# WORK PLAN FOR THE
# DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES
# FOR VOLATILE ORGANIC COMPOUNDS IN SOIL
# IN THE CENTRAL FILL AND OIL HOUSE AREAS
# UNION PACIFIC RAILROAD YARD
# SACRAMENTO, CALIFORNIA

**DAMES & MOORE**

APRIL 1994
DAMES & MOORE PROJECT NO. 00173-080-044

SAC104.10

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April 27, 1994

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California Environmental Protection Agency
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Attention: Mr. Jose Salcedo
Project Engineer

Re: **Work Plan**
**Development of Remedial Action**
**Objectives for Volatile Organic Compounds**
**In Soil**
**Central Fill and Oil House Areas**
**Union Pacific Railroad Yard**
**Sacramento, California**
**D&M Project No. 00173-080-044**

Dear Mr. Salcedo:

At the request of Union Pacific Railroad Company (UPRR), Dames & Moore is forwarding to you the enclosed Work Plan for Development of Remedial Action Objectives for Volatile Organic Compounds In Soil at the above-referenced site. Please provide us with your comments on the work plan and, if you have any questions, please call us at (916) 387-7530.

Sincerely,

DAMES & MOORE

Fred Fogel for

John D. Fawcett, P.E.
Lead Consultant

Jim Brake, R.G.
Project Manager

Enclosure

SAC104.28

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**PROJECT NUMBER 00173-080-044**

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# WORK PLAN FOR THE DEVELOPMENT OF REMEDIAL ACTION OBJECTIVES FOR VOLATILE ORGANIC COMPOUNDS IN SOIL IN THE CENTRAL FILL AND OIL HOUSE AREAS UNION PACIFIC RAILROAD YARD SACRAMENTO, CALIFORNIA

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# SACRAMENTO, CALIFORNIA

## 1.0 INTRODUCTION

This Work Plan was prepared by Dames & Moore for the Union Pacific Railroad Company (UPRR) to assist UPRR in developing Remedial Action Objectives (RAOs) for volatile organic compounds (VOCs) in soil in the Central Fill Area and Oil House Area of the UPRR Sacramento railyard (Figure 1). The need to develop RAOs for VOCs in soil in the Central Fill Area and Oil House Area was brought about by the California Environmental Protection Agency, Department of Toxic Substances Control's (DTSC) comments on the Revised Draft Remedial Action Plan (RAP) (Dames & Moore, 1993). The RAP describes the remedial action alternative selection process and presents the selected remedial alternative for soil and groundwater at the site. In their comments on the RAP, the DTSC stated that UPRR must develop RAOs for VOCs in soil in both the Central Fill and Oil House areas, that are protective of groundwater quality.

This Work Plan describes the tasks that will be performed for the development of RAOs for VOCs. The Work Plan was developed in accordance with the Enforceable Agreement between UPRR and the DTSC dated March 26, 1987.

### 1.1 PURPOSE AND OBJECTIVES

The purpose of the tasks described in this Work Plan is to gather and evaluate the necessary data to develop RAOs for VOCs in soil and subsequently, evaluate the most effective remedial strategy for VOC-impacted soil. The objectives are as follows:

- Collect and analyze soil gas, soil matrix, and groundwater samples from the Central Fill Area and the Oil House Area in order to supplement existing data;
- Perform vadose zone modeling in order to develop RAOs for VOCs in soil and estimate a potential allowable residual mass (ARM) of VOCs; and
- Develop a cost-effective remedial strategy for VOCs in soil in the Central Fill and Oil House areas.

In a response to comments on the Revised Draft RAP, Dames & Moore proposed to the DTSC that reasonable RAOs for VOCs in vadose zone soil be based on an ARM of VOCs in soil. An ARM is defined as that mass of VOCs distributed in the vadose zone such that modeled values of leachate resulting from yearly average infiltration of precipitation do not raise VOC concentrations in "background quality" groundwater to levels that exceed maximum contaminant levels (MCLs).

As part of the calculation of the ARM and, subsequently, RAOs, soil gas samples and soil matrix samples will be collected and analyzed for VOCs to assess the extent of VOC-impacted soil. These data will be used, along with physical property data from analysis of the soil matrix samples, to calculate an ARM.

Soil matrix samples will be collected from the soil gas monitoring wells. These wells will be located based on the results of the soil gas sampling, and may be used for a soil vapor extraction (SVE) pilot test. The SVE pilot test will be used to determine the effective radius of influence of a vacuum extraction well on the vadose zone. The results of the pilot test will be used to evaluate whether SVE is appropriate for remediating VOCs present in the vadose zone.

## 1.2 REPORT ORGANIZATION

Section 1.0 is a brief introduction to this Work Plan, with the Purpose and Objectives stated in Section 1.1 and a brief description of the site and its location discussed in Section 1.3. Section 2.0 summarizes the results of previous soil gas surveys, sampling and analyses from Cone Penetrometer and Hydropunch (CPT/HP) locations, analyses of soil samples collected from test pits, and analyses of groundwater samples collected in the Central Fill and Oil House areas. Section 3.0 presents the Sampling and Analysis Plan. Section 3.1 outlines the procedures for implementing the soil gas and groundwater sampling. Soil matrix sampling and soil gas monitoring well installation procedures are outlined in Section 3.2. Section 4.0 describes the vadose zone modeling that will be performed in order to calculate RAOs for VOCs in soil. Section 5.0 discusses the reporting format for the data collected. Section 6.0 is a schedule for the tasks. Section 7.0 provides an outline of the Quality Assurance Project Plan (QAPjP) for this work. The QAPjP is a stand-alone document that addresses the quality assurance and quality control procedures for sample collection, analysis, and reporting. Included in the QAPjP is a quality assurance plan from Hydro Geo Chem for sample collection and analyses. Section 8.0 lists the references cited in the Work Plan. Appendix A contains a surface elevation contour map and a comprehensive map with test pit locations and other soil sampling locations, and appropriate test pit logs. Appendix B contains the analytical data from the previous soil gas sampling investigation. Appendix C contains the detailed Standard Operating Procedures (SOPs) for some of the tasks that will be performed. Appendix D contains the procedures that Hydro Geo Chem will use to collect soil gas samples and grab groundwater samples.

## 1.3 SITE LOCATION AND DESCRIPTION

The UPRR site is located in the Sacramento city limits approximately one mile south of the downtown area (Figure 1). The Central Fill Area (Soil Operable Unit 2), as defined in the Revised Draft RAP (Dames & Moore, 1993) is located in the center of the eastern or inactive portion of the site. The Oil House Area (part of soil Operable Unit 1), as defined in the Revised Draft RAP (Dames & Moore, 1993), is located on the eastern side of the inactive portion of the site. The inactive portion of the site encompasses an area of approximately 63 acres.

## 2.0 BACKGROUND AND PREVIOUS WORK

A history of site operations is provided in the Addendum RI/FS (Dames & Moore, 1991a). It is based on historical records, aerial photographs, interviews with UPRR employees, and UPRR drawings dating back to 1910. Contamination in the Central Fill Area and Oil House Area are believed to be primarily from the following sources:

- Central Fill Area — solvents, cleaners, and degreasers which were used to clean and strip engine parts in the maintenance facilities and were disposed of in either fill material of the Central Fill Area or a former surface impoundment located in this area; and
- Oil House Area — fuels and oils previously stored in above-ground and below-ground storage tanks.

The Central Fill Area was historically used as a disposal area for debris, including plaster board, drums, railroad ties, and construction debris. The Oil House Building in the Oil House Area was historically used to store drummed fluids and was the site of above- and below-ground storage tanks. The tanks were removed in or before 1986.

Numerous test pits, soil borings, CPT/HP, and monitoring wells have been used to assess the sources and types of contamination in the soil and groundwater of the Central Fill and Oil House areas. Areas of elevated concentrations of constituents of concern were identified from soil gas and soil sample analyses. Figure 3 outlines areas of elevated concentrations of TPH and VOCs in soil in the Central Fill Area. Figure 4 presents the locations of elevated concentrations of TPH in soil in the Oil House Area. Areas outlined on these figures only indicate whether or not constituents were detected during previous studies. Analytical data from previous studies can only be used to approximate the concentrations of constituents in soil. The following sections discuss the types of contamination found in soil and groundwater in each area.

### 2.1 PREVIOUSLY IDENTIFIED SOIL CONTAMINATION IN THE CENTRAL FILL AREA

Organic compounds detected in soils in the Central Fill Area consist of chlorinated VOCs and total petroleum hydrocarbons (TPH). Previous studies indicate that petroleum hydrocarbons are primarily associated with fill materials. Concentrations of hydrocarbons in soils range from several hundred to 76,000 milligrams per kilogram (mg/kg) at depths from two to ten feet below ground surface (bgs) with minor amounts of TPH in the ten- to fifteen-foot depth range. Figure 3 shows the general location of areas of elevated concentrations of VOCs and TPH in soil previously identified in the Central Fill Area. Test pit locations and logs are included in Appendix A and are expected to be used as an indicator of subsurface conditions.

Low levels of acetone and toluene were also detected in soil samples collected from soil borings. Acetone was detected at a concentration of 0.18 mg/kg at a maximum depth of 20 feet bgs, and toluene was detected at a concentration of 0.015 mg/kg at a maximum depth of 20 feet bgs (Dames & Moore, 1991a). Acetone is a known laboratory contaminant and therefore will not be analyzed for during this study.

During the Addendum RI/FS (Dames & Moore, 1991a), two soil borings were drilled, sampled, and completed as groundwater monitoring wells (MW-42 and MW-43), and six additional test pits (TP-267, TP-268, TP-269, TP-270, TP-271, and TP-291) were excavated in the Central Fill Area (see Appendix A). The test pits were excavated and one of the groundwater monitoring wells (MW-43) installed in locations within the Central Fill Area where soil gas samples showed elevated levels of VOCs. Soil samples were collected from the soil borings and test pits and analyzed for organic compounds. Ten of the soil samples were analyzed for diesel range hydrocarbons, seven for VOCs, and three for aromatic compounds.

Diesel range hydrocarbons were detected at concentrations ranging from 200 to 7,000 mg/kg in four of ten soil samples collected from test pits TP-267, TP-268 and TP-291. These samples were collected below the extent of buried debris at depths of 15 feet in TP-267, 13 feet in TP-268, and at 11 feet in TP-291. Remains of metal drums were found and stained soils were observed in all three of these test pits. The aromatic compounds toluene and xylene were detected at 17.0 mg/kg and 14.0 mg/kg, respectively in the sample collected from 12.5 feet bgs in test pit TP-267 (Appendix A). Chlorinated VOCs were not detected in any of the soil samples analyzed.

One drum excavated from the Central Fill Area contained a black viscous petroleum-based material. The material was sampled and the fuel fingerprint indicated the material consisted of #2 diesel, heavy oil, and kerosene at levels of 7,800; 95,000; and 18,000 mg/kg, respectively.

A total of 26 soil gas samples were collected from 19 locations in the Central Fill Area during the Addendum RI/FS (Dames & Moore, 1991a). Results of the soil gas sampling are included in Appendix B. Where possible, samples from two depth intervals were collected. Elevated levels of total volatile hydrocarbons (TVH), 1,1,1-Trichloroethane (TCA), 1,1-Dichloroethene (1,1-DCE), 1,1-Dichloroethane (1,1-DCA), Tetrachloroethene (PCE), and Trichloroethene (TCE) were measured in samples from the northern portion of the Central Fill Area. Concentration contour data indicate two areas of elevated concentrations of VOCs. An area of elevated hydrocarbons, primarily in the range of 0 to 5 feet bgs, exists in the south central part of the Central Fill Area. 1,1,1-TCA and PCE were also reported within this shallow sampling interval in the southeastern part of the Central Fill Area. No deep interval samples were collected from this area due to lack of penetration of the sampling probe (Figure 3).

## 2.2 PREVIOUSLY IDENTIFIED SOIL CONTAMINATION IN THE OIL HOUSE AREA

Petroleum hydrocarbons were previously detected in soil samples collected from the Oil House Area at concentrations ranging from 367 to 11,300 mg/kg. Petroleum hydrocarbon concentrations generally decreased with depth.

Nine soil gas samples were collected from six locations in the vicinity of the Oil House Area (Dames & Moore, 1991a). Analytical results for these samples are summarized as follows:

- Benzene was not detected in any of the soil gas samples collected in the Oil House Area. However, benzene was detected in soil sampling locations, immediately adjacent to the Oil House Area;
- TVHs were detected in four soil gas samples at concentrations ranging from 4 ug/L to 496 ug/L;
- Carbon Tetrachloride ($CCL_4$) was detected at low levels in three soil gas samples; however, it was also detected in ambient air; and
- 1,1,1-TCA was detected in one soil sample analyzed.

Results of the soil gas survey are included in Appendix B. The area with elevated levels of TPH found in the Oil House Area is outlined on Figure 4.

One additional test pit (TP-266) was completed in the Oil House Area during the Addendum to the RI/FS (Dames & Moore, 1991a). The test pit was excavated to a depth of 12.5 feet bgs. The results of the analyses of the soil sample collected at 6.5 feet bgs showed 94 mg/kg diesel range hydrocarbons, and non-detect for aromatic compounds (see Appendix A). Although the previous soil gas sampling survey did not detect benzene in the Oil House Area, it has been found in groundwater samples in this area, and the source has not been located. Soil gas sampling during this Work Plan may help define the source of benzene in soil.

## 2.3 ADDITIONAL GROUNDWATER INVESTIGATIONS

Additional groundwater investigations were performed in the Central Fill Area and Oil House Area from 1990 to 1993 using HP in-situ sampling techniques. Additionally, monitoring of groundwater monitoring wells in the Central Fill Area and Oil House Area has been ongoing since 1988. Groundwater samples collected from eight HP locations in the Central Fill Area in October 1991, contained 1,1-DCA and 1,1-DCE in concentrations exceeding the maximum contaminant levels (MCLs) for groundwater. TCE was present in groundwater samples at concentrations less than its MCL. Results of the additional groundwater investigations and monitoring indicate a potential source of chlorinated VOCs upgradient (northwest) of groundwater monitoring well MW-33 (Figure 4). Monitoring well MW-33 is located approximately 450 feet southeast of the southern boundary of the Central Fill Area. Results of the additional on-site CPT/HP investigations were reported in Addendum RI/FS (Dames & Moore, 1991a, Table 10).

VOCs reported for the sample collected from HP-19 in the Oil Area House include 1,1-DCA, 1,1-DCE, and 1,2-DCA at concentrations exceeding their respective MCLs. 1,1,1-TCA and TCE were reported at concentrations less than their MCLs. Two groundwater samples collected from locations between the Central Fill Area and the Oil House Area (HP-81 and HP-85) contained 1,1-DCE at concentrations exceeding the MCL, and 1,1-DCA, chloroform, and $CCL_4$ at concentrations less than their MCLs (HP locations are shown on Figure 2A in Appendix A).

Ongoing groundwater monitoring since 1988 has identified that 1,1-DCE is the most widely distributed VOC in groundwater. It has been detected in groundwater samples collected from the Central Fill Area and seven off-site wells southeast of the site. Impacted groundwater in the shallow water table aquifer, or first hydrostratigraphic zone (HSZ) is grouped into two different plumes:

- Plume A - the first and second HSZ impacted both on- and off-site by chlorinated VOCs, encompassing a smaller plume of aromatic hydrocarbons; this plume is shown on Figure 5;
- Plume B - the first HSZ aquifer is impacted by low concentrations (near MCLs) of chlorinated VOCs.

The upgradient limit and potential source area of chlorinated VOCs in groundwater for groundwater operable unit GW-1 appears to be just south of groundwater monitoring well MW-2 in the Central Fill Area (Figure 5). Examination of a 1953 aerial photograph indicates the presence of a former surface impoundment just south of MW-2. This feature could potentially be the source of chlorinated VOCs in groundwater.

Benzene has been detected at concentrations exceeding the MCL of 1 μg/l in monitoring wells MW-4 and MW-13, located in the Oil House Area (Figure 4). The highest concentration measured was 10,000 μg/l in MW-13. Toluene, ethylbenzene and xylene were also detected in MW-13, and ethylbenzene and xylene were detected in MW-4. However, levels of toluene, xylene, and ethylbenzene were below their respective MCLs for drinking water. To date, analytical results of groundwater samples collected from HP and monitoring wells indicate that aromatic hydrocarbons in groundwater are restricted to the Oil House Area and have not migrated off-site.

# 3.0 SAMPLING AND ANALYSIS PLAN

The tasks presented in this section will be performed to gather the necessary data to calculate an ARM and to develop RAOs for VOCs in the Central Fill and Oil House areas and will consist of the following:

- Collection of vadose zone soil gas samples and analysis for VOCs and BTEX;
- Collection of groundwater grab samples and analysis for VOCs and BTEX;
- Collection of vadose zone soil matrix samples from soil borings, and physical testing for the parameters required for input into the model;
- Performing chemical analysis on soil samples to estimate leachable concentrations of VOCs using the EPA-approved Toxic Characteristic Leaching Procedure (TCLP); and
- Construction of soil gas monitoring wells in the soil borings.

## 3.1 SOIL GAS AND GROUNDWATER SAMPLING AND ANALYSIS

Soil gas samples will be collected from multiple locations and depths in the Central Fill and Oil House areas. Proposed sampling locations are shown on Figures 5 and 6 for the Central Fill Area and Oil House Area, respectively. Groundwater grab samples will be collected from selected soil gas sampling holes that are extended into the water table. Sample types and quantities to be collected are provided in Table 1. A list of analyses to be performed on the soil gas, and groundwater grab samples is provided in Table 2.

Soil gas and groundwater grab sampling locations were selected based on review of past site operations, previous soil gas sample analytical results (Appendix B), previous soil matrix sample analytical results, and patterns of groundwater contamination (Figure 5). Sampling points will be staked in the field prior to sampling. After sampling, the location and elevation of each sampling point will be surveyed by a licensed surveyor.

To facilitate calculation of ARMs, soil gas samples will be collected from three depths in each location in the vadose zone: the upper, middle, and lower third of the length of the soil column from ground surface to approximately four feet above the top of the water table. These soil-gas profiles will also aid in the selection of appropriate remedial alternatives. For example, if VOC contamination occurs deep within the vadose zone, it may not be prudent to excavate the shallow overburden to uncover the deeper contamination. Rather, alternative remedial methods such as soil gas extraction or dual extraction should be considered.

Soil gas sample collection and analyses has been subcontracted to Hydro Geo Chem of Whittier, California. Soil gas samples will be collected and on-site analyses performed in a mobile laboratory. Ten percent of the soil gas samples will be sent to Air Toxics, Ltd., of Folsom, California as a quality control check. Groundwater grab samples will be collected from selected soil gas sampling locations and analyzed by D&M Laboratories of Petaluma, California. Soil gas and groundwater grab samples will be analyzed for the following chemical parameters:

- Carbon Tetrachloride ($CCl^4$)
- Chloroform
- TCE
- 1,1,1-TCA
- 1,1-DCE
- 1,2-DCA
- trans-1,1-DCE
- 1,1-DCA
- cis-1,1-DCE
- PCE
- Vinyl Chloride
- Benzene
- Toluene
- Xylene
- Ethylbenzene

The detailed methodology for collecting the soil gas samples and grab groundwater samples are described in Appendices C and D. Methods for analyzing the soil gas and groundwater grab samples are listed in Table 2 and described in the QAPjP.

### 3.1.1 Methods for Collecting Soil Gas Samples and Groundwater Grab Samples

Prior to the start of the soil gas sampling program, a Dames & Moore geologist will collect one round of water levels from wells MW-2, MW-3, MW-42, and MW-43 in the Central Fill Area (Figure 3), and from monitoring wells MW-4, MW-11, MW-12, MW-13, MW-14, and MW-41 in the Oil House Area (Figure 4). Using the estimated ground elevation (Figure 1A in Appendix A), the depth to water will be calculated for each proposed soil gas sampling location.

Three soil gas samples will be attempted to be collected at each sampling location. An upper, middle, and lower depth sample will be collected, based on the depth to water in each location. The lower soil gas sample from each location will be collected at approximately four feet above the top of the water table. This will ensure that the soil gas sample is representative of the vadose zone above the water table. The capillary fringe zone for the local soils, silty clay to sandy silt, is estimated to be less than three feet thick (Driscoll, 1987). The remaining two soil gas samples from each location will be collected from depths that are 1/3 (upper sample) and 2/3 (middle sample) of the depth of the lower sample (i.e., if the lower sample is projected to be collected at 21 feet bgs, then the upper sample will be collected at approximately 7 feet bgs, and the middle sample will be collected at approximately 14 feet bgs).

Soil gas samples will be collected in summa canisters from each horizon using the methodology outlined in Appendix D. Soil gas samples will be analyzed in the field by Hydro Geo Chem for the analytes listed above.

Duplicate samples will be collected in Summa canisters for ten percent of the soil gas samples. One canister will be analyzed in the field by the mobile lab, and the other will be sent to the fixed base laboratory for analyses as a quality control check (Table 1).

After collecting soil gas samples, from selected locations, the holes will be extended approximately one to two feet beneath the water table for collection of a groundwater grab sample. Groundwater grab samples will be collected from some of the proposed soil gas sampling locations shown on Figures 6 and 7, for the Central Fill Area and Oil House Area, respectively. These are tentative locations for the collection of groundwater samples. The locations may change based on the results of the soil gas survey. Locations of groundwater grab samples will be used to help define the width of impacted groundwater in the east-west direction, and to help determine source areas of VOCs in soil. Groundwater grab samples will be sent to Dames & Moore Labs and analyzed for the same analytes as the soil gas samples by EPA Method 8010A/8020A. A total of ten groundwater grab samples are planned to be collected in the Central Fill Area and five from the Oil House Area. A detailed description of the procedure for collecting groundwater grab samples is provided in Appendices C and D.

#### 3.1.1.1 Proposed Soil Gas Sampling Locations in the Central Fill Area

Approximately 75 soil gas samples will be collected in the Central Fill Area. This estimate is based on 25 soil gas sampling locations with three sampling depths per location. Ten of the proposed soil gas sampling locations were selected using previous data and are shown on Figure 6. The remaining 15 soil gas sampling locations will be based on the results of analysis of samples from the first ten sampling locations.

The proposed soil gas sampling locations were selected to further characterize the areas previously identified to have elevated concentrations of VOCs and TVH, and to further investigate areas that had elevated levels of TPH in soil samples. After these initial samples are collected and areas of elevated concentrations of constituents are defined, then areas where soil gas samples have not been collected will be investigated.

The methodology for selecting locations for the remaining soil gas samples are as follows. For locations SG-26 through SG-30, if a soil gas sample has elevated concentrations of constituents of concern, then soil gas samples will be collected from a location upgradient (to the north/northwest) of the original location. Further up-gradient sample collection will be based on the analysis results of the first upgradient soil gas samples. Soil gas samples will be collected downgradient or upgradient of locations SG-31 through SG-35 if soil gas samples show elevated concentrations of constituents of concern. Secondary soil gas sampling locations will be placed approximately 100 feet in the appropriate direction from the original location, unless field conditions prohibit this, or closer sample spacing seems appropriate.

It is assumed that the original soil gas sampling locations are close enough together in the east-west direction to define the contamination in the east-west direction. If necessary, soil gas samples may be located halfway between two proposed locations to further characterize an area.

#### 3.1.1.2 Proposed Soil Gas Sampling Locations in the Oil House Area

It is proposed that a total of 45 soil gas samples will be collected in the Oil House Area — 15 soil gas sampling locations with three sample depths per location. Procedures for selecting the soil gas sampling depths will be the same as those outlined in Section 3.1.1.1. Locations of eight of the proposed soil gas sampling locations in the Oil House Area were selected using previous data and are shown on Figure 7. Proposed soil gas sampling locations in the Oil House Area are spaced approximately 50 feet apart. Locations of the remaining seven soil gas sampling locations will be based on the results of analysis of samples from the first eight sampling locations.

## 3.2 SOIL MATRIX SAMPLING AND SOIL GAS MONITORING WELL CONSTRUCTION

Soil matrix samples will be collected and analyzed to obtain information for the vadose zone modeling. The vadose zone model will be used to estimate the amount of constituents that can leach to groundwater and subsequently to estimate an ARM. The ARM will be used to establish the RAOs for VOCs in soil and ultimately, these data will be used to help design the most cost-efficient remedy for VOC-impacted soil.

Soil matrix samples will be obtained from borings drilled in areas identified by the soil gas survey as having elevated VOC concentrations. Selected borings will be completed as soil gas monitoring wells that can be used in a soil gas extraction pilot test. It is anticipated that a total of five soil gas monitoring wells will be constructed in the Central Fill Area and three in the Oil House Area.

Soil borings will be drilled and soil samples collected using hollow-stem auger drilling methods. Drilling and sampling procedures are described in Appendix C. Soil samples will be collected every five feet during the drilling of the borings using a modified California split spoon sampler. The depth of each boring will be based on depth to groundwater in that location. Soil borings will be terminated approximately four feet above the water table. The lithology of each soil sample will be described by a Dames & Moore geologist and noted on a soil sampling log (Appendix C).

Twenty soil samples will be selected in the field for physical testing and total organic carbon (TOC) analyses. Fifteen of the soil samples will be from the five boreholes drilled in the Central Fill Area, and the remaining five soil samples will be from the three boreholes drilled in the Oil House Area. Depths of soil matrix samples selected for analysis will be based on the results of the soil gas survey. Soil matrix samples will be analyzed for the following:

- Moisture content;
- Bulk density;
- Total organic carbon; and
- Porosity.

Some of the soil samples selected for matrix analysis will also be selected for chemical analysis. These samples will be analyzed for the following:

- VOCs (Table 2); and
- Leachate concentrations of VOCs by TCLP.

Boring locations will be surveyed and incorporated into the soil analytical database. Soil gas monitoring wells will be constructed at selected locations from 2-inch-diameter PVC. Screen slot size and length will be determined from an analysis of the grain size, and the vertical extent of impacted soil in the area of interest, respectively. Locations for wells constructed for the soil gas extraction pilot test will be determined by the extent of VOC impacted soil and the local lithology. Basic methods for installing the soil gas monitoring wells are included in Appendix C.

## 4.0 VADOSE ZONE MODELING AND DEVELOPMENT OF RAOs

RAOs for on-site soil will be developed using the results of information obtained from the analysis of soil gas, soil matrix, and groundwater samples. The sampling data will be input into an EPA vadose zone computer model (**VLEACH**). **VLEACH** considers a typical UPRR site soil column or profile extending from the ground surface to the groundwater table, and relates the chemical (VOC) phase changes between soil gas, soil matrix, and soil pore water. **VLEACH** uses infiltration from precipitation (another model input) and estimates what the concentration of a specified VOC will be in the vadose zone pore water that exists at the base of the typical soil column, just before joining and mixing with the groundwater. The amount of a typical VOC existing at the base of the vadose zone is then used to determine if a groundwater impact is possible. A groundwater impact is assumed to occur if the concentration of a given VOC released from the vadose zone causes exceedance of the MCL in groundwater. The soil RAO is the concentration of a given VOC in the soil profile which will not leach from the soil profile and cause groundwater quality to meet or exceed MCLs.

The development of RAOs for VOCs in the Central Fill Area and Oil House Area will be implemented in the following manner:

- Map the distribution of the measured soil gas analysis for VOCs;
- Estimate VOC soil matrix concentrations using VOC soil gas concentrations and appropriate soil physical and chemical property data;
- Perform vadose zone modeling using VLEACH to estimate the quantity of VOCs that could leach to groundwater on a yearly basis;
- Calculate the resulting VOC concentration in groundwater using the estimated concentration of VOCs in soil leachate;
- Calculate the concentration of VOCs in groundwater that exceed MCLs, then calculate RAOs for VOC levels in the vadose zone;
- Calculate the volumes of vadose zone soils that exceed the RAOs; and
- Compare the results of the above model calculations with analytical results from the TCLP analysis as requested by the DTSC.

## 5.0 REPORT

In order to aid in data interpretation and in preparation of the letter report, the analytical data will be received from the laboratory in electronic form, input into the database, verified, and output into tables. Detected values of VOCs will be plotted on computer-generated base maps. Separate maps will be prepared for the upper, middle, and lower levels of the vadose zone as well as groundwater (for each VOC compound detected). In addition, analytical results will be plotted on up to four cross sections. Data points on the maps will be contoured using statistical techniques (e.g., kriging). Data will be input into a vadose zone model (VLEACH) that will be used to determine the RAOs for soil, and the volumes of impacted soil.

A draft letter report will be prepared that includes discussions of: the field sampling results, the results of the modeling, an estimate of the ARM, and the development of the RAOs. The results of this Work Plan will be used to help design the soil gas extraction pilot test.

## 6.0 SCHEDULE

Work will begin within five days of approval by the DTSC of the Work Plan. It is anticipated that the field work will require approximately ten weeks to complete. Data interpretation, vadose zone modeling, and report preparation are scheduled to be completed approximately eight weeks following completion of the field work.

## 7.0 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Quality assurance and quality control procedures for the tasks performed in this Work Plan are outlined in the Draft Quality Assurance Project Plan (QAPjP). The Draft QAPjP is a stand alone document prepared in compliance with the United States Environmental Protection Agency Region 9 guidelines. The Draft QAPjP includes:

- Project organization and responsibilities;
- Quality assurance objectives;
- Quality assurance and control of the soil gas, soil matrix, and groundwater sampling, and the gas monitoring well installation;
- Sample custody procedures;
- Field instrument calibration procedures;
- Analytical methods;
- Data reduction, validation, and reporting;
- Internal quality control;
- Assessment of data precision, accuracy and completeness; and
- Corrective actions.

## 8.0 REFERENCES

Dames & Moore, 1991a, Addendum Remedial Investigation/ Feasibility Study Report, November 1991.

Dames & Moore, 1991b, Work Plan, Additional On-Site Soil and Groundwater Investigations, Union Pacific Railroad Yard, Sacramento, California, May 1991.

Dames & Moore, 1993, Revised Draft Remedial Action Plan, Union Pacific Railroad Yard, Sacramento, California, June 1993.

Driscoll, Fletcher G., 1987, Groundwater and Wells, Johnson Division, St. Paul, Minnesota, pp. 156-7.

TABLES

TABLE 1: Sampling Schedule for the Central Fill and Oil House Areas, Union Pacific Railroad Yard, Sacramento, California

| Area | Estimated Number of Days | Event | Estimated Number of Samples/Locations | Duplicates | Trip Blanks/ Equipment Blanks | Sample Analyses | Comments |
|---|---|---|---|---|---|---|---|
| Central Fill Area | 5 | Soil Vapor Sampling | 75/25 | NA | NA | List A | 10 % of the samples will be analyzed by another laboratory for QA/QC measures. |
| | NA | Groundwater Grab Sampling | 10/10 | 1 | 1/1 | List A | Collect from Soil Vapor Sampling Holes |
| | NA | Soil Matrix Sampling | 25 | NA | NA | Lithology | Collect During Soil Vapor Monitoring Well Drilling |
| | | | 15 | NA | NA | List B | |
| | | | 15 | NA | 1/1 | List A | |
| | 5 | Vapor Monitoring Well Installation | 5 | NA | NA | NA | |
| Oil House Area | 3 | Soil Vapor Sampling | 45/15 | NA | NA | List A | 10 % of the samples will be analyzed by another laboratory for QA/QC measures. |
| | NA | Groundwater Grab Sampling | 5/5 | 1 | 1/1 | List A | Collect from Soil Vapor Sampling Holes |
| | NA | Soil Matrix Sampling | 15 | NA | NA | Lithology | Collect During Soil Vapor Monitoring Well Drilling |
| | | | 5 | NA | NA | List B | |
| | | | 5 | NA | 1/1 | List A | |
| | 3 | Vapor Monitoring Well Installation | 3 | NA | NA | NA | |

NA Not Applicable

TCLP Toxicity Characteristic Leaching Procedure

List A

- Carbon Tetrachloride
- Chloroform
- Trichloroethene (TCE)
- 1,1,1-Trichloroethane (TCA)
- 1,1-Dichloroethene (DCE)
- 1,2-Dichloroethane (DCA)
- Tetrachloroethene (PCE)
- cis-1,1-DCE
- trans-1,1-DCE
- 1,1-DCA
- Vinyl Chloride
- Benzene
- Toluene
- Ethylbenzene
- Xylene

List B

- Moisture Content
- Bulk Density
- Specific Gravity
- Porosity
- Fraction of Organic Carbon
- TCLP (formerly WET test leachability)

TABLE 2: List of Analyses for Samples Collected in the Central Fill and Oil House Areas, Union Pacific Railroad Yard, Sacramento, California

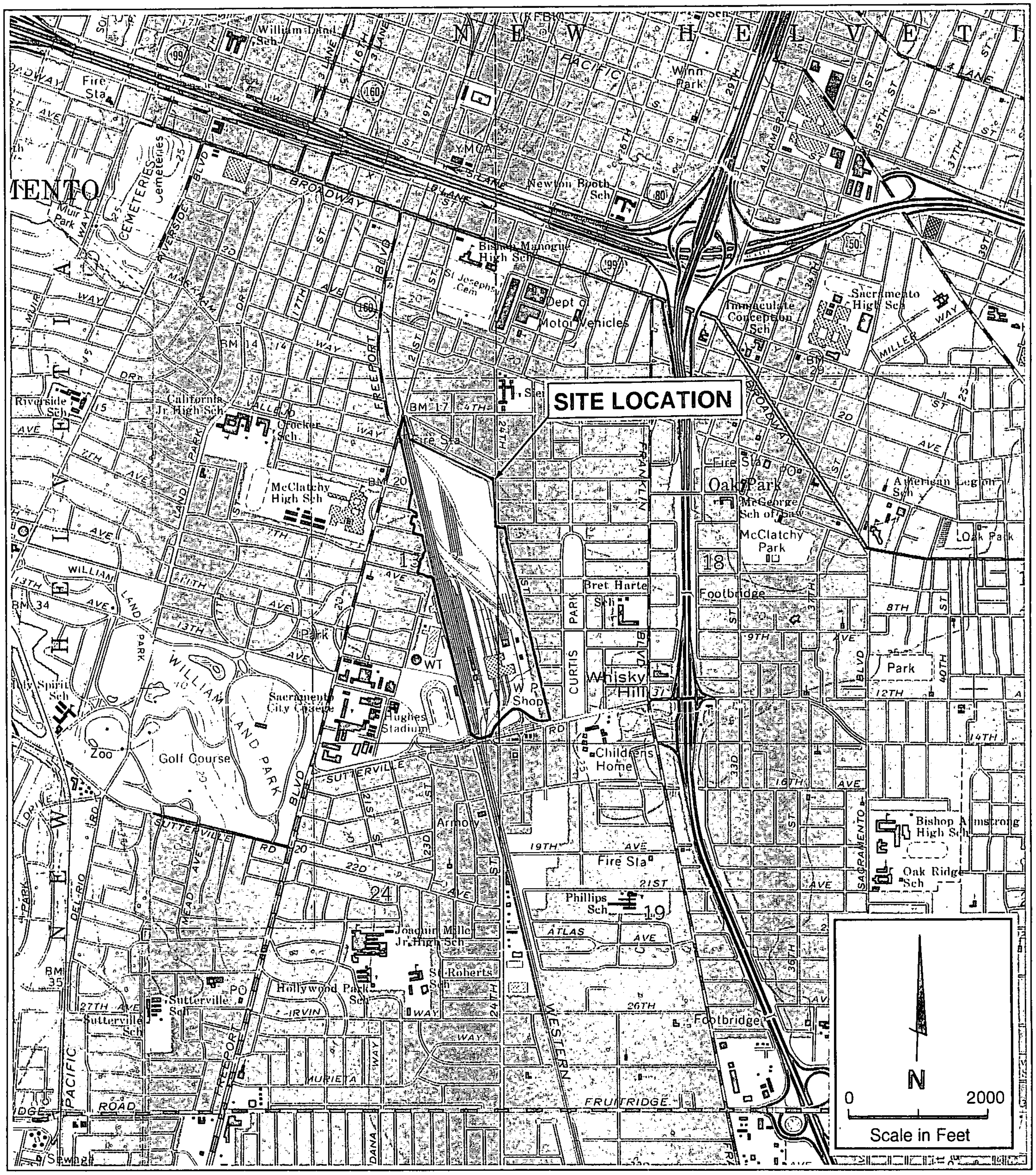
| Sample Type | Analyses | Method of Analyses | Estimated Number of Samples | Sample Size | Laboratory | Comments |
|---|---|---|---|---|---|---|
| Soil Vapor | List A | EPA 8021 | 120 | 6 Liter | Hydro Geo Chem, Inc.<br>11606 E. Washington Blvd<br>Whittier, CA 90606<br>(310) 699-3053 | Field Lab |
| | List A | EPA TO-14 | 12 (1) | 6 Liter | Air Toxics<br>180 Blue Ravine Road<br>Suite B<br>Folsom, CA 95630<br>(916) 985-1020 | |
| Groundwater | List A | EPA 8010A/8020A | 21 (2) | VOA Vial | Dames & Moore Labs<br>3700 Lakeville Highway<br>Petaluma, CA 94954<br>(707) 763-8245 | |
| Soil Matrix | Porosity<br>BD<br>MC<br>SG | Calculated<br>ASTM D-4531<br>ASTM D-2216<br>ASTM D-854 | 20 | SS | Dames & Moore,<br>8801 Folsom Blvd. Suite 200<br>Sacramento, CA 95826<br>(916) 387-7517 Jerry | |
| | List A | EPA 8010A/8020A | 17 (2) | SS | Dames & Moore Labs<br>3700 Lakeville Highway<br>Petaluma, CA 94954<br>(707) 763-8245 | |
| | TCLP | EPA 1311 | | | | |
| | List A | EPA 8240/8260 | | | | |
| | List A | EPA 8010A/8020A | 4 (3) | | | |
| | TOC | EPA 9060 | 20 | SS | Maxwell S-Cubed<br>8808 Balboa Ave<br>San Diego, CA 92123<br>(619) 637-7412 | |

| | |
|---|---|
| MC | Moisture Content |
| BD | BulkDensity |
| SG | Specific Gravity |
| TOC | Total Organic Carbon |
| TCLP | Toxicity Characteristic Leaching Procedure |
| SS | Split Spoon Sampling Ring (6 inch x 2.5 inch), 1 for sand and finer, 2 for coarse gravel |
| (1) | Quality control samples, splits of 10% of the samples collected by Hydro Geo Chem. |
| (2) | Estimated number of samples, includes trip blanks, equipment blanks, and duplicate samples. |
| (3) | Trip blanks and equipment blanks (water) associated with soil sampling. |

List A

Carbon Tetrachloride
Chloroform
Trichloroethene (TCE)
1,1,1-Trichloroethane (TCA)
1,1-Dichloroethene (DCE)
1,2-Dichloroethane (DCA)
Tetrachloroethene (PCE)
cis-1,1-DCE
trans-1,1-DCE
1,1-DCA
Vinyl Chloride
Benzene
Toluene
Ethylbenzene
Xylene

FIGURES



REFERENCE: USGS 7.5' Quadrangle; East and West Sacramento, California, Photorevised 1980.

