

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

**GENERAL REQUIREMENTS
FOR
SUBSURFACE INVESTIGATIONS
CHARNOCK SUB-BASIN INVESTIGATION AREA**

(revised January 20, 2006)

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0. INTRODUCTION:

The objectives of subsurface soil and/or groundwater investigations are to evaluate historical and current waste discharges, define the lateral and vertical extents of contamination, define soil and aquifer properties that affect contaminant mobility and transport, and to lead to mitigation of potential sources of ongoing groundwater pollution. Investigations are intended to focus on possible preferential pathways that could allow transport of MTBE-gasoline to drinking water aquifers. This includes investigating improperly constructed or abandoned wells, discontinuous aquitard(s), faults acting as boundaries to or conduits for flow, subsurface utilities, and excavations that cut through aquitards or require dewatering.

In addition to the general requirements provided herein, workplans must be submitted for each investigation to be conducted. Specific requirements for subsurface soil investigations, groundwater investigations, laboratory requirements for soil and water sample analyses, laboratory report form, and active soil gas investigations are provided. Site-specific modification to these requirements may be approved upon consultation with the California Regional Water Quality Control Board, Los Angeles Region (Regional Board). Field work must not be initiated without approval from the Regional Board and 5 business day advance e-mail notification to the Regional Board.

For sites that have multiple investigation areas, such as co-mingled plume, the items that are common to all investigation areas (e.g., objectives, data quality objectives (DQOs), how the data will be used, descriptions of investigation methods, QA/QC program, etc.) may be discussed once, collectively, for all investigation areas. Items that are unique to the various investigation areas (e.g., rationale for specific sampling locations, summaries of data, soil boring logs, etc.) shall be discussed individually.

The Regional Board UST Program promotes electronic submittal of reports to save resources for both the public and private sectors. The paper copy of a technical report may be reduced to include only main contents of the report along with e-copy in the CD-ROM, which contains the full report in a Portable Deliverable Format (PDF). For a general guideline of e-report or other requirements, please see our web page at http://www.waterboards.ca.gov/losangeles/html/programs/ust/04_0621_e-QMRGuideline6-04.pdf.

The requirements for various aspects of subsurface investigations are presented in the following sections.

1. PERSONNEL:

A California professional geologist (PG), certified hydrogeologist (CHG), professional engineer (P.E.) or certified engineering geologist (C.E.G.) shall be on site to direct or conduct subsurface investigations for certain periods of time proportional to the scope and complexity of the work to be completed and to sign all workplans and final technical reports.

2. SITE HEALTH AND SAFETY PLAN:

Submit a site-specific health and safety plan for subsurface investigation, commensurate with the scope and nature of work to be completed.

3. WORKPLANS:

The minimum requirements for workplans for common types of subsurface investigations are presented in the following subsections. Workplans for investigations not specifically identified below shall be prepared in general accordance with applicable portions of the following subsections and shall also provide a similar level of detail and completeness.

3.1. GENERAL:

At a minimum, a workplan must include:

- 1) Objectives of the investigation, including data quality objectives (DQOs),
- 2) The technical approach, including rationale for all sampling locations and methods,
- 3) All assumptions which provide a basis for the technical approach (such as lithology at the site, understanding of contaminant migration, groundwater flow conditions, etc.) shall be stated,
- 4) An explanation of how data generated during site specific investigations will be used at the local scale,
- 5) A description of field methods. Provide standard operating procedures (may be provided by including appendices),
- 6) A tabular data summary showing all historical soil and groundwater chemical and physical data to date,
- 7) A tabular data summary showing monitoring well screen intervals, completion depths, survey elevation, water elevations, and free product thickness, if any,

- 8) Soil boring logs and well drilling logs documented from prior work at the site,
- 9) Describe Quality Assurance/Quality Control (QA/QC) program proposed in the workplan,
- 10) A project schedule including all major activities including submittal of a final technical report, and
- 11) Submit workplans to the Regional Board (see "Reporting" below).

3.2. WORKPLANS FOR SUBSURFACE SOIL INVESTIGATIONS:

Workplans for subsurface soil investigations shall also include, but not be limited to, the following:

- 1) Soil samples shall be collected in areas where gasoline was historically or is currently managed (i.e. pipelines, USTs, associated piping, dispenser islands, vents, etc.). Additionally, if a Soil Gas Investigation was conducted and "hot spot" areas were identified, the "hot spot" areas shall also be investigated by advancing a sufficient number of continuously cored soil test borings to delineate the horizontal and vertical extent of any gasoline impacted soil.
- 2) Take soil samples at minimum 5-foot intervals and at each change in lithology or changes in soil contamination as determined by an organic vapor analyzer (OVA) or on-site lab.
- 3) Continuous coring can provide information that may be used to design soil vapor extraction wells and/or groundwater monitoring wells. At a minimum, one continuous core must be extended to the water table at an onsite location other than the known source areas.
- 4) Take samples from the middle of any low permeability or high moisture content units if the units are thicker than five feet.
- 5) Explain proposed drilling method, equipment, and procedures for completing soil borings.
- 6) Describe equipment and procedures for collecting and handling of geologic materials for chemical or physical testing.
- 7) Identify borehole backfill materials, procedures, and disposal method for soil cuttings.

