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DRAFT CONTAMINATION ASSESSMENT CHICORA TANK FARM (CTF) CNC CHARLESTON SC

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ENVIRONMENTAL SCIENCE AND ENGINEERING. INC.

DRAFT
CONTAMINATION ASSESSMENT
CHICORA TANK FARM
NAVBASE CHARLESTON
CHARLESTON, SOUTH CAROLINA

Prepared for:

NAVAL FACILITIES ENGINEERING COMMAND
SOUTHERN DIVISION

Charleston, S.C.

Prepared by:

ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.
Tampa, Florida

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1.0 INTRODUCTION

1.1 BACKGROUND

The Chicora Tank Farm is part of the Naval Supply Center, (NSC) Charleston, S.C.. Six storage tanks comprise the tank farm as shown in Figure 1.0-1. The tanks are constructed of reinforced concrete, are partially below ground, and are covered (above normal grade) with soil and grass. Each tank is underlain by a french drain system designed to collect potential petroleum product seepage. The french drain system discharges into a holding pond equipped with an oil skimmer. The french drain system and pond are sampled periodically, and samples analyzed for oil and grease content. Of the six tanks, three (3906-K, 3906-L, and 3906-P) are suspected of leaking diesel oil. Seepage is occurring through the tank walls into the pump room associated with each of the tanks.

1.2 OBJECTIVE AND SCOPE

The Naval Facilities Engineering Command (NAVFACENGCOM), Southern Division, issued Contract No. N62467-86-C-0171 to Environmental Science and Engineering, Inc. (ESE) in May 1986 to conduct groundwater investigations at various locations. The objective of the investigation at the Chicora Tank Farm is to determine whether diesel oil seepage has contaminated the soils surrounding tanks 3906-K, 3906-L, and 3906-P. To accomplish the objective, three soil borings were constructed and sampled around each of the three tanks. The samples were analyzed for benzene, toluene, and xylene (BTX) concentrations utilizing EPA Method 602, and for total recoverable petroleum hydrocarbons (TRPH) concentrations utilizing EPA Method 418.1.

1.3 LOCATION

The NSC is part of the Charleston Naval Complex which is located in Charleston and Berkley Counties on South Carolina's central coast. The complex is divided into two major areas, Naval Base North and Naval Base

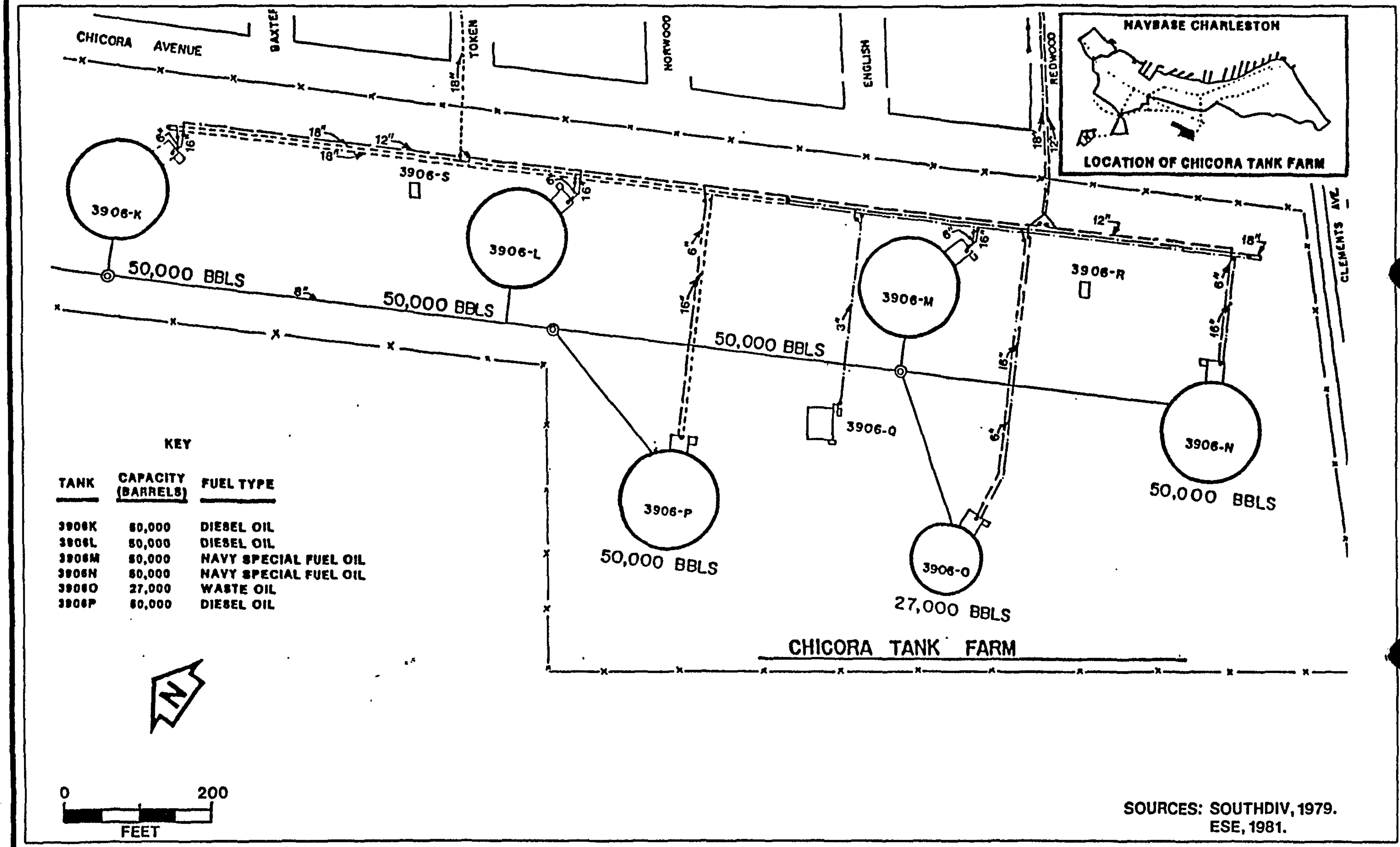

Figure 1.0-1
CHICORA TANK FARM LAYOUT

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