GEOMATRIX

WORK PLAN

American President Lines Terminal
1395 Middle Harbor Road
Oakland, California

2485
3277

Prepared for

Port of Oakland
530 Water Street
Oakland, California 94607

October 1992
Project No. 2026

Geomatrix Consultants

100 Pine Street, 10th Floor
San Francisco, CA 94111
(415) 434-9400 • FAX (415) 434-1365

GEOMATRIX

6 November 1992
Project 2026

Ms. Jennifer Eberle
Alameda County Health Care Services
80 Swan Way, Room 200
Oakland, California 94621

Subject: Work Plan
American President Lines Terminal
1395 Middle Harbor Road
Oakland, California

Dear Ms. Eberle:

This letter serves as a cover letter for the October 1992 Work Plan prepared by Geomatrix Consultants, Inc. (Geomatrix) on behalf of the Port of Oakland. The work plan is submitted under the professional registration of the undersigned. The work plan presents the proposed scope of work to evaluate the extent of soil containing petroleum hydrocarbons and volatile organic compounds and groundwater quality in the vicinity of former underground storage tanks at the subject site.

If you have any questions or require further information, please contact either of the undersigned.

Sincerely,

GEOMATRIX CONSULTANTS, INC.

REGISTERED PROFESSIONAL ENGINEER
ELIZABETH K. WELLS
No. 47968
Exp. 12/31/95
CIVIL
STATE OF CALIFORNIA

Elizabeth K. Wells, P.E.
Project Engineer

John D Hallnatt FOR
Sally E. Goodin, R.G.
Senior Geologist

cc: Jon Amdur, Port of Oakland

PORT OF OAKLAND

October 22, 1992

Ms. Jennifer Eberle
Hazardous Materials Specialist
Alameda County Health Agency
Division of Hazardous Materials
80 Swan Way, Room 200
Oakland, CA 94621

3777

Subject: Work Plan for the Site Investigation at the American President Lines Terminal 1395 Middle Harbor Road, Oakland California

Dear Ms. Eberle:

Enclosed, you will find the Proposed Work Plan for the American President Lines Underground Storage Tank (UST) removal site. The UST removal report was transmitted to Mr. Dennis Byrne of your office on 7 July 1992.

Please review the plan at your earliest possible convenience. If you need clarification on any of the information in the UST Removal Report, or the Proposed Work Plan, we will be glad to meet with you to discuss this project further. The Port's consultant, Geomatrix, is prepared to commence work as soon as we receive written approval from the County to proceed.

Please contact Mr. Jon Amdur of my staff at 272-1184 if you have any questions or comments. Thank you for your patience while we prepared the Proposed Work Plan.

Sincerely,

Jon Amdur (for)

Neil Werner
Port Environmental
Compliance Supervisor

enclosure\

100 Pine Street, 10th Floor
San Francisco, CA 94111
(415) 434-9400 • FAX (415) 434-1365

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15 October 1992
Project 2026

Mr. Jon Amdur
Port of Oakland
530 Water Street
Oakland, CA 94607

Subject: Work Plan
American President Lines Terminal
1395 Middle Harbor Road
Oakland, California

Dear Mr. Amdur:

Enclosed are five copies of the Work Plan for the subject site. The work plan presents the proposed scope of work to evaluate the extent of soil containing petroleum hydrocarbons and volatile organic compounds and groundwater quality in the vicinity of former underground storage tanks at the subject site.

We appreciate the opportunity to continue to provide our consulting services to the Port of Oakland. If you have any questions or require further information, please contact either of the undersigned.

Sincerely yours,

GEOMATRIX CONSULTANTS, INC.

Elizabeth K. Wells

Elizabeth K. Wells, P.E.
Project Engineer

Sally E. Goodin

Sally E. Goodin, R.G.
Senior Geologist

EKW/SEG/lsm
2026XWP.LTR

Enclosures

GEOMATRIX

WORK PLAN

American President Lines Terminal
1395 Middle Harbor Road
Oakland, California

Prepared for

Port of Oakland
530 Water Street
Oakland, California 94607

October 1992
Project No. 2026

Geomatrix Consultants

GEOMATRIX

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WORK PLAN
American President Lines Terminal
Port of Oakland
Oakland, California

1.0 INTRODUCTION

This work plan was prepared by Geomatrix Consultants, Inc. (Geomatrix), on behalf of the Port of Oakland (Port) to assess subsurface conditions near the former location of four underground storage tanks at the subject site (Figure 1). The work plan is intended to evaluate the lateral and vertical extent of soil containing petroleum hydrocarbons and volatile organic compounds and groundwater quality in the vicinity of the tanks. The activities to be performed under this work plan include drilling soil borings and sampling soil, installing and developing monitoring wells, and sampling groundwater. The background, rationale, field methods, and proposed schedule are discussed in the following sections.

2.0 BACKGROUND

Four underground storage tanks were removed from the site between 6 January and 4 March 1992. The tanks were removed by Tank Protect Engineering of Union City, California, a contractor retained by the Port. Geomatrix observed tank removal and soil excavation and collected soil and grab groundwater samples for chemical analysis. Observations and results of the tank removal are discussed in Geomatrix's June 1992 Underground Storage Tank Removal Report prepared for the Port and submitted to the Alameda County Health Care Services Agency, Department of Environmental Health (ACHCSA).

Until removal in 1992, two tanks were used to store diesel (one 10,000-gallon capacity fiberglass, and one 5,000-gallon capacity steel), one tank was used to store gasoline (1,000-gallon capacity fiberglass), and one tank was used to store waste oil (550-gallon capacity steel). It is unknown when the tanks were installed. Diesel fuel was pumped from the two diesel tanks, and waste oil was removed from the waste oil tank before the tanks were removed. The gasoline tank contained no fluid. Observations of the tanks upon removal indicated that the diesel tanks contained no holes; the gasoline tank was punctured during removal; and the waste oil tank contained several small holes. In addition, free-phase petroleum product was observed floating on the groundwater in the tank excavation.

Soil samples collected from the tank excavation indicated that soil near the tanks had been impacted as a result of leakage. Approximately 300 cubic yards of soil were removed from the tank excavation and treated by aeration to remove volatile compounds and bioremediation to remove total petroleum hydrocarbons. However, some soil containing petroleum hydrocarbons and volatile organic compounds (VOCs) was left in place due partly to physical obstructions in the excavation area. A grab groundwater sample collected from the tank excavation contained elevated concentrations of halogenated VOCs.

3.0 SCOPE OF WORK

The proposed scope of work includes drilling soil borings, collecting soil samples for chemical analysis, installing three monitoring wells, and sampling groundwater. These activities are described in this section. All field activities will be performed in accordance with Geomatrix protocols (Appendix A).

3.1 SOIL SAMPLING

Geomatrix will conduct a soil boring program at the site to collect soil samples for chemical analysis. ~~Eight soil boring locations~~ have been proposed based on analytical results of the excavation soil samples, ~~three of which will be converted to monitoring wells;~~ proposed boring locations are shown on Figure 2. Before work begins, Geomatrix will obtain a soil boring permit from the Alameda County Flood Control and Water Conservation District (ACFCWCD), and will arrange for a utility check to be performed to clear the proposed boring locations of underground utilities.

Soil borings will be drilled to a maximum depth of 20 feet using 8-inch-diameter hollow-stem augers. The borings will be continuously cored using a 5-foot dry core sampler and lithologic logs will be developed for each borehole. All drilling equipment will be steam-cleaned before drilling each boring. Soil samples for chemical analysis will be collected from immediately above the water table, and at a depth of 5 feet below the water table; additional samples may be submitted for chemical analysis based on field observations. Soil samples for chemical analysis will be collected directly from the sampler in clean, thin-walled brass tubes. The samples will be sealed, cooled, and delivered to a state-certified analytical laboratory under Geomatrix chain-of-custody procedures. Soil samples will be analyzed for the compounds that were detected at elevated concentrations in the tank excavation. These include total petroleum hydrocarbons (TPH) as gasoline by modified U.S. Environmental Protection Agency (EPA) Method 8015; TPH as diesel and oil by EPA Method 8015; benzene, toluene, ethylbenzene, and xylenes (BTEX) by EPA Method 8020; and halogenated VOCs by EPA Method 8010.

Soil cuttings from the borings will be placed in 55-gallon drums for temporary storage at a designated on-site location before appropriate final disposal. Soil borings will be backfilled with a cement/bentonite grout to within a few inches of ground surface. Asphalt patch will be applied at the surface of each boring to match current grade.

3.2 INSTALLATION OF MONITORING WELLS

Three monitoring wells will be installed near the tank excavation under permit from the ACFCWCD. The wells will be used to evaluate the direction of groundwater flow and to monitor the potential migration of constituents from the affected area. For this work plan, we assumed that groundwater flows in a south-westerly direction toward San Francisco Bay. One monitoring well will be installed in the assumed upgradient direction of the tank excavation; two will be installed in the assumed downgradient direction. The monitoring wells will be installed within 10 feet of the perimeter of the affected area based on observations made in the field during drilling and sampling activities. Proposed well locations are shown on Figure 2. The monitoring wells will be installed in three of the proposed soil borings described in Section 3.1.

The monitoring wells will be screened across the water table to a maximum depth of 10 feet below the water table; the well screens will not extend across the Bay Mud. The wells will be constructed using 2-inch-diameter, flush-threaded, schedule-40 polyvinyl chloride (PVC) pipe, and will be screened using 0.01-inch slot size factory slotted PVC pipe. The well annulus will be backfilled with a filter pack of quartz sand to one foot above the 10-foot-long slotted screen section. A bentonite seal will be placed above the filter pack, and the remaining annulus will be backfilled with a bentonite-cement seal to provide protection from surface water runoff. A locking cap and traffic-rated cover will be placed over the monitoring well at the ground surface.

