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Addendum

Site Assessment Addendum
Tank S781
Midway Park
Marine Corps Base
Camp Lejeune, North Carolina

Contract N62470-90-R-7626

Naval Facilities Engineering Command
Norfolk, Virginia

May 1993

O'BRIEN & GERE
ENGINEERS, INC.

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SECTION 1 - INTRODUCTION

1.01 Purpose and Scope

The objective of this report is to present information that has been gathered regarding subsurface contamination in the vicinity of Tank S781, located near Building 45 at Midway Park, Marine Corps Base, Camp Lejeune, North Carolina.

In May 1992 O'Brien & Gere Engineers, Inc. (OBG) completed a site investigation which included monitoring well installation, penetrometer probes (hydropunch), soil borings, ground water elevation and free product monitoring, soil and ground water sampling and analysis and in-situ permeability testing. Results of this site investigation indicated that additional borings were required to better define the lateral and vertical extent of petroleum constituents in the soil. This report presents an Addendum Report to the site assessment, an updated Risk Assessment and a Remediation Assessment for the study area.

1.02 Site Description

Building 45 at Midway Park is in an enclosed compound which services large machinery for the Marine Corps Base, Camp Lejeune. Until May 1992 the compound accommodated several garage-type buildings and storage sheds, a pump house, a small vehicle re-fueling area and an above ground storage tank with a capacity of approximately 176,000 gallons (Tank S781). According to the Environmental Management Department, MCB Camp Lejeune, the pump house and above ground storage tank were removed in May 1992.

Topsoil from an undisturbed area near Building 1700 was used to grade and seed the Site.

Prior to the Marine Base acquisition, pre-1942, the land was owned by Carolina Power and Light (CP&L) (formerly known as Tidewater Electric) and used to house a power plant. CP&L still maintains and operates two power plant substations just outside the compound's fence to the south.

Preliminary site investigations were conducted in November 1990 by Dewberry and Davis (Exhibit A). During these investigations five hand augers, five soil borings and two monitoring wells were completed proximal to Tank S781. While the ground water samples did not indicate contaminant levels above method detection limits, three soil samples demonstrated Total Petroleum Hydrocarbon (TPH) concentrations above the action level of 10 ppm. TPH concentrations ranged from below method detection limits to 2200 ppm. The highest concentration (2200 ppm) was found along the suspected vicinity of underground piping from the pump house toward the main building.

In December 1991, OBG conducted a site investigation revealing quantities of TPH in the soil that ranged from 4.32 mg/kg to 12,000 mg/kg with the highest concentrations being found in the soils collected from MW4 and B4, proximal and directly downgradient of Tank S781. The site investigation report dated May 1992 indicated that additional sampling and analysis were required to better define the extent of TPH contamination at the Site. This report addendum summarizes the results of the supplemental investigation.

SECTION 2 - SITE ASSESSMENT

2.01 Hydrogeology

2.01.1 Field Investigation

A subsurface investigation, designed to define the site's geologic conditions and delineate the extent of a possible contaminant plume, was completed in December 1991. Fourteen monitoring wells (seven nested pairs), four soil borings and ten penetrometer probes were completed in the study area. Figure 2 illustrates the subsurface drilling locations of 1991. Laboratory results from that investigation indicated that additional soil borings were required to better define the contaminant extent. During the week of October 4th 1992, twelve soil borings were completed in the study area (B1A - B12A). Drilling operations were completed in accordance with drilling procedures outlined in Appendix D, and under the supervision of an OBG geologist by ATEC Associates, Inc. (ATEC) of Raleigh, NC. An illustration of the addendum soil boring locations is provided as Figure 6.

Each of the twelve soil borings was completed to a depth of fifteen feet below grade. Cuttings generated from drilling operations were containerized for future disposal. Split spoon samples were collected in five foot intervals during the drilling of each soil boring. All soil sampling was conducted under the guidelines of ASTM D-1586. Appendix A contains lithologic descriptions of each soil sample, recorded in the field at the time of collection. Two soil samples from each location were selected for laboratory analysis as discussed in Section 2.02.3.

2.01.2 Site Geologic Conditions

Camp Lejeune is situated in the Atlantic Coastal Plain Physiographic Province which, in North Carolina, is characterized by low elevations and limited topographic relief (USGS, 1988). The Camp Lejeune area overlies cretaceous sediments of sands, silts and clays that thicken towards the east and reach a thickness of approximately 2500 feet. The subsurface investigation of December 1991 of Tank S781 involved the upper 30 feet of sediments. Split spoon samples (Appendix A) revealed a subsurface geology characterized by unconsolidated sands, silts and clays. Below the topsoil and the brown, medium to fine grained sand of the uppermost four feet lie at least twenty feet of sands with small amounts of silt and clay which vary in colors from buff to orange, brown and white. At approximately 11 to 19 feet below grade lies a thin lamina of coarse to very coarse sand, which is underlain by gray to greenish-gray medium sands. Figures 4 and 5 present an approximate geologic cross section of the study area.

Lithological descriptions of soil samples obtained from borings completed in October 1992 are recorded on bore logs located in Appendix A. Sediments from the soil borings are dominated by sands with small amounts of clay and silt and are consistent with past studies.

2.01.3 Ground Water Flow

On two separate occasions ground water elevations were gauged in all of the monitoring wells at the Site. Using an electronic oil/water interface probe, ground water was measured to be between

17 and 19 feet below the top of casing, or between 3 and 5 feet above mean sea level (AMSL). Using the elevational data summarized on Table 1, a ground water contour map was derived. Figure 3 illustrates the ground water flow for December 1991. The measurements obtained on the second monitoring event (January 1992) support this flow direction. The ground water measurements at MW7 were dubious on both monitoring occasions and this measurement was not used when formulating the ground water contour map. Applying and estimated effective porosity of 0.40, and an average hydraulic gradient of 0.002 ft/ft, the ground water appears to be flowing in a west to northwesterly direction at approximately 0.03 ft/day or 10 ft/yr. Ground water elevations, flow direction and local topography all suggest that ground water from the site discharges to Northeast Creek.

2.02 Environmental Assessment

2.02.1 Free Product Characterization

Using an electronic oil/water interface probe, ground water and possible free product were measured in each monitoring well. On two separate occasions all fourteen monitoring wells were gauged and free product was not detected in any of the wells. Ground water samples obtained from the penetrometer probes were also scrutinized for the possible presence of free phased hydrocarbons. None of the ten samples contained free product.

2.02.2 Air Characterization

During all field activities worker's breathing zone and ambient air were monitored for volatile organics using a calibrated

photoionization detector (PID). At no time did the worker's breathing zone or the ambient air quality exceed 1 ppm.

2.02.3 Soil Characterization

Two soil samples from each addendum soil boring were selected for laboratory analysis. At each location a sample from the water table and five feet above the water table were sent to Environmental Testing Services, Inc., in Norfolk, Virginia for analysis of Total Petroleum Hydrocarbons (TPH) by Methods 3550 and 5330. One sample, taken from B11A was also analyzed for TCLP compounds. Laboratory results are available for review in Appendix C.

TCLP analysis was conducted on a soil sample from boring 11a. All parameters of the TCLP analysis were below laboratory detection limits with the exception of barium. Barium was present in levels below regulatory levels (0.091 mg/l).

Samples analyzed for TPH by Method 5030 (low to medium boiling point hydrocarbons) demonstrated TPH concentrations ranging from below laboratory detection limits to 2.0 mg/kg. This analysis will detect fuel types with low to medium boiling points (including BTEX-containing hydrocarbons). TPH concentrations by Method 3550 (medium to high boiling point including hydrocarbons containing semi-volatile constituents) ranged from below laboratory detection limits to 59 mg/kg. Soil boring B11A contained the highest concentrations of TPH by Method 3550 (59.0 mg/kg) and Method 5030 (2.0 mg/kg). Soil TPH concentrations are summarized on Figures 7 and 8 and are described below.

Tank S781 Area

As shown on Figure 7, soil borings in the immediate vicinity of Tank S781 had the following concentrations of total petroleum hydrocarbons: (NOTE: Sample #'s with the suffix "A" are from the 1992 investigation)

Sample#	Sample Depth (feet)	TPH (mg/kg)
B1-A	14-16	25
B-4	4-6	11,000
B-4	9-11	12,000
MW-4	14-16	255
MPSB1	0-5	1200
MPSB2	0-5	1400-2200

As discussed in Section 3 of the May, 1992 Site Assessment Report, it is not unreasonable to assume that these TPH concentrations are the result of the operation of tank S781.

Field to the Northwest of Building 45 Complex

The field to the northwest of the building 45 complex shows evidence of past industrial use. A road traverses this field, and a piece of equipment was discovered in this field near MW-14 during the Fall 1991 investigation.

As shown on Figure 8, soil borings in the field to the northwest of the building 45 complex had the following concentrations of total petroleum hydrocarbons:

Sample#	Sample Depth (feet)	TPH (mg/kg)
MW-8	0-2	6.7
MW-8	4-6	22.8
MW-14	0-2	4.3
MW-14	2-4	11.4
B-4A	9-11	LT-1
B-4A	14-16	LT-1

B-5A	0-2	17
B-5A	4-6	LT1
B-6A	0-2	20
B-6A	4-6	4
B-10A	0-2	LT-1
B-10A	4-6	LT-1
B-11A	0-2	59
B-11A	4-6	LT1

Relatively low concentrations of TPH are consistent throughout this area and likely unrelated to the operation of Tank S781. This conclusion is drawn based on the following:

- Volatile organic compounds were not detected in hydropunches H-7, H-4, and H6, which are located between the tank and this field.
- TPH was not detected in water table soils from B5A, and B11A (i.e., 4'-6'), whereas TPH was detected in the surface soils (i.e., 0'-2'), suggesting a surface source.
- TPH was not detected at all in soils from boring 10A.
- TPH concentrations in the surface sample from B6A was higher than the water table sample, suggesting a surface source.
- TPH was detected at a higher concentration in the water table sample from MW-8 than the surface soil sample. However, the fact that TPH was detected in the surface soil sample suggests that surface deposition of petroleum compound could be a source.

The observation might be made that the concentrations of TPH in the surface soils are due to a fluctuating ground water table, instead of a surface source. This would be plausible, however, the absence of TPH in the ground water table soil samples from B5A and B11A, coupled with the detection of TPH in those surface soil samples, would suggest a surface source.

Based on the above evaluation, the TPH concentrations detected in the field to the west of the building 45 complex are unlikely to be related to the operation of Tank S781 and are therefore considered outside the scope of this report.

2.02.4 Ground Water Characterization

Between December 6 and 12, 1991 ground water samples were collected from each monitoring well and hydropunch location. Ground water samples were sent to OBG Laboratories in Syracuse, NY for analysis by EPA Methods 8010, 8020, 8100 and TCLP. EPA 8000 methods (8010, 8020, 8100) are derived from the EPA 600 methods (601, 602, 610, respectively). The two methods apply the same technique and number of parameters. Standard laboratory QA/QC procedures were applied in accordance with the referenced EPA methods. Laboratory results are available for review in Appendix B.

All parameters, included in analytical methods EPA 8100 and TCLP, demonstrated values below laboratory detection limits. Constituents of the EPA 8010 and 8020 methodologies that were found to be above laboratory detection limits were below Ambient Water Quality Criteria.

2.02.4 Quality Assurance/Quality Control

Throughout field operations steps were taken to maintain quality assurance and quality control (QA/QC). Field instruments such as the PID, pH meter and specific conductivity meter were calibrated on site and daily. The PID was calibrated to 100 ppm

isobutylene. Specific conductivity and pH meters were calibrated to standardized solutions.

Sampling equipment was decontaminated by using a series of rinses involving distilled water, non-phosphate detergent, methanol and dilute nitric acid. A rinse blank (field blank) was included in the analysis to confirm the decontamination process effectiveness.

Standard laboratory QA/QC procedures were applied in accordance with the referenced EPA Methods. In addition, trip blanks and duplicate samples were used.

SECTION 3 - RISK ASSESSMENT

3.01 Introduction

This section presents an evaluation of the risk to human health associated with the former location and operation of an aboveground waste oil storage tank, #S-781, located within the Building 45 compound at the Marine Corps Base (MCB), Camp Lejeune, North Carolina. An initial site characterization and risk assessment were performed by O'Brien & Gere Engineers in the Spring of 1992. Subsequent to the report on the initial site characterization and risk assessment (report dated May 1992), the tank and the pump house have been removed; piping has been capped and abandoned in place, and the area has been graded and seeded.

This risk assessment specifically addresses the risk to human health related to identified environmental contamination resulting from the presence of fuels from the former location and operation of the tank. The results of this risk assessment are used in developing a corrective action/remedial action strategy, as presented in Section 4 of this report. This risk assessment has been prepared as an addendum/revision to the Site Assessment Report submitted in May 1992, in order to incorporate the changes to the site (removal of the tank and the pump house) and additional data obtained from new soil borings.

This risk assessment has been prepared at the request of the Atlantic Division Naval Facilities Engineering Command. Marine Corps Base, Camp Lejeune will submit this document to the North Carolina Department of Environment, Health and Natural Resources

(DEHNR). The DEHNR will then make a determination regarding potential corrective action requirements, as discussed in Section 4 of this report.

The associated field investigation for this project is previously described in Sections 1 and 2 of this report. The field investigation and subsequent risk assessment (Section 3 herein) and remediation assessment (Section 4) have been developed in accordance with DEHNR regulations codified in NC Title 15A, Chapter 2, Subchapter 2N, Criteria and Standards Applicable to Underground Storage tanks. This Site Assessment Report has been developed so as to be acceptable to NC DEHNR.

Criteria discussed and/or used in this risk assessment are drawn from DEHNR and parallel U.S. Environmental Protection Agency (EPA) regulations and/or guidelines, where applicable. This document is consistent with typical goals of performing risk assessments related to environmental contamination. The primary guidance document applied in developing this section is the EPA's "Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual". As such, it analyzes potential site-related acute and chronic health risks presented to on-site and off-site receptors, under both current and future use scenarios.

3.02 Site-Specific Descriptive Information

3.02.1 History

The 176,000 gallon capacity storage tank was originally owned and operated by Tidewater Electric, prior to 1942, and was used to store fuel oil. Raleigh, N.C. and Jacksonville, N.C. offices of

Carolina Power and Light (CP&L) were contacted regarding the operation of tank S-781 under the ownership of CP&L (previously named Tidewater Electric), prior to 1942. No historical information on the past operation of the tank was available from CP&L.

Following the Marine Corp acquisition of the property in 1942, the tank was used to store waste oils, primarily related to diesel engine maintenance and repair. According to Environmental Management Department, MCB Camp Lejeune, the operation of the tank involved the tank itself, the pump house, lines (underground piping) between the tank and pump house, and lines running from the tank to the building. According the Facilities Utilization Officer, in charge of the operations at building 45, there are no other avenues for petroleum hydrocarbons at the site related to tank S-781 other than to the pump house and Building 45. Information regarding the tank was provided by the Environmental Management Department, MCB Camp Lejeune, N.C. According to the Department, the tank was emptied in 1988, however, approximately eight inches of thick sludge still remained in the bottom of the tank after it was emptied.

There is no history of leaks from the tanks. However, a Department representative reported that a pump leak occurred, possibly when the tank was emptied in 1988. According to the representative, this leak resulted in excavation of the impacted soils within the immediate area of the tank.

According to the Department and a Construction Representative for MCB Camp Lejeune, the tank and its foundation were dismantled and removed in May 1992. The brick retaining wall surrounding the tank was also dismantled and removed. No excavation was performed, other than to remove the associated pump house that was built into the ground. Piping was capped and abandoned in place. Soils were not removed from the area nor disposed of from the site. Existing on-site soils were used to fill the area previously occupied by the pump house. Approximately 200 - 250 cubic yards of topsoil were brought in to grade the site. According to the Construction Representative, this topsoil fill was taken from an unused and undisturbed area of the Base at the edge of a wooded area near Building 1700. According to the Construction Representative, who was present during the tank removal activities, there were no petroleum-based odors noted during the site work, nor were petroleum-saturated soils observed.

Preliminary site investigations were conducted in November 1990 by Dewberry and Davis. Five hand auger, five soil borings and two monitoring wells were completed in the area of tank S-781. While the ground water samples did not indicate contaminant levels above method detection limits, three soil samples yielded total petroleum hydrocarbon (TPH) concentrations exceeding 10 ppm. TPH concentrations ranged from below method detection limits to 2200 ppm.

A site investigation was conducted in the Spring of 1992 by O'Brien & Gere Engineers, Inc. The results of this investigation

indicated subsurface TPH contamination (4' - 6', and 9' - 11') of 11,000 - 12,000 ppm at boring B-4, located west of the tank, just outside of the (former) brick retaining well which surrounded the tank. Additional subsurface TPH contamination (14' - 16') of 255 ppm was identified at MW4, located southwest of the former tank location. Ground water sample results from this investigation are discussed in Section 3.03.2 following. An additional study was conducted by the Environmental Management Department in April, 1992 in preparation for the tank removal. These results indicated subsurface (0' - 5') TPH soil contamination in the area south of the tank, both near the pipeline leading from the pump house to the tank (1200 ppm), and further south, to the south of the pump house (1400 - 2200 ppm).

Additional soil borings and soil sample analyses were conducted in October 1992 by O'Brien & Gere Engineers, Inc. The applicable results of these field activities are discussed in Section 3.03.1.

3.02.2 Site & Surrounding Area Description

The tank was located adjacent to Building 45, the Base's heavy equipment maintenance and storage building. Building 45 is located approximately 130 feet southwest of the Camp Lejeune railroad, which parallels a four-lane road (Highway 24). Residential housing is located on the other side of this road, northeast of the former tank location. The area south and west of the tank/Building 45 is undeveloped and wooded. The Building 45 area is enclosed by a locked fence. Access is gained only during regular work hours.

The fencing to the east runs between the site and the railroad tracks. Surface drainage ditches parallel the railroad, between the fence and the railroad.

The ground cover over the former tank area is grassy, with a gentle downward slope toward the northwest. Some gravel areas exist immediately adjacent to Building 45. The nearest surface water is Northeast Creek, approximately 800 feet to the northwest. There are no water supply wells within 1200 feet of the site. A map of the site is presented as Figure 2.

3.02.3 Demographics

The population at Camp Lejeune includes military personnel and their families, as well as civilian employees. Based on observations made during a site visit on October 20, 1992, approximately 5 - 10 people are employed at the Building 45 compound, a typical 8-hour/day, 5-day/week job.

3.03 Current Site Data

The October 1992 site investigation included 12 soil borings (B1A - B12A). These are described in detail in Section 2.01 of this report, and are noted on Figure 6. Of these 12 borings, two are located in a proximity so as to be within the scope of this risk assessment; these are B1-A and B2-A, both located within the fenced-in area of Building 45. B1-A is located approximately 175 feet south of the former tank location; B2-A is located approximately 450 feet south of the site. Both B1-A and B2-A are located within the fenced in area of Building 45; the other 10 borings are located 450 - 850 feet from the former tank location,

outside of the controlled, fenced-in area. Activity on and uses of the areas outside of the fenced area surrounding Building 45 differ from those within the compound. Also, there were no reported activities outside of the fenced in area related to the former operation of the tank. Therefore, data from boring B1-A and B2-A will considered further in the following subsections, in keeping with the focus of this risk assessment. Data from borings B3-A through B12-A will not be considered as applicable to this risk assessment.

3.03.1 Soil Data

Two soil samples from each of the October 1992 soil borings were selected for laboratory analyses for TPH using a gas chromatograph/flame ionization detector (GC-FID), according to SW-846 Methods 3550 and 5030 (per North Carolina requirements). Soil samples from B1-A and B2-A were collected at two depths ranges; 9'-11', and 14'-16'. Refer to Figure 6 for new borings and previous O'Brien & Gere Engineers' sample locations.

Soil TPH results for B2-A samples, at both 9'-11' and 14'-16', were below the detection limit of 1 mg/kg. The deeper sample from B1-A exceeded the North Carolina criterion concentration of 10 mg/kg TPH; the results of B1-A (14'-16') was 25 mg/kg. Results of B1-A (9'-11') were below detection limits.

A review of previous O'Brien & Gere data includes:

B-4	4' - 6'	11,000
B-4	9' - 11'	12,000
MW4	14' - 16'	255

ACS Environmental data from April 1992 includes:

MPSB1	0' - 5'	1200
MPSB2	0' - 5'	1400 - 2200

MPSB1 was located close to the O'Brien & Gere Engineers' boring B1, while MPSB2 was located approximately 90 feet further south, just south of the (former) pump house.

3.03.01.1 Soil Data Evaluation

The TPH detected in B1-A (14' - 16') were noted by the analytical laboratory (ETS) to consist of higher carbon-chain petroleum compounds (C_{12}-C_{32}) such as diesel oils and kerosene, as opposed to shorter-chain hydrocarbons (C_6-C_{12}) such as gasoline compounds. This is consistent with the former uses of the storage tank.

The contamination previously noted at B4 and MW4 are located in the immediate area of the former pump house for the tank. As such, it is reasonable to assume that detected contamination is related to subsurface piping running between the tank and the pump house. Data collected in April 1992 also indicates subsurface soil contamination to the south of the tank, in the vicinity of the former tank, underground piping, and to the south of the former pump house.

As noted previously, subsurface disturbance of site soils was minimal, i.e., limited to the removal of the tank foundation and the pump house. Excavation of subsurface soils did not take place.

Site soils were not removed from the site, but were used as fill for the pump house area. Outside topsoil was brought in and used as cover/grading over the area. As such, previous data indicating surface and subsurface soil contamination is considered as still applicable to the site (although the surface data from MPSB1 and MPSB2) are now covered by the fill topsoil, and thus are now subsurface).

In summary, it appears that subsurface soil contamination (TPH) is present in close proximity to the former tank location and pump house, including south of the pump house, and is likely related to the former operation of tank S-781. In addition, one sample (B1-A) indicates subsurface contamination 175 feet south of the former tank location. The presence of TPH residues in subsurface soil samples is considered in the exposure pathways, as discussed in subsections 3.05.2, 3.05.4 and 3.05.5.

3.03.2 Ground Water Data

This section refers to ground water data collected during the Spring 1992 field investigation.

No free product was detected in the fourteen ground water monitoring wells, nor was free product detected in the ten hydropunches.

Ground water samples from each monitoring well and hydropunch were analyzed for volatile organic compounds by SW-846 methods 8010 and 8020 (equivalent to EPA Methods 601 and 602). In addition, samples from MW1, MW7 and MW11 were analyzed by EPA SW-846 method 8100 equivalent to Method 610), (polynuclear aromatic hydrocarbons;

PAHs). Ground water samples from MW3 were analyzed for full scan TCLP compounds. Section 2 of this report provides additional details on the analytical scheme.

TCLP results were below regulatory limits; PAHs results were less than the detection limits.

The 8010/8020 results were below method detection limits, with the exception of the following compounds:

Detected Compound	Sample Number	Results (mg/l)	NC Standard (mg/l)	MCL (mg/l)
chlorobenzene	H5	0.005	0.3	0.1 *
1,2-dichlorobenzene	H8	0.031	0.62	0.6 *
1,3-dichlorobenzene	H5	0.006	0.62	0.6 *
1,4-dichlorobenzene	H5	0.084	0.0018	0.075
1,1-dichloroethane	MW3	0.016	n/a	n/a
"	H1	0.002	n/a	n/a
1,1-dichloroethylene	MW4(dup)	0.002	0.007	0.007
1,2-dichloroethylene	MW4	0.002	n/a	0.07 *
ethylbenzene	MW3	0.016	0.029	0.7 *
toluene	MW12	0.002	1.0	2.0 *
"	H9	0.002	1.0	2.0 *
vinyl chloride	MW4(dup)	0.002	0.000015	0.002

The NC standards are the water quality standards applicable to the ground waters of North Carolina, as dictated in Title 15, Subchapter 2L, Section 0.0200, of the North Carolina Administrative Code, dated 12/1/89. The standard applies to Class GA waters, which are considered to be drinkable in their natural state (i.e., potable water supplies).

MCL's are the Maximum Contaminant Level allowable for drinking water, under the National Primary Drinking Water Regulations. Those marked with the * indicate proposed limits; all others are final and current limits.

"n/a" indicates that North Carolina has not established a criterion for this chemical.

3.03.02.2 Ground Water Data Evaluation

The following compounds were detected in excess of the North Carolina criteria:

- 1,4-dichlorobenzene (p-dichlorobenzene) in H5
- vinyl chloride, in duplicate sample for MW4.

1,4-dichlorobenzene, detected in H5 at 0.084 mg/l, exceeds the regulatory criteria. Therefore, it is considered in the exposure scenarios, as discussed in subsections 3.05.02, 3.05.03 and 3.05.04.

The vinyl chloride was below detection limits in the other portion of the duplicate sample for MW4. Vinyl chloride detected at 0.002 mg/l does not exceed the federal MCL criterion.

The other organic compounds detected in the ground water samples are within regulatory limits, as presented on the above table. The only exception is 1,1-dichloroethane, for which no regulatory limit has been established to date.

Ground water flow, based on data collected from the seven nested wells, is in a west-northwesterly direction; ground water flow velocity is calculated to be approximately 10 feet/year.

3.03.03 Ambient Air Data

Ambient air quality was monitored during field activities in the Spring of 1992, with a photoionizing organic vapor detector (PID) with a 10.2 eV lamp. PID readings were recorded from the breathing zone of the on-site workers and at the ground surface every 15 to 30 minutes. The PID readings did not exceed the detection limit of the PID (1 ppm) at any time during the ambient air monitoring.

Mr. Adams mentioned that ambient air monitoring was conducted during the tank removal project, and that no readings in excess of 10 ppm were noted (monitoring instrument was not specified).

3.04 Identification of Chemicals and Media of Concern

Based on the results of the site investigation, as described in the previous section, the environmental contaminants to be considered in the following exposure scenarios are 1,4-dichlorobenzene in the ground water, and TPH in the subsurface soils.

3.05 Risk Assessment Approach

3.05.1 Introduction

This risk assessment addresses the potential for exposure to the ground water and TPH-contaminated subsurface soils in the area of tank #S-781, under current and reasonably anticipated future conditions and site uses. Four potential exposure pathways are considered in assessing potential risk related to the identified contamination: 1) air, 2) surface water, 3) ground water, and 4) soil.