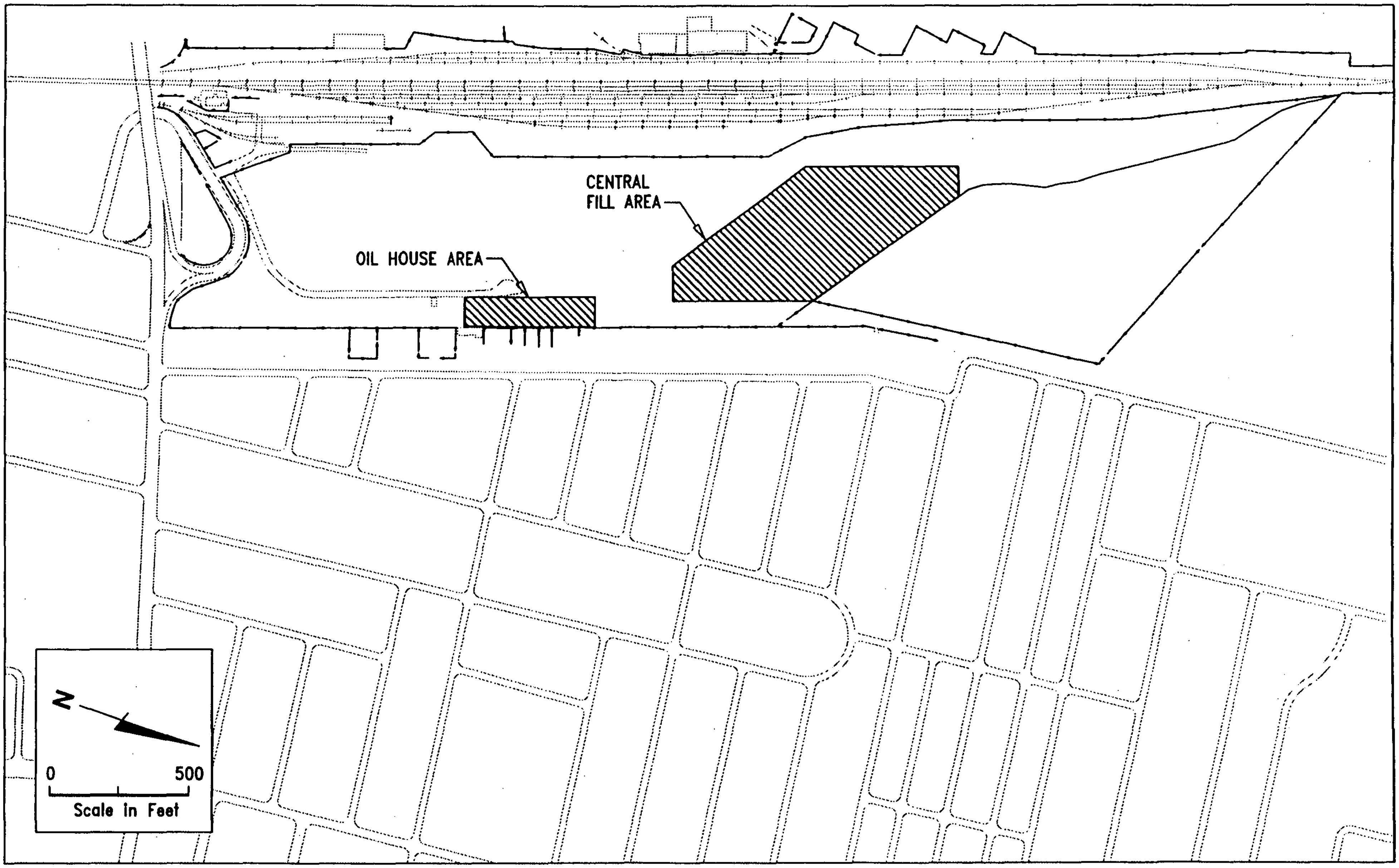
## SITE VICINITY MAP

Union Pacific Railroad Yard
Sacramento, California

DAMES & MOORE

00173-076-044

FIGURE 1



DAMES & MOORE

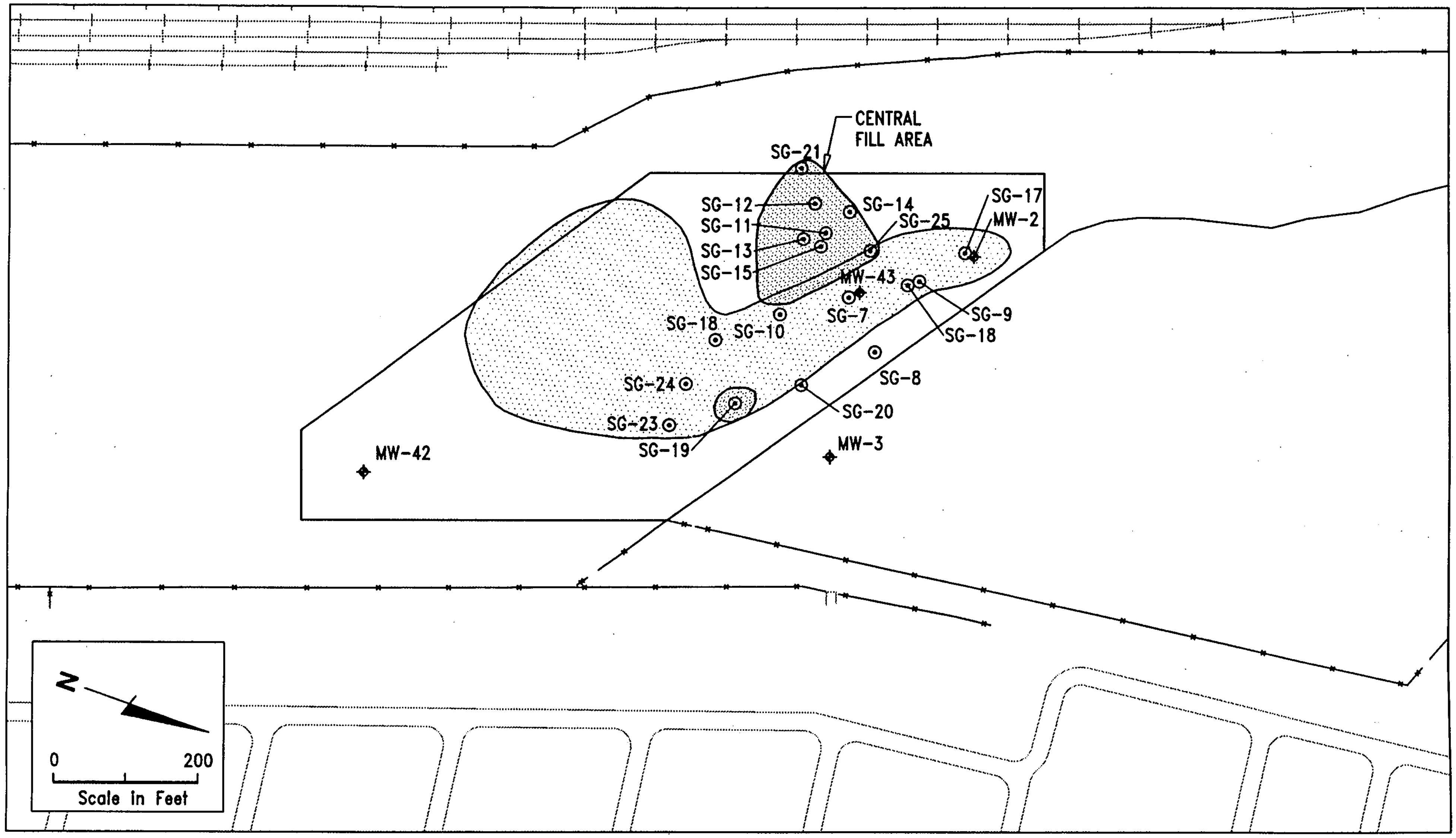
## LOCATIONS OF THE CENTRAL FILL AND THE OIL HOUSE AREAS

Union Pacific Railroad Yard
Sacramento, California

DAMES & MOORE

00173-080-5715-044 JBS 4/7/94 5715A

FIGURE 2



DAMES & MOORE

**EXPLANATION**

MW-4 ⌖ Monitoring Well

SG-3 ⊙ Previous Soil Gas Sampling Location

○ Previously Identified Area of Elevated Concentrations of VOCs (from soil gas data)

▨ Previously Identified Area of Elevated Concentrations of Total Petroleum Hydrocarbons (TPH)(from test pit soil samples)

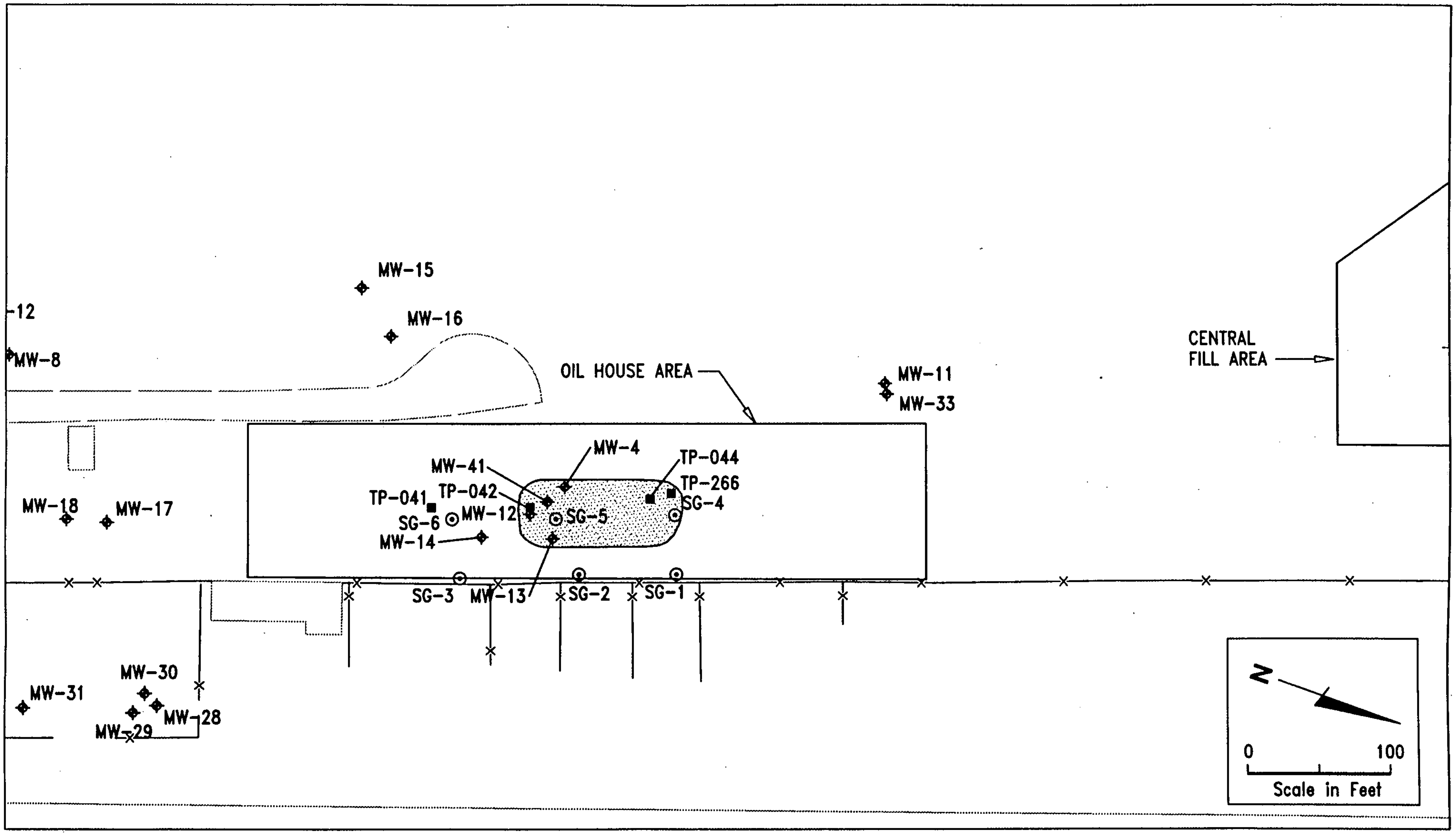
DAMES & MOORE

00173-080-5715-044 JBS 4/7/94 5715A

# PREVIOUSLY IDENTIFIED AREAS OF ELEVATED CONCENTRATIONS OF VOCs AND TPH IN SOIL IN THE CENTRAL FILL AREA

Union Pacific Railroad Yard
Sacramento, California

FIGURE 3



DAMES & MOORE

MW-4 ◆ Monitoring Well

SG-3 ⊙ Previous Soil Gas Sampling Location

TP-042 ■ Test Pit Location
(Logs included in Appendix A)

▨ Previously Identified Area of Elevated Concentrations of Total Petroleum Hydrocarbons (TPH)
(from analyses of soil samples and soil gas sample)

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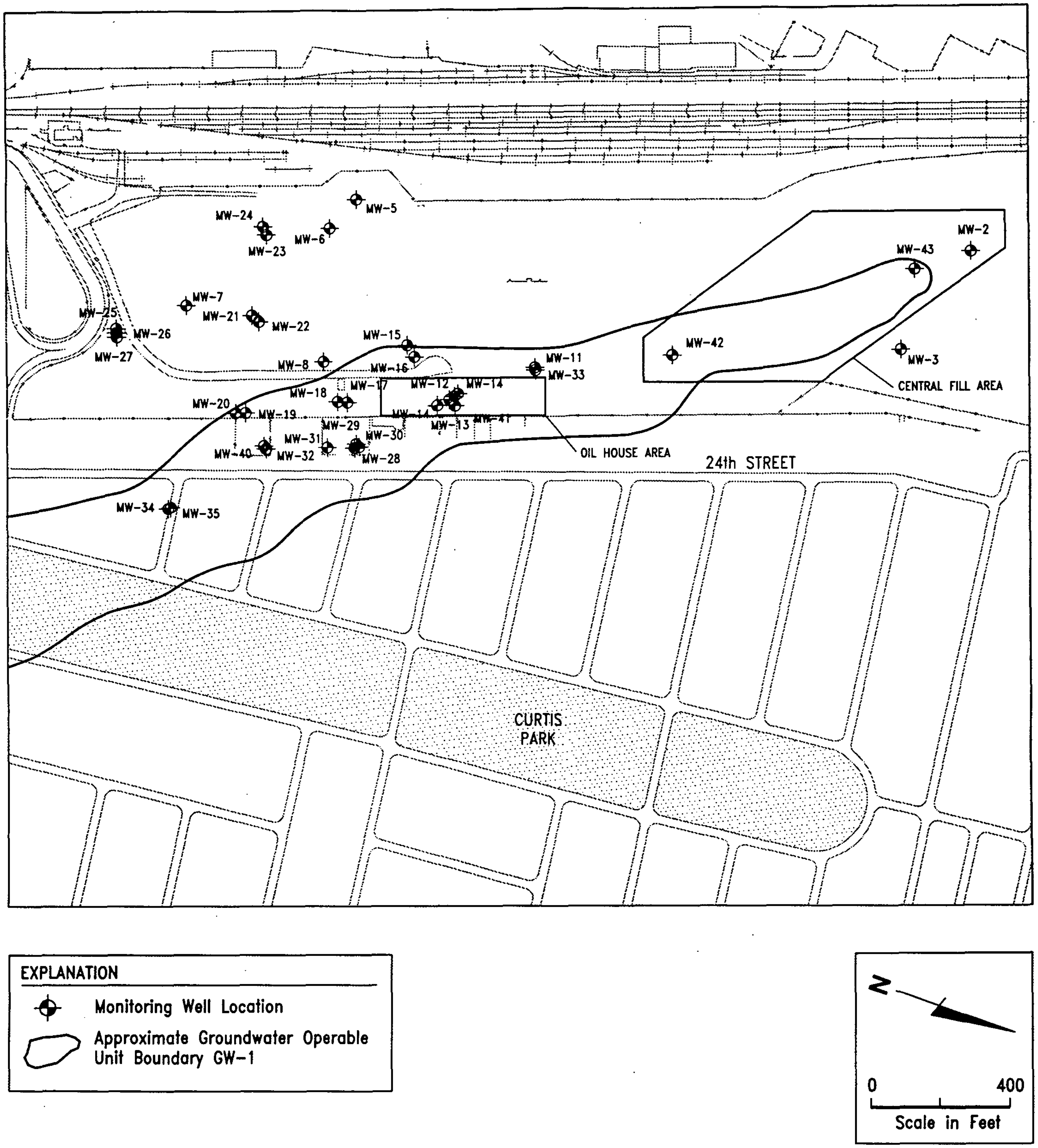
# PREVIOUSLY IDENTIFIED AREAS OF ELEVATED CONCENTRATIONS OF TPH IN SOIL IN THE OIL HOUSE AREA

Union Pacific Railroad Yard
Sacramento, California

00173-080-5715-044 JBS 4/7/94 5715A

FIGURE 4



# GROUNDWATER CONTAMINANT PLUME

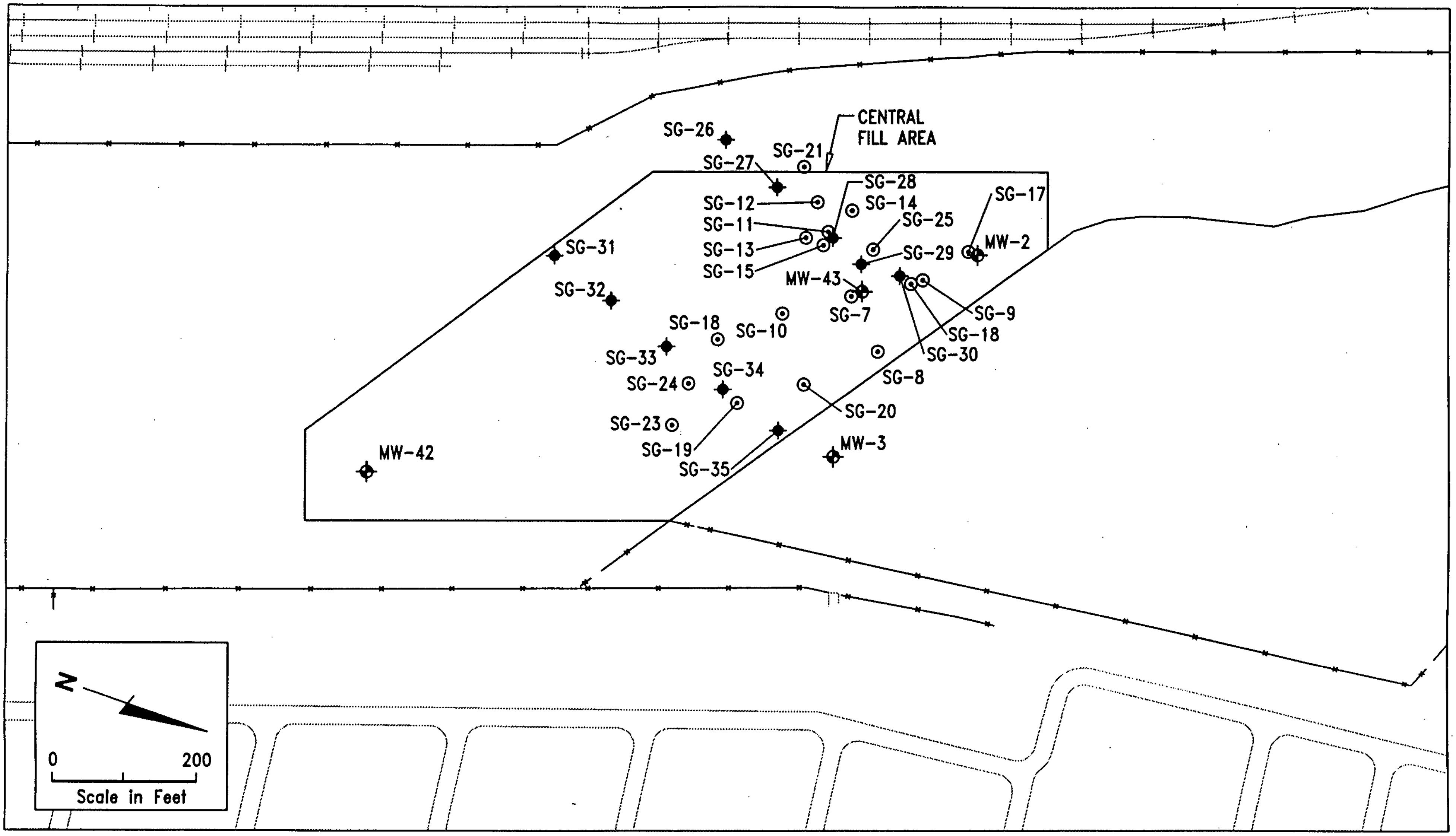
Union Pacific Railroad Yard
Sacramento, California

DAMES & MOORE

00173-080-5715-044 JBS 4/7/94 5715B

FIGURE 5

DAMES & MOORE



**EXPLANATION**

MW-42 ⌖ Monitoring Well

SG-24 ⊙ Previous Soil Gas Sampling Location

SG-35 ◆ Proposed Soil Gas Sampling Location

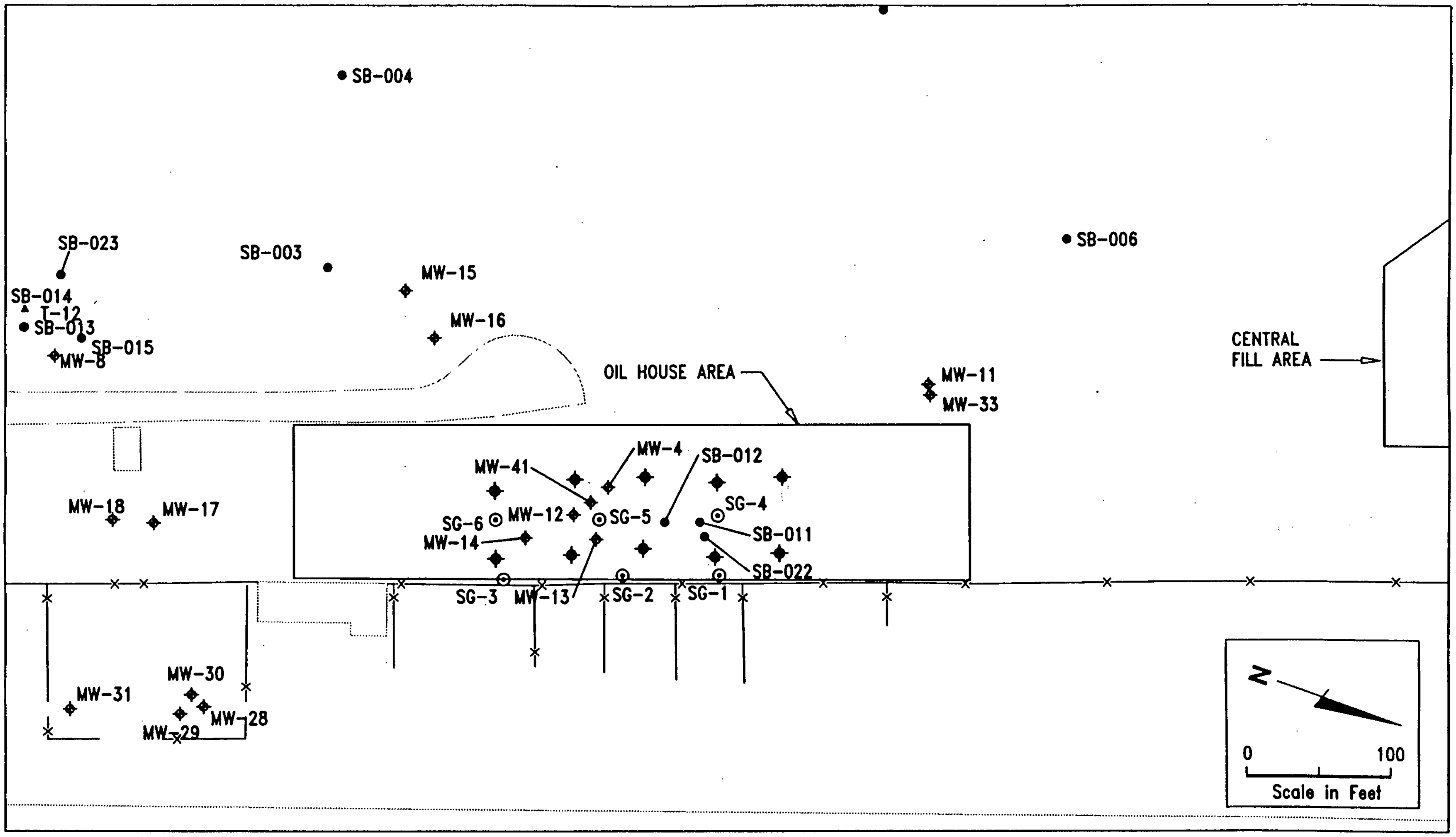
# PROPOSED AND PREVIOUS SOIL GAS SAMPLING LOCATIONS IN THE CENTRAL FILL AREA

Union Pacific Railroad Yard
Sacramento, California

DAMES & MOORE

00173-080-5715-044 JBS 4/7/94 5715A

FIGURE 6



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**EXPLANATION**

MW-11 ◈ Monitoring Well

SG-5 ⊙ Previous Soil Gas Sampling Location

◆ Proposed Soil Gas Sampling Location

—X—X— Fence Line

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# PROPOSED AND PREVIOUS SOIL GAS SAMPLING LOCATIONS IN THE OIL HOUSE AREA

Union Pacific Railroad Yard
Sacramento, California

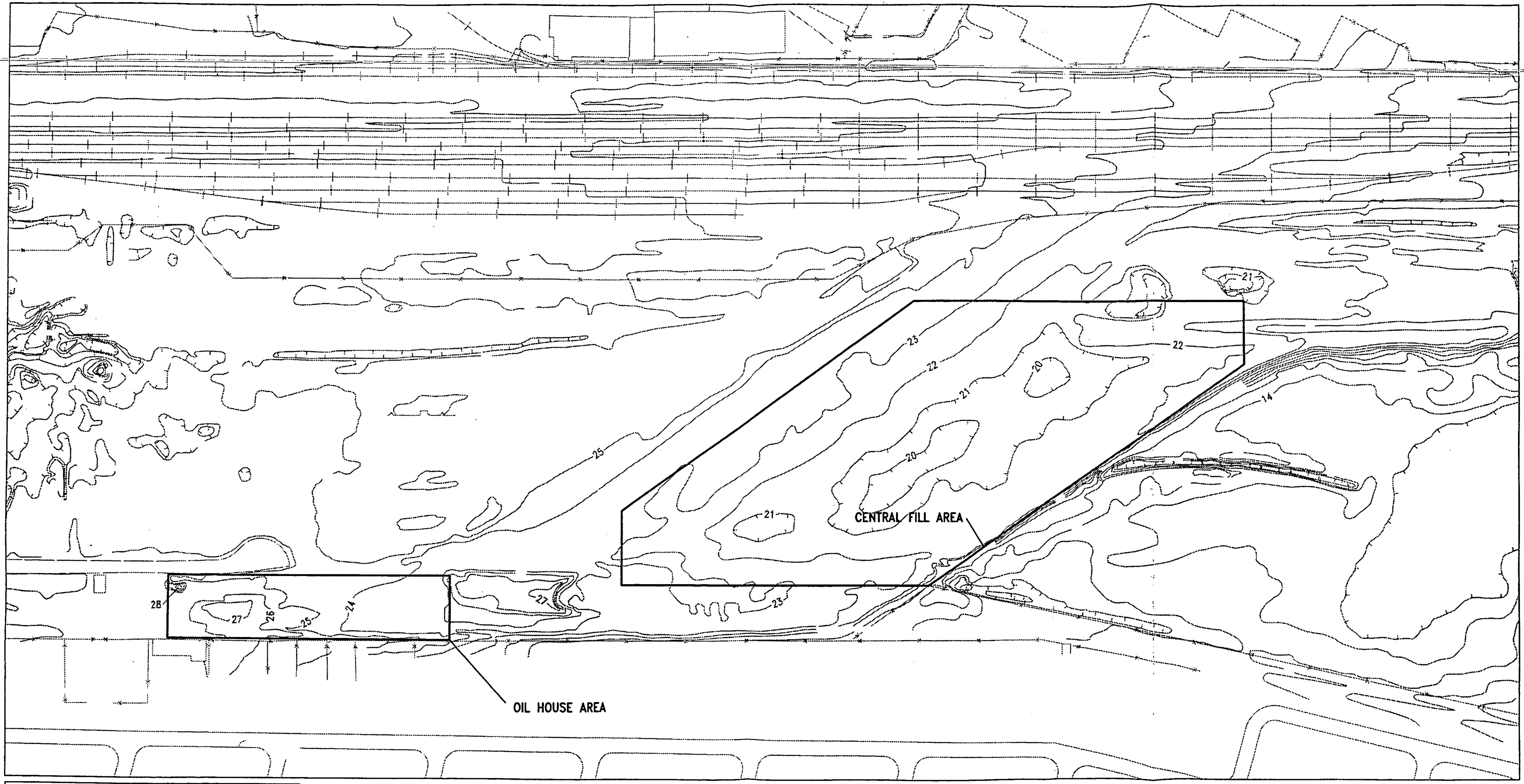
00173-080-5715-044 JBS 4/7/94 5715A

FIGURE 7

# Appendix A

# APPENDIX A

# TEST PIT LOCATIONS, TEST PIT FIELD LOGS, AND FIELD MAPS



**EXPLANATION**

Elevation of Ground Surface Relative to Mean Sea Level Datum (Contour Interval One foot)

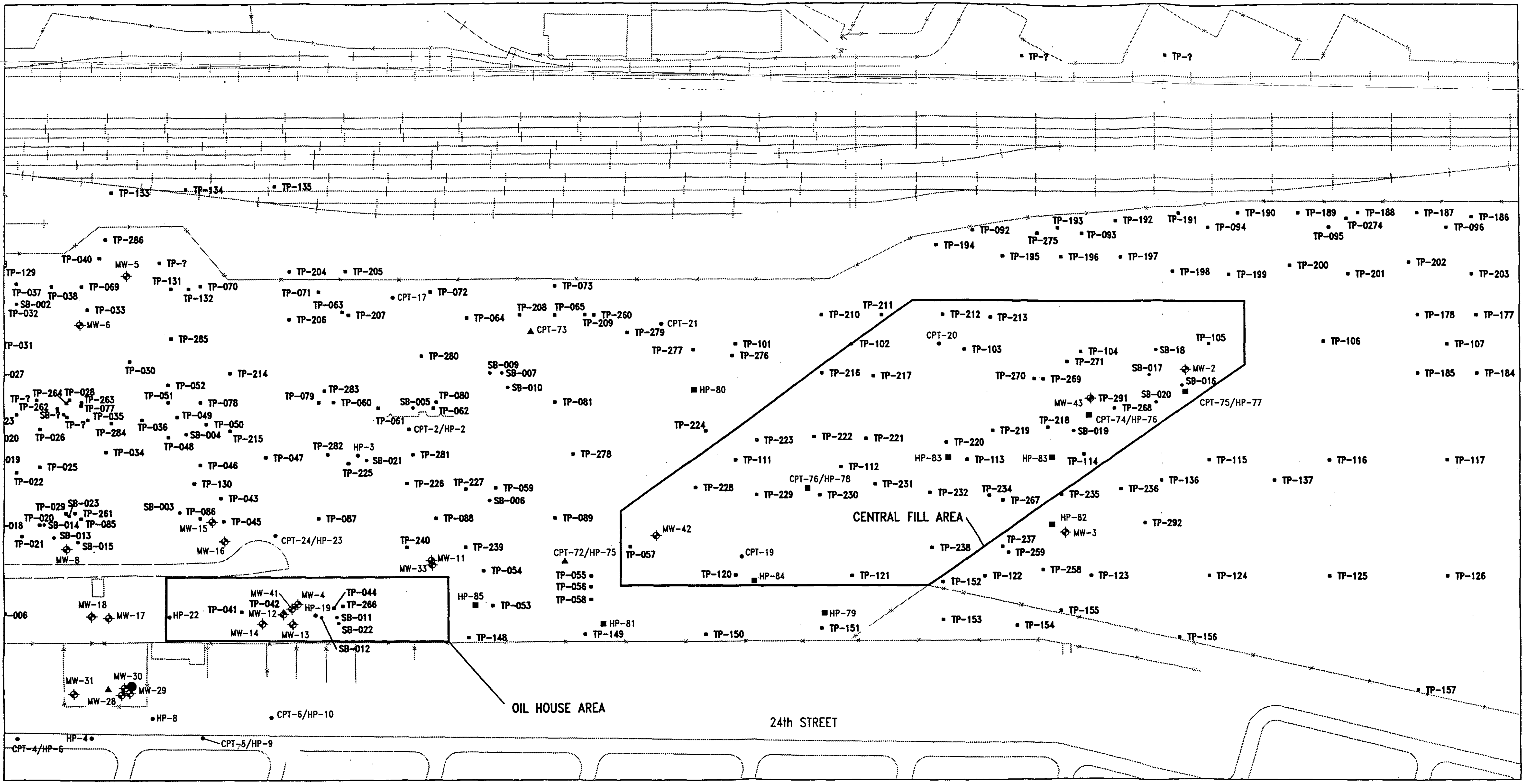
**GROUND SURFACE ELEVATIONS FOR THE CENTRAL FILL AND OIL HOUSE AREAS**

Union Pacific Railroad Yard
Sacramento, California

DAMES & MOORE

00173-080-5715-044 SJR 4/7/94 5715D

FIGURE 1A



EXPLANATION

| | |
|---|---|
| ⌖ MW-13 | Monitoring Well Location |
| • SB-012 | Soil Boring Location |
| • CPT-6/HP-10 | Cone Penetrometer and Hydropunch Test |
| ■ TP-041 | Test Pit Location |
| ■ HP-85 | Hydropunch Test |

N

0 180
Scale in Feet

## TEST PIT, MONITORING WELL, CPT/HP, AND SOIL BORING LOCATIONS IN THE CENTRAL FILL AND OIL HOUSE AREA

Union Pacific Railroad Yard
Sacramento, California

DAMES & MOORE

00173-080-5715-044 SJR 4/7/94 5715C

FIGURE 2A

# TEST PIT LOG

JOB NAME UPR - SACRAMENTO
JOB NUMBER 00173-064-044
DATE COMPLETED 12/22/87

# P-41

| SAMPLING | | | |
|---|---|---|---|
| Sample Type | Blows Per Foot | OVM (ppm) | SAMPLES |
| HD | 42 | 4 | |
| HD | 21 | 4 | |
| HD | 27 | 4 | |
| HD | 21 | 4 | |

DEPTH IN FEET

0 5 10 15 20 25 30 35

| SYMBOLS | DESCRIPTION |
|---|---|
| ML | ORANGE BROWN AND GRAY BROWN SILT; MOIST. FILL. |
| | SLIGHTLY MOIST. FILL. |
| ML | INTERFACE AT 2.5 FEET BELOW SURFACE; SHARP; HORIZONTAL. |
| | LIGHT BROWN TO ORANGE BROWN SILT; DRY. NATIVE SOIL. |

NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 4.5 FEET ON 12/22/87.

TEST PIT LOG
Dames & Moore

# TEST PIT LOG

**P-42**

JOB NAME UPR - SACRAMENTO
JOB NUMBER 00173-064-044
DATE COMPLETED 12/22/87

| DEPTH IN FEET | Sample Type | Blows Per Foot | OVM (ppm) | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | HD | 7 | 4 | | | DARK GRAY SAND AND CLAYEY SILT MIXED; MOIST; ODOROUS. FILL. |

NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 3.0 FEET ON 12/22/88

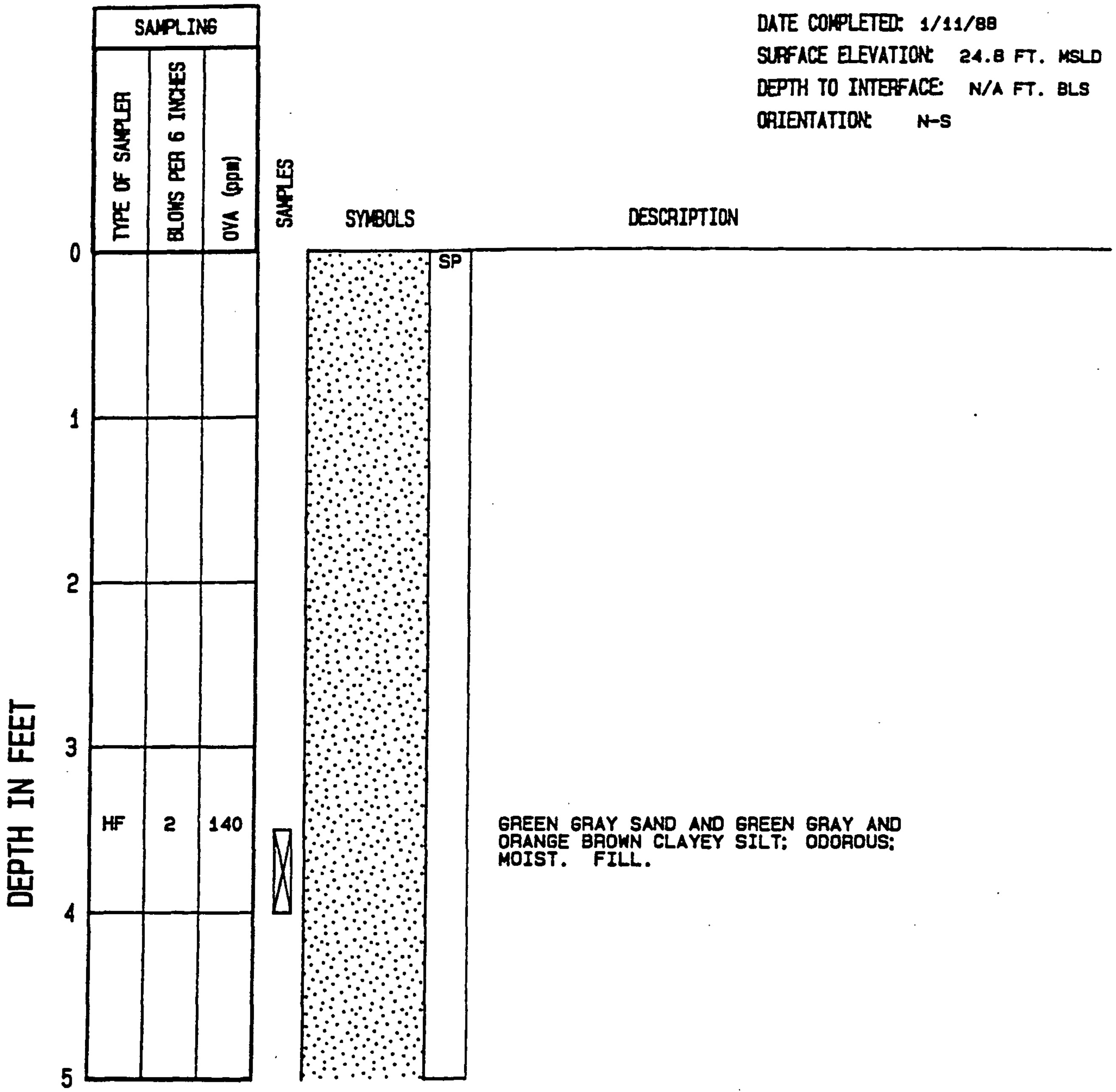
Depth scale: 0, 5, 10, 15, 20, 25, 30, 35

## TEST PIT LOG

Dames & Moore

# P-44

DATE COMPLETED: 1/11/88
SURFACE ELEVATION: 24.8 FT. MSLD
DEPTH TO INTERFACE: N/A FT. BLS
ORIENTATION: N-S



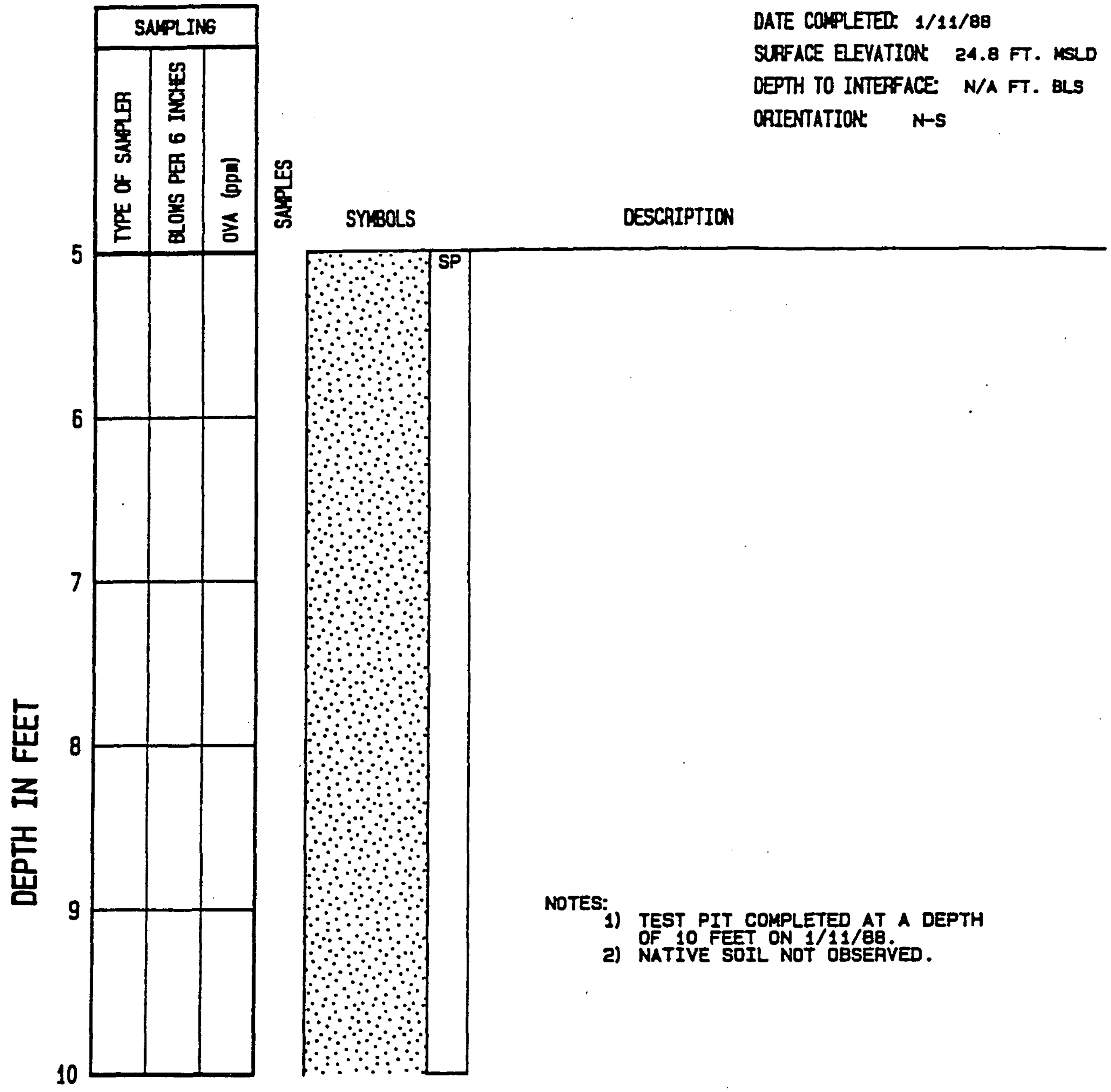
GREEN GRAY SAND AND GREEN GRAY AND ORANGE BROWN CLAYEY SILT; ODOROUS; MOIST. FILL.

