N60508.AR.002399
NAS WHITING FIELD
5090.3a

SITE ASSESSMENT PLAN FOR OIL/WATER SEPARATOR AND PRODUCT LINE INVESTIGATION WITH TRANSMITTAL NAS WHITING FIELD FL

10/1/1997

BROWN & ROOT ENVIRONMENTAL

7648-3.4-19 Rev. 0
10/1/97

0001

SITE ASSESSMENT PLAN FOR OIL/WATER SEPARATOR AND PRODUCT LINE INVESTIGATION

Naval Air Station
Whiting Field
Milton, Florida

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order CTO-0037

OCTOBER 1997

SITE ASSESSMENT PLAN
FOR OIL/WATER SEPARATOR AND PRODUCT LINE INVESTIGATION

NAVAL AIR STATION
WHITING FIELD
MILTON, FLORIDA

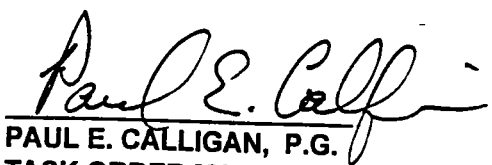
Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
Brown & Root Environmental
661 Andersen Drive; Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0037

October 1997

REVIEWED BY:



PAUL E. CALLIGAN, P.G.
TASK ORDER MANAGER
BROWN & ROOT ENVIRONMENTAL
TALLAHASSEE, FLORIDA

APPROVED FOR SUBMITTAL BY:

DEBBIE WROBLEWSKI
PROGRAM MANAGER
BROWN & ROOT ENVIRONMENTAL
PITTSBURGH, PENNSYLVANIA

Brown & Root Environmental

1311 Executive Center Drive
Ellis Building, Suite 220
Tallahassee, FL 32301-5067

(904) 656-5458
FAX: (904) 656-7403
CG CA06998
CG C015768

BRE/TLH-97-700/7648/3.2

13 October, 1997

Project Number 7648

Commanding Officer
Department of the Navy
Southern Division
Naval Facilities Engineering Command
ATTN: Mr. Nick Ugolini (Code 1843)
Remedial Project Manager
2155 Eagle Drive
North Charleston, South Carolina 29406

Reference: Clean Contract No. N62467-94-D0888
Contract Task Order No. 0037

Subject: Site Assessment Plan for
Oil/Water Separator and Product Line
NAS Whiting Field, Milton, Florida

Dear Mr. Ugolini:

Brown & Root Environmental is pleased to submit the Site Assessment Plan for the referenced site.

Subcontracts to initiate Phase I field activities are being prepared. It is anticipated that field investigation activities will be able to be initiated in mid November.

If you have any questions regarding this plan or require further information, please contact me at (850) 656-5458.

Very truly yours,

Paul E. Calligan, P.G.
Task Order Manager

PC/gg

Enclosures (1)

c: Mr. Jim Holland, NAS Whiting Field
Ms. D. Evans-Ripley, SOUTHDIV (w/o enclosure)
Ms. D Wroblewski (w/o enclosure)
Mr. A. Kendrick

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLES

FIGURES

1.0 INTRODUCTION

1.1 REGULATORY BACKGROUND

The U.S. Navy (Navy) Southern Division (SouthDiv) Naval Facilities Engineering Command (NAVFAC) has retained Brown and Root Environmental (B&R Environmental) to perform a Site Assessment (SA) at Naval Air Station (NAS) Whiting Field in Milton, Florida. The SA involves field and reporting requirements to further assess the extent of petroleum contamination in subsurface soil and groundwater in areas near a closed oil/water separator for Tank System 2933A and closed Jet Petroleum No. 5 (JP-5) pipeline. A Contamination Assessment Report (CAR) was completed for the oil/water separator location in September 1995. The CAR identified "excessively contaminated soil," as defined by Chapter 62-770.200 of the Florida Administrative Code (FAC) and dissolved petroleum hydrocarbons above State Action Levels in the groundwater in an intermittent perched water bearing zone. In December 1996, the oil/water separator was removed and approximately 34 cubic yards of "excessively contaminated soil" was removed as an Initial Remedial Action (IRA). A Storage Tank Removal Form and Closure Assessment Form were submitted to the Florida Department of Environmental Protection (FDEP) for removal of the oil/water separator. In March 1996, a Closure Assessment Report was completed for the JP-5 product pipeline which serviced two aboveground storage tank (ASTs), Tank No. 2891 and Tank No. 2892. The Closure Assessment Report identified three areas along the product pipeline where "excessively contaminated soil" was detected.

B&R Environmental has prepared this Site Assessment Plan (SAP) to provide the rationale and methods for performing the field activities associated with collecting data to evaluate petroleum hydrocarbons in the soil and groundwater at the subject locations. Data collected during the investigation will be used to confirm and supplement the data obtained during the previous contamination assessment activities. Data from these investigations along with additional data collected by B&R Environmental, will be used to prepare a Site Assessment Report (SAR) for the study area in accordance with Chapter 62-770, FAC. The SAR will conclude with a recommendation of No Further Action (NFA), a Monitoring Only Plan (MOP) or development of a Remedial Action Plan (RAP).

This SAP was prepared for Navy SouthDiv under Contract Task Order (CTO) 0037, for the Comprehensive Long-term Environmental Action Navy (Clean III) Contract Number N62467-94-D-0888. The scope of work requested by Navy SouthDiv under CTO 0037 had required a CAR be completed for the subject locations. Revision recently made by the Florida legislature to Chapter 62-770, FAC, has substituted the nomenclature "Site Assessment Report" for "Contamination Assessment Report" for

investigations involving the release of petroleum products from petroleum distribution systems. Therefore, as required by Chapter 62-770, FAC a SAR will be completed and submitted to the FDEP for review and approval, based on the scope of work presented in this SAP.

1.2 FACILITY BACKGROUND

NAS Whiting Field is located in Santa Rosa County, which is in Florida's northwest coastal area, approximately 7 miles north of Milton and 20 miles northeast of Pensacola (Figure 1-1). NAS Whiting Field presently consists of two airfields separated by an industrial area. The installation is approximately 2,560 acres in size. Figure 1-2 presents the installation layout and the location of the sites (closed oil/water separator and JP-5 fuel product line) at NAS Whiting Field.

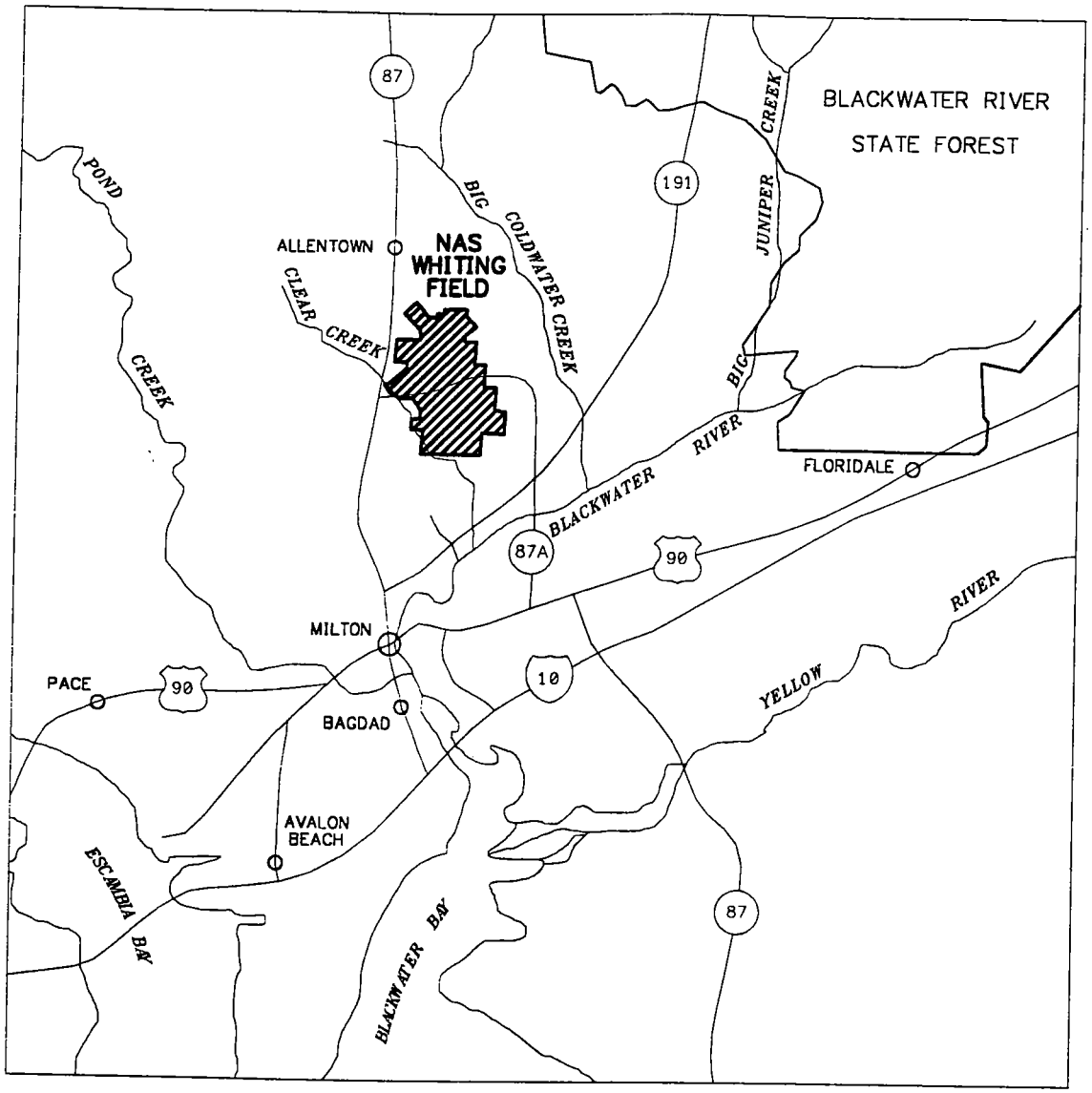
NAS Whiting Field, home of Training Air Wing Five (TRAWING FIVE), was constructed in the early 1940s. It was commissioned as the Naval Auxiliary Air Station Whiting Field in July 1943 and has served as a naval aviation training facility ever since its commissioning. The field's mission has been to train student naval aviators in the use of basic instruments; formation and tactic phases of fixed-wing, propeller-driven aircraft; and basic and advanced helicopter operation.

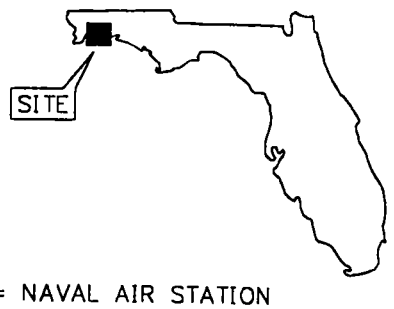
1.3 OBJECTIVE

The objective of the proposed field investigation is to collect additional data to evaluate the extent of petroleum hydrocarbons in subsurface soils and groundwater as identified during previous assessments conducted for the study area (i.e., CAR for the oil/water separator and the Product Line Closure Assessment report for the JP-5 product line for ASTs No. 2891 and No. 2892). Data collected during the investigation will be used to prepare a SAR as required by Chapter 62-770.600, FAC and to evaluate if remedial actions are required.

The SA field investigation will be conducted in accordance with the methods described in Chapter 62-770, FAC (1997).

ACAD: K:/CADD/7648/7641GM01.DWG 09/08/97 TAD





0 5 10

SCALE IN MILES

SOURCE:

ABB ENVIRONMENTAL SERVICES INC. 1992

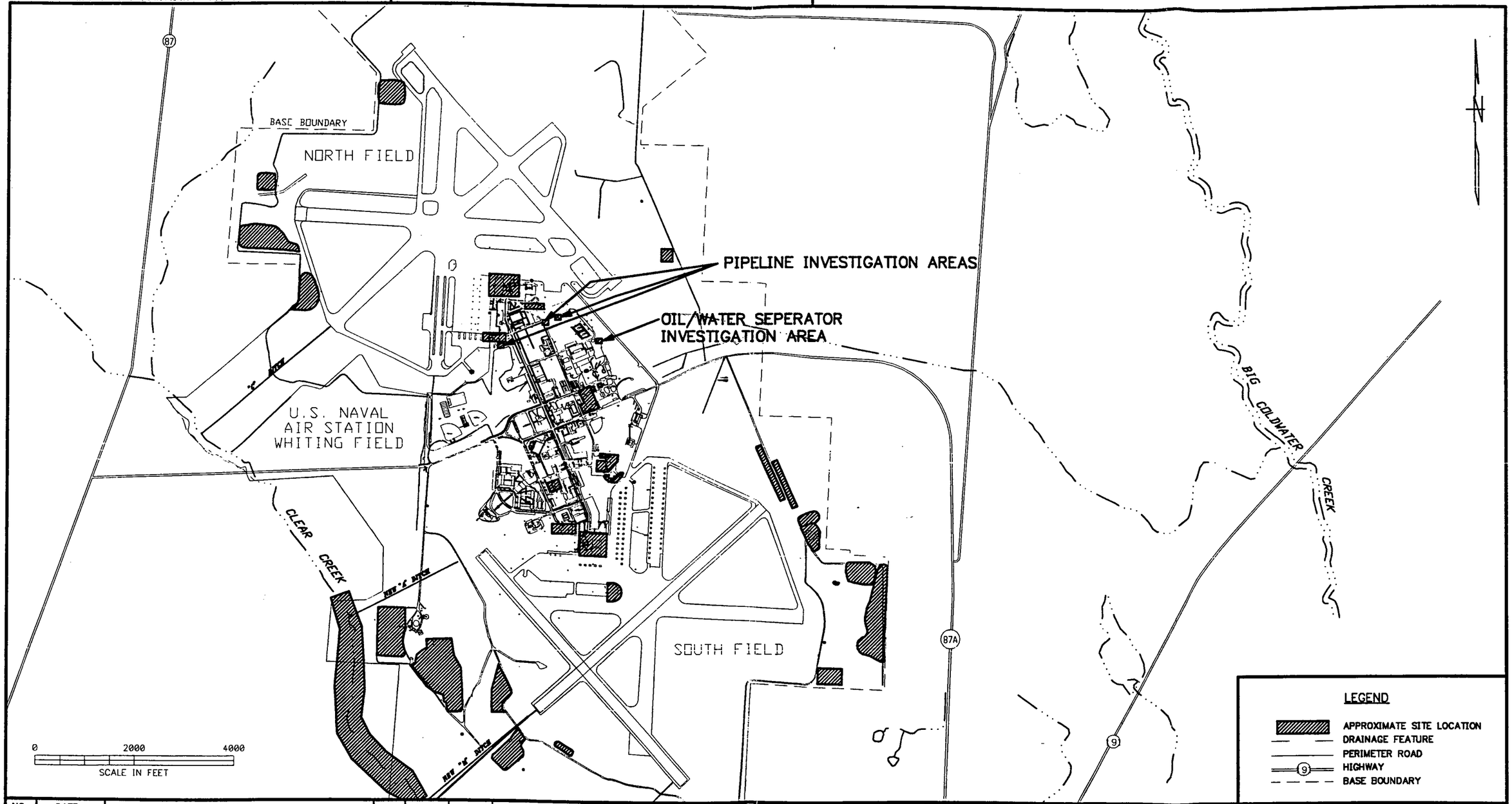
NOTE:

NAS = NAVAL AIR STATION

DRAWN BY TAD DATE 9/8/97	Brown & Root Environmental	CONTRACT NO. 7648	OWNER NO. ————
CHECKED BY GFG DATE 9/10/97	FACILITY LOCATION MAP NAS WHITING FIELD MILTON, FLORIDA	APPROVED BY P.CALLIGAN	DATE 9/10/97
COST/SCHED-AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE 1-1	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

ACAD: K:/CADD/7648/7648CM08.DWG 09/09/97 TAD



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY TAD DATE 9/10/97
CHECKED BY GFG DATE 9/10/97
COST/SCHED-AREA
SCALE AS NOTED

Brown & Root Environmental

SITE LOCATION MAP
NAS WHITING FIELD
MILTON, FLORIDA

CONTRACT NO. 7648
OWNER NO. ———
APPROVED BY P.CALLIGAN DATE 9/10/97
APPROVED BY DATE ———
DRAWING NO. FIGURE 1-2
REV. 0

FORM CADD NO. SOUTH_BH.DGN - REV 0 - 02/11/97

2.0 SITE DESCRIPTION

The SA investigation activities will be limited to the vicinity of the oil/water separator for Tank System 2933A and three areas where "excessively contaminated soil" was identified in the Product Line Closure Assessment Report completed for the pipeline system for AST No. 2891 and Tank No. 2892. Collectively, this study area will be referred to as the Site.

Oil/Water Separator

Tank System 2993A is located approximately 200 feet east of Building 2993 in an earthen grassy area which slopes to the east. Two 230,000-gallon above ground jet fuel tanks within concrete containment and two small storage buildings are located within the vicinity.

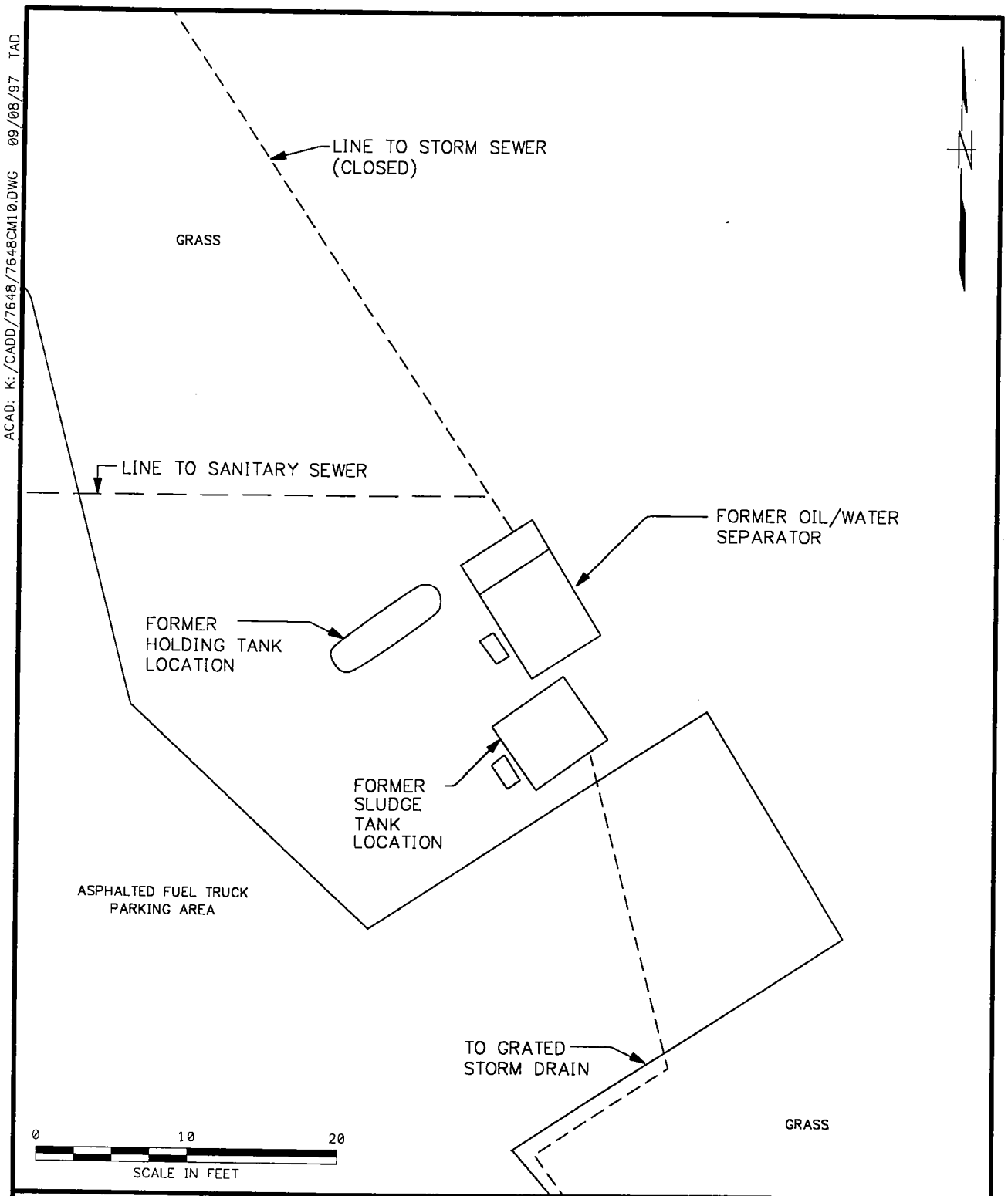
Tank System 2993A consisted of an oil/water separator, a 500-gallon underground storage tank (UST) used to store jet fuel, and sludge tank, as shown on Figure 2-1. In December 1996 the oil/water separator, UST, and sludge tank were removed. The oil/water separator provided secondary containment for overfills occurring at the 500-gallon UST, and also received the rainfall collected in a stormwater collection sump from runoff from a near-by Fuel Truck Parking area. At the time the oil/water separator was removed the separator's drain pipe from the UST had been physically isolated from the UST.

Product Pipeline

On March 27, 1996 a Closure Assessment was performed on a product pipeline system once affiliated with two ASTs identified as Tank No. 2891 and Tank No. 2892. The product pipeline distribution system layout is provided on Figure 2-2. The product pipeline system was taken out of service through in-place closure. The AST facility and the associated product pipeline system are located on the south side of Hornet Street at the NAS.

The section of the product pipeline system being investigated for the SA, will include pipeline which begins at the pump station facility located on Hornet Street, and extends in a southwesterly direction along Hornet Street under Saratoga Street to an abandoned dispensing facility. The pipeline was used to transport jet fuel stored in the ASTs to the dispensing facility.

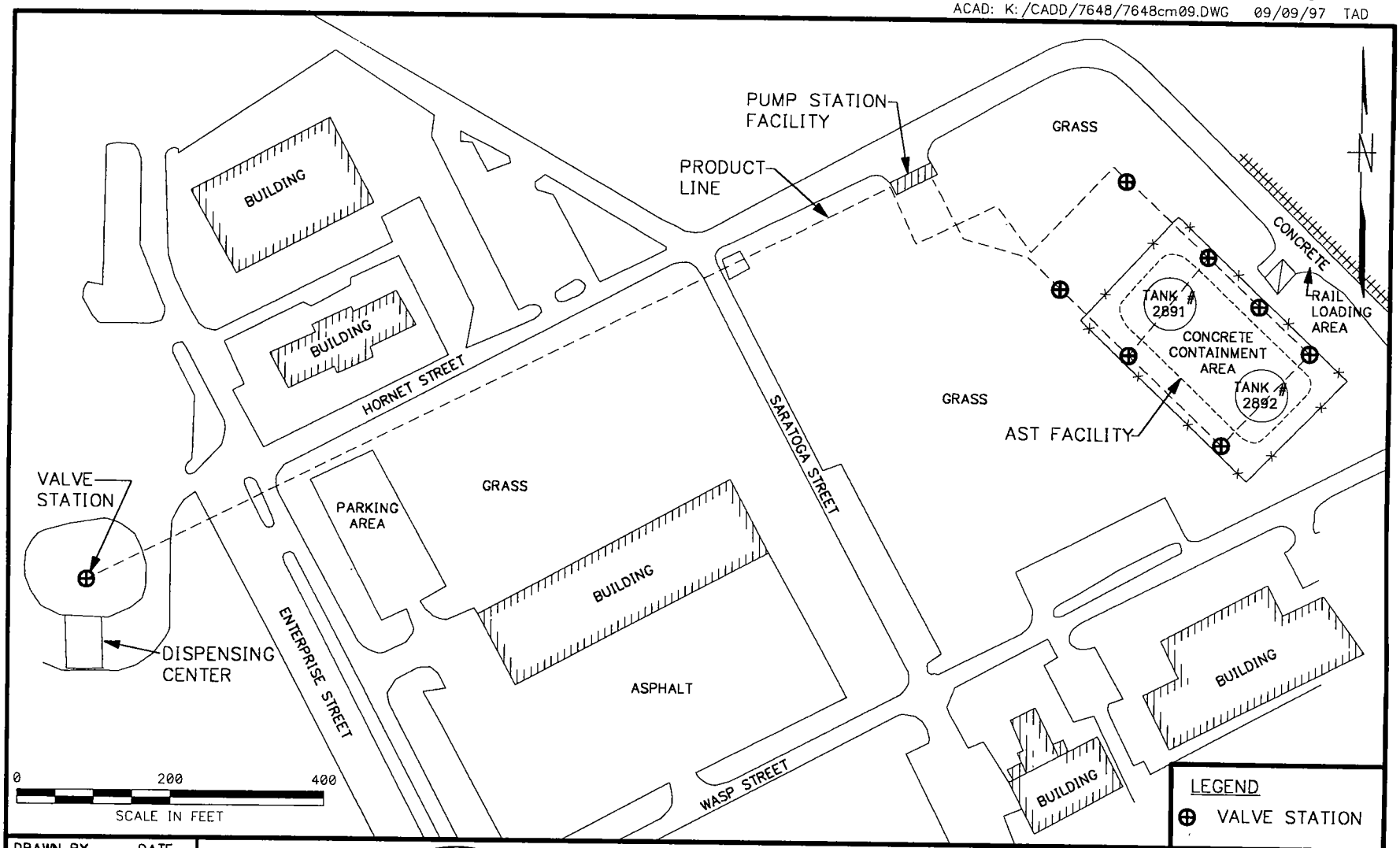
The product pipeline section from the pump station to the dispensing facility consists of 10-inch diameter metal pipe and is approximately 1315 feet in length. The product line maintains a



DRAWN BY TAD DATE 9/8/97	Brown & Root Environmental	CONTRACT NO. 7648	OWNER NO. ———
CHECKED BY GFG DATE 9/10/97	SITE PLAN FOR OIL/ WATER SEPARATOR (SITE 2993A) NAS WHITING FIELD MILTON, FLORIDA	APPROVED BY P.CALLIGAN	DATE 9/10/97
COST/SCHED–AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE 2–1	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

ACAD: K:/CADD/7648/7648cm09.DWG 09/09/97 TAD



DRAWN BY DATE TAD 9/10/97	Brown & Root Environmental	CONTRACT NO. 7648	OWNER NO. ———
CHECKED BY DATE GFG 9/10/97	SITE PLAN FOR AREA OF PRODUCT LINE INVESTIGATION NAS WHITING FIELD MILTON, FLORIDA	APPROVED BY P.CALLIGAN	DATE 9/10/97
COST/SCHED-AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE 2-2	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

consistent below gradient depth of approximately 3 feet except for an above ground junction located at the southeast corner of Hornet Street and Saratoga Street and an exposed portion near the pump station facility. The piping section is located within a relatively flat grassy surface area.

3.0 PREVIOUS INVESTIGATIONS

Oil/Water Separator

In September 1994, during an inspection of the oil/water separator system by the FDEP, free product was observed in the northeast compliance well, one of four leak detection wells installed in the vicinity of the oil/water separator unit. A Discharge Notification Form (DNF) filed for the release listed the type of substance discharged as jet fuel. Product was removed from the well and the system was taken out of service. The DNF form filed for the release is included in Appendix A.

In May 1995, a CAR investigation was initiated to investigate the areal extent of petroleum hydrocarbons in the groundwater and soil in the vicinity of the oil/water separator system (W. Grady Swan, Inc. Project No. WGS95-0094). A soil hydrocarbon vapor assessment was completed by advancing twenty one (21) soil borings (borings 1 to 21) to 5 feet below land surface (bls) and two (2) deep borings (borings 22 and 23) to 31 feet bls and 45 feet bls in the vicinity of the oil/water separator. Soil hydrocarbon vapor readings collected from soil samples indicated "excessively contaminated soil" as defined in Chapter 62-770, FAC for kerosene type fuel releases. The "excessively contaminated soil" was identified from the land surface to approximately 5 feet bls within an area radiating outward 10 to 15 feet from the oil/water separator, and to a depth of 20 to 35 feet bls within and immediately adjacent to the oil/water separator. To confirm the vertical extent of petroleum constituents in the soil, (as defined by OVA data), samples were collected at borings 22 and 23 at depths of 29 to 31 feet bls and 45 feet bls, respectively. These samples were analyzed for volatile organic halocarbons, volatile organic aromatics, and polynuclear aromatic hydrocarbons. The results of the soil laboratory analysis reported all parameters below the laboratory method detection limits. Soil headspace concentration contours and soil vapor profile data from the CAR are provided in Appendix B.

The CAR investigation identified a perched aquifer at approximately 4 to 10 feet bls beneath the Site. Five monitoring wells were installed during the CAR investigation in May 1995 to determine groundwater flow direction, hydraulic gradient, and the horizontal extent of groundwater contamination in the perched aquifer. On June 2, 1995 groundwater samples were collected from monitoring wells MW-1, MW-4, MW-5 and the southwest compliance well for Kerosene Analytical Group parameters. The water quality results indicated the perched aquifer was contaminated with dissolved hydrocarbons above FDEP target levels established in Chapter 62-770, FAC at the

"source" location (MW-4). Groundwater quality concentration contours generated from the CAR are provided in Appendix B.

The CAR investigation concluded that a thin localized perched aquifer underlies the area near the oil/water separator. The perched aquifer is located near the surface and contains groundwater only sporadically, primarily following heavy rainfall. Groundwater elevation contour maps and monitoring well gauging data from the CAR are provided in Appendix B.

The CAR identified the source of contamination to be stormwater discharges from the Fuel Truck Parking Area to the leaking oil/water separator.

In December 1996, the oil/water separator and sludge tank associated with the oil/water separator system were removed. A 500-gallon UST located adjacent to the oil/water separator was also removed. During removal of the oil/water separator, an IRA was conducted to remove "excessively contaminated soil" in the area of the oil/water separator. Approximately 34 cubic yards of soil were removed from an excavation approximately 10 feet by 15 feet by 6 feet in depth. A Closure form, IRA form and DNF filed at the time of system closure is included in Appendix B.

Product Pipeline

On March 27, 1996, a Closure Assessment was performed on the product pipeline system once affiliated with two ASTs identified as Tank No. 2891 and Tank No. 2892. The product pipeline system was taken out of service through in-place closure (Jim Stidham & Associates, Inc., April, 1996).

As part of the Closure Assessment 52 soil borings were advanced to assess soil conditions for the product pipeline system. Of these soil borings, 17 (SB-1 through SB-17) were advanced along the product line extending from the dispensing area to the pump station facility; 20 borings (SB-18 through SB-38) were installed along the product line extending from the pump station to the ASTs; seven borings (SB-39 to SB-45) were advanced adjacent to the rail loading area; five borings (SB-46 through SB-50)-were installed around the dispensing area; and two additional borings (SB-51 and SB-52) were installed at the pump station facility. The soil borings were completed at depths of 4 to 7 feet bls except at SB-33, SB-34, and SB-35, where the boring terminated at 12 feet bls, 20 feet bls, and 12 feet bls, respectively. Soil samples from the borings were collected at two foot intervals and screened for hydrocarbon vapors. Results of the soil vapor screening identified "excessively contaminated soil," as defined in Chapter 62-770, FAC for kerosene type fuel

release, at boring locations SB-1, SB-12, and SB-17. Borings SB-1, SB-12, and SB-17 are located near the dispensing facility, pipe junction, and pump station facility, respectively. A DNF was filed with the FDEP due to the detection of "excessively contaminated soil". The DNF listed the type of substance discharged as jet fuel with the cause for the leak identified as unknown. The DNF, along with figures and tables identifying soil sample locations and corresponding hydrocarbon vapor readings collected during the assessment, are included in the Closure Assessment Report provided in Appendix C.

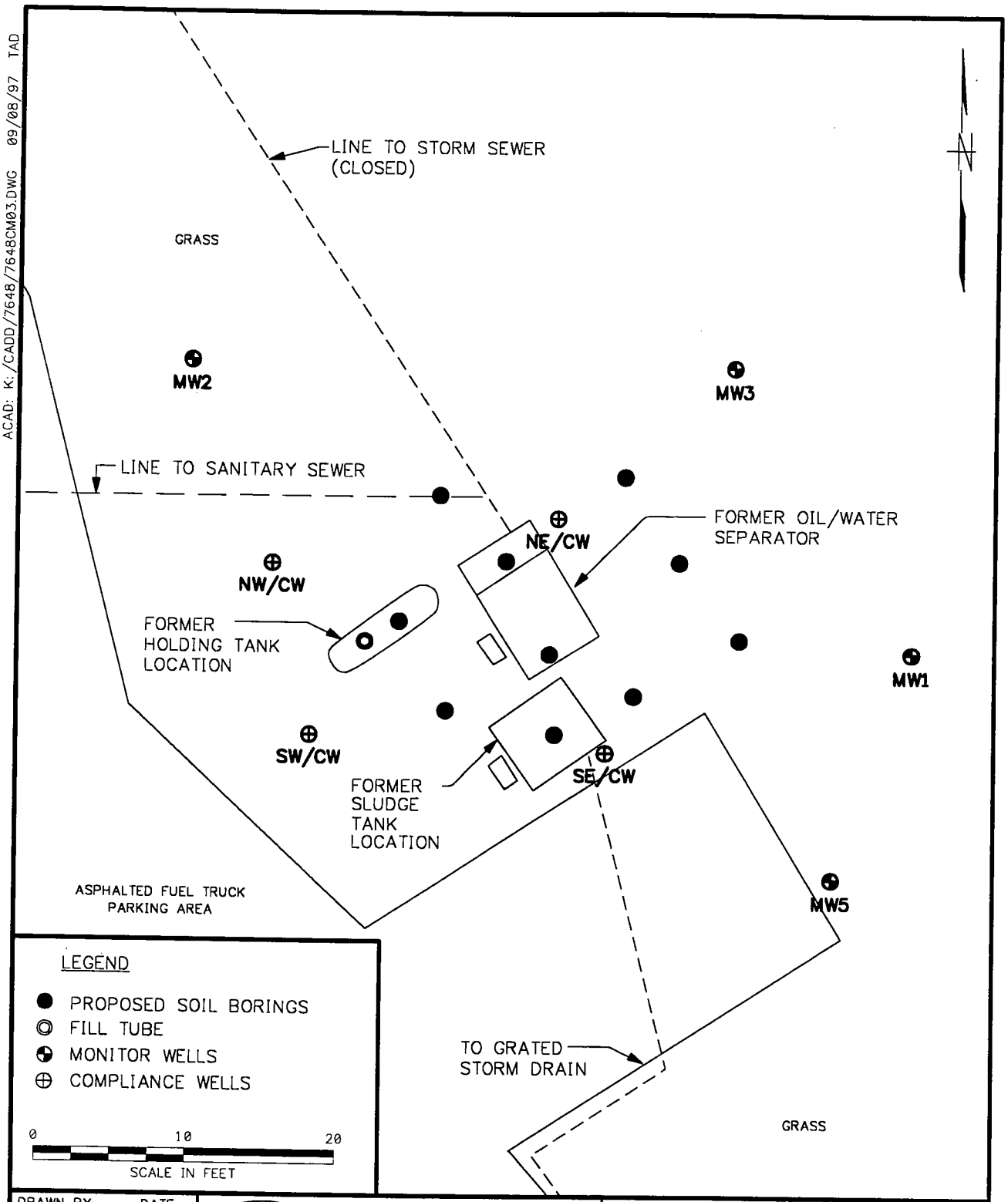
4.0 SCOPE OF PROPOSED ASSESSMENT

The proposed scope of work will involve the installation of soil borings and monitoring wells to evaluate the extent of petroleum compounds in the soil and groundwater within the study area. B&R Environmental estimates that 40 soil borings and 16 monitoring wells will be installed. Approximately 10 soil borings and four monitoring wells will be installed in the area of the former oil/water separator (Figure 4-1). In addition, approximately 10 soil borings and four monitoring wells will be installed at each of the three locations along the product line where "excessively contaminated" soil was identified during previous investigations (Figure 4-2).

The assessment activities will take place in two phases. During the first phase (Phase 1) a soil hydrocarbon vapor assessment will be performed using direct push technology (DPT), such as a geoprobe, to install soil borings to delineate the horizontal and vertical extent of vadose zone soil contamination and characterize the site geology. Soil samples at each boring location will be collected and the headspace from each sample will be screened for hydrocarbon vapors using an organic vapor analyzer (OVA). Three vadose zone soil samples which register the highest hydrocarbon vapor readings will be retained for laboratory analysis. The samples will be analyzed for constituents of the Kerosene Analytical Group as defined by Chapter 62-770. The samples will be used to confirm the OVA screening data and provide quantitative data for petroleum hydrocarbon concentrations in areas where the highest concentrations of petroleum hydrocarbons are suspected. Results of the soil hydrocarbon assessment will be used to determine optimum locations and minimum number of groundwater monitoring wells needed to characterize the groundwater dissolved hydrocarbon plume.

The second phase (Phase 2) will involve the installation of approximately 16 monitoring wells using the hollow stem auger drilling technique to assess the distribution of dissolved hydrocarbons in the surficial aquifer. Concurrent with this phase of work, groundwater samples will be collected from the newly installed wells for analysis of Kerosene Analytical Group constituents as defined by Chapter 62-770, FAC. Specific capacity tests will be performed on three of the monitoring wells to evaluate aquifer characteristics.

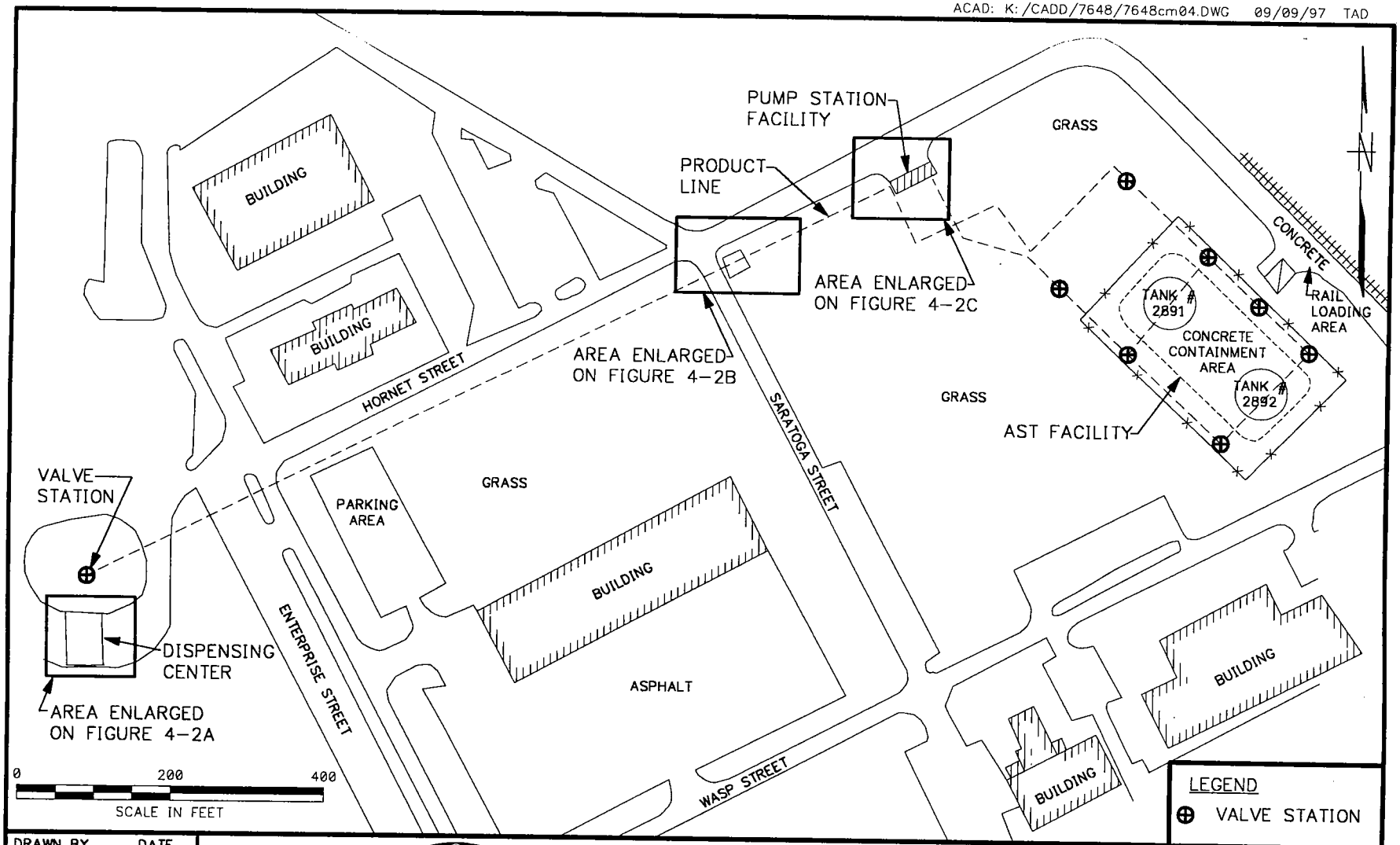
The relative top of casing elevation and horizontal location of all the newly installed monitoring wells and removal and disposal of investigative-derived waste generated during the Phase I and Phase 2 field investigations will be performed as part of the Phase 2 field investigation. The horizontal locations of the monitoring wells will be surveyed in accordance with the Florida Plane Coordinate System, UTM or base coordinator grid system as deemed appropriate by the Navy's Remedial Project Engineer (RPM) and the



DRAWN BY TAD DATE 9/8/97	Brown & Root Environmental	CONTRACT NO. 7648	OWNER NO. ————
CHECKED BY GFG DATE 9/10/97	PROPOSED SOIL BORING LOCATIONS OIL/ WATER SEPARATOR (SITE 2993A) NAS WHITING FIELD MILTON, FLORIDA	APPROVED BY P.CALLIGAN DATE 9/10/97	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 4-1	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

ACAD: K:/CADD/7648/7648cm04.DWG 09/09/97 TAD



DRAWN BY TAD 9/10/97	Brown & Root Environmental	CONTRACT NO. 7648	OWNER NO. ———
CHECKED BY GFG 9/10/97	SOIL BORING LOCATION MAP AREA OF PRODUCT LINE INVESTIGATION NAS WHITING FIELD MILTON, FLORIDA	APPROVED BY P.CALLIGAN	DATE 9/10/97
COST/SCHED-AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE 4-2	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

Activity Public Works Office. The monitoring well top of casing elevations will be surveyed in accordance with USGS NAD'83.

4.1 SOIL INVESTIGATION

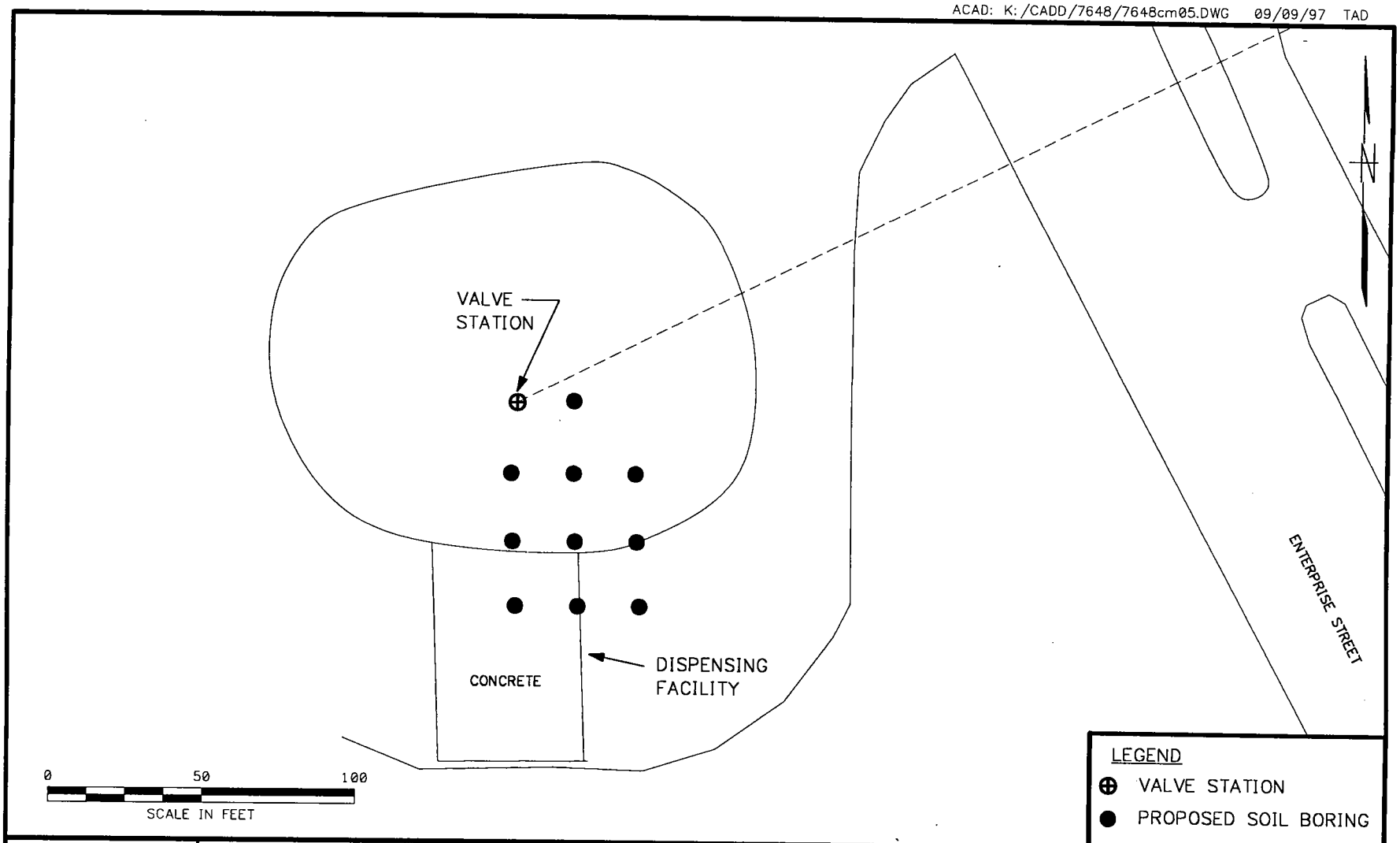
The soil hydrocarbon vapor assessment borings will be advanced using DPT. This method of drilling is preferred due to the subsurface lithology which is predominantly quartz sand within the upper 25 feet of sediments underlying the study area. The use of DPT will also minimize the amount of soil cuttings generated during boring activities.