In the analysis of each exposure pathway, three key components are considered:

1. known source;
2. mechanisms for release and medium/vehicle for transport of contaminant(s);
3. potential receptor populations.

If an exposure pathway has these three components, it is considered as a complete exposure pathway. If an exposure pathway lacks one of these necessary components it is concluded that there is no potential for exposure via that incomplete pathway, and

therefore no risk. Each pathway is analyzed separately in the following sections. Each analysis includes the following:

1. a description of the waste source;
2. mechanisms for release and transport of contamination in the environment;
3. the time frame of potential releases (i.e., continuous or episodic);
4. the existence of potential receptor populations;
5. potential exposure scenarios;
6. potential uptake routes (ingestion, inhalation, dermal absorption);

Should all of the above be present, it is determined that the exposure pathway is complete, and further quantitative analysis is then made. Exposure point concentrations are estimated, followed by exposure intakes.

Exposure scenarios may include current and future use conditions, children and adult exposures, and both carcinogenic and non-carcinogenic effects of chemicals involved in the exposure, as applicable. The calculated exposure intake is then compared to human-health based reference data, and an assessment of the potential for adverse health effects is then made. Details of this quantitative analysis process are presented for the exposure pathway(s) to which it is applied.

3.05.2 Air Exposure Pathway

Three potential mechanisms for release of identified contamination to the air are considered in assessing risks related to the air exposure pathway:

1) episodic fugitive dust emissions of contaminated soil particulates;
2) continuous emissions of volatile components of soil contamination, through the soil, to the ambient air at the site; and

3) continuous emissions of volatile components of soil contamination, through soils, into subsurface structures at the site.

3.05.2.1 Potential Exposure to Fugitive Dust Emissions

Episodic releases of contaminated fugitive dusts to the general atmosphere would result if contaminated surface and/or subsurface soils were exposed to surface scouring action (e.g., wind, vehicle traffic, foot traffic, heavy equipment operation). The areas surrounding the identified subsurface contamination were graded and seeded in May 1992, and are now covered by vegetation (grass and weeds). No surface contamination was visually observed during a site visit on October 20, 1992. Contamination was detected prior to the tank removal project at a depth of 0' - 5'. Since site soils remained on-site and were used to fill the pump house area, it is likely that detected contaminants are still on-site. Likewise, detected subsurface contamination remains, as it was undisturbed. Off-site topsoil was brought in to cover/grade the site. Vegetation covers the soil, minimizing erosion. In addition, there is minimal site activity (foot traffic) over the area which could result in scouring actions on near-surface and subsurface contaminated soils. Based on this information, the potential for fugitive dust emissions in the area is negligible under current use conditions.

Based on information provided by the Environmental Management Department, there are no plans to make use of the study area. In fact, former vehicle washing operations at a nearby concrete pad, involving the "basin" oil/water separator have ceased. Current

plans are to leave the former tank area open area, unused, and not subject to foot or vehicle traffic. Uses and operations of Building 45 will not undergo substantial change with respect to land use, operations, or materials in the foreseeable future. Based on this, there is negligible potential for scouring actions to impact existing contaminated subsurface soils under future anticipated conditions.

3.05.02.2 Potential Exposure to Volatile Emissions in the General Atmosphere

Volatilization involves evaporation of volatile components from contaminated media. Vapors can then migrate up through the soils to release at the soil surface under certain conditions.

The identified ground water contaminant is 1,4-dichlorobenzene. Soil and vegetative cover would both inhibit and dilute volatilization of 1,4-dichlorobenzene, to the extent that the release of such vapors into the general atmosphere would be insignificant. Soil interactions such as adsorption and degradation, as indicated by environmental degradation half-lives, as well as dilution and dispersion actions of ambient air movement, would result in minimal concentrations of such vapors with respect to concern for human exposure.

Based on the above discussions, no significant vapor emissions related to subsurface soil contamination are reasonably expected in the area of the tank. Thus, the risk potentially associated with volatile emissions from subsurface soils is negligible.

3.05.02.3 Potential Exposure to Volatile Emissions Released into Subsurface Structures

Building 45 is most likely constructed on a concrete slab, although the Environmental Management Department could not confirm this. The oil/water separator, located just southwest of tank S-781, is the nearest sub-grade structure, but it is neither enclosed nor occupied, and is no longer used.

In general, there are few subsurface structures at Camp Lejeune, due to the high water table. Therefore, most buildings are constructed on slab. The only likely subsurface items are utility conduits, and the abandoned pipe lines leading to/from the tank. Thus, no identified receptor areas exist to complete the end of the transport route. Based on this, the exposure pathway for volatile constituents of site contaminants that might migrate through soils into on-site subsurface structures is incomplete. As such, there is no risk of exposure via this mechanism.

3.05.02.4 Conclusion on Air Exposure Pathway

There is no significant risk of exposure via the air exposure pathway.

3.05.03 Surface Water Exposure Pathway

Two mechanisms for release of identified contamination to surface waters are considered in assessing risks related to the surface water exposure pathway:

1) contamination of surface water by contact with surface contamination; and
2) contamination of surface water by ground water discharge.

There are no identified surface water streams within the study area. The nearest surface water is Northeast Creek, approximately 800 feet to the west (generally downgradient).

3.05.03.1 Potential Exposure to Contaminated Surface Water in Contact with Surface Contamination

There was no observed surface contamination in the immediate area of the tank. As stated above, there are no permanent surface water bodies, including streams, within the study area. As there is no observable surface contamination, nor is there surface water at the study area to serve as either a source or a transport vehicle, this potential exposure pathway is incomplete, and therefore there is no risk associated with this pathway.

3.05.03.2 Potential Exposure to Contaminated Surface Water via Ground Water Discharge

Based on information obtained from this investigation, the following ground water discharge-to-surface water scenario is possible. The ground water flows west-northwesterly; the nearest downgradient surface water body (Northeast Creek) is 800 feet to the west. As such, ground water from the study area would likely flow west-northwesterly via natural migration pathways and discharge to Northeast Creek, over an extended period of time. The potential for exposures occurring in surface water contaminated by ground water flowing from the Site to Northeast Creek far in the future is beyond both the current and reasonably anticipated future use/conditions scenarios. In addition, 1,4-dichlorobenzene is not readily soluble in water, therefore such transport would be

inhibited. Finally, prolonged migration of such a low concentration of 1,4-dichlorobenzene would lead to negligible concentrations over such a distance, due to soil interactions, degradation, etc.

Therefore, the potential impact of site-related ground water on surface water is negligible.

3.05.03.3 Conclusion on Surface Water Exposure Pathway

There is no significant human health risk, based on current and reasonably anticipated future use scenarios, via the surface water pathway.

3.05.04 Ground Water Exposure Pathway

Two mechanisms for release of identified contamination to or through ground waters are considered in assessing risks related to the ground water exposure pathway:

1) Direct withdrawal and use/consumption of contaminated ground water (contamination, as detected, or contamination via leaching from subsurface soils); and

2) Exposure to ground water during subsurface disturbance.

3.05.04.1 Potential Exposure via Contaminated Ground Water Use/ Consumption

There are no identified ground water users. According to the Environmental Management Department, the ground water of the shallow aquifer at Camp Lejeune is not used for human consumption or other operations/purposes which might lead to potential human exposure. Potable ground water use in the area is limited to deeper aquifers: the Castle Hayne aquifer at approximately 150' below the ground surface, and the Beaufort Aquifer, at 150' - 200'

below grade. There are no known users/uses of the shallow aquifer (15' below grade). Thus there is no receptor population.

Based on the lack of a receptor population, this exposure pathway is incomplete, and therefore there is no risk to human health related to use/consumption of the ground water at the tank area. Based on the confining nature of the Castle Hayne Formation, the potential for migration of contaminants to the deeper aquifers does not appear likely.

3.05.04.2 Potential Exposure via Disturbance/Contact with Ground Water

Based on information provided by the Environmental Management Department, there are no current nor anticipated plans to change the use of the study area; i.e., there are no known nor anticipated subsurface disturbance activities to take place in the study area. Therefore, there is no potential for exposure via contact with ground waters.

3.05.04.3 Conclusion on Ground Water Pathway

There is no potential for exposure, and therefore no significant risk related to the ground water exposure pathway.

3.05.05 Soil Exposure (Direct Contact) Pathway

One mechanism for exposure related to identified contamination is considered in assessing risks related to the soil exposure pathway:

1. Direct contact.

Near-surface and subsurface soil contamination was detected at the site. Depth of contamination ranged from 0 to 16 feet.

Detected subsurface contamination remains, as it was undisturbed. Site surface soils remained on-site and were used to fill the pump house area. Off-site topsoil was brought in to cover/grade the site. The grading and seeding were completed in May 1992; the site is now covered by vegetation (grass and weeds). Therefore, while detected surface and subsurface contaminants are still on-site, the off-site topsoil used in grading, and the vegetative cover, now cover both the surface and subsurface contamination. Therefore, the detected soil contamination is referred to in this section as subsurface contamination.

3.05.05.1 Potential Exposure via Direct Contact with Contaminated Subsurface Soils

There is no current nor anticipated disturbance of contaminated subsurface soils (see also discussion in Sections 3.05.02.1 and 3.05.04.3). Thus there is no potential for direct contact with contaminated subsurface soils under current or anticipated future conditions.

In summary, under current and anticipated future conditions, there is no potential for exposure related to direct contact with the contaminated subsurface soils. However, if excavation of soils in the area of B4 were to occur, there is potential for exposure which may involve significant health risk, related to exposure to the contaminated subsurface soils.

3.06 Conclusion

Based on the above assessment, there is no significant exposure to TPH residue contamination present at the former

location of tank #S-781, Camp Lejeune, North Carolina, and therefore no current or anticipated future risk.

Should plans to regrade, remove piping, change the use of the area, etc. be instituted, the issue of TPH contamination in the subsurface soils, particularly at boring B4 should be re-visited prior to ground-breaking activities. Such subsurface disturbance may pose a health risk, which should be evaluated at that time.

SECTION 4 - REMEDIATION ASSESSMENT

As stated in the May 1992 Site assessment document, the lack of significant ground water contamination associated with Tank S-781 suggests that remediation focus on the soil containing residual petroleum product. Although no current, significant risks are identified for the Tank S781 area, subsurface concentrations of TPH in soil are considered unacceptable to the State of North Carolina. Available data indicate that the contamination is localized around the transfer pipeline between the tank and the pump house. The recommended remedial approach is to excavate contaminated soils around the former pipeline between the former tank and pump house and transport to a certified disposal facility. Disposal options include brick manufacturing plants, treatment at thermal or bioremediation facilities and use in asphalt paving materials. The soil remediation endpoint is 160 ppm, as determined by the Site Sensitivity Evaluation (SSE) procedure, found in the "Ground Water Section Guidelines for the Investigation and Remediation of Soils and Ground Water" dated March 1993 (Appendix F).

Based on the lack of significant ground water contamination associated with Tank S-781, the results of the risk assessment, and the industrial nature of the site, it is proposed that remediation focus on those soils in excess of 100 mg/kg.

REFERENCES

Dewberry & Davis, January 1991. Technical Memorandum No. 2 Results of Field Investigation, Marine Corps Base, Camp LeJeune, North Carolina.

O'Brien & Gere Engineers, Inc., July 1988. Contaminated Groundwater Study, Camp LeJeune, North Carolina.

O'Brien & Gere Engineers, Inc., May 1992. Site Assessment Tank S781, Midway Park, Marine Corps Base, Camp LeJeune, North Carolina.

Lloyd, O. Jr. and Daniel, C. III; U.S. Geological Survey, 1988. Water Resources Investigations Report 88-4034.

Tables

TABLE 1
GROUNDWATER ELEVATIONS

Tank S781, Midway Park
Marine Corps Base, Camp Lejeune, North Carolina

Well #	Top of Casing Elevation	Depth to Water 12/91	Groundwater Elevation (AMSL) 12/91	Depth to Water 1/92	Groundwater Elevation (AMSL) 1/92
MW1	22.26	19.01	3.25	17.96	4.30
MW2	22.10	18.85	3.25	17.80	4.30
MW3	18.63	15.42	3.21	14.45	4.18
MW4	18.39	15.29	3.10	14.25	4.14
MW5	19.06	16.00	3.06	14.78	4.28
MW6	18.13	15.10	3.03	13.92	4.21
MW7	8.72	6.50	2.22	5.05	3.67
MW8	8.90	6.74	2.16	5.25	3.65
MW9	12.90	10.74	2.16	9.50	3.40
MW10	12.90	10.76	2.14	9.50	3.40
MW11	19.13	11.75	7.38	9.96	9.17
MW12	19.24	16.02	3.22	14.34	4.90
MW13	8.91	6.84	2.07	5.45	3.46
MW14	8.94	6.90	2.04	5.64	3.30
MW A	14.50	11.26	3.24	10.01	4.49
MW B	13.96	10.67	3.29	9.32	4.64

TABLE 2
IN-SITU PERMEABILITY RESULTS

Tank S781, Midway Park
Marine Corps Base, Camp Lejeune, North Carolina

WELL #	IN-SITU PERMEABILITY	
	FT/SEC	GPD/FT^2
MW1	*	*
MW2	1.3×10^{-4}	84.0
MW3	7.4×10^{-5}	47.7
MW4	4.2×10^{-5}	27.3
MW5	2.8×10^{-4}	180.0
MW6	6.6×10^{-5}	42.4
MW7	1.0×10^{-4}	67.4
MW8	6.8×10^{-5}	44.1
MW9	8.3×10^{-5}	53.7
MW10	1.1×10^{-4}	69.4
MW11	5.7×10^{-6}	3.7
MW12	1.5×10^{-5}	9.5
MW13	5.7×10^{-5}	36.9
MW14	6.7×10^{-5}	43.2

GEOMETRIC MEAN = 6.1×10^{-5} FT/SEC; 39 GPD/FT^2

* Unable to complete test due to difficult field conditions

TABLE 3
pH AND SPECIFIC CONDUCTIVITY MEASUREMENTS

Tank S781, Midway Park
Marine Corps Base, Camp Lejeune, North Carolina

Well #	pH (Standard Units)	Specific Conductivity (uMHOS/Cn)
MW1	7.5	100
MW2	7.5	100
MW3	6.5	700
MW4	6.5	500
MW5	7.5	200
MW6	7.5	100
MW7	6.5	300
MW8	7.0	600
MW9	7.0	300
MW10	7.5	300
MW11	7.0	500
MW12	7.0	200
MW13	6.5	500
MW14	6.5	300

TABLE 4
Tank S781
Marine Corps Base
Camp Lejeune, North Carolina

SUMMARY OF RISK ASSESSMENT

EXPOSURE PATHWAY	RELEASE/TRANSPORT MECHANISM	IS PATHWAY COMPLETE?	RISK?	COMMENTS
AIR	fugitive dusts	yes	negligible	based on offsite topsoil, grading, vegetation, minimal use
	volatile emissions to ambient air	yes	negligible	based on concentration, soil interactions, soil & vegetative cover, dilution/dispersion by ambient air
	volatile emissions to subsurface structures	no	none	no receptor points
SURFACE WATER	contact with surface contamination	no	none	no surface water; no observed surface contamination
	ground water discharge to surface water	yes	negligible	due to distance, ground water flow rate, degradation, dilution, soil interactions
GROUND WATER	ground water use	no	none	no receptor points; shallow ground water not used/drawn for drinking or other purposes. Vertical migration to confined Castle Hayne aquifer (used for drinking water) unlikely
	exposure during subsurface disturbance	no	none	no plans for disturbance
SOIL	direct contact	no	none	contaminated soils are subsurface; soil and vegetative cover exists; no plans for disturbance

Figures

FIGURE 1

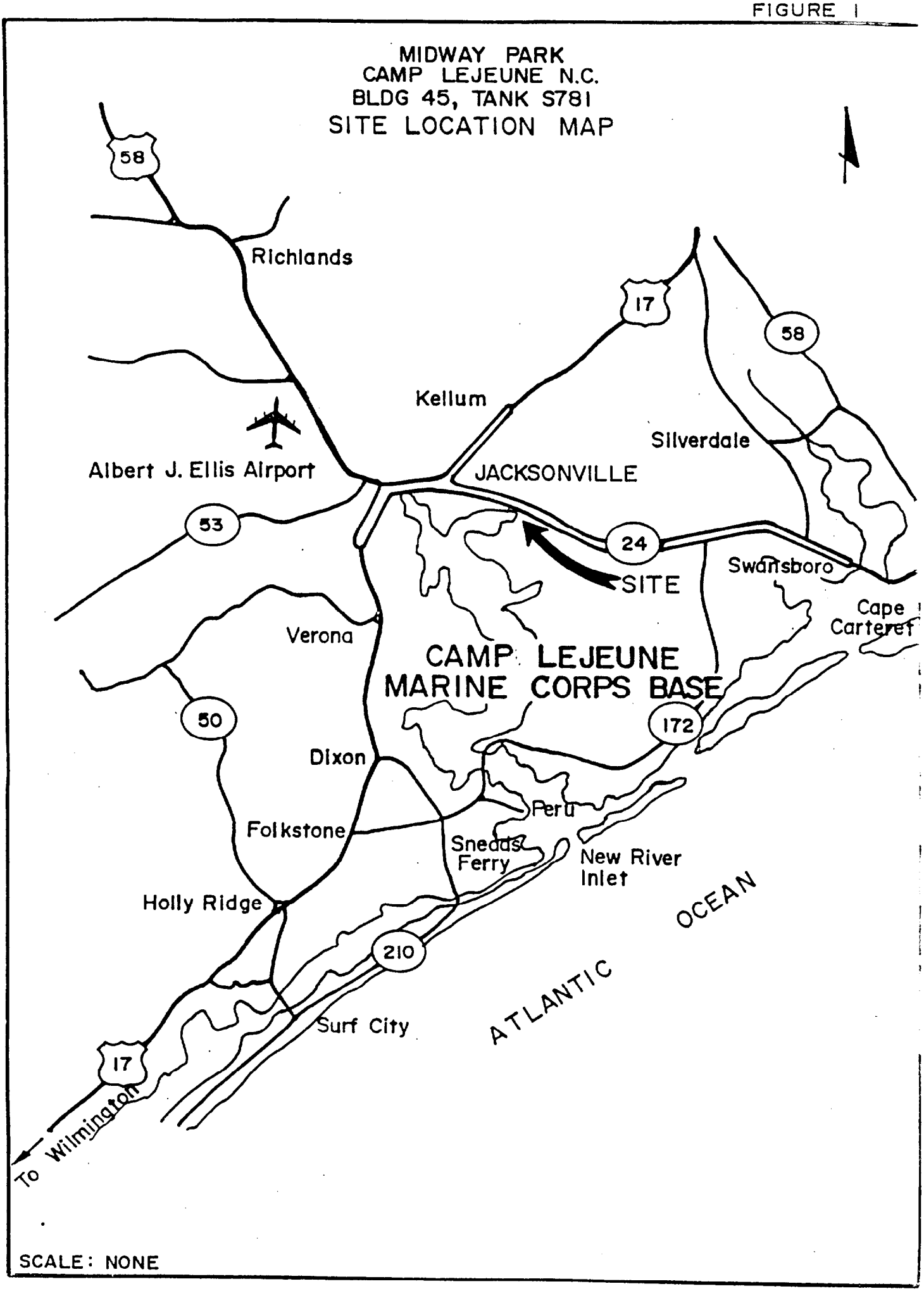

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FIGURE 2

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781
SUBSURFACE INVESTIGATION
LOCATION MAP – DEC. 1991

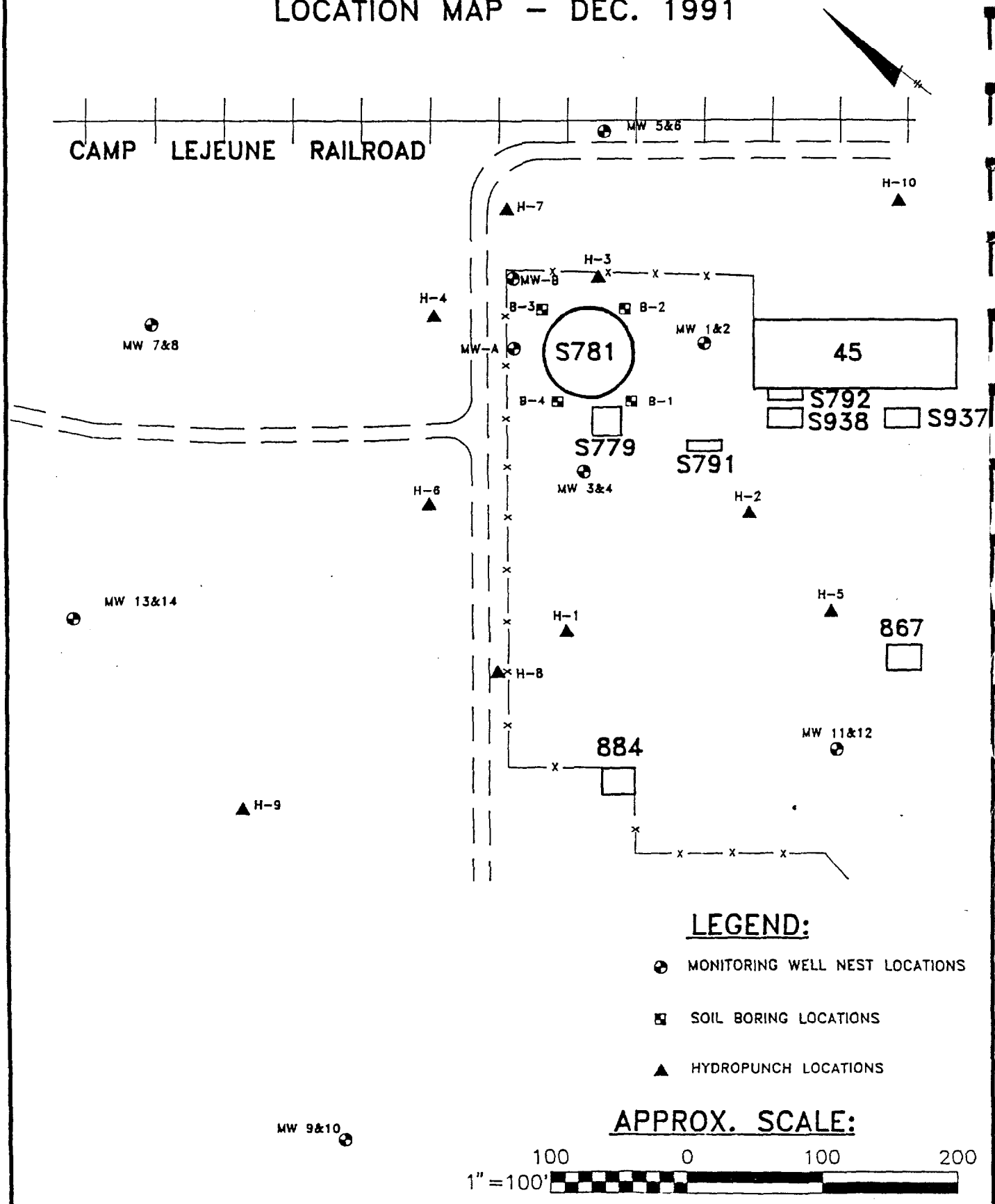

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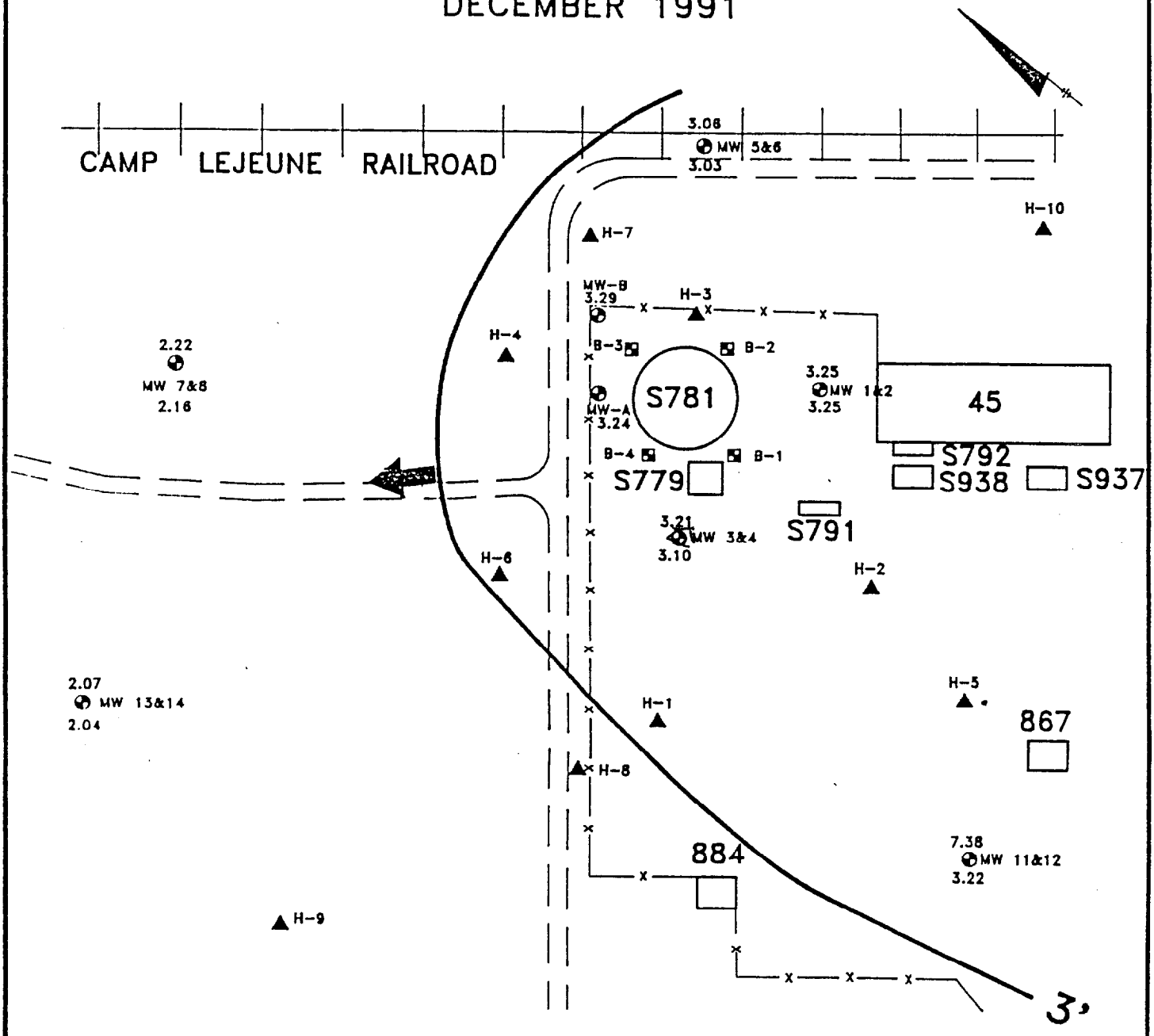
FIGURE 3