# TEST PIT LOG

Dames & Moore

## P-44

DATE COMPLETED: 1/11/88
SURFACE ELEVATION: 24.8 FT. MSLD
DEPTH TO INTERFACE: N/A FT. BLS
ORIENTATION: N-S



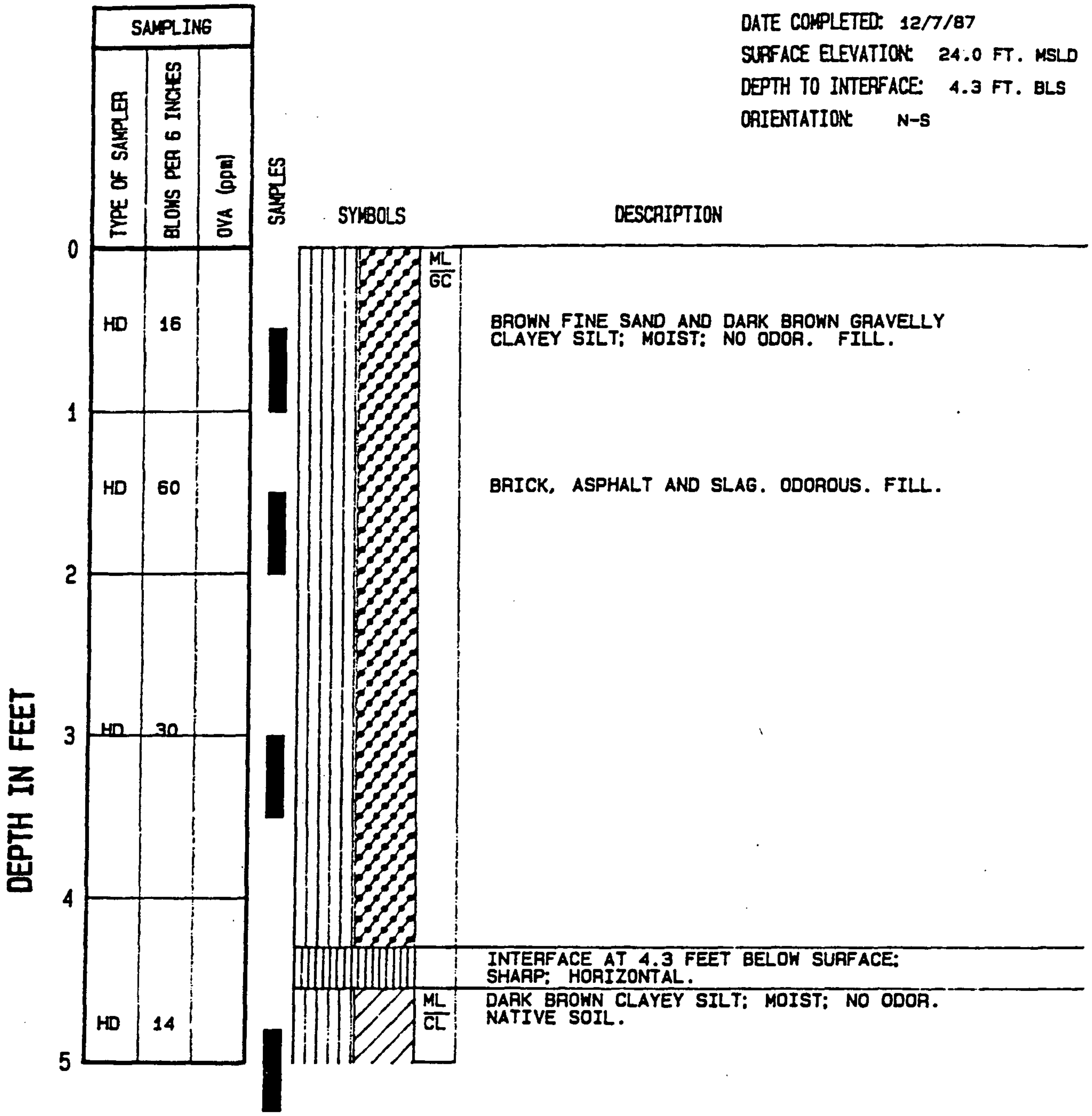
NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 10 FEET ON 1/11/88.
2) NATIVE SOIL NOT OBSERVED.

# TEST PIT LOG

Dames & Moore

## P-57

DATE COMPLETED: 12/7/87
SURFACE ELEVATION: 24.0 FT. MSLD
DEPTH TO INTERFACE: 4.3 FT. BLS
ORIENTATION: N-S



| TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) |
|---|---|---|
| HD | 16 | |
| HD | 60 | |
| HD | 30 | |
| HD | 14 | |

| SYMBOLS | DESCRIPTION |
|---|---|
| ML/GC | BROWN FINE SAND AND DARK BROWN GRAVELLY CLAYEY SILT; MOIST; NO ODOR. FILL. |
| | BRICK, ASPHALT AND SLAG. ODOROUS. FILL. |
| | INTERFACE AT 4.3 FEET BELOW SURFACE; SHARP; HORIZONTAL. |
| ML/CL | DARK BROWN CLAYEY SILT; MOIST; NO ODOR. NATIVE SOIL. |

# TEST PIT LOG

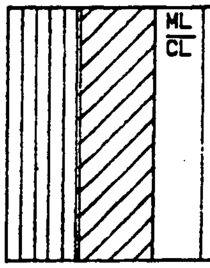
Dames & Moore

# P-57

DATE COMPLETED: 12/7/87
SURFACE ELEVATION: 24.0 FT. MSLD
DEPTH TO INTERFACE: 4.3 FT. BLS
ORIENTATION: N-S

DEPTH IN FEET

| DEPTH IN FEET | SAMPLING | | | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| | TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) | | | |
| 5 | HD | 18 | | ■ | ML/CL | DARK RED BROWN |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |



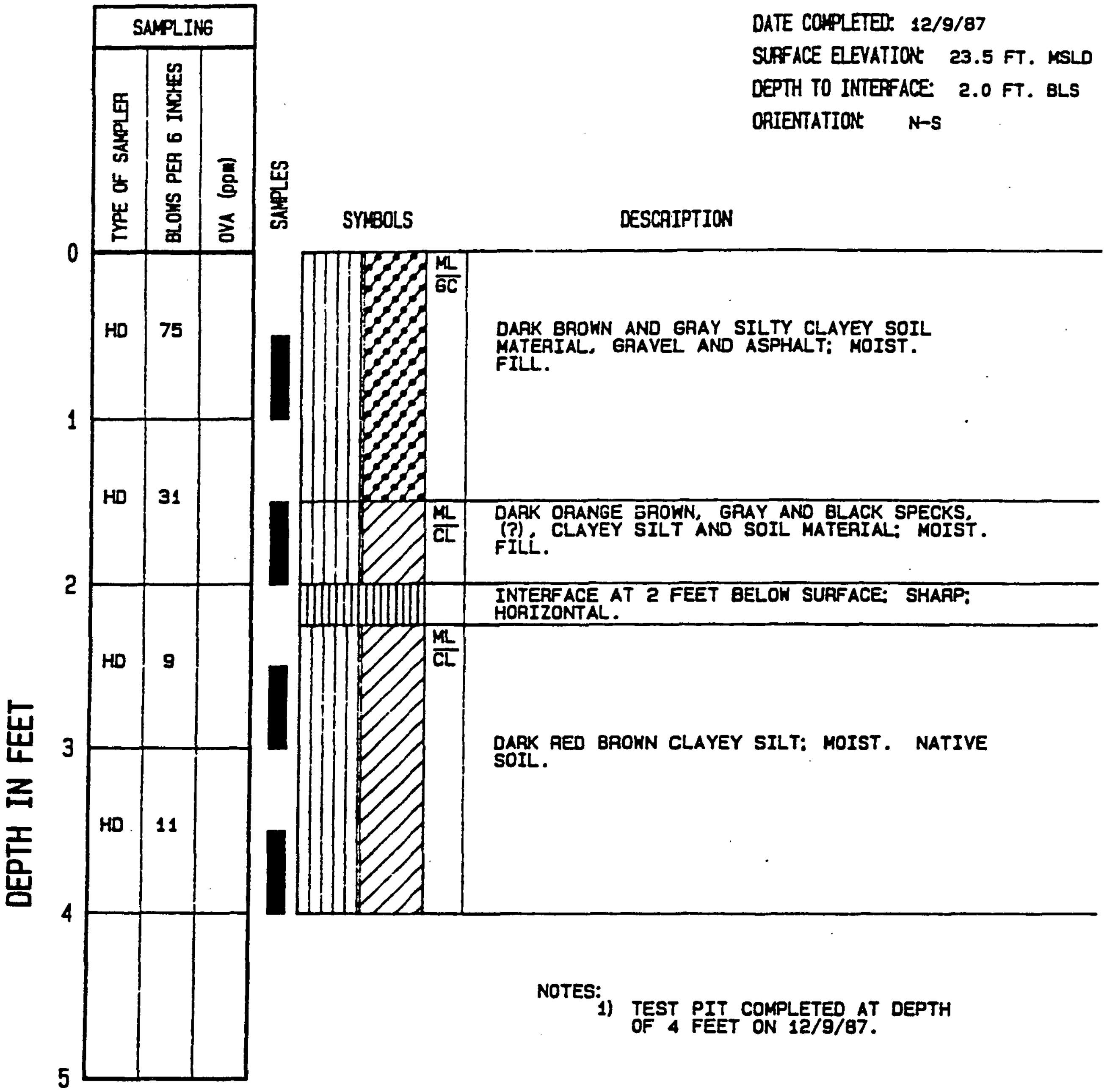
NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 6.3 FEET ON 12/7/87.

# TEST PIT LOG

Dames & Moore

# P-102

DATE COMPLETED: 12/9/87
SURFACE ELEVATION: 23.5 FT. MSLD
DEPTH TO INTERFACE: 2.0 FT. BLS
ORIENTATION: N-S



| DEPTH IN FEET | SAMPLING | | |
|---|---|---|---|
| | TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) |
| 0–1 | HD | 75 | |
| 1–2 | HD | 31 | |
| 2–3 | HD | 9 | |
| 3–4 | HD | 11 | |
| 4–5 | | | |

| SYMBOLS | DESCRIPTION |
|---|---|
| ML/GC | DARK BROWN AND GRAY SILTY CLAYEY SOIL MATERIAL, GRAVEL AND ASPHALT; MOIST. FILL. |
| ML/CL | DARK ORANGE BROWN, GRAY AND BLACK SPECKS, (?), CLAYEY SILT AND SOIL MATERIAL; MOIST. FILL. |
| | INTERFACE AT 2 FEET BELOW SURFACE; SHARP; HORIZONTAL. |
| ML/CL | DARK RED BROWN CLAYEY SILT; MOIST. NATIVE SOIL. |

NOTES:
1) TEST PIT COMPLETED AT DEPTH OF 4 FEET ON 12/9/87.

# TEST PIT LOG

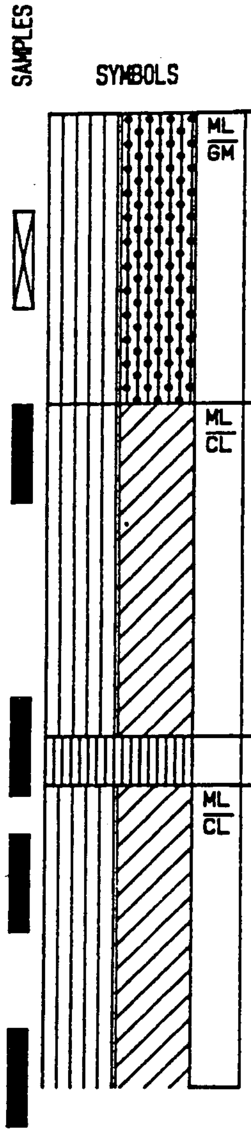
Dames & Moore

# P-103

DATE COMPLETED: 12/9/87
SURFACE ELEVATION: 22.0 FT. MSLD
DEPTH TO INTERFACE: 3.2 FT. BLS
ORIENTATION: N-S

DEPTH IN FEET

| SAMPLING |  |  |
|---|---|---|
| TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) |
| HF |  |  |
| HD | 55 |  |
| HD | 50 |  |
| HD | 22 |  |
| HD | 13 |  |



DESCRIPTION

ML/GM — GRAVELLY SILTY SOIL MATERIAL; MOIST; SLIGHTLT ODOROUS. FILL.

ML/CL — DARK RED BROWN CLAYEY SILTY SOIL MATERIAL WITH BLACK SPECKS; MOIST; NO ODOR. FILL.

INTERFACE AT 3.2 FEET BELOW SURFACE; SHARP; HORIZONTL.

ML/CL — DARK RED BROWN CLAYEY SILT; MOIST; NO ODOR. NATIVE SOIL.

# TEST PIT LOG

Dames & Moore

# P-103

DATE COMPLETED: 12/9/87
SURFACE ELEVATION: 22.0 FT. MSLD
DEPTH TO INTERFACE: 3.2 FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING<br>TYPE OF SAMPLER | SAMPLING<br>BLOWS PER 6 INCHES | SAMPLING<br>OVA (ppm) | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| 5 | | | | | ▥▨ ML/CL | |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |

NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 5.5 FEET ON 12/9/87.

## TEST PIT LOG

Dames & Moore

## P-104

DATE COMPLETED: 12/10/87
SURFACE ELEVATION: 21.0 FT. MSLD
DEPTH TO INTERFACE: 3.75 FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING<br>TYPE OF SAMPLER | SAMPLING<br>BLOWS PER 6 INCHES | SAMPLING<br>OVA (ppm) | SAMPLES | SYMBOLS | | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 0 | HD | 20 | | ■ | ▨ | ML<br>CL | DARK RED BROWN CLAYEY SILT; MOIST. FILL. |
| 1 | HD | 12 | | ■ | ▨ | | |
| 2 | | | | | ▨ | | |
| 3 | HD | 12 | | ■ | ▨ | ML<br>SC | ORANGE BROWN TO BROWN SANDY CLAYEY SILT TO SILTY FINE SAND; MOIST. FILL. |
| 3.75 | | | | | ▥ | | INTERFACE AT 3.75 FEET BELOW SURFACE; SHARP; HORIZONTAL. |
| 4 | HD | 10 | | ■ | ▨ | ML<br>SM | DARK BROWN FINE SANDY SILT; MOIST. NATIVE SOIL. |
| 5 | | | | | | | |

# TEST PIT LOG

Dames & Moore

## P-104

DATE COMPLETED: 12/10/87
SURFACE ELEVATION: 21.0 FT. MSLD
DEPTH TO INTERFACE: 3.75 FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING<br>TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| 5 | | | | | ML/SM | |
| | HD | 8 | | ■ | ML/SC | DARK RED BROWN SANDY SILT WITH MINOR CLAY: MOIST. |
| 6 | | | | | | |
| 7 | | | | | | |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |

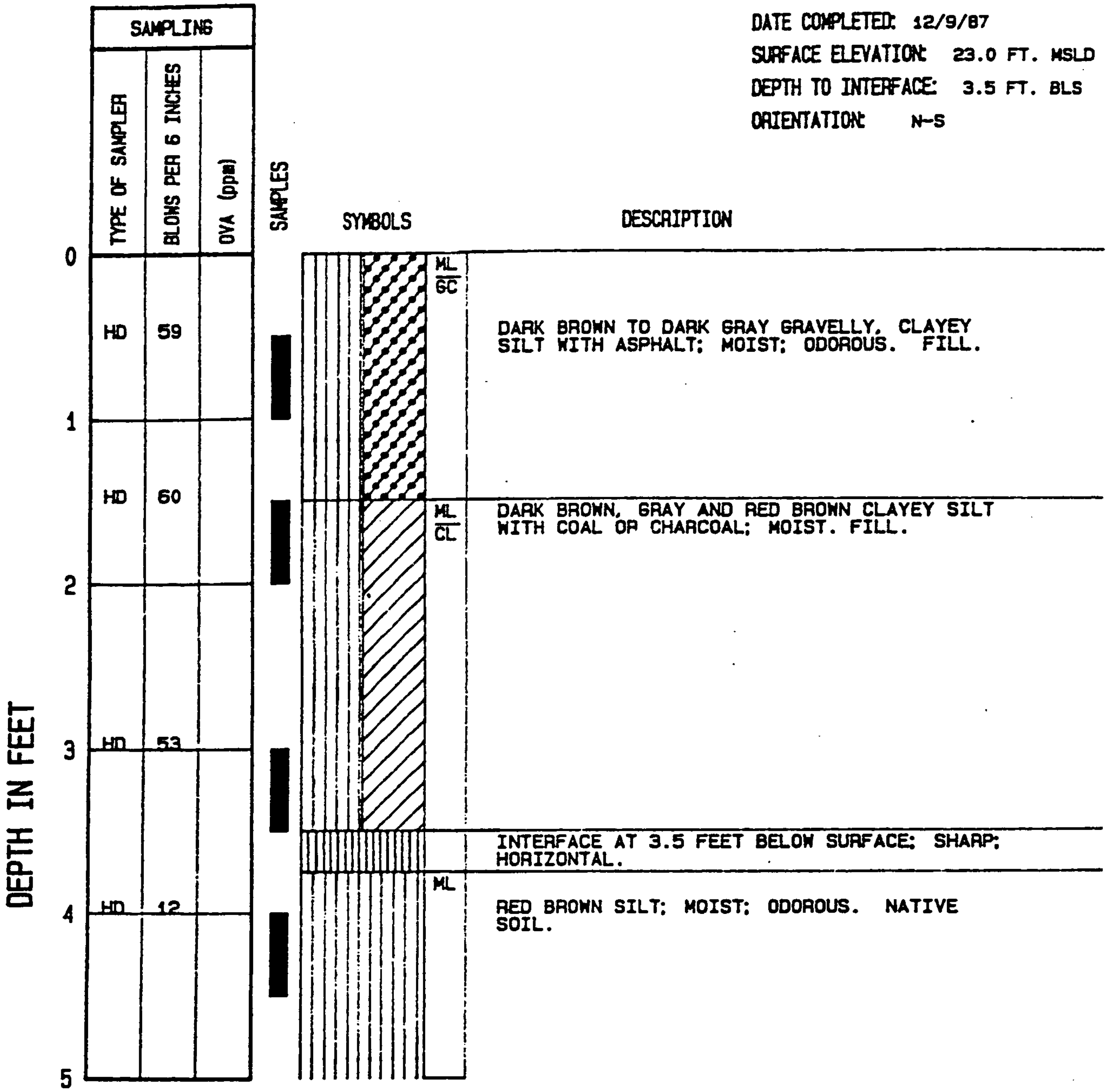
NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 5.75 FEET ON 12/10/87.

# TEST PIT LOG

Dames & Moore

# P-111

DATE COMPLETED: 12/9/87
SURFACE ELEVATION: 23.0 FT. MSLD
DEPTH TO INTERFACE: 3.5 FT. BLS
ORIENTATION: N-S



| TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) |
|---|---|---|
| HD | 59 | |
| HD | 60 | |
| HD | 53 | |
| HD | 12 | |

DARK BROWN TO DARK GRAY GRAVELLY, CLAYEY SILT WITH ASPHALT; MOIST; ODOROUS. FILL.

DARK BROWN, GRAY AND RED BROWN CLAYEY SILT WITH COAL OR CHARCOAL; MOIST. FILL.

INTERFACE AT 3.5 FEET BELOW SURFACE: SHARP; HORIZONTAL.

RED BROWN SILT; MOIST; ODOROUS. NATIVE SOIL.

## TEST PIT LOG

Dames & Moore

## P-111

DATE COMPLETED: 12/9/87
SURFACE ELEVATION: 23.0 FT. MSLD
DEPTH TO INTERFACE: 3.5 FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING<br>TYPE OF SAMPLER | SAMPLING<br>BLOWS PER 6 INCHES | SAMPLING<br>OVA (ppm) | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| 5 | HD | 12 |  | ■ | ▥ ML |  |
| 6 |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |

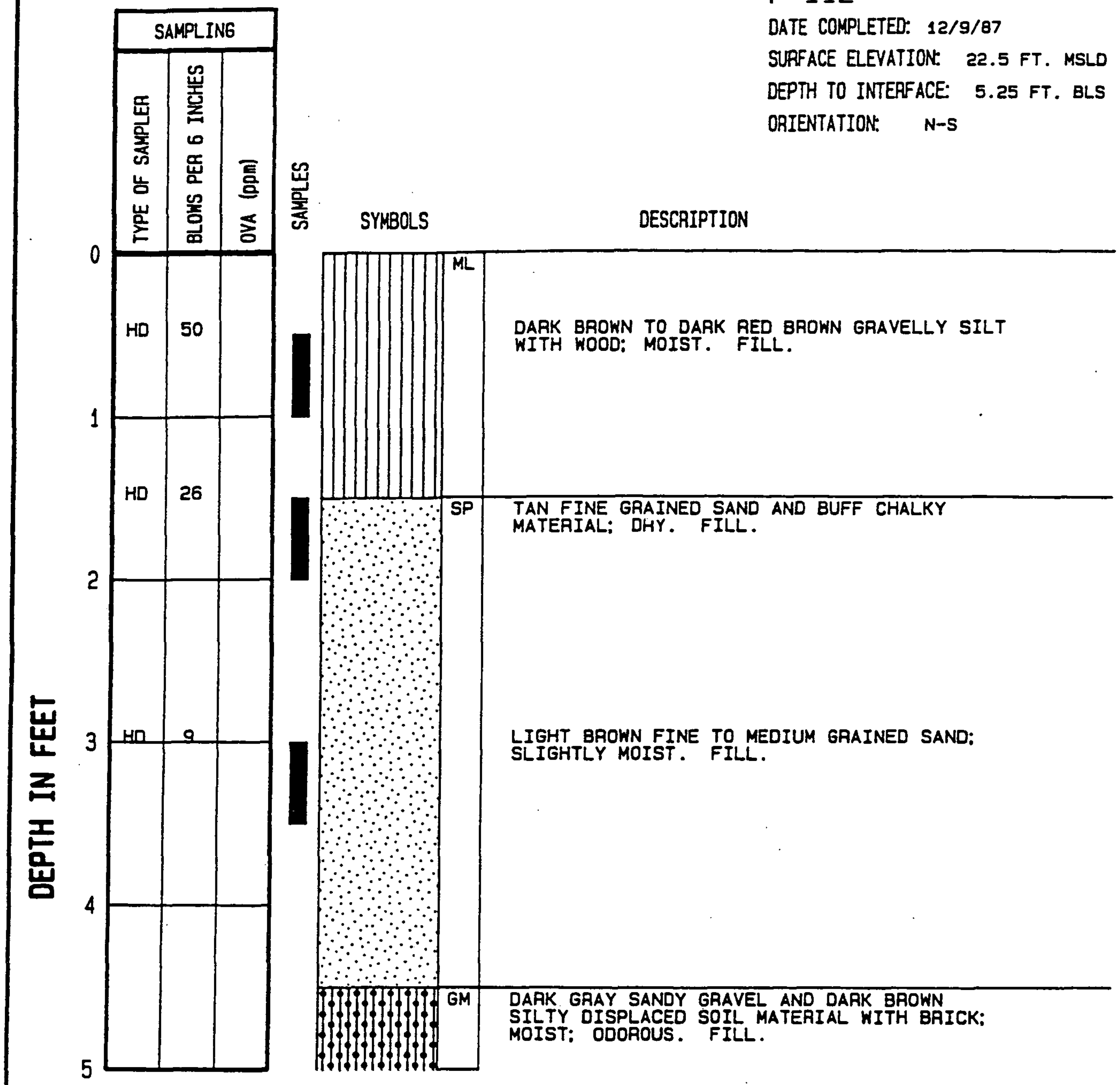
NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 5.5 FEET ON 12/9/87.

# TEST PIT LOG

Dames & Moore

# P-112

DATE COMPLETED: 12/9/87
SURFACE ELEVATION: 22.5 FT. MSLD
DEPTH TO INTERFACE: 5.25 FT. BLS
ORIENTATION: N-S



| SAMPLING | | |
|---|---|---|
| TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) |
| HD | 50 | |
| HD | 26 | |
| HD | 9 | |

DESCRIPTION

DARK BROWN TO DARK RED BROWN GRAVELLY SILT WITH WOOD; MOIST. FILL.

TAN FINE GRAINED SAND AND BUFF CHALKY MATERIAL; DRY. FILL.

LIGHT BROWN FINE TO MEDIUM GRAINED SAND; SLIGHTLY MOIST. FILL.

DARK GRAY SANDY GRAVEL AND DARK BROWN SILTY DISPLACED SOIL MATERIAL WITH BRICK; MOIST; ODOROUS. FILL.

# TEST PIT LOG

Dames & Moore

# P-112

DATE COMPLETED: 12/9/87
SURFACE ELEVATION: 22.5 FT. MSLD
DEPTH TO INTERFACE: 5.25 FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING | | | SAMPLES | SYMBOLS | | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) | | | | |
| 5 | HD | 20 | | ▮ | ▦ | GM | |
| | HD | 12 | | ▮ | ▥ | | INTERFACE AT 5.25 FEET BELOW SURFACE; SHARP; HOPRIZONTAL. |
| | | | | ▮ | ▨ | ML/CL | DARK RED BROWN CLAYEY SILT; MOIST; NO ODOR. NATIVE SOIL. |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |

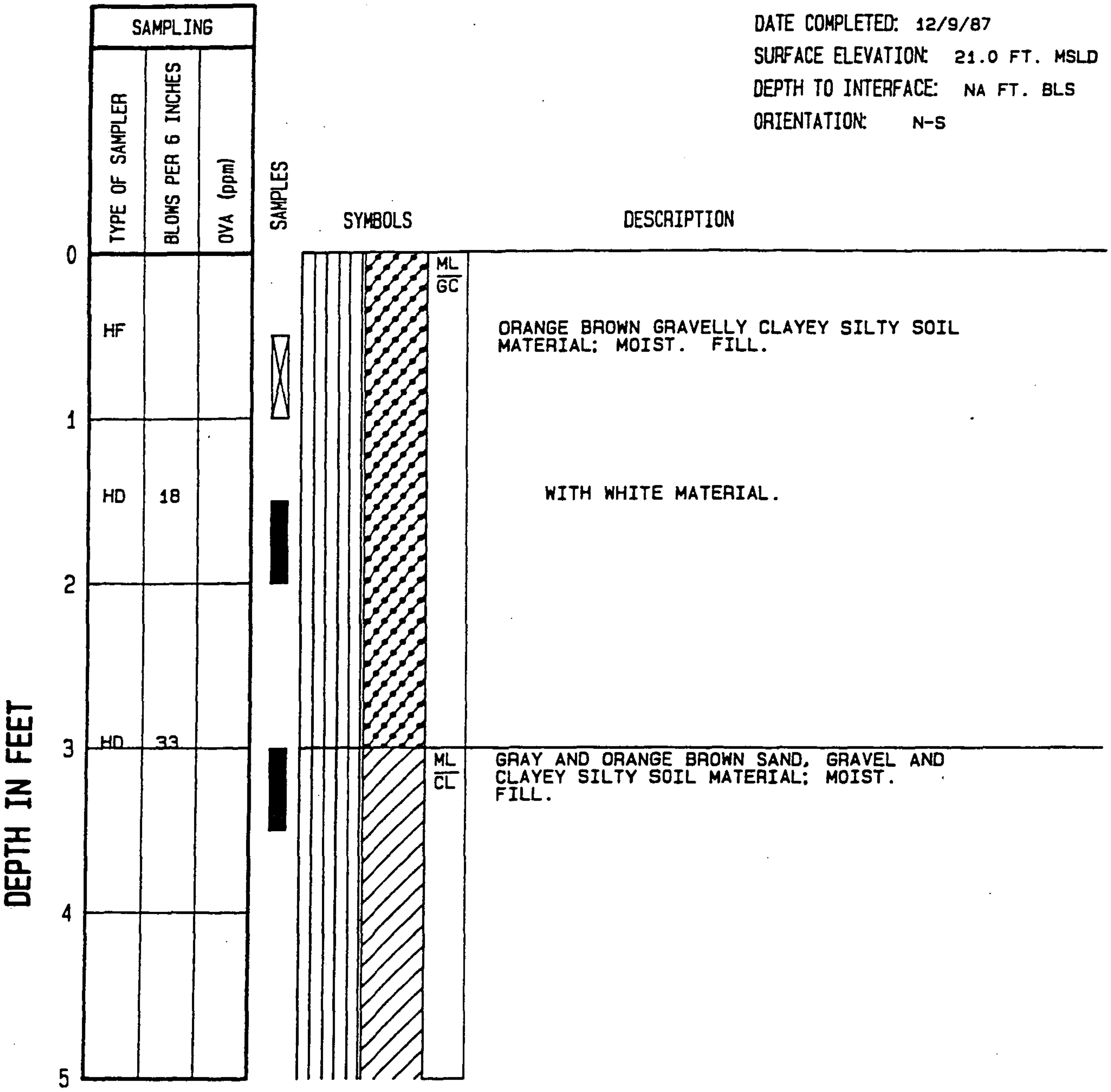
NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 6.25 FEET ON 12/9/87.

# TEST PIT LOG

Dames & Moore

# P-113

DATE COMPLETED: 12/9/87
SURFACE ELEVATION: 21.0 FT. MSLD
DEPTH TO INTERFACE: NA FT. BLS
ORIENTATION: N-S



ORANGE BROWN GRAVELLY CLAYEY SILTY SOIL MATERIAL; MOIST. FILL.

WITH WHITE MATERIAL.

GRAY AND ORANGE BROWN SAND, GRAVEL AND CLAYEY SILTY SOIL MATERIAL; MOIST. FILL.

# TEST PIT LOG

Dames & Moore

## P-113

DATE COMPLETED: 12/9/87
SURFACE ELEVATION: 21.0 FT. MSLD
DEPTH TO INTERFACE: NA FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING<br>TYPE OF SAMPLER | SAMPLING<br>BLOWS PER 6 INCHES | SAMPLING<br>OVA (ppm) | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| 5 | HD | 12 | | ■ | ML<br>CL | ORANGE BROWN CLAYEY SILT; MOIST. FILL. |
| 6 | | | | | | |
| 7 | | | | | ML | DARK BROWN AND GRAY SILTY SOIL MATERIAL WITH BRICK AND WOOD; MOIST; ODOROUS. FILL. |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |

NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 8 FEET ON 12/9/87.
2) FILL/NATIVE SOIL INTERFACE NOT OBSERVED.

# TEST PIT LOG

Dames & Moore

P-114

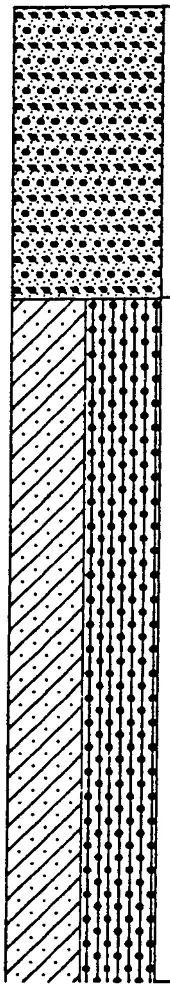
DATE COMPLETED: 1/12/88

SURFACE ELEVATION: 21.5 FT. MSLD

DEPTH TO INTERFACE: NOT OBSERVED FT. BLS

ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING: TYPE OF SAMPLER | SAMPLING: BLOWS PER 6 INCHES | SAMPLING: OVA (ppm) | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | GP | |
| | HF | | | ☒ | | BROWN SANDY GRAVEL; MOIST. FILL. |
| 1 | | | | | | |
| | HD | 33 | | ■ | SC<br>GM | BROWN GRAVELLY SILTY SANDY CLAY WITH WHITE MATERIAL; MOIST. FILL. |
| 2 | | | | | | |
| 3 | HD | 25 | | ■ | | FILL |
| 4 | | | | | | |
| 5 | | | | | | |



# TEST PIT LOG

Dames & Moore

## P-114

DATE COMPLETED: 1/12/88
SURFACE ELEVATION: 21.5 FT. MSLD
DEPTH TO INTERFACE: NOT OBSERVED FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING<br>TYPE OF SAMPLER | SAMPLING<br>BLOWS PER 6 INCHES | SAMPLING<br>OVA (ppm) | SAMPLES | SYMBOLS | | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 5 | HD | 25 | | ▮ | ▨ | SC<br>GM | FILL |
| 6 | | | | | | | |
| 7 | | | | | | | |
| 8 | | | | | | | |
| 9 | | | | | | | |
| 10 | | | | | | | |

NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 6 FEET ON 1/12/88.
2) WHITE MATERIAL IS CONSOLIDATED POWDERY MATERIAL SIMILAR TO DRYWALL.
3) FILL/NATIVE SOIL INTERFACE NOT OBSERVED.

# TEST PIT LOG

Dames & Moore

# P-120

DATE COMPLETED: 12/7/87
SURFACE ELEVATION: 23.0 FT. MSLD
DEPTH TO INTERFACE: NOT OBSERVED FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING | | | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| | TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) | | | |
| 0 | HD | 3 | | ■ | SP | BROWN FINE GRAINED SAND; MOIST. FILL. |
| 1 | HD | 2 | | ■ | | |
| 2 | | | | | | |
| 3 | HD | 2 | | ■ | | |
| 4 | | | | | | |
| 5 | | | | | | |

# TEST PIT LOG

Dames & Moore

## P-120

DATE COMPLETED: 12/7/87
SURFACE ELEVATION: 23.0 FT. MSLD
DEPTH TO INTERFACE: NOT OBSERVED FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING |  |  | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
|  | TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) |  |  |  |
| 5 | HD | 3 |  | ■ | ▥ ML/CL | BOTTOM OF SAMPLE RING CONTAINED DARK BROWN CLAYEY SILT; MOIST. FILL. |
| 6 |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |

NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 6 FEET ON 12/7/87.
2) INTERFACE NOT SEEN.
3) CONCRETE CHUNKS MIXED WITH SOIL AT 6 FEET AND BELOW.

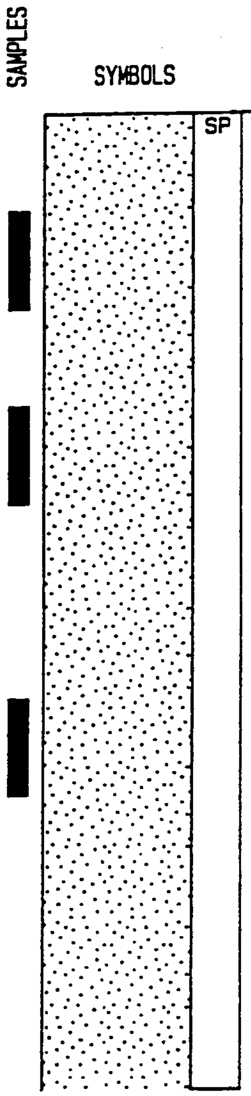
# TEST PIT LOG

Dames & Moore

# P-121

DATE COMPLETED: 12/7/87
SURFACE ELEVATION: 20.5 FT. MSLD
DEPTH TO INTERFACE: NOT OBSERVED FT. BLS
ORIENTATION: N-S

| DEPTH IN FEET | SAMPLING<br>TYPE OF SAMPLER | SAMPLING<br>BLOWS PER 6 INCHES | SAMPLING<br>OVA (ppm) |
|---|---|---|---|
| 0 | | | |
| | HD | 9 | |
| 1 | | | |
| | HD | 13 | |
| 2 | | | |
| 3 | HD | 12 | |
| 4 | | | |
| 5 | | | |



DESCRIPTION

BROWN FINE GRAINED SAND; MOIST. FILL.

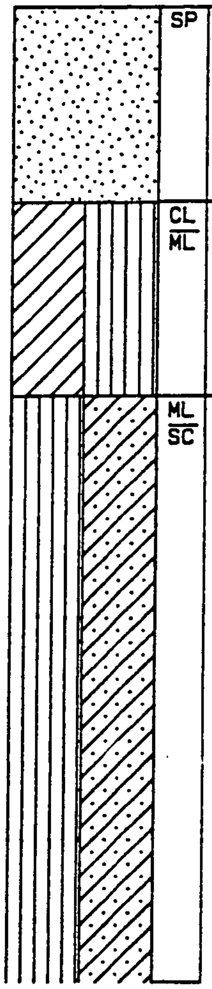
SOME SOIL PEDS OF DARK BROWN GRAVELLY SILT. FILL.