Approximately 40 soil borings will be installed during the Phase 1 field investigation to assess the horizontal and vertical extent of petroleum contamination in vadose zone soils. Soil samples will be collected continuously from each boring to a depth of approximately 25 feet bls. Soil samples will be collected using either a two foot or four foot sampler with plastic liners. Soil samples will be collected at two foot intervals and screened for hydrocarbon vapors following procedures for headspace analysis as prescribed by Chapter 62-770.200, FAC. The actual depths of the soil borings will be adjusted in the field as necessary. If headspace field screening data or visual observations of the soil samples indicate soil contamination extends below 25 feet bls, boring advancement will continue until the vertical extent of the contamination has been defined or the depth exceeds the capabilities of the DPT method. If contaminated soil is detected beyond the range of the DPT method, samples will be collected using a drill rig with split-spoon sampling capabilities during Phase 2 of the investigation.

Each soil boring will be hand augured or pre-probed from the surface to four feet bls to ensure that no underground utilities are present. The location of the proposed borings are provided on Figures 4-1, 4-2. 4-2A, 4-2B, and 4-2C.

If soil contamination is identified above FDEP target levels (soil hydrocarbon vapor readings greater than 10 ppm) at any proposed boring location, additional soil borings would be advanced to assess the areal extent of soil contamination. It is assumed 40 soil borings will provide sufficient areal coverage to delineate the soil contamination in the area of the oil/water separator and three areas along the product pipeline where "excessively contaminated soil" had previously been identified. At each study location (i.e., oil/water separator and three areas along the product pipeline where "excessively contaminated soil" was previously identified) soil grab samples will be collected. The soil grab samples will be collected from vadose zone soils which exhibited high, medium and low organic vapor readings. A total of 12 soil grab samples will be collected during the DPT borings and retained for laboratory analysis of the Kerosene Analytical Group parameters.

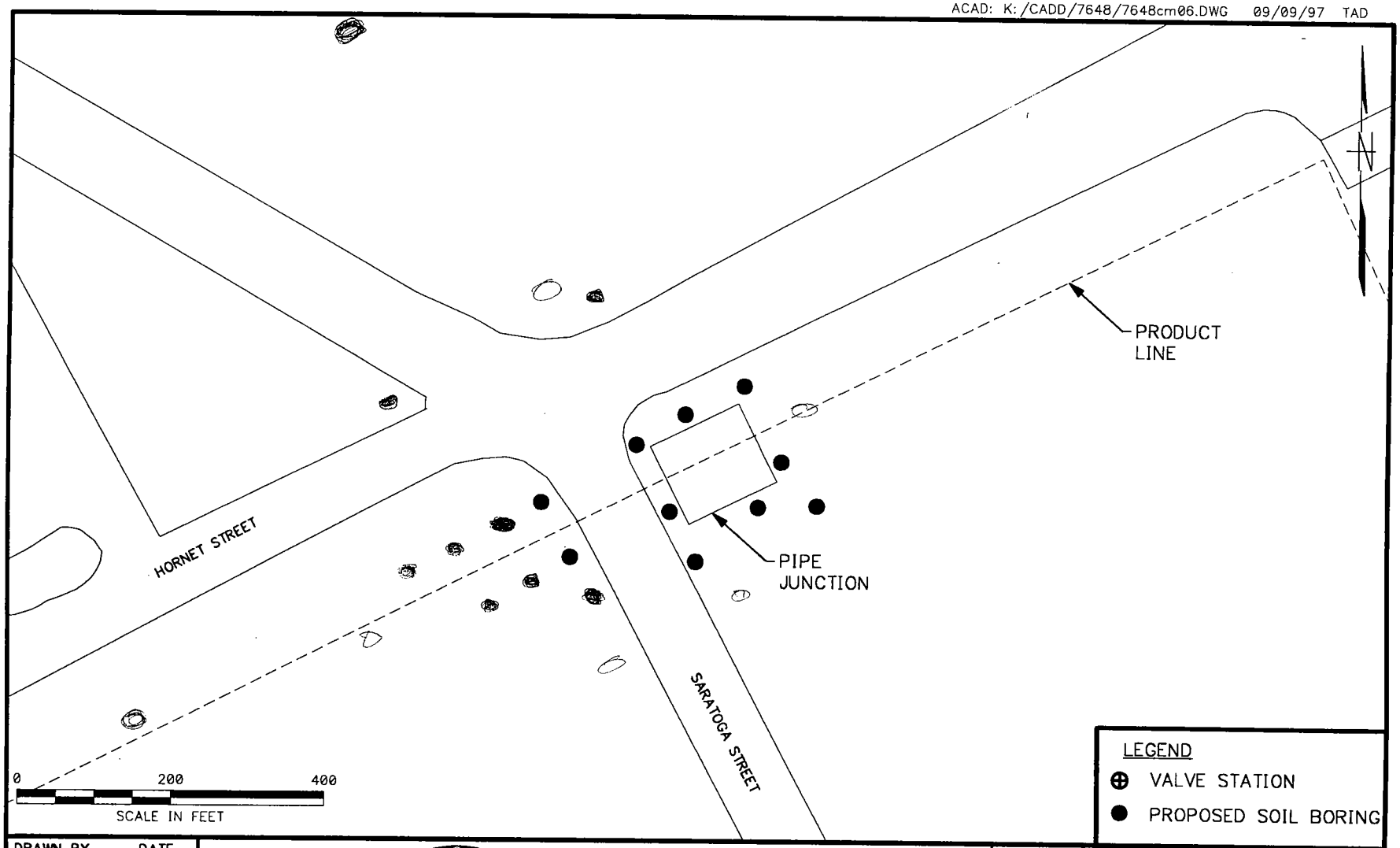
ACAD: K:/CADD/7648/7648cm05.DWG 09/09/97 TAD



DRAWN BY TAD DATE 9/10/97	Brown & Root Environmental	CONTRACT NO. 7648	OWNER NO. ———
CHECKED BY GFG DATE 9/10/97	**PROPOSED SOIL BORING LOCATION MAP AREA OF PRODUCT LINE INVESTIGATION NAS WHITING FIELD MILTON, FLORIDA**	APPROVED BY P.CALLIGAN	DATE 9/10/97
COST/SCHED-AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE 4-2A	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

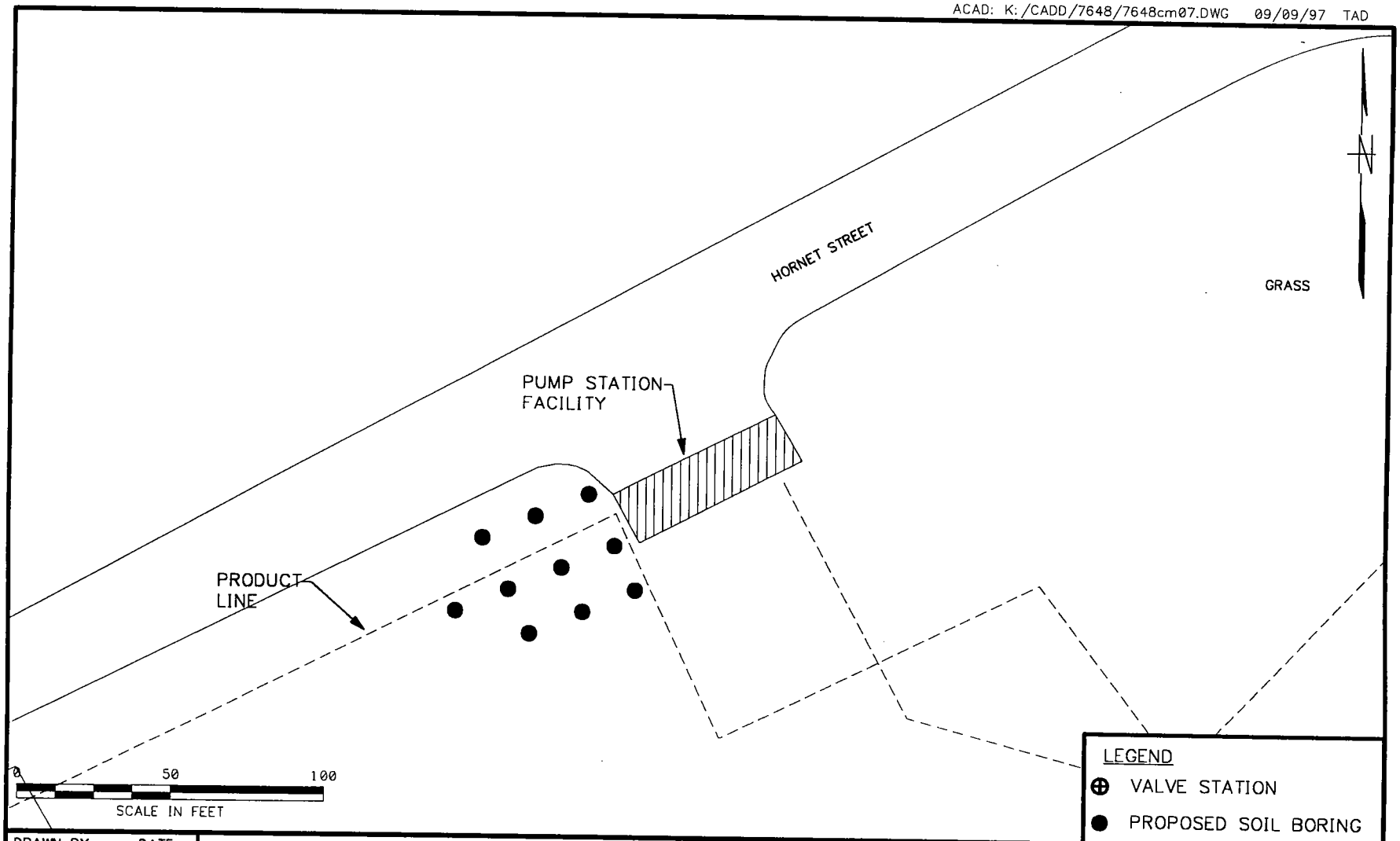
ACAD: K:/CADD/7648/7648cm06.DWG 09/09/97 TAD



DRAWN BY TAD DATE 9/10/97	Brown & Root Environmental	CONTRACT NO. 7648	OWNER NO. ———
CHECKED BY GFG DATE 9/10/97	PROPOSED SOIL BORING LOCATION MAP AREA OF PRODUCT LINE INVESTIGATION NAS WHITING FIELD MILTON, FLORIDA	APPROVED BY P.CALLIGAN	DATE 9/10/97
COST/SCHED–AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE 4–2B	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

ACAD: K:/CADD/7648/7648cm07.DWG 09/09/97 TAD



DRAWN BY TAD DATE 9/10/97	Brown & Root Environmental	CONTRACT NO. 7648	OWNER NO. ———
CHECKED BY GFG DATE 9/10/97	PROPOSED SOIL BORING LOCATION MAP AREA OF PRODUCT LINE INVESTIGATION NAS WHITING FIELD MILTON, FLORIDA	APPROVED BY P.CALLIGAN DATE 9/10/97	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE AS NOTED		DRAWING NO. FIGURE 4-2C	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

In addition to the soil sampling proposed during the DPT soil assessment, a limited number of soil samples will be collected during the installation of the monitoring wells. These additional soil samples will be used to characterize the site lithology at greater depth and to verify that the vertical extent of contamination has been defined. These samples will be limited to one monitoring well boring at each of the four areas of the investigation. The borings will be sampled at 5-foot intervals from the depth of the deepest DPT sample collected during Phase I to the proposed termination of the monitoring well boring. A split-barrel sampler with a minimum diameter of 2-inches and at least 2 feet in length will be used to collect the samples. The split-barrel sampler will provide sufficient sample for headspace analysis and lithologic characterization. The samples will be collected following procedures presented in ASTM D 1586-84 included in Appendix E.

Each soil boring will be backfilled with Type 1 Portland Cement. All locations drilled through asphalt or concrete will be completed with similar material and finished flush to existing grade. All soil samples obtained from the borehole will be screened with an OVA and then collected for lithologic and/or chemical analysis.

A lithologic description will be made of each soil sample collected and a completed log of each boring will be maintained by the on-site geologist in accordance with Standard Operating Procedure (SOP) GH 1.5 included in Appendix D. At a minimum, the boring log will contain the following information:

- Sample Numbers and Types
- Sample Depths
- Sample Recovery/Sample Interval
- Soil Density or Cohesiveness
- Soil Color
- Unified Soil Classification System (USCS) Material Description

In addition, depths of changes in lithology, sample moisture observations, depth to water, OVA readings, drilling methods, and total depth of each borehole should be included on each log, as well as any other pertinent observations. An example of the boring log form is attached in Appendix D.

The site's lithology and soil quality will be assessed from soil samples collected during the soil hydrocarbon vapor survey and from soil samples collected during the drilling of the monitoring wells (see Section 4.2.1).

4.2 GROUNDWATER INVESTIGATION

It is anticipated that 16 monitoring wells will be required to assess the horizontal extent of dissolved hydrocarbons in the area of the oil/water separator and three areas along the product pipeline where "excessively contaminated soil" was identified . The installation of the water table monitoring wells will be completed during the Phase 2 field investigation. The proposed monitoring well locations will be determined based on spatial distribution of the soil hydrocarbon vapor readings generated from the Phase I field investigation and the local groundwater flow pattern as identified in previous investigations conducted at the Base. (i.e., Remedial Investigation Industrial Area Groundwater Investigation, Interim Report (ABB ES 1996b), and Contamination Assessment Report for Site 2293A). The Navy and FDEP will be contacted to discuss the locations of the proposed monitoring wells. Well installation permits will be obtained from the Northwest Florida Water Management District prior to drilling activities.

4.2.1 Monitoring Well Installation

Monitoring wells will be installed using hollow-stem auger drilling methods. These wells will be used to monitor groundwater quality and evaluate the horizontal extent of dissolved petroleum constituents in the groundwater. Each boring advanced for monitoring well installation will be hand dug from the surface to four feet bls using a post hole digger to ensure that no underground utilities are present. Monitoring wells will be constructed of 2-inch ID, Schedule 40, flush-joint, PVC riser and flush-joint, factory slotted well screen. Each section of casing and screen shall be National Sanitation Foundation (NSF) approved. Screen slot size shall be 0.01 inch. Unless otherwise specified, the top of the screen interval will be positioned approximately 5 feet above the water table. Screen sections will be 15 feet in length. After the borings are drilled to the desired depth, (6-inch minimum diameter boring for 2-inch ID wells), the well will be installed through the augers.

The lithology has been sufficiently characterized from previous investigations at NAS that a sieve analysis of the soils is not needed in determining the type of sand pack and screen slot size for well completion. Clean silica sand of U.S. Standard Sieve Size No. 20/30 will be installed as the filter sand pack for the monitoring well. The sand pack will be set from 6-inches below the bottom of the screen to approximately two feet above the top of the well screen. A one foot thick, secondary sand seal consisting of U.S. Standard Sieve Size No. 30/65 will be placed on top of the filter sand. The well will be grouted to the surface with a Type 1 Portland cement/bentonite slurry. The sand filter pack, sand seal, and grout will be installed via tremied methods to insure proper setting of the well materials. The depths of all backfill materials will be constantly monitored during the well installation process by means of a weighted

stainless steel or fiberglass tape. The position of the top of the screen interval, sand pack and bentonite seal may be adjusted as site conditions warrant (elevated water table, etc.)

Each monitoring well will be completed with an above ground locking stainless steel protective casing set within a 3 feet by 3 feet cement apron. A detail of monitoring well construction is shown on Figure 4-3. All locks supplied for the wells will be keyed alike. After installation, the ground surface and the top of the PVC riser pipe will be surveyed to within 0.01-foot vertical accuracy using datum points as discussed previously in Section 4.0.

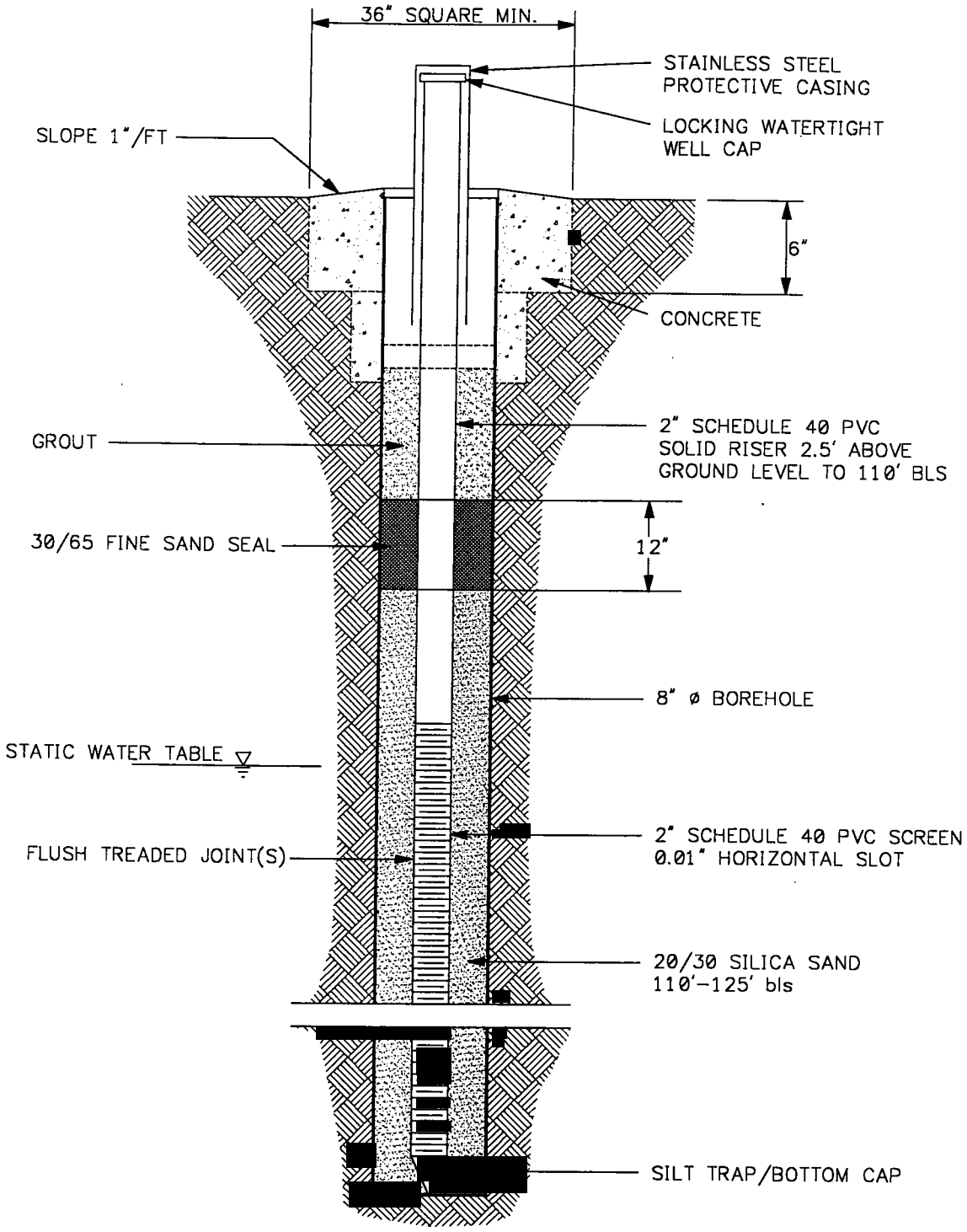
A monitoring well construction diagram will be completed for each well installed. A sample of the monitoring well construction form is provided in Appendix D.

The monitoring wells will be developed no sooner than 24 hours after installation to remove fine material from around the monitored interval of the well. Wells will be developed by bailing and surging, or by pumping, as determined by the field geologist. The pH, temperature, specific conductance and turbidity of the purge water will be measured and recorded throughout development. Wells will be developed up to a maximum of one hour or until these measurements become stable or the purge water is visibly clear. Water quality stabilization will be determined using the following criteria: temperature +/- 1^{o}C, pH +/- 1 unit, specific conductance +/- 10 *u*mhos/cm and turbidity remains within a 10 Nephelometric Turbidity Unit (NTU) range for 2 consecutive readings. Wells will be developed until approved by the field geologist.

4.2.2 Groundwater Sampling

Groundwater samples will be obtained from monitoring wells used in the assessment investigations in accordance with B&R Environmental Comprehensive Quality Assurance Plan (FDEP Comp QAP Plan No. 870055). Prior to obtaining samples, water levels and total well depths will be measured and the wells will be purged using a low-flow submersible pump. Three to five well volumes will be purged. If wells are purged dry with less than three well volumes removed, the water level in the well will be allowed to recover at least 80 percent, then a sample will be collected. Field measurements of pH, temperature, specific conductance and turbidity will be taken after each volume of water is purged. Stabilization of the above parameters is defined in the previous paragraphs. If these parameters do not stabilize after three volumes, up to five volumes will be removed. Before purging, a clear bailer or an oil water interface probe will be used to check for free product. No samples will be collected from a well that exhibits measurable free product. The thickness of the free product will be measured and recorded. Samples will be obtained using a low-flow submersible pump. The samples will be transferred directly into the appropriate (pre-preserved) sample bottles for analysis. Samples to be analyzed for volatile constituents shall be taken

ACAD: K:/CADD/7648/7648CM02.DWG 09/08/97 TAD



DRAWN BY TAD DATE 9/8/97	Brown & Root Environmental	CONTRACT NO. 7648	OWNER NO. ———
CHECKED BY GFG DATE 9/10/97	TYPICAL WATER TABLE MONITORING WELL DETAIL NAS WHITING FIELD MILTON, FLORIDA	APPROVED BY P.CALLIGAN	DATE 9/10/97
COST/SCHED-AREA		APPROVED BY	DATE
SCALE AS NOTED		DRAWING NO. FIGURE 4-3	REV. 0

FORM CADD NO. SOUTH_AV.DWG - REV 0 - 02/07/97

first and immediately sealed in the vial so that no headspace exists. The sample constituents analyzed are summarized in Table 4-1. All pertinent field and sampling data shall be recorded using a groundwater sample form, attached in Appendix D.

Groundwater samples will be collected from three select monitoring wells for field screening for dissolved oxygen and ferrous iron, and laboratory analysis for nitrate, sulfate, and methane. These parameters will be used to evaluate the sites potential for natural attenuation (intrinsic bioremediation).

4.2.3 Groundwater Level Measurements

Synoptic water level measurements will be taken from all monitoring wells at the sites within a 4-hour period to minimize fluctuations due to changes in barometric pressure and/or infiltration of precipitation. Static water level measurements will be measured from the north rim of the top of the PVC riser pipe using an electronic water level indicator. The newly installed wells shall be notched and marked so that the same point will be referenced for all measurements. The depth to water will be measured to the nearest 0.01 foot below the

top of the PVC riser pipe. Three consecutive water level readings will be recorded from the well to the nearest 0.01 foot to assure an accurate water level is recorded. Water level measurements will be recorded to the nearest 0.01 foot in the appropriate field log book.

4.3 AQUIFER TESTS

B&R Environmental will perform a specific capacity pumping test on three selected shallow monitoring wells at the Site. Each specific capacity test will be performed by pumping the well at a constant rate and measuring drawdown in the pumping well until the drawdown has stabilized. Static water levels in the pumped well will be measured using an electronic data logger. Specific capacity of the aquifer will be calculated from the test data and the aquifer transmissivity value estimated using methodology described by Kasenow and Pare, 1995. A hydraulic conductivity value will be estimated based on the aquifer transmissivity value and estimated aquifer thickness.

4.4 EQUIPMENT DECONTAMINATION

The equipment involved in field sampling activities will be decontaminated prior to and during drilling and sampling activities. This equipment includes drill rigs, downhole tools, augers, well casing and screens, and soil and water sampling equipment.

TABLE 4-1

FIELD INVESTIGATION
ENVIRONMENTAL SAMPLE SUMMARY/INVESTIGATIVE DERIVED WASTE (IDW)
CHARACTERIZATION AND ANALYSES
OIL/WATER SEPARATOR AND PRODUCT PIPELINE INVESTIGATION
NAS Whiting Field, Milton, Florida

Analyte	Proposed Method (1)	Env. Samples	IDW Samples (2)	Duplicate Samples	Rinsate Blanks (Aqueous)	Field Blank (Aqueous)	Trip Blanks (Aqueous)	Total Samples
GROUNDWATER								
VOH	EPA 601	16	1	2	2	2	2	25
VOA	EPA 602	16	1	2	2	2	2	25
PAH	EPA 610	16	1	2	2	2	0	23
LEAD	EPA 239.2	16	1	2	2	2	0	23
TRPH	FL-PRO	16	1	2	2	2	0	23
EDB	EPA 504.1	16	1	2	2	2	0	23
Nitrate	EPA 300	3	0	0	0	0	0	3
Sulfate	EPA 300	3	0	0	0	0	0	3
Methane	RSK SOPs 147 and 175	3	0	0	0	0	0	3
TOTAL		105	6	12	12	12	2	149
SOIL								
VOH	EPA 8010	0	1	0	0	0	0	1
VOA	EPA 8020	12	1	0	2	0	0	15
PAH	EPA 8100	12	1	0	2	0	0	15
Leachability	EPA 1312	3	0	0	0	0	0	3
TRPH	FL-PRO	12	1	0	2	0	0	15
8 RCRA Metals	8 RCRA Metals	0	1	0	0	0	0	1
Total Halides	EPA 5050/9056	0	1	0	0	0	0	1
TOTAL		39	6	0	6	0	0	51

(1) Method referenced reflects FDEP requirements.

(2) IDW sample numbers based upon disposing of 32 55-gallon drums (1 composite sample) of liquid and 96 55-gallon drums (1 composite sample) of soil.
All analyses are analyzed using standard 30-day laboratory turn around time.

4.4.1 Major Equipment

All downhole drilling equipment used in the construction and sampling of the monitoring wells, including downhole drill and sampling tools shall be steam cleaned prior to beginning work, between boreholes, any time the drill rig leaves the drilling site prior to completing a boring, and at the conclusion of the drilling program.

These decontamination operations will consist of washing equipment using a high-pressure steam wash from a potable water supply and Alconox soap. Then the equipment will be rinsed with tap water. All decontamination activities will take place at a predetermined location. Additional requirements for drilling equipment decontamination can be found in SOP SA-7.1 included in Appendix D.

4.4.2 Sampling Equipment

All equipment such as trowels, bailers, and split spoon samplers used for collecting samples will be decontaminated prior to beginning field sampling and between sample locations. The following decontamination steps will be taken:

- Tap water and Alconox or liquinox detergent rinse.
- Tap water rinse.
- If trace metals are to be sampled rinse with 10-15% reagent grade nitric acid (the nitric acid should not be used on steel sampling equipment).
- Rinse thoroughly with de-ionized, analyte-free water.
- Rinse with isopropanol
- Rinse thoroughly with de-ionized, analyte-free water
- Air dry.
- Wrap equipment in aluminum foil until use.

Field meters such as pH, conductivity and temperature instrument probes will be rinsed first with tap water, then with de-ionized, analyte-free water, and finally with the sample liquid.

4.5 WASTE HANDLING

Drill cuttings from monitoring well installations, well development water, and purge water will be collected and containerized in DOT approved (Specification 17C) 55-gallon drums. Each drum will be sealed and labeled and left at a drum staging area pending groundwater analytical results and/or composite waste

sample results for disposal. A waste staging areas will be established at the site location to store investigative derived waste generated during the assessment investigation. A lined decontamination pad will be constructed and used to collect the water from steam cleaning of drilling equipment All decontamination materials generated during the site investigation will be containerized for proper disposal.

4.6 SAMPLE HANDLING

Sample handling includes the field-related consideration concerning the selection of sample containers, preservatives, allowable holding times and analysis requested. In addition, sample identification, packaging, and shipping will be addressed. All sample handling procedures will be in accordance with B&R Environmental's Comprehensive Quality Assurance Plan (CompQAP No. 870055).

The CompQAP address the topics of containers and sample preservations. A summary of bottle ware requirements, preservation requirements, and sample holding times are provided in Table 4-2.

4.7 SAMPLE IDENTIFICATION

Each sample collected will be assigned a unique sample tracking number. The sample tracking number will consist of a three-segment, alpha-numeric code that identifies the building number (the Site), sample medium, location, the sampling event identifier (or sample depth in case of soil samples) and the QC designation, if applicable. Any other pertinent information regarding sample identification will be recorded in the field logbook.

The alpha-numeric coding to be used in the sample system is explained in the subsequent definitions:

NN(N or A)	-	(Building Designation)
AA	-	(Medium)
AANN	-	(Location)
NNN(N)	-	(QC Designation, if applicable)

Table 4-2

Summary of Analysis, Bottleware Requirements, Preservation Requirements, and Holding Times
NAS Whiting Field, Milton, Florida

Parameter	Analytical Method	Sample Container	Volume	Preservation	Maximum Holding Time (1)
Aqueous Samples					
VOHs	EPA Method 601	Glass Volatile Vial	40 ml	Add HCl to pH < 2; Chill to 4 degrees Celcius	14 days
VOAs Plus MTBE	EPA Method 602	Glass Volatile Vial	40 ml	Add HCl to pH < 2; Chill to 4 degrees Celcius	14 days
1,2-Dibromomethane	EPA Method 504	Glass Volatile Vial	40 ml	Add HCl to pH < 2; Chill to 4 degrees Celcius	28 days
PAHs	EPA Method 610	Amber Glass	2.5 L	Chill to 4 degrees Celcius	7 days until extraction; 40 days to analysis
Lead (total and dissolved)	EPA Method 239.2	High Density Polyethylene	500 ml	Chill to 4 degrees Celcius	180 days
TRPH	FL-PRO	Glass	1L	Add HCl to pH < 2; Chill to 4 degrees Celcius	28 days
Nitrate	EPA 300	High Density Polyethylene	100 ml	Chill to 4 degrees Celcius	48 hours
Sulfate	EPA 300	High Density Polyethylene	100 ml	Chill to 4 degrees Celcius	28 days
Methane	RSK SOPs 147 and 175	Glass Volatile Vial	40 ml	Add HCL to pH 2, Chill to 4 degrees Celcius	NA

VOHs - Volatile Organic Halocarbons
VOAs - Volatile Organic Aromatics
MTBE - Methyl-tert-butyl-ether
HCl - Hydrochloric acid
PAHS - Polynuclear Aromatic Hydrocarbons
TRPH - Total Recoverable Petroleum Hydrocarbons
RCRA - Resource Conservation and Recovery Act
RSK SOP - EPA's Kerr Laboratory Standard Operating Procedure
NA - Not Available
(1) - Holding time is measured from date of sample collection to date of sample analysis.

Table 4-2 (Continued)

Summary of Analysis, Bottleware Requirements, Preservation Requirements, and Holding Times
NAS Whiting Field Milton, Florida

Parameter	Analytical Method	Sample Container	Volume	Preservation	Maximum Holding Time
Solid Samples					
VOHs	EPA Method 8010	Clear Wide Mouth Glass	4 ounces	Chill to 4 degrees Celcius	14 days
VOAs	EPA Method 8020	Clear Wide Mouth Glass	8 ounces	Chill to 4 degrees Celcius	7 days to extraction; 40 days to analysis
RCRA Metals	SW-846 Method 6010/7000 series	Clear Wide Mouth Glass	4 ounces	Chill to 4 degrees Celcius	180 days; except mercury 28 days
Lead	239.2	Clear Wide Mouth Glass	500 ml	Chill to 4 degrees Celcius	180 days
PAHs	EPA Method 8100	Clear Wide Mouth Glass	8 ounces	Chill to 4 degrees Celcius	14 days to extraction; 40 days to analysis
TRPH	FL-PRO	Clear Wide Mouth Glass	4 ounces	Chill to 4 degrees Celcius	28 days
Total Halides	EPA Method 5050/9056	Clear Wide Mouth Glass	500 ml	Chill to 4 degrees Celcius	28 days

VOAs - Volatile Organic Halocarbons
VOHs - Volatile Organic Aromatics
MTBE - Methyl-tert-butyl-ether
H2SO4 - Sulfuric acid
HCl - Hydrochloric acid
PAHs - Polynuclear Aromatic Hydrocarbons
TRPH - Total Recoverable Petroleum Hydrocarbons
RCRA - Resource Conservation and Recovery Act
(1) - Holding time is measured from date of sample collection to date of sample analysis.

Character Type:

A = Alpha
N = Numeric

Medium:

GW = Groundwater sample form a monitoring well
SS = Subsurface soil sample taken via soil boring
TW = Temporary well groundwater sample

Sample Location:

Subsurface soil sample locations (SS) will correspond to the boring number (i.e., SB02)

Groundwater sample locations (GW) will correspond to the well number (i.e, 58-1)

Temporary well groundwater sample locations (TW) will correspond to the temporary well number (i.e, 58-TW1).

Sample Identifier:

For soil samples = Sample depth interval, in feet

For groundwater = Sampling round

QA Sample Designation:

D = Duplicate
F = Field Blank
B = Equipment Rinsate Blank
T = Trip Blank

For example, a groundwater sample collected from monitoring well MW-01 at Building 362 UST would be designated as 362-GW-MW01-001.

A duplicate sample from that same well would be 362-GW-MW01-001D.

A subsurface soil sample taken from Monitoring Well Boring 01 at Building 362 UST, at a depth of 4 to 6 feet bls would be 362-SS-MW01-0406.

Information regarding sample labels to be attached before shipment to a laboratory is contained SOP SA-6.3 included in Appendix D. Examples of sample labels, chain of custody seals, and chain-of-custody forms are included in Appendix D.

4.8 SAMPLE PACKAGING AND SHIPPING

Samples will be packaged and shipped in accordance with B&R Environmental's CompQAP (FDEP Comp QA Plan No. 870055). The Field Operations Leader will be responsible for completion of the following forms when samples are collected for shipping.

- Sample labels
- Chain-of-Custody labels
- Appropriate labels applied to shipping coolers
- Chain-of Custody Forms
- Federal Express Air Bills

4.9 SAMPLE CUSTODY

The chain-of-custody begins with the release of the sample bottles from the laboratory and must be documented and maintained from that point forward. To maintain custody of the sample bottles or samples, they must be in someone's physical possession, in a locked room or vehicle, or sealed with an intact custody seal. When the possession of the bottles or samples is transferred from one person to another it will be documented on the field logbook and on the chain-of-custody. An example of a chain-of-custody record is provided in Appendix D.

4.10 QUALITY CONTROL (QC) SAMPLES

In addition to periodic calibration of field equipment and appropriate documentation, quality control samples will be collected or generated during environmental sampling activities. Quality control samples include field blanks, field duplicates, field replicates, and trip blanks. Each type of field quality control sample is defined as follows:

Rinsate Blank - Rinsate blanks are obtained under representative field conditions by running organic free water through sample collection equipment (bailer, split-spoon, etc.) after decontamination and placing it in the appropriate containers for analysis. Rinsate blanks will be used to assess the effectiveness of decontamination procedures. Rinsate blanks will be collected for each type of non-dedicated sampling equipment used and will be submitted as shown in Table 4-1.

Field Duplicate - Field duplicate(s) are two water samples collected independently at a sample location during a single act of sampling under representative field conditions. Field duplicates sample frequencies are provided in Table 4-3. The duplicates shall be analyzed for the same parameters in the laboratory as indicated in Table 4-1.

Trip Blanks - Trip blank(s) will be prepared at the laboratory facility and will accompany the VOA/VOH vials to the sampling site and back to the laboratory. Trip blanks are not required by the FDEP unless 10 or more volatiles samples are collected during a given sampling event. Trip blank sample frequency are provided in Table 4-3.

4.11 FIELD MEASUREMENTS

Certain field measurements will be recorded during sampling activities including groundwater temperature, pH, specific conductance and turbidity. Instruments used in the field to record this data and additional instruments will be calibrated according to the procedures described below.

4.11.1 Parameters

- Air monitoring - OVA
- Temperature - Temperature probe
- Specific conductance - Specific conductance meter
- pH - pH meter
- turbidity - turbidity meter
- Depth to water table - interface probe

TABLE 4-3

QUALITY CONTROL SAMPLE FREQUENCY
NAS WHITING FIELD, MILTON FLORIDA

Number of Samples	Precleaned Equipment Blank	Field-Cleaned Equipment Blank	Trip Blank (VOCs)	Duplicate
10+	minimum of one, then 5%	minimum of one, then 5%	one per cooler	minimum of one, then 10%
5-9	one*	one*	not required	one
<5	one*	one*	not required	not required

*Note: For nine or fewer samples, a precleaned equipment blank and/or a field-cleaned equipment blank is required. A field-cleaned equipment blank must be collected if equipment is cleaned in the field.

4.11.2 Equipment Calibration

The electronic water-level indicator will be calibrated prior to mobilization and periodically at the discretion of the Field Operations Leader. The remaining instruments will be calibrated daily and/or according to the manufacturer's operation manual.

Calibration will be documented on an Equipment Calibration Log as shown in Appendix D. During calibration, an appropriate maintenance check will be performed on each piece of equipment. If damaged or defective parts are identified during the maintenance check and it is determined that the damage could have an impact on the instrument's performance, the instrument will be removed from service until defective parts are repaired or replaced.

4.11.3 Equipment Maintenance

Measuring equipment used in environmental monitoring or analysis and test equipment used for calibration and maintenance shall be controlled by established procedures. Measuring equipment shall have an initial calibration and shall be recalibrated at scheduled intervals against certified standards.

B&R Environmental maintains a large inventory of sampling and measurement equipment. In the event that failed equipment cannot be repaired, replacement equipment can be shipped to the site by overnight express carrier to minimize downtime.

4.12 FIELD QA/QC PROGRAM

4.12.1 Control Parameters

Field control parameters and limits, which address various field blanks and duplicate samples, are described in Section 4.10 QC Samples. Control checks and sampling frequency are also presented in Section 4.10.

4.12.2 Control Limits

QA/QC specifications for field measurements are summarized on Table 4-4. This table shows control parameters to be assessed, control limits, and corrective actions to be implemented.

TABLE 4-4

FIELD QA/QC SPECIFICATIONS
NAS WHITING FIELD, MILTON, FLORIDA

Analysis	Control Parameter	Control Limit	Corrective Action
Air monitoring using an organic vapor analyzer (FID)	Daily check of calibration of FID	Calibration to manufacturer's specifications	Recalibrate. If unable to calibrate, replace.
pH of water	Continuing calibration check of pH 7.0 buffer	pH = 7.0 ± 0.1	Recalibrate. If unable to calibrate, replace electrode.
Specific conductance of water	Continuing calibration check of standard solution	± 1% of standard	Recalibrate.
Temperature of water	Check against NIST precision thermometer	± 0.1°C at two different temperatures	Reset thermistors in accordance with manufacturer's specifications; dispose of inaccurate thermometer.

FID – flame ionization detector
NIST – National Institute of Standards and Technology

The B&R Environmental representative on site at each well and boring will confirm measurements of total depth of holes, dimensions and placement of well screens and casings, and volume and placement of filter pack and grout materials by independent measurement. The Field Operations Leader will examine field laboratory records and field log books on a weekly basis during field activities.

4.12.3 Corrective Actions

The need for corrective actions may become apparent during surveillance of field activities, procurement of services and supplies, or other operations that may affect the quality of work. The identification of significant conditions adverse to quality, the cause of the conditions, and the corrective actions shall be documented and reported to the appropriate levels of management. The B&R Environmental TOM will have overall responsibility for implementing corrective actions, and must identify those from initiating corrective action to remedy immediate effects of the problem.

The corrective action program covers the analysis of the cause of any negative findings and the corrective actions required. This program includes the investigation of the case of significant or repetitious unsatisfactory conditions relating to the quality of sampling service, or the failure to adhere to required quality assurance practices such as Standard Operating Procedures.

4.13 RECORD KEEPING

In addition to chain-of-custody records associated with sample handling, packaging and shipping, certain standard forms will be completed for sample description and documentation. These shall include sample log sheets (for soil and groundwater samples), daily record subsurface investigation reports, and logbooks. An example of these forms can be found in Appendix D.

A bound/weatherproof field notebook shall be maintained by each sampling event leader. The field team leader or designee, shall record all information related to sampling or field activities. This information may include sampling time, weather conditions, unusual events (e.g., well tampering), field measurements, descriptions of photographs, etc.

A site logbook shall be maintained by the Field Operations Leader. The requirements of the logbook are referenced in Appendix D. This book will contain an summary of the day's activities and will reference the field notebooks when applicable.

Each field team leader who is supervising a drilling subcontractor activity must complete a Daily Record Subsurface Investigation Report (DRSIR). The DRSIR documents the activities and progress of the daily drilling activities. The information contained within this report is used for billing verification and progress reports. The driller's signature is required at the end of each working day to verify work accomplished, hours worked, standby time. and material used. An example of this form is provided in Appendix D.

At the completion of field activities, the Field Operations Leader shall submit to the Project Manager all field records, data, field notebooks, logbooks, chain-of-custody receipts, sample log sheets, drilling logs, daily logs, etc.

4.14 SITE MANAGEMENT AND BASE SUPPORT

B&R Environmental will perform this project with support from the Navy. This section of the Work Plan describes the project contacts, support personnel, project milestones and time frames of all major events.

Throughout the duration of the investigation activities, work at the NAS will be coordinated through SouthDiv and NAS personnel. The primary contacts are as follows:

1. SouthDiv Engineer in Charge
   Mr. Nick Ugolini
   (803) 820-5596

2. NAS Officer in Charge
   Mr. Jim Holland
   (850) 623-7181 ext 49

4.14.1 Support From NAS

The following support functions will be provided by NAS personnel

- Assist B&R Environmental in locating underground utilities prior to the commencement of drilling operations.

- Provide existing engineering plans, drawings, diagram, files, etc., to facilitate evaluation of the Sites under investigation.

- Provide all historical data, background geological and hydrogeological information, and initial site investigation documents.

4.14.2 Assistance From NAS

NAS personnel will aid in arranging the following:

- Personnel identification badges, vehicle passes, and/or entry permits.

- A secure staging area (approximately 1,000 square feet) for storing equipment and supplies.

- A supply (e.g., fire hydrant, stand pipe, ect.) of large quantities of potable water for equipment cleaning etc.

- As required, provide escorts for contract personnel working in secured areas (all contract personnel working at the Naval Base will be U.S. citizens).

- Establish a decontamination area and waste staging area located adjacent or near the study area.

4.14.3 Support From B&R Environmental

The project will be staffed with personnel from the B&R Environmental Tallahassee, Florida office. During field activities, B&R Environmental will provide a senior level geologist and/or staff geologist, and equipment technician.

Mr. Paul Calligan, P.G., is the Task Order Manager (TOM) for CTO 0037 and will be the primary point of contact. He is responsible for cost and schedule control as well as technical performance. Mr. Calligan is a Florida Licensed Professional Geologist and will serve as the TOM and will provide senior level review and oversight during field activities. Mr. Calligan will be the primary point of contact for the Field Operations Leader.

4.14.4 Contingency Plan

In the event of problems which may be encountered during site activities, the SouthDiv point of contact will be notified immediately, followed by the B&R Environmental TOM and the NAS point of contact. The TOM will determine a course of action so as to not interfere with the schedule or budget. All contingency plans will be approved through the SouthDiv point of contact before being enacted.

5.0 PROPOSED LABORATORY ANALYSIS

Soil samples will be collected from borings conducted during the soil hydrocarbon vapor assessment (Phase I field investigation) and groundwater samples will be collected from newly installed monitoring wells (Phase 2 field investigation). The groundwater and soil samples will be collected for laboratory analyses and analyzed in accordance with parameters as identified in Chapter 62-770.600, FAC (see Sections 5.1 and Section 5.2 below for specific sampling requirements regarding soil and groundwater).

5.1 SOIL INVESTIGATION

Three soil samples will be collected and analyzed for constituents in the Kerosene Analytical Group as defined by Chapter 62-770.600, FAC. Parameters within these groups are identified on Table 4-1. The soil samples will be collected from the three borings which exhibited the highest headspace readings during the soil hydrocarbon vapor assessment.

5.2 GROUNDWATER INVESTIGATION

Groundwater samples will be collected from each newly installed permanent monitoring wells and analyzed for parameters in the Kerosene Analytical Group in accordance with Chapter 62-770.600, FAC. Groundwater samples will also be collected from three select monitoring wells for field screening for dissolved oxygen and ferrous iron. Laboratory analysis for nitrate, sulfate, and methane will also be performed on the samples. The field screening data and parameters analyzed from select well samples will be used to provide data to evaluate the potential for natural attenuation of petroleum constituents to occur at the site through intrinsic bioremediation. A groundwater environmental sampling summary and a summary of Investigative Derived Waste sample parameters are summarized in included in Table 4-1.

6.0 PROPOSED SCHEDULE

Phase 1 of the field work is proposed to begin in early November, 1997 and take approximately 10 days to complete. Phase 2 work is anticipated to begin in early to mid December, 1997 and take approximately 24 days to complete. Phase 2 of the field work will begin immediately upon approval of the permanent monitoring well locations by the FDEP and the Navy, following review of Phase I soil hydrocarbon vapor assessment data. The SAR will be completed and submitted to the Navy for review approximately 40 days after receipt of the laboratory analysis from the Phase 2 sampling activities.