3.3. WORKPLANS FOR GROUNDWATER INVESTIGATIONS:

The minimum scope of work required for investigating groundwater at a PRP site (and at each individual investigation area where multiple investigation areas have been specified at a given PRP site, such as a co-mingled plume), initially, shall include an investigation of the uppermost aquifer underlying the site. Investigation of the saturated zone will, at a minimum, include the following:

- 1) Install a minimum three groundwater monitoring wells into the uppermost aquifer, one upgradient and two downgradient from potential source areas. Additional downgradient groundwater monitoring wells may be required based upon available data including site history and locations of UST systems.
- 2) A minimum of one continuously cored soil test boring/groundwater monitoring well advanced to the first aquitard, (or if the aquitard is not present, to first groundwater) to define local stratigraphy and to obtain reliable site specific data for designing initial groundwater monitoring wells. The initial continuously cored soil test boring/groundwater monitoring well shall be completed at an appropriate upgradient location on site, where no gasoline contaminants are anticipated to be present.
- 3) At a minimum the first deep exploratory test boring, or the well constructed in it, shall be geophysically logged. Monitoring wells installed at the PRP site must be geophysically logged.
- 4) If and when any municipal supply well(s) operated by the City of Santa Monica are turned on within the Charnock Sub-Basin Investigation Area, PRP site groundwater monitoring wells installed into the shallow aquifer and/or the Silverado (or equivalent) aquifer, shall be monitored for possible influence due to drawdown and/or recovery.
- 5) Quarterly groundwater monitoring shall be included in the workplan and conducted as described below. The Quarterly Groundwater Monitoring Report shall be submitted to this Regional Board on the schedule included in Item 10 of Section 12 of these General Requirements.
- 6) If groundwater monitoring wells currently exist at a PRP site and these wells were incorrectly installed (i.e., screened across an aquitard separating two aquifers), then these wells must be legally abandoned and replacement wells installed to evaluate any potential impacts resulting from their installation. At sites where groundwater monitoring wells have been screened across an aquitard separating two aquifers and/or at sites where an aquitard separating the shallow saturated zone from the Silverado aquifer is not present, deeper groundwater investigation shall be implemented. At these sites, three wells installed into the next deeper aquifer shall be completed. Improperly installed wells shall be legally abandoned and replaced with wells properly constructed to monitor the upper aquifer. As with the investigation of shallow aquifers, locate two of the three wells downgradient from the improperly constructed well(s). The construction, development,

and abandonment of groundwater monitoring wells must comply with requirements prescribed in the California Well Standards (Bulletin 74-90), published by the California Department of Water Resources (can be seen at www.dpla2.water.ca.gov and go to "groundwater")

- 7) Provide a map, to scale, showing the location(s) of the proposed well(s) and any nearby (within 1,000 feet) existing groundwater monitoring and drinking water supply well(s).
- 8) Provide well design criteria, specifications, and construction details including casing and screen materials, screen length and placement with respect to water table, depth and type of annular seal.
- 9) Propose and explain drilling method(s) to be used and decontamination procedures.
- 10) Provide disposal plans for soil cuttings and well development water.
- 11) Describe details of water sampling and provide:
 - a) Water level measurement procedures;
 - b) Purge techniques, purge volumes, and parameters (pH, temperature, conductivity, and turbidity) to assure the collection of a representative water sample;
 - c) Water sampling device(s);
 - d) Procedures to minimize loss of samples by adsorption and/or volatilization.
- 12) Describe methods for sample handling and preservation.

3.4. WORKPLANS FOR SOIL VAPOR EXTRACTION REBOUND TESTING:

Prior to shutting down a Soil Vapor Extraction (SVE) system, a rebound test approved by the Regional Board is required. A workplan shall be submitted to the Regional Board for approval prior to conducting the rebound test. The workplan shall propose to comply with the procedures in this section at a minimum. The workplan shall also propose a schedule for conducting the rebound test and an outline of the report to be submitted. During the rebound test, system operating information required by the Section 9.2 "SVE System Quarterly Progress Report" of these General Requirements below and air samples shall be collected in accordance with the following schedule and procedures:

- 1) After influent vapor concentrations reach non-detect or asymptotic levels for all gasoline constituents, shut down the system for a period of 2 weeks.

- 2) Re-start the system and collect influent samples at the following frequencies: 1 day, 7 days, and every two weeks until two consecutive concentrations are at non-detect or asymptotic levels for all gasoline constituents.
- 3) If concentrations have not reached a non-detect or asymptotic levels, resume system operation for further cleanup.
- 4) If concentrations have reached non-detect or asymptotic levels, shut down the system for an additional period of 4 weeks.
- 5) Re-start the system and collect influent samples at the following frequencies: 1 day, 7 days, and every two weeks until concentrations are at non-detect or asymptotic levels for all gasoline constituents.
- 6) Tedlar bags shall not be used as soil vapor sample containers during rebound testing.
- 7) Soil matrix samples may be required for confirmation of cleanup in areas where contaminants were previously detected.

4. FIELD PROCEDURES:

Do not proceed with fieldwork without prior approval from the Regional Board. Provide e-mail notification to personnel listed in Section 12 of these General Requirements at least 5 business days prior to initiating fieldwork to permit observation of field activities and/or to take split samples, as needed.

If the fieldwork proceeds offsite, a public notice (flyer) is required to be distributed to the residents who will likely be impacted by the fieldwork (e.g., traffic, parking, or noise) at least five working days prior to commencing drilling. The template of the public notification shall be approved by the Regional Board prior to distribution, and at a minimum, include Regional Board's contact telephone numbers.

The following investigation procedures must be addressed in a workplan at a minimum.

4.1. GENERAL:

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

- 1) Impacts of discharges on groundwater quality,
- 2) Lateral and vertical extent of contaminant plume(s),
- 3) Groundwater gradient and direction of flow,

- 4) Specific aquifer properties as required,
- 5) Depth of impacted aquifers (including groundwater production zones),
- 6) Slug test at individual wells as required on a case by case basis.