# TEST PIT LOG

Dames & Moore

## P-121

DATE COMPLETED: 12/7/87
SURFACE ELEVATION: 20.5 FT. MSLD
DEPTH TO INTERFACE: NOT OBSERVED FT. BLS
ORIENTATION: N-S



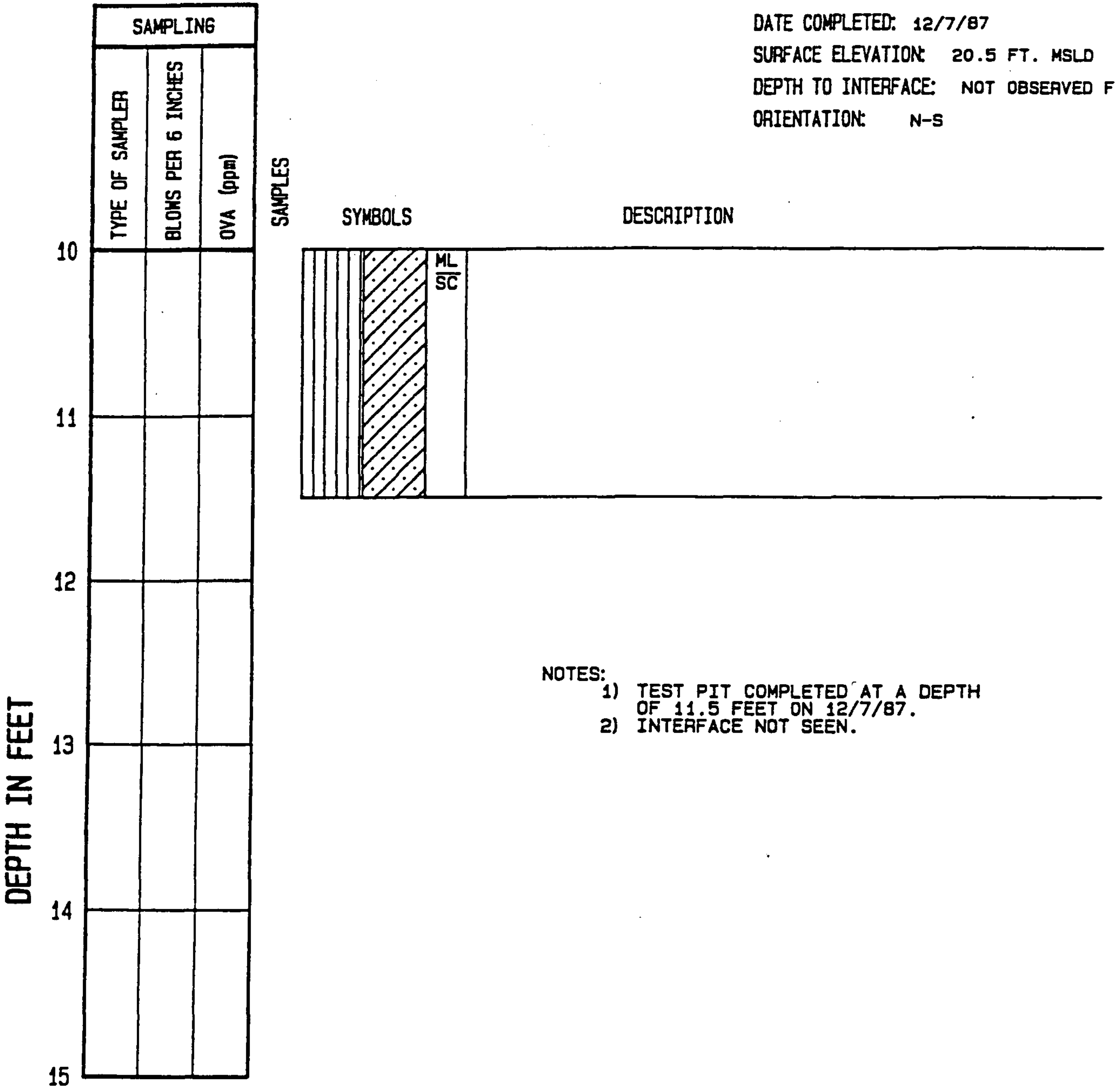
| DEPTH IN FEET | SAMPLING | | | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| | TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) | | | |
| 5 | | | | | SP | |
| 6 | HD | 6 | | ■ | CL/ML | DARK GRAY AND BROWN SILTY CLAY; MOIST; ODOROUS. FILL. |
| 7 | | | | | ML/SC | ORANGE BROWN, BROWN AND GRAY CLAYEY SANDY SILT; MOIST; ODOROUS. FILL. |
| 8 | | | | | | |
| 9 | | | | | | |
| 10 | | | | | | |

# TEST PIT LOG

Dames & Moore

# P-121

DATE COMPLETED: 12/7/87
SURFACE ELEVATION: 20.5 FT. MSLD
DEPTH TO INTERFACE: NOT OBSERVED FT. BLS
ORIENTATION: N-S



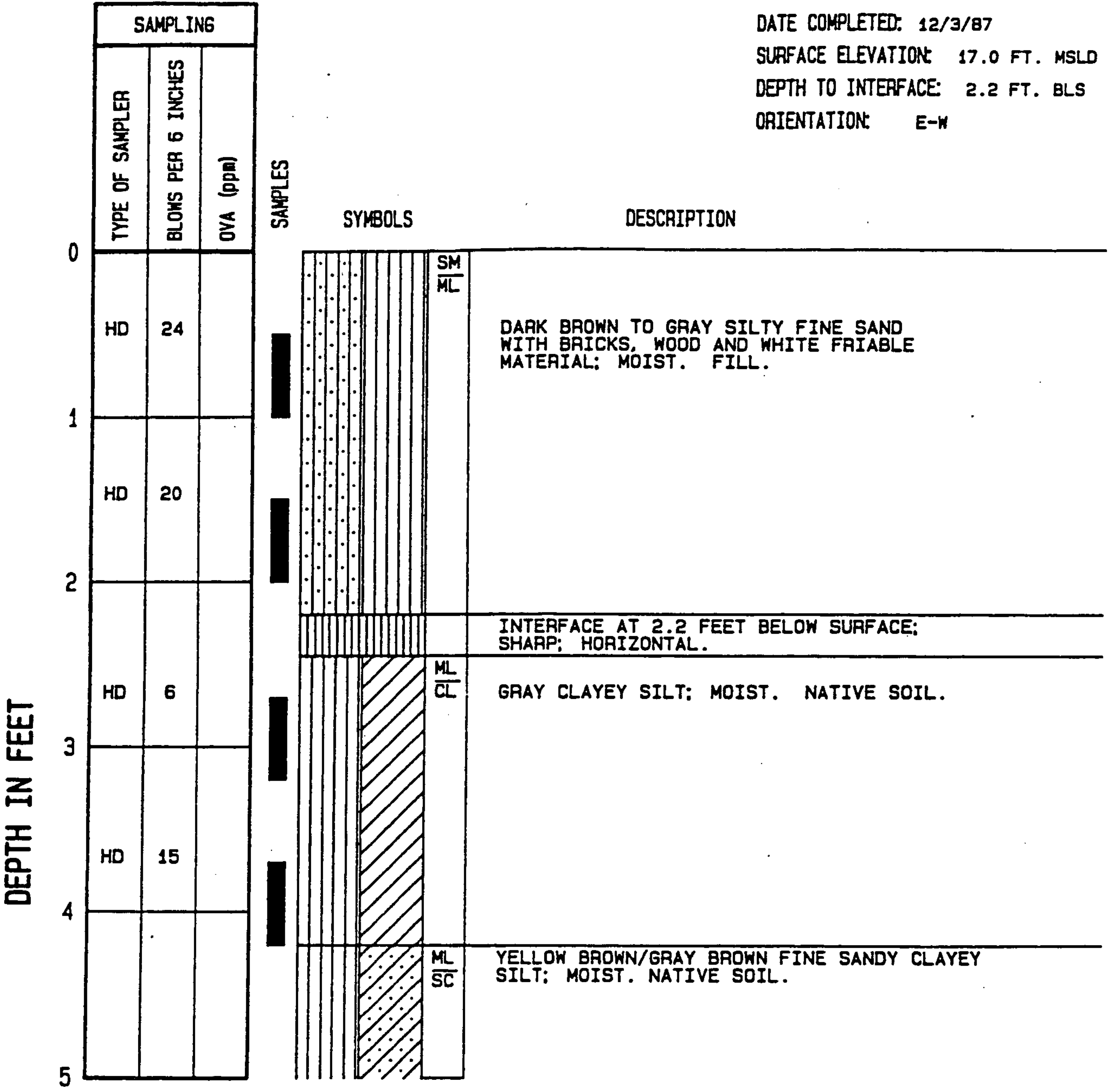
NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 11.5 FEET ON 12/7/87.
2) INTERFACE NOT SEEN.

# TEST PIT LOG

Dames & Moore

# P-122

DATE COMPLETED: 12/3/87
SURFACE ELEVATION: 17.0 FT. MSLD
DEPTH TO INTERFACE: 2.2 FT. BLS
ORIENTATION: E-W



| TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) |
|---|---|---|
| HD | 24 | |
| HD | 20 | |
| HD | 6 | |
| HD | 15 | |
| | | |

SM/ML: DARK BROWN TO GRAY SILTY FINE SAND WITH BRICKS, WOOD AND WHITE FRIABLE MATERIAL; MOIST. FILL.

INTERFACE AT 2.2 FEET BELOW SURFACE; SHARP; HORIZONTAL.

ML/CL: GRAY CLAYEY SILT; MOIST. NATIVE SOIL.

ML/SC: YELLOW BROWN/GRAY BROWN FINE SANDY CLAYEY SILT; MOIST. NATIVE SOIL.

# TEST PIT LOG

Dames & Moore

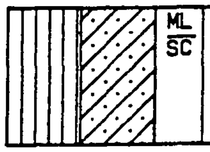
## P-122

DATE COMPLETED: 12/3/87
SURFACE ELEVATION: 17.0 FT. MSLD
DEPTH TO INTERFACE: 2.2 FT. BLS
ORIENTATION: E-W

| DEPTH IN FEET | SAMPLING | | | SAMPLES |
|---|---|---|---|---|
| | TYPE OF SAMPLER | BLOWS PER 6 INCHES | OVA (ppm) | |
| 5 | HD | 25 | | ■ |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |

SYMBOLS

DESCRIPTION



NOTES:
1) TEST PIT COMPLETED AT A DEPTH OF 5.7 FEET ON 12/3/87.

# TEST PIT LOG

Dames & Moore

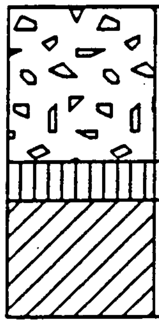
# TEST PIT: TP-152

DATE COMPLETED: 8/17/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2450
E 910

DEPTH IN FEET: 0, 5, 10, 15, 20, 25

| SAMPLING<br>SAMPLER TYPE | <br>BLOWS PER SIX INCHES | <br>HNu (ppm) | SAMPLES |
|---|---|---|---|
| G | NA | ND | ☒ |
| G | NA | ND | ☒ |
| HD | 12 | ND | ■ |
| HD | 28 | ND | ■ |
| G | NA | ND | ■ |

SYMBOLS



| | DESCRIPTION |
|---|---|
| F | INHOMOGENOUS FILL.<br>BROWN SANDY SILT, matrix contains debris, pieces of metal glass, wire, brick, wood and black clayey material.<br>White building board material |
| ML | DARK BROWN CLAYEY SANDY SILT, trace fine gravel, stiff, dry.<br>FILL |
| CL | NATIVE SOIL<br>BROWNISH-YELLOW SANDY SILTY CLAY, with sand, very stiff, dry, some black to dark gray streaking |

NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 8 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-198

DATE COMPLETED: 7/25/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 9 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2850
E 350

| DEPTH IN FEET | SAMPLING | | | SAMPLES | SYMBOLS | | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | | | | |
| 0 | | | | | ▨ | CL | BROWN TO DARK BROWN SILTY CLAY, trace gravel, hard, dry.<br>Contains large blocks of concrete between 2 to 3 feet.<br>Grading to dark brown, dry to moist, very stiff. |
| | HD | 21 | ND | ■ | ▨ | | |
| | HD | 20 | ND | ■ | ▨ | | |
| 5 | | | | | ▨ | | |
| | | | | | ▨ | | As above, medium stiff.<br>FILL |
| | G | NA | ND | ☒ | ▨ | | |
| | G | NA | ND | ☒ | ▨ | CL | NATIVE SOIL<br>BROWNISH-YELLOW TO YELLOWISH-RED SILTY CLAY, some sand, moist, medium stiff. |
| 10 | | | | | ▨ | | |
| | G | NA | ND | ☒ | ▨ | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |

NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 11 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

# TEST PIT: TP-199

DATE COMPLETED: 7/24/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 9 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2950
E 350

DEPTH IN FEET: 0, 5, 10, 15, 20, 25

| SAMPLING | | | |
|---|---|---|---|
| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
| HD | 56 | ND | ■ |
| HD | 21 | ND | ■ |
| G | | ND | ☒ |
| G | | ND | ☒ |
| G | | ND | ☒ |

| SYMBOLS | | DESCRIPTION |
|---|---|---|
| ▨ | CL | BROWNISH-YELLOW SILTY CLAY with some gravel, hard, dry.<br>Grading to dark brown, dry to moist, very stiff, trace of small metal pieces.<br>Contains pieces of re-bar.<br>Grading to dark brown, medium stiff, moist.<br>FILL |
| ▨ | CL | NATIVE SOIL<br>BROWNISH-RED SILTY CLAY, medium stiff, moist. |

NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 11.5 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-210

**DATE COMPLETED:** 8/2/89
**SURFACE ELEVATION:** FT. MSLD
**DEPTH TO INTERFACE:** 2 FT.
**ORIENTATION:** E-W
**DRILLING METHOD:** BACKHOE
**LOCATION:** N 2250
E 450

| DEPTH IN FEET | SAMPLING | | | SAMPLES |
|---|---|---|---|---|
| | SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | |
| 0 | | | | |
| | HD | 31 | 10 | ■ |
| | HD | 30 | 10 | |
| 5 | | | | |
| 10 | | | | |
| 15 | | | | |
| 20 | | | | |
| 25 | | | | |

| SYMBOLS | | DESCRIPTION |
|---|---|---|
| ▥ | ML | BROWN CLAYEY SILT, fine gravel, hard, dry, containing organic material, roots, concrete blocks.<br>FILL |
| ▨ | CL | NATIVE SOIL<br>BROWNISH-YELLOW SILTY CLAY, hard, dry, containing roots. (HARDPAN) |

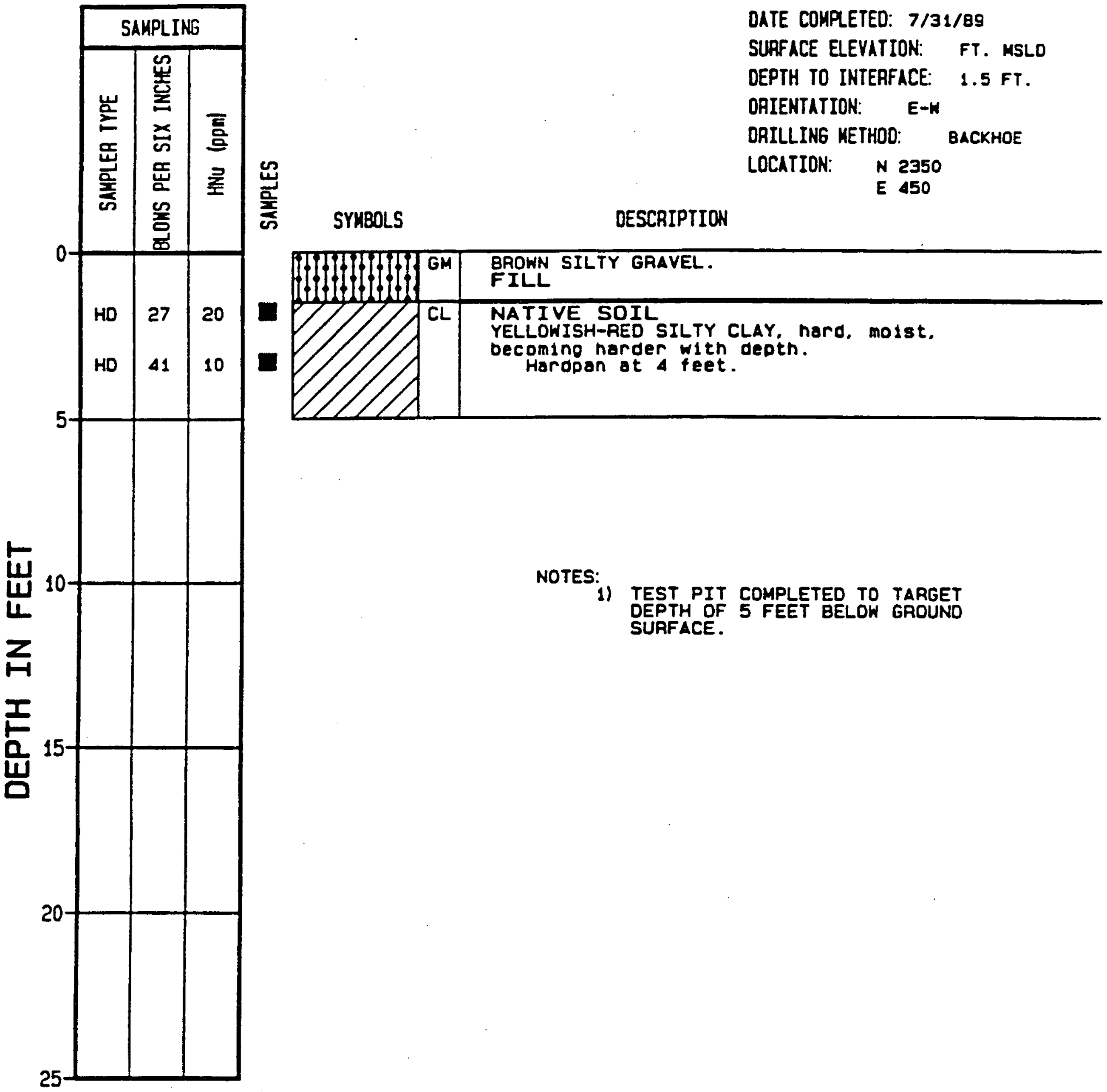
NOTES:
1) TEST PIT COMPLETED TO REFUSAL DEPTH OF 4 FEET BELOW GROUND SURFACE DUE TO HARDPAN.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-211

DATE COMPLETED: 7/31/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 1.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2350
E 450



| SAMPLING | | | | | | |
|---|---|---|---|---|---|---|
| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES | SYMBOLS | | DESCRIPTION |
| | | | | ▥ | GM | BROWN SILTY GRAVEL.<br>FILL |
| HD | 27 | 20 | ■ | ▨ | CL | NATIVE SOIL<br>YELLOWISH-RED SILTY CLAY, hard, moist, becoming harder with depth.<br>Hardpan at 4 feet. |
| HD | 41 | 10 | ■ | | | |

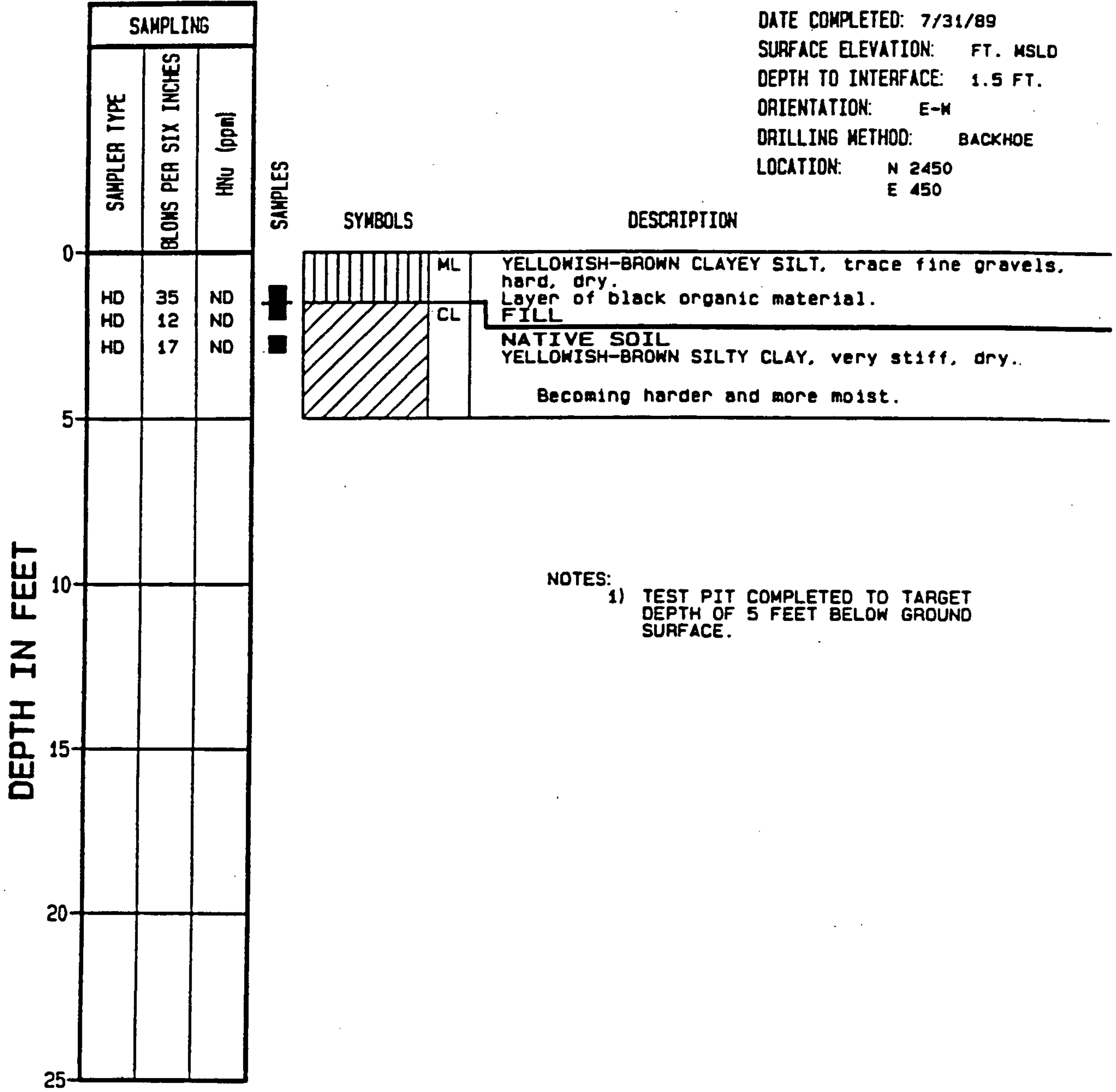
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 5 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-212

DATE COMPLETED: 7/31/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 1.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2450
E 450



| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) |
|---|---|---|
| HD | 35 | ND |
| HD | 12 | ND |
| HD | 17 | ND |

YELLOWISH-BROWN CLAYEY SILT, trace fine gravels, hard, dry.
Layer of black organic material.
FILL
NATIVE SOIL
YELLOWISH-BROWN SILTY CLAY, very stiff, dry.
Becoming harder and more moist.

NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 5 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-213

DATE COMPLETED: 7/31/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 3 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2550
E 450

| DEPTH IN FEET | SAMPLING | | | SAMPLES | SYMBOLS | | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | | | | |
| 0 | | | | | | GM | BROWN SILTY GRAVEL, hard. |
| | | | | | ▨ | CL | BROWNISH-YELLOW SILTY CLAY with sand, very stiff, moist.<br>FILL |
| | HD | 17 | ND | ■ | | | |
| | HD | 8 | ND | ■ | ▨ | CL | NATIVE SOIL<br>Dark brown with sand, moist.<br>Grading to yellowish-red silty clay with sand, stiff, moist. |
| 5 | G | NA | ND | ■ | | | |
| 10 | | | | | | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |

NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 5 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

Dames & Moore

## TEST PIT: TP-216

DATE COMPLETED: 8/1/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 2.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2250
E 550

| DEPTH IN FEET | SAMPLING: SAMPLER TYPE | SAMPLING: BLOWS PER SIX INCHES | SAMPLING: HNu (ppm) | SAMPLES | SYMBOLS | | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| 0 | | | | | ▨ | GC | GRAVEL.<br>DARK STAINED SOILS.<br>FILL |
| | HD | 17 | 10 | ■ | ▨ | CL | NATIVE SOIL<br>BROWNISH-YELLOW TO OLIVE GRAY SILTY CLAY, stiff, moist<br>Grading to yellowish-red. |
| 5 | G | NA | ND | ☒ | | | |
| 10 | | | | | | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |

NOTES:
1) TEST PIT COMPLETED TO A DEPTH OF 6 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

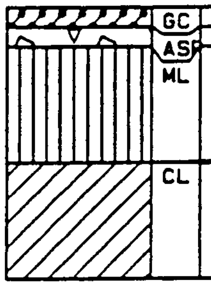
# TEST PIT: TP-217

DATE COMPLETED: 8/1/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 4 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2350
E 550

DEPTH IN FEET

| DEPTH IN FEET | SAMPLING: SAMPLER TYPE | SAMPLING: BLOWS PER SIX INCHES | SAMPLING: HNu (ppm) | SAMPLES |
|---|---|---|---|---|
| 0 | | | | |
| | HD | 18 | 15 | ■ |
| | HD | 14 | 15 | ■ |
| | HD | 8 | 10 | ■ |
| 5 | | | | |
| | G | NA | ND | ☒ |
| 10 | | | | |
| 15 | | | | |
| 20 | | | | |
| 25 | | | | |

SYMBOLS



DESCRIPTION

GC BROWN SILTY GRAVEL.

ASP ASPHALT.

ML BROWNISH-YELLOW TO YELLOWISH-RED CLAYEY SILT, hard, trace greenish-gray material that is stained.
Coal layer.
Dark gray clayey silt, some sand, very stiff, moist, dark organic material.

FILL

CL NATIVE SOIL
DARK BROWN TO REDDISH-BROWN SILTY CLAY, some sand, moist.
As above

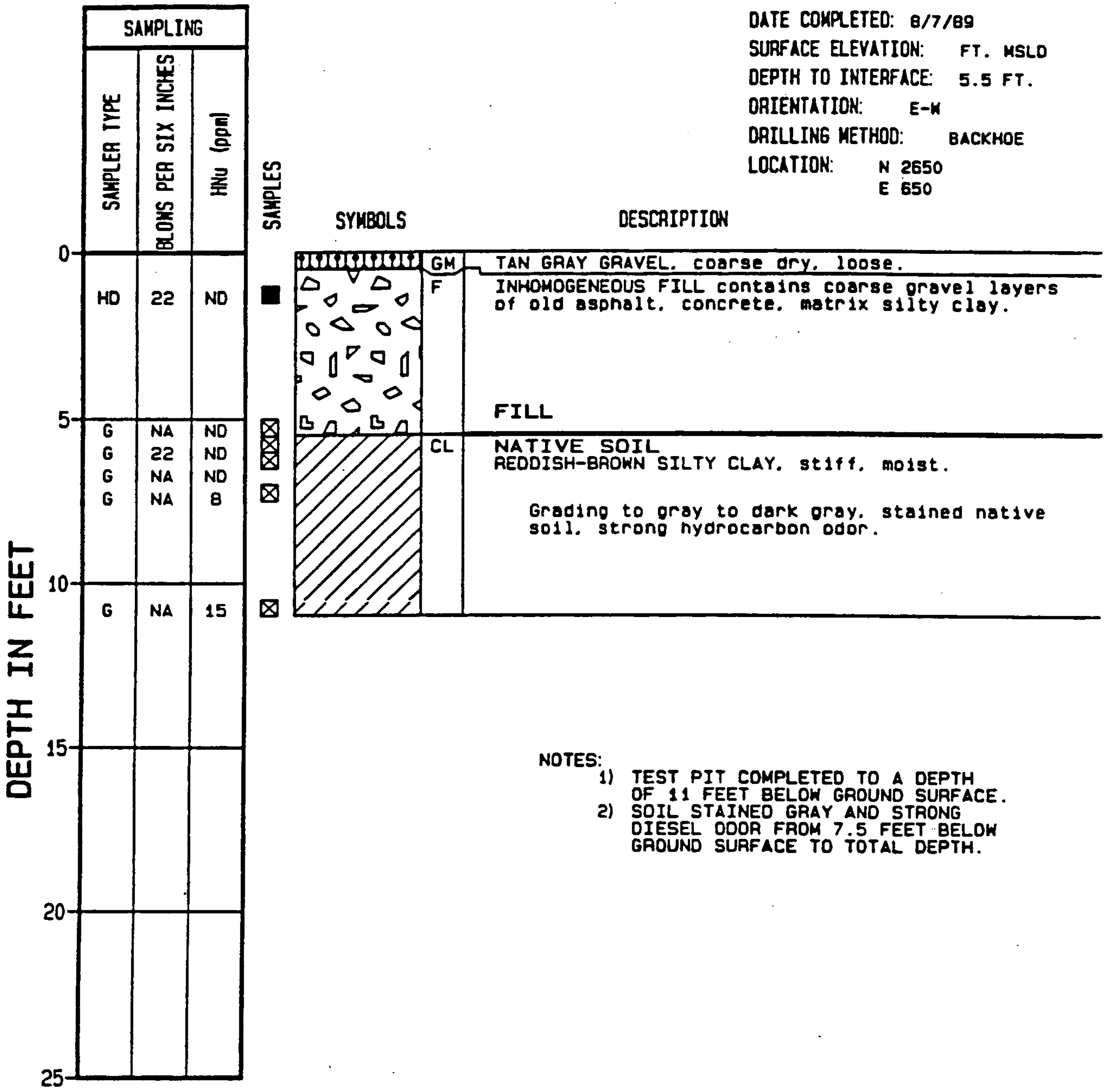
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 7 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

# TEST PIT: TP-218

DATE COMPLETED: 8/7/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 5.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2650
E 650



| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
|---|---|---|---|
| HD | 22 | ND | ■ |
| G | NA | ND | ☒ |
| G | 22 | ND | ☒ |
| G | NA | ND | ☒ |
| G | NA | 8 | ☒ |
| G | NA | 15 | ☒ |

| | DESCRIPTION |
|---|---|
| GM | TAN GRAY GRAVEL, coarse dry, loose. |
| F | INHOMOGENEOUS FILL contains coarse gravel layers of old asphalt, concrete, matrix silty clay.<br>FILL |
| CL | NATIVE SOIL<br>REDDISH-BROWN SILTY CLAY, stiff, moist.<br>Grading to gray to dark gray, stained native soil, strong hydrocarbon odor. |

NOTES:
1) TEST PIT COMPLETED TO A DEPTH OF 11 FEET BELOW GROUND SURFACE.
2) SOIL STAINED GRAY AND STRONG DIESEL ODOR FROM 7.5 FEET BELOW GROUND SURFACE TO TOTAL DEPTH.

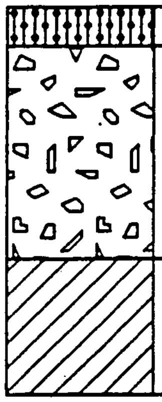
# TEST PIT LOG

Dames & Moore

# TEST PIT: TP-219

DATE COMPLETED: 8/7/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 6.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2550
E 650

| DEPTH IN FEET | SAMPLING<br>SAMPLER TYPE | <br>BLOWS PER SIX INCHES | <br>HNu (ppm) | SAMPLES |
|---|---|---|---|---|
| 0 | | | | |
| | HD | 24 | ND | ■ |
| 5 | | | | |
| | G | NA | ND | ■ |
| | G | NA | ND | ■ |
| | G | NA | ND | ■ |
| 10 | | | | |
| 15 | | | | |
| 20 | | | | |
| 25 | | | | |



| SYMBOLS | | DESCRIPTION |
|---|---|---|
| | GM | BROWN FINE TO COARSE GRAINED SILTY GRAVEL, moist. |
| | F | INHOMOGENEOUS FILL.<br>BROWN CLAYEY SILT MATRIX with fine to coarse gravel, containing partially decomposed plant material, blocks of concrete and asphalt, pieces of scrap metal and wood.<br>Grading to dark brown, with sand, stiff, dry.<br>FILL |
| | CL | NATIVE SOIL<br>YELLOWISH-RED SILTY CLAY with sand, stiff, moist.<br>As above. |

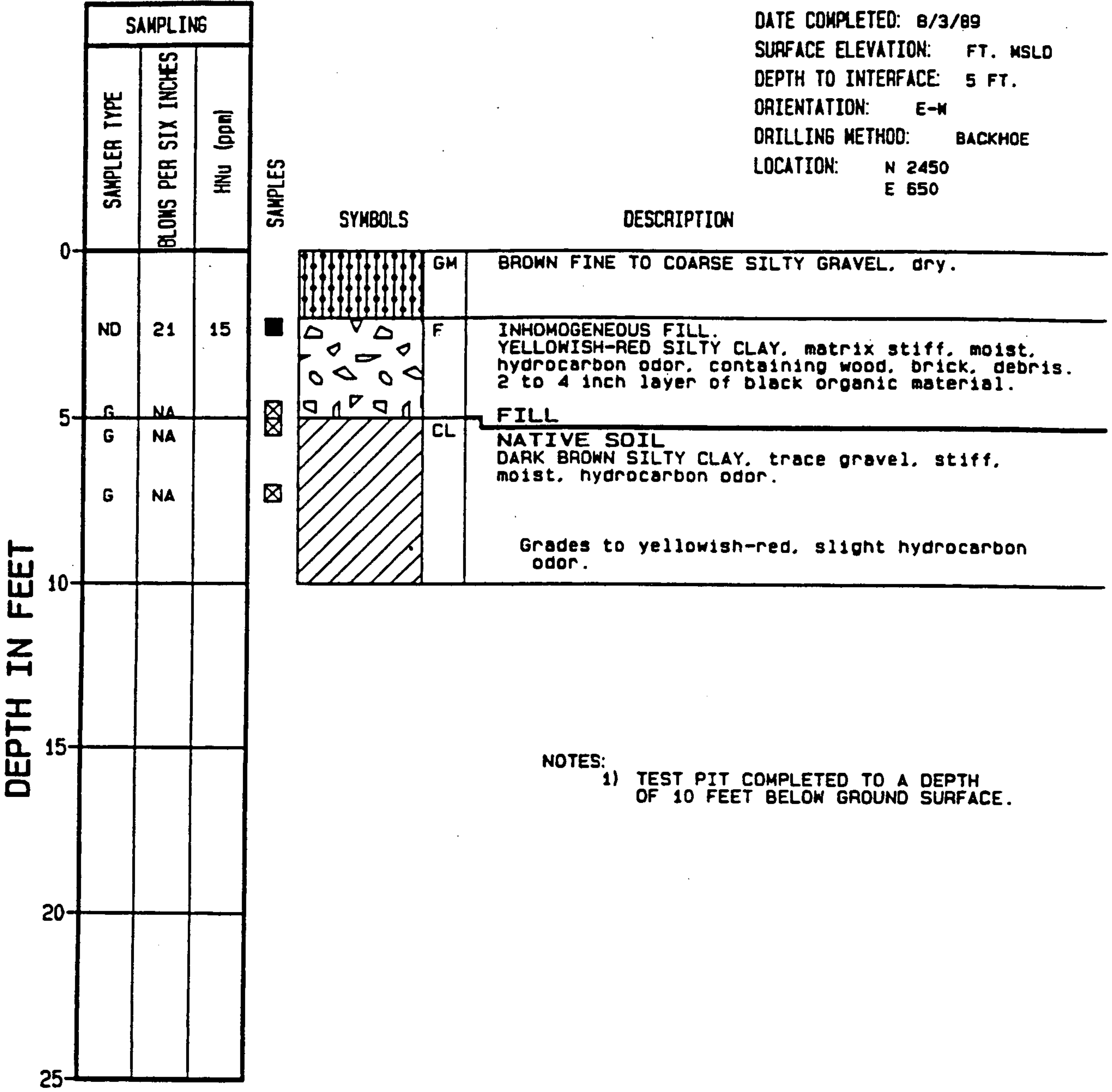
NOTES:
1) TEST PIT COMPLETED TO A TARGET DEPTH OF 10 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-220

DATE COMPLETED: 8/3/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2450
E 650



| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
|---|---|---|---|
| ND | 21 | 15 | ■ |
| G | NA | | ⊠ |
| G | NA | | ⊠ |
| G | NA | | ⊠ |

| SYMBOLS | DESCRIPTION |
|---|---|
| GM | BROWN FINE TO COARSE SILTY GRAVEL, dry. |
| F | INHOMOGENEOUS FILL.<br>YELLOWISH-RED SILTY CLAY, matrix stiff, moist, hydrocarbon odor, containing wood, brick, debris. 2 to 4 inch layer of black organic material.<br>FILL |
| CL | NATIVE SOIL<br>DARK BROWN SILTY CLAY, trace gravel, stiff, moist, hydrocarbon odor.<br>Grades to yellowish-red, slight hydrocarbon odor. |

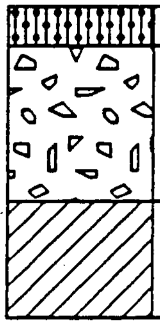
NOTES:
1) TEST PIT COMPLETED TO A DEPTH OF 10 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

## TEST PIT: TP-221

DATE COMPLETED: 8/3/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2350
E 650



| DEPTH IN FEET | SAMPLING: SAMPLER TYPE | SAMPLING: BLOWS PER SIX INCHES | SAMPLING: HNu (ppm) | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | GM | GRAYISH-TAN SILTY SANDY GRAVEL, dry. |
| | HD | 50 | 8 | ■ | F | REDDISH-BROWN SILTY CLAY MATRIX, stiff, moist, contains brick fragments, gravel, pieces of wire and rubber. |
| | HD | 10 | 35 | ■ | | |
| 5 | HD | 25 | 40 | ■ | | Grading to light gray fine to medium sand, well graded, dry. |
| | G | NA | 100 | ☒ | CL | Gray coarse grained slag material, hard, dry.<br>FILL |
| | G | NA | NR | ☒ | | NATIVE SOIL<br>DARK BROWN SILTY CLAY, medium stiff, moist. |
| | G | NA | NR | ☒ | | |
| 10 | | | | | | |
| 15 | | | | | | |
| 20 | | | | | | |
| 25 | | | | | | |

NOTES:
1) TEST PIT COMPLETED TO A TARGET DEPTH OF 8 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

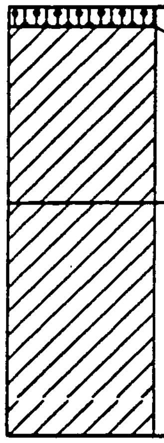
Dames & Moore

# TEST PIT: TP-222

DATE COMPLETED: 8/1/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2250
E 650

DEPTH IN FEET: 0, 5, 10, 15, 20, 25

| SAMPLING | | | |
|---|---|---|---|
| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
| HD | | ND | ■ |
| HD | 11 | 35 | ■ |
| HD | 9 | 30 | ■ |
| G | NA | | ■ |
| G | NA | | ■ |
| G | NA | | ■ |



| SYMBOLS | | DESCRIPTION |
|---|---|---|
| | GM | GRAY FINE GRAINED SILTY GRAVEL, dry. |
| ▨ | CL | REDDISH-BROWN SILTY CLAY, medium stiff, moist, occassional 6" lenses of fine grained sand.<br>Tarry appearance, moist.<br>Dark gray with pieces of coal, odorous.<br>FILL |
| ▨ | CL | NATIVE SOIL<br>GRAY SILTY CLAY, medium stiff, moist.<br>Grading to reddish-brown. |

NOTES:
1) TEST PIT COMPLETED TO A TARGET DEPTH OF 11 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

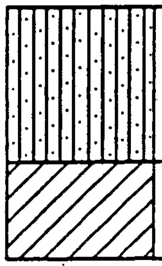
Dames & Moore

# TEST PIT: TP-223

DATE COMPLETED: 8/2/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 4 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2150
E 650

| DEPTH IN FEET | SAMPLING<br>SAMPLER TYPE | SAMPLING<br>BLOWS PER SIX INCHES | SAMPLING<br>HNu (ppm) | SAMPLES |
|---|---|---|---|---|
| 0 | | | | |
| | HD | 33 | 15 | ■ |
| | HD | 41 | 20 | ■ |
| | HD | 17 | 20 | |
| 5 | | | | |
| | G | NA | NR | ☒ |
| 10 | | | | |
| 15 | | | | |
| 20 | | | | |
| 25 | | | | |

SYMBOLS



DESCRIPTION

SM TAN GRAY SILTY SAND with gravel, dry.
grades to reddish-brown, minor gravel, dense, moist.

1-2 inch layer of black organic material.
FILL

CL NATIVE SOIL
DARK BROWN SILTY CLAY, stiff, moist.