If necessary, a post SA meeting will be held and a Responsibility Assignment Matrix (RAM) developed to establish responsibilities for implementation of remedial action. Several remedial action options will be discussed with the Remedial Action Contractor (RAC) during the meeting and the most appropriate method for site remediation will be selected. Based on the selected remedial action, specific responsibilities for implementation of the remedial action will be delegated between B&R Environmental and the RAC. The Remedial Action Plan developed for the site will be based on the remedial action options discussed during the RAM meeting.

7.0 REFERENCES

ABB Environmental Services, Inc., April 1997. Remedial Investigation and Feasibility Study General Information Report, Naval Air Station Whiting Field, Milton, Florida.

ABB Environmental Services, Inc., October 1996. Remedial Investigation Industrial Area Groundwater Investigation interim Report, Naval Air Station Whiting Field, Milton, Florida.

Brown & Root Environmental, 1995 Revision. Comprehensive Quality Assurance Plan, FDEP COMP QA PLAN # 870055.

Chapter 62-770 of the Florida Administrative Code. July/August 1997.

Kasenow, M. and P.Pare, 1995. Using Specific Capacity to Estimate Transmissivity: Field and Computer Methods, Water Resource Publications, pp. 3-11.

Jim Stidham & Associates, Inc. April 1996. Product Closure Assessment Report, United States Naval Air Station Whiting Field, Milton Florida.

W. Grady Swann, Inc, Project No. WGS95-0094, Contamination Assessment Report Site 29931, N.A.S. Whiting Field, Milton, Florida

APPENDICES

APPENDIX A

DISCHARGE NOTIFICATION FORM (OIL/WATER SEPARATOR)

Florida Department of Environmental Regulation
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

DER Form # 17-761.900(1)
Form Title Discharge Reporting Form
Effective Date December 10, 1990
DER Application No. _____ (Filled in by DER)

Discharge Reporting Form

Use this form to notify the Department of Environmental Regulation of.

1. Results of tank tightness testing that exceed allowable tolerances within ten days of receipt of test result.
2. Petroleum discharges exceeding 25 gallons on pervious surfaces as described in Section 17-761.460 F.A.C. within one working day of discovery.
3. Hazardous substance (CERCLA regulated), discharges exceeding applicable reportable quantities established in 17-761.460(2) F.A.C., within one working day of the discovery.
4. Within one working day of discovery of suspected releases confirmed by: (a) released regulated substances or pollutants discovered in the surrounding area, (b) unusual and unexplained storage system operating conditions, (c) monitoring results from a leak detection method or from a tank closure assessment that indicate a release may have occurred, or (d) manual tank gauging results for tanks of 550 gallons or less, exceeding ten gallons per weekly test or five gallons averaged over four consecutive weekly tests.

Mail to the DER District Office in your area listed on the reverse side of this form

PLEASE PRINT OR TYPE
Complete all applicable blanks

1. DER Facility ID Number: 578516386 2. Tank Number: 2993A 3. Date: 9-21-94
4. Facility Name: NAS WHITING FIELD
   Facility Owner or Operator: PUBLIC WORKS OFFICER
   Facility Address: 7151 USS WASP STREET MILTON, FL 32570-685
   Telephone Number: (904) 623-7268 County .... SANTA ROSA
   Mailing Address: SAME
5. Date of receipt of test results or discovery: 9-21-94 month/day/year
6. Method of initial discovery. (circle one only)
   A. Liquid detector (automatic or manual)
   B. Vapor detector (automatic or manual)
   C. Tightness test (underground tanks only).
   D. Emptying and Inspection.
   E. Inventory control.
   F. Vapor or visible signs of a discharge in the vicinity.
   G. Closure: _____ (explain)
   (H.) Other: PRODUCT IN MONITOR WELL
7. Estimated number of gallons discharged: UNKNOWN (PRODUCT WAS REMOVED FROM WELL & TANK TAKEN OUT OF SERVICE)
8. What part of storage system has leaked? (circle all that apply) A Dispenser B. Pipe C. Fitting D. Tank (E.) Unknown
9. Type of regulated substance discharged. (circle one)
   A. leaded gasoline
   B. unleaded gasoline
   C. gasohol
   D. vehicular diesel
   F. aviation gas
   (G.) jet fuel
   L. used/waste oil
   M. diesel
   O. new/lube oil
   V. hazardous substance includes pesticides, ammonia, chlorine and derivatives (write in name or Chemical Abstract Service CAS number) _____
   Z. other (write in name) _____
10. Cause of leak. (circle all that apply)
    (A.) Unknown
    B. Split
    C. Loose connection
    D. Corrosion
    E. Puncture
    F. Installation failure
    G. Spill _____
    H. Overfill
    I. Other (specify) _____
11. Type of financial responsibility. (circle one)
    A. Third party insurance provided by the state insurance contractor
    B. Self-insurance pursuant to Chapter 17-769.500 F.A.C.
    (C.) Not applicable
    D. None

To the best of my knowledge and belief all information submitted on this form is true, accurate, and complete.

CDR Brian K Harris, PWO
Printed Name of Owner, Operator or Authorized Representative

Signature of Owner, Operator or Authorized Representative

APPENDIX B

SITE 2993A CONTAMINATION ASSESSMENT REPORT DATA

- **Soil Vapor Headspace Concentration Maps**
- **Groundwater Quality Concentration Maps**
- **Groundwater Elevation Contour Maps**
- **Table of Survey and Monitoring Data**
- **Table of Soil Vapor Profile**
- **Discharge Notification Form, Initial Remedial Action Form, and Closure Assessment Form for Oil/Water Separator Closure**

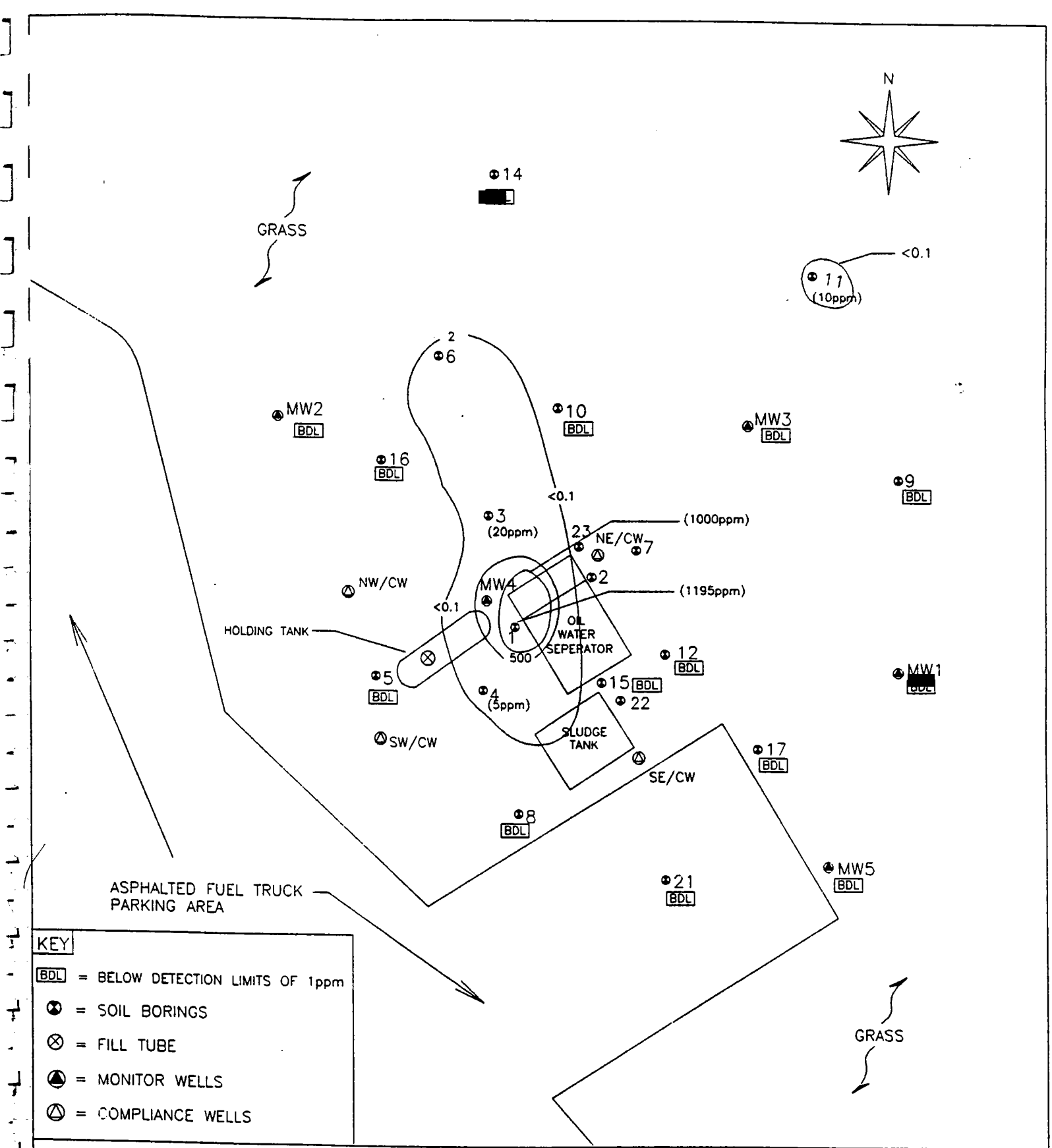


FIGURE 3
SOIL VAPOR HEADSPACE CONCENTRATION CONTOUR MAP
(ABOVE WATER TABLE, 1 FT-BLS)
SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094	DATE: 5/16/95
FILE NAME: WHITING7	CONTOUR INTERVAL: VARIES SCALE: 1" = 10'

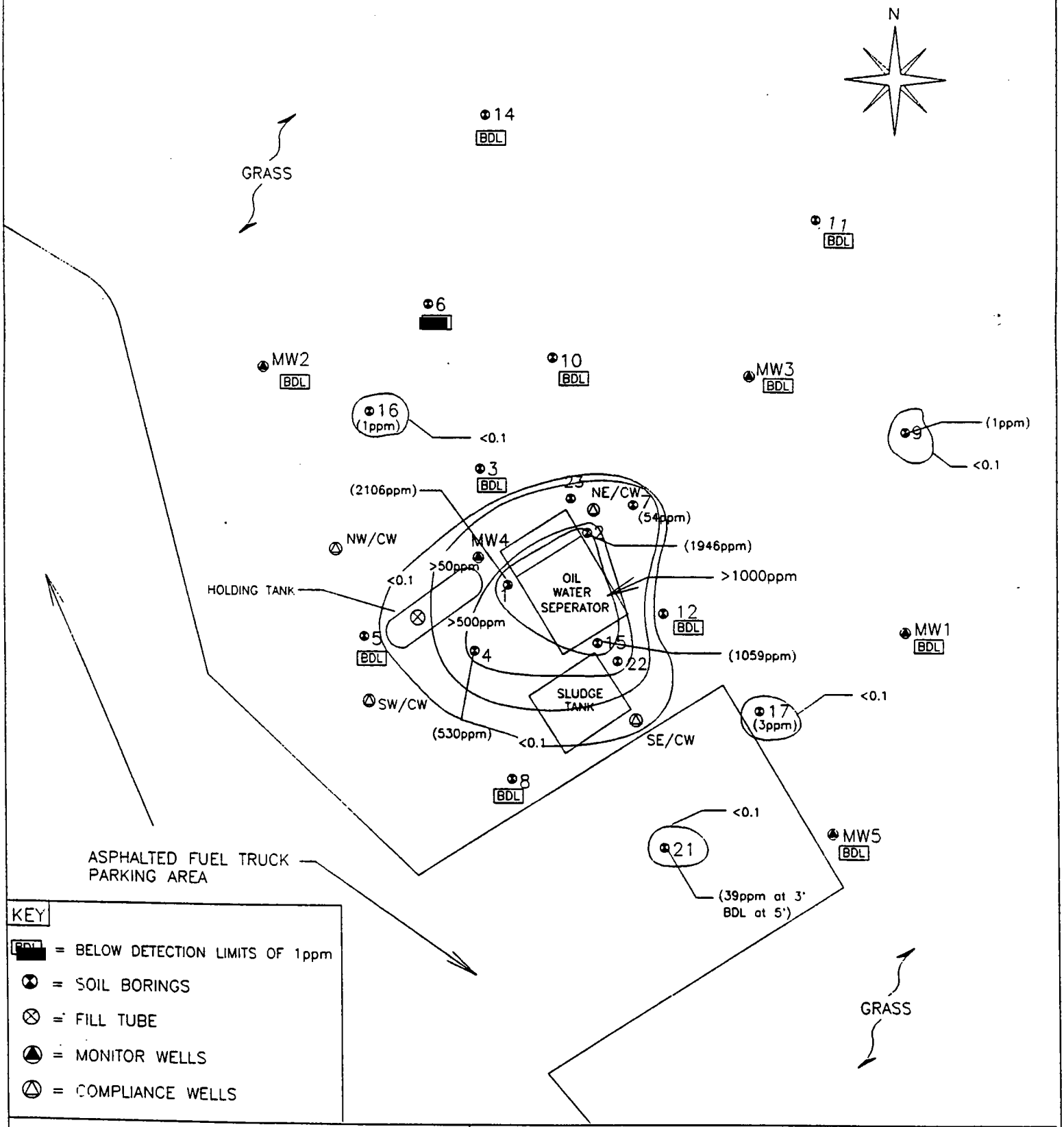
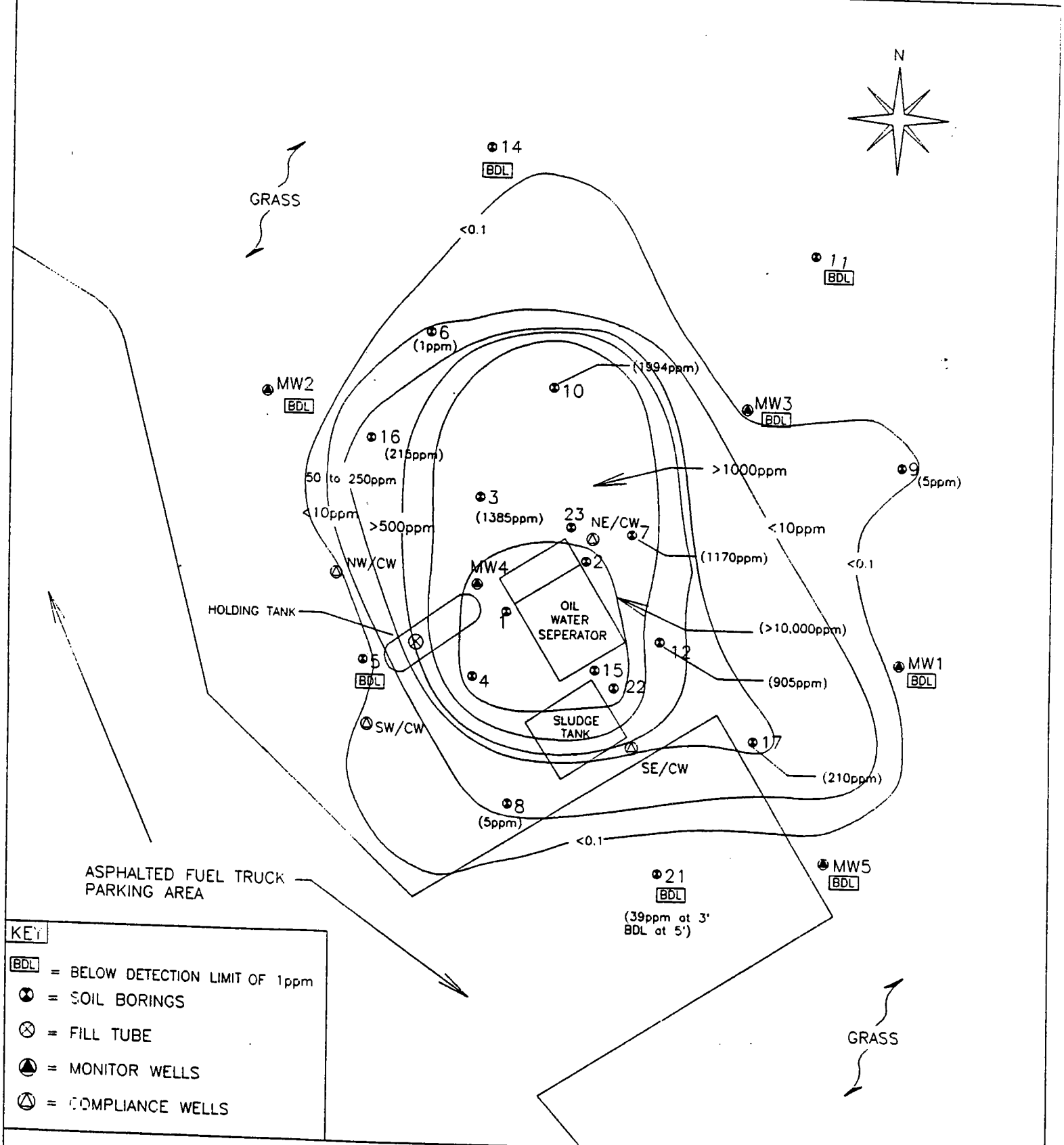


FIGURE 4
SOIL VAPOR HEADSPACE CONCENTRATION CONTOUR MAP
(AT WATER TABLE, 3 FT-BLS)
SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094	DATE: 5/16/95
FILE NAME: WHITING3	CONTOUR INTERVAL: VARIES SCALE: 1" = 10'



KEY

BDL = BELOW DETECTION LIMIT OF 1ppm

⊗ = SOIL BORINGS

⊗ = FILL TUBE

▲ = MONITOR WELLS

△ = COMPLIANCE WELLS

FIGURE 5
SOIL VAPOR HEADSPACE CONCENTRATION CONTOUR MAP
(AT WATER TABLE, 5 FT-BLS)
SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094	DATE: 5/16/95
FILE NAME: WHITING2	CONTOUR INTERVAL: VARIES SCALE: 1" = 10'

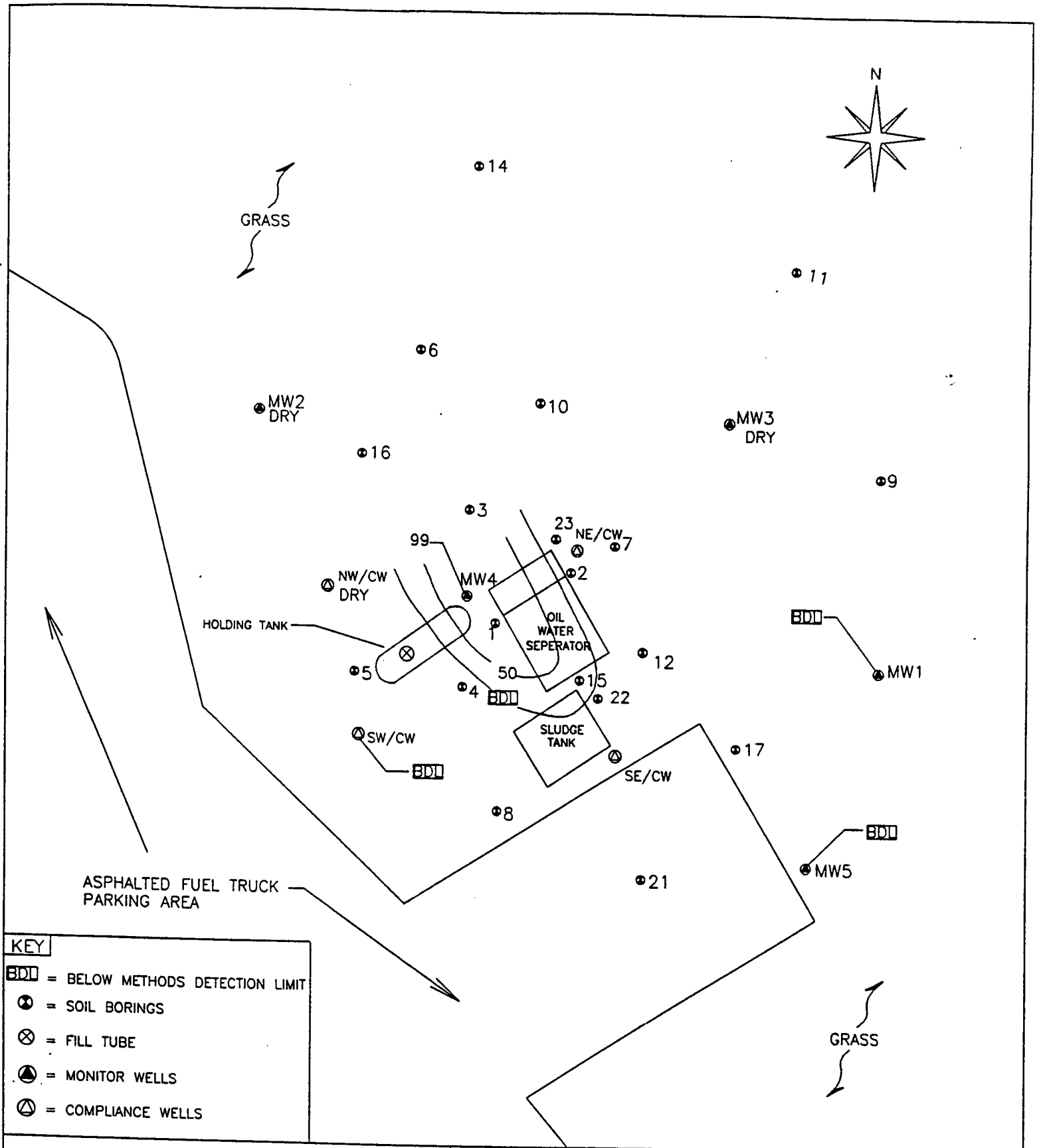


FIGURE 7
BTEX CONCENTRATIONS IN GROUNDWATER IN PARTS PER BILLION
SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094	DATE: 6/02/95
FILE NAME: WHITING9	CONTOUR INTERVAL: 50ppb SCALE: 1" = 10'

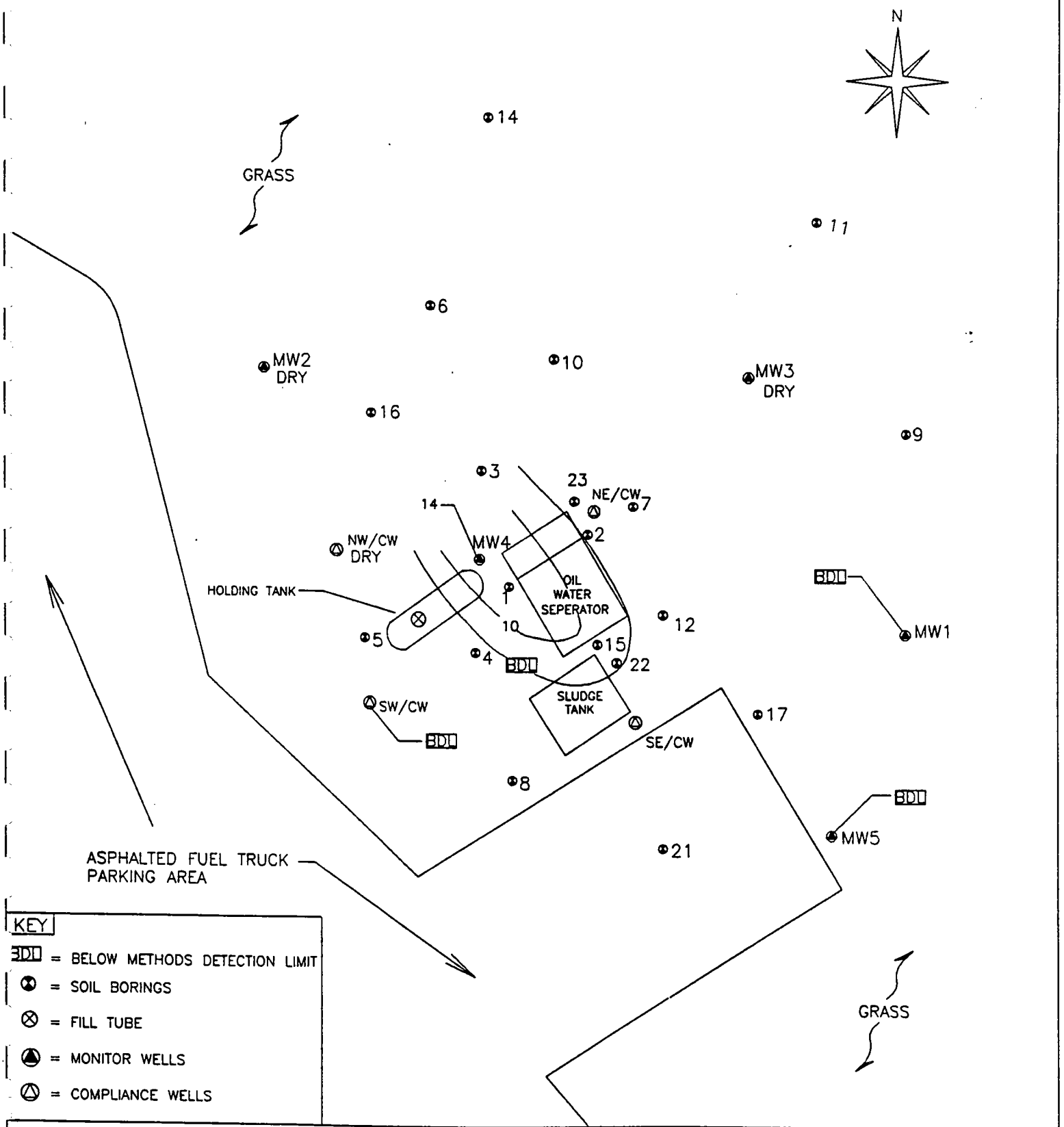


FIGURE 8
BENZENE CONCENTRATIONS IN GROUNDWATER IN PARTS PER BILLION
SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094	DATE: 6/02/95
FILE NAME: WHITING B	CONTOUR INTERVAL: 10ppb SCALE: 1" = 10'

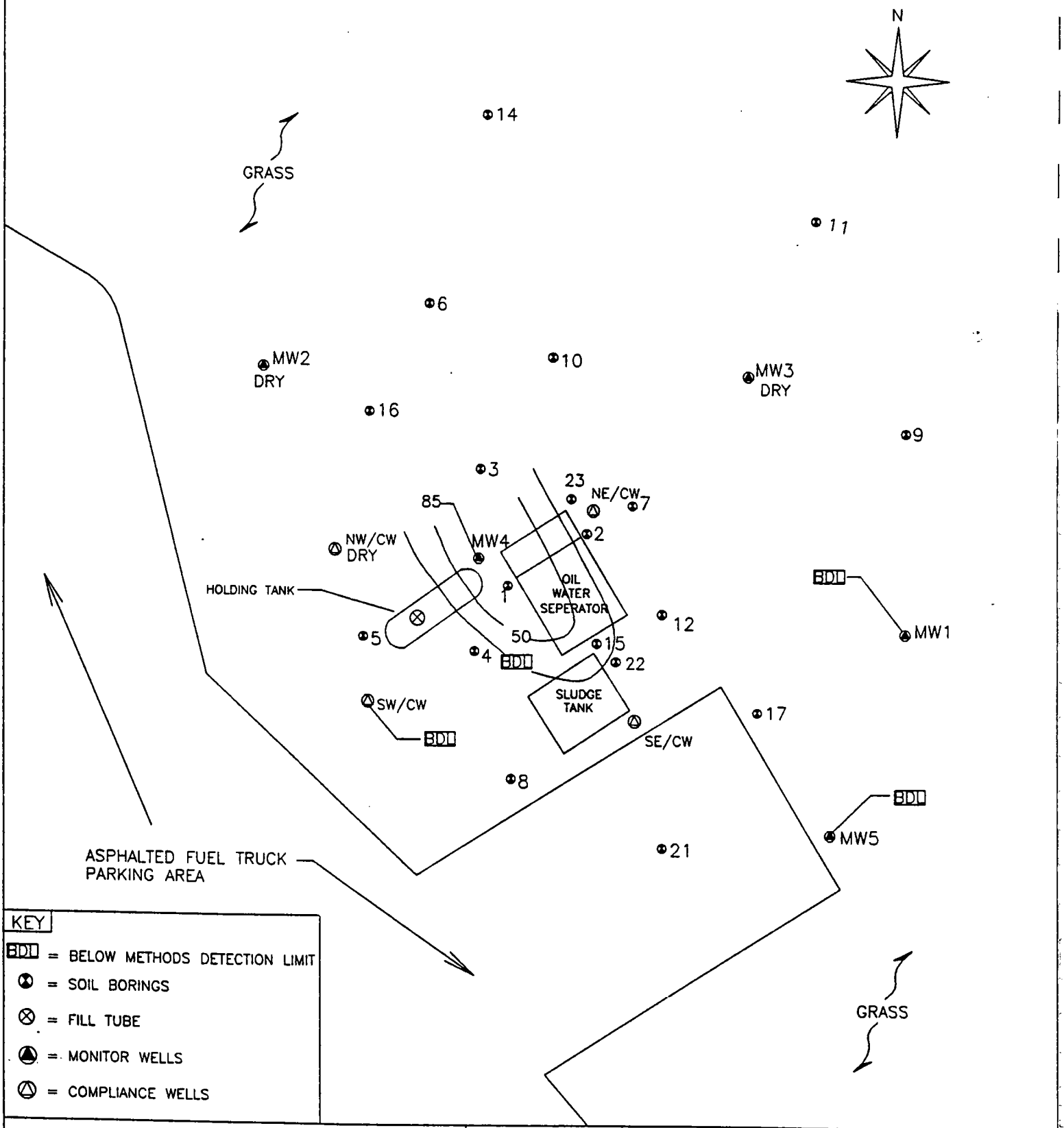


FIGURE 9

XYLENES CONCENTRATIONS IN GROUNDWATER IN PARTS PER BILLION
SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094	DATE: 6/02/95
FILE NAME: WHITING X	CONTOUR INTERVAL: 50ppb SCALE: 1" = 10'

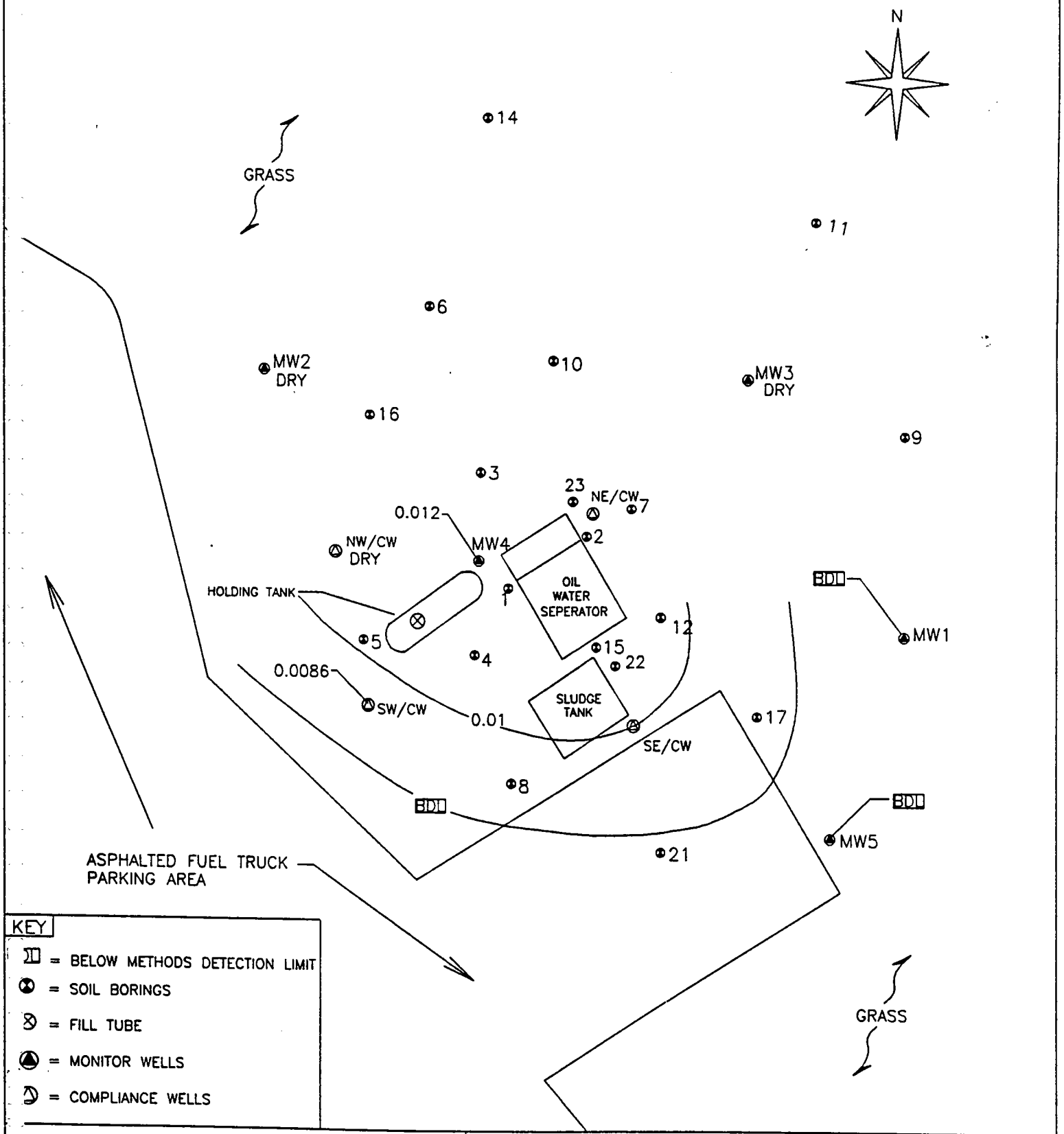


FIGURE 10
LEAD CONCENTRATIONS IN GROUNDWATER IN PARTS PER MILLION
SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094	DATE: 6/02/95
FILE NAME: WHITINGL	CONTOUR INTERVAL: SCALE: 1" = 10'

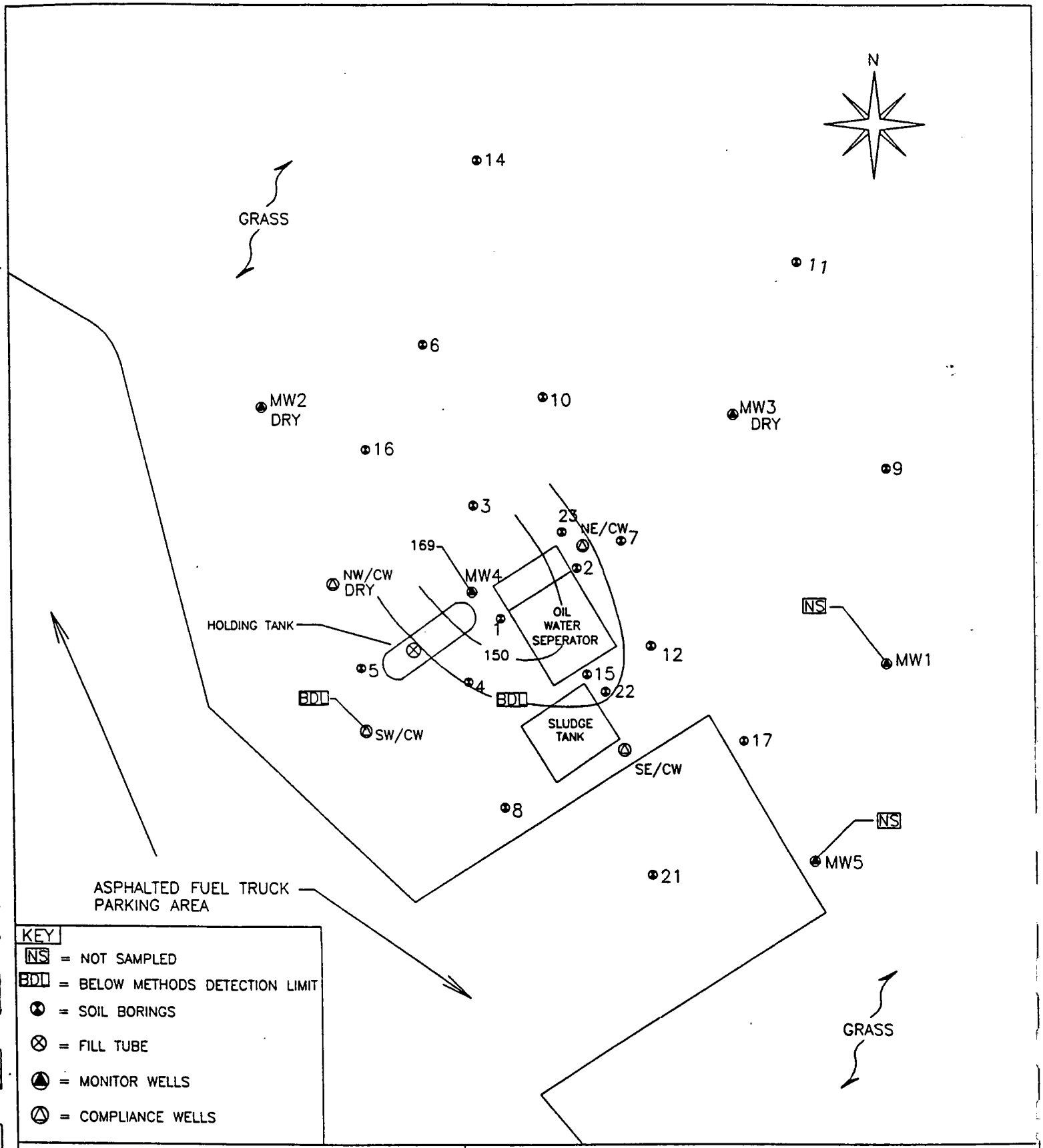


FIGURE 11

TOTAL NAPHTHALENES CONCENTRATIONS IN GROUNDWATER IN PARTS PER BILLION

SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094	DATE: 6/02/95
FILE NAME: WHITING N	CONTOUR INTERVAL: 150ppb SCALE: 1" = 10'

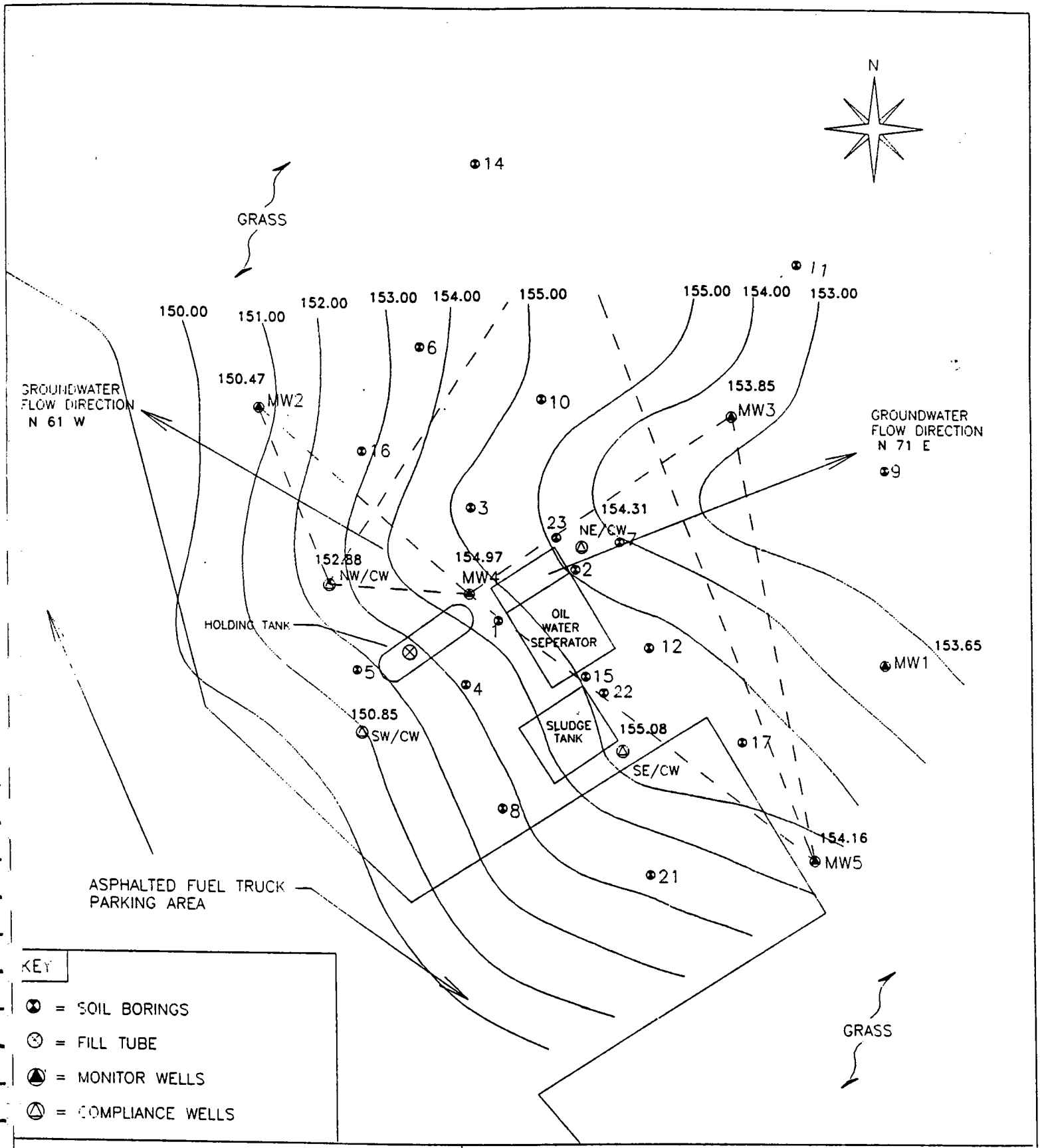


FIGURE 6
GROUNDWATER CONTOUR MAP
SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094

DATE: 05/23/95

FILE NAME: WHITING8

CONTOUR INTERVAL: 1.0'

SCALE: 1" = 10'

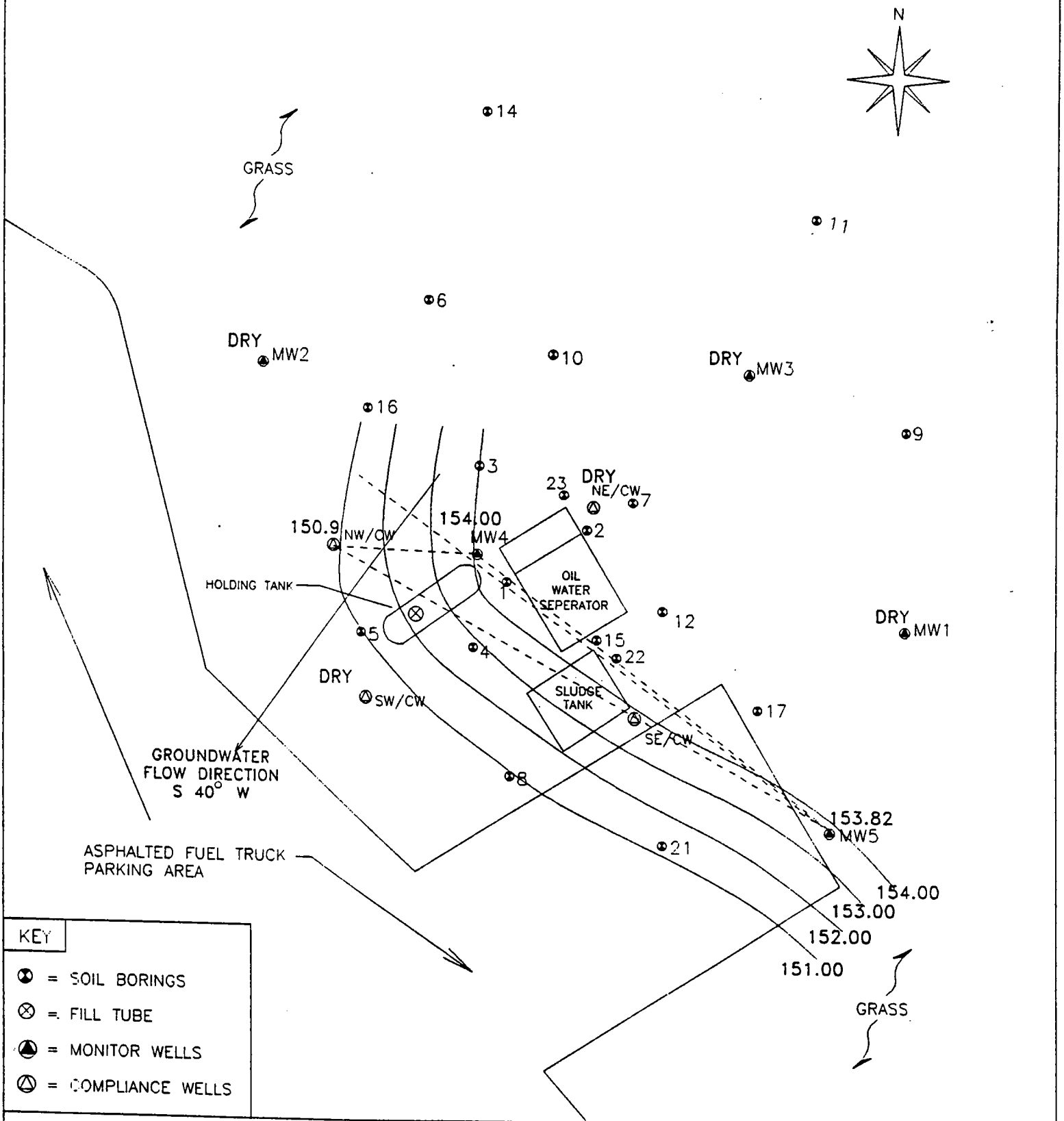


FIGURE 15
GROUNDWATER CONTOUR MAP
SITE 2993A
NAS WHITING FIELD
MILTON, FLORIDA

W. GRADY SWANN, INC.
3814 W. JACKSON STREET
PENSACOLA, FLORIDA 32505
(904) 432-5766

PROJECT NO: WGS95-0094	DATE: 06/20/95
CONTOUR INTERVAL: 1.0'	SCALE: 1" = 10'