After allowing the well seal to set (approximately 72 hours), the monitoring well will be developed to remove fines from the casing, stabilize the filterpack, and establish hydraulic communication between the well and the surrounding water-yielding zone.

Soil cuttings from the well boreholes and purged groundwater from well development will be placed in 55-gallon drums for temporary storage at a designated on-site location before appropriate final disposal.

Following well completion, the well casings will be surveyed to establish their elevations.

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3.3 GROUNDWATER SAMPLING

Typically one year of quarterly groundwater monitoring is required at sites where leakage is suspected to have occurred from an underground storage tank. Therefore, Geomatrix will initiate a quarterly monitoring program at the subject site after the wells are installed. A groundwater sample will be collected from each newly installed monitoring well for chemical analysis for total petroleum hydrocarbons (TPH) as diesel; TPH as oil; TPH as gasoline; BTEX; and halogenated VOCs. Groundwater samples will be analyzed using the methods described in Section 3.1. In addition, the first sample collected from each well will be analyzed for total dissolved solids to assess the general groundwater quality. The groundwater samples will be delivered under Geomatrix chain-of-custody procedures to a state-certified analytical laboratory.

ask for SM 5520 C + F

Groundwater generated during sampling activities will be stored temporarily on site in 55-gallon drums for temporary storage at a designated on-site location before appropriate final disposal.

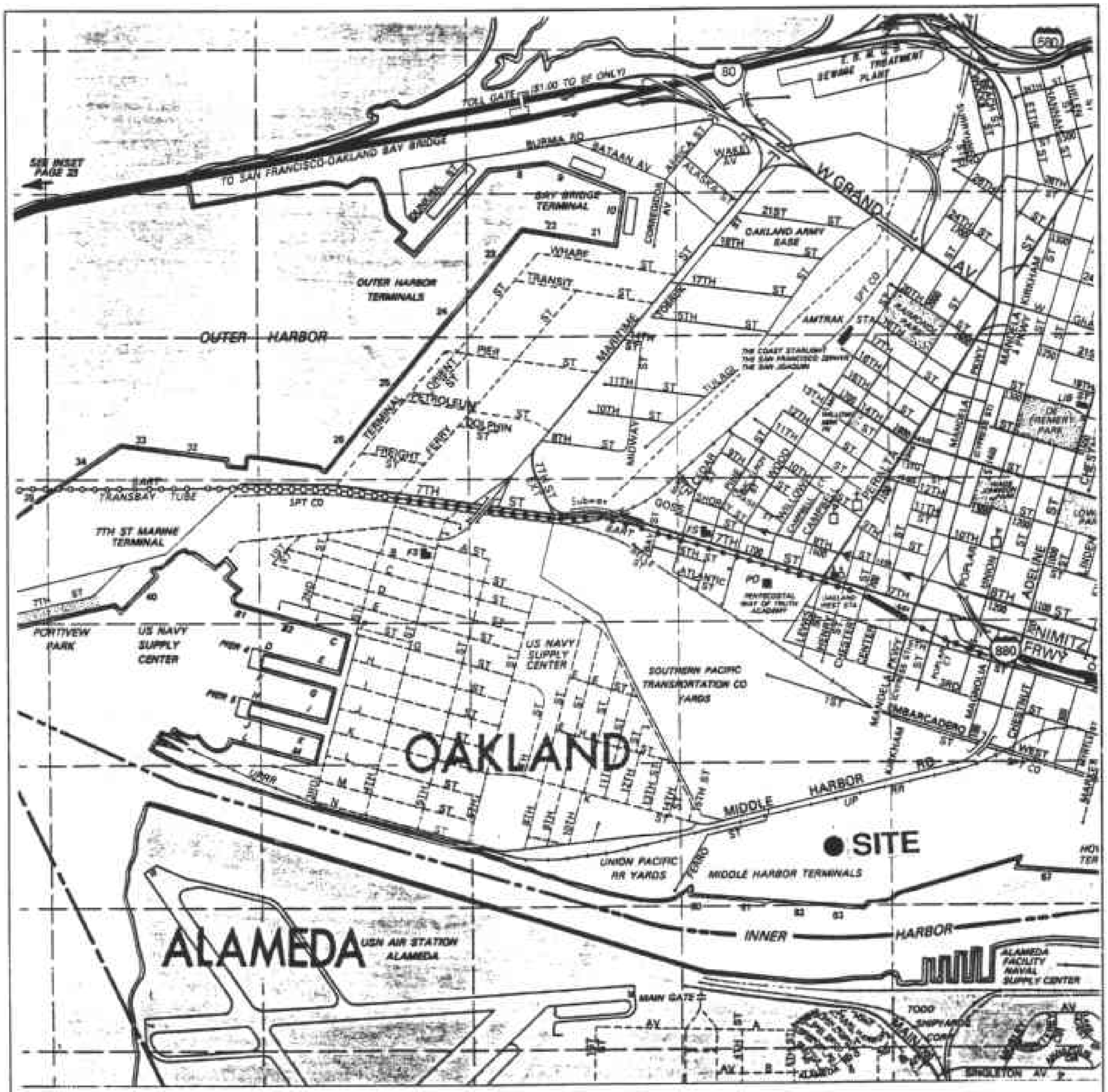
4.0 REPORTING

Geomatrix will describe the soil sampling and well installation activities in a report to the Port of Oakland. The report will include lithologic logs of the boreholes, well construction diagrams, and a summary of the analytical results for soil samples and groundwater samples from the first quarterly sampling event. The extent of affected soil and recommendations for further action also will be discussed in the report.

Groundwater sampling activities and results from subsequent quarterly sampling events will be described in quarterly reports. The fourth quarterly report will include recommendations for further groundwater monitoring based on the analytical data from the first year of sampling.

5.0 SCHEDULE

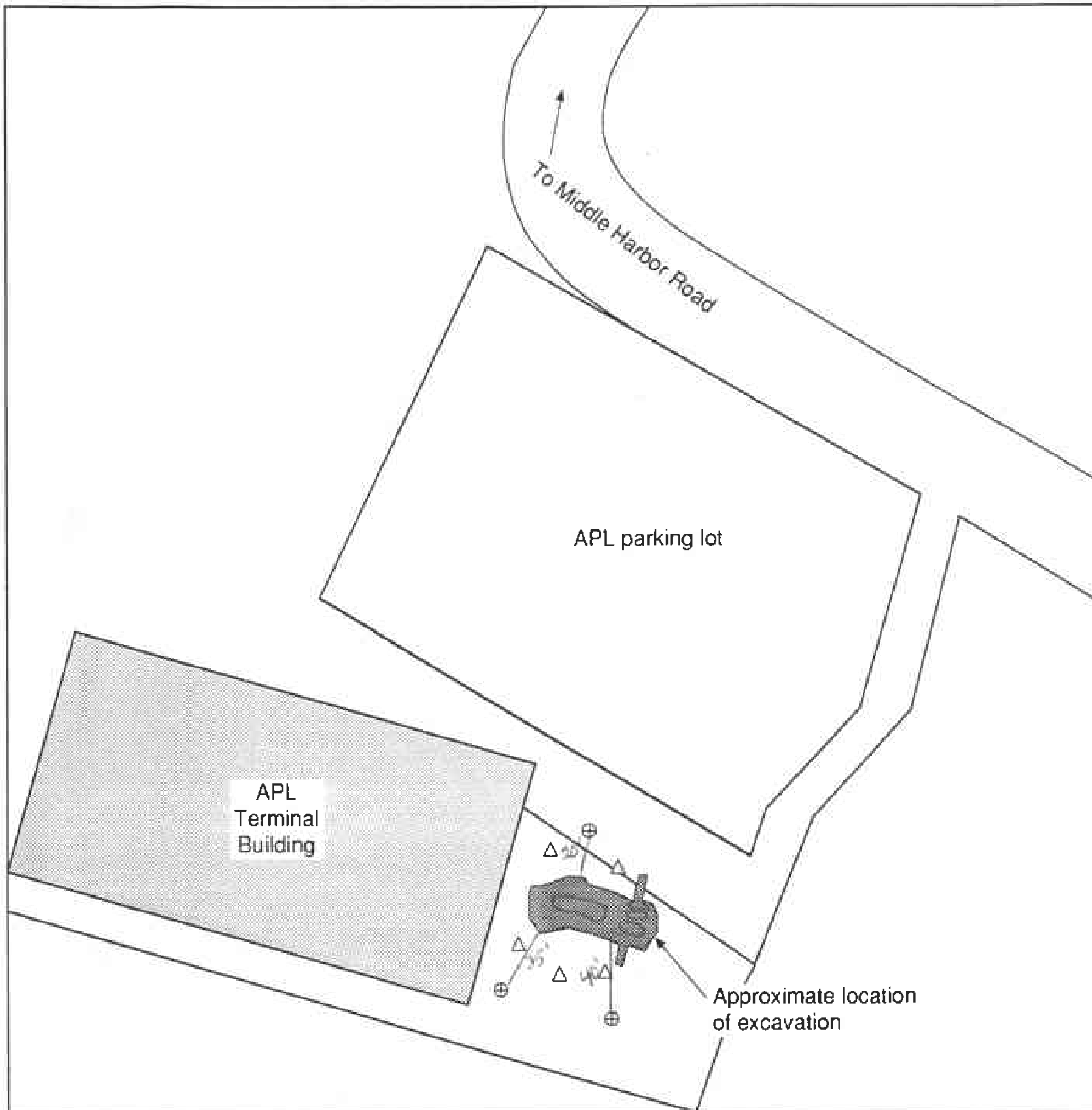
Field activities proposed in this work plan can be initiated upon approval from the ACHCSA and the Port of Oakland. We anticipate that field activities, including the soil boring program, installation of monitoring wells, well development, and first sampling event, can be completed within three weeks. We anticipate the final report summarizing these activities and presenting analytical results will be submitted to the Port of Oakland and ACHCSA within six weeks of the groundwater sampling event.