NOTES:
1) TEST PIT COMPLETED TO A TARGET DEPTH OF 6.5 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-224

DATE COMPLETED: 8/2/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 1.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2050
E 650

| DEPTH IN FEET | SAMPLING | | | SAMPLES | SYMBOLS | | DESCRIPTION |
|---|---|---|---|---|---|---|---|
| | SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | | | | |
| 0 | | | | | ▨ | GC | THICK GRAVEL LAYER.<br>FILL |
| | HD | 45 | ND | ■ | ▨ | CL | NATIVE SOIL<br>BROWNISH-YELLOW SILTY CLAY, hard, dry. |
| | HD | 35 | ND | ■ | | | Grading to yellowish-red, hard, dry to moist. |
| 5 | | | | | | | |
| 10 | | | | | | | |
| 15 | | | | | | | |
| 20 | | | | | | | |
| 25 | | | | | | | |

NOTES:
1) TEST PIT COMPLETED TO A TARGET DEPTH OF 5 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

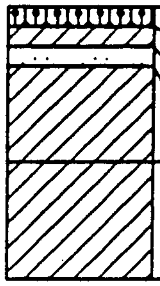
Dames & Moore

# TEST PIT: TP-228

DATE COMPLETED: 8/1/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 4 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2050
E 750

DEPTH IN FEET: 0, 5, 10, 15, 20, 25

| SAMPLING | | | |
|---|---|---|---|
| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
| HD | 38 | 15 | ■ |
| HD | 22 | 16 | ■ |
| HD | 15 | 18 | |
| G | NA | NR | ⊠ |



| | DESCRIPTION |
|---|---|
| GM | TAN BROWN SILTY SANDY GRAVEL, dry. |
| CL | REDDISH-BROWN SILTY CLAY with gravel. |
| SP | GRAY FINE GRAINED SAND, poorly graded, dry. |
| CL | GRAYISH-BROWN SILTY CLAY.<br>2-inch layer of dark gray organic material with chunks of charcoal and pieces of bone.<br>FILL |
| CL | NATIVE SOIL<br>GRAYISH-BROWN SILTY CLAY grading to reddish-brown.<br>Becoming siltier with depth. |

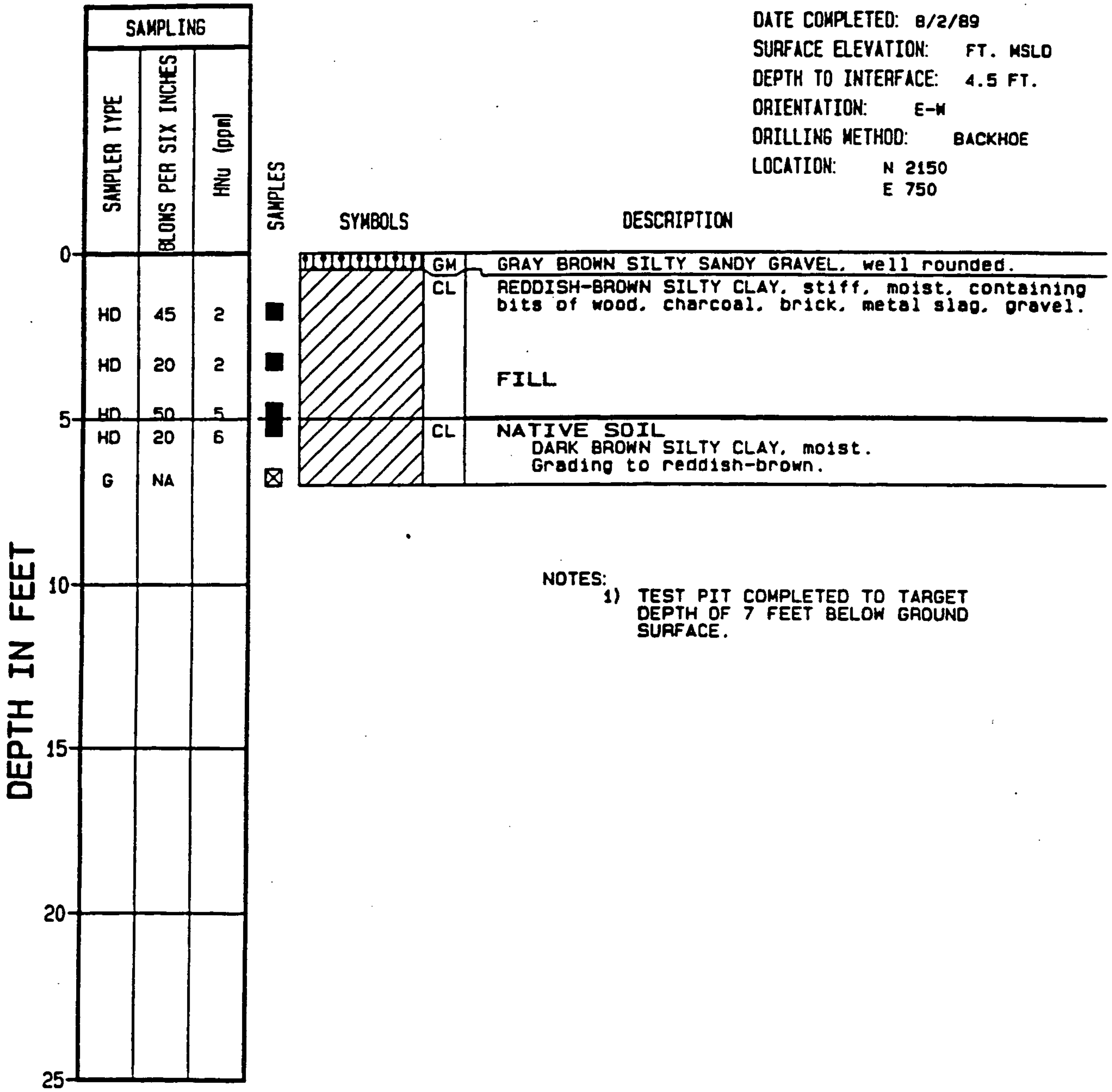
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 7 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

# TEST PIT: TP-229

DATE COMPLETED: 8/2/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 4.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2150
E 750



| SAMPLING<br>SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
|---|---|---|---|
| HD | 45 | 2 | ■ |
| HD | 20 | 2 | ■ |
| HD | 50 | 5 | ■ |
| HD | 20 | 6 | ■ |
| G | NA | | ⊠ |

| SYMBOLS | DESCRIPTION |
|---|---|
| GM | GRAY BROWN SILTY SANDY GRAVEL, well rounded. |
| CL | REDDISH-BROWN SILTY CLAY, stiff, moist, containing bits of wood, charcoal, brick, metal slag, gravel.<br>FILL |
| CL | NATIVE SOIL<br>DARK BROWN SILTY CLAY, moist.<br>Grading to reddish-brown. |

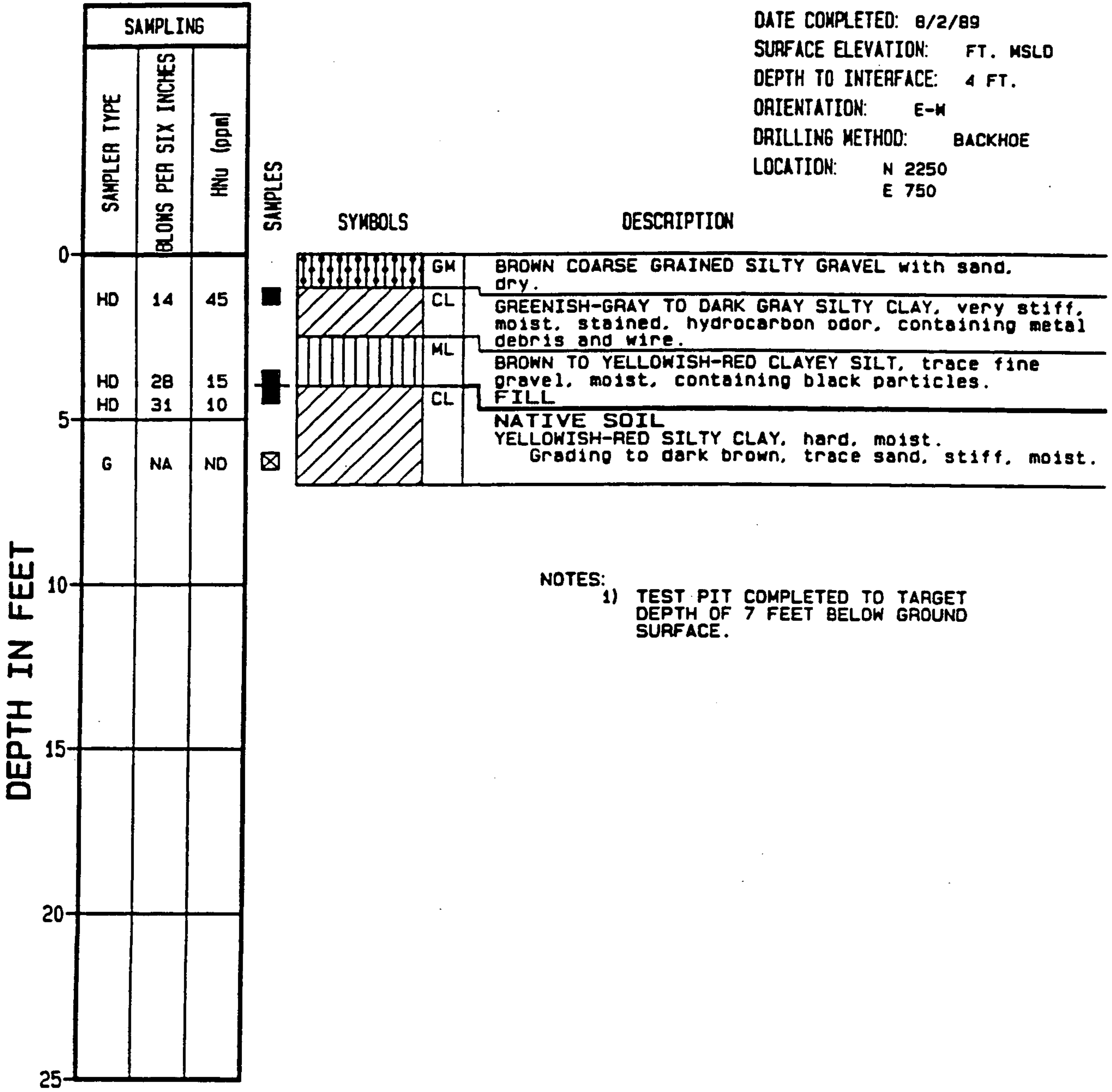
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 7 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-230

DATE COMPLETED: 8/2/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 4 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2250
E 750



| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
|---|---|---|---|
| HD | 14 | 45 | ■ |
| HD | 28 | 15 | ■ |
| HD | 31 | 10 | |
| G | NA | ND | ⊠ |

| SYMBOLS | DESCRIPTION |
|---|---|
| GM | BROWN COARSE GRAINED SILTY GRAVEL with sand, dry. |
| CL | GREENISH-GRAY TO DARK GRAY SILTY CLAY, very stiff, moist, stained, hydrocarbon odor, containing metal debris and wire. |
| ML | BROWN TO YELLOWISH-RED CLAYEY SILT, trace fine gravel, moist, containing black particles.<br>FILL |
| CL | NATIVE SOIL<br>YELLOWISH-RED SILTY CLAY, hard, moist.<br>Grading to dark brown, trace sand, stiff, moist. |

NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 7 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

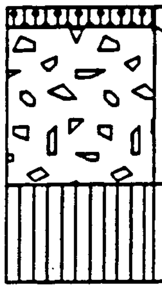
Dames & Moore

# TEST PIT: TP-231

DATE COMPLETED: 8/2/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 4.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2355
E 745

| DEPTH IN FEET | SAMPLING<br>SAMPLER TYPE | SAMPLING<br>BLOWS PER SIX INCHES | SAMPLING<br>HNu (ppm) | SAMPLES |
|---|---|---|---|---|
| 0 | | | | |
| | HD | 53 | 5 | ■ |
| | HD | 17 | 8 | ■ |
| | HD | 11 | 8 | ■ |
| 5 | | | | |
| | G | NA | NR | ☒ |
| 10 | | | | |
| 15 | | | | |
| 20 | | | | |
| 25 | | | | |

SYMBOLS



| | DESCRIPTION |
|---|---|
| GM | TAN GRAY SILTY SANDY GRAVEL, dry. |
| F | INHOMOGENEOUS FILL.<br>DARK TO REDDISH-BROWN SILTY CLAY MATRIX, very stiff, moist, containing gravel, wood debris, charcoal, metal pieces.<br>FILL |
| ML | NATIVE SOIL<br>DARK BROWN SANDY SILT, stiff, moist. |

NOTES:

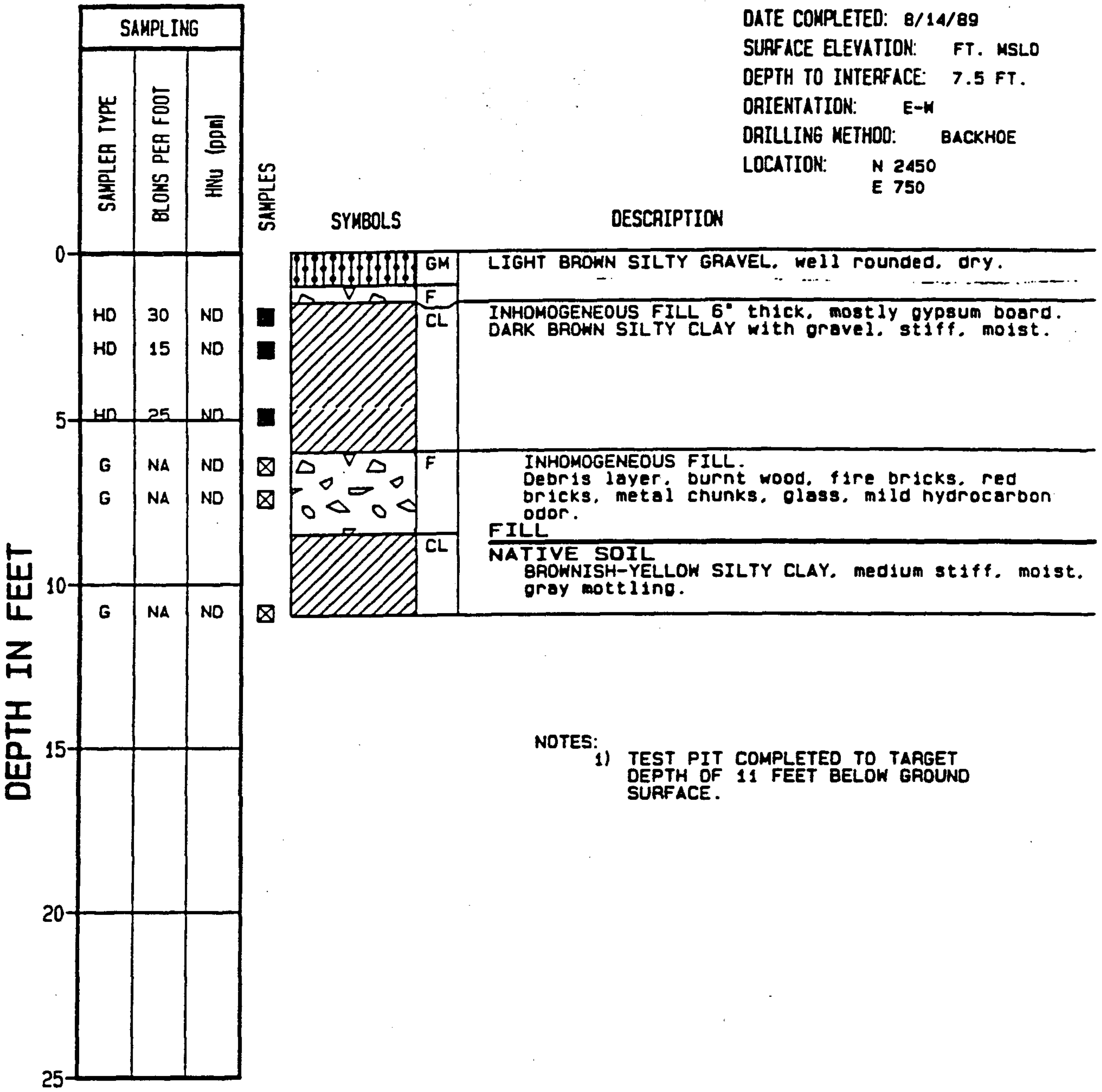
1) TEST PIT COMPLETED TO TARGET DEPTH OF 7 FEET BELOW GROUND SURFACE.
2) BURIED DRUM CONTAINING BRICKS AND BURNT COAL MATERIAL REMOVED FROM DEPTH OF 1.5 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

# TEST PIT: TP-232

DATE COMPLETED: 8/14/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 7.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2450
E 750



| SAMPLER TYPE | BLOWS PER FOOT | HNu (ppm) | SAMPLES |
|---|---|---|---|
| HD | 30 | ND | ■ |
| HD | 15 | ND | ■ |
| HD | 25 | ND | ■ |
| G | NA | ND | ☒ |
| G | NA | ND | ☒ |
| G | NA | ND | ☒ |

| SYMBOLS | DESCRIPTION |
|---|---|
| GM | LIGHT BROWN SILTY GRAVEL, well rounded, dry. |
| F | INHOMOGENEOUS FILL 6" thick, mostly gypsum board. |
| CL | DARK BROWN SILTY CLAY with gravel, stiff, moist. |
| F | INHOMOGENEOUS FILL.<br>Debris layer, burnt wood, fire bricks, red bricks, metal chunks, glass, mild hydrocarbon odor.<br>FILL |
| CL | NATIVE SOIL<br>BROWNISH-YELLOW SILTY CLAY, medium stiff, moist, gray mottling. |

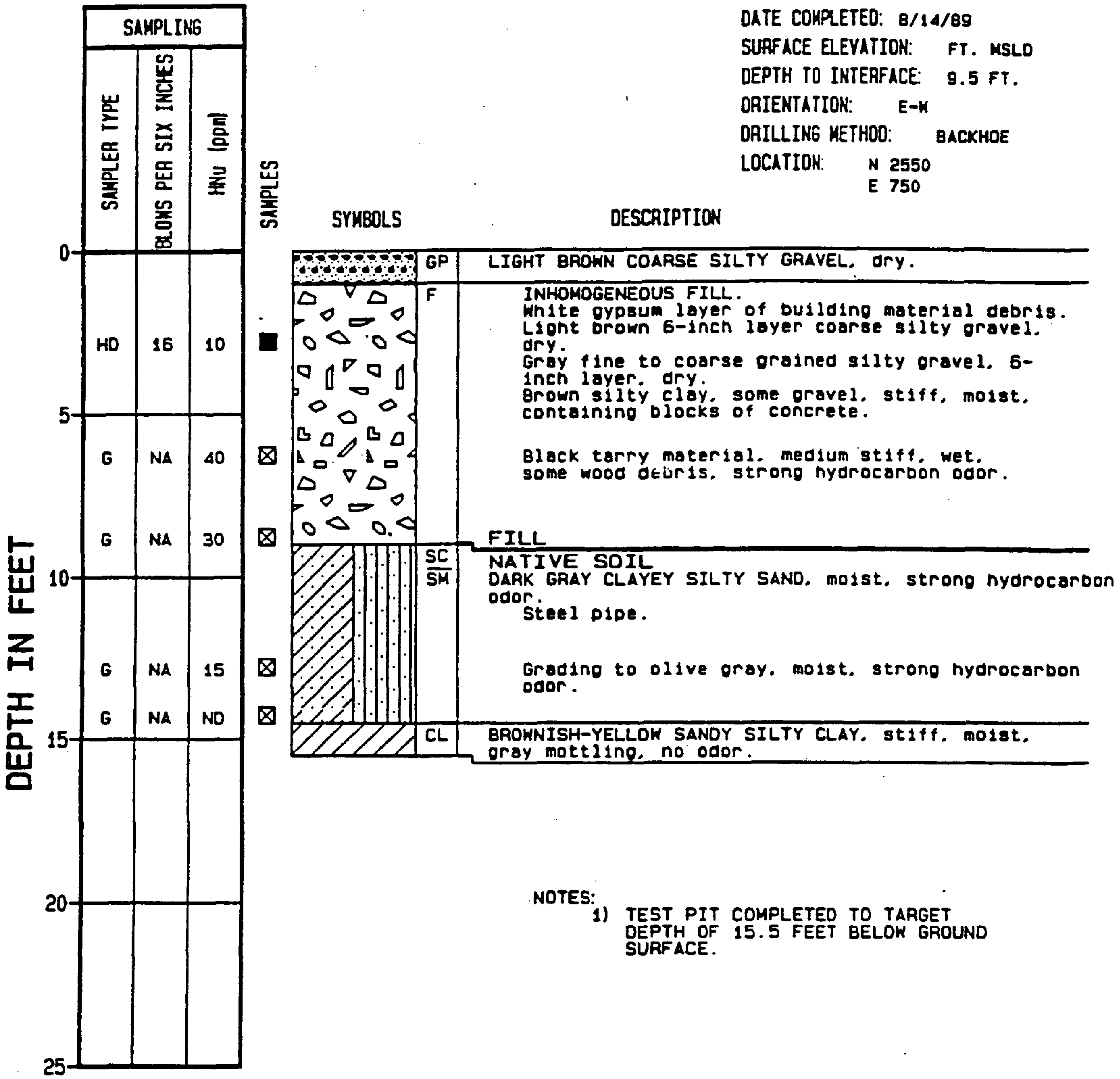
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 11 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

# TEST PIT: TP-234

DATE COMPLETED: 8/14/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 9.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2550
E 750



| SAMPLING | | | |
|---|---|---|---|
| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
| HD | 16 | 10 | ■ |
| G | NA | 40 | ☒ |
| G | NA | 30 | ☒ |
| G | NA | 15 | ☒ |
| G | NA | ND | ☒ |

| | DESCRIPTION |
|---|---|
| GP | LIGHT BROWN COARSE SILTY GRAVEL, dry. |
| F | INHOMOGENEOUS FILL.<br>White gypsum layer of building material debris.<br>Light brown 6-inch layer coarse silty gravel, dry.<br>Gray fine to coarse grained silty gravel, 6-inch layer, dry.<br>Brown silty clay, some gravel, stiff, moist, containing blocks of concrete.<br>Black tarry material, medium stiff, wet, some wood debris, strong hydrocarbon odor.<br>FILL |
| SC/SM | NATIVE SOIL<br>DARK GRAY CLAYEY SILTY SAND, moist, strong hydrocarbon odor.<br>Steel pipe.<br>Grading to olive gray, moist, strong hydrocarbon odor. |
| CL | BROWNISH-YELLOW SANDY SILTY CLAY, stiff, moist, gray mottling, no odor. |

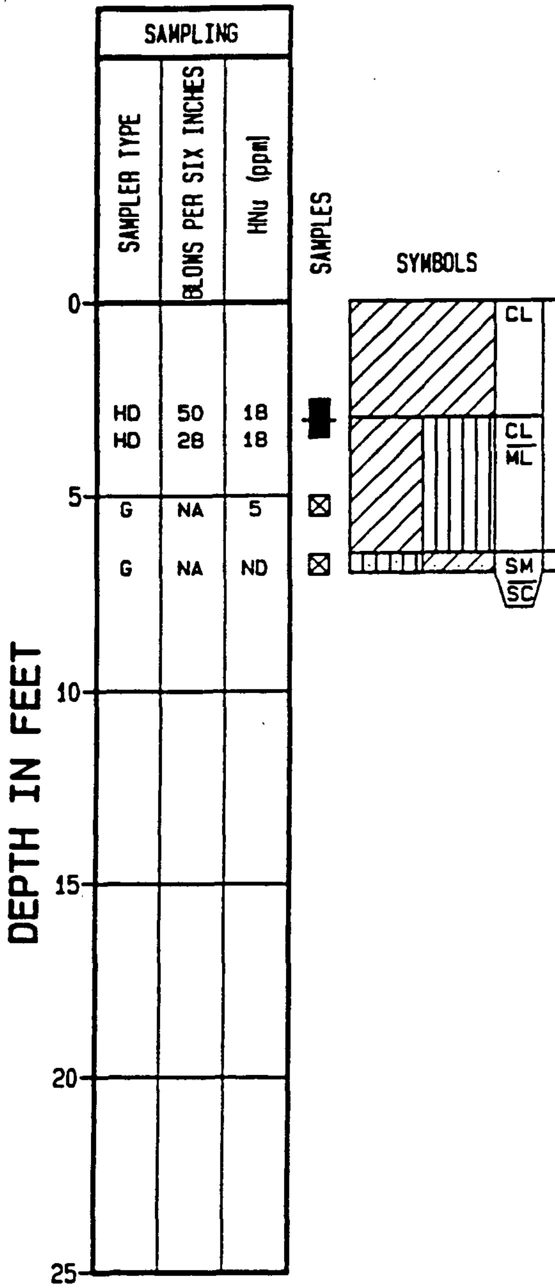
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 15.5 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-235

DATE COMPLETED: 8/16/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 3 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2650
E 760



| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
|---|---|---|---|
| HD | 50 | 18 | ■ |
| HD | 28 | 18 | |
| G | NA | 5 | ☒ |
| G | NA | ND | ☒ |

DESCRIPTION

CL — ORANGE BROWN SILTY CLAY, very stiff, moist, gray mottling, containing pieces of coal, concrete and gravel.

**FILL**

CL/ML — **NATIVE SOIL**
INTERFACE SHARP, WAVY.
OLIVE GRAY SILTY CLAY TO CLAYEY SILT, medium stiff, damp, brownish-yellow mottling, micaceous, porous, root casts, slight hydrocarbon odor.

SM/SC — DARK BROWN TO OLIVE GRAY FINE TO MEDIUM GRAINED CLAYEY SILT TO SILTY CLAY, trace pebbles, orange brown mottling, porous, no odor, some roots, 1-2mm pores

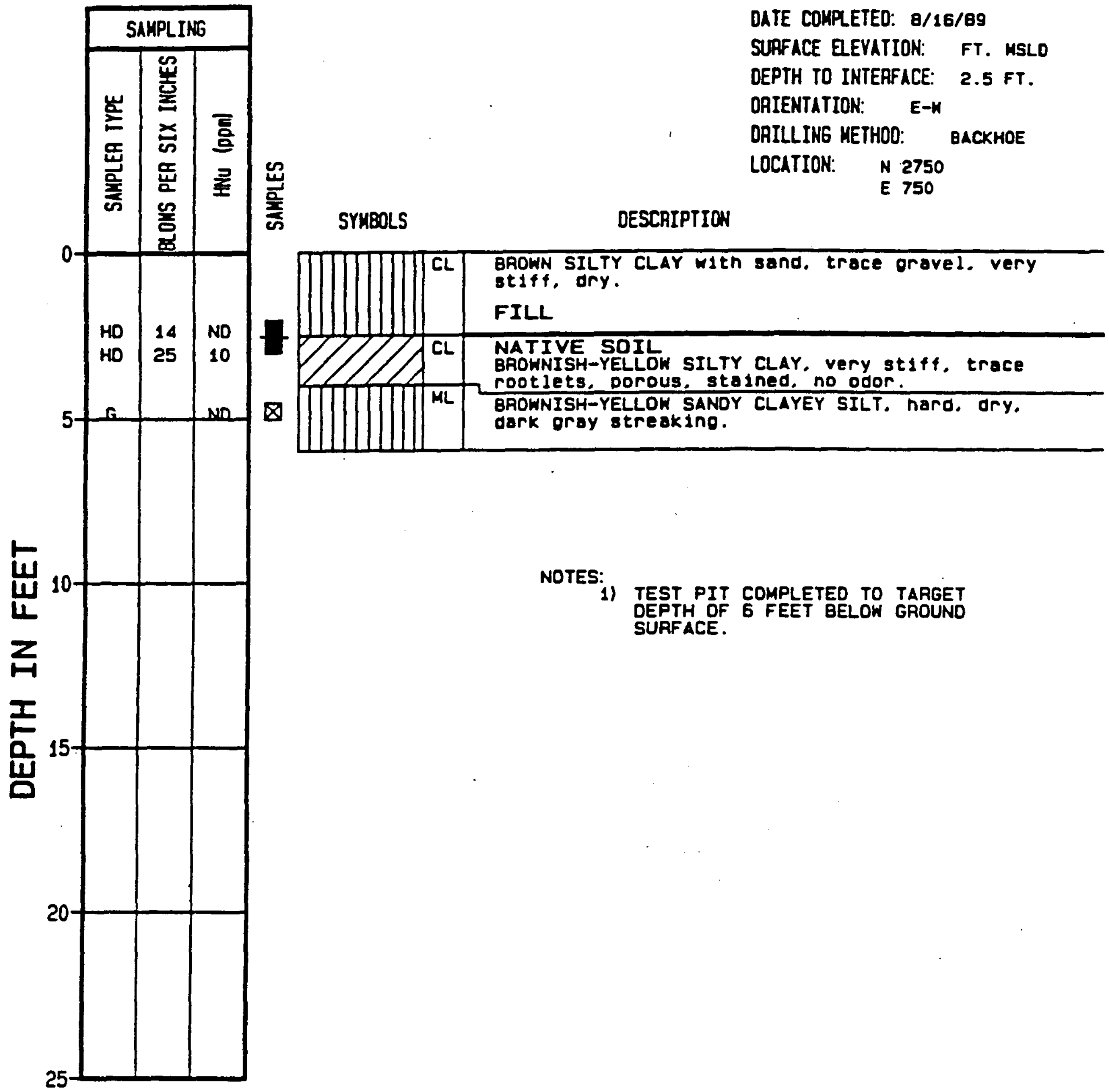
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 7 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

# TEST PIT: TP-236

DATE COMPLETED: 8/16/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 2.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2750
E 750



| DEPTH IN FEET | SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES | SYMBOLS | DESCRIPTION |
|---|---|---|---|---|---|---|
| 0 | | | | | CL | BROWN SILTY CLAY with sand, trace gravel, very stiff, dry.<br>FILL |
| | HD | 14 | ND | ■ | | |
| | HD | 25 | 10 | | CL | NATIVE SOIL<br>BROWNISH-YELLOW SILTY CLAY, very stiff, trace rootlets, porous, stained, no odor. |
| | | | | | ML | BROWNISH-YELLOW SANDY CLAYEY SILT, hard, dry, dark gray streaking. |
| 5 | G | | ND | ☒ | | |

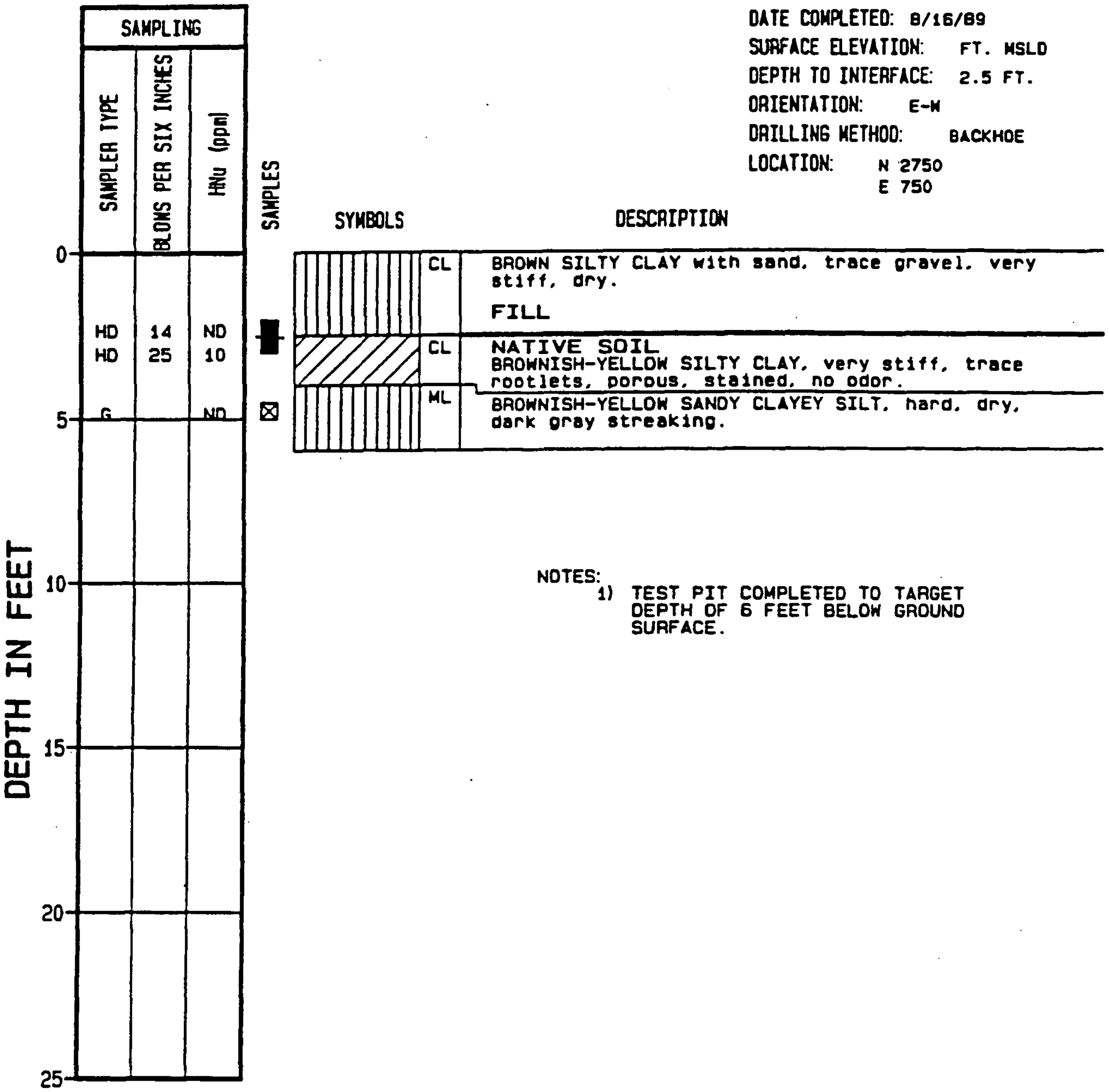
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 6 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

# TEST PIT: TP-236

DATE COMPLETED: 8/16/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 2.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2750
E 750



| SAMPLING: SAMPLER TYPE | SAMPLING: BLOWS PER SIX INCHES | SAMPLING: HNu (ppm) |
|---|---|---|
| HD | 14 | ND |
| HD | 25 | 10 |
| G | | ND |

| SYMBOLS | DESCRIPTION |
|---|---|
| CL | BROWN SILTY CLAY with sand, trace gravel, very stiff, dry.<br>FILL |
| CL | NATIVE SOIL<br>BROWNISH-YELLOW SILTY CLAY, very stiff, trace rootlets, porous, stained, no odor. |
| ML | BROWNISH-YELLOW SANDY CLAYEY SILT, hard, dry, dark gray streaking. |

NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 6 FEET BELOW GROUND SURFACE.

# TEST PIT LOG

Dames & Moore

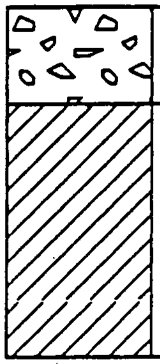
# TEST PIT: TP-237

DATE COMPLETED: 8/15/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 2.5 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2550
E 850

DEPTH IN FEET: 0, 5, 10, 15, 20, 25

| SAMPLING | | | |
|---|---|---|---|
| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
| HD | 10 | 20 | ☒ |
| HD | 20 | 5 | ■ |
| HD | 20 | 2 | ■ |
| G | NA | ND | ☒ |

SYMBOLS



DESCRIPTION

**F**

INHOMOGENEOUS FILL.
LIGHT BROWN SILTY CLAY MATRIX trace gravel and sand, dry, containing debris consisting of layered gypsum board, brick red clay, fire bricks, gravel, wire, chunks of metal, glass and drums.
FILL

**CL**

NATIVE SOIL
OLIVE GRAY SILTY CLAY with trace fine to medium sand, porous, mottled reddish-brown and yellowish-brown, medium stiff, moist, strong hydrocarbon odor.

Grading to reddish-yellow, micaceous, very porous, root casts, gray and orange brown mottling, stiff, moist, no odor.

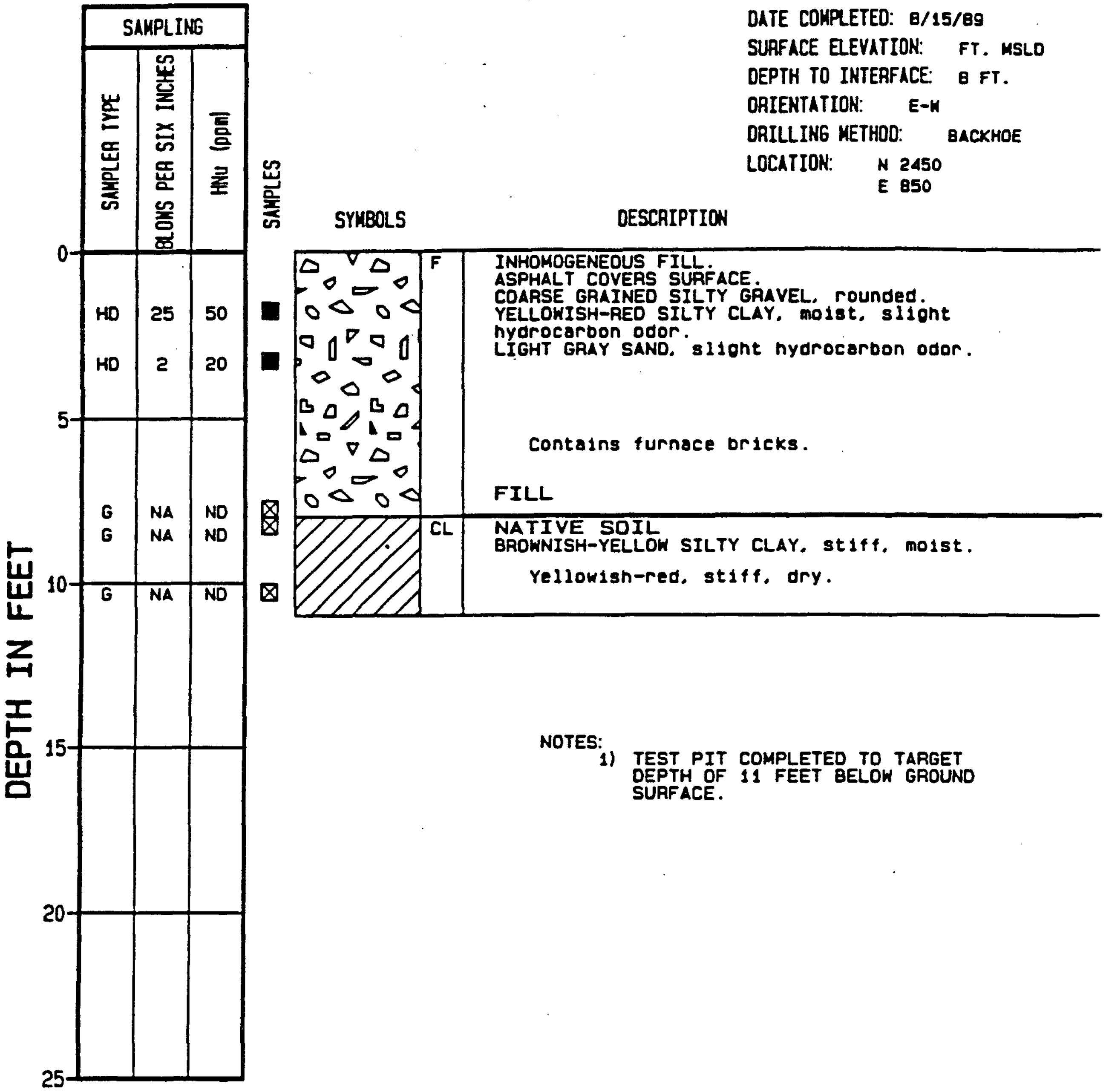
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 9 FEET BELOW GROUND SURFACE.
2) TWO BURIED DRUMS REMOVED FROM 1 TO 2 FEET BELOW GROUND SURFACE: ONE DRUM FILLED; THE OTHER DRUM CONTAINED PETROLEUM FLUID, POSSIBLY HYDRAULIC FLUID.