TABLE 2
SURVEYING AND MONITORING DATA
N.A.S. WHITING FIELD
SITE 2993A
MILTON, FLORIDA

PROJECT NUMBER: WGS 95-0094

WELL NUMBER	CASING ELEVATION (FT)	DEPTH TO FLUID (FT)	RELATIVE GW ELEVATION (FT)
	MAY 23, 1995		
MW-1	158.10	4.45	153.65
MW-2	160.00	9.53	150.47
MW-3	157.80	3.95	153.85
MW-4	159.50	4.53	154.97
MW-5	158.75	4.59	154.16
NE/CW	158.94	4.63	154.31
SE/CW	159.27	4.22	155.05
NW/CW	159.94	7.06	152.88
SW/CW	159.83	8.98	150.85
	JUNE 20, 1995		
MW-1	158.10	DRY	-
MW-2	160.00	DRY	-
MW-3	157.80	DRY	-
MW-4	159.50	5.50	154.00
MW-5	158.75	4.93	153.82
NE/CW	158.94	DRY	-
SE/CW	159.27	8.50	150.77
NW/CW	159.94	9.03	150.91
SW/CW	159.83	DRY	-

LEGEND:
MW = MONITOR WELL
ELEVATION REFERENCE - 160.00 (ARBITRARY)
GW = GROUNDWATER

TBL3CAR.SAM

TABLE 4

W. GRADY SWANN, INC. 3814 W. Jackson Street Pensacola, Florida 32505 (904) 432-5766	PROJECT NAS WHITING FIELD SOIL VAPOR PROFILE NAS WHITING FIELD MILTON, FLORIDA	DATE: 5/15/95 PROJECT # WGS 95-0094 INSTRUMENT USED: Foxboro Century 108GC Calibrated to 100ppm & 9000ppm Methane in Air Mixtures(Unless otherwise noted)

TABLE 4

RESULTS OF SOIL VAPOR HEADSPACE CONCENTRATIONS

BLS = Below land surface • PPMt = Total Vapor Concentration • PPMf = Filtered Vapor Concentration • PPMc = Corrected Vapor Concentration

LOCATION	DEPTH (FT. BLS)	PPMt	PPMf	PPMc
SB1 WO	1	1,490	295	1,195
WO/WT	3	3,000	894	2,106
WO/WT	3.5 (Top of tank)	>10000	>10000	>10000
SB2	1	<0.1	<0.1	<0.1
WO/WT	3	2,490	544	1,946
WO	5	>10000	>10000	>10000
SB3	1	20	<0.1	20
WT	3	<0.1	<0.1	<0.1
WO	5	1,400	15	1,385
SB4	1	5	<0.1	5
WO/WT	3	580	50	530
WO	5	>10000	>10000	>10000
SB5	1	<0.1	<0.1	<0.1
WT	3	<0.1	<0.1	<0.1
	5	<0.1	<0.1	<0.1
SB6	1	2	<0.1	2
WT	3	<0.1	<0.1	<0.1
	5	1	<0.1	1
SB7	2	<0.1	<0.1	<0.1
WT	3	55	1	54
WO	5	1,190	20	1,170
SB8	1	<0.1	<0.1	<0.1
WT	3	<0.1	<0.1	<0.1
	5	15	10	5
SB9	1	<0.1	<0.1	<0.1
WT	3	1	<0.1	1
	5	5	<0.1	5

WO = WEATHERED PETROLEUM ODOR, NO = NO ODOR, WT = WATER TABLE, SB = SOIL BORING, MW=MONITOR WELL

TABLE 4

W. GRADY SWANN, INC. 3814 W. Jackson Street Pensacola, Florida 32505 (904) 432-5766	PROJECT NAS WHITING FIELD SOIL VAPOR PROFILE NAS WHITING FIELD MILTON, FLORIDA	DATE: 5/15/95 PROJECT # WGS 95-0094 INSTRUMENT USED: Foxboro Century 108GC Calibrated to 100ppm & 9000ppm Methane in Air Mixtures(Unless otherwise noted)

TABLE 4 cont'd

RESULTS OF SOIL VAPOR HEADSPACE CONCENTRATIONS

BLS = Below land surface • PPMt = Total Vapor Concentration • PPMf = Filtered Vapor Concentration • PPMc = Corrected Vapor Concentration

LOCATION	DEPTH (FT. BLS)	PPMt	PPMf	PPMc
SB10	1	<0.1	<0.1	<0.1
WT	3	<0.1	<0.1	<0.1
WO	5	1,994	<0.1	1,994
SB11	1	10	<0.1	10
WT	3	<0.1	<0.1	<0.1
	5	<0.1	<0.1	<0.1
SB12	1	<0.1	<0.1	<0.1
WT	3	<0.1	<0.1	<0.1
WO	5	1,195	290	905
SB13/MW1	1	<0.1	<0.1	<0.1
WT	3	<0.1	<0.1	<0.1
	5	<0.1	<0.1	<0.1
SB14	1	<0.1	<0.1	<0.1
WT	3	<0.1	<0.1	<0.1
	5	<0.1	<0.1	<0.1
SB15	1	<0.1	<0.1	<0.1
WO/WT	3	1,499	440	1,059
WO	5	>10000	>10000	>10000
SB16	1	<0.1	<0.1	<0.1
WT	3	1	<0.1	1
WO	5	220	5	215
SB17	1	<0.1	<0.1	<0.1
WT	3	3	<0.1	3
WO	5	210	10	200
SB18/MW2	1	<0.1	<0.1	<0.1
WT	3	<0.1	<0.1	<0.1
	5	<0.1	<0.1	<0.1

WO = WEATHERED PETROLEUM ODOR, NO = NO ODOR, WT = WATER TABLE, SB = SOIL BORING, MW=MONITOR WELL

TABLE 4

W. GRADY SWANN, INC. 3814 W. Jackson Street Pensacola, Florida 32505 (904) 432-5766	PROJECT NAS WHITING FIELD SOIL VAPOR PROFILE NAS WHITING FIELD MILTON, FLORIDA	DATE: 5/15/95 PROJECT # WGS 95-0094 INSTRUMENT USED: Foxboro Century 108GC Calibrated to 100ppm & 9000ppm Methane in Air Mixtures(Unless otherwise noted)

TABLE 4 cont'd

RESULTS OF SOIL VAPOR HEADSPACE CONCENTRATIONS

BLS = Below land surface • PPMt = Total Vapor Concentration • PPMf = Filtered Vapor Concentration • PPMc = Corrected Vapor Concentration

LOCATION	*DEPTH (FT. BLS)*	*PPMt*	*PPMf*	*PPMc*
SB19/MW3	1	<0.1	<0.1	<0.1
WT	3	<0.1	<0.1	<0.1
	5	<0.1	<0.1	<0.1
SB20/MW5	1	<0.1	<0.1	<0.1
WT	3	<0.1	<0.1	<0.1
	5	<0.1	<0.1	<0.1
SB21	1	<0.1	<0.1	<0.1
WT	3	39	<0.1	39
	5	<0.1	<0.1	<0.1
Results of Soil Vapor Headspace Analysis Collected from Split Spoon Samples during deep drill sampling at SB22 and SB23 locations				
SB22 (WO)	9-11	200	13	187
WO	14-16	130	43	87
Faint odor	19-21	90	15	75
	24-26	7	<0.1	7
	29-31	3.5	<0.1	3.5
SB23	10	340	140	200
	15	100	20	80
	20	12	10	2
	25	340	8	332
	30	140	<0.1	140
	35	70	<0.1	70
	40	10	<0.1	10
	45	2	<0.1	2
Results of Borehole Vapor Background Scan using Trace-techtor Catalytic Combustible Gas Indicator				
SB1	3.5	580		
SB2	5	140		
SB3	5	300		
SB4	5	180		
SB5	5	4		

TABLE 4

W. GRADY SWANN, INC. 3814 W. Jackson Street Pensacola, Florida 32505 (904) 432-5766	PROJECT NAS WHITING FIELD SOIL VAPOR PROFILE NAS WHITING FIELD MILTON, FLORIDA	DATE: 5/15/95 PROJECT # WGS 95-0094 INSTRUMENT USED: Foxboro Century 108GC Calibrated to 100ppm & 9000ppm Methane in Air Mixtures(Unless otherwise noted)

TABLE 4 cont'd

Results of Borehole Background Scan (Cont.)		
Sample Location	Depth (FT-BLS)	Vapor Concentration in ppm
SB6	5	8
SB7	5	140
SB8	5	12
SB9	5	6
SB10	5	240
SB11	5	6
SB12	5	260
SB13	5	10
SB14	5	8
SB15	5	1,600
SB16	5	60
SB17	5	40
SB18	5	8
SB19	5	8
SB20	5	8
SB21	5	7

Florida Department of Environmental Regulation
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

DER Form # 17-761.900(1)
Form Title Discharge Reporting Form
Effective Date December 10, 1990
DER Application No. _____ (Filled in by DER)

Discharge Reporting Form

Use this form to notify the Department of Environmental Regulation of.

1. Results of tank tightness testing that exceed allowable tolerances within ten days of receipt of test result.
2. Petroleum discharges exceeding 25 gallons on pervious surfaces as described in Section 17-761.460 F.A.C. within one working day of discovery
3. Hazardous substance (CERCLA regulated), discharges exceeding applicable reportable quantities established in 17-761.460(2) F.A.C., within one working day of the discovery.
4. Within one working day of discovery of suspected releases confirmed by: (a) released regulated substances or pollutants discovered in the surrounding area, (b) unusual and unexplained storage system operating conditions, (c) monitoring results from a leak detection method or from a tank closure assessment that indicate a release may have occurred, or (d) manual tank gauging results for tanks of 550 gallons or less, exceeding ten gallons per weekly test or five gallons averaged over four consecutive weekly tests.

Mail to the DER District Office in your area listed on the reverse side of this form

PLEASE PRINT OR TYPE
Complete all applicable blanks

1. DER Facility ID Number: 578516386 2. Tank Number: 2993A 3. Date: 9-21-94
4. Facility Name: NAS WHITING FIELD
   Facility Owner or Operator: PUBLIC WORKS OFFICER
   Facility Address: 7151 USS WASP STREET MILTON, FL 32570-68
   Telephone Number: (904) 623-7268 County .... SANTA ROSA
   Mailing Address: SAME
5. Date of receipt of test results or discovery: 9-21-94 month/day/yr
6. Method of initial discovery. (circle one only)
   A. Liquid detector (automatic or manual) D. Emptying and Inspection. F. Vapor or visible signs of a discharge in the vicinity.
   B. Vapor detector (automatic or manual) E. Inventory control. G. Closure: _____ (explain)
   C. Tightness test (underground tanks only). (H.) Other: PRODUCT IN MONITOR WELL
7. Estimated number of gallons discharged: UNKNOWN (PRODUCT WAS REMOVED FRO & TANK TAKEN OUT OF SERVICE)
8. What part of storage system has leaked? (circle all that apply) A Dispenser B. Pipe C. Fitting D. Tank (E.) Unknown
9. Type of regulated substance discharged. (circle one)
   A. leaded gasoline D. vehicular diesel L. used/waste oil V. hazardous substance includes pesticides, ammonia, chlorine and derivatives (write in name or Chemical Abstract Service CAS number) _____
   B. unleaded gasoline F. aviation gas M. diesel
   C. gasohol (G.) jet fuel O. new/lube oil Z. other (write in name) _____
10. Cause of leak. (circle all that apply)
    (A.) Unknown C. Loose connection E. Puncture G. Spill _____ I. Other (specify) _____
    B. Split D. Corrosion F. Installation failure H. Overfill
11. Type of financial responsibility. (circle one)
    A. Third party insurance provided by the state insurance contractor (C.) Not applicable
    B. Self-insurance pursuant to Chapter 17-769.500 F.A.C. D. None

To the best of my knowledge and belief all information submitted on this form is true, accurate, and complete.

CDR Brian K Harris, PWO
Printed Name of Owner, Operator or Authorized Representative

Signature of Owner, Operator or Authorized Representative

2993 Closure Assessment

Florida Department of Environmental Regulation

Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

DER Form # 17-761.900(1)
Form Title Discharge Reporting Form
Effective Date December 10, 1990
DER Application No. _____ (Filled in by DER)

Discharge Reporting Form

se this form to notify the Department of Environmental Regulation of:

1. Results of tank tightness testing that exceed allowable tolerances within ten days of receipt of test result.
2. Petroleum discharges exceeding 25 gallons on pervious surfaces as described in Section 17-761.460 F.A.C. within one working day of discovery.
3. Hazardous substance (CERCLA regulated), discharges exceeding applicable reportable quantities established in 17-761.460(2) F.A.C., within one working day of the discovery.
4. Within one working day of discovery of suspected releases confirmed by: (a) released regulated substances or pollutants discovered in the surrounding area, (b) unusual and unexplained storage system operating conditions, (c) monitoring results from a leak detection method or from a tank closure assessment that indicate a release may have occurred, or (d) manual tank gauging results for tanks of 550 gallons or less, exceeding ten gallons per weekly test or five gallons averaged over four consecutive weekly tests.

Mail to the DER District Office in your area listed on the reverse side of this form

PLEASE PRINT OR TYPE
Complete all applicable blanks

1. DER Facility ID Number: _____ 2. Tank Number: _____ 3. Date: 01/31/97
4. Facility Name: BLDG 2993

   Facility Owner or Operator: BULK FUELING

   Facility Address: WASP RD

   Telephone Number: (904) 623-7246 County: SANTA ROSA

   Mailing Address: PWCCC 7183 Langley ST, NAS Whiting Field, MILTON FL. 32570
5. Date of receipt of test results or discovery: 01/17/97 (Previously 09/95 by G. Swan) month/day/year
6. Method of initial discovery. (circle one only)
   A. Liquid detector (automatic or manual)
   B. Vapor detector (automatic or manual)
   C. Tightness test (underground tanks only).
   D. Emptying and Inspection.
   E. Inventory control.
   F. Vapor or visible signs of a discharge in the vicinity
   (G.) Closure: _____ (explain)
   H. Other: Contamination Assessment Report by G. Swan 09/1995
7. Estimated number of gallons discharged: UNKNOWN
8. What part of storage system has leaked? (circle all that apply) A. Dispenser B. Pipe C. Fitting D. Tank (E) Unknown
9. Type of regulated substance discharged. (circle one)
   A. leaded gasoline
   B. unleaded gasoline
   C. gasohol
   D. vehicular diesel
   F. aviation gas
   (G) jet fuel
   L. used/waste oil
   M. diesel
   O. new/lube oil
   V. hazardous substance includes pesticides, ammonia, chlorine and derivatives (write in name or Chemical Abstract Service CAS number) _____
   Z. other (write in name) _____
10. Cause of leak. (circle all that apply)
    (A) Unknown
    B. Split
    C. Loose connection
    D. Corrosion
    E. Puncture
    F. Installation failure
    G. Spill _____
    H. Overfill
    I. Other (specify) _____
11. Type of financial responsibility. (circle one)
    A. Third party insurance provided by the state insurance contractor
    B. Self-Insurance pursuant to Chapter 17-769.500 F.A.C.
    (C.) Not applicable
    D. None
12. **To the best of my knowledge and belief all information submitted on this form is true, accurate, and complete.**

LESLIE J NICHOLS
Printed Name of Owner, Operator or Authorized Representative

Signature of Owner, Operator or Authorized Representative

Northwest District
160 Governmental Center
Pensacola, Florida 32501-5794
904 436-8300

Northeast District
7825 Baymeadows Way, Suite B 200
Jacksonville, Florida 32207
904-798-4200

Central District
3319 Maguire Blvd. Suite 232
Orlando, Florida 32803-3767
407-894-7555

Southwest District
4520 Oak Fair Blvd.
Tampa, Florida 33610-7347
813-623-5561

South District
2295 Bay St.
Fort Myers, Florida 33901-2899
813-332-6975

Southeast District
1900 S Congress Ave. Suite A
West Palm Beach, Florida 33406
407 433 2650

PETROLEUM CONTAMINATION
INITIAL REMEDIAL ACTION NOTIFICATION FORM

This notification provides written confirmation of initial remedial action (IRA) as required by Chapter 17-770.300(5) and (8), Florida Administrative Code. Notification must be within three working days of initiation of an IRA. Upon completion of the IRA, an Initial Remedial Action Report should be submitted.

I. Facility Name: BUILDING 2993

Facility Address: WHITING FIELD NAVAL AIR STATION MILTON, FL

DER Facility Number (if applicable): _____

Date of Initiation of IRA: 01/17/1997

II. FREE PRODUCT RECOVERY (Please provide brief responses.) NONE

A. Type of Product Discharged: _____

B. Estimated Quantity Lost: _____ gallons

C. Product Thickness in Wells, Boreholes, Excavations, or Utility Conduits (Attach Site Plan indicating locations and depths): _____

D. Method of Product Recovery: _____

E. Type of Discharge During Product Recovery: _____

F. Type of Treatment and Expected Effluent Quality from Any Discharge: _____

G. Quantity and Disposal of Recovered Product: _____

III. SOIL EXCAVATION

A. Estimated Volume of Contaminated Soil Excavated (Attach Site Plan indicating location of excavation(s) and soil borings): 34.45 cubic yards (in place) (See Closure Report For Sketch)

B. Type of Product in Soil: JP 5

C. Method Used to Determine Excess Soil Contamination: OVA

D. Method of Treatment or Disposal of Contaminated Soil: LANDFILL

IV. REPORTING

This notification should be submitted to the appropriate Local Program, if any, or to:

Florida Department of Environmental Regulation
Bureau of Waste Cleanup
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

[signature]
Person Completing Form

President
Title, Affiliation

[signature] 2-11-97
Signature, Date

PETROLEUM CONTAMINATION
INITIAL REMEDIAL ACTION REPORT FORM

An Initial Remedial Action report, summarizing the initial remedial action (IRA), should be prepared to satisfy the requirements of Chapters 17-770.630(1)14; 17-773.500(1)(a)4; and 17-773.500(2)(a)4, Florida Administrative Code, (FAC). This form may be used for the IRA report. The report should be sent to the appropriate local program and:

Florida Department of Environmental Regulation
Bureau of Waste Cleanup
Engineering Support Section
2600 Blair Stone Road
Tallahassee, FL 32399-2400

I. FACILITY NAME: BUILDING #. 2993

Facility Address: WASP Bd, NAS WHITING FIELD, MILTON FL

DER Facility Number (if applicable): _____

Date IRA Initiated: 12/26/1996 Date IRA Completed: 01/15/1997

II. FREE PRODUCT RECOVERY NONE

A. Type(s) of Product Discharged: _____

B. Quantity

1. Estimated Gallons Lost: _____
2. Gallons Recovered: _____ through _____ (date)
3. Attach Exhibit Indicating Amount of Product Recovered, Dates and Cumulative Totals.

C. Attach a Scaled Site Plan, Indicating the Locations and Product Thickness in Wells, Boreholes, Excavations, or Utility Conduits and Wells Utilized for Recovery of Free Product.

D. Method of Product Recovery: _____

_____

_____

E. Type of Discharge During Product Recovery: _____

_____

F. Type of Treatment, i.e., Oil/Water Separator: N/A

G. Attach Written Proof of Proper Disposal of Recovered Product:

III. SOIL EXCAVATION

NOTE: Soil shall be defined as excessively contaminated using the procedure stated in Chapter 17-770.200(2), FAC. Representative soil sampling shall be performed as close to the time of excavation as possible, but at no time shall exceed three (3) months prior to the start of excavation. Stockpiled soils greater than thirty (30) days on site waiting for treatment and disposal, must be re-sampled immediately prior to disposal to assure soils are still excessively contaminated.

If soil sampling data indicates that the amount of soil that is excessively contaminated exceeds 1500 cubic yards, treatment of all excessively contaminated soil at the site shall be addressed in a remedial action plan, and no soil IRA activities shall be performed except for the removal of soils in the immediate vicinity of the tanks.

Only soil above the ambient water table at the time of excavation can be considered as excessively contaminated soil.

Unless the established weight per unit volume of 1.4 tons/cubic yard (as referenced in FAC Rule 17-775) is used for the excavated soil, the weight per unit volume must be determined by a field test (in which an accurately measured volume of soil is weighed) at the time of excavation.

A. Volume of Contaminated Soil Excavated in Cubic Yards: ~ 34.45. Dimensions Including Depth of Excavation(s): ~ 10 FT by 15.5 FT @ ≈ 6 FT IN DEPTH

NOTE: Attach written proof from the Department in the form of an Alternate Procedure Approval Order authorizing excavating over 1500 cubic yards if applicable. Authorization must be prior to the excavation of soils.

B. Type(s) of Product in Soil: HYDROCARBON (JP 5)

ste Management Inc. - Florida
Industrial Waste Service Center
[illegible] N.W. 48th Street
Pompano Beach, FL 33073

A Waste Management Company

NON- HAZARDOUS MANIFEST

SC № 6653

GENERATOR

Generators NAVAL Air Station - Whiting Field
Address Bldg. 2993 (Bull Furling)
Facility ST MILTON FL. 32570
Phone 904-623-1644 P.O.#
Generators Signature [signature]

TRANSPORTER

Driver Name (Print) Lloyd K Maddox
Truck Number #104
I hereby acknowledge that the above-described materials were received from the generator site were transported without incident to the destination listed below.
Lloyd K Maddox 1-17-97
Driver Signature Delivery Date

Description of Waste Materials	Profile Number	Account #	Total Quantity	Weight
Contaminated Construction Soil	469309	00543	17.40	

DESTINATION

Site Name SPRINGHILL REGIONAL LANDFILL
Address 4345 Hwy 27 S. GRACEVILLE FL
Phone Number (904) 263-7100 @ 19.44

I hereby acknowledge receipt of the above-described materials.
C.M. Moss
Name of Authorized (Print)
C Moss 1/17/97
Signature Receipt Date

WHITE - GENERATOR YELLOW - LANDFILL PINK - LANDFILL GOLD - TRANSPORTER

Fax Copy TO 1-904-623-7515

Waste Management Inc. - Florida
Industrial Waste Service Center
2900 N.W. 48th Street
Pompano Beach, FL 33073

A Waste Management Company

NON- HAZARDOUS MANIFEST

SC № 6654

GENERATOR — TRANSPORTER

Generators NAVAL AIR STATION - WHITING FIELD
Address BLDG 2998 (BULK FUELING)
HANGER ST, MILTON, FL 32570
Phone (904) 623-1644 P.O.#
Generators Signature R E [illegible]

Driver Name (Print) Earnest Chavers
Truck Number 101
I hereby acknowledge that the above-described materials were received from the generator site were transported without incident to the destination listed below.
Driver Signature 1-17-97
Delivery Date

Description of [redacted]	[redacted]	Amount	Quantity	Weight
PETROLEUM CONTAMINATED SOIL	[redacted]		10 TONS	

DISPOSAL

Site Name SPRINGHILL REGIONAL LANDFILL
Address 4445 HWY 279, GRACEVILLE, FL.
Phone Number (904) 263-7100 019644
I hereby acknowledge receipt of the above-described materials.
C Moss
Name of Authorized (Print)
C Moss 1/17/97
Signature
Receipt Date

WHITE - GENERATOR YELLOW - LANDFILL PINK - LANDFILL GOLD - TRANSPORTER

FAX COPY TO 1-904-623-7515

Florida Department of Environmental Regulation
Twin Towers Office Bldg • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

Form Title: Underground Storage Tank Installation & Removal Form for Certified Contractors
Effective Date: December 10 1990
DER Application No. _____ (Filled in by DER)

Underground Storage Tank Installation and Removal Form For Certified Contractors

Pollutant Storage System Specialty Contractors as defined in Section 489.113, Florida Statutes (Certified contractors as defined in Section 17-761.200, Florida Administrative Code) shall use this form to certify that the installation, replacement or removal of the storage tank system(s) located at the address listed below was performed in accordance with Department Reference Standards.

General Facility Information

1. DER Facility Identification No.: _____
2. Facility Name: 2993 BULK FUELING Telephone: (____) _____
3. Street Address (physical location): WASP STREET
4. Owner Name: UNITED STATE NAVY R.O.I.C.C Telephone: (____) _____
5. Owner Address: BLDG 1416 7183 LANGLEY ST NAS WHITING FIELD MILTON FL 32570
6. Number of Tanks: a. Installed at this time _____ b. Removed at this time 2
7. Tank(s) Manufactured by: UNKNOWN
8. Date Work Initiated: DECEMBER 10, 1996 9. Date Work Completed: DECEMBER 11, 1996

Underground Pollutant Tank Installation Checklist

Please certify the completion of the following installation requirements by placing an (X) in the appropriate box.

1. The tanks and piping are corrosion resistant and approved for use by State and Federal Laws. ☐
2. Excavation, backfill and compaction completed in accordance with NFPA (National Fire Protection Association) 30(87), API (American Petroleum Institute) 1615, PEI (Petroleum Equipment Institute) RP100-87 and the manufacturers' specifications. ☐
3. Tanks and piping pretested and installed in accordance with NFPA 30(87), API 1615, PEI/RP100(87) and the manufacturers' specifications. ☐
4. Steel tanks and piping are cathodically protected in accordance with NFPA 30(87), API 1632, UL (Underwriters Laboratory) 1746, STI (Steel Tank Institute) R892-89 and the manufacturer's specifications. ☐
5. Tanks and piping tested for tightness after installation in accordance with NFPA 30(87) and PEI/RP100-87. ☐
6. Monitoring well(s) or other leak detection devices installed and tested in accordance with Section 17-761.640, Florida Administrative Code (F.A.C.) ☐
7. Spill and overfill protection devices installed in accordance with Section 17-761.500, F.A.C. ☐
8. Secondary containment installed for tanks and piping as applicable in accordance with Section 17-761.500, F.A.C. ☐

Please Note: The numbers following the abbreviations (e.g. API 1615) are publication or specification numbers issued by these instututions.

Underground Pollutant Tank Removal Checklist

1. Closure assessment performed in accordance with Section 17-761.800, F.A.C. ☒
2. Underground tank removed and disposed of as specified in API 1604 in acordance with Section 17-761.800, F.A.C. ☒

Northwest District
Northeast District
Central District
Southwest District
South District
Southeast District

DER Form # 17-761.900(5)
Form Title Underground Storage Tank Installation & Removal Form for Certified Contractors
Effective Date December 10, 1990
DER Application No _____ If issued by DER

Certification

hereby certify and attest that I am familiar with the facility that is registered with the Florida Department of Environmental Regulation; that to the es f my knowledge and belief, the tank installation, replacement or removal at this facility was conducted in accordance with Chapter 489 and ec n 376.303, Florida Statutes and Chapter 17-761, Florida Administrative Code (and its adopted reference sources from publications and standards the National Fire Protection Association (NFPA), the American Petroleum Institute (API), the National Association of Corrosion Engineers (NACE), merican Society for Testing and Materials (ASTM); Petroleum Equipment Institute (PEI); Steel Tank Institute (STI); Underwriters Laboratory (UL); and e nk and integral piping manufacturers' specifications; and that the operations on the checklist were performed accordingly.

LESLIE J. NICHOLS — PC-C055743

(Type or Print) Certified Pollutant Tank Contractor Name
Pollutant Storage System Specialty Contractor License Number (PSSSC)

PSSSC Number

Certified Tank Contractor Signature — 1-14-97 Date

ROBERT CLARKE — 1-14-97 Date

(Type or Print) Field Supervisor Name

Field Supervisor Signature — 1-14-97 Date

e vner or operator of the facility must register the tanks with the Department at least 10 days before the installation. The installer must submit s form no more than 30 days after the completion of installation to the Department of Environmental Regulation at the address printed at the top page one.

Florida Department of Environmental Regulation
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

Form Title: Closure Assessment Form
Effective Date: December 10, 1990
DER Application No. _____ (Filled in by DER)

Closure Assessment Form

Owners of storage tank systems that are replacing, removing or closing in place storage tanks shall use this form to demonstrate that a storage system closure assesment was performed in accordance with Rule 17-761 or 17-762, Florida Administrative Code. Eligible Early Detection Incentive (EDI) and Reimbursement Program sites do not have to perform a closure assessment.

Please Print or Type
Complete All Applicable Blanks

1. Date: 1-14-97
2. DER Facility ID Number: _____ 3. County: SANTA ROSA
4. Facility Name: BLDG 2993
5. Facility Owner: BULK FUELING
6. Facility Address: WASP RD
7. Mailing Address: ROICC, NAS WHITING FIELD, 7183 LANGLEY ST, MILTON FL 32570
8. Telephone Number: (904) 623-7246 9. Facility Operator: BULK FUELING
10. Are the Storage Tank(s): **(Circle one or both)** A. Aboveground or (B) Underground
11. Type of Product(s) Stored: FUEL JP-5
12. Were the Tank(s): **(Circle one)** A. Replaced (B.)Removed C. Closed In Place D. Upgraded (aboveground tanks only)
13. Number of Tanks Closed: 1 14. Age of Tanks: UNKNOWN

Facility Assessment Information

Yes	No	Not Applicable	
☐	☒		1. Is the facility participating in the Florida Petroleum Liability Insurance and Restoration Program (FPLIRP)?
☐	☒		2. Was a Discharge Reporting Form submitted to the Department? If yes, When: _____ Where: _____
☒	☐		3. Is the depth to ground water less than 20 feet?
☒	☐	☐	4. Are monitoring wells present around the storage system? If yes, specify type: ☐ Water monitoring ☐ Vapor monitoring
☐	☒	☐	5. Is there free product present in the monitoring wells or within the excavation?
☐	☐	☒	6. Were the petroleum hydrocarbon vapor levels in the soils greater than 500 parts per million for gasoline? Specify sample type: ☐ Vapor Monitoring wells ☐ Soil sample(s)
☒	☐	☐	7. Were the petroleum hydrocarbon vapor levels in the soils greater than 50 parts per million for diesel/kerosene? Specify sample type: ☐ Vapor Monitoring wells ☐ Soil sample(s)
☒	☐	☐	8. Were the analytical laboratory results of the ground water sample(s) greater than the allowable state target levels? (See target levels on reverse side of this form and supply laboratory data sheets)
☐	☐	☒	9. If a used oil storage system, did a visual inspection detect any discolored soil indicating a release?
☐	☒		10. Are any potable wells located within ¼ of a mile radius of the facility?
☐	☒		11. Is there a surface water body within ¼ mile radius of the site? If yes, indicate distance: _____

Northwest District
160 Governmental Center
Pensacola, Florida 32501 5794
904 436 8300

Northeast District
7825 Baymeadows Way, Suite B 200
Jacksonville, Florida 32207
904 798 4200

Central District
3319 Maguire Blvd. Suite 232
Orlando, Florida 32803 3767
407 894 7555

Southwest District
4520 Oak Fair Blvd
Tampa, Florida 33610 7347
813 623 5561

South District
2269 Bay St.
Fort Myers, Florida 33901 2898
813 332 6975

Southeast District
1900 S Congress Ave. Suite A
West Palm Beach, Florida 33406
407 433 7650

)ate: 1-14-97 CLOSURE ASSESSMENT REVIEW CHECKLIST

a lity Name: BLDG 2993 Facility #

a lity Owner or Operator: BULK FUELING

acility Address: WASP RD Phone

laiiing Address:

e:	No	N/A Unk	
–	X	—	Is this an EDI/PLIRP/ATRP site? (circle one)

ave the following forms been received?:

–	—	—	Storage Tank Registration/Notification Form
–	—	—	Discharge Notification/Reporting Form?
–	—	—	Closure Assessment Form?
–	—	—	Was an OVA used on site? FID/PID (circle one) (w/carbon filter?)
–	—	—	Were any OVA readings greater than 50 ppm or 500 ppm? (circle one that applies)
–	X	—	Was there visual evidence of contamination/discharge? (i.e. soil staining, sheen, tank holes, etc.)
–	—	—	Was excessively contaminated soil removed? If so, how much? (IRA information received)
–	—	—	Were manifests for soil, water, sludge &/or tanks received?
–	—	—	Is the depth to groundwater given? If so what.
–	—	—	Was groundwater analysis done? 601 602 610 418.1 (circle test(s) done)
–	—	—	Were any results greater than SRLs? If so which?

/e the following been received?

—	—	All lab analyses?
—	—	All OVA readings?
—	—	Lab quality assurance and control statement or #?
—	—	Field quality assurance and control statement?

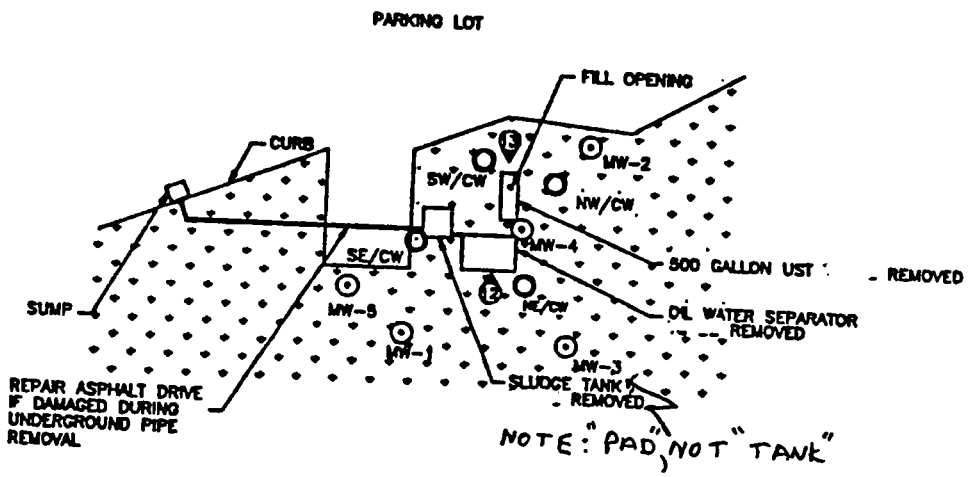
te map indicating location of:

—	—	storage tank system?
X	—	dispensers?
—	—	monitoring wells?
—	—	buildings/roads?
X	—	storm drains?
—	—	(sampling? soil & groundwater)(circle)

comments/recommendations on back. Reviewed by:

BUILDING 2993

NOT TO SCALE



LEGEND

- GRASS
- PHOTO NUMBER/DIRECTION
- MONITORING WELL (MW)
- COMPLIANCE WELLS (CW)
  - (SE = SOUTHEAST)
  - (SW = SOUTHWEST)
  - (NE = NORTHEAST)
  - (NW = NORTHWEST)

REMOVED

APPENDIX C

PRODUCT LINE CLOSURE REPORT

JIM STIDHAM & ASSOCIATES, INC.

547 N. MONROE ST., SUITE 201 - POST OFFICE BOX 3547 - TALLAHASSEE, FLORIDA 32303-3547
TELEPHONE: 904/222-3975 FAX: 904/681-0560

PRODUCT LINE CLOSURE ASSESSMENT REPORT

UNITED STATES NAVAL AIR STATION WHITING FIELD MILTON, FLORIDA 32570

FDEP FACILITY I.D. #578516386

APRIL 12, 1996

PREPARED FOR:

SANTA ROSA COUNTY STORAGE TANK PROGRAM
ESCAMBIA COUNTY PUBLIC HEALTH UNIT
1190 WEST LEONARD STREET, SUITE 2
PENSACOLA, FLORIDA 32501

PREPARED BY:

JIM STIDHAM & ASSOCIATES, INC.

CLOSURE ASSESSMENT REPORT
UNITED STATES NAVAL AIR STATION
WHITING FIELD
FACILITY ID # 578516386

INTRODUCTION

On March 27, 1996 Jim Stidham & Associates, Inc. (JSA) began performance of closure assessment activities on a system of product lines that were once affiliated with two above ground storage tanks (ASTs) that are identified as Tank #2891 and Tank #2892. This AST facility and the associated product line system are located on the south side of Hornet Street , United States Naval Air Station, Whiting Field, Milton, Florida 32570 (Figure 1). The product line system extends from the northwest area of the AST facility that contains Tank #2891 and Tank #2892 to a pump station facility located on Hornet Street. The product line system then proceeds in a southwesterly direction along Hornet Street under Saratoga Street to a dispensing facility. The product line system was taken out of service and closed in place by Environmental Recovery, Inc. (ERI) and Minority Speciality Contractors Inc. (MSC).

JSA arrived on the site on March 27, 1996 and met with Eric Taylor of Minority Speciality Contractors to discuss the product line closure assessment at the above referenced facility. The product lines are constructed of metal and are located approximately three feet below land surfaces (BLS) in most areas. The product line system included in this closure assessment consists of two separate lines from the AST facility to the pump station building located along Hornet Street with a single 10-inch product line extending from this pump station facility to a product dispensing area. There is also a 4-inch product line connecting the two ASTs to a former dispensing area approximately 110 feet to the northeast of the AST facility. Figure 2 displays the product lines included in this closure assessment. Each of the two product lines that extend from the ASTs to the pump station line connects to both ASTs and contain valve stations at various locations between the ASTs and the pump station facility. One 8-inch product line services the northeast side of the AST facility and travels in a northwesterly direction to the southwest side of the pump station facility. A second 10-inch product line services the southwest side of the AST facility and extends from the AST in a northwesterly direction and connects to the southeast portion of the pump station facility. A 10-inch line extends in a southwesterly direction along Hornet Street from the pump station to a former dispensing facility located southwest of the junction of Hornet and Enterprise Streets. The following

information summarizes the activities that occurred at this facility as a part of this Product Line Closure Assessment Report.

SITE HISTORY

There is a total of four product line systems associated with the AST system at the above mentioned facility. The product lines at this facility were taken out of service through in-place closure by Environmental Recovery, Inc. (ERI) from February 26, 1996 to February 29, 1996. The product lines involved in this product line closure assessment were affiliated with two 231,000 gallon ASTs that contain Jet Petroleum #5 (JP-5).

PRODUCT LINE ASSESSMENT (PLCA)

Beginning on March 26, 1995 and concluding on March 29, 1996, JSA performed the product line closure assessment for these four product line systems that were affiliated with the two ASTs (Tank #2891 and Tank #2892). The two ASTs at this facility remain in service (Figure 2).

Soil samples were collected for organic volatile analysis (OVA) at the beginning and the end of each product line and also on a 100-foot interval basis along each product line. Additional soil samples were collected in the areas where product line direction changes occur and also in the areas of valve stations located along the product lines associated with this closure assessment. Soil samples were also collected in the vicinity of both the former rail loading area and the former dispensing area. For the purposes of this product line closure assessment report, the four product lines in question will be identified as System 1, System 2, System 3, and System 4. System 1 is identified as the product line extending from the dispensing area to the pump station facility. System 2 is identified as the product line that extends from the southeast side of the pump station facility to the southwest side of the AST facility. The product line that extends from the southwest area of the pump station facility to the northeast portion of the AST facility is identified as System 3. System 4 consists of the 4-inch product line that extends from the northeast area of the AST facility to a former rail loading area located approximately 110 feet to the northeast.

System 1 consists of approximately 1315 feet of 10 inch metal product lines. This product line maintains a consistent below gradient depth of approximately 3 feet except for an aboveground junction located near Soil Boring #13 (SB-13) and an exposed portion near the pump station facility.

A total of 17 soil borings was installed along this product line, beginning with SB-1 located near the dispensing facility and ending with SB-17 near the pump station facility. SB-2 was installed near a valve station that is located on a 45-degree direction change in the product line. All other soil borings are located on a 100-foot interval basis (or less depending upon obstructions such as roads and parking lots). Elevated OVA values were encountered in soil collected from SB-1, SB-12 , and SB-17. Soil samples collected from the remaining soil borings indicated OVA readings below detection limits. Two additional soil borings were also installed around the pump station facility. These soil borings were installed to a depth of 7 feet BLS and revealed OVA readings below detection limits. Figure 3 displays the location of the soil borings along the product line located within System 1.

The second system, System 2, consists of approximately 605 feet of 10 inch metal product lines. With the exception of an exposed area near the pump station facility, this product line is approximately 3 feet below land surface (BLS) throughout its extent. Soil borings SB-18 through SB-24 and SB-36 and SB-37 were installed along the product line on a 100-foot interval basis to include product line direction changes and valve stations. SB-18 was installed on one end of the product line near the pump station facility and SB-37 was installed at the opposite end near the AST area. All soil borings, with the exception of SB-18, were installed to a depth of 7 feet BLS for collection of soil for OVA analysis. SB-18 was installed to a depth of only four feet BLS since the product line is exposed above land surface in this area. All soil samples collected from these soil borings revealed OVA values below detection limits. Figure 4 displays the location of these soil borings along the product line designated as System 2.

System 3 contains approximately 795 feet of 8 inch metal product lines. The majority of this product line is approximately 3 feet BLS except for the portion of the product line located within the AST facility. The depth of the product line within the AST facility is approximately 8 feet BLS. A total of eleven soil borings were installed along this product line system, beginning with SB-25 near the pump station facility and ending with SB-35 in the area of the AST facility. In the area where this product line is located approximately 3 feet BLS, soil borings SB-25 through SB-32 were installed to a depth of 7 feet BLS. Within the area of the AST facility where this product line is located approximately 8 feet BLS, soil borings SB-33, SB-34, and SB-35 were installed to a depth of 12 feet BLS. These three soil borings were installed in the immediate vicinity of valve stations. All of the soil borings along System 3 were installed on a 100-foot interval basis and included all product line direction changes and valve stations. All soil samples collected for OVA analysis along this product line contained values below detection limits. The locations of these soil borings are displayed in Figure 5.

The product line contained within System 4 consists of metal 4 inch piping that extends from the northeast portion of the AST facility to a former rail loading area located approximately 110 feet to the northeast side of the AST facility. At one time, this AST facility was supplied with JP-5 products by way of rail transport. The product line designated as System 4 once served as an off loading area for the JP-5 fuel transported to the AST facility by rail. This system contains six off loading junctions, all of which combine into one 4-inch product line that was once connected to the AST facility. A total of seven soil borings (SB-39 through SB-45) were installed in the rail loading area of this product line with one soil boring adjacent to each rail loading junction and one soil boring in the area where this product line changes direction to travel to the AST facility. An additional soil boring (SB-38) was also placed between the rail loading area and the AST facility. Soil samples collected for OVA analysis from SB-39 through SB-45 revealed excessive levels of petroleum contamination from soil collected at depths of three and four feet BLS. Soil collected for analysis from SB-38 revealed excessive levels of petroleum contamination from soil collected at a depth of 7 feet BLS. Figure 6 displays the product line designated as System 4 and the soil borings installed along this product line.

Additional soil borings were also placed in the area of the former dispensing facility. A total of six soil borings were installed around this former dispensing area, including SB-1 which was installed in the area where the product line joins the dispensing area. Soil samples taken for OVA analysis from SB-46 through SB-50 contained values below detection limits. However, as previously mentioned, SB-1 contained excessive levels of petroleum contamination at a depth of 7 feet BLS. The locations for the soil borings around this dispensing facility are displayed in Figure 7.

The threshold for excessively contaminated soil was set at 50 parts per million (ppm) following Chapter 62-770.200(2) for mixed product group contamination sources. The Closure Assessment Form is included in Appendix A.

The soil collected for analysis was scanned with a Foxboro Century 128, organic vapor analyzer (OVA). This instrument is a flame ionization detector (FID) used to conduct field analysis of soil samples. Standard manufacturers operating procedures were followed and all field calibrations were made according to manufacturer's recommendations.

The soil samples were sealed in half-filled 16 ounce glass jars and the OVA readings were taken in the headspace above the soil as recommended by FDEP's Guidelines for Assessments and Remediation of Petroleum Contaminated Soils and in accordance with Florida Administrative Code

(FAC) Chapter 62-770.200(2). Duplicate soil samples were collected from each test site so that samples could be analyzed for total biogenic content using a carbon filter attachment. Total Volatile Hydrocarbons (TVH) were then determined by subtracting the biogenic reading from the OVA reading.

SUMMARY

During Product Line Closure Assessment activities of the product line systems affiliated with tank #2891 and tank #2892, JSA installed fifty-two soil borings in the soil located around the product lines involved in this product line closure assessment. Soil borings were installed along the product lines on a 100-foot interval basis. Soil borings were also installed in the areas of product line direction changes and also in the areas of valve junction stations and product line termination areas. While the majority of the soil collected for OVA analysis revealed values below detection limits, soil samples collected from SB-1, SB-12, SB-17, SB-38, SB-39, SB-40, SB-41, SB-42, SB-43, SB-44, and SB-45 revealed excessive levels of petroleum contamination (>50 ppm). A Discharge Reporting Form has been prepared for submittal and is included in Appendix B.