4.2. ACTIVE SOIL GAS INVESTIGATIONS:

Perform active soil gas investigations in accordance with the Regional Board's "Advisory - Active Soil Gas Investigations" (dated January 28, 2003), with the changes below. The specific sections changed are identified below together with the changes needed. The soil gas survey shall be designed for gasoline constituents, including MTBE, TBA, TAME, DIPE, and ETBE. However, if there are areas on the site where chlorinated volatile organics could have been used/stored/discharged (i.e., waste oil tanks, sumps, clarifiers, and/or parts cleaning operations for automotive repairs) then the target compound list may need to be expanded. The sections referred below coincide with those in the Regional Board's "Interim Guidance (2/1997)."

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|---------------|---|
| Section 2.2 | Adjust and/or modify the site specific purge volume versus contaminant concentration testing for MTBE recovery and detection. |
| Section 3.1 | The primary target compound list can be significantly reduced to include only TPH _G , BTEX, MTBE, TBA, TAME, DIPE, ETBE, and ethanol, unless other constituents of concern are to be included in the site investigation. |
| Section 3.5.1 | Add calibration and laboratory control standard for MTBE, TBA, TAME, DIPE, and ETBE. |
| Section 3.7.1 | Perform initial calibration for gasoline constituents only (i.e., TPH _G , BTEX, MTBE, TBA, TAME, DIPE, and ETBE), unless other constituents of concern are to be included in the site investigation. |
| Section 3.7.3 | Calculate response factors (RF) for TPH _G , BTEX, MTBE, TBA, TAME, DIPE, and ETBE only, unless other constituents of concern are to be included in the site investigation. |
| Section 3.8.1 | Perform mid-point calibrations for TPH _G , BTEX, MTBE, TBA, TAME, DIPE, and ETBE prior to performing any sample analysis. |
| Section 3.8.2 | Daily mid-point calibrations for TPH _G , BTEX, MTBE, TBA, TAME, DIPE, and ETBE only, unless other constituents of concern are to be included in the site investigation. |

- Section 3.8.3 Difference in RF from initial calibration $\pm 15\%$.
- Section 3.10.4 Detection limits at 100 $\mu\text{g/L}$ for TPH_G.
- Section 3.10.6 Surrogate compounds for two aromatic compounds (benzene and toluene), and for MTBE.
- Section 4.4 At a minimum, isoconcentration maps for TPH_G, benzene, MTBE, and TBA are to be completed.
- Section 5.1 The drilling of any soil test borings or installation of groundwater monitoring wells are to be evaluated under a separate workplan after completing the soil gas survey.
- Section 6.0 The need to install fixed placed discrete zone vapor monitoring wells (for periodic monitoring) can be evaluated on a case by case basis after completion of the initial active soil gas investigation on site.

Soil gas analysis shall also comply with Section 8 of the General Requirements.

All data points shall be surveyed and their X, Y, and elevation coordinates shall be given for all data points in reporting documents.

If gasoline constituents were detected in soil gas samples collected at the PRP site, then the PRP must implement a soil and/or groundwater investigation in accordance with these General Requirements.

4.3. EXPLORATORY BORINGS:

- 1) Extend boring depth if groundwater is encountered or if there is obvious soil contamination at the bottom of the borehole (OVA or on-site lab).
- 2) Do not use soil samples obtained by any air or fluid drilling methods for petroleum hydrocarbons and aromatic hydrocarbons, MTBE or any other volatile analyses completed.
- 3) Provide complete and legible boring logs including:
 - a) Description of earth materials, conditions (moisture, color, etc.), and classifications per Unified Soil Classification System (USCS);
 - b) Lithographic column with USCS abbreviations and symbols;
 - c) Sample depth in feet;

- d) Penetration in blows per foot (blow counts) and inches (or percent) of sample recovered;
 - e) Vapor readings of samples using OVA.
- 4) Take, seal, and transport discrete soil samples in accordance with EPA Method 5035 to the testing laboratory for analysis. Do not use samples to be submitted for laboratory analyses for field screening or classification.
 - 5) Comply with chain of custody procedures. Samples must be handled and analyzed per the Laboratory Requirements for Soil and Water Sample Analyses (Section 5).
 - 6) Sample and analyze water, if groundwater is encountered, only after converting to a monitoring well or piezometer. Hydro-punch/geoprobes are not replacements for permanent groundwater monitoring wells. Grab groundwater samples are not able to provide groundwater-monitoring data over time. Hydro-punch/geoprobes can be used to initially screen analytical groundwater data and strategically identify permanent groundwater monitoring well locations.
 - 7) All soil data points shall be surveyed relative to the California State Plane Coordinate System. The vertical and horizontal surveys shall be referenced to the North American Datum of 1927 (NAD27) and the National Geodetic Vertical Datum of 1929 (NGVD29). Therefore X, Y, and elevation coordinates shall be given for all soil data points in reporting documents.

4.4. MONITORING WELL CONSTRUCTION/DEVELOPMENT:

- 1) Use a minimum of 4" diameter schedule 40 PVC well casing material. On a case by case basis, the Regional Board may approve wells constructed with 2" diameter casing.
- 2) Do not penetrate a competent clay layer below a saturated zone. Conduct physical and hydraulic tests to determine competency of any confining zone materials. Take a sample of the confining materials at the end of borehole for chemical and physical analysis.
- 3) In the event of installing a deep well, a conduct casing shall be used to prevent contaminants migrating from the shallow aquifer to the deep aquifer.
- 4) Provide the Regional Board staff with the boring logs, and proposed well screen intervals by e-mail or fax and with telephone notification of these transmissions to the undersigned, and wait one full business day for the Regional Board to provide the approval or amendments to the proposed well screen intervals in writing (e-mail or facsimile). If, at the end of one full business day, the Regional Board staff has not pro-

vided the approval or amendments, you may proceed with installation of the monitoring wells with the well screen intervals as proposed.

