources), and the potential for migration of contaminants to receptors. Estimating the approximate travel time for a contaminant plume to reach a nearby receptor is a key part of the investigation. This estimation will serve as a basis for the next step in the process, assigning a cleanup priority classification.

Geologic data that has already been collected from nearby sites can provide an overview of what conditions may be encountered beneath the site. For example, an uninterrupted vertical profile of the stratigraphy by continuous core or cone penetrometer can help verify if the regional conceptual model of the geology applies to this site. If the conceptual model using regional data implies that persistent downward vertical groundwater gradients may exist, these gradients and the vertical extent of MTBE impacts should be investigated using cluster wells or other methods. The converse is also true; sites located in areas with known upward gradient may not require site specific assessment of vertical migration.

At some sites, there may be information available that will allow an estimation of the magnitude of petroleum released (ie. amount of free product, amount of impacted soil, inventory records documenting a release, etc.). Although these data can help infer whether the release was relatively large or small, detailed estimates of mass or volume released have historically proven to be highly inaccurate. Therefore, while knowledge of the relative magnitude of the release can help guide remedial decisions, attempting to precisely quantify the number of gallons or pounds released is not recommended.

The SCM is continually updated during this process. Also, the SCM should be compared to the SCM for other sites in the agency's portfolio on a regular basis. If it becomes apparent that the site in question does not pose a threat to any nearby receptors in the near future and other sites may pose a higher threat, resources should be directed to those other sites before the investigation is fully completed.

Note: Determining the plume travel time is not intended to be an end in itself nor a detailed effort requiring extensive computer fate and transport modeling. Conservative estimates based upon literature values for aquifer properties, average site groundwater gradients, and zero retardation can be quickly made. Installation of a guard well in the down gradient direction can provide early detection if the rough estimate of travel time is not sufficiently accurate.

Step 5. Update Conceptual Model/Assign Cleanup Priority Classification

This step, assigning a cleanup priority, occurs after sufficient data has been collected to estimate the travel time for the contaminant plume to reach a receptor. At this point in the process, the site is given a priority for remediation based upon the estimated plume travel time to the nearest down-gradient receptor, timeframe for intended use of the aquifer, or other criteria determined by the lead agency. At a minimum, each agency should review their cases annually to determine if the site's priority classifications should be changed based upon new data that has been received. It should be noted that non-water quality related issues may require work sooner than expected (e.g. legislative requests, redevelopment, property transfers, etc.).The following is a suggested cleanup priority system, summarized in Table 1:

Class 1:
Criteria: Groundwater MTBE plume travel time to nearest downgradient receptor: < 5 years

Regulatory Response Timing: Implement remedial action plan as soon as possible, not later than 1 year after determination of cleanup priority class:

Class 2:
Criteria: Groundwater MTBE plume travel time to nearest downgradient receptor: > 5 years and < 20 years

Regulatory Response Timing: Implement remedial action plan within 5 years after determination of cleanup priority class.

Class 3:
Criteria: Groundwater MTBE plume travel time to nearest downgradient receptor: > 20 years

Regulatory Response Timing: Direct cleanup resources to these sites after sites in classes 1 and 2 have been addressed.

Table 1 - Cleanup Priority Classification Criteria

Cleanup Priority Class	Groundwater plume travel time to nearest downgradient receptor (years)	Regulatory Response Timing (years)
1	< 5	1
2	5 - 20	5
3	> 20	-

Step 6. Corrective Action / Remediation
When the lead agency determines that a site requires remedial action, those actions should be taken expeditiously. In general, the type of response actions taken at MTBE release sites will be similar to the type of actions taken at traditional petroleum releases. The primary difference is that responses to MTBE will need to be swifter and more aggressive to reduce the spread of MTBE to a wider area. Remedial alternatives may include, but are not limited to, the following either individually or in combination:

- Soil excavation and/or dewatering of source areas
- Soil vapor extraction
- Groundwater extraction and above-ground treatment
- Flow-through remediation cells/in-situ bioremediaton
- Free product removal
- In-situ air sparging
- Soil vapor extraction/dual phase extraction

Removing MTBE from the subsurface at high concentrations is much more cost effective than extracting water or vapor with low concentrations. At many sites, aggressive interim remediation in the source area can help diminish the chances of creating a large diluted plume of MTBE. Large dilute plumes are more difficult to remediate and have impacts that are more widespread. In many cases, source area remediation may reduce subsurface impacts sufficiently to protect surrounding water quality. Sites with plumes that could impact drinking water wells may need to have plume containment measures implemented. This may include groundwater extraction and treatment at onsite or offsite remedial extraction wells. For more information regarding the details of implementing these technologies, please refer to the references in Appendix B.

Step 7. Verification Monitoring

Periodic groundwater monitoring is used to supplement the initial assessment data, and to confirm assumptions about the site conceptual model. The objective of groundwater monitoring is to determine if the site conditions will meet regulatory requirements and may include evaluating seasonal changes in site conditions, documenting evidence of source depletion, evaluating plume stability or migration, or assessing the effectiveness of corrective actions. If there is reason to believe downward migration of contaminants may be occurring, clustered monitoring wells or other methods of determining vertical gradients should be used to determine the extent that vertical migration occurs.

While assessment strategies may differ between BTEX and oxygenates, periodic monitoring strategies are similar. The potentially more rapid rate of migration of oxygenates should be considered when determining an appropriate sampling frequency and monitoring well spacing.
Data from periodic monitoring should be interpreted and summarized using potentiometric contour maps and isoconcentration contour maps.

Variations in concentration over time at individual wells can be used to understand source depletion and potential hydraulic influences on plume migration. Concentrations may be analyzed over distance along a plume centerline to assess plume stability and thus potential threat to nearby receptors. Concentrations of oxygenates and other constituents of concern can be determined over time at appropriately located monitoring points downgradient of the source and oriented along the direction of ground water flow. The trend in concentrations at these points will confirm whether the plume is shrinking, stable, or expanding (e.g. if the plume is shrinking, concentrations will decrease over time or space; if the plume is stable, concentrations will remain relatively constant over time and space). For further discussion, refer to the references listed in Appendix B.

