Cademartori Trucking Co.
1833 PERALTA STREET
OAKLAND, CALIFORNIA 94607

Paul M. Smith
Alameda County Department of Environmental Health
80 Swan Way, Room 200
Oakland CA 94621

15 October 1990

Workplan for Remediation and Investigation Activities
Cademartori Trucking Facility
1833 Peralta Street
Oakland CA

Dear Mr. Smith:

In response to your correspondence of 3 August 1990, we are submitting the attached workplan. The workplan describes our proposed soil removal, soil sampling, groundwater gradient determination, groundwater sampling, and reporting activities. The workplan was prepared by a professional engineering consultant who we have retained to advise Cademartori Trucking on this project.

The workplan outlines, in a logical and sequential manner, the prudent steps we can reasonably foresee at this point in time. We request your review, comment, and approval of the proposed work.

Cademartori Trucking will await your approval prior to beginning work. Please contact me if you have any questions, technical or otherwise.

Sincerely,

Linda Cademartori

Attachments

cc: Lester Feldman, San Francisco Bay Regional Water Quality Control Board, Oakland CA

STREAMBORN

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Workplan
Soil Remediation, Soil Investigation, and Groundwater Monitoring
Cademartori Trucking Facility
Oakland CA

Prepared For:
Cademartori Trucking
1833 Peralta Street
Oakland CA 94607

REGISTERED PROFESSIONAL ENGINEER
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Expires 12/31/92

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Contents

INTRODUCTION

This workplan describes additional excavation, soil sampling, and groundwater monitoring procedures to be conducted at the Cademartori Trucking facility, 1833 Peralta, Oakland CA (Figure 1). The work should be performed in phases which will expedite closure of open excavations (Figure 2) and allow determination of the nature and extent of soil and groundwater contamination.

Additional excavation should be performed at the former locations of the tanks (existing open excavations) to remove visibly contaminated soil. Verification samples should be collected at the limits of the additional excavation provided field observations confirm the contaminated soil has been removed (no visible staining, lack of odor, lack of elevated readings with the field organic vapor monitor).

As described in this workplan, groundwater monitoring should consist of three approximate 1-inch diameter driven well-point piezometers located to better define the local hydraulic gradient and two 2-inch diameter monitoring wells installed within 10 feet of the detected releases to assess the impacts of release on groundwater.

BACKGROUND

The property is currently operated as a motor-freight facility, serving as a base for trucks and temporary storage of goods in transit. Oil changing was historically performed at the facility, but no longer.

Two fuel tanks from a common excavation (10,000-gallon diesel and 1,000-gallon leaded/unleaded gasoline) and one oil tank from another excavation (5,000-gallon waste oil/unknown use) were removed by Diablo Tank and Equipment on 10 July 1990. During tank removal, limited petroleum-stained soil was excavated. Excavated soil was stockpiled adjacent to each excavation. Soil and groundwater samples were collected after removal of the tanks and limited additional excavation. Excavation, stockpile, and sample locations are shown on Figure 2. Currently, facility operations are restricted by the presence of open excavations and soil stockpiles resulting from the tank removal.

Results of soil analyses are summarized in Table 1. Elevated levels of total petroleum hydrocarbons as diesel (TPH-diesel), benzene, xylenes, and ethylbenzene were detected in soil samples from the fuel tanks excavation; however, TPH-gasoline and lead were not detected in soil samples from the fuel tanks excavation. Elevated concentrations of oil & grease, TPH-gasoline, TPH-diesel, and toluene, ethylbenzene, and xylenes were detected in soil from the oil tank excavation. Halogenated volatile organic compounds were not detected in soil from the oil tank excavation.

Results of groundwater analyses are summarized in Table 2. Elevated concentrations of TPH-diesel were detected in groundwater from the fuel tanks excavation. Groundwater from the oil tank excavation contained TPH-diesel, TPH-gasoline, benzene, toluene, xylenes, and ethylbenzene, in addition to oil & grease. Halogenated volatile organic compounds were not detected in groundwater from the oil tank excavation.

Cademartori Trucking is located within the northern Merrit Sand Outcrop groundwater sub-area (*Geohydrology and Groundwater - Quality Overview, East Bay Plain Area, Alameda County, California, 205(J) Report,* Alameda County Flood Control and Water Conservation District, 1990). The Merrit Sand is described as a loose, well sorted, fine to medium sand and silt containing lenses of clay and sandy clay. The soils exposed in the excavation sidewalls at the Cademartori Trucking facility consist predominantly of silty sand containing thin silt strata. Groundwater is present in the excavations at a depth of approximately 5 to 6 feet below ground surface. since tank removal, representatives of Cademartori Trucking have observed water level fluctuations in the excavations, which may be attributed to tidal influences.

PURPOSE

The investigation described in this workplan will allow expedited closure of the tank excavations and address selected objectives of the Alameda County Department of Environmental Health, including:

- Better definition of the horizontal and vertical extent of soil contamination
- Better definition of the sources and nature of groundwater contamination
- Determination of the local groundwater gradient direction
- Evaluation of potential remedial alternatives, if necessary

In order to remove a potential continued source of groundwater contamination, this workplan describes limited additional excavation of visibly contaminated vadose-zone soil associated with the former underground storage tanks. The limits of the additional excavation should be determined by physical characteristics of the site combined with in-field evaluation of the extent of stained soil as the excavation progresses. It is anticipated that contaminated tank backfill material will be excavated along with a limited fringe of surrounding soil. Areas initially targeted for additional excavation are shown on Figure 3. The removal of contaminated soil should be confirmed by laboratory analysis of verification samples collected from visibly uncontaminated soil at the limits of the enlarged excavations. Visibly contaminated soil remaining after additional excavation should not be sampled. Additional soil sampling may be conducted during installation of monitoring wells. The proposed additional excavation should be conducted prior to groundwater monitoring.

Groundwater monitoring should consist of 3 drive-point piezometers and 2 monitoring wells . The piezometers should be installed first to allow measurement of the local groundwater gradient. The wells should be installed downgradient and within 10 feet of the release locations. Anticipated well and drive-point piezometer locations are shown on Figure 3. Additional soil samples may be collected for chemical analysis during monitoring well installation, contingent upon the results of additional excavation and verification sampling. Groundwater from the monitoring wells should be sampled initially after completion, and quarterly for three quarters thereafter.

Soil sampling and groundwater monitoring should comply with Regional Water Quality Control Board guidance (*Tri-Regional Board Staff Recommendations for Preliminary Evaluation and Investigation of Underground Tank Sites*, San Francisco Bay Regional Water Quality Control Board, 10 August 1990).

SCOPE OF WORK

Phase 1 - Soil Excavation and Verification Sampling

Additional Excavation Additional excavation should be performed to remove a possible continuing source of groundwater contamination. The extent of additional excavation should be determined using field screening techniques (visual observation, odor, field organic vapor monitor), subject to physical constraints (buildings, utilities, etc). Upon removal of visibly contaminated soil, field check samples should be collected from the excavation sidewalls for vapor screening with a field organic vapor meter. Field vapor screening should be performed by placing soil into a glass jar, sealing the jar, allowing the jar to equilibrate for approximately 15 minutes (shaking the jar periodically), and then measuring the headspace in the jar with the organic vapor meter. If organic vapors are detected, the excavation should be advanced a short distance and the process repeated. When organic vapor concentrations are no longer measurable by this technique, verification samples should be collected for laboratory analysis.

Verification Sampling Verification sampling should be conducted in accordance with Standard Operating Procedure (SOP) 9A-Verification Sampling For Underground Storage Tank Removal (Appendix A) and the requirements set forth in Table 3. Verification samples should be collected at approximate 20- foot intervals around the perimeter of the enlarged excavation.

Verification samples from the fuel tanks excavation should be analyzed for TPH-diesel and benzene, toluene, xylenes, and ethylbenzene (EPA Method 8020) because these were the compounds detected in soil samples collected during tank removal (Table 1). Verification samples from the waste oil tank excavation should be analyzed for oil & grease (SM 503), TPH-diesel, TPH-gasoline, and benzene, toluene, xylenes, and ethylbenzene (EPA Method 8020) because these were the compounds detected in soil samples collected during removal (Table 1). For the waste oil tank excavation, all analyses need not be performed on every sample and a stratified testing program may be conducted to determine representative results.

Phase 2 - Drive-Point Piezometer Installation and Gradient Measurement

Drive-Point Piezometer Installation Three drive point piezometers should be installed to allow determination of the local hydraulic gradient prior to monitoring well installation. Drive-point piezometers should be installed in accordance with SOP5A: Drive-Point Piezometers (Appendix A), the requirements delineated in Table 4, and the schematic shown on Figure 4. Soilgas samples should be collected during piezometer installation and analyzed in the field using an organic vapor meter.

To help prevent clogging of the screen during driving, piezometers should be constructed using well-points with an opening size of 0.010 inches. Clogging of the screen may cause the need for piezometer development by flushing with distilled water and pumping with a peristaltic pump. Riser from the well-point should be flush thread pipe sturdy enough to withstand pneumatic driving stresses.

Gradient Measurement Groundwater elevations should be determined by surveying the elevations of measuring points on the drive-point piezometers and then measuring the water levels in each piezometer. Measuring point elevations of each piezometer should be surveyed relative to a temporary benchmark with an assumed elevation. Water levels should be measured using an electric sounder. Water level and survey measurements should be accurate to the nearest 0.1-foot. The horizontal location of each piezometer should be measured to the nearest ±1-foot and locations plotted on a facility map.

Phase 3 - Groundwater Monitoring

Drilling and Soil Sampling Drilling and soil sampling should be performed in accordance with SOP1A: Hollow-Stem Auger Drilling and Split-Spoon Soil Sampling (Appendix A) and the requirements delineated in Table 5. Each borehole should be continuously sampled and logged. Approximately 3 representative samples from each boring should be collected and archived for potential physical and chemical testing.

Soil samples should be retained for potential testing at maximum 5-foot intervals or discernable changes in material type, whichever is more frequent. Samples should be screened in the field using an organic vapor monitor and if field observations indicate the presence of soil contamination, then additional samples may be collected from the contaminated horizon. If the results of Phase 1 excavation do not document the removal of contaminated soil, additional soil samples may need to be collected and analyzed from the borings.

If field observations do not indicate the presence of soil contamination, then 1 representative soil sample from beneath the water table in each boring should be analyzed. These analyses will serve to define the vertical extent of soil contamination. A sample of aquifer material suitable for grain size analysis should be collected and archived (to provide more accurate well design criteria in the event additional wells are required).

Soil samples should be analyzed for oil & grease (SM 503), TPH-diesel, TPH-gasoline, and benzene, toluene, xylenes, and ethylbenzene (EPA Method 8020).

Well Completion Two 2-inch diameter groundwater monitoring wells should be constructed following the practices outlined in SOP2A: Completion of Borings as Wells (Appendix A), the schematic shown on Figure 5, and the specifications contained in Table 6.

The groundwater monitoring wells should be installed with 7.5 feet of .010 slotted PVC screen and a filter pack of number 2/12 clean sand due to the anticipated silty soils. Since the detection of either dissolved or floating contaminants is desired, the well screen should straddle the water table. The 7.5-foot length of screen is desirable to account for uncertainties in the location of the water table due to seasonal and tidal influences.

The conditions anticipated during preparation of this workplan may not be encountered and modifications to the well completion specifications may be appropriate. For example, if an aquitard or non-water bearing soil horizon is encountered at a depth of 2.5 feet below the water table, then drilling should stop and the well screen should extend to only 2.5 feet below the water table. Such field design modifications preserve the natural integrity of the aquifer system thus reducing concerns about cross-contamination.

Well Development Monitoring wells should be developed in accordance with SOP3A: Well Development (Appendix A). Well development should produce relatively non-turbid formation water, subject to reasonable time limitations. Due to the silty nature of the soils at the property, sufficient water may not be produced by the formation to develop the monitoring well according to the desired criteria.

Well Sampling Monitoring well sampling should be performed as described in SOP4A: Well Purging and Sampling (Appendix A) and Table 7. The first sampling event should be conducted immediately after well development, with subsequent sampling events planned for three quarters. Groundwater sampling should consist of initial purging to draw fresh formation water into the well. If the well does not provide sufficient recharge, the purge step may be abbreviated.

Groundwater samples from the well downgradient of the fuel tanks excavation should be analyzed for TPH-diesel, TPH-gasoline, and benzene, toluene, xylenes, and ethylbenzene. Groundwater samples from the well downgradient of the waste oil tanks excavation should be analyzed for oil & grease, TPH-gasoline, TPH-diesel, and benzene, toluene, xylenes, and ethylbenzene. These analytes were selected based upon their detection in soil and groundwater samples collected by Diablo Tank and Equipment at the facility (Tables 1 and 2).

Investigation-Derived Waste

The work described in this workplan will generate the following wastes:

- Soil stockpiles, soil cuttings, and excess soil samples

- Excavation dewatering effluent, development and purge water, and decontamination wastewater

Excavation dewatering effluent, development and purge water, and decontamination wastewater can be containerized together, and stored on-site.

Soil may be stored in stockpiles pending determination of potential handling strategies (disposal at a landfill, on-site treatment).

Wastes represented by chemical measurements in soil and groundwater where chemicals are not detected may be treated as inert. Limited quantities of inert waters may be discharged to sanitary sewers, subject to sanitary district approval. Inert soils may be disposed of at a local Class III landfill or may be reused as fill material.

Non-inert wastes require specific interpretation with respect to current regulations. These regulations require classification of the waste by the generator; accordingly, it should be the responsibility of Cademartori Trucking to classify and arrange for treatment and/or disposal of these wastes.

Reporting

One report and three updates should be submitted. The initial report should document the additional excavation and verification sampling, installation and monitoring of piezometers, monitoring well construction, soil sampling, well development, and soil and groundwater analytical results from well installation. The initial report should describe variations from the procedures outlined in this workplan.

A quarterly update should be prepared upon receipt of the results of analysis of the quarterly groundwater samples. Each of the quarterly updates should compare the most recent analytic results with results of earlier sampling rounds. The quarterly updates should discuss any changes in chemistry or water level.

QUALITY ASSURANCE/QUALITY CONTROL

Specific quality control procedures are discussed in the standard operating procedures of Appendix A. Quality control samples should consist of the following:

- Laboratory blanks, replicates, and spikes for soil analyses
- Laboratory blanks, replicates, and spikes for groundwater analyses
- Travel blanks for groundwater analyses
- Field replicates and cross-contamination blanks for groundwater (if natural samples detect contamination)

Field-Generated Quality Control Samples A travel blank for analysis by EPA Method 8020 should be submitted for analysis with each groundwater sample. If concentrations of any analytes are detected during one of the quarterly events, a cross-contamination blank and duplicate groundwater sample should be collected on subsequent quarterly sampling rounds. The cross-contamination blank should be collected by passing deionized water through and around the decontaminated sample-contacting equipment. Analytical parameters for the groundwater duplicate and groundwater cross-contamination blank should correspond to the detected compounds

Laboratory-Generated Quality Control Samples The laboratory should report results of laboratory blank, laboratory replicate, and laboratory spike analyses conducted during soil and groundwater analysis. The results of laboratory-generated quality control samples should be provided in addition to the field quality control samples.