- 5) Characterize aquifer materials based upon sieve analysis for proper selection of filter pack and screen. Less than 10% of the filter pack should enter the well
- 6) Suspend and centralize casing materials such that it is not resting against the sides nor bottom of the hole prior to fixing in place.
- 7) Place grout of either cement, bentonite or mixture in an appropriate manner to avoid bridging.
- 8) Provide geophysical logging for all well boreholes by qualified personnel to confirm the geologic logging per USCS during the drilling.
- 9) Establish benchmark relative to mean sea level. Provide benchmark location and survey date. Measure water levels to 0.01 feet.
- 10) All groundwater data points shall be surveyed relative to the California State Plane Coordinate System. The vertical and horizontal surveys shall be referenced to the North American Datum of 1927 (NAD27) and the National Geodetic Vertical Datum of 1929 (NGVD29) Therefore X, Y, and elevation coordinates shall be given for all groundwater data points in reporting documents.
- 11) Wait at least 48 hours, but not more than 7 days, for well seal materials to set before well development. Develop well such that the waters sampled are representative of the formation water. Obtain water sample with less than 5 NTUs of turbidity measurement to be acceptable for petroleum hydrocarbon, aromatic hydrocarbons, MTBE and other volatile analyses that may be required.
- 12) Monitoring wells must be equipped with locking covers or equivalent level of protection in compliance with California Department of Water Resources Bulletin 74-90 (California Well Standards, Monitoring Well Standards, Section 10) to prevent unauthorized access.

4.5. GEOPHYSICAL LOGGING:

All exploratory test borings and wells shall be logged using downhole geophysical methods. Of particular importance is the geophysical logging of boreholes and wells that were not continuously cored (or if there was poor soil core recovery) when drilled. Wells that will have to be removed because they are screened across aquitards or provide a conduit for contaminant migration shall also be geophysically logged prior to abandonment. Suggested suite for cased borings/wells:

- 1) EM Induction Log
- 2) Natural Gamma Log
- 3) Density Log
- 4) Neutron Log

The density and neutron logs are not required in borings/wells that are continuously cored/sampled by trained individuals. The density and neutron logs are not required for existing wells.

Suggested suite for holes drilled using mud rotary method:

- 1) Spontaneous Potential Log
- 2) Resistivity Log (long normal, short normal)
- 3) Caliper Log
- 4) Open Hole Sonic Log

4.6. WATER SAMPLING:

- 1) Wait a minimum of three days, but not more than 7 days, after well development.
- 2) Comply with chain of custody procedures. Samples must be handled and analyzed per the Laboratory Requirements for Soil and Water Sample Analyses (below), and LARWQCB Lab Reporting Forms and Instructions (below).

4.7. PHYSICAL PROPERTY TESTING:

A representative number of soil samples shall be collected for physical property testing at depths representative of the vadose zone, and aquifer and aquitard materials on site. These data shall be used to guide installation of groundwater monitoring wells and for site specific assessment, remediation, and transport modeling activities. Soil chemical and physical data collected during site assessment and/or remediation phases to perform site-specific risk assessment and/or fate and transport modeling must include the following:

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

- 1) Fraction of organic carbon content (foc)
- 2) Grain-size distribution

- 3) Effective soil porosity
- 4) Bulk density
- 5) Soil moisture content
- 6) Plasticity index for clayey and silty materials (Atterberg limits)
- 7) Gas permeability (if possible)
- 8) Vertical permeability.

5. LABORATORY REQUIREMENTS FOR SOIL AND WATER SAMPLE ANALYSES:

5.1. GENERAL:

- 1) Comply with sample chain of custody procedures equivalent to those in Section 9.2.2.7, Chapter 9 of SW846 Update III.
- 2) Employ a laboratory certified by the State Department of Health Services, Environmental Laboratory Accreditation Program (ELAP) for each analytical testing method to be used (ELAP list is available at <http://www.dhs.ca.gov/ps/ls/elap>).
- 3) Quantify method detection limits (MDLs) for low level testing. Report concentrations for constituents identified greater than MDLs and less than Estimated Quantitation Limit (EQL) with a "J" flag indicating an estimated concentration. Otherwise, indicate as trace and provide estimated concentration.
- 4) Report an analytical result as "non-detected" (<MDL, with the MDL specified in parenthesis)
- 5) Take appropriate corrective actions for any laboratory contamination or matrix interference problems and report the corrective actions in support of the analytical results. Do not have results blank adjusted.
- 6) Report all analytical results and QA/QC sample results on the Lab Form 10A (for volatile organics and petroleum hydrocarbons). Run all QA/QC items specified above on the same dates when samples were actually analyzed.
- 7) Include laboratory QA/QC procedures and performance as follows:
 - a) Calibration check standards including the most recent initial calibration range (the lowest to the highest injected concentrations) and average response factors (RF),

%RSD, daily RF from continuing (mid-point) calibration and its percent difference from the initial calibration average RF;

- b) Method blanks (daily);
- c) Laboratory quality control check samples (LCS) and spiking concentrations (daily). LCS chemical standards and calibration standards must be obtained from different supply sources;
- d) Surrogate samples and spiking concentrations (each sample);
- e) Matrix spike and matrix spike duplicates (MS/MSD) (every batch of samples). If more than 10 samples are obtained for the subsurface investigation project, spike at least one of them; and
- f) If an internal standard is used, the RF for the internal standard and the equation to determine the sample concentrations shall be submitted.