Appendices:
A Physical/chemical properties of oxygenates
B Technical references
C Site conceptual model reports
D Finding leaks in tank systems

Appendix A
Physical Properties of BTEX and Oxygenates

	Pure Phase Solubility[1]	log K_{oc}[2]	Vapor Pressure[3]	Henry's Law Constant[4]	Retardation Factor[5]	
	mg/L	log l/kg	mm Hg	Dimensionless	Soil Condition A[6]	Soil Condition B[7]
Benzene	1,780	1.5 - 2.2	76 - 95.2	0.22	1.59	3.38
Toluene	535	1.6 - 2.3	28.4	0.24	1.75	3.99
Ethylbenzene	161	2.0 - 3.0	9.5	0.35	3.66	11.6
m-Xylene	146	2.0 - 3.2	8.3	0.31	4.34	14.4
Ethanol	Miscible	0.20 - 1.21	49 - 56.5	0.00021 - 0.00026	1.04	1.17
Methanol	Miscible	0.44 - 0.92	121.6	0.00011	1.04	1.16
TBA	Miscible	1.57	40 - 42	0.00048 - 0.00059	1.31	2.25
MTBE	43,000 - 54,300	1.0 - 1.1	245 - 256	0.023 - 0.12	1.09	1.38
ETBE	26,000	1.0 - 2.2	152	0.11	1.33	2.34
TAME	20,000	1.3 - 2.2	68.3	0.052	1.47	2.89
DIPE	2,039 - 9,000	1.46 - 1.82	149 - 151	0.195 - 0.41	1.37	2.47

Notes:

Data from Zogorski et al. (1997). Values at 20 or 25 °C

TBA: tertiary butyl alcohol

MTBE: methyl tertiary butyl ether

ETBE: ethyl tertiary butyl ether

DIPE: di-isopropyl ether

1 = The propensity of a chemical to dissolve into water, expressed in milligrams of chemical per liter of water.

2 = The propensity of a chemical to adsorb to soil. Defined as the ratio of the concentration of the chemical adsorbed onto organic carbon to the concentration of the chemical dissolved in water

3 = The propensity of a chemical to migrate from NAPL to the gas phase. The vapor pressure of a chemical is the pressure exerted by the gas phase when it is in equilibrium with the liquid phase.

4 = The propensity of a chemical to partition between the dissolved phase and the gas phase. The Henry's Law Constant is defined as the ratio of the equilibrium concentration of the chemical in the gas phase to the equilibrium concentration of the chemical in water.

5 = The average velocity of plume migration for a chemical will typically be lower than the average velocity of the associated groundwater. The retardation factor is the ratio of the velocity of the groundwater to the velocity of the associated chemical plume. This factor is calculated; a function of soil bulk density, soil effective porosity, soil organic carbon content, and the organic carbon partitioning coefficient of the chemical.

6 = Soil Condition A: $f_{oc=}$0.001 mg/mg, bulk density=1.75 kg/L, porosity=0.25

7 = Soil Condition B: $f_{oc=}$0.004 mg/mg, bulk density=1.75 kg/L, porosity=0.25

Appendix B

Technical References

Site Investigation / Conceptual Model

1. Expedited Site Assessment Tools For Underground Storage Tank Sites – A Guide For Regulators (USEPA, Office of Underground Storage Tanks, March 1997)

2. Strategies for Characterizing Subsurface Releases of Gasoline Containing MTBE, American Petroleum Institute, API Publication No. 4699

3. Course manual "Assessment and Management of MtBE Impacted Sites", SWRCB & USEPA, 1999

4. Guidelines for Hydrogeologic Characterization of Hazardous Substance Release Sites, Cal/EPA, 1995

5. Standard Guide for Accelerated Site Characterization for Confirmed or Suspected Petroleum Release Sites, ASTM E1912-98

Remediation

6. How to Evaluate Alternative Cleanup Technologies For Underground Storage Tank Sites, USEPA, EPA 510-B-94-003, 1994

7. Pump-and-Treat Ground-Water Remediation, A Guide for Decision Makers and Practitioners, USEPA – Office of Research and Development, EPA/625/R-95/005

8. The Performance and Cost of MTBE Remediation Technologies, Proceedings of the 1998 Petroleum Hydrocarbons and Organic Chemicals in Water conference, D.N. Creek, J.M. Davidson

9. Treatment Technologies for Removal of Methyl Tertiary Butyl Ether (MTBE) from Drinking Water, MTBE Research Partnership: Western States Petroleum Association, Association of California Water Agencies, Oxygenated Fuels Association, 1998

10. Cost and Performance Evaluation of Treatment Technologies for MTBE-Contaminated Water, in *Health and Environmental Assessment of MTBE, UC TSR&TP Report to the Governor of California*, Keller, AA, OC Sandall, RG Rinker, MM Mitani, B Bierwagen, MJ Snodgrass, 1998.

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11. Fuel Oxygenates and Water Quality: Current Understanding of Sources, Occurrence in Natural Waters, Environmental Behavior, Fate, and Significance. Chapter 2 in *Interagency Assessment of Oxygenated Fuel*, Office of Science & Technology Policy, Executive Office of the President, Washington, D.C., Zogorski, J.S., A. Morduchowitz, A.L. Baehr, B.J. Bauman, D.L. Conrad, R.T. Drew, N.E. Korte, W. W. Lapham, J. F. Pankow, and E.R Washington., 1997

Electronic Information Sources

12. California Environmental Protection Agency (Cal/EPA) www.calepa.ca.gov
13. State Water Resources Control Board (SWRCB) www.swrcb.ca.gov
14. California Department of Health Services (DHS) www.dhs.ca.gov
15. United States Environmental Protection Agency (EPA) www.epa.gov
16. Lawrence Livermore National Laboratory (LLNL) www.llnl.gov
17. Association of California Water Agencies (ACWA) www.acwanet.com
18. American Petroleum Institute (API) www.api.org/mtbe
19. Western States Petroleum Association (WSPA) www.wspa.org
20. American Society of Testing and Materials (ASTM) www.astm.org
21. National Water Research Institute (NWRI) www.ocwd.com/nwri

Appendix C

Site Conceptual Model Reports

The Site Conceptual Model (SCM) is a written or graphical representation of the release scenario, site characteristics (geology, hydrogeology, etc.) and the likely distribution of chemicals at the site. It links potential sources to potential receptors through transport of chemicals in air, soil, and water. It also provides a framework for the entire project and a communication tool for regulators, responsible parties, and other stakeholders. The goals of the conceptual model are listed below:

