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CONFIRMATION STUDY FINAL SUBMISSION ASSESSMENT OF POTENTIAL OIL AND HAZARDOUS WASTE CONTAMINATION OF SOIL AND GROUND WATER CNC CHARLESTON SC

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GERAGHTY & MILLER, INC.

*CONFIRMATION STUDY*

# *Assessment of Potential Oil and Hazardous-Waste Contamination of Soil and Ground Water, Naval Shipyard, Charleston, South Carolina*

*prepared for*

*NAVAL FACILITIES ENGINEERING COMMAND*
*Southern Division*
*Charleston, South Carolina*

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Geraghty & Miller, Inc.

# FINAL SUBMISSION (100%)
# CONFIRMATION STUDY

## ASSESSMENT OF POTENTIAL OIL AND HAZARDOUS-WASTE CONTAMINATION OF SOIL AND GROUND WATER AT THE CHARLESTON NAVAL SHIPYARD, CHARLESTON, SOUTH CAROLINA

Prepared for

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
Charleston, South Carolina

October 29, 1982

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# EXECUTIVE SUMMARY

## Introduction

This Confirmation Study was performed at the Naval Shipyard in Charleston, South Carolina, to fulfill the Phase II requirements of the Navy Assessment and Control of Installation Pollutants Program. This study was a follow-up to the Phase I Initial Assessment Study, which involved an on-site investigation to verify and characterize the presence of soil and ground-water contamination at eight sites. The sites studied included the following areas identified in Figure 2: (1) caustic-pond area, (2) chemical-disposal area, (3) landfill area, (4) pesticide-mixing area, (5) electrical-transformer storage area, (6) oil-sludge pit area, (7) POL-transfer area, and (8) former fire-fighting training pit.

During this investigation, a total of 132 shallow borings were drilled; 29 monitor wells were installed; and 26 soil samples were collected for chemical analyses. Water samples were also collected from each of the monitor wells and analyzed for selected chemical and physical constituents (see Appendices C through H for analyses results).

## Hydrogeologic Setting

The Charleston Naval Shipyard is located on a peninsula of land and is surrounded on three sides by brackish surface water of the Cooper River. The topography of the shipyard, particularly the southern portion, has been altered by dredge and fill activities. The average land-surface elevation is about 5 feet above mean sea level.

The uppermost surficial deposits are composed primarily of silt and clay interbedded with sand and shell which are approximately 45 feet thick. Ground-water movement through these surficial deposits is very slow from points of higher elevation toward the Cooper River or Shipyard Creek. The ground water in the surficial deposits is mineralized due to its proximity to brackish water and the extensive amount of filling activities using material dredged from the Cooper River and Shipyard Creek. The levels of dissolved solids in ground water are generally well in excess of EPA's drinking-water standards, and contains low levels of industrial chemicals. There is no potential for utilizing the surficial ground waters for drinking purposes.

The surficial deposits are underlain by confining deposits of the Cooper Marl (Formation) which is composed primarily of calcareous clay to a depth of about 250 feet. The Santee Limestone (Formation) underlies the Cooper Marl in the Charleston area. Withdrawal from industrial wells tapping the Sanatee Limestone range from 200 to 500 gallons per minute. In the vicinity of the shipyard, ground water in the Santee Limestone contains 1,000 to 1,500 milligrams per liter of total dissolved solids. There is little or no potential for downward movement of ground water from the surficial deposits into the Santee Limestone because of the thick confining deposits between the two and the upward hydraulic gradient at the site.

## Major Findings and Conclusions

### Caustic Pond

The caustic pond received calcium hydroxide sludge for several decades prior to the early 1970's. Water infiltrating into the surficial ground water would have had a relatively high pH; however, the results of water-sample analyses collected from four monitor wells show that this water was neutralized by the naturally-occurring acidic soils at the site. Calcium hydroxide is not considered a hazardous waste and the site does not pose any threat to the environment. The site is not in violation of any applicable Federal, State, Navy, or Department of Defense standard; however, there is a potential safety problem if the calcium hydroxide were to come in contact with sensitive portions of the body, such as the eyes.

### Chemical-Disposal Area

Small quantities of warfare decontaminating agents DANC-DS-2 and DANC-N4 were buried at unknown locations in the chemical-disposal area. These chemicals are strongly alkaline and can cause chemical burns if contact with the skin or eyes occurs. Analyses of water samples from five monitor wells in the area did not detect the presence of chemical constituents associated with these decontaminating agents. However, several other industrial chemicals such as methylene chloride and chlorobenzene were detected in water samples collected from these monitor wells. Presumably waste products containing these materials have been disposed of in this area. The presence of these compounds do not pose a significant threat to the environment, and the area is not in violation of any applicable Federal, State, Navy, or Department of Defense standard.

## Landfill Area

From the 1930's until 1973, solid wastes generated at the shipyard were disposed of at the shipyard landfill. These wastes included sanitary wastes and various inorganic and organic chemicals. The liquid wastes were placed in drums before disposal, and combustible wastes were burned daily. The residue from the burning was pushed into the marsh as fill along with concrete rubble, metal scrap, and other non-combustile material. These waste materials were then covered and the area contoured to prevent ponding of surface waters and to facilitate surface-water runoff.

The results of the chemical analyses of water samples collected from 13 monitor wells along the edge of the landfill reveal the presence of relatively low levels of dissolved metals and compounds on EPA's organic priority pollutant list. The seepage of these constituents into Shipyard Creek, which drains an industrialized area, or the

Cooper River is extremely slow, at the rate of 1 to 2 feet per year due to the low hydraulic gradient and the low permeability of the surficial deposits.

## Pesticide-Mixing Area

The pesticide-mixing area is a relatively small area, 50 ft x 25 ft, which was used to wash off equipment used in the spraying and mixing of pesticides. No pesticides, herbicides, or PCBs were detected in the shallow ground water because of the strong affinity these compounds have for the soil, as well as their low solubilities in water. However, pesticides and PCBs were detected in ten soil samples collected at three soil horizons: the surface, a depth of six inches, and a depth of 2 ft. The highest concentrations of DDT, 5.3 and 1.48 micrograms per gram, were found at land surface, with much lower concentrations found at deeper depths. There are no applicable Federal, State, Navy, or DOD standards on allowable residual DDT levels in the soil, and the levels of PCBs were below those which would require them to be removed under Federal regulations.

## Electrical Transformer Storage Area

Building 3902, the adjacent concrete slab, and the surrounding area (Figure 11) were used for the storage of electrical equipment, including transformers. Prior to 1976, the fluid contained in the electrical transformers had accidentally been spilled on occasion. The fluid was believed to include PCBs and was sometimes drained before the transformers were removed from the area.

The shallow ground water at the electrical transformer storage area contains very low levels of PCBs, pesticides, and arsenic, although composite soil samples collected in this area contain relatively high levels of these constituents. The highest concentrations of DDT and PCBs were 40 and 62 micrograms per gram, respectively. According to Federal standards, soils with concentrations of PCBs in excess of 50 micrograms per gram are considered to be a hazardous PCB-containing material and must be disposed of in accordance with Federal regulations. There are no applicable Federal, State, Navy, or Department of Defense standards on allowable residual DDT levels in the soil.

## Oil-Sludge Pit Area

Prior to 1971, oil from the industrial activities at the shipyard were disposed of into three pits near Building X10 (Figure 12). By 1956, two of the pits had been covered, and in 1974 the oil was removed from the remaining pit which was also covered with fill material.

The results of the boring program (87 shallow borings) showed that a long, narrow body of oil, approximately 50 feet wide by 600 feet long and trending in a northeast-southwest direction, exists in the southwestern portion of the oil-sludge area (Figure 15). Measurements taken in the borings indicate that the oil ranges in thickness from about 2 to 4 inches. Very little oil has infiltrated into the surficial deposits adjacent to the pits because of the low horizontal hydraulic gradient, the low permeability of the surficial deposits, and the high viscosity of the oil. Under these conditions, a long time would be required for the oil to move laterally via the shallow ground-water system into the Cooper River or Shipyard Creek. It is possible that the oil body could reach immobile saturation prior to reaching these surface-water bodies.

## POL-Transfer Area

Petroleum, oil, and lubricants entering the shipyard are transferred from railroad tank cars to storage tanks at the POL-transfer area (Figure 16). In 1981, during the construction of a fence, some of the fence-post holes that were dug reportedly became filled with oil. A total of 36 shallow oil borings were drilled in order to identify whether or not an oil plume exists within the POL-transfer area.

The results of the boring program indicate that only traces of oil were found in some of the borings in the vicinity of the POL-transfer area. Based on these findings, it appears that any oil present in the surficial deposits in this area is very localized.

## Fire-Fighting Training Pit

The fire-fighting training pit is located at the southern end of the shipyard and is no longer in use. It reportedly ranged between 30 to 50 feet in diameter and was used between 1966 and 1971 for training purposes. Oil, gasoline, and alcohol were poured into this pit, ignited, and subsequently extinguished during fire-fighting training exercises. No oil or any traces of oil were found in any of the borings drilled at the fire-fighting training pit area.

# RECOMMENDATIONS

## Basic Considerations

In July 1982, EPA published the National Oil and Hazardous Substances Contingency Plan (hereinafter referred to as the Plan) which outlines federal responsibilities under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), commonly referred to as Superfund Law. The Plan contains the framework for determining the federal responsibility in responding to releases or threatened releases of oil and hazardous substances as authorized by CERCLA. This framework was used "to determine the most cost-effective remedy which will effectively minimize and mitigate the danger posed by the release and provide adequate protection of public health, welfare, or the environment" (EPA, March 1982).

The Plan also states that "Section 104(c)(4) of CERCLA requires that the need for protection of public health, welfare, and the environment at the facility under consideration be balanced against the amount of money available in the (Hazardous Substance Response) Fund to respond to other sites which present or may present a threat to public health or welfare or the environment...(40 CFR 300.68k)."

In accordance with the Plan, a limited number of alternatives for source control or remedial action were presented for each site in the 80% Submission of this report, and where appropriate, one of the alternatives listed was a no-action alternative. A no-action alternative is appropriate when: (1) action may cause a greater environmental or health danger than no action, or (2) there is no appropriate engineering solution. These alternatives were then screened by the U. S. Navy (including the Naval Facilities Engineering Command, the Naval Facilities Engineering Command - Southern Division, the Naval Energy and Environmental Support Activity, and the Charleston Naval Shipyard) using three broad criteria: (1) cost, (2) effects of the alternative, and (3) acceptable engineering practices (40 CFR 300.68h).

Presented below are the remedial actions that were selected as a result of this screening process.

(1) Caustic Pond

Due to restricted access to the base and the fact that the caustic pond is somewhat isolated from the main activities of the base, the remedial action selected was to identify the caustic pond as a potential safety hazard by posting signs around the pond and identifying the site as such on the Base Master Development Plan.

(2) Chemical-Disposal Area

The remedial action selected for the chemical-disposal area was also to identify the area as a potential safety hazard by posting signs and identifying the safety hazard associated with this area on the Base Master Development Plan.

(3) Landfill Area

Since the landfill has already been covered and contoured and no other appropriate engineering solution is cost effective, the no-action alternative was selected for this site.

(4) Pesticide-Mixing Area

The selected alternative is to disc the surface soils in with the deeper soils and then seed the area with grass.

(5) Electrical Transformer Storage Area

A more definitive soil-sampling and analysis program should be implemented in the areas encompassing sampling lines OC-2, OC-3, and OC-11 (Figure 11) to determine more precisely the locations where the concentrations of PCBs exceed 50 micrograms per gram. This can be accomplished by griding the area into smaller parcels and collecting a surface soil sample from each grid parcel and analyzing for its PCB content.

After the soils exceeding 50 micrograms per gram of PCBs are located, they should be excavated and disposed of in a PCB landfill unless an approved, more cost-effective EPA treatment method is available. The area should then be disced so that the surface soils are mixed in with the deeper soils. The area should then be seeded with grass.

## Oil-Sludge Pit

The ditch dug in this area to convey surface-water runoff away from the site should be completed by installing a bypass pipe, in the area opposite the oil plume, with a collection system at the downstream end. The ditch will still serve its purpose of conveying surface-water runoff away from the site while preventing the oil from entering the ditch and reaching Shipyard Creek. The collection system should be pumped periodically to remove any oil that collects in it.

## POL-Transfer Area

No remedial action is needed for this area.

## Fire-Fighting Training Pit

No remedial action is needed for this area.

# INTRODUCTION

## Background

The Confirmation Study was performed as part of the Navy Assessment and Control of Installation Pollutants (NACIP) program which is designed to identify contamination of Navy lands resulting from the past operations and to institute corrective measures as needed. The NACIP program consists of three phases. The first phase is the Initial Assessment Study which utilizes record searches and personal interviews to collect and evaluate all evidence supporting the existence of a contamination problem at an installation. The second phase, the Confirmation Study, involves on-site investigations to confirm or refute the existence of contamination, and to quantify the extent of the problem if contamination is present. The third and final phase is the implementation of corrective actions and remedial measures to control or mitigate the contamination.

Although the Initial Assessment Study (IAS, 1981) was not completed until midway through this Confirmation Study, the scope of work for this study was amended to include additional sites identified in the IAS. Thus, this investigation, which includes both the verification and characterization steps of the confirmation phase, essentially addresses all of the sites identified in the IAS.

## Location and Objective of the Investigation

In April 1981, Geraghty & Miller, Inc., was retained by the U. S. Department of the Navy, Southern Division, Naval Facilities Engineering Command, to provide hydrogeological consulting services at the Charleston Naval Shipyard (see Figure 1). Specifically, Geraghty & Miller, Inc., was requested to assess the potential for oil and hazardous-waste contamination of soil and ground water from abandoned oil-sludge pits, a chemical-disposal area, a caustic-settling pond, and a solid-waste landfill. To achieve the stated objective, a ground-water contamination investigation was designed, consisting of the installation of soil borings, ground-water monitor wells, and the physical and chemical analyses of soil and water samples. The soil borings provided information on the presence or absence of oil floating on the ground water, residues of chemical compounds retained in the soils, the subsurface geology, and the hydraulic conductivities of selected soils. The monitor wells provided information on the direction of ground-water seepage and the concentrations of dissolved chemical compounds.

On May 15, 1981, a preliminary planning conference was held during which personnel from Geraghty & Miller, Inc., presented a concept submission describing the elements of the proposed investigation. During this meeting, it was mutually agreed that the assessment of the fire-fighting training site

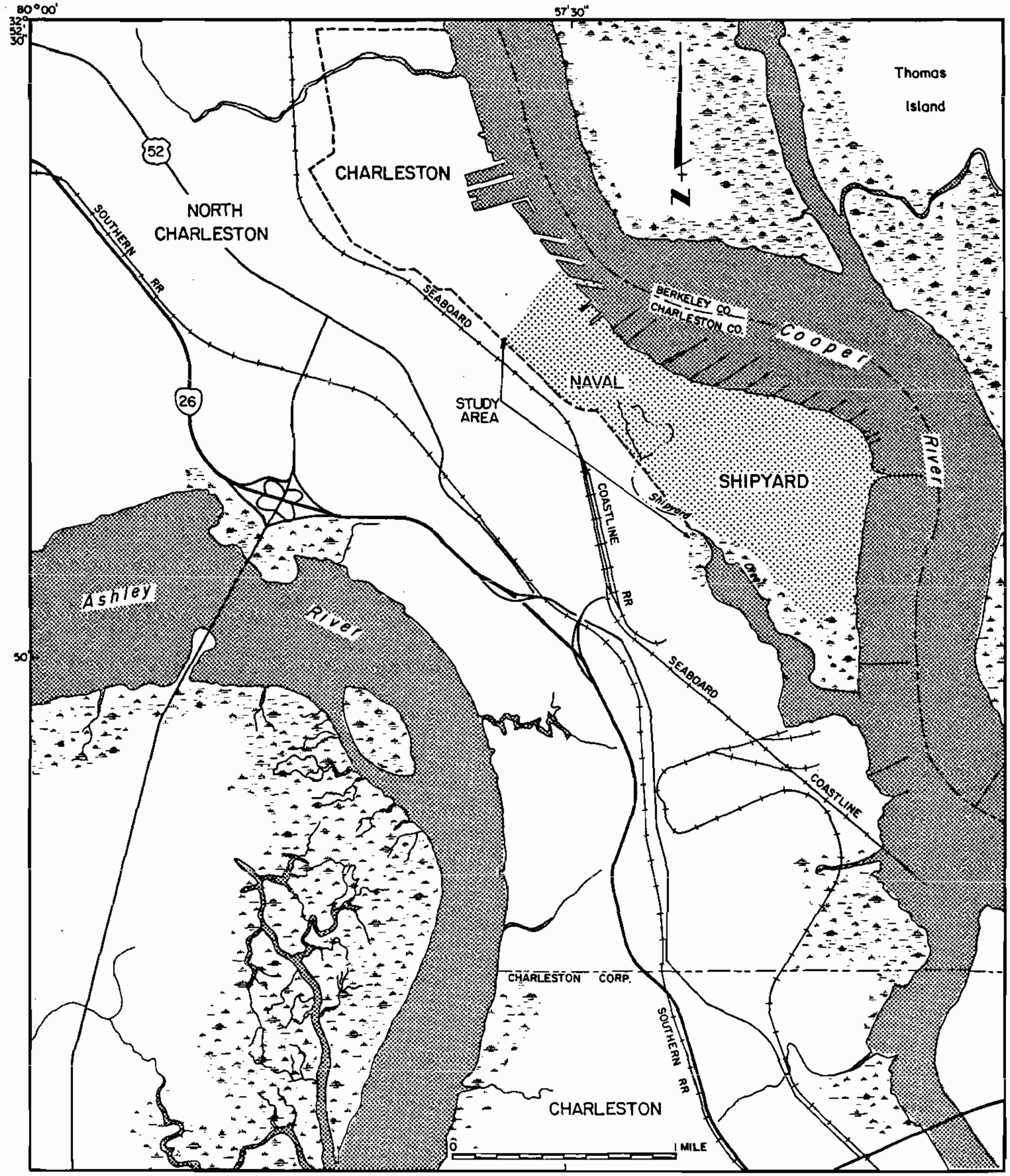


Figure 1. Map Showing the Location of the Study Area at the Charleston Naval Shipyard, Charleston, South Carolina.

in the southeast corner of the Charleston Naval Shipyard would be deleted from the original scope of work and be replaced by an assessment of oil and PCB (polychlorinated biphenyl) contamination in soil and ground water near the electrical transformer storage area.

Based on the findings of the IAS, the scope of work was amended in October 1981 and funded in January 1982 to include an investigation of (1) the old pesticide-mixing area, (2) the old fire-fighting training site, and (3) the POL-transfer area (petroleum, oil, and lubricant transfer area). The locations of the individual sites investigated are shown in Figure 2.

## Work Performed in the Field

The drilling and testing program conducted at the Charleston Naval Shipyard was performed in two phases. The first phase was conducted during June and July 1981, and the second phase was performed in January and February 1982.

### Boring and Monitor-Well Construction

Both phases consisted mainly of the installation of a series of monitor wells, which were drilled to a maximum depth of 62 ft (feet) at the locations shown in Figure 3. A number of shallow soil borings were also drilled in order to determine the presence or absence of oil in the surficial

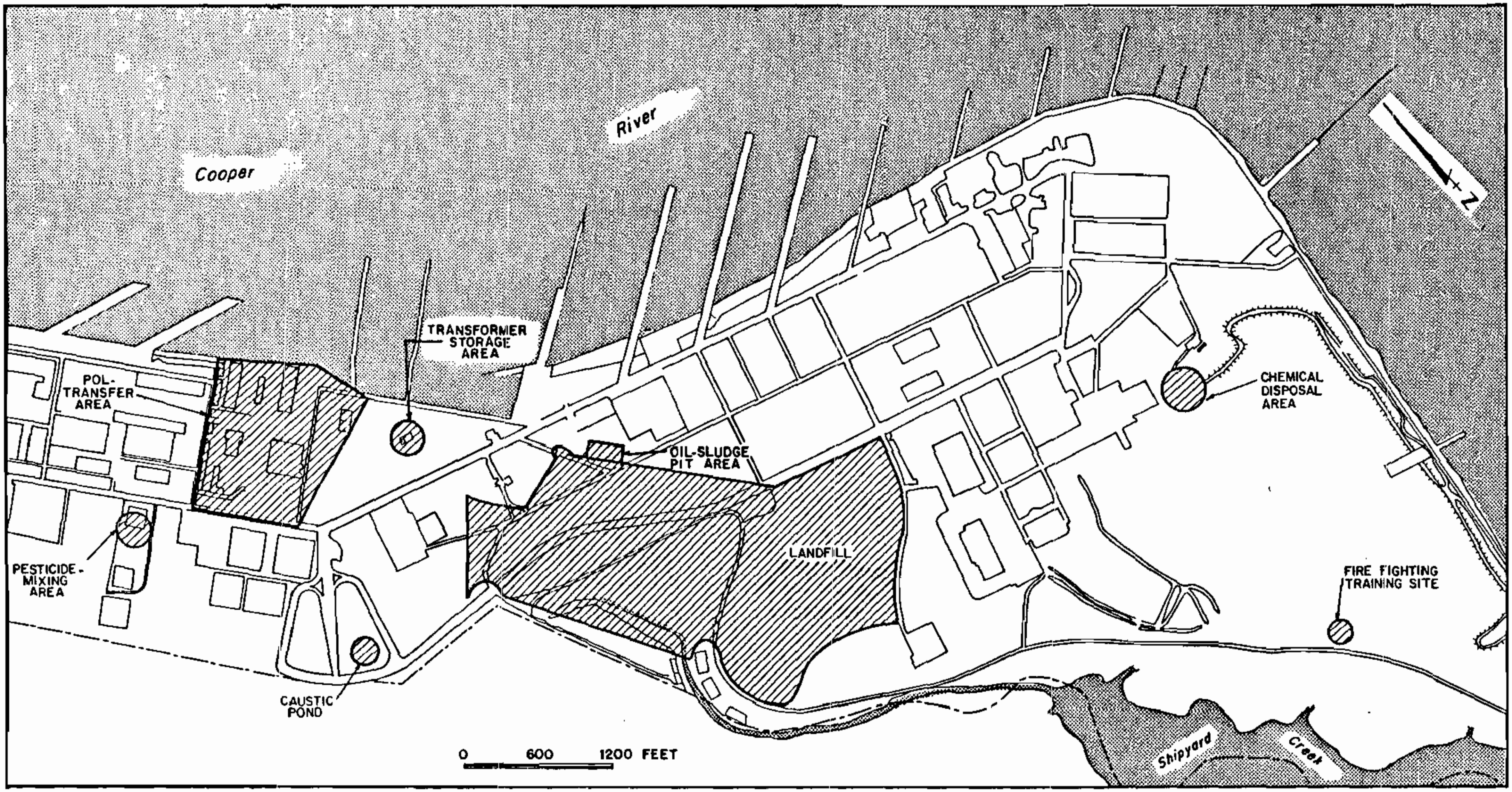


Figure 2. Location of the Sites Studied During the Investigation.

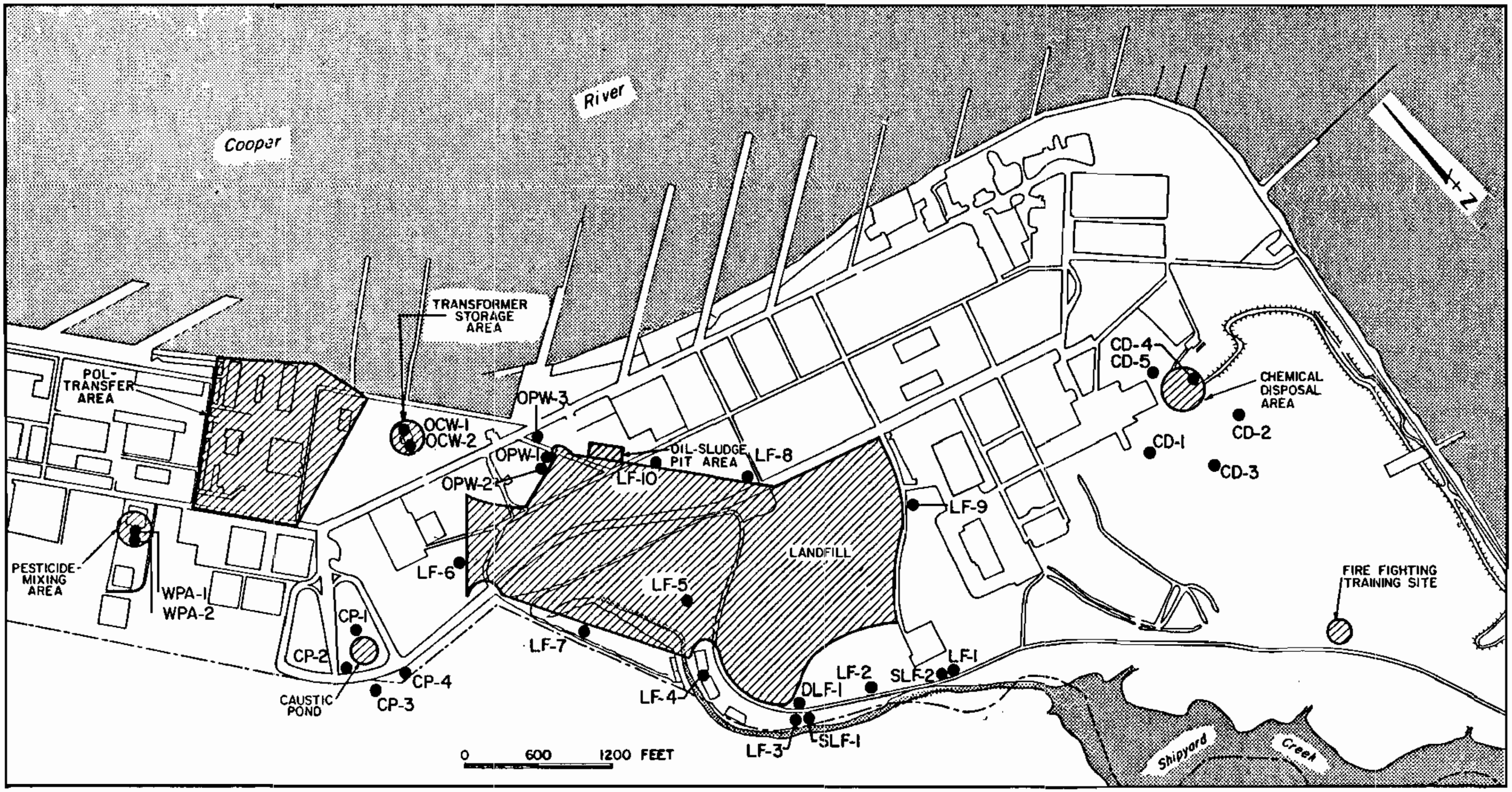


Figure 3. Location of the Monitor Wells Installed During the Investigation.

deposits at and near: (1) the old fire-fighting training site, (2) the POL-transfer area, and (3) the abandoned oil-sludge pits.

During the field program, a total of 132 shallow borings were drilled, 29 monitor wells were installed, and 26 soil samples were collected for chemical analysis. A hydrogeologist from Geraghty & Miller, Inc., supervised the field program, collected the ground-water samples and water-level data, and described the lithologic characteristics of the soil samples.

At each monitor-well location, a soil boring was drilled prior to the construction of the monitor well. Selected soil samples were collected at the landfill and were sent to Soil Consultants, Inc., for laboratory determination of the physical characteristics of the soils. Upon completion of each boring, the borehole diameter was enlarged to four inches (8 inches for well DLF-1), and the monitor well was constructed by inserting into the borehole a 1.5-inch-diameter PVC casing (4 inches for well DLF-1) and an attached 3-foot-long well screen. Each monitor well was then gravel packed by the tremie method from the bottom of the well screen up to a depth of at least two ft above the top of the screen. A fine sand cap was then placed on top of the gravel pack to prevent migration of the cement grout into the gravel pack. A neat cement grout was then placed in the annulus, by the tremie method, from the top of the fine sand cap to land surface. After the cement was allowed to set, each well was developed by the air-lift method for a minimum of one hour. Figure 4 is a general construction diagram of a 1.5-inch-diameter shallow monitor well. Figure 5 is a construction diagram of 4-inch-diameter monitor well, DLF-1. Specific depths, screen settings, and gravel-pack intervals for individual wells are given in Table 1.