5.2. FIELD QA/QC SAMPLING PROGRAM:

Chemical analyses must include the following:

- 1) Equipment blank(s) for every day samples are collected for chemical analysis. Every tool used such as a bailer, SimulProbe, split spoon sampler with sleeves, etc. shall be included.
- 2) Trip blank in every cooler (analyzed for petroleum hydrocarbons, including MTBE)
- 3) All QA/QC samples are to be analyzed for the standard analytical suite (TPH_G, BTEX, MTBE, TBA, TAME, DIPE, ETBE, and ethanol). Any positive identification shall be confirmed by using GC/MS methods.

5.3. SOIL SAMPLE ANALYSES:

- 1) Collect all soil samples to be analyzed for gasoline constituents or volatile organic compounds in accordance with EPA Method 5035.
- 2) Analyze samples in accordance with Table 1.
- 3) The Regional Board have adopted the use of the EQL in order to obtain comparable results from investigations. The EQL is selected as the lowest non-zero standard in the calibration curve. The required EQLs are specified in Table 1.
- 4) Complete initial calibration consisting of a minimum of three points.

- 5) Analyze samples for aromatic hydrocarbons, MTBE, TBA, TAME, DIPE, and ETBE prior to analyses for TPH_G unless separate samples are obtained at the site.
- 6) Specify and explain extraction method(s) and procedures to be used to prepare samples for hydrocarbon analyses based upon soil type and hydrocarbon characteristics. Fine-grained soils (clay or silt) or long-chain hydrocarbons require sufficient extraction time, which must be identified in the workplan and verified in the laboratory report.

5.4. WATER SAMPLE ANALYSES:

- 1) Analyze all water samples in accordance with Table 1.
- 2) The Regional Board have adopted the use of the EQL in order to obtain comparable results from investigations. The EQL is selected as the lowest non-zero standard in the calibration curve. The required EQLs are specified in Table 1.
- 3) Complete initial calibration consisting of a minimum of three points.
- 4) Analyze samples for aromatic hydrocarbons, MTBE, TBA, TAME, DIPE, ETBE, and ethanol prior to analyses for TPH_G unless separate samples are obtained at the site.
- 5) Analyze trip blanks, equipment blanks, and duplicate samples in addition to QA/QC items specified above.
- 6) Submit a separate sample for turbidity analysis and report result.

<i>Table 1: Analytical Requirements</i>			
Analyte	Matrix	Analytical Method	Required MDL
MTBE	Soil	EPA 8260B	2 µg/kg
TBA	Soil	EPA 8260B	20 µg/kg
TAME	Soil	EPA 8260B	2 µg/kg
DIPE	Soil	EPA 8260B	2 µg/kg
ETBE	Soil	EPA 8260B	2 µg/kg

General Requirements for Subsurface Investigations
 Charnock Sub-Basin Investigation Area

TPH _G	Soil	Cal-LUFT GC/MS(EPA8260B)	100-200 µg/kg
BTEX	Soil	EPA 8260B	1 µg/kg
Ethanol	Soil	Cal-LUFT GC/MS(EPA8260B)	500 µg/kg
MTBE	Water	EPA 8260B	1 µg/L
TBA	Water	EPA 8260B	10 µg/L
TAME	Water	EPA 8260B	1 µg/L
DIPE	Water	EPA 8260B	1 µg/L
ETBE	Water	EPA 8260B	1 µg/L
TPH _G	Water	Cal-LUFT GC/MS(EPA8260B)	50-100 µg/L
BTEX	Water	EPA 8260B	0.5 µg/L
Ethanol	Water	Cal-LUFT GC/MS(EPA8260B)	250 µg/L
1,2,4- Trimethylbenzene	Water	EPA 8260B	0.5 µg/L
1,3,5- Trimethylbenzene	Water	EPA 8260B	0.5 µg/L

5.5 LABORATORY REPORTING OF HALOGENATED VOLATILE COMPOUNDS:

Prior to consideration of case closure, responsible party must analyze at least one round of groundwater samples including all common aromatic and chlorinated volatile organic compounds per EPA Method 8260B. If the site has a waste oil tank, the full suite of aromatic and chlorinated analytes must also be tested and reported per EPA Method 8260B. When the Regional Board requests for the full suite of compounds, the following requirements must be met:

- 1) All halogenated volatile compounds analyzed by EPA Method 8260B as listed below shall be reported by the testing laboratory:

Acetone	cis-1,2-Dichloroethene (c-1,2-DCE)
Bromodichloromethane	trans-1,2-Dichloroethene (t-1,2-DCE)
Bromoform	1,2-Dichloropropane
Bromomethane	cis-1,3-Dichloropropene
Carbon tetrachloride	trans-1,3-Dichloropropene
Chlorobenzene	Methylene chloride (Dichloromethane)
Chloroethane	1,1,2,2-Tetrachloroethane
Chloroform	1,1,1,2-Tetrachloroethane
Chloromethane	Tetrachloroethene (PCE)
Dibromochloromethane	1,1,1-Trichloroethane (1,1,1-TCA)
1,2-Dichlorobenzene	1,1,2-Trichloroethane (1,1,2-TCA)
1,3-Dichlorobenzene	Trichloroethene (TCE)
1,4-Dichlorobenzene	Trichlorofluoromethane (Freon 11)
1,1-Dichloroethane (1,1-DCA)	Dichlorodifluoromethane (Freon 12)
1,2-Dichloroethane (1,2-DCA)	Vinyl chloride (VC)
1,1-Dichloroethylene (1,1-DCE)	

- 2) Analytical instrumentation used for EPA Method 8260B analyses must be calibrated for all compounds listed in Table 1 and Item 1 above at a minimum;
- 3) All testing results (including NDs) must be reported in the laboratory report;

- 4) In the summary table of each quarterly monitoring report, analytical results for all compounds listed in Table 1 (ND or not) must be reported; and
- 5) Any additional constituents that are detected above the method detection limits by EPA 8260B must be reported in the summary table (no NDs).