TABLES

WHITING FIELD

UNITED STATES NAVAL AIR STATION

MILTON, FLORIDA

FDEP FACILITY ID #: 578516386

TABLE 1

SB LOCATION	DEPTH (ft)	OVA (ppm)	BIO (ppm)	TVH (ppm)	SOIL DESCRIPTION
SB - 1	1	<1	<1	<1	TAN SAND
SB - 1	3	<1	<1	<1	TAN SAND
SB - 1	5	<1	<1	<1	TAN SAND
SB - 1	7	640	29	611	TAN SANDY CLAY
SB - 2	1	<1	<1	<1	TAN SAND
SB - 2	3	<1	<1	<1	TAN SAND
SB - 2	5	<1	<1	<1	TAN SAND
SB - 2	7	<1	<1	<1	TAN & BROWN SANDY CLAY
SB - 3	1	<1	<1	<1	TAN SAND
SB - 3	3	<1	<1	<1	TAN SAND
SB - 3	5	<1	<1	<1	TAN SAND
SB - 3	7	<1	<1	<1	TAN & ORANGE SANDY CLAY
SB - 4	1	<1	<1	<1	TAN SAND
SB - 4	3	<1	<1	<1	TAN SAND
SB - 4	5	<1	<1	<1	TAN SAND
SB - 4	7	<1	<1	<1	TAN SAND
SB - 5	1	<1	<1	<1	DARK SAND
SB - 5	3	<1	<1	<1	TAN SAND
SB - 5	5	<1	<1	<1	TAN SAND
SB - 5	7	<1	<1	<1	TAN SANDY CLAY
SB - 6	1	<1	<1	<1	TAN SAND
SB - 6	3	<1	<1	<1	TAN SAND
SB - 6	5	<1	<1	<1	BROWN CLAYEY SAND
SB - 6	7	<1	<1	<1	BROWN SANDY CLAY
SB - 7	1	<1	<1	<1	TAN SAND
SB - 7	3	<1	<1	<1	TAN SAND
SB - 7	5	<1	<1	<1	TAN & BROWN CLAYEY SAND
SB - 7	7	<1	<1	<1	TAN & BROWN SANDY CLAY
SB - 8	1	<1	<1	<1	TAN SAND
SB - 8	3	<1	<1	<1	TAN SAND
SB - 8	5	<1	<1	<1	TAN & BROWN CLAYEY SAND
SB - 8	7	<1	<1	<1	TAN & BROWN SANDY CLAY
SB - 9	1	<1	<1	<1	TAN SAND
SB - 9	3	<1	<1	<1	TAN SAND
SB - 9	5	<1	<1	<1	BROWN & ORANGE SAND
SB - 9	7	<1	<1	<1	TAN & ORANGE SANDY CLAY
SB - 10	1	<1	<1	<1	TAN SAND
SB - 10	3	<1	<1	<1	TAN SAND
SB - 10	5	<1	<1	<1	TAN & BROWN CLAYEY SAND
SB - 10	7	<1	<1	<1	TAN & BROWN SANDY CLAY

OVA - Organic Vapor Analyzer
BIO - Biogenic Reading
TVH - Total Volatile Hydrocarbons
PPM - Parts Per Million
SB - Soil Boring

WHITING FIELD

UNITED STATES NAVAL AIR STATION

MILTON, FLORIDA

FDEP FACILITY ID #: 578516386

TABLE 1 (CONT.)

SB LOCATION	DEPTH (ft)	OVA (ppm)	BIO (ppm)	TVH (ppm)	SOIL DESCRIPTION
SB - 11	1	<1	<1	<1	TAN SAND
SB - 11	3	<1	<1	<1	TAN SAND
SB - 11	5	<1	<1	<1	BROWN SAND
SB - 11	7	<1	<1	<1	TAN & BROWN SANDY CLAY
SB - 12	1	<1	<1	<1	TAN SAND
SB - 12	3	<1	<1	<1	TAN SAND
SB - 12	5	250	2	248	TAN & GREY SAND
SB - 12	7	440	4.4	435.6	TAN & GREY SAND
SB - 13	1	<1	<1	<1	TAN SAND
SB - 13	3	<1	<1	<1	TAN SAND
SB - 13	5	<1	<1	<1	TAN SAND
SB - 13	7	<1	<1	<1	TAN SANDY CLAY
SB - 14	1	<1	<1	<1	TAN SAND
SB - 14	3	<1	<1	<1	TAN SANDY CLAY
SB - 14	5	<1	<1	<1	TAN SAND
SB - 14	7	<1	<1	<1	TAN SANDY CLAY
SB - 15	1	<1	<1	<1	DARK SAND
SB - 15	3	<1	<1	<1	TAN SAND
SB - 15	5	<1	<1	<1	TAN SANDY CLAY
SB - 15	7	<1	<1	<1	TAN SANDY CLAY
SB - 16	1	<1	<1	<1	REDISH SAND
SB - 16	3	<1	<1	<1	TAN SANDY CLAY
SB - 16	5	<1	<1	<1	TAN SANDY CLAY
SB - 16	7	<1	<1	<1	TAN SANDY CLAY
SB - 17	1	<1	<1	<1	TAN SAND
SB - 17	3	>1000	<1	>1000	GREY & TAN SANDY CLAY
SB - 17	4	>1000	<1	>1000	GREY & TAN SANDY CLAY
SB - 18	1	<1	<1	<1	TAN SAND
SB - 18	3	<1	<1	<1	TAN & BROWN CLAYEY SAND
SB - 18	4	1.2	<1	1.2	BROWN SANDY CLAY
SB - 19	1	<1	<1	<1	TAN SAND
SB - 19	3	<1	<1	<1	TAN SAND
SB - 19	5	<1	<1	<1	GREY & WHITE CLAYEY SAND
SB - 19	7	<1	<1	<1	GREY & WHITE CLAYEY SAND
SB - 20	1	<1	<1	<1	TAN SAND
SB - 20	3	<1	<1	<1	TAN SAND
SB - 20	5	<1	<1	<1	TAN & BROWN CLAYEY SAND
SB - 20	7	<1	<1	<1	TAN & BROWN SANDY CLAY
SB - 21	1	<1	<1	<1	TAN SAND
SB - 21	3	<1	<1	<1	TAN SAND

OVA - Organic Vapor Analyzer
BIO - Biogenic Reading
TVH - Total Volatile Hydrocarbons
PPM - Parts Per Million
SB - Soil Boring

WHITING FIELD
UNITED STATES NAVAL AIR STATION
MILTON, FLORIDA
FDEP FACILITY ID #: 578516386

TABLE 1 (CONT.)

SB LOCATION	DEPTH (ft)	OVA (ppm)	BIO (ppm)	TVH (ppm)	SOIL DESCRIPTION
SB - 21	5	<1	<1	<1	BROWN CLAYEY SAND
SB - 21	7	<1	<1	<1	BROWN SANDY CLAY
SB - 22	1	N/A	N/A	N/A	
SB - 22	3	<1	<1	<1	TAN SAND
SB - 22	5	<1	<1	<1	TAN & BROWN CLAYEY SAND
SB - 22	7	<1	<1	<1	TAN & BROWN SANDY CLAY
SB - 23	1	<1	<1	<1	TAN SAND
SB - 23	3	<1	<1	<1	TAN SAND
SB - 23	5	<1	<1	<1	BROWN CLAYEY SAND
SB - 23	7	<1	<1	<1	BROWN SANDY CLAY
SB - 24	1	<1	<1	<1	TAN SAND
SB - 24	3	<1	<1	<1	TAN SAND
SB - 24	5	<1	<1	<1	BROWN CLAYEY SAND
SB - 24	7	<1	<1	<1	BROWN SANDY CLAY
SB - 25	1	<1	<1	<1	TAN SAND
SB - 25	3	<1	<1	<1	TAN SAND
SB - 25	5	<1	<1	<1	BROWN CLAYEY SAND
SB - 25	7	<1	<1	<1	BROWN SANDY CLAY
SB - 26	1	<1	<1	<1	TAN SAND
SB - 26	3	<1	<1	<1	TAN SAND
SB - 26	5	<1	<1	<1	TAN SANDY CLAY
SB - 26	7	<1	<1	<1	TAN SANDY CLAY
SB - 27	1	<1	<1	<1	DARK SAND
SB - 27	3	<1	<1	<1	TAN SAND
SB - 27	5	<1	<1	<1	TAN SANDY CLAY
SB - 27	7	<1	<1	<1	TAN SANDY CLAY
SB - 28	1	<1	<1	<1	TAN SAND
SB - 28	3	<1	<1	<1	TAN SAND
SB - 28	5	<1	<1	<1	TAN SANDY CLAY
SB - 28	7	<1	<1	<1	TAN SANDY CLAY
SB - 29	1	<1	<1	<1	TAN SAND
SB - 29	3	<1	<1	<1	TAN SAND
SB - 29	5	<1	<1	<1	TAN SANDY CLAY
SB - 29	7	<1	<1	<1	TAN SANDY CLAY
SB - 30	1	<1	<1	<1	TAN SAND
SB - 30	3	<1	<1	<1	TAN SAND
SB - 30	5	<1	<1	<1	RED SANDY CLAY
SB - 30	7	<1	<1	<1	RED SANDY CLAY
SB - 31	1	<1	<1	<1	TAN SAND
SB - 31	3	<1	<1	<1	TAN SAND

OVA - Organic Vapor Analyzer
BIO - Biogenic Reading
TVH - Total Volatile Hydrocarbons
PPM - Parts Per Million
SB - Soil Boring

WHITING FIELD

UNITED STATES NAVAL AIR STATION
MILTON, FLORIDA
FDEP FACILITY ID #: 578516386

TABLE 1 (CONT.)

SB LOCATION	DEPTH (ft)	OVA (ppm)	BIO (ppm)	TVH (ppm)	SOIL DESCRIPTION
SB - 31	5	<1	<1	<1	RED SANDY CLAY
SB - 31	7	<1	<1	<1	RED SANDY CLAY
SB - 32	1	<1	<1	<1	DARK SAND
SB - 32	3	<1	<1	<1	TAN SAND
SB - 32	5	<1	<1	<1	TAN SANDY CLAY
SB - 32	7	<1	<1	<1	TAN SANDY CLAY
SB - 33	8	<1	<1	<1	GRAVEL & SAND FILL
SB - 33	10	<1	<1	<1	BROWN SANDY CLAY
SB - 33	12	<1	<1	<1	BROWN SANDY CLAY
SB - 34	8	<1	<1	<1	GRAVEL & SAND FILL
SB - 34	10	<1	<1	<1	BROWN SANDY CLAY
SB - 34	12	<1	<1	<1	BROWN SANDY CLAY
SB - 34	14	<1	<1	<1	BROWN SANDY CLAY
SB - 34	16	<1	<1	<1	BROWN SANDY CLAY
SB - 34	18	<1	<1	<1	BROWN SANDY CLAY
SB - 34	20	<1	<1	<1	BROWN SANDY CLAY (DAMP)
SB - 35	8	<1	<1	<1	GRAVEL & SAND FILL
SB - 35	10	<1	<1	<1	BROWN SANDY CLAY
SB - 35	12	<1	<1	<1	BROWN SANDY CLAY
SB - 36	1	<1	<1	<1	TAN SAND
SB - 36	3	<1	<1	<1	TAN SAND
SB - 36	5	<1	<1	<1	BROWN CLAYEY SAND
SB - 36	7	<1	<1	<1	BROWN SANDY CLAY
SB - 37	1	<1	<1	<1	BROWN SAND
SB - 37	3	<1	<1	<1	BROWN SAND
SB - 37	5	<1	<1	<1	RED CLAYEY SAND
SB - 37	7	<1	<1	<1	RED SANDY CLAY
SB - 38	1	<1	<1	<1	TAN SAND
SB - 38	3	<1	<1	<1	TAN SAND
SB - 38	5	<1	<1	<1	TAN SANDY CLAY
SB - 38	7	300	120	180	DARK SANDY CLAY
SB - 39	1	<1	<1	<1	TAN SAND
SB - 39	3	190	8.6	181.4	DARK SANDY CLAY
SB - 39	4	280	15	265	DARK SANDY CLAY
SB - 40	1	<1	<1	<1	TAN SANDY CLAY
SB - 40	3	<1	<1	<1	TAN SANDY CLAY
SB - 40	4	670	32	638	GREY & TAN SANDY CLAY
SB - 41	1	<1	<1	<1	TAN SAND
SB - 41	3	68	<1	<1	GREY & TAN SANDY CLAY
SB - 41	4	>1000	62	>938	GREY & TAN SANDY CLAY

OVA - Organic Vapor Analyzer
BIO - Biogenic Reading
TVH - Total Volatile Hydrocarbons
PPM - Parts Per Million
SB - Soil Boring

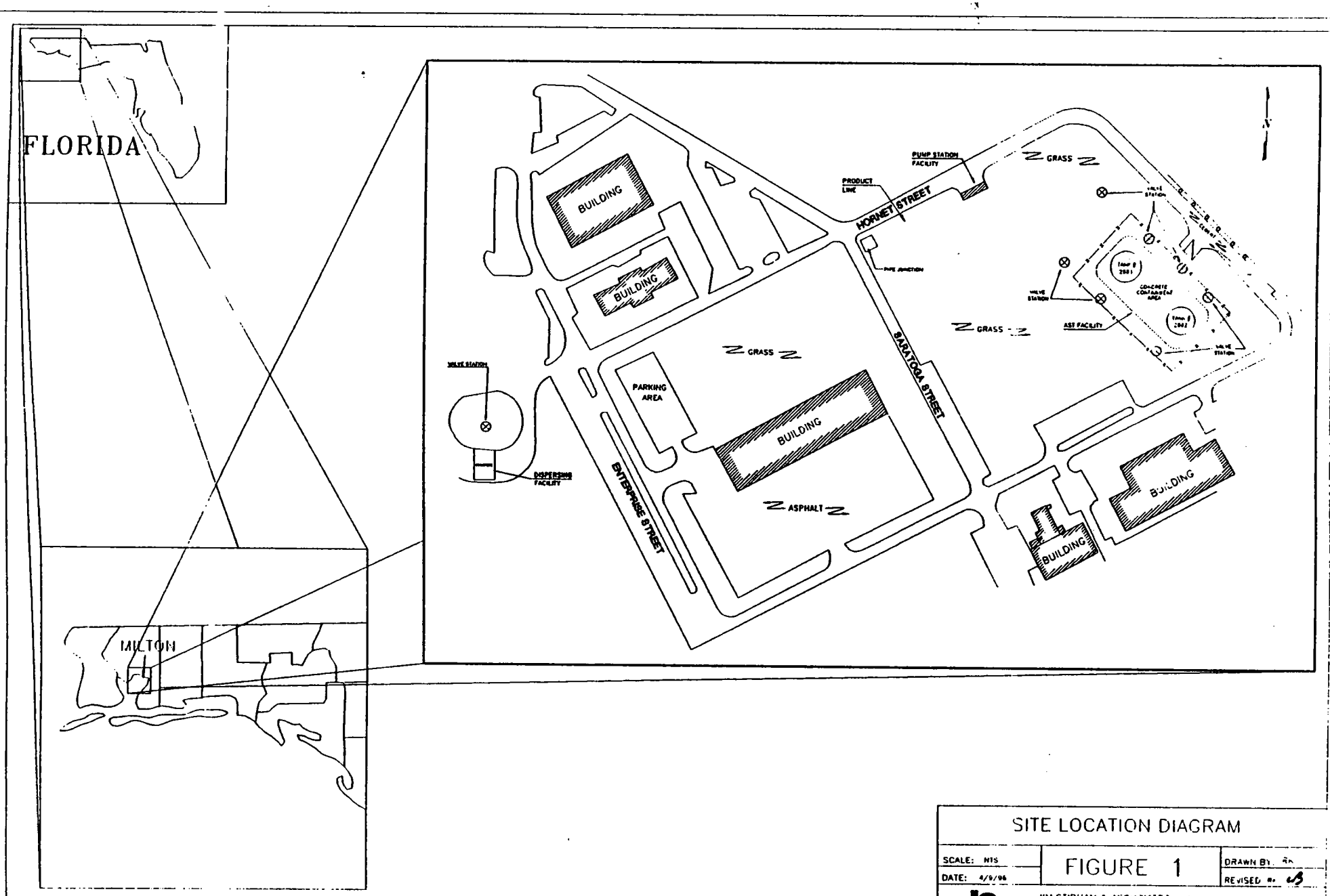
WHITING FIELD
UNITED STATES NAVAL AIR STATION
MILTON, FLORIDA
FDEP FACILITY ID #: 578516386

TABLE 1 (CONT.)

SB LOCATION	DEPTH (ft)	OVA (ppm)	BIO (ppm)	TVH (ppm)	SOIL DESCRIPTION
SB - 42	1	<1	<1	<1	TAN & BROWN SAND
SB - 42	3	>1000	360	>640	GREY SAND
SB - 42	4	500	60	440	GREY SAND
SB - 43	1	21	9.3	11.7	BROWN SAND
SB - 43	3	>1000	120	>880	GREY SAND
SB - 43	4	>1000	28	>972	GREY SAND
SB - 44	1	29	11	18	TAN SAND
SB - 44	3	150	215	INV	GREY SAND
SB - 44	4	320	140	180	GREY SAND
SB - 45	1	<1	<1	<1	BROWN SAND
SB - 45	3	90	36	54	GREY SAND
SB - 45	4	110	26	84	GREY SAND
SB - 46	1	<1	<1	<1	TAN SAND
SB - 46	3	<1	<1	<1	TAN SAND
SB - 46	5	<1	<1	<1	BROWN CLAYEY SAND
SB - 46	7	<1	<1	<1	BROWN SANDY CLAY
SB - 47	1	<1	<1	<1	TAN SAND
SB - 47	3	<1	<1	<1	TAN SAND
SB - 47	5	<1	<1	<1	BROWN CLAYEY SAND
SB - 47	7	<1	<1	<1	BROWN SANDY CLAY
SB - 48	1	<1	<1	<1	TAN SAND
SB - 48	3	<1	<1	<1	TAN SAND
SB - 48	5	<1	<1	<1	TAN CLAYEY SAND
SB - 48	7	<1	<1	<1	BROWN SANDY CLAY
SB - 49	1	<1	<1	<1	TAN SAND
SB - 49	3	<1	<1	<1	TAN SAND
SB - 49	5	<1	<1	<1	TAN CLAYEY SAND
SB - 49	7	<1	<1	<1	BROWN SANDY CLAY
SB - 50	1	<1	<1	<1	TAN SAND
SB - 50	3	<1	<1	<1	TAN SAND
SB - 50	5	<1	<1	<1	BROWN CLAYEY SAND
SB - 50	7	<1	<1	<1	BROWN SANDY CLAY
SB - 51	1	<1	<1	<1	GREY SAND
SB - 51	3	<1	<1	<1	GREY SAND
SB - 51	5	<1	<1	<1	TAN SAND
SB - 51	7	<1	<1	<1	GREY SAND
SB - 52	1	<1	<1	<1	GREY SAND
SB - 52	3	<1	<1	<1	BROWN SAND
SB - 52	5	<1	<1	<1	GREY SAND
SB - 52	7	<1	<1	<1	GREY SAND

OVA - Organic Vapor Analyzer
BIO - Biogenic Reading
TVH - Total Volatile Hydrocarbons
PPM - Parts Per Million
SB - Soil Boring
INV - Invalid

FIGURES



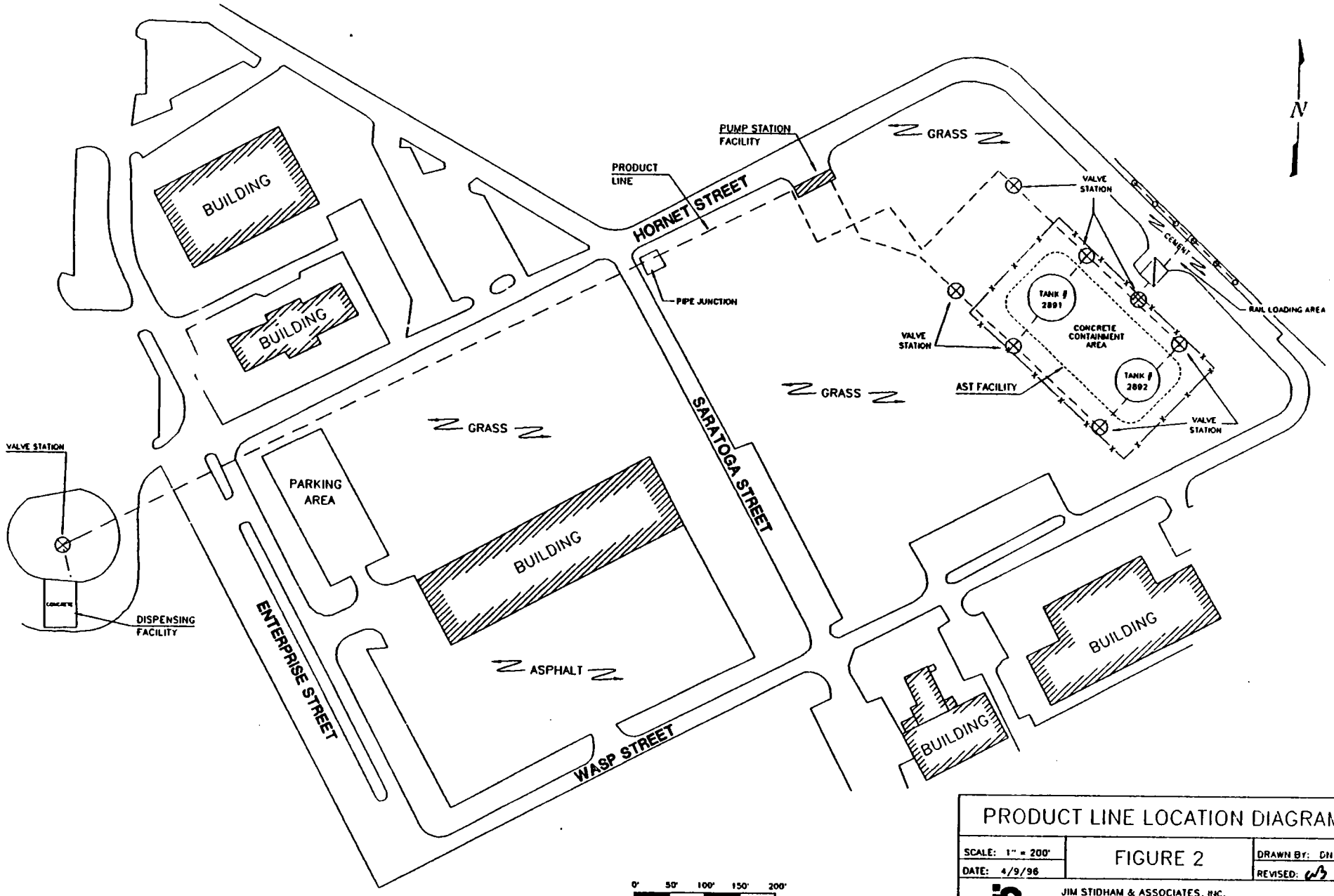
SITE LOCATION DIAGRAM

SCALE: NTS	FIGURE 1	DRAWN BY: RS
DATE: 4/9/96		REVISED BY: WS

JIM STIDHAM & ASSOCIATES, INC.
TALLAHASSEE, FLORIDA

WHITING FIELD
MILTON, FLORIDA

DRAWING NO.



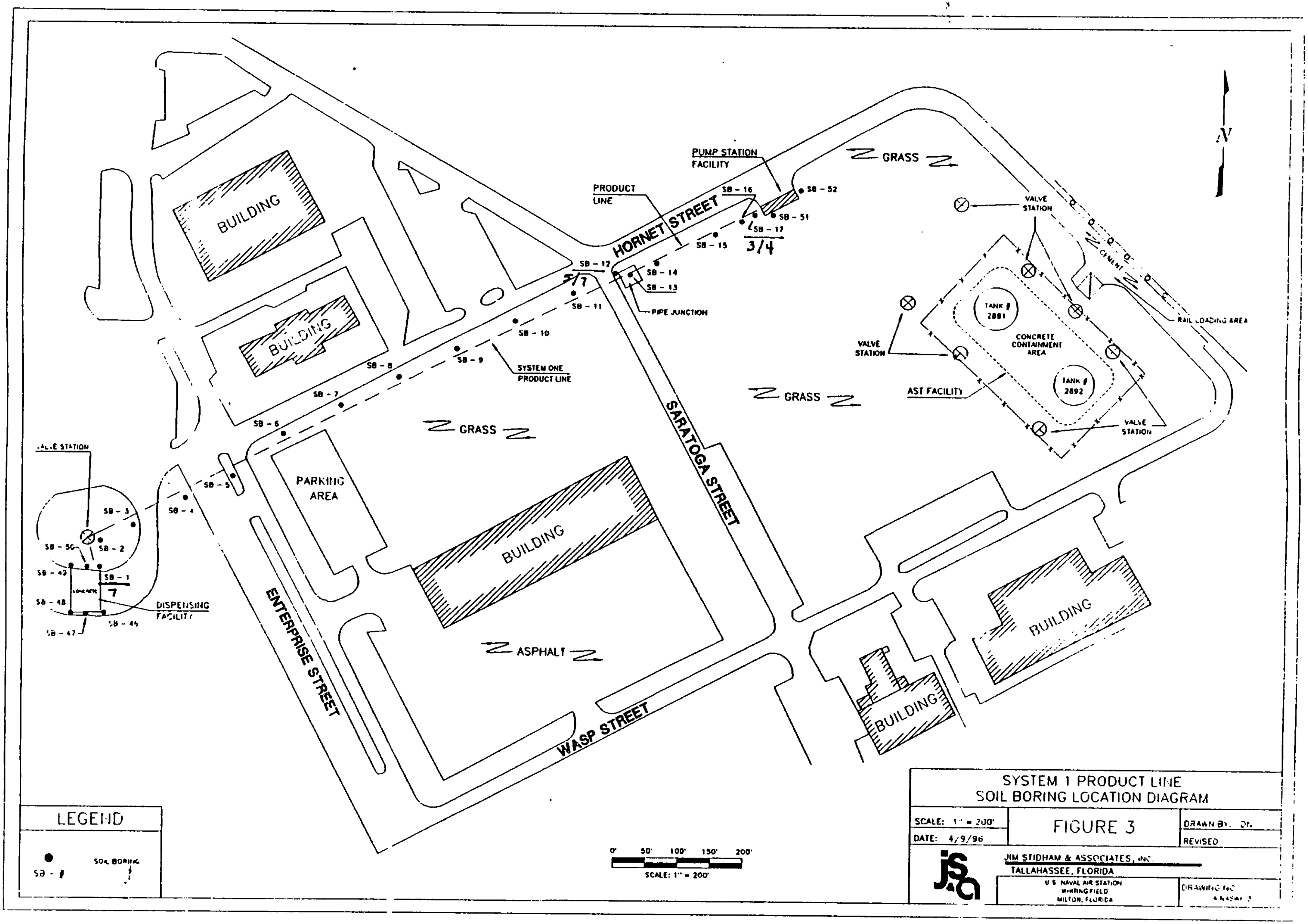
PRODUCT LINE LOCATION DIAGRAM

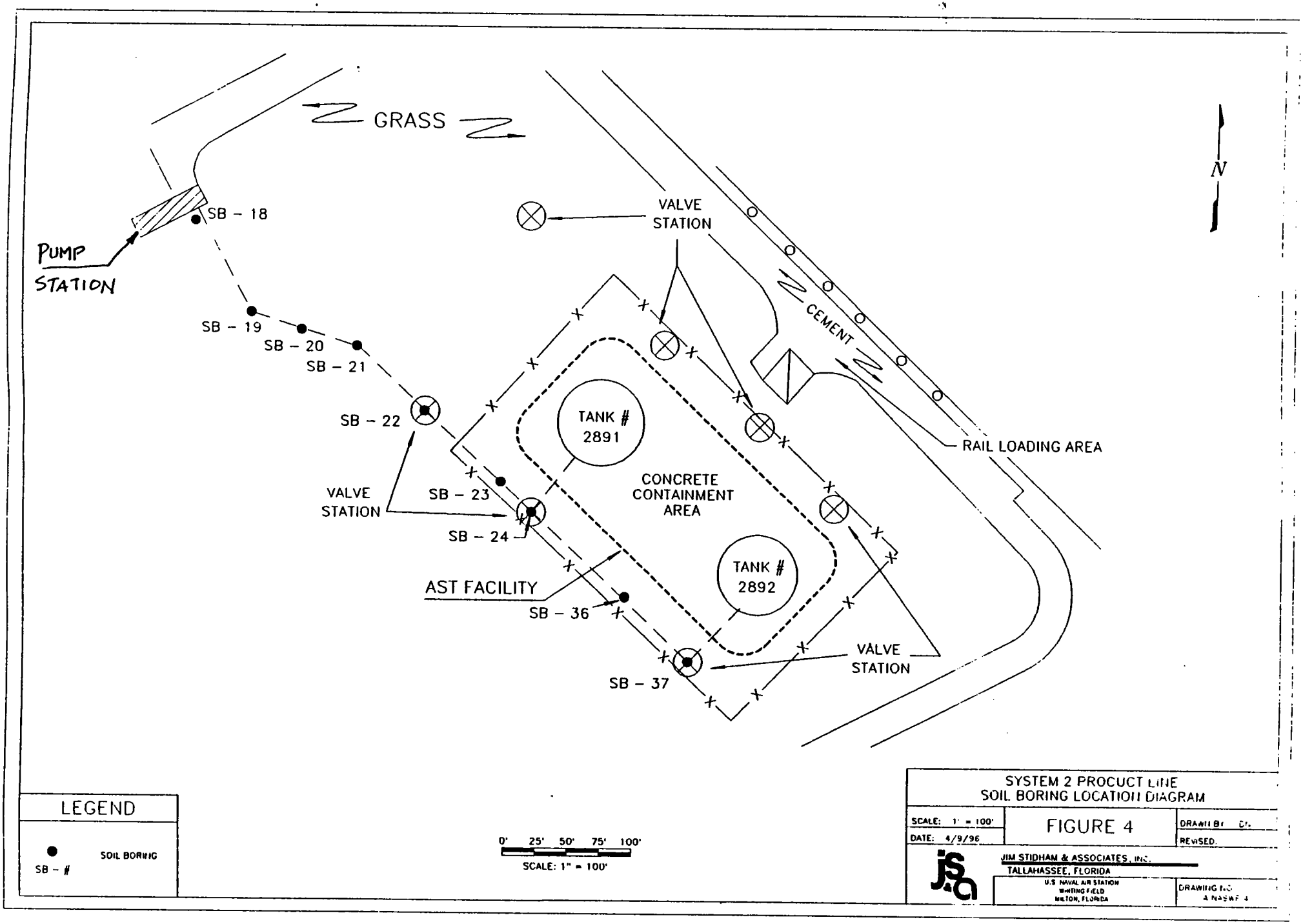
SCALE: 1" = 200'	FIGURE 2	DRAWN BY: DN
DATE: 4/9/96		REVISED: WB

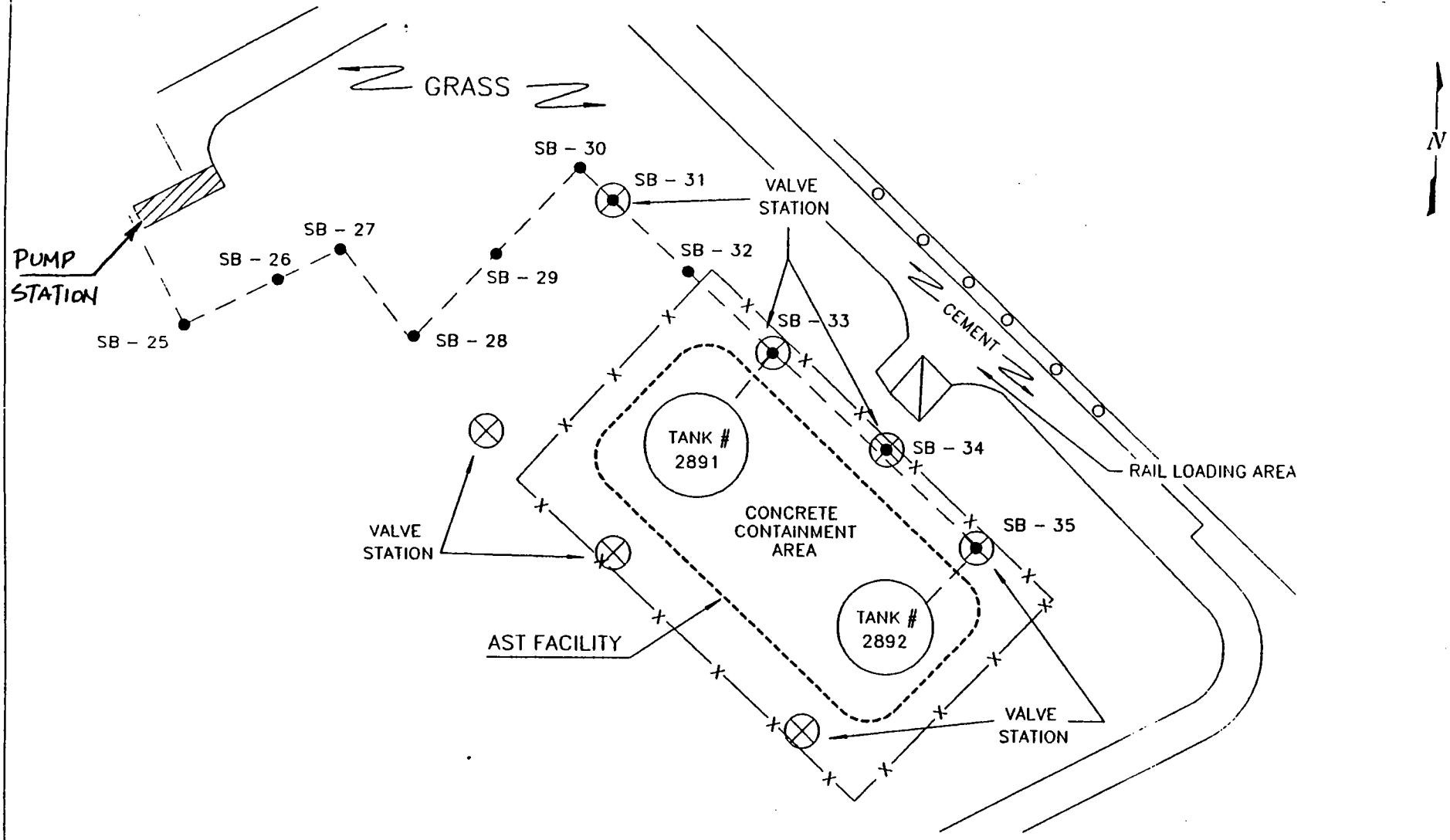
JIM STIDHAM & ASSOCIATES, INC.
TALLAHASSEE, FLORIDA

U.S. NAVAL AIR STATION
WHITING FIELD
MILTON, FLORIDA

DRAWING NO : A NASWF 2


SYSTEM 1 PRODUCT LINE
SOIL BORING LOCATION DIAGRAM
SCALE: 1" = 200'
DATE: 4/9/96
FIGURE 3
DRAWN BY:
REVISED:
JIM STIDHAM & ASSOCIATES, INC.
TALLAHASSEE, FLORIDA
U.S. NAVAL AIR STATION
WHITING FIELD
MILTON, FLORIDA
DRAWING NO.
LEGEND
SOIL BORING
SB - #
0' 50' 100' 150' 200'
SCALE: 1" = 200'
N
BUILDING
BUILDING
BUILDING
BUILDING
BUILDING
PARKING AREA
GRASS
GRASS
GRASS
ASPHALT
HORNET STREET
SARATOGA STREET
ENTERPRISE STREET
WASP STREET
PUMP STATION FACILITY
PRODUCT LINE
PIPE JUNCTION
SYSTEM ONE PRODUCT LINE
VALVE STATION
VALVE STATION
VALVE STATION
AST FACILITY
CONCRETE CONTAINMENT AREA
TANK # 2891
TANK # 2892
RAIL LOADING AREA
DISPENSING FACILITY
CONCRETE
SB - 1
SB - 2
SB - 3
SB - 4
SB - 5
SB - 6
SB - 7
SB - 8
SB - 9
SB - 10
SB - 11
SB - 12
SB - 13
SB - 14
SB - 15
SB - 16
SB - 17
SB - 45
SB - 47
SB - 48
SB - 49
SB - 50
SB - 51
SB - 52
3/4
7
7


GRASS
N
VALVE STATION
SB – 18
PUMP STATION
SB – 19
SB – 20
SB – 21
SB – 22
CEMENT
RAIL LOADING AREA
TANK # 2891
CONCRETE CONTAINMENT AREA
VALVE STATION
SB – 23
SB – 24
TANK # 2892
AST FACILITY
SB – 36
VALVE STATION
SB – 37
LEGEND
SOIL BORING
SB – #
0' 25' 50' 75' 100'
SCALE: 1" = 100'
SYSTEM 2 PROCUCT LINE
SOIL BORING LOCATION DIAGRAM
SCALE: 1" = 100'
DATE: 4/9/96
FIGURE 4
DRAWN BY Dr.
REVISED
JIM STIDHAM & ASSOCIATES, INC.
TALLAHASSEE, FLORIDA
U.S. NAVAL AIR STATION
WHITING FIELD
MILTON, FLORIDA
DRAWING NO.



LEGEND

SB – # SOIL BORING

0' 25' 50' 75' 100'

SCALE: 1" = 100'

SYSTEM 3 PRODUCT LINE
SOIL BORING LOCATION DIAGRAM

SCALE: 1" = 100'

FIGURE 5

DRAWN BY: DH

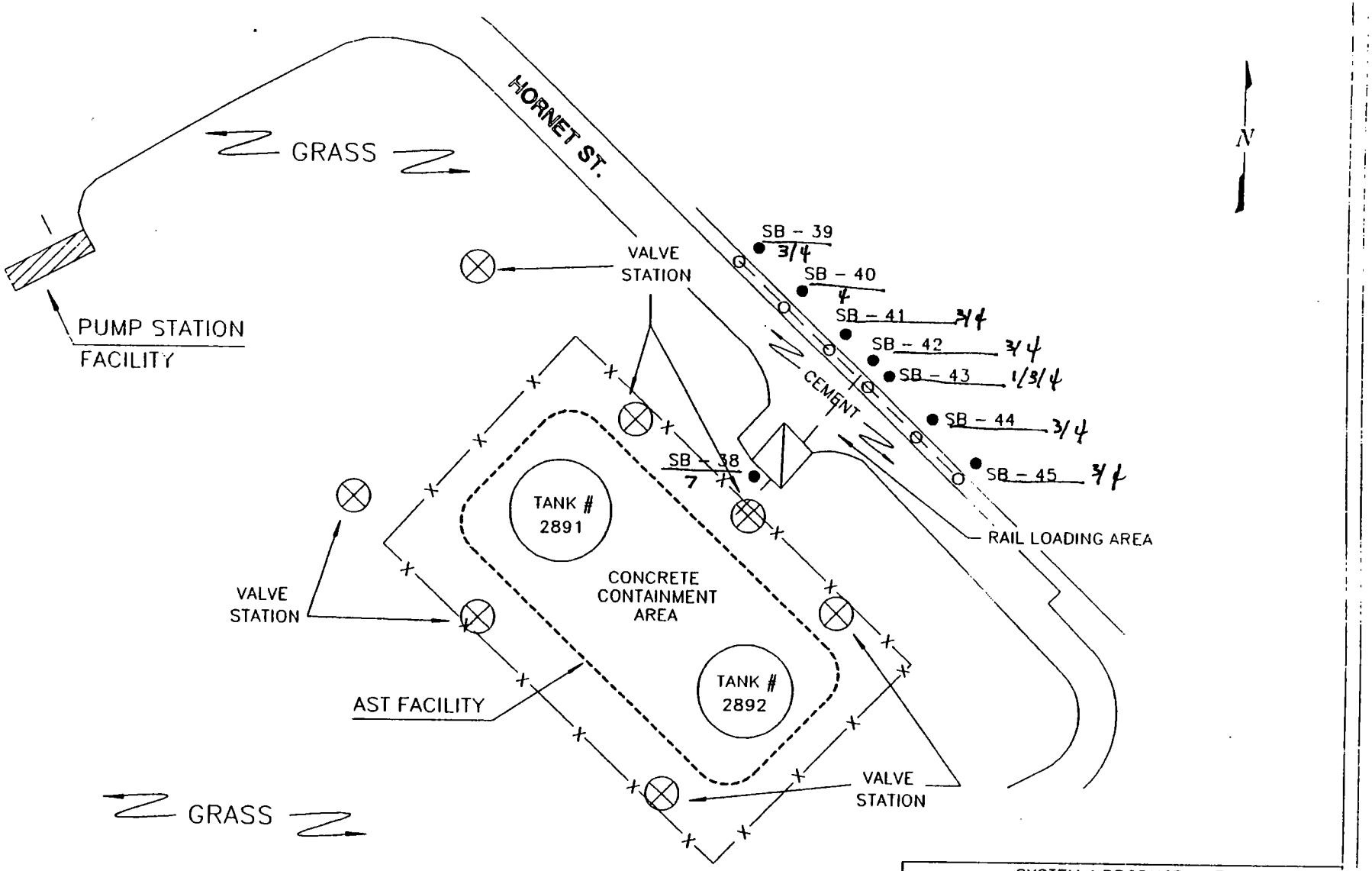
DATE: 4/9/96

REVISED:

JIM STIDHAM & ASSOCIATES, INC.
TALLAHASSEE, FLORIDA

U.S. NAVAL AIR STATION
WHITING FIELD
MILTON, FLORIDA

DRAWING NO:
A NASWF 5



LEGEND

● SOIL BORING
SB - #

0' 25' 50' 75' 100'
SCALE: 1" = 100'

SYSTEM 4 PRODUCT LINE
SOIL BORING LOCATION DIAGRAM

SCALE: 1" = 100'
DATE: 4/9/96

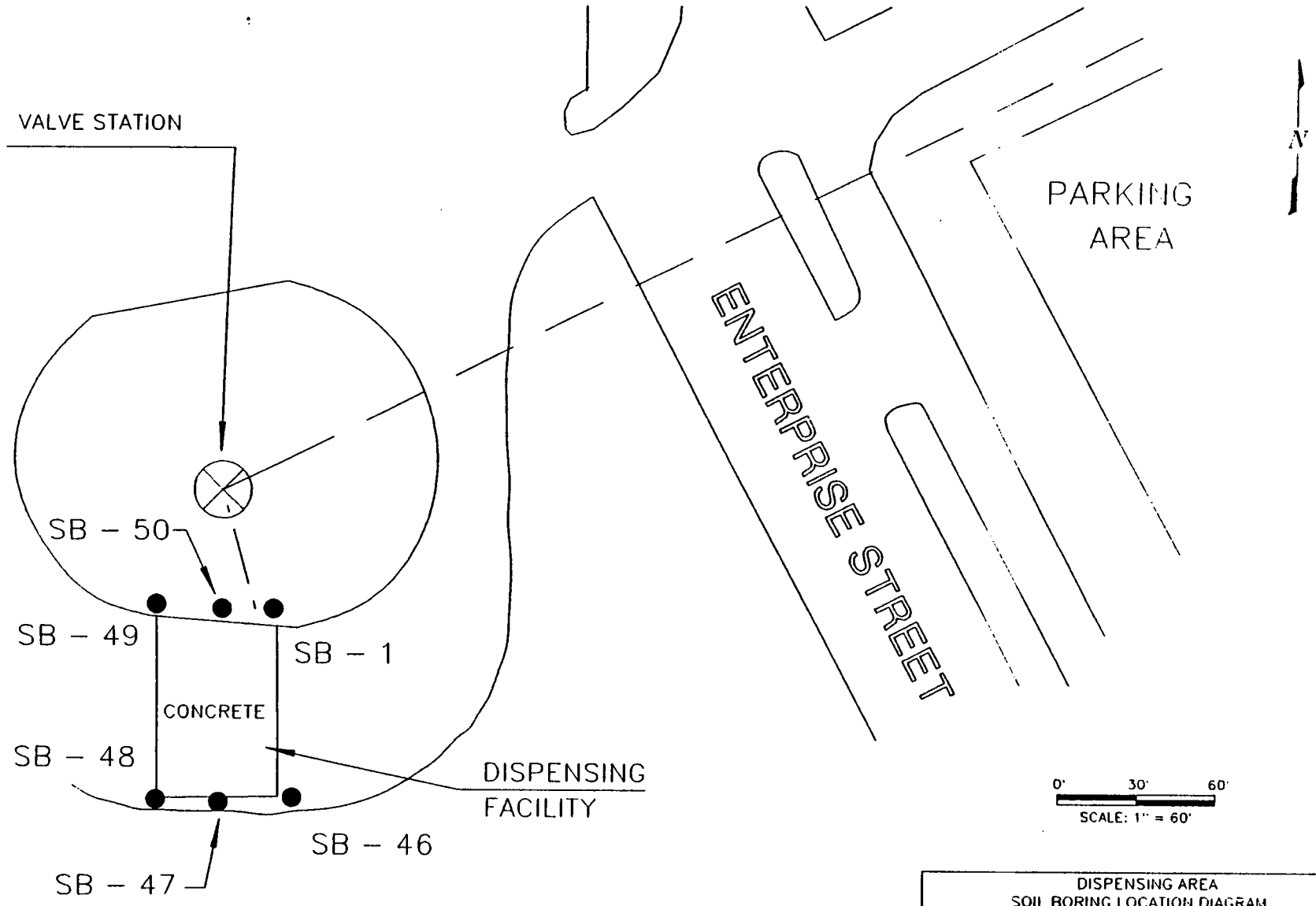
FIGURE 6

DRAWN BY:
REVISED

JIM STIDHAM & ASSOCIATES, INC.
TALLAHASSEE, FLORIDA

U.S. NAVAL AIR STATION
WHITING FIELD
MILTON, FLORIDA

DRAWING NO.



LEGEND

● SB–# SOIL BORING

DISPENSING AREA
SOIL BORING LOCATION DIAGRAM

SCALE: 1" = 60'

DATE: 4/9/96

FIGURE 7

DRAWN BY: DL

REVISED:

JIM STIDHAM & ASSOCIATES, INC.
TALLAHASSEE, FLORIDA

U.S. NAVAL AIR STATION
WHITING FIELD
MILTON, FLORIDA

DRAWING NO
A NASWF

APPENDIX A

Florida Department of Environmental Regulation
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

Effective Date: December 10, 1990
DER Application No. _____
(If used by DER)

Closure Assessment Form

Owners of storage tank systems that are replacing, removing or closing in place storage tanks shall use this form to demonstrate that a sto system closure assesment was performed in accordance with Rule 17-761 or 17-762, Florida Administrative Code. Eligible Early Detection Incentive (EDI) and Reimbursement Program sites do not have to perform a closure assessment.