## TEST PIT LOG

Dames & Moore

# TEST PIT: TP-238

DATE COMPLETED: 8/15/89
SURFACE ELEVATION: FT. MSLD
DEPTH TO INTERFACE: 8 FT.
ORIENTATION: E-W
DRILLING METHOD: BACKHOE
LOCATION: N 2450
E 850



| SAMPLING | | | |
|---|---|---|---|
| SAMPLER TYPE | BLOWS PER SIX INCHES | HNu (ppm) | SAMPLES |
| HD | 25 | 50 | ■ |
| HD | 2 | 20 | ■ |
| G | NA | ND | ☒ |
| G | NA | ND | ☒ |
| G | NA | ND | ☒ |

| | DESCRIPTION |
|---|---|
| F | INHOMOGENEOUS FILL.<br>ASPHALT COVERS SURFACE.<br>COARSE GRAINED SILTY GRAVEL, rounded.<br>YELLOWISH-RED SILTY CLAY, moist, slight hydrocarbon odor.<br>LIGHT GRAY SAND, slight hydrocarbon odor.<br>Contains furnace bricks.<br>FILL |
| CL | NATIVE SOIL<br>BROWNISH-YELLOW SILTY CLAY, stiff, moist.<br>Yellowish-red, stiff, dry. |

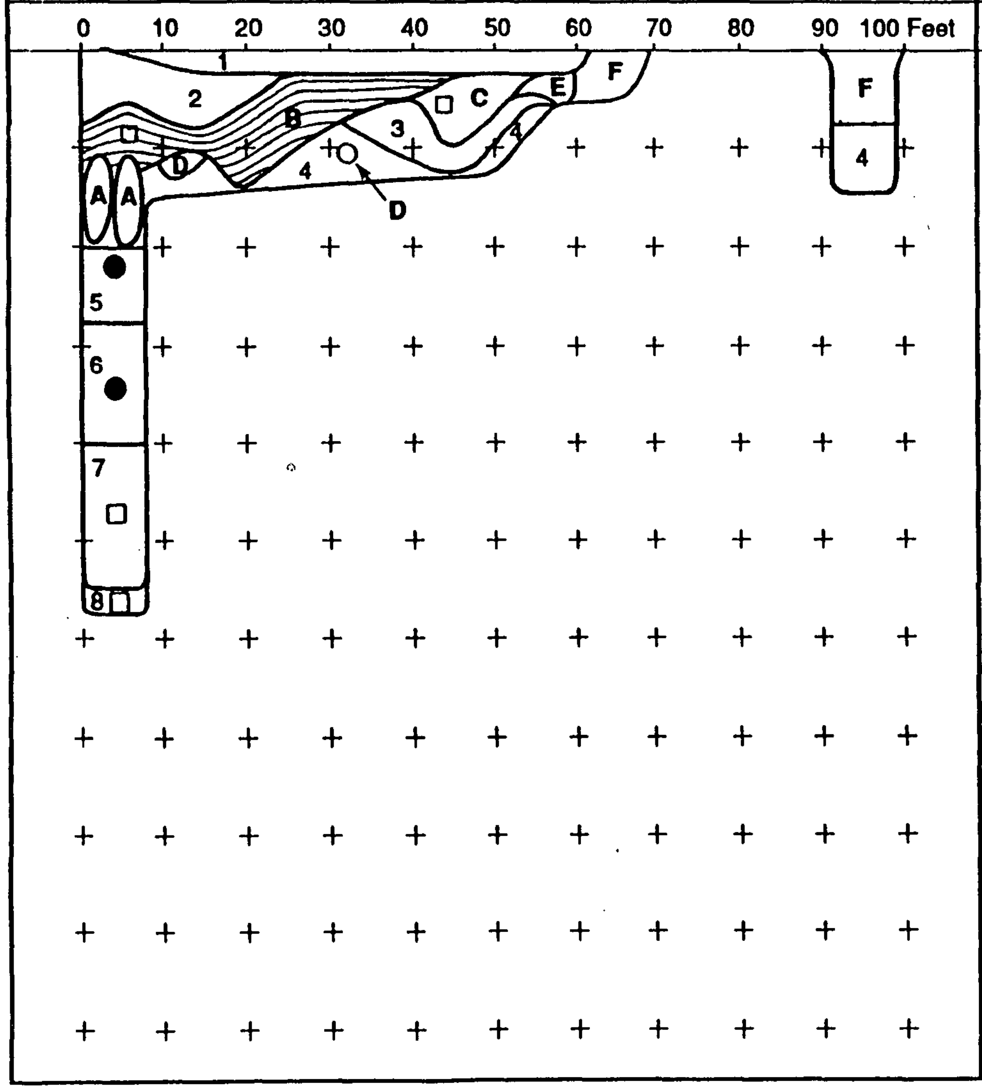
NOTES:
1) TEST PIT COMPLETED TO TARGET DEPTH OF 11 FEET BELOW GROUND SURFACE.

## TEST PIT LOG

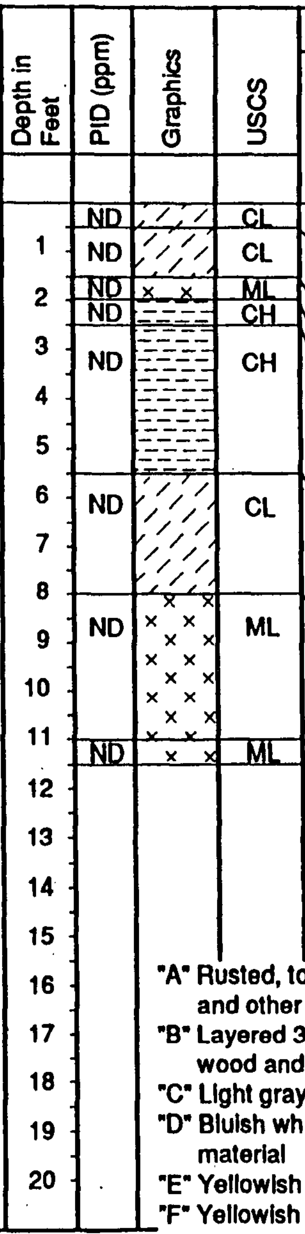
Dames & Moore

Date Completed: 5/8/91
Surface Elevation: ~ 16 Feet (MSL Datum)
Depth to Native Soil: 8.0 Feet BGS
Orientation: NW-SE

EXPLANATION
● Hand Driven Sample
☐ Grab Sample



TEST PIT CROSS SECTION



Description

1. Brown silty clay with little sand, little yellowish red mottles, dry, some fine-medium roots, little 1/4-1/2 in. gravels, fill
2. Dark brown silty clay with little fine sand, little chunks gypsum board, trace rusted nails and bolts, slightly moist, fill
3. Brown and yellowish brown clayey silt with fine sand, massive, moist, fill
4. Dark brown silty clay with little fine sand, little 0.25-1.5mm pores, moist, fill
5. Brown and dark brown silty clay with little fine sand, moist, trace yellowish red mottles, fill
6. Dark brown and dark gray silty clay with some fine sand, moist with fresh surfaces appearing wet, massive, no roots or pores, probably fill
7. Dark olive gray clayey silt with some fine sand, little 0.5-3.0 mm pores, weakly cemented, some hydrocarbon odor, moist with fresh surfaces appearing wet, some black stains, disturbed native subsoil.
8. Yellowish red clayey silt with some fine-medium sand, trace 0.1-0.25mm pores, trace manganese, stains or clay lining the pores, native subsoil

Total Depth: 11.5 Feet

"A" Rusted, torn and soiled steel drums containing soil, gypsum, board and other refuse, PID is non-detect in and around the drums
"B" Layered 3/8 in. thick gypsum board with little broken glass, burnt wood and rusted nails and bolts
"C" Light gray and light brown soil, hard, little 0.25-0.5mm pores, fill
"D" Bluish white, massive, slightly moist, trace fine pores, non-soil material
"E" Yellowish red and black soil, hard, some rusted fragments of iron.
"F" Yellowish red soil matrix with some red brick, scrap iron fragments, broken glass, concrete chunks and burnt wood fragments

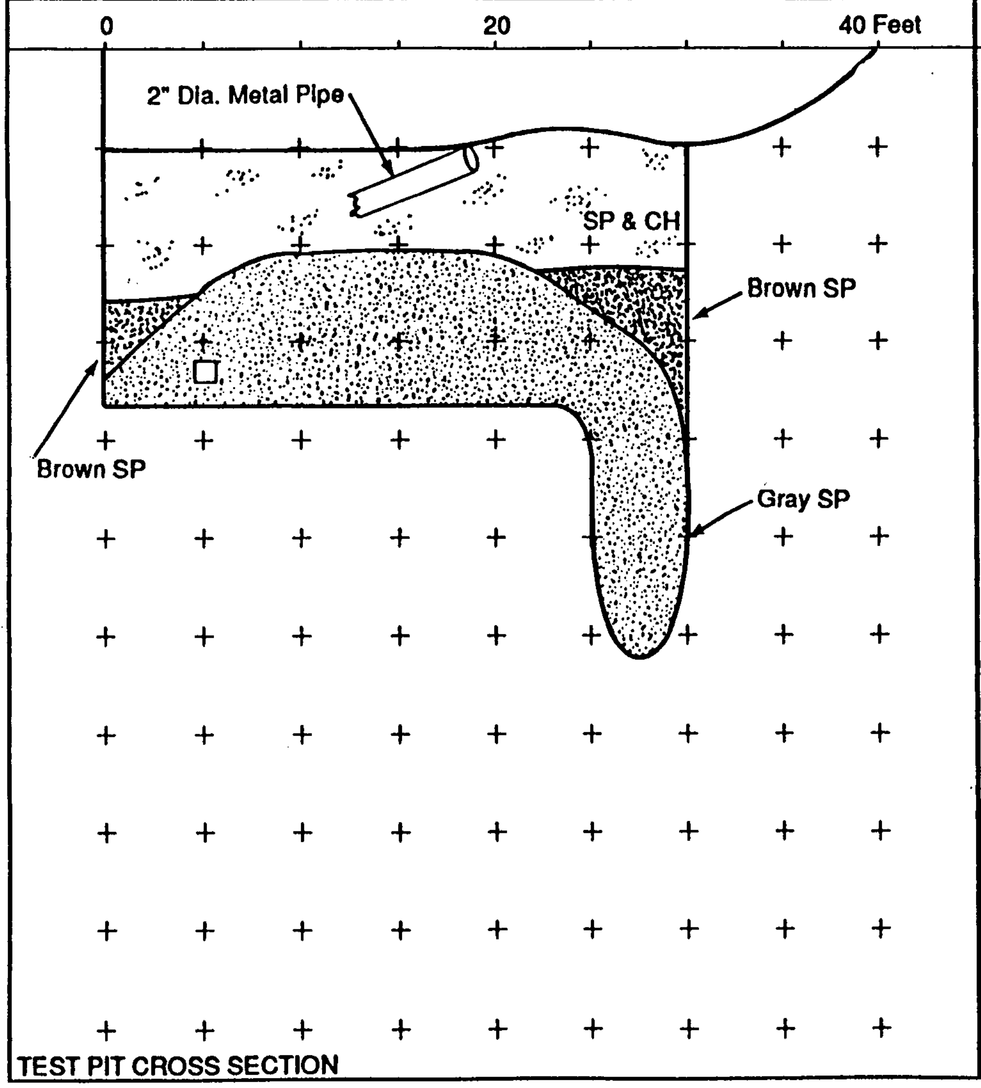
# TEST PIT LOG P-259

Union Pacific Railroad Yard
Sacramento, California
NOVEMBER 1991

DAMES & MOORE
00173-064-044 TP259

Date Completed: 5/13/91
Surface Elevation: ~ 25 Feet (MSL Datum)
Depth to Native Soil: > 12.5 Feet BGS
Orientation: E-W

EXPLANATION
○ Hand Driven Sample
☐ Grab Sample



TEST PIT CROSS SECTION

| Depth in Feet | PID (ppm) | Graphics | USCS | Description |
|---|---|---|---|---|
| 1 | ND | | SM | Brown grading to gray at 1.5 ft silty medium sand, little 1/4-1 in. gravels, hard, slightly moist, fill. |
| 2 | ND | | SP and CH | Light brown 0.25-0.75 mm sand mixed with yellowish red silty clay with trace fine sand, clay is moist, fill. |
| 3 | | | | |
| 4 | | | | |
| 5 | ND | | SP | Brown poorly sorted sand (0.25-0.75 mm), moist, fill. |
| 6 | | | | |
| 7 | | | | |
| 8 | 6-50 | | SP | Gray poorly sorted sand (0.25-0.75 mm), moist, sloughs easily, undermining the upper soil, moist, strong diesel odor, wet at ~ 12 ft, fill. |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |
| 13 | | | | Total Depth: 12.5 Feet |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

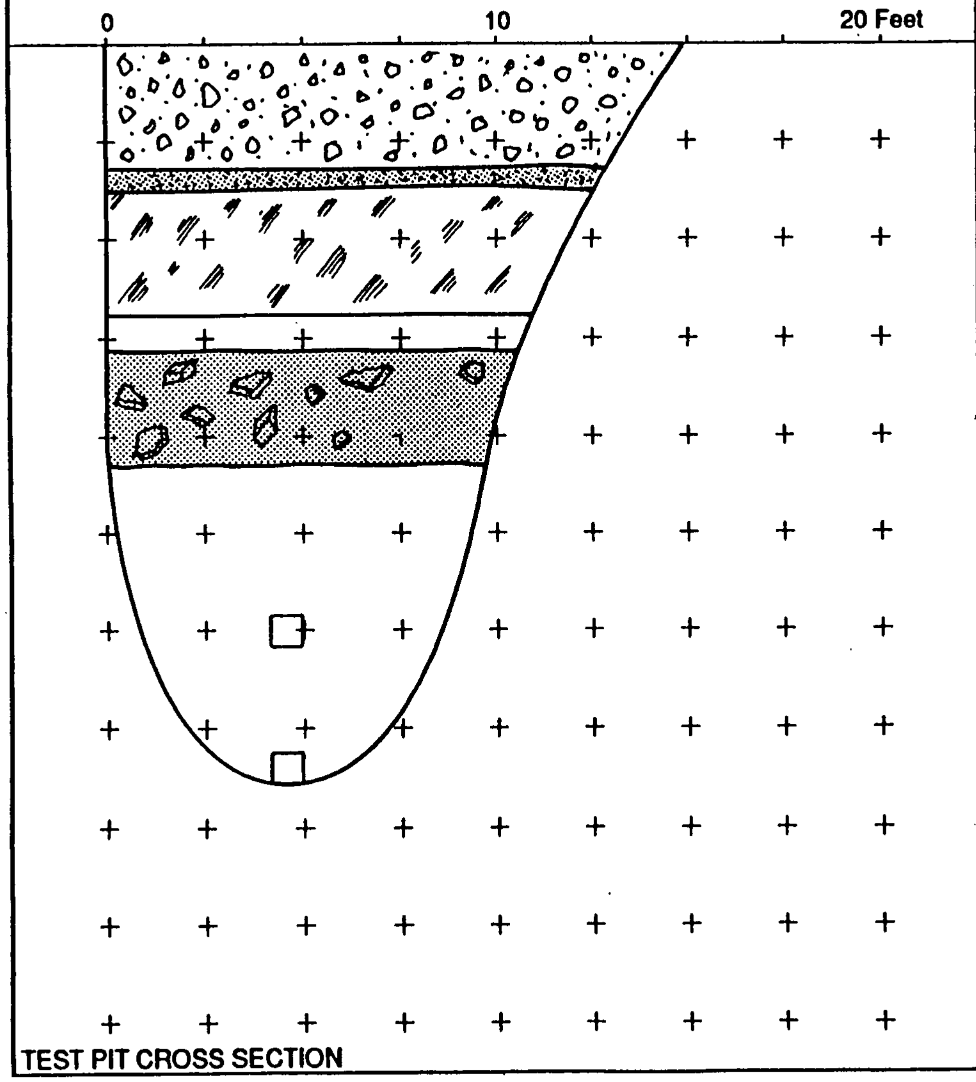
## TEST PIT LOG P-266

Union Pacific Railroad Yard
Sacramento, California
NOVEMBER 1991

DAMES & MOORE

Date Completed: 5/13/91
Surface Elevation: ~ 22 Feet (MSL Datum)
Depth to Native Soil: 9.0 Feet BGS
Orientation: S-N

EXPLANATION
○ Hand Driven Sample
☐ Grab Sample



TEST PIT CROSS SECTION

| Depth in Feet | PID (ppm) | Graphics | USCS | Description |
|---|---|---|---|---|
| | | | | Surface is 1 in. gravel with 1-2 in. thick asphalt veneer below. |
| 1<br>2 | - | | GM | Brown silty medium sand with abundant 1 in. gravel, dry, fill. |
| 3 | - | | SM | Black 2-3 in. layer of silty sand with some 1/4-1/2 in. gravel, fill. |
| 4<br>5 | - | | CL | Mix of yellowish red and brown silty clay with little fine sand, little gray inclusions, moist, hard, fill. |
| 6 | - | - | - | Bluish white, massive, hard, moist, non-soil material. |
| 7<br>8<br>9 | - | - | - | Blackened (burned) chunks of wood and remains of metal drums in a black soil matrix, strong hydrocarbon odor. |
| 10<br>11<br>12<br>13<br>14 | - | | ML | Olive clayey silt with some fine sand, moist, strong hydrocarbon odor, lightens toward bottom of pit, disturbed native subsoil. |
| 15 | | | | Total Depth: 15.0 Feet |
| 16<br>17<br>18<br>19<br>20 | | | | Note:<br>PID inoperable |

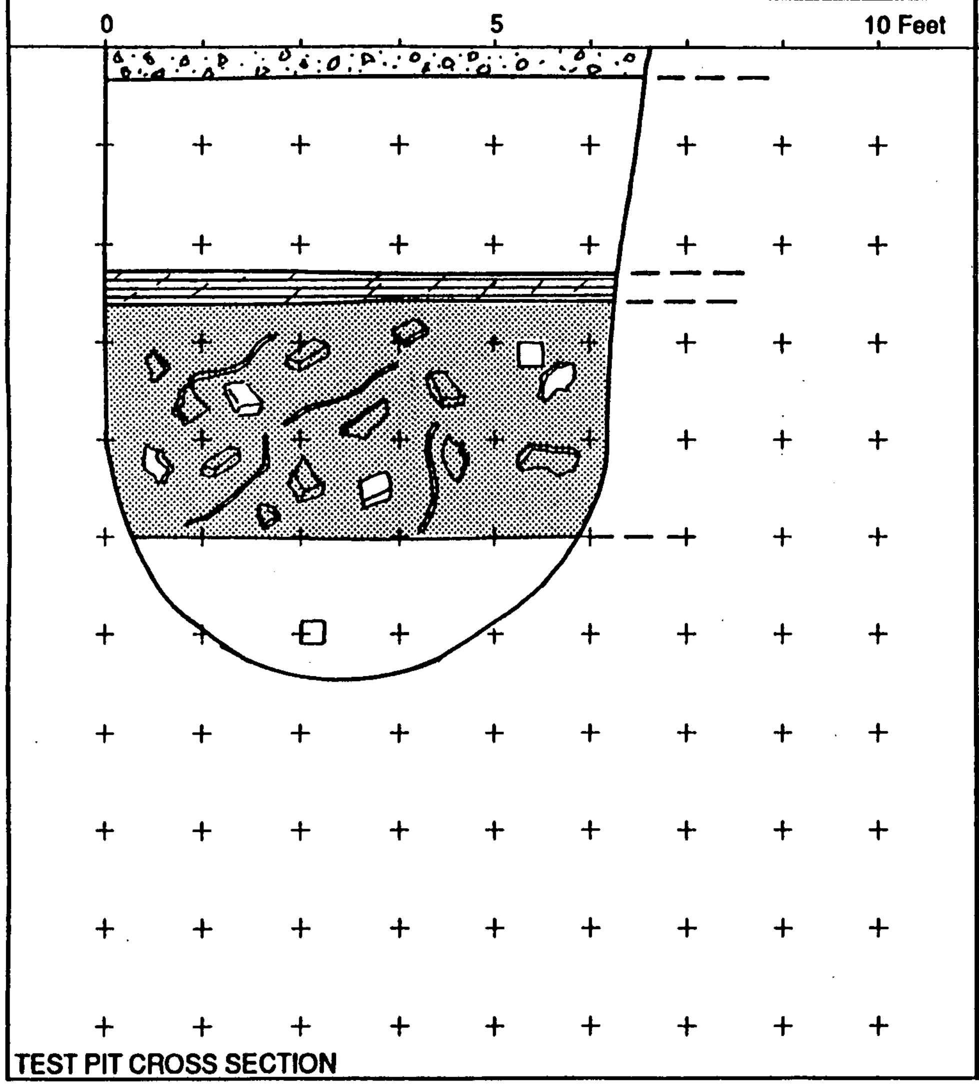
## TEST PIT LOG P-267

Union Pacific Railroad Yard
Sacramento, California
NOVEMBER 1991

DAMES & MOORE

Date Completed: 5/13/91
Surface Elevation: ~ 22 Feet (MSL Datum)
Depth to Native Soil: 10.0 Feet BGS
Orientation: N-S

EXPLANATION
○ Hand Driven Sample
☐ Grab Sample



TEST PIT CROSS SECTION

| Depth in Feet | PID (ppm) | Graphics | USCS | Description |
|---|---|---|---|---|
| | | | | 1 in. gravel and 1-2 in. thick asphalt veneer at surface. |
| | - | ○ ○ | GM | Brown silty sand with abundant 1 in. gravel. |
| 1 | - | ▨ | CL | Yellowish red and brown silty clay with some fine sand, moist, fill. |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | - | | - | White layered gypsum board with some black refuse at top 1 ft, below contains chunks of red brick, metal fragments, wire, plastic, remains of a metal drum containing black material (a sample of this substance was obtained), moisture seeping into pit at 6 ft bgs, black (soil?) matrix. |
| 6 | | | | |
| 7 | | | | |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | - | ▨ | CL | Olive silty clay with some fine sand, disturbed native subsoil. |
| 12 | | | | |
| 13 | | | | Total Depth: 13.0 Feet |
| 14 | | | | |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

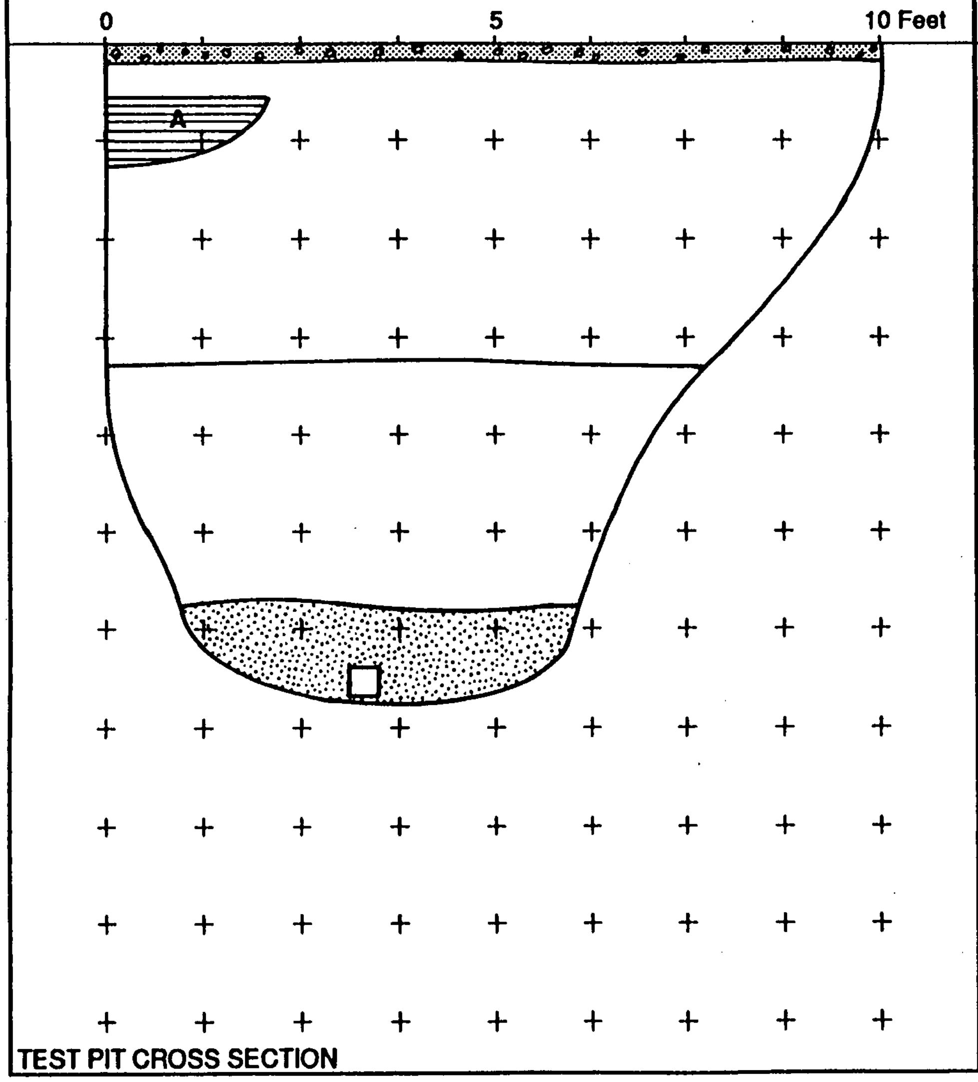
## TEST PIT LOG P-268

Union Pacific Railroad Yard
Sacramento, California
NOVEMBER 1991

DAMES & MOORE

Date Completed: 5/14/91
Surface Elevation: ~ 22 Feet (MSL Datum)
Depth to Native Soil: 6.5 Feet BGS
Orientation: SE-NW

EXPLANATION
○ Hand Driven Sample
☐ Grab Sample



TEST PIT CROSS SECTION

| Depth in Feet | PID (ppm) | Graphics | USCS | Description |
|---|---|---|---|---|
| | | - | - | Black asphalt layer at surface with some 1/2-1 in. gravel. |
| 1 | <5 | | | |
| 2 | ND | | SM and CL | On north side of trench: brown silty fine sand, sand grains 0.5-1.0 mm, some 3/4 in. gravel, slightly moist, fill - on south side of trench area: brown silty clay with some fine sand, moist, some yellowish red mottles, little 3/4 in. gravel, fill . |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |
| 6 | | | | |
| 7 | ND | | ML | Yellowish red fine sandy silt, moist, probably native subsoil. |
| 8 | | | | |
| 9 | | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | ND | | SP | Brown poorly sorted 1 mm sand, moist, probably native subsoil, micaceous. |
| 13 | | | | Total Depth: 13.5 Feet |
| 14 | | | | "A" - Layered 1/2 in. thick white gypsum board. |
| 15 | | | | |
| 16 | | | | |
| 17 | | | | |
| 18 | | | | |
| 19 | | | | |
| 20 | | | | |

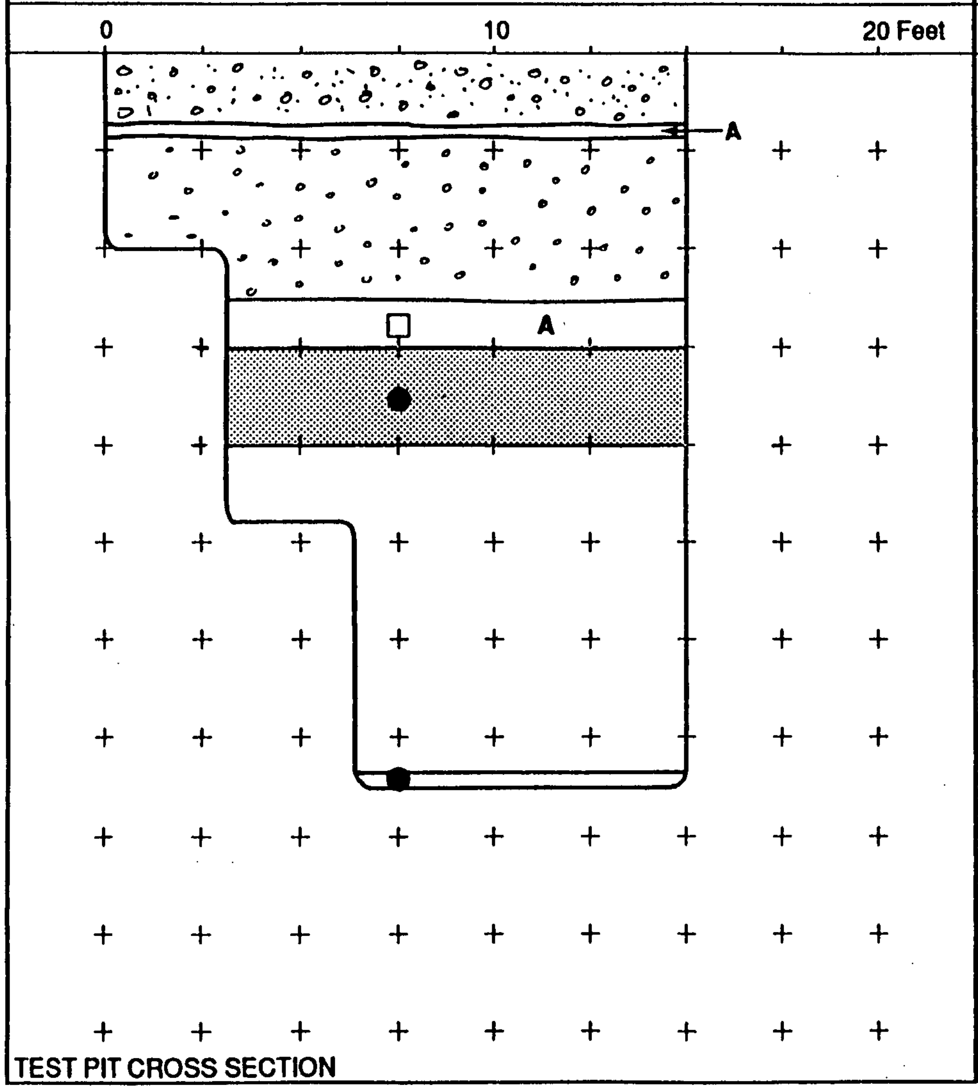
# TEST PIT LOG P-269

Union Pacific Railroad Yard
Sacramento, California
NOVEMBER 1991

DAMES & MOORE

Date Completed: 5/15/91
Surface Elevation: ~ 22 Feet (MSL Datum)
Depth to Native Soil: 7.25 Feet BGS
Orientation: S-N

EXPLANATION
● Hand Driven Sample
☐ Grab Sample



| Depth in Feet | PID (ppm) | Graphics | USCS | Description |
|---|---|---|---|---|
| 0–1 | ND | - | - | 1 in. thick black asphalt veneer with brown soil of a variety of textures beneath, some 3/4 in. gravel and chunks of asphalt, fill. |
| 1–3 | ND | ▨ | CL | Brown silty clay with some fine sand, moist, some 1/4-1 in. gravel, fill. |
| 3–7.25 | ND | ▨ | CL | Dark brown silty clay with some fine sand, no gravels, moist, massive, 6 in. gradational contact at bottom, soft in places, color below top foot is reddish brown, and lightens and reddens towards bottom, fill. |
| 7.25–7.5 | ND |  | CH | Yellowish red silty clay with some fine sand, moist, native subsoil. |
| 7.5 |  |  |  | Total Depth: 7.5 Feet |

"A" - Bluish white, massive, hard, moist, non-soil material.

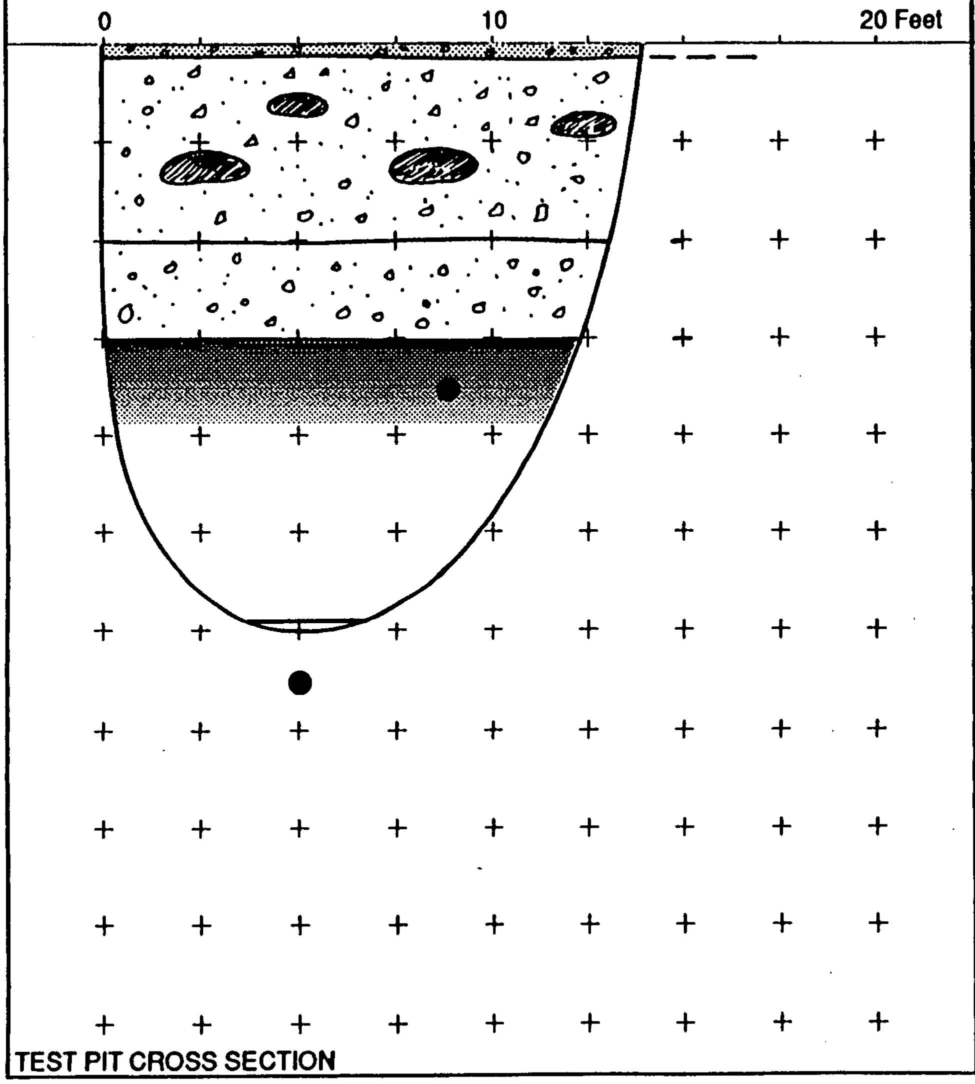
# TEST PIT LOG P-270

Union Pacific Railroad Yard
Sacramento, California
NOVEMBER 1991

DAMES & MOORE

Date Completed: 5/14/91
Surface Elevation: ~ 22 Feet (MSL Datum)
Depth to Native Soil: 6.0 Feet BGS
Orientation: SE-NW

EXPLANATION
● Hand Driven Sample
☐ Grab Sample



TEST PIT CROSS SECTION

| Depth in Feet | PID (ppm) | Graphics | USCS | Description |
|---|---|---|---|---|
| | ND | | - | Black asphalt surface with some 3/4 in. gravels. |
| 1 | ND | | SM | Silty medium sand (1-2 mm grains) with some 1/4-1 in. gravels, little chunks of asphalt, slightly moist, brown, fill. |
| 2 | ND | | CL | Brown and yellowish red silty clay with some fine sand, moist, little 1/4-1 in. gravels and chunks of asphalt, fill. |
| 3 | ND | | ML | Dark brown fine sandy silt, moist, massive, top 1 in. is black, gradually lightens and reddens downward to yellowish red color, fill. |
| 6 | ND | | CH | Yellowish red clayey silt and some fine sand, little manganese stained 0.5-4.0 mm pores, moist, massive, native subsoil.<br>Total Depth: 6.0 Feet |

# TEST PIT LOG P-271

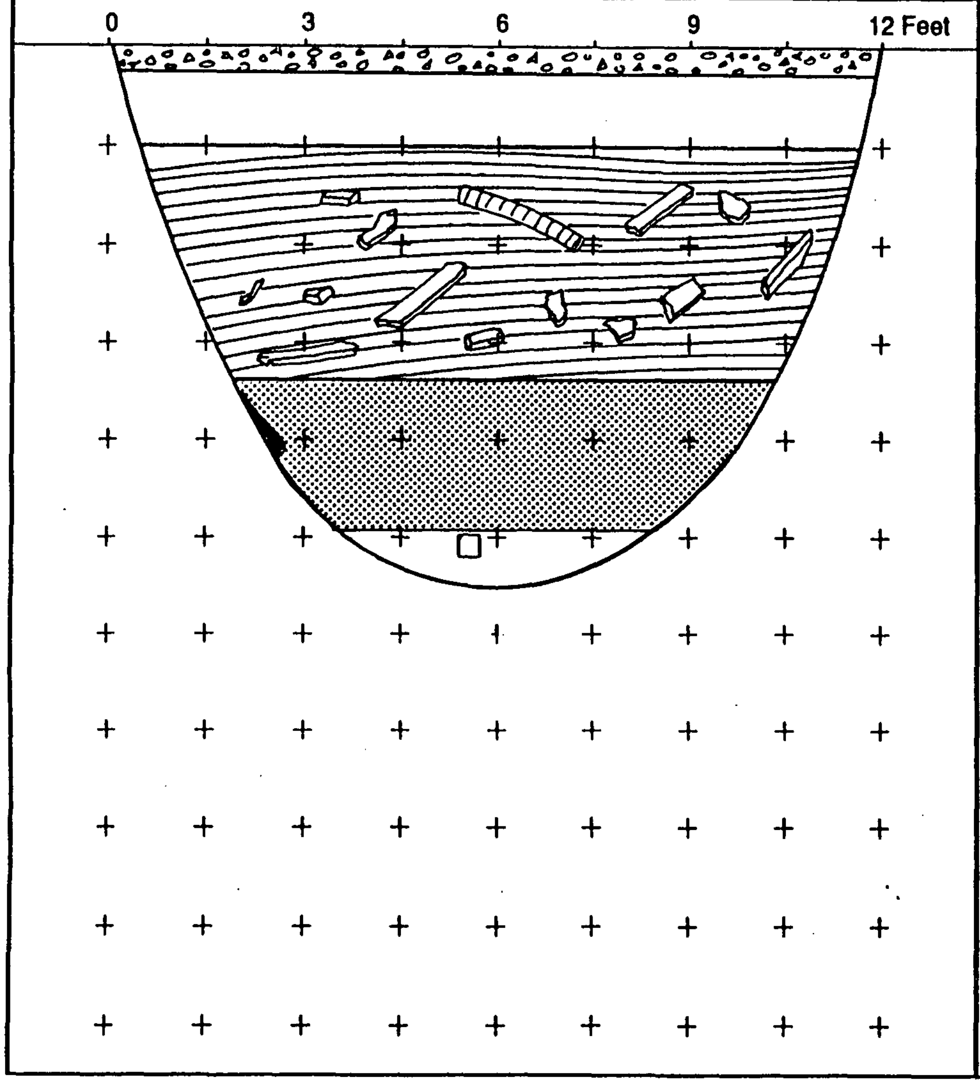
Union Pacific Railroad Yard
Sacramento, California
NOVEMBER 1991

DAMES & MOORE

00173-064-044 TEST PIT TP283

Date Completed: 5/23/91
Surface Elevation: ~ Feet (MSL Datum)
Depth to Native Soil: 10.5 Feet BGS
Orientation: N-S

EXPLANATION
○ Hand Driven Sample
☐ Grab Sample



TEST PIT CROSS SECTION

| Depth in Feet | PID (ppm) | Graphics | USCS | Description |
|---|---|---|---|---|
| | ND | | ML | Light brown clayey silt with some 1 in. gravel, hard, fill. |
| 1<br>2 | ND | | CH | Yellowish red silty clay with some fine sand, moist, fill. |
| 3<br>4<br>5<br>6 | ND | | - | Layers of gypsum board with little brick, glass, metal, plastic and concrete slabs up to 8 in. thick, remains of a crushed metal drum containing little black viscous liquid and a length of 4 in. corrugated rubber hose at 3 ft, fill. |
| 7<br>8<br>9 | 2 | | - | Dark brown and black stained soil, hydrocarbon and sulfur odor, viscous black liquid observed oozing from trench wall, fill. |
| 10<br>11 | 2 | | - | Olive gray stained soil, moist, native subsoil.<br>Total Depth: 11.0 Feet |
| 12<br>13<br>14<br>15<br>16<br>17<br>18<br>19<br>20 | | | | Note: MW-43 borehole was advanced into clean backfill placed into P-291 |

## TEST PIT LOG P-291

Union Pacific Railroad Yard
Sacramento, California
NOVEMBER 1991

DAMES & MOORE
00173-064-044 TP291

# AppenDix B

# APPENDIX B

# PREVIOUS SOIL GAS SAMPLING
RESULTS FOR THE CENTRAL FILL AREA AND OIL HOUSE AREA

### 1991 SOIL GAS ANALYSIS RESULTS
### VOLATILE ORGANIC COMPOUNDS
### UNION PACIFIC RAILROAD YARD
### SACRAMENTO, CALIFORNIA

| SAMPLE | AIR-1 | AIR-2 | AIR-3 | AIR-4 | SG-01 | SG-01A | SG-01B | SG-02 |
|---|---|---|---|---|---|---|---|---|
| DATE | 05/07/91 | 05/07/91 | 05/08/91 | 05/09/91 | 05/07/91 | 05/07/91 | 05/07/91 | 05/07/91 |
| DEPTH | | | | | 6.5 | 5.0 | 5.0 | 3.0 |
| QA | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | < 0.0004 | < 0.0004 | < 0.0003 | < 0.0001 | < 0.0010 | - | < 0.0010 | < 0.0006 |
| 1,1-DICHLOROETHANE | < 0.0800 | < 0.0800 | < 0.0900 | < 0.0300 | < 0.0800 | - | < 0.0800 | < 0.0800 |
| 1,1-DICHLOROETHENE | < 0.0200 | < 0.0200 | < 0.0300 | < 0.0300 | < 0.0200 | - | < 0.0200 | < 0.0200 |
| 1,2-DICHLOROETHANE | < 0.0600 | < 0.0600 | < 0.0600 | < 0.0200 | < 0.0600 | - | < 0.0600 | < 0.0600 |
| BENZENE | < 0.0800 | < 0.0800 | < 0.0400 | < 0.0400 | < 0.0800 | - | < 0.0800 | < 0.0800 |
| CARBON TETRACHLORIDE | < 0.0001 | < 0.0001 | 0.0010 | 0.0010 | < 0.0001 | - | < 0.0010 | < 0.0010 |
| ETHYL BENZENE | < 0.2000 | < 0.2000 | < 0.1000 | < 0.1000 | < 0.2000 | - | < 0.2000 | < 0.2000 |
| PERCHLOROETHYLENE | - | - | < 0.0003 | < 0.0002 | - | - | - | - |
| TOLUENE | < 0.1000 | < 0.1000 | < 0.0500 | < 0.0500 | < 0.1000 | - | < 0.1000 | < 0.1000 |
| TOTAL VOLATILE HYDROCARBONS | < 0.3000 | < 0.3000 | < 0.2000 | < 0.2000 | 59.0000 | - | < 0.1000 | 0.3000 |
| TRICHLOROETHYLENE | < 0.0100 | < 0.0100 | < 0.0008 | < 0.0003 | < 0.0100 | - | < 0.0100 | < 0.0100 |
| VINYL CHLORIDE | < 0.3000 | < 0.3000 | - | - | - | < 0.3000 | - | - |
| XYLENE | < 0.3000 | < 0.3000 | < 0.1000 | < 0.1000 | < 0.3000 | - | < 0.3000 | < 0.3000 |

All units reported as ug/L

< = Constituent below detection limit. Detection limits may vary depending on interference by other sample constituents.
- = Parameter not analyzed.
I = Interference from adjacent peaks.