Field Meter Quality Control Procedures Meters for measurement of field parameters (pH, specific conductance, and temperature) should be calibrated daily. Calibration standards should generally approximate or span the anticipated range of measurements. Recalibration may be appropriate if unusual measurements are noticed. Calibration data should be documented on the instrument calibration log.

The field organic vapor monitor (used for site safety and to screen soil samples during drilling) should be calibrated using a standard gas prior to the beginning of each field day. Recalibration may be appropriate if unusual measurements are noticed. Calibration data should be documented on the instrument calibration log.

HEALTH AND SAFETY

The Site Safety Plan in Appendix B presents the procedures which should be followed to protect the safety of on-site workers during planned field work at the subject property. Physical and chemical hazards, such as working around heavy equipment and exposure to chemicals, are addressed. Work is planned in a previously investigated area, with existing data suggesting minimal chemical hazards. Nevertheless, the procedures in the Site Safety Plan are intended to comply with the pertinent sections of 29 CFR 1910.120, Hazardous Waste Operations and Emergency Response.

Table 1

Soil Analytical Results from Samples Collected During Tank Removal

Sample Location	Sample Designation	Sample Date	Sample Type	Sample Depth (feet)	Oil & Grease (mg/kg)	TPH As Gasoline (mg/kg)	TPH As Diesel (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Xylenes (mg/kg)	Halogenated Volatile Organic Compounds (mg/kg)	Lead (mg/kg)
Fuel Tanks	3	10 July 1990	Grab		NM	NM	<10	<0.005	<0.005	<0.005	<0.015	NM	NM
Fuel Tanks	4	10 July 1990	Grab		NM	NM	4,800	0.17	<0.1	0.34	1	NM	NM
Oil Tank	5	10 July 1990	Grab		160	20	<10	<0.005	0.01	0.03	0.13	<0.2 to <1	NM
Oil Tank	6	10 July 1990	Grab		730	37	50	<0.005	0.01	0.05	0.15	<0.2 to <1	NM
Fuel Tanks	7	10 July 1990	Grab		NM	<1	NM	0.03	<0.005	<0.005	<0.015	NM	<5
Fuel Tanks	8	10 July 1990	Grab		NM	<1	NM	0.04	<0.005	<0.005	<0.015	NM	<5
Stockpile	9	10 July 1990	Composite		NM	NM	4,500	0.24	0.92	0.38	2	NM	NM
Stockpile	10	10 July 1990	Composite		NM	NM	3,300	<0.1	<0.1	0.17	0.33	NM	NM
Stockpile	11	10 July 1990	Composite		1,200	<1	27	<0.005	<0.005	<0.005	<0.015	<0.2 to <1	NM

General Notes

(a) TPH = Total Petroleum Hydrocarbons

(b) Halogenated Volatile Organic Compounds = compounds analyzed per EPA Method 8010

(c) < Denotes less than detection limit

(d) NM Denotes not analyzed

(e) Samples collected by Diablo Tank and Equipment and analyzed by GTEL Environmental Laboratories

Table 2

Groundwater Analytical Results from Samples Collected During Tank Removal

Sample Location	Sample Designation	Sample Date	Sample Type	Sample Depth (feet)	Oil & Grease (µg/L)	TPH As Gasoline (µg/L)	TPH As Diesel (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-benzene (µg/L)	Xylenes (µg/L)	Halogenated Volatile Organic Compounds (µg/L)
Fuel Tanks	1	10 July 1990	Grab		NM	NM	77,000	<3	<3	<3	<6	NM
Oil Tank	2	10 July 1990	Grab		4,000	3,200	200	240	14	2	10	<0.2 to <1

General Notes

(a) TPH = Total Petroleum Hydrocarbons

(b) Halogenated Volatile Organic Compounds = compounds analyzed per EPA Method 601

(c) < Denotes less than detection limit

(d) NM Denotes not analyzed

(e) Samples collected by Diablo Tank and Equipment and analyzed by GTEL Environmental Laboratories

Table 3

Soil Sampling and Testing Requirements During Verification Sampling

Item	Requirement
Sampling Interval and Sample Type	Collect grab samples in liners at 20 foot centers along perimeter of enlarged excavation. Sample from visibly uncontaminated soil. Collect samples from representative soil types if different soil types are present.
Sampler	2 inch diameter by 3-to 6-inch long liner.
Sampling Procedure	Expose fresh soil face in sidewall of excavation and drive liner into freshly-exposed soil. Remove liner by excavating with hand-trowel.
Sampler Decontamination	Wash with soap, rinse with tap water, rinse with distilled water.
Field Observations and Measurements	Screen samples with field organic vapor monitor. Visually classify samples according to ASTM D 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Measure sample depth and horizontal sample location. Complete field sketch of soil sample location.
Samples Retained for Chemical Testing-Fuel Tanks Excavation	Analyze for Total Petroleum Hydrocarbons as Diesel (EPA Method 3510) and BTXE (EPA Method 8020).
Samples Retained for Chemical Testing-Waste Oil Tank Excavation	Analyze for Oil and Grease (EPA Method 413.1), Total Petroleum Hydrocarbons as Diesel (EPA Method 3510), Total Petroleum Hydrocarbons as Gasoline (extraction by EPA Method 5030 with analysis by GCFID), and BTXE (EPA Method 8020). Conduct selective testing program - all analyses need not be performed on all samples.
Sample Handling for Chemical Testing	Cap liner with Teflon sheet, plastic cap, and duct tape (do not use electrical tape). Label liner, place in ziplock bag, and store on ice in cooler until delivery to the laboratory. Log chemical samples on chain-of-custody form and maintain sample security.
Quality Control Samples for Chemical Testing	None

Table 4

Piezometer Installation Requirements

Item	Requirement
Riser Type	Steel rod with flush-threaded couplings
Riser Diameter	Approximate ±1/2-inch ID,
Riser Length	Approximately 5 feet
Drive Point	Galvanized, ±1-inch ID
Screen Length	2 feet
Slots	0.01-inch, wire wrapped or factory-slotted
Riser and Screen Decontamination	Steam clean, pressure wash, or soap wash and tap water rinse prior to installation
Grout Seal	Neat cement from approximately 18 inches to surface
Closure	Threaded top plug (not locking)

Table 5
Soil Sampling and Testing Requirements During Drilling

Item	Requirement
Sampling Interval and Sample Type	Collect split-spoon samples continuously from surface to total depth. Collect samples in liners at maximum 5-foot intervals or detectable changes in strata, whichever is more frequent. Collect additional samples in liners for potential chemical testing if elevated organic vapor readings are observed. Remaining samples may be collected without liners for classification purposes.
Sampler	Split-spoon sampler, 1.4-inch ID without liners, 2-inch ID with liners.
Liners	2-inch diameter by 3- or 6-inch length, brass or stainless.
Sampler and Liner Decontamination	Pressure wash or steam clean split-spoon between samples and borings. For liners, wash with soap, rinse with tap water, rinse with distilled water.
Field Observations and Measurements	Screen samples with field organic vapor monitor. Visually classify samples according to ASTM D 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Measure penetration resistance (blows/foot) during driving of split-spoon.
Hollow-Stem Auger	Approximate 4-inch inside diameter (approximate 8-inch flight diameter)
Samples Retained for Physical Testing	Archive one sample (liner) from the formation material encountered within the screened interval. Analyze this sample for grain size distribution (ASTM D 422) if groundwater sampling discloses contamination and additional wells are needed.
Sample Handling for Physical Testing	Cap liner with plastic end caps, label, and store at room temperature.
Samples Retained for Chemical Testing	Retain samples for chemical testing at maximum 5-foot intervals or detectable changes in strata. If field observations do not indicate contamination, analyze 1 sample from beneath the groundwater table per boring for Total Petroleum Hydrocarbons as Diesel (EPA Method 3510) and Gasoline (extraction by EPA Method 5030 with analysis by GCFID), Oil & Grease (SM 503) and BTXE (EPA Method 8020). If compounds are below detection limits, archive remaining samples for possible future analysis pending results of groundwater sampling and testing. If contamination is observed, make selective determination of need for additional soil analyses.
Sample Handling for Chemical Testing	Cap liner with Teflon sheet, plastic cap, and duct tape (do not use electrical tape). Label liner, place in ziplock bag, and store on ice in cooler until delivery to the laboratory. Log chemical samples on chain-of-custody form and maintain sample security.
Quality Control Samples for Chemical Testing	None

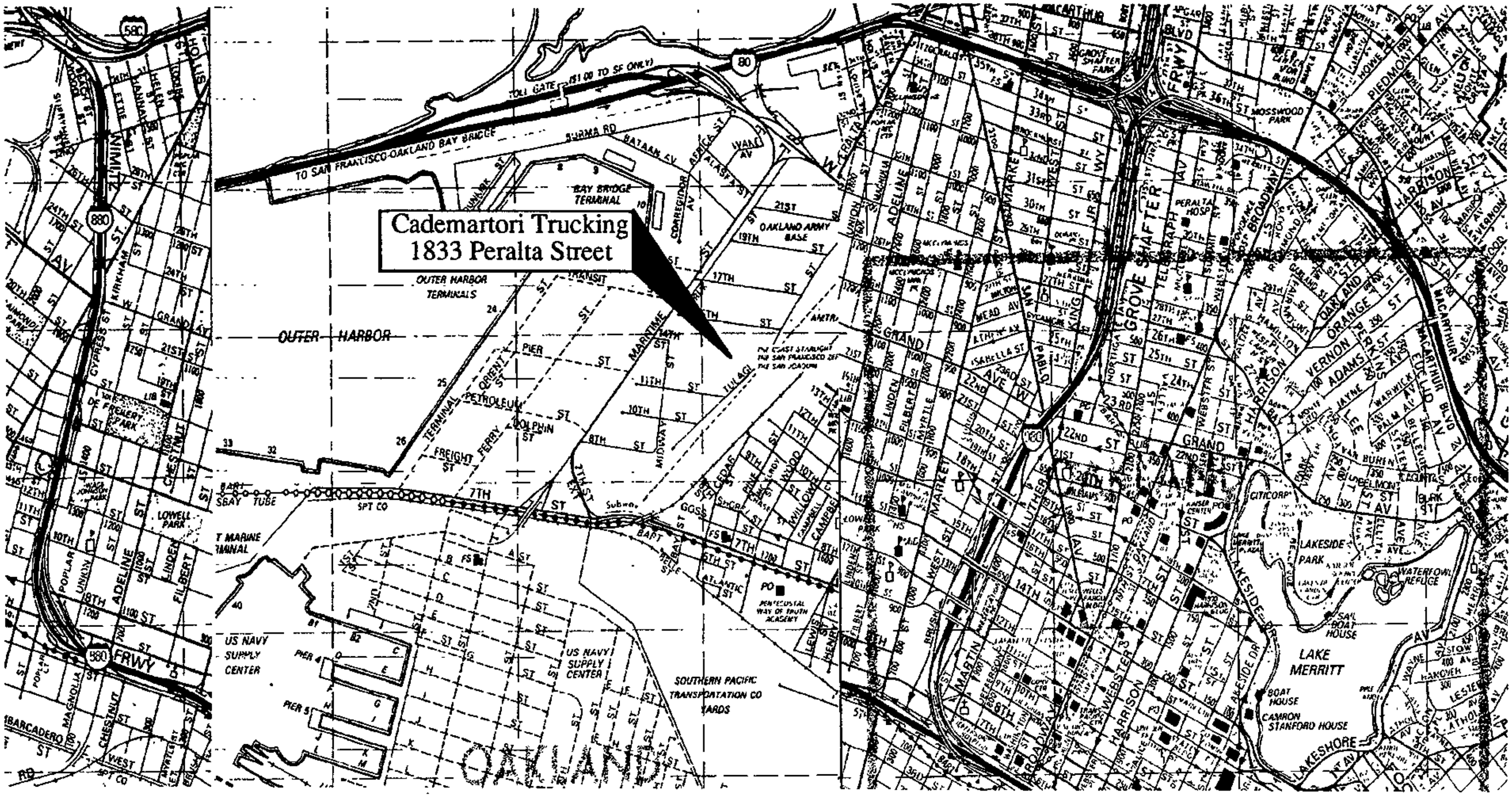
Table 6
Well Completion Specifications

Item	Requirement
Casing Type	Schedule 40 PVC, flush-threaded couplings
Casing Diameter	Nominal 2-inch Inside Diameter
Total Depth	±11 feet
Centralizers	None
Bottom Cap	Threaded or Slip-on (use stainless steel screws for slip-on cap, do not use glue)
Sediment Trap	None
Screen Length	7.5 feet
Slots	0.010-inch, factory-slotted
Casing and Screen Decontamination	Steam clean or pressure wash prior to installation
Filter Pack	#2/12 or similar clean silica sand
Filter Pack Interval	6 inches below bottom cap to approximately 1.5 feet above top of screened interval
Bentonite Seal	Natural bentonite, minimum 1-foot layer above filter pack
Grout	Cement-bentonite (approximately 5% bentonite)
Surface Completion	8-inch diameter flush-mounted traffic-rated box with locking top cap

Table 7

Groundwater Sampling and Testing Requirements

Item	Requirement
Sampling Frequency	Quarterly for 1 year (4 events, 1 every 3 months)
Purge Equipment	Submersible pump or bailer
Purge Equipment Decontamination	Pressure wash or steam clean, wash with soap, rinse with tap water, rinse with distilled water
Field Measurements and Observations	Water level prior to purge, turbidity (qualitative clarity and color), pH, temperature, specific conductivity, purge volume
Sampler	Teflon bailer with bottom-emptying device
Sampler Decontamination	Pressure wash or steam clean, wash with soap, rinse with tap water, rinse with distilled water
Natural Sample Collection	Lower bailer to midpoint of standing water column to collect sample, discharge sample from bottom of bailer to bottom of sample containers without aeration
Sample Containers	One 1-liter amber glass bottle for Oil & Grease, One 100-milliliter glass bottle for Total Petroleum Hydrocarbons as Diesel, and three 40-milliliter glass vials each for BTXE and Total Petroleum Hydrocarbons as Gasoline
Analyses for Well Downgradient of Fuel Tanks Excavation	Total Petroleum Hydrocarbons and Diesel, Total Petroleum Hydrocarbons as Gasoline, Benzene, Toluene, Xylenes, and Ethylbenzene
Analyses for Well Downgradient of Waste Oil Tank Excavation	Oil & Grease, Total Petroleum Hydrocarbons and Diesel, Total Petroleum Hydrocarbons as Gasoline, Benzene, Toluene, Xylenes, and Ethylbenzene
Sample Handling and Preservation	Verify no headspace, acidify BTXE with HCl to pH<2. Label containers, place in ziplock bags, store on ice in cooler, enter onto chain-of-custody, maintain sample custody until sent to laboratory.
Quality Control Samples	One travel blank per sampling event for BTXE. Collect cross-contamination blanks and duplicates during subsequent sampling events if detectable concentrations of analytes are measured in natural samples.