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781
GROUNDWATER CONTOUR MAP
DECEMBER 1991



LEGEND:

- MONITORING WELL NEST LOCATIONS
- SOIL BORING LOCATIONS
- HYDROPUNCH LOCATIONS
- FLOW DIRECTION

2.16
MW 9&10
2.14

APPROX. SCALE:

100 0 100 200

1" = 100'

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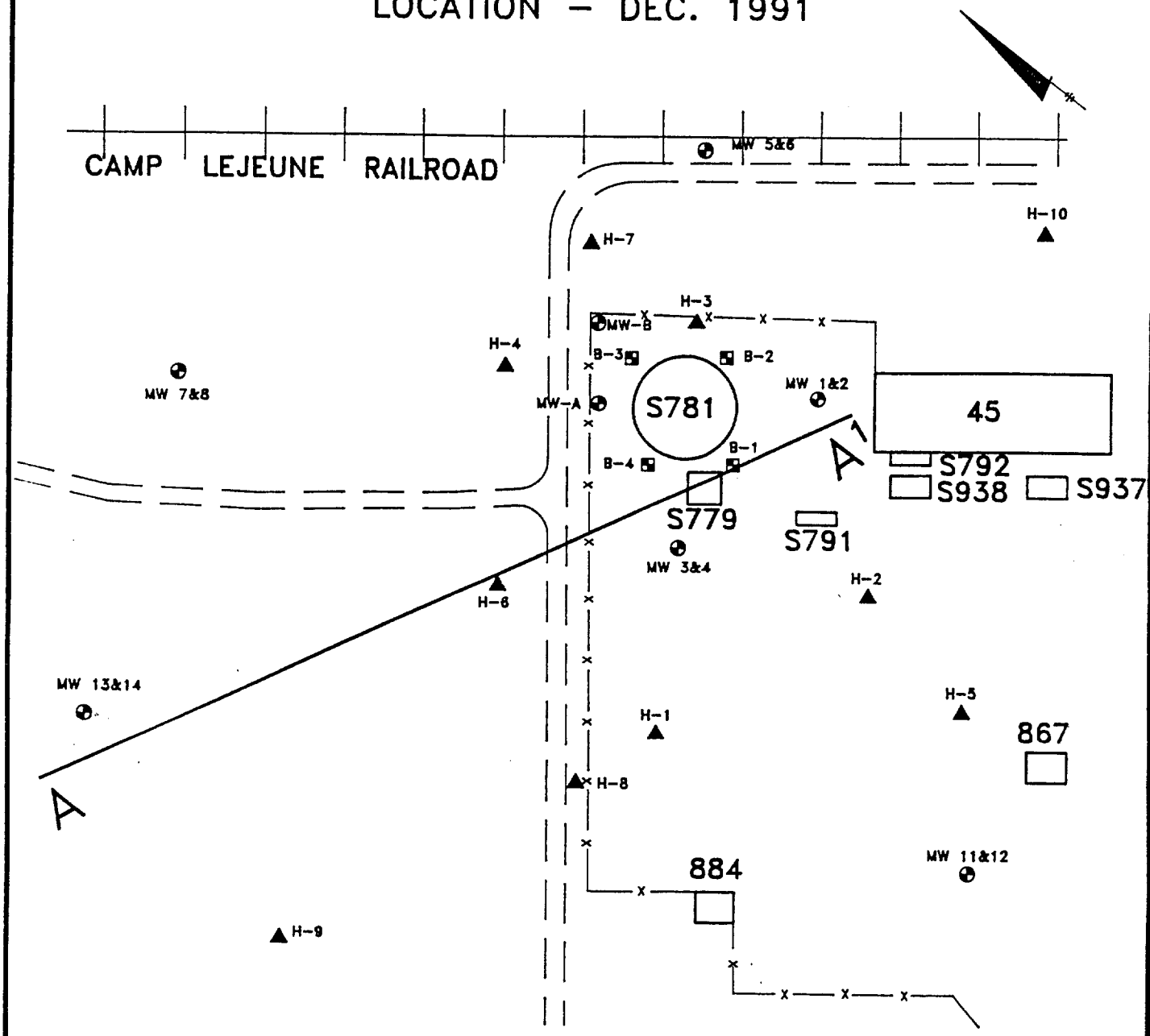
FIGURE 4

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781
GEOLOGIC CROSS-SECTION A-A^1
LOCATION - DEC. 1991



LEGEND:

- MONITORING WELL NEST LOCATIONS
- SOIL BORING LOCATIONS
- HYDROPUNCH LOCATIONS

APPROX. SCALE:

1" = 100'

100 0 100 200

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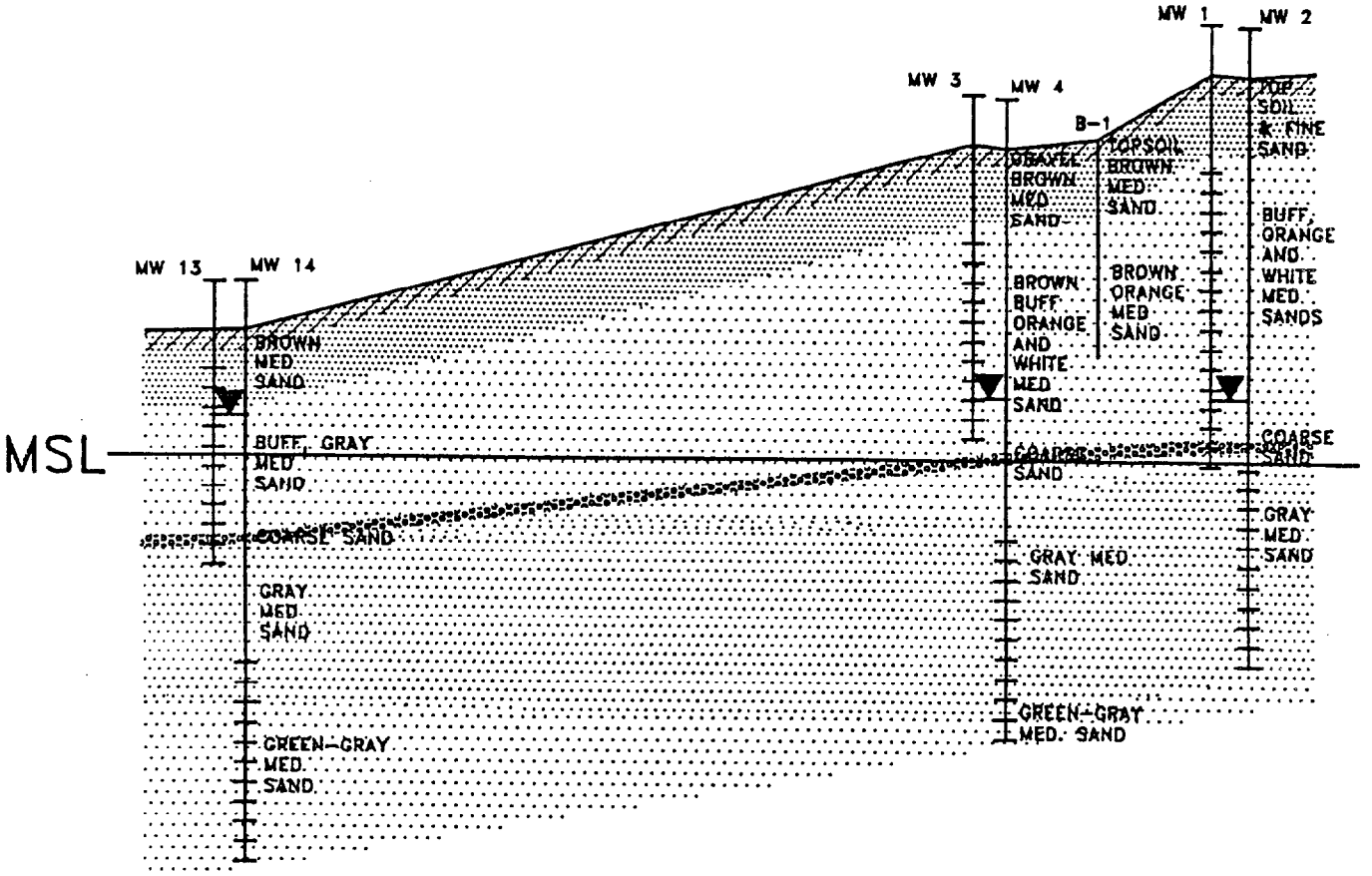
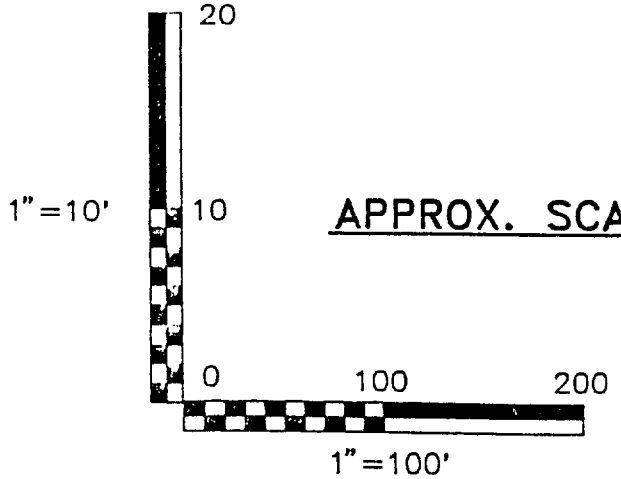
FIGURE 5

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781
GEOLOGIC CROSS-SECTION A-A^1
DEC. 1991





APPROX. SCALE:

LEGEND:

- GROUNDWATER ELEVATION
- MONITORING WELL
- SCREENED INTERVAL

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MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781
ADDENDUM SOIL BORING LOCATIONS
OCT. 1992

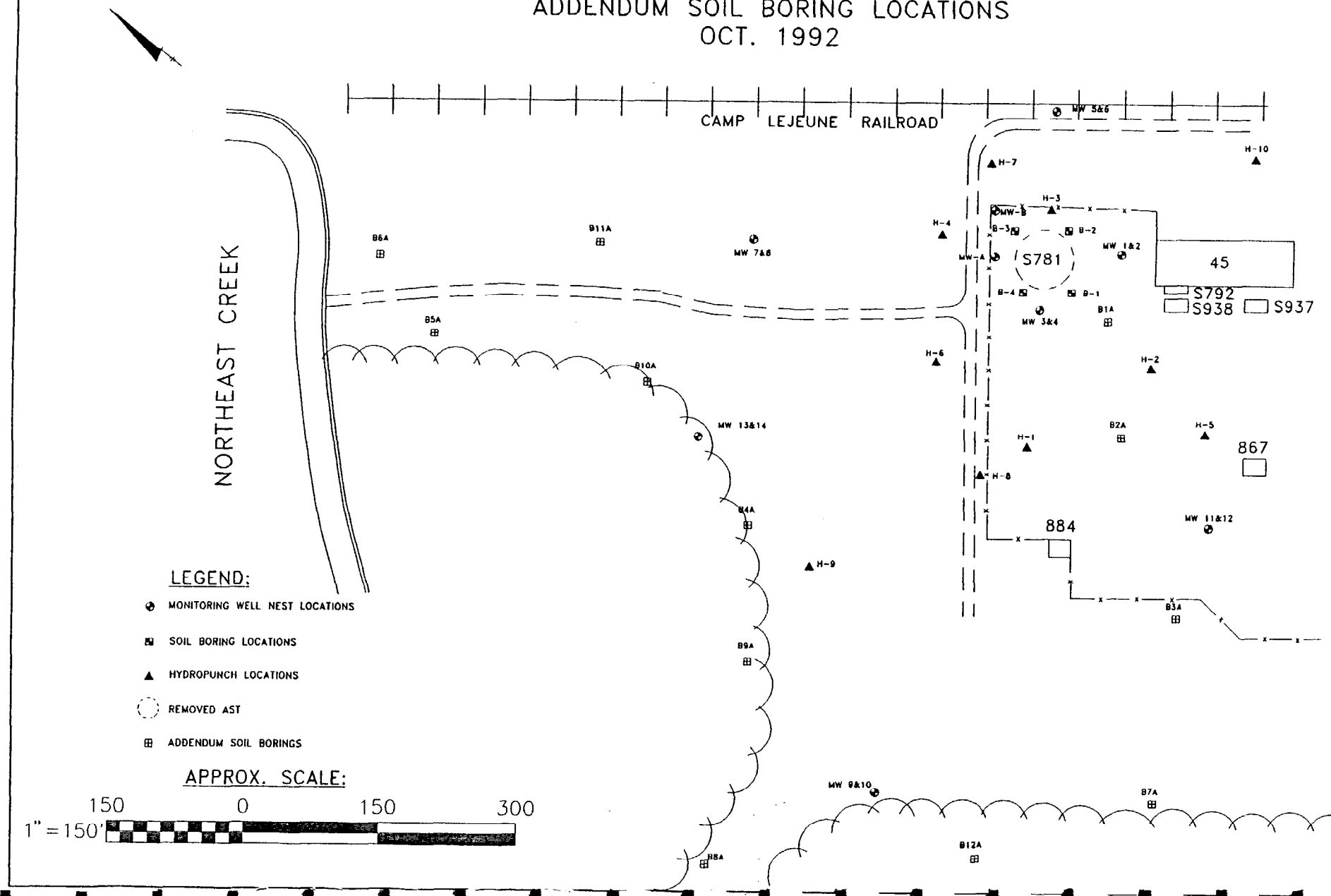

FIGURE 6

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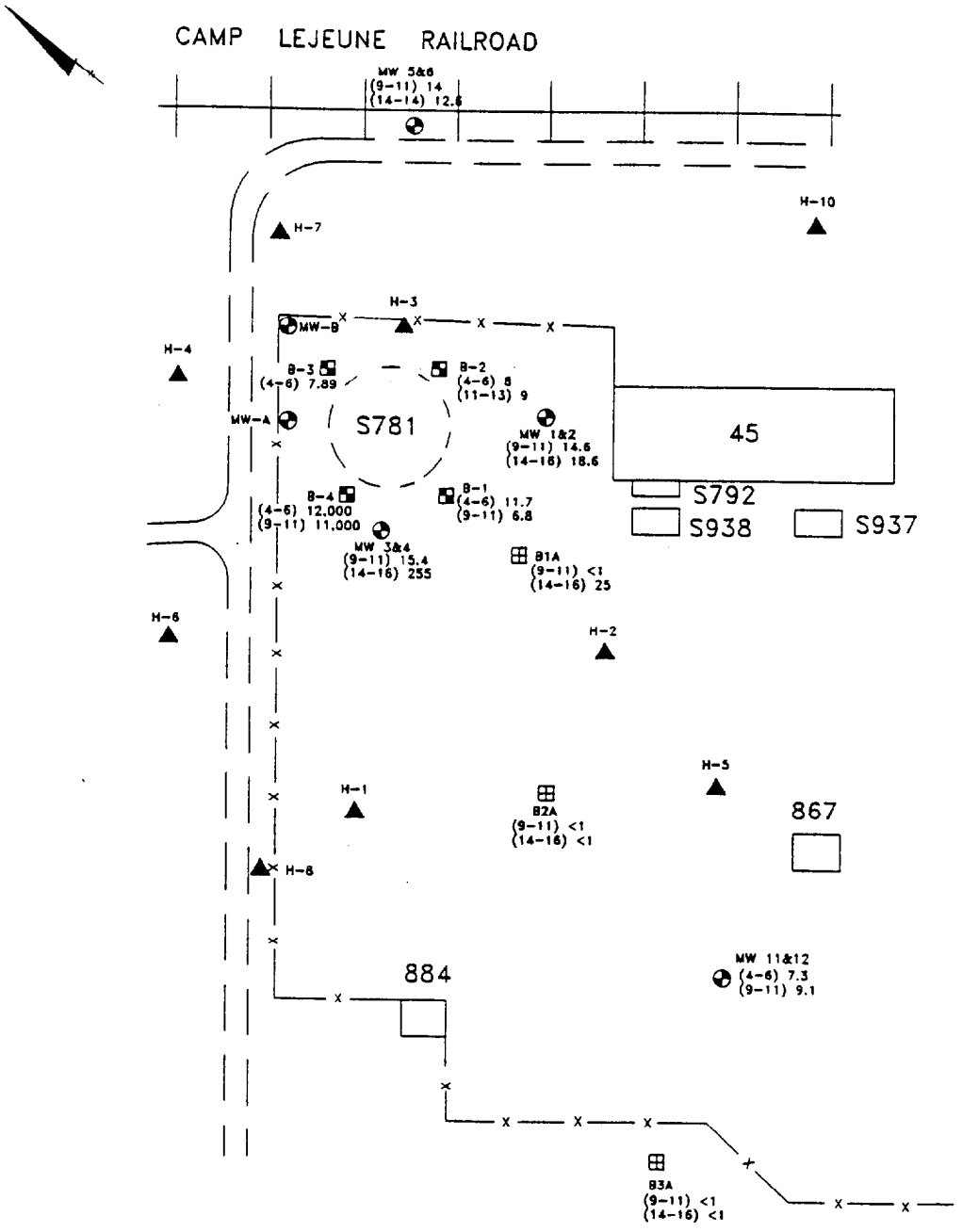
MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781
TPH CONCENTRATIONS



LEGEND:

(4-6) 8 (DEPTH) TPH CONCENTRATION IN mg/kg

- MONITORING WELL NEST LOCATIONS
- SOIL BORING LOCATIONS
- HYDROPUNCH LOCATIONS
- REMOVED AST
- ADDENDUM SOIL BORINGS

APPROX. SCALE:

100 0 100 200

1" = 100'

O'BRIEN & GERE ENGINEERS INC.

MIDWAY PARK
CAMP LEJEUNE N.C.
BLDG 45, TANK S781
TPH CONCENTRATIONS

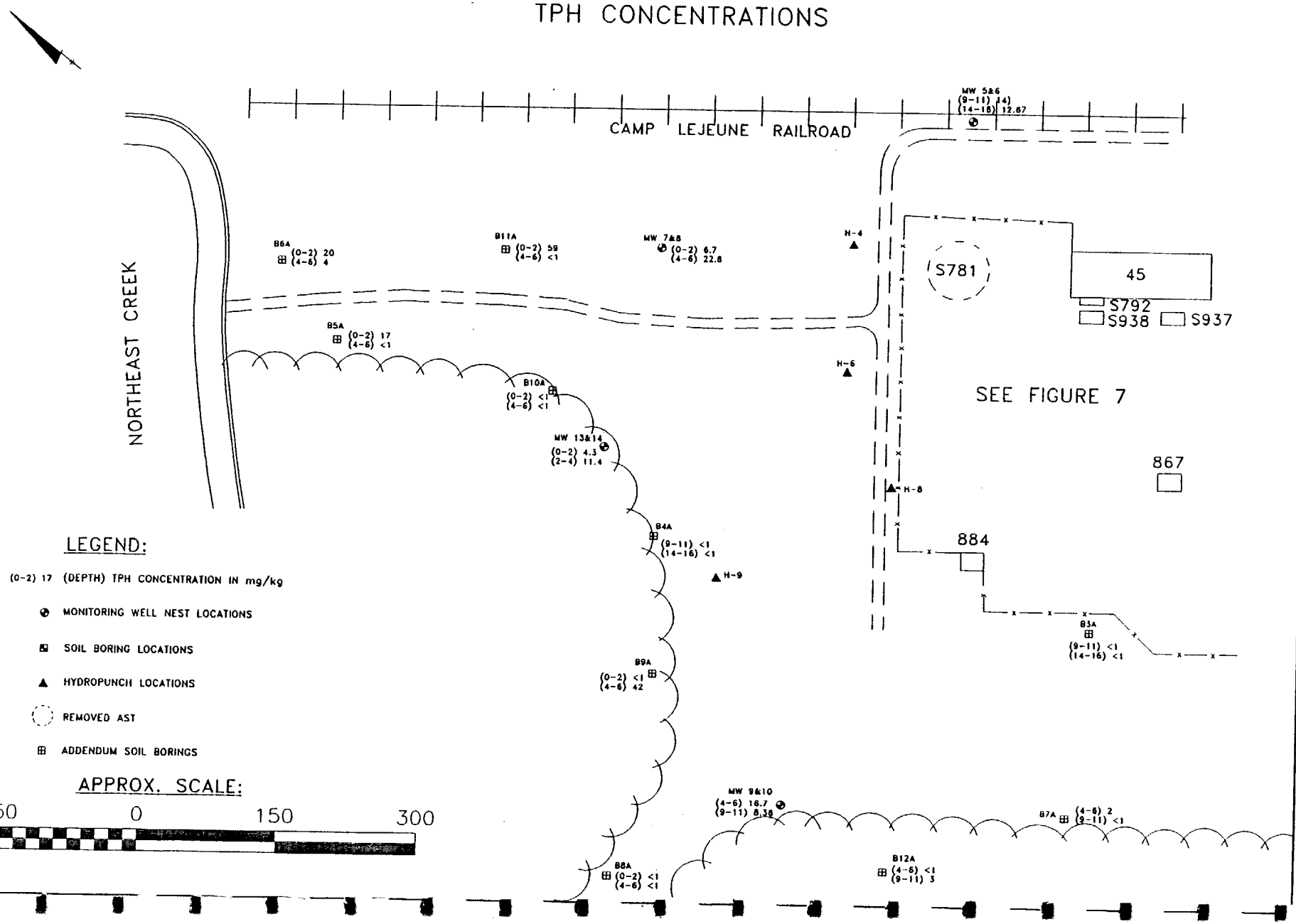


FIGURE 8

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Appendices

APPENDIX A

BORE LOGS AND WELL CONSTRUCTION DATA

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B1a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/5/92 Ended: 10/5/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	12/20/20/16	24/12		Gray, medium sand with gravel and pebbles.	
4	4-6	4/3/3/3	24/21		Tan, medium sand.	
9	9-11	3/3/5/7	24/20		Orange and tan, medium sand.	
14	14-16	14/11/17/16	24/21		Orange/tan, medium sand. Bottom 10" wet.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B2a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/5/92 Ended: 10/5/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	4/5/6/7	24/12		Gravel on top of grayish-brown, medium sand.	
4	4-6	4/8/6/8	24/24		Tan, medium sand.	
9	9-11	5/1/1/2	24/24		Top 16" brown/tan, medium sand. Bottom 8" dark brown, fine sand with silt. Very moist.	
14	14-16	19/15/13/8	24/		Orange and white interbedded, medium sand. Saturated.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B3a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/5/92 Ended: 10/5/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	1/2/3/3	24/18		Tan, medium sand.	
4	4-6	4/6/10/16	24/24		Top 8" tight, tan, medium to fine sand. Bottom 16" white, fine sand.	
9	9-11	6/7/9/11	24/20		Gray, medium sand.	
14	14-16	4/5/5/7	24/24		Medium to coarse, saturated, tan sand.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B4a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/5/92 Ended: 10/5/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	WOH/1/1/1	24/24		Brown to tan, medium sand.	
4	4-6	3/5/3/3	24/20		Tan, medium to fine sand. Small amount of clay.	
9	9-11	4/7/8/7	24/18		Top 14" orange, medium sand. Bottom 4" gray/ white, medium sand. Very moist.	
14	14-16	5/9/11/12	24/24		Gray/white, medium sand.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B5a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/5/92 Ended: 10/5/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	4/4/5/2	24/24		Gravel on top of brown, medium sand.	
4	4-6	2/2/2/2	24/20		Saturated, medium to coarse sand. Tan and white.	
9	9-11	1/1/1/3	24/24		Orange and gray, fine to coarse sand. Some clay.	
14	14-16	1/2/4/3	24/24		Orange and gray, fine to coarse sand. Some clay.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B6a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/5/92 Ended: 10/5/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	1/1/1/1	24/18		Dark gray, find sand. Some organic debris. Very moist.	
4	4-6	5/1/1/2	24/6		Dark gray, wet, fine sand.	
9	9-11	WOH/1/1/1	24/24		Dark gray, fine sand. 6" of organic debris.	
14	14-16	1/1/1/1	24/24		Dark gray, fine sand.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B7a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/6/92 Ended: 10/6/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	5/6/5/6	24/24		Brown and black, medium to fine sand.	
4	4-6	4/4/5/6	24/19		Gray/white and dark brown, medium sand.	
9	9-11	4/7/7/7	24/12		Brown fine sand on top of 8" of brown medium sand. Wet.	
14	14-16	5/2/6/11	24/24		Brown medium to coarse sand.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B8a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/6/92 Ended: 10/6/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	2/3/3/2	24/18		Dark brown, sandy soil.	
4	4-6	9/4/3/3	24/24		Brown, medium sand. Some organic debris.	
9	9-11	8/1/2/2	24/24		Top 12" brown, medium sand. Bottom 12" brown, saturated, medium sand.	
14	14-16	1/9/5/6	24/12		Brown, medium to coarse sand.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B9a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/6/92 Ended: 10/6/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	2/2/2/5	24/20		Brown medium sand.	
4	4-6	2/2/3/4	24/24		Tan/gray medium to coarse sand. Bottom 18" is wet.	
9	9-11	3/3/6/7	24/24		Tan medium sand.	
14	14-16	4/4/5/6	24/24		Tan medium sand.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B10a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/6/92 Ended: 10/6/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	1/2/2/2	24/12		Dark brown, sandy soil.	
4	4-6	6/5/7/5	24/24		Gray, medium sand. Saturated.	
9	9-11	11/4/5/5	24/6		Medium gray sand.	
14	14-16	4/5/5/6	24/12		Medium gray sand.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B11a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/6/92 Ended: 10/6/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	2/2/3/4	24/12		Topsoil and brown, medium sand.	
4	4-6	3/3/4/5	24/24		Grau\brown, medium sand. Bottom 8" saturated.	
9	9-11	5/6/7/4	24/16		Tan/gray, medium to coarse sand.	
14	14-16	4/5/5/7	24/24		Tan/gray, medium to coarse sand.	