## Water-Level Measurements

After the monitor wells were installed, water levels were measured in each well, and the elevations of the measuring points, at the tops of the well casings, were then determined by a surveyor certified in South Carolina. The water-level measurements were then referenced to a common datum, mean low water, so that the direction of ground-water flow and the hydraulic gradients could be determined.

## Water and Soil Analyses

### Phase I

The ground-water sampling portion of the field program was also divided into two different phases. Upon completion of the first phase, water samples were collected from all of the available monitor wells. Water samples collected from the monitor wells in the caustic-pond area were sent to General Engineering Laboratories in Charleston, South Carolina, to be analyzed for selected constituents. Samples

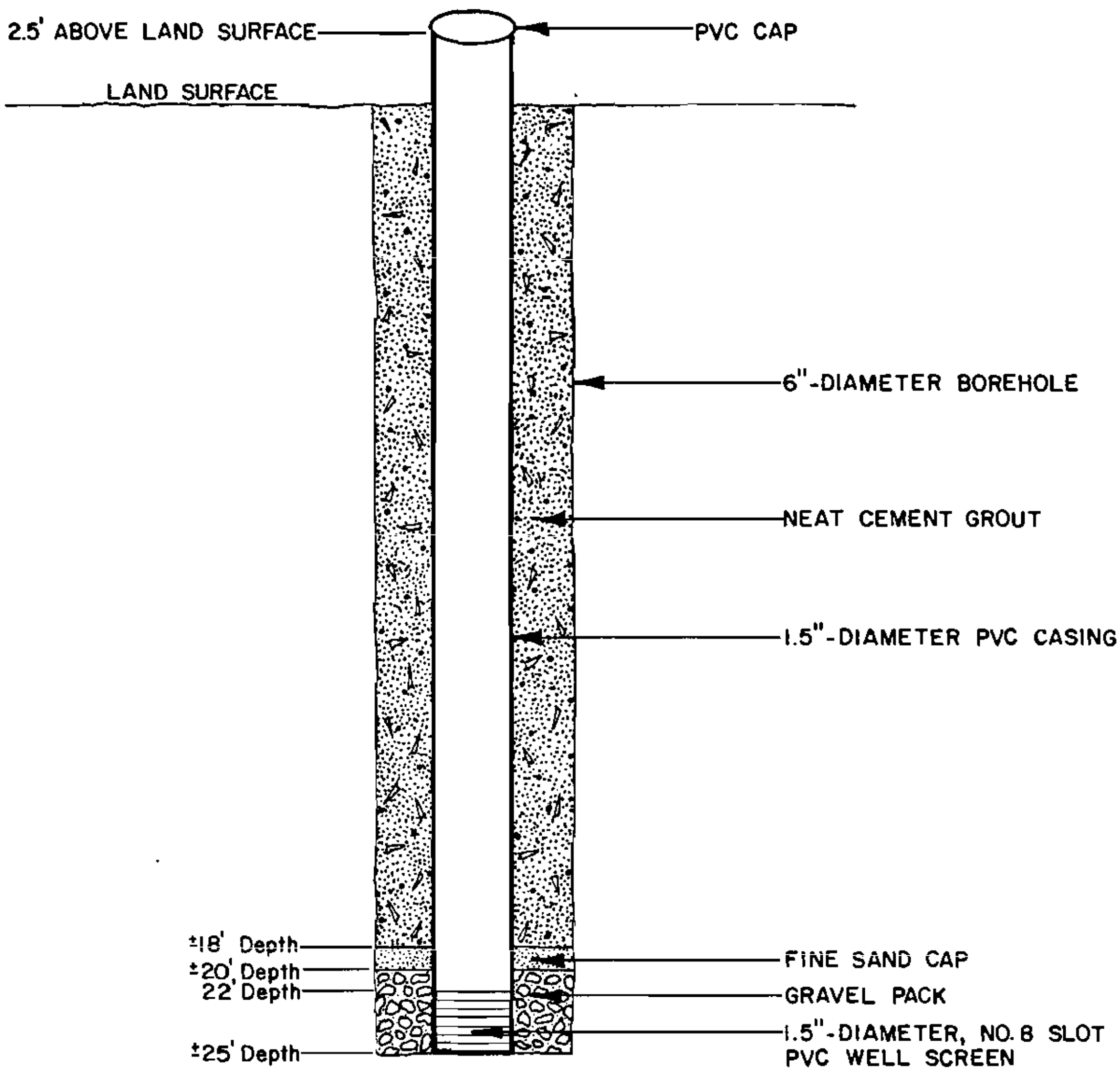


Figure 4. General Construction Diagram of a 1.5-Inch-Diameter Monitor Well.

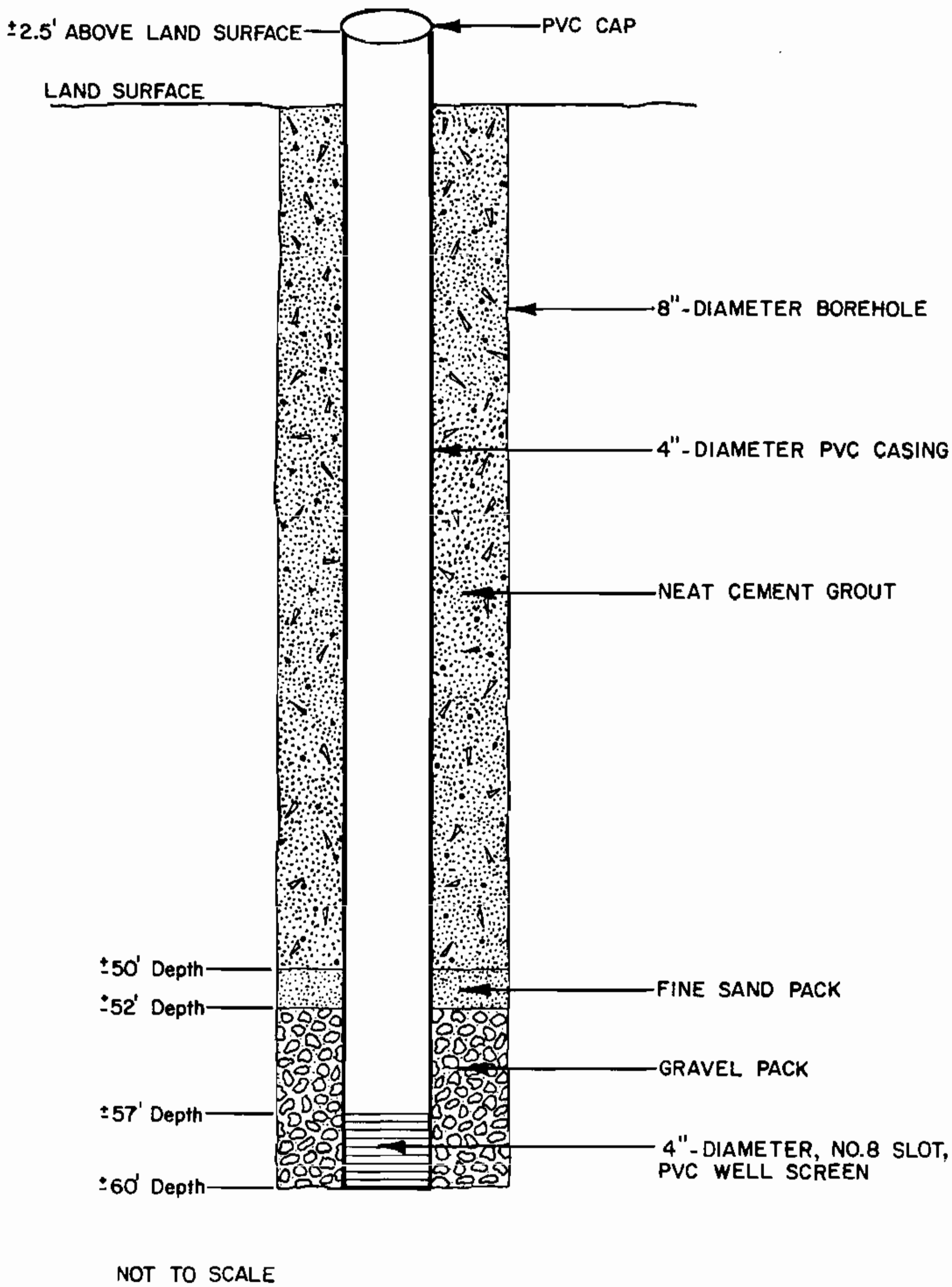


Figure 5. Construction Diagram of Monitor Well DLF-1.

TABLE 1. CONSTRUCTION DETAILS OF MONITOR WELLS

| Well No. and Location | Total Depth (ft/bls)[1] | Screen Setting (ft/bls) | Gravel-Pack Setting (ft/bls) |
|---|---|---|---|
| Caustic-Pond Area | | | |
| CP-1 | 25 | 22 - 25 | 18 - 25 |
| CP-2 | 25 | 17 - 20 | 14 - 25 |
| CP-3 | 25 | 22 - 25 | 18 - 25 |
| CP-4 | 25 | 22 - 25 | 18 - 25 |
| Oil-Sludge Pit Area | | | |
| OPW-1 | 10 | 7 - 10 | 4 - 10 |
| OPW-2 | 4 | 1 - 4 | 0 - 4 |
| OPW-3 | 10 | 7 - 10 | 4 - 10 |
| Pesticide-Mixing Area | | | |
| WPA-1 | 13 | 10 - 13 | 7 - 15 |
| WPA-2 | 13 | 10 - 13 | 7 - 14 |
| Landfill Area | | | |
| LF-1 | 25 | 22 - 25 | 18 - 25 |
| LF-2 | 20 | 17 - 20 | 14 - 20 |
| LF-3 | 25 | 22 - 25 | 18 - 25 |
| LF-4 | 25 | 22 - 25 | 18 - 25 |
| LF-5 | 31 | 27 - 30 | 22 - 31 |
| LF-6 | 15 | 5 - 12 | 7 - 15 |
| LF-7 | 11.5 | 7 - 10 | 4 - 11.5 |
| LF-8 | 15 | 12 - 15 | 7 - 15 |
| LF-9 | 14 | 11 - 14 | 6 - 14 |
| LF-10 | 12.5 | 9.5 - 12.5 | 4 - 12.5 |

Table 1 (Continued)

| Well No. and Location | Total Depth (ft/bls)[1] | Screen Setting (ft/bls) | Gravel-Pack Setting (ft/bls) |
|---|---|---|---|
| SLF-1 | 8 | 5 - 8 | 3 - 8 |
| SLF-2 | 8 | 5 - 8 | 3 - 8 |
| DLF-1 | 62 | 60 - 57 | 50 - 62 |
| Chemical-Disposal Area | | | |
| CD-1 | 16.5 | 12 - 15 | 10 - 16.5 |
| CD-2 | 15 | 12 - 15 | 8 - 15 |
| CD-3 | 15 | 12 - 15 | 8 - 15 |
| CD-4 | 16.5 | 12 - 15 | 8 - 16.5 |
| CD-5 | 10 | 7 - 10 | 4 - 10 |
| Electrical Transformer Storage Area | | | |
| WOC-1 | 10 | 7 - 10 | 3 - 10 |
| WOC-2 | 10.5 | 7.5 - 10.5 | 3 - 10.5 |

1) Feet below land surface.

collected from the remaining wells were shipped to ERCO (Energy Resources Company) in Cambridge, Massachusetts, for detailed chemical analyses.

During the first phase, six soil samples were also collected in the electrical transformer storage area referred to also as the "Old Corral." These samples were collected around Building 3902 and the slab on which the electrical transformers had been stored and along the eastern fence. All of these soil samples were sent to General Engineering Laboratories for PCB analysis.

Phase II

In February 1982, water samples were collected from the monitor wells installed during the second phase and from selected monitor wells installed during the first phase of the field program. All of the water samples were shipped to ERCO for analysis of selected chemical constituents.

Soil samples were collected from the pesticide-mixing area and the electrical transformer storage area and sent to ERCO for chemical analysis. In the pesticide-mixing area, eight samples were collected at four different locations at a depth of 6 inches and at a depth of 2 ft. At the electrical transformer storage area, twelve composite soil samples were collected along each side of Building 3902 and the concrete slab at a depth of six inches.

## TOPOGRAPHY AND DRAINAGE

The Charleston Naval Shipyard is located in the lower South Carolina Coastal Plain on the Cooper River side of the Charleston Peninsula, which is formed by the confluence of the Cooper and Ashley Rivers (see Figure 1). Natural drainage at the shipyard is to Shipyard Creek and the Cooper River. Surface water at the shipyard is conveyed by storm sewers into these watercourses.

The topography at the shipyard is flat with elevations ranging from a high of about 20 ft msl (mean sea level) at the northern end of the shipyard to sea level along the Cooper River and Shipyard Creek. The average land-surface elevation is approximately 5 ft msl. The topography of much of the study area, particularly at the southern end, has been altered by dredge and fill activities and by the disposal of solid wastes at the landfill.

## REGIONAL HYDROGEOLOGIC SETTING

The uppermost or surficial deposits in the Charleston area are composed of interbedded sand, shell, silt, and clay that are approximately 15 to 80 ft thick. The quality of ground water in the surficial deposits is generally good, except in the coastal areas where dredged fill has been placed. Where sufficient thickness of clean sand exists, ground-water yields up to 100 gpm (gallons per minute) may be pumped (South Carolina Water Resources Commission, 1974).

The surficial deposits are underlain by the Cooper Marl (Formation), which is composed primarily of calcareous clay, although locally buried stream channels may be present. In areas where the buried channels consist of clean sand or shells, short-term yields of 50 gpm or more may be obtained. However, these water-bearing zones are generally too isolated and too small to sustain significant withdrawals (South Carolina Water Resources Commission, 1974).

The Cooper Marl is underlain by the Santee Limestone (Formation) which is composed of poorly indurated, fossiliferous limestone. The top of the Santee Limestone is about 250 ft below msl at the shipyard and it crops out approximately 40 miles to the northwest at Lake Marion in Orangeburg County and in southeastern Calhoun County (South Carolina Water Resources Commission, 1972). In the vicinity of the shipyard, ground water in the Santee Limestone contains 1,000 to 1,500 mg/l (milligrams per liter) of total dissolved solids and, under natural conditions, ground-water levels in the aquifer are several tens of feet above msl. In July 1981, the water level in a well tapping the Santee Limestone at the shipyard was about 15 ft above msl (IAS, 1981). In the vicinity of Charleston, ground-water withdrawals from industrial wells tapping the Santee Limestone range from about 200 to 500 gpm (South Carolina Water Resources Commission, 1974.)

## SITE-SPECIFIC HYDROGEOLOGIC SETTING

### Geology

According to the results of examination of soil samples collected during the drilling program, the surficial deposits are composed of fine-grained sand, silt, and clay (see Appendix A for lithologic descriptions of the soil samples). Sand lenses are present in localized areas; however, these are generally only several feet thick. Much of the material, particularly in the southern portion, represents material dredged from Cooper River and Shipyard Creek. Figures 6, 7, 8, and 9 are geologic cross-sections through the caustic pond, the landfill, and the chemical-disposal areas that depict the nature and distribution of the sediments beneath these locations.

In monitor well DLF-1, which was drilled to a depth of 62 ft, the top of the Cooper Marl was found at a depth of 45 ft. The sediments between 45 and 62 ft consisted of a hard, calcareous, slightly sandy clay and, in order to estimate the permeability of this calcareous clay, consolidation tests were performed on two undisturbed samples. From the results of these tests, the permeabilities of these samples were calculated to be $1.3 \times 10^{-4}$ and $3.2 \times 10^{-5}$ cm/sec (centimeters per second).

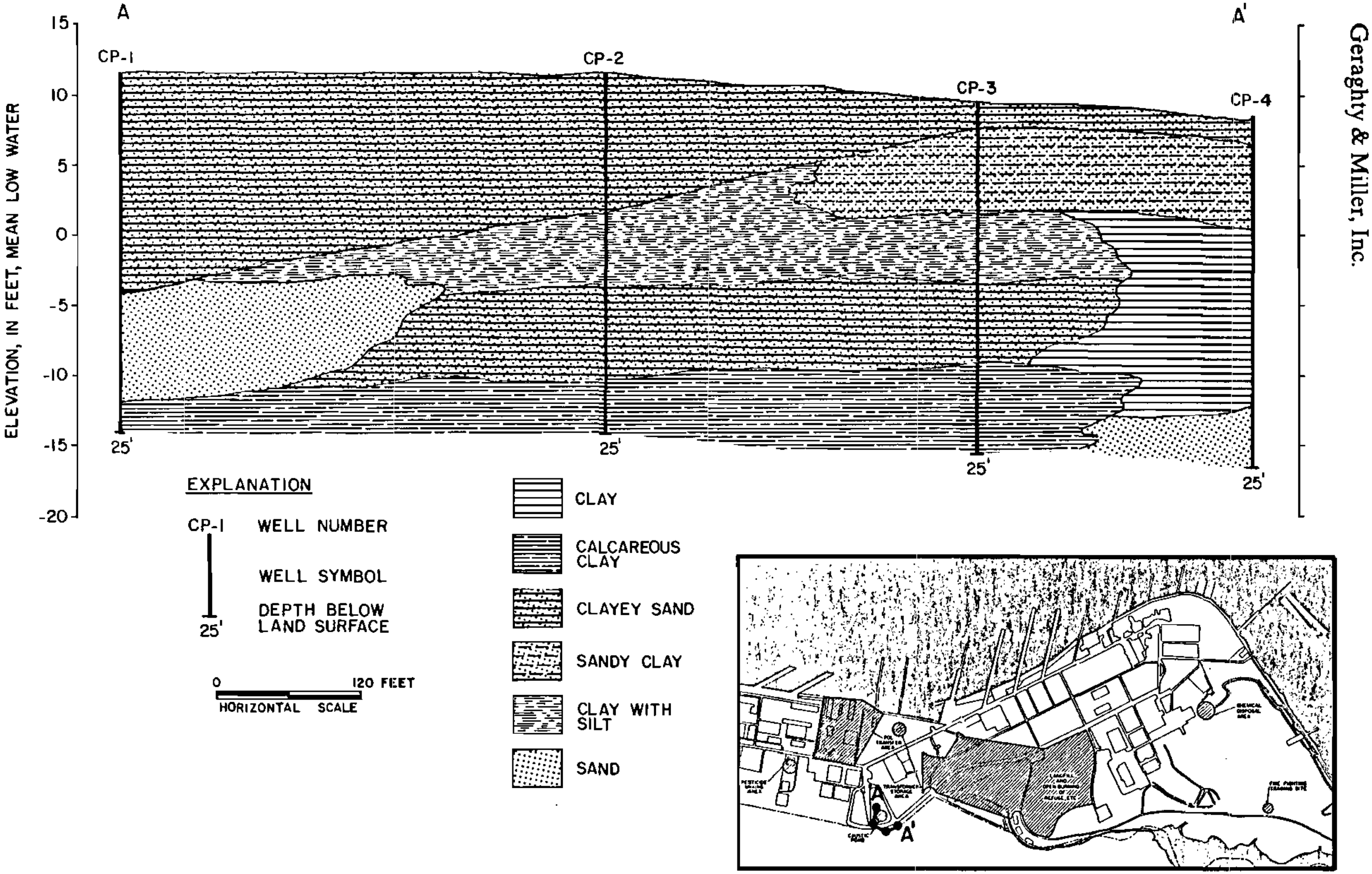


Figure 6. Geologic Cross-Section A-A' Through the Caustic-Pond Area.

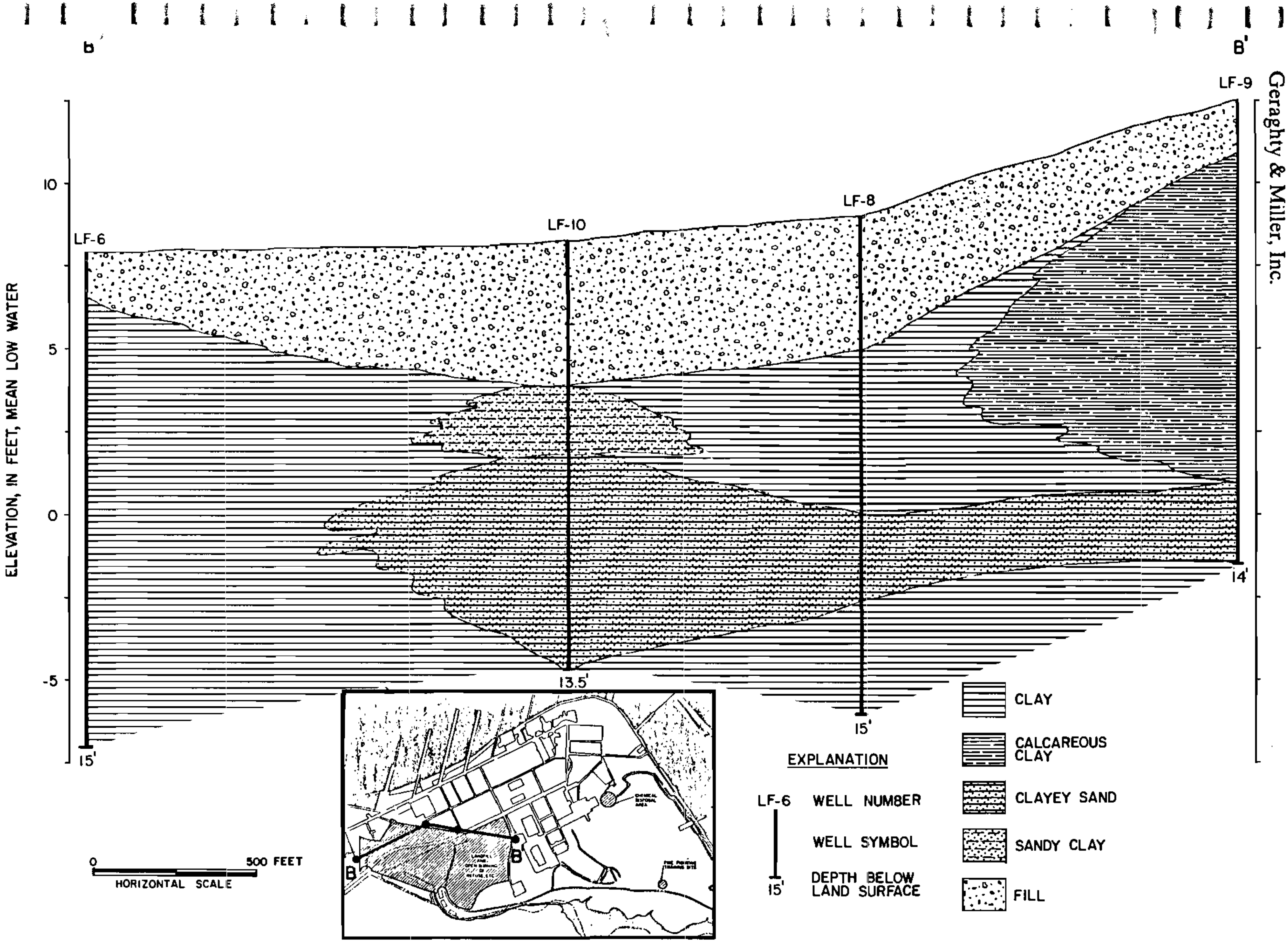


Figure 7. Geologic Cross-Section B-B' Through the Landfill Area.

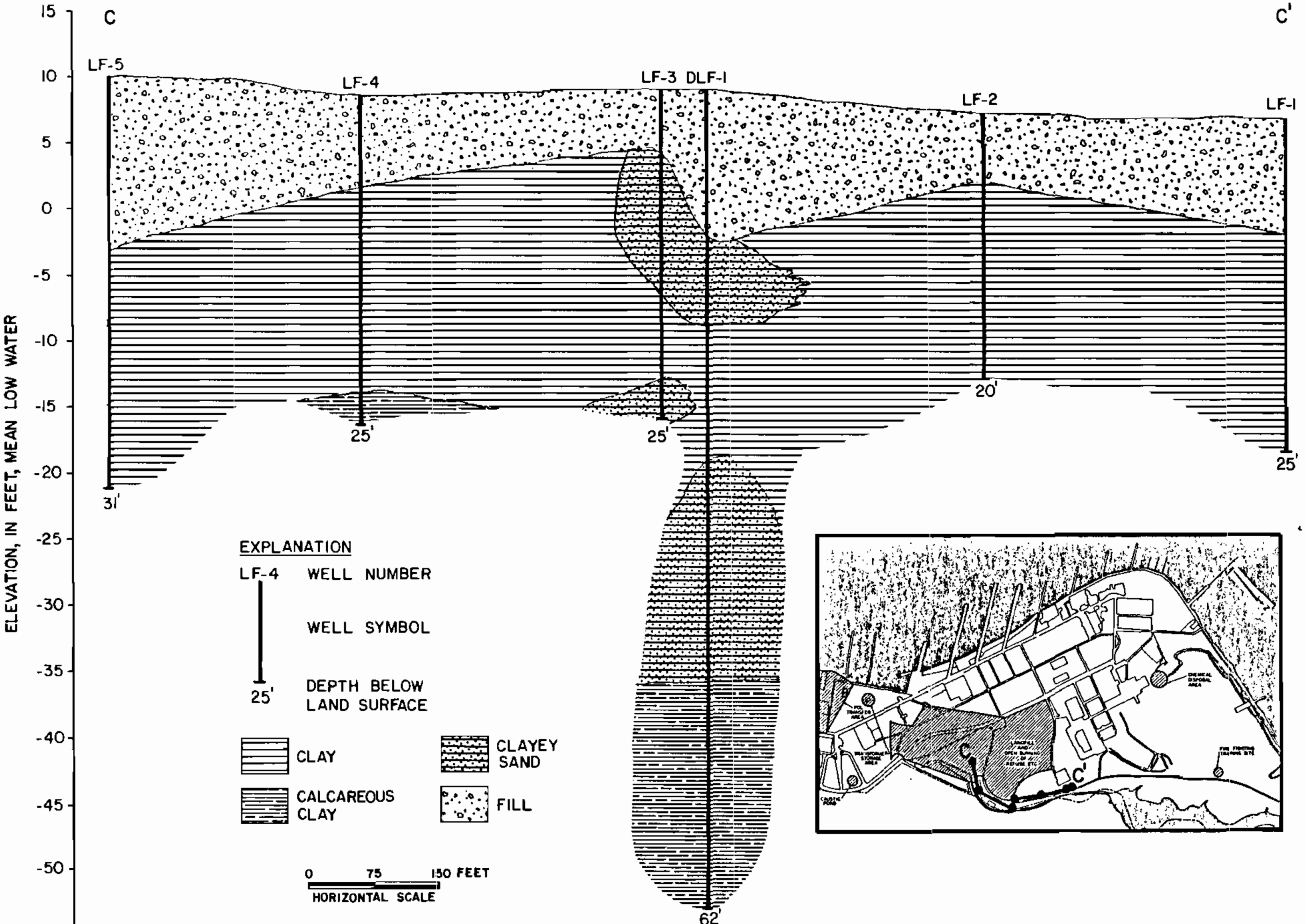


Figure 8. Geologic Cross-Section C-C' Through the Landfill Area.