0 3,000

Approximate Scale in Feet

N

Figure 1

Facility Location

Cademartori Trucking
Oakland CA

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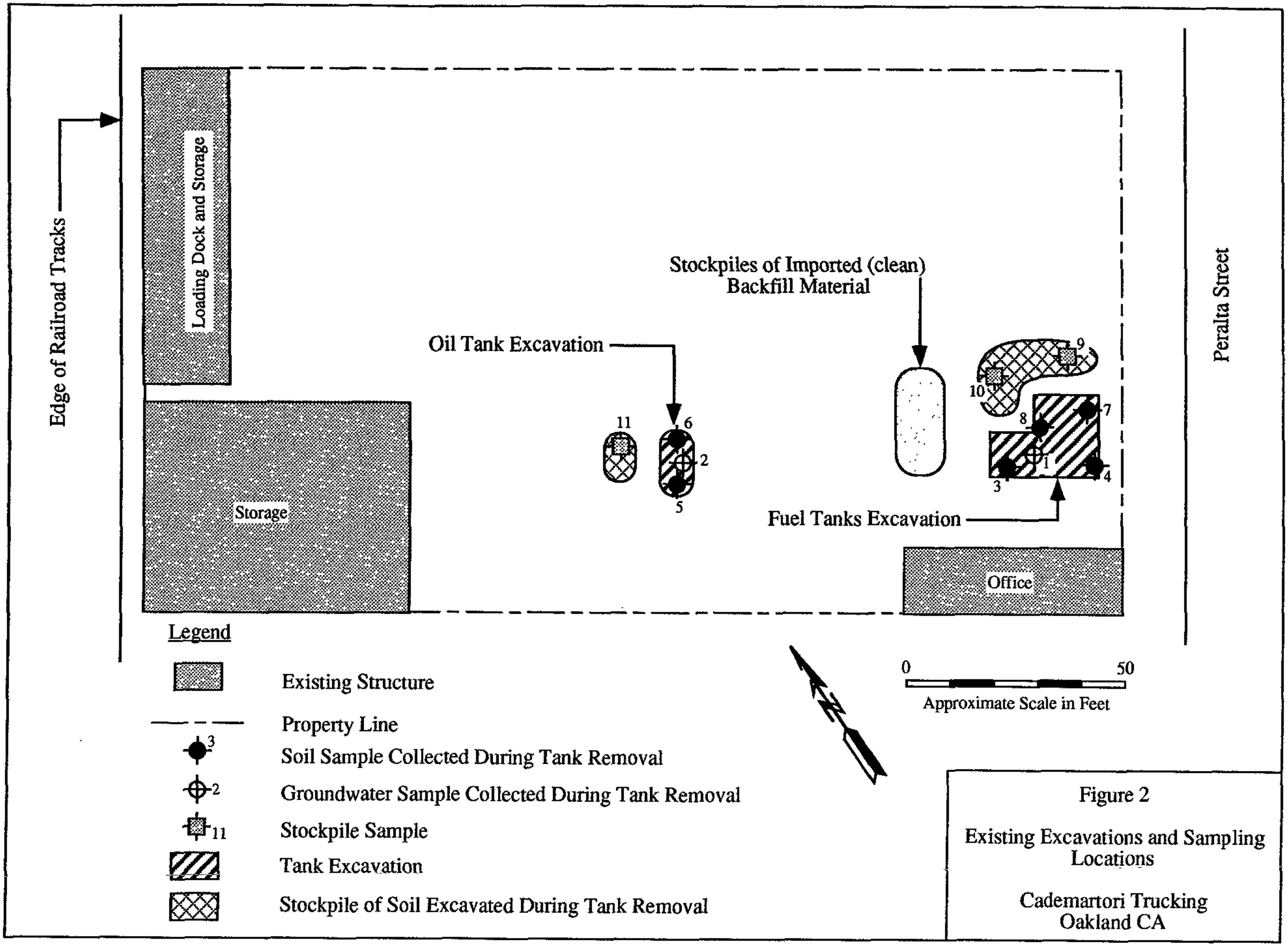

Figure 2

Existing Excavations and Sampling Locations

Cademartori Trucking
Oakland CA

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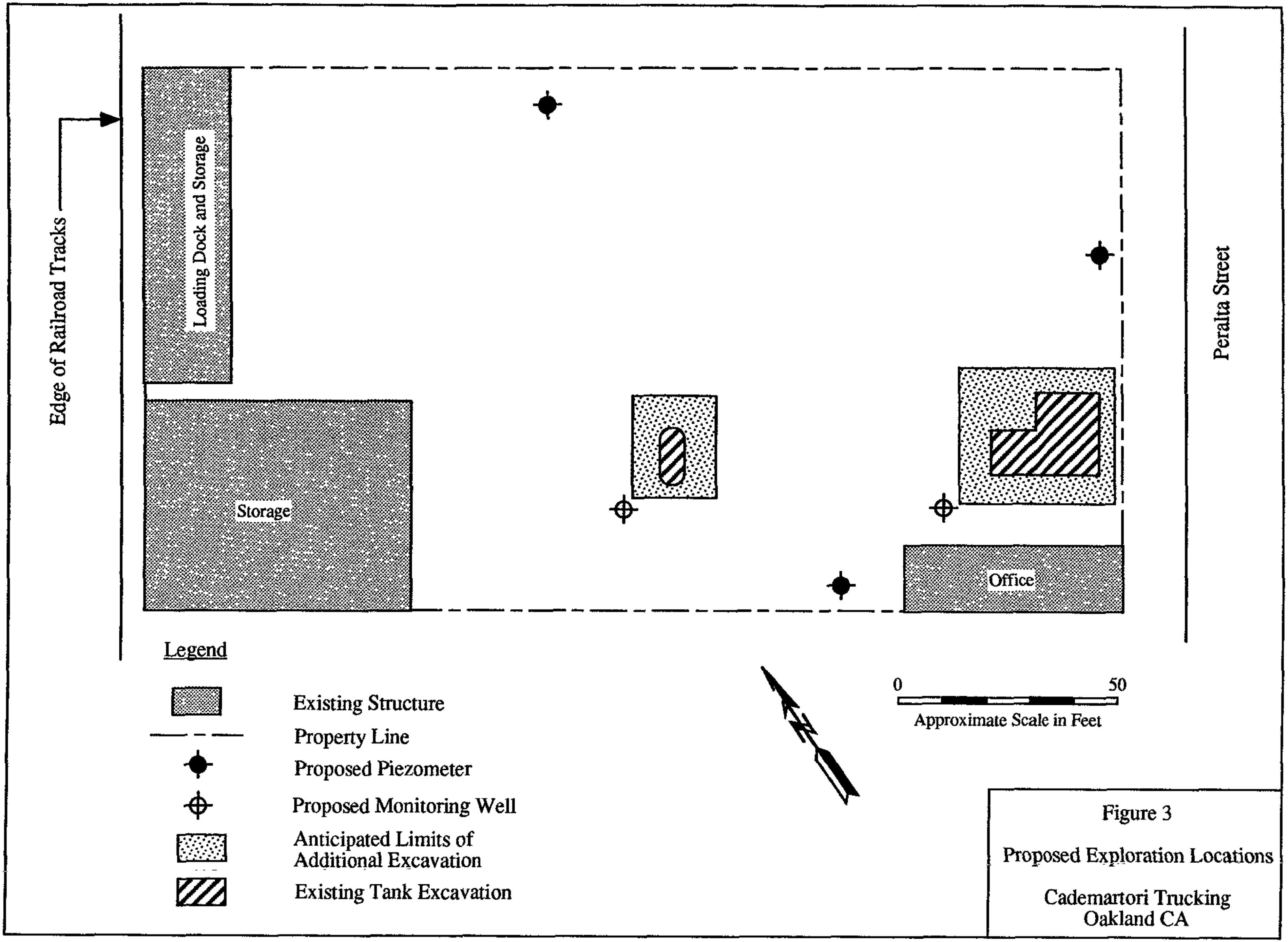

Figure 3

Proposed Exploration Locations

Cademartori Trucking
Oakland CA

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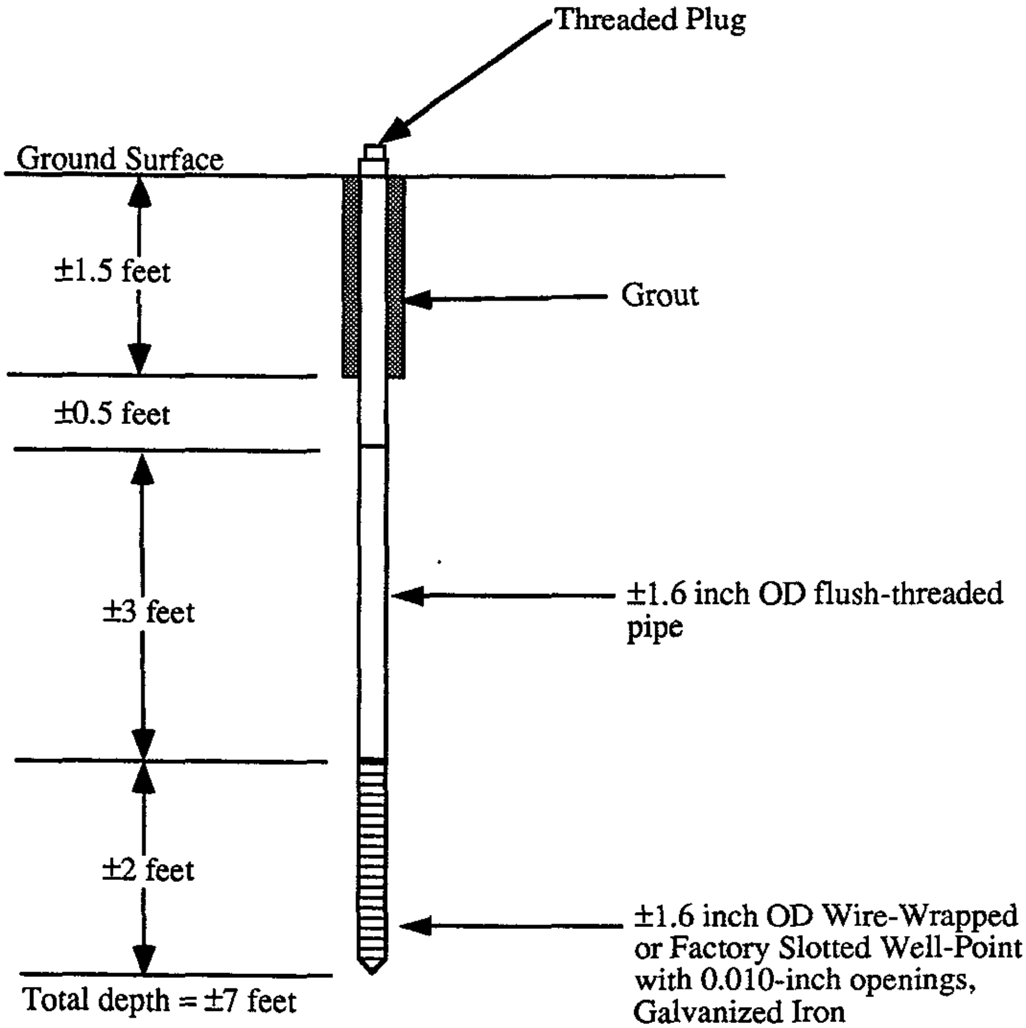

Figure 4

Drive-Point Piezometer Schematic

Cademartori Trucking
Oakland CA

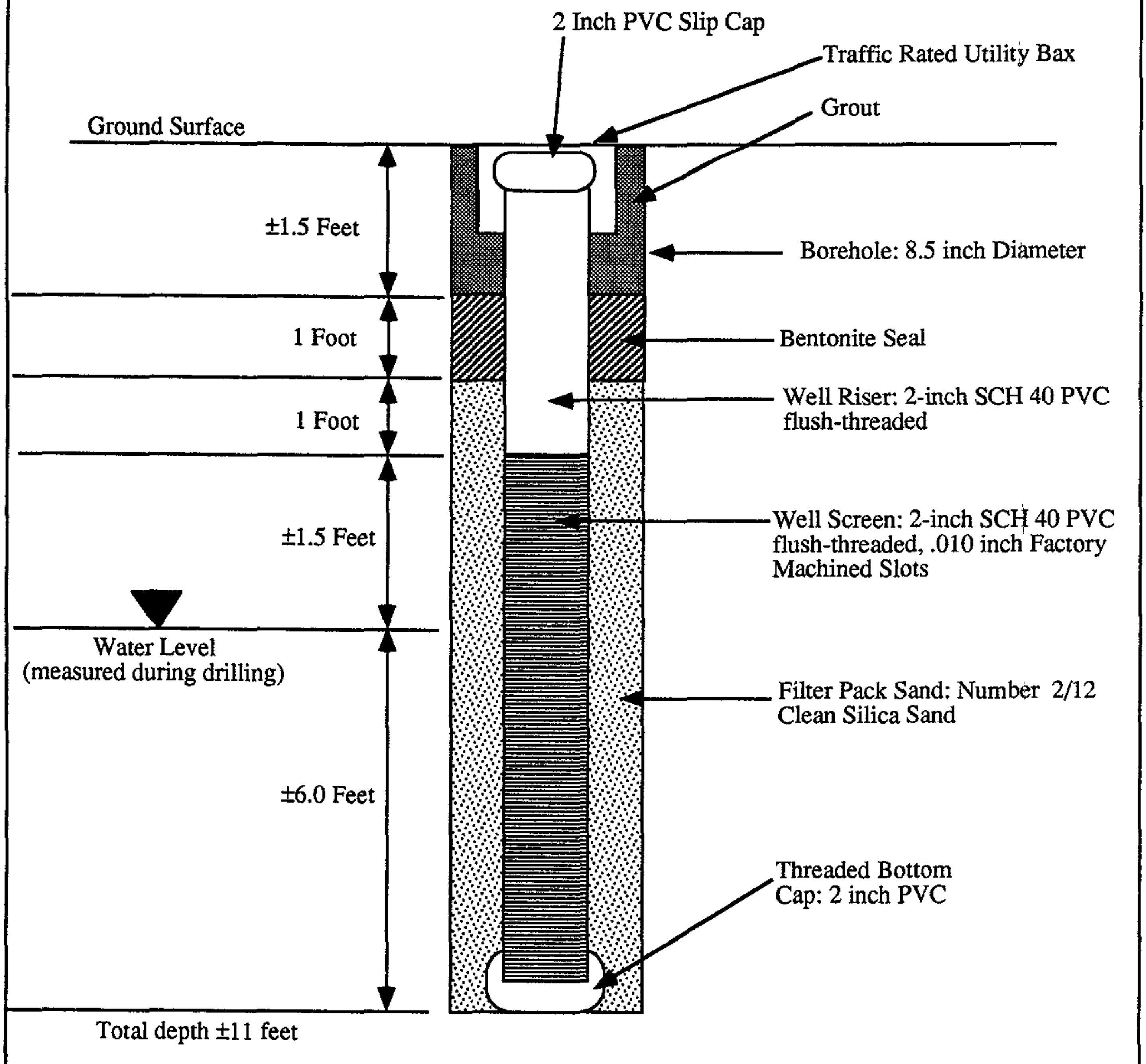

Figure 5

Montoring Well Schematic

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Appendix A

Standard Operating Procedures

STANDARD OPERATING PROCEDURE (SOP) 1A
HOLLOW-STEM AUGER DRILLING AND SPLIT-SPOON SOIL SAMPLING

1.0 INTRODUCTION AND SUMMARY

This SOP describes methods for drilling with the use of hollow-stem augers and soil sampling with the use of split-spoon samplers. Drilling activities covered by this SOP may be conducted to obtain soil samples or to create a borehole within which a well may be constructed. Soil samples may be obtained to log subsurface materials, to collect samples for chemical characterization, or to collect samples for physical parameter characterization.