- Identify how the distribution of chemicals is changing in space and time
- Identify potential current and future receptors
- Identify environmental issues that need to be addressed

Reporting

Reports submitted to regulatory agencies are by necessity specific to the type of information they are presenting. They may contain a summary of activities, backup data to support conclusions, etc. A report that attempts to convey a representation of a SCM needs to meet the goals listed above. To meet these goals, investigation reports usually, at a minimum, contain the following elements:

I. Text
   1. Site Description, Land Use, and Water Use
   2. Chronology of Events
   3. Site Stratigraphy and Hydrogeology
   4. Well and Conduit Study
   5. Estimation of Release Mass (if available)
   6. Source Removal Activities
   7. Remediation Activities

II. Figures
   1. Site Location Map
   2. Site Vicinity Map with Receptor Wells
   3. Site Map with Groundwater Gradients, Cross Section Lines, and any known preferential pathways
   4. Site Map with Isoconcentration Contours
   5. Cross Section - long axis of plume
   6. Cross Section - short axis of plume
   7. Cross Section of Regional Geology (optional)
   8. Concentration vs. Time Plots for Each Well
   9. Concentration vs. Distance (optional)

III. Tables
   1. Groundwater Elevation Data
   2. Groundwater Analytical Data
   3. Soil Analytical Data

Appendix D

Finding Leaks in Tank Systems

The purpose of this document is to identify available resources and potential activities that can be performed at suspected release sites to confirm and determine the source of a suspected release from a UST system. The appropriate level of effort for this task is interrelated with the results of groundwater monitoring, extent and type of the release, and other site-specific characteristics.

This investigation may be an iterative process and it is important that all data and findings be maintained and properly documented. A joint effort of a team of clean-up staff and leak prevention staff is needed to oversee activities and analyze the findings. The subsurface contaminant distribution may point to a leak source; e.g., relatively clean tank pit but high contaminant levels around a specific dispenser or near specific piping joint.

I. **Preliminary Site Evaluation –** The local inspector may perform these activities. All activities and findings should be documented item by item.

A. Visual Evaluation and Interviews

1. Check surfaces around UST systems for any visible signs of spills. Evaluate and document the condition of the concrete and asphalt – look for cracks, stains, etc. Pay particular attention to the area around fill pipes and dispenser islands.

2. Interview the operators with respect to unusual operating conditions, known spills and leaks, inventory reconciliation, etc.

3. Check monitoring equipment (all sensors, Line Leak Detectors, ATG, CITLDS) control panel for presence of alarm lights, trouble lights, and power lights. Power light should be on; trouble and alarm lights should be off.

B. Records Review

1. Review records of any water pumped-out from the tanks.

2. Review records of product or water removed from the sumps, spill containment boxes, and dispenser containment boxes.

3. Review records of product spills by customers filling their gas tanks or gasoline delivery trucks and the action taken to clean up the spill.

4. Review inventory records and the results of any Statistical Inventory Reconciliation (SIR) test reports. In the SIR reports, pay attention to the product-gain and inconclusive test results. Compare the test information with the test method specifications listed in the "Leak Detection Equipment and Test Methods List – LG 113". A quick method of checking inventory records is to count the number of positive and negative daily variances in a month. The number of positives and the number of negatives should be almost equal. (E.g., in 30 days of recording, there should be 15 positives and 15 negatives; 18 of one and 12 of the other is suspicious; 10 of one and 20 of the other indicates a problem of some kind.

5. Review any past tank and piping tests performed at the site. Verify that tests were properly conducted. Compare the test information with the test method specifications listed in the "Leak Detection Equipment and Test Methods List – LG 113". Review the test results closely to determine if the tester did any system fixes (loose valves and connections and loose fill pipes) in order to make the test pass. Determine what follow-up action was taken at the site for reported fail results.

6. Check the spill containment box for presence or indication of product spills from product deliveries.

7. Check all sumps for presence of product, corrosion, or indication of product releases.

8. Check under-dispensing piping for any visible signs of product releases (drips, tarnished piping, etc.). This check should be done both while the dispenser is idle and during dispensing.

9. Dipstick the tank to check for water and product and allow for at least 24-48 hours. Use the tank chart and tank installation information to determine the rate of any losses or gains from the tank (same concept as manual tank gauging). Tank should be locked up and not used during this time. Note: temperature should be stable and no deliveries for a few days before the start of the test. The longer the test the better. A test should run for 48 hours unless the tank size is small. This test may not be appropriate if it significantly interferes with the daily operation of the facility.

10. To the extent possible, document the type, model, and brand of all major UST system components. This information should be reviewed and compared with any data on manufacturer recalls or any other frequently reported manufacturer defects.

II. **Detailed Site Evaluation and Data Collection -** A qualified and authorized contractor should perform these activities with oversight of the local inspector. All hands-on work on equipment must be performed in accordance with the manufacturer's instructions and test procedures, findings should be documented in detail, and all system reports printed.

A. Check for potential overfill events.

1. Check the overfill prevention device and report whether it is functional.

2. If the tank is equipped with an Automatic Tank Gauging System, (ATG) have the contractor check the system for overfill alarms, review product delivery records, and cross check deliveries with ATG system inventory records for consistency to verify proper deliveries.

3. If possible, contact the company delivering product to the facility to find out if they had any overfills (this may be just a nice try!). The ATG may also have a record of overfills. If delivery invoices are available, check to see if they contain before and after stick readings. Look for after delivery readings that are above the tank 95% level. Document results and file.

B. Functional equipment checks – These activities do not lead directly to locating a potential source of release. However, you should verify that leak detection equipment is functional before reviewing past test reports, and using the equipment to test the UST system components. All work must be performed in accordance with the manufacturer's instructions provided in the equipment maintenance manuals.