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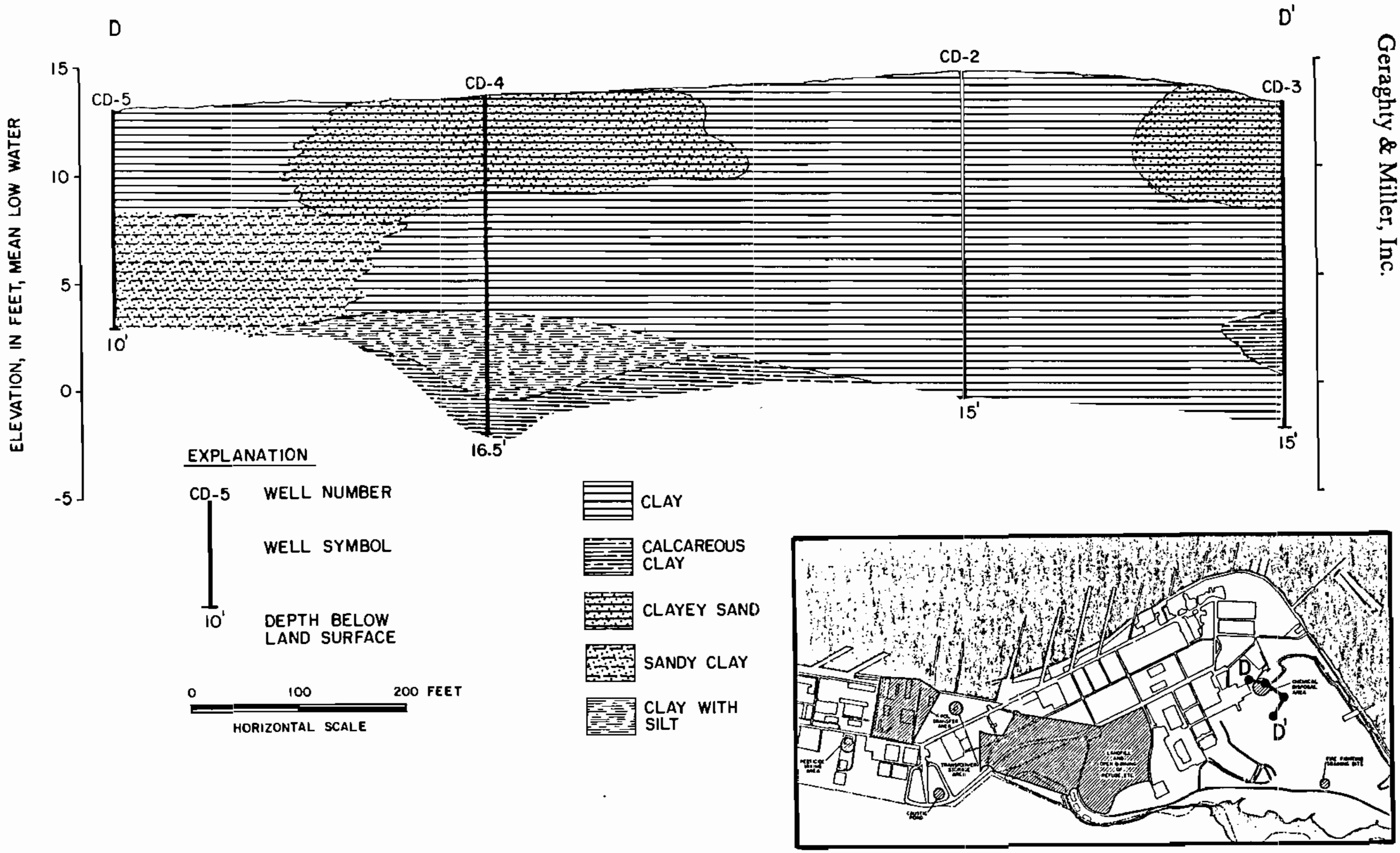


Figure 9. Geologic Cross-Section D-D' Through the Chemical-Disposal Area.

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Sieve analyses were performed on the fill material sampled at monitor well LF-1 and on a sample of the soft, gray clay found throughout the site. The permeabilities were calculated to be: $1 \times 10^{-2}$ to $1 \times 10^{-3}$ cm/sec for the fill and $1 \times 10^{-6}$ and $1 \times 10^{-7}$ cm/sec for the gray clay.

## Ground-Water Levels

### Horizontal Direction

Water levels were measured in the monitor wells and referenced to mean low water by a topographic survey. The ground-water levels that were measured on July 28, 1981, and February 10, 1982, are shown in Table 2. On February 10, the highest water level recorded, 11.75 ft mlw (mean low water), was in well CD-1 near the chemical-disposal area, and the lowest recorded, 5.33 ft mlw, was in well LF-3, next to Shipyard Creek downgradient of the landfill. The horizontal hydraulic gradient is very low at the site and, as expected, ground water is moving laterally from the central portions of the shipyard toward the Cooper River and Shipyard Creek. At the caustic pond, ground-water flow is toward the north; at the chemical-disposal area it is toward the east; at the pesticide-mixing area, it is north-northeast; at the oil-sludge pit, it is north-northeast; and at the landfill, a ground-water mound occurs so that flow is both toward the northeast and south.

TABLE 2. GROUND-WATER ELEVATIONS IN THE STUDY AREA, JULY 28, 1981, AND FEBRUARY 10, 1982[1)]

| Well No. and Location | Ground-Surface Elevation (ft) | Measuring-Point Elevation (ft) | Elevation of Water Table 7/28/81 (ft) | Elevation of Water Table 2/10/82 (ft) |
|---|---|---|---|---|
| Chemical-Disposal Area | | | | |
| CD-1 | 14.7 | 18.22 | 9.24 | 11.75 |
| CD-2 | 14.0 | 17.55 | 8.93 | 10.25 |
| CD-3 | 13.0 | 16.45 | 9.49 | 10.66 |
| CD-4 | 12.8 | 16.25 | 7.08 | 8.91 |
| CD-5 | 12.1 | 15.63 | 8.47 | 10.39 |
| Caustic-Pond Area | | | | |
| CP-1 | 11.61 | 14.06 | 5.81 | 6.41 |
| CP-2 | 11.63 | 14.95 | 6.81 | 7.65 |
| CP-3 | 9.84 | 12.74 | 7.39 | - |
| CP-4 | 8.74 | 11.39 | 7.64 | 7.90 |
| Electrical Transformer Storage Area | | | | |
| WOC-1 | 9.46 | 12.13 | - | 6.31 |
| WOC-2 | 9.31 | 12.32 | - | 6.80 |
| Landfill Area | | | | |
| LF-1 | 6.4 | 8.88 | 8.22 | 8.17 |
| LF-2 | 6.9 | 9.42 | 5.89 | 5.71 |
| LF-3 | 8.9 | 11.35 | 4.39 | 5.33 |
| LF-4 | 8.7 | 11.22 | 5.61 | 5.56 |
| LF-5 | 10.7 | 12.66 | 9.36 | 10.95 |
| LF-6 | 7.91 | 10.92 | - | 7.06 |

Table 2 (Continued)

| Well No. and Location | Ground-Surface Elevation (ft) | Measuring-Point Elevation (ft) | Elevation of Water Table 7/28/81 (ft) | 2/10/82 (ft) |
|---|---|---|---|---|
| LF-7 | 16.44 | 19.49 | - | 10.21 |
| LF-8 | 9.05 | 11.44 | - | 8.58 |
| LF-9 | 12.55 | 15.75 | - | 11.20 |
| LF-10 | 8.21 | 10.54 | - | 6.77 |
| SLF-1 | 8.69 | 11.19 | 6.01 | 5.51 |
| SLF-2 | 6.50 | 9.00 | 5.62 | 5.48 |
| DLF-1 | 9.17 | 11.67 | 6.98 | 5.69 |
| Pesticide-Mixing Area | | | | |
| WPA-1 | 15.22 | 17.81 | - | 9.85 |
| WPA-2 | 15.22 | 16.98 | - | 10.00 |

1) Referenced to mean low water (mlw).

map p. 18.

## Vertical Direction

Several wells were installed at different depths to determine the vertical head relationships. The data collected from wells SLF-1, LF-3, and DLF-1 indicates that overall an upward hydraulic gradient exists at the site between the top of the Cooper Marl and the base of the surficial deposits. This suggests that there is little or no potential for downward movement of ground water from the surficial deposits into the Santee Limestone. The hydraulic relationship could be reversed if pumping of ground water from the Santee Limestone resulted in a significant lowering of the potentiometric surface of the Santee Limestone at the shipyard.

## Ground-Water Quality

The quality of the ground water in the surficial deposits reflects several factors, including: (1) the low land-surface elevations and its proximity to brackish water; (2) the extensive amount of filling activities using material dredged from the Cooper River and Shipyard Creek; (3) the industrial activities associated with the shipyard's functions; (4) the use of bottom ash and oil as a cover for roads and parking lots; and (5) the disposal of oil and hazardous wastes. As a result, the ground water in the surficial deposits is somewhat mineralized with levels of dissolved solids that are generally well in excess of EPA's drinking-water standards and contains low levels of industrial chemicals.

## RESULTS OF THE WATER-QUALITY ANALYSES

### Caustic-Pond Area

For several decades prior to the early 1970's, acetylene gas was produced at the shipyard, and its byproduct, calcium hydroxide, was disposed of in a shallow pond (caustic pond) (Figure 2). Water with a high pH infiltrated into the surficial deposits and moved with the shallow ground water. Presently, the pond bottom contains up to a foot of sludge and a portion of it underlying Bainbridge Avenue has been filled.

Water samples were collected from each of the four monitor wells (Figure 3) to assess the impact of the disposal of calcium hydroxide on the shallow ground-water environment. The samples collected were analyzed in the field for pH and specific conductance and, in a water-quality laboratory, for calcium, chloride, and sulfate content. The results, which are shown in Appendix C, indicate that the pH is slightly acid to slightly basic, ranging from 6.3 to 7.3; the calcium and chloride contents and specific conductance are somewhat elevated, ranging, respectively, from 101 to 490 mg/l, from 423 to 823 mg/l, and from 1,970 to 7,400 umhos/cm (micromhos per centimeter). The relatively neutral pH values suggest that the normally high pH of the caustic water infiltrating from the pond has been lowered due to the naturally-occurring acidic soils at the site (IAS, 1981).

## Chemical-Disposal Area

The chemical-disposal area (Figure 2) is located at the southern end of the shipyard in the vicinity of the skeet and pistol ranges. The area was designated as the chemical-disposal area because in the past small quantities of warfare decontaminating agents DANC-DS-2 and DANC-M4 have been buried in the area. During the construction of bunkers at the skeet range in 1972 and 1974, construction workers suffered chemical burns when drums of these chemicals were unearthed; it is believed that these chemicals were also buried in the berm behind the pistol range.

DANC-DS-2 is a strongly alkaline, water-soluble material that contains diethylene triamine and ethyl cellosolve. Although in pure form ethyl cellosolve forms peroxide, it will not form a peroxide in water, but may hydrolize or decompose to other products. DS-2 components are so water soluble that they are difficult to analyze for in water samples. DANC-M4 contains 1,1,2,2-tetrachloroethane (acetylene tetrachloride), which is a volatile, relatively water soluble, chlorinated hydrocarbon. DANC-M4 also contains a substance that is strongly irritating and releases free chlorine (nascent chlorine) when contacted with water. Chloride ion, 1,1,2,2-tetrachlorethane, and elevated pH are the only indicators of these decontaminating agents anticipated to be residual in ground water.

Water samples collected from the five monitor wells (Figure 3) installed in the chemical-disposal area were analyzed for pH, cadmium, iron, lead, magnesium, mercury, sodium, fluoride, nitrate, sulfate, total organic carbon, specific conductance, chloride, base-neutral compounds and volatile organic compounds. The results of these analyses are presented in Appendix D.

The data show that shallow ground water in the chemical-disposal area has conductivities ranging from 1,900 to 27,000 umhos/cm, a pH of from 6.68 to 8.63, and is mineralized. The levels of cadmium, lead, and mercury were below their detection limits, the iron content was less than 1.2 mg/l, and the fluoride content was less than 1 mg/l. No quantifiable amounts of base-neutral compounds were found except for 15 and 34 ug/l (micrograms per liter) of bis(2-ethylhexyl) phthalate in wells CD-4 and CD-2, respectively. This compound is common around industrial areas and is present in sediments of all rivers receiving municipal or industrial effluent. Either Navy industrial activity or the presence of dredged material could account for its presence.

The water samples analyzed for volatile organic compounds indicated that chlorobenzene was present at levels of 0.14 and 10.68 mg/l in wells CD-3 and CD-5, respectively. During the second sampling, well CD-3 contained 1.5 ug/l of chloroform and methylene chloride was found in all five wells at levels up to 2.0 mg/l. Methylene chloride is frequently used as a degreasing agent, and the data suggest that waste materials containing methylene chloride may have also been deposited in the chemical-disposal area.

The water samples were also analyzed for 1,1,2,2-tetrachloroethane during the scan for volatile organic compounds. The results show that 1,1,2,2-tetrachloroethane was not present in any of the five monitor wells.

## Landfill Area

From the 1930's until 1973, solid wastes generated at the shipyard were disposed of at the shipyard landfill, which has increased to the size shown in Figure 2. These wastes included sanitary wastes, asbestos, acids, PCBs, oils, solvents, paints, paint sludges, mercury, metal sludges, acid-neutralization sludges, and various inorganic and organic chemicals. The liquid wastes were placed in drums before disposal, and combustible wastes were burned daily. The residue from the burning was pushed into the marsh as fill along with concrete rubble, metal scrap, and other non-combustible material. The waste materials were then covered whenever cover materials were available from building excavations, soil dredged from the river bottom, and bottom ash from the power plant (IAS, 1981).

The water-quality samples collected from the monitor wells in the landfill area (Figure 3) were analyzed for arsenic, barium, chromium, selenium, silver, cadmium, iron, lead, magnesium, mercury, sodium, fluoride, nitrate, sulfate, total organic carbon, specific conductance, chloride, 14 volatile organic compounds, 11 acid-extractable compounds, 47 base-neutral compounds, pH, and PCBs. The laboratory results of these analyses are presented in Appendix E.

The data show that ground water in the surficial deposits is slightly basic, is mineralized, and has a specific conductance ranging from 6,400 to 40,000 umhos/cm in wells LF-2 and LF-3, respectively. Water collected from well DLF-1, which taps the Cooper Marl, had a specific conductance of only 580 umhos/cm, indicating that good quality ground water from the upper portions of the Santee Limestone is moving upward into the surficial deposits.

The concentrations of chromium, cadmium, selenium, silver, lead, arsenic, mercury, and nitrate were low, generally less than the detection limit. The barium content, which probably originated from pigment materials contained in paints and coatings, was relatively high (0.38 to 4.6 mg/l) and exceeded EPA's (U. S. Environmental Protection Agency) drinking-water standards for wells LF-7 and LF-10. The maximum fluoride content was 0.56 mg/l and the maximum iron content was 4.1 mg/l, which is in excess of EPA's secondary drinking-water standards.

Of the ten wells sampled for acid-extractables and base-neutral compounds, only one well showed the presence of acid-extractables. The well, LF-6, contained 15 ug/l of pentachlorphenol. This compound is a common wood-preserving material that probably resulted from the disposal of waste pilings or wood-preserving materials in the landfill. Traces of other chlorinated phenols were present, but none were in quantifiable amounts.

As in the case of the chemical-disposal area, bis-2-ethylhexyl phthalate was the only quantifiable base-neutral compound detected. This compound was detected in quantifiable amounts in four of the wells and ranged from 18 ug/l in well LF-3 to 90 ug/l in well LF-7.

Water samples from all 13 wells were analyzed for selected volatile organic compounds. Low levels of chloroform, dibromochloromethane, chlorobenzene, and vinyl chloride were found in some of these wells, all at concentrations of less than 25 ug/l. Methylene chloride was detected in nine of the 13 wells, with the greatest concentrations, 1,600, 650, 570, and 220 ug/l, found in wells LF-9, LF-8, SLF-2, and LF-3, respectively. Water from well DLF-1, which taps the upper Cooper Marl, was analyzed for the volatile organic compounds and none were detected.

Water sampled from ten wells were analyzed for the presence of seven PCB compounds. Only one well, LF-6, contained a quantifiable concentration that was reported to be only 0.1 ug/l of PCB (Aroclor 1254).

## Pesticide-Mixing Area

The pesticide-mixing area (Figure 10) is located in the central portion of the shipyard due west of and adjacent to storage tank 39-D and north of Building 42. The area is approximately 50 x 25 ft in size and is devoid of vegetation. Prior to 1971, pesticides were mixed in the small shed south of the denuded area, and equipment used for spraying and mixing was washed in this area and the waste water was allowed to drain into the soils.

Water samples were collected from monitor wells WPA-1 and WPA-2 (Figure 10) to determine whether past practices of pesticide mixing and equipment washing had affected the shallow ground water. The samples were sent to ERCO Laboratories for analysis of pesticides, herbicides, PCBs, and arsenic, and the laboratory results, which are presented in Appendix F, show that the concentrations of all of the above parameters were below their detection limits and that the pH of the ground water is about 6.

## Electrical Transformer Storage Area

Building 3902, the adjacent concrete slab, and the surrounding area (Figure 11) were used for the storage of

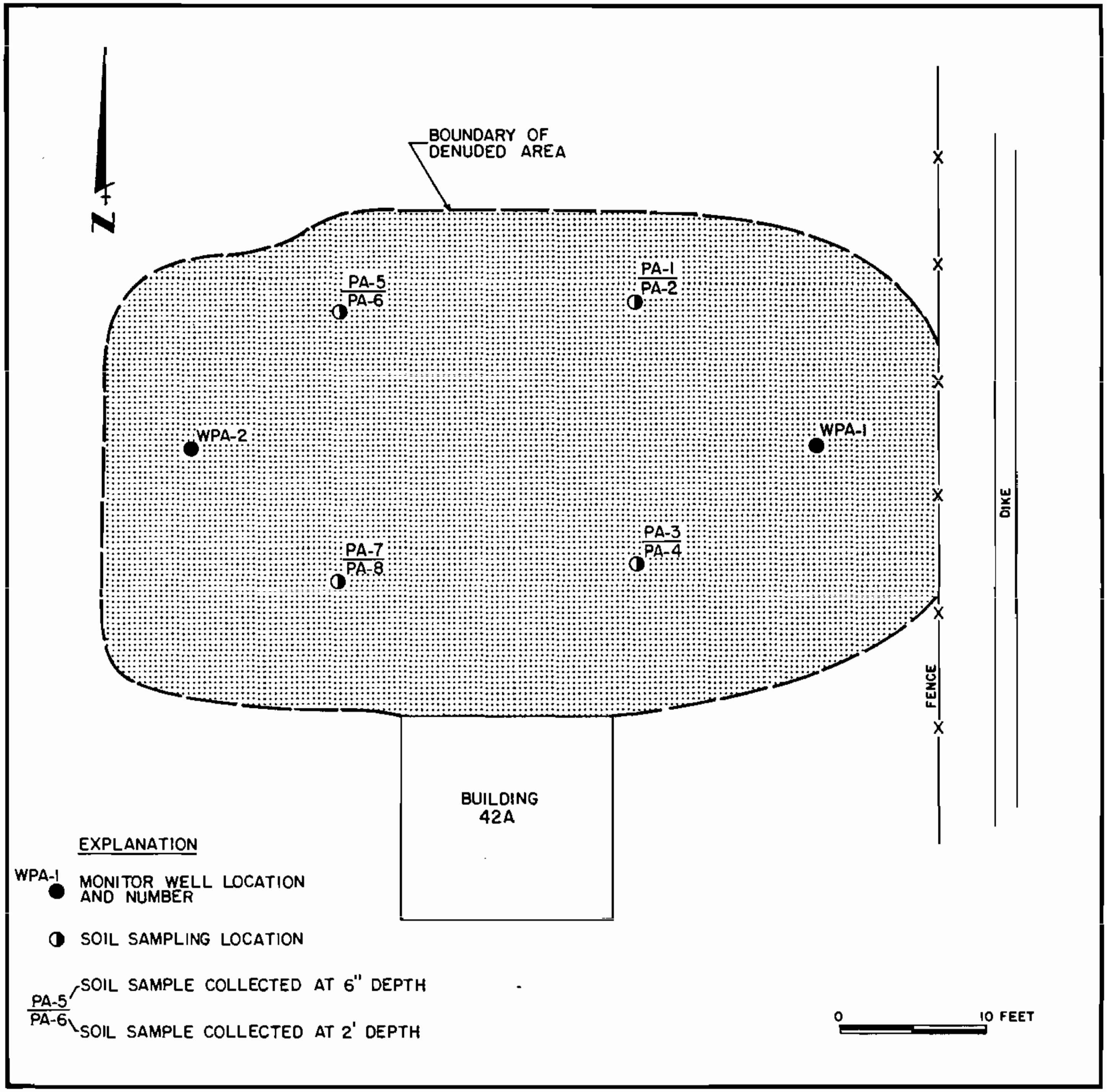


Figure 10. Location of Monitor Wells Installed and Soil Samples Collected in the Pesticide-Mixing Area.

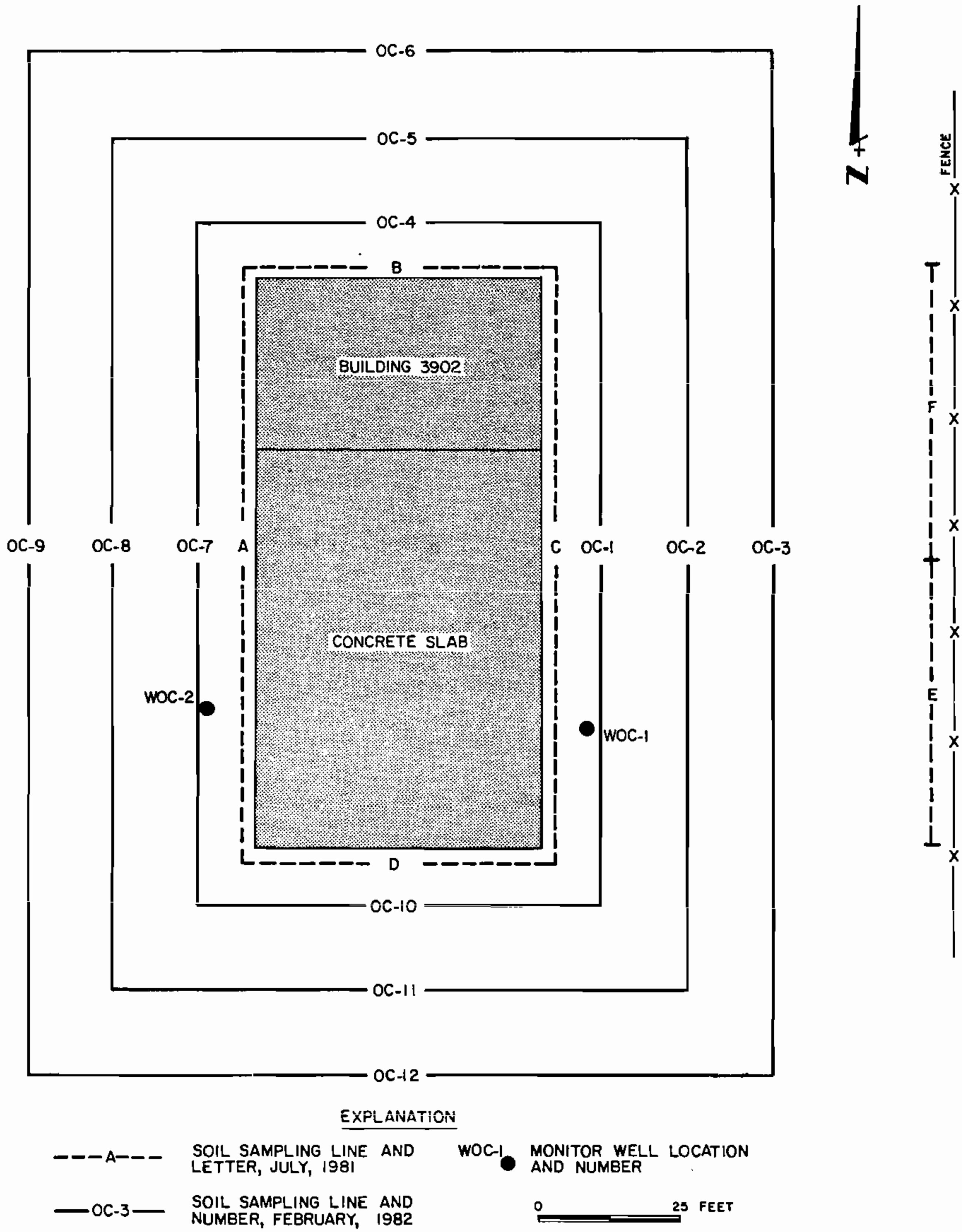


Figure 11. Location of Monitor Wells Installed and Composite Soil Samples Collected in the Electrical Transformer Storage Area.

electrical equipment, including transformers. Prior to 1976, the fluid contained in the electrical transformers, which was believed to include PCBs, had accidentally been spilled on occasion and was sometimes drained before the transformers were removed from the area.

Water samples were collected from wells WOC-1 and WOC-2 (Figure 11) on February 12, 1982, and were analyzed for arsenic, pesticides, and PCBs (see Appendix G). Water from well WOC-1 contained 19 ug/l of arsenic, 0.2 ug/l of DDT, and 0.2 ug/l of PCB (Aroclor 1260). Water from well WOC-2 contained 13 ug/l of arsenic, 0.1 ug/l of DDT, 1 ug/l each of alpha, beta, and gamma BHC and 0.6 ug/l of PCB (Aroclor 1260). BHC is benzene hexachloride which occurs in different isomeric configurations; that is, BHC has the same basic formula but the arrangement of the hydrogen and chlorine on the carbon ring is different.

## Oil-Sludge Pit Area

Prior to 1971, oil from the industrial activities at the shipyard were disposed of in three pits near Building X10 (Figure 12). By 1956, two of the pits had been covered, and in 1974 the oil was removed from the remaining pit which was also covered with compacted fill material.

Water samples were collected from two wells (Figure 3) installed in the area, wells OPW-1 and OPW-3 (well OPW-2 contained oil) and analyzed for sulfate content, 14 volatile

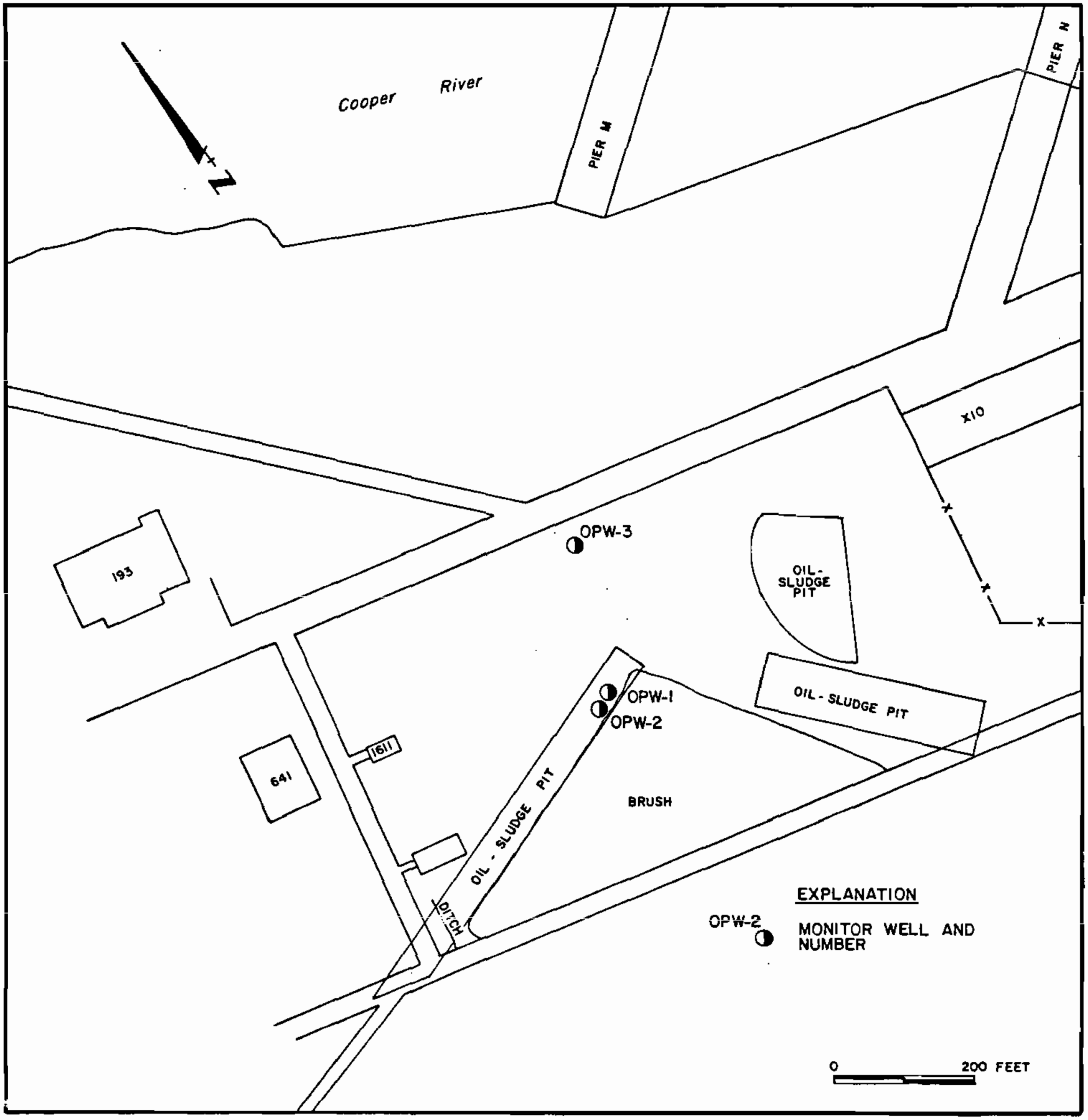


Figure 12. Locations of Monitor Wells Installed at the Oil-Sludge Pits.

organic compounds, and PCBs (see Appendix H). Wells OPW-1 and OPW-3 contained <1 and 780 mg/l of sulfate and 0.84 and 0.17 mg/l of methylene chloride, respectively. PCBs were not detected in the water sampled from OPW-3; however, well OPW-1 contained 0.04 ug/l of PCB (Aroclor 1260).