The soil sampling techniques described in this SOP are generally suitable for chemical characterization and physical classification tests; because a driven split-spoon sampler is employed, the resulting soil samples should generally be considered "disturbed" with respect to physical structure and may not be suitable for measuring sensitive physical parameters, such as strength and compressibility. The augering techniques described in this SOP generally produce a borehole with a diameter corresponding to the outside diameter of the auger flights, a relatively small annulus of remoulded soil surrounding the outside diameter of the auger flights, and limited capability for cross-contamination between subsurface strata as the leading flights of the augers pass from contaminated strata to uncontaminated underlying strata. However, should conditions require strict measures to help prevent cross-contamination or maintain the integrity of an aquitard, consideration should be given to augmenting the procedures of this SOP, for example, by using pre-drilled and grouted isolation casing.

The procedures for hollow-stem auger drilling and split-spoon soil sampling generally consist of initial decontamination, advancement of the augers, driving and recovery of the split-spoon sampler, logging and packaging of the soil samples, decontamination of the split-spoon, and continued augering and sampling until the total depth of the borehole is reached. Withdrawal of the augers upon reaching the total depth requires completion of the borehole by grouting, by constructing a well, or other measures; borehole completion is not covered in this SOP.

2.0 EQUIPMENT AND MATERIALS

- Drill rig, drill rods, hollow-stem augers, and drive-weight assembly (for driving the split-spoon sampler) should conform to ASTM D 1586 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils, except: (1) hollow-stem augers may exceed 6.5 inches inside diameter as may be necessary for installing 4-inch diameter well casing, (2) hollow-stem augers should have a center bit assembly (end plug), (3) alternative drive-weight assemblies or downhole hammers are acceptable as long as the type, weight, and equivalent free fall are noted on the boring log.
- Split-spoon sampler should conform to ASTM D 1586 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils, except: (1) split-spoon should be fitted with liners for collection of chemical characterization sample, and (2) allowable split-spoon diameters include nominal 1-1/2-inch inside diameter by nominal 2-inch outside diameter (Standard Penetration Test split-spoon), nominal 2-inch inside diameter by nominal 2-1/2-inch outside diameter (California Modified split-spoon),

or nominal 2-1/2-inch inside diameter by nominal 3-inch outside diameter (Dames & Moore split-spoon). The split-spoon type and length of the split-barrel portion of the sampler should be noted on the boring log, as should the use of a sample catcher if employed.

- Liners should be 3- to 6-inch length, fitted with plastic end-caps, brass or stainless steel, with a nominal diameter corresponding to that of the inside diameter of the split-spoon sampler. The boring log should note whether brass or stainless steel liners were used.
- Teflon sheets, approximate 6-mil thickness, precut to a diameter or width of the liner diameter plus approximately 1 inch
- 1/2-pint widemouth glass jars, laboratory cleaned
- Kimwipes, certified clean silica sand, or deionized water (for blank sample preparation)
- Duct tape
- Sample labels, boring log forms, chain-of-custody forms, hazardous waste labels, and daily report forms
- Ziploc plastic bags of size to accommodate a liner
- Stainless steel spatula and knife
- Cooler with ice or dry ice (do not use blue ice)
- Field organic vapor monitor. The make, model, and calibration information of the field organic vapor monitor (including compound and concentration of calibration gas) should be noted on the boring log.
- Aluminum foil, and rubber bands
- Pressure washer or steam cleaner
- Large trough (such as a water tank for cattle), plastic-lined pit, or equivalent for decontamination of hollow-stem augers, drill rod, and end plug
- Buckets and bristle brushes for decontamination of liners, split-spoon sampler, and other small gear
- Low residue, organic free soap such as Liqui-nox or Alconox
- Distilled water
- Steel, 55-gallon, open-top drums conforming to the requirements of DOT 17H

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

3.0 TYPICAL PROCEDURES

The following typical procedures are intended to cover the majority of drilling and sampling conditions. However, normal field practice requires re-evaluation of these procedures and implementation of alternate procedures upon encountering unusual or unexpected subsurface conditions. Deviations from the following typical procedures may be expected and should be noted on the boring log.

1 Decontaminate drill rig, drill rods, hollow-stem augers, split-spoon sampler and other drilling equipment immediately prior to mobilization to the site.

2 Investigate the location of the proposed boreholes for buried utilities and obstructions. At least 48 hours before drilling, contact known or suspected utility services individually or through collective services such as "USA" and "Underground Alert". As appropriate, retain private buried utility location services or geophysical investigation services to search for buried utilities and obstructions. Also as appropriate, pothole suspect utility locations prior to drilling or relocate boreholes. During initial advancement of each borehole, drill cautiously and have the driller pay particular attention to the "feel" of the hollow-stem auger. The suspected presence of an obstruction, buried pipeline or cable, utility trench backfill, or similar may be cause for suspension of drilling, subject to further investigation.

3 Advance the hollow-stem auger, fitted with end plug, to the desired sampling depth. Note depth interval, augering conditions, and driller's comments on boring log. Samples should be taken at intervals of 5 feet or less in homogeneous strata and at detectable changes of strata.

4 Remove drill rod and end plug from the hollow stem and note presence of water mark on drill rod, if any. If below the groundwater table in clean sand, allow water level in hollow-stem to equilibrate prior to removing end plug and remove plug slowly so as to minimize suction at the base of the plug. Also, monitor top of hollow-stem using field organic vapor monitor, as appropriate.

5 Decontaminate split-spoon, liners, spatulas and knives, and other equipment that may directly contact the chemical characterization sample. Fit split-spoon with liners and attach to drill rod.

6 Lower split-spoon sampler through hollow-stem of auger until sampler is resting on soil. Note discrepancy between elevation of tip of sampler and leading edge of augers, if any. If more than 6-inches of slough exists inside the hollow-stem augers, consider the conditions unsuitable and re-advance the hollow-stem augers and end plug to a new sampling depth.

7 Drive and recover the split-spoon according to the requirements of ASTM D 1586 - Standard Method for Penetration Test and Split-Barrel Sampling of Soils. Record depth interval, hammer blows for each 6-inches, and sample recovery on boring log. Monitor the recovered split-spoon with the field organic vapor monitor, as appropriate.

8 Remove either bottom-most or second-from-bottom liner (or both) from split-spoon for purposes of chemical characterization and physical parameter testing. Observe soil at each end of liner(s) for purposes of completing sample description. Place teflon sheet at each end of liner, cover with plastic caps, and tape plastic caps with duct tape (do not use electrical tape) to further minimize potential loss of moisture or volatile

compounds. Label liner(s) and place in ziploc bag on ice or dry ice inside cooler.

9 Extrude soil from remaining liner(s) and subsample representative 1-inch cube (approximate dimensions). Place subsample in widemouth glass jar, cover jar with aluminum foil and seal foil to jar with rubber band. Allow jar to equilibrate at ambient conditions for approximately 5 minutes and screen for organic vapors by inserting the probe of the field organic vapor monitor through the aluminum foil. Record depth interval, observed sample reading, and ambient (background) reading on the boring log. Glass jars may be reused by discarding the soil subsample and wiping any residue from the jar using a paper towel.

10 Visually classify soil sample in approximate accordance with ASTM D 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Descriptions should include moisture content, color, textural information, group symbol, group name, and odor. Optional descriptions, especially if classification is performed with protective gloves, include particle angularity and shape, clast composition, plasticity, dilatancy, dry strength, toughness, and reaction with HCl. Add notes on geologic structure of sample, as appropriate. Record depth interval, visual classification, and other notes to the boring log.

11 Repeat steps 3 through 10 until total depth of borehole is reached.

12 Complete borehole according to the requirements specified elsewhere.

13 Decontaminate hollow-stem augers, drill rod, and end plug between boreholes and after finishing last borehole prior to drill rig leaving site.

14 Change decontamination solutions and clean decontamination trough, buckets, and brushes between boreholes.

15 Containerize soil cuttings, excess soil sample, and decontamination wastewaters in steel drums. Affix hazardous waste labels to the drums.

16 Complete pertinent portion of the chain-of-custody form and daily activity report.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality control sampling consists of sequential replicates, collected at an approximate frequency of 1 sequential replicate for every 10 natural samples. Sequential replicates are collected by packaging two adjacent liners of soil from a selected split-spoon drive. Each sample is labeled according to normal requirements. The replicate samples obtained in such a manner are suitable for assessing the reproducibility of both chemical and physical parameters. Interpretations of data reproducibility should recognize the potential for significant changes in soil type, even over 6-inch intervals. Accordingly, sequential replicates do not supply the same information as normally encountered duplicate or split samples. Duplicate or split samples are better represented by the laboratory performing replicate analyses on adjacent subsamples of soil from the same liner.

Optional quality control samples may be collected to check for cross-contamination using field blanks. Field blanks may be prepared by (1) swipe sampling decontaminated liners and split-spoon with kimwipes, (2) pouring clean silica sand into a decontaminated split-spoon sampler that has been fitted with liners, or (3) pouring deionized water over the decontaminated liners and split-spoon and collecting the water that contacts the sampling implements for aqueous analysis. Field blanks may be prepared at the discretion of the field staff given reasonable doubt regarding the efficacy of the decontamination procedures.

The comparability of the field visual classification may be checked by conducting laboratory classification tests. Requests for laboratory testing verification of the field classification should be left to the discretion of the field staff.

Field decisions that may also affect the quality of collected data include the frequency of sampling and the thoroughness of documentation. Subject to reasonable limitations of budget and schedule, the completeness, comparability, and representativeness of data obtained using this SOP will be enhanced by decreasing the sampling interval (including collecting continuous samples with depth) and increasing the level of detail for sample classification and description of drilling conditions. More frequent sampling and more detailed documentation may be appropriate in zones of chemical concentration or in areas of critical geology (for example, zones of changing strata or cross-correlation of confining strata).

5.0 DOCUMENTATION

Observations, measurements, and other documentation of the drilling and soil sampling effort should be recorded on the following:

- Daily Report
- Field Notebook
- Boring Log
- Sample Label
- Chain-of-Custody

Documentation should include any deviations from this SOP, notations of unusual or unexpected conditions, and documentation of the containerization and disposition/disposal of investigation-derived waste. Specific instructions for selected forms are provided below.

5.1 Sample Label

- Project name and project number
- Boring or well number
- Sample depth interval (feet below ground surface), record the depth interval using notation similar to "19.2-19.7", generally do not record just one depth "19.2" because of uncertainty regarding the location such depth corresponds to (midpoint, top, etc.)
- Sample date and sample time
- Sampler
- Optional designation of orientation of sample within the subsurface, for example, an arrow with "up" or "top" designated

5.2 Boring Log

- Project name and project number
- Boring number
- Description of boring location, including taped or paced measurements to noticeable topographic features (a location sketch should be considered)
- Date and time drilling started and completed
- Drilling company and name of drilling supervisor, optional names and responsibilities of drillers helpers
- Manufacturer and model number of drill rig
- Inside diameter of the hollow stem and outside diameter of the auger flights of the hollow-stem augers, optional description of type of bit on end plug and leading edge of auger, optional description of the size of drill rod
- Depth at which groundwater was first encountered with the notation "during drilling"
- Method of borehole completion
- Other notations and recordings described previously in 2. EQUIPMENT AND MATERIALS and 3. TYPICAL PROCEDURES

6.0 DECONTAMINATION

Prior to entering the site, the drill rig and appurtenant items (drill rod, hollow-stem augers, end plug, split-spoon sampler, shovels, troughs and buckets, drillers stand, etc.) should be decontaminated by steam cleaning or pressure washing. Between each borehole, appurtenant items that contacted downhole soil (essentially all appurtenant items including drill rod, hollow-stem augers, end plug, split spoon sampler, shovels, troughs and buckets, etc.) should be decontaminated by steam cleaning or pressure washing. Prior to leaving the site, the drill rig and appurtenant items should be decontaminated by steam cleaning and pressure washing. Onsite decontamination should be conducted within the confines of a trough or lined pit to temporarily contain the wastewater. Between each borehole and prior to demobilization, the trough or lined pit should be decontaminated by steam cleaning or pressure washing. If a rack or other support is used to suspend appurtenant items over the trough or lined pit during decontamination, only the rack or other support needs to be decontaminated between boreholes.

Prior to each sample, the split-spoon sampler, liners, sample catcher, spatulas and knives, and other equipment or materials that may directly contact the sample should be decontaminated. Decontamination for these items should consist of a soap wash (Alconox, Liquinox, or other organic free - low residue soap), followed by a tap water rinse, followed by a distilled water rinse. Wastewater from the soap wash should be temporarily contained. Wastewater from the tap water and distilled water rinses may be discharged to the ground surface or a sanitary sewer.

Between each borehole, buckets and brushes should be decontaminated by steam cleaning or pressure washing. Before each borehole, fresh decontamination solutions should be prepared.

7.0 INVESTIGATION-DERIVED WASTE

Wastes resulting from the activities of this SOP may include soil cuttings, excess soil sample, decontamination wastewaters, and miscellaneous waste (paper, plastic, gloves, jars, aluminum foil, etc.) Unless otherwise prohibited by the Site Safety Plan, miscellaneous waste should be double-bagged in plastic garbage bags and disposed of as municipal waste.

Soil cuttings and excess soil sample from each borehole should be placed in individual steel drums with hazardous waste labels affixed. Solids from multiple boreholes may be combined within a single drum if field observations (presence or absence of chemical staining and field organic vapor monitoring) indicate the solids are similarly uncontaminated or similarly contaminated. Given sufficient drums and reasonable doubt, separate drums should be used for each borehole.

Decontamination wastewaters for each borehole should be placed in individual steel drums with hazardous waste labels affixed. Wastewaters from multiple boreholes may be combined, subject to the same limitations as solids.

8.0 SAFETY

Normal and special safety precautions are described in the Site Safety plan. The Site Safety plan should be reviewed periodically during drilling to keep mindful of important safety measures. Physical hazards typically prevail because the drill rig contains exposed rotating and hammering equipment and because drill rod and augers are heavy material with sharp edges.

Chemical hazards are typically discovered upon withdrawal of the end plug or withdrawal of the soil-filled split-spoon sampler from the hollow-stem auger, as well as removal of the soil-filled liners from the split-barrel. Opportune monitoring for volatile chemicals may be conducted at these times. Splash protection and direct contact protection are also essential measures to minimize the potential for chemical exposure.

9.0 REFERENCES

American Society for Testing and Materials, 1989. 1989 Annual Book of ASTM Standards, Section 4 - Construction, Volume 4.08 - Soil and Rock, Building Stones; Geotextiles. ASTM, Philadelphia, PA. 1989.

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, and D.M. Nielsen, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH. 1989.

U.S. Environmental Protection Agency, 1989a. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

U.S. Environmental Protection Agency, 1989b. Soil Sampling Quality Assurance User's Guide - Second Edition. National Technical Information Service, PB 89-189 864/AS, Springfield, VA. 1989.