Please Print or Type
Complete All Applicable Blanks

1. Date: April 12, 1996
2. DER Facility ID Number: 578516386
3. County: Santa Rosa County
4. Facility Name: Whiting Field, Naval Air Station
5. Facility Owner: Whiting Field, Naval Air Station
6. Facility Address: HWY 87 A, Milton, Florida 32570
7. Mailing Address: HWY 87 A, Milton, Florida 32570
8. Telephone Number: (904) 623-7181
9. Facility Operator: Whting Field, NAS
10. Are the Storage Tank(s): (Circle one or both) A. Aboveground or B. Underground
11. Type of Product(s) Stored: Jet Fuel #5 (JP-5)
12. Were the Tank(s): (Circle one) A. Replaced B. Removed C. Closed in Place D. Upgraded (aboveground tanks o
13. Number of Tanks Closed: Product line ONLY
14. Age of Tanks: N/A

Facility Assessment Information

Yes	No	Not Applicable	
[ ]	[ ]	X	1. Is the facility participating in the Florida Petroleum Liability Insurance and Restoration Program (FPLIRP)?
[X]	[ ]		2. Was a Discharge Reporting Form submitted to the Department? If yes, When: _____ Where: Escambia Co. Public Works
[ ]	[X]		3. Is the depth to ground water less than 20 feet?
[X]	[ ]	[ ]	4. Are monitoring wells present around the storage system? If yes, specify type: [X] Water monitoring [ ] Vapor monitoring
[ ]	[ ]	[X]	5. Is there free product present in the monitoring wells or within the excavation?
[ ]	[ ]	[X]	6. Were the petroleum hydrocarbon vapor levels in the soils greater than 500 parts per million for gasoline? Specify sample type: [ ] Vapor Monitoring wells [ ] Soil sample(s)
[X]	[ ]	[ ]	7. Were the petroleum hydrocarbon vapor levels in the soils greater than 50 parts per million for diesel/kerosen Specify sample type: [ ] Vapor Monitoring wells [X] Soil sample(s)
[ ]	[ ]	[X]	8. Were the analytical laboratory results of the ground water sample(s) greater than the allowable state target leve (See target levels on reverse side of this form and supply laboratory data sheets)
[ ]	[ ]	[X]	9. If a used oil storage system, did a visual inspection detect any discolored soil indicating a release?
[ ]	[X]		10. Are any potable wells located within ¼ of a mile radius of the facility?
[ ]	[X]		11. Is there a surface water body within ¼ mile radius of the site? If yes, indicate distance: _____

Northwest District
160 Governmental Center
Pensacola, Florida 32501-5794
904 436 8300

Northeast District
7825 Baymeadows Way, Suite B-200
Jacksonville, Florida 32256
904 488 4805

Central District
3319 Maguire Blvd., Suite 232
Orlando, Florida 32803-3767
407 894 7555

Southwest District
4520 Oak Fair Blvd.
Tampa, Florida 33610-7347
813 623 5561

South District
2269 Bay St.
Fort Myers, Florida 33901-2896
813 332 6975

Southeast District
1900 S. Congress Ave., Suite A
West Palm Beach, Florida 33406
407 433 2650

DER Form #	17 761.900(1)
Form Title	Closure Assessment Form
Effective Date	December 10, 1990
DER Application No.	(Filled in by DER)

12. A detailed drawing or sketch of the facility that includes the storage system location, monitoring wells, buildings, storm drains, sample locations and dispenser locations must accompany this form.
13. If a facility has a pollutant storage tank system that has both gasoline and kerosene/diesel stored on site, both EPA Method 602 and EPA Method 610 must be performed on the ground water samples obtained.
14. Amount of soils removed and receipt of proper disposal.
15. If yes is answered to any one of questions 5-9, a Discharge Reporting Form 17-761.900(1) indicating a suspected release shall be submitted to the Department within one working day.
16. A copy of this form and any attachments must be submitted to the Department's district office in your area and to the locally administered program office under contract with the Department within 60 days of completion of tank removal or filling a tank with an inert material.

Signature of Owner

Chris E. Brockmeier

Signature of Person Performing Assessment

Date

4/12/96

Date

CHRIS E. BROCKMEIER, E.I. - PROJECT ENGINEER - JIM STIDHAM & ASSOC, INC.

Title of Person Performing Assessment

State Ground Water Target Levels That Affect A Pollutant Storage Tank System Closure Assessment

State ground water target levels are as follows:

1. For gasoline (EPA Method 602):
   a. Benzene 1 ug/l
   b. Total VOA 50 ug/l
      - Benzene
      - Toluene
      - Total Xylenes
      - Ethylbenzene
   c. Methyl Test-Butyl Ether (MTBE) 50 ug/l

2. For kerosene/diesel (EPA Method 610):
   a. Polynuclear Aromatic Hydrocarbons (PAHS) (Best achievable detection limit, 10 ug/l maximum)

APPENDIX B

Florida Department of Environmental Regulation
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

DER Form # 17-761.900(1)
Form Title Discharge Reporting Form
Effective Date December 10, 1990
DER Application No. _____ (Filled in by DER)

Discharge Reporting Form

Use this form to notify the Department of Environmental Regulation of:

1. Results of tank tightness testing that exceed allowable tolerances within ten days of receipt of test result.
2. Petroleum discharges exceeding 25 gallons on pervious surfaces as described in Section 17-761.460 F.A.C. within one working day of discovery.
3. Hazardous substance (CERCLA regulated), discharges exceeding applicable reportable quantities established in 17-761.460(2) F.A.C., with one working day of the discovery.
4. Within one working day of discovery of suspected releases confirmed by: (a) released regulated substances or pollutants discovered in the surrounding area, (b) unusual and unexplained storage system operating conditions, (c) monitoring results from a leak detection meth or from a tank closure assessment that indicate a release may have occurred, or (d) manual tank gauging results for tanks of 550 gallons or less, exceeding ten gallons per weekly test or five gallons averaged over four consecutive weekly tests.

Mail to the DER District Office in your area listed on the reverse side of this form

PLEASE PRINT OR TYPE
Complete all applicable blanks

1. DER Facility ID Number: 578516386 2. Tank Number: Product Line 3. Date: April 12, 1996
4. Facility Name: Whiting Field, Naval Air Staion (NAS)
   Facility Owner or Operator: Whiting Field, NAS
   Facility Address: HWY 87 A, Milton, Florida 32570
   Telephone Number: (904) 623-7181 County: Santa Rosa County
   Mailing Address: HWY 87 A, Milton, Florida 32570
5. Date of receipt of test results or discovery: April 12, 1996 month/day/ye
6. Method of initial discovery. (circle one **only**)
   A. Liquid detector (automatic or manual)
   B. Vapor detector (automatic or manual)
   C. Tightness test (underground tanks only).
   D. Emptying and Inspection.
   E. Inventory control.
   F. Vapor or visible signs of a discharge in the vicini
   G. Closure: Greater 50 ppm (expla
   H. Other: _____
7. Estimated number of gallons discharged: Unknown
8. What part of storage system has leaked? (circle all that apply) A. Dispenser B. Pipe C. Fitting D. Tank E. Unknown
9. Type of regulated substance discharged. (circle one)
   A. leaded gasoline
   B. unleaded gasoline
   C. gasohol
   D. vehicular diesel
   F. aviation gas
   (G) jet fuel
   L. used/waste oil
   M. diesel
   O. new/lube oil
   V. hazardous substance includes pesticides, ammoni chlorine and derivatives (write in name or Chemical Abstract Service CAS number) _____
   Z. other (write in name) _____
10. Cause of leak. (circle all that apply)
    (A) Unknown
    B. Split
    C. Loose connection
    D. Corrosion
    E. Puncture
    F. Installation failure
    G. Spill _____
    H. Overfill
    I. Other (specify) Unknown
11. Type of financial responsibility. (circle one)
    A. Third party insurance provided by the state insurance contractor
    B. Self-insurance pursuant to Chapter 17-769.500 F.A.C.
    (C) Not applicable
    D. None
12. **To the best of my knowledge and belief all information submitted on this form is true, accurate, and complete.**

Printed Name of Owner, Operator or Authorized Representative

Signature of Owner, Operator or Authorized Representative

APPENDIX D

BROWN & ROOT ENVIRONMENTAL STANDARD OPERATING PROCEDURES AND STANDARD FIELD FORMS

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

FIGURES

1.0 PURPOSE

The purpose of this document is to establish standard procedures and technical guidance on borehole and sample logging.

2.0 SCOPE

These procedures provide descriptions of the standard techniques for borehole and sample logging. These techniques shall be used for each boring logged to provide consistent descriptions of subsurface lithology. While experience is the only method to develop confidence and accuracy in the description of soil and rock, the field geologist/engineer can do a good job of classification by careful, thoughtful observation and by being consistent throughout the classification procedure.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Site Geologist. Responsible for supervising all boring activities and assuring that each borehole is completely logged. If more than one rig is being used on site, the Site Geologist must make sure that each field geologist is properly trained in logging procedures. A brief review or training session may be necessary prior to the start up of the field program and/or upon completion of the first boring.

5.0 PROCEDURES

The classification of soil and rocks is one of the most important jobs of the field geologist/engineer. To maintain a consistent flow of information, it is imperative that the field geologist/engineer understand and accurately use the field classification system described in this SOP. This identification is based on visual examination and manual tests.

5.1 Materials Needed

When logging soil and rock samples, the geologist or engineer may be equipped with the following:

- Rock hammer
- Knife
- Camera
- Dilute hydrochloric acid (HCl)
- Ruler (marked in tenths and hundredths of feet)
- Hand Lens

5.2 Classification of Soils

All data shall be written directly on the boring log (Figure 1) or in a field notebook if more space is needed. Details on filling out the boring log are discussed in Section 5.5.

5.2.1 USCS Classification

Soils are to be classified according to the Unified Soil Classification System (USCS). This method of classification is detailed in Figure 1 (Continued).

FIGURE 1

BORING LOG (EXAMPLE)

BORING LOG

Page ___ of ___

PROJECT NAME: ____________________

PROJECT NUMBER: ____________________ BORING NUMBER: ____________________

DRILLING COMPANY: ____________________ DATE: ____________________

DRILLING RIG: ____________________ GEOLOGIST: ____________________

DRILLER: ____________________

Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/ Consistency or Rock Hardness	Color	Material Classification	U S C S *	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
		[redacted]											

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

Remarks: ____________________

Drilling Area Background (ppm): ____

Converted to Well: Yes ______ No ______ Well I.D. #: ____________________

FIGURE 1 (CONTINUED)

Subject: BOREHOLE AND SAMPLE LOGGING

Number: GH-1.5

Revision: 0

Page: 5 of 21

Effective Date: 03/01/96

SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

COARSE-GRAINED SOILS More Than Half of Material is LARGER Than No. 200 Sieve Size				
FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger than 3 Inches and Basing Fractions on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES
GRAVELS (50% or more of coarse fraction retained on No. 4 sieve)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel sand mixtures, little or no fines.
	GRAVELS W/FINES (More than 12% fines)	Non plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
SANDS (50% or more of coarse fraction passes No. 4 sieve)	CLEAN SANDS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.
	SANDS W/FINES (More than 12% fines)	Non plastic fines (for identification procedures, see ML)	SM	Silty sands, poorly graded sand silt mixtures.
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.

FINE-GRAINED SOILS More Than Half of Material is SMALLER Than No. 200 Sieve Size					
FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger than 3 Inches and Basing Fractions on Estimated Weights)				GROUP SYMBOL	TYPICAL NAMES
Identification Procedures on Fraction Smaller than No. 40 Sieve Size	DRY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)		
SILTS AND CLAYS Liquid limit <50	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
	Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Slight to Medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity.
SILTS AND CLAYS Liquid limit >50	Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts.
	High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
	Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			PT	Peat and other organic soils

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW GC, well graded gravel sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS

DESIGNATION	STANDARD PENETRATION RESISTANCE BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Loose	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNC COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENNESS		
Descriptive Terms	Screwdriver or Knife Effects	Hammer Effects	Descriptive Terms	Abbreviations	Spacing
Soft	Easily Gouged	Crushes when pressed with hammer	Very Broken	(V. Br.)	0-3"
Medium Soft	Can be Gouged	Breaks (one blow); crumbly edges	Broken	(Br.)	3"-1'
Medium Hard	Can be scratched	Breaks (one blow); sharp edges	Blocky	(Bl.)	1'-3'
Hard	Cannot be scratched	Breaks conchoidally (several blows); sharp edges	Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES

S-3" Split-Barrel Sample

ST-3" O.D. Undisturbed Sample

O - Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES

N-NX (Conventional) Core (2.1/8" O.D.)

Q-HQ (Wireline) Core (3.7/8" O.D.)

Z - Other Core Sizes, Specify in Remarks

WATER LEVELS

12/18
▽ 12.4' Initial Level w/Date & Depth

12/18
▼ 12.4' Stabilized Level w/Date & Depth

This method of classification identifies soil types on the basis of grain size and cohesiveness.

Fine-grained soils, or fines, are smaller than the No. 200 sieve and are of two types: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition. The careful study of the USCS will aid in developing the competence and consistency necessary for the classification of soils.

Coarse-grained soils shall be divided into rock fragments, sand, or gravel. The terms sand and gravel not only refer to the size of the soil particles but also to their depositional history. To insure accuracy in description, the term rock fragments shall be used to indicate angular granular materials resulting from the breakup of rock. The sharp edges typically observed indicate little or no transport from their source area, and therefore the term provides additional information in reconstructing the depositional environment of the soils encountered. When the term "rock fragments" is used it shall be followed by a size designation such as "(1/4 inchΦ-1/2 inchΦ)" or "coarse-sand size" either immediately after the entry or in the remarks column. The USCS classification would not be affected by this variation in terms.

5.2.2 Color

Soil colors shall be described utilizing a single color descriptor preceded, when necessary, by a modifier to denote variations in shade or color mixtures. A soil could therefore be referred to as "gray" or "light gray" or "blue-gray." Since color can be utilized in correlating units between sampling locations, it is important for color descriptions to be consistent from one boring to another.

Colors must be described while the sample is still moist. Soil samples shall be broken or split vertically to describe colors. Samplers tend to smear the sample surface creating color variations between the sample interior and exterior.

The term "mottled" shall be used to indicate soils irregularly marked with spots of different colors. Mottling in soils usually indicates poor aeration and lack of good drainage.

Soil Color Charts shall not be used unless specified by the project manager.

5.2.3 Relative Density and Consistency

To classify the relative density and/or consistency of a soil, the geologist is to first identify the soil type. Granular soils contain predominantly sands and gravels. They are noncohesive (particles do not adhere well when compressed). Finer-grained soils (silts and clays) are cohesive (particles will adhere together when compressed).

The density of noncohesive, granular soils is classified according to standard penetration resistances obtained from split-barrel sampling performed according to the methods detailed in Standard Operating Procedures GH-1.3 and SA-1.2. Those designations are:

Designation	Standard Penetration Resistance (Blows per Foot)
Very loose	0 to 4
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split-barrel sampler with a 2-inch outside diameter 12 inches into the material using a 140-pound hammer falling freely through 30 inches. The sampler is driven through an 18-inch sample interval, and the number of blows is recorded for each 6-inch increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the last 12 inches of each sample interval. It is important to note that if gravel or rock fragments are broken by the sampler or if rock fragments are lodged in the tip, the resulting blow count will be erroneously high, reflecting a higher density than actually exists. This shall be noted on the log and referenced to the sample number. Granular soils are given the USCS classifications GW, GP, GM, SW, SP, SM, GC, or SC (see Figure 1).

The consistency of cohesive soils is determined by performing field tests and identifying the consistency as shown in Figure 2.

Cohesive soils are given the USCS classifications ML, MH, CL, CH, OL, or OH (see Figure 1).

The consistency of cohesive soils is determined either by blow counts, a pocket penetrometer (values listed in the table as Unconfined Compressive Strength), or by hand by determining the resistance to penetration by the thumb. The pocket penetrometer and thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 foot of the sample in the split-barrel sampler. The sample shall be broken in half and the thumb or penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil. Consistency shall not be determined solely by blow counts. One of the other methods shall be used in conjunction with it. The designations used to describe the consistency of cohesive soils are shown in Figure 2.

FIGURE 2

CONSISTENCY FOR COHESIVE SOILS

Consistency	Standard Penetration Resistance (Blows per Foot)	Unconfined Compressive Strength (Tons/Sq. Foot by pocket penetration)	Field Identification
Very soft	0 to 2	Less than 0.25	Easily penetrated several inches by fist
Soft	2 to 4	0.25 to 0.50	Easily penetrated several inches by thumb
Medium stiff	4 to 8	0.50 to 1.0	Can be penetrated several inches by thumb with moderate effort
Stiff	8 to 15	1.0 to 2.0	Readily indented by thumb but penetrated only with great effort
Very stiff	15 to 30	2.0 to 4.0	Readily indented by thumbnail
Hard	Over 30	More than 4.0	Indented with difficulty by thumbnail

5.2.4 Weight Percentages

In nature, soils are comprised of particles of varying size and shape, and are combinations of the various grain types. The following terms are useful in the description of soil:

Terms of Identifying Proportion of the Component	Defining Range of Percentages by Weight
Trace	0 - 10 percent
Some	11 - 30 percent
Adjective form of the soil type (e.g., "sandy")	31 - 50 percent

Examples:

- Silty fine sand: 50 to 69 percent fine sand, 31 to 50 percent silt.
- Medium to coarse sand, some silt: 70 to 80 percent medium to coarse sand, 11 to 30 percent silt.
- Fine sandy silt, trace clay: 50 to 68 percent silt, 31 to 49 percent fine sand, 1 to 10 percent clay.
- Clayey silt, some coarse sand: 70 to 89 percent clayey silt, 11 to 30 percent coarse sand.

5.2.5 Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgment. A suggested parameter for this would be calling a soil wet if rolling it in the hand or on a porous surface liberates water, i.e., dirties or muddies the surface. Whatever method is adopted for describing moisture, it is important that the method used by an individual remains consistent throughout an entire drilling job.

Laboratory tests for water content shall be performed if the natural water content is important.

5.2.6 Stratification

Stratification can only be determined after the sample barrel is opened. The stratification or bedding thickness for soil and rock is depending on grain size and composition. The classification to be used for stratification description is shown in Figure 3.

5.2.7 Texture/Fabric/Bedding

The texture/fabric/bedding of the soil shall be described. Texture is described as the relative angularity of the particles: rounded, subrounded, subangular, and angular. Fabric shall be noted as to whether the particles are flat or bulky and whether there is a particular relation between particles (i.e., all the flat particles are parallel or there is some cementation). The bedding or structure shall also be noted (e.g., stratified, lensed, nonstratified, heterogeneous varved).

FIGURE 3

BEDDING THICKNESS CLASSIFICATION

Thickness (metric)	Thickness (Approximate English Equivalent)	Classification
> 1.0 meter	> 3.3'	Massive
30 cm - 1 meter	1.0' - 3.3'	Thick Bedded
10 cm - 30 cm	4" - 1.0'	Medium Bedded
3 cm - 10 cm	1" - 4"	Thin Bedded
1 cm - 3 cm	2/5" - 1"	Very Thin Bedded
3 mm - 1 cm	1/8" - 2/5"	Laminated
1 mm - 3 mm	1/32" - 1/8"	Thinly Laminated
< 1 mm	<1/32"	Micro Laminated

(Weir, 1973 and Ingram, 1954)

5.2.8 Summary of Soil Classification

In summary, soils shall be classified in a similar manner by each geologist/engineer at a project site. The hierarchy of classification is as follows:

- Density and/or consistency
- Color
- Plasticity (Optional)
- Soil types
- Moisture content
- Stratification
- Texture, fabric, bedding
- Other distinguishing features

5.3 Classification of Rocks

Rocks are grouped into three main divisions: sedimentary, igneous and metamorphic. Sedimentary rocks are by far the predominant type exposed at the earth's surface. The following basic names are applied to the types of rocks found in sedimentary sequences:

- Sandstone - Made up predominantly of granular materials ranging between 1/16 to 2 mm in diameter.
- Siltstone - Made up of granular materials less than 1/16 to 1/256 mm in diameter. Fractures irregularly. Medium thick to thick bedded.
- Claystone - Very fine-grained rock made up of clay and silt-size materials. Fractures irregularly. Very smooth to touch. Generally has irregularly spaced pitting on surface of drilled cores.
- Shale - A fissile very fine-grained rock. Fractures along bedding planes.
- Limestone - Rock made up predominantly of calcite ($CaCO_3$). Effervesces strongly upon the application of dilute hydrochloric acid.
- Coal - Rock consisting mainly of organic remains.
- Others - Numerous other sedimentary rock types are present in lesser amounts in the stratigraphic record. The local abundance of any of these rock types is dependent upon the depositional history of the area. Conglomerate, halite, gypsum, dolomite, anhydrite, lignite, etc. are some of the rock types found in lesser amounts.

In classifying a sedimentary rock the following hierarchy shall be noted:

- Rock type
- Color
- Bedding thickness
- Hardness
- Fracturing
- Weathering
- Other characteristics

5.3.1 Rock Type

As described above, there are numerous types of sedimentary rocks. In most cases, a rock will be a combination of several grain types, therefore, a modifier such as a sandy siltstone, or a silty sandstone can be used. The modifier indicates that a significant portion of the rock type is composed of the modifier. Other modifiers can include carbonaceous, calcareous, siliceous, etc.

Grain size is the basis for the classification of clastic sedimentary rocks. Figure 4 is the Udden-Wentworth classification that will be assigned to sedimentary rocks. The individual boundaries are slightly different than the USCS subdivision for soil classification. For field determination of grain sizes, a scale can be used for the coarse grained rocks. For example, the division between siltstone and claystone may not be measurable in the field. The boundary shall be determined by use of a hand lens. If the grains cannot be seen with the naked eye but are distinguishable with a hand lens, the rock is a siltstone. If the grains are not distinguishable with a hand lens, the rock is a claystone.

5.3.2 Color

The color of a rock can be determined in a similar manner as for soil samples. Rock core samples shall be classified while wet, when possible, and air cored samples shall be scraped clean of cuttings prior to color classifications.

Rock color charts shall not be used unless specified by the Project Manager.

5.3.3 Bedding Thickness

The bedding thickness designations applied to soil classification (see Figure 3) will also be used for rock classification.

5.3.4 Hardness

The hardness of a rock is a function of the compaction, cementation, and mineralogical composition of the rock. A relative scale for sedimentary rock hardness is as follows:

- Soft - Weathered, considerable erosion of core, easily gouged by screwdriver, scratched by fingernail. Soft rock crushes or deforms under pressure of a pressed hammer. This term is always used for the hardness of the saprolite (decomposed rock which occupies the zone between the lowest soil horizon and firm bedrock).
- Medium soft - Slight erosion of core, slightly gouged by screwdriver, or breaks with crumbly edges from single hammer blow.
- Medium hard - No core erosion, easily scratched by screwdriver, or breaks with sharp edges from single hammer blow.
- Hard - Requires several hammer blows to break and has sharp conchoidal breaks. Cannot be scratched with screwdriver.

Note the difference in usage here of the works "scratch" and "gouge." A scratch shall be considered a slight depression in the rock (do not mistake the scraping off of rock flour from drilling with a scratch in the rock itself), while a gouge is much deeper.

FIGURE 4

GRAIN SIZE CLASSIFICATION FOR ROCKS

Particle Name	Grain Size Diameter
Cobbles	> 64 mm
Pebbles	4 - 64 mm
Granules	2 - 4 mm
Very Coarse Sand	1 - 2 mm
Coarse Sand	0.5 - 1 mm
Medium Sand	0.25 - 0.5 mm
Fine Sand	0.125 - 0.25 mm
Very Fine Sand	0.0625 - 0.125 mm
Silt	0.0039 - 0.0625 mm

After Wentworth, 1922

5.3.5 Fracturing

The degree of fracturing or brokenness of a rock is described by measuring the fractures or joint spacing. After eliminating drilling breaks, the average spacing is calculated and the fracturing is described by the following terms:

- Very broken (V. BR.) - Less than 2-inch spacing between fractures
- Broken (BR.) - 2-inch to 1-foot spacing between fractures
- Blocky (BL) - 1- to 3-foot spacing between fractures
- Massive (M.) - 3 to 10-foot spacing between fractures

The structural integrity of the rock can be approximated by calculating the Rock Quality Designation (RQD) of cores recovered. The RQD is determined by adding the total lengths of all pieces exceeding 4 inches and dividing by the total length of the coring run, to obtain a percentage.

Method of Calculating RQD
(After Deere, 1964)

$$RQD\ \% = r/l \times 100$$

r = Total length of all pieces of the lithologic unit being measured, which are greater than 4 inches length, and have resulted from natural breaks. Natural breaks include slickensides, joints, compaction slicks, bedding plane partings (not caused by drilling), friable zones, etc.

l = Total length of the coring run.

5.3.6 Weathering

The degree of weathering is a significant parameter that is important in determining weathering profiles and is also useful in engineering designs. The following terms can be applied to distinguish the degree of weathering:

- Fresh - Rock shows little or no weathering effect. Fractures or joints have little or no staining and rock has a bright appearance.
- Slight - Rock has some staining which may penetrate several centimeters into the rock. Clay filling of joints may occur. Feldspar grains may show some alteration.
- Moderate - Most of the rock, with exception of quartz grains, is stained. Rock is weakened due to weathering and can be easily broken with hammer.
- Severe - All rock including quartz grains is stained. Some of the rock is weathered to the extent of becoming a soil. Rock is very weak.

5.3.7 Other Characteristics

The following items shall be included in the rock description:

- Description of contact between two rock units. These can be sharp or gradational.
- Stratification (parallel, cross stratified).

- Description of any filled cavities or vugs.
- Cementation (calcareous, siliceous, hematitic).
- Description of any joints or open fractures.
- Observation of the presence of fossils.
- Notation of joints with depth, approximate angle to horizontal, any mineral filling or coating, and degree of weathering.

All information shown on the boring logs shall be neat to the point where it can be reproduced on a copy machine for report presentation. The data shall be kept current to provide control of the drilling program and to indicate various areas requiring special consideration and sampling.

5.3.8 Additional Terms Used in the Description of Rock

The following terms are used to further identify rocks:

- Seam - Thin (12 inches or less), probably continuous layer.
- Some - Indicates significant (15 to 40 percent) amounts of the accessory material. For example, rock composed of seams of sandstone (70 percent) and shale (30 percent) would be "sandstone -- some shale seams."
- Few - Indicates insignificant (0 to 15 percent) amounts of the accessory material. For example, rock composed of seam of sandstone (90 percent) and shale (10 percent) would be "sandstone -- few shale seams."
- Interbedded - Used to indicate thin or very thin alternating seams of material occurring in approximately equal amounts. For example, rock composed of thin alternating seams of sandstone (50 percent) and shale (50 percent) would be "interbedded sandstone and shale."
- Interlayered - Used to indicate thick alternating seams of material occurring in approximately equal amounts.

The preceding sections describe the classification of sedimentary rocks. The following are some basic names that are applied to igneous rocks:

- Basalt - A fine-grained extrusive rock composed primarily of calcic plagioclase and pyroxene.
- Rhyolite - A fine-grained volcanic rock containing abundant quartz and orthoclase. The fine-grained equivalent of a granite.
- Granite - A coarse-grained plutonic rock consisting essentially of alkali feldspar and quartz.
- Diorite - A coarse-grained plutonic rock consisting essentially of sodic plagioclase and hornblende.
- Gabbro - A coarse-grained plutonic rock consisting of calcic plagioclase and clinopyroxene. Loosely used for any coarse-grained dark igneous rock.

The following are some basic names that are applied to metamorphic rocks:

- Slate - A very fine-grained foliated rock possessing a well developed slaty cleavage. Contains predominantly chlorite, mica, quartz, and sericite.
- Phyllite - A fine-grained foliated rock that splits into thin flaky sheets with a silky sheen on cleavage surface.
- Schist - A medium to coarse-grained foliated rock with subparallel arrangement of the micaceous minerals which dominate its composition.
- Gneiss - A coarse-grained foliated rock with bands rich in granular and platy minerals.
- Quartzite - A fine- to coarse-grained nonfoliated rock breaking across grains, consisting essentially of quartz sand with silica cement.

5.4 Abbreviations

Abbreviations may be used in the description of a rock or soil. However, they shall be kept at a minimum. Following are some of the abbreviations that may be used:

C - Coarse	Lt - Light	Yl - Yellow
Med - Medium	BR - Broken	Or - Orange
F - Fine	BL - Blocky	SS - Sandstone
V - Very	M - Massive	Sh - Shale
Sl - Slight	Br - Brown	LS - Limestone
Occ - Occasional	Bl - Black	Fgr - Fine-grained
Tr - Trace		

5.5 Boring Logs and Documentation

This section describes in more detail the procedures to be used in completing boring logs in the field. Information obtained from the preceding sections shall be used to complete the logs. A sample boring log has been provided as Figure 5.

The field geologist/engineer shall use this example as a guide in completing each boring log. Each boring log shall be fully described by the geologist/engineer as the boring is being drilled. Every sheet contains space for 25 feet of log. Information regarding classification details is provided either on the back of the boring log or on a separate sheet, for field use.

FIGURE 5
COMPLETED BORING LOG (EXAMPLE)

BORING LOG

Page 1 of 1

PROJECT NAME: NSB - SITE
PROJECT NUMBER: 9594
DRILLING COMPANY: SOILTEST CO.
DRILLING RIG: CME-55
BORING NUMBER: SB/MW 1
DATE: 3/8/96
GEOLOGIST: SJ CONTI
DRILLER: R. ROCK

Sample No. and Type or RQD	Depth (Ft) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft) or Screened Interval	MATERIAL DESCRIPTION: Soil Density/Consistency or Rock Hardness	Color	Material Classification	USCS*	Remarks	PID/FID Reading (ppm): Sample	Sampler BZ	Borehole**	Driller BZ**
S-1	0.0	7/6	1.5/2.0		M DENSE	BRN	SILTY SAND - SOME	SM	MOIST SL. ORG ODOR	5	0	0	0
C 0800	2.0	9/10				TO BLK	ROCK FR; TR BRICKS						
							(FILL)		FILL TO 4'±				
	4.0			4.0									
S-2 C		5/7	2.9/2.0		M DENSE	BRN	SILTY SAND - TR FINE	SM	MOIST - W ODOR	10	0	-	-
0810	6.0	9/8					GRAVEL		NAT. MATL. - NO SAMPLE				
	•			7'▽ =					SB01-0406 FOR ANALYSIS				
	8.0			8.0									
S-3 C		6/8	1.9/2.0		DENSE	TAN BRN	FINE TO COARSE SAND	SW	WET	0	0	0	0
0820	10.0	17/16					TR. F. GRAVEL		WIT WATER ~ 7'±				
	12.0			12.0									
S-4 C		7/6	1.6/2.0		STIFF	GRAY	SILTY CLAY	CL	MOIST → WET	0	.5	-	-
0830	14.0	5/8											
	15.0			15.0					AUGER REF @ 15'				
				LIMSTONE 16	M HARD	BRN	SILTSTONE	WBR	WEATHERED				
									LO L JNTS @ 15.5				
9/5	①		4.0/5.0						WATER STAINS @ 16.5, 17.1, 17.5	0	0	0	0
				19'					LOSING SOME				
	20.0				HARD	GRAY	SANDSTONE - SOME	BR	DRILL H2O @ 17'±				
							SILTSTONE		SET TEMP 6" CAS TO 15.5				
4.8/5.0	②		5.0/5.0						SET 2"Φ PVC SCREEN 16-25	0	0	0	0
									SAND 14-25				
	25.0			25					PELLETS 12-14				

* When rock coring, enter rock brokenness.
** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated response read.

• 1-20Z
1-80Z

Drilling Area Background (ppm): 0

Remarks: CME-55 R16 4¼" ID HSA - 9" OD ±
2" SPLIT SPOONS ■ 140 LB HAM[redacted] - 30" DROP
NX CORE IN BEDROCK RUN [redacted] = 15 min

Converted to Well: Yes ✓ No ____ Well I.D. #: MW-1

5.5.1 Soil Classification

- Identify site name, boring number, job number, etc. Elevations and water level data to be entered when surveyed data is available.

- Enter sample number (from SPT) under appropriate column. Enter depth sample was taken from (1 block = 1 foot). Fractional footages, i.e., change of lithology at 13.7 feet, shall be lined off at the proportional location between the 13- and 14-foot marks. Enter blow counts (Standard Penetration Resistance) diagonally (as shown). Standard penetration resistance is covered in Section 5.2.3.

- Determine sample recovery/sample length as shown. Measure the total length of sample recovered from the split-spoon sampler, including material in the drive shoe. Do not include cuttings or wash material that may be in the upper portion of the sample tube.

- Indicate any change in lithology by drawing a line at the appropriate depth. For example, if clayey silt was encountered from 0 to 5.5 feet and shale from 5.5 to 6.0 feet, a line shall be drawn at this increment. This information is helpful in the construction of cross-sections. As an alternative, symbols may be used to identify each change in lithology.

- The density of granular soils is obtained by adding the number of blows for the last two increments. Refer to Density of Granular Soils Chart on back of log sheet. For consistency of cohesive soils refer also to the back of log sheet - Consistency of Cohesive Soils. Enter this information under the appropriate column. Refer to Section 5.2.3.

- Enter color of the material in the appropriate column.

- Describe material using the USCS. Limit this column for sample description only. The predominate material is described last. If the primary soil is silt but has fines (clay) - use clayey silt. Limit soil descriptors to the following:

  - Trace: 0 - 10 percent
  - Some: 11 - 30 percent
  - And/Or: 31 - 50 percent

- Also indicate under Material Classification if the material is fill or natural soils. Indicate roots, organic material, etc.

- Enter USCS symbol - use chart on back of boring log as a guide. If the soils fall into one of two basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example ML/CL or SM/SP.

- The following information shall be entered under the "Remarks" column and shall include, but is not limited by, the following:

  - Moisture - estimate moisture content using the following terms - dry, moist, wet and saturated. These terms are determined by the individual. Whatever method is used to determine moisture, be consistent throughout the log.

- Angularity - describe angularity of coarse grained particles using the terms angular, subangular, subrounded, or rounded. Refer to ASTM D 2488 or Earth Manual for criteria for these terms.

- Particle shape - flat, elongated, or flat and elongated.

- Maximum particle size or dimension.

- Water level observations.

- Reaction with HCl - none, weak, or strong.

• Additional comments:

- Indicate presence of mica, caving of hole, when water was encountered, difficulty in drilling, loss or gain of water.

- Indicate odor and Photoionization Detector (PID) or Flame Ionization Detector (FID) reading if applicable.

- Indicate any change in lithology by drawing a line through the lithology change column and indicate the depth. This will help when cross-sections are subsequently constructed.

- At the bottom of the page indicate type of rig, drilling method, hammer size and drop, and any other useful information (i.e., borehole size, casing set, changes in drilling method).

- Vertical lines shall be drawn (as shown in Figure 5) in columns 6 to 8 from the bottom of each sample to the top of the next sample to indicate consistency of material from sample to sample, if the material is consistent. Horizontal lines shall be drawn if there is a change in lithology, then vertical lines drawn to that point.

- Indicate screened interval of well, as needed, in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.2 Rock Classification

• Indicate depth at which coring began by drawing a line at the appropriate depth. Indicate core run depths by drawing coring run lines (as shown) under the first and fourth columns on the log sheet. Indicate RQD, core run number, RQD percent, and core recovery under the appropriate columns.

• Indicate lithology change by drawing a line at the appropriate depth as explained in Section 5.5.1.

• Rock hardness is entered under designated column using terms as described on the back of the log or as explained earlier in this section.

- Enter color as determined while the core sample is wet; if the sample is cored by air, the core shall be scraped clean prior to describing color.

- Enter rock type based on sedimentary, igneous or metamorphic. For sedimentary rocks use terms as described in Section 5.3. Again, be consistent in classification. Use modifiers and additional terms as needed. For igneous and metamorphic rock types use terms as described in Sections 5.3.8.

- Enter brokenness of rock or degree of fracturing under the appropriate column using symbols VBR, BR, BL, or M as explained in Section 5.3.5 and as noted on the back of the Boring Log.

- The following information shall be entered under the remarks column. Items shall include but are not limited to the following:

    - Indicate depths of joints, fractures and breaks and also approximate to horizontal angle (such as high, low), i.e., 70° angle from horizontal, high angle.

    - Indicate calcareous zones, description of any cavities or vugs.

    - Indicate any loss or gain of drill water.

    - Indicate drop of drill tools or change in color of drill water.

- Remarks at the bottom of Boring Log shall include:

    - Type and size of core obtained.

    - Depth casing was set.

    - Type of rig used.

- As a final check the boring log shall include the following:

    - Vertical lines shall be drawn as explained for soil classification to indicate consistency of bedrock material.

    - If applicable, indicate screened interval in the lithology column. Show top and bottom of screen. Other details of well construction are provided on the well construction forms.

5.5.3 Classification of Soil and Rock from Drill Cuttings

The previous sections describe procedures for classifying soil and rock samples when cores are obtained. However, some drilling methods (air/mud rotary) may require classification and borehole logging based on identifying drill cuttings removed from the borehole. Such cuttings provide only general information on subsurface lithology. Some procedures that shall be followed when logging cuttings are:

- Obtain cutting samples at approximately 5-foot intervals, sieve the cuttings (if mud rotary drilling) to obtain a cleaner sample, place the sample into a small sample bottle or "zip lock"

bag for future reference, and label the jar or bag (i.e. hole number, depth, date, etc.). Cuttings shall be closely examined to determine general lithology.

- Note any change in color of drilling fluid or cuttings, to estimate changes in lithology.
- Note drop or chattering of drilling tools or a change in the rate of drilling, to determine fracture locations or lithologic changes.
- Observe loss or gain of drilling fluids or air (if air rotary methods are used), to identify potential fracture zones.
- Record this and any other useful information onto the boring log as provided in Figure 1.

This logging provides a general description of subsurface lithology and adequate information can be obtained through careful observation of the drilling process. It is recommended that split-barrel and rock core sampling methods be used at selected boring locations during the field investigation to provide detailed information to supplement the less detailed data generated through borings drilled using air/mud rotary methods.

5.6 Review

Upon completion of the borings logs, copies shall be made and reviewed. Items to be reviewed include:

- Checking for consistency of all logs.
- Checking for conformance to the guideline.
- Checking to see that all information is entered in their respective columns and spaces.

6.0 REFERENCES

Unified Soil Classification System (USCS).

ASTM D2488, 1985.

Earth Manual, U.S. Department of the Interior, 1974.

7.0 RECORDS

Originals of the boring logs shall be retained in the project files.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

ATTACHMENTS (EXAMPLES)

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs and reports generally initiated and maintained for documenting Brown & Root Environmental field activities.

2.0 SCOPE

Documents presented within this procedure (or equivalents) shall be used for all Brown & Root Environmental field activities, as applicable. Other or additional documents may be required by specific client contracts.

3.0 GLOSSARY

None

4.0 RESPONSIBILITIES

Project Manager - The Project Manager is responsible for obtaining hardbound, controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all forms used in site activities (i.e., records, field reports, and upon the completion of field work, the site logbook) in the project's central file.

Field Operations Leader (FOL) - The Field Operations Leader is responsible for ensuring that the site logbook, notebooks, and all appropriate forms and field reports illustrated in this guideline (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time-frame.

5.0 PROCEDURES

5.1 Site Logbook

5.1.1 General

The site logbook is a hard-bound, paginated controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start or completion of borehole/trench/monitoring well installation or sampling activities
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues (level of protection observed, etc.)
- Weather conditions

A site logbook shall be maintained for each project. The site logbook shall be initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that onsite activities take place which involve Brown & Root Environmental or subcontractor personnel. Upon completion of the fieldwork, the site logbook must become part of the project's central file.

The following information must be recorded on the cover of each site logbook:

- Project name
- Brown & Root Environmental project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2), but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the site notebook in which the measurements are recorded (see Attachment A).

All logbook, notebook, and log sheet entries shall be made in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, the data shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook pages used must be signed and dated. The site logbook must also be signed by the Field Operations Leader at the end of each day.

5.1.2 Photographs

When movies, slides, or photographs are taken of a site or any monitoring location, they must be numbered sequentially to correspond to logbook entries. The name of the photographer, date, time, site location, site description, and weather conditions must be entered in the logbook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook. If possible, such techniques shall be avoided, since they can adversely affect the admissibility of photographs as evidence. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Adequate logbook notation and receipts must be compiled to account for routine film processing. Once processed, the slides of photographic prints shall be consecutively numbered and labeled according to the logbook descriptions. The site photographs and associated negatives must be docketed into the project's central file.

5.2 Site Notebooks

Key field team personnel may maintain a separate dedicated notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a separate site notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a site notebook.

5.3 Sample Forms

A summary of the forms illustrated in this procedure is shown as the listing of Attachments in the Table of Contents for this SOP. Forms may be altered or revised for project-specific needs contingent upon client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOP.

5.3.1 Sample Collection, Labeling, Shipment and Request for Analysis

5.3.1.1 Sample Log Sheet

Sample Log Sheets are used to record specified types of data while sampling. Attachments B-1 to B-4 are examples of Sample Log Sheets. The data recorded on these sheets are useful in describing the waste source and sample as well as pointing out any problems encountered during sampling. A log sheet must be completed for each sample obtained, including field quality control (QC) samples.

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B-5. Adhesive labels must be completed and applied to every sample container. Sample labels can usually be obtained from the appropriate Program source or are supplied from the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record Form

The Chain-of-Custody (COC) Record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site. One part of the completed form is retained by the field crew while the other two portions are sent to the laboratory. An example of a Chain-of-Custody Record form is provided as Attachment B-6. A supply of these forms are purchased and stocked by the field department of the various Brown & Root Environmental offices. Alternately, COC forms supplied by the laboratory may be used. Once the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed COC form (any discrepancies between the sample labels and COC form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the Brown & Root Environmental Project Manager). The COC form is signed and one of the remaining two parts are retained by the laboratory while the last part becomes part of the samples' corresponding analytical data package. Internal laboratory chain-of-custody procedures are documented in the Laboratory Quality Assurance Plan (LQAP).

5.3.1.4 Chain-of-Custody Seal

Attachment B-7 is an example of a custody seal. The Custody seal is also an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transit to the laboratory. The COC seals are signed and dated by the samplers and affixed across the opening edges of each cooler containing environmental samples. COC seals may be available from the laboratory; these seals may also be purchased from a supplier.

5.3.2 Geohydrological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

A groundwater level measurement sheet, shown in Attachment C-1 must be filled out for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. The pumping test data sheet (Attachment C-2) facilitates this task by standardizing the data collection format, and allowing the time interval for collection to be laid out in advance.

5.3.2.3 Packer Test Report Form

A packer test report form shown in Attachment C-3 must be completed for each well upon which a packer test is conducted following well installation.

5.3.2.4 Summary Log of Boring

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring (Attachment C-4) is used for this purpose and must be completed for each soil boring performed. In addition, if volatile organics are monitored on cores, samples or cuttings from the borehole (using HNU or OVA detectors), these results must be entered on the boring log (under the "Remarks" column) at the appropriate depth. The "Remarks" column can also be used to subsequently enter the laboratory sample number and the concentration of a few key analytical results. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

A Monitoring Well Construction Details Form must be completed for every monitoring well piezometer or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock), different forms are used (see Attachments C-5 through C-9). Similar forms are used for flush-mount well completions. The Monitoring Well Construction Details Form is not a controlled document.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log (Attachment C-10) must be filled out by the responsible field geologist or sampling technician.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of

equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log (Attachment D) which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device used in the field; entries must be made for each day the equipment is used.

5.4 Field Reports

The primary means of recording onsite activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation, but are not easily useful for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain onsite for extended periods of time and are thus not accessible for timely review by project management.

5.4.1 Weekly Status Reports

To facilitate timely review by project management, Xeroxed copies of logbook/notebook entries may be made for internal use. To provide timely oversight of onsite contractors, Daily Activities Reports are completed and submitted as described below.

It should be noted that in addition to the summaries described herein, other summary reports may also be contractually required.

5.4.2 Daily Activities Report

5.4.2.1 Description

The Daily Activities Report (DAR) documents the activities and progress for each day's field work. This report must be filled out on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring which involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors (Attachment E is an example of a Daily Activities Report).

5.4.2.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.2.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the Daily Activities Report to the Field Operations Leader (FOL) for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DAR reports are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the Project Manager.