# RESULTS OF THE SOIL-SAMPLING PROGRAM

## Pesticide-Mixing Area

A soil-sampling program was conducted at the pesticide-mixing area on February 12, 1982. A total of eight samples were collected at the four locations shown in Figure 10 and analyzed for arsenic, herbicides, pesticides, and PCBs. In order to define the vertical distribution of these constituents, two samples were collected at each sampling location, one at a depth of six inches and the other at a depth of two feet. The results of the analyses are presented in Appendix F. Odd numbered samples were collected at a depth of six inches, and even numbered samples were collected at a depth of 2 ft.

Concentrations of arsenic in the soil ranged from 1.1 ug/gm (micrograms per gram) in PA-4 to a high of 6.3 ug/gm in PA-1, and analyses for herbicides 2,4-D and 2,4,5-TP indicated that the levels of these constituents in the soil were less than the detection limit.

The eight soil samples were each analyzed for 18 pesticides, and up to six pesticides were detected. Three of the six pesticides are interrelated in that DDD and DDE are metabolites of DDT and are formed during the biodegradation of DDT. The fact that these were found in all eight samples is significant since DDT has not been in general use for about 15 years; therefore, they represent a compound that has been present in the soil for a long period of time. All three have a strong affinity for soils, have low solubilities in water and, therefore, tend to be rather immobile, which explains why none were detected in water samples from monitor wells WPA-1 and WPA-2.

In the upper six inches, the soil contained 0.1, 0.88, 0.006, and 0.2 ug/gm of DDT in samples PA-1, PA-3, PA-5, and PA-7, respectively. Samples collected at a depth of 2 ft contained 0.04, 0.007, 0.02, and 0.004 ug/gm of DDT for samples PA-2, PA-4, PA-6, and PA-8, respectively. In general, at each sampling location, the upper samples contained much more DDT than did the lower samples. A similar relationship was found for DDE and DDD. Three other pesticides were found in samples PA-3 and PA-7, including heptachlor, beta BHC, and delta BHC.

The eight soil samples were also analyzed for seven PCB compounds, and six of the samples were found to contain only one of these compounds, Aroclor 1260. Soil samples PA-3, PA-1, and PA-7 contained 0.1, 0.039, and 0.036 ug/gm of Aroclor 1260, respectively. Soil samples PA-4, PA-5, and PA-6 contained 0.002 to 0.007 ug/gm of Aroclor 1260.

In May 1982, personnel from the Navy collected two samples of the uppermost soil within the pesticide-mixing area. The results, which are also presented in Appendix F, indicate that the greatest concentration of DDT in the soil is at land surface, at 1.48 and 5.3 ug/gm. These data, along with the previous data collected at the pesticide-mixing area, show that the concentration of DDT in the soil is highest at land surface and decreases rapidly at depth.

Electrical Transformer Storage Area

A soil-sampling program was conducted at the electrical transformer storage area to determine the effects of past storage practices in the area. The sampling program was carried out in two phases. The first phase was conducted in July 1981 and consisted of collecting composite samples along lines running parallel to the sides of Building 3902 and the attached cement slab (Figure 11). Four composite samples, A through D, were collected at a depth of six inches, one from each side of the building. Each composite soil sample was collected at 3-ft intervals on a sampling line at a distance of 2 ft from each side of the building and slab. Two composite samples, E and F, were also collected along the fence east of the building and slab. Each of these samples were collected every 3 ft at a depth of six inches for a distance of 50 ft along the fence. During Phase I, a total of six composite soil samples, A through F, were collected in the electrical transformer storage area. These were analyzed by General Engineering Laboratories for determination of PCB content and the results are presented in Appendix G.

The second sampling phase was conducted in February 1982 to better define the horizontal distribution of PCB in the soil. Composite soil samples, OC-1 through OC-12, were collected on sampling lines paralleling each side of the building and attached slab at distances of 10 ft, 25 ft, and 40 ft away from the building and slab (Figure 11). As in Phase I, these samples were collected every 3 ft at a depth of six inches. A total of 12 composite soil samples, OC-1 through OC-12, were collected in the electrical transformer storage area during Phase II. These samples were analyzed for pesticide content, PCB, and arsenic by ERCO, and the results are presented in Appendix G.

The arsenic concentrations in the composite soil samples ranged from 1.3 ug/gm in sample OC-12 to 15.5 ug/gm in sample OC-3. The concentrations of PCB in samples immediately adjacent to the building and slab, and the fence line (Phase I sampling lines A through F) were less than the detection limit of 10 ug/gm. Ten of the other 12 composite samples were found to contain one of the seven PCB compounds, Aroclor 1260. Samples OC-2, OC-3, and OC-11 contained the greatest concentrations of Aroclor 1260, 62.0, 37.0, and 11.0 ug/gm, respectively. Samples OC-6, OC-7, and OC-8 contained 3.2, 3.0, and 1.1 ug/gm. No Aroclor was detected in sample OC-1 or OC-12, and the other samples, OC-4, OC-5, OC-9, and OC-10, contained 0.675 ug/gm or less. In general, the greatest concentrations of Aroclor 1260, as depicted in Figure 13, were found east of Building 3902 at distances of 25 and 40 ft away.

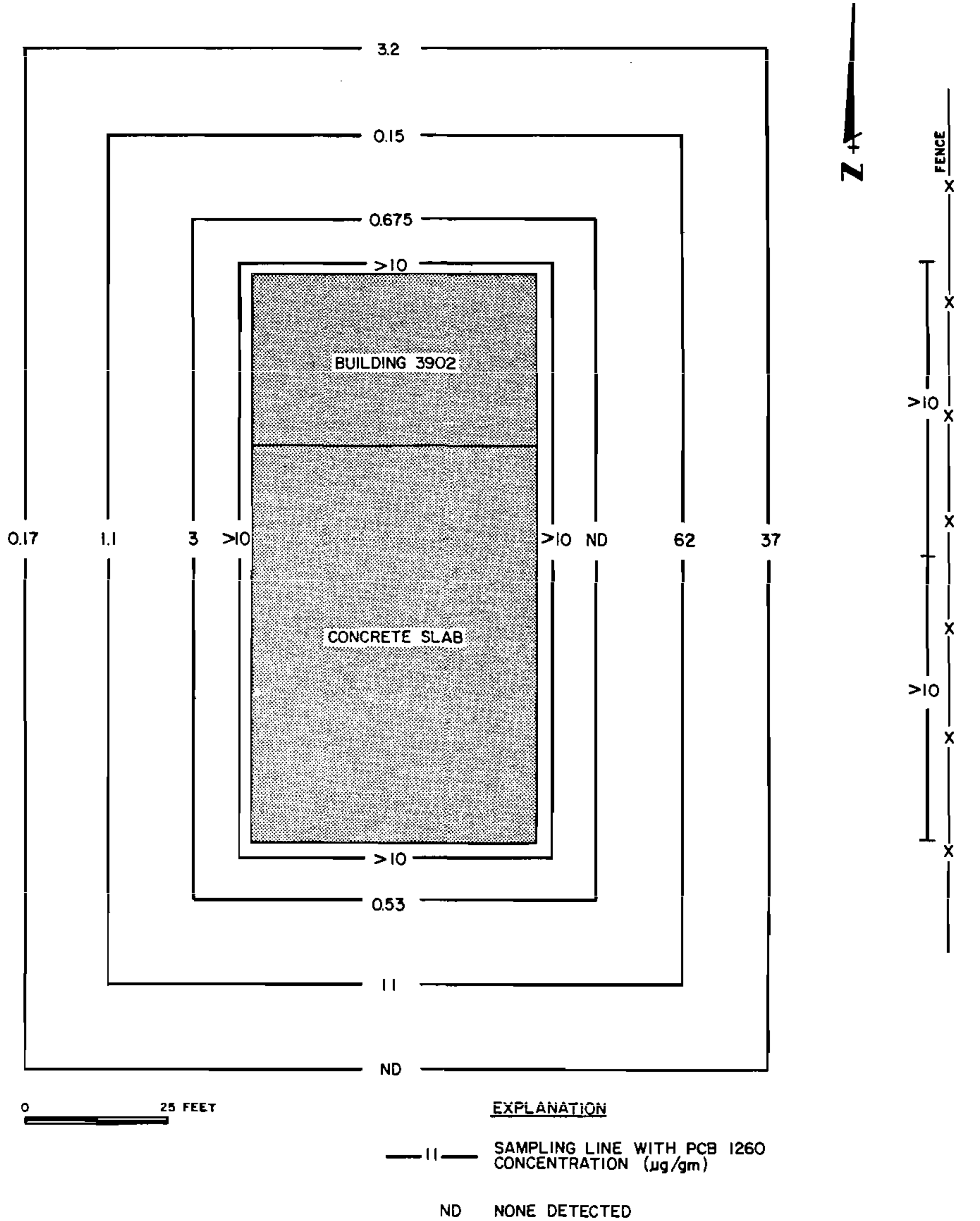


Figure 13. Concentration of PCB in Composite Soil Samples Collected in the Electrical Transformer Storage Area.

Somewhat surprising were the levels of DDT and its daughter compounds found in the soil at the site. Samples OC-1, OC-2, OC-3, OC-6, OC-7, OC-8, OC-10, OC-11, and OC-12 all had DDT concentrations in excess of 1 ug/gm with the highest concentrations, 28 and 40 ug/gm in samples OC-1 and OC-11, respectively. Concentrations of this magnitude again represent residues that presumably have remained in the soil for a period of years. In Figure 14, the distribution of the concentrations of DDT, DDD, and DDE combined is shown.

The soil samples also contained benzene hexachloride compounds, although the concentrations of these were generally much less than that found for DDT. Presumably, the electrical transformer storage area must have been used at some time for storage of pesticides as well as for transformers containing PCBs.

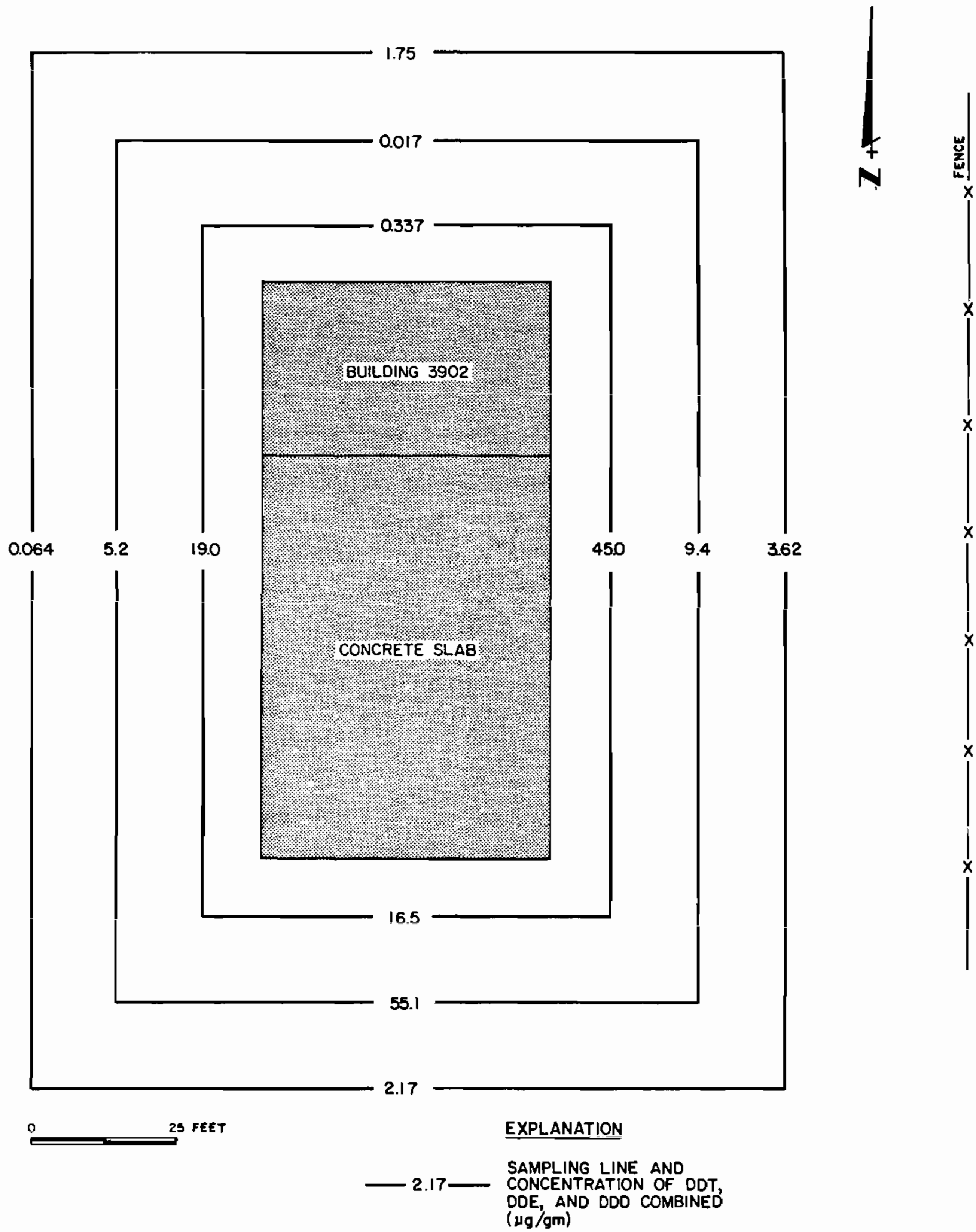


Figure 14. Combined Concentrations of DDT, DDE, and DDD in Soil Samples Collected in the Electrical Transformer Storage Area.

## RESULTS OF THE OIL TEST-BORING PROGRAM

### Oil-Sludge Pit Area

During Phase I, shallow borings were installed in the reported vicinity of the abandoned oil-sludge pits. The field investigation was expanded during Phase II after oil was discovered in a section of a newly-dug ditch located as shown in Figure 12.

Within the area of the abandoned oil-sludge pits, a total of 87 shallow borings were drilled to determine the areal extent of oil in the ground. Six borings were also drilled along the Cooper River to determine if oil seeping from these pits had moved toward the river. Because oil floats on top of the water table, the borings were drilled to the top of the water table at an average depth of about 4 ft.

The results of the boring program are illustrated in Figure 15, which depicts whether or not oil was present in each boring. Furthermore, the figure shows those borings in which only a trace of oil was found in the form of a slight oily residue or oily odor. A long, narrow body of oil exists in the southwestern portion of the oil-sludge area. The oil body, as illustrated in Figure 15, is approximately 50 ft wide by 600 ft long and trends in a northeast-southwest direction. Measurements taken in borings and in well OPW-2 indicate that the oil ranges in thickness from about two (2) to four (4) inches. East of the oil body is a small area of

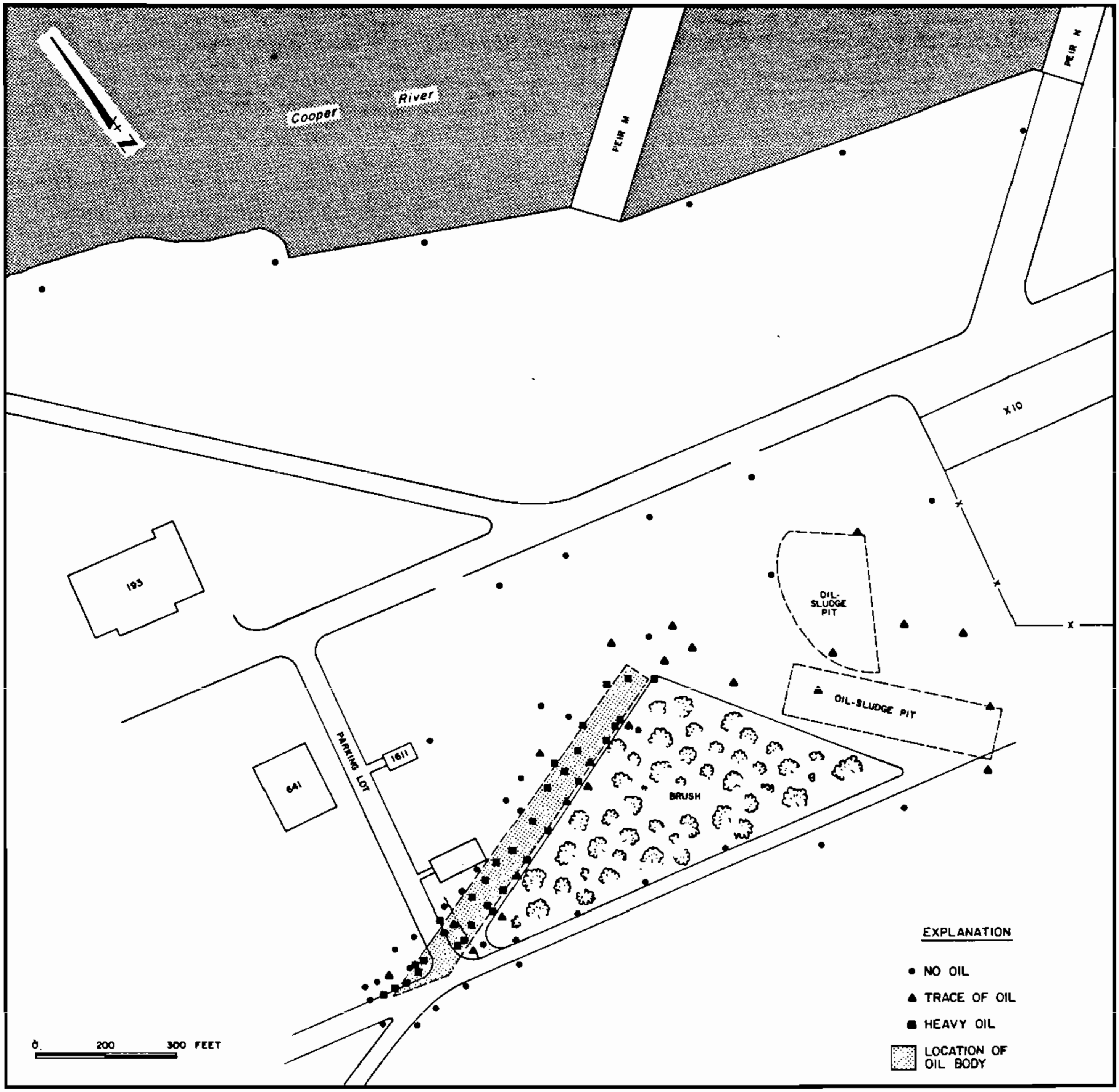


Figure 15. Location of Oil-Test Borings Showing the Presence or Absence of Oil in the Oil-Sludge Pit Area.

oily residue; however, the remaining portions of the oil-sludge area were found to be free of oil.

## POL-Transfer Area

Petroleum, oil, and lubricants entering the shipyard are transferred from railroad tank cars to storage tanks at the POL-transfer area (Figure 16). In 1981, during the construction of a fence, some of the fence-post holes that were dug reportedly became filled with oil. A total of 36 shallow oil borings were drilled in order to identify whether or not an oil plume exists within the POL-transfer area. These were drilled to the top of the water table at an average depth of about 5 ft, at the locations shown in Figure 16.

The results of the boring program indicate that only traces of oil were found in the vicinity of the POL-transfer area. Traces of oil were found in borings POL-4, POL-5, and POL-6; however, these borings are located within the actual POL-transfer area. Traces of oil were also found along the fence in borings POL-1 and POL-9, and a trace of oil was found in boring POL-14. No other traces of oil were found in the area, including borings along the Cooper River. Based on these findings, it appears that any oil present in the surficial deposits in this area is very localized.

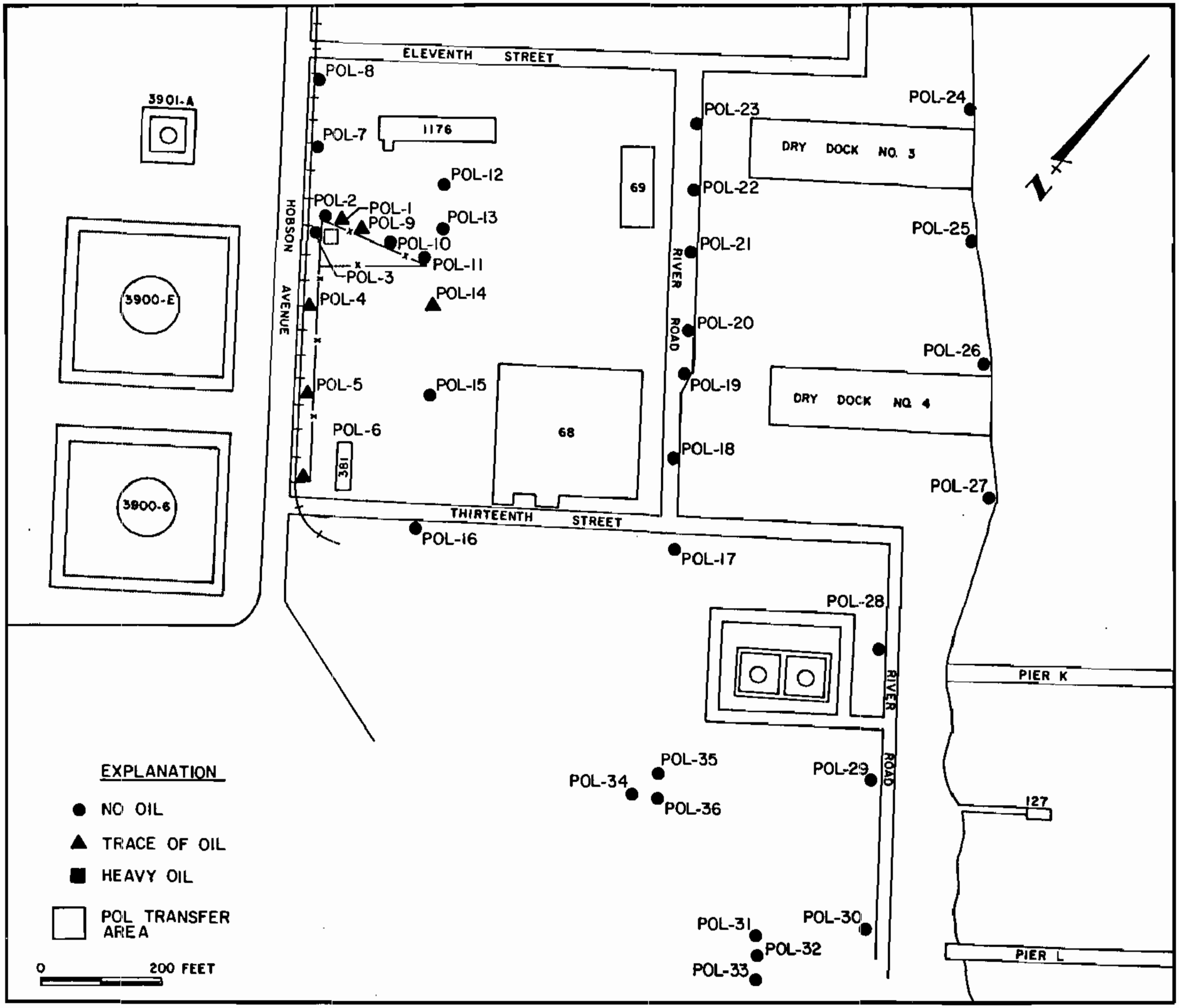


Figure 16. Locations and Results of the Oil-Test Borings Installed in the POL-Transfer Area.

## Fire-Fighting Training Pit

The fire-fighting training pit is located at the southern end of the shipyard (see Figure 3) and is no longer in use. It reportedly ranged between 30 to 50 ft in diameter and was used between 1966 and 1971 for training purposes. Oil, gasoline, and alcohol were poured into this pit, ignited, and subsequently extinguished during fire-fighting training exercises. The approximate location of the pit was determined by NAVFAC personnel and three soil borings were drilled. These borings were drilled at the fire-fighting pit, one in the center of the pit, and the other two along the road bordering Shipyard Creek (Figure 17). No oil nor any traces of oil were found in any of the borings.

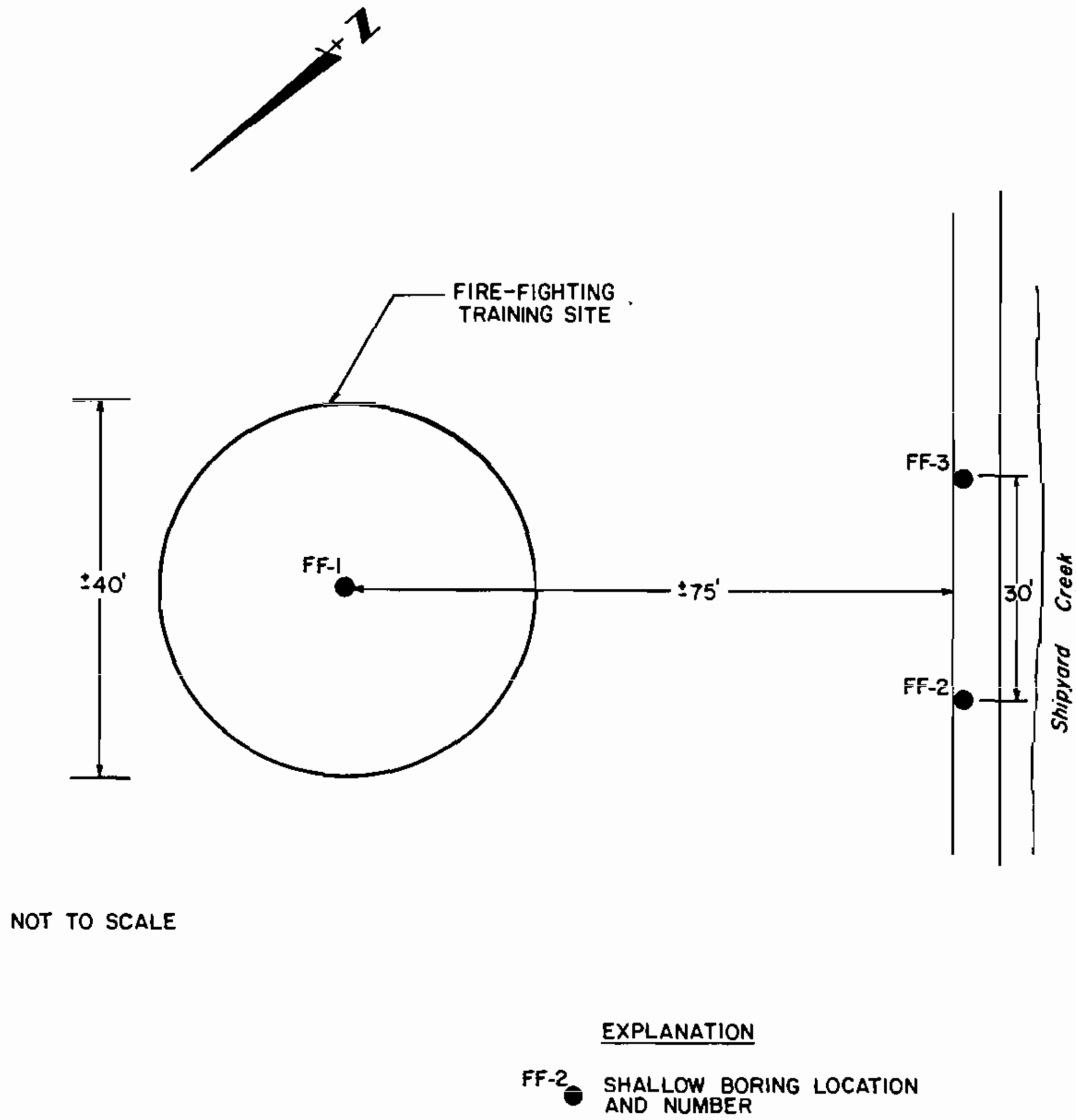


Figure 17. Locations of the Oil-Test Borings Installed at the Former Fire-Fighting Pit.