STANDARD OPERATING PROCEDURE (SOP) 2A

COMPLETION OF BORINGS AS WELLS

1.0 INTRODUCTION AND SUMMARY

This SOP describes methods for installation of a monitoring well within an existing borehole. The well construction techniques discussed in this SOP are generally suitable for construction of wells screened in one groundwater zone which will be used for water quality sampling and/or observations of groundwater elevation (piezometers). Typically, 2- or 4-inch diameter wells, with total depths less than 80 feet will be installed using this SOP. Large diameter or deep wells may require modification of the methods described herein. Discussion of specific well casing and screen material is beyond the scope of this SOP, and well casing and screen material should be selected on a site specific basis. The permitting activities of this SOP apply in California and different permits are needed in other locations.

The procedures for construction of wells generally consist of well permitting, well design, decontamination of well casing and screen, simultaneous assembly and lowering of casing and screen into the borehole, placement of the filter-pack around the screen, installation of a bentonite seal above the filter pack, sealing of the remaining annular space with grout, and surface completion. The procedures described below are intended to conform to practices outlined in Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells (Aller, et al., 1989); A Compendium of Superfund Field Operations Methods (U. S. EPA, 1989); and California Well Standards (Final Draft), (California Department of Water Resources, 1990) .

2.0 EQUIPMENT AND MATERIALS

- Pressure washer or steam cleaner
- Grout mixing equipment
- Tap water
- Hand tools (pipe wrenches, chain wrenches, pipe vise, shovels, rubber mallet, etc.)
- Tape measure long enough to reach the bottom of the boring
- Well casing, screen, and end caps
- Centralizers (if required)
- Buckets and bristle brushes for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- Filter pack material (typically clean sand of specified gradation)
- Bentonite pellets (or powder) for seal above filter pack, unaltered sodium bentonite
- Cement for grout
- Locking hasp
- Protective surface casing
- Well construction log and daily report forms

- Calculator

Site specific conditions may require other specialized equipment, thus great care should be taken to anticipate conditions reasonably expected to occur during well installation.

3.0 TYPICAL PROCEDURES

The following procedures apply to most well installations. However, normal field practice requires re-evaluation and modification of these procedures upon encountering unexpected situations during well construction. Deviations from the following procedures are to be expected and should be documented.

1 Determine local jurisdiction charged with regulation of wells and apply for required local permits. Local jurisdictions may include county, water district, or city. Determine special design considerations (such as minimum length of grout seal) and inspection requirements (such as witnessing the placement of the grout seal). Also file notice of intent to construct well with the California Department of Water Resources using its standardized form.

2 Well design begins with the conception of the specific purpose for the well, and should include consideration of the specific analytes of interest, anticipated subsurface conditions at the intended well location, and the soil conditions encountered during drilling and recorded on the boring log.

Design considerations discussed in this SOP are limited to portions of the well subject to modification by information gathered during drilling. Such information includes depth to groundwater, thickness of water bearing strata, and grain size distribution of the water bearing strata. Conceptual well designs should be modified as required in the field to prevent connection of naturally separate groundwater zones, to allow an adequate surface seal to be installed, and to maximize the chance for detection of the contaminants of concern. Modifications of conceptual designs should be discussed with the project supervisor prior to implementation whenever possible.

3 Prior to installation in the borehole, well casing and screen should be decontaminated and inspected to help minimize cross-contamination which may affect subsequent water quality samples.

Decontamination should comprise steam cleaning, pressure washing, or equivalent, with tap water rinse. If oil or grease contamination is suspect, decontamination should also include a soap wash and tap water rinse. This procedure should be applied to both the outside and the inside of well casing and screen immediately before assembly and well installation.

4 Assembly of the well screen and blank casing is accomplished simultaneously with insertion into the boring. Initially, a bottom plug is attached to the bottom of the screen and the screen is lowered into the boring. The next length of casing (screen or blank depending on the specific well design) is attached and the process is repeated until the well extends from the ground surface to the bottom of the boring. Various types of mechanical clamps are used to prevent dropping of the well screen into the well during assembly. It is useful to leave surplus blank casing extending above grade at this point to facilitate subsequent construction activities.

Measure the length of well screen and blank casing inserted into the boring and record the quantities on the well construction log. The total length of well screen and casing should be confirmed by taping.

5 Install the filter pack by pouring filter pack material into the annulus between the casing and borehole. Unless otherwise delineated in the Workplan, Quality Assurance Project Plan, or Sampling Plan, install filter pack from (1) an elevation approximately 6 inches beneath the elevation of the bottom cap of the well casing to (2) approximately 2 feet above the top of the screened interval.

If augers or drill casing remain in the ground during well construction, the annulus between the well material and the casing may be used as a tremie If the well is constructed in an open borehole, then the filter pack should be placed using a tremie pipe. The filter pack should be poured slowly into the borehole and the depth to the top of the filter pack should be "tagged" periodically with a tape. Adequate time should be allowed for the sand to settle through standing water prior to tagging or the tape may be lost by burial. Tagging is time consuming, however it provides reasonable checks of filter pack bridging during installation.

If augers or other temporary casing are being used as a tremie, they should be withdrawn as the filter pack is placed. During placement, the elevation of the tip of the augers/temporary casing should be kept slightly above the top of the filter pack. Minimizing the separation between the top of the filter pack and tip of the augers/temporary casing during filter pack placement will help prevent inclusions of formation material or slough within the filter pack. However, if the tip of the augers/temporary casing is not kept above the top of the filter pack and the filter pack is allowed to settle within the augers/temporary casing, a filter pack bridge may occur and the well casing may become "locked" inside the augers/temporary casing.

The quantity of filter pack material required to fill the annulus should be calculated. The quantity of filter pack material actually installed in the well should be measured and compared to the calculated quantity. Both quantities should be recorded on the well construction log.

6 The bentonite seal is installed by pouring bentonite pellets or slurried bentonite powder onto the top of the filter pack. Unless otherwise delineated in the Workplan, Quality Assurance Project Plan, or Sampling Plan, the bentonite seal should extend approximately two feet above the top of the filter pack. The quantity and type of bentonite used should be recorded on the well construction log. The top of the bentonite seal should be measured by taping. If bentonite pellets are used and the seal exists above the groundwater table, water should be poured on top of the pellets after their installation and the pellets should be allowed to hydrate for approximately 10 minutes before proceeding with installation of the overlying grout seal.

7 The grout seal should be tremied into the well to prevent inclusions of formation material or slough in the annular seal. Unless otherwise delineated in the Workplan, Quality Assurance Project Plan, or Sampling Plan, grout seal may consist of (1) neat cement grout, using 1 sack (94 pounds dry weight) of Type I/II Portland cement to 5 gallons of water, or (2) cement-bentonite grout using the same basic formula but substituting approximately 5% powdered bentonite for part of the cement. Local

requirements may require inspection of grout seal placement by the regulating authority.

If augers or temporary casing remain in the borehole during grouting, the level of the grout should be kept above the tip of the augers or casing to help prevent inclusions of formation material in the grout seal.

The volume of the grout actually used should be recorded on the well construction log and compared to the calculated annular volume of the sealed interval. Any discrepancies should be noted on the well construction log.

8 Complete the surface of the well by installing a protective surface casing and locking mechanism around the top of the well casing. Unless otherwise delineated in the Workplan, Quality Assurance Project Plan, or Sampling Plan, the protective casing should be anchored approximately 3 feet into the grout annulus.

9 The completed well should be protected from disturbance while bentonite seal hydrates and grout cures. Further well activities, such as development or sampling, should be withheld for a period of 3 to 7 days to allow these materials to obtain an initial set.

10 Complete and file form DWR 188 plus reports or forms required by local agencies.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance checks for well completion include comparison of theoretical versus actual volumes of filter pack, bentonite seal, and grout seal. Discrepancies that indicate actual "take" was less than theoretical may indicate inclusions of formation material or slough within the annulus. Specific attention to such discrepancies is necessary if the bentonite seal and grout seal are needed to separate contaminated from uncontaminated zones that may be penetrated by the well.

Other quality assurance details include accurate measurement and documentation of the lengths and types of materials used to complete the well.

5.0 DOCUMENTATION

Observations, measurements, and other documentation of the well completion effort should be recorded on the following:

- Daily Report
- Field Notebook
- Well Completion Log
- DWR 188

Documentation should include any deviations from this SOP, as well as documentation of the containerization and disposition/disposal of investigation-derived waste.

6.0 DECONTAMINATION

Materials used for filter pack, bentonite seal, and grout seal should be new at the beginning of each project. Typically, damaged or partially-used containers of material that are brought onsite by drillers or other material suppliers should not be used for well completion. If there is sufficient question regarding contamination of materials, obtain representative samples for later laboratory testing.

Well casing and screen should be decontaminated immediately prior to insertion within the borehole. Casing and screen with oil or grease staining may be rejected or decontaminated by washing with soap, rinsing with tap water, and then steam cleaning, pressure washing or equivalent. New and visually clean casing and screen should be decontaminated by steam cleaning, pressure washing, or equivalent.

If augers or temporary casing are removed during well construction, these materials should be decontaminated by steam cleaning, pressure washing, or equivalent.

7.0 INVESTIGATION-DERIVED WASTE

Wastewater from casing and screen decontamination may be discharged to the ground surface near the well subject to the landowner's permission. Otherwise, these wastewaters may be discharged to the sanitary sewer.

Borehole fluids displaced during well completion, excess grout, and decontamination wastes from the cleaning of augers or temporary casing should be placed in steel drums. The drums should be labeled with a hazardous waste label indicating the generator's name and accumulation date. The drums should also be labeled with a description of contents and well number from which the wastes originated.

8.0 SAFETY

Primary chemical hazards during well completion are associated with dermal exposure to borehole fluids that may be displaced during completion. Primary protection against dermal exposure includes splash protection and gloves.

Other specific site safety guidance is provided in the Site Safety Plan.

9.0 REFERENCES

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, and D.M. Nielsen, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH. 1989.

U.S. Environmental Protection Agency, 1989. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

STANDARD OPERATING PROCEDURE (SOP) 3A
WELL DEVELOPMENT

1.0 INTRODUCTION AND SUMMARY

This SOP describes procedures to develop wells that have been properly installed. Typically, fine soil particles are entrained within the filter pack and adjacent formation during well installation. The well development procedures described herein are intended to help remove the fine soil particles, resulting in enhanced hydraulic response of the well and increased representativeness of water quality samples collected from the well.

Typically, this SOP will be used to develop 2- or 4-inch diameter monitoring wells and occasionally larger diameter monitoring or pumping wells; all screened within a single groundwater zone. The procedures described herein should be modified for domestic wells. The procedures described herein may also need modification if product is observed in the well.

Well development activities generally include decontaminating the downhole equipment, repetitive combinations of surging/swabing and overpumping/bailing, measurement and observation of well yield, turbidity, and field parameters, and containerizing the development wastewater. Development is typically conducted until (1) no further improvement in well response and turbidity is observed, or (2) a reasonable time has been devoted to development.

2.0 EQUIPMENT AND MATERIALS

- Pressure washer or steam cleaner
- Buckets and bristle brushes for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- Tap water
- Steel, 55-gallon, open-top drums conforming to the requirements of DOT 17H
- Field organic vapor monitor. The make, model, and calibration information of the field organic vapor monitor (including compound and concentration of calibration gas) should be documented.
- Glass beaker, ±250 milliliter for measurement of field parameters. A similar flow-through cell may also be used.
- Water level meter
- pH, temperature, and specific conductivity instruments, including pH and specific conductivity standards approximating or spanning the natural groundwater parameters.
- Vented surge block or swab of appropriate diameter for the screened interval of the well casing.
- Bailing and/or overpumping equipment consisting of one or a combination of the following:

  Bailer: Steel or PVC. Dedicated or new bailer rope. Generally as large a diameter as will fit down well.

Surface Centrifugal Pump: Limited to water lift of approximately 20 feet. Dedicated or new flexible plastic suction hose. Foot valve and flow control valve optional.

Air-Lift Pump: Dual-casing assembly with eductor casing (outer casing) to extend at least 2 feet beyond inner casing. Foot valve should be provided at the bottom of the eductor casing to prevent release of aerated water into the well when the air lift pump is turned off. Air from compressor should be dual-filtered to remove oil.

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

3.0 TYPICAL PROCEDURES

The following procedures are intended to cover the majority of well development conditions. However, normal field practice requires re-evaluation of these procedures upon encountering unusual or unexpected conditions such as observation of free product, measuring elevated pH in the development water, or observing dramatic increases in turbidity as development progresses. Deviations from the following procedures may be expected and should be documented.

1. Development should generally be initiated after the well sealing materials (grout) have obtained an initial cure. Typically, development may begin 3 to 7 days after well completion.
2. Remove top cap and perform field organic vapor monitoring of well casing.
3. Measure static water level and total depth of well. Compare total depth to well completion diagram. Calculate volume of standing water in casing.
4. Decontaminate downhole equipment (see section DECONTAMINATION in this SOP).
5. Begin bailing or overpumping using as high an evacuation rate as possible. Record the following at the beginning of development and during each bail/overpump cycle:
   - Volume removed and time
   - pH, temperature, and specific conductance
   - Turbidity (clarity and color)
   - Approximate drawdown and well yield
   - Whether well was bailed/pumped dry
   - Other observations (such as presence of product) as appropriate

   Bail/overpump until at least one casing volume of standing water has been removed. Continue bailing/overpumping if the removed water remains very turbid, indicating removal of fines from the screened interval. Terminate bailing/overpumping upon improvement of clarity.
6. Surge/swab the well to loosen fines from the screened interval. Position vented surge block several feet above the screened interval and surge/swab with upward motion. Lower the surge/swab several feet and repeat, keep surging/swabing progressively lower intervals until the bottom of the screened interval is reached. For each interval, surge/swab for several minutes or as indicated by field experimentation.

7. Repeat items 5 and 6 until evacuated water at the end of the bailing/overpumping cycle is low or non-turbid, field parameters are representative of natural groundwater conditions, and well yield has stabilized at a value representative of the intercepted groundwater zone. Terminate development after a reasonable period of time even if these conditions are not observed. Unless otherwise specified in the Workplan, Quality Assurance Project Plan, or Sampling Plan, 4 hours may typically be taken as a reasonable time effort.
8. Terminate development by bailing or overpumping for an extended period of time to remove fines that have been loosened by the last cycle of surging/swabing. Record final observations.
9. Containerize development water and decontamination wastewater in steel drum(s). Label drum(s) with hazardous waste label, description of contents, and well number from which waste originated.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Meters for measurement of field parameters should be calibrated at least once per day. Calibration standards should generally approximate or span natural groundwater characteristics. Recalibration may be appropriate if unusual measurements are noticed. Calibration activities should be documented on the instrument calibration log.

Quantitative turbidity measurements may be taken with a turbidity meter (both field and laboratory versions are available). If qualitative descriptions of turbidity are used, these terms (very-, moderate-, low-turbidity) may be further defined on the development log. Representative samples may also be collected and returned to the laboratory for measurement with a turbidity meter.

Because well development is typically the first activity of a newly completed well and because the activity is fairly vigorous, the following precautions may be appropriate:

- If product is observed but not anticipated within the groundwater zone intercepted by a well, and the well penetrated a contaminated overlying groundwater zone, well development may be interrupted subject to further consideration or study. Faulty well sealing may result in migration of product from overlying to underlying groundwater zones, which is exacerbated during development.
- If elevated pH is observed but not anticipated, and the well is being developed soon after completion, well development may be interrupted subject to further consideration or study. Elevated pH may originate from grout that has not yet cured, or from grout contamination of the filter pack.
- If turbidity increases dramatically after surging/swabing and does not return to previously observed levels, the cause may be a broken well casing, broken screen, or dislodged end cap, which allows soil to enter the casing unretarded by the filter pack. Probing the well may disclose a break or faulty joint. Consider interrupting well development if this condition is suspected.