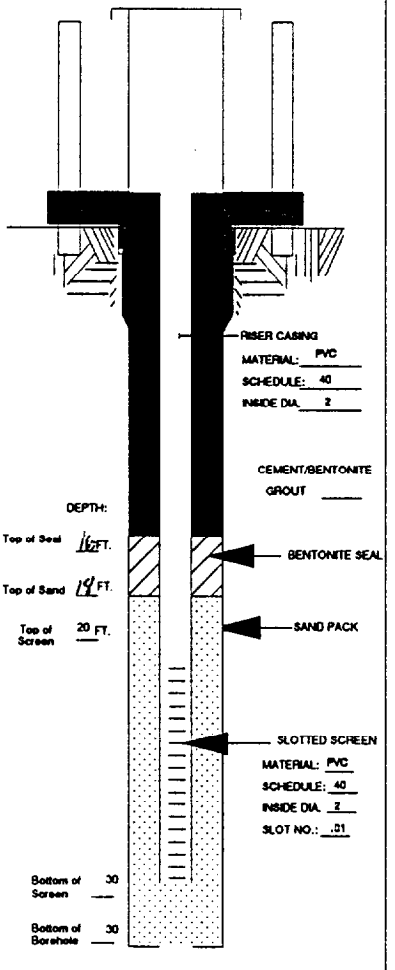
O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B12a Sheet 1 of 1
Project Location: Midway Park Client: Navy	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No. 5269.001.311
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 10/6/92 Ended: 10/6/92

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	2/2/3/4	24/24		Tan, medium sand.	
4	4-6	6/4/6/6	24/24		Tan, medium sand to white, medium sand.	
9	9-11	4/4/6/7	24/24		Tan/gray, medium to coarse sand.	
14	14-16	5/4/7/9	24/24		Tan/gray, medium to coarse sand.	

O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-2 Sheet 1 of 1
Location: Midway Pk Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Tom Sweeting OBG Geologist T. Bickerstaff		Dates: Started: 12/5/91 Ended: 12/5/91

Depth	Sample Depth	Blows /6"	Penetr/ Recovery	PID Value	Sample Description
0	0-2	4/3/3/4	24/24	.3	Topsoil. Fine sand, some coarse.
2	2-4	2/3/3/2	24/24	1.1	Very fine, buff sand.
4	4-6	2/3/3/3	24/24	.6	Buff sand (top 1/2), sharp contact; bottom 1/2 of spoon brown, find sand with silt and clay.
9	9-11	6/12/16/22	24/24	-.1	Interbedded b uff, whit?, and orange medium sands.
14	14-16	8/11/10/13	24/24	-.2	Buff to white and orange, medium sand. Tip is wet.
19	19-21	3/4/4/5	24/20	.7	Gray and orange, mediumm sand. Some coarse.
24	24-26	2/3/4/5	24/24	.1	Gray, medium sand.
29	29-31	4/6/13/16	24/20	-.1	Gray, medium sand.
30					Bottom of well.

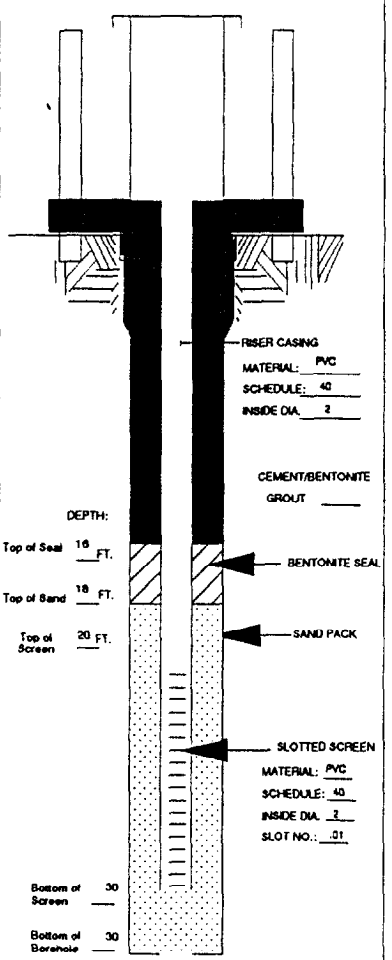
Monitoring Well Specifications



O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-4 Sheet 1 of 1
Location: Midway PK. Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Tom Sweeting OBG Geologist T. Bickerstaff		Dates: Started: 12/5/91 Ended: 12/5/91

Depth	Sample Depth	Blows /6"	Penetr/ Recovery	PID Value	Sample Description
0	0-2	6/12/21/23	24/12	0	Topsoil. Fossilliferous pebbles and medium sand.
2	2-4	20/16/16/15	24/12	0	Brown, medium sand.
4	4-6	4/5/6/8	24/20	0	Medium orange sand. Moist
9	9-11	9/16/17/20	24/15	0	Medium buff to white sand.
14	14-16	5/6/5/5	24/19	0	Saturated, coarse, brown sand with gray clay stringers and some pebbles.
19	19-21	1/1/2/2	24/24	.1	Medium, gray and brown sand. odor, but no PID reading.
24	24-26	3/5/19/38	24/24	7.5	Fine, gray sand. Odor.
29	29-31	3/19/28/52	24/24	3.5	Fine, gray to green sand. Odor.
30					Bottom of well.

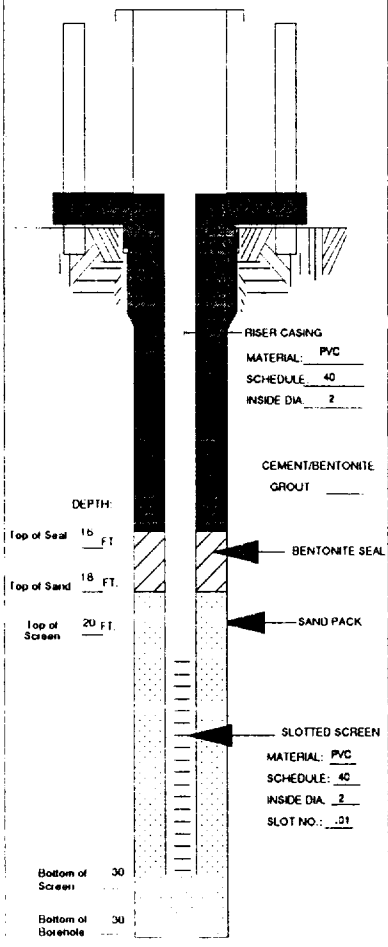
Monitoring Well Specifications



O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-6 Sheet 1 of 1
Location: Midway PK : Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Tom Sweeting OBG Geologist T. Bickerstaff		Dates: Started: 12/6/91 Ended: 12/6/91

Depth	Sample				Sample Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value	
0	0-2	6/6/6/10	24/24	0	Topsoil. Medium gray sand.
2	2-4	7/7/7/6	24/24	0	Medium gray sand.
4	4-6	4/3/6/8	24/24	.1	Medium gray sand.
9	9-11	7/5/4/5	24/24	0	Very fine, gray sand on top. Silt with clay and sand on bottom.
14	14-16	7/3/7/11	24/24	0	Saturated, orange, coarse sand. Gray, medium sand on top.
19	19-21	4/5/8/11	24/24	.2	Grayish-green, medium sand.
24	24-26	1/1/1/1	24/24	.2	Grayish-green, medium sand.

Monitoring Well Specifications

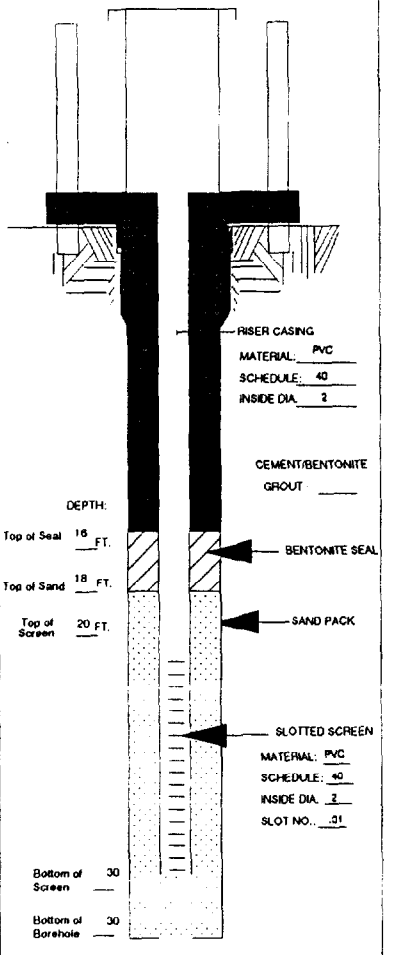


O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-8 Sheet 1 of 1
Location: Midway PK Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Tom Sweeting OBG Geologist T. Bickerstaff		Dates: Started: 12/6/91 Ended: 12/6/91

Depth	Sample Depth	Blows /6"	Penetr/ Recovery	PID Value	Sample Description
0	0-2	2/4/5/5	24/12	* .2	Topsoil. Medium sand, brown.
2	2-4	4/5/8/10	24/24	0	Gray, medium to fine sand. Some silt.
4	4-6	8/6/4/3	24/18	.2	Bottom 1/2 wet, fine, gray sand.
9	9-11	1/1/1/2	24/24	0	Green, gray, medium sand. Streaks of greener sand.
14	14-16	1/2/4/5	24/24	.1	Green, gray, medium sand. Streaks of greener sand.
19	19-21	8/16/26/31	24/24	.3	Green, gray, medium sand. Streaks of greener sand.
24	24-26	10/25/29/35	24/	.4	Green, gray, medium sand. Streaks of greener sand.
30					Bottom of well.

* AMBIENT AIR REGISTERED 0.3 PPM ON PID

Monitoring Well Specifications

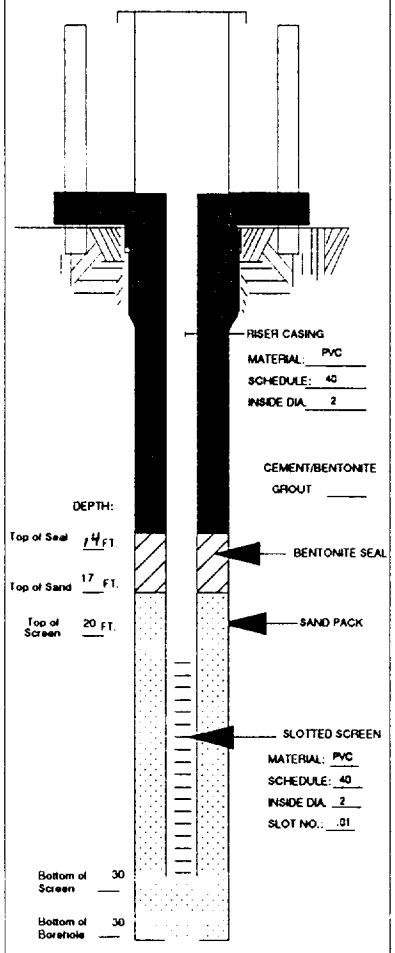


O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-10 Sheet 1 of 1
Location: Midway PK Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Tim Williams OBG Geologist T. Bickerstaff		Dates: Started: 12/9/91 Ended: 12/9/91

Depth	Sample Depth	Blows /6"	Penetr/ Recovery	PID Value	Sample Description
0	0-2	2/3/5/6	24/20	* 1.3	Light brown, medium sand.
2	2-4	4/4/3/4	24/24	1.3	Buff, medium sand.
4	4-6	4/3/2/3	24/16	1.4	White and buff, medium sand.
9	9-11	4/3/3/4	24/24	1.3	Medium, white sand on top of orange and green-gray sand. Wet.
14	14-16	4/5/6/6	24/24	1.3	Green-gray, fine sand.
19	19-21	1/2/5/8	24/24	1.4	Gray, medium sand.
24	24-26	10/17/27/31	24/24	1.3	Medium, gray sand.
29	29/31	9/13/22/27	24/24	1.3	Medium, gray sand.

* AMBIENT AIR RECORDED 1.3 PPM ON PID

Monitoring Well Specifications

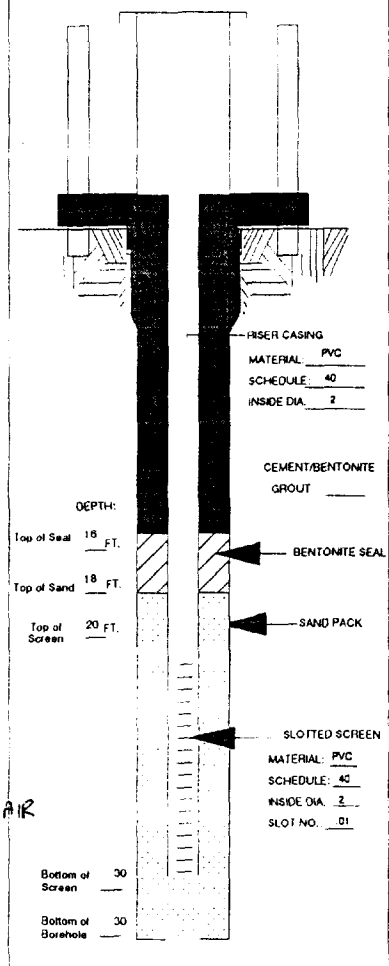


O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-12 Sheet 1 of 1
Location: Midway PK Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Tom Sweeting OBG Geologist T. Bickerstaff		Dates: Started: 12/9/91 Ended: 12/10/91

Depth	Sample Depth	Blows /6"	Penetr/ Recovery	PID Value	Sample Description
0	0-2	1/2/3/5	24/24	* 1.3	Brown, medium sand.
2	2-4	5/5/5/5	24/24	1.3	Gray, medium sand on top of brown, medium sand with silt and clay.
4	4-6	1/3/5/8	24/24	1.4	Gray silt, clay with some sand on top of medium, buff sand.
9	9-11	1/1/1/3	24/24	1.3	Silt on top of gray silt and clay interbedded with laminae of red, medium sand. Wet.
14	14-16	6/8/10/7	24/24	1.3	Gray-red clay grading to gray, medium sand with silt.
19	19-21	1/1/1/4	24/24	1.4	Medium gray sand with silt.
24	24-26	1/3/2/1	24/24	1.3	Orange, medium sand.
30					Bottom of well.

*PID RECORDED 1.3 FOR AMBIENT AIR

Monitoring Well Specifications



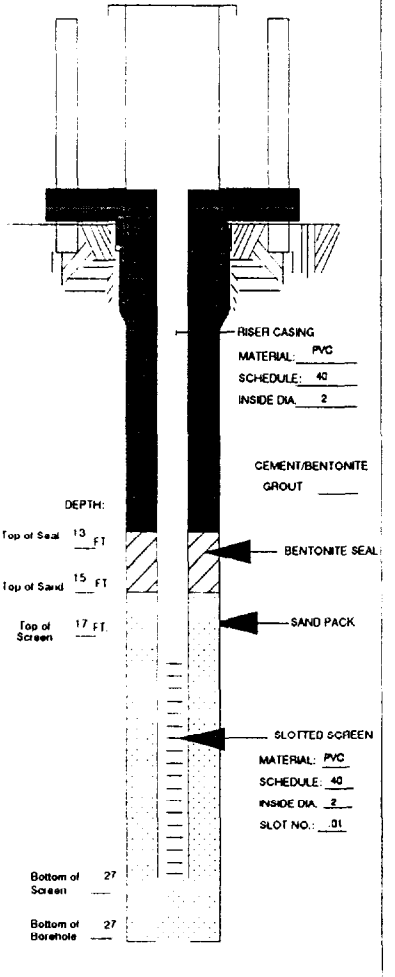
O'Brien & Gere Engineers, Inc.	Boring Log/Protective Casing Well	Report of Boring No. MW-14 Sheet 1 of 1
Location: Midway PK Client: Navy Drilling Type: Hollow Stem	SAMPLER Type: 2" O.D. Split Spoon Hammer: 140# Fall: 30"	Ground Water Depth File No.

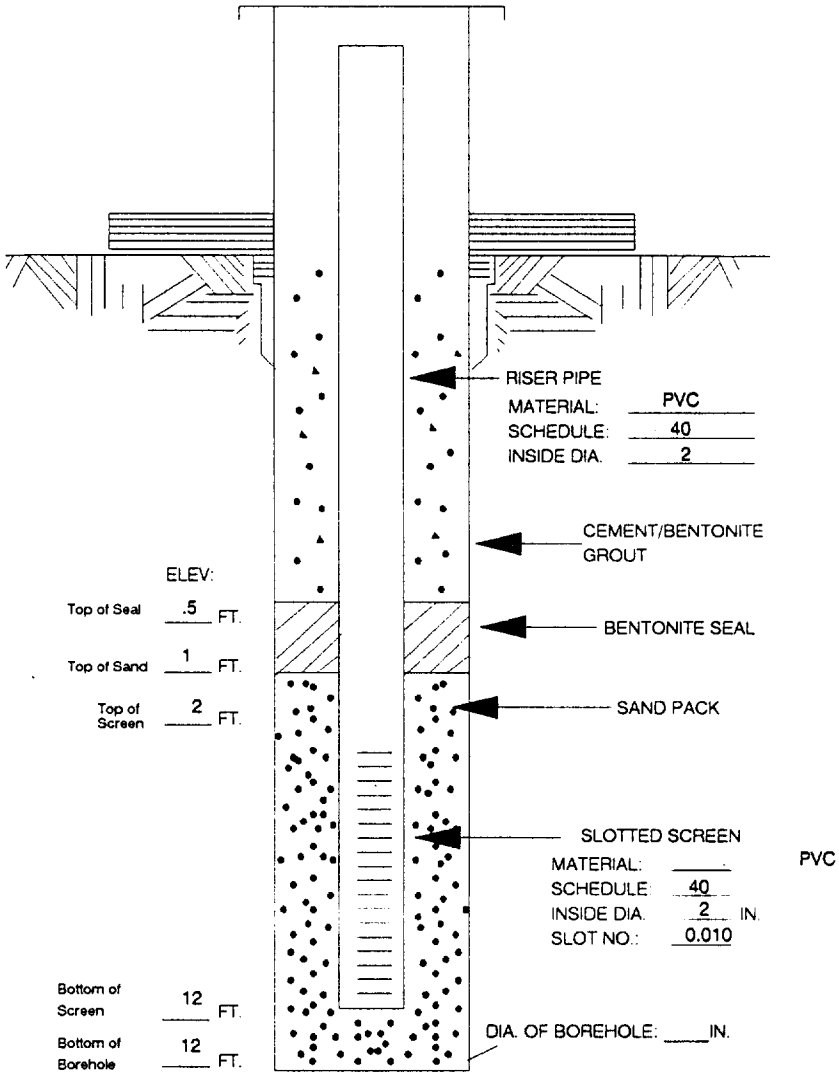
Boring Co.: ATEC
Foreman: Tom Sweeting
OBG Geologist T. Bickerstaff

Dates:
Started: 12/9/91 Ended: 12/10/91

Depth	Sample Depth	Blows /6"	Penetr/ Recovery	PID Value	Sample Description
0	0-2	1/1/1/2	24/24	.3	Light brown, medium sand, some fines.
2	2-4	2/2/2/3	24/24	.2	Light brown, medium to very fine sand. Some silt. Bottom 1/2 of spoon wet.
4	4-6	3/3/3/4	24/18	0	Gray, fine to very fine sand.
9	9-11	1/2/4/6	24/24	0	Gray-green to brown, medium to coarse sand.
14	14-16	1/1/3/4	24/24	0	Gray, medium sand. Tip is orangey-brown, coarse sand.
19	19-21	11/6/20/24	24/24	0	Green-gray, medium sand.
26					
27					Bottom of well.

Monitoring Well Specifications





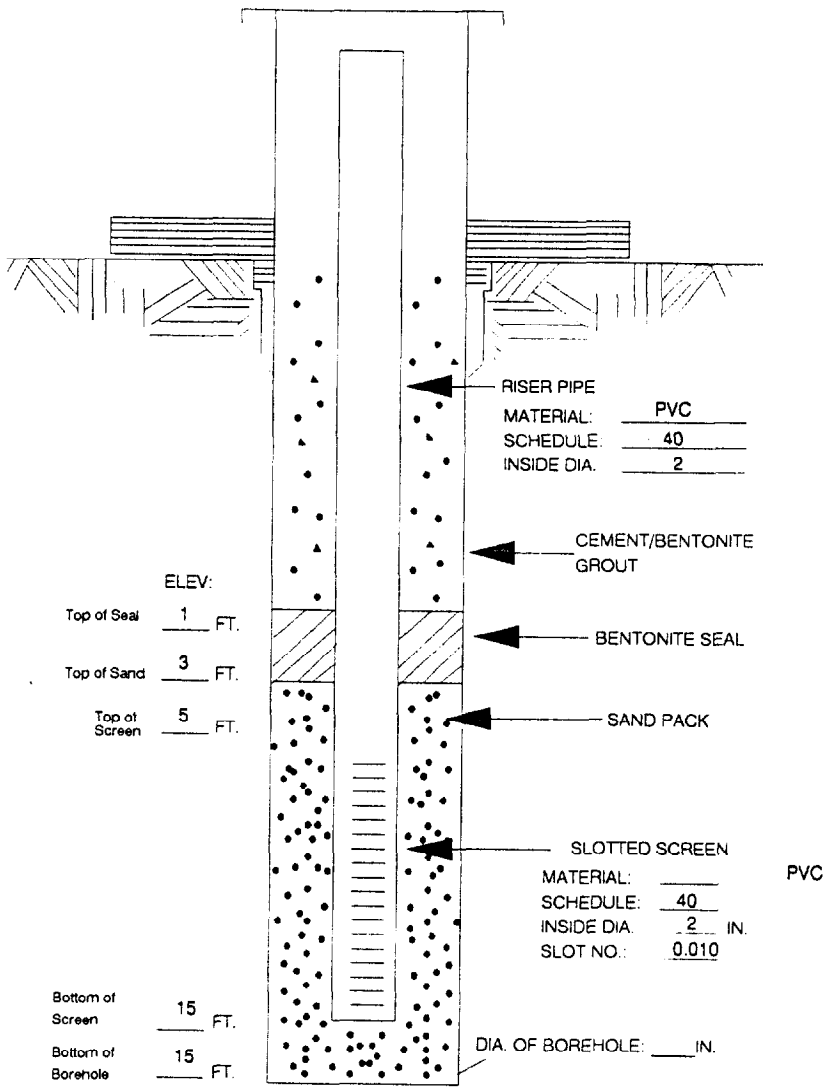
TYPICAL OVERBURDEN MONITORING WELL

N.T.S.

MIDWAY PARK

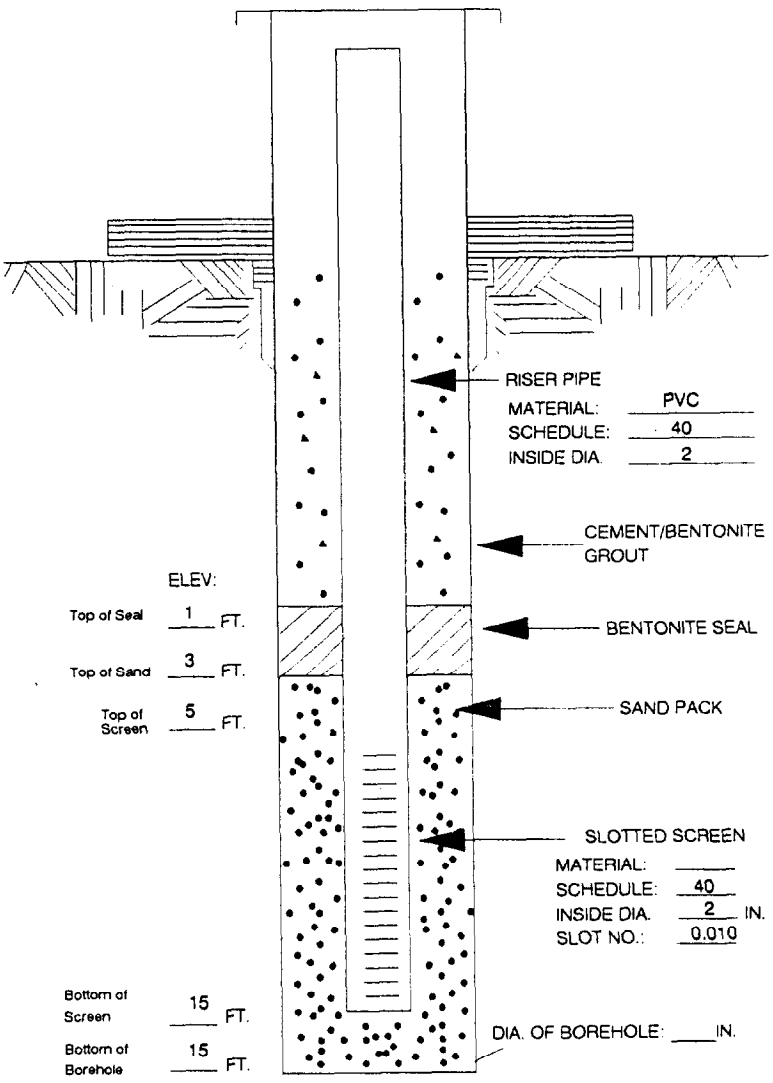
MW-13

12/11/91



TYPICAL OVERBURDEN MONITORING WELL
N.T.S.