## SIGNIFICANCE OF THE FINDINGS AND ALTERNATIVES FOR REMEDIAL MEASURES

### Caustic-Pond Area

The IAS identified the caustic pond (see Figure 2) as a potential hazardous-waste site due to the disposal of calcium hydroxide into the pond prior to the early 1970's. Although calcium hydroxide is not considered a hazardous waste, it has the potential to elevate the pH of water in contact with it. The water-quality data collected from the wells installed around the caustic pond indicate that the shallow ground water is mineralized and that naturally-occurring acidic conditions of the soils in the caustic pond area have effectively neutralized the high pH of the water that has infiltrated from the pond into the shallow ground-water system.

Based on the data collected, the site is not in violation of any applicable Federal, State, Navy, or DOD (Department of Defense) standard. Although the site does not pose any significant threat to the environment, it is a potential safety problem in the event that the calcium hydroxide were to come in direct contact with sensitive portions of the body, such as the eyes.

There are several alternatives available to mitigate the potential safety problem, including: (1) identifying the caustic pond as a potential safety hazard by posting signs (2) restricting access to the site, (3) dewatering the pond and excavating and drying the calcium hydroxide so that it may be recycled on base, (4) in-situ chemical treatment to encapsulate the calcium hydroxide, and (5) placing a soil cap on top of the calcium hydroxide, contouring the site to prevent ponding of surface water, and identifying the site as containing a calcium hydroxide sludge on the Base Master Development Plan.

Implementation of alternative number (1) is the least costly and is considered to be an effective alternative due in part to the fact that the site is somewhat isolated from the activities of the base. Implementation of alternative number (2) would require fencing in the area at a cost of about $10,000 to $15,000. However, because the caustic pond is adjacent to one of the main entrances to the base, the fenced-in area may be considered an eyesore. Alternative number (3) is attractive because it offers the potential to eliminate the problem; however, the cost of removing and drying the calcium hydroxide, which is estimated to be about $25,000, probably would not offset the relatively low cost of purchasing calcium hydroxide directly from a supplier. Implementation of alternative number (4) would be very costly and is not considered to be cost-effective. Alternative number (5) is attractive because the area could be used for other purposes because of its park-like setting. However, because the cost is estimated to be $15,000, this may not be a cost-effective alternative.

Chemical-Disposal Area

Within the chemical-disposal area (Figure 2), small quantities of warfare decontaminating agents DANC-DS-2 and DANC-M4 have been buried. The precise location(s) of these burial areas is unknown although some are believed to be buried in the berm behind the pistol range. The shallow ground water in this area is mineralized and cannot be used for potable water supplies. The results of the chemical analyses of water samples collected from monitor wells in the vicinity of the chemical disposal area reveals the presence of methylene chloride, chlorobenzene, chloroform, and phthalate esters in the shallow ground-water system. The phthalate esters, which are commonly found around industrial areas, and chloroform were found in low concentrations. The concentrations of methylene chloride, a compound frequently used as a degreasing agent, suggest that some methylene chloride waste materials have been deposited in the area along with the reportedly small quantities of DANC-DS-2 and DANC-M4. The pH of the shallow ground water on the area is near neutral although, presumeably in localized areas near the buried DANC, the pH of the ground water may be high. The presence of these compounds do not pose a threat to the environment, and the area is not in volation of any applicable Federal, State, Navy, or DOD standard. However, in areas immediately adjacent to the buried DANC, the high pH of the water and the buried residue itself poses a potential safety hazard to persons digging in these areas because of the potential for caustic burns.

Two alternatives are available to mitigate this potential safety hazard. Alternative number 1 is to identify the shallow ground water and solid residues in the surficial deposits at the site as potential safety hazards by posting signs, and noting on the Base Master Development Plan that caution should be exercised while excavating in the chemical disposal area. The cost is estimated to be less than $1,000. Alternative number 2 is to locate the buried containers of DANC using shallow geophysical techniques, excavate them and dispose of them in a solid-waste or hazardous-waste landfill, and to locate the buried methylene chloride waste materials using a detailed soil-boring and/or monitoring well installation and sampling program and disposing of these materials in a solid-waste or hazardous-waste landfill. This alternative is estimated to cost from $100,000 to $200,000 and may not be totally effective due to the difficulty in locating these materials.

Landfill Area

The landfill area received solid wastes generated at the shipyard between the 1930's and 1973. The area has since been covered with soil and contoured to prevent the ponding of surface water. The results of the chemical analyses of water samples collected from monitor wells along the edge of the landfill reveal the presence of low levels of dissolved metals, acid-extractable, base-neutral and volatile organics compounds on EPA's organic priority pollutant list. Since the shallow ground waters are mineralized and are not used for potable water supplies, the primary concern is the potential environmental effect of leachate seeping into Shipyard Creek or Cooper River. The seepage of these constituents into these surface-water bodies is extremely slow and is estimated to be moving at the rate of 1 to 2 feet per year. Furthermore, these surface-water bodies contain mineralized water and the shipyard is located in an industrialized area.

There are several alternatives to mitigate the potential effects of this leachate, including the: (1) installation of an impermeable barrier around the landfill, (2) placement of a clay confining cap or synthetic liner on top of the landfill, (3) installation of a ground-water collection system around the landfill to intercept the leachate for treatment, and (4) no action. Each of the first three alternatives are extremely expensive and are not considered cost effective.

## Pesticide-Mixing Area

The pesticide-mixing area is a relatively small area, 50 ft x 25 ft, that was used to wash off equipment used in the spraying and mixing of pesticides. No pesticides, herbicides, or PCBs were detected in the shallow ground water because of the strong affinity that these compounds have for the soil and their low solubilities in water. However, pesticides and PCBs were detected in the soil with the highest concentrations occurring near land surface and much lower concentrations at deeper depths. There are no applicable Federal, State, Navy, or DOD standard on allowable residual DDT levels in the soil, and the levels of PCBs were below that which would require them to be removed under Federal regulations. There are several alternatives for remedial action, including: (1) excavation of the surface soil and disposal in a solid-waste or hazardous-waste landfill, (2) encapsulation of the surface soil, and (3) discing the surface soils in with the deeper soils and then seeding the area with grass. Implementation of alternatives (1) or (2) would cost several thousands of dollars, whereas alternative (3) would cost less than $1,000.

## Electrical Transformer Storage Area

The data collected in the electrical transformer storage area shows that the shallow ground water at the electrical transformer storage area contains very low levels of PCBs, pesticides, and arsenic, although the soils in this area contain relatively high levels of these constituents. According to Federal standards, soils with concentrations of PCBs in excess of 50 ug/gm are considered to be a hazardous

PCB-containing material (40 CFR, 761.2, and 40 CFR, 761.10) and must be disposed of in accordance with Federal regulations.

The highest concentration of PCBs was found in soil sample OC-2, at 62 ug/gm. Soil samples OC-3 and OC-11 had concentrations of 37 and 11 ug/gm, respectively. Since these samples were composites of ±100-ft-long strips, presumably there are areas along the OC-2, OC-3, and OC-11 strips that exceed the 50 ug/gm limit. Therefore, in order to comply with Federal standards, the location of soils in those areas that exceed 50 ug/gm must be identified and either (1) removed and disposed of in a PCB landfill, or (2) chemically treated or incinerated using techniques approved by EPA.

A more definitive soil-sampling and analysis program should be implemented to determine more precisely the locations where the concentrations of PCBs exceed 50 ug/gm. This can be accomplished by griding the area into smaller parcels and collecting a surface soil sample from each grid parcel for analysis for PCB content. The cost for implementing the detailed soil-sampling and analysis program is estimated to be between $5,000 and $10,000.

After the soils that exceed 50 ug/gm of PCBs are located, they should be excavated and disposed of in a PCB landfill unless a more cost-effective EPA-approved treatment method is available. The remaining area should then be disced in order to mix the surface soils with the deeper soils, then seeded with grass.

## Oil-Sludge Pit Area

Oil and oil-sludges were disposed of in several pits which were later abandoned and filled with gravel and sand. Very little of the oil has infiltrated into the surficial deposits adjacent to the pits because of the low horizontal hydraulic gradient ($4.5 \times 10^{-3}$), the low permeability of the surficial deposits (approximately $1 \times 10^{-5}$ to $1 \times 10^{-6}$ cm/sec), and the high viscosity of the oil (approximately $1 \times 10^{-4}$ pounds-second per square foot). Under existing conditions, it would require a very long period of time for the oil to move laterally with the shallow ground water into the Cooper River or Shipyard Creek. The oil may in fact reach immobile saturation prior to reaching these surface-water bodies. There are circumstances under which the oil could migrate quickly toward either the Cooper River or Shipyard Creek. In fact, during this investigation a ditch was dug that intercepted the oil body, and the ditch had to be dammed immediately to prevent migration of the oil into Shipyard Creek.

In order to prevent this oil from migrating toward either Shipyard Creek or Cooper River, a collection system could be installed which would consist of the installation of ditches, infiltration galleries (French drains), or a combination of these. Once installed, the collection system would be pumped so that the oil could be separated from the water. The oil could then be sold as waste oil or burned in an incinerator, and the water can be reintroduced into the shallow ground-water system to speed up the oil-recovery process. Presented in Figure 18 is a schematic diagram showing the layout of a possible oil-collection system using ditches. The cost of installing this system is estimated to be $45,000 to $60,000.

Given the low potential for this oil to move laterally through the ground-water system, it may be more cost effective to install a bypass pipe in the existing ditch with a simple collection system at the downstream end. The ditch would still serve its purpose of conveying surface-water runoff away from the site while preventing the oil from entering the ditch. The collection system would periodically be pumped to remove any oil that collects in it.

## POL-Transfer Area

No oil plumes were found in the POL-transfer area; therefore, no remedial actions are required.

## Former Fire-Fighting Training Pit

As in the case of the POL-transfer area, no oil plumes were detected in the shallow deposits; therefore, no remedial actions are required.

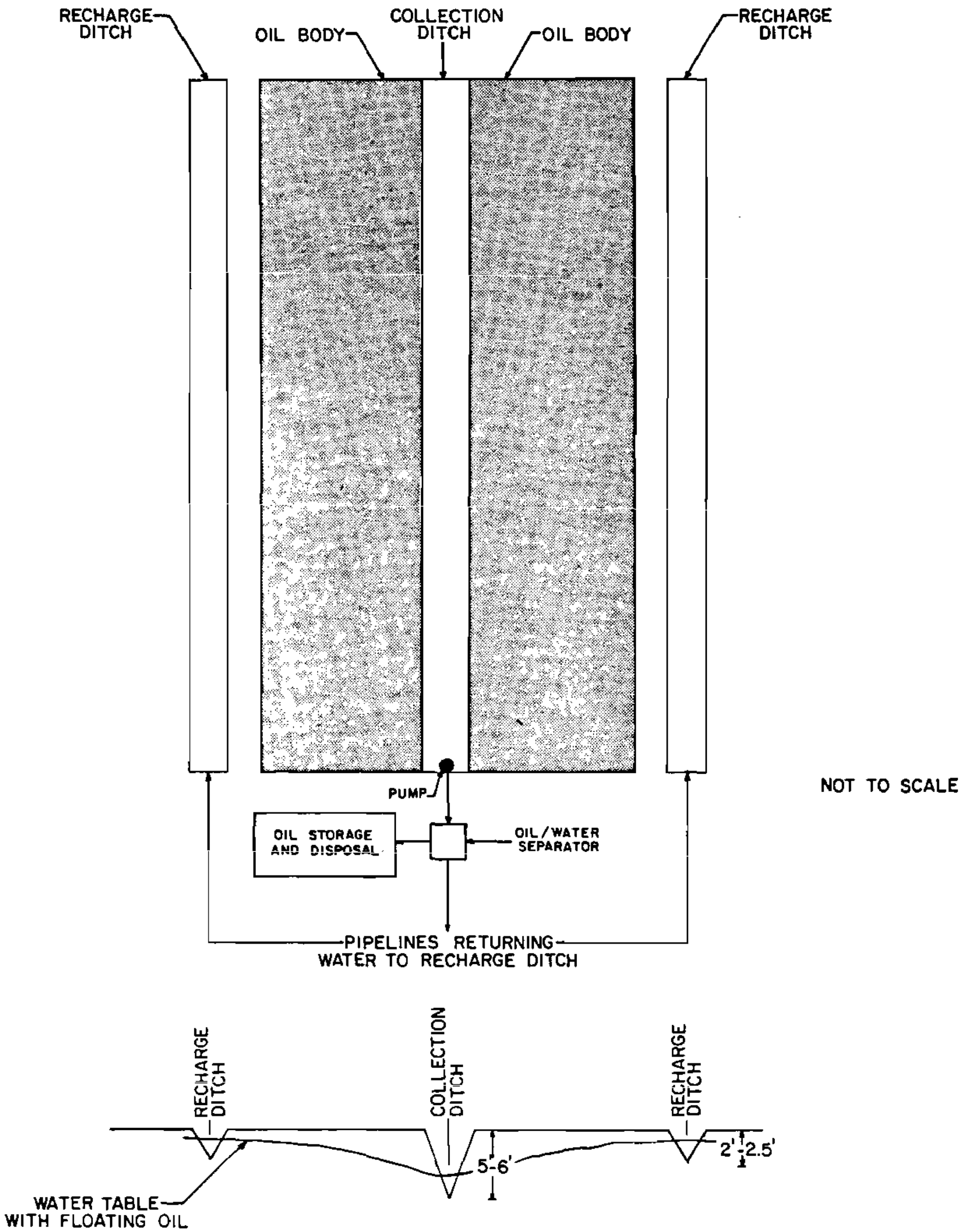


Figure 18. Schematic Diagram Showing an Oil-Recovery System Utilizing Ditches.

## CLOSING COMMENT

The IAS for the Charleston Naval Shipyard identified seven abandoned sites where "sufficient evidence exists to indicate a threat to human health and/or the environment." This Confirmation Study investigated these seven sites along with one other site, the electrical transformer storage area, where transformers with oils containing PCBs were stored. The data collected during this investigation showed that no immediate response is needed for any of the sites; however, remedial measures are required for many of the sites and these are listed in the Recommendations section of this report.

Geraghty & Miller, Inc., gratefully acknowledges the help that it received from numerous individuals associated with the Southern Division of NAVFAC, the shipyard, and the Naval Energy and Environmental Support Authority. In particular, we wish to express our sincere appreciation to Mr. Joseph McCauley and Mr. Richard Bozung with the Southern Division, both of whom provided valuable guidance, insight, and pertinent suggestions throughout this study.

In closing, Geraghty & Miller, Inc., appreciates being given the opportunity to assist the Navy in the NACIP program and looks forward to working with the Navy on future studies.

Respectfully submitted,

GERAGHTY & MILLER, INC.

Peter L. Palmer, P.E.
Senior Scientist

Philip J. Ciaravella
Hydrogeologist

October 29, 1982

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South Carolina Water Resources Commission: ACE Framework Study, Ashley-Combahee-Edisto River Basin, August 1972.

South Carolina Water Resources Commission: Cooper River Environmental Study, Report No. 117. April 1974.

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# APPENDIX A: LITHOLOGIC LOGS

## LITHOLOGIC LOG OF WELL CP-1

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, slightly sandy, light tan to gray... | 0 - 10 | 10 |
| Clay, gray, soft, with organic debris and a trace of fine sand..................... | 10 - 15 | 5 |
| Sand, stiff, gray, with a trace of clay and scattered shell fragments............ | 15 - 23 | 8 |
| Clay, soft, calcareous, brownish-gray..... | 23 - 25 | 2 |

## LITHOLOGIC LOG OF WELL CP-2

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, slightly sandy, tan................. | 0 - 3 | 3 |
| Clay, sandy, very stiff, grayish-tan...... | 3 - 10 | 7 |
| Clay, plastic, gray, with a trace of silt. | 10 - 15 | 5 |
| Clay, sandy, soft, gray.................. | 15 - 21.5 | 6.5 |
| Clay, stiff, calcareous, slightly sandy, grayish-green............................ | 21.5 - 25 | 3.5 |

## LITHOLOGIC LOG OF WELL CP-3

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, slightly sandy, tan to reddish-brown.................................... | 0 - 2 | 2 |
| Sand, fine-grained, slightly clayey, dark gray to black........................... | 2 - 8 | 6 |
| Clay, plastic, gray, with a trace of silt. | 8 - 14 | 6 |
| Clay, slightly sandy, stiff, gray, scattered shell fragments................ | 14 - 18.5 | 4.5 |
| Clay, calcareous, soft, slightly sandy, brownish-green.......................... | 18.5 - 25 | 6.5 |

## LITHOLOGIC LOG OF WELL CP-4

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, slightly sandy, medium stiff, tan... | 0 - 2 | 2 |
| Sand, fine-grained, gray, with a trace of clay and scattered small shell fragments.. | 2 - 8 | 6 |
| Clay, soft, dark gray, with scattered decaying vegetable matter................. | 8 - 18 | 10 |
| Clay, medium stiff, gray, with scattered roots................................... | 18 - 23 | 5 |
| Sand, fine-grained, slightly clayey, tan...................................... | 23 - 25 | 2 |

## LITHOLOGIC LOG OF WELL CD-1

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, medium-grained, with a trace of small shell fragments.................... | 0 - 5 | 5 |
| Clay, soft, gray, with laminations of fine sand..................................... | 5 - 10 | 5 |
| Sand, medium grained, gray, with a trace of clay.................................. | 10 - 12 | 2 |
| Clay, soft, gray, with laminations of fine sand and decaying wood.................... | 12 - 16.5 | 4.5 |

## LITHOLOGIC LOG OF WELL CD-2

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, very soft, brown................... | 0 - 5 | 5 |
| Clay, very soft, green, with decaying vegetable matter......................... | 5 - 15 | 10 |

## LITHOLOGIC LOG OF WELL CD-3

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, stiff, tan, with a trace of sand and scattered roots.......................... | 0 - 4 | 4 |
| Clay, soft, dark gray, with decaying wood fragments................................ | 4 - 10 | 6 |
| Clay, very soft, gray, with decaying wood fragments and a trace of silt............ | 10 - 11.5 | 1.5 |
| Clay, very soft, dark gray................ | 11.5 - 15 | 3.5 |

## LITHOLOGIC LOG OF WELL CD-4

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, stiff, tan, slightly sandy, with scattered roots.......................... | 0 - 4 | 4 |
| Clay, soft, dark gray..................... | 4 - 10 | 6 |
| Clay, very soft, dark gray, with a trace of silt and scattered laminations of fine sand...................................... | 10 - 14 | 4 |
| Clay, calcareous, hard, brownish-green, with a trace of sand and fragments of decaying wood............................ | 14 - 16.5 | 2.5 |

## LITHOLOGIC LOG OF WELL CD-5

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, very soft, dark gray................ | 0 - 5 | 5 |
| Sand, fine grained, slightly clayey, gray...................................... | 5 - 10 | 5 |

## LITHOLOGIC LOG OF WELL LF-1

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, medium-grained, with gravel and a trace of clay............................ | 0 - 8.5 | 8.5 |
| Clay, very soft, dark gray, with scattered gravel and decaying vegetable matter...... | 8.5 - 16.5 | 8 |
| Clay, very soft, gray..................... | 16.5 - 25 | 8.5 |

## LITHOLOGIC LOG OF WELL DLF-1

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Fill - gravel, sand, debris .............. | 0 - 12 | 12 |
| Clay, soft, gray, with a trace of sand.... | 12 - 20 | 8 |
| Clay, soft, gray.......................... | 20 - 32 | 12 |
| Clay, soft, gray, with a trace of sand and shell fragments.......................... | 32 - 45 | 13 |
| Clay, hard, calcareous, slightly sandy, grayish-green ............................ | 45 - 62 | 17 |

## LITHOLOGIC LOG OF WELL LF-2

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, medium-grained, with gravel......... | 0 - 5 | 5 |
| Clay, very soft, gray..................... | 5 - 11 | 6 |
| Clay, very soft, dark gray, with decaying vegetable matter.......................... | 11 - 20 | 9 |

## LITHOLOGIC LOG OF WELL LF-3

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Fill - sand and gravel.................... | 0 - 4 | 4 |
| Clay, calcareous, hard, dark green, with some sand and gravel...................... | 4 - 13 | 9 |
| Clay, soft, dark gray..................... | 13 - 20 | 7 |
| Clay, soft, dark gray, with a trace of sand and scattered shell fragments........ | 20 - 22 | 2 |
| Sand, fine grained, clayey, dark gray, with fragments of decaying wood........... | 22 - 25 | 3 |

## LITHOLOGIC LOG OF WELL LF-4

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Fill - gravel and sandy clay............. | 0 - 7 | 7 |
| Clay, soft, gray, with a trace of gravel.. | 7 - 15 | 8 |
| Clay, soft, grayish-green, with scattered laminations of very fine sand............ | 15 - 18.5 | 3.5 |
| Clay, plastic, dark gray, with scattered shell fragments and pieces of decayed vegetable matter......................... | 18.5 - 22 | 3.5 |
| Clay, stiff, calcareous, green, with a trace of sand............................ | 22 - 25 | 3 |

## LITHOLOGIC LOG OF WELL LF-5

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, fine grained, tan, with gravel and debris (fill) | 0 - 5 | 5 |
| Gravel, clayey (fill) | 5 - 13 | 8 |
| Clay, soft, dark gray, with scattered pieces of decaying wood | 13 - 21 | 8 |
| Clay, soft, gray, with scattered shell fragments | 21 - 31 | 10 |

## LITHOLOGIC LOG OF WELL LF-6

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, stiff, dark brown, with a trace of sand, wood, and gravel (fill) | 0 - 1.5 | 1.5 |
| Clay, very soft, dark gray, with roots | 1.5 - 4 | 2.5 |
| Clay, very soft, dark gray | 4 - 15 | 11 |

## LITHOLOGIC LOG OF WELL LF-7

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, fine-grained, loose, brown, with gravel and wood (fill) | 0 - 2.5 | 2.5 |
| Sand, fine-grained, clayey, loose, dark gray to brown, with gravel and wood (fill) | 2.5 - 7.5 | 5 |
| Sand, fine-grained, loose, gray, with gravel (fill) | 7.5 - 9 | 1.5 |
| Clay, sandy, stiff, reddish-brown | 9 - 11.5 | 2.5 |

## LITHOLOGIC LOG OF WELL LF-8

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, stiff, dark gray, with gravel (fill) | 0 - 1.5 | 1.5 |
| Sand, wood and gravel, with brick fragments (fill)............................ | 1.5 - 4 | 2.5 |
| Clay, very soft, dark gray, with decaying vegetable matter......................... | 4 - 9 | 5 |
| Clay, very soft, dark gray, with scattered laminations of fine sand........ | 9 - 11.5 | 2.5 |
| Clay, very soft, dark gray............... | 11.5 - 15 | 3.5 |

## LITHOLOGIC LOG OF WELL LF-9

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, fine-grained, clayey, gray, with roots and gravel.......................... | 0 - 1.5 | 1.5 |
| Clay, medium stiff, greenish-gray, with roots and a trace of sand................. | 1.5 - 5 | 3.5 |
| Clay, stiff, greenish-gray, with shell fragments and a trace of sand............ | 5 - 11.5 | 6.5 |
| Clay, soft, sandy, gray.................. | 11.5 - 14 | 2.5 |

## LITHOLOGIC LOG OF WELL LF-10

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, fine-grained, clayey, loose, gray, with roots................................ | 0 - 1.5 | 1.5 |
| Clay with gravel and brick fragments...... | 1.5 - 4 | 2.5 |
| Sand, fine-grained, slightly clayey, gray, with pieces of wood...................... | 4 - 6.5 | 2.5 |
| Clay, very soft, dark gray, with a trace of sand................................. | 6.5 - 12.5 | 6 |

## LITHOLOGIC LOG OF WPA-1

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, fine-grained, dark brown, with roots | 0 - 4 | 4 |
| Sand, fine-grained, slightly clayey, firm, orangish-brown.......................... | 4 - 7.5 | 3.5 |
| Clay, stiff, slightly sandy, gray......... | 7.5 - 9 | 1.5 |
| Sand, fine-grained, firm, light gray, with a trace of clay...................... | 9 - 12.5 | 3.5 |
| Clay, soft, dark gray, with a trace of sand.................................... | 12.5 - 15 | 2.5 |

## LITHOLOGIC LOG OF WPA-2

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, fine-grained, orangish-brown, with scattered roots.......................... | 0 - 4 | 4 |
| Clay, sandy, stiff, orangish-brown........ | 4 - 6.5 | 2.5 |
| Sand, fine-grained, clayey, firm, orangish-brown.......................... | 6.5 - 13 | 6.5 |
| Clay, soft, dark gray..................... | 13 - 14 | 1 |

## LITHOLOGIC LOG OF WOC-1

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Clay, sandy, medium stiff, dark gray to brown................................... | 0 - 1.5 | 1.5 |
| Clay, very soft, dark gray, with roots.... | 1.5 - 6.5 | 5 |
| Sand, fine to medium-grained, loose, gray, with shell fragments..................... | 6.5 - 10 | 3.5 |

## LITHOLOGIC LOG OF WOC-2

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Sand, clayey, fine-grained, brown......... | 0 - 1.5 | 1.5 |
| Clay, soft, dark gray, with roots......... | 1.5 - 6.5 | 5 |
| Sand, loose, fine to medium-grained, gray, with thin layers of grayish-green clay and scattered shell fragments............ | 6.5 - 9 | 2.5 |
| Sand, loose, fine to medium-grained, with scattered shell fragments................ | 9 - 10.5 | 1.5 |

## LITHOLOGIC LOG OF WELL OPW-1

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Fill - sand and gravel.................... | 0 - 2 | 2 |
| Sand, slightly clayey, gray to brown...... | 2 - 3.5 | 1.5 |
| Sand, fine-grained, tan, with scattered gravel................................. | 3.5 - 5 | 1.5 |
| Sand, fine-grained, dark gray to brown, with scattered debris - wood and bricks... | 5 - 10 | 5 |

## LITHOLOGIC LOG OF WELL OPW-2

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Fill - very hard sand and gravel.......... | 0 - 2 | 2 |
| Sand, slightly clayey, fine-grained, tan to brown............................... | 2 - 4 | 2 |

# LITHOLOGIC LOG OF WELL OPW-3

| Description | Depth (ft) | Thickness (ft) |
|---|---|---|
| Fill - sand and gravel.................... | 0 - 2 | 2 |
| Sand, clayey, with gravel (fill).......... | 2 - 5 | 3 |
| Sand, fine to medium-grained, gray, with scattered shell fragments and a trace of clay...................................... | 5 - 8 | 3 |
| Sand, fine to medium-grained, gray, with a trace of clay........................... | 8 - 10 | 2 |

# APPENDIX B: LABORATORY SOIL-TEST RESULTS

Soil Consultants, Inc.
FOUNDATION & TESTING ENGINEERS
P.O. Drawer 698, Charleston, S.C. 29402
Phone (803) 723-4539

August 26, 1981

Geraghty and Miller, Inc.
Consulting Ground Water Geologists
and Hydrologists
P. O. Box 271173
Tampa, Florida 33688



Attention: Mr. Philip J. Ciaravella
Hydrogeologist

Re: Monitor Wells, U. S. Naval Station
Charleston, S. C.
SCI Project 81138

Gentlemen:

Enclosed you will find the below laboratory test reports on various tests recently completed on the undisturbed samples obtained from the above noted project.