1. Print and check system set up for any programming errors.
2. Verify that all monitoring equipment and sensors are functional by testing all sensors.
3. Review the system diagnostic information to identify any system problems.
4. Perform a quantitative test on line leak detectors (mechanical and electronic) to determine that they can detect a leak of at least 3 gallons per hour. This is a test where the contractor simulates an artificial leak and the system response to that leak rate is evaluated and compared with the system requirements and the setup information

C. Check alarm history, system failure history, and leak test history reports.

1. Review the history of system alarms including system functional alarms.
2. If the tank is equipped with an ATG review the records of in-tank water and the history of high water alarms.
3. Review the history of leak tests performed by Continuous In-Tank Leak Detection System (CITLDS), ATG systems and electronic line leak detectors. Analyze the test results closely by comparing the test information with the test method specifications listed in the "Leak Detection Equipment and Test Methods List – LG 113"

D. Test all secondary containment.

1. Perform a hydrostatic test of the spill containment box (This is a very crude test method that currently only is performed at the time of installation. Containment box is filled with water; water level is marked or measured, and checked again in 24 hours to verify if the box is liquid-tight. Document the results.
2. Perform a hydrostatic test of all sumps (see item 1 above) and document the results. Also verify that all sensors are functional.
3. Check all piping penetrations and fittings for proper seal, verify secondary containment piping terminates in the sump, and verify that any potential releases from the primary piping into the secondary piping will drain into the sump (i.e. the reducer that was used to isolate the secondary during the installation tightness test has been removed or if a drain port was installed the outlet is not plugged).
4. Conduct a tightness test on the secondary piping and the interstitial space of the tank using an approved test method.
5. If there is dispenser containment present perform a hydrostatic test (see item 1 above) and verify that the leak-sensing mechanism is functional.

E. Activate Leak detection tests using on-site equipment.

1. Put the ATG system in a leak test mode (preferably 0.1 gph mode if available) and review the test result. Note that there should be no product dispensing from the tank until the test is completed. Evaluate the test results, not just for pass/fail. Review the measured leak rates and if needed, extrapolate the number to a full tank leak rate to determine if there may be a release from the tank. Also make sure that in-tank water is recorded before and after the test and look for water ingress during the test.

2. Activate mechanical line leak detector test mode (3gph) and electronic line leak detector test modes (3gph, 0.1 gph and 0.2gph), review the test results, and make note of any alarms or slow-flow or product pump shutdowns. Note that there should be no product dispensed from the piping system until the test is completed.

III. Tank and Line Tests – (These tests must be performed By a Licensed Tester)

A. Have the product lines tightness tested by a licensed tank tester using an approved test method. Be present during the test if possible. Compare the test information with the test method specifications listed in the "Leak Detection Equipment and Test Methods List – LG 113". Make sure the tester performs the test before doing any repairs or system fixes. If the test fails, any fixes should be done before a second test is conducted. All activities, including any repairs need to be documented and reviewed.

B. Have the ullage space of the tank tightness tested by a licensed tank tester using an approved test method.

C. Have the product-filled portion of the tank tested using an approved test method. Do not require the addition of any product to the tank for this test. In the event that the tank is leaking, the contamination may get worse if more product is added to the tank. Evaluate the test results, not just for pass/fail. Review the measured leak rates and if needed, extrapolate the number to a full tank leak rate to determine if there may be a release from the tank. Also make sure that in-tank water is recorded before and after the test and look for water ingress.

IV. External Full-System Evaluation for Vapor and Liquid Releases

Perform an external evaluation.

Appendix N
Stormwater Best Management Practices (BMPS)

I. INTRODUCTION

The purpose of this appendix is to provide guidance for choosing the Best Management Practices (BMPs) to control the quantity and quality of stormwater at projects where the Site Assessment and Mitigation (SAM) Program of the San Diego County of San Diego Department of Environmental Health is the lead agency. As part of the SAM permit requirements, stormwater control needs to be used to reduce or eliminate potential pollutants from entering stormwater conveyance systems or waters of the state. Many sections of the SAM Manual make reference to this appendix as the first steps to be used for the control of stormwater at a site.

This appendix is not an exhaustive guide for all possible situations that may arise during SAM activities. However, an attempt has been made to address the more common activities conducted at a typical SAM site. For activities that may not be covered in this appendix, you will find additional references within this appendix to assist you in selecting an appropriate BMP.

In providing the guidelines to ensure compliance with the Municipal Permit (see description below), this appendix is divided into three categories as follows:

A. Sediment/Soil
B. Water
C. Transportation

Each of these categories addresses common activities and minimum BMPs that must be used during these activities. Table N-1 at the end of the appendix lists common SAM activities and the appropriate stormwater BMPs that correspond to each activity. Figure N-1 illustrates the decision-making process pertaining to stormwater BMPS at SAM sites.

II. REGULATORY FRAMEWORK

The County of San Diego is required to comply with the San Diego Regional Water Quality Control Board (RWQCB) Order No. 2001-01 National Pollution Discharge Elimination System (NPDES) – Municipal Stormwater Permit Number CAS 0109758 by enacting requirements to protect water quality throughout the San Diego region. San Diego County Ordinances No. 9424 and 9426 were adopted by the Board of Supervisors on February 21, 2002, and allow for the regulation of stormwater, particularly addressing the management and discharge of pollutants to the County's stormwater conveyance system and receiving waters.

Order No. 2001-01was issued by the RWQCB to the County of San Diego, the incorporated cities of San Diego County, and the San Diego Unified Port District (co-permitees). The Municipal Stormwater Permit sets waste discharge requirements for discharges of urban runoff to the municipal separate storm sewer systems (MS4s) draining the watersheds of the San Diego region.

In addition, the Order seeks to protect the health and safety of County of San Diego residents by:

- Prohibiting polluted non-stormwater discharges to the stormwater conveyance system and receiving waters.
- Setting minimum requirements for stormwater management.
- Requiring development projects to reduce stormwater pollution and erosion.

- Requiring the management of stormwater flows from development projects to prevent erosion and to protect and enhance existing water dependant habitats.

- Establishing standards for the use of off-site facilities for stormwater management.

- Establishing notice procedures and standards for adjusting stormwater and non-stormwater management requirements where necessary.