(cont.)
1991 SOIL GAS ANALYSIS RESULTS
VOLATILE ORGANIC COMPOUNDS
UNION PACIFIC RAILROAD YARD
SACRAMENTO, CALIFORNIA

| SAMPLE | SG-03A | SG-03B | SG-04 | SG-04 | SG-05 | SG-06 | SG-07 | SG-08 |
|---|---|---|---|---|---|---|---|---|
| DATE | 05/07/91 | 05/07/91 | 05/07/91 | 05/07/91 | 05/08/91 | 05/08/91 | 05/08/91 | 05/08/91 |
| DEPTH | 3.5 | 3.5 | 5.0 | 6.0 | 4.0 | 4.5 | 4.0 | 6.0 |
| QA | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | - | < 0.0010 | < 0.0010 | < 0.0010 | < 0.0003 | < 0.0030 | 0.0000 I | 0.0200 |
| 1,1-DICHLOROETHANE | - | < 0.0800 | < 0.0800 | < 0.0800 | < 0.0900 | < 0.0900 | 2.0000 | < 0.2000 |
| 1,1-DICHLOROETHENE | - | < 0.0200 | < 0.0200 | < 0.0200 | < 0.0300 | < 0.0300 | < 0.3000 | < 0.0500 |
| 1,2-DICHLOROETHANE | - | < 0.0600 | < 0.0600 | < 0.0600 | < 0.0600 | < 0.0600 | < 0.0600 | < 0.1000 |
| BENZENE | - | < 0.0800 | < 0.0800 | < 0.0800 | < 0.0400 | < 0.0400 | < 0.0400 | < 0.0700 |
| CARBON TETRACHLORIDE | - | < 0.0010 | < 0.0010 | < 0.0010 | 0.0005 | 0.0006 | < 0.0010 | < 0.0003 |
| ETHYL BENZENE | - | < 0.2000 | < 0.2000 | < 0.2000 | < 0.1000 | < 0.1000 | < 0.1000 | < 0.3000 |
| PERCHLOROETHYLENE | - | - | - | - | < 0.0003 | < 0.0003 | < 0.0030 | < 0.0006 |
| TOLUENE | - | < 0.1000 | < 0.1000 | < 0.1000 | < 0.0500 | < 0.0500 | < 0.0500 | < 0.1000 |
| TOTAL VOLATILE HYDROCARBONS | - | < 0.1000 | < 0.1000 | 496.0000 | < 0.2000 | 4.0000 | 2.0000 | < 0.4000 |
| TRICHLOROETHYLENE | - | < 0.0100 | < 0.0100 | < 0.0100 | < 0.0008 | < 0.0008 | < 0.0008 | < 0.0020 |
| VINYL CHLORIDE | < 0.3000 | - | - | - | - | - | - | - |
| XYLENE | - | < 0.3000 | < 0.3000 | < 0.3000 | < 0.1000 | < 0.1000 | < 0.1000 | < 0.3000 |

All units reported as ug/L

< = Constituent below detection limit. Detection limits may vary depending on interference by other sample constituents.
- = Parameter not analyzed.
I = Interference from adjacent peaks.

(cont.)

### 1991 SOIL GAS ANALYSIS RESULTS
### VOLATILE ORGANIC COMPOUNDS
### UNION PACIFIC RAILROAD YARD
### SACRAMENTO, CALIFORNIA

| SAMPLE | SG-08 | SG-09 | SG-10 | SG-11 | SG-11 | SG-12 | SG-12 | SG-13 |
|---|---|---|---|---|---|---|---|---|
| DATE | 05/08/91 | 05/08/91 | 05/08/91 | 05/08/91 | 05/08/91 | 05/08/91 | 05/08/91 | 05/08/91 |
| DEPTH | 10.0 | 4.5 | 4.5 | 5.0 | 10.0 | 5.0 | 10.0 | 5.0 |
| QA | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 0.0100 | 0.2000 | 0.0100 | 24.0000 | 26.0000 | 3.0000 | 7.0000 | 24.0000 |
| 1,1-DICHLOROETHANE | < 0.0900 | < 0.0900 | 0.5000 | 62.0000 | 49.0000 | 5.0000 | 8.0000 | 10.0000 |
| 1,1-DICHLOROETHENE | < 0.0300 | < 0.0300 | 0.0500 | 9.0000 | 7.0000 | 1.0000 | 2.0000 | 3.0000 |
| 1,2-DICHLOROETHANE | < 0.0600 | < 0.0600 | < 0.0600 | < 0.3000 | < 0.3000 | < 0.3000 | < 0.3000 | < 0.3000 |
| BENZENE | < 0.0400 | < 0.0400 | < 0.0400 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 |
| CARBON TETRACHLORIDE | < 0.0001 | < 0.0001 | < 0.0010 | < 0.0006 | < 0.0006 | < 0.0006 | < 0.0006 | < 0.0060 |
| ETHYL BENZENE | < 0.1000 | < 0.1000 | < 0.1000 | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 |
| PERCHLOROETHYLENE | < 0.0003 | < 0.0003 | < 0.0003 | 31.0000 | 29.0000 | 0.0700 | 3.0000 | 12.0000 |
| TOLUENE | < 0.0500 | < 0.0500 | < 0.0500 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 |
| TOTAL VOLATILE HYDROCARBONS | < 0.2000 | < 0.2000 | 0.4000 | 32.0000 | 22.0000 | 24.0000 | 2.0000 | 8.0000 |
| TRICHLOROETHYLENE | < 0.0008 | < 0.0008 | 0.0050 | 5.0000 | 8.0000 | 0.2000 | 1.0000 | 2.0000 |
| VINYL CHLORIDE | - | - | - | - | - | - | - | - |
| XYLENE | < 0.1000 | < 0.1000 | < 0.1000 | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 |

All units reported as ug/L

< = Constituent below detection limit. Detection limits may vary depending on interference by other sample constituents.
- = Parameter not analyzed.
I = Interference from adjacent peaks.

(cont.)

## 1991 SOIL GAS ANALYSIS RESULTS
## VOLATILE ORGANIC COMPOUNDS
## UNION PACIFIC RAILROAD YARD
## SACRAMENTO, CALIFORNIA

| SAMPLE | SG-13 | SG-14 | SG-14 | SG-15 | SG-15 | SG-16 | SG-17 | SG-17 |
|---|---|---|---|---|---|---|---|---|
| DATE | 05/08/91 | 05/08/91 | 05/08/91 | 05/09/91 | 05/09/91 | 05/09/91 | 05/09/91 | 05/09/91 |
| DEPTH | 10.0 | 5.0 | 9.5 | 5.0 | 10.0 | 4.5 | 5.0 | 10.0 |
| QA | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 25.0000 | 24.0000 | 24.0000 | 4.0000 | 13.0000 | 2.0000 | 7.0000 | 0.0020 |
| 1,1-DICHLOROETHANE | 18.0000 | 12.0000 | 14.0000 | 5.0000 | 12.0000 | < 0.2000 | 4.0000 | 15.0000 |
| 1,1-DICHLOROETHENE | 5.0000 | 0.3000 | 0.7000 | 0.7000 | 6.0000 | < 0.1000 | < 0.1000 | 15.0000 |
| 1,2-DICHLOROETHANE | < 0.3000 | < 0.3000 | < 0.3000 | < 0.1000 | < 0.1000 | < 0.1000 | < 0.1000 | < 0.1000 |
| BENZENE | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 |
| CARBON TETRACHLORIDE | < 0.0006 | < 0.0006 | < 0.0006 | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 | < 0.0007 |
| ETHYL BENZENE | < 0.7000 | < 0.7000 | < 0.7000 | < 0.0007 | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 |
| PERCHLOROETHYLENE | 20.0000 | 4.0000 | 3.0000 | 21.0000 | 21.0000 | 0.0400 | < 0.0010 | 2.0000 |
| TOLUENE | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 | < 0.2000 |
| TOTAL VOLATILE HYDROCARBONS | 8.0000 | 5.0000 | 5.0000 | 10.0000 | 34.0000 | 1.0000 | 4.0000 | 360.0000 |
| TRICHLOROETHYLENE | 4.0000 | 0.0900 | 0.2000 | 3.0000 | 5.0000 | < 0.0020 | < 0.0020 | 2.0000 |
| VINYL CHLORIDE | - | - | - | - | - | - | - | - |
| XYLENE | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 | < 0.7000 |

---

All units reported as ug/L

< = Constituent below detection limit. Detection limits may vary depending on interference by other sample constituents.
- = Parameter not analyzed.
I = Interference from adjacent peaks.

(cont.)

## 1991 SOIL GAS ANALYSIS RESULTS
## VOLATILE ORGANIC COMPOUNDS
## UNION PACIFIC RAILROAD YARD
## SACRAMENTO, CALIFORNIA

| SAMPLE | SG-18 | SG-19 | SG-20 | SG-21 | SG-22 | SG-23 | SG-24 | SG-25 |
|---|---|---|---|---|---|---|---|---|
| DATE | 05/09/91 | 05/09/91 | 05/09/91 | 05/09/91 | 05/09/91 | 05/09/91 | 05/09/91 | 05/09/91 |
| DEPTH | 5.0 | 6.0 | 5.75 | 6.0 | 6.0 | 5.0 | 5.0 | 5.5 |
| QA | | | | | | | | |
| 1,1,1-TRICHLOROETHANE | 0.0070 | < 0.0003 | 0.0020 | < 0.0003 | 5.0000 | 0.0030 | < 0.0003 | 7.0000 |
| 1,1-DICHLOROETHANE | < 0.2000 | < 0.0800 | < 0.0800 | < 0.0800 | < 0.0800 | < 0.0800 | < 0.0800 | 2.0000 |
| 1,1-DICHLOROETHENE | < 0.1000 | < 0.0700 | < 0.0700 | < 0.0700 | < 0.0700 | < 0.0700 | < 0.0700 | < 0.0700 |
| 1,2-DICHLOROETHANE | < 0.1000 | < 0.0500 | < 0.0500 | < 0.0500 | < 0.0500 | < 0.0500 | < 0.0500 | < 0.0500 |
| BENZENE | < 0.0900 | < 0.0900 | < 0.0900 | < 0.0900 | < 0.0900 | < 0.0900 | < 0.0900 | < 0.0900 |
| CARBON TETRACHLORIDE | < 0.0007 | < 0.0004 | < 0.0004 | < 0.0004 | < 0.0004 | < 0.0004 | < 0.0004 | < 0.0004 |
| ETHYL BENZENE | < 0.7000 | < 0.4000 | < 0.4000 | < 0.4000 | < 0.4000 | < 0.4000 | < 0.4000 | < 0.4000 |
| PERCHLOROETHYLENE | < 0.0010 | 0.0100 | 0.0100 | < 0.0006 | 0.3000 | < 0.0006 | 0.0500 | 0.2000 |
| TOLUENE | < 0.0200 | < 0.1000 | < 0.1000 | < 0.1000 | < 0.1000 | < 0.1000 | < 0.1000 | < 0.1000 |
| TOTAL VOLATILE HYDROCARBONS | < 0.9000 | 50.0000 | < 0.4000 | 6.0000 | 2.0000 | < 0.4000 | < 0.4000 | 5.0000 |
| TRICHLOROETHYLENE | < 0.0020 | 0.0070 | < 0.0009 | < 0.0009 | < 0.0009 | < 0.0009 | 0.0100 | 0.0100 |
| VINYL CHLORIDE | - | - | - | - | - | - | - | - |
| XYLENE | < 0.7000 | < 0.3000 | < 0.3000 | < 0.3000 | < 0.3000 | < 0.3000 | < 0.3000 | < 0.3000 |

All units reported as ug/L

< = Constituent below detection limit. Detection limits may vary depending on interference by other sample constituents.
- = Parameter not analyzed.
I = Interference from adjacent peaks.

# Appendix C

# APPENDIX C

# STANDARD OPERATING PROCEDURES

## INDEX OF STANDARD OPERATING PROCEDURES

# APPENDIX C

# STANDARD OPERATING PROCEDURES

## INTRODUCTION

This Appendix describes the Standard Operating Procedures (SOP) for field tasks to be completed during soil gas, groundwater grab, and soil matrix sampling activities at the Union Pacific Railroad Yard, Sacramento, California. The SOPs are intended to augment the descriptions of sampling, monitoring, and data collection in the text. These procedures were developed as general descriptions of field methods that will be employed during various phases of the field investigation. The purpose of the SOPs is to standardize and document field procedures and the collection of field data. Appendix D contains Hydro Geo Chem's SOP for the collection of soil gas and grab groundwater samples.

Each SOP describes the purpose, equipment needs, proper field documentation forms, and methodology for a general field task. Specific health and safety procedures and information are presented in the site-specific Health and Safety Plan. Field personnel will be familiar with the Health and Safety Plan prior to implementing field procedures. Full-size copies of field documentation forms referenced in the SOPs are included at the end of this Appendix. SOPs are subdivided into more specific procedures, when necessary. Overall, the SOPs listed below provide general methods and procedures which may be changed due to variations in field conditions. Changes in procedures will be documented by issuing a Revised SOP.

Procedures for the following field tasks are described in this Appendix:

| | |
|---|---|
| SOP 1.0 | Water Sampling |
| SOP 2.0 | Field Measurements - Water |
| SOP 3.0 | Equipment Decontamination |
| SOP 4.0 | Soil, Water, and Waste Disposal |
| SOP 5.0 | Sample Shipment |
| SOP 6.0 | Soil Borings |
| SOP 7.0 | Logging of Soil Borings - USCS |
| SOP 8.0 | Installation and Construction - Soil Gas Monitoring Wells |
| SOP 9.0 | Soil Sampling |

# APPENDIX C

## STANDARD OPERATING PROCEDURES

## 1.0 WATER SAMPLING

| | |
|---|---|
| Purpose and Scope: | The purpose of these procedures is to describe the general methodology for collecting representative groundwater samples for chemical analysis. The following procedures describe the techniques to be implemented for water-level measurements, well purging, sampling withdrawal, and sample collection. Groundwater samples for this Work Plan will be collected from the soil gas sampling tube. That procedure is outlined in Appendix D. |
| Equipment: | Bailer - stainless-steel, teflon, PVC, or disposable polyethylene;<br>Bailer reel with twine;<br>A tarp or plastic sheet;<br>Water level indicator (100-foot length);<br>pH meter, conductivity meter(EC), and thermometer;<br>Turbidity meter;<br>Sample containers (laboratory cleaned and provided);<br>Electric submersible pump;<br>Electric generator;<br>Electric submersible pump control box;<br>Ice chests; and<br>Blue ice. |
| Documentation: | Field Memorandum;<br>Water Sample Tracking form;<br>Field Record of Water Sampling form;<br>Sample Chain of Custody; and<br>Instrument Calibration Log.<br>(All forms are to be included in a bound field notebook.) |

### 1.1 SET-UP

Prior to the sampling event, an appropriately trained professional will be responsible for reviewing available information and preparing the proper equipment. Preparation and set-up for water sampling will include the following:

- Review of the sample locations and number of samples to be collected with Task Manager;
- Confirmation of analyte list with Task Manager;
- Notifying the laboratory two to three weeks in advance of sampling of the number of samples and types of analyses. Request the proper number and type of sample containers. Upon receipt, inspect sample containers, notify laboratory of any missing or damaged containers;

- Notifying on-site personnel of sampling schedule, and clear access to wells;
- Checking and calibrating water level meter, pH, EC, temperature, and turbidity meters to ensure the meters are accurate and are in good working condition (see SOP 2.0);
- Assembling all required equipment and check that it is in proper working condition; and
- As part of preparation and mobilization, a bound field notebook will be compiled to be used during the sampling event. The notebook will include blank copies of the necessary documentation forms including: field memoranda, water sample tracking forms, field records of water sampling, and instrument calibration forms. The notebook may also include well specification information and sample location maps. Upon completion of the monitoring event, the notebook will be turned into the Task Manager for review and approval.

## 1.2 GROUNDWATER SAMPLING

Groundwater samples will be collected from soil gas sampling holes after purging so that fresh formation water is sampled. All non-dedicated equipment will be decontaminated, assembled, calibrated, and tested prior to sampling. Monitoring well construction logs, along with available water level data, will be reviewed.

Field instruments will be calibrated prior to beginning daily sampling activities according to procedures outlined in SOP 2.0. Calibration information will be recorded on the Instrument Calibration Form and noted on Field Memorandums. All field groundwater measurements will be recorded on Field Record of Water Sampling forms.

The static water level will then be measured with an electric water level indicator. Depth-to-water measurements will be recorded to the nearest 0.01 foot on the Field Record of Water Sampling form. Each well will then be purged to allow sample collection of fresh formation water. Purged water will be contained in the 2,000-gallon on-site purge water tank. Purging at each location will continue until the following two conditions are met:

- Three casing volumes are removed from the hole. To calculate the volume of water in the well, use the equation:

$$CV = \left( 7.48 \frac{g}{ft^3} \right) \times \pi \times r^2 \times H$$

where:

CV = one casing volume of water in well (gallons)
H = height of water column (feet)
r = radius of well casing (feet)

- The field pH, specific conductivity, and temperature measurements of the discharged water have stabilized to consecutive readings within 10% of previous readings.

Wells that are pumped or bailed dry prior to removing three casing volumes of water will be allowed to recover and then pumped or bailed dry a second time. Field measurements of temperature, pH, and specific conductivity will then be collected as the well fills again. Samples will be collected when measurements have stabilized.

Samples will be collected as soon as recharge has occurred or at the completion of purging. Samples will be collected for volatiles at 100 ml/minute and other parameters at rates of 500 to 1,000 ml/minute. The dedicated sample pump or a disposable bailer will be used to obtain the samples from the well. For sample collection, the bailer will be lowered with minimum splash to just below the water surface. Samples will be collected in the following order:

- volatile organic compounds; and
- other parameters.

Volatile organic compounds will be collected in containers with no headspace. Sample fractions for metals and other inorganic compounds will be filtered and preserved in the field according to laboratory instruction. Sample preservative requirements are presented in Table C-5.2. Samples that require filtering will be filtered using a disposable 0.45 $\mu$m (micron) filter. If the sample is turbid, a pre-filter will be used to prevent clogging. An adequate sample volume will be pumped through the filter and into the sample containers. The filter will be disposed of and all filtering information will be recorded on the Field Record of Water Sampling form.

Labels will be affixed to each sample bottle recording sample number, well number, date, time, analysis required, preservative used, and collector's initials. In addition, all information will be recorded on the Field Record of Water Sampling form and field log along with a description of the physical appearance of the sample including color, clarity, suspended solids, etc.

A Chain-of-Custody form will accompany each sample to establish the required documentation necessary to track sample possession. Information on this form includes project number, name, signature of collector, sample number, date and time of collection, sample type (grab or composite), number of containers, analyses required, signature of persons involved in the chain of possession, and inclusive dates of possession. A copy of the Chain-of-Custody form will be maintained by the sampling personnel. The Chain-of-Custody form will be maintained as part of the project files once analyses have been completed and the signed Chain-of-Custody form has been returned by the laboratory. Sample handling will be conducted as described in SOP 5.0.

Non-dedicated and non-disposable bailers, pumps, meters, reels, water levels meters, and Teflon tubing will be decontaminated upon completion of sampling (see SOP 3.0 - Equipment Decontamination).

## 2.0 FIELD MEASUREMENTS - WATER

| | |
|---|---|
| Purpose and Scope: | These procedures describe the techniques to be implemented when field measurements of groundwater are collected. The methods described are intended to provide uniformity and continuity in operation, calibration, and maintenance of both the equipment and measuring techniques by different qualified field analysts or technicians. Measurements described below include pH, electrical conductivity (EC), temperature, and groundwater elevation. Procedures below were derived from manufacturer's recommendations and include methods for calibration and measurement. |
| Equipment: | pH meter (one that can perform a two-point calibration) and electrode;<br>pH buffer solutions (pH 4.0, 7.0, 10.0) (NIST traceable);<br>Electrical conductivity (EC) meter;<br>EC Reference Standards (NIST traceable);<br>Thermometer (NIST traceable);<br>Zobell's Solution;<br>Turbidity meter;<br>Water level indicator;<br>Distilled or deionized water;<br>Spray water bottle;<br>Sample cup or beaker; and<br>Extra batteries. |
| Documentation: | Field Memorandum;<br>Field Record of Water Sampling form;<br>Instrument Calibration form; and<br>Water Sample Tracking form. |

### 2.1 SET-UP

Prior to taking any field measurements, the geologist will assemble all necessary equipment and check all instruments to be used to ensure they are in proper working condition. Each meter will then be calibrated. Calibration data will be recorded on an Instrument Calibration form.

### 2.2 WATER LEVEL MEASUREMENT

Water level measurements will be referenced to a known elevational datum. The measuring point at the top of the casing will be permanently marked and surveyed and measurements will be consistently taken from the same marked point. Water levels will be measured prior to well evacuation with an electrical sounding or equivalent device.

Water levels will be measured by lowering the probe or tape measure into the well until contact with the water surface is indicated. The electric tape will be marked at the reference measuring point and partly withdrawn. Readings will be verified by repeating the procedure until successive measurements differ by less than 0.01 foot, and then recorded. Measuring devices will be decontaminated prior to and after use in each monitoring well.

If the water level measurement indicates the well is dry, the total well depth measurement will be recorded and compared with well construction specifications. If the total depth measurement and the well specifications do not match, the dedicated pumps will be temporarily removed from the well and placed into a plastic bag. The total depth will then be remeasured to ensure that there is no interference between the pump and water level probe.

## 2.3 pH MEASUREMENT

The general procedures for the operation, calibration, and maintenance of a field pH meter and its accessories are described below. Manufacturer's specifications and recommendations should be followed or referred to when the need arises.

Prior to use, the pH meter should be examined for cleanliness and checked for defects and any possible need of repair. The checks should include the battery and electrode.

- Battery checks will include measurements to determine if it is functional to full scale. Batteries will be replaced if found to be weak.
- Electrode checks will consist of checking that the electrode is properly connected to the meter. The electrode tip should be covered by a rubber sleeve or cap that protects the electrolyte from flowing out of the opening or from drying. The cap will be removed and saved for storage. If bubbles are seen in the bulb area of the electrode, the electrode is to be shaken downward. This action will help eliminate bubbles that may have been generated during storage or shipment.
- The meter and electrode will be checked daily by trained personnel according to procedures provided by the equipment's manufacturer.

Procedures for calibrating the meter and for measuring the pH of a water sample are listed below:

- Turn on power;
- Allow meter to stabilize for three to five minutes. The meter is not to be used or left in direct sunlight, cold wind, or rain;
- Calibrate the meter. The meter is to be calibrated daily or periodically (see QAPP) during continuous use of the meter. Instrument calibration consists of the following steps:

  - Select two buffer solutions obtained from a commercial supplier (pH 4 and 7 if acidic conditions are expected of sampling water or pH 7 and 10 if alkaline conditions are expected).
  - Measure temperature of buffers using a clean thermometer. Ensure that the thermometer is rinsed with distilled water before and after each use.
  - Rinse electrode with distilled water and replace protective cap.
  - Place pH electrode in pH 7.0 buffer solution and set the temperature knob at the mark indicating the solution temperature.
  - Switch the control knob to the "pH" position. Gently swirl the solution and allow reading to stabilize. When reading is stable, enter or adjust the meter to read the appropriate value for the pH 7 buffer at that temperature (the exact procedure will vary for different meters).
  - Measure the temperature of the second buffer solution and set the temperature knob at the mark indicating the solution temperature.
  - Rinse the electrode with distilled water and place in the buffer solution, allowing reading to stabilize. When reading is stable, enter or adjust the meter to read the appropriate value for the second pH buffer solution After calibration to 2 buffer solutions, rinse the probe with distilled water and place it in the pH 7 buffer. If the meter reads the appropriate value for the pH 7 buffer, it is calibrated.

- Measure pH of unknown solution as follows:
  - Measure temperature of unknown sample solution.
  - Set the temperature knob at the mark indicating the solution temperatures.
  - Place probe into sample and allow meter reading to stabilize.
  - Record data on appropriate form or log.

## 2.4 ELECTRICAL CONDUCTIVITY

This procedure describes the operation, calibration, and maintenance of a conductivity meter for conductivity measurements and use in field sampling activity. Manufacturer's specifications and recommendations for the instrument used should be followed or referred to when needed.

Prior to use in the field, the conductivity meter should be examined for cleanliness and checked for defects and any possible need of repair. The checks should include whether the battery is operable, whether the conductivity meter is zeroed, and whether its probe is conditioned for proper functioning.

Scheduled maintenance will include daily checks by trained personnel according to procedures provided by the equipment's manufacturer.

Procedures for calibrating an EC meter and taking an EC reading of an unknown solution are listed below:

- Check battery level (see above) before using the meter;
- Calibrate or standardize the instrument using a standard solution. Select a standard solution having a conductivity value near expected value of water sample. The standard solution should be of known integrity;
- Measure temperature of the standard solution;
- Turn conductivity "RANGE" selector to lowest position that will accommodate the conductivity of the value standard solution on the readout meter;
- Set power switch to "ON" and immerse probe in solution, ensuring that probe is immersed to a depth to cover the electrodes. When immersing probe, dip it up and down in solution to expel any air bubbles inside and immediately outside the probe body; and
- Allow meter to equilibrate, then adjust the "CALIBRATION" knob until meter indicates known value of standard solution on conductivity scale.

To take a reading of an unknown sample solution:

- Immerse probe in sample solution, being certain that electrodes are covered, that all air has been expelled, and that probe is not in contact with the walls or bottom of the sample container;
- Turn "RANGE" selector counterclockwise to obtain the appropriate on-scale indication;
- Note meter indication on conductivity scale;
- Remove probe from sample solution and rinse it thoroughly in distilled water before proceeding to measure next samples or putting away the equipment; and
- Record data on log.

## 2.5 TEMPERATURE

This operating procedure describes the operation, calibration, and maintenance of a thermometer and its accessories for use in the field. Manufacturer's specifications and recommendations should be followed or referred to when the need arises.

Prior to measuring a sample, examine the thermometer for cleanliness, defects, and any possible need of repair. The checks should include the battery and probe.

Procedures:

- Slide switch toward display to turn the unit on;
- If the "LOW-BAT" notation is present in the display, replace battery;
- Take temperature as soon as possible after removing from well or stream, making sure the sample reading is not taken in direct sunlight;
- Stir liquid continuously while measuring temperature;
- Record measured temperature in field log and other required information on the Field Record of Water Sampling forms; and
- Decontaminate probe when finished.

## 2.6 TURBIDITY

The general procedures for the operation, calibration and maintenance of a field turbidity meter are discussed below. Manufacturer's specifications and recommendations should be followed or referred to, as necessary.

Prior to use, check that the meter is clean and that the battery is charged. If the battery is low, the low-battery light will light up. Calibrate and operate the meter as follows:

- Turn meter on by turning scale knob to "20";
- Place vial with 0.10 NTU standard solution into the measuring chamber. Place cover on chamber to eliminate outside light sources;
- After the digital reading has stabilized, adjust calibration knob to read 0.10 NTU;
- Remove calibration vial and place sample vial (with sample) in measurement chamber. If necessary, clean vial of water droplets or dirt with a clean paper towel; and
- Wait for digital read-out to stabilize and record value on Field Record of Water Sampling form.

## 3.0 EQUIPMENT DECONTAMINATION

| | |
|---|---|
| Purpose and Scope: | The purpose of this procedure is to describe the SOPs for equipment decontamination to minimize the potential for cross contamination between wells or sampling locations. This procedure describes the methodologies to be followed to maximize proper decontamination of drilling and sampling equipment. |
| Equipment: | Steam cleaner;<br>Four 5-gallon buckets;<br>Bottle brushes;<br>Distilled water;<br>Potable water;<br>Non-phosphate cleaning solution (Alconox®); and<br>4-ml plastic sheeting. |
| Documentation: | Field Memorandum |

## 3.1 DECONTAMINATION PROCEDURES

Decontamination procedures described in this section are applicable to any non-dedicated, non-disposable equipment. Disposable equipment will be disposed of according to procedures described in SOP 4.0. All investigative-derived wastes will be stored in the 2,000-gallon on-site purge water tank pending characterization for disposal.

### Sampling Equipment

Prior to use and after each sample is collected, all soil and groundwater sampling equipment will either be washed twice in a non-phosphate (Alconox®) solution or washed, rinsed with potable water, and rinsed again with distilled water. Hard bristle bottle brushes may be used in the first two wash buckets to remove mud and debris. Samplers should be allowed to drain dry after the final distilled water rinse.

Potable water will be obtained from on-site sources. Distilled water will be supplied in 5-gallon containers by Alhambra Water.

### Drilling and Excavating Equipment

Drilling and excavating equipment, including backhoe buckets, drill bits, casing, augers, and tools or other equipment that may have come in contact with potentially impacted soils or water, will be steam-cleaned between each location. The steam cleaner will be capable of generating a working pressure of

2,000 pounds per square inch (psi), a discharge rate of 5 gallons per minute (gpm), and an operating temperature of 200°F.

An on-site area will be designated as the decontamination area. After completion of each boring, drill casing or augers, drill bits, and drill rods will be transported by truck to the steam cleaning area. Drill casing from the monitoring well drilling procedures will be cleaned while on the support truck. Hollow-stem augers (if used) will be placed on lumber in the decontamination area for cleaning.

In addition to the drilling equipment, all monitoring-well casing, stainless steel screen, and centralizers will be steam-cleaned prior to installation. Cleaned well materials will be covered with 4 mil visqueen, and transported to the well site.

### Submersible Pumps

If a non-dedicated submersible pump is necessary to properly evacuate a well, it will be cleaned using a three step wash. First, the pump intake device is to be submersed into non-phosphate cleaning solution and run until the bucket is empty. Second, the pump is to be submersed into a bucket containing potable water and run until the bucket is empty. The second step can be repeated to sufficiently rinse the pump. The third step involves rinsing the pump with distilled water using the same method as Steps 1 and 2.

### Personnel Decontamination

All personnel will follow the personnel decontamination procedures outlined in the project Health and Safety Plan.

# 4.0 SOIL, WATER, AND WASTE DISPOSAL

| | |
|---|---|
| Purpose and Scope: | This SOP describes the general procedure for proper handling, storage and disposal of potentially impacted on-property and off-property soil cuttings and purge water generated during drilling and water sampling. Activities which would generate soil cuttings include: soil borings monitoring well installation; and downhole falling head permeability tests. Activities which would generate purge water and decontamination water include: water sampling; and all activities where decontamination water is generated. |
| Equipment: | DOT-approved transport containers with covers for soil and water (e.g., 55-gallon drums, 20-yard roll-off bins, Baker Tanks, etc.); and<br>Appropriate sample containers and sampling equipment. |
| Documentation: | Field memorandum |

## 4.1 CONTAINMENT

Drill cuttings and water generated during drilling may be containerized in DOT-approved transport containers. Purge water resulting from water sampling will also be contained. Containers will be labeled by field personnel to identify contents, date, and source location (well or boring ID). Labels will be weather-resistant vinyl, and waterproof ink markers will be used.

## 4.2 DISPOSAL

Purge water collected from groundwater monitoring wells will be disposed of by discharging into the onsite groundwater treatment system. The groundwater treatment system discharges treated water to the City of Sacramento combined sewer/storm drain system under permit with the County of Sacramento Sanitation District.

## 5.0 SAMPLE SHIPMENT

| | |
|---|---|
| Purpose and Scope: | The activities described in this procedure outline general methodology to be used during the shipment of soil, water, and sediment samples to the analytical laboratory. The objectives of this SOP are as follows: |

- To ensure quality control in the shipping of soil, water, and sediment samples;
- To develop uniformity of operation between different field personnel;
- To serve as a means that will allow traceability of error(s) during shipment; and
- To set forth procedures by which legal chain-of-custody documentation is followed.

Equipment:

Cooler suitable for sample shipment and holding ice;
Custody seals;
Shipping tape and packaging materials;
Absorbent material;
Labels;
Zippered storage bags; and
"Blue" type ice.

Documentation:

Field Memorandum
Sample Tracking form
Sample Chain-of-Custody (COC) form

### 5.1 PROCEDURES

Samples collected in the field will be stored during the day in the field in ice-cooled containers. Samples collected during the morning may be temporarily stored in a refrigerator (if available) until shipment in the afternoon. All samples stored in the coolers or the refrigerator will be documented on the sample tracking form. When samples are being packaged for shipment, the procedures listed below will be followed.

- Field personnel will see that each sample in the cooler is listed on the Sample Tracking form and the COC.

- Each cooler will be numbered. The number of each cooler will be noted on the Sample Tracking form and the COC. The freight identification number will also be noted on the sample tracking form and the COC.

- Samples will be packed with abundant packaging material to minimize the potential for damage during shipment. Samples will be packaged with either "wet" ice or "blue-ice".

- The completed COC will be signed and placed in a plastic, zippered storage bag and taped to the inside cover of the cooler.

- Custody seals will be placed on the cooler, then the cooler will be taped shut with clear shipping tape.
- Samples will typically be shipped to the laboratory daily. Copies of the completed COC will be kept in the field office by the field manager.
- Contact will be made with the laboratory Project Manager to inform them of the coming shipment.
- Upon receiving the sample shipment, the analytical laboratory will inspect the sample containers for damage, and compare the shipment to the COC.
- The laboratory will sign and date the COC, noting the appropriate information and deficiencies, and immediately fax a copy of the COC to Dames & Moore.
- Upon receiving the fax of the COC, Dames & Moore will authorize analysis of the sample shipment or provide appropriate direction to the laboratory to address the deficiencies.

# 6.0 SOIL BORINGS

| | |
|---|---|
| Purpose and Scope: | The activities described in this procedure outline general methodology to be used in drilling penetrative soil borings. The resulting borings can be used for stratigraphic description, well construction, physical and chemical sampling, and down-hole hydrogeologic tests. This procedure describes the equipment and forms required, as well as set-up procedures to be completed for each boring. In addition, various drilling methods that may be used during remedial action, and borehole abandonment procedures are detailed. |
| Equipment: | Drilling rig, drilling tools, and support truck with water tanks;<br>Steam cleaner;<br>Grout plant and tremmie pipe;<br>Portland cement, Types I through V;<br>Powdered bentonite; and<br>Plastic sheeting; |
| Documentation: | Field Memorandum; and<br>Soil Boring Log. |

## 6.1 SET-UP PROCEDURES

All set-up and soil boring procedures will be conducted under the supervision of a Dames & Moore geologist, hydrogeologist, or engineer. Dames & Moore field personnel are responsible for:

- Identifying each borehole location;
- Confirming the drilling location with the project manager;
- Reviewing the Health and Safety Plan;
- Obtaining proper clearance for potential above- and below-ground hazards; and,
- Obtaining proper permitting prior to initiating drilling.

Prior to drilling, and between each borehole location, all down-hole drilling and sampling tools will be steam-cleaned. The work area will be well marked with traffic cones and barricade tape. In some cases, special methods may be necessary to penetrate surface paving (concrete). Cuttings generated during drilling will be controlled by lining the borehole area with plastic sheeting and by containing cuttings in bins or on plastic sheeting.

Upon completion of each boring, the location will be clearly marked or staked for surveying.

## 6.2 DRILLING METHOD

The hollow-stem auger method will be used to instal the soil vapor wells.

Where hollow-stem auger drilling methods are specified, hollow-stem augers, with lock bolt jointed 5-foot sections, and drill rod, plug, and bit assembly will be used. Auger diameter will be selected based upon auger availability, drilling rig capability, anticipated boring depth, sampler type, and intended boring use. A boring log based upon continuous or interval sampling and observed cuttings, will be prepared in accordance with the lithologic logging procedures outlined in SOP 7.0.

Drilling fluids will be used with hollow-stem augers only in cases where flowing sands require maintenance of a positive hydraulic gradient between the inside and outside of the augers. In those cases, potable water will be pumped directly to the inside of the augers. If the drill rod assembly within the auger should become bound by flowing sands, potable water will be pumped to the top of the drill rod assembly and the assembly will be raised and lowered through the augers until they become unbound. The source, time, and duration of use, and rate of flow of drilling water, as well as justification for water use, will be recorded on the boring log.

## 6.3 BOREHOLE DESTRUCTION

All soil borings not converted to wells will be permanently sealed to prevent vertical migration of contaminants. Soil borings shall be destroyed by backfilling, from bottom to the surface, with Holeplug™, Enviroplug™, Volclay™, or a cement-bentonite grout slurry. Boreholes that extend below the water table will be backfilled by tremmie method. Grout material can be poured from the surface in boreholes that do not penetrate the water table. Fill materials are used in the following manner:

- Holeplug™ and Enviroplug™ bentonite do not require mixing but are poured into the borehole dry and charged with clean water.
- Volclay™ and cement-bentonite grout (herein termed cement grout) require mixing with clean, potable water. The mix should not contain more than 5 percent bentonite.