MIDWAY PARK
MW-11
12/9/91



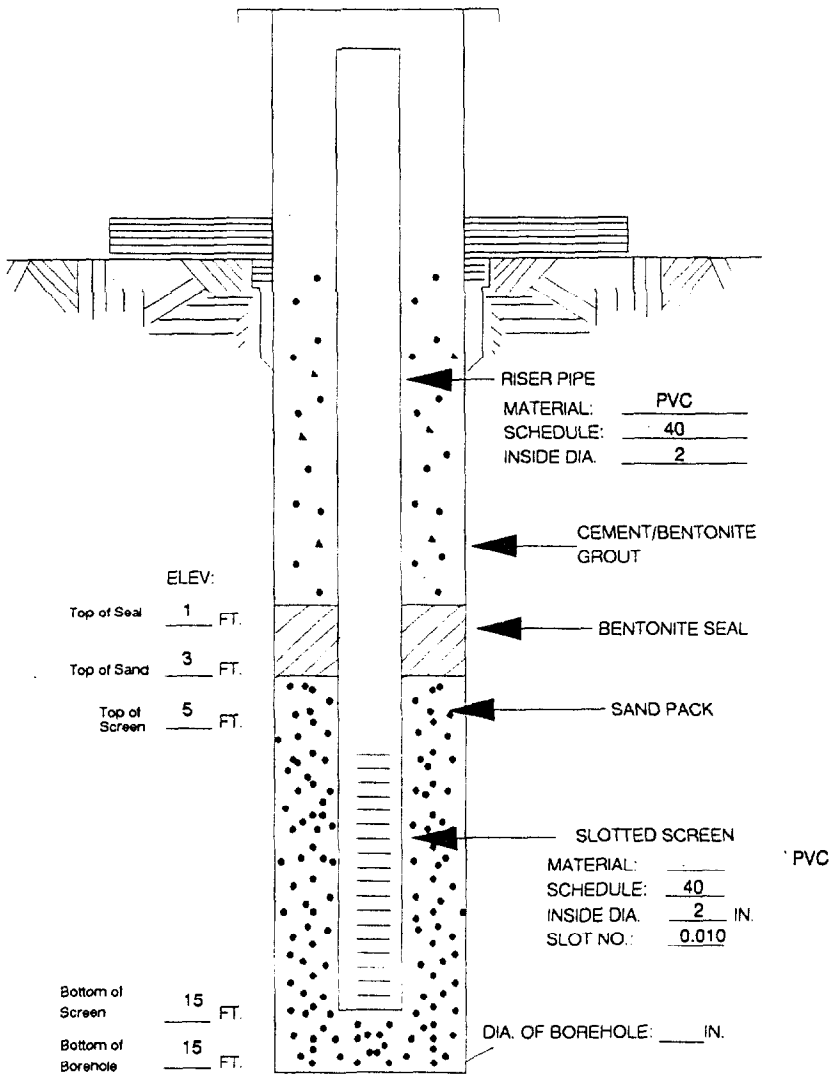
TYPICAL OVERBURDEN MONITORING WELL

N.T.S.

MIDWAY PARK

MW-9

12/9/91



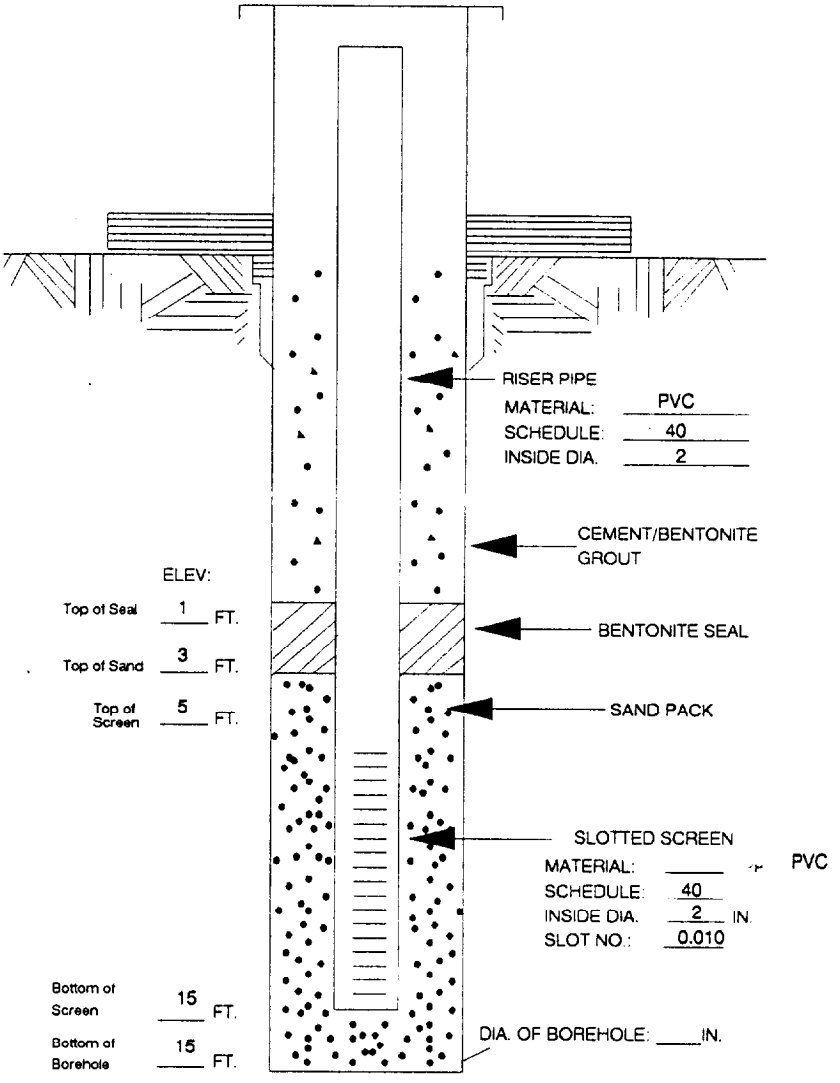
TYPICAL OVERBURDEN MONITORING WELL

N.T.S.

MIDWAY PARK

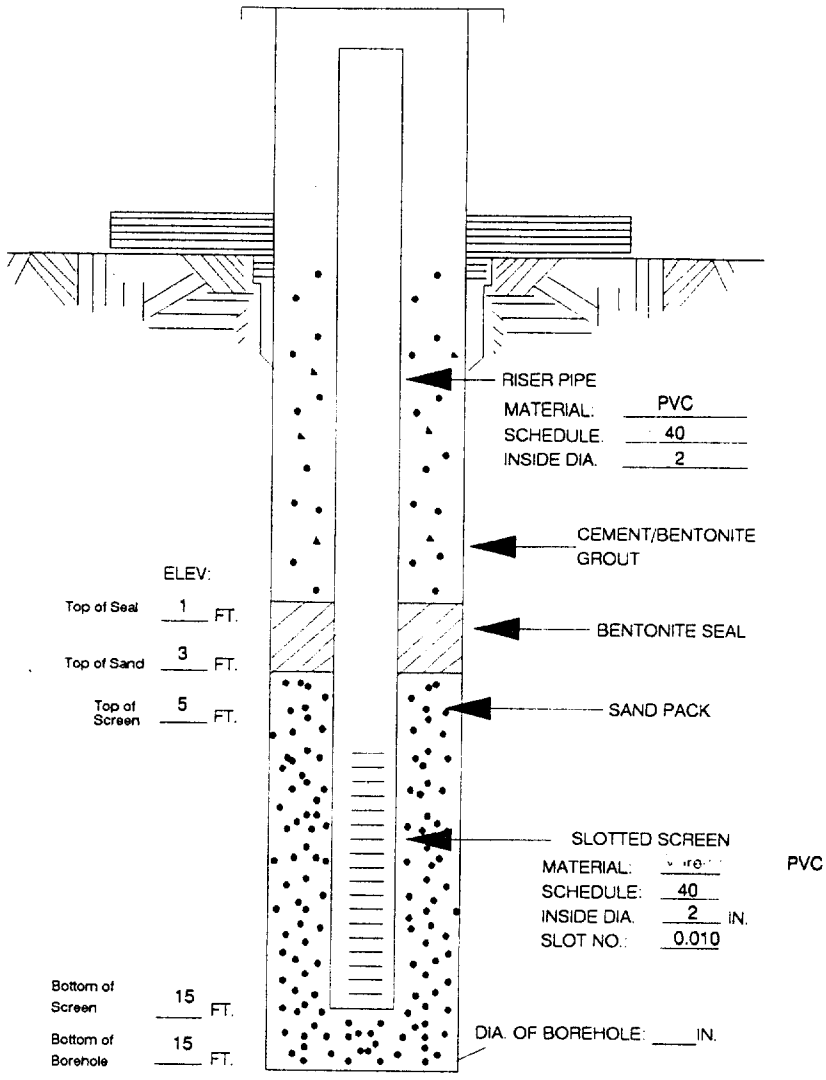
MW-7

12/6/91



TYPICAL OVERBURDEN MONITORING WELL
N.T.S.

MIDWAY PARK
MW-5
12/6/91



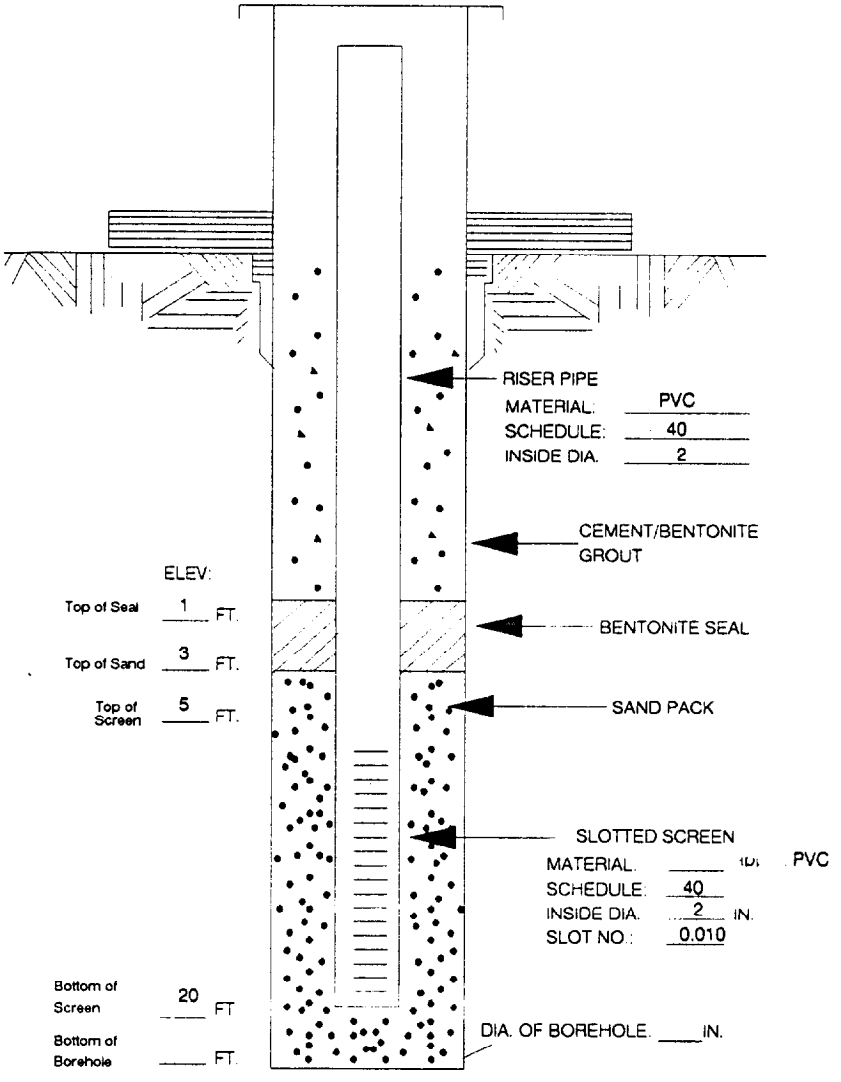
TYPICAL OVERBURDEN MONITORING WELL

N.T.S.

MIDWAY PARK

MW-3

12/4/91



TYPICAL OVERBURDEN MONITORING WELL
N.T.S.

MIDWAY PARK
MW-1
12/4/91

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B4 Sheet 1 of 1
Project Location: Midway Park Client: Navy Drill Type: HOLLOW STEM AUGER	SAMPLER Type: 2" OD. SPLIT SPOON Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Chip Lefever OBG Geologist T. Bickerstaff		Dates: Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	5/5/5/8	24/20	.2	Brown, medium sand.	
2	2-4	7/8/9/5	24/10	.2	Medium, brown sand with medium, dark brown sand at tip.	
4	4-6	2/3/3/4	24/24	78.6	Black, tar-like, medium to fine sand. Free product.	
6	6-8	10/16/16/18	24/24	116	Black, tar-like, medium to fine sand. Free product.	
9	9-11	9/16/14/19	24/24	146	Black, tar-like, medium to fine sand. Free product.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B1 Sheet 1 of 1
Project Location: Midway Park Client: Navy Drill Type: Hollow Stem Auger	SAMPLER Type: 2" OD. SPLIT SPOON Hammer: 140 lbs. Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Chip Lefever OBG Geologist T. Bickerstaff		Dates: Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	4/6/8/9	24/20	0	Topsoil. Medium brown sand. Piece of broken coal at bottom of spoon.	
2	2-4	6/6/5/5	24/20	-.1	Medium loose, brown sand.	
4	4-6	3/2/3/5	24/18	0	Medium, orange sand.	
9	9-11	6/8/10/11	24/24	.1	Brown, medium sand. Saturated.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B2 Sheet 1 of 1
Project Location: Midway Park Client: Navy Drill Type: Hollow stem auger	SAMPLER Type: 2" OD. SPLITSPOON Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Chip Lefever OBG Geologist T. Bickerstaff		Dates: Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	3/3/3/4	24/24	.2	Topsoil on top of brown, medium sand.	
2	2-4	3/1/2/1	24/20	.3	Medium, brown sand.	
4	4-6	WOH	24/18	0	Very fine, brown sand.	
9	9-11	6/16/24/23	24/24	.2	White, fine sand.	
11	11-13	5/13/17/20	24/	.2	Fine, white sand. Tip is orange. medium sand. Wet.	

O'Brien & Gere Engineers, Inc.	TEST BORING LOG	Report of Boring No. B3 Sheet 1 of 1
Project Location: Midway Park Client: Navy Drill Type: HOLLOW STEM AUGER	SAMPLER Type: 2" OD SPLIT SPOON Hammer: 140# Fall: 30"	Ground Water Depth File No.
Boring Co.: ATEC Foreman: Chip Lefever OBG Geologist T. Bickerstaff		Dates: Started: 12/5/91 Ended: 12/5/91

Depth	Sample				Sample Description	Stratum Change General Description
	Depth	Blows /6"	Penetr/ Recovery	PID Value		
0	0-2	2/2/4/4	24/24	.1	Fine to medium, brown sand.	
2	2-4	1/1/2/1	24/20	.3	Medium, brown sand.	
4	4-6	7/4/6/8	24/20	.4	Medium, buff sand.	
9	9-11	6/9/13/12	24/24	.5	Medium, brown sand. Tip is saturated. Some coarse sand.	

APPENDIX B

LABORATORY RESULTS - LIQUIDS

OBG LABORATORIES, INC.

Laboratory Report

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

Toxicity Characteristic Leaching Procedure MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91

Description	MW-3
Sample #	N9616
TCLP Metals:	
ARSENIC	<0.5
BARIUM	<10.
CADMIUM	<0.1
CHROMIUM	<0.5
LEAD	<0.5
MERCURY	<0.0005
SELENIUM	<0.1
SILVER	<0.5

Comments:

Certification No.: 315

Units: mg/l

Authorized: Mark Santucci

Date: January 8, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

OBG LABORATORIES, INC.

Laboratory Report

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

Toxicity Characteristic Leaching Procedure MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91

Description	MW-3
Sample #	N9616
TCLP Pesticides/Herbicides:	
CHLORDANE	<0.01
ENDRIN	<0.005
HEPTACHLOR	<0.005
HEPTACHLOR EPOXIDE	<0.005
LINDANE	<0.005
METHOXYCHLOR	<0.01
TOXAPHENE	<0.05
2,4-D	<0.01*
2,4,5-TP (SILVEX)	<0.01*

Analytical Record:

Date Leachate Created 12-17-91

Date Herbicide Extracted Sub

Date Pesticide Extracted 12-19-91

Date Herbicide Analyzed Sub

Date Pesticide Analyzed 1-6-92

Comments: *Laboratory analysis subcontracted to Hudson Environmental Services, Inc., NYS DOH Lab ID# 11140

Certification No.: 10155

Units: mg/l

Authorized: Monika Santucci

Date: January 14, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

OBG LABORATORIES, INC.

Laboratory Report

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

Toxicity Characteristic Leaching Procedure MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91

Description	MW-3
Sample #	N9616
TCLP Semivolatile Organics:	
o-CRESOL	<0.1
m-CRESOL	
p-CRESOL	
CRESOL, TOTAL	
1,4-DICHLOROBENZENE	
2,4-DINITROTOLUENE	
HEXACHLOROBENZENE	
HEXACHLOROBUTADIENE	
HEXACHLOROETHANE	
NITROBENZENE	
PENTACHLOROPHENOL	<0.5
PYRIDINE	<1.0
2,4,5-TRICHLOROPHENOL	<0.5
2,4,6-TRICHLOROPHENOL	<0.1
Analytical Record:	
Date Leachate Created	12-17-91
Date Extracted	12-18-91
Date Analyzed	12-31-91

Comments:

Certification No.: 315

Units: mg/l

Authorized: Monika Santucci

Date: January 14, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

METHOD 8100

OBG LABORATORIES, INC.

Laboratory Report

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

SOIL HYDROCARBON CONTAMINATION MATRIX: Water

Date Analyzed 1-1-92 DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91

Description	MW-1	MW-7	MW-11
Sample #	N9617	N9620	N9621
ACENAPHTHENE	<50.	<10.	<45.
ACENAPHTHYLENE			
ANTHRACENE			
BENZ(a)ANTHRACENE			
BENZO(a)PYRENE			
BENZO(b)FLUORANTHENE			
BENZO(k)FLUORANTHENE			
BENZO(g,h,i)PERYLENE			
CHRYSENE			
DIBENZ(a,h)ANTHRACENE			
FLUORANTHENE			
FLUORENE			
INDENO(1,2,3-cd)PYRENE			
NAPHTHALENE			
PHENANTHRENE			
PYRENE			

Comments: Elevated detection limits due to limited sample.

Certification No.: 315

Units: µg/l

Authorized: Monika Santucci

Date: January 14, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-6-91 DATE RECEIVED 12-9-91 DATE ANALYZED 12-14,16-91

DESCRIPTION:	H1	H2	H3	H4	H5	H6
SAMPLE NO.:	N9213	N9214	N9215	N9216	N9217	N9218
Benzene	<1.	<1.	<1.	<1.	<1.	<1.
Benzyl chloride	<10.	<10.	<10.	<10.	<10.	<10.
Bis (2-chloroethoxy) methane	<5000.	<5000.	<5000.	<5000.	<500,000.**	<5000.
Bromobenzene	<5.	<5.	<5.	<5.	<5.	<5.
Bromodichloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Bromoform	<10.	<10.	<10.	<10.	<10.	<10.
Bromomethane	<10.	<10.	<10.	<10.	<10.	<10.
Carbon tetrachloride	<1.	<1.	<1.	<1.	<1.	<1.
Chlorobenzene	↓	↓	↓	↓	5.	↓
Chloroethane	↓	↓	↓	↓	<1.	↓
2-Chloroethylvinyl ether	<10.	<10.	<10.	<10.	<10.	<10.
Chloroform	<1.	<1.	<1.	<1.	<1.	<1.
1-Chlorohexane	<10.	<10.	<10.	<10.	<10.	<10.
Chloromethane	<10.	<10.	<10.	<10.	<10.	<10.
Chloromethylmethyl ether	<100.	<100.	<100.	<100.	<100.	<100.
2-Chlorotoluene	<5.	<5.	<5.	<5.	<5.	<5.
4-Chlorotoluene	<5.	<5.	<5.	<5.	<50.*	<5.
Dibromochloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Dibromomethane	<10.	<10.	<10.	<10.	<10.	<10.
1,2-Dichlorobenzene	<5.	<5.	<5.	<5.	<100.**	<5.
1,3-Dichlorobenzene	↓	↓	↓	↓	6.*	↓
1,4-Dichlorobenzene	↓	↓	↓	↓	84.**	↓
Dichlorodifluoromethane	<10.	<10.	<10.	<10.	<10.	<10.

Authorized: [signature]

Date: January 7, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-6-91 DATE RECEIVED 12-9-91 DATE ANALYZED 12-14,16-91

DESCRIPTION:	H1	H2	H3	H4	H5	H6
SAMPLE NO.:	N9213	N9214	N9215	N9216	N9217	N9218
1,1-Dichloroethane	2.	<1.	<1.	<1.	<1.	<1.
1,2-Dichloroethane	<1.					
1,1-Dichloroethylene						
1,2-Dichloroethylene (total)						
Dichloromethane						
1,2-Dichloropropane						
cis-1,3-Dichloropropylene						
trans-1,3-Dichloropropylene						
Ethylbenzene						
1,1,2,2-Tetrachloroethane						
1,1,1,2-Tetrachloroethane						
Tetrachloroethylene						
Toluene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane						
Trichloroethylene						
Trichlorofluoromethane						
1,2,3-Trichloropropane						
Vinyl chloride						
Xylene (total)	<3.	<3.	<3.	<3.	<3.	<3.

Comments: *1,3-Dichlorobenzene and 4-Chlorotoluene coelute using Method 8010/8020. The value at this retention time was quantitated using a 1,3-Dichlorobenzene standard.

** 1,2-Dichlorobenzene, 1,4-Dichlorobenzene and Bis (2-chloroethoxy)methane coelute using Method 8010/8020. The value at this retention time was quantitated using 1 1,4-Dichlorobenzene standard.

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/1

Authorized: Michael W. Pettoff

Date: January 7, 1992

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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-6-91 DATE RECEIVED 12-9-91 DATE ANALYZED 12-16-91

DESCRIPTION:	H7
SAMPLE NO.:	N9219
Benzene	<1.
Benzyl chloride	<10.
Bis (2-chloroethoxy) methane	<5000.
Bromobenzene	<5.
Bromodichloromethane	<1.
Bromoform	<10.
Bromomethane	<10.
Carbon tetrachloride	<1.
Chlorobenzene	
Chloroethane	
2-Chloroethylvinyl ether	<10.
Chloroform	<1.
1-Chlorohexane	<10.
Chloromethane	<10.
Chloromethylmethyl ether	<100.
2-Chlorotoluene	<5.
4-Chlorotoluene	<5.
Dibromochloromethane	<1.
Dibromomethane	<10.
1,2-Dichlorobenzene	<5.
1,3-Dichlorobenzene	
1,4-Dichlorobenzene	
Dichlorodifluoromethane	<10.

Authorized: [signature]

Date: January 7, 1992

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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-6-91 DATE RECEIVED 12-9-91 DATE ANALYZED 12-16-91

DESCRIPTION:	H7
SAMPLE NO.:	N9219
1,1-Dichloroethane	<1.
1,2-Dichloroethane	
1,1-Dichloroethylene	
1,2-Dichloroethylene (total)	
Dichloromethane	
1,2-Dichloropropane	
cis-1,3-Dichloropropylene	
trans-1,3-Dichloropropylene	
Ethylbenzene	
1,1,2,2-Tetrachloroethane	
1,1,1,2-Tetrachloroethane	
Tetrachloroethylene	
Toluene	
1,1,1-Trichloroethane	
1,1,2-Trichloroethane	
Trichloroethylene	
Trichlorofluoromethane	
1,2,3-Trichloropropane	
Vinyl chloride	
Xylene (total)	<3.

Comments:

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/l

Authorized:

Date: January 7, 1992

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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-20,22-91

DESCRIPTION:	MW-1	MW-3	MW-5	MW-7	MW-11	MW-4
SAMPLE NO.:	N9617	N9618	N9619	N9620	N9621	N9622
Benzene	<1.	<10.	<1.	<1.	<1.	<1.
Benzyl chloride	<10.	<100.	<10.	<10.	<10.	<10.
Bis (2-chloroethoxy) methane	<500.	<5000.	<500.	<500.	<500.	<500.
Bromobenzene	<5.	<50.	<5.	<5.	<5.	<5.
Bromodichloromethane	<1.	<10.	<1.	<1.	<1.	<1.
Bromoform	<10.	<100.	<10.	<10.	<10.	<10.
Bromomethane	<1.	<10.	<1.	<1.	<1.	<1.
Carbon tetrachloride	↓	↓	↓	↓	↓	↓
Chlorobenzene	↓	↓	↓	↓	↓	↓
Chloroethane	↓	↓	↓	↓	↓	↓
2-Chloroethylvinyl ether	<10.	<100.	<10.	<10.	<10.	<10.
Chloroform	<1.	<10.	<1.	<1.	<1.	<1.
1-Chlorohexane	<10.	<100.	<10.	<10.	<10.	<10.
Chloromethane	<1.	<10.	<1.	<1.	<1.	<1.
Chloromethylmethyl ether	<100.	<1000.	<100.	<100.	<100.	<100.
2-Chlorotoluene	<5.	<50.	<5.	<5.	<5.	<5.
4-Chlorotoluene	<5.	<50.	<5.	<5.	<5.	<5.
Dibromochloromethane	<1.	<10.	<1.	<1.	<1.	<1.
Dibromomethane	<10.	<100.	<10.	<10.	<10.	<10.
1,2-Dichlorobenzene	<5.	<50.	<5.	<5.	<5.	<5.
1,3-Dichlorobenzene	↓	↓	↓	↓	↓	↓
1,4-Dichlorobenzene	↓	↓	↓	↓	↓	↓
Dichlorodifluoromethane	<10.	<100.	<10.	<10.	<10.	<10.