The use of BMPs to control stormwater within and running off a SAM site would generally follow guidelines for regulated facilities or construction sites. SAM sites that are currently regulated businesses or are actively in construction may have Storm Water Pollution Prevention Plans (SWPPP) in-place that define appropriate BMPs for the planned activity. Should the SAM-related activity include operations that could potentially create other forms of contaminated non-stormwater releases, modification to the plan or submittal of a new plan is warranted. Sites that are currently inactive, or those that do not have an approved SWPPP will require submittal and approval of a plan that at a minimum meets County ordinances. If a SWPPP has not been prepared, a Stormwater Management Practices Standard Project Form (Table N-2), included in Appendix N, can be included and attached to a SAM workplan. It is important to contact the individual co-permittee regarding individual requirements. Table N-3 at the end of Appendix N lists the contact phone numbers for each of the co-permittees.

Many activities at SAM sites require BMPs to manage stormwater flows, prevent non-stormwater discharges, and prevent erosion. It is important that BMPs at SAM sites be continually evaluated for effectiveness at various stages of the regulatory process. Documents provided to SAM, such as workplans, interim remedial action plans and corrective action plans, must include proposed stormwater BMPs as part of their scope of work. .

III. STORMWATER BMPS FOR SAM SITES

A. Sediment / Soil

All contaminated or potentially contaminated soil must be managed to prevent it from being discharged into a stormwater conveyance or receiving water. All contaminated soil must be placed on an impervious surface (or plastic ground covering), bermed and completely covered with plastic sheeting.

1. Excavations, UST Removals/Installations, Remediation Trenching

During UST removals/installations, or trenching, adequate perimeter protection BMPs must be installed and maintained to prevent the discharge of stormwater pollutants. All storm drain inlets on site must be protected using inlet protection BMPs. Excavation should take place during a period of time when no rain event (greater than 50 percent probability) is forecasted. During a significant storm event, BMPs, such as the following, must be implemented to control runoff from the Site:

- **Silt fence:** A silt fence is a temporary linear sediment barrier of permeable fabric designed to intercept and slow the flow of sediment-laden sheet flow runoff.

- **Gravel bag barrier:** A gravel bag barrier is a temporary linear sediment barrier consisting of stacked gravel bags, designed to intercept and slow the flow of sediment-laden sheet flow runoff.

- **Straw bale barrier:** A straw bale barrier is a temporary linear sediment barrier consisting of straw bales, designed to intercept and slow sediment-laden sheet flow runoff.

- **Fiber rolls:** Fiber rolls (sediment logs or wattles), composed of bio-degradable fibers stuffed in a photo-degradable open weave netting, are designed to reduce sediment runoff from disturbed sediment into the storm drain system or watercourses. Fiber rolls are porous and allow water to filter through fibers and trap sediment, increase filtration rates, slow runoff, and reduce sheet and rill erosion.

- **Drop inlet sediment barrier:** A drop inlet sediment barrier is a temporary barrier placed at an inlet. The sediment barrier may be constructed of stone, concrete block, straw bales, or silt fence material, and gravel. These barriers will prevent sediment from entering the storm drains during construction operations. Sediment-laden runoff is ponded before entering the storm drain, thus allowing some sediment to fall out of suspension.

- **Curb inlet sediment barrier:** Curb inlet sediment barriers are temporary barriers constructed from concrete block and gravel or gravel filled sandbags. These barriers are intended to reduce the sediment discharged into storm drains by ponding the runoff and allowing the sediment to settle out. The structures allow for overflow from high runoff events and the gravel allows the ponds to dewater rapidly.

2. Stockpiles

A stockpile should be placed on plastic and covered when no material is being added to the stockpile. Protection of stockpiles is a year-round requirement. Procedures and practices to reduce or eliminate pollution of stormwater from stockpiles of soil, rock and paving materials, such as portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, aggregate subbase or pre-mixed aggregate and asphalt binder (so called “cold mix” asphalt), is required. The following practices are required:

- Locate stockpiles away from concentrated flows of stormwater, drainage courses, and inlets.

- Protect all stockpiles from stormwater run-on using a temporary perimeter sediment barrier such as berms, dikes, silt fences or gravel bag barriers.

- Implement wind erosion control practices as appropriate on all stockpiled material.

3. Drilling

During a rain event, BMPs, such as those used for sediment stockpiles, should be implemented to prevent water that comes in contact with drill cuttings from entering the stormwater conveyance system. Bagged materials must be placed on pallets and under cover. Following drilling activities, remove cuttings and clean the site to the maximum extent practicable.

4. Nonoperating Sites

Nonoperating sites are sites that are being remediated or monitored by an oversight agency (i.e. SAM, RWQCB) but are not conducting retail operations. Often these sites are not covered by asphalt or concrete and are subject to erosion. These sites should be assessed to ensure that the minimum BMP's necessary to prevent materials from entering the stormwater system have been implemented. Minimum BMP's should include:

- Practice good housekeeping
- Contain waste
- Minimize disturbed areas
- Stabilize disturbed areas
- Protect slopes/channels
- Control site perimeter
- Control site erosion

In addition, since non-operating sites are exposed and subject to erosion, dust control measures may need to be implemented to minimize dust generation and the off-site migration of dust into the stormwater conveyance system.

Dust control measures are practices that help reduce surface and air movement of dust from disturbed sediment surfaces. Particular dust control measures that are implemented at a site will depend on the topography and land cover of a given site, as well as the soil characteristics and expected rainfall at the site.

A number of methods can be used to control dust from a site. The following is a brief list of some control measures and their design criteria. Not all control measures will be applicable to a given site:

- **Sprinkling/Irrigation:** Sprinkling the ground surface with water until it is moist is an effective dust control method for haul roads and other traffic routes.

- **Vegetative Cover:** In areas not expected to handle vehicle traffic, vegetative stabilization of disturbed soil is often desirable.

- **Mulch:** Any loose covering of soil with organic residues, such as grass, straw, or wood fibers, can be used to check erosion and stabilize exposed soil. Mulching can be a quick and effective means of dust control for a recently disturbed area. Mulch should only be applied a few inches in depth. Runoff, contaminated with organic material, is typical when excess mulch is applied, especially on slopes.

- **Wind Breaks:** Wind breaks are barriers (either natural or constructed) that reduce wind velocity through a site and therefore reduce the possibility of suspended particles.

- **Stone:** Stone may be an effective dust deterrent for construction roads and entrances or as a mulch in areas where vegetation cannot be established.

- **Spray-on Chemical Soil Treatments (palliatives):** Examples of chemical adhesives include resin-water emulsions, bonded fiber matrix, and guar binder.