At the time of our August 3, 1981, telephone discussion you indicated that you desired a consolidation test on Sample No. 1, Boring No. DLF-1. As noted on the Undisturbed Sample Characteristics this was not possible due to high sand content. In view of the similar depth of this sample and that of Sample No. 4, Boring No. LF-1, we performed several additional tests to provide you with as much information as possible due to the vast differences in these two samples.

DATA

| | | |
|---|---|---|
| Undisturbed Sample Characteristics | - | 2 Sheets |
| Soil Mechanic Laboratory Data | - | 1 Sheet |
| Consolidation Test (including calculated permeability) | - | 2 Sheets |

If we can be of further service, please call on us.

Sincerely,

SOIL CONSULTANTS, INC.

I. D. Smith, Jr., P.E.
V. P. Of Laboratories
IDSJr.:kmg enclosures

| MATERIALS TESTING REPORT | SOIL CONSULTANTS, INC. | UNDISTURBED SAMPLE CHARACTERISTICS |
|---|---|---|

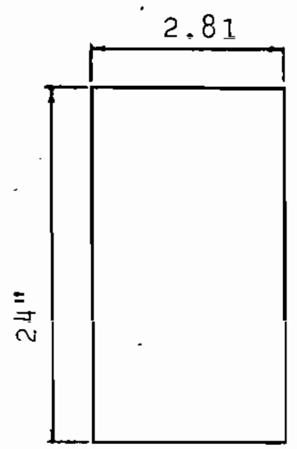
PROJECT and STATE Geraghty and Miller Inc., Tampa Florida
Monitor Wells, U. S. Naval Station, Charleston, S.C. (SCI 81138)

| TESTED AT | APPROVED BY | DATE |
|---|---|---|
| SCI, Charleston, S. C. | [signature] | 8-4-81 |

| FIELD SAMPLE NO | DEPTH (ft) from | DEPTH (ft) to | SAMPLE LOCATION | TYPE OF SAMPLE | LABORATORY NO |
|---|---|---|---|---|---|
| 1 | 20'0" | 22'0" | Boring No. DLF-1 | Pushed | 81-1410 |

| COLOR | RELATIVE MOISTURE | CONSISTENCY | POROSITY OR STRUCTURE | TEXTURE | POCKET PENETROMETER (TSF) | VISUAL CLASSIFICATION (USCS) |
|---|---|---|---|---|---|---|
| Dark Gray | Damp | Solid | Banded | Silty clay with very high sand content - numerous sand lenses. | | |

ω 39.7 % $\gamma_d$ 1.306 g/cc




**REMARKS**

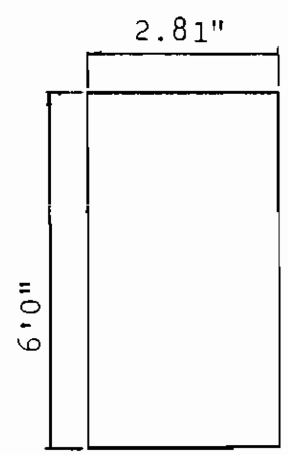
Numerous sand lenses and high sand content would not permit consolidation test. See Soil Mechanics Data Sheet for confirmation of SM Soil

1/4" to 1/2" Dark gray silty clay

| FIELD SAMPLE NO | DEPTH (ft) from | DEPTH (ft) to | SAMPLE LOCATION | TYPE OF SAMPLE | LABORATORY NO |
|---|---|---|---|---|---|
| 3 | 50'0" | 52'0" | Boring No. DLF-1 | Pushed | 81-1410A |

| COLOR | RELATIVE MOISTURE | CONSISTENCY | POROSITY OR STRUCTURE | TEXTURE | POCKET PENETROMETER (TSF) | VISUAL CLASSIFICATION (USCS) |
|---|---|---|---|---|---|---|
| Brownish Green (Marl) | Very moist | solid | Uniform | Clay and silt | | |

ω 69.7 % $\gamma_d$ 0.936 g/cc




**REMARKS**

Consolidation Test

| MATERIALS TESTING REPORT | SOIL CONSULTANTS, INC. | UNDISTURBED SAMPLE CHARACTERISTICS |
|---|---|---|

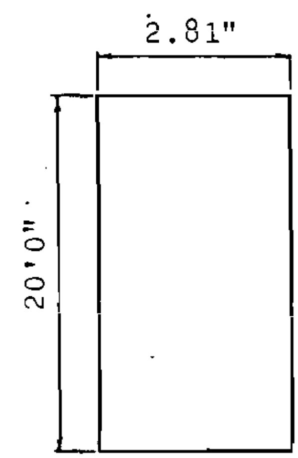
| | | | |
|---|---|---|---|
| PROJECT and STATE | Geraghty and Miller, Inc., Tampa Florida Monitor Wells, U. S. Naval Station, Charleston, S. C. (SCI 81138) | | |
| TESTED AT | SCI, Charleston, S. C. | APPROVED BY [signature] | DATE 8-11-81 |

| FIELD SAMPLE NO | DEPTH (ft) from | DEPTH (ft) to | SAMPLE LOCATION | TYPE OF SAMPLE | LABORATORY NO |
|---|---|---|---|---|---|
| 4 | 60'0" | 62'0" | Boring No. DLF-1 | Pushed | 81-1410B |

| COLOR | RELATIVE MOISTURE | CONSISTENCY | POROSITY OR STRUCTURE | TEXTURE | POCKET PENETROMETER (TSF) | VISUAL CLASSIFICATION (USCS) |
|---|---|---|---|---|---|---|
| Brownish Green (Marl) | Very moist | Solid | Uniform | Clay and silt | | |

ω 43.1 % $\gamma_d$ 1.223 g/cc

**REMARKS**



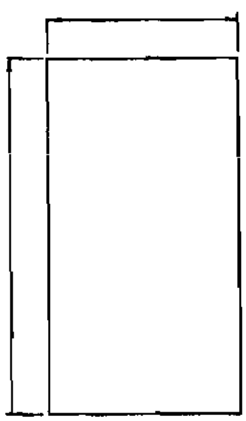

Consolidation Test and
Washed sieve analysis

| FIELD SAMPLE NO | DEPTH (ft) from | DEPTH (ft) to | SAMPLE LOCATION | TYPE OF SAMPLE | LABORATORY NO |
|---|---|---|---|---|---|
| | | | | | |

| COLOR | RELATIVE MOISTURE | CONSISTENCY | POROSITY OR STRUCTURE | TEXTURE | POCKET PENETROMETER (TSF) | VISUAL CLASSIFICATION (USCS) |
|---|---|---|---|---|---|---|
| | | | | | | |

ω ____ % $\gamma_d$ ____ g/cc

**REMARKS**



Geraghty and Miller, Inc., Tampa Florida
Monitor Wells, U. S. Naval Station, Charleston, S. C.
(SCI 81138)

# SOIL CONSULTANTS, INC.

SOIL MECHANICS LABORATORY DATA
Sheet 1 of 1

| Laboratory Sample Number 81- | Field Number | | Depth | Field Classification | .002 mm | .005 | .02 | .05 | #200 .074 | #100 .149 | #60 | #40 | #20 | #10 | #4 | 3/8" | 1/2" | 3/4" | 1" | 1 1/2" | 3" mm | LL | PI | Unified Classification | Dry Unit Weight | $H_2O$ w in % | $G_s$ | Consolidation Test | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1410 | 1 | Boring DLF-1 | 20'0" 22'0" | | | | | | 38.1 | 38.4 | 56.6 | 80.3 | 94.9 | 989 | 998 | | 100 | | | | | 29.0 NP | 8.4 NP | * | 1306 | 39.7 | | | | |
| 1410A | 3 | Boring DLF-1 | 50'0" 52'0" | | | | | | | | | | | | | | | | | | | | | | 0926 | 69.7 | 2660 | X | | |
| 1410B | 4 | Boring DLF-1 | 60'0" 62'0" | | | | | | 67.2 | 77.9 | 93.5 | 97.6 | 99.0 | 996 | 100 | | | | | | | | | | 1223 | 43.1 | 2645 | X | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1410C | 1 | Boring LF 1 | 5'0" 6'6" | | | | | | 1.4 | 4.5 | 12.3 | 14.4 | 18.9 | 355 | 541 | | 809 | 100 | | | | | | | | | | | | |
| 1410D | 2 | Boring LF 1 | 10'0" 11'6" | | | | | | 2.7 | 3.4 | 4.0 | 5.4 | 8.8 | 208 | 382 | | 658 | 722 | 100 | | | | | | | | | | | |
| 1410E | 4 | Boring LF 1 | 20'0" 21'6" | | | | | | 99.3 | (Insufficient sample for further testing) | | | | | | | | | | | | | | | | | | | | |

* represents the hand picked more clayey portion of this sample for additional information

(SCI 81138) Lab No. 81-1410B

| MATERIALS TESTING REPORT | Soil Consultants, Inc. | CONSOLIDATION TEST |
|---|---|---|

| PROJECT and STATE | SAMPLE LOCATION |
|---|---|
| Geraghty and Miller Inc., Tampa Fla. Monitor Wells, U.S. Naval Sta., Charleston, SC | Boring DLF-1 |

| FIELD SAMPLE NO. | DEPTH | GEOLOGIC ORIGIN |
|---|---|---|
| 3 | 50'0"to52'0" | |

| TYPE OF SAMPLE | TESTED AT | APPROVED BY | DATE |
|---|---|---|---|
| Pushed | SCI-Charleston, SC | [signature] | 8-22-81 |

CLASSIFICATION (Marl)

$G_s$ 2.660 LL ____ PI ____

INITIAL DENSITY $\gamma_d$ 0.926

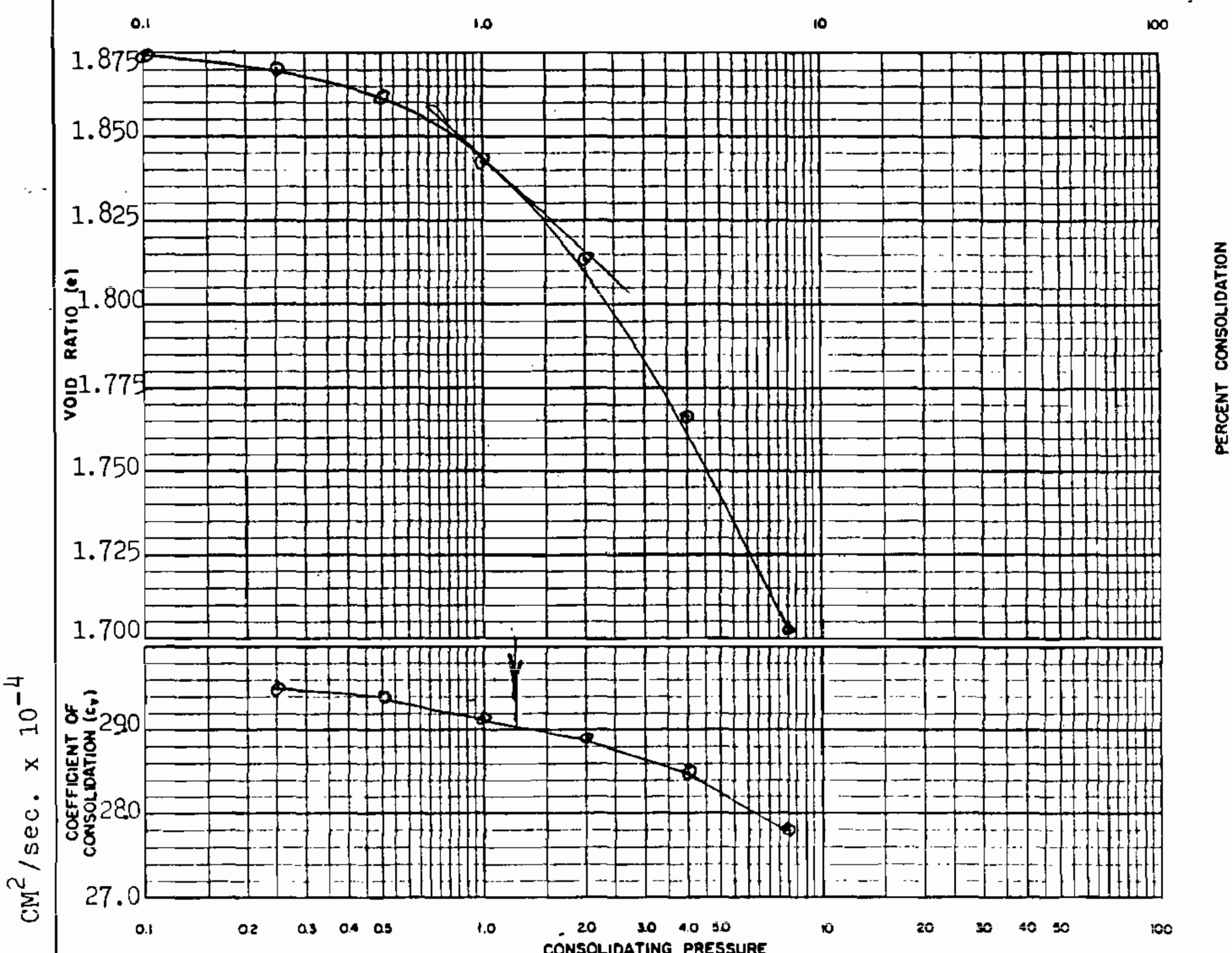
INITIAL VOID RATIO, $e_o$ 1.874

COMPRESSION INDEX, $C_c$ ____

TEST SPECIFICATIONS: MOISTURE CONTENT, %

| START OF TEST | DEG. OF SAT. AT START OF TEST | END OF TEST |
|---|---|---|
| 69.7 | 98.9 | 67.5 |

Flooded after loading to 110 KSF




REMARKS Drainage top and bottom
Sample 2.5" diameter, 1" thick
cc = 1.890 - 1.700 - 0.190
Permeability @ 1.25 KSF k = 13.5 x $10^{-5}$

# APPENDIX C: CHEMICAL ANALYSES

## CAUSTIC-POND AREA

# GENERAL ENGINEERING LABORATORIES

Full Service Chemical Testing and Analysis

**Office & Lab.**
1313 Ashley River Road
Charleston, S.C.
Phone (803) 556-8171

**Mailing Address**
P.O. Box 30712
Charleston, S.C. 29407

## Analysis Sheet

Client Geraghty & Miller, Inc.
P.O. Box 271173
Tampa, Florida 33688

Date August 4, 1981
P.O. No.
Requested by Mr. Phil Ciaravella

Sample Identification | Results

Analysis of Monitoring Wells
(July 28, 9181)

| | CP-1 | GP-2 | CP-3 | CP-4 |
|---|---|---|---|---|
| ph | 6.5 | 6.3 | 6.75 | 7.3 |
| Conductivity, MMHOS/CM | 3100 | 7400 | 1970 | 2700 |
| Calcium, mg/L | 250 | 490 | 192 | 101 |
| Chloride, mg/L | 670 | 1340 | 423 | 823 |
| Sulfate, mg/L | 279 | 552 | 116 | 124 |

By [signature]
George C. Greene, PhD

# APPENDIX D: CHEMICAL ANALYSES

## CHEMICAL-DISPOSAL AREA

ENERGY RESOURCES CO. INC

TRACE METAL ANALYSIS

- Report Sheet -

Analyzed for: Geraghty & Miller
Charleston, S.C.

mg/l unless otherwise stated

| ERCO ID | CLIENT ID | F | $NO^3$ | $SO_4$ | TOC | COND umhos/cm |
|---|---|---|---|---|---|---|
| 51-915a | CD-1 | 0.46 | <0.01 | 26 | 110 | 27,000 |
| 51-916 | CD-2 | 0.57 | 0.02 | <1 | 110 | 32,000 |
| 51-917 | CD-3 | 0.13 | 0.23 | 4 | 63 | 1,900 |
| 51-918 | CD-4 | 0.71 | <0.01 | 400 | 190 | 11,000 |
| 51-919 | CD-5 | 0.69 | <0.01 | 61 | 170 | 14,000 |

If customer has any questions regarding analysis, refer to sample in question by its ERCO ID #.

Sample Rcvd. 7/30/81

Reported by

Date Analysis Completed 8/25/81

Checked by

ENERGY RESOURCES CO. INC

## TRACE METAL ANALYSIS

- Report Sheet -

Analyzed for: Geraghty & Miller
Charleston, S.C.

ug/l unless otherwise stated

| ERCO ID | CLIENT ID | Cd | Fe | Pb | Mg mg/l | Hg | Na mg/l |
|---|---|---|---|---|---|---|---|
| 51-915a | CD-1 | <1 | 200 | <5 | 800 | <0.1 | 5500 |
| 51-916 | CD-2 | <1 | 400 | <5 | 820 | <0.1 | 6300 |
| 51-917 | CD-3 | <1 | 46 | <5 | 260 | <0.1 | 2200 |
| 51-918 | CD-4 | <1 | 130 | <5 | 280 | <0.1 | 2500 |
| 51-919 | CD-5 | <1 | 1200 | <5 | 280 | <0.1 | 2800 |

If customer has any questions regarding analysis, refer to sample in question by its ERCO ID #.

Sample Rcvd. 7/30/81 Reported by ______

Date Analysis Completed 8/25/81 Checked by ______

ENERGY RESOURCES CO. INC.

INORGANIC CHEMISTRY LABORATORY

- Report of Chemical Analyses -

Client: Geraghty & Miller
Charleston, S.C.

| ERCO ID | Client ID | Cl Concentration (gm/l) |
|---|---|---|
| 51-915[a] | CD-1 | 7.3 |
| 51-916 | CD-2 | 6.6 |
| 51-917 | CD-3 | 0.2 |
| 51-918 | CD-4 | 1.9 |
| 51-919 | CD-5 | 2.7 |

Sample Rcvd. 7/30/81

Date Completed 8/25/81

Date of this rpt. 5/4/82

Reported by *Kale*

Checked by ____

Sample Rcvd: 7/30/81

Date Analysis Completed: 8/7/81

All Results In: mg/l

Reported By: ____________

Checked By: ____________

ENERGY RESOURCES CO. INC.

VOLATILE ORGANICS ANALYSIS

\- Report Sheet -

Analyzed for: Geraghty & Miller

| Compounds (in order of elution) | CD-1 | CD-2 | CD-3 | CD-4 | CD-5 |
|---|---|---|---|---|---|
| Vinyl chloride | | | | | |
| Methylene chloride | 0.58 | 0.32 | | | |
| 1,1-dichloroethylene | | | | | |
| 1,1-dichloroethane | | | | | |
| trans-1,2-dichloroethylene | | | | | |
| 1,2-dichloroethane | | | | | |
| 1,1,1-trichloroethane | | | | | |
| 1,2-Dichloropropane | | | | | |
| Trichloroethylene | | | | | |
| 1,1,2-Trichloroethane | | | | | |
| Tetrachloroethylene | | | | | |
| Chlorobenzene | | | 0.14 | | 10.68 |
| Unknown | 0.20 | | | | |

Comments: All blank spaces are ND's (none detected) (<0.05 mg/l, or 50 ppb)

Sample Rcvd: 2/12/82
Date Analysis Completed: 2/23/82
All Results In: ug/l (ppb)
Reported By: MS
Checked By: JDW

ENERGY RESOURCES CO. INC.

VOLATILE ORGANICS ANALYSIS

\- Report Sheet -

Analyzed for: G&M SC Navy

| Compounds (in order of elution) | CD-1 13-1239 | CD-2 13-1240 | CD-3 13-1241 | CD-4 13-1242 | CD-5 13-1246 |
|---|---|---|---|---|---|
| Vinyl chloride | | | | | |
| Methylene chloride | 28 | 2000 | 7.5 | 1800 | 1500 |
| 1,1-dichloroethylene | | | | | |
| 1,1-dichloroethane | | | | | |
| 1,2-dichloroethylene | | | | | |
| Chloroform | | | 1.5 | | |
| 1,2-dichloroethane | | | | | |
| 1,1,1-trichloroethane | | | | | |
| Carbon tetrachloride | | | | | |
| Bromodichloromethane | | | | | |
| Trichloroethylene | | | | | |
| Dibromochloromethane | | | | | |
| Bromoform | | | | | |
| 1,1,2,2-Tetrachloroethane | | | | | |

Comments: All blank spaces are ND's (none detected)

ENERGY RESOURCES CO.,INC.

SUMMARY OF BASE/NEUTRAL PRIORITY POLLUTANTS

CLIENT: Geraghty & Miller

CLIENT I.D.: CD 1 DATE SAMPLE RECEIVED: 2/12/82

ERCO I.D.: 13-1239 DATE SAMPLE COMPLETED: 2/28/82

| | BASE/NEUTRAL | ug/l | | BASE/NEUTRAL | ug/l |
|---|---|---|---|---|---|
| 1B | acenaphthene | ND | 68B | di-n-butyl phthalate | ND |
| 2B | benzidine | ND | 69B | di-n-octyl phthalate | ND |
| 3B | 1,2,4-trichlorobenzene | ND | 70B | diethyl phthalate | * |
| 9B | hexachlorobenzene | ND | 71B | dimethyl phthalate | ND |
| 12B | hexachloroethane | ND | 72B | benzo(a)anthracene | ND |
| 18B | bis(2-chloroethyl)ether | ND | 73B | benzo(a)pyrene | ND |
| 20B | 2-chloronaphthalene | ND | 74B | 3,4-benzofluoranthene | ND |
| 25B | 1,2-dichlorobenzene | ND | 75B | benzo(k)fluoranthene | ND |
| 26B | 1,3-dichlorobenzene | ND | 76B | chrysene | ND |
| 27B | 1,4-dichlorobenzene | ND | 77B | acenaphthylene | ND |
| 28B | 3,3-dichlorobenzidine | ND | 78B | anthracene | ND |
| 35B | 2,4-dinitrotoluene | ND | 79B | benzo(ghi)perylene | ND |
| 36B | 2,6-dinitrotoluene | ND | 80B | fluorene | ND |
| 37B | 1,2-diphenylhydrazine | ND | 81B | phenanthrene | ND |
| 39B | fluoranthene | ND | 82B | dibenzo(a,h)anthracene | ND |
| 40B | 4-chlorophenyl phenyl ether | ND | 83B | indeno(1,2,3-cd)pyrene | ND |
| 41B | 4-bromophenyl phenyl ether | ND | 84B | pyrene | ND |
| 42B | bis(2-chloroisopropyl)ether | ND | 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |
| 43B | bis(2-chloroethoxy)methane | ND | | | |
| 52B | hexachlorobutadiene | ND | | | |
| 53B | hexachlorocyclopentadiene | ND | | | |
| 54B | isophorone | ND | | | |
| 55B | naphthalene | ND | | | |
| 56B | nitrobenzene | ND | | | |
| 61B | N-nitrosodimethylamine | ND | | | |
| 62B | N-nitrosodiphenylamine | ND | | | |
| 63B | N-nitrosodi-n-propylamine | ND | | | |
| 66B | bis(2-ethylhexyl)phthalate | * | | | |
| 67B | butyl benzyl phthalate | ND | | | |

ND = Not Detected

NA = Not Applicable

* = 1-9 ug/l

Reported by: MM

Checked by: C Rodgers

ENERGY RESOURCES CO., INC.
SUMMARY OF BASE/NEUTRAL PRIORITY POLLUTANTS

CLIENT: Geraghty & Miller

CLIENT I.D.: CD 2 DATE SAMPLE RECEIVED: 2/12/82

ERCO I.D.: 13-1240 DATE SAMPLE COMPLETED: 2/28/82

| | BASE/NEUTRAL | ug/l |
|---|---|---|
| 1B | acenaphthene | ND |
| 2B | benzidine | ND |
| 3B | 1,2,4-trichlorobenzene | ND |
| 9B | hexachlorobenzene | ND |
| 12B | hexachloroethane | ND |
| 18B | bis(2-chloroethyl)ether | ND |
| 20B | 2-chloronaphthalene | ND |
| 25B | 1,2-dichlorobenzene | ND |
| 26B | 1,3-dichlorobenzene | ND |
| 27B | 1,4-dichlorobenzene | ND |
| 28B | 3,3-dichlorobenzidine | ND |
| 35B | 2,4-dinitrotoluene | ND |
| 36B | 2,6-dinitrotoluene | ND |
| 37B | 1,2-diphenylhydrazine | ND |
| 39B | fluoranthene | ND |
| 40B | 4-chlorophenyl phenyl ether | ND |
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | 34 |
| 67B | butyl benzyl phthalate | ND |

| | BASE/NEUTRAL | ug/l |
|---|---|---|
| 68B | di-n-butyl phthalate | ND |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

ND = Not Detected
NA = Not Applicable
* = 1-9 ug/l

Reported by: NHM
Checked by: C. Rodger

ENERGY RESOURCES CO.,INC.

SUMMARY OF BASE/NEUTRAL PRIORITY POLLUTANTS

CLIENT: Geraghty & Miller

CLIENT I.D.: CD 3 DATE SAMPLE RECEIVED: 2/12/82

ERCO I.D.: 13-1241 DATE SAMPLE COMPLETED: 2/28/82

| | BASE/NEUTRAL | ug/l | | BASE/NEUTRAL | ug/l |
|---|---|---|---|---|---|
| 1B | acenaphthene | ND | 68B | di-n-butyl phthalate | * |
| 2B | benzidine | ND | 69B | di-n-octyl phthalate | ND |
| 3B | 1,2,4-trichlorobenzene | ND | 70B | diethyl phthalate | * |
| 9B | hexachlorobenzene | ND | 71B | dimethyl phthalate | * |
| 12B | hexachloroethane | ND | 72B | benzo(a)anthracene | ND |
| 18B | bis(2-chloroethyl)ether | ND | 73B | benzo(a)pyrene | ND |
| 20B | 2-chloronaphthalene | ND | 74B | 3,4-benzofluoranthene | ND |
| 25B | 1,2-dichlorobenzene | ND | 75B | benzo(k)fluoranthene | ND |
| 26B | 1,3-dichlorobenzene | ND | 76B | chrysene | ND |
| 27B | 1,4-dichlorobenzene | ND | 77B | acenaphthylene | ND |
| 28B | 3,3-dichlorobenzidine | ND | 78B | anthracene | ND |
| 35B | 2,4-dinitrotoluene | ND | 79B | benzo(ghi)perylene | ND |
| 36B | 2,6-dinitrotoluene | ND | 80B | fluorene | ND |
| 37B | 1,2-diphenylhydrazine | ND | 81B | phenanthrene | ND |
| 39B | fluoranthene | ND | 82B | dibenzo(a,h)anthracene | ND |
| 40B | 4-chlorophenyl phenyl ether | ND | 83B | indeno(1,2,3-cd)pyrene | ND |
| 41B | 4-bromophenyl phenyl ether | ND | 84B | pyrene | ND |
| 42B | bis(2-chloroisopropyl)ether | ND | 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |
| 43B | bis(2-chloroethoxy)methane | ND | | | |
| 52B | hexachlorobutadiene | ND | | | |
| 53B | hexachlorocyclopentadiene | ND | | | |
| 54B | isophorone | ND | | | |
| 55B | naphthalene | * | | | |
| 56B | nitrobenzene | ND | | | |
| 61B | N-nitrosodimethylamine | ND | | | |
| 62B | N-nitrosodiphenylamine | ND | | | |
| 63B | N-nitrosodi-n-propylamine | ND | | | |
| 66B | bis(2-ethylhexyl)phthalate | * | | | |
| 67B | butyl benzyl phthalate | ND | | | |

ND = Not Detected

NA = Not Applicable

* = 1-9 ug/l

Reported by: NMM

Checked by: C. Rodger

ENERGY RESOURCES CO.,INC.
SUMMARY OF BASE/NEUTRAL PRIORITY POLLUTANTS

CLIENT: Geraghty & Miller

CLIENT I.D.: CD 4 DATE SAMPLE RECEIVED: 2/12/82

ERCO I.D.: 13-1242 DATE SAMPLE COMPLETED: 2/28/82

| | BASE/NEUTRAL | ug/l |
|---|---|---|
| 1B | acenaphthene | ND |
| 2B | benzidine | ND |
| 3B | 1,2,4-trichlorobenzene | ND |
| 9B | hexachlorobenzene | ND |
| 12B | hexachloroethane | ND |
| 18B | bis(2-chloroethyl)ether | ND |
| 20B | 2-chloronaphthalene | ND |
| 25B | 1,2-dichlorobenzene | ND |
| 26B | 1,3-dichlorobenzene | ND |
| 27B | 1,4-dichlorobenzene | ND |
| 28B | 3,3-dichlorobenzidine | ND |
| 35B | 2,4-dinitrotoluene | ND |
| 36B | 2,6-dinitrotoluene | ND |
| 37B | 1,2-diphenylhydrazine | ND |
| 39B | fluoranthene | ND |
| 40B | 4-chlorophenyl phenyl ether | ND |
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | 15 |
| 67B | butyl benzyl phthalate | ND |

| | BASE/NEUTRAL | ug/l |
|---|---|---|
| 68B | di-n-butyl phthalate | * |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

ND = Not Detected
NA = Not Applicable
* = 1-9 ug/l

Reported by: MHM
Checked by: C. Rodgers

ENERGY RESOURCES CO.,INC.