6. BASELINE ANALYSES:

Groundwater from all monitoring wells shall be analyzed for the following additional analytes. Baseline analyses shall be performed during the first sampling event that the well is included in the Charnock Sub-Basin Investigation.

- 1) Alkalinity by EPA Method 310.1,
- 2) Conductivity by EPA Method 120.1,
- 3) Iron, manganese, calcium, magnesium, potassium, sodium, total chromium, and chromium six by EPA Method 200.7 or EPA Method 6010,
- 4) Chloride, nitrate, phosphate, and sulfate by EPA Method 150 or EPA Method 300, and
- 5) pH by EPA Method 9045,
- 6) Eh (redox potential) by agency approved field measurement method,
- 7) Prior to consideration of case closure, responsible party must analyze at least one round of groundwater samples including all common aromatic and chlorinated volatile organic compounds per EPA Method 8260B. If the site has a waste oil tank, the full suite of aromatic and chlorinated analytes must also be tested and reported per EPA Method 8260B.
- 8) If the site is required to conduct monitoring for natural attenuation parameters, the following requirements must be met:

7. NATURAL ATTENUATION PARAMETERS

A. Primary Natural Attenuation Criteria

Meet the following conditions prior to testing for the secondary natural attenuation parameters:

- a) Groundwater contaminant plume must be fully defined.

- b) Groundwater monitoring program on a quarterly basis must be completed for at least two years including data of MTBE and other oxygenates.
- c) Groundwater concentration has consistently decreased or been stable.
- d) Determination of site-specific hydraulic conductivity must be conducted: Refer the ASTM D4044-91 for the slug test procedures. Other field methods (e.g., pumping test) are also acceptable to determine hydraulic conductivity.
- e) Characterization of MTBE and other oxygenates plume vertical extent must be completed with discrete multi-depth groundwater sampling at all groundwater vulnerable areas designated by the Board.

B. Secondary Natural Attenuation Parameters

Analyze the secondary natural attenuation parameters only after the primary natural attenuation criteria are met. Analyze the secondary natural attenuation parameters at all groundwater monitoring wells inside and outside of the plume. Conform to Table 2 below for parameters and testing methods.

<i>Table 2: Analytical Requirements for Secondary Natural Attenuation Parameters</i>		
Parameters	Test Method	Required MDL
pH	EPA Method 150.2 or Field instrument	n/a
Dissolved oxygen (DO)	EPA Method 360.1 or Field instrument	n/a
Redox potential (ORP)	Field instrument	n/a
Sulfate (SO ₄)	EPA Method 300	5 mg/L
Nitrate (NO ₃)	EPA Method 300	0.1 mg/L
Ferrous iron (Fe ²⁺)	EPA Method 200	0.1 mg/L
Methane (CH ₄)	EPA Method 8015(M)	5 µg/L

8. LABORATORY REQUIREMENTS FOR SOIL GAS SAMPLING

The following quality assurance/quality control (QA/QC) procedures apply to analysis of soil vapor samples. Since the California Environmental Laboratory Accreditation Program (ELAP) does not grant certificate for EPA methods for soil vapor sample analysis, additional QA/QC procedures are required (see Regional Board's "Advisory - Active Soil Gas Investigations" dated January 28, 2003). The following items are required regarding the analytical standard operation procedures (SOP):

- (1) Primary target compounds
- (2) Detection limits for each target compound
- (3) Detector(s) to be used
- (4) Initial calibration standard
- (5) Continuous calibration standard
- (6) Laboratory control samples and standard (different lot numbers from the calibration standard)
- (7) Blank samples
- (8) Surrogate samples and standard (early and late eluters)
- (9) Estimate of sample concentration (using average response factors)
- (10) Sample holding time
- (11) The end of day laboratory control samples are needed for at least 50% recovery if all vapor samples show non-detect in a day
- (12) Reporting shall include the following items:
 - i. Site name
 - ii. Laboratory name
 - iii. Date of analysis
 - iv. Name of analyst
 - v. Instrument identification
 - vi. Normal injection volume

- vii. Injection time
- viii. Any special analytical conditions/remark
- ix. Initial calibration
 - a. Source of standard (**STD LOT ID NO.**)
 - b. Detector (**DETECTOR**)
 - c. Retention time (**RT**)
 - d. Standard mass or concentration (**MASS/CONC**)
 - e. Peak area (**AREA**)
 - f. Response factor (**RF**)
 - g. Average response factor (**RF_{ave}**)
 - h. Standard deviation (**SD_{n-1}**) of RF, using the following equation:
$$[\sum_{i=1}^n (\text{RF}_{\text{ave}} - \text{RF}_i)^2 / (n - 1)]^{1/2}$$

(n = number of points in initial calibration)
 - i. Percent relative standard deviation (**%RSD**), i.e., $(\text{SD}_{n-1} / \text{RF}_{\text{ave}}) \times 100$
 - j. Acceptable range of %RSD (**ACC RGE**)
- x. Daily continuous calibration
 - a. Source of standard
 - b. Detector
 - c. Retention time (RT)
 - d. Standard mass or concentration
 - e. Peak area
 - f. Response factor (RF)