Reference: Thomas Brothers Maps
Alameda County
1990

0 2200 Feet

GEOMATRIX	SITE LOCATION MAP American President Lines Terminal 1395 Middle Harbor Road Oakland, California	Figure 1 Project No. 2026



EXPLANATION

⊕ Proposed monitoring well

△ Proposed soil boring

0 80 Feet

Based on figure provided by the Port of Oakland

GEOMATRIX

LOCATION OF PROPOSED SOIL BORINGS AND MONITORING WELLS
American President Lines Terminal
1395 Middle Harbor Road
Oakland, California

Figure 2

Project No. 2026

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APPENDIX A

PROTOCOLS

DRILLING OF SOIL BORINGS

1.0 INTRODUCTION

This protocol describes the procedures to be followed during the drilling and logging of soil borings. The information gathered from the exploratory borings will provide information about geologic conditions, soil engineering properties and/or soil quality. If the soil boring is utilized for monitoring well installation, the well will be installed in accordance with the protocol "Installation of Monitoring Wells."

The procedures presented herein are intended to be of a general use. As the work progresses and, if warranted, appropriate revisions will be made and approved in writing by the project manager.

2.0 DRILLING

The soil borings will be drilled using the mud rotary or hollow stem auger method. In mud rotary borings, appropriate drilling fluid additives, such as bentonite, will be used to maintain an open hole and to carry cuttings to the surface. However, no organic drilling fluid additives will be used. The drilling mud shall be circulated into a settling tank or basin located near the boring. Viscosity of the drilling fluid will be assessed periodically and will be controlled throughout the drilling operation to achieve the required results (hole stability, sample return, and minimum mud cake formation). Only clean water from a municipal supply will be used as makeup water for drilling fluid. Exploratory borings drilled using the hollow stem auger generally do not require the use of drilling fluid additives. If required, clean water from a municipal supply will be used to carry cuttings from the auger borings.

The specific depth of each soil boring will be determined by the Geomatrix project manager before drilling. The Geomatrix field geologist/engineer will specify to the drill rig operator the penetration rate, the depth of soil sample collection, method of sample retrieval, and other matters pertaining to the satisfactory completion of the borings. All drill cuttings, unused soil samples, and drilling fluids generated during drilling of soil borings will be stored and disposed of in accordance with all legal requirements.

The drill rods, augers, hoses, and other components in which fluids and cuttings circulate, drive samplers, and bits will be thoroughly steam cleaned before and after drilling of each boring. Only clean water from a municipal supply will be used for decontamination of drilling equipment.

3.0 SAMPLING AND LOGGING

3.1 Obtaining Samples

Discrete or continuous cores, drive samples, wire-line samples, or drill cuttings will be collected and described. A detailed log of these samples will be made. Grain-size (sieve) analyses may be performed on selected samples in potential well completion zones and in other zones. These analyses will be summarized on standard grain-size analysis sheets. Other physical testing may also be performed on soil samples to evaluate other physical properties. Samples for chemical analysis will be collected in accordance with the protocol "Soil Sampling for Chemical Analysis."

3.1.1 Coring. Cores will be collected continuously from the mud rotary borings, with a nominal 6-foot long, split-barrel sampler using the wire-line method of sampler operation.

Continuous cores from the auger borings will be collected with a nominal 5-foot long, split-barrel sampler using a continuous sample tube system. The core diameter will be a minimum of 2 inches. In general, the split-barrel sampler will be opened for inspection and logging of the retrieved core. If the samples will be retained for further visual inspection and/or physical testing the core will be placed into core boxes or clear acrylic tubing of slightly larger diameter, typically in segments varying in length from 1 to 3 feet, depending on soil core consistency. The ends of the tubes will be capped. At selected depth intervals, the split-barrel sampler may be fitted with brass liners for collection of soil cores for possible subsequent chemical or physical testing.

For discrete sampling of mud rotary or auger borings, sampling will be accomplished by driving or pushing a nominal 2-foot long, split-barrel modified California sampler, or equivalent. The sampler will be fitted with brass liners for collection of soil samples. In general, the samples will be retained for visual inspection and possible subsequent chemical or physical testing. The field geologist/engineer will carefully record on a field log (Figure 1-1) information pertaining to the sampling, such as rate of penetration, hydraulic ram pressure or drive-hammer blow count, coring smoothness and sample recovery.

Samples may be retained for future review and/or preserved for chemical or physical analysis, as specified by the project manager. The samples will be stored and labeled to show project number, boring number, and cored interval denoted either by depth or sequential numbering system. Procedures for the preservation and transport of soil samples retained for chemical analysis are presented in the protocol "Soil Sampling for Chemical Analysis".

3.1.2 Collecting Cuttings. The field geologist/engineer may collect cuttings from the drilling return for every 5-foot increment of the mud rotary borings that are not continuously cored. Sampling and logging will be done by adherence to the following procedures:

A. The height of the drilling table above ground surface, lengths of the drill bit, sub and drill collars, and length of drill rods should be taken into account in calculating the depth of penetration.

B. A small diameter, fine mesh, hand screen shall be used to obtain a sample of the cuttings from the borings by holding the screen directly in the flow of the drill fluid return line.

C. A composite sample may be obtained from the return line by leaving the screen in place during the time it takes the driller to advance the boring to any preselected depth.

D. The travel time for cuttings to reach the surface may be estimated each time the driller adds a new length of drill rod by timing the first arrival of cuttings after circulation is resumed. This travel time shall be used along with the depth of penetration to estimate the start and finish of each 5-foot sampling interval.

E. Place the samples on a sampling table, labeled in consecutive order. After each joint of drill rod has been advanced, or at other convenient intervals, selected samples that illustrate specific geologic features may be transferred to a plastic sample bag labeled with the project number, monitoring well number, and sample interval. The retained samples will be used during preparation of a detailed lithologic log.

3.2 Logging of Exploratory Borings

The observations of the field geologist/engineer shall be recorded on a soil boring log as shown on Figure 1-1. The drill rig operator and the field geologist/engineer will discuss significant changes in material penetrated by the drill, changes in drilling conditions, hydraulic pressure, drilling action, and drilling fluid circulation rate. The field geologist/engineer will be present during drilling of soil borings and will observe and record such changes by time and depth.

Cuttings and core samples will be examined in the field. A lithologic description will be recorded on the log including soil or rock type, grain size, texture, hardness, degree of induration, calcareous content, presence of fossils and other materials (gypsum, hydrocarbons), color, relative moisture content, estimated Unified Soil Classification System (USCS) soil type, and other pertinent information.

The original logs shall be sent or delivered to the Geomatrix office for review by the registered geologist and the project manager and for storage in the project files.

4.0 GEOPHYSICAL LOGS

Following completion of drilling of mud rotary borings, spontaneous potential, single-point resistance, 6-foot lateral resistance, and natural gamma logs may be performed immediately after the drilling fluid has been circulated to remove all of the cuttings. Geophysical logging will be done as quickly and efficiently as possible, while the boring side wall is still in good condition, to minimize the possibility of interference with the down-hole probes. Instruments on the logging unit will be adjusted to give the maximum definition of strata boundaries. The protocol "Geophysical Logging" describes in detail the procedures for geophysical logging of the exploratory borings.

5.0 FIELD SCREENING

Soil samples and ambient air conditions at the boring locations may be screened using a portable photoionization detector (PID). The purpose of the field screening is to test the presence of volatile organic compounds (VOC) in ambient air for personnel health and safety monitoring during field activities and/or to assess the presence of VOC's in soil samples. Procedures for field screening are described in the protocol "Soil Sampling for Chemical Analysis".

6.0 DESTROYING SOIL BORINGS

Soil borings that are not completed as monitoring wells will be destroyed by filling the holes with a cement/sand grout or cement/bentonite grout. The grout will be placed in one continuous pour before its initial set from the bottom of the boring to ground surface. The grout will be emplaced by pumping through a tremie pipe or flexible hose fitted with a steel pipe extension, lowered to the bottom of the borings. The grout will be pumped until a return of fresh grout is visible at the surface. Borings that are terminated above the water table may be abandoned by a continuous grout pour originating at the ground surface.

PROJECT:		Log of Boring No.			
BORING LOCATION:		ELEVATION AND DATUM:			
DRILLING CONTRACTOR:		DATE STARTED:		DATE FINISHED:	
DRILLING METHOD:		TOTAL DEPTH:		MEASURING POINT:	
DRILLING EQUIPMENT:		DEPTH TO WATER	FIRST	COMPL.	24 HRS.
SAMPLING METHOD:		LOGGED BY:			
HAMMER WEIGHT:	DROP:	RESPONSIBLE PROFESSIONAL:		REG. NO.	

DEPTH (feet)	SAMPLES: Sample No.	SAMPLES: Sample	SAMPLES: Blows/ Foot	DESCRIPTION NAME (USCS Symbol): color, moist, % by wt., plast., density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:	REMARKS

B-1-89/Modified

Geomatrix Consultants	Project No.	