6.0 ATTACHMENTS

Attachment A	TYPICAL SITE LOGBOOK ENTRY
Attachment B-1	EXAMPLE GROUNDWATER SAMPLE LOG SHEET
Attachment B-2	EXAMPLE SURFACE WATER SAMPLE LOG SHEET
Attachment B-3	EXAMPLE SOIL/SEDIMENT SAMPLE LOG SHEET
Attachment B-4	CONTAINER SAMPLE LOG SHEET FORM
Attachment B-5	SAMPLE LABEL
Attachment B-6	CHAIN-OF-CUSTODY RECORD FORM
Attachment B-7	CHAIN-OF-CUSTODY SEAL
Attachment C-1	EXAMPLE GROUNDWATER LEVEL MEASUREMENT SHEET
Attachment C-2	EXAMPLE PUMPING TEST DATA SHEET
Attachment C-3	PACKER TEST REPORT FORM
Attachment C-4	EXAMPLE BORING LOG
Attachment C-5	EXAMPLE OVERBURDEN MONITORING WELL SHEET
Attachment C-5A	EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)
Attachment C-6	EXAMPLE CONFINING LAYER MONITORING WELL SHEET
Attachment C-7	EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL
Attachment C-8	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK
Attachment C-8A	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK (FLUSHMOUNT)
Attachment C-9	EXAMPLE TEST PIT LOG
Attachment D	EXAMPLE EQUIPMENT CALIBRATION LOG
Attachment E	EXAMPLE DAILY ACTIVITIES RECORD
Attachment F	FIELD TRIP SUMMARY REPORT

ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY

START TIME: _____ DATE: _____

SITE LEADER: _____

PERSONNEL:

BROWN & ROOT ENV.	DRILLER	EPA
_____	_____	_____
_____	_____	_____
_____	_____	_____

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenney and fire hoses were set up.
2. Drilling activities at well ____ resumes. Rig geologist was _____. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well _____.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _____.
4. Well _____ drilled. Rig geologist was _____. See Geologist's Notebook, No. 2, page ____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _____.
8. Test pit _____ dug with cuttings placed in dump truck. Rig geologist was _____. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit ___ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

_____
Field Operations Leader

ATTACHMENT B-1
EXAMPLE GROUNDWATER SAMPLE LOG SHEET

GROUNDWATER

SAMPLE LOG SHEET

Page ____ of ____

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

☐ Domestic Well Data
☐ Monitoring Well Data
☐ Other Well Type: _____ Sampled By: _____
☐ QA Sample Type: _____ C.O.C. No.: _____

Sampling Data

Date: _____
Time: _____
Method: _____

pH	S.C.	Temp. (°C)	Turbidity	Color	TBD	TBD	TBD

Purge Data

Date: _____
Method: _____

	Volume	pH	S.C.	Temp. (°C)	Turbidity	Color	TBD	TBD
Monitor Reading (ppm):	Initial							
Well Casing Dia. & Material Type:	1							
Total Well Depth (TD):	2							
Static Water Level (WL):	3							
TD-WL (ft.) =	4							
One Casing Volume: (gal/L)	5							
Start Purge (hrs.):								
End Purge (hrs.):								
Total Purge Time (min):								
Total Amount Purged (gal/L):								

Analysis	Preservative	Container Requirements	Collected (✓)

Observations/Notes:

Circle If Applicable

MS/MSD	Duplicate ID No:	Signature(s):

TBD: To Be Determined

ATTACHMENT B-2
EXAMPLE SURFACE WATER SAMPLING LOG SHEET

SURFACE WATER SAMPLING LOG SHEET

Page ___ of ___

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

☐ Spring ☐ Pond Sampled By: _____

☐ Stream ☐ Lake

☐ Other _____

☐ QA Sample Type: _____ C.O.C. No.: _____

Sample Data		
Date and Time	Method	Depth

pH	S.C.	Temp. (°C)	Turbidity	Color	TBD	TBD	TBD

Analysis	Preservative	Container Requirements	Collected (✓)

Observations/Notes:

Circle if Applicable:	Signature(s):
MS/MSD | Duplicate ID No.:	

TBD: To Be Determined

ATTACHMENT B-3
EXAMPLE SOIL/SEDIMENT SINGLE SAMPLE LOG SHEET

SOIL/SEDIMENT
SINGLE SAMPLE LOG SHEET

Page ____ of ____

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

☐ Surface Soil
☐ Subsurface Soil
☐ Sediment
☐ Other _____
☐ QA Sample Type: _____

Sampled By: _____

C.O.C. No.: _____

Sample Method:

Depth Sampled:

Sample Date and Time:

Type of Sample
☐ Grab
☐ Composite
☐ Grab-Composite
☐ High Concentration
☐ Low Concentration

Composite Sample Data

Sample	Time	Color/Description

Grab Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)

Analyses	Container Requirements	Collected (✓)

Map:

Observations/Notes:

Circle if Applicable:

MS/MSD | Duplicate ID No:

Signature(s):

ATTACHMENT B-4
CONTAINER SAMPLE LOG SHEET FORM

Brown & Root Environmental

Page ___ of _

☐ Container Data

Case #: _____

By: _____

Project Site Name: _____ Project Site No. _____

Brown & Root Env. Source No. _____ Source Location: _____

Container Source	Container Description
☐ Drum ☐ Bung Top ☐ Lever Lock ☐ Bolted Ring ☐ Other _____ ☐ Bag/Sack ☐ Tank ☐ Other _____	Color: _____ Condition: _____ Markings: _____ Vol. of Contents: _____ Other: _____

Disposition of Sample	Sample Description	Layer 1	Layer 2	Layer 3
☐ Container Sampled ☐ Container opened but not sampled. Reason: _____ ☐ Container not opened. Reason: _____	Phase Color Viscosity % of Total Volume Other	☐Sol. ☐Liq. _____ ☐L ☐M ☐H _____ _____	☐Sol. ☐Liq. _____ ☐L ☐M ☐H _____ _____	☐Sol. ☐Liq. _____ ☐L ☐M ☐H _____ _____

Monitor Reading:	Type of Sample: ☐ Low Concentration ☐ High Concentration ☐ Grab ☐ Composite ☐ Grab-composite		
Sample Method:			
Sample Date & Time:	Sample Identification	Organic	Inorganic
Sampled by:			
Signature(s):			
Analysis:	Date Shipped		
	Time Shipped		
	Lab		
	Volume		

ATTACHMENT B-5

SAMPLE LABEL

Brown & Root Environmental PROJECT: _____

STATION LOCATION: _____

DATE: ____/____/____ TIME: _____ hrs.

MEDIA: WATER ☐ SOIL ☐ SEDIMENT ☐ _____ ☐

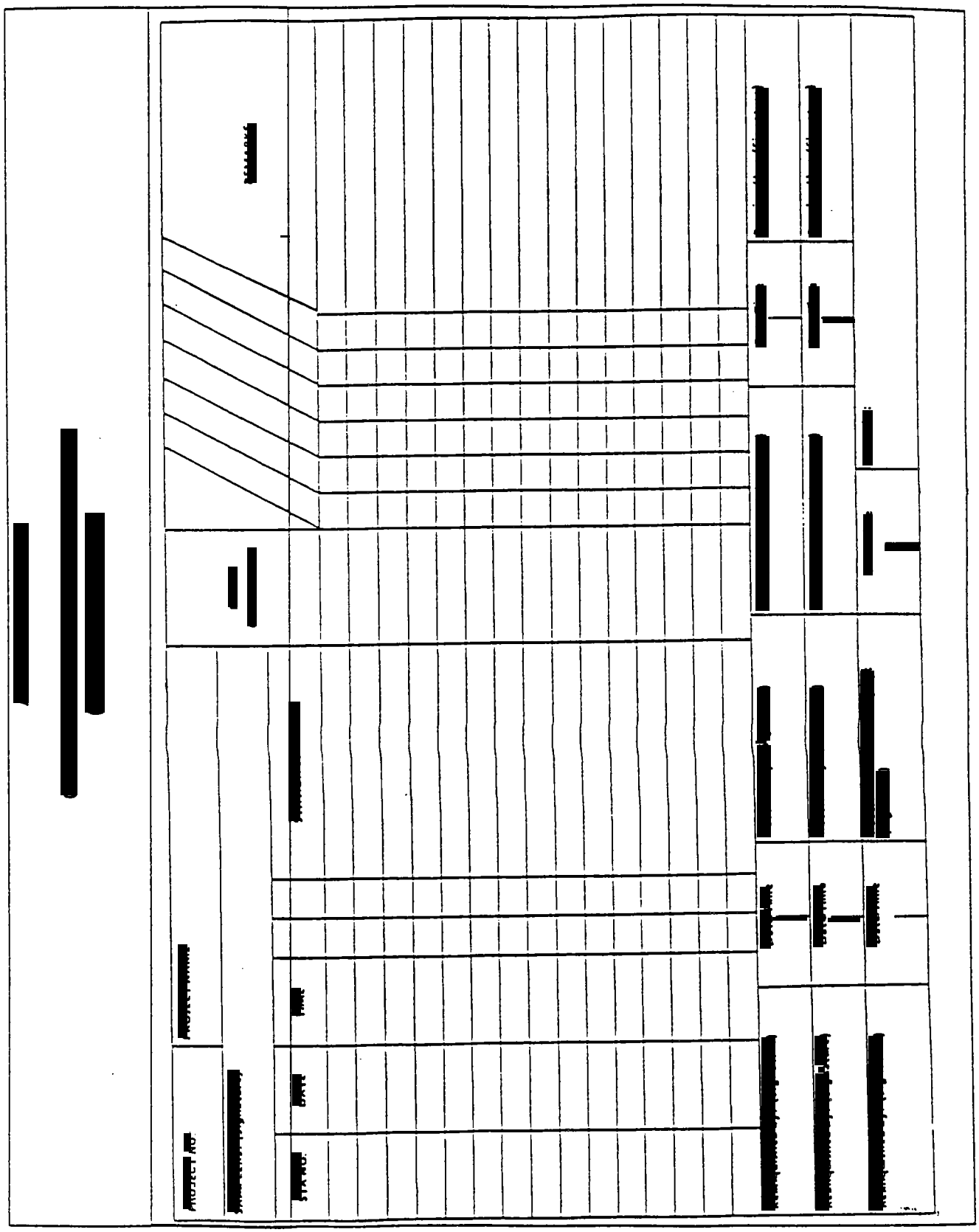
CONCENTRATION: LOW ☐ MEDIUM ☐ HIGH ☐

TYPE: GRAB ☐ COMPOSITE ☐

ANALYSIS	PRESERVATION
VOA ☐ BNAs ☐	Cool to 4°C ☐
PCBs ☐ PESTICIDES ☐	HNO_3 to pH < 2 ☐
METALS: TOTAL ☐ DISSOLVED ☐	NaOH to pH > 12 ☐
CYANIDE ☐	_____ ☐
_____ ☐	

Sampled by: _____

Remarks:



ATTACHMENT B-7

CHAIN-OF-CUSTODY SEAL

Signature Date CUSTODY SEAL	**CUSTODY SEAL** **Date** **Signature**

ATTACHMENT C-1
EXAMPLE GROUNDWATER LEVEL MEASUREMENT SHEET

GROUNDWATER LEVEL MEASUREMENT SHEET

Page ___ of ___

PROJECT NAME: _____ LOCATION: _____
PROJECT NUMBER: _____ MEASURING DEVICE: _____
PERSONNEL: _____ ADJUSTMENT FACTOR: _____
DATE: _____ REMARKS: _____
WEATHER CONDITIONS: _____

Well or Piezometer Number	Time	Elevation of Reference Point (Feet)*	Water Level Indicator Reading (Feet)*	Groundwater Elevation (Feet)*	Comments

*Measurements to nearest 0.01 foot.

Signature(s): _____

ATTACHMENT C-2
EXAMPLE PUMPING TEST DATA SHEET

PUMPING TEST DATA SHEET

Page ___ of ___

PROJECT NAME: _____
PROJECT NUMBER: _____
PUMPING TEST: [ ]
TEST NUMBER: _____
METHOD OF MEASUREMENT: _____
DATE(s): _____
STATIC H_2O LEVEL (ft) (SO) _____
PUMPING TEST PERFORMED BY: _____
REMARKS: _____

PUMPING WELL NUMBER: _____
MEASURED WELL NUMBER: _____
STEP DRAW DOWN TEST [ ]
MONITORING POINT: _____
DEPTH CORRECTION (ft) _____
PUMP SETTING (Ft. below monitoring point): _____
DISTANCE FROM PUMPING WELL (ft) (r): _____

MILITARY TIME	ELAPSED TIME SINCE PUMP START OR STOP (Min.)	WATER LEVEL (Ft.)	CORRECTION (Ft.)	DRAW DOWN OR RECOVERY (Ft.)	FLOW METER READING (Gals.)	PUMPING RATE (GPM)	REMARKS

SIGNATURE(s): _____

ATTACHMENT C-3

PACKER TEST REPORT FORM

PROJECT: ____________ PROJECT NO.: ____________ TEST NO: ____________ PAGE ____ OF ____

BORING NO.: ____________ CASING DEPTH: ____________ CONTRACTOR: ____________ STATIC WATER LEVEL ____________

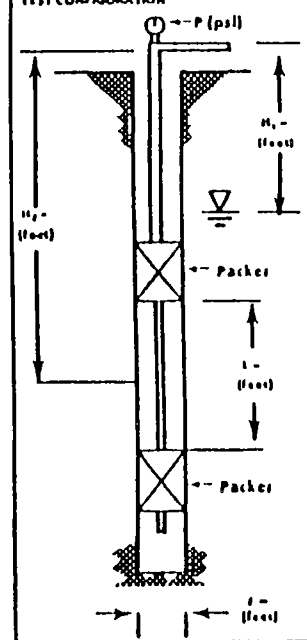
TEST INTERVAL: ____________ BY: ____________ CHECKED: ____________ PACKER PRESSURE ____________

Flow Test					Calculated Results							
Pressure P (psi)	Elapsed Time (min)	Flow Reading	Δ Flow, ΔQ (ft³)	Δ Flow, ΔQ (gal)	Flow Rate Q (gal/min)	H_1* (ft)	Hp(ft) = 2.31 (psi)	H_2* (ft)	H = Hp + (H1 or H2)	Cp	K (ft/yr) = Cp Q/H	K (cm/sec) = [illegible] K (ft/yr)

CP = (1/(2 π L)) ln(L/r) (70,315 S)
7.48 Gallons = 1 ft³
1 psi = 2.31 ft head
Remarks: ____________

* H_1 is used when the test length is below the water table.
H_2 is used when the test length is above the water table.

TEST CONFIGURATION



Length of Test Section in feet, L	Cp: EX	Cp: AX	Cp: BX	Cp: NX
[illegible]	[illegible]	[illegible]	25,000	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]
20	[illegible]	[illegible]	[illegible]	[illegible]

ATTACHMENT C-4
EXAMPLE BORING LOG

BORING LOG

Page___ of___

PROJECT NAME: _____
PROJECT NUMBER: _____
DRILLING COMPANY: _____
WATER LEVEL DATA: _____

BORING NUMBER: _____
DATE : _____
GEOLOGIST: _____

[redacted] | Remarks

*When rock coring enter rock brokeness.

CONVERTED TO WELL : ___ Yes ___ No: WELL I.D.#: _____
REMARKS: _____

Signature(s): _____

LEGEND

SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

COARSE-GRAINED SOILS — More Than Half of Material is LARGER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)			GROUP SYMBOL	TYPICAL NAMES
GRAVELS (50% or more of coarse fraction > No. 4 sieve size)	CLEAN GRAVELS (Little or No Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
	GRAVELS W/FINES (More than 12% Fines)	Non plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel sand-clay mixtures.
SANDS (50% or more of coarse fraction < No. 4 sieve size)	CLEAN SANDS (Little or No Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.
	SANDS W/FINES (More than 12% Fines)	Non plastic fines (for identification procedures, see ML)	SM	Silty sands, poorly graded sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.

FINE-GRAINED SOILS — More Than Half of Material is SMALLER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights) — Identification Procedures on Fraction Smaller than No. 40 Sieve Size				GROUP SYMBOL	TYPICAL NAMES
	DRY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)		
SILTS AND CLAYS (Liquid Limit <50)	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
	Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Slight to Medium	Slow	Slight	OL	Organic silts and organic silt clays of low plasticity.
SILTS AND CLAYS (Liquid Limit >50)	Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
	Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			PT	Peat and other organic soils

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS

DESIGNATION	STANDARD PENETRATION RESISTANCE BLOWS/FOOT
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS

CONSISTENCY	UNC CONFINED COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily penetrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)

Descriptive Terms	Screwdriver or Knife Effects	Hammer Effects
Soft	Easily Gouged	Crushes when pressed with hammer
Medium Soft	Can be Gouged	Breaks (one blow); crumbly edges
Medium Hard	Can be scratched	Breaks (one blow); sharp edges
Hard	Cannot be scratched	Breaks conchoidally (several blows); sharp edges

ROCK BROKENESS

Descriptive Terms	Abbreviation	Spacing
Very Broken	(V. Br.)	0-2"
Broken	(Br.)	2"-1'
Blocky	(Bl.)	1'-3'
Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES

S 3" Split Barrel Sample

U 3" O.D. Undisturbed Sample

O - Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES

R NX (Conventional) Core (2-1/8" O.D.)

Q HQ (Ultraline) Core (3-1/2" O.D.)

X Other Core Sizes, Specify in Remarks

WATER LEVELS

12/18 ▽ 13.6' Initial Level w/Date & Depth

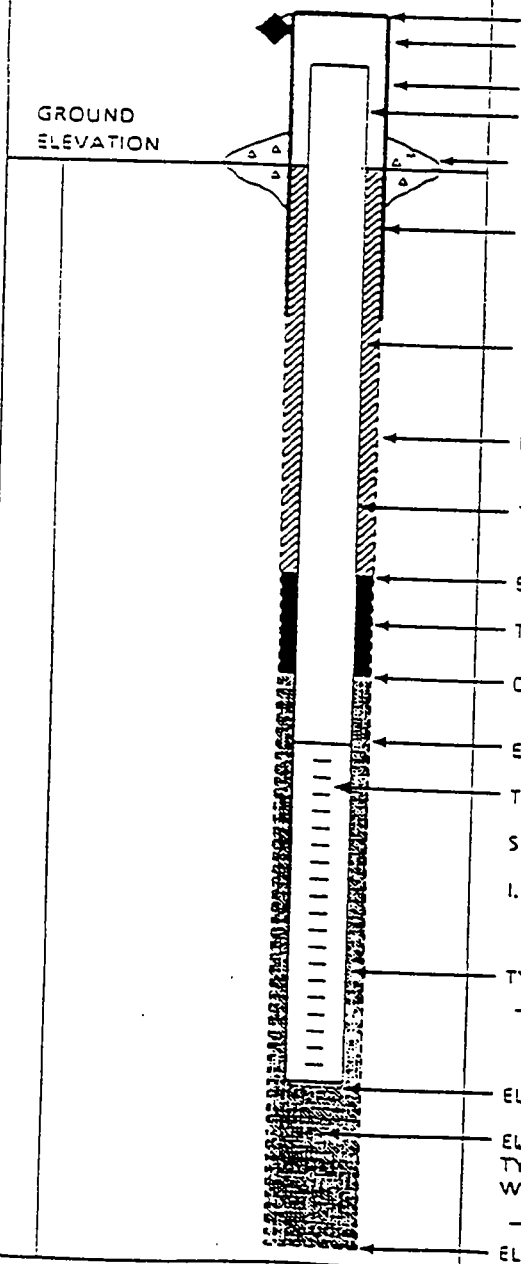
12/18 ▽ 13.6' Stabilized Level w/Date & Depth

ATTACHMENT C-5
EXAMPLE OVERBURDEN MONITORING WELL SHEET

BORING NO.: _____

OVERBURDEN
MONITORING WELL SHEET

PROJECT _____ LOCATION _____ DRILLER _____
PROJECT NO. _____ BORING _____ DRILLING
ELEVATION _____ DATE _____ METHOD _____
FIELD GEOLOGIST _____ DEVELOPMENT
METHOD _____



ELEVATION OF TOP OF SURFACE CASING : _____
ELEVATION OF TOP OF RISER PIPE: _____
STICK - UP TOP OF SURFACE CASING. _____
STICK - UP RISER PIPE . _____
TYPE OF SURFACE SEAL: _____
I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____
RISER PIPE I.D. _____
TYPE OF RISER PIPE: _____
BOREHOLE DIAMETER: _____
TYPE OF BACKFILL: _____
ELEVATION / DEPTH TOP OF SEAL: _____ / _____
TYPE OF SEAL: _____
DEPTH TOP OF SAND PACK: _____
ELEVATION / DEPTH TOP OF SCREEN: _____ / _____
TYPE OF SCREEN: _____
SLOT SIZE x LENGTH: _____
I.D. OF SCREEN: _____
TYPE OF SAND PACK: _____
ELEVATION / DEPTH BOTTOM OF SCREEN: _____ / _____
ELEVATION / DEPTH BOTTOM OF SAND PACK: _____ / _____
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____
ELEVATION / DEPTH OF HOLE: _____ / _____

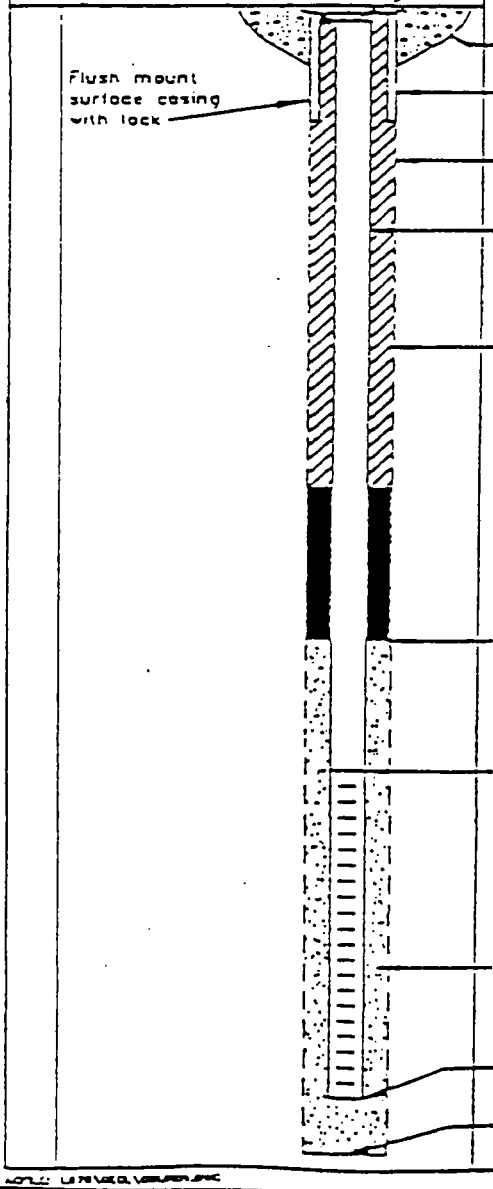
ATTACHMENT C-5A
EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)

BORING NO.: _____

MONITORING WELL SHEET

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION TOP OF RISER: _____
TYPE OF SURFACE SEAL: _____
TYPE OF PROTECTIVE CASING: _____
I.D. OF PROTECTIVE CASING: _____
DIAMETER OF HOLE: _____
TYPE OF RISER PIPE: _____
RISER PIPE I.D.: _____
TYPE OF BACKFILL/SEAL: _____
_____
DEPTH/ELEVATION TOP OF SAND: _____ / _____
DEPTH/ELEVATION TOP OF SCREEN: _____ / _____
TYPE OF SCREEN: _____
SLOT SIZE x LENGTH: _____
TYPE OF SAND PACK: _____
DIAMETER OF HOLE IN BEDROCK: _____
DEPTH/ELEVATION BOTTOM OF SCREEN: _____ / _____
DEPTH/ELEVATION BOTTOM OF SAND: _____ / _____
DEPTH/ELEVATION BOTTOM OF HOLE: _____ / _____
BACKFILL MATERIAL BELOW SAND: _____

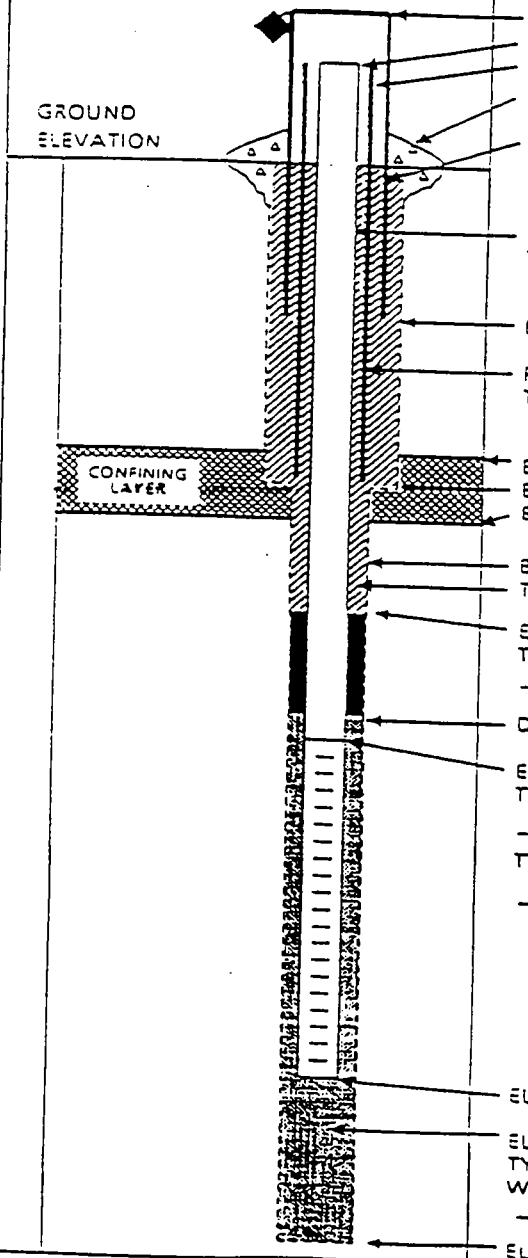
NOTE: UNLESS OTHERWISE NOTED

ATTACHMENT C-6
EXAMPLE CONFINING LAYER MONITORING WELL SHEET

BORING NO.: _____

CONFINING LAYER
MONITORING WELL SHEET

PROJECT _____ LOCATION _____ DRILLER _____
PROJECT NO. _____ BORING _____ DRILLING
ELEVATION _____ DATE _____ METHOD _____
FIELD GEOLOGIST _____ DEVELOPMENT
METHOD _____



ELEVATION OF TOP OF SURFACE CASING : _____
ELEVATION OF TOP OF RISER PIPE: _____
ELEVATION TOP OF PERM. CASING: _____
TYPE OF SURFACE SEAL: _____
I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____
RISER PIPE I.D. _____
TYPE OF RISER PIPE: _____
BOREHOLE DIAMETER: _____
PERM. CASING I.D. _____
TYPE OF CASING & BACKFILL: _____
ELEVATION / DEPTH TOP CONFINING LAYER: _____
ELEVATION / DEPTH BOTTOM OF CASING: _____
ELEVATION / DEPTH BOT. CONFINING LAYER: _____
BOREHOLE DIA. BELOW CASING: _____
TYPE OF BACKFILL: _____
ELEVATION / DEPTH TOP OF SEAL: _____
TYPE OF SEAL: _____
DEPTH TOP OF SAND PACK: _____
ELEVATION/DEPTH TOP OF SCREEN: _____
TYPE OF SCREEN: _____
TYPE OF SAND PACK: _____
ELEVATION / DEPTH BOTTOM OF SCREEN: _____
ELEVATION / DEPTH BOTTOM OF SAND PACK: _____
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____
ELEVATION / DEPTH OF HOLE: _____

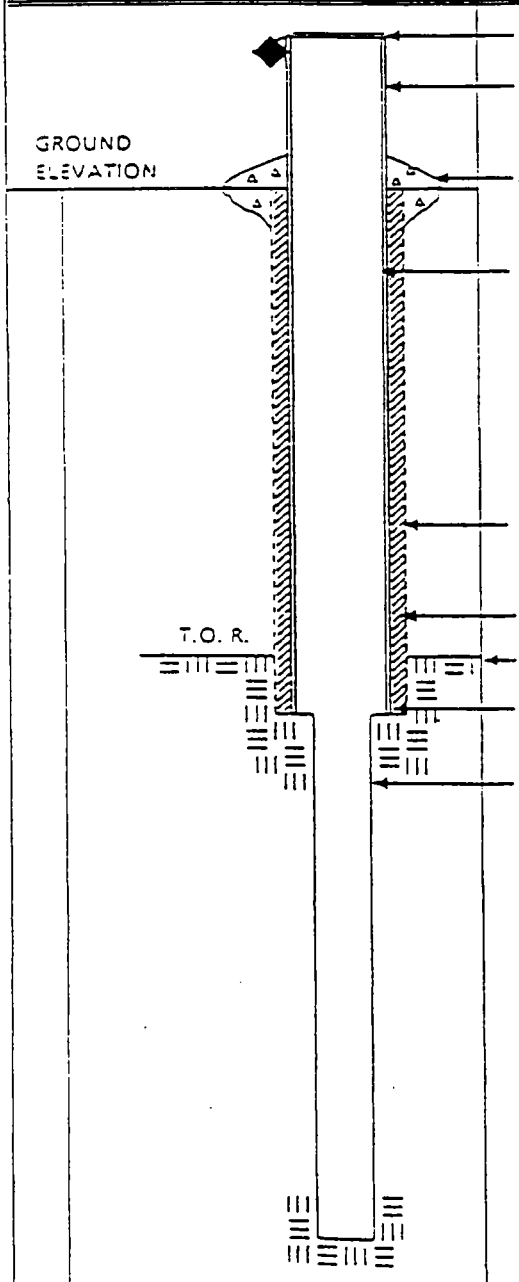
ATTACHMENT C-7
EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL

BORING NO.: _____

BEDROCK
MONITORING WELL SHEET
OPEN HOLE WELL

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

TYPE OF SURFACE SEAL: _____

I.D. OF CASING: _____

TYPE OF CASING: _____

TEMP. / PERM.: _____

DIAMETER OF HOLE: _____

TYPE OF CASING SEAL: _____

DEPTH TO TOP OF ROCK: _____

DEPTH TO BOTTOM CASING: _____

DIAMETER OF HOLE IN BEDROCK: _____

DESCRIBE IF CORE / REAMED WITH BIT:

_____

_____

_____

DESCRIBE JOINTS IN BEDROCK AND DEPTH:

_____

_____

_____

ELEVATION / DEPTH OF HOLE: _____ / _____

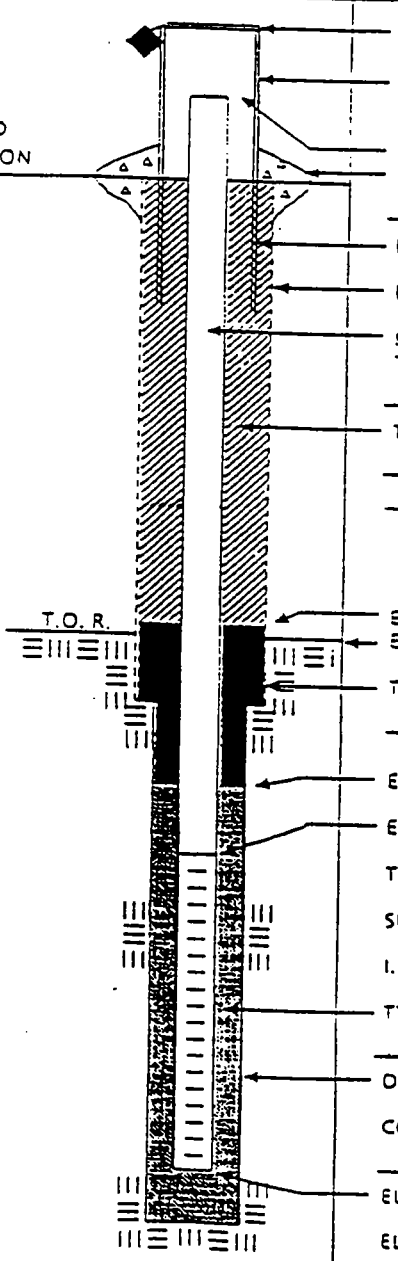
ATTACHMENT C-8
EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK

BORING NO.: _____

BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF SURFACE CASING: _____

STICK UP OF CASING ABOVE GROUND SURFACE: _____

ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____

DIAMETER OF HOLE: _____

RISER PIPE I.D.: _____

TYPE OF RISER PIPE: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____ / _____

ELEVATION / DEPTH TOP OF BEDROCK: _____ / _____

TYPE OF SEAL: _____

ELEVATION / DEPTH TOP OF SAND: _____ / _____

ELEVATION / DEPTH TOP OF SCREEN: _____ / _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

I.D. SCREEN: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

CORE / REAM: _____

ELEVATION / DEPTH BOTTOM SCREEN: _____ / _____

ELEVATION / DEPTH BOTTOM OF HOLE: _____ / _____

ATTACHMENT C-8A
EXAMPLE BEDROCK MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK (FLUSHMOUNT)

BORING NO.: _____

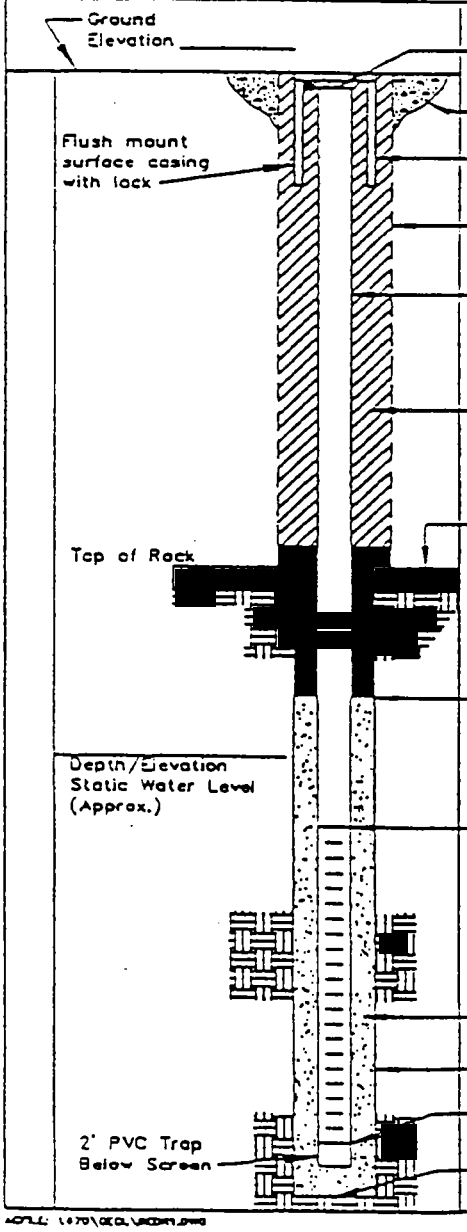
BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT: _____ LOCATION: _____ DRILLER: _____

PROJECT NO.: _____ BORING: _____ DRILLING METHOD: _____

ELEVATION: _____ DATE: _____ DEVELOPMENT METHOD: _____

FIELD GEOLOGIST: _____



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

TYPE OF PROTECTIVE CASING: _____

I.D. OF PROTECTIVE CASING: _____

DIAMETER OF HOLE: _____

TYPE OF RISER PIPE: _____

RISER PIPE I.D.: _____

TYPE OF BACKFILL/SEAL: _____

_____

DEPTH/ELEVATION TOP OF BEDROCK: _____ /

DEPTH/ELEVATION TOP OF SAND: _____ /

DEPTH/ELEVATION TOP OF SCREEN: _____ /

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

DEPTH/ELEVATION BOTTOM OF SCREEN: _____ /

DEPTH/ELEVATION BOTTOM OF SAND: _____ /

DEPTH/ELEVATION BOTTOM OF HOLE: _____ /

BACKFILL MATERIAL BELOW SAND: _____

ATTACHMENT C-9
EXAMPLE TEST PIT LOG

TEST PIT LOG

Brown & Root Environmental

PROJECT: _____ TEST PIT NO.:

PROJECT NO _____ DATE: _____

LOCATION: _____

FIELD GEOLOGIST: _____

DEPTH (FT.)	LITHOLOGY CHANGE (DESCRIPT.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS

Test Pit: Cross Section and / or Plan View

REMARKS _____

PHOTO LOG _____

TEST PIT _____

PAGE ____ OF ____

ATTACHMENT D
EXAMPLE EQUIPMENT CALIBRATION LOG

Brown & Root Environmental

EQUIPMENT CALIBRATION LOG

INSTRUMENT NAME / MODEL : _____

JOB NAME : _____

MANUFACTURER : _____

JOB NUMBER : _____

CALIBRATION DATE	INITIAL SETTINGS	STANDARDS USED	PROCEDURE	ADJUSTMENTS MADE	FINAL SETTINGS	SIGNATURE	COMMENTS

ATTACHMENT E
EXAMPLE DAILY ACTIVITIES RECORD

DAILY ACTIVITIES RECORD — **Brown & Root Environmental**

PROJECT _____ LOCATION _____
CLIENT _____ ARRIVAL TIME _____ JOB NO. _____
DATE _____ DEPARTURE TIME _____
CONTRACTOR _____ DRILLER _____
BORING NO. _____ HNUS REPRESENTATIVE _____

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

COMMENTS: _____

APPROVED BY:

_____ HNUS FIELD REPRESENTATIVE

_____ DRILLER OR REPRESENTATIVE

ATTACHMENT F
FIELD TRIP SUMMARY REPORT
PAGE 1 OF 2

SUNDAY

Date: _____ Personnel: ____

Weather: _____ Onsite: ____

____

Site Activities: _____

_____

_____

_____

MONDAY

Date: _____ Personnel: ____

Weather: _____ Onsite: ____

____

Site Activities: _____

_____

_____

_____

TUESDAY

Date: _____ Personnel: ____

Weather: _____ Onsite: ____

____

Site Activities: _____

_____

_____

_____

WEDNESDAY

Date: _____ Personnel: ____

Weather: _____ Onsite: ____

____

Site Activities: _____

_____

_____

_____

ATTACHMENT F
PAGE 2 OF 2
FIELD TRIP SUMMARY REPORT

THURSDAY

Date: _____

Weather: _____ Personnel: ____

Onsite: ____

Site Activities: _____ ____

_____

_____

_____

FRIDAY

Date: _____

Weather: _____ Personnel: ____

Onsite: ____

Site Activities: _____ ____

_____

_____

_____

SATURDAY

Date: _____

Weather: _____ Personnel: ____

Onsite: ____

Site Activities: _____ ____

_____

_____

_____

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this procedure is to provide guidelines regarding the appropriate procedures to be followed when decontaminating drilling equipment, monitoring well materials, chemical sampling equipment and field analytical equipment.

2.0 SCOPE

This procedure addresses drilling equipment and monitoring well materials decontamination, as well as chemical sampling and field analytical equipment decontamination. This procedure also provides general reference information on the control of contaminated materials.

3.0 GLOSSARY

None.

4.0 RESPONSIBILITIES

Project Manager - Responsible for ensuring that all field activities are conducted in accordance with approved project plan(s) requirements.

Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved Standards Operating Procedures or as otherwise dictated by the approved project plan(s).

5.0 PROCEDURES

To ensure that analytical chemical results reflect actual contaminant concentrations present at sampling locations, the various drilling equipment and chemical sampling and analytical equipment used to acquire the environment sample must be properly decontaminated. Decontamination minimizes the potential for cross-contamination between sampling locations, and the transfer of contamination offsite.

5.1 Drilling Equipment

Prior to the initiation of a drilling program, all drilling equipment involved in field sampling activities shall be decontaminated by steam cleaning at a predetermined area. The steam cleaning procedure shall be performed using a high-pressure spray of heated potable water producing a pressurized stream of steam. This steam shall be sprayed directly onto all surfaces of the various equipment which might contact environmental samples. The decontamination procedure shall be performed until all equipment is free of all visible potential contamination (dirt, grease, oil, noticeable odors, etc.) In addition, this decontamination procedure shall be performed at the completion of each sampling and/or drilling location, including soil borings, installation of monitoring wells, test pits, etc. Such equipment shall include drilling rigs, backhoes, downhole tools, augers, well casings, and screens. Where the drilling rig is set to perform multiple borings at a single area of concern, the steam-cleaning of the drilling rig itself may be waived with proper approval. Downhole equipment, however, must always be steam-cleaned between borings. Where PVC well casings are to be installed, decontamination is not required if the manufacturer provides these casings in factory-sealed, protective, plastic sleeves (so long as the protective packaging is not compromised until immediately before use.

The steam cleaning area shall be designed to contain decontamination wastes and waste waters and can be a lined excavated pit or a bermed concrete or asphalt pad. For the latter, a floor drain must be

provided which is connected to a holding facility. A shallow above-ground tank may be used or a pumping system with discharge to a waste tank may be installed.

In certain cases such an elaborate decontamination pad is not possible. In such cases, a plastic lined gravel bed pad with a collection system may serve as an adequate decontamination area. Alternately, a lined sloped pad with a collection pump installed at the lower end may be permissible. The location of the steam cleaning area shall be onsite in order to minimize potential impacts at certain sites.

Guidance to be used when decontaminating drilling equipment shall include:

- As a general rule, any part of the drilling rig which extends over the borehole, shall be steam cleaned.
- All drilling rods, augers, and any other equipment which will be introduced to the hole shall be steam cleaned.
- The drilling rig, all rods and augers, and any other potentially contaminated equipment shall be decontaminated between each well location to prevent cross contamination of potential hazardous substances.

Prior to leaving at the end of each work day and/or at the completion of the drilling program, drilling rigs and transport vehicles used onsite for personnel or equipment transfer shall be steam cleaned, as practicable. A drilling rig left at the drilling location does not need to be steam cleaned until it is finished drilling at that location.

5.2 Sampling Equipment

5.2.1 Bailers and Bailing Line

The potential for cross-contamination between sampling points through the use of a common bailer or its attached line is high unless strict procedures for decontamination are followed. For this reason, it is preferable to dedicate an individual bailer and its line to each sample point, although this does not eliminate the need for decontamination of dedicated bailers. For non-dedicated sampling equipment, the following conditions and/or decontamination procedures must be followed.

Before the initial sampling and after each successive sampling point, the bailer must be decontaminated. The following steps are to be performed when sampling for organic contaminants. Note: contract-specific requirements may permit alternative procedures.

- Potable water rinse
- Alconox or Liquinox detergent wash
- Scrubbing of the line and bailer with a scrub brush (may be required if the sample point is heavily contaminated with heavy or extremely viscous compounds)
- Potable water rinse
- Rinse with 10 percent nitric acid solution*
- Deionized water rinse

---

* Due to the leaching ability of nitric acid on stainless steel, this step is to be omitted if a stainless steel sampling device is being used and metals analysis is required with detection limits less than approximately 50 ppb.

- Acetone or methanol rinse (in some EPA Regions, isopropanol is used instead)
- Hexane rinse**
- Copious distilled/Deionized water rinse
- Air dry

If sampling for volatile organic compounds (VOCs) only, the nitric acid, acetone, methanol, and hexane rinses may be omitted. Only reagent grade or purer solvents are to be used for decontamination. When isopropanol is used, the bailer must be thoroughly dry before using to acquire the next sample.

In general, specially purchased pre-cleaned disposable sampling equipment is not decontaminated (nor is an equipment rinsate blank collected) so long as the supplier has provided certification of cleanliness. If decontamination is performed on several bailers at once (i.e., in batches), bailers not immediately used may be completely wrapped in aluminum foil (shiny-side toward equipment) and stored for future use. When batch decontamination is performed, one equipment rinsate is generally collected from one of the bailers belonging to the batch before it is used for sampling.

It is recommended that clean, dedicated braided nylon or polypropylene line be employed with each bailer use.

5.2.2 Sampling Pumps

Most sampling pumps are low volume (less than 2 gpm) pumps. These include peristaltic, diaphragm, air-lift, pitcher and bladder pumps, to name a few. If these pumps are used for sampling from more than one sampling point, they must be decontaminated prior to initial use and after each use.

The procedures to be used for decontamination of sampling pumps compare to those used for a bailer except that the 10 percent nitric acid solution is omitted. Each of the liquid factions is to be pumped through the system. The amount of pumping is dependent upon the size of the pump and the length of the intake and discharge hoses. Certain types of pumps are unacceptable for sampling purposes. For peristaltic pumps, the tubing is replaced rather than cleaned.

An additional problem is introduced when the pump relies on absorption of water via an inlet or outlet hose. For organic sampling, this hose should be Teflon. Other types of hoses leach organics (especially phthalate esters) into the water being sampled or adsorb organics from the sampled water. For all other sampling, the hose should be Viton, polyethylene, or polyvinyl chloride (listed in order of preference). Whenever possible, dedicated hoses should be used. It is preferable that these types of pumps not be used for sampling, only for purging.

5.2.3 Filtering Equipment

On occasion, the sampling plan may require acquisition of filtered groundwater samples. Field-filtering is addressed in SOP SA-6.1 and should be conducted as soon after sample acquisition as possible. To this end, three basic filtration systems are most commonly used: the in-line disposable Teflon filter, the inert gas over-pressure filtration system, and the vacuum filtration system.

For the in-line filter, decontamination is not required since the filter cartridge is disposable, however, the cartridge must be disposed of in an approved receptacle and the intake and discharge lines must still be decontaminated or replaced before each use.

** If sampling for pesticides, PCBs, or fuels.

For the over-pressure and the vacuum filtration systems, the portions of the apparatus which come in contact with the sample must be decontaminated as outlined in the paragraphs describing the decontamination of bailers. (Note: Varieties of both of these systems come equipped from the manufacturer with Teflon-lined surfaces for those that would come into contact with the sample. These filtration systems are preferred when decontamination procedures must be employed.)

5.2.4 Other Sampling Equipment

Field tools such as trowels and mixing bowls are to be decontaminated in the same manner as described above.

5.3 Field Analytical Equipment

5.3.1 Water Level Indicators

Water level indicators that come into contact with groundwater must be decontaminated using the following steps:

- Rinse with potable water
- Rinse with deionized water
- Acetone or methanol rinse (unless otherwise directed by manufacturer)
- Rinse with deionized water

Water level indicators that do not come in contact with the groundwater but may encounter incidental contact during installation or retrieval need only undergo the first and last steps stated above.

5.3.2 Probes

Probes (e.g., pH or specific-ion electrodes, geophysical probes, or thermometers) which would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise (e.g., dissolved oxygen probes). Probes that contact a volume of groundwater not used for laboratory analyses can be rinsed with deionized water. For probes which make no direct contact, (e.g., OVA equipment) the probe is self-cleaning when exposure to uncontaminated air is allowed and the housing can be wiped clean with paper-towels or cloth wetted with alcohol.

5.4 Waste Handling

For the purposes of these procedures, contaminated materials are defined as any byproducts of field activities that are suspected or known to be contaminated with hazardous substances. These byproducts include such materials as decontamination solutions, disposable equipment, drilling muds, well-development fluids, and spill-contaminated materials and Personal Protection Equipment (PPE).

The procedures for obtaining permits for investigations of sites containing hazardous substances are not clearly defined at present. In the absence of a clear directive to the contrary by the EPA and the states, it must be assumed that hazardous wastes generated during field activities will require compliance with Federal agency requirements for generation, storage, transportation, or disposal. In addition, there may be state regulations that govern the disposal action. This procedure exclusively describes the technical methods used to control contaminated materials.