SUMMARY OF BASE/NEUTRAL PRIORITY POLLUTANTS

CLIENT: Geraghty & Miller

CLIENT I.D.: CD 5 DATE SAMPLE RECEIVED: 2/12/82

ERCO I.D.: 13-1246 DATE SAMPLE COMPLETED: 2/28/82

| | BASE/NEUTRAL | ug/l |
|---|---|---|
| 1B | acenaphthene | ND |
| 2B | benzidine | ND |
| 3B | 1,2,4-trichlorobenzene | ND |
| 9B | hexachlorobenzene | ND |
| 12B | hexachloroethane | ND |
| 18B | bis(2-chloroethyl)ether | ND |
| 20B | 2-chloronaphthalene | ND |
| 25B | 1,2-dichlorobenzene | ND |
| 26B | 1,3-dichlorobenzene | ND |
| 27B | 1,4-dichlorobenzene | ND |
| 28B | 3,3-dichlorobenzidine | ND |
| 35B | 2,4-dinitrotoluene | ND |
| 36B | 2,6-dinitrotoluene | ND |
| 37B | 1,2-diphenylhydrazine | ND |
| 39B | fluoranthene | ND |
| 40B | 4-chlorophenyl phenyl ether | ND |
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | * |
| 67B | butyl benzyl phthalate | ND |

| | BASE/NEUTRAL | ug/l |
|---|---|---|
| 68B | di-n-butyl phthalate | * |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

ND = Not Detected

NA = Not Applicable

* = 1-9 ug/l

Reported by: NH

Checked by: C. Rodgers

## pH MEASUREMENTS OF WATER SAMPLES COLLECTED FROM MONITOR WELLS AT THE CHEMICAL-DISPOSAL AREA[1]

| Well Number | pH 7/27/81 | pH 2/11/82 |
|---|---|---|
| CD-1 | 6.85 | 7.22 |
| CD-2 | 6.85 | 7.10 |
| CD-3 | 7.45 | 8.63 |
| CD-4 | 7.30 | 7.15 |
| CD-5 | 7.30 | 6.68 |

[1] Measured at the time of sample collection.

# APPENDIX E: CHEMICAL ANALYSES

## LANDFILL AREA

ENERGY RESOURCES CO. INC

TRACE METAL ANALYSIS

- Report Sheet -

Analyzed for: Geraghty & Miller
Charleston, S.C.

mg/l unless otherwise stated

| ERCO ID | CLIENT ID | F | $NO^3$ | $SO_4$ | TOC | COND umhos/cm |
|---|---|---|---|---|---|---|
| 51-920 | LF-1 | 0.34 | <0.01 | 28 | 120 | 32,000 |
| 51-921 | LF-2 | 0.16 | 0.10 | 15 | 120 | 6,400 |
| 51-922 | LF-3 | 0.29 | <0.01 | <1 | 88 | 40,000 |
| 51-923 | LF-4 | 0.56 | <0.01 | 600 | 100 | 31,000 |
| 51-924 | LF-5 | 0.53 | <0.01 | <1 | 150 | 36,000 |
| 51-925 | SLF-1 | 0.52 | <0.01 | <1 | 63 | 6,500 |
| 51-926 | SLF-2 | 0.25 | <0.01 | 130 | 67 | 19,000 |
| 51-927 | DLF-1 | 0.16 | 0.25 | 37 | 57 | 580 |

If customer has any questions regarding analysis, refer to sample in question by its ERCO ID #.

Sample Rcvd. 7/30/81

Reported by

Date Analysis Completed 8/25/81

Checked by

ENERGY RESOURCES CO. INC

## TRACE METAL ANALYSIS

- Report Sheet -

Analyzed for: Geraghty & Miller
Charleston, S.C.

ug/l unless otherwise stated

| ERCO ID | CLIENT ID | Cd | Fe | Pb | Mg mg/l | Hg | Na mg/l |
|---|---|---|---|---|---|---|---|
| 51-920 | LF-1 | <1 | 58 | <5 | 760 | 0.4 | 6000 |
| 51-921 | LF-2 | <1 | 80 | <5 | 110 | <0.1 | 1200 |
| 51-922 | LF-3 | <1 | 600 | <5 | 1020 | <0.1 | 7200 |
| 51-923 | LF-4 | <1 | 4100 | <5 | 560 | <0.1 | 5100 |
| 51-924 | LF-5 | <1 | 310 | <5 | 960 | <0.1 | 6800 |
| 51-925 | SLF-1 | <1 | 1700 | <5 | 140 | <0.1 | 1000 |
| 51-926 | SLF-2 | <1 | 320 | <5 | 140 | <0.1 | 3000 |
| 51-927 | DLF-1 | <1 | 36 | <5 | 1.6 | <0.1 | 34 |

If customer has any questions regarding analysis, refer to sample in question by its ERCO ID #.

Sample Rcvd. 7/30/81 Reported by ______

Date Analysis Completed 8/25/81 Checked by ______

ENERGY RESOURCES CO. INC

## INORGANIC ANALYSIS

- Report Sheet -
µg/l

Analyzed for: Geraghty & Miller
Waters

| ERCO ID | CLIENT ID | As | Ba | Cd | Cr | Pb | Hg | Se | Ag |
|---|---|---|---|---|---|---|---|---|---|
| IC-82- | | | | | | | | | |
| 578 | LF-6 | 15 | 380 | <2 | <5 | <5 | <0.1 | <20 | <1 |
| 579 | LF-7 | <10 | 1300 | <2 | <5 | <5 | <0.1 | <20 | <1 |
| 580 | LF-8 | 66 | 590 | <2 | <5 | 18 | <0.1 | <20 | <1 |
| 581 | LF-9 | <10 | 380 | <2 | <5 | 22 | <0.1 | <20 | <1 |
| 581 | ERCO DUPLICATE | -- | 370 | <2 | <5 | 22 | <0.1 | <20 | <1 |
| 582 | LF-10 | <10 | 4620 | <2 | <5 | <5 | <0.1 | <20 | <1 |
| 583 | SLF-1 | <10 | -- | -- | <5 | -- | -- | <20 | <1 |
| 584 | SLF-2 | <10 | -- | -- | <5 | -- | -- | <20 | <1 |
| 585 | LF-1 | 70 | -- | -- | 8.2 | -- | -- | <20 | <1 |
| 586 | LF-3 | 24 | -- | -- | <5 | -- | -- | <20 | <1 |
| 587 | LF-4 | <10 | -- | -- | <5 | -- | -- | <20 | <1 |

If customer has any questions regarding analysis, refer to sample in question by its ERCO ID#.

Sample Rcvd. 2/17/82 Reported by

Date Analysis Completed 3/16/82 Checked by

ENERGY RESOURCES CO. INC.

INORGANIC CHEMISTRY LABORATORY

- Report of Chemical Analyses -

Client: Geraghty & Miller
Charleston, S.C.

| ERCO ID | Client ID | Cl Concentration (gm/l) |
|---|---|---|
| 51-920 | LF-1 | 11.0 |
| 51-921 | LF-2 | 1.6 |
| 51-922 | LF-3 | 7.3 |
| 51-923 | LF-4 | 7.2 |
| 51-924 | LF-5 | 7.1 |
| 51-925 | SLF-1 | 0.93 |
| 51-926 | SLF-2 | 3.8 |
| 51-927 | DLF-1 | 0.07 |

Sample Rcvd. 7/30/81

Date Completed 8/25/81

Date of this rpt. 5/4/82

Reported by *Kah*

Checked by ____________

ENERGY RESOURCES CO. INC.
SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller

IENT I.D. SLF-1

CO I.D. 13-1254

DATE SAMPLE RECEIVED 2/17/82

DATE ANALYSIS COMPLETED 3/1/82

| | ACID COMPOUNDS | µg/l |
|---|---|---|
| A | 2,4,6-trichlorophenol | ND |
| A | p-chloro-m-cresol | ND |
| A | 2-chlorophenol | ND |
| A | 2,4-dichlorophenol | ND |
| A | 2,4-dimethylphenol | ND |
| A | 2-nitrophenol | ND |
| A | 4-nitrophenol | ND |
| A | 2,4-dinitrophenol | ND |
| A | 4,6-dinitro-o-cresol | ND |
| A | pentachlorophenol | ND |
| A | phenol | ND |

| | BASE/NEUTRAL COMPOUNDS | |
|---|---|---|
| | acenaphthene | ND |
| | benzidine | ND |
| | 1,2,4-trichlorobenzene | ND |
| | hexachlorobenzene | ND |
| B | hexachloroethane | ND |
| B | bis(2-chloroethyl)ether | ND |
| B | 2-chloronaphthalene | ND |
| B | 1,2-dichlorobenzene | ND |
| B | 1,3-dichlorobenzene | ND |
| B | 1,4-dichlorobenzene | * |
| B | 3,3-dichlorobenzidine | ND |
| | 2,4-dinitrotoluene | ND |
| B | 2,6-dinitrotoluene | ND |
| | 1,2-diphenylhydrazine | ND |
| | fluoranthene | ND |
| B | 4-chlorophenyl phenyl ether | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | µg/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | * |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | ND |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by: NKY

Checked by: C. Ledger

ENERGY RESOURCES CO. INC.
SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller

IENT I.D. SLF-2 | DATE SAMPLE RECEIVED 2/17/82

CO I.D. 13-1255 | DATE ANALYSIS COMPLETED 3/1/82

| | ACID COMPOUNDS | µg/l |
|---|---|---|
| A | 2,4,6-trichlorophenol | ND |
| A | p-chloro-m-cresol | ND |
| A | 2-chlorophenol | ND |
| A | 2,4-dichlorophenol | ND |
| A | 2,4-dimethylphenol | ND |
| A | 2-nitrophenol | ND |
| A | 4-nitrophenol | ND |
| A | 2,4-dinitrophenol | ND |
| A | 4,6-dinitro-o-cresol | ND |
| A | pentachlorophenol | ND |
| A | phenol | ND |

| | BASE/NEUTRAL COMPOUNDS | |
|---|---|---|
| | acenaphthene | ND |
| | benzidine | ND |
| | 1,2,4-trichlorobenzene | ND |
| | hexachlorobenzene | ND |
| 3 | hexachloroethane | ND |
| 3 | bis(2-chloroethyl)ether | ND |
| 3 | 2-chloronaphthalene | ND |
| 3 | 1,2-dichlorobenzene | ND |
| 3 | 1,3-dichlorobenzene | ND |
| 3 | 1,4-dichlorobenzene | * |
| 3 | 3,3-dichlorobenzidine | ND |
| 3 | 2,4-dinitrotoluene | * |
| 3 | 2,6-dinitrotoluene | ND |
| 3 | 1,2-diphenylhydrazine | ND |
| 3 | fluoranthene | ND |
| 3 | 4-chlorophenyl phenyl ether | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | µg/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | * |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | ND |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by: [signature]

Checked by: C. Rodgers

ENERGY RESOURCES CO. INC.
SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

ıENT Geraghty & Miller

IENT I.D. LF-1

ƆO I.D. 13-1256

DATE SAMPLE RECEIVED 2/17/82

DATE ANALYSIS COMPLETED 3/1/82

| | ACID COMPOUNDS | ug/l |
|---|---|---|
| A | 2,4,6-trichlorophenol | ND |
| A | p-chloro-m-cresol | ND |
| A | 2-chlorophenol | ND |
| . | 2,4-dichlorophenol | ND |
| A | 2,4-dimethylphenol | ND |
| A | 2-nitrophenol | ND |
| A | 4-nitrophenol | ND |
| ' | 2,4-dinitrophenol | ND |
| A | 4,6-dinitro-o-cresol | ND |
| A | pentachlorophenol | ND |
| A | phenol | ND |

| | BASE/NEUTRAL COMPOUNDS | |
|---|---|---|
| | acenaphthene | ND |
| | benzidine | ND |
| | 1,2,4-trichlorobenzene | ND |
| | hexachlorobenzene | ND |
| ; | hexachloroethane | ND |
| ; | bis(2-chloroethyl)ether | ND |
| ; | 2-chloronaphthalene | ND |
| , | 1,2-dichlorobenzene | ND |
| ; | 1,3-dichlorobenzene | ND |
| . | 1,4-dichlorobenzene | ND |
| | 3,3-dichlorobenzidine | ND |
| | 2,4-dinitrotoluene | ND |
| | 2,6-dinitrotoluene | ND |
| . | 1,2-diphenylhydrazine | ND |
| | fluoranthene | ND |
| | 4-chlorophenyl phenyl ether | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | ug/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | * |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | * |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | * |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by: WKM

Checked by: C. Rodgers

ENERGY RESOURCES CO. INC.
SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller
IENT I.D. LF-3 DATE SAMPLE RECEIVED 2/17/82
CO I.D. 13-1257 DATE ANALYSIS COMPLETED 3/1/82

| | ACID COMPOUNDS | ug/l |
|---|---|---|
| A | 2,4,6-trichlorophenol | ND |
| A | p-chloro-m-cresol | ND |
| A | 2-chlorophenol | ND |
| A | 2,4-dichlorophenol | ND |
| A | 2,4-dimethylphenol | ND |
| A | 2-nitrophenol | ND |
| A | 4-nitrophenol | ND |
| A | 2,4-dinitrophenol | ND |
| A | 4,6-dinitro-o-cresol | ND |
| A | pentachlorophenol | ND |
| A | phenol | ND |

| | BASE/NEUTRAL COMPOUNDS | |
|---|---|---|
| | acenaphthene | ND |
| | benzidine | ND |
| | 1,2,4-trichlorobenzene | ND |
| | hexachlorobenzene | ND |
| B | hexachloroethane | ND |
| B | bis(2-chloroethyl)ether | ND |
| B | 2-chloronaphthalene | ND |
| B | 1,2-dichlorobenzene | ND |
| B | 1,3-dichlorobenzene | ND |
| B | 1,4-dichlorobenzene | ND |
| B | 3,3-dichlorobenzidine | ND |
| | 2,4-dinitrotoluene | ND |
| B | 2,6-dinitrotoluene | ND |
| B | 1,2-diphenylhydrazine | ND |
| B | fluoranthene | ND |
| B | 4-chlorophenyl phenyl ether | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | ug/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | 18 |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | ND |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by: [signature]

Checked by: C. Rodgers

ENERGY RESOURCES CO. INC.
SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller

IENT I.D. LF-4 DATE SAMPLE RECEIVED 2/17/82

CO I.D. 13-1258 DATE ANALYSIS COMPLETED 3/1/82

| ACID COMPOUNDS | ug/l |
|---|---|
| 2,4,6-trichlorophenol | ND |
| p-chloro-m-cresol | ND |
| 2-chlorophenol | ND |
| 2,4-dichlorophenol | ND |
| 2,4-dimethylphenol | ND |
| 2-nitrophenol | ND |
| 4-nitrophenol | ND |
| 2,4-dinitrophenol | ND |
| 4,6-dinitro-o-cresol | ND |
| pentachlorophenol | ND |
| phenol | ND |

| BASE/NEUTRAL COMPOUNDS | |
|---|---|
| acenaphthene | ND |
| benzidine | ND |
| 1,2,4-trichlorobenzene | ND |
| hexachlorobenzene | ND |
| hexachloroethane | ND |
| bis(2-chloroethyl)ether | ND |
| 2-chloronaphthalene | ND |
| 1,2-dichlorobenzene | ND |
| 1,3-dichlorobenzene | ND |
| 1,4-dichlorobenzene | ND |
| 3,3-dichlorobenzidine | ND |
| 2,4-dinitrotoluene | ND |
| 2,6-dinitrotoluene | ND |
| 1,2-diphenylhydrazine | ND |
| fluoranthene | ND |
| 4-chlorophenyl phenyl ether | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | ug/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | * |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | * |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by: NHM

Checked by: C. Rodgers

ENERGY RESOURCES CO. INC.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller

IENT I.D. LF-6

CO I.D. 13-1248

DATE SAMPLE RECEIVED 2/17/82

DATE ANALYSIS COMPLETED 3/1/82

| | ACID COMPOUNDS | ug/l |
|---|---|---|
| A | 2,4,6-trichlorophenol | * |
| A | p-chloro-m-cresol | ND |
| A | 2-chlorophenol | ND |
| A | 2,4-dichlorophenol | * |
| A | 2,4-dimethylphenol | ND |
| A | 2-nitrophenol | ND |
| A | 4-nitrophenol | ND |
| A | 2,4-dinitrophenol | ND |
| A | 4,6-dinitro-o-cresol | * |
| A | pentachlorophenol | 15 |
| A | phenol | * |

| | BASE/NEUTRAL COMPOUNDS | |
|---|---|---|
| | acenaphthene | ND |
| | benzidine | ND |
| | 1,2,4-trichlorobenzene | ND |
| | hexachlorobenzene | ND |
| | hexachloroethane | ND |
| | bis(2-chloroethyl)ether | ND |
| | 2-chloronaphthalene | ND |
| | 1,2-dichlorobenzene | ND |
| | 1,3-dichlorobenzene | ND |
| | 1,4-dichlorobenzene | ND |
| | 3,3-dichlorobenzidine | ND |
| | 2,4-dinitrotoluene | ND |
| | 2,6-dinitrotoluene | ND |
| | 1,2-diphenylhydrazine | ND |
| | fluoranthene | ND |
| | 4-chlorophenyl phenyl ether | ND |

ND = Not detected

NA = Not applicable

* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | ug/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | * |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | * |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | * |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | * |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by:

Checked by:

ENERGY RESOURCES CO. INC.
SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller

IENT I.D. LF-7 DATE SAMPLE RECEIVED 2/17/82

CO I.D. 13-1249 DATE ANALYSIS COMPLETED 3/1/82

| | ACID COMPOUNDS | ug/l |
|---|---|---|
| A | 2,4,6-trichloroohenol | ND |
| A | o-chloro-m-cresol | ND |
| A | 2-chlorophenol | ND |
| A | 2,4-dichlorophenol | ND |
| A | 2,4-dimethylphenol | ND |
| A | 2-nitrophenol | ND |
| A | 4-nitrophenol | ND |
| A | 2,4-dinitrophenol | ND |
| A | 4,6-dinitro-o-cresol | ND |
| A | pentachlorophenol | * |
| A | phenol | ND |

| BASE/NEUTRAL COMPOUNDS | ug/l |
|---|---|
| acenaphthene | ND |
| benzidine | ND |
| 1,2,4-trichlorobenzene | ND |
| hexachlorobenzene | ND |
| hexachloroethane | ND |
| bis(2-chloroethyl)ether | ND |
| 2-chloronaphthalene | ND |
| 1,2-dichlorobenzene | ND |
| 1,3-dichlorobenzene | ND |
| 1,4-dichlorobenzene | * |
| 3,3-dichlorobenzidine | ND |
| 2,4-dinitrotoluene | ND |
| 2,6-dinitrotoluene | ND |
| 1,2-diphenylhydrazine | ND |
| fluoranthene | ND |
| 4-chlorophenyl phenyl ether | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | ug/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | 90 |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | ND |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by: [signature]

Checked by: C. Rodgers

ENERGY RESOURCES CO. INC.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller

IENT I.D. LF-8

CO I.D. 13-1250

DATE SAMPLE RECEIVED 2/17/82

DATE ANALYSIS COMPLETED 3/1/82

| | ACID COMPOUNDS | ug/l |
|---|---|---|
| A | 2,4,6-trichlorophenol | ND |
| A | p-chloro-m-cresol | ND |
| A | 2-chlorophenol | ND |
| A | 2,4-dichlorophenol | ND |
| A | 2,4-dimethylphenol | ND |
| A | 2-nitrophenol | ND |
| A | 4-nitrophenol | ND |
| A | 2,4-dinitrophenol | ND |
| A | 4,6-dinitro-o-cresol | ND |
| A | pentachlorophenol | ND |
| A | phenol | ND |

| | BASE/NEUTRAL COMPOUNDS | |
|---|---|---|
| | acenaphthene | ND |
| | benzidine | ND |
| | 1,2,4-trichlorobenzene | ND |
| | hexachlorobenzene | ND |
| B | hexachloroethane | ND |
| B | bis(2-chloroethyl)ether | ND |
| B | 2-chloronaphthalene | ND |
| B | 1,2-dichlorobenzene | ND |
| B | 1,3-dichlorobenzene | ND |
| B | 1,4-dichlorobenzene | ND |
| B | 3,3-dichlorobenzidine | ND |
| B | 2,4-dinitrotoluene | ND |
| B | 2,6-dinitrotoluene | ND |
| B | 1,2-diphenylhydrazine | ND |
| B | fluoranthene | ND |
| B | 4-chlorophenyl phenyl ether | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | ug/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | 65 |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | * |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by: 

Checked by: 

ENERGY RESOURCES CO. INC.
SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller

IENT I.D. LF-9 | DATE SAMPLE RECEIVED 2/17/82

CO I.D. 13-1251 | DATE ANALYSIS COMPLETED 3/1/82

| ACID COMPOUNDS | µg/l |
|---|---|
| 2,4,6-trichlorophenol | ND |
| p-chloro-m-cresol | ND |
| 2-chlorophenol | ND |
| 2,4-dichlorophenol | ND |
| 2,4-dimethylphenol | ND |
| 2-nitrophenol | ND |
| 4-nitrophenol | ND |
| 2,4-dinitrophenol | ND |
| 4,6-dinitro-o-cresol | ND |
| pentachlorophenol | ND |
| phenol | ND |

| BASE/NEUTRAL COMPOUNDS | µg/l |
|---|---|
| acenaphthene | ND |
| benzidine | ND |
| 1,2,4-trichlorobenzene | ND |
| hexachlorobenzene | ND |
| hexachloroethane | ND |
| bis(2-chloroethyl)ether | ND |
| 2-chloronaphthalene | ND |
| 1,2-dichlorobenzene | ND |
| 1,3-dichlorobenzene | ND |
| 1,4-dichlorobenzene | ND |
| 3,3-dichlorobenzidine | ND |
| 2,4-dinitrotoluene | ND |
| 2,6-dinitrotoluene | ND |
| 1,2-diphenylhydrazine | ND |
| fluoranthene | ND |
| 4-chlorophenyl phenyl ether | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | µg/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | * |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | ND |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | ND |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by: N H

Checked by: C Rodgers

ENERGY RESOURCES CO. INC.
SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller
IENT I.D. LF-10 | DATE SAMPLE RECEIVED 2/17/82
CO I.D. 13-1252 | DATE ANALYSIS COMPLETED 3/1/82

| | ACID COMPOUNDS | µg/l |
|---|---|---|
| A | 2,4,6-trichlorophenol | ND |
| A | p-chloro-m-cresol | ND |
| A | 2-chlorophenol | ND |
| A | 2,4-dichlorophenol | * |
| A | 2,4-dimethylphenol | ND |
| A | 2-nitrophenol | ND |
| A | 4-nitrophenol | ND |
| A | 2,4-dinitrophenol | ND |
| A | 4,6-dinitro-o-cresol | ND |
| A | pentachlorophenol | ND |
| A | phenol | * |

| | BASE/NEUTRAL COMPOUNDS | |
|---|---|---|
| | acenaphthene | * |
| | benzidine | ND |
| | 1,2,4-trichlorobenzene | ND |
| | hexachlorobenzene | ND |
| B | hexachloroethane | ND |
| B | bis(2-chloroethyl)ether | ND |
| B | 2-chloronaphthalene | ND |
| B | 1,2-dichlorobenzene | ND |
| B | 1,3-dichlorobenzene | ND |
| B | 1,4-dichlorobenzene | ND |
| B | 3,3-dichlorobenzidine | ND |
| B | 2,4-dinitrotoluene | ND |
| B | 2,6-dinitrotoluene | ND |
| B | 1,2-diphenylhydrazine | ND |
| B | fluoranthene | ND |
| B | 4-chlorophenyl phenyl ether | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

| | BASE NEUTRAL COMPOUNDS | µg/l |
|---|---|---|
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | 23 |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | * |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | * |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene /phenanthrene | * |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | See 78B |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

Reported by: [signature]

Checked by: C. Rodgers

ENERGY RESOURCES CO. INC.

SUMMARY OF ORGANIC PRIORITY POLLUTANT ANALYSIS

IENT Geraghty & Miller

IENT I.D. Procedural Blank — DATE SAMPLE RECEIVED 2/17/82

CO I.D. 13-1253 — DATE ANALYSIS COMPLETED 3/1/82

| | ACID COMPOUNDS | ug/l |
|---|---|---|
| A | 2,4,6-trichlorophenol | ND |
| A | p-chloro-m-cresol | ND |
| A | 2-chlorophenol | ND |
| A | 2,4-dichlorophenol | ND |
| A | 2,4-dimethylphenol | ND |
| A | 2-nitrophenol | ND |
| A | 4-nitrophenol | ND |
| A | 2,4-dinitrophenol | ND |
| A | 4,6-dinitro-o-cresol | ND |
| A | pentachlorophenol | ND |
| A | phenol | ND |

| | BASE/NEUTRAL COMPOUNDS | ug/l |
|---|---|---|
| | acenaphthene | ND |
| | benzidine | ND |
| | 1,2,4-trichlorobenzene | ND |
| | hexachlorobenzene | ND |
| B | hexachloroethane | ND |
| B | bis(2-chloroethyl)ether | ND |
| B | 2-chloronaphthalene | ND |
| B | 1,2-dichlorobenzene | ND |
| B | 1,3-dichlorobenzene | ND |
| B | 1,4-dichlorobenzene | ND |
| B | 3,3-dichlorobenzidine | ND |
| B | 2,4-dinitrotoluene | ND |
| B | 2,6-dinitrotoluene | ND |
| B | 1,2-diphenylhydrazine | ND |
| B | fluoranthene | ND |
| B | 4-chlorophenyl phenyl ether | ND |
| 41B | 4-bromophenyl phenyl ether | ND |
| 42B | bis(2-chloroisopropyl)ether | ND |
| 43B | bis(2-chloroethoxy)methane | ND |
| 52B | hexachlorobutadiene | ND |
| 53B | hexachlorocyclopentadiene | ND |
| 54B | isophorone | ND |
| 55B | naphthalene | ND |
| 56B | nitrobenzene | ND |
| 61B | N-nitrosodimethylamine | ND |
| 62B | N-nitrosodiphenylamine | ND |
| 63B | N-nitrosodi-n-propylamine | ND |
| 66B | bis(2-ethylhexyl)phthalate | * |
| 67B | butyl benzyl phthalate | ND |
| 68B | di-n-butyl phthalate | ND |
| 69B | di-n-octyl phthalate | ND |
| 70B | diethyl phthalate | ND |
| 71B | dimethyl phthalate | ND |
| 72B | benzo(a)anthracene | ND |
| 73B | benzo(a)pyrene | ND |
| 74B | 3,4-benzofluoranthene | ND |
| 75B | benzo(k)fluoranthene | ND |
| 76B | chrysene | ND |
| 77B | acenaphthylene | ND |
| 78B | anthracene | ND |
| 79B | benzo(ghi)perylene | ND |
| 80B | fluorene | ND |
| 81B | phenanthrene | ND |
| 82B | dibenzo(a,h)anthracene | ND |
| 83B | indeno(1,2,3-cd)pyrene | ND |
| 84B | pyrene | ND |
| 129B | 2,3,7,8-tetrachlorodibenzo-p-dioxin | ND |

ND = Not detected
NA = Not applicable
* = 1-9 ug/l

Reported by:

Checked by: C. Rodgers

Sample Rcvd: 7/30/81
Date Analysis
Completed: 8/7/81
All Results In: mg/l
Reported By:
Checked By:

ENERGY RESOURCES CO. INC.