SOIL SAMPLING FOR CHEMICAL ANALYSIS

1.0 INTRODUCTION

This protocol describes procedures to be followed for collecting soil samples and conducting soil field screening in conjunction with the drilling of soil borings. Selected soil samples will be submitted to a designated subcontracted laboratory for chemical analysis. The subcontracted laboratory must be certified by the California Department of Health Service (DOHS) as defined in the protocol "Soil Chemical Analysis". The procedures presented herein are intended to be of general use. As the work progresses and if warranted, appropriate revisions will be made and approved in writing by the Geomatrix project manager.

2.0 DRILLING

The drilling of soil borings will be in accordance with the protocol "Drilling of Soil Borings."

3.0 SAMPLE COLLECTION AND PRESERVATION

Soil samples will be collected in clean brass liners that have been washed with detergent-water solution and rinsed with tap water. The brass liners will generally be set in a 2-inch diameter split-spoon sampler and then driven or pushed into soil at the selected sampling depth. The sampler will be washed with laboratory grade detergent-water solution to remove any soil present and then it will be rinsed with tap water prior to and between sampling. Upon disassembly of the soil sampler, the Geomatrix field geologist/engineer will take charge of the sample. The sample will be parted at the joints between the brass liners using a clean, sharp, stainless steel knife or spatula. The sample will be quickly inspected for color, appearance, and composition and then capped. Capping will be done with PTFE sheeting and/or aluminum foil covered by polyethylene caps. Capped samples will be sealed with rubber or PVC tape and will be labeled, enclosed in plastic bags, and stored in ice-cooled chests until delivered to the laboratory.

Sample containers will be labeled using waterproof ink and having the following information written on them.

A. Project number
B. Sample number
C. Boring number
D. Sample depth
E. Date and Time

4.0 SOIL FIELD SCREENING

A portable photoionization detector (PID) or other type of organic vapor analyzer, may be used to screen selected soil samples collected from the soil borings. The purpose for the field screening of selected soil samples is to assess the presence of volatile organic compounds in the soil samples. The PID measures total volatile organics in the air in parts per million (ppm) by volume in reference to a selected standard. Calibration of the PID will be performed each day prior to the soil sampling. The PID cannot specifically identify each volatile compound, but can be adjusted to be sensitive to selected volatile organics.

The PID screening method for selected soil samples consists of transferring a soil sample into a clean one pint Mason jar or plastic zip-lock bag. After some time has elapsed, the jar or bag will be opened and the headspace quickly screened for the presence of volatile organics. No soil sample used for field screening will be submitted to the laboratory for chemical analysis. The PID may also be used in auger borings to periodically screen for volatile organics in the air space at the top opening of the hollow stem auger, after the auger's bottom plug has been removed. All PID readings for soil samples and ambient air at the top of the auger will be recorded on the boring logs. Positive readings from the PID screening may be used for selection of soil samples for chemical analysis.

5.0 DOCUMENTATION

5.1 Boring Log

Soil samples collected from soil borings will be recorded on the boring log sheets (Figure 2-1). These logs provide a means of uniquely identifying and tracking the samples. When sampling is completed, the log sheets will be placed in the project file.

5.2 Chain of Custody Procedures

After samples have been collected and labeled, they will be maintained under chain of custody procedures. These procedures document the transfer of custody of samples from the field to the laboratory.

A chain of custody record (Figure 2-2) will be filled out for each sample sent to the laboratory for analysis. Information contained on the triplicate carbonless form shall include:

A. Date and time sampled.
B. Sample number.
C. Analyses required.
D. Remarks, including any preservatives and special conditions.

E. Container number in which sample has been packaged.

Blank spaces on the chain of custody record will be crossed out between last sample number listed and signatures at the bottom of the sheet.

After carefully packaging the samples into ice-cooled chests for transfer to the laboratory, the field sampler will sign the chain of custody record and will record the time and the date. The original imprint of the chain of custody record will accompany the sample containers. A duplicate copy will be placed in the Geomatrix project file.

Laboratory receipt of the soil samples is discussed in the protocol "Soil Chemical Analysis".

6. EQUIPMENT CLEANING

The sampler, brass liners, spatula, and any tools used in the assembly and disassembly of the sampler will be thoroughly cleaned before and after use on each boring. All soil will be removed from the tools and parts using a stiff-bristled brush, and the tools will be steam-cleaned or washed in laboratory-grade detergent water followed by rinsing in clean water.

Log of Boring No.

PROJECT:	
BORING LOCATION:	ELEVATION AND DATUM:
DRILLING CONTRACTOR:	DATE STARTED: / DATE FINISHED:
DRILLING METHOD:	TOTAL DEPTH: / MEASURING POINT:
DRILLING EQUIPMENT:	DEPTH TO WATER / FIRST / COMPL. / 24 HRS.
SAMPLING METHOD:	LOGGED BY:
HAMMER WEIGHT: / DROP:	RESPONSIBLE PROFESSIONAL: / REG. NO.

DEPTH (feet)	SAMPLES Sample No.	Sample	Blows/ Foot	DESCRIPTION NAME (USCS Symbol): color, moist, % by wt., plast., density, structure, cementation, react. w/HCl, geo. inter. Surface Elevation:	REMARKS

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Chain-of-Custody Record

№

Date:

Page of

Project No.:

Samplers (Signatures):

Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel	TPH as BTEX													Cooled	Soil (S) or water (W)	Acidified	Number of containers	Additional comments

ANALYSES — REMARKS

Turnaround time:

Results to:

Total No. of containers

Relinquished by:	Date:	Relinquished by:	Date:	Relinquished by:	Date:	Method of shipment:
Signature:		Signature:		Signature:		Laboratory comments and Log No.:
Printed name:		Printed name:		Printed name		
Company:		Company:		Company		
Received by:	Time:	Received by:	Time:	Received by	Time	
Signature:		Signature:		Signature		
Printed name:		Printed name:		Printed name		
Company:		Company:		Company		

Geomatrix Consultants
100 Pine St. 10th Floor
San Francisco, CA 94111
(415) 434-9400

Project No.

Figure

SOIL CHEMICAL ANALYSIS

1.0 INTRODUCTION

Chemical analysis of selected soil samples will be performed by a designated subcontracted laboratory that will adhere to the guidelines outlined in this protocol. Adherence to these guidelines will be monitored by the project manager.

2.0 LABORATORY QUALIFICATIONS

The subcontracted laboratory must be certified by the California Department of Health Services (DOHS) to perform analyses of hazardous materials under the Hazardous Materials Laboratory Certification program mandated by AB3449, Chapter 1209. The subcontracted laboratory must also be operating in compliance with a written quality assurance program, subject to prior review by Geomatrix Consultants.

3.0 SAMPLE SUBMISSION

The soil samples will be delivered to the subcontracted laboratory prepared and preserved according to specifications in Test Methods for Evaluating Solid Waste (EPA, 1986). The samples will be accompanied by a Geomatrix chain of custody record (Figure 3-1).

4.0 LABORATORY PRACTICES

4.1 Laboratory Custody Procedures

Laboratory custody procedures concerning the acquisition and handling of samples and the documentation required therewith will be in accordance with the procedures outlined below.

A. Receipt of Samples at the Laboratory

One person designated as the sample custodian will be responsible for the receipt of the samples at the laboratory. Upon sample delivery, the custodian will:

- Observe the physical condition of the sample container(s) noting any broken seals or other evidence of tampering.
- Verify that the information on the chain of custody record corresponds to that on the sample labels.
- Record the information on the sample labels into a laboratory notebook.
- Report any damage to or leakage of sample to the laboratory supervisor and the Geomatrix project manager, and record this information in the laboratory notebook.
- Sign the chain of custody record, including the date and time received, and secure the record in a locked file cabinet.
- Place the samples in a secured storage area.

B. Damaged Samples

In the event of sample leakage or any other evidence of damage to a sample, the Geomatrix project manager will be contacted for a decision regarding sample disposition.

C. Sample Storage

Samples, prepared samples, and standard solutions will remain in a secured cabinet or room at all times unless being used for analysis. Access to this area will be limited to the laboratory supervisor, the sample custodian, and designated laboratory personnel. After analysis, samples will be retained in a secured area until notified otherwise by project manager.

5.0 TEST METHODS AND SAMPLE HANDLING

The methods of analysis will be established by prior agreement between Geomatrix Consultants and the subcontracted laboratory. Detailed methodology of the testing techniques will be based on the reference documents listed herein. In general, the quality control aspects of the laboratory procedures will be in accordance with the following references:

1. U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, November 1986.
2. California State Water Resources Control Board, Leaking Underground Fuel Tank Manual, October 1989.
3. Regional Water Quality Control Board, North Coast, San Francisco Bay and Central Valley Regions, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, November 1989.
4. 40 CFR, Part 136.

Frequently requested analyses and their sample handling requirements are listed in Table 3-1. In the event that one of these methods proves to be unsatisfactory for accurate and precise determinations of a constituent, the subcontracted laboratory will consult with Geomatrix about an alternate method. The alternate method must be approved by the Geomatrix project manager before the analysis is performed.

6.0 PROCEDURES

Procedures described in the quality assurance manual of the subcontracted laboratory performing the chemical testing are sufficient to adequately describe each test method including sample preparation and handling, operation of test equipment, conduct of test, recording of original data, and other information. Standard analysis procedures that have been published will be used and referenced as such.

7.0 DISPOSITION OF RECORDS, DOCUMENTS AND PROCEDURES

Records, log books, data sheets, and any other documents generated before, during, and after analysis of the samples shall be placed in a secured drawer or file when not in use.

At the termination of the contract with the laboratory, or upon request, the laboratory will relinquish to Geomatrix all records, documents, and procedures pertaining to the work performed.