5.0 DOCUMENTATION

The well completion schematic should be taken into the field to serve as reference information. Observations, measurements, and other documentation of the development effort should be recorded on the following:

- Daily Report
- Field Notebook
- Instrument Calibration Log
- Well Development Log

Documentation should include any deviations from this SOP, as well as the documentation of the containerization and disposition/disposal of investigation-derived waste.

6.0 DECONTAMINATION

Prior to entering the site, well development equipment should be decontaminated by steam cleaning, pressure washing, or equivalent.

Prior to development of each well, down-well equipment should be decontaminated by steam cleaning or pressure washing, washing with soap, and rinsing with tap water, or equivalent.

Prior to leaving the site, equipment should be steam cleaned, pressure washed, or equivalent.

7.0 INVESTIGATION-DERIVED WASTE

Development water and decontamination wastewater should be containerized in steel drums. Drums should be labeled with hazardous waste labels, including: generator's name and accumulation date. The drums should also be labeled with a description of contents and well number of waste origination. Waste from different wells may be combined in single drums, but chemically-affected and clean wastes should not be mixed.

8.0 SAFETY

Primary chemical hazards during well development are associated with dermal exposure. Primary protection against dermal exposure includes splash protection and gloves. Air-lift pumping may also exacerbate the release of volatile organic compounds from groundwater to air, thus increasing the risk of exposure; frequent monitoring with the field organic vapor monitor may be employed to mitigate this risk.

Other specific site safety guidance is provided in the Site Safety Plan.

9.0 REFERENCES

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, and D.M. Nielsen, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH. 1989.

U.S. Environmental Protection Agency, 1989. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

STANDARD OPERATING PROCEDURE (SOP) 4A
WELL PURGING AND SAMPLING

1.0 INTRODUCTION AND SUMMARY

This SOP describes procedures to purge and sample wells that have been properly installed and developed. Typically, this SOP will be used for sampling monitoring wells with 2- or 4-inch diameter casing. The sampling described herein is appropriate for a variety of groundwater analyses, including: total and dissolved metals, volatile and semi-volatile organic compounds, and general minerals. For newly installed and developed well, the purging and sampling described in this SOP is typically performed at least 7 days after well development to allow ambient groundwater conditions to re-establish in the vicinity of the well.

The procedures described in this SOP should be modified for domestic wells or wells with dedicated sampling equipment. The procedures should also be modified if product is observed in the well.

Typical well sampling and purging activities include decontaminating the purging and sampling equipment, purging the stagnant water from the well casing and filter pack by pumping or bailing, measuring field parameters and evacuated volume of groundwater during purging, terminating the purging process when field parameters stabilize, collecting groundwater samples by pumping or bailing, and labeling and preserving the collected samples.

2.0 EQUIPMENT AND MATERIALS

- Pressure washer or steam cleaner
- Buckets and bristle brushes for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- If sampling is to be performed for metals, dilute (10%) reagent-grade nitric acid for decontamination
- Tap water
- Distilled water
- Deionized water for cross-contamination blanks
- Cooler with ice (do not use blue ice or dry ice)
- Ziplock bags of size to accommodate sample containers
- Steel, 55-gallon, open-top drums, DOT 17H
- Field organic vapor monitor. The make, model, and calibration information of the field organic vapor monitor (including compound and concentration of calibration gas) should be documented.
- Laboratory-cleaned containers of proper type and size for the analytical parameters (refer to Table 1)
- Reagent-grade chemicals for sample preservation, as required for the analytical parameters (refer to Table 1)
- If dissolved metals analyses are required, 45-micron cellulose acetate filters and filtering device. Alternate filter type and size (cellulose nitrate,

Teflon, or glass-fiber pre-filters) may be required as specified in the Quality Assurance Project Plan or Sampling Plan. The make, type, and size of filter, including disposable filters, should be documented.

- Glass beaker, ±250 milliliter for measurement of field parameters. A similar flow-through cell may also be used.
- Water level meter
- pH, temperature, and specific conductivity instruments, including pH and specific conductivity standards approximating or spanning the natural groundwater parameters. As specified in the Quality Assurance Project Plan or Sampling Plan, oxidation-reduction potential (ORP) or dissolved oxygen meters may also be required.
- Purging equipment consisting of one of the following:

  Bailer: Steel, PVC, Teflon, or stainless steel. Dedicated or new bailer rope.

  Bladder Pump: Plastic or Teflon bladder. 4-inch or 6-inch diameter by ±4-foot long decontamination chambers.

  Submersible Electric Pump: Normally used where relatively large quantities of purge water are expected from wells with quick recharge. Pump should have flow control valve and foot valve. 6-inch diameter by ±4-foot long decontamination chambers.

  Surface Centrifugal Pump: Limited to water lift of approximately 20 feet. Dedicated or new flexible plastic suction hose. Foot valve. Flow control valve.
- Sampling device consisting of one of the following:

  Bailer: Teflon or stainless steel. Dedicated or new bailer rope. If samples are collected for volatile organic compound analysis, bailer should also be fitted with bottom-emptying device.

  Bladder Pump: Teflon bladder. Dedicated or new Teflon or Tygon tubing for sample discharge line. 4-inch or 6-inch diameter by ±4-foot long decontamination chambers.

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

3.0 TYPICAL PROCEDURES

The following procedures are intended to cover the majority of purging and sampling conditions. However, normal field practice requires re-evaluation of these procedures and implementation of alternate procedures upon encountering unusual or unexpected conditions. Deviations from the following procedures may be expected and should be documented.

1. Remove top cap and perform field organic vapor monitoring of well casing
2. Measure static water level and total depth and compare to historic measurements. Remeasure if discrepancies are noted with historic data. Document observations of product, if appropriate. Calculate volume of standing water in casing.

3. Decontaminate purging and sampling equipment (see section DECONTAMINATION in this SOP)

4. Begin purging and if possible, adjust purge rate to expose as little of the screened interval as possible (subject to reasonable time constraints). Record the following observations at the beginning of purge, periodically during purge, and during sampling:

   - Purge volume and time
   - pH, temperature, and specific conductivity
   - Turbidity (clarity and color)
   - Approximate drawdown and well yield during purge
   - Whether well was purged dry
   - Other observations (such as presence of product) as appropriate

5. Terminate purging when one of the following conditions is observed:

   Quick Recharge Wells: Well shows stabilized field parameters and at least 3 casing volumes of standing water have been removed - ready for sampling. If field parameters have not stabilized after removal of 5 casing volumes of standing water, terminate purging anyway. Wells should be allowed to recover to at least 1/2 the original standing water depth prior to sampling.

   Slow Recharge Wells: Wells that are initially purged dry, and do not recover to 1/2 the original standing water depth within 4 hours, should be purged dry again and then sampled when sufficient recovery has occurred to submerge the sampling bailer or pump. Generally, 3 feet of recovery may be considered sufficient recovery for normal bailer or pump submergence.

6. If recharge has submerged the entire screened interval, sample from mid-depth of screened interval. Otherwise, sample from mid-depth of water column at time of sampling.

7. If dissolved metals analyses are to be performed, filter sample. Also if dissolved metals analyses are to be performed and the sample is moderately turbid or very turbid, collect companion filtered and unfiltered samples.

8. For parameters other than dissolved metals, do not filter sample. Fill sample containers directly and preserve according to the requirements of Table 1. Containers should generally filled to capacity. 40 milliliter glass vials should be filled from the bottom using a sample discharge tube (bottom-emptying device for bailer or discharge tube of bladder pump). 40 milliliter vials should not have headspace.

9. Label sample containers, place in ziplock bag, and place on ice in cooler.

10. Log samples onto chain-of-custody form and maintain sample custody until shipped to laboratory.

11. Containerize purge water, excess sample, and decontamination wastewater in steel drum(s). Label drum(s) with hazardous waste label, contents, and well number from which waste originated.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality control samples should consist of the following:

- Duplicate samples at a frequency of 1 per 10 natural samples
- Cross-contamination blank (also known as a sampler rinsate blank) at a frequency of 1 per 10 natural samples. Cross-contamination blanks are prepared by passing deionized water over and through decontaminated sampling equipment (including sample filter if used).
- If analyses require collection of samples in 40 milliliter vials, travel blanks should also be included at a frequency of 1 per day of sampling.
- Optional quality control samples include standard reference materials and natural matrix spikes.

Meters for measurement of field parameters should be calibrated at least once per day. Calibration standards should generally approximate or span natural groundwater characteristics. Recalibration may be appropriate if unusual measurements are noticed. Calibration activities should be documented on the instrument calibration log.

5.0 DOCUMENTATION

The following information should be collected prior to sampling and taken into the field for reference:

- Well completion schematic
- Summary of historic water level, total depth, and field parameter measurements

Observations, measurements, and other documentation of the purging and sampling effort should be recorded on the following:

- Daily Report
- Field Notebook
- Instrument Calibration Log
- Well Purge and Sample Log
- Chain-of-Custody

Documentation should include any deviations from this SOP, as well as documentation of the containerization and disposition/disposal of investigation-derived waste.

6.0 DECONTAMINATION

Prior to entering the site, purging and sampling equipment should be decontaminated by steam cleaning, pressure washing, or equivalent.

Prior to sampling each well, down-well equipment and equipment that will contact the sample (except sample containers) should be decontaminated according to the following procedure:

- Steam clean or pressure wash (optional unless oily contamination covers equipment)
- Wash with soap

- Rinse with tap water
- Double rinse with distilled water

If metals are included in the analytical parameters, the decontamination procedures should include:

- Steam clean or pressure wash (optional unless oily contamination covers equipment)
- Wash with soap
- Rinse with tap water
- Rinse with dilute nitric acid (skip for pumps containing metal parts)
- Rinse with tap water
- Double rinse with distilled water

Suction or discharge hoses from purge pumps need external decontamination only. Purge or sampling pumps should be decontaminated by filling the decontamination chamber with the aforementioned solutions and pumping the solutions from the chamber to the waste drum.

Prior to leaving the site, purging and sampling equipment should be steam cleaned, pressure washed, or equivalent.

7.0 INVESTIGATION-DERIVED WASTE

Purge water, excess sample, and decontamination wastewater should be containerized in steel drums. Drums should be labeled with hazardous waste labels, including: Generator's name and accumulation date. Wastes from different wells may be combined, but wastes that are anticipated to contain chemical should not be mixed with waste that are not thought to be contaminated.

8.0 SAFETY

Primary chemical hazards during well purging and sampling are associated with dermal exposure. Acids used for decontamination and sample preservation may also present chemical hazards. Primary protection against dermal exposure includes splash protection and gloves. Special chemical hazards may be associated with the presence of product, if discovered during sampling. Water quality samples are not generally considered representative in the presence of product. Accordingly, it may be appropriate to abandon sampling efforts if product is discovered.

Other specific site safety guidance is provided in the Site Safety Plan.

9.0 REFERENCES

Aller, L., T.W. Bennett, G. Hackett, R.J. Petty, J.H. Lehr, H. Sedoris, and D.M. Nielsen, 1989. Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells. National Water Well Association, Dublin, OH. 1989.

U.S. Environmental Protection Agency, 1989a. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

U.S. Environmental Protection Agency, 1989b. USEPA Method Study #39, Method 504, 1,2-Dibromoethane (EDB) and 1,2-Dibromo-3-Chloropropane (DBCP) in Water, Pb 89-119 580/AS. National Technical Information Service, Springfield VA. 1989.

Table 1

Sampling and Preservation for Groundwater Samples

Parameter	Analytical Method	Container	Preservation	Maximum Holding Time
Purgeable Halocarbons by GC	EPA 8010	Two 40 ml glass vials	HCl to pH<2, cool to 4 degrees Celsius	14 days after collection
Purgeable Aromatics by GC	EPA 8020	Two 40 ml glass vials	HCl to pH<2, cool to 4 degrees Celsius	14 days after collection
Organochlorine Pesticides and PCB's	EPA 8080	Two 1 liter amber glass	Cool to 4 degrees Celsius	Extract 7 days after collection Analyze 40 days after extraction
Organophosphorus Pesticides	EPA 8140	Two 1 liter amber glass	Cool to 4 degrees Celsius	Extract 7 days after collection Analyze 40 days after extraction
Chlorinated Herbicides (Phenoxy Herbicides)	EPA 8150	Two 1 liter amber glass	Cool to 4 degrees Celsius	Extract 7 days after collection Analyze 40 days after extraction
Volatile Organic Compounds by GC/MS	EPA 8240	Two 40 ml glass vials	Cool to 4 degrees Celsius	14 days after collection
Semi-Volatile Organic Compounds by GC/MS (Base/Neutral/Acid Extractable Organics)	EPA 8270	Two 1 liter amber glass	Cool to 4 degrees Celsius	Extract 7 days after collection Analyze 40 days after extraction
Dibromoethane (EDB) and 1,2-Dibromo-3-Chloropropane (DBCP)	EPA 504	Two 1 liter amber glass	Cool to 4 degrees Celsius	Extract 7 days after collection Analyze 40 days after extraction
Total Petroleum Hydrocarbons as Deisel	Extract by EPA 3550 and analyze by GCFID	Two 40-ml glass vials	HCl to pH<2, cool to 4 degrees Celsius	Extract 7 days after collection Analyze 7 days after extraction
Oil & Grease	SM 503	One 1-liter glass with aluminum foil-lined cap	H_2SO_4 to pH<2, cool to 4 degrees Celsius	28 days after collection
Total Metals	EPA 7000 Series	One 1/2 liter poly	HNO3 to pH<2, cool to 4 degrees Celsius	6 months after collection (28 days for mercury)
Dissolved Metals	EPA 7000 Series	One 1/2 liter poly	HNO3 to pH<2, cool to 4 degrees Celsius	6 months after collection (28 days for mercury)
General Minerals	Various	Two 1 liter poly	Cool to 4 degrees Celsius	7 days after collection

STANDARD OPERATING PROCEDURE (SOP) 5A
DRIVE-POINT PIEZOMETERS

1.0 INTRODUCTION AND SUMMARY

This SOP describes the methods for installation of drive-point piezometers. Field activities covered in this SOP may be used to obtain soilgas samples, groundwater samples from shallow depths, and water level data. Drive-point piezometers may be used as an efficient and cost effective alternative to monitoring wells to allow contaminant detection and mapping in shallow aquifers. Drive-point piezometers may also be used as soilgas probes and as groundwater or soil vapor extraction points. Drive points are installed using hand held air-powered equipment, providing for installation in areas of restricted access.

Since the drive points are driven through the soil column, the potential for contamination of underlying strata (by material carried down from above) exists. Thus caution should be employed when applying this tool and interpreting analytical results.

Installation of drive-point piezometers generally consists of initial decontamination of tools and materials, pre-digging of the initial 1 to 2 feet, driving of the piezometer, collection of soilgas samples if appropriate, driving of the piezometer to total depth, and surface completion.