Authorized: Monika Santucci

Date: January 8, 1992

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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-20,22-91

DESCRIPTION:	MW-1	MW-3	MW-5	MW-7	MW-11	MW-4
SAMPLE NO.:	N9617	N9618	N9619	N9620	N9621	N9622
1,1-Dichloroethane	<1.	16.	<1.	<1.	<1.	<1.
1,2-Dichloroethane		<10.				
1,1-Dichloroethylene						
1,2-Dichloroethylene (total)						2.
Dichloromethane						<1.
1,2-Dichloropropane						
cis-1,3-Dichloropropylene						
trans-1,3-Dichloropropylene						
Ethylbenzene		16.				
1,1,2,2-Tetrachloroethane		<10.				
1,1,1,2-Tetrachloroethane						
Tetrachloroethylene						
Toluene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane						
Trichloroethylene						
Trichlorofluoromethane						
1,2,3-Trichloropropane						
Vinyl chloride						
Xylene (total)	<3.	<30.	<3.	<3.	<3.	<3.

Comments:

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/l

Authorized: Monika Santucci

Date: January 8, 1992

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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-22,23-91

DESCRIPTION:	MW-4 Field Dup.	MW-2	MW-6	MW-8	MW-9	MW-10
SAMPLE NO.:	N9623	N9624	N9625	N9626	N9627	N9628
Benzene	<1.	<1.	<1.	<10.	<1.	<1.
Benzyl chloride	<10.	<10.	<10.	<100.	<10.	<10.
Bis (2-chloroethoxy) methane	<500.	<500.	<500.	<5000.	<500.	<500.
Bromobenzene	<5.	<5.	<5.	<50.	<5.	<5.
Bromodichloromethane	<1.	<1.	<1.	<10.	<1.	<1.
Bromoform	<10.	<10.	<10.	<100.	<10.	<10.
Bromomethane	<1.	<1.	<1.	<10.	<1.	<1.
Carbon tetrachloride	↓	↓	↓	↓	↓	↓
Chlorobenzene	↓	↓	↓	↓	↓	↓
Chloroethane	↓	↓	↓	↓	↓	↓
2-Chloroethylvinyl ether	<10.	<10.	<10.	<100.	<10.	<10.
Chloroform	<1.	<1.	<1.	<10.	<1.	<1.
1-Chlorohexane	<10.	<10.	<10.	<100.	<10.	<10.
Chloromethane	<1.	<1.	<1.	<10.	<1.	<1.
Chloromethylmethyl ether	<100.	<100.	<100.	<1000.	<100.	<100.
2-Chlorotoluene	<5.	<5.	<5.	<50.	<5.	<5.
4-Chlorotoluene	<5.	<5.	<5.	<50.	<5.	<5.
Dibromochloromethane	<1.	<1.	<1.	<10.	<1.	<1.
Dibromomethane	<10.	<10.	<10.	<100.	<10.	<10.
1,2-Dichlorobenzene	<5.	<5.	<5.	<50.	<5.	<5.
1,3-Dichlorobenzene	↓	↓	↓	↓	↓	↓
1,4-Dichlorobenzene	↓	↓	↓	↓	↓	↓
Dichlorodifluoromethane	<10.	<10.	<10.	<100.	<10.	<10.

Authorized: Monika Santucci

Date: January 8, 1992

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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-22,23-91

DESCRIPTION:	MW-4 Field Dup.	MW-2	MW-6	MW-8	MW-9	MW-10
SAMPLE NO.:	N9623	N9624	N9625	N9626	N9627	N9628
1,1-Dichloroethane	<1.	<1.	<1.	<10.	<1.	<1.
1,2-Dichloroethane	<1.					
1,1-Dichloroethylene	2.					
1,2-Dichloroethylene (total)	<1.					
Dichloromethane						
1,2-Dichloropropane						
cis-1,3-Dichloropropylene						
trans-1,3-Dichloropropylene						
Ethylbenzene						
1,1,2,2-Tetrachloroethane						
1,1,1,2-Tetrachloroethane						
Tetrachloroethylene						
Toluene						
1,1,1-Trichloroethane						
1,1,2-Trichloroethane						
Trichloroethylene						
Trichlorofluoromethane						
1,2,3-Trichloropropane						
Vinyl chloride	2.					
Xylene (total)	<3.	<3.	<3.	<30.	<3.	<3.

Comments:

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/l

Authorized: Monika Santucci

Date: January 8, 1992

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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-9,12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-23-91

DESCRIPTION:	MW-12	MW-13	MW-14	H8	H9	H10
SAMPLE NO.:	N9629	N9630	N9631	N9632	N9633	N9634
Benzene	<1.	<1.	<1.	<1.	<1.	<1.
Benzyl chloride	<10.	<10.	<10.	<10.	<10.	<10.
Bis (2-chloroethoxy) methane	<500.	<500.	<500.	<500.	<500.	<500.
Bromobenzene	<5.	<5.	<5.	<5.	<5.	<5.
Bromodichloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Bromoform	<10.	<10.	<10.	<10.	<10.	<10.
Bromomethane	<1.	<1.	<1.	<1.	<1.	<1.
Carbon tetrachloride	↓	↓	↓	↓	↓	↓
Chlorobenzene						
Chloroethane						
2-Chloroethylvinyl ether	<10.	<10.	<10.	<10.	<10.	<10.
Chloroform	<1.	<1.	<1.	<1.	<1.	<1.
1-Chlorohexane	<10.	<10.	<10.	<10.	<10.	<10.
Chloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Chloromethylmethyl ether	<100.	<100.	<100.	<100.	<100.	<100.
2-Chlorotoluene	<5.	<5.	<5.	<5.	<5.	<5.
4-Chlorotoluene	<5.	<5.	<5.	<5.	<5.	<5.
Dibromochloromethane	<1.	<1.	<1.	<1.	<1.	<1.
Dibromomethane	<10.	<10.	<10.	<10.	<10.	<10.
1,2-Dichlorobenzene	<5.	<5.	<5.	31.*	<5.	<5.
1,3-Dichlorobenzene	↓	↓	↓	<5.	↓	↓
1,4-Dichlorobenzene				*		
Dichlorodifluoromethane	<10.	<10.	<10.	<10.	<10.	<10.

Authorized: Monika Santucci

Date: January 8, 1992

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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-9,12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-23-91

DESCRIPTION:	MW-12	MW-13	MW-14	H8	H9	H10
SAMPLE NO.:	N9629	N9630	N9631	N9632	N9633	N9634
1,1-Dichloroethane	<1.	<1.	<1.	<1.	<1.	<1.
1,2-Dichloroethane						
1,1-Dichloroethylene						
1,2-Dichloroethylene (total)						
Dichloromethane						
1,2-Dichloropropane						
cis-1,3-Dichloropropylene						
trans-1,3-Dichloropropylene						
Ethylbenzene						
1,1,2,2-Tetrachloroethane						
1,1,1,2-Tetrachloroethane						
Tetrachloroethylene						
Toluene	2.				2.	
1,1,1-Trichloroethane	<1.				<1.	
1,1,2-Trichloroethane						
Trichloroethylene						
Trichlorofluoromethane						
1,2,3-Trichloropropane						
Vinyl chloride						
Xylene (total)	<3.	<3.	<3.	<3.	<3.	<3.

Comments: *1,2-Dichlorobenzene and 1,4-Dichlorobenzene coelute using EPA Method 8010/8020. The value at this retention time was quantitated using a 1,2-Dichlorobenzene standard.

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/l

Authorized: Monika Santucci

Date: January 8, 1992

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OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-24-91

DESCRIPTION:	Field Blank	QC Trip Blank
SAMPLE NO.:	N9635	N9636
Benzene	<1.	<1.
Benzyl chloride	<10.	<10.
Bis (2-chloroethoxy) methane	<500.	<500.
Bromobenzene	<5.	<5.
Bromodichloromethane	<1.	<1.
Bromoform	<10.	<10.
Bromomethane	<1.	<1.
Carbon tetrachloride		
Chlorobenzene		
Chloroethane		
2-Chloroethylvinyl ether	<10.	<10.
Chloroform	<1.	<1.
1-Chlorohexane	<10.	<10.
Chloromethane	<1.	<1.
Chloromethylmethyl ether	<100.	<100.
2-Chlorotoluene	<5.	<5.
4-Chlorotoluene	<5.	<5.
Dibromochloromethane	<1.	<1.
Dibromomethane	<10.	<10.
1,2-Dichlorobenzene	<5.	<5.
1,3-Dichlorobenzene		
1,4-Dichlorobenzene		
Dichlorodifluoromethane	<10.	<10.

Authorized: Monika Santucci

Date: January 8, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

OBG LABORATORIES, INC.

Volatile Organics
Method 8010/8020

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91 DATE ANALYZED 12-24-91

DESCRIPTION:	Field Blank	QC Trip Blank
SAMPLE NO.:	N9635	N9636
1,1-Dichloroethane	<1.	<1.
1,2-Dichloroethane		
1,1-Dichloroethylene		
1,2-Dichloroethylene (total)		
Dichloromethane		1.*
1,2-Dichloropropane		<1.
cis-1,3-Dichloropropylene		
trans-1,3-Dichloropropylene		
Ethylbenzene		
1,1,2,2-Tetrachloroethane		
1,1,1,2-Tetrachloroethane		
Tetrachloroethylene		
Toluene		
1,1,1-Trichloroethane		
1,1,2-Trichloroethane		
Trichloroethylene		
Trichlorofluoromethane		
1,2,3-Trichloropropane		
Vinyl chloride		
Xylene (total)	<3.	<3.

Comments: *Laboratory contaminant

Methodology: USEPA,SW-846, November 1986, 3rd Edition

Certification No.: 315

Units: µg/l

Authorized: Monika Santucci

Date: January 8, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
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OBG LABORATORIES, INC.

Laboratory Report

CLIENT U.S. NAVY JOB NO. 3543.001.517

DESCRIPTION Midway Park, Camp Lejeune, NC

Toxicity Characteristic Leaching Procedure MATRIX: Water

DATE COLLECTED 12-12-91 DATE RECEIVED 12-13-91

Description	MW-3
Sample #	N9616
TCLP Volatile Organics:	
BENZENE	<0.05
CARBON TETRACHLORIDE	<0.05
CHLOROBENZENE	<10.0
CHLOROFORM	<0.60
1,2-DICHLOROETHANE	<0.05
1,1-DICHLOROETHYLENE	<0.07
METHYL ETHYL KETONE	<20.0
TETRACHLOROETHYLENE	<0.07
TRICHLOROETHYLENE	<0.05
VINYL CHLORIDE	<0.02
Analytical Record:	
Date Leachate Created	-
Date Analyzed	12-26-91

Comments:

Certification No.: 315

Units: mg/l

Authorized: Monika Santucci

Date: January 8, 1992

OBG Laboratories, Inc., *an O'Brien & Gere Limited Company*
5000 Brittonfield Parkway / Suite 300, Box 4942 / Syracuse, NY 13221 / (315) 437-0200

APPENDIX C

LABORATORY RESULTS - SOIL

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, Virginia 23502 • (804) 461-ETSI (3874) • Fax (804) 461-0379

January 8, 1992

ANALYTICAL SERVICES REPORT SHEET

Customer:
Mr. John Conway
O'Brien & Gere Engineers, Inc.
440 Viking Drive
Virginia Beach, Virginia 23452

Sample Description:
2 soil samples delivered on December 19, 1991 designated as Midway Park.

RESULTS

I. Total Petroleum Hydrocarbons: California Method GC/FID.

Sample ID	TPH in mg/kg
B 4 (4-6)	12,000
B 4 (9-11)	11,000

Anne S. Burnett
Quality Control Officer

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, Virginia 23502 • (804) 461-ETSI (3874) • Fax (804) 461-0379

ANALYTICAL SERVICES REPORT SHEET

Customer:
Mr. John Conway
O'Brien & Gere Engineers, Inc.
440 Viking Drive
Virginia Beach, Virginia 23452

Sample Description:
9 soil samples delivered on December 19, 1991 designated as Midway Park.

RESULTS

I. **Total Petroleum Hydrocarbons**: California Method, GC/FID.

Sample ID	TPH in mg/kg
MW 12 (4-6)	7.32
MW 12 (9-11)	9.11
MW 14 (0-2)	4.32
MW 14 (2-4)	11.4
B 1 (4-6)	11.1
B 1 (9-11)	6.84
B 2 (4-6)	8.12
B 2 (11-13)	9.57
B 3 (4-6)	7.89

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II. pH Analysis: Orion ion-analyzer with a two point calibration.

Sample ID	Analyst	pH
MW 12 (9-11)	JK	5.06

III. Flashpoint: EPA SW-846 Method 1010.

Sample ID	Analyst	Flashpoint
MW 12 (9-11)	JK	Negative to 110°C

Anne S. Burnett
Quality Control Officer

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ANALYTICAL SERVICES REPORT SHEET

Customer:
Ms. Tina Bickerstaff
O'Brien & Gere Engineers, Inc.
440 Viking Drive
Virginia Beach, Virginia 23452

Sample Description:
10 soil samples delivered on December 19, 1991 designated as Midway Park.

RESULTS

I. Total Petroleum Hydrocarbons: California Method, GC/FID.

Sample ID	TPH in mg/kg
MW2 14-16	18.6
MW2 9-11	14.6
MW4 9-11	15.4
MW4 14-16	255.0
MW6 9-11	14.0
MW6 14-16	12.6
MW8 0-2	6.72
MW8 11-6	22.8
MW10 4-6	16.7
MW10 9-11	8.38

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II. pH Analysis: EPA Method 150.1.

Sample ID	pH
MW2 14-16	5.03
MW4 14-16	6.23
MW6 14-16	4.81
MW8 4-6	7.36

III. Flashpoint: EPA SW-846 Method 1010.

Sample ID	Results
MW2 14-16	Negative to 110°C
MW4 14-16	Negative to 110°C
MW6 14-16	Negative to 110°C
MW8 4-6	Negative to 110°C

IV. Toxicity Characteristic Leaching Process (TCLP): EPA SW-846 Method 1311.

Sample ID	Results
MW2 14-16	See attached compound list
MW4 14-16	See attached compound list

Anne S. Burnett
Quality Control Officer

ENVIRONMENTAL TESTING SERVICES, INC.
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TOXICITY CHARACTERISTICS LEACHING PROCESS (TCLP)
CONSTITUENT AND REGULATORY LEVELS

Toxicity Characteristic Leaching Process (TCLP): EPA Manual SW-846 Method 1311.

Sample ID: MW2 14-16

Compound	Concentration (mg/l)	Regulatory Level (mg/l)
Arsenic	<0.050	5.0
Barium	0.62	100.0
Benzene	<0.009	0.5
Cadium	<0.010	1.0
Carbon tetrachloride	<0.005	0.5
Chlordane	<0.008	0.03
Chlorobenzene	<0.005	100.0
Chloroform	<0.005	6.0
Chromium	<0.050	5.0
o-Cresol	<0.020	200.0
m-Cresol	<0.040	200.0
p-Cresol	<0.040	200.0
Cresol	<0.005	200.0
2,4-D	<0.010	10.0
1,4-Dichlorobenzene	<0.005	7.5
1,2-Dichloroethane	<0.005	0.5
1,1-Dichloroethylene	<0.005	0.7
2,4-Dinitrotoluene	<0.008	0.13

Anne S. Burnett
Quality Control Officer

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TOXICITY CHARACTERISTICS LEACHING PROCESS (TCLP)
CONSTITUENT AND REGULATORY LEVELS
CONTINUED

Sample ID: MW2 14-16

Compound	Concentration (mg/l)	Regulatory Level (mg/l)
Endrin	<0.005	0.02
Heptachlor (and its hydroxide)	<0.004	0.008
Hexachlorobenzene	<0.010	0.13
Hexachloro-1,3-butadiene	<0.010	0.5
Hexachloroethane	<0.010	3.0
Lead	<0.010	5.0
Lindane	<0.002	0.4
Mercury	<0.002	0.2
Methoxychlor	<0.010	10.0
Methyl ethyl ketone	<0.005	200.0
Nitrobenzene	<0.010	2.0
Pentachlorophenol	<0.020	100.0
Pyridine	<0.010	5.0
Selenium	<0.050	1.0
Silver	<0.010	5.0
Tetrachloroethylene	<0.005	0.7
Toxaphene	<0.010	0.5
Trichloroethylene	<0.005	0.5
2,4,5-Trichlorophenol	<0.010	400.0
2,4,6-Trichlorophenol	<0.010	2.0
2,4,5-TP (Silvex)	<0.005	1.0
Vinyl chloride	<0.010	0.2

Anne S. Burnett
Quality Control Officer

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TOXICITY CHARACTERISTICS LEACHING PROCESS (TCLP)
CONSTITUENT AND REGULATORY LEVELS

Toxicity Characteristic Leaching Process (TCLP): EPA Manual SW-846 Method 1311.

Sample ID: MW4 14-16

Compound	Concentration (mg/l)	Regulatory Level (mg/l)
Arsenic	<0.050	5.0
Barium	1.24	100.0
Benzene	<0.009	0.5
Cadium	<0.010	1.0
Carbon tetrachloride	<0.005	0.5
Chlordane	<0.008	0.03
Chlorobenzene	<0.005	100.0
Chloroform	<0.005	6.0
Chromium	<0.050	5.0
o-Cresol	<0.020	200.0
m-Cresol	<0.040	200.0
p-Cresol	<0.040	200.0
Cresol	<0.005	200.0
2,4-D	<0.010	10.0
1,4-Dichlorobenzene	<0.005	7.5
1,2-Dichloroethane	<0.005	0.5
1,1-Dichloroethylene	<0.005	0.7
2.4-Dinitrotoluene	<0.008	0.13

Anne S. Burnett
Quality Control Officer

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TOXICITY CHARACTERISTICS LEACHING PROCESS (TCLP)
CONSTITUENT AND REGULATORY LEVELS
CONTINUED

Sample ID: MW4 14-16

Compound	Concentration (mg/l)	Regulatory Level (mg/l)
Endrin	<0.005	0.02
Heptachlor (and its hydroxide)	<0.004	0.008
Hexachlorobenzene	<0.010	0.13
Hexachloro-1,3-butadiene	<0.010	0.5
Hexachloroethane	<0.010	3.0
Lead	<0.010	5.0
Lindane	<0.002	0.4
Mercury	<0.002	0.2
Methoxychlor	<0.010	10.0
Methyl ethyl ketone	<0.005	200.0
Nitrobenzene	<0.010	2.0
Pentachlorophenol	0.179	100.0
Pyridine	<0.010	5.0
Selenium	<0.050	1.0
Silver	<0.010	5.0
Tetrachloroethylene	<0.005	0.7
Toxaphene	<0.010	0.5
Trichloroethylene	<0.005	0.5
2,4,5-Trichlorophenol	<0.010	400.0
2,4,6-Trichlorophenol	<0.010	2.0
2,4,5-TP (Silvex)	<0.005	1.0
Vinyl chloride	<0.010	0.2

Anne S. Burnett
Quality Control Officer

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, Virginia 23502 • (804) 461-ETSI (3874) • Fax (804) 461-0379

December 24, 1992

Customer:
Mr. Dan Coleman
O'Brien & Gere Engineers, Inc.
440 Viking Drive
Virginia Beach, Virginia 23452

Sample Description:
Designation: Midway Park
Sample site: Camp Lejeune
Sampled by: TB
1 Sample collected: 12-11-92
Matrix: Soil

CERTIFICATE OF ANALYSIS

Sample ID: B11A 4-6 ETS ID: #25206

Analysis	Method	Results	Det. Limit	Units	Date/ Time Analyzed	Analyst
Benzene	8260	U	3.0	ug/kg	12-21-92/16:18	PK
Bromobenzene	8260	U	11.0	ug/kg	12-21-92/16:18	PK
Bromochloromethane	8260	U	9.0	ug/kg	12-21-92/16:18	PK
Bromodichloromethane	8260	U	3.0	ug/kg	12-21-92/16:18	PK
Bromoform	8260	U	20.0	ug/kg	12-21-92/16:18	PK
Bromomethane	8260	U	1.0	ug/kg	12-21-92/16:18	PK
n-Butylbenzene	8260	U	10.0	ug/kg	12-21-92/16:18	PK
sec-Butylbenzene	8260	U	12.0	ug/kg	12-21-92/16:18	PK
tert-butylbenzene	8260	U	33.0	ug/kg	12-21-92/16:18	PK
Carbon Tetrachloride	8260	U	2.0	ug/kg	12-21-92/16:18	PK
Chlorobenzene	8260	U	3.0	ug/kg	12-21-92/16:18	PK
Chloroethane	8260	U	2.0	ug/kg	12-21-92/16:18	PK
Chloroform	8260	U	4.0	ug/kg	12-21-92/16:18	PK
Chloromethane	8260	U	5.0	ug/kg	12-21-92/16:18	PK
2-Chlorotoluene	8260	U	8.0	ug/kg	12-21-92/16:18	PK
4-Chlorotoluene	8260	U	6.0	ug/kg	12-21-92/16:18	PK
Dibromochlormethane	8260	U	7.0	ug/kg	12-21-92/16:18	PK
1,2-Dibromo-3-chloropropane	8260	U	50.0	ug/kg	12-21-92/16:18	PK
1,2-Dibromoethane	8260	U	10.0	ug/kg	12-21-92/16:18	PK
Dibromomethane	8260	U	1.0	ug/kg	12-21-92/16:18	PK
1,2-Dichlorobenzene	8260	U	5.0	ug/kg	12-21-92/16:18	PK
1,3-Dichlorobenzene	8260	U	5.0	ug/kg	12-21-92/16:18	PK
1,4-Dichlorobenzene	8260	U	4.0	ug/kg	12-21-92/16:18	PK

U = Not detected above quantitation limit

Geoffrey C. Hinshelwood
Laboratory Manager

Sample ID: B11A 4-6 ETS ID: #25206

Analysis	Method	Results	Det. Limit	Units	Date/ Time Analyzed	Analyst
Dichlorodifluoromethane	8260	U	11.0	ug/kg	12-21-92/16:18	PK
1,1-Dichloroethane	8260	U	3.0	ug/kg	12-21-92/16:18	PK
1,2-Dichloroethane	8260	U	2.0	ug/kg	12-21-92/16:18	PK
1,1-Dichloroethene	8260	U	5.0	ug/kg	12-21-92/16:18	PK
cis-1,2-Dichloroethene	8260	U	6.0	ug/kg	12-21-92/16:18	PK
trans-1,2-Dichloroethene	8260	U	3.0	ug/kg	12-21-92/16:18	PK
1,2-Dichloropropane	8260	U	2.0	ug/kg	12-21-92/16:18	PK
1,3-Dichloropropane	8260	U	8.0	ug/kg	12-21-92/16:18	PK
2,2-Dichloropropane	8260	U	8.0	ug/kg	12-21-92/16:18	PK
1,1-Dichloropropene	8260	U	12.0	ug/kg	12-21-92/16:18	PK
1,4-Difluorobenzene (IS)	8260	U	1.0	ug/kg	12-21-92/16:18	PK
Ethylbenzene	8260	U	3.0	ug/kg	12-21-92/16:18	PK
Hexachlorobutadiene	8260	U	10.0	ug/kg	12-21-92/16:18	PK
Isopropylbenzene	8260	U	10.0	ug/kg	12-21-92/16:18	PK
p-Isopropyltoluene	8260	U	26.0	ug/kg	12-21-92/16:18	PK
Methylene chloride	8260	U	9.0	ug/kg	12-21-92/16:18	PK
Naphthalene	8260	U	1.0	ug/kg	12-21-92/16:18	PK
n-Propylbenzene	8260	U	1.0	ug/kg	12-21-92/16:18	PK
Styrene	8260	U	27.0	ug/kg	12-21-92/16:18	PK
1,1,1,2-Tetrachloroethane	8260	U	7.0	ug/kg	12-21-92/16:18	PK
1,1,2,2-Tetrachloroethane	8260	U	20.0	ug/kg	12-21-92/16:18	PK
Tetrachloroethene	8260	U	5.0	ug/kg	12-21-92/16:18	PK
Toluene	8260	U	8.0	ug/kg	12-21-92/16:18	PK
1,2,3-Trichlorobenzene	8260	U	14.0	ug/kg	12-21-92/16:18	PK
1,2,4-Trichlorobenzene	8260	U	20.0	ug/kg	12-21-92/16:18	PK
1,1,1-Trichlorothane	8260	U	4.0	ug/kg	12-21-92/16:18	PK
1,1,2-Trichloroethane	8260	U	8.0	ug/kg	12-21-92/16:18	PK
Trichloroethene	8260	U	2.0	ug/kg	12-21-92/16:18	PK
Trichlorofluoromethane	8260	U	7.0	ug/kg	12-21-92/16:18	PK
1,2,3-Trichloropropane	8260	U	9.0	ug/kg	12-21-92/16:18	PK
1,2,4 Trimethylbenzene	8260	U	9.0	ug/kg	12-21-92/16:18	PK
1,3,5-Trimethylbenzene	8260	U	6.0	ug/kg	12-21-92/16:18	PK
Vinyl chloride	8260	U	4.0	ug/kg	12-21-92/16:18	PK
Total Xylenes	8260	U	10.0	ug/kg	12-21-92/16:18	PK

U = Not detected above quantitation limit

Geoffrey C. Hinshelwood
Laboratory Manager

E.P.A. SW-846 METHOD 8270
TABLE 1 - ACID EXTRACTABLES

Sample ID: B11A 4-6 ETS ID: #25206

Analysis	Method	Results	Det. Limit	Units	Date/ Time Analyzed	Analyst
4-Chloro-3-methylphenol	8270	U	200	ug/kg	12-21-92/16:18	PK
2-Chlorophenol	8270	U	200	ug/kg	12-21-92/16:18	PK
2,4-Dichlorophenol	8270	U	200	ug/kg	12-21-92/16:18	PK
2,4-Dimethylphenol	8270	U	200	ug/kg	12-21-92/16:18	PK
2,4-Dinitrophenol	8270	U	200	ug/kg	12-21-92/16:18	PK
2-Methyl-4,6-dinitrophenol	8270	U	200	ug/kg	12-21-92/16:18	PK
2-Nitrophenol	8270	U	200	ug/kg	12-21-92/16:18	PK
4-Nitrophenol	8270	U	200	ug/kg	12-21-92/16:18	PK
Pentachlorophenol	8270	U	200	ug/kg	12-21-92/16:18	PK
Phenol	8270	U	200	ug/kg	12-21-92/16:18	PK
2,4,5-Trichlorophenol	8270	U	200	ug/kg	12-21-92/16:18	PK
2,4,6-Trichlorophenol	8270	U	200	ug/kg	12-21-92/16:18	PK