WATER AND SOIL ANALYTICAL METHODS AND HANDLING

Parameter	Method	Containers[1]	Preservation[1]	Maximum Holding Time[1]
Total Petroleum Hydrocarbons:				
as diesel	GCFID (3550)[2]	2 - 1 liter amber glass	cool, 4°C	14 days
as gasoline	GCFID (5030)[2]	2 - 40 ml VOA glass	HCL to pH2: cool, 4°C	14 days
Benzene, Toluene, Xylene, and Ethylbenzene	EPA 8020 (soil) EPA 602 (water)	2 - 40 ml VOA glass	HCL to pH 2: cool, 4°C	14 days
Oil and Grease	503 D & E (soil) 503 A & E (water)	2 - 1 liter amber glass	cool, 4°C, H_2SO_4 to pH<2	28 days
Volatile Organics	EPA 8240 or 8010	2 - 40 ml VOA glass	HCL to pH 2: cool, 4°C[3]	14 days
Semi-volatile Organics	EPA 8270 or 8020	2 - 1 liter amber glass	cool, 4°C	14 days
Metals (dissolved)	EPA 7000 series for specific metal	1 - 500 ml plastic	Field filtration (0.45 micron filter): field acidify to pH 2 with HNO_3 except: Cr^{+6} - Cool, 4°C	6 months, except: Hg - 28 day Cr^{+6} - 24 hrs

Notes:

[1] All soils should be collected in full, clean brass liners, capped with foil and plastic caps, and sealed with PVC tape. Soils should be cooled as indicated under "preservation" and maximum holding times apply to both soil and water.
[2] DHS recommended procedure as presented in LUFT manual using gas chromatography with a flame ionization detector.
[3] If chlorinated hydrocarbons are found or expected onsite (e.g., sampling of treated drinking water), 8010 or 8240 may be run without HCL with a 7 day holding time.

References:

U.S. EPA, 1986, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW-846, Third Edition, July.
State Water Resources Control Board, 1989, Leaking Underground Fuel Tank (LUFT) Field Manual, Tables 3-3 and 3-4, October.
Regional Water Quality Control Boards, North Coast, San Francisco Bay, and Central Valley Regions, 1989, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, 9 November.

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Chain-of-Custody Record

№

Date

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Project No.:

Samplers (Signatures):

Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel	TPH as BTEX													Cooled	Soil (S) or water (W)	Acidified	Number of containers	Additional comments

(The ANALYSES heading covers the EPA Method, TPH and unlabelled columns. The REMARKS heading covers Cooled, Soil (S) or water (W), Acidified, Number of containers and Additional comments.)

Turnaround time:

Results to:

Total No. of containers:

Relinquished by:	Date:	Relinquished by:	Date:	Relinquished by:	Date:	Method of shipment:
Signature:		Signature:		Signature:		Laboratory comments and Log No.:
Printed name:		Printed name:		Printed name:		
Company:		Company:		Company:		
Received by:	Time:	Received by:	Time:	Received by:	Time:	
Signature:		Signature:		Signature:		
Printed name:		Printed name:		Printed name:		
Company:		Company:		Company:		

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Project No.

Figure

INSTALLATION OF MONITORING WELLS

1.0 INTRODUCTION

This protocol describes procedures to be followed during installation of monitoring wells. The procedures presented herein are intended to be of general use. As the work progresses, and if warranted, appropriate revisions will be made and approved in writing by the project manager.

2.0 MONITORING WELL INSTALLATION

Each monitoring well will be designed to register the potentiometric surface and to permit water sampling of a specific water-bearing zone. The field geologist/engineer, in consultation with the project hydrogeologist (California registered geologist), will specify the screened interval using the lithologic log and geophysical log (if performed) for control and will design the materials and techniques for well completion to be compatible with the formations. Drilling and logging of the borings for the monitoring wells will be in conformance with the protocol "Drilling of Soil Borings." Construction and completion of all monitoring wells will be in conformance with the following provisions.

2.1 Screen and Pipe

The monitoring well casing will generally be consist of stainless steel or polyvinylchloride (PVC) schedule 40 (minimum) casing. The inside diameter of the casing will be large enough to permit easy passage of an appropriate water level probe and equipment for purging wells and water sample collection. The anticipated inside diameter of the casing is 2 to 4 inches.

The well screen will be machine-slotted PVC or wire-wrapped stainless steel screen. The slot sizes will be compatible in size with the selected filter material. The screened sections will provide flow between the pervious material in the water-bearing zone and the monitoring well, allowing efficiency in well development and representative samples from the aquifer.

2.2 Filter Material

Filter material will be well graded, clean sand with less than 2 percent by weight passing a No. 200 sieve and less than 5 percent by weight of calcareous material. The filter material will be either a standard sand gradation designed for a range of anticipated soil types or a sand gradation specifically designed to fit the soils collected from anticipated well completion zones.

2.3 Setting Screens and Riser Casing

Upon completion of drilling and/or geophysical logging, the monitoring well will be assembled and lowered into the boring. The casing and screen will be suspended a few inches above the bottom of the boring. The monitoring well assembly will be designed so that the well screen is opposite the water-bearing zone that is to be monitored. The bottom of the screen will typically be flush with the bottom of the well and will have a welded or threaded bottom cap. The PVC pipe joints will be flush coupled. No PVC cement or other solvents will be used to fasten the joints of casing or screen. Centralizers will be used to center the well assembly in borings drilled by the mud rotary method. Centralizers will generally be placed at the top and bottom of the screened interval and not more than 40 feet apart along the casing. Centralizers will not be placed on well assemblies in borings drilled by the hollow stem auger method because the hollow stem auger will adequately center the well casing and screen in the borehole.

For borings drilled by the mud rotary method, clean water may be added to the drill mud fluid and circulated in the borehole after the monitoring well assembly has been lowered to the specified depth. Circulation will continue until the suspended sediment in the return fluid has been thinned. After installation of the monitoring well assembly, filter sand will then be tremied into the annular space using a 2-inch diameter PVC or steel pipe. For borings drilled by the hollow stem auger method, the filter sand will be placed after the monitoring well assembly has been lowered to the specific depth through the augers. The augers will be incrementally raised as the filter sand in placed by free fall through the augers. The filter pack elevation will be measured after each increment to detect possible bridging. If bridging occurs, it will be broken by washing the filter materials into proper place with clean water. The sand will be in a calculated quantity sufficient to fill the annular space to a level of about 1 foot above the top of the perforated casing. The depth to the top of the filter pack will be verified by measuring, using a tremie pipe or a weighted tape.

Once the depth to the top of the filter pack has been verified, a layer of bentonite may be placed in the annular space. If the bentonite is to be placed below standing water, pellets may be poured into a tremie pipe for mud rotary borings or through augers for hollow stem auger borings. If the bentonite is to be placed above standing water, a wet bentonite slurry should be used or pellets may be placed in three-inch lifts. Each lift should be moistened with clean water of known chemistry. A sufficient quantity of bentonite will be poured to fill the annular space to a level of not more than 2 feet above the top of the filter pack. The depth to the top of the bentonite pellet layer will be verified by measuring, using the tremie pipe or a weighted tape.

A neat cement grout seal (with bentonite additive) will be placed from the top of the bentonite pellet layer to the ground surface. The grout seal will be placed by pumping through a tremie pipe lowered to within five feet of the top of the bentonite seal in mud rotary borings. The grout seal will be placed in hollow stem auger borings by free fall through the augers as they are incrementally raised or by pumping through flexible hose fitted with a steel pipe extension lowered to near the bottom of the grouted zone. The grout must be tremied if there is any standing water in the augers above the bentonite. The neat/cement grout will be a mixture of the following proportions: one sack (94 pounds) portland cement, approximately 2 to 3 percent by weight (of cement) powdered bentonite, and approximately 8 gallons of water. Only clean water from a municipal supply will be used to prepare the grout. After grouting, no work will be done on the monitoring well until the grout has set a minimum of 24 hours.

2.4 Development of Monitoring Wells

When the monitoring well installation is complete, the well will be developed by surging, bailing, and pumping. The objective of well development is to remove sediment that may have accumulated during construction and to consolidate the filter pack around the well screen. A minimum of 24 hours must pass between completion of grouting and development, to allow sufficient curing of the grout. A stainless steel bailer will be used to removed sediment and turbid water from the bottom of the well. A swab or surge block will be run along the length of the well screen in order to flush the filter pack and adjacent formation of fine sediment. Swabbing will be conducted slowly to minimize disruption to the filter pack and screen. The well will be bailed again to remove sediment drawn in by the swabbing process. Following the bailing and swabbing, the well will be pumped with a positive displacement pump, gas-driven bladder pump, or submersible pump. A bailer may be used for shallow low-yield wells. During development, the clarity of the water will be monitored and the pH, specific conductance, and temperature of the return water will also be measured. Well development will proceed until the return water is, in the judgment of the Geomatrix field personnel, is of sufficient clarity and field water quality parameters have stabilized. If the screened interval is too long to be developed adequately in one stage, additional stages will be employed, in which the end of the pump intake will be raised or lowered to various depths, as required.

2.5 Capping Monitoring Well

Upon completion of the well, a suitable slip-on cap, threaded end cap, or waterproof cap will be fitted on the top of the riser casing to prevent the entry of surface runoff or foreign matter. A steel well cover with a locking top will be set in concrete or grout around the riser casing for protection. A steel protective well cover will be completed either above the ground surface, in which case a concrete pedestal with four steel stanchions may be built around it or below the ground surface in a precast concrete valve box with a traffic rated cover. All wells will be locked for security.