2.0 EQUIPMENT AND MATERIALS

- Air Compressor, 30-pound air hammer, pipe drive adapter, suitable length of air line
- Drive-point (perforated pipe or well point)
- Drive/riser pipe capable of attachment to drive-point, preferability flush threading
- Post hole digger for pilot hole
- Hand tools (pipe wrenches, hand level, adjustable wrench, etc.)
- Ear plugs, work gloves, steel toed boots
- Bristle brushes and buckets for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- Air pump, air tight adapters, flexible tubing, and Tedlar bags for soilgas sampling
- Peristaltic pump and tubing or small-diameter bailer for groundwater sampling
- Tape measure
- Water level sounder
- Cement for surface seal
- Construction log and field notebook

3.0 TYPICAL PROCEDURES

The following procedures are intended to facilitate installation of drive-point piezometers to shallow depths (generally less than 25 feet).

1. Obtain permits from local agency charged with regulation of wells City, County, and State agencies may all have regulations pertaining to installation of drive-point piezometers. Permitting may require negotiation of design features with, and inspection of installation by regulatory personnel.

2. Design the drive-point piezometer Determine soilgas sampling depth and total depth by comparison with on-site or nearby boring logs. Consider site specific soil properties relevant to driving the piezometer, and choose drive-point and drive/riser pipe accordingly. Determine the location of any underground utilities on the site.

3. Decontamination Inspect drive-point and piezometer drive/riser pipe for foreign material (oil, dirt, etc.) which may affect sample quality. All components of the drive-point piezometer should be thoroughly decontaminated prior to driving. Decontamination should consist of steam cleaning or scrubbing in hot water, scrubbing with a detergent solution, a tap water rinse, and a distilled or deionized water rinse. A long handled brush capable of running the entire length of the piezometer drive/riser pipe sections should be used to scrub the interior of the drive/riser pipe.

4. Dig a pilot hole at the desired location The pilot hole should be advanced at least 18 inches. The pilot hole provides a crude guide for the initial driving of the drive-point piezometer, as well as space for the surface seal. The pilot hole also permits evaluation of the presence of shallow utilities at the piezometer location.

5. Begin driving the piezometer Immediately prior to driving and approximately every 3 inches for the first 2 to 3 feet, the drive-point piezometer should be leveled. A hand level capable of measuring plumbness of vertical objects should be placed against the drive-point or riser pipe to assure a straight drive. Inclined piezometers may fail during driving due to uneven application of driving force at joints. Plumbness is checked by frequently placing the level on the sides of the drive-point or drive/riser pipe. Each plumbness check should include at least 2 measurements at 90 degrees to each other around the drive-point or drive/riser pipe.

   Driving is accomplished by attaching the pipe drive adapter to the air hammer, connecting the air hammer to the air supply, placing the pipe drive adapter onto the drive/riser pipe and then activating the air hammer. Care must be taken to maintain an evenly distributed downward force during driving to maintain plumbness. The integrity of the drive-point piezometer should be checked periodically during driving by running a flexible tape down the pipe annulus. This will verify that the drive-point has not collapsed, and provide assurance of the depth to which the point has been advanced.

6. Soilgas Sampling Upon reaching the desired sampling depth a soilgas sample may be collected. Soilgas samples are collected by removing the drive adapter from the riser pipe, attaching air tight adapter fittings including a nipple capable of providing an air tight seal to flexible tubing to the drive/riser pipe, connecting the sampling pump to the nipple with flexible tubing, and connecting the discharge of the sampling pump to a Tedlar bag.

The volume of each cycle of the sampling pump must be known to assure adequate purging of the annular volume of the piezometer. Hand pumps typically meet these requirements. A minimum of one annular volume of vapor should be purged from the piezometer prior to filling the Tedlar bag. This helps assure that the sample is not diluted by ambient air. Prior to filling the Tedlar bag the soilgas should be monitored using a PID to detect the presence of organic vapors. PID monitoring of the soilgas will provide a basis for a collection/no collection decision. After collection of the soilgas sample, driving may be continued or the drive-point may be completed as a soil vapor probe.

7. Document As-Driven Condition Upon reaching the total depth the drive-point piezometer should be measured using a flexible tape to verify the depth. The presence or absence of groundwater and drive-point depth should be recorded on the completion form, and in field notes. If groundwater is detected, the water level should be recorded. Water levels are measured by lowering a water level sounder probe into the piezometer.

8. Surface Seal Fill the annular space around the riser pipe with neat cement. Generally this space coincides with the pilot hole. The seal should be completed flush to existing grade. Care should be taken to assure that cement is mixed thick enough to prevent flow along the riser pipe to the subsurface. Clean sand may be placed in the bottom of the pilot hole after cessation of driving to prevent flow of cement if necessary.

9. Groundwater Sampling Groundwater samples may be obtained by bailing if the inside diameter of the drive-point and riser pipe permit it, or by use of a peristaltic pump and flexible tubing. An attempt should be made to purge 3 piezometer volumes prior to collecting the groundwater sample. However it may be prudent to collect the initial volume removed if a reasonable doubt exists as to whether sufficient flow to purge the piezometer will be obtained.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance checks for drive-point piezometer installation consist of verification and accurate measurement of length of drive-point, lengths of drive/riser pipe, depths to soilgas sampling points, and total depth. Inspection of the drive-point and drive/riser pipe for adequate decontamination provides another quality control check.

5.0 DOCUMENTATION

Observations, measurements, and other documentation of the well completion of the drive-point piezometer installation should be recorded on the following:

- Daily report
- Field Notebook
- Piezometer Completion Log

Documentation should include deviations from this SOP, including descriptions of problems encountered during installation and attempted/implemented remedies.

6.0 DECONTAMINATION

Materials used for construction of drive-point piezometers consist of threaded pipe, drive-point, and possibly pipe couplings. These items are typically contaminated with cutting oil and loose material which may interfere with sample integrity. Therefore great care should be taken to adequately decontaminate components of the drive-point piezometer. Decontamination should include steam cleaning and/or scrubbing in hot soapy water, scrubbing in a detergent solution, a tap water rinse, and a deionized or distilled water rinse.

Care should be taken to inspect and decontaminate sampling apparatus such as tubing, bailers, sounders, and flexible tapes which may be used inside the drive-point piezometer during sample collection.

Air hammers may occasionally discharge oil or grease, great care should be taken to prevent contact of discharged oil or grease with the drive-point or drive/riser pipe during driving. If oil or grease contacts the piezometer components, they should be decontaminated prior to further driving. Attempts to prevent such contact should be made by use of plastic sheeting or other suitable barrier material.

7.0 SAFETY

Primary safety concerns during installation of drive-point piezometers are associated with exposure to noise associated with use of the air hammer, and eye injuries due to fragments generated by pounding metal surfaces. Protection against hearing impairment includes use of ear plugs. Eye protection is afforded by use of safety glasses or a face shield.

STANDARD OPERATING PROCEDURE (SOP) 9A
VERIFICATION SAMPLING FOR UNDERGROUND STORAGE TANK REMOVAL

1.0 INTRODUCTION AND SUMMARY

This SOP describes procedures for verification sampling during the removal of underground storage tanks. The sampling protocols described herein are suitable for collecting soil and groundwater samples for chemical analysis, limited physical testing, and visual classification. These procedures are intended to allow collection of verification samples which will provide the information necessary to evaluate whether a release has occurred and if a leak is suspected, what residual contaminant levels remain after initial excavation of contaminated soil. This SOP also describes the collection of grab groundwater samples from within the tank removal excavation.

2.0 EQUIPMENT AND MATERIALS

- Backhoe or other piece of equipment capable of obtaining a grab soil sample from the base and sidewalls of the excavation (typically the same backhoe as that used to excavate for tank removal)
- Brass or stainless steel liners, 3- to 6-inch length and 2- or 2.5-inch diameter, fitted with plastic endcaps
- Hammer or other tool to drive liners into soil
- Teflon sheets, approximate 6-mil thickness
- 1/2-pint wide-mouth glass jars, 40-ml amber glass vials with teflon septa closures, 1-liter amber glass wide mouthed jars, and 500-ml poly bottles, laboratory cleaned. Laboratory grade HCl and HNO_3 for preservation of groundwater samples.
- Kimwipes, certified clean silica sand, or deionized water (for blank sample preparation)
- Duct tape
- Sample labels, excavation log forms, chain-of-custody forms, hazardous waste labels, and field notebook
- Ziploc plastic bags of size to accommodate sample containers
- Stainless steel spatula and knife
- Cooler with ice
- Field organic vapor monitor. The make, model, and calibration information of the field organic vapor monitor (including compound and concentration of calibration gas) should be noted in the field notes.
- Buckets and bristle brushes for decontamination
- Low residue, organic free soap such as Liquinox or Alconox
- Distilled water

As specified in the Site Safety Plan, additional safety and personnel decontamination equipment and materials may be needed.

3.0 TYPICAL PROCEDURES

These sampling procedures are generally applicable. However local regulations should be researched prior to beginning a specific project, as they may require different procedures than described herein.

1. Obtain grab sample of soil using backhoe bucket Beneath each end of the former tank (fill end only for tank volume <1000 gallons) obtain a backhoe bucket full of soil from a depth of 1 to 3 feet below former tank invert, or backfill-native soil interface, whichever is shallower. If the water table is above the bottom of the excavation, then verification samples should be collected immediately above the water table in the excavation side walls. If staining, elevated organic vapor monitor readings, or other evidence of release are present in the excavation - then additional samples should be collected of the affected soil.
2. Collect soil sample in liner Trim the soil in the backhoe bucket as required to expose fresh unaerated material. Fill a liner by driving it into the soil in the backhoe bucket. Remove the liner (excavate with trowel if necessary) and cap each end with pre-cut teflon sheeting and plastic end cap, seal with Duct tape (do not use electrical tape). Label the liner and place in a zip-lock bag on ice in a cooler. Measure cavity created by liner removal from soil with field organic vapor monitor and record result. Visually describe soil according to ASTM D 2488-Standard Practice for Description and Identification of Soils (Visual-Manual Procedure).
3. Repeat steps 1 and 2 until sampling requirements are met.
4. If excavation of product or vent piping was conducted, collect one soil sample per 20 linear feet of such piping. Because of shallow depth, soil samples from beneath piping may generally be collected by directly driving the liner into freshly exposed soil (without the aid of a backhoe).
5. If excavation to determine the extent of a suspected release was performed, collect one verification sample along every 10 to 20 lineal feet of the excavation perimeter (depending on site characteristics).
6. If groundwater is encountered during tank removal, a sample should be collected. The groundwater sample should be collected using a bailer.
7. Record sampling information on a sampling form and a chain-of-custody form.
8. Measure horizontal and vertical dimensions necessary to reconstruct sampling location. The depths of all samples should be measured and recorded in field notes. The excavation should be located relative to prominent site features such as buildings, intersections, fence lines, and a sketch showing the site features, excavation perimeter, and sample locations should be prepared in the field.

4.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality control samples are not normally collected during soil sampling.

Optional quality control soil samples may include collection of replicates, at an approximate frequency of 1 replicate for every 10 natural samples. Replicates are collected by driving two liners adjacent to each other. Each sample is labeled according to normal requirements. The replicate samples obtained in such a manner are suitable for assessing the reproducibility of both chemical and physical parameters. Interpretation of the reproducibility of data should recognize the potential for significant changes in soil type over even a 6-inch interval. Accordingly, replicates do not supply the same information as normally encountered duplicate or split samples. Duplicate or split samples are better represented by the laboratory performing replicate analyses on adjacent subsamples of soil from the same liner.

Optional quality control samples may be collected to check for cross-contamination using field blanks. Field blanks may be prepared by (1) swipe sampling decontaminated liners and split-spoon with kimwipes, (2) pouring clean silica sand into a decontaminated liner, or (3) pouring deionized water over the decontaminated liner and collecting the water that contacts the sampling implements for aqueous analysis. Field blanks may be prepared at the discretion of the field staff given reasonable doubt regarding the efficacy of the decontamination procedures.

5.0 DOCUMENTATION

Observations, measurements, and other documentation should be recorded on the following:

- Daily Report
- Field Notebook
- Underground Storage Tank Sampling Form
- Sample Label
- Chain-of-Custody

In addition to the standardized entries, notations of unusual or unexpected conditions as well as deviations from this SOP should be recorded.

6.0 DECONTAMINATION

Prior to entering the site,the backhoe and appurtenant items (bucket, tracks, shovels, troughs and buckets, etc.) should be decontaminated by steam cleaning or pressure washing. Between each tank excavation (if more than one), appurtenant items that contacted soil should be decontaminated by steam cleaning or pressure washing. Prior to leaving a site where contamination was encountered, the backhoe and appurtenant items should be decontaminated by steam cleaning or pressure washing. Onsite decontamination should be conducted within the confines of a trough or lined pit to temporarily contain the wastewater.

Prior to sample collection, the liners, end caps, trowel, liner driving equipment, and other equipment or materials that may directly contact the sample should be decontaminated. Decontamination for these items should consist of a soap wash, followed by a tap water rinse, followed by a distilled water rinse.

Between each excavation, buckets and brushes should be decontaminated by steam cleaning or pressure washing. Before each excavation, fresh decontamination solutions should be prepared.

7.0 VERIFICATION SAMPLING-DERIVED WASTE

Wastes resulting from the activities of this SOP may include decontamination wastewaters and miscellaneous waste (paper, plastic, gloves, jars, aluminum foil, etc.) Unless otherwise prohibited by the Site Safety Plan, miscellaneous waste disposed of as municipal waste.

Wastewaters may be discharged to sanitary sewers, subject to sewer district restrictions.

8.0 SAFETY

Normal and special safety precautions are described in the Site Safety plan. Physical hazards typically prevail because the backhoe or excavator contains exposed moving parts constructed of heavy material with sharp edges.

Chemical hazards are typically discovered upon removal of the tank from the excavation. Opportune monitoring for volatile chemicals may be conducted at this time.

9.0 REFERENCES

American Society for Testing and Materials, 1989. 1989 Annual Book of ASTM Standards, Section 4 - Construction, Volume 4.08 - Soil and Rock, Building Stones; Geotextiles. ASTM, Philadelphia, PA. 1989.

Regional Board Staff Recommendations for Initial Evaluation and Investigation of Underground Tanks, Tri-Regional Recommendations, 2 June 1988 and 1 July 1988 (revised 3 April 1989)

U.S. Environmental Protection Agency, 1989a. A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, OSWER Directive 9355.0-14. USEPA, Office of Emergency and Remedial Response, Washington, DC. December 1989.

U.S. Environmental Protection Agency, 1989b. Soil Sampling Quality Assurance User's Guide - Second Edition. National Technical Information Service, PB 89-189 864/AS, Springfield, VA. 1989.