U = Not detected above quantitation limit

Geoffrey C. Hinshelwood
Laboratory Manager

E.P.A. METHOD 8270 GC/MS
TABLE 2 - BASE/NEUTRAL EXTRACTABLES

Sample ID: B11A 4-6 ETS ID: #25206

Analysis	Method	Results	Det. Limit	Units	Date/ Time Analyzed	Analyst
Acenaphthene	8270	U	660	ug/kg	12-21-92/16:18	PK
Acenaphthylene	8270	U	660	ug/kg	12-21-92/16:18	PK
Acetophenone	8270	U	330	ug/kg	12-21-92/16:18	PK
Anthracene	8270	U	660	ug/kg	12-21-92/16:18	PK
Aniline	8270	U	330	ug/kg	12-21-92/16:18	PK
Aldrin	8270	U	20	ug/kg	12-21-92/16:18	PK
Benzoic Acid	8270	U	1600	ug/kg	12-21-92/16:18	PK
Benzidine	8270	U	330	ug/kg	12-21-92/16:18	PK
Benzo(a)anthracene	8270	U	660	ug/kg	12-21-92/16:18	PK
Benzo(b)fluoranthene	8270	U	660	ug/kg	12-21-92/16:18	PK
Benzo(k)fluoranthene	8270	U	660	ug/kg	12-21-92/16:18	PK
Benzo(a)pyrene	8270	U	660	ug/kg	12-21-92/16:18	PK
Benzo(ghi)perylene	8270	U	660	ug/kg	12-21-92/16:18	PK
Benzyl butyl phthalate	8270	U	660	ug/kg	12-21-92/16:18	PK
Benzyl alcohol	8270	U	1300	ug/kg	12-21-92/16:18	PK
alpha-BHC	8270	U	50	ug/kg	12-21-92/16:18	PK
beta-BHC	8270	U	50	ug/kg	12-21-92/16:18	PK
gamma-BHC	8270	U	50	ug/kg	12-21-92/16:18	PK
delta-BHC	8270	U	50	ug/kg	12-21-92/16:18	PK
Bis(2-chloroethyl) ether	8270	U	330	ug/kg	12-21-92/16:18	PK
Bis(2-chloroethoxy) methane	8270	U	330	ug/kg	12-21-92/16:18	PK
Bis(2-ethylhexyl) phthalate	8270	U	330	ug/kg	12-21-92/16:18	PK
Bis(2-chloroisopropyl) ether	8270	U	330	ug/kg	12-21-92/16:18	PK
4-Bromophenyl phenyl ether	8270	U	330	ug/kg	12-21-92/16:18	PK
Chlordane	8270	U	80	ug/kg	12-21-92/16:18	PK
1-Chloronaphthalene	8270	U	660	ug/kg	12-21-92/16:18	PK
2-Chloronaphthalene	8270	U	660	ug/kg	12-21-92/16:18	PK
4-Chlorophenyl phenyl ether	8270	U	660	ug/kg	12-21-92/16:18	PK
Chrysene	8270	U	660	ug/kg	12-21-92/16:18	PK

U = Not detected above quantitation limit

Geoffrey C. Hinshelwood
Laboratory Manager

E.P.A. METHOD 8270 GC/MS
TABLE 2 - BASE/NEUTRAL EXTRACTABLES

Sample ID: B11A 4-6 ETS ID: #25206

Analysis	Method	Results	Det. Limit	Units	Date/ Time Analyzed	Analyst
4,4'-DDD	8270	U	40	ug/kg	12-21-92/16:18	PK
4,4'-DDE	8270	U	40	ug/kg	12-21-92/16:18	PK
4,4'-DDT	8270	U	40	ug/kg	12-21-92/16:18	PK
Dibenzo(a,h)anthracene	8270	U	660	ug/kg	12-21-92/16:18	PK
Dibenzofuran	8270	U	660	ug/kg	12-21-92/16:18	PK
Di-n-butylphthalate	8270	U	500	ug/kg	12-21-92/16:18	PK
1,3-Dichlorobenzene	8270	U	660	ug/kg	12-21-92/16:18	PK
1,2-Dichlorobenzene	8270	U	660	ug/kg	12-21-92/16:18	PK
1,4-Dichlorobenzene	8270	U	660	ug/kg	12-21-92/16:18	PK
3,3-Dichlorobenzidine	8270	U	660	ug/kg	12-21-92/16:18	PK
Dieldrin	8270	U	40	ug/kg	12-21-92/16:18	PK
Diethyl phthalate	8270	U	330	ug/kg	12-21-92/16:18	PK
Dimethyl phthalate	8270	U	330	ug/kg	12-21-92/16:18	PK
2,4-Dinitrotoluene	8270	U	330	ug/kg	12-21-92/16:18	PK
2,6-Dinitrotoluene	8270	U	330	ug/kg	12-21-92/16:18	PK
Di-n-octylphthalate	8270	U	660	ug/kg	12-21-92/16:18	PK
Diphenylamine	8270	U	500	ug/kg	12-21-92/16:18	PK
1,2-Diphenylhydrazine	8270	U	500	ug/kg	12-21-92/16:18	PK
Endosulfan I	8270	U	40	ug/kg	12-21-92/16:18	PK
Endosulfan II	8270	U	40	ug/kg	12-21-92/16:18	PK
Endosulfan sulfate	8270	U	40	ug/kg	12-21-92/16:18	PK
Endrin	8270	U	40	ug/kg	12-21-92/16:18	PK
Endrin aldehyde	8270	U	500	ug/kg	12-21-92/16:18	PK
Endrin ketone	8270	U	500	ug/kg	12-21-92/16:18	PK
Fluoranthene	8270	U	660	ug/kg	12-21-92/16:18	PK
Fluorene	8270	U	660	ug/kg	12-21-92/16:18	PK
Heptachlor	8270	U	100	ug/kg	12-21-92/16:18	PK
Heptachlor epoxide	8270	U	100	ug/kg	12-21-92/16:18	PK
Hexachlorobenzene	8270	U	660	ug/kg	12-21-92/16:18	PK

U = Not detected above quantitation limit

Geoffrey C. Hinshelwood
Laboratory Manager

E.P.A. METHOD 8270 GC/MS
TABLE 2 - BASE/NEUTRAL EXTRACTABLES

Sample ID: B11A 4-6 ETS ID: #25206

Analysis	Method	Results	Det. Limit	Units	Date/ Time Analyzed	Analyst
Hexachlorobutadiene	8270	U	660	ug/kg	12-21-92/16:18	PK
Hexachlorocyclopentadiene	8270	U	660	ug/kg	12-21-92/16:18	PK
Hexachloroethane	8270	U	660	ug/kg	12-21-92/16:18	PK
Indeno(1,2,3-cd)pyrene	8270	U	660	ug/kg	12-21-92/16:18	PK
Isophorone	8270	U	660	ug/kg	12-21-92/16:18	PK
2-Methylnaphthalene	8270	U	660	ug/kg	12-21-92/16:18	PK
Naphthalene	8270	U	660	ug/kg	12-21-92/16:18	PK
2-Nitroaniline	8270	U	3300	ug/kg	12-21-92/16:18	PK
Nitrobenzene	8270	U	330	ug/kg	12-21-92/16:18	PK
N-Nitrosdimethylamine	8270	U	660	ug/kg	12-21-92/16:18	PK
N-Nitrosodi-n-propylamine	8270	U	660	ug/kg	12-21-92/16:18	PK
N-Nitrosdiphenylamine	8270	U	660	ug/kg	12-21-92/16:18	PK
PCB-1016	8270	U	500	ug/kg	12-21-92/16:18	PK
PCB-1221	8270	U	500	ug/kg	12-21-92/16:18	PK
PCB-1232	8270	U	500	ug/kg	12-21-92/16:18	PK
PCB-1242	8270	U	500	ug/kg	12-21-92/16:18	PK
PCB-1248	8270	U	500	ug/kg	12-21-92/16:18	PK
PCB-1254	8270	U	500	ug/kg	12-21-92/16:18	PK
PCB-1260	8270	U	500	ug/kg	12-21-92/16:18	PK
Phenanthrene	8270	U	660	ug/kg	12-21-92/16:18	PK
Pyrene	8270	U	660	ug/kg	12-21-92/16:18	PK
Toxaphene	8270	U	400	ug/kg	12-21-92/16:18	PK
1,2,4-Trichlorobenzene	8270	U	660	ug/kg	12-21-92/16:18	PK

U = Not detected above quantitation limit

Geoffrey C. Hinshelwood
Laboratory Manager

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, Virginia 23502 • (804) 461-ETSI (3874) • Fax (804) 461-0379

ANALYTICAL SERVICES REPORT SHEET

Customer:
Ms. Tina Bickerstaff
O'Brien & Gere Engineers, Inc.
440 Viking Drive
Virginia Beach, Virginia 23452

Sample Description:
Designation: Midway Park
Matrix: Soil
Sampler: T. Bickerstaff
Date collected: October 5, 1992
and October 6, 1992
No. of samples: 25

CERTIFICATE OF ANALYSIS

I. **Total Petroleum Hydrocarbons**: EPA SW-846 Method 3550 & 5030.
(Results reported in mg/kg)

ETS ID#	Sample ID	TPH Low-Med	TPH Med-High
23341	B1-A (9-11)	<1	<1
23342	B1-A (14-16)	<1	25
23343	B2-A (9-11)	<1	<1
23344	B2-A (14-16)	<1	<1
23345	B3-A (9-11)	<1	<1
23346	B3-A (14-16)	<1	<1
23347	B4-A (9-11)	<1	<1
23348	B4-A (14-16)	<1	<1
23349	B5-A (0-2)	<1	17
23350	B5-A (4-6)	1	<1
23351	B6-A (0-2)	<1	20
23352	B6-A (4-6)	<1	4
23353	B7-A (4-6)	<1	2
23354	B7-A (9-11)	<1	<1
23355	B8-A (4-6)	<1	<1
23356	B8-A (4-6)	<1	<1
23357	B9-A (0-2)	<1	<1
23358	B9-A (4-6)	1	42
23359	B10-A (0-2)	<1	<1
23360	B10-A (4-6)	<1	<1
23361	B11-A (0-2)	2	59
23362	B11-A (4-6)	<1	<1
23363	B12-A (4-6)	<1	<1
23364	B12-A (9-11)	<1	3

II. **Toxicity Characteristic Leaching Process**: EPA SW-846 Method 1311.

ETS ID#	Sample ID	
23365	B11-A (9-11)	See Appendix A

Anne S. Burnett
Quality Control Officer

ENVIRONMENTAL TESTING SERVICES, INC.
P.O. Box 12715 • 888 Norfolk Square • Norfolk, Virginia 23502 • (804) 461-ETSI (3874) • Fax (804) 461-0379

APPENDIX A

TOXICITY CHARACTERISTICS LEACHING PROCESS (TCLP) CONSTITUENT AND REGULATORY LEVELS

Toxicity Characteristic Leaching Process (TCLP): EPA Manual SW-846 Method 1311.

ETS ID: #23365 **Sample ID:** B11-A (9-11)

Compound	Concen. (mg/L)	MDL (mg/L)	Reg. levels in mg/L
Arsenic	U	0.05	5.0
Barium	0.091	0.007	100.0
Benzene	U	0.009	0.5
Cadmium	U	0.01	1.0
Carbon tetrachloride	U	0.005	0.5
Chlordane	U	0.008	0.03
Chlorobenzene	U	0.005	100.0
Chloroform	0.010	0.005	6.0
Chromium	U	0.05	5.0
o-Cresol	U	0.02	200.0
m-Cresol	U	0.04	200.0
p-Cresol	U	0.04	200.0
Cresol	U	0.005	200.0
2,4-D	U	0.010	10.0
1,4-Dichlorobenzene	U	0.005	7.5
1,2-Dichloroethane	U	0.005	0.5
1,1-Dichloroethylene	U	0.005	0.7
2,4-Dinitrotoluene	U	0.008	0.13
Endrin	U	0.005	0.02
Heptachlor	U	0.004	0.008
Hexachlorobenzene	U	0.010	0.13
Hexachloro-1,3-butadiene	U	0.010	0.5
Hexachloroethane	U	0.010	3.0
Lead	U	0.01	5.0
Lindane	U	0.002	0.4
Mercury	U	0.002	0.2
Methoxychlor	U	0.010	10.0
Methyl ethyl ketone	U	0.005	200.0
Nitrobenzene	U	0.010	2.0
Pentachlorophenol	U	0.020	100.0
Pyridine	U	0.010	5.0
Selenium	U	0.05	1.0
Silver	U	0.01	5.0
Tetrachloroethylene	U	0.005	0.7
Toxaphene	U	0.010	0.5
Trichloroethylene	U	0.005	0.5
2,4,5-Trichlorophenol	U	0.010	400.0
2,4,6-Trichlorophenol	U	0.010	2.0
2,4,5-TP (Silvex)	U	0.005	1.0
Vinyl chloride	U	0.010	0.2

U = Not detected above quantitation limit

Anne S. Burnett
Quality Control Officer

APPENDIX D

UST MONITORING WELL CONSTRUCTION AND FIELD OPERATIONS

UST MONITORING WELL CONSTRUCTION

AND

FIELD OPERATIONS

REQUIREMENTS

Well permits required by state agencies are the responsibility of the contractor. All monitoring wells will be installed in accordance with the following Navy UST monitoring well specifications.

DRILLING

During the drilling program, boreholes will be advanced using conventional hollow stem auger drilling methods. If it is the opinion of the contractor that air or mud rotary drill methods are necessary, approval must be obtained from the EIC. Presentation of justification for a boring method change shall be presented prior to drilling.

The wells will be constructed of flush joint threaded PVC well screen and riser casing depending on conditions encountered during borehole completion.

Well construction details are shown in Figures A-1 and A-2. A drill mounted on an All-Terrain-Vehicle (ATV) may be required for access to remote areas. Each rig will use necessary tools, supplies and equipment supplied by the contractor to drill each site. Drill crews should consist of an experienced driller and a driller assistant for work on each rig. A geologist, experienced in hazardous waste site investigations, shall be on site to monitor the drillers efforts and for air monitoring/safety control. Additional contractor personnel may be needed to transport water to the rigs, clean tools, assist in the installation of the security and marker pipes, construct the concrete aprons/collars and develop the wells. A potable water source on base will be designated by the Government.

Standard penetration tests will be performed in accordance with ASTM D-1586. Standard penetration tests will be performed at the following depths: 0.0-foot to 1.5-foot; 1.5-foot to 3.0-foot; 3.0-foot to 4.5-foot; and 5-foot centers thereafter. A boring log of the soil type, stratification, consistency and groundwater level will be prepared.

Groundwater sampling using a Hydropunch penetrometer (or similar penetrometer probe) and the corresponding laboratory analysis will be used to help define the lateral and horizontal extent of the contamination. The Hydropunch sample shall be obtained from either the upper or lower portion of the aquifer as needed. The use of augering to provide a pilot hole shall not be used. The Hydropunch operation shall not produce soil debris or excess groundwater. The proposed location of Hydropunch penetrometer sampling shall be detailed in the preliminary well location plan.

SAMPLING

Two soil samples will be obtained from each boring/well in accordance with ASTM Method D-1586 for split barrel sampling. The first sample will be obtained from 2 to 5 feet below ground surface. The second soil sample will be from the water table to 5 feet above the water table. Each soil sample will be screened in the field using an HNu photoionizer, organic vapor detector or similar type direct readout instrument to identify the presence of petroleum product within the soils. This field screening will provide a preliminary indication of the vertical and horizontal extent of petroleum contamination in order to select the optimum locations of other monitoring wells during the drilling program. Based on the field screening, monitoring wells will be installed at the locations where the most significant accumulation of fuel is encountered. Groundwater sample shall be obtained from each well and penetrometer probe after development is completed per the instructions below.

DEVELOPMENT

After completion of the soil sampling and drilling to the specified depth, 2-inch or 4-inch (as required by the EIC) I.D. flush-threaded Schedule 40 PVC (Schedule 80 in traffic areas) monitoring wells with slotted screens and well casings will be installed in the borehole. A 5 to 15-foot section of 0.01 inch slotted PVC well screen should be used in each well. Deep/shallow well pairs are to be used to obtain samples from both the upper and lower portions of the surficial aquifer. A sand pack will be placed around each slotted well screen extending to 2 feet above the top of the screen. A bentonite seal (minimum thickness - 1 ft.) will be placed on top of the sand pack. Finally, a ground mixture of two parts sand and one part cement, thoroughly mixed with the specified amount of potable water, will be placed in the borehole and rodded to insure a proper seal.

All wells will be developed following their installation to remove fine ground materials that may have entered the well during construction. This will be accomplished by either bailing or continuous low yield pumping. Equipment used for well installation, that may have come in contact with potentially contaminated material will be decontaminated with a high pressure steam clean wash followed by a potable supply water rinse. For the purpose of this scope of work, it is assumed that all fluid generated from well development and equipment decontamination can be disposed of on the ground at each respective well site.

After development, a standard slug permeability test will be done at each 2" monitoring well that does not contain product.

Soil removed from the borehole will containerized in DOT approved barrels and properly identified. It is expected that sampling required for this effort will suffice for determining if the material is hazardous. The drill equipment and tools will be cleaned prior to drilling each well using a portable decontamination system/operation supplied by the contractor. Wash water at the sites will not be contained, unless otherwise directed by the Government, and may seep into the ground locally.

Supplies and equipment will be transported to the lay-down area designated on the station by the Government. Any office space, trailers, etc., required for drilling, subsequent sampling and shipping shall be arranged and provided by the contractor.

WELL HEAD COMPLETION

A 4-inch diameter security pipe with a hinged locking cap will be installed on the well casing top having an embedment depth of 2.5 feet into the grout.

There are two acceptable methods of completing the wellheads.

In non-traffic areas the acceptable method of finishing a wellhead is shown in figure A-1. Each well will be marked with three Schedule 40 steel pipes, 3-inch I.D., imbedded in a minimum of 2.5-foot of 3,000 psi concrete. (The concrete used to secure the three pipes will be poured at the same time and be an integral part of the 5-foot by 5-foot by 0.5-foot concrete apron described above.). The security pipes will extend a minimum 2.5 feet and maximum 4.0 feet above the ground surface. The steel marker pipes will be filled with concrete and painted day-glo yellow or an equivalent.

In traffic areas (and non-traffic areas where required), a "flush" manhole type cover shall be built into a concrete pad as shown in figure A-2. If the well as installed through a paved or concrete surface, the annular space between the casing and the bore hole shall be grouted to a depth of at least 2.5 feet and finished with a concrete collar. If the well was not installed through a concrete or paved medium and still finished as a high traffic area well, a concrete apron measuring 5-foot by 5-foot by 0.5 foot will be constructed around each well. This apron/collar will be constructed of 3,000 psi ready-mixed concrete. The concrete will be crowned to provide and to meet the finished grade of surrounding pavement as required. The concrete pads can be constructed within five days after all of the wells have been installed.

In all finishing methods, the well covers will be properly labeled by metal stamping on the exterior of the security pipe locking cap and by labeling vertically on the exterior of the security pipe or manhole cover as appropriate. The labeling shall consist of the letters UGW (UST Groundwater) (to describe the medium and the reason for the well) and a number specific to each well.

A sign reading "NOT FOR POTABLE USE OR DISPOSAL" SHALL BE FIRMLY ATTACHED TO EACH WELL.

* The contractor or project team may supplement these requirements, but may not modify or delete them, in total or in part, without prior approval of the Contracting Officer.

APPENDIX E

GROUND WATER SAMPLING PROCEDURES

GROUND WATER SAMPLING PROTOCOL

The following procedures should be used to collect representative ground water samples from ground water observation wells:

1. Identify the well and record the location on the Ground Water Sampling Field Log (GSFL (Attachment A)).

2. Put on a new pair of disposable gloves.

3. Cut a slit in the center of the plastic sheet, and slip it over the well creating clean surface onto which the sampling equipment can be positioned.

4. Clean all meters, tools, equipment, etc., before placing on the plastic sheet.

5. Using an electric well probe, measure the depth of the water column and the bottom of the well. Record this information in the GSFL.

6. Compute the volume of water in the well, and record this volume on the GSFL.

7. Attach enough polypropylene rope to a bailer to reach the bottom of the well, and lower the bailer slowly into the well making certain to submerge it only far enough to fill one-half full. The purpose of this is to recover any oil film, if one is present on the water table.

8. Pull the bailer out of the well keeping the rope on the plastic sheet. Empty the ground water from the bailer into a glass container and observe its appearance. NOTE: This sample will not undergo laboratory analysis, and is collected to observe the physical appearance of the ground water only.

9. Record the physical appearance of the ground water on the GSFL.

10. Lower the bailer to the bottom of the well and agitate the bailer up and down to resuspend any material settled in the well.

11. Initiate bailing the well.

12. Continue bailing the well throughout the water column until three times the volume of the well has been removed

or until the well is bailed dry. If the well is bailed dry, allow sufficient time for the well to recover before proceeding with sample collection. Record this information on the GSFL.

13. Remove the sampling bottles from their transport containers and prepare the bottles for receiving samples. Inspect all labels to insure proper sample identification. Sample bottles should be kept cool with their caps on until they are ready to receive samples. Arrange the sampling containers to allow for convenient filling.

14. Fill each sample container in the order determined by the RCRA Technical Guidance Document.

15. If the sample bottle cannot be filled quickly, keep them cool with the caps on until they are filled. NOTE: Samples must not be allowed to freeze.

16. Record the physical appearance of the ground water observed during sampling on the GSFL.

17. After the last sample has been collected, record the data and time, and if required, empty one bailer of ground water into a beaker and measure the pH, conductivity and temperature of the ground water following the procedures outlined in the equipment operation manuals. Record this data on the GSFL. The beaker must then be rinsed with distilled water prior to re-use.

18. Replace the well cap and lock the well protection assembly before leaving the well location.

19. Place the polypropylene rope, gloves, plastic sheeting and any other associated refuse into a plastic bag for disposal.

20. Decontaminate the bailer using a non-phosphate soap and rinses of distilled water, methanol and diluted nitric acid.

APPENDIX F

SITE SENSITIVITY EVALUATION FOR PETROLEUM CONTAMINATED SOIL

SITE SENSITIVITY EVALUATION FOR PETROLEUM CONTAMINATED SOIL

The purpose of the Site Sensitivity Evaluation (SSE) is to evaluate the sensitivity of groundwater to contamination by the release of petroleum related substances from the vadose zone. The "in-situ" soil clean-up levels, based on total petroleum fuel hydrocarbons (TPFH) and or oil and grease (O&G), is determined by the SSE score; i.e., higher SSE scores require a lower TPFH or O&G soil clean-up level. The SSE is only applicable for petroleum contaminated sites.

If groundwater levels at the site are generally known, or can be determined from field observations, one boring may be sufficient to obtain information necessary to complete the SSE. Also, if a release is discovered during a tank excavation, field investigations such as test pits, soil borings, or deeper excavation into the tank pit itself, may provide the necessary information.

A Site Sensitivity Evaluation should be performed on <u>all</u> sites that meet the following criteria:

1). Contaminated soils are located 5 feet or more from the water table, top of bedrock or transmissive indurated sediments (shell limestone, fractured shale or sandstone, etc.) at sites in category A or B. The applicability of the separation distance on sites in category C, D, or E will be determined by DEM.

2). Contaminated soil does not create a human exposure pathway via ingestion, absorption, or inhalation.

NOTE: *For sites where the criteria in 1 and 2 above are <u>not</u> met, the clean-up levels will be 10 ppm TPFH (EPA Method 5030), 40 ppm TPFH (EPA Method 3550), or 250 ppm TPFH (EPA Method 9071) (unless DEM specifies otherwise). The references to EPA methods 5030 and 3550 throughout this document include the use of the California GC-FID method for TPFH and are referred to only as 5030 and 3550 for brevity.*

The Site Sensitivity Evaluation (SSE) will determine the soil clean-up levels that must be achieved for each site. Depending on the SSE scores, the final clean-up level for site soils may range between 10 to 300 ppm TPFH (for EPA Method 5030), 40 to 1200 ppm TPFH (for EPA Method 3550), and 250 to 3000 ppm O&G (for EPA Method 9071). Soils exhibiting contamination levels greater than (>) 300 ppm TPFH (for EPA Method 5030) or > 1200 ppm TPFH (for EPA Method 3550) , or > 3000 ppm TPFH (for EPA Method 9071) must be remediated (unless otherwise directed by DEM).

"Contaminated soil" in this document refers to soils containing greater than 10 ppm TPFH for low boiling point fuels, greater than 40 ppm TPFH for medium boiling point fuels and greater than 250 ppm for oil and grease. Remedial activities will <u>not</u> be required on soil exhibiting TPFH levels of less than or equal to (≤) 10 ppm TPFH (EPA Method 5030), levels

of ≤ 40 ppm TPFH (EPA method 3550), and O&G levels of ≤ 250 ppm (EPA Method 9071). However, in cases where groundwater have been contaminated or other special site conditions exist, a lower clean-up level and/or additional investigation may be required by the DEM..

In any case, whenever soil remediation is necessary, the treatment/disposal technologies that are utilized should be cost effective and provide adequate protection of human health and the environment.

SITE SENSITIVITY EVALUATION (SSE)

STEP 1: Site Characteristics Evaluation

The sensitivity of groundwater to contamination from petroleum contaminated soils is evaluated by assessing 5 specific site characteristic. These characteristics are rated in accordance with their potential for contributing to the contamination of groundwater; the greater the potential contribution, the higher the score. The overall sensitivity of a site is determined by a numerical value representing the sum of values for each site characteristic.

Complete the SSE score sheet (Table 1) and proceed to step 2

Explanation of Site Characteristics

Grain Size - The main objective of this analysis is to estimate soil permeability, potential for contaminant attenuation, and whether zone restrictions for contaminant transfer exist.

Sample Collection and Location: The sample collected for determination of grain size should be representative of the predominant soil type found in the area of the deepest contaminated soils located beneath the tank pit, or in proximity to the tank pit (in the apparent downgradient direction.) Retaining this soil sample for future reference is advisable.