2.6 Documentation

A well construction diagram (Figure 5-1) for each monitoring well will be completed by the field geologist/engineer and submitted to the project hydrogeologist upon completion of each monitoring well. In addition, the details of well installation, construction, development, and field measurements of water quality parameters will be summarized as daily entries in the daily field records or data sheets. The daily field records and/or data sheets will also be submitted to the project hydrogeologist upon completion of each monitoring well.

3.0 CLEANING OF DRILLING EQUIPMENT

Cleaning of the drill rig and associated equipment shall follow the procedures discussed in Section 2 of the protocol "Drilling of Soil Borings".

All well casing materials will be cleaned thoroughly before they are installed. This is particularly critical to minimize potential for cross contamination in a multi-aquifer environment. The following cleaning procedure has generally been found to be effective and may be used or adapted as appropriate for general conditions of materials to be cleaned.

1. Swab surfaces, inside and out, with detergent-water solution.

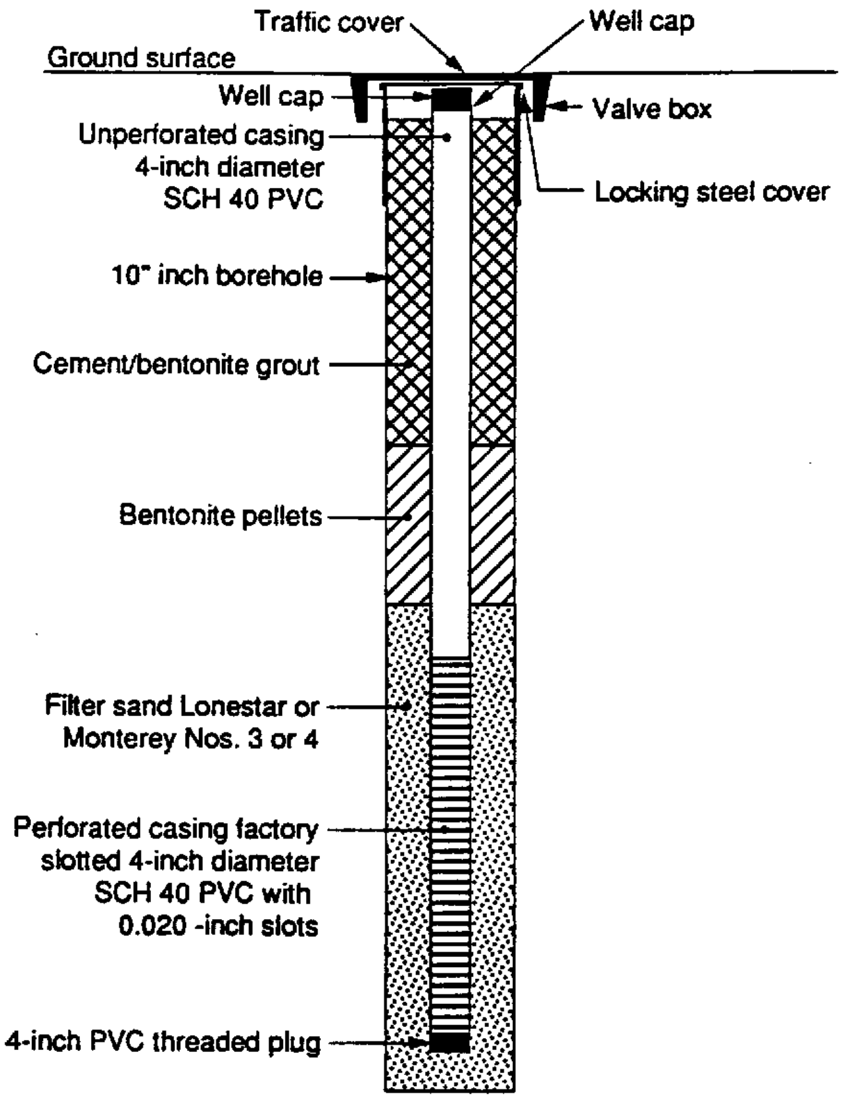
2. Steam clean with a detergent-potable water solution.

3. Steam rinse with clean potable water.

4. Cover with clean plastic to protect equipment from contact with chemical products, dust, or other contaminants.

Alternatively, well casing materials that have been steam-cleaned and sealed in individual airtight plastic bags by the factory can be used.

Equipment used for well development will be cleaned using procedures similar to that for cleaning the well casing.



Not to scale

	TYPICAL MONITORING WELL CONSTRUCTION DIAGRAM	Figure
		Project No.

WATER LEVEL AND WELL DEPTH MEASUREMENTS

1.0 INTRODUCTION

This protocol describes procedures to be followed during water level and well depth measurements. The procedures presented herein are intended to be of a general nature and, as the investigation progresses and when warranted, appropriate revisions may be made and approved in writing by the project manager.

2.0 WATER LEVEL AND DEPTH MEASUREMENTS

All water level measurements shall be recorded to the nearest hundredth foot, and all well depth measurements shall be noted to the nearest half foot. All equipment placed in the wells for water level and well depth measurements will be cleaned prior to reuse, as discussed in Section 3. Care will be taken to not drop any foreign objects into the wells and to not allow the tape or sounding device to touch the ground around the well during monitoring.

2.1 Water Level Measurements

Water level measurements will be done by one of the following methods:

A. Wetted-tape Method

A steel surveyor's tape (e.g., Lufkin Highway Nubian Type B) will be prepared by coating several feet of the lower end of the tape with chalk. A lead weight is attached to the lower end of the steel tape to keep it taut. The tape is lowered into the well until a foot or two of the chalked portion is submerged.

Tape without weight can be used if the well opening or pump casing clearance is too small and restricts the passage of weight. The proper length to lower the tape may have to be determined experimentally. Measurement will be done as follows:

1. Lower and hold the tape at an even foot mark at the Measuring Point (MP) and note this tape reading.

2. Remove the steel tape from the well. Subtract the wetted length from the even foot mark noted in Step 1 and record this as water level below MP on the appropriate data sheet (Figure 6-1).

B. Electric Sounder Method

An electric sounder consists of a contact electrode that is suspended by an insulated electric cable from a reel that has an ammeter, a buzzer, a light, or other closed circuit indicator attached. The indicator shows a closed circuit and flow of current when the electrode touches the water surface. The electric sounders used in this project will be calibrated by measuring each interval and remarking them where necessary.

The procedure for measuring water levels with an electric sounder is as follows:

1. Switch on.

2. Lower the electric sounder cable into the well until the ammeter or buzzer indicates a closed circuit. Raise and lower the electric cable slightly until the shortest length of cable that gives the maximum response on the indicator is found.

3. With the cable in this fixed position, note the length of cable at the MP.

4. Since the electric cable is graduated in intervals, use a pocket steel tape measure (graduated in hundredths of a foot) to interpolate between consecutive marks. Care must be taken that the tape measurements are subtracted from graduated mark footage value when the water level hold point (determined in Step 3) is below the graduated mark and added when above the mark. Record the resulting value as water level below MP (Figure 6-1).

2.2 Well Total Depth Measurement

Total depth of a well will be measured by sounding with a weighted steel surveying tape or an electric sounding line, weighted when possible. Procedures to be followed are described below.

A. Measure the distance between the zero mark on the end of the measuring line and the bottom of the weight.

B. Lower the weighted steel tape into the well until the tape becomes slack or there is noticeable decrease in weight, which indicates the bottom of the well. Raise the tape slowly until it becomes taut (this may have to be done several times to determine that taut point) and, with the tape in this fixed position, note the reading at the MP. Adjust it for the difference described in Step 1, and record the resulting value as well depth. This procedure will be performed before and after initial well development or as necessary to determine total well casing depth.

C. Record the well depth value on a Monitoring Well Sampling Record (Figure 6-2).

4.0 EQUIPMENT CLEANING

Steel tapes and electric wells sounders will be cleaned after measurements in each well are completed. Cleaning procedures will be accomplished as follows:

A. Rinse probe or portion of cable/tape immersed in well water with clean water or a laboratory-grade detergent solution.

B. Rinse with deionized water.

C. Dry with a clean paper towel.

Solutions resulting from cleaning procedures will be collected and transported to a designated storage tank by the field sampler.

WATER LEVEL MONITORING RECORD

GEOMATRIX

Project ______________________________ Project No. ____________________

Date ____________________ Recorded By ______________________________

Note: Use these abbreviations to make your life easier:
- P = Pumping　　SC = Specific Conductance Measured
- I = Inaccessible　　WS = Water Sample Collected

Well No.	Date	Water Level Below MP (feet)	Corrections (feet)	Water Level Below GL (feet)	Water Level Elevation (feet, MSL)	Remarks

GEOMATRIX		Figure
		Project No.

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MONITORING WELL SAMPLING RECORD AND WELL DEVELOPMENT DATA

Well ID:
Sample ID.: Duplicate ID.:
Sample Depth:
Project No:
Project Name:
Date:
Sampled By:

Initial Depth to Water:
Depth to Water after Purging:
Total Depth of Well:
Well Diameter:
1 Casing Volume =
4 Casing Volumes =
Method of Purging:
Method of Sampling:

TIME	INTAKE DEPTH	RATE (gpm)	CUM. VOL. (gal)	TEMP. (°C)	pH (units)	CONDUCTIVITY (µmhos/cm)	REMARKS (color, turbidity & sediment)

Ph CALIBRATION (CHOOSE TWO)					Model or Unit No.:
Buffer Solution	pH 4.0	pH 7.0	pH 10.0		
Temp. °C					
Instrument Reading					

SPECIFIC CONDUCTANCE - CALIBRATION:						Model or Unit No.:
KCL Solution (µmhos/cm at 20°C	1409	12856				
Temp. °C						
Instrument Reading						

Notes

revised 9/91

GEOMATRIX

Figure

Project No.