The plan documents for site activities must include a description of control procedures for contaminated materials. This planning strategy must assess the type of contamination, estimate the amounts that would be produced, describe containment equipment and procedures, and delineate storage or disposal methods. As a general policy, it is wise to select investigation methods that minimize the generation of contaminated spoils. Handling and disposing of potentially hazardous materials can be dangerous and expensive. Until sample analysis is complete, it is assumed that all produced materials are suspected of contamination from hazardous chemicals and require containment.

5.5 Sources of Contaminated Materials and Containment Methods

5.5.1 Decontamination Solutions

All waste decontamination solutions and rinses must be assumed to contain the hazardous chemicals associated with the site unless there are analytical or other data to the contrary. The waste solution volumes could vary from a few gallons to several hundred gallons in cases where large equipment required cleaning.

Containerized waste rinse solutions are best stored in 55-gallon drums (or equivalent containers) that can be sealed until ultimate disposal at an approved facility. Larger equipment such as backhoes and tractors must be decontaminated in an area provided with an impermeable liner and a liquid collection system. A decontamination area for large equipment could consist of a bermed concrete pad with a floor drain leading to a buried holding tank.

5.5.2 Disposable Equipment

Disposable equipment that could become contaminated during use typically includes PPE, rubber gloves, boots, broken sample containers, and cleaning-wipes. These items are small and can easily be contained in 55-gallon drums with lids. These containers should be closed at the end of each work day and upon project completion to provide secure containment until disposed.

5.5.3 Drilling Muds and Well-Development Fluids

Drilling muds and well-development fluids are materials that may be used in groundwater monitoring well installations. Their proper use could result in the surface accumulation of contaminated liquids and muds that require containment. The volumes of drilling muds and well-development fluids used depend on well diameter and depth, groundwater characteristics, and geologic formations. There are no simple mathematical formulas available for accurately predicting these volumes. It is best to rely on the experience of reputable well drillers familiar with local conditions and the well installation techniques selected. These individuals should be able to estimate the sizes (or number) of containment structures required. Since guesswork is involved, it is recommended that an slight excess of the estimated amount of containers required will be available.

Drilling muds are mixed and stored in what is commonly referred to as a mud pit. This mud pit consists of a suction section from which drilling mud is withdrawn and pumped through hoses, down the drill pipe to the bit, and back up the hole to the settling section of the mud pit. In the settling section, the mud's velocity is reduced by a screen and several flow-restriction devices, thereby allowing the well cuttings to settle out of the mud/fluid.

The mud pit may be either portable above-ground tanks commonly made of steel (which is preferred) or stationary in-ground pits as depicted in Attachment A. The above-ground tanks have a major advantage over the in-ground pits because the above-ground tanks isolate the natural soils from the

contaminated fluids within the drilling system. These tanks are also portable and can usually be cleaned easily.

As the well is drilled, the cuttings that accumulate in the settling section must be removed. This is best done by shoveling them into drums or other similar containers. When the drilling is complete, the contents of the above-ground tank are likewise shoveled or pumped into drums, and the tank is cleaned and made available for its next use.

If in-ground pits are used, they should not extend into the natural water table. They should also be lined with a bentonite-cement mixture followed by a layer of flexible impermeable material such as plastic sheeting. Of course, to maintain its impermeable seal, the lining material used would have to be nonreactive with the wastes. An advantage of the in-ground pits is that well cuttings do not necessarily have to be removed periodically during drilling because the pit can be made deep enough to contain them. Depending on site conditions, the in-ground pit may have to be totally excavated and refilled with uncontaminated natural soils when the drilling operation is complete.

When the above-ground tank or the in-ground pit is used, a reserve tank or pit should be located at the site as a backup system for leaks, spills, and overflows. In either case, surface drainage should be such that any excess fluid could be controlled within the immediate area of the drill site.

The containment procedure for well-development fluids is similar to that for drilling muds. The volume and weight of contaminated fluid will be determined by the method used for development. When a new well is pumped or bailed to produce clear water, substantially less volume and weight of fluid result than when backwashing or high-velocity jetting is used.

5.5.4 Spill-Contaminated Materials

A spill is always possible when containers of liquids are opened or moved. Contaminated sorbents and soils resulting from spills must be contained. Small quantities of spill-contaminated materials are usually best contained in drums, while larger quantities can be placed in lined pits or in other impermeable structures. In some cases, onsite containment may not be feasible and immediate transport to an approved disposal site will be required.

5.6 Disposal of Contaminated Materials

Actual disposal techniques for contaminated materials are the same as those for any hazardous substance, that is, incineration, landfilling, treatment, and so on. The problem centers around the assignment of responsibility for disposal. The responsibility must be determined and agreed upon by all involved parties before the field work starts. If the site owner or manager was involved in activities that precipitated the investigation, it seems reasonable to encourage his acceptance of the disposal obligation. In instances where a responsible party cannot be identified, this responsibility may fall on the public agency or private organization investigating the site.

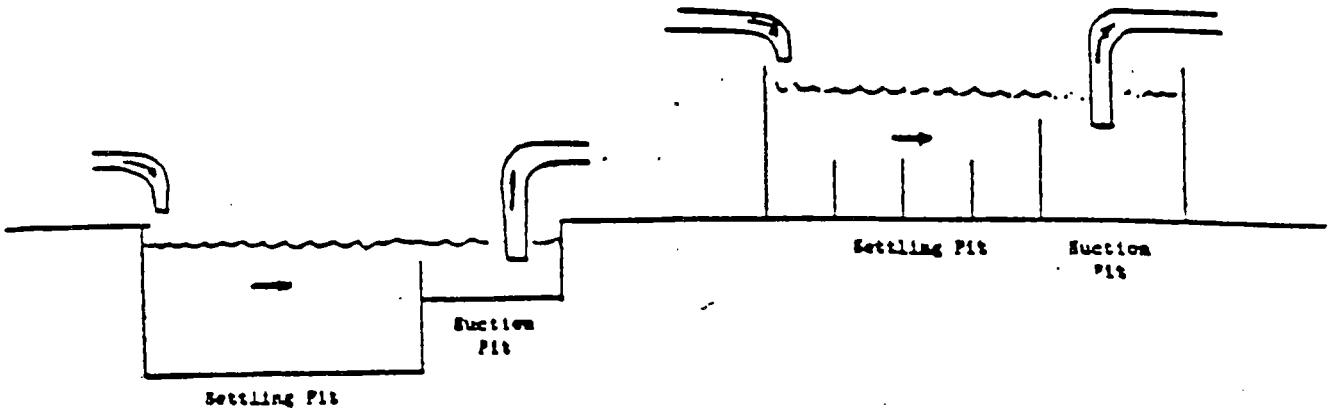
Another consideration in selecting disposal methods for contaminated materials is whether the disposal can be incorporated into subsequent site cleanup activities. For example, if construction of a suitable onsite disposal structure is expected, contaminated materials generated during the investigation should be stored at the site for disposal with other site materials. In this case, the initial containment structures should be evaluated for use as long-term storage structures. Also, other site conditions such as drainage control, security, and soil type must be considered so that proper storage is provided. If onsite storage is expected, then the containment structures should be specifically designed for that purpose.

6.0 REFERENCES

Brown & Root Environmental: Standard Operating Procedure No. 4.33, Control of Contaminated Material.

ATTACHMENT A

TWO TYPES OF MUD PITS USED IN WELL DRILLING



In-Ground Pit

Above-Ground Pit

STANDARD FIELD FORMS

AS A MINIMUM, THE FOLLOWING ITEMS MUST BE INCLUDED IN THE FIELD LOGBOOK

o All entries must be made in blue or black indelible ink.

o Errors must be lined out ONCE and INITIALED.

o Each page must be sequentially numbered, dated, signed and the project number must be written at the top of each page. No blank pages.

o List the time of arrival at work site, and the names of all BRE personnel.

o State the level of personal protection required (level D, level D mod., level C, etc.)

o Designation of the Field Team Leader and a Site Safety Officer.

o State that a Site Safety Meeting/Briefing was conducted and who was present.

o List weather conditions and update as necessary.

o List specific reason(s) for site visit (sampling, drilling, etc...).

o List Subcontractor(s) present at the site and time of arrivals to the site, list all heavy equipment (such as drilling rig, back hoe, jackhammer, etc....).

o List name(s) and time(s) of arrival/departure of anyone visiting the site (such as BRE or subcontractor personnel, Client, regulators, inspectors.....)

o Describe the method of decontamination for drilling tools, bailers, and other equipment. Site the reference(s) that you use for decontamination (i.e., In accordance with Section 5 of BRE's FDEP -approved CompQAP, etc..)

o Indicate that the field instruments have been calibrated and indicate where the calibration information can be found if it is not listed in this logbook. Identify field instruments used by model number and I.D. number or serial number.

o A physical description of all samples must be recorded. Give location of samples, boreholes, etc... A diagram or map would be most appropriate.

o Describe the condition of the site prior to departure (such as wells locked, pump operational, diffused aerator down, barricades properly located, boreholes properly abandoned, etc.....)

o Handling of drill cuttings, development/purge water, and other site derived wastes (e.g., drumming, spreading on plastic, etc.)

o Reference all field forms that are used.

UNDER NO CIRCUMSTANCES SHOULD THE FIELD LOGBOOK BE IN ANYONE'S POSSESSION OTHER THAN BRE PERSONNEL.

Arnold C. Lamb
District Manager of Quality Assurance
February 2, 1995

DAILY ACTIVITIES RECORD

PROJECT NAME: _____ PROJECT NUMBER: _____

CLIENT: _____ LOCATION: _____

DATE: _____ ARRIVAL TIME: _____

B&RE PERSONNEL: _____ DEPARTURE TIME: _____

CONTRACTOR: _____ DRILLER: _____

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

COMMENTS: _____

_____

_____

_____

APPROVED BY:

_____ _____

B&RE REPRESENTATIVE DRILLER

DATE: _____

DOCUMENTATION OF FIELD CALIBRATION

SITE NAME: ______________________ PROJECT NO.: ______________

Date of Calibration	Instrument Name and Model	B & R Environmental Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot Number)	Remarks/ Comments
				Pre-Calibration	Post-Calibration	Pre-Calibration	Post-Calibration		

Brown & Root Environmental

MULTIPLE SAMPLE LOG SHEET

☐ SURFACE SOIL
☐ SUBSURFACE SOIL
☐ SEDIMENT
☐ LAGOON/POND
☐ OTHER

PAGE ___ OF ___

SAMPLER(S) SIGNATURE _____

PROJECT NAME: _____

PROJECT NUMBER: _____

AREA DESIGNATION _____

Sample No.	SAMPLE METHOD	DEPTH (FT)	DATE	TIME	SAMPLED BY	CONCENTRATION (L)OW (H)IGH	(G)RAB (C)OMPOSITE	ANALYSES							No. OF CONT. TOTAL	SOIL DESCRIPTION

REMARKS:

LAB:

COC NO:

Brown & Root Environmental
455 FAIRWAY DRIVE, SUITE 200
DEERFIELD BEACH, FLORIDA 33441
(305) 570-5885 (305) 570-5974 (FAX)

SITE MANAGER: _____
PROJECT NAME: _____
BRE PROJECT NO.: _____ CODE: _____
P.O. NO.: _____

SHIPPED TO: _____
(LABORATORY NAME, CITY)

PAGE __ OF __

CHAIN OF CUSTODY RECORD

LABORATORY ANALYSIS

SAMPLED BY (PRINT): _____
SAMPLER SIGNATURE: _____

☐ STANDARD TAT ☐ RUSH
☐ 24 HR. ☐ 48 HR. ☐ 72 HR. ☐ 7 DAYS
RESULTS DUE DATE: _____

LAB NO.	DATE	TIME	SAMPLE IDENTIFICATION	SAMPLE TYPE COMP.	SAMPLE TYPE GRAB	MATRIX	PRES. TYPE / PARAMETERS	NUMBER OF CONTAINERS
			TOTAL NUMBER OF CONTAINERS					

COMMENTS:

EMPTY BOTTLES RELINQUISHED BY (SIGNATURE) ①	SEAL INTACT? YES NO N/A	DATE: TIME:	EMPTY BOTTLES RECEIVED BY (SIGNATURE) ②	SEAL INTACT? YES NO N/A	DATE: TIME:
RELINQUISHED BY (SIGNATURE) ③	SEAL INTACT? YES NO N/A	DATE: TIME:	RECEIVED BY (SIGNATURE) ④	SEAL INTACT? YES NO N/A	DATE: TIME:
RELINQUISHED BY (SIGNATURE) ⑤	SEAL INTACT? YES NO N/A	DATE: TIME:	RECEIVED BY (SIGNATURE) ⑥	SEAL INTACT? YES NO N/A	DATE: TIME:

SPECIAL INSTRUCTIONS:

LABORATORY REMARKS:

SAMPLE CONTAINERS PRECLEANED BY:
☐ BRE ☐ LABORATORY ☐ MANUFACTURER

METHOD OF SHIPMENT: _____

BILL OF LADING NO.: _____

WHITE-FULLY EXECUTED COPY
YELLOW-RECEIVING LABORATORY COPY
PINK-SAMPLERS' COPY/QA COPY

SAMPLING TEAM:

RECEIVED FOR LABORATORY BY (SIGNATURE):

No. 0257

Brown & Root Environmental

SAMPLING LOG

BRE Project No: | Page of

Client Site ID: | Date: | Sampler(s):

Weather: | Facility Address:

Sampling Method: Teflon Bailer Y N Other | SOP Cleaning Y N

Comments:

GROUNDWATER SYSTEM PERFORMANCE AND QUALITY CONTROL SAMPLES

A	B	C	D	E	Sample ID	Time	Source	pH	Temp.	Sp. Cond.
							GWS Influent			
							GWS Effluent			
							Equipment Blank			
							Equipment Blank			
							Trip Blank			
							Duplicate ( )			
							Duplicate ( )			

TEST PARAMETERS

	Test Method	Container Type	Preserv. Type
A			
B			
C			
D			
E			

GROUNDWATER SAMPLES

A	B	C	D	E	Sample ID	Time	Source	pH	Temp.	Sp. Cond.	TD	Csg Dia (in)	DTW	Purge Vol

UNITS: TEMPERATURE = DEGREES CELSIUS/pH = STANDARD UNITS/SPECIFIC CONDUCTANCE = UMHOS/CM

WELL CASING VOLUMES (GALLONS/FT OF SATURATED CASING, FOR 5x PURGE) 1.25" = 0.32 / 2" = 0.32 / 4" = 3.27 / 6" = 7.35

NOTE: A 3x PURGE IS OK FOR: 4" = 1.96 / 6" = 4.41 PROVIDED 3 CONSISTENT REPEAT FIELD METER READINGS ARE OBSERVED

SINGLE SAMPLE LOG SHEET

Page ___ of ___

Project Site Name: _____ Sample ID No.: _____

Project No.: _____ Sample Location: _____

- ☐ Surface Soil
- ☐ Subsurface Soil
- ☐ Sediment
- ☐ Other _____
- ☐ QA Sample Type: _____

Sampled By: _____

C.O.C. No.: _____

Sample Method:

Depth Sampled:

Sample Date and Time:

Type of Sample
- ☐ Grab
- ☐ Composite
- ☐ Grab-Composite
- ☐ High Concentration
- ☐ Low Concentration

Composite Sample Data

Sample	Time	Color/Description

Grab Sample Data

Color	Description: (Sand, Clay, Dry, Moist, Wet, etc.)

Analysis	Container Requirements	Collected (✓)

Map:

Observations/Notes:

Circle if Applicable:

MS/MSD | Duplicate ID No:

Signature(s):

MONITORING WELL SHEET

BORING NO.: _____

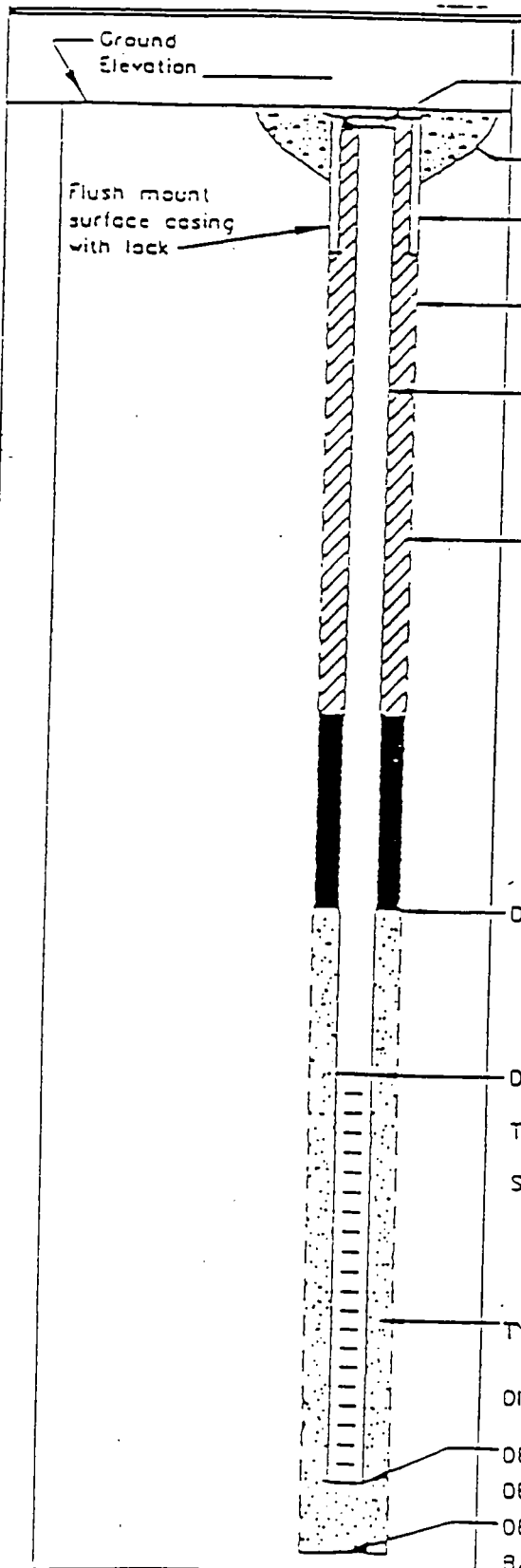
PROJECT _____ LOCATION _____ DRILLER _____

PROJECT NO. _____ BORING _____ DRILLING

ELEVATION _____ DATE _____ METHOD _____

FIELD GEOLOGIST _____ DEVELOPMENT

METHOD _____



ELEVATION TOP OF RISER: _____

TYPE OF SURFACE SEAL: _____

TYPE OF PROTECTIVE CASING: _____

I.D. OF PROTECTIVE CASING: _____

DIAMETER OF HOLE: _____

TYPE OF RISER PIPE: _____

RISER PIPE I.D.: _____

TYPE OF BACKFILL/SEAL: _____

_____

DEPTH/ELEVATION TOP OF SAND: _____ / _____

DEPTH/ELEVATION TOP OF SCREEN: _____ / _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

TYPE OF SAND PACK: _____

DIAMETER OF HOLE IN BEDROCK: _____

DEPTH/ELEVATION BOTTOM OF SCREEN: _____ / _____

DEPTH/ELEVATION BOTTOM OF SAND: _____ / _____

DEPTH/ELEVATION BOTTOM OF HOLE: _____ / _____

BACKFILL MATERIAL BELOW SAND: _____

Rev. 0
March 27, 1997

MONITORING WELL DEVELOPMENT RECORD

Well:_____
Site :_____
Date Installed: _____
Date Developed:_____
Dev. Method:_____
Pump Type:_____

Depth to Bottom (ft): _____
Static Water Level Before(ft):_____
Static Water Level After (ft):_____
Screen Length (ft):_____
Specific Capacity:_____
Casing ID (in): _____

Site Geologist: _____
Drilling Co.: _____
Project:_____
Project Number:_____
Sheet No._____ of _____

Time	Estimated Sediment Thickness (ft)	Cumulative Water Volume or Pumping Rate (gallons/gpm)	Water Level Reading (ft. below TOC)	Temperature (units_____)	pH	Specific Conductance (microsiemens/cm)	Turbidity (NTU)	Remarks (odor, color, etc.)

SOUTHNAVFAC

LOG OF BORING

Page

PROJECT NO:	PROJECT NAME:
PROJECT LOCATION:	DATE DRILLED:
DRILLING COMPANY:	SURFACE ELEVATION: *Feet*
DRILLING METHOD:	BORING DIAMETER: *Inches*
DRILLING RIG:	GEOLOGIST:

DEPTH feet	SAMPLE NUMBER	BLOWS/FT.	PID (ppm) Sample	PID (ppm) B. Zone	PID (ppm) Borehole	PID (ppm) Drill B. Z.	GRAPHIC LOG	USCS/RQD	GEOLOGIC DESCRIPTION Density/Consistency, Hardness, Color	WELL DIAGRAM
5										
10										
15										
20										
25										
30										
35										
40										

JOB NUMBER:

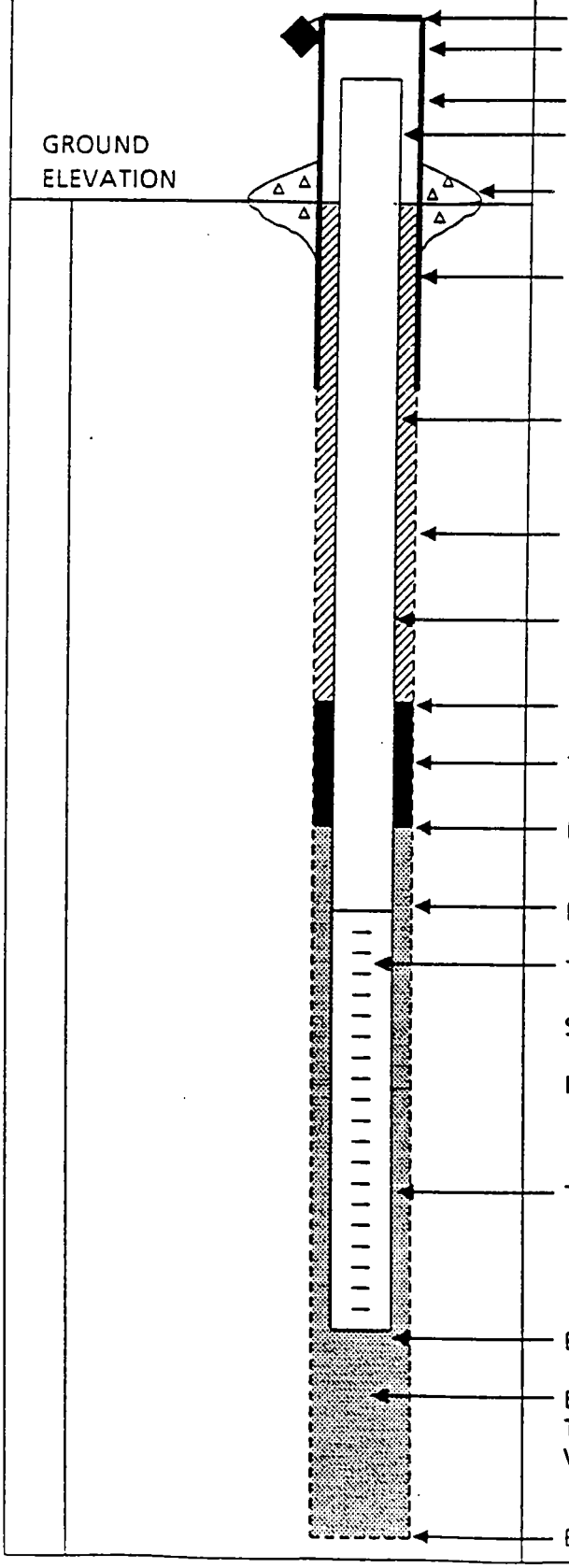
BORING NO.: _____

SOUTHNAVFAC

OVERBURDEN MONITORING WELL SHEET

PROJECT _____ LOCATION _____
PROJECT NO. _____ BORING _____
ELEVATION _____ DATE _____
FIELD GEOLOGIST _____

DRILLER _____
DRILLING METHOD _____
DEVELOPMENT METHOD _____



ELEVATION OF TOP OF SURFACE CASING : _____
ELEVATION OF TOP OF RISER PIPE: _____

STICK - UP TOP OF SURFACE CASING: _____
STICK - UP RISER PIPE : _____

TYPE OF SURFACE SEAL: _____

I.D. OF SURFACE CASING: _____
TYPE OF SURFACE CASING: _____

RISER PIPE I.D. _____
TYPE OF RISER PIPE: _____

BOREHOLE DIAMETER: _____

TYPE OF BACKFILL: _____

ELEVATION / DEPTH TOP OF SEAL: _____ / _____

TYPE OF SEAL: _____

DEPTH TOP OF SAND PACK: _____

ELEVATION / DEPTH TOP OF SCREEN: _____ / _____

TYPE OF SCREEN: _____

SLOT SIZE x LENGTH: _____

I.D. OF SCREEN: _____

TYPE OF SAND PACK: _____

ELEVATION / DEPTH BOTTOM OF SCREEN: _____ / _____

ELEVATION / DEPTH BOTTOM OF SAND PACK: _____ / _____
TYPE OF BACKFILL BELOW OBSERVATION WELL: _____

ELEVATION / DEPTH OF HOLE: _____ / _____

CERTIFICATE OF CONFORMANCE

Well Designation:_____
Site Name: _____
Date Installed: _____
Project Name: _____

Site Geologist: _____
Drilling Company: _____
Driller:_____
Project Number: _____

Material	Brand/Description	Source/Supplier	Sample Collected ?
Well Casing			
Well Screen			
End Cap			
Drilling Fluid			
Drilling Fluid Additives			
Backfill Material			
Annular Filter Pack			
Bentonite Seal			
Annular Grout			
Surface Cement			
Protective Casing			
Paint			
Rod Lubricant			
Compressor Oil			

To the best of my knowledge, I certify that the above described materials were used during installation of this monitoring well.

Signature of Site Geologist:_____

APPENDIX E

ASTM D 1586-84

Designation: D 1586 – 84 (Reapproved 1992)ε1

Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils[1]

This standard is issued under the fixed designation D 1586; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DOD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

ε1NOTE—Editorial changes were made throughout October 1992.

1. Scope

1.1 This test method describes the procedure, generally known as the Standard Penetration Test (SPT), for driving a split-barrel sampler to obtain a representative soil sample and a measure of the resistance of the soil to penetration of the sampler.

1.2 *This standard does not purport to address all of the safety problems, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For a specific precautionary statement, see 5.4.1.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 2487 Test Method for Classification of Soils for Engineering Purposes[2]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[2]

D 4220 Practices for Preserving and Transporting Soil Samples[2]

D 4633 Test Method for Stress Wave Energy Measurement for Dynamic Penetrometer Testing Systems[2]

3. Terminology

3.1 *Descriptions of Terms Specific to This Standard*

3.1.1 *anvil*—that portion of the drive-weight assembly which the hammer strikes and through which the hammer energy passes into the drill rods.

3.1.2 *cathead*—the rotating drum or windlass in the rope-cathead lift system around which the operator wraps a rope to lift and drop the hammer by successively tightening and loosening the rope turns around the drum.

3.1.3 *drill rods*—rods used to transmit downward force and torque to the drill bit while drilling a borehole.

3.1.4 *drive-weight assembly*—a device consisting of the hammer, hammer fall guide, the anvil, and any hat drop system.

3.1.5 *hammer*—that portion of the drive-weight ass consisting of the 140 ± 2 lb (63.5 ± 1 kg) impact which is successively lifted and dropped to provic energy that accomplishes the sampling and penetratio

3.1.6 *hammer drop system*—that portion of the weight assembly by which the operator accomplish lifting and dropping of the hammer to produce the bl

3.1.7 *hammer fall guide*—that part of the drive assembly used to guide the fall of the hammer.

3.1.8 *N-value*—the blowcount representation of th tration resistance of the soil. The *N*-value, reported in blows per foot, equals the sum of the number of blows required to drive the sampler over the depth interval of 6 to 18 in. (150 to 450 mm) (see 7.3).

3.1.9 ΔN—the number of blows obtained from each of the 6-in. (150-mm) intervals of sampler penetration (see 7.3).

3.1.10 *number of rope turns*—the total contact angle between the rope and the cathead at the beginning of the operator's rope slackening to drop the hammer, divided by 360° (see Fig. 1).

3.1.11 *sampling rods*—rods that connect the drive-weight assembly to the sampler. Drill rods are often used for this purpose.

3.1.12 *SPT*—abbreviation for Standard Penetration Test, a term by which engineers commonly refer to this method.

4. Significance and Use

4.1 This test method provides a soil sample for identification purposes and for laboratory tests appropriate for soil obtained from a sampler that may produce large shear strain disturbance in the sample.

4.2 This test method is used extensively in a great variety of geotechnical exploration projects. Many local correlations and widely published correlations which relate SPT blowcount, or *N*-value, and the engineering behavior of earthworks and foundations are available.

5. Apparatus

5.1 *Drilling Equipment*—Any drilling equipment that provides at the time of sampling a suitably clean open hole before insertion of the sampler and ensures that the penetration test is performed on undisturbed soil shall be acceptable. The following pieces of equipment have proven to be

[1] This method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.02 on Sampling and Related Field Testing for Soil Investigations.

Current edition approved Sept. 11, 1984. Published November 1984. Originally published as D 1586 – 58 T. Last previous edition D 1586 – 67 (1974).

[2] *Annual Book of ASTM Standards*, Vol 04.08.

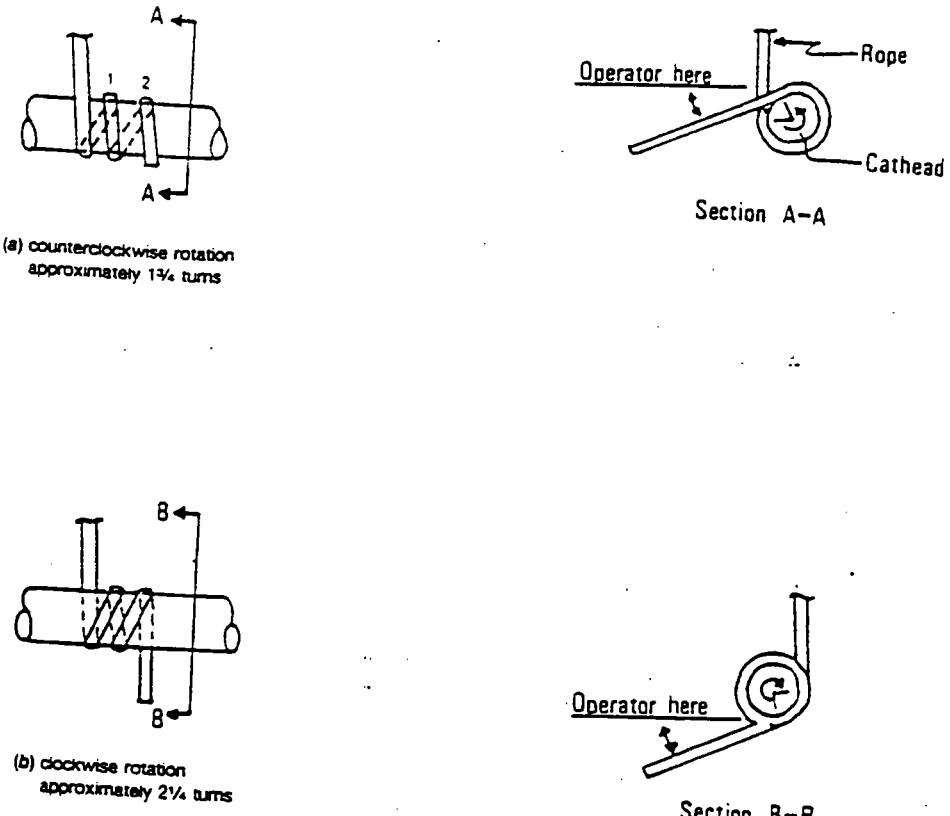


FIG. 1 Definitions of the Number of Rope Turns and the Angle for (a) Counterclockwise Rotation and (b) Clockwise Rotation of the Cathead

suitable for advancing a borehole in some subsurface conditions.

5.1.1 *Drag, Chopping, and Fishtail Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjuction with open-hole rotary drilling or casing-advancement drilling methods. To avoid disturbance of the underlying soil, bottom discharge bits are not permitted; only side discharge bits are permitted.

5.1.2 *Roller-Cone Bits*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used in conjunction with open-hole rotary drilling or casing-advancement drilling methods if the drilling fluid discharge is deflected.

5.1.3 *Hollow-Stem Continuous Flight Augers*, with or without a center bit assembly, may be used to drill the boring. The inside diameter of the hollow-stem augers shall be less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm).

5.1.4 *Solid, Continuous Flight, Bucket and Hand Augers*, less than 6.5 in. (162 mm) and greater than 2.2 in. (56 mm) in diameter may be used if the soil on the side of the boring does not cave onto the sampler or sampling rods during sampling.

5.2 *Sampling Rods*—Flush-joint steel drill rods shall be used to connect the split-barrel sampler to the drive-weight assembly. The sampling rod shall have a stiffness (moment of inertia) equal to or greater than that of parallel wall "A" rod (a steel rod which has an outside diameter of 1⅜ in. (41.2 mm) and an inside diameter of 1⅛ in. (28.5 mm).

NOTE 1—Recent research and comparative testing indicates the type rod used, with stiffness ranging from "A" size rod to "N" size rod, will usually have a negligible effect on the *N*-values to depths of at least 100 ft (30 m).

5.3 *Split-Barrel Sampler*—The sampler shall be constructed with the dimensions indicated in Fig. 2. The driving shoe shall be of hardened steel and shall be replaced or repaired when it becomes dented or distorted. The use of liners to produce a constant inside diameter of 1⅜ in. (35 mm) is permitted, but shall be noted on the penetration record if used. The use of a sample retainer basket is permitted, and should also be noted on the penetration record if used.

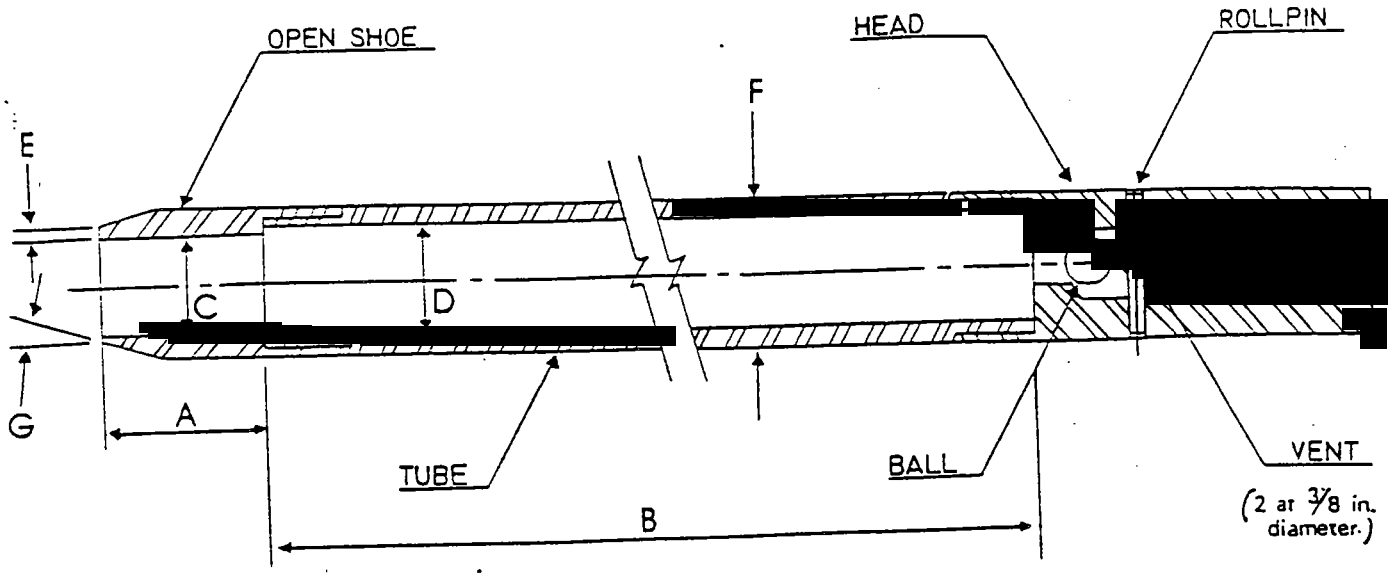
NOTE 2—Both theory and available test data suggest that *N*-values may increase between 10 to 30 % when liners are used.

5.4 *Drive-Weight Assembly:*

5.4.1 *Hammer and Anvil*—The hammer shall weigh 140 ± 2 lb (63.5 ± 1 kg) and shall be a solid rigid metallic mass. The hammer shall strike the anvil and make steel on steel contact when it is dropped. A hammer fall guide permitting a free fall shall be used. Hammers used with the cathead and rope method shall have an unimpeded overlift capacity of at least 4 in. (100 mm). For safety reasons, the use of a hammer assembly with an internal anvil is encouraged.

NOTE 3—It is suggested that the hammer fall guide be permanently marked to enable the operator or inspector to judge the hammer drop height.

5.4.2 *Hammer Drop System*—Rope-cathead, trip, semi-automatic, or automatic hammer drop systems may be used, providing the lifting apparatus will not cause penetration of



A = 1.0 to 2.0 in. (25 to 50 mm)
B = 18.0 to 30.0 in. (0.457 to 0.762 m)
C = 1.375 ± 0.005 in. (34.93 ± 0.13 mm)
D = 1.50 ± 0.05 − 0.00 in. (38.1 ± 1.3 − 0.0 mm)
E = 0.10 ± 0.02 in. (2.54 ± 0.25 mm)
F = 2.00 ± 0.05 − 0.00 in. (50.8 ± 1.3 − 0.0 mm)
G = 16.0° to 23.0°

The 1½ in. (38 mm) inside diameter split barrel may be used with a 16-gage wall thickness split liner. The penetrating end of the drive shoe may be slightly rounded. Metal or plastic retainers may be used to retain soil samples.

FIG. 2 Split-Barrel Sampler

the sampler while re-engaging and lifting the hammer.

5.5 *Accessory Equipment*—Accessories such as labels, sample containers, data sheets, and groundwater level measuring devices shall be provided in accordance with the requirements of the project and other ASTM standards.

6. Drilling Procedure

6.1 The boring shall be advanced incrementally to permit intermittent or continuous sampling. Test intervals and locations are normally stipulated by the project engineer or geologist. Typically, the intervals selected are 5 ft (1.5 mm) or less in homogeneous strata with test and sampling locations at every change of strata.

6.2 Any drilling procedure that provides a suitably clean and stable hole before insertion of the sampler and assures that the penetration test is performed on essentially undisturbed soil shall be acceptable. Each of the following procedures have proven to be acceptable for some subsurface conditions. The subsurface conditions anticipated should be considered when selecting the drilling method to be used.

6.2.1 Open-hole rotary drilling method.

6.2.2 Continuous flight hollow-stem auger method.

6.2.3 Wash boring method.

6.2.4 Continuous flight solid auger method.

6.3 Several drilling methods produce unacceptable borings. The process of jetting through an open tube sampler and then sampling when the desired depth is reached shall not be permitted. The continuous flight solid auger method shall not be used for advancing the boring below a water table or below the upper confining bed of a confined non-cohesive stratum that is under artesian pressure. Casing may not be advanced below the sampling elevation prior to sampling. Advancing a boring with bottom discharge bits is not permissible. It is not permissible to advance the boring for subsequent insertion of the sampler solely by means of previous sampling with the SPT sampler.

6.4 The drilling fluid level within the boring or hollow-stem augers shall be maintained at or above the in situ groundwater level at all times during drilling, removal of drill rods, and sampling.

7. Sampling and Testing Procedure

7.1 After the boring has been advanced to the desired sampling elevation and excessive cuttings have been removed, prepare for the test with the following sequence of operations.

7.1.1 Attach the split-barrel sampler to the sampling rods and lower into the borehole. Do not allow the sampler to drop onto the soil to be sampled.

7.1.2 Position the hammer above and attach the anvil to the top of the sampling rods. This may be done before the sampling rods and sampler are lowered into the borehole.

7.1.3 Rest the dead weight of the sampler, rods, anvil, and drive weight on the bottom of the boring and apply a seating blow. If excessive cuttings are encountered at the bottom of the boring, remove the sampler and sampling rods from the boring and remove the cuttings.

7.1.4 Mark the drill rods in three successive 6-in. (0.15-m) increments so that the advance of the sampler under the impact of the hammer can be easily observed for each 6-in. (0.15-m) increment.

7.2 Drive the sampler with blows from the 140-lb (63.5-

kg) hammer and count the number of blows applied in each 6-in. (0.15-m) increment until one of the following occurs:

7.2.1 A total of 50 blows have been applied during any one of the three 6-in. (0.15-m) increments described in 7.1.4.

7.2.2 A total of 100 blows have been applied.

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

7.2.4 The sampler is advanced the complete 18 in. (0.45 m) without the limiting blow counts occurring as described in 7.2.1, 7.2.2, or 7.2.3.

7.3 Record the number of blows required to effect each 6 in. (0.15 m) of penetration or fraction thereof. The first 6 in. is considered to be a seating drive. The sum of the number of blows required for the second and third 6 in. of penetration is termed the "standard penetration resistance," or the "*N*-value." If the sampler is driven less than 18 in. (0.45 m), as permitted in 7.2.1, 7.2.2, or 7.2.3, the number of blows per each complete 6-in. (0.15-m) increment and per each partial increment shall be recorded on the boring log. For partial increments, the depth of penetration shall be reported to the nearest 1 in. (25 mm), in addition to the number of blows. If the sampler advances below the bottom of the boring under the static weight of the drill rods or the weight of the drill rods plus the static weight of the hammer, this information should be noted on the boring log.

7.4 The raising and dropping of the 140-lb (63.5-kg) hammer shall be accomplished using either of the following two methods:

7.4.1 By using a trip, automatic, or semi-automatic hammer drop system which lifts the 140-lb (63.5-kg) hammer and allows it to drop 30 ± 1.0 in. (0.76 m ± 25 mm) unimpeded.

7.4.2 By using a cathead to pull a rope attached to the hammer. When the cathead and rope method is used the system and operation shall conform to the following:

7.4.2.1 The cathead shall be essentially free of rust, oil, or grease and have a diameter in the range of 6 to 10 in. (150 to 250 mm).

7.4.2.2 The cathead should be operated at a minimum speed of rotation of 100 RPM, or the approximate speed of rotation shall be reported on the boring log.

7.4.2.3 No more than 2¼ rope turns on the cathead may be used during the performance of the penetration test, as shown in Fig. 1.

NOTE 4—The operator should generally use either 1¾ or 2¼ rope turns, depending upon whether or not the rope comes off the top (1¾ turns) or the bottom (2¼ turns) of the cathead. It is generally known and accepted that 2¾ or more rope turns considerably impedes the fall of the hammer and should not be used to perform the test. The cathead rope should be maintained in a relatively dry, clean, and unfrayed condition.

7.4.2.4 For each hammer blow, a 30-in. (0.76-m) lift and drop shall be employed by the operator. The operation of pulling and throwing the rope shall be performed rhythmically without holding the rope at the top of the stroke.

7.5 Bring the sampler to the surface and open. Record the percent recovery or the length of sample recovered. Describe the soil samples recovered as to composition, color, stratification, and condition, then place one or more representative portions of the sample into sealable moisture-proof containers (jars) without ramming or distorting any apparent stratification. Seal each container to prevent evaporation of soil moisture. Affix labels to the containers bearing job designation, boring number, sample depth, and the blow count per 6-in. (0.15-m) increment. Protect the samples against extreme temperature changes. If there is a soil change within the sampler, make a jar for each stratum and note its location in the sampler barrel.

8. Report

8.1 Drilling information shall be recorded in the field and shall include the following:

8.1.1 Name and location of job,

8.1.2 Names of crew,

8.1.3 Type and make of drilling machine,

8.1.4 Weather conditions,

8.1.5 Date and time of start and finish of boring,

8.1.6 Boring number and location (station and coordinates, if available and applicable),

8.1.7 Surface elevation, if available,

8.1.8 Method of advancing and cleaning the boring,

8.1.9 Method of keeping boring open,

8.1.10 Depth of water surface and drilling depth at the time of a noted loss of drilling fluid, and time and date when reading or notation was made,

8.1.11 Location of strata changes,

8.1.12 Size of casing, depth of cased portion of boring,

8.1.13 Equipment and method of driving sampler,

8.1.14 Type sampler and length and inside diameter of barrel (note use of liners),

8.1.15 Size, type, and section length of the sampling rods, and

8.1.16 Remarks.

8.2 Data obtained for each sample shall be recorded in the field and shall include the following:

8.2.1 Sample depth and, if utilized, the sample number,

8.2.2 Description of soil,

8.2.3 Strata changes within sample,

8.2.4 Sampler penetration and recovery lengths, and

8.2.5 Number of blows per 6-in. (0.15-m) or partial increment.

9. Precision and Bias

9.1 *Precision*—A valid estimate of test precision has not been determined because it is too costly to conduct the necessary inter-laboratory (field) tests. Subcommittee D18.02 welcomes proposals to allow development of a valid precision statement.

9.2 *Bias*—Because there is no reference material for this test method, there can be no bias statement.

9.3 Variations in *N*-values of 100 % or more have been observed when using different standard penetration test apparatus and drillers for adjacent borings in the same soil formation. Current opinion, based on field experience, indicates that when using the same apparatus and driller, *N*-values in the same soil can be reproduced with a coefficient of variation of about 10 %.

9.4 The use of faulty equipment, such as an extremely massive or damaged anvil, a rusty cathead, a low speed cathead, an old, oily rope, or massive or poorly lubricated rope sheaves can significantly contribute to differences in *N*-values obtained between operator-drill rig systems.

9.5 The variability in N-values produced by different drill rigs and operators may be reduced by measuring that part of the hammer energy delivered into the drill rods from the sampler and adjusting N on the basis of comparative energies. A method for energy measurement and N-value adjustment is given in Test Method D 4633.

10. Keywords

10.1 blow count; in-situ test; penetration resistance; split-barrel sampling; standard penetration test