If structural controls are used, they should be inspected for deterioration on a regular basis to ensure that they are still achieving their intended purpose.

A. Water

Discharge of contaminated non-stormwater to conveyance systems is prohibited unless regulated by a NPDES or waste discharge permit. Incidental non-stormwater generated from these activities must be contained. Depending upon volume, non-stormwater may be allowed to accumulate and evaporate, or may be sampled to determine suitability for discharge to the sewer system.

Non-stormwater generated at a SAM site should be contained and properly handled. The use of standard land disturbance BMPs such as covering storm drain inlets with plastic/weighted and taped or other material used for this purpose, silt fencing, gravel bags around the perimeter of the site, desilting basins, and construction site entrance stabilization should be included in plans for UST Installation or Closure, Site Assessments and Corrective Action. Specific BMPs for these activities may be obtained from the “County of San Diego Stormwater Standards Manual”, Table A Attachment F-1 of the County of San Diego Storm Water Management Plan, or from the “Caltrans Storm Water Quality Handbooks” and the “California Storm Water BMP Handbook for Construction.”

1. Spill Prevention and Control

BMPs are implemented anytime chemicals and/or hazardous substances are used or stored. Spills should be immediately mitigated using dry methods if practicable, but if wet methods are necessary, all downstream storm drain inlets must be properly protected to prevent discharges. Water used for cleaning and decontamination shall be retained on-site and shall be collected and disposed of properly. Maintain spill response kits on-site at all times and control spills in a manner that prevents the discharge of spilled material to the conveyance system or watercourses.

2. Water Control at Excavations

Take all necessary precautions and preventative measures to prevent the flow of water, including groundwater, from mixing with hazardous substances or entering underground storage tank excavations. Preventative measures may consist of, but are not limited to: berms, cofferdams, grout curtains, freeze walls, and seal course concrete or any combination thereof. If water enters an excavation and becomes contaminated, such water shall be collected and removed. Contaminated water shall be retained in clean, closed top, watertight holding tanks. Dispose of this water in accordance with all federal, state, and local laws.

3. Sediment Control

Discharging sediment-laden water, as a result of an excavation dewatering, into any stormwater conveyance system or water of the State without filtration is prohibited. Therefore a temporary method to filter sediment-laden water from excavated areas on construction sites must be implemented prior to discharge to the storm drain or surface waters. Applicable methods of sediment control include: filter box, portable sediment tank, sump pit, and perforated standpipe wrapped in filter pack and surrounded by stones. The filtration structure must be inspected frequently during operation and repaired or replaced once sediment build-up decreases the efficiency of the structure design. Water, resulting from the dewatering of an excavation that is part of an unauthorized release investigation or remediation, is prohibited from being discharged to a stormwater conveyance system or receiving water. Water may be discharged under a Waste Discharge Requirements (WDR) permit or site specific permit issued by the RWQCB, provided compliance with all relevant NPDES or WDR permit conditions is maintained to the satisfaction of the RWQCB.

B. Transportation

1. Construction Site Exits

The purpose of stabilizing exits at a site is to minimize the amount of sediment leaving the area via motorized vehicles. All exits to a site must be stabilized prior to site disturbance activities. The stabilized site exits should be long and wide enough so that the largest construction vehicle that will enter the site will fit through the exit with room to spare. If many vehicles are expected to use an exit in any one day, the site exit should be wide enough for the passage of two vehicles at the same time with room on either side of each vehicle. The following are BMPs that will assist in controlling the amount of sediment leaving a site:

- Install a pad of gravel over filter cloth at the site exit. As a vehicle drives over the gravel pad, mud and sediment are removed from the vehicle's wheels and offsite transport of sediment is reduced.

- Establish a vehicle washing station at the site exit. Wash stations can remove a substantial amount of sediment from tires and under the carriage of vehicles before they leave a site. This prevents sediment from being transported onto public roadways. Divert runoff from vehicle washing stations into a sediment trap to help ensure that sediment and rinse water are kept on-site and disposed of properly. Remove accumulated sediment from the wash rack and/or sediment sump to maintain system performance.

- Sweep and/or vacuum sediment from paved loading, unloading and stockpile areas to prevent the sediment from entering a storm drain or watercourse. Properly dispose of waste at an approved dumpsite. Since sweeping and vacuuming may not be effective when sediment is wet or muddy, other BMPs may have to be implemented to remove the sediment from the roadway.

- Sweep paved areas adjacent to the site exit.

2. Vehicle/Equipment Maintenance, Fueling and Washing Areas

Sites that perform onsite vehicle and/or equipment maintenance, fueling or washing need to implement BMPs to prevent pollutants from entering the stormwater conveyance system and the groundwater supply. The following BMPs shall be implemented at all vehicle and/or equipment maintenance and washing areas:

- Designate a paved and covered area for maintenance, fueling and washing. If the site does not have a paved surface, implement appropriate BMPs to ensure that pollutants cannot enter the stormwater conveyance system.
- Eliminate improper connections from these areas to the storm drain system.
- Maintain a spill kit on-site at all times and develop a spill prevention and cleanup plan for vehicle maintenance and repair areas and all equipment that may leak hazardous materials.
- Elevate hazardous materials off of the ground and store indoors or cover with an impervious material such as a tarp, if stored outdoors. Keep hazardous material containers lidded and properly labeled at all times.
- Dispose of hazardous materials and wash water in accordance with all federal, state and local laws and regulations.
- Inspect vehicles and equipment for leaks daily. Repair leaks immediately.

IV. DEFINITIONS

Best Management Practices: Best Management Practices (BMPs) are defined in 40 CFR 122.2 as schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operation procedures and practices to control plant site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw materials storage. In the case of municipal stormwater permits, BMPs are typically used in place of numeric effluent

Catch Basin: A storm drain inlet having a sump below the outlet to capture settled solids.

Copermittee (or Co-permittee): A permittee to the Municipal Stormwater Permit that is only responsible for permit conditions relating to the discharges from its area of jurisdiction.

Dewatering Operations: The removal of groundwater during construction activities.

Discharge: The volume of liquid and/or solid that passes a fixed point within a given period of time. An all-inclusive outflow term that describes a variety of flows such as from a pipe to a stream, or from a stream to a lake or ocean.