SAMPLING OF MONITORING WELLS AND WATER SUPPLY WELLS

1.0 INTRODUCTION

This protocol describes procedures to be followed during collection of field water quality measurements and groundwater samples for laboratory chemical analysis from monitoring wells and water supply wells. The procedures presented herein are intended to be of general use. As the work progresses, and if warranted, appropriate revisions will be made and approved in writing by the Geomatrix project manager.

2.0 SAMPLING

2.1 Sample Collection

A. Monitoring Wells - At least three well casing volumes will be pumped to purge the well. To verify that the water samples are representative of the aquifer, periodic measurements of the temperature, pH, and specific conductance will be made with field equipment. Samples will be collected only when the temperature, pH, and specific conductance reach relatively constant values.

   A submersible pump or a positive air displacement pump will be used for evacuating (purging) the monitoring well casing. A Teflon bailer or a stainless steel positive displacement Teflon® bladder pump with Teflon® tubing will be used to collect the water samples for laboratory chemical analysis.

   Each sampling sequence will begin with the well having the least suspected chemical concentration. Successive samples will be obtained from wells of increasing suspected chemical concentration.

B. Water Supply Wells - The water supply wells, designated by the project manager, will be sampled by purging the wells for a minimum of 15 minutes, followed by water sample collection from the discharge point nearest to the well head.

A monitoring well sampling record (Figure 7-1) will be used to record the following information:

1. Sample number (or name).
2. Date and time sampled.
3. Well designation (State well numbering system for water supply wells, and unique sequential number for monitoring wells).
4. Owner's name, or other common designation for water supply wells.
5. Method of purging (bailing, pumping, etc.).
6. Amount of water purged.
7. Extraordinary circumstances (if any).
8. Name of sample collector.
9. Results of instrument calibration/standardization and field measurements (temperature, pH, and specific electrical conductance).
10. Depth from which sample was obtained (if known).

2.2 Sample Containers and Preservation

Appropriate sample containers for the analyses to be performed will be obtained from the subcontracted analytical laboratory in accordance with EPA methods (SW-846) or the State Water Resources Control Board LUFT Manual. Frequently requested analyses and sample handling requirements are listed in Table 7-1.

2.3 Sample Labeling

Sample containers will be labeled with self-adhesive tags having the following information written in waterproof ink:

A. Project number.

B. Sample number.

C. Date and time sample was collected.

D. Signature or initials of sample collector.

E. Requested analytical method.

2.4 Quality Control Samples

In order to document the precision and accuracy of analytical data, the following procedures will be periodically employed.

A. Replicate Sample - Sets of water samples will be collected in identical containers from the same water source and will be given different sample identification numbers. These numbers will be recorded on the sample control log sheets and water quality sampling record. One set of the samples, termed the "primary" sample, will be submitted to the primary subcontracted laboratory. The additional sets of samples, termed the replicate samples, will be submitted to the primary laboratory and/or to the secondary laboratory for identical analyses or an alternative analytical procedure as specified by the project manager.

B. Blank Samples - Blank samples will consist of field blanks or travel blanks. A field blank is deionized water that is added to the sample bottles at the time of sample collection. A travel blank is deionized water that is added to the sample bottle by the subcontracted laboratory and which accompanies the other sample containers throughout the trip from the laboratory to the field and back to the laboratory. The field blank sample bottles are preserved and labeled in the same manner as the groundwater samples and are stored with the groundwater samples. Travel blanks are prepared by the subcontracted laboratory and are preserved in the same manner as groundwater samples, but are identified as travel blanks on the sample label.

   Travel blank samples will be designated as such on the chain of custody record. A field blank and/or a travel blank will be prepared for each set of samples collected and analyzed for the same compounds as the groundwater samples.

2.5 Handling, Storage, and Transportation

Efforts will be made to handle, store, and transport supplies and samples safely. Exposure to dust, direct sunlight, high temperature, adverse weather conditions, and possible contamination will be avoided. Samples will be placed in an ice-cooled chest immediately following collection and will be delivered by Geomatrix Consultants to the subcontracted laboratory as soon as possible.

3.0 FIELD MEASUREMENTS

Field measurements of temperature, pH, and specific conductance will be performed on groundwater samples. Data obtained from field water quality measurements will be recorded on the monitoring well sampling record. Field measurements will be made on separate aliquots of groundwater which will not be submitted for laboratory analysis.

3.1 Temperature Measurement

Temperature measurements will be made with a mercury filled thermometer or an electronic thermistor, and all measurements will be recorded in degrees Celsius.

3.2 pH Measurement

The pH measurement will be made as soon as possible after collection of the sample, generally within a few minutes.

Calibration/standardization and field measurements will be performed at the beginning of each sampling day in accordance with the equipment manufacturer's specifications as outlined in the instruction manual for the specific pH meter used. Two of the following buffers of pH-4, pH-7, and pH-10 which most closely bracket the anticipated range of groundwater conditions from neutral pH-7 will be used for instrument calibration.

3.3 Specific Conductance Measurement

Specific conductance will be measured by immersing the conductivity probe directly in the water source or into a sample. The probes used should automatically compensate for the temperature of the sample. Measurements will be reported in units of micromhos per centimeter at 25 degrees Celsius.

Calibration/standardization and field measurements will be performed in accordance with the equipment manufacturer's specifications as outlined in the instruction manual for the specific conductivity meter used. The conductivity meter will be calibrated at the beginning of each sampling day with standardized potassium chloride (KCl) solutions.

4.0 DOCUMENTATION

4.1 Field Data Sheets

Specially formatted field data sheets (Figure 7-1) will be used to record the information collected during water quality sampling. Following completion of sampling and review by the project manager or task leader, the data sheets will be placed in the project file.

4.2 Chain of Custody Procedures

After samples have been collected and labeled, they will be maintained under chain of custody procedures. These procedures document the transfer of custody of samples from the field to a designated laboratory.

A chain of custody record (Figure 7-2) will be filled out for each shipment of samples to be sent to the laboratory for analysis. Information contained on the triplicate carbonless form will include the following:

A. Date and time the sample was taken.

B. Sample number and the number of sample bottles.

C. Analyses required.

D. Remarks including preservatives added and any special conditions or specific quality control measures.

E. Anticipated range of maximum concentrations for organic compounds.

F. Labeling of travel blanks.

Blank spaces on the chain of custody record (Figure 7-2) will be crossed out between last sample number listed and signatures at the bottom of the sheet.

After carefully packaging the samples into containers (e.g., ice chests) for transfer to the laboratory, the field sampler will sign the chain of custody record and record the time and the date. The original imprint of the chain of custody record will accompany the sample containers. Following review by the project manager or task leader, a duplicate copy will be placed in the project file.

Laboratory receipt of the samples is discussed in the protocol "Water Quality Analysis."

5.0 EQUIPMENT CLEANING

Sample bottles and bottle caps will be cleaned by the subcontracted laboratory using standard EPA approved protocols. Sample bottles and bottle caps will be protected from contact with solvents, dust, or other contamination between time of receipt by Geomatrix Consultants and time of actual usage at the sampling site.

Sampling equipment that will be reused shall be cleaned/decontaminated after sampling of each well. Thermometers, pH electrodes, and conductivity probes that will be used repeatedly will be cleaned after sampling of each well and at any time during sampling if the object comes in contact with foreign matter.

Cleaning/decontamination of sampling apparatus after sampling of each well will be performed. Decontamination of the Teflon® bladder pump will be performed according to a laboratory tested method.

Purged waters and solutions resulting from cleaning the inside of pumps and hoses will be collected and transported to a designated storage tank on site by the field sampler. Disposal of purged water will be arranged following receipt of laboratory analyses for groundwater samples.

WATER AND SOIL ANALYTICAL METHODS AND HANDLING

Parameter	Method	Containers[1]	Preservation[1]	Maximum Holding Time[1]
Total Petroleum Hydrocarbons:				
as diesel	GCFID (3550)[2]	2 - 1 liter amber glass	cool, 4°C	14 days
as gasoline	GCFID (5030)[2]	2 - 40 ml VOA glass	HCL to pH2: cool, 4°C	14 days
Benzene, Toluene, Xylene, and Ethylbenzene	EPA 8020 (soil) EPA 602 (water)	2 - 40 ml VOA glass	HCL to pH 2: cool, 4°C	14 days
Oil and Grease	503 D & E (soil) 503 A & E (water)	2 - 1 liter amber glass	cool, 4°C, H_2SO_4 to pH<2	28 days
Volatile Organics	EPA 8240 or 8010	2 - 40 ml VOA glass	HCL to pH 2: cool, 4°C[3]	14 days
Semi-volatile Organics	EPA 8270 or 8020	2 - 1 liter amber glass	cool, 4°C	14 days
Metals (dissolved)	EPA 7000 series for specific metal	1 - 500 ml plastic	Field filtration (0.45 micron filter): field acidify to pH 2 with HNO_3 except: Cr^{+6} - Cool, 4°C	6 months, except: Hg - 28 day Cr^{+6} - 24 hrs

Notes:

[1] All soils should be collected in full, clean brass liners, capped with foil and plastic caps, and sealed with PVC tape. Soils should be cooled as indicated under "preservation" and maximum holding times apply to both soil and water.

[2] DHS recommended procedure as presented in LUFT manual using gas chromatography with a flame ionization detector.