VOLATILE ORGANICS ANALYSIS

- Report Sheet -

Analyzed for: Geraghty & Miller

| Compounds (in order of elution) | DLF-1 | SLF-1 | SLF-2 |
|---|---|---|---|
| Vinyl chloride | | | |
| Methylene chloride | | 0.09 | 0.57 |
| 1,1-dichloroethylene | | | |
| 1,1-dichloroethane | | | |
| trans-1,2-dichloroethylene | | | |
| 1,2-dichloroethane | | | |
| 1,1,1-trichloroethane | | | |
| 1,2-Dichloropropane | | | |
| Trichloroethylene | | | |
| 1,1,2-Trichloroethane | | | |
| Tetrachloroethylene | | | |
| Chlorobenzene | | | |
| Unknown | | | |

Comments: All blank spaces are ND's (none detected) (<0.05 mg/l, or 50 ppb)

Sample Rcvd: 7/30/81
Date Analysis
Completed: 8/7/81
All Results In: mg/l
Reported By:
Checked By:

ENERGY RESOURCES CO. INC.

VOLATILE ORGANICS ANALYSIS

\- Report Sheet -

Analyzed for: Geraghty & Miller

| Compounds (in order of elution) | LF-1 | LF-2 | LF-3 | LF-4 | LF-5 |
|---|---|---|---|---|---|
| Vinyl chloride | | | | | |
| Methylene chloride | 0.07 | | 0.22 | | |
| 1,1-dichloroethylene | | | | | |
| 1,1-dichloroethane | | | | | |
| trans-1,2-dichloroethylene | | | | | |
| 1,2-dichloroethane | | | | | |
| 1,1,1-trichloroethane | | | | | |
| 1,2-Dichloropropane | | | | | |
| Trichloroethylene | | | | | |
| 1,1,2-Trichloroethane | | | | | |
| Tetrachloroethylene | | | | | |
| Chlorobenzene | | 0.05 | | | |
| Unknown | | | | | |

Comments: All blank spaces are ND's (none detected) (<0.05 mg/l, or 50 ppb)

Sample Rcvd: 2/17/82
Date Analysis Completed: 3/15/82
All Results In: μg/l (ppb)
Reported By:
Checked By:

Analyzed for: G & M SC Navy

ENERGY RESOURCES CO. INC.

VOLATILE ORGANICS ANALYSIS

- Report Sheet -

| Compounds (in order of elution) | LF-6 13-1248 | LF-7 13-1249* | LF-8 13-1250 | LF-9 13-1251 | LF-10 13-1252** |
|---|---|---|---|---|---|
| Vinyl chloride | | 24 | | | |
| Methylene chloride | 3.2 | 2.2 | 650 | 1600 | 145 |
| 1,1-dichloroethylene | | | | | |
| 1,1-dichloroethane | | | | | |
| 1,2-dichloroethylene | | | | | |
| Chloroform | 5.4 | 1.2 | 1.3 | 3.1 | |
| 1,2-dichloroethane | | | | | |
| 1,1,1-trichloroethane | | | | | |
| Carbon tetrachloride | | | | | |
| Bromodichloromethane | | | | | |
| Trichloroethylene | | | | | |
| Dibromochloromethane | | | 2.5 | 3.4 | |
| Bromoform | | | | | |
| Tetrachloroethylene | | | | | |

Comments: All blank spaces are ND's (none detected).
*2.9 ppb chlorobenzene
**~2 ppb. 1,2-dichloropropane (tentative ID)

ENERGY RESOURCES CO. INC

## PCB ANALYSIS

Sample Rcvd: 2/17/82

Date Analysis Completed: 3/22/82

All Results In: μg/l (ppb)

Reported By: [signature]

Checked By: [signature]

Analyzed for: Geraghty & Miller

| Client ID: | DET. LIMIT | LF-6<br>13-1248 | LF-7<br>13-1249 | LF-8<br>13-1250 | LF-9<br>13-1251 | LF-10<br>13-1252 | Procedural Blank<br>13-1253 | SLF-1<br>13-1254 | SLF-2<br>13-1255 | LF-1<br>13-1256 | LF-3<br>13-1257 | LF-4<br>13-1258 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aroclor 1221 | 0.1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Aroclor 1232 | 0.1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Aroclor 1016 | 0.1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Aroclor 1242 | 0.1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Aroclor 1248 | 0.1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Aroclor 1254 | 0.1 | 0.1 | ND | <.1 | ND | ND | ND | ND | <.1 | <.1 | ND | ND |
| Aroclor 1260 | 0.1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| Aroclor 1262 | 0.1 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |

Comments:

ND = not detected.

## pH MEASUREMENTS OF WATER SAMPLES COLLECTED FROM MONITOR WELLS AT THE LANDFILL AREA[1]

| Well Number | pH 7/28/81 | pH 2/15/82 |
|---|---|---|
| LF-1 | 7.40 | 7.20 |
| LF-2 | 7.55 | - |
| LF-3 | 7.40 | 7.39 |
| LF-4 | 7.35 | 7.32 |
| LF-5 | 7.80 | - |
| LF-6 | - | 8.02 |
| LF-7 | - | 7.02 |
| LF-8 | - | 7.50 |
| LF-9 | - | 7.19 |
| LF-10 | - | 8.74 |
| SLF-1 | - | 7.04 |
| SLF-2 | 7.70 | 7.42 |
| DLF-1 | 8.85 | - |

[1] Measured at the time of sample collection.

# APPENDIX F: CHEMICAL ANALYSES

## PESTICIDE-MIXING AREA

ENERGY RESOURCES CO. INC

INORGANIC ANALYSIS

- Report Sheet -
- µg/l

Analyzed for: Geraghty & Miller
Sediments - waters

| ERCO ID | CLIENT ID | As |
|---|---|---|
| IC-82- | | |
| | Waters | µg/l |
| 576 | WPA-1 | <10 |
| 577 | WPA-2 | <10 |
| 577 ERCO | DUPLICATE | <10 |

If customer has any questions regarding analysis, refer to sample in question by its ERCO ID#.

Sample Rcvd. 2/17/82 Reported by

Date Analysis Completed 3/16/82 Checked by

ENERGY RESOURCES CO. INC

INORGANIC ANALYSIS

- Report Sheet -
μg/gm dry wgt.

Analyzed for: Geraghty & Miller
Sediments

| ERCO ID | CLIENT ID | As |
|---|---|---|
| IC-82 | | |
| 554 | PA-1 | 6.3 |
| 555 | PA-2 | 2.8 |
| 556 | PA-3 | 3.9 |
| 556 ERCO | DUPLICATE | 3.0 |
| 557 | PA-4 | 1.1 |
| 558 | PA-5 | 2.9 |
| 559 | PA-6 | 4.2 |
| 560 | PA-7 | 5.7 |
| 561 | PA-8 | 4.8 |

F-2

If customer has any questions regarding analysis, refer to sample in question by its ERCO ID#.

Sample Rcvd. 2/17/82 Reported by Laa

Date Analysis Completed 3/16/82 Checked by NGL

ENERGY RESOURCES CO. INC.

HERBICIDE ANALYSES

| | | 2,4-D (µg/l) | | 2,4,5-TP (µg/l) | |
|---|---|---|---|---|---|
| ERCO ID | G&M ID | Det. Limit | Conc. | Det. Limit | Conc. |
| 28-552 | WPA-1 | 0.05 | ND | 0.02 | ND |
| 28-553 | WPA-2 | 0.05 | ND | 0.02 | ND |
| 28-554 | PA-1 | 5.0 | ND | 1.5 | ND |
| 28-555 | PA-2 | 5.0 | ND | 1.5 | ND |
| 28-556 | PA-3 | 5.0 | ND | 1.5 | ND |
| 28-557 | PA-4 | 5.0 | ND | 1.5 | ND |
| 28-558 | PA-5 | 5.0 | ND | 1.5 | ND |
| 28-559 | Soil Blank | 5.0 | ND | 1.5 | ND |
| 28-560 | PA-7 | 5.0 | ND | 1.5 | ND |
| 28-561 | PA-8 | 5.0 | ND | 1.5 | ND |
| 28-562 | PA-9 | 5.0 | ND | 1.5 | ND |

ND = none detected

Reported by: George Perry

Checked by: ADW

ENERGY RESOURCES COMPANY INC.

Sample Rcvd: 2/17/82

Date Analysis Completed: 3/25/82

| Analyzed for: Client ID | WPA-1 | WPA-2 | PA-1 | PA-2 | PA-3 | PA-4 | PA-5 | blank | PA-6 | PA-7 | PA-8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Compounds | 28-552 | 28-553 | 28-554 | 28-555 | 28-556 | 28-557 | 28-558 | 28-559 | 28-560 | 28-561 | 28-561 |
| 1. 89P aldrin | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 2. 90P dieldrin | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 3. 91P chlordane | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 4. 92P 4,4'-DDT | ND | ND | 100 | 40 | 880 | 7 | 6 | ND | 20 | 200 | 4 |
| 5. 93P 4,4'-DDE | ND | ND | 230 | 40 | 350 | 4 | 7 | ND | 15 | 250 | 3 |
| 6. 94P 4,4'-DDD | ND | ND | 11 | 7 | 150 | ND | ND | ND | 1 | 18 | ND |
| 7. 95P α-endosulfan | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 8. 96P β-endosulfan | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 9. 97P endosulfan sulfate | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 10. 98P endrin | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 11. 99P endrin aldehyde | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 12. 100P heptachlor | ND | ND | ND | ND | 2 | ND | ND | ND | ND | 1.0 | ND |
| 13. 101P heptachlor epoxide | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 14. 102P α-BHC | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 15. 103P β-BHC | ND | ND | ND | ND | 1 | ND | ND | ND | ND | 1 | ND |
| 16. 104P γ-BHC | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 17. 105P δ-BHC | ND | ND | ND | ND | 2 | ND | ND | ND | ND | 1 | ND |
| 18. 106P PCB-1242 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 19. 107P PCB-1254 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 20. 108P PCB-1221 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 21. 109P PCB-1232 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 22. 110P PCB-1248 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 23. 111P PCB-1260 | ND | ND | 39 | ND | 100 | 2 | 2 | ND | 7 | 36 | 1 |
| 24. 112P PCB-1016 | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |
| 25. 113P toxaphene | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND | ND |

*-1-9 µg/l
**- ·1 µg/l

All results in µg/l (ppb) or ng/gm

Reported by:

Checked by:

pH MEASUREMENTS OF WATER SAMPLES
COLLECTED FROM MONITOR WELLS AT THE
PESTICIDE-MIXING AREA,
FEBRUARY 12, 1982[1]

| Well Number | pH |
|---|---|
| WPA-1 | 6.02 |
| WPA-2 | 6.04 |

[1] Measured at the time of sample collection.

**ENVIRONMENTAL SCIENCE CORPORATION**

P.O. BOX 616
50 WALNUT STREET • MIDDLETOWN, CONN. 06457
TELEPHONE: 347-6961

Laboratory Report

LAB. REPORT NO. C-0440

State Certification No. PH-0476

CLIENT
Commanding Officer
Southern Division
Naval Facilities Command
2144 Melbourne Street
P.O. Box 10068
Charleston, S.C. 29411

DATE May 17, 1982

CLIENT PHONE NO (803) 743-5510

SPECIAL INSTRUCTIONS: 0004

| SAMPLE DESCRIPTION | TEST | RESULTS | |
|---|---|---|---|
| Pesticide Mixing Area 2" Sample #1 | D,P DDT | 5.3 | µg/ml (ppm) |
| | P,P DDT | <0.01 | µg/gr (ppm) |
| | DDT total | 5.3 | µg/ml |
| | 2,4 D | <0.01 | µg/gr (ppm) |
| | 2,4,5 TP (Silvex) | 0.51 | µg/gr (ppm) |
| Pesticide Mixing Area 2" Sample #2 | D,D DDT | 0.08 | µg/gr |
| | P,P DDT | 1.4 | µg/gr |
| | Total DDT | 1.48 | µg/gr (ppm) |
| | 2,4 D | 0.09 | µg/gr (ppm) |
| | 2,4,5 TP (Silvex) | <0.01 | µg/gr (ppm) |

ANALYSES OF SOIL SAMPLES COLLECTED BY NAVAL PERSONNEL, May 1982.

REMARKS

June 15, 1982
DATE REPORTED

LABORATORY DIRECTOR

# APPENDIX G: CHEMICAL ANALYSES
# ELECTRICAL TRANSFORMER STORAGE AREA

# GENERAL ENGINEERING LABORATORIES

Full Service Chemical Testing and Analysis

**Office & Lab.**
1313 Ashley River Road
Charleston, S.C.
Phone (803) 556-8171

**Mailing Address**
P.O. Box 30712
Charleston, S.C. 29407


## Analysis Sheet

| | |
|---|---|
| Client Geraghty & Miller, Inc.<br>P.O. Box 271173<br>Tampa, Florida 33688 | Date July 16, 1981<br>P.O. No.<br>Requested by Mr. Peter Palmer |

**Sample Identification**

Analysis of Soil Samples for PCBs

**Results**

| Sample Identification | PCB Concentration |
|---|---|
| Sample A | <10 mg/kg |
| Sample B | <10 mg/kg |
| Sample C | <10 mg/kg |
| Sample D | <10 mg/kg |
| Sample E | <10 mg/kg |
| Sample F | <10 mg/kg |

By [signature]
George C. Greene, PhD

ENERGY RESOURCES CO. INC

INORGANIC ANALYSIS

- Report Sheet -
µg/gm dry wgt.

Analyzed for: Geraghty & Miller
Sediments

| ERCO ID | CLIENT ID | As |
|---|---|---|
| IC-82 | | |
| 562 | OC-1 | 6.7 |
| 563 | OC-2 | 6.0 |
| 564 | OC-3 | 15.5 |
| 565 | OC-4 | 4.1 |
| 566 | OC-5 | 2.1 |
| 567 | OC-6 | 10.2 |
| 568 | OC-7 | 7.3 |
| 569 | OC-8 | 6.9 |



If customer has any questions regarding analysis, refer to sample in question by its ERCO ID#.

Sample Rcvd. 2/17/82 Reported by *Lax*

Date Analysis Completed 3/16/82 Checked by *[signature]*

ENERGY RESOURCES CO. INC

INORGANIC ANALYSIS

- Report Sheet -
μg/gm dry wgt. - μg/l

Analyzed for: Geraghty & Miller
Sediments - waters

| ERCO ID | CLIENT ID | As |
|---|---|---|
| IC-82- | | |
| | **Sediments** | μg/gm |
| 570 | OC-9 | 3.9 |
| 570 | ERCO DUPLICATE | 3.3 |
| 571 | OC-10 | 5.1 |
| 572 | OC-11 | 2.8 |
| 573 | OC-12 | 1.3 |
| | **Waters** | μg/l |
| 574 | WOC-1 | 19 |
| 575 | WOC-2 | 13 |

If customer has any questions regarding analysis, refer to sample in question by its ERCO ID#.

Sample Rcvd. 2/17/82    Reported by Laa

Date Analysis Completed 3/16/82    Checked by [signature]

ENERGY RESOURCES CO. INC.
PESTICIDE ANALYSIS REPORT

Analyzed for: Geraghty & Miller    All results in: μg/l (ppb)

| Client ID: | WOC-1 | WOC-2 |
|---|---|---|
| 89P aldrin | ND | ND |
| 90P dieldrin | ND | ND |
| 91P chlordane | ND | ND |
| 92P 4,4'-DDT | 0.2 | ND |
| 93P 4,4'-DDE | ND | ND |
| 94P 4,4'-DDD | ND | 0.1 |
| 95P alpha-endosulfan | ND | ND |
| 96P beta-endosulfan | ND | ND |
| 97P endosulfan sulfate | ND | ND |
| 98P endrin | ND | ND |
| 99P endrin aldehyde | ND | ND |
| 100P heptachlor | ND | ND |
| 101P heptachlor epoxide | ND | ND |
| 102P alpha-BHC | ND | 1.0 |
| 103P beta-BHC | ND | ND |
| 104P gamma-BHC | ND | 1.0 |
| 105P delta-BHC | ND | 1.0 |
| 106P PCB-1242 | ND | ND |
| 107P PCB-1254 | ND | ND |
| 108P PCB-1221 | ND | ND |
| 109P PCB-1232 | ND | ND |
| 110P PCB-1248 | ND | ND |
| 111P PCB-1260 | 0.2 | 0.6 |
| 112P PCB-1016 | ND | ND |
| 113P toxaphene | ND | ND |

Sample Received: 2/17/82    Reported by: E. Kwang
Date Completed: 3/25/82    Checked by: [signature]
Comments: ND = not detected (less than 1. μg/l)

ENERGY RESOURCES CO. INC.
PESTICIDE ANALYSIS REPORT

Analyzed for: Geraghty & Miller    All results in: ng/gm (ppb)

| Client ID: | OC-1 | OC-2 | OC-3 | OC-4 | OC-5 |
|---|---|---|---|---|---|
| 89P aldrin | ND | ND | ND | ND | ND |
| 90P dieldrin | ND | ND | ND | ND | ND |
| 91P chlordane | ND | ND | ND | ND | ND |
| 92P 4,4'-DDT | 28,000. | 4,400. | 1,600. | 100. | 7. |
| 93P 4,4'-DDE | 11,000. | 3,600. | 1,300. | 230. | 9. |
| 94P 4,4'-DDD | 6,100. | 1,400. | 720. | 7. | 1. |
| 95P alpha-endosulfan | ND | ND | ND | ND | ND |
| 96P beta-endosulfan | ND | ND | ND | ND | ND |
| 97P endosulfan sulfate | ND | ND | ND | ND | ND |
| 98P endrin | ND | ND | ND | ND | ND |
| 99P endrin aldehyde | ND | ND | ND | ND | ND |
| 100P heptachlor | 7. | ND | 1. | 2. | 1. |
| 101P heptachlor epoxide | ND | ND | ND | ND | ND |
| 102P alpha-BHC | 60. | 2. | 2. | ND | ND |
| 103P beta-BHC | 120. | 77. | ND | ND | ND |
| 104P gamma-BHC | 150. | ND | ND | ND | ND |
| 105P delta-BHC | 780. | 4. | 17. | 1. | ND |
| 106P PCB-1242 | ND | ND | ND | ND | ND |
| 107P PCB-1254 | ND | ND | ND | ND | ND |
| 108P PCB-1221 | ND | ND | ND | ND | ND |
| 109P PCB-1232 | ND | ND | ND | ND | ND |
| 110P PCB-1248 | ND | ND | ND | ND | ND |
| 111P PCB-1260 | ND | 62,000. | 37,000. | 675. | 150. |
| 112P PCB-1016 | ND | ND | ND | ND | ND |
| 113P toxaphene | ND | ND | ND | ND | ND |

Sample Received: 2/17/82    Reported by: E. Kwong
Date Completed: 3/25/82    Checked by: [signature]
Comments: ND = not detected (less than 1. ng/gm)

G-5

ENERGY RESOURCES CO. INC.
PESTICIDE ANALYSIS REPORT

Analyzed for: Geraghty & Miller        All results in: ng/gm (ppb)

| Client ID: | | OC-6 | OC-7 | OC-8 | OC-9 | OC-10 |
|---|---|---|---|---|---|---|
| 89P | aldrin | ND | ND | ND | ND | ND |
| 90P | dieldrin | ND | ND | ND | ND | ND |
| 91P | chlordane | ND | ND | ND | ND | ND |
| 92P | 4,4'-DDT | 1,100. | 13,000. | 3,200. | 29. | 11,000. |
| 93P | 4,4'-DDE | 560. | 3,300. | 600. | 18. | 2,900. |
| 94P | 4,4'-DDD | 94. | 2,700. | 1,400. | 17. | 2,600. |
| 95P | alpha-endosulfan | ND | ND | ND | ND | ND |
| 96P | beta-endosulfan | ND | ND | ND | ND | ND |
| 97P | endosulfan sulfate | ND | ND | ND | ND | ND |
| 98P | endrin | ND | ND | ND | ND | ND |
| 99P | endrin aldehyde | ND | ND | ND | ND | ND |
| 100P | heptachlor | 1. | 1. | ND | ND | 10. |
| 101P | heptachlor epoxide | ND | ND | ND | ND | ND |
| 102P | alpha-BHC | ND | 2. | 1. | 1. | 5. |
| 103P | beta-BHC | ND | 20. | 14. | ND | 45. |
| 104P | gamma-BHC | 1. | 44. | 22. | ND | 43. |
| 105P | delta-BHC | 1. | 150. | 88. | 1. | 171. |
| 106P | PCB-1242 | ND | ND | ND | ND | ND |
| 107P | PCB-1254 | ND | ND | ND | ND | ND |
| 108P | PCB-1221 | ND | ND | ND | ND | ND |
| 109P | PCB-1232 | ND | ND | ND | ND | ND |
| 110P | PCB-1248 | ND | ND | ND | ND | ND |
| 111P | PCB-1260 | 3,200. | 3,000. | 1,100. | 170. | 530. |
| 112P | PCB-1016 | ND | ND | ND | ND | ND |
| 113P | toxaphene | ND | ND | ND | ND | ND |

Sample Received: 2/17/82        Reported by: E. Kwong
Date Completed: 3/25/82        Checked by: [signature]
Comments: ND = not detected (less than 1. ng/gm)

ENERGY RESOURCES CO. INC.
PESTICIDE ANALYSIS REPORT

Analyzed for: Geraghty & Miller  All results in: ng/gm (ppb)

| Client ID: | | OC-11 | OC-12 | Blank | OC-9* | OC-10* |
|---|---|---|---|---|---|---|
| 89P | aldrin | ND | ND | ND | ND | ND |
| 90P | dieldrin | ND | ND | ND | ND | ND |
| 91P | chlordane | ND | ND | ND | ND | ND |
| 92P | 4,4'-DDT | 40,000. | 1,200. | ND | 48. | 14,000. |
| 93P | 4,4'-DDE | 8,200. | 590. | ND | 20. | 3,100. |
| 94P | 4,4'-DDD | 6,900. | 380. | ND | 23. | 3,000. |
| 95P | alpha-endosulfan | ND | ND | ND | ND | ND |
| 96P | beta-endosulfan | ND | ND | ND | ND | ND |
| 97P | endosulfan sulfate | ND | ND | ND | ND | ND |
| 98P | endrin | ND | ND | ND | ND | ND |
| 99P | endrin aldehyde | ND | ND | ND | ND | ND |
| 100P | heptachlor | 29. | ND | ND | ND | 8. |
| 101P | heptachlor epoxide | ND | ND | ND | ND | ND |
| 102P | alpha-BHC | 25. | 1. | ND | 1. | 10. |
| 103P | beta-BHC | 140. | 2. | ND | ND | 62. |
| 104P | gamma-BHC | 150. | 3. | ND | ND | 64. |
| 105P | delta-BHC | 660. | ND | ND | 1. | 240. |
| 106P | PCB-1242 | ND | ND | ND | ND | ND |
| 107P | PCB-1254 | ND | ND | ND | ND | ND |
| 108P | PCB-1221 | ND | ND | ND | ND | ND |
| 109P | PCB-1232 | ND | ND | ND | ND | ND |
| 110P | PCB-1248 | ND | ND | ND | ND | ND |
| 111P | PCB-1260 | 11,000. | ND | ND | 180. | 510. |
| 112P | PCB-1016 | ND | ND | ND | ND | ND |
| 113P | toxaphene | ND | ND | ND | ND | ND |

Sample Received: 2/17/82  Reported by: E. Hwang
Date Completed: 3/25/82  Checked by: [signature]

Comments: ND = not detected (less than 1. ng/gm)
*Duplicate

# pH MEASUREMENTS OF WATER SAMPLES COLLECTED FROM MONITOR WELLS AT THE ELECTRICAL TRANSFORMER STORAGE AREA, FEBRUARY 12, 1982[1]

| Well Number | pH |
|---|---|
| WOC-1 | 7.36 |
| WOC-2 | 7.33 |

[1] Measured at the time of sample collection.

# APPENDIX H: CHEMICAL ANALYSES

## OIL-SLUDGE PITS

ENERGY RESOURCES CO. INC.

INORGANIC CHEMISTRY LABORATORY

- Report of Chemical Analyses -

Client: Geraghty & Miller
Charleston, S.C.

| ERCO ID | Client ID | Cl Concentration (gm/l) |
|---|---|---|
| 51-928 | OP-1 | 6.0 |
| 51-929 | OP-3 | 1.4 |

Sample Rcvd. 7/30/81
Date Completed 8/25/81
Date of this rpt. 5/4/82
Reported by Kale
Checked by

ENERGY RESOURCES CO. INC

TRACE METAL ANALYSIS

- Report Sheet -

Analyzed for: Geraghty & Miller
Charleston, S.C.

mg/l unless otherwise stated

| ERCO ID | CLIENT ID | F | $NO^3$ | $SO_4$ | TOC | COND umhos/cm |
|---|---|---|---|---|---|---|
| 51-928 | OP-1 | -- | -- | <1 | -- | -- |
| 51-929 | OP-3 | -- | -- | 780 | -- | -- |

If customer has any questions regarding analysis, refer to sample in question by its ERCO ID #.

Sample Rcvd. 7/30/81

Reported by ____________

Date Analysis Completed 8/25/81

Checked by ____________

Sample Rcvd: 7/30/81

Date Analysis Completed: 8/7/81

All Results In: mg/l

Reported By: ____________

Checked By: ____________

ENERGY RESOURCES CO. INC.

VOLATILE ORGANICS ANALYSIS

- Report Sheet -

Analyzed for: Geraghty & Miller

| Compounds (in order of elution) | OP-1 | OP-3 |
|---|---|---|
| Vinyl chloride | | |
| Methylene chloride | 0.84 | 0.17 |
| 1,1-dichloroethylene | | |
| 1,1-dichloroethane | | |
| trans-1,2-dichloroethylene | | |
| 1,2-dichloroethane | | |
| 1,1,1-trichloroethane | | |
| 1,2-Dichloropropane | | |
| Trichloroethylene | | |
| 1,1,2-Trichloroethane | | |
| Tetrachloroethylene | | |
| Chlorobenzene | | |
| Unknown | 1.39 | |

Comments: All blank spaces are ND's (none detected) (<0.05 mg/l, or 50 ppb)

Sample Rcvd: 8/3/81

Date Analysis Completed: 8/26/81

All Results In:

Reported By: Kathy Hemmerle

Checked By: Kalv

ENERGY RESOURCES CO. INC.

POLYCHLORINATED BIPHENYLS (PCB)

- Report Sheet -

Analyzed for: Geraghty Miller

| | Detection Limit | 51-928 OP-1 28-312 | 51-929 OP-3 28-313 |
|---|---|---|---|
| Aroclor 1221 | | ND | ND |
| Aroclor 1232 | | ND | ND |
| Aroclor 1016 | | ND | ND |
| Aroclor 1242 | | ND | ND |
| Aroclor 1248 | | ND | ND |
| Aroclor 1254 | | ND | ND |
| Aroclor 1260 | | .04ppb | ND |
| Aroclor 1262 | | ND | ND |

Comments:

300B17/3-81

H-4

## pH MEASUREMENTS OF WATER SAMPLES COLLECTED FROM MONITOR WELLS AT THE OIL-SLUDGE PIT AREA, JULY 29, 1981[1]

| Well Number | pH |
|---|---|
| OPW-1 | 7.50 |
| OPW-3 | 6.40 |

[1] Measured at the time of sample collection.