- g. Percent difference between RF and RF_{ave} from initial calibration
- h. Acceptable range of %DIFF (**ACC RGE**)
- xi. LCS and surrogate. Same format as daily continuous calibration
- xii. Environmental sample
 - a. Sample identification
 - b. Sampling depth
 - c. Purge volume
 - d. Vacuum pressure
 - e. Sampling time
 - f. Injection time
 - g. Injection volume
 - h. Dilution factor (or concentration factor if trap is used)
 - i. Detector for quantitation
 - j. Retention time (RT)
 - k. Peak area
 - l. Concentration in $\mu\text{g/L}$ (**CONC**)
 - m. Total number of peaks found by each detector
 - n. Unidentified peaks and/or other analytical remarks
- xiii. Surrogate and second column confirmation
- xiv. Mark RT and compound name on:
 - a) second column chromatogram of standard and
 - b) second column chromatogram of confirmation sample.

9. LARWQCB LAB REPORTING FORMS AND INSTRUCTIONS:

All analytical data shall be provided in accordance with the following documents, which can be found on the Regional Board website at www.waterboards.ca.gov/losangeles under the Information and Resources -- Lab Report Form:

- 1) Instructions for RWQCB-LA Laboratory Report Form Cover Pages (2 pages)
- 2) Laboratory Report Form Cover Pages (2 pages)
- 3) Instructions for LARWQCB Laboratory Report Form for Organics (10 pages)
- 4) LARWQCB Lab Form 10A (4 pages)

10. REPORTING:

10.1. INVESTIGATION REPORTS:

Submit one copy of the final technical report to the Regional Board within 6 weeks after completion of field activities. Reports shall include an introduction detailing site background and history, regional and site hydrogeology, the scope of work performed and the rationale, and any deviations from the approved workplan, if any. This shall include a description of all field drilling and sampling activities including a minimum of one site specific cross section, tabular summary of all sample analytical results (this includes historical data) and detection limits (include results of field QA/QC samples) and related QA/QC data, conclusions based upon the analytical results and investigation findings, and recommendations for additional work as needed. Report all analytical results and QA/QC data on the RWQCB Lab Form 10A (for petroleum hydrocarbons and volatile organics). The paper copies of all the technical reports submitted to this Regional Board can be reduced and shall contain the following required information at a minimum: 1) cover page, 2) table of contents, 3) project summary, 4) signature page, 5) most current figures and maps [area and site maps, direction of flow, monitoring locations, plume concentrations, free product, etc.], 6) data summary tables for the last two years (other historical data can be included in the electronic copy), and 7) contaminant mass removal summary, if applicable.

For a general guideline of e-report, please see Regional Board's new requirements (dated June 15, 2004) set forth by this Regional Board UST Program (available at http://www.waterboards.ca.gov/losangeles/html/programs/ust/04_0621_e-QMRGuideline6-04.pdf). In addition to hard copies of reports, data, reports, and groundwater models must be submitted electronically in Word, Excel, AutoCAD or Adobe Acrobat PDF readable formats. Regional Board' staff will meet with you to review aerial photographs to determine which photographs must be submitted.

- 1) Incorporate all boring logs, geophysical logs, and sieve analysis results with interpretation in final report.
- 2) Your quarterly groundwater monitoring report must include the following:
 - A separate summary table containing current concentrations.
 - A summary table containing all historical data per each well with groundwater depth (or elevation) and well screen intervals.
 - A regional map depicting site vicinity business and street, etc.
 - A site plot plan depicting site location, tank and associated system locations.
 - A site map depicting all well locations and groundwater elevations (contour) with flow gradient and direction.
 - An isoconcentration map for TPH(g), benzene, MTBE, and TBA, respectively.
 - A hydrograph superimposing on concentration over time at the most impacted well for TPH(g), benzene, MTBE, and TBA (or at any other wells as warranted).
- 3) Recommend additional on-site or off-site assessment required and any plans for site remediation, as needed.
- 4) The final technical report must be signed by a California professional geologist or engineer or certified engineering geologist with five years hydrogeologic experience to be accepted.

10.2. SOIL VAPOR EXTRACTION SYSTEM QUARTERLY PROGRESS REPORT

During operation of the soil vapor extraction system, including rebound test periods, quarterly Soil Vapor Extraction (SVE) progress reports shall be submitted on the same schedule as the quarterly groundwater monitoring reporting schedule included in Item 10 of Section 12 of these General Requirements. SVE progress reports shall include the following:

- 1) System status,

- 2) Flow rate, temperature, pressure readings and vapor concentrations,
- 3) Cumulative contaminant (TPH_G, benzene, MTBE, and TBA) extraction total to date in pounds of contaminants removed. This information may also be presented in a graphical format,
- 4) Analytical results of influent and effluent vapor concentrations,
- 5) System operation details, including periods of shutdown and equipment malfunctions,
- 6) Overall evaluation of system effectiveness,
- 7) Data collected per monitoring and recording requirements of approved SVE workplan,
- 8) Plans and recommendations for additional activities,
- 9) Results of Rebound Testing conducted during quarter,
- 10) Additionally, the following information shall be presented in tabular format:
 - System Operation Information: Meter hours, percent uptime, open wells, system influent vacuum (pre-dilution), system influent flow-rate (standard cubic feet per minute, pre-dilution), temperature;
 - Individual Extraction Well Operation Information: OVA-FID readings, vacuum, air velocity, lab results for monthly individual well vapor samples;
 - Mass removal;
 - System Soil Vapor Analytical Information: pre-dilution concentrations for TPH_G, benzene, toluene, xylenes, ethylbenzene, MTBE, TBA, DIPE, TAME, ETBE, ethanol and mass removal rates for these compounds;
- 11) The following information shall be presented in figures:
 - SVE well concentrations over time for MTBE, TBA, and TPH_G;
 - Total system influent concentrations (pre-dilution) over time; and
 - Field OVA-PID readings over time.