[3] If chlorinated hydrocarbons are found or expected onsite (e.g., sampling of treated drinking water), 8010 or 8240 may be run without HCL with a 7 day holding time.

References:

U.S. EPA, 1986, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW-846, Third Edition, July.

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Regional Water Quality Control Boards, North Coast, San Francisco Bay, and Central Valley Regions, 1989, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, 9 November.

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(415) 434-9400

MONITORING WELL SAMPLING RECORD AND WELL DEVELOPMENT DATA

Well ID: ____
Sample ID.: ____ Duplicate ID.: ____
Sample Depth: ____
Project No: ____
Project Name: ____
Date: ____
Sampled By: ____

Initial Depth to Water: ____
Depth to Water after Purging: ____
Total Depth of Well: ____
Well Diameter: ____
1 Casing Volume = ____
4 Casing Volumes = ____
Method of Purging: ____
Method of Sampling: ____

TIME	INTAKE DEPTH	RATE (gpm)	CUM. VOL. (gal)	TEMP. (°C)	pH (units)	CONDUCTIVITY (µmhos/cm)	REMARKS (color, turbidity & sediment)

Ph CALIBRATION (CHOOSE TWO)					Model or Unit No.:
Buffer Solution	pH 4.0	pH 7.0	pH 10.0		
Temp. °C					
Instrument Reading					

SPECIFIC CONDUCTANCE - CALIBRATION:						Model or Unit No.:
KCL Solution (µmhos/cm at 20°C	1409	12856				
Temp. °C						
Instrument Reading						

Notes ____

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Figure

Project No.

GEOMATRIX

Chain-of-Custody Record

№

Date:

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Project No.:

Samplers (Signatures):

ANALYSES

REMARKS

Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel	TPH as BTEX													Cooled	Soil (S) or water (W)	Acidified	Number of containers

Additional comments

[illegible]

Turnaround time:

Results to:

Total No. of containers:

Relinquished by:	Date:	Relinquished by:	Date:	Relinquished by:	Date:	Method of shipment:
Signature:		Signature:		Signature:		Laboratory comments and Log No.:
Printed name:		Printed name:		Printed name:		
Company:		Company:		Company:		
Received by:	Time:	Received by:	Time:	Received by:	Time:	
Signature:		Signature:		Signature:		
Printed name:		Printed name:		Printed name:		
Company:		Company:		Company:		

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100 Pine St. 10th Floor
San Francisco, CA 94111
(415) 434-9400

Project No.

Figure

WATER QUALITY ANALYSIS

1.0 INTRODUCTION

The water quality analysis program for the investigation in the vicinity of the project site will be performed by a designated subcontracted laboratory that will adhere to the guidelines outlined in this protocol. Adherence to these guidelines will be monitored by the project manager.

2.0 LABORATORY QUALIFICATIONS

The subcontracted laboratory must be certified by the California Department of Health Services (DOHS) to perform analyses of hazardous materials under the Hazardous Materials Laboratory Certification program mandated by AB3449, Chapter 1209. The subcontracted laboratory must also be a DOHS approved laboratory and must be operating in compliance with a written quality assurance program, subject to prior review by Geomatrix Consultants.

3.0 SAMPLE SUBMISSION

All samples will be delivered to the laboratory in ice-cooled chests. The samples will be accompanied by a Geomatrix chain of custody record (Figure 9-1). All samples submitted for volatile organic or metals analyses may be accompanied by an estimate of the concentration for the highest concentration constituent, if known. The estimates will be given as code letters in accordance with the following:

Organics		Meters	
Range (µg/l)	Designation	Range (mg/l)	Designation
0 - 200	A	0.10	A
200 - 600	B	0.10 - 10	B
600 - 2,000	C	10 - 100	C
2,000 - 6,000	D	>100	D
6,000 - 20,000	E		
20,000 - 60,000	F		

4.0 LABORATORY PRACTICES

4.1 Laboratory Custody Procedures

Laboratory custody procedures concerning the acquisition and handling of samples and the documentation required therewith will be in accordance with the procedures outlined below.

A. Receipt of Samples at the Laboratory

One person designated as the sample custodian will be responsible for the receipt of the samples at the laboratory. Upon sample delivery, the custodian will:

1. Observe the physical condition of the sample container(s) noting any broken seals or other evidence of tampering.

2. Verify that the information on the chain of custody record corresponds to that on the sample labels.

3. Record the information on the sample labels into a laboratory notebook.

4. Report any damage to, or leakage of sample to the laboratory supervisor and the Geomatrix project manager, and record this information in the laboratory notebook.

5. Sign the chain of custody record, including the date and time received, and secure the record in a locked file cabinet.

6. Place the samples in a secured storage area.

B. Damaged Samples

In the event of sample leakage, headspace in a VOA sample bottle, or any other evidence of damage to a sample, the Geomatrix project manager will be contacted for a decision regarding sample disposition.

C. Sample Storage

Samples, prepared samples, and standard solutions will remain in a secured cabinet or room at all times unless being used for analysis. Access to this area will be limited to the laboratory supervisor, the sample custodian, and designated laboratory personnel. After analysis, samples will be retained in a secured area until notified otherwise by Geomatrix Consultants.

5.0 TEST METHODS AND SAMPLE HANDLING

The methods of analysis will be established by prior agreement between Geomatrix Consultants and the subcontracted laboratory. Detailed methodology of the testing techniques will be based on the reference documents listed herein. In general, the quality control aspects of the laboratory procedures will be in accordance with the following references:

1. U.S. Environmental Protection Agency, Test Methods for Evaluating Solid Waste, November 1986.
2. California State Water Resources Control Board, Leaking Underground Fuel Tank Manual, October 1989.
3. Regional Water Quality Control Board, North Coast, San Francisco Bay and Central Valley Regions, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, November 1989.
4. 40 CFR, Part 136.

Frequently requested analyses and their sample handling requirements are listed in Table 9-1. In the event that one of these methods proves to be unsatisfactory for accurate and precise determinations of a constituent, the subcontracted laboratory will consult with Geomatrix about an alternate method. The alternate method must be approved by the Geomatrix project manager before the analysis is performed.

6.0 DISPOSITION OF RECORDS, DOCUMENTS AND PROCEDURES

Records, log books, data sheets, and any other documents generated before, during, and after analysis of the samples will be placed in a secured drawer or file when not in use.

At the termination of the contract with the designated subcontractor, or upon request, the subcontractor shall relinquish to Geomatrix Consultants all records, documents, and procedures pertaining to the work performed.

WATER AND SOIL ANALYTICAL METHODS AND HANDLING

Parameter	Method	Containers[1]	Preservation[1]	Maximum Holding Time[1]
Total Petroleum Hydrocarbons:				
as diesel	GCFID (3550)[2]	2 - 1 liter amber glass	cool, 4°C	14 days
as gasoline	GCFID (5030)[2]	2 - 40 ml VOA glass	HCL to pH2: cool, 4°C	14 days
Benzene, Toluene, Xylene, and Ethylbenzene	EPA 8020 (soil) EPA 602 (water)	2 - 40 ml VOA glass	HCL to pH 2: cool, 4°C	14 days
Oil and Grease	503 D & E (soil) 503 A & E (water)	2 - 1 liter amber glass	cool, 4°C, H_2SO_4 to pH<2	28 days
Volatile Organics	EPA 8240 or 8010	2 - 40 ml VOA glass	HCL to pH 2: cool, 4°C[3]	14 days
Semi-volatile Organics	EPA 8270 or 8020	2 - 1 liter amber glass	cool, 4°C	14 days
Metals (dissolved)	EPA 7000 series for specific metal	1 - 500 ml plastic	Field filtration (0.45 micron filter): field acidify to pH 2 with HNO_3 except: Cr^{+6} - Cool, 4°C	6 months, except: Hg - 28 day Cr^{+6} - 24 hrs

Notes:

1 All soils should be collected in full, clean brass liners, capped with foil and plastic caps, and sealed with PVC tape. Soils should be cooled as indicated under "preservation" and maximum holding times apply to both soil and water.

2 DHS recommended procedure as presented in LUFT manual using gas chromatography with a flame ionization detector.

3 If chlorinated hydrocarbons are found or expected onsite (e.g., sampling of treated drinking water), 8010 or 8240 may be run without HCL with a 7 day holding time.

References:

U.S. EPA, 1986, Test Methods for Evaluating Solid Waste - Physical/Chemical Methods - SW-846, Third Edition, July.
State Water Resources Control Board, 1989, Leaking Underground Fuel Tank (LUFT) Field Manual, Tables 3-3 and 3-4, October.
Regional Water Quality Control Boards, North Coast, San Francisco Bay, and Central Valley Regions, 1989, Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, 9 November.

GEOMATRIX

Chain-of-Custody Record

Chain-of-Custody Record	No	Date:	Page of

Project No.:

Samplers (Signatures):

Date	Time	Sample Number	EPA Method 8010	EPA Method 8020	EPA Method 8240	EPA Method 8270	TPH as gasoline	TPH as diesel	TPH as BTEX												Cooled	Soil (S) or water (W)	Acidified	Number of containers	Additional comments

ANALYSES — REMARKS

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Relinquished by:	Date:	Relinquished by:	Date:	Relinquished by:	Date:	Method of shipment:
Signature:		Signature:		Signature:		Laboratory comments and Log No.:
Printed name:		Printed name:		Printed name:		
Company:		Company:		Company:		
Received by:	Time:	Received by:	Time:	Received by:	Time:	
Signature:		Signature:		Signature:		
Printed name:		Printed name:		Printed name:		
Company:		Company:		Company:		

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Figure