REVISED 10 AUGUST 1990

RECOMMENDED MINIMUM VERIFICATION ANALYSES FOR UNDERGROUND TANK LEAKS

HYDROCARBON LEAK	SOIL ANALYSIS		WATER ANALYSIS	
Unknown Fuel	TPH G	GCFID(5030)	TPH G	GCFID(5030)
	TPH D	GCFID(3550)	TPH D	GCFID(3510)
	BTX&E	8020 or 8240	BTX&E	602, 624 or 8260
	or TPH AND BTX&E by 8260 CRYOGENIC FOCUSING			
Leaded Gas	TPH G	GCFID(5030)	TPH G	GCFID(5030)
	BTX&E	8020 or 8240	BTX&E	602, 624 or 8260
	or TPH AND BTX&E by 8260 CRYOGENIC FOCUSING			
	TOTAL LEAD	AA	TOTAL LEAD	AA
	---Optional---			
	TEL	DHS-LUFT	TEL	DHS-LUFT
	EDB	DHS-AB1803	EDB	DHS-AB1803
Unleaded Gas	TPH G	GCFID(5030)	TPH G	GCFID(5030)
	BTX&E	8020 or 8240	BTX&E	602, 624 or 8260
	or TPH AND BTX&E by 8260 CRYOGENIC FOCUSING			
Diesel	TPH D	GCFID(3550)	TPH D	GCFID(3510)
	BTX&E	8020 or 8240	BTX&E	602, 624 or 8260
	or TPH AND BTX&E by 8260 CRYOGENIC FOCUSING			
Jet Fuel	TPH D	GCFID(3550)	TPH D	GCFID(3510)
	BTX&E	8020 or 8240	BTX&E	602, 624 or 8260
	or TPH AND BTX&E by 8260 CRYOGENIC FOCUSING			
Kerosene	TPH D	GCFID(3550)	TPH D	GCFID(3510)
	BTX&E	8020 or 8240	BTX&E	602, 624 or 8260
	or TPH AND BTX&E by 8260 CRYOGENIC FOCUSING			
Fuel/Heating Oil	TPH D	GCFID(3550)	TPH D	GCFID(3510)
	BTX&E	8020 or 8240	BTX&E	602, 624 or 8260
	or TPH AND BTX&E by 8260 CRYOGENIC FOCUSING			
Chlorinated Solvents	CL HC	8010 or 8240	CL HC	601 or 624
	BTX&E	8020 or 8240	BTX&E	602 or 624
	or CL HC AND BTX&E 8260		or CL HC AND BTX&E 8260	
Non Chlorinated Solvents	TPH D	GCFID(3550)	TPH D	GCFID(3510)
	BTX&E	8020 or 8240	BTX&E	602 or 624
	or TPH AND BTX&E 8260		or TPH AND BTX&E 8260	
Waste and Used Oil or Unknown	TPH G	GCFID(5030)	TPH G	GCFID(5030)
	TPH D	GCFID(3550)	TPH D	GCFID(3510)
(All analyses must be completed and submitted)	or TPH AND BTX&E by 8260 CRYOGENIC FOCUSING			
	O & G	5520 D&F	O & G	5520 C&F
	BTX&E	8020 or 8240	BTX&E	602, 624 or 8260
	CL HC	8010 or 8240	CL HC	601 or 624
	ICAP or AA TO DETECT METALS: Cd, Cr, Pb, Zn, Ni			
	METHOD 8270 FOR SOIL OR WATER TO DETECT:			
	PCB*		PCB*	
	PCP*		PCP*	
	PNA		PNA	
	CREOSOTE		CREOSOTE	

*If found, analyze for dibenzofurans (PCBs) or dioxins (PCP)

Appendix B

Site Safety Plan

SITE SAFETY PLAN

The contents of this site safety plan are based in part upon experience and judgement and in part on known features of the site. This plan should not be used as a substitute for good judgement if unanticipated conditions are encountered during field work.

Anticipated Field Work The field work anticipated during preparation of this plan includes: excavation of petroleum hydrocarbon contaminated soil, installation of drive-point piezometers, drilling, soil sampling, and monitoring well construction, development, purging, and sampling.

Chemical Hazard Evaluation Chemicals detected in soil from the property during previous work were oil & grease, TPH-diesel, TPH-gasoline, benzene, toluene, ethylbenzene, and xylenes. Table B1 compares the maximum reported concentration of these chemicals in soil from the property with potentially applicable exposure standards. The comparison presented in Table B1 demonstrates a low likelihood for chemical exposure at levels of concern.

Physical Hazard Evaluation Physical hazards which may be be encountered while working on this project are anticipated to include: work around heavy machinery, heavy lifting, slip-trip-fall, loud noise, and exposure to the weather.

Health and Safety Responsibilities This site safety plan will be implemented by the site safety officer under the supervision of the project manager, and in coordination with appropriate client representatives. Safety personnel and their responsibilities are presented in Table B2.

Work Zone A work zone should be established around the excavations, drill rig, and sampling activities. The work zone is an area of sufficient size to allow safe completion of the work while maintaining control of access to the work area. The work zone should be maintained by requesting people not directly involved in the work to stay out of the immediate work area, or other suitable means such as barricades or flagging.

No smoking or chewing of tobacco, eating, or drinking will be allowed in the work zone. An area will be designated onsite for short breaks, if necessary.

Personal Protective Equipment Since available chemistry data indicate a low likelihood for worker exposure at levels of concern, field work should begin in modified Level-D personal protection. Modified Level-D health and safety requirements are summarized in Table B3.

If monitoring results exceed the action levels specified below, then personal protective equipment will be upgraded to modified Level-C (Table B3).

Monitoring Visual monitoring is the responsibility of everybody on the work site. Onsite workers should evaluate themselves for signs of fatigue as the work progresses. Work breaks should be taken as reasonably required to maintain worker efficiency. Modifications to work schedules should be made as required to promote worker safety.

The breathing zone should be monitored using a field organic vapor monitor (ThermoAnalytical OVM 580B or equal) capable of detecting organic vapors such as benzene, toluene, ethylbenzene, and xylenes. The field organic vapor monitor should allow quantification of organic vapors to 1 part per million in air (volume/volume). If continual readings greater than 5 ppm above background are detected in the breathing zone, then personal protective equipment will be upgraded to modified Level-C from modified Level-D. 5 ppm was selected as a conservative upgrade criteria as this is one-half the 8-hour time weighted average exposure limit for benzene (Table B1). If continual readings greater than 50 ppm above background are recorded in the breathing zone, then work should stop. Work will be resumed upon consultation with the project manager and client, and may include additional safety precautions.

Emergency Procedures. These procedures are designed to allow rapid treatment of workers for injuries or exposure to hazardous substances occurring on the worksite. A secondary purpose of these procedures is to allow documentation of emergencies which occur on the job. As in other aspects of the work, good judgement and logic should prevail in an emergency. Modifications to these procedures may be required in response to unanticipated conditions encountered in the field.

Emergency information is summarized in Table B4 and Figure B1.

If required, first aid should be provided for the injured worker.

The site safety officer should be notified immediately of an emergency. It is the site safety officer's responsibility to document the emergency and report it to the project manager and client representative in a timely manner.

Documentation Documentation specific to the Site Safety Plan consists of the tail gate safety meeting form. A copy of the tailgate safety meeting form is attached to this Site Safety Plan. Health and safety issues not addressed on the tailgate safety meeting form should be recorded in the field notebook.

Decontamination Decontamination refers to removal of possible chemicals from workers and monitoring equipment. In many instances, removal and thorough cleaning of work clothing is adequate for worker decontamination. However if skin contact with chemical containing material occurs during field work, the affected area should be scrubbed thoroughly with soap and water.

Monitoring equipment should be kept clean by wiping as required with a paper towel or other suitable material.

Health and Safety Wastes Wastes generated by health and safety practices include disposable protective equipment such as gloves, tyvek-coveralls, and boot covers. These items may be disposed of as municipal garbage.

Table B1

Chemical Hazard Evaluation

Chemical	Maximum Detected Concentration in Groundwater (mg/l)	Maximum Detected Concentration in Soil (mg/kg)	Short Term Exposure Limit (ppm v/v)	8 Hour Time Weighted Average (ppm v/v)	Immediately Dangerous to Life and Health (ppm v/v)
TPH-Gasoline	3.2	37	500	300	NA
TPH-Diesel	77	4,800	NA	NA	NA
Oil and Grease	4	730	NA	NA	NA
Benzene	0.24	0.017	NA	10	NA
Toluene	0.014	0.01	150	100	2,000
Ethylbenzene	0.002	0.34	125	100	2,000
Xylenes	0.01	1	150	100	10,000

General Notes

(a) Exposure criteria from American Conference of Governmental Industrial Hygienists, *Threshold Limit Values and Biological Exposure Indices for 1988-1989*, and National Institute for Occupational Safety and Health, *Pocket Guide to Chemical Hazards*, 1985

(b) NA indicates no applicable value listed in cited references

Table B2

Safety Personnel and Responsibilities

Personnel	Responsibilities
Project Manager (Doug Lovell)	Enforcement of Site Safety Plan, provide properly trained onsite personnel to complete the work, coordination of safety issues with client.
Site Safety Officer (Greg Reller)	Enforcement of Site Safety Plan, coordination and documentation of field safety procedures, communication of safety issues to project manager, delineate work zone, atmospheric monitoring, review site safety procedures with subcontractors, conduct tailgate site safety meeting, contact Underground Service Alert, clear underground utilities, maintain adequate supply of safety equipment onsite
Subcontractor's Site Safety Officer	Understand and obtain subcontracting crews' compliance with Site Safety Plan, maintain onsite supply of safety equipment for subcontractor's personnel, relay safety concerns to Site Safety Officer

Table B3

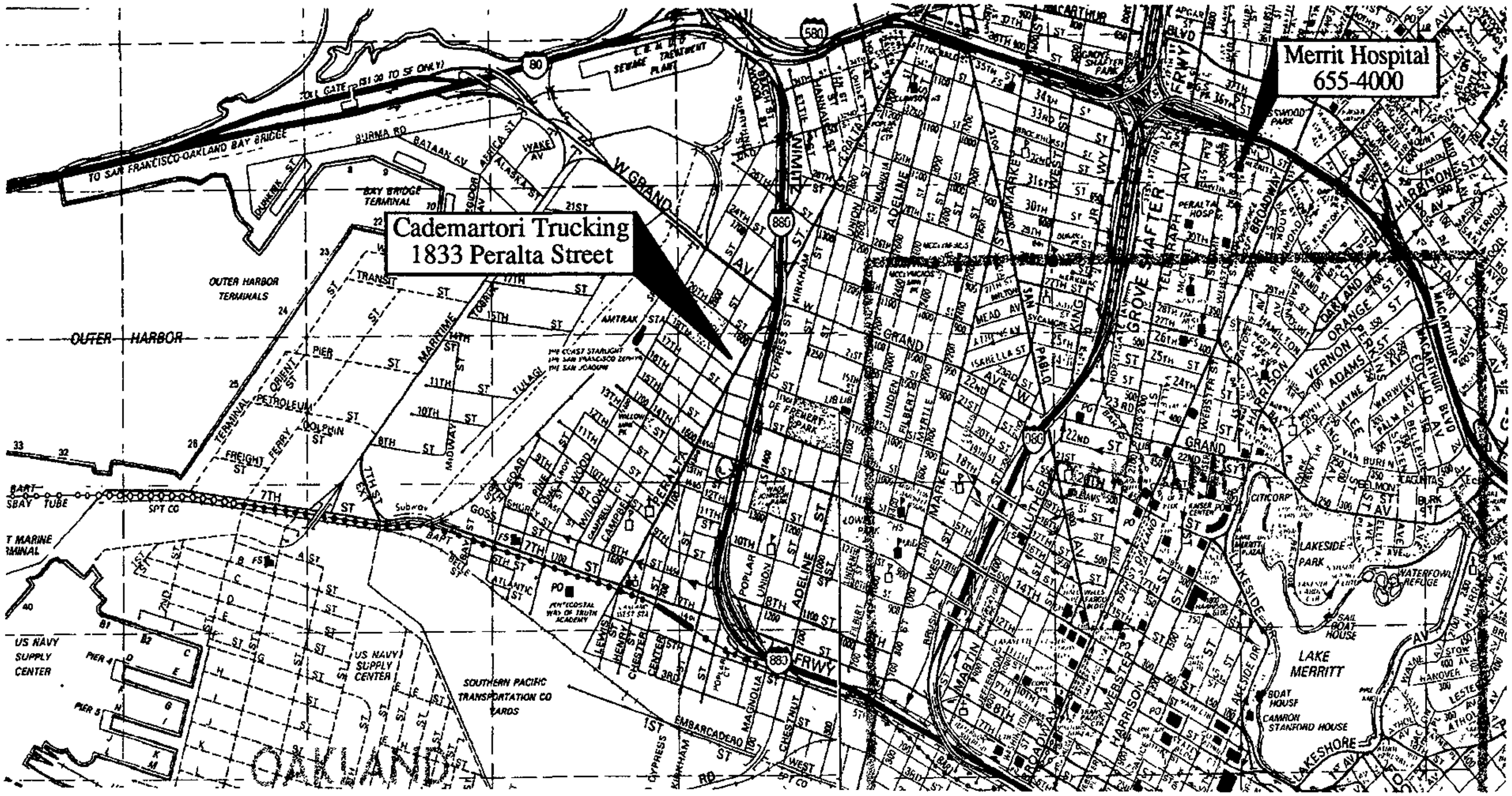
Personnel Protective and Monitoring Equipment

Item	Requirement
Modified Level-D Personal Protective Equipment	Hardhat, dedicated work clothing (cotton coveralls or tyveks), chemical resistant steel toed boots, work gloves or chemical resistant gloves (as appropriate), first aid kit, fire extinguisher, optional eye and hearing protection.
Modified Level-C Personal Protective Equipment	Add Half-face respirator with OV-HEPA cartridges and required tyveks to modified Level-D protective equipment. Change respirator cartridges upon detection of breakthrough (by smell), increase in breathing resistance, or daily (whichever is more frequent)
Atmospheric Monitoring	Field organic vapor monitor capable of detecting organic vapor concentrations of 1 ppm (v/v). Field organic vapor monitor to be calibrated to known reference gas daily. Action levels (measurement in the breathing zone of work area): >5 ppm for 10 minutes: upgrade to modified Level C >50 ppm for 10 minutes: stop work, consult with project manager and client
Visual Monitoring	Evaluate co-workers for signs of fatigue and visual signs of distress due to physical labor and possible chemical exposure.

Table B4

Emergency Information

Emergency Service or Contact	Telephone	Address and Directions
Hospital	(415)655-4000	Merrit Hospital Hawthorn Avenue and Webster Oakland CA • Leave the site and turn left onto Peralta Street • Follow Peralta to 34th Street and turn right onto 34th street • Follow 34th Street to hospital • Hospital is on right after Andover Street • Refer to Figure B1
Ambulance	911	
Fire Department	911	
Police Department	911	
On-site Telephone	415/465-1996	
Streamborn Site Safety Officer	Greg Reller 415/528-4234 (work)	
Streamborn Project Manager	Doug Lovell 415/528-4234 (work) 415/528-4180 (home)	
Cademartori Trucking	Linda Cademartori 415/465-1996(work)	
Subcontractors	To be determined	



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Approximate Scale in Feet

Figure B1

Hospital Location

Cademartori Trucking
Oakland CA

Tailgate Safety Meeting

Client: ______________________________ Date: ____________________

Work Location: ______________________________ Time: ____________________

______________________________ Conducted By: ____________________

____

Work Description: ____

____

Potential Chemical Hazards: ____

____

Physical Hazards: ____

____

____

Protective Clothing/Equipment: ____

____

Conditions for Upgrade of Protective Equipment: ____

____

Nearest Emergency Hospital: ______________________________ Telephone: ____________________

Route To Hospital: ____

____

____

Attendees

Printed Name	Signature