Sample Classification: The soil sample collected as described above should be classified according to the Unified Soil Classification System (ASTM designation D-2487) or the U.S. Department of Agriculture's method of soil classification. (A visual and textural field inspection will suffice.)

NOTE: *Sample collection and classification should be performed by a qualified person, who through a combination of training and experience, is competent to evaluate the conditions existing at an underground storage tank (UST) system site, including the physical and chemical conditions of the subsurface. (A geologist, soils scientist, engineer or technician active in this field and with experience should be qualified).*

Relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying "soils"- Structures in soils that may significantly increase the permeability such as numerous quartz veins, fractures, coarse grained sandy bed in clays and silts, weathered coarse grained igneous intrusions, etc.

Distance from location of deepest contaminated soil to water table - The determination may be based upon water table wells in the immediate vicinity, mottling of the soil, an auger hole in the excavation or immediate vicinity, or specific knowledge of an area. If an auger hole is made in the excavation, it shall immediately be grouted with neat cement or bentonite.

Is the top of bedrock or transmissive indurated sediments located above the water table? Is there evidence of a water table at the top of bedrock or top of transmissive indurated sediments (shell limestone, fractured shale or sandstone, etc.)?

Artificial conduits present within the zone of contamination - Are there water lines, sewer lines, telephone cables, product dispensing piping, etc., in contamination zone?

Complete the SSE score sheet (Table 1). Proceed to Step 2.

STEP 2: Initial Clean-up Level (See Table 2)

Once the SSE score has been obtained, select the corresponding initial clean-up level for the type of hydrocarbons (low boiling point, medium boiling point, or oil and grease) released on site. Proceed to Step 3.

STEP 3: Final Clean-up Level (See Table 2 and Site Category Descriptions)

Determine and document the site category (A, B, C, D, or E) based on field evaluations. Use Table 2 and the Site Category Descriptions to select the corresponding final clean-up level. Based on the final clean-up levels obtained, determine the quantity of soil that requires remediation.

Submit data and other evidence used in the determination of the final cleanup level to the appropriate Regional Office. Upon review of the information provided, the Regional Office will verify the site's final soil cleanup level. Upon completion of the SSE, the responsible party should immediately begin remediation of soils containing TPFH concentrations in excess of the final proposed cleanup level. The responsible party should maintain accurate records of the remediation process and be prepared to justify all remediation activities.

Table 1

Site Sensitivity Evaluation (SSE)

Site Characteristics Evaluation (Step 1)

Characteristic	Condition	Rating	
Grain Size*	Gravel Sand Silt Clay	150 100 50 0	100
Are relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying "soils".	Present and intersecting the water table. Present but not intersecting the water table. None present.	10 5 0	0
Distance from location of deepest contaminated soil** to water table.	5 - 10 feet >10 - 40 feet >40 feet	20 10 0	20
Is the top of bedrock or transmissive indurated sediments located above the water table?	Yes No	20 0	0
Artificial conduits present within the zone of contamination.	Present and intersecting the water table. Present but not intersecting the water table. Not present.	10 5 0	5
		Total Site Characteristics Score:	125

* **Predominant grain size based on Unified Soil Classification System or U.S. Dept. of Agriculture's Soil Classification Method.**

** (>10 ppm TPH by Method 5030; >40 ppm TPH by Method 3550; >250 ppm O&G by Method 9071)

Table 2

Site Sensitivity Evaluation (SSE)

Initial Cleanup Level (Step 2) — Final Cleanup Level (Step 3)

Low Boiling Point Hydrocarbons

Total Site Characteristics Score	Initial Cleanup Level TPFH (ppm) EPA Method 5030
>150	≤10
121-150	20
91-120	40
61-90	60
31-60	80
0-30	100

Select Site Category*

Final Cleanup Level				
Category A & B (Multiply initial cleanup level by 1)	1	x ____	= ____	ppm
Category C & D (Multiply initial cleanup level by 2)	2	x ____	= ____	ppm
Category E (Multiply initial cleanup level by 3)	3	x ____	= ____	ppm

Medium Boiling Point Hydrocarbons

Total Site Characteristics Score	Initial Cleanup Level TPFH (ppm) EPA Method 3550
>150	≤40
121-150	80
91-120	160
61-90	240
31-60	320
0-30	400

Select Site Category*

Final Cleanup Level				
Category A & B (Multiply initial cleanup level by 1)	1	x ____	= ____	ppm
Category C & D (Multiply initial cleanup level by 2)	2	x 80	= 160	ppm
Category E (Multiply initial cleanup level by 3)	3	x ____	= ____	ppm

Oil & Grease (O&G)

Total Site Characteristics Score	Initial Cleanup Level O&G (ppm) EPA Method 9071
>150	≤250
121-150	400
91-120	550
61-90	700
31-60	850
0-30	1000

Select Site Category*

Final Cleanup Level				
Category A & B (Multiply initial cleanup level by 1)	1	x ____	= ____	ppm
Category C & D (Multiply initial cleanup level by 2)	2	x ____	= ____	ppm
Category E (Multiply initial cleanup level by 3)	3	x ____	= ____	ppm

* See Site Category Descriptions

TABLE 3
SITE SENSITIVITY EVALUATION (SSE)

SITE CATEGORY DESCRIPTIONS

CATEGORY A (*Site meets any one of the criteria)*

1. Water Supply well(s) contaminated and not served by accessible public water supply.
2. Vapors present in confined areas at explosive or health concern levels.
3. Treated surface water supply in violation of the safe drinking water standards.

CATEGORY B (*Any One*)

1. Water supply well(s) contaminated, but served by accessible public water supply.
2. Water supply well(s) within 1500 feet of site, but not contaminated and not served by accessible public water supply.
3. Vapors present in confined areas but not at explosive or health concern levels.

CATEGORY C (*Both*)

1. No known water supply well(s) contaminated.
2. Water supply well(s) greater than 1500 feet from site but not served by accessible public water supply.

CATEGORY D (*Both*)

1. No known water supply well(s) contaminated.
2. Water supply well(s) within 1500 feet of site but served by accessible public water supply.

CATEGORY E (*Both*)

1. No known water supply well(s) contaminated or within 1500 feet of site.
2. Area served by accessible public water supply.

Exhibits

EXHIBIT A

TECHNICAL MEMORANDUM NO. 2
RESULTS OF FIELD INVESTIGATION

TECHNICAL MEMORANDUM NO. 2
RESULTS OF FIELD INVESTIGATION

Prepared for:

Public Works Division
Marine Corps Base, Camp Lejeune

Contract N62470-C090-6796

D&D Project No: LZ682-000001-93160-D086

Prepared by:

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January 1991

The TCLP constituents detected in the sample leachate above their detection limits include Trichloroethylene, Arsenic, Barium, Cadmium, Chromium and Lead. Only Trichloroethylene exceeded its regulatory level; 6.13 ppm vs. 0.5 ppm.

The sample did not contain PCBs above the detection limit of 5.0 ppm and was not hazardous by reactivity, ignitability or corrosivity.

6.2 Site Geology. The site was investigated by five hand augers advanced to a depth of 1 to 4.5 feet, five soil borings advanced to a depth of 5 feet and two monitor wells advanced to a depth of 20 feet. The test locations are shown on the Midway Park Site sheet in the sleeve at the back of this report. The general locations are as follows:

- Hand augers MPHA-1, 2, 3 and 4 were around the perimeter of the tank, inside the brick containment wall.
- Hand auger MPHA 5 was near the pump house where piping was suspected to enter.
- Soil boring MPSB-1 was located near the suspected vicinity of the underground piping halfway between the tank and pump house.
- Soil borings MPSB 2, 3, 4 and 5 were located along the suspected vicinity of underground piping from the pump house southeast toward the main building.

A surface sample was obtained of a black tar/asphalt substance on the surface within the brick containment wall (sample MPHA-4A). The monitor wells, MPMW-1 and 2 were installed to the northwest and north-northwest of the tank near the perimeter fence, in attempt to intercept the suspected downgradient flow of groundwater at the site.

The soils encountered at each of the hand auger and soil boring location are described in Table 5. The soils encountered in the monitor wells are presented in boring logs (Plates 1 and 2). The soils encountered at all test locations were almost exclusively very fine to fine sands with trace to no silt. These sands were grey to brown to orange in the upper few feet, then graded to light tan to orangish tan and near white with depth. MPHA-5 encountered approximately 1 foot of fine sand with little silt then refused on the concrete associated with the pump house (four attempts were made). Some wood debris was encountered at an approximate depth of 3 feet in soil boring MPSB-3 and some wood and concrete debris was

BORING: MPMW-1
LOCATION: MIDWAY PARK, CAMP LEJEUNE
DATE COMPLETED: NOVEMBER 27, 1990

DEPTH (FEET)	TEST SAMPLE	BLOW COUNT	SOIL CLASS	DESCRIPTION
0				MOTTLED BROWN FINE SAND, SOME SILT, NO
–	#1	4-4-5-5	SM	ODOR, MOIST, MEDIUM DENSE.
–	0'-2'		ML	3" BLACK SILT (OLD TOP SOIL?).
–			SP	BROWN TO ORANGISH TAN FINE SAND, LITTLE
–			--	SILT, MOIST.
–			SM	
–	#2	2-2-2-3		ORANGISH TAN FINE SAND, TRACE SILT,
–	3'-5'			NO ODOR, MEDIUM DENSE, MOIST.
–				GRADING LIGHT ORANGISH TAN.
–				
5				GRADING LIGHT TAN.
–				
–				
–				
–				
–				
–				
–				
–				
10		CUTTINGS	SP	GRADING FINE TO MEDIUM GRAINED,
–				VERY MOIST TO WET.
–				
–				
–				
–				
–				
–				
–				
–				
15		CUTTINGS		GRADING WITH TRACE COARSE SAND AND
–				FINE GRAVEL, SATURATED.
–				
–				
–				
–				
–				
–				
–				
–				
20				
–				
–				

BORING COMPLETED AT A DEPTH OF 20 FEET.
WELL CONSTRUCTION: 2 INCH I.D. PVC PIPE WITH 15 FEET OF SCREEN SET AT 23 FEET (DEEPER DUE TO LOSE SAND BELOW WELL TIP), FILTER SAND PACK UP TO 5 FEET, BENTONITE UP TO 3 FEET, GROUT TO SURFACE, LOCKING CASE, STICKUP = 3.21 FT.
WATER LEVELS: DATE 11-30-90
DEPTH 11.59 FT. FROM TOP OF CASING.

PLATE 1

BORING: MPMW-2
LOCATION: MIDWAY PARK, CAMP LEJEUNE
DATE COMPLETED: NOVEMBER 28, 1990

DEPTH (FEET)	TEST SAMPLE	BLOW COUNT	SOIL CLASS	DESCRIPTION
0				LIGHT GRAYISH BROWN FINE SAND, LITTLE
–	#1	2-2-2-2	SP	SILT, TRACE ROOTS, MOIST, LOOSE.
–	0'-2'		--	GRADING BROWN.
–			SM	
–				TAN FINE SAND,TRACE SILT, NO ODOR,
–				MOIST, MEDIUM DENSE.
–	#2	3-3-3-4		GRADING GREY.
–	3'-5'			
–				GRADING LIGHT TAN TO LIGHT ORANGISH
–				TAN.
5				
–				
–				
–				
–				
–				
–				
–				
–			SP	
–				
10		CUTTINGS		GRADING FINE TO MEDIUM GRAINED,
–				VERY MOIST TO WET.
–				
–				
–				
–				
–				
–				
–				
–				
15		CUTTINGS		GRADING WITH TRACE COARSE SAND AND
–				FINE GRAVEL, SATURATED.
–				
–				
–				
–				
–				
–				
–				
–				
20				
–				
–				

BORING COMPLETED AT A DEPTH OF 18 FEET.
WELL CONSTRUCTION: 2 INCH I.D. PVC PIPE WITH 13 FEET OF SCREEN SET AT 18 FEET. SAND PACK UP TO 4 FEET, BENTONITE UP TO 2 FEET, GROUT TO SURFACE, LOCKING CASE, STICKUP = 2.26 FT.
WATER LEVELS: DATE 11-30-90
DEPTH 10.88 FT. FROM TOP OF CASING.

PLATE 2

TABLE 4

(CONTINUED)

CAMP LEJEUNE HAZARDOUS WASTE OIL TANKS
LABORATORY RESULTS OF TANK CONTENTS

SITE	HOLCOMB	MIDWAY	NEW RIVER	TARAWA
DATE SAMPLED	11/27/90	11/26/90	11/27/90	11/26/90
TANK DESIGNATION	891	S-781	AS421	STT-66
OTHER				
PCB	<5.0	<0.200	<5.0	<5.0
REACTIVITY				
TOTAL HYDROGEN CYANIDE	<5	<5	<5	<5
TOTAL HYDROGEN SULFIDE	<10	<10	<10	<10
IGNITABILITY				
FLASHPOINT	>212 F	>212 F	>212.2 F	208.4 F
CORROSIVITY				
pH	9.0 S.U.	5.88 S.U.	5.31 S.U.	7.25 S.U.

NOTES:

1) ALL RESULTS ARE PRESENTED IN PARTS PER MILLION (PPM), WHICH IS ANALOGOUS TO MILLIGRAMS PER KILOGRAM FOR THE VOC'S, PCB'S, REACTIVITY AND THE TCLP FOR HOLCOMB, NEW RIVER AND TARAWA. PPM IS ANALOGOUS TO MILLIGRAMS PER LITER FOR THE TCLP FOR MIDWAY. FLASHPOINT IS IN DEGREES FAHRENHEIT (F) AND pH IS IN STANDARD UNITS.
2) VOLATILE ORGANIC COMPOUNDS (VOC) IS A PARTIAL LIST CONSISTING OF 34 CHEMICALS. THOSE NOT INCLUDED IN THE TABLE WERE BELOW THEIR DETECTION LIMITS. THE DETECTION LIMIT FOR VOC'S WERE 0.125 PPM AT MIDWAY AND 0.500 PPM AT THE OTHER SITES.
3) TOXICITY CHARACTERISTIC LEACHING PROCEDURE (TCLP) WAS WAS ONLY APPLICABLE TO THE MIDWAY SITE; THE OTHER SITES CONSISTED OF OIL SAMPLES FOR WHICH THE EXTRACTION WAS NOT APPLICABLE. THEREFORE, THE RESULTS FOR THOSE THREE SITES ARE FOR TOTAL CONCENTRATIONS IN THE WASTE OIL, WHILE THE RESULTS FOR MIDWAY ARE FOR THE LEACHATE FROM THE SLUDGE SAMPLED.
4) ND - NOT DETECTED; "<" - LESS THAN THE DETECTION LIMIT.
5) "0.294/1.9" FOR MIDWAY INDICATE RESULTS FROM FIRST AND SECOND LABORATORIES.
6) S.U. - STANDARD UNITS
7) F - DEGREES FAHRENHEIT
8) MCL - MAXIMUM CONTAMINANT LEVEL

TABLE 4

CAMP LEJEUNE HAZARDOUS WASTE OIL TANKS
LABORATORY RESULTS OF TANK CONTENTS

SITE	HOLCOMB	MIDWAY	NEW RIVER	TARAWA	
DATE SAMPLED	11/27/90	11/26/90	11/27/90	11/26/90	
TANK DESIGNATION	891	S-781	AS421	STT-66	
ESTIMATED VOLUME	24600 GAL	5100 GAL	330 GAL	450 GAL	
VOC'S					**MCL**
CHLOROBENZENE	0.607	0.597	ND	ND	0.06
CHLOROFORM	ND	0.914	5.27	ND	0.1
CHLOROMETHANE	ND	0.547	ND	ND	—
1,1-DICHLOROETHANE	ND	0.294/1.9	ND	1.45	—
1,1-DICHLOROETHENE	3.69	ND	ND	ND	—
METHYLENE CHLORIDE	ND	0.562	0.542	ND	—
TETRACHLOROETHENE	ND	0.709	ND	5.12	—
1,1,1-TRICHLOROETHANE	11.1	2.00/13.0	ND	4.43	0.2
TRICHLOROETHENE	2.23	314.0	1.08	ND	—
TRICHLOROFLUOROMETHANE	2.06	1.18	1.39	2.94	—
1,1,2-TRICHLOROTRI-FLUOROETHANE	ND	10.5	0.513	ND	—
BENZENE	7.31	2.78/11.0	ND	3.15	0.005
1,2-DICHLOROBENZENE	ND	0.213	ND	ND	0.62
ETHLYBENZENE	19.7	6.97/39.0	0.571	22.6	0.68
TOLUENE	6.20	20.5/96.0	2.80	7.12	2.0
TOTAL XYLENES	73.7	23.2/260.0	3.97	87.9	0.44
TCLP					**REG. LEVEL**
ARSENIC	0.100	0.002	0.151	0.100	5.0
BARIUM	15	1.8	ND	40	100.0
BENZENE	7.31	ND	ND	3.15	0.50
CADMIUM	2.24	0.138	1.01	1.74	1.0
CHLOROFORM	ND	ND	5.27	ND	6.0
CHROMIUM	80	0.14	55	95	5.0
1,1-DICHLOROETHYLENE	3.69	ND	ND	ND	0.70
LEAD	20	0.4	15	25	5.0
MERCURY	ND	ND	2.40	0.200	0.2
METHYL ETHYL KETONE	11.2	ND	7.19	20.4	200.0
TRICHLOROETHYLENE	2.23	6.13	1.08	ND	0.5
TETRACHLOROETHYLENE	ND	ND	ND	5.12	0.7

TABLE 5

SOIL DESCRIPTIONS
MIDWAY PARK WASTE OIL TANK

LOCATION	DEPTH	DESCRIPTIONS	DEPTH/ TPH	BLOW COUNT
MPHA-1	0'-1'	BROWN AND DARK GREY FINE SAND, NO ODOR, MOIST.	0'-1'	N/A
	1'-2'	GRADING BROWN TO TAN.	<10 PPM	
	2'-3'	GRADING TAN TO LIGHT TAN.	2'-4'	
	3'-4'	GRADING LIGHT TAN TO WHITE.	<10 PPM	
MPHA-2	0'-1'	BROWN AND GREY FINE SAND, OCCASIONAL PIECES OF TAR OR ASPHALT, NO ODOR, MOIST.	0'-1' <10 PPM	N/A
	1'-2'	GRADING DARK ORANGISH TAN, NO TAR/ASPHALT.	1'-4'	
	2'-3'	GRADING LIGHT ORANGISH TAN.	<10 PPM	
	3'-4'	GRADING LIGHT TAN TO NEAR WHITE.		
MPHA-3	0'-1'	TAN FINE SAND, TRACE SILT, NO ODOR, MOIST.	0'-4.5'	N/A
	1'-1.5'	GRADING LIGHT BROWN, LITTLE SILT.	<10 PPM	
	1.5'-3'	GRADING YELLOWISH TAN.		
	3'-4.5'	GRADING LIGHT BROWN.		
MPHA-4	0'	SOME TAR/ASPHALT ON SURFACE.	0'	N/A
	0'-1'	ORANGISH TAN FINE SAND, LITTLE SILT, NO ODOR, MOIST.	<10 PPM 0'-4'	
	1'-2'	GRADING LIGHT TAN, TRACE SILT.	<10 PPM	
	2'-4'	GRADING LIGHT TAN TO WHITE.		
MPHA-5	0'-1'	BROWN FINE SAND, LITTLE SILT, NO ODOR, MOIST.	0'-1'	N/A
	1'	REFUSAL ON CONCRETE.	<10 PPM	
MPSB-1	0'-1'	2" TOP SOIL. BROWN FINE SAND, LITTLE SILT, NO ODOR, MOIST.	0'-5' 1200 PPM	0'-2' 2-5-9-9
	1'-4.5'	GRADING TAN AND BROWN, TRACE SILT.		3'-5'
	4.5'-5'	GRADING ORANGE.		3-3-4-2
MPSB-2	0'-0.5'	CRUSHED GRAVEL.	0'-5'	0'-2'
	0.5'-1'	GREY FINE SAND, TRACE SILT, NO ODOR, MOIST.	2200 PPM	9-11-16-16
	1'-1.5'	GRADING BROWN, TRACE GRAVEL.		3'-5'
	1.5'-2'	GRADING LAYERED BROWN AND BLACK, MODERATE PETROLEUM ODOR.		3-3-4-2
	3'-4.5'	TAN FINE SAND, TRACE SILT, NO ODOR, MOIST.		
	4.5'-5'	GRADING ORANGE.		
MPSB-3	0'-0.5'	CRUSHED GRAVEL.	2'-5'	
	0.5'-1'	DARK BROWN FINE SAND, NO ODOR, MOIST.	<10 PPM	1'-3'
	1'-2'	GRADING MOTTLED BROWN AND ORANGE, LITTLE GRAVEL.		11-9-7-7
	2'-2.7'	GRADING MOTTLED TAN AND BLACK.		
	2.7'-3'	GRADING DARK ORANGE BROWN AND TAN, PIECE OF WOOD IN SPOON.		3'-5' 4-4-8-4
	3'-4'	GRADING TAN, 2" WOOD.		
	4'-5'	GRADING ORANGE.		
MPSB-4	0'-0.5'	CRUSHED GRAVEL.		
	0.5'-5'	MOTTLED ORANGE AND TAN FINE SAND, TRACE SILT, NO ODOR, MOIST.	1'-5' <10 PPM	1'-3' 11-12-9-6 3'-5' 2-2-1-2

TABLE 5

(CONTINUED)

SOIL DESCRIPTIONS
MIDWAY PARK WASTE OIL TANK

LOCATION	DEPTH	DESCRIPTIONS	DEPTH/ TPH	BLOW COUNT
MPSB-5	0'-0.5'	CRUSHED GRAVEL.	3'-5'	
	0.5'-1.8'	ORANGISH BROWN FINE SAND, NO ODOR, MOIST.	<10 PPM	1'-3'
	1.8'-2.5'	5" WOOD AND CONCRETE IN SPOON. CONCRETE OBSTRUCTION IN SIDE OF BORING AT 2'.		5-8-4-3
	2.5'-5'	DARK ORANGE BROWN FINE SAND, TRACE SILT, NO ODOR, MOIST. PIECE OF WOOD AT 4.5'.		3'-5' 2-1-1-2

NOTES:
1) DEPTHS ARE APPROXIMATE.
2) TPH - TOTAL PETROLEUM HYDROCARBONS.
3) PPM- CONCENTRATION IN PARTS PER MILLION, WHICH IS ANALOGOUS TO MILLIGRAMS PER KILOGRAM.
4) BLOW COUNTS ARE THE NUMBER OF BLOWS REQUIRED TO DRIVE A STANDARD SPLIT SPOON 2 FEET IN 6 INCH INCRIMENTS.
5) SEE INDIVIDUAL LOGS FOR MONITOR WELLS MPMW-1 AND MPMW-2.

TABLE 6

MIDWAY PARK WASTE OIL TANK
LABORATORY RESULTS OF SOIL AND WATER SAMPLES

SAMPLE	DEPTH	TPH	BENZENE	TOLUENE	ETHYL BENZENE	TOTAL XYLENES	V7	V17	V20	V25	V27	TOX	PCB
MPHA-1A	0'-1'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-1B	2'-4'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-2A	0'-1'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-2B	1'-4'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-3	0'-4.5'	ND	ND	0.046	ND	ND	ND	ND	ND	ND	ND	--	--
MPHA-4A	SURFACE	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-4B	0'-4'	ND	--	--	--	--	--	--	--	--	--	--	--
MPHA-5	0'-1'	ND	--	--	--	--	--	--	--	--	--	--	--
MPSB-1	0'-5'	1200 IR	--	--	--	--	--	--	--	--	--	--	--
MPSB-2	0'-5'	2200 IR 1480 IR*	ND	0.014	ND	0.026	0.006	0.029	0.044	0.240	0.020	--	--
MPSB-3	2'-5'	ND	--	--	--	--	--	--	--	--	--	--	--
MPSB-4	1'-5'	ND	--	--	--	--	--	--	--	--	--	--	--
MPSB-5	3'-5'	ND	--	--	--	--	--	--	--	--	--	--	--
MPMW-1A	0'-2'	20 D 2400 IR	--	--	--	--	--	--	--	--	--	--	--
MPMW-1B	3'-5'	ND D 70 IR	--	--	--	--	--	--	--	--	--	--	--
MPMW-1W	WATER	ND	--	--	--	--	--	--	--	--	--	0.008	ND
MPMW-2	0'-5'	ND	--	--	--	--	--	--	--	--	--	--	2.03**
MPMW-2W	WATER	ND	--	--	--	--	--	--	--	--	--	0.034	ND

NOTES:
1) ALL RESULTS ARE PRESENTED IN PARTS PER MILLION (PPM), WHICH IS ANALOGOUS TO MILLIGRAMS PER KILOGRAMS.
2) TPH- TOTAL PETROLEUM HYDROCARBONS. TEST METHOD IS BY GAS CHROMATOGRAPH (GC); "D" INDICATES DIESEL, "IR" - INDICATES INFRARED SPECTROPHOTOMETRY METHOD IN LIEU OF OR IN ADDITION TO GC METHOD. "**" - INDICATES TEST RESULTS FROM SECOND LABORATORY.
3) VOLATILE ORGANIC COMPOUNDS (VOC) ARE 34 COMMON PRIORITY POLLUTANTS. V7 - CHLOROFORM, V17 MEHYLENE CHLORIDE, V20 - 1,1,1 TRICHLOROETHANE, V25 - 1,1,2 TRICHLOROTRIFLUOROETHANE (FREON), V27 - CHLOROBENZENE. INCLUDES BENZENE, TOLUENE, ETHYLBENZENE AND TOTAL XYLENES (BTEX). ALL OTHER COMPOUNDS WERE BELOW THEIR DETECTION LIMITS.
4) TOX - TOTAL ORGANIC HALIDES.
5) PCB - POLYCHLORINATED BIPHENOLS. "***" - QUANTIFICATION BASED UPON AROCLOR 1242
6) "ND" - NOT DETECTED. DETECTION LIMITS: TPH IN SOIL = 10 PPM, TPH IN WATER = 1.0 PPM, VOC AND BTEX IN SOIL = 0.005 PPM, PCB IN SOIL = 0.050 PPM, PCB IN WATER = 0.001 PPM.