Dry Weather Season: May 1 through September 30 of each year.

Dry Cleaning Methods: Cleaning techniques which include use of a broom and dustpan, a vacuum, or mop, to clean up spills or debris.

Good Housekeeping: A common practice related to the storage, use, or cleanup of materials performed in a manner that minimizes the discharge of pollutants.

Monitoring: Refers to a variety of activities and processes through which Copermittees may obtain information relevant to implementation of their storm water quality management programs so that the need for and/or opportunities for revision or refinement can be identified.

Municipal Stormwater Permit: NPDES Order No. 2001-01, adopted February 21, 2001 by the San Diego RWQCB, which sets waste discharge requirements for discharges of urban runoff to the municipal separate storm sewer systems.

National Pollution Discharge Elimination System (NPDES): These permits pertain to the discharge of waste to surface waters only. All State and Federal NPDES permits are also Waste Discharge Requirements (WDR).

Pollution: Defined in the Porter-Cologne Water Quality Control Act, section 13050 (l) "means an alteration of the quality of the waters of the state by waste to a degree which unreasonably affects either of the following:

(A) The waters for beneficial uses.
(B) Facilities which serve these beneficial uses.

Pollution may include contamination."

Rainy, Wet Weather Season: October 1 though April 30.

Receiving Waters: All surface water bodies within the permit area into which wastewater or treated effluent is discharged.

Sediment: Organic or inorganic material that is carried by or suspended in water.

Spill: An accidental dumping or spilling of a potential pollutant onto the ground or into a waterway.

Storm Water (or Stormwater): "Stormwater" is defined as urban runoff and snowmelt runoff consisting only of those discharges that originate from precipitation events. Stormwater is that portion of precipitation that flows across a surface to the storm drain system or receiving waters.

Storm Water (or Stormwater) Conveyance System: Streets, gutters, inlets, conduits, natural or artificial drains, channels and watercourses, or other facilities that are owned, operated, maintained and used for the purpose of collecting, storing, transporting or disposing of stormwater.

Structural Control: A type of best management practice (BMP) that employs engineered and constructed systems to improve the quality and/or quantity of runoff (e.g. detention ponds and constructed wetlands).

REFERENCES

County of San Diego Watershed Protection, Stormwater Management, and Discharge Control Ordinance, Chapter 8, Article 1, Section 67.

Guide for BMP Selection in Urban Developed Areas (2001). ASCE Envir. and Water Res. Inst. Reston, VA.

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Start at the Source, Design Guidance Manual for Stormwater Quality Protection. Bay Area Stormwater Management Agencies Association. 1999 Edition. Oakland, CA.

San Diego County Association of Resource Conservation District. Spring, 1998 San Diego County Edition. Best Management Practices for Erosion and Sediment Control and Storm Water Retention/Detention

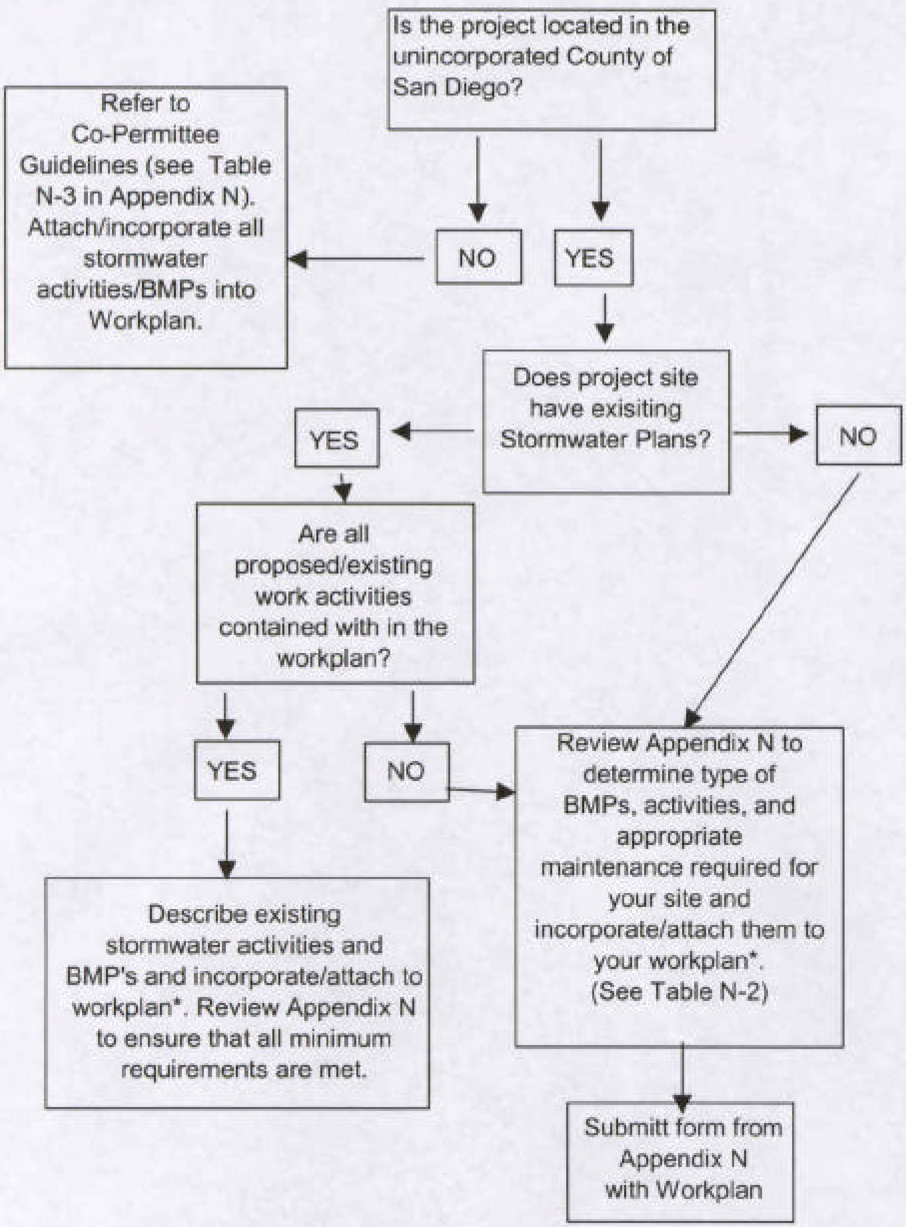
Caltrans Urban Runoff Quality Handbook: Planning and Design Staff Guide (Best Management Practices Handbooks (1998). California Department of Transportation.