Soil borings that penetrate two or more HSZ levels will be plugged with cement grout from bottom to top.

After 24 hours, the grouted borehole shall be checked for grout settlement. That day, any settlement depression shall be filled with grout and checked 24 hours later. This process shall be repeated until firm grout remains at the ground surface.

# 7.0 LOGGING OF SOIL BORINGS — USCS

| | |
|---|---|
| Purpose and Scope: | This procedure describes basic methods for logging soil borings. Logging of soil borings assures that data, information, and descriptions generated from each borehole are properly collected and documented. This procedure describes equipment and forms required, the information necessary to complete a boring log, and methods for describing drill cuttings and soil samples. |
| Equipment: | Hand lens;<br>Dilute HCl;<br>Soil knife;<br>Water level indicator;<br>Rock hammer;<br>Measuring tape;<br>Compass; and<br>Plastic bags. |
| Documentation: | Field Memorandum; and<br>Soil Boring Log. |

## 7.1 BORING LOGS

The boring log form that will be used to record information during drilling is included in at the end of this Appendix. The procedures which will be followed in completing the boring log are outlined below.

On the first page of the log for each boring, the following information at the top of the boring log will be filled in completely and will include:

- Job number;
- Client's name;
- Job location;
- Boring number;
- Drilling contractor;
- Operator's name;
- Rig number, if there is more than one at the site;
- Name of person conducting the logging;
- Elevation and reference datum; and
- Complete and accurate location sketch with dimensions to landmarks, important features such as road intersections, corners of large buildings, or other man-made structures. A north arrow will be included.

Water levels will be recorded each day prior to drilling start-up, and as appropriate. The casing depth must be noted for each water level reading. Drilling mud use must be noted, if appropriate. Water levels will be referenced to ground surface, unless otherwise noted. The field personnel will identify a specific static water level at the conclusion of the boring. However, any questions about the water level having reached equilibrium will be noted. When more than one boring is drilled, the elevations of the water levels will be tabulated to permit a field check of the consistency of readings from boring to boring.

The exact drilling and sampling methods used will be indicated, as well as the bit type and size, drill rod size, hammer weight and drop, types of samplers, and the rig type. Surface conditions will be noted, including vegetation or ground cover and land use, general topography (rolling, level, etc.), and physical features (hillside, river bottom, etc.). The time and date of the commencement and conclusion of the boring down time, and the end and start of each shift should also be noted on the log. Each succeeding page of the field log should contain at a minimum:

- Job number;
- Client name;
- Boring number;
- Permit number (where applicable);
- Sheet number; and
- Water level measurements.

Upon completion of each boring, a standard completion note will be placed at the bottom of the last page of the boring log. The note will include:

- Boring completed at (depth) feet on (date);
- Casing used to a depth of (depth) feet on (date);
- Ground water level recorded at (depth) feet on (date);
- Hole backfilled to ground surface on (date);
- The casing size and depth will be recorded; and
- Depth numbers recorded in decimals.

## 7.2 LOGGING PROCEDURES

The left side of the boring log will be filled out accurately and completely for each soil sample and sampling attempt. The following information will be included:

- The sampler type. The abbreviations for sampler types are TW for thin-wall, P for piston, ST for Shelby Tube, and SS for standard split spoon. These abbreviations, or notations as to other sampler types, will be used in the "sampler type" column.

- The inches driven and recovered for each sample attempt.
- The depth of casing for each sample attempt.
- The sample number and depth. The sample depth is always measured to the top of the sample. A sample attempt where no sample is recovered will not be numbered, but the fact that a sampling attempt was made must be noted.
- The blow count for each 6-inch interval will be recorded opposite the appropriate interval on the depth scale.
- The sampling attempts will be marked in the "depth in feet" column.

The right side of the log will contain a detailed description of the soil strata encountered and all pertinent information regarding drilling operations and estimated soil and groundwater properties.

- Soil will be classified according to the Unified Soil Classification System (USCS) (Figure SOP 7.1). The textural name for the soil will be written in the "soil graph" column at the appropriate depth interval.
- Abrupt soil changes will be marked by a solid horizontal line and the appropriate depth in the "soil graph" column. Gradational soil changes will be marked by a dashed line. Diagonal lines should not be used. (Field personnel are best qualified to estimate the depth of changes. This task will not be delegated to office personnel, who have not observed the drilling operation.)
- Soil color descriptions will be consistent with the Munsell Soil Color Chart.
- Abbreviations will be used on the logs to save space for editing purposes.

Comments on the field log are extremely important. Some important aspects of the drilling operation that will be recorded follow:

- The organic content of the soil and the depth of topsoil and roots;
- Any sudden change in the speed, sound, or penetration rate of the drill rig;
- If sampling is not continuous, drill cuttings will be used to complete the log; and
- Any sample that is suspected of being disturbed, contaminated, or chemically or physically altered during the drilling process.

On jobs lasting more than a few days, field personnel will make specific arrangements for sending boring logs to the Project Manager, or someone designated by the Project Manager. Field personnel will retain one copy of the log in the field for reference throughout the job.

## 8.0 INSTALLATION AND CONSTRUCTION — SOIL GAS WELLS

| | |
|---|---|
| Purpose and Scope: | This operating procedure describes the procedures for the construction, soil gas monitoring wells. These methods ensure construction of monitoring wells that will provide representative samples of soil gas for analysis, or be used as soil gas extraction wells, and effectively isolate for sampling purposes the geologic strata impacted by VOCs. |
| Equipment: | Drilling rig, drilling tools, and support truck with water tanks;<br>Steam cleaner;<br>Grout plant and tremmie pipe;<br>Portland cement, Types I through V;<br>Powdered bentonite;<br>Well casing and screen, cap and bottom plug (screen slot size based upon target geologic formation);<br>Stainless steel centralizers;<br>Bentonite pellets;<br>Washed, graded sand (grain size based on formation and screen slot size utilized);<br>Protective casing and padlock;<br>Concrete mix; and<br>Plastic sheeting. |
| Documentation: | Field Memorandum;<br>Soil Boring Log; and<br>Well Construction form. |

### 8.1 PREPARATION AND SET-UP

All necessary drilling/well permits and utility clearances shall be obtained prior to the start of drilling operations. A Dames & Moore hydrogeologist experienced in design and construction of monitoring wells will be present to supervise the well construction. Unless otherwise arranged, well construction supplies and equipment will be supplied by the drilling subcontractor. Prior to drilling and well construction, all drilling equipment, tools, and well materials to be used in well construction will be cleaned thoroughly with a portable steam cleaning system supplied by the drilling subcontractor. Between well installations, drilling equipment and tools will be cleaned at the designated decontamination area (see SOP 3.0 - Equipment Decontamination).

### 8.2 MONITORING WELL DESIGN

During completion of the soil boring (SOP 6.0 - Soil Borings), the Dames & Moore geologist will prepare a boring log and keep a time log of significant events during each working day. Logs will indicate field classification of soils, sampling depths, first encountered and static groundwater levels,

- A bentonite seal at least three feet thick will be placed immediately above the primary filter pack. The level of the top of the bentonite seal will be verified by tag-line measurement. If pellets are used, adequate time for hydration with distilled water of the pellets will be allowed before grouting the remaining annulus.

- Boring cuttings will not be used as backfill. The borehole annulus will be grouted with a cement-bentonite grout mix which will extend to within approximately two feet of the ground surface. The top two feet will be filled with a concrete mix used to make the concrete pad and secure the protective casing.

- The grout will then be allowed to settle. If significant settlement of grout occurs, additional grout will be added to the prescribed depth of approximately two feet below ground surface prior to the installation of the protective casing and the concrete pad.

## 8.4 WELLHEAD COMPLETION

For wells completed above ground surface, steel security pipe with a lockable cover will be installed in the grout to a depth of one to two feet and equipped with a padlock. For flush-mount wells, a steel protector and cover with water-tight seal will be installed in the grout. The integrity of the well will be protected with a lockable sanitary sealing well cap with an expandable O-ring which forms an air-tight seal. All locks will be keyed alike.

For wells completed above ground surface, the drilling subcontractor will construct a concrete apron (3ft × 3ft × 0.5ft) around each well. Concrete aprons will be crowned to provide positive runoff away from the well. Concrete pads may be constructed within three days after wells have been installed. If necessary, steel guard posts 2-inches in diameter and filled with concrete will be installed around the pads. Posts will be five feet long and will have a minimum stickup of 2.5 feet above ground surface and 2.5 feet below ground surface. For flush mounts, the space around the protective casing will be filled with concrete and sloped to direct surface water away from the well.

## 8.5 WELL CONSTRUCTION SUMMARY DIAGRAMS

Upon completion of well construction, the standard Dames & Moore well log form will be completed. The following information will be included:

- Job name and number;
- Job location;
- Well number;
- Permit number (where applicable);
- Land-surface elevation and datum;
- Date of installation;

- Drilling method (i.e., hollow-stem auger, air hammer, air rotary, or mud-rotary);
- Drilling contractor;
- Drilling fluids (where applicable);
- Amount of fluids lost during drilling;

- Well construction details, such as:
    - Type of well (i.e., flush-mount or stick-up);
    - Hole diameter;
    - Well casing diameter, material, and amount;
    - Final well depth;
    - Depth and type of filter pack;
    - Depth of bentonite seal; and
    - Depth and type of grout mixture.
- Well purpose (i.e., monitoring or recovery).

## 9.0 SOIL SAMPLING

Purpose and Scope: Soil samples will be collected for identification/classification purposes, physical and chemical analysis, and to evaluate behavior of subsurface materials. This SOP describes the techniques to be implemented for a variety of methods of soil sampling, soil coring, surface soil sampling, and sample compositing. In addition, equipment and documentation requirements necessary for sampling are described.

Equipment:
Stainless steel spatulas;
Stainless steel spades;
Stainless steel hand auger buckets and hand auger accessories;
Power auger/drilling rig;
Split spoon samplers;
Teflon sheets;
Plastic sheeting;
Stainless steel sampling rings;
Plastic ring caps;
Stainless steel measuring cup;
Silicon-based tape;
Stainless steel trowel;
Cleaning and decontamination equipment;
Sample labels;
Ice chest
"Blue" ice; and
Zipper storage bags.

Documentation:
Field Memorandum;
Soil Boring Log;
Field Record of Soil Sampling (Field Record); and
Sample Chain of Custody (COC).

### 9.1 GENERAL PROCEDURES

Due to the wide variety of sampling conditions, types of samples, and purpose for collecting soil samples, several possible methods may be used to collect the soil sample. Specific procedures for various methods are described below. However, there are numerous procedures that will be followed for most soil sampling methods. These procedures include:

- Prepare Field Record sheets and record relevant data on Field Memorandum prior to sampling;
- Decontaminate sampling equipment as specified in SOP 3.0, if samples destined for chemical analysis are to be collected;
- Clear surface vegetation, rocks, and other material not designated for sampling from the sampling point;

- Use drilling or penetration methods (SOP 6.0 - Soil Borings) if necessary to reach the desired sampling depth;

- Collect sample using method described in Section 9.2.2;

- Lithologically log the sample and boring (SOP 7.0 - Logging of Soil Borings).

- Fill necessary sample containers;

- Affix sample container with appropriate labels, being sure to provide required information;

- Place the properly labeled sample container in an appropriate carrying container at required temperature;

- Either discard or decontaminate all items which contact the sample such as trowel, split-spoon sampler, and gloves before proceeding to the next sampling location;

- Add information pertaining to the sample to the COC, Field Memorandum, and Field Record of Soil Sampling forms; and

- Package and ship samples as described in SOP 5.0 - Sample Shipment.

## 9.2 SUBSURFACE SOIL SAMPLING

Several methods may be used to collect subsurface soil samples. Some of the Dames & Moore procedures for the more common sampling methods are described below.

### 9.2.1 Set-up Procedures

Several drilling methods may be used to reach desired depths for soil sampling. Generally, samples are collected at regular intervals (approximately every five feet). Potential drilling methods and general soil boring procedures are described in SOP 6.0 (Soil Borings). In addition to drilling methods, subsurface depths can be reached by a power auger, a hand bucket auger, or a backhoe.

When the desired depth has been reached, the borehole will be prepared for sampling. To prepare for sampling, the borehole should be cleaned out to the desired sampling depth using equipment that will ensure that the material to be sampled is not disturbed by the operation. When drilling in saturated sands and silts, the bit should be withdrawn slowly, to prevent loosening of the soil around the hole. When using dual tube or casing hammer methods, care will be taken not to drive the casing below the desired sampling depth before the sample is collected.

When the desired sampling depth has been reached and the borehole has been prepared, there are several subsurface methods that will be used to collect samples. These methods include:

- Penetration test and split-barrel sampler (split-spoon);
- Thin wall sampler (Dames & Moore Type U Sampler);
- Continuous sampling system;
- Collection of cuttings; and
- Shelby tube sampling.

### 9.2.2 Penetration Test and Split-Barrel Sampling

Penetration test and split-barrel sampling are methods used to collect representative disturbed soil samples. Samples collected by these methods will be used for description and identification, chemical analysis, and in some cases, physical analysis. A split-barrel sampler consists of a section of pipe that splits into two pieces along its axis. A driving shoe and waste barrel screwed to the ends hold the split section together during driving. Aids for sample retention may also be incorporated into the split-barrel sampler. These include catchers, spring or gravity traps (in the lower end), and check valves (in the top end). The standard sampler has an outside diameter of 2 inches and an inside diameter of 1-3/8 inches.

The penetration test samplers have been used to develop an empirical relationship between driving resistance and the relative density of soil. The procedure for determining and interpreting penetration resistance or relative density is collectively referred as the Standard Penetration Test (SPT). This procedure is as follows:

- After the boring has been advanced to the desired sampling depth, and extracted drill cuttings have been suitably removed, a split-barrel sampler (outside diameter 2 inches, inside diameter 1-3/8 inches) attached to drill rods is lowered to the bottom of the cleaned-out borehole.

- Once the sampler is on the bottom of the borehole, three 6-inch increments are marked on the drill rods above a convenient fixed datum.

- The sampler is driven by a 140-lb hammer free falling a distance of 30 inches onto a collar or drive head attached to the top of the rods. The sampler is driven a total of 18 inches into the undisturbed soil, and the number of blows required to advance each 6-inch increment is recorded.

- The standard penetration test should be terminated if one of the following occurs:

    - A total of 50 blows has been applied during any one of the three 6-inch increments;

    - A total of 100 blows has been applied;

    - There is no observed advance of the sampler during the application of 10 successive blows of the hammer.

- After the total penetration of the sampler has been achieved, the sampler is brought to the surface and opened.

The sample is then logged and removed and the sampler is decontaminated before reassembly. If the standard split barrel samples are to be retained for future reference, they will be placed in zippered plastic bags and labeled according to standard procedures. Typically, samples are taken at each lithologic change and at intervals not greater than five feet (unless otherwise stipulated by the field engineer or geologist).

# APPENDIX C

## ATTACHMENT 1
## FIELD DOCUMENTATION FORMS

This attachment presents full-size reproducible copies of seven. Field Documentation forms. The forms are presented in the order that they are referenced, and include:

- Field Memorandum
- Water Sample Tracking Form
- Field Record of Water Sampling form
- Sample Chain of Custody
- Field Instrument Calibration Form
- Soil Boring Log
- Well Construction Summary

# FIELD MEMORANDUM

| ACTION | INFO | |
|---|---|---|
| To: | | File: |
| | | |
| | | |
| | | |
| | | X-Ref: |
| | | |
| | | |
| | | |
| | | |
| | | Date: |

From:

Reply Required By:

Subject:

Reference(s):

ROUTING

114.8 (REV. 5-68)

## WATER SAMPLE TRACKING FORM

Page ___ of ___

**PROJECT:** ____________________

**JOB NUMBER:** ____________________

| Sample ID | Groundwater | Surface Water | Storm Water | Field Blank | Date | Time | QA Duplicate |
|---|---|---|---|---|---|---|---|
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SOP_FORMS\H2OSMPLE.TRK

# FIELD RECORD OF WATER SAMPLING

Well No. ____________________
Date: ____________________
Depth of Well: ____________________
Sampling Event: ____________________
Casing Type/Diameter: ____________________
Location: ____________________
Sampled by: ____________________

## PURGING PRIOR TO SAMPLING

Purging Method: ____________________
Pump Flow Rate: ____________________
One Casing Volume (CV), gallons: __________
Initial Water Level: ____________________
Purge Volume (3 CVs), gallons: __________

| Date | Time | Temp | Spec. Cond. | pH | Turbidity | Eh | Gallons Removed | Comments (appearance of water, odor, etc.) |
|---|---|---|---|---|---|---|---|---|
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## RECORD OF SAMPLING

Sampling Method: ____________________
Date of Sample: ____________ Time: ____________ Depth of Sample: ________

| Sample No. | Container Types | Analysis |
|---|---|---|
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| | | |

Temp: ____________________
Spec.
Cond: ____________________
pH: ____________________
Eh: ____________________

Comments: ____________________

SOP_FORMS\FIELDREC.H20

# CHAIN OF CUSTODY

**Project #** ______________

Client:
Dames & Moore
8801 Folsom Blvd., Suite 200
Sacramento, CA 95826
(916) 387-8800
Attention: ______________

Signatures
Dames & Moore ______________ Date: ________

Sampler: ______________

**!! IMPORTANT!!**
UPON RECEIPT OF THIS FORM:

1. INSPECT ALL SAMPLES.
2. NOTE ANY DAMAGED CONTAINERS
3. SIGN AND DATE THIS FORM.
4. SEND A FAX OF THIS FORM TO:
   RICK MOREN / DAMES & MOORE
   FAX # (916) 387-0802
5. *DO NOT BEGIN WORK* UNTIL AUTHORIZATION IS RECEIVED FROM DAMES & MOORE BY TELEPHONE.

| Sample No. | Soil | Water | Date | Time | # of Containers | Laboratory Number |
|---|---|---|---|---|---|---|
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Analysis Requested for *ALL* Samples Listed

Relinquished by: ______________ Date: ______ Time: ______ Rec'd by: ______________ Date: ______ Time: ______
Relinquished by: ______________ Date: ______ Time: ______ Rec'd by: ______________ Date: ______ Time: ______
Relinquished by: ______________ Date: ______ Time: ______ Rec'd by: ______________ Date: ______ Time: ______

**For Lab Use Only**

Cooler Radiologic Survey Pass/Fail

Condition of Samlple Containers: ☐ Good ☐ Other: ______________

SOP_FORMS\CHAIN

Page ___ of ___

# FIELD INSTRUMENT CALIBRATION LOG

Parameter: ____________________

Instrument: ____________________ Serial No.: ____________________

Manufacturer: ____________________ Date Placed in Service: ____________________

Calibration Procedure: ____________________

____________________

____________________

____________________

Required Calibration Frequency: ____________________

| Date | Time | Results | Comments* | Calibrated by: |
|---|---|---|---|---|
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***Note:** Include information on Standard Manufacturer, Lot Number, and/or Serial Number in Comments as appropriate.

Reviewed by: ____________________

# SOIL BORING LOG

LOCATION OF BORING

JOB NUMBER

CLIENT

LOCATION

DRILLING METHOD:

BORING NUMBER

SHEET OF

SAMPLING METHOD:

DRILLING

| START | FINISH |
|---|---|
| TIME | TIME |
| DATE | DATE |

DATUM

ELEVATION

SURFACE CONDITIONS:

| SAMPLER TYPE | INCHES DRIVEN / INCHES RECOVERED | TIME | SAMPLE NUMBER / SAMPLE DEPTH | BLOWS/FT. SAMPLER | OVA |  |  | DEPTH IN FEET | SOIL GRAPH |  |
|---|---|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | AUGER | SAMPLE | CUTTINGS |  |  |  |
|  |  |  |  |  |  |  |  | 0 |  |  |
|  |  |  |  |  |  |  |  | 1 |  |  |
|  |  |  |  |  |  |  |  | 2 |  |  |
|  |  |  |  |  |  |  |  | 3 |  |  |
|  |  |  |  |  |  |  |  | 4 |  |  |
|  |  |  |  |  |  |  |  | 5 |  |  |
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|  |  |  |  |  |  |  |  | 7 |  |  |
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|  |  |  |  |  |  |  |  | 8 |  |  |
|  |  |  |  |  |  |  |  | 9 |  |  |
|  |  |  |  |  |  |  |  | 0 |  |  |
|  |  |  |  |  |  |  |  | 1 |  |  |

45525

BY

DATE ______ CHECKED BY ______

Job Name ______________________ Well No. ______________________

Job Number ______________________ Boring No. X-Ref ______________________

# MONITORING WELL CONSTRUCTION SUMMARY

Survey Coordinates ______________________ Elevation Ground Level ______________________

______________________ Elevation Top of Casing ______________________

**Drilling Summary**

Total Depth Drilled ______________________

Borehole Diameter ______________________

Driller ______________________

______________________

Rig ______________________

Bit(s) ______________________

______________________

Drilling Fluid ______________________

______________________

Total Depth of Well ______________________

Casing Stick-up Height ______________________

Surface Completion ______________________

**Construction Time Log**

| Task | Start Date | Start Time | Finish Date | Finish Time |
|---|---|---|---|---|
| Drilling | | | | |
| | | | | |
| | | | | |
| | | | | |
| Geophys.Logging | | | | |
| Casing | | | | |
| | | | | |
| | | | | |
| | | | | |
| Filter Placement | | | | |
| Pre-Development | | | | |
| Cementing | | | | |
| | | | | |
| | | | | |

**Well Design & Specifications**

Basis: Geologic Log ______ Geophysical Log ______

Casing String(s): CC=Conductor Casing C=Casing S=Screen ST=Sediment Trap

| Depth | String(s) | Elevation |
|---|---|---|
| ____ – ____ | ____ | ____ – ____ |
| ____ – ____ | ____ | ____ – ____ |
| ____ – ____ | ____ | ____ – ____ |
| ____ – ____ | ____ | ____ – ____ |
| ____ – ____ | ____ | ____ – ____ |

Conductor CC1 ______________________

Casing CC2 ______________________

Casing C1 ______________________

C2 ______________________

Screen S1 ______________________

S2 ______________________

Sed. Trap ST ______________________

Grout Seal ______________________

______________________

Bentonite Seal ______________________

______________________

Filter Pack ______________________

______________________

Centralizers ______________________

______________________

| | Date | Time | Date | Time |
|---|---|---|---|---|
| **Well Development** | | | | |

______________________

______________________

______________________

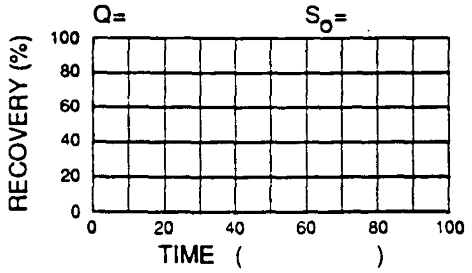
Initial Water Level ______________________

Final Water Level ______________________

**Stabalization Test Data**

| Time | pH | Spec. Cond. | Temp (C) | Turbidity |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**Recovery Data**



Comments: ______________________

______________________

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______________________

T.D. =

Observed by: ______________ Client: ______________ Location: ______________

DAMES & MOORE

# FIELD RECORD

## SOIL SAMPLES

Sampling Method: ______________________________
______________________________________________

Job Number: ______________________________
Client: ______________________________
Location: ______________________________
Sampled By: ________________ Page ___ of ___

| Boring/Test Pit No. | Sample No./I.D. | Depth | Sample Location | Date/Time | Description/ Classification | pH | Sample Container | Lab Submitted to/Date | Comments |
|---|---|---|---|---|---|---|---|---|---|
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# Appendix

# D

Nickel has been shown to plate surfaces well; it will not flake or chip easily, thereby preventing exposure of the steel surface of the sampling probe.

### 1.2.2 Adapters

Gas samples are collected from stainless steel adapters fitted at the top of each probe. These adapters are equipped with a septum-sealed sample withdrawal port.

### 1.2.3 Syringes

Soil gas samples are collected in 10mL, gas-tight, all-glass-and-Teflon syringes equipped with built-in on-off valve (Dynatech A-2).

### 1.2.4 Vacuum/Volume Sampling System

Soil gas samples are collected using a truck vacuum system (Geoprobe Systems, P/N AT-1001). The system consists of an evacuated 11-liter canister and vacuum pump. A gauge on the canister is calibrated both in inches of mercury and liters, the latter allowing the operator to determine the volume of vapor removed from the probe. Samples are taken after the system has returned to equilibrium (i.e., when the vacuum equals zero). See Figure 3.

### 1.2.5 Groundwater Samples

Groundwater is sampled through the 1⅜″ EW drill rod using ⅜″ stainless steel bailers.

## 1.3 SAMPLE COLLECTION

### 1.3.1 Pre-Sample Purge

The probe is purged before collecting a soil gas sample to ensure that a representative sample is collected. The probe is purged by connecting the probe to the evacuated canister and allowing air to flow from the probe into the chamber on the Vacuum/Volume system. The volume of air removed from the probe is measured on a gauge that is calibrated in liters.

### 1.3.2 Soil Gas Sampling

A syringe is inserted into the probe via the stainless steel adaptor after allowing the system to return to atmospheric pressure. A 10mL aliquot of soil vapor is withdrawn from the probe and the valve on the syringe is immediately closed. Duplicate samples are collected from all locations.

### 1.3.3 Grab Groundwater Sampling

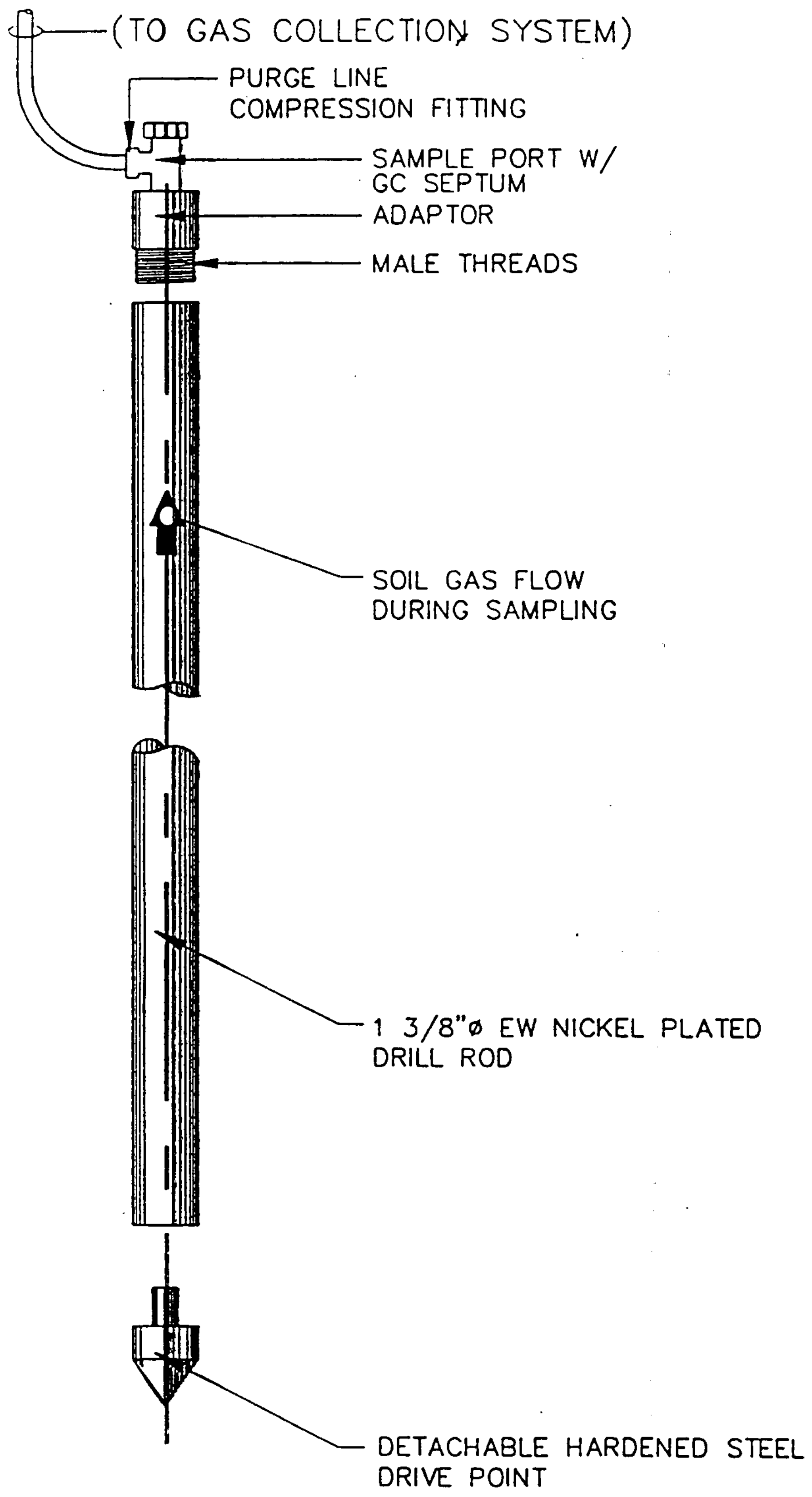
Groundwater samples are collected using ⅜" stainless steel bailers. The bailers are lowered into the inside of the probe using a nylon cord that is replaced before each sampling. The water sample is carefully poured in 40mL VOA vials in a manner to avoid introducing air bubbles to the water sample. The liquid-full vials are then immediately capped with a Teflon-lined septum cap and delivered to the mobile lab for analysis.

## 1.4 DECONTAMINATION OF EQUIPMENT

Prior to each use and reuse, each soil sampler, stainless steel sleeve, sampling probe, point and bailer are steam-cleaned and stored in clean storage areas on the drive point rigs. Care is taken with this equipment to eliminate both soil-surface and cross-hole contamination. Vinyl or latex surgical gloves are worn during handling and assembly of the sampling apparatus.

Adapters and stainless steel bottles are heated to 120°C using a convection oven and held for one hour at that temperature. Carbon-packed desorption cartridges used as traps for the purged soil and water samples are purged with helium at 400°C for eight minutes.

Separate storage areas are provided for used and cleaned equipment. Equipment is cleaned before each use.



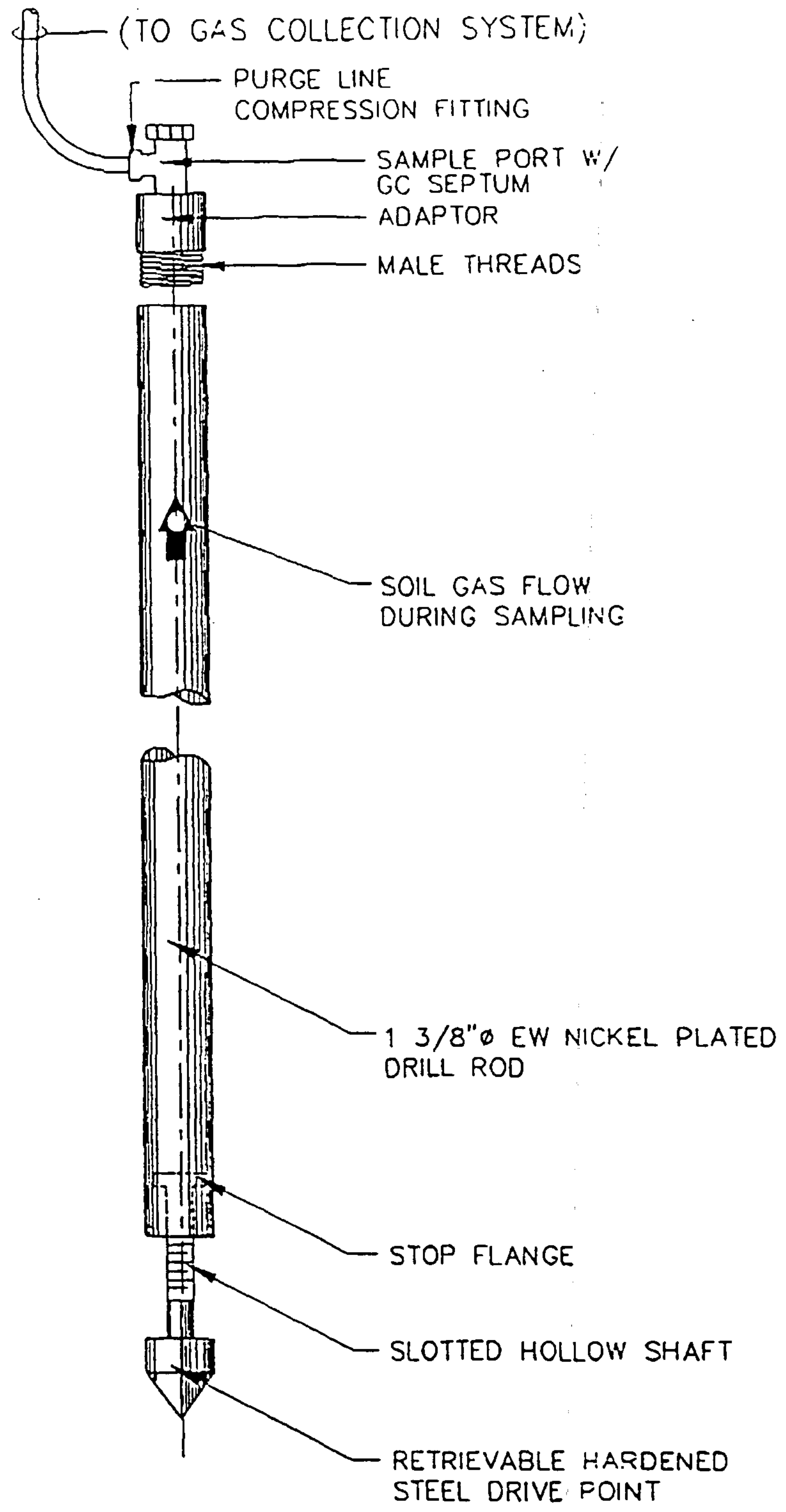
NTS

NAME: D:\0861\0861001A.DWG DATE: JAN 11, 1994 TIME: 11:45 AM

HYDRO
GEO
CHEM, INC.

## SOIL GAS SAMPLING PROBE

| Approved | Date | Revised | Date | Reference: | FIG. |
|---|---|---|---|---|---|
|  | 1/11/94 |  |  | 0861001A | 1. |



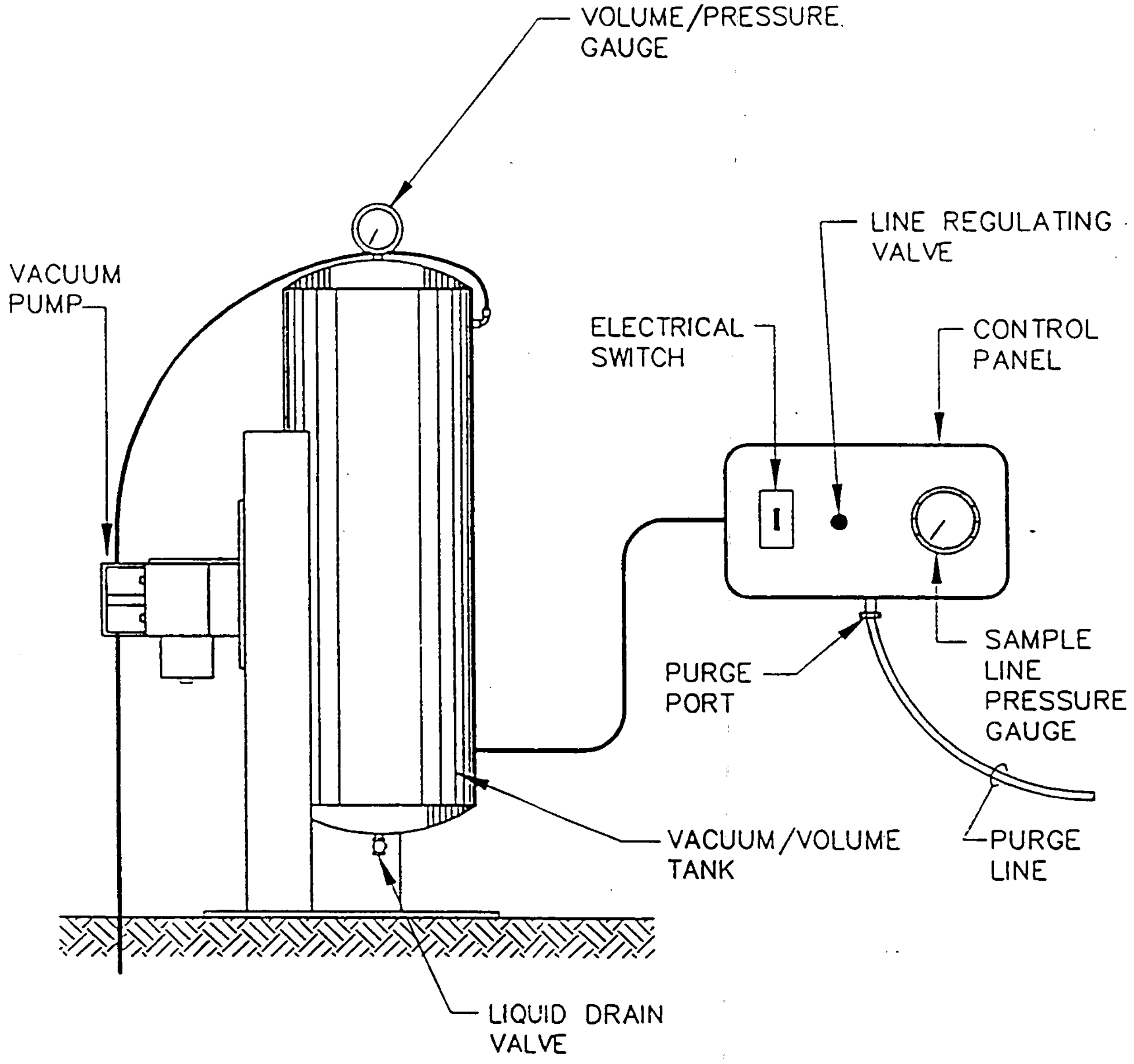
NTS

NAME: [illegible] DATE: MAR 23 1994 TIME: 12:10 PM

HYDRO
GEO
CHEM, INC.

## SOIL GAS SAMPLING PROBE EQUIPPED WITH RETRIEVABLE POINT

| Approved | Date | Revised | Date | Reference: | FIG. |
|---|---|---|---|---|---|
|  | 3/23/94 |  |  | 0861001B | 2 |



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## SOIL GAS
## PURGE/SAMPLING APPARATUS

| Approved | Date | Revised | Date | Reference: | FIG. |
|---|---|---|---|---|---|
|  | 1/11/94 |  |  | 0861003A | 3 |

## HYDRO GEO CHEM, INC.

*Field Data Sheet*

**Data Base File:**
**Project Name:**
**Project Number:**

Sample Number
Sample Depth
Sampled by
Date
Time
Recorded by
Matrix (✓): Soil Gas ☐ Soil ☐ Water ☐

**Sample Location:**

**Field Parameters:**

Weather:
Wind Dir/Speed:
Air Temp ($^{o}$F):
Ground Surface:

**Purge Data:**

Purge Method:
Probe Volume: ml
Adapter Number:
Purge Rate: ml/min
Purge Time: min
Purge Vacuum: in. Hg
Equilibrium Time: min

**Sample Information:**

Time Sampled: A = B =
Sample Size: A = B = ml
Sample Vacuum: A = B = in. Hg
Notes:

**Analysis Summary:**

Lab Receipt (Sig):
Date/Time:

| | Compound | Concentration: (µg/L) (mg/kg)<br>A = | B = | Notes |
|---|---|---|---|---|
| 1 | Benzene | | | |
| 2 | Toluene | | | |
| 3 | Ethylbenzene | | | |
| 4 | m/p Xylenes | | | |
| 5 | o-Xylene | | | |
| 6 | | | | |
| 7 | THC | | | |
| 8 | | | | |
| 9 | % Surr. Recovery | | | |
| 10 | | | | |
| 11 | | | | |
| 12 | | | | |

Continues (Circle)