11. DOCUMENT SUBMITTAL REQUIREMENTS:

All deliverables and technical reports related to the Charnock Sub-Basin Investigation Area that are required by the Regional Board shall be submitted in the format and to the distribution list provided in this letter. Deliverables and technical reports include but are not limited to work-plans, workplan addenda, investigation reports, design reports, quarterly groundwater monitoring reports, report addenda, and letter responses to Regional Board' comments.

Electronic copies may be submitted on CD-ROM or floppy disk.

Parties shall submit paper and electronic copies of all deliverables and technical reports in the quantities indicated, to the following (1 hard copy total):

1 paper copy, 1 electronic copy

Dr. Yue Rong (yrong@waterboards.ca.gov)
California Regional Water Quality Control Board,
Los Angeles Region
320 West 4th Street, Suite 200
Los Angeles, CA 90013

12. QUARTERLY GROUNDWATER MONITORING AND REPORTING:

Quarterly groundwater monitoring shall be conducted until notified by the Regional Board in writing that this work is no longer required. Perform the following actions at all source sites for which the PRP has responsibility.

- 1) Perform quarterly groundwater level monitoring, sampling, and analyses and submit quarterly monitoring reports for a period of two years, or until notified by the Regional Board in writing that this work is no longer required.
- 2) The quarterly monitoring reports shall include the following, for each saturated zone: a) a description and dates of field activities, b) a summary of the current groundwater levels (and elevations) and the change from the previous period, c) a summary of groundwater analytical results.
- 3) Include tables containing the following information, for each saturated zone: a) historical and current groundwater gauging and elevation data, and b) historical and current groundwater analytical results.
- 4) Include a summary table with the quarterly monitoring reports which provides monitoring well construction details, as depicted below:

General Requirements for Subsurface Investigations
Charnock Sub-Basin Investigation Area

Well ID	Date Construction Completed	Total Depth of Well (ft bgs) and (elevation MSL)	Screened Interval (ft bgs) and (elevation MSL)	Well Casing Nominal Diameter (inches)	Filter Pack Interval (ft bgs) and (elevation MSL)

- 5) Include figures depicting: a) The site location within the Charnock Sub-Basin, b) a site plan showing all monitoring wells, c) contoured potentiometric surface (for each saturated zone), d) dissolved hydrocarbon and oxygenate concentrations.
- 6) Include detailed descriptions of the procedures used for monitoring and sampling activities.
- 7) Include copies of field monitoring and well purging/sampling records.
- 8) Include all laboratory reports and chain-of-custody forms.
- 9) Include all shipping papers and disposal/recycling records for investigation derived wastes.
- 10) All groundwater monitoring reports are to be submitted by the fifteenth day following the end of the quarter as shown in the following schedule:

<u>Reporting Period</u>	<u>Report Due Date</u>
January - March	April 15 th
April - June	July 15 th
July - September	October 15 th
October - December	January 15 th

- 11) Provide e-mail notification at least five business days prior to commencement of any field-work (including water level gauging and groundwater monitoring well sampling activities). E-mail notification shall be submitted to the individuals identified in the Report Submittal and E-Mail Notification section, below.
- 12) Provide a public notification for offsite field activities in accordance with the requirements specified in Section 4.

13. ELECTRONIC NOTIFICATION:

All parties are required to continue to provide e-mail notification to the following at least five business days prior to commencement of any field work (including water level gauging and groundwater monitoring well sampling activities):

Name	Organization	E-mail Address
Yue Rong	LA RWQCB	yrong@waterboards.ca.gov
Jay Huang	LA RWQCB	jhuang@waterboards.ca.gov
Weixing Tong	LA RWQCB	wtong@waterboards.ca.gov

Include in the header or subject line of all e-mail messages “Site No. x Field Work Notification” where x is the Agency-designated site number. The text of the message shall contain a brief description of the work to be performed, when the work will be performed, when the work was approved by the Regional Board, where the work will be performed, and street address of the site.

14. ELECTRONIC SUBMISSION OF LABORATORY DATA TO THE STATE GEOTRACKER INTERNET DATABASE

On September 30, 2004, the State Water Resources Control Board (SWRCB) adopted the resolution to revise regulations in Chapter 30, Division 3 of Title 23 of California Code of Regulations (CCR), which requires persons to ensure electronic submission of laboratory analytical data (i.e., soil or water chemical analysis) and locational data (i.e., location and elevation of groundwater monitoring wells), via the Internet to the SWRCB's GeoTracker database. The regulations and other background information are available at <http://geotracker.waterboards.ca.gov>.

In accordance with the above regulations, you are required to submit all future laboratory data over the Internet in the Electronic Deliverable Format to the SWRCB's GeoTracker database for any soil and/or groundwater samples obtained after September 1, 2001. This would include any sampling completed for underground storage tank system removal, site assessment activities, periodic groundwater monitoring, and post cleanup verification sampling. Per the same regulations, you are also required to submit locational data for all groundwater monitoring wells (i.e., latitude, longitude, and elevation survey data) together with groundwater information (i.e., elevation, depth to free product, monitoring well status, etc.) and a site map commencing January 1, 2002. Hard copy paper reports for the main contents are still required per Regional Board guidelines available at http://www.waterboards.ca.gov/losangeles/html/programs/ust/04_0621_e-QMRGuideline6-04.pdf.