California Industrial/Commercial Stormwater Inspection Program Handbook for Municipal Agencies. Alameda Countywide Clean Water Program. March 1996

California Urban Runoff Best Management Practices Handbooks (1993) for Construction Activity, Municipal, and Industrial/Commercial. Los Angeles County Department of Public Works.

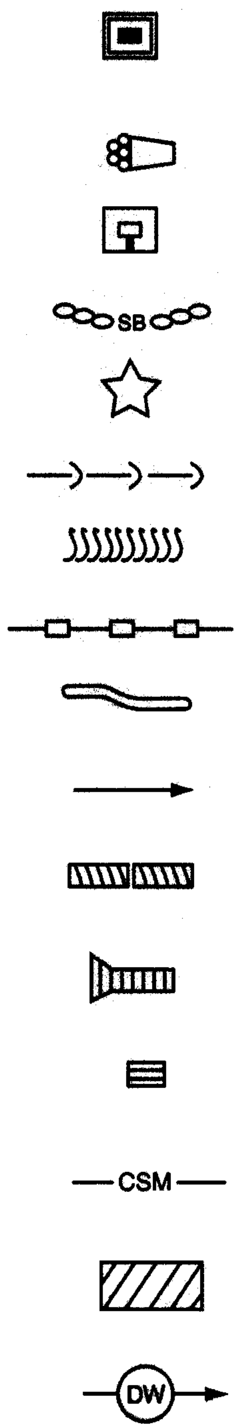
Designing for Effective Sediment and Erosion Control on Construction Sites. Jerald S. Fifield, Ph.D., CPESC.

Figure N-1 - SAM Stormwater Decision Tree San Diego County



* *Instead of listing/describing all stormwater activities and BMPs, you may reference the SAM Manual Appendix N in your workplan and state that you will adhere to said guidelines.*

FIGURE N-2
Common Stormwater Symbols



Storm drain inlet protection

Protection/velocity dissipation device

Sediment trap

Sandbag/gravel bay barrier

Stormwater discharge/sampling location

Check dams

Earthen/grass swales

Silt fences

Fiber rolls

Runoff flow direction

Straw bales

Site entrance/exist

Drop inlet

Contaminated soil mangaement

Excavation area

Dewatering

Table N-1 - Stormwater BMPS By SAM Activity

Categories of SAM Activities	Stormwater Best Management Practices															
	Silt Fence	Gravel Bag Barrier	Straw Bale Barrier	Fiber Rolls	Check Dam	Hydraulic Mulch	Hydroseeding	Soil Binders	Straw Mulch	Erosion Control Covers	Sediment Trap	Street Sweeping and Vacuuming	Stabilized Construction Roadway	Entrance/Outlet Tire Wash	Shaker Plates	Good Housekeeping Practices
Soil																
Drilling												X				X
Stockpiles		X	X	X						X						
Excavation Materials	X	X	X	X	X						X					
Trenching	X	X	X	X	X						X					
UST Removal	X	X	X	X	X						X					
Non-operative Sites (Dirt Lots)	X	X	X	X	X	X	X	X	X	X	X					
Water																
Decontamination												X				X
Transporation																
Construction Site Entrances												X	X	X	X	X
Vehicle Maintenance and Washing Area											X	X				X

Table N-2: Stormwater Management Practices Standard Project Form

Project Site: Street Address______________________________________City________________

SAM Case #: H__________ **Owner:** ____________________________

1. The following categories of activities checked on the left side of the table below are anticipated to take place during the course of this SAM Case project. The best management practices checked for each category of activity will be available and implemented as appropriate over the course of the project.

	Stormwater Best Management Practices															
Categories of SAM Activities	Silt Fence	Gravel Bag Barrier	Straw Bale Barrier	Fiber Rolls	Check Dam	Hydraulic Mulch	Hydroseeding	Soil Binders	Straw Mulch	Erosion Control Covers	Sediment Trap	Street Sweeping and Vacuuming	Stabilized Construction Roadway	Entrance/Outlet Tire Wash	Shaker Plates	Good Housekeeping Practices
Soil																
Drilling																
Stockpiles																
Excavation Materials																
Trenching																
UST Removal																
Non-operative Sites (Dirt Lots)																
Water																
Decontamination																
Transporation																
Construction Site Entrances																
Vehicle Maintenance and Washing Area																

2. Monitoring to be implemented to ensure proper application and maintenance of BMPs:

3. Other comments:

Table N-3 - Co-Permittee Contacts

Co-Permittee Stormwater Contacts			Co-Permitee Excavation Contacts	
Entity	Department	Phone Number	Department	Phone Number
County of San Diego		888-846-0800	Planning and Land Use	858-565-5981
San Diego Unified Port District	Environmental Services	619-686-6254	Parks & Recreation	619-686-6467
City of La Mesa	Public Works	619-667-1450	Engineering	619-667-1154
City of El Cajon		619-441-1653	Planning and Zoning	619-441-1741
City of National City	Engineering	619-336-4380	Engineering	619-336-4380
City of Imperial Beach	Public Works	619-423-8311	Community Development	619-628-1356
City of Chula Vista	Engineering	619-691-5021	Permits & Licenses	619-691-5024
City of Carlsbad	Public Works / Water	760-438-2722		
City of Oceanside	Water Utilities	760-435-5800		
City of Encinitas	Engineering	760-633-2770		
City of Del Mar		760-753-1120	Planning & Community Development	760-755-9337
City of San Diego		619-525-8647	License & Permit	619-446-5000
City of Lemon Grove		760-438-2722	Planning	619-825-3815
City of Escondido		760-839-4668		
City of Poway	Public Services	858-679-5415		
City of Coronado	Public Services	619-522-7380		
City of San Marcos	Public Works	760-744-1050		
City of Solana Beach	Engineering & Public Works	858-720-2470		
City of Santee	Development Services (Stormwater)	619-258-4100		
City of Vista	Engineering	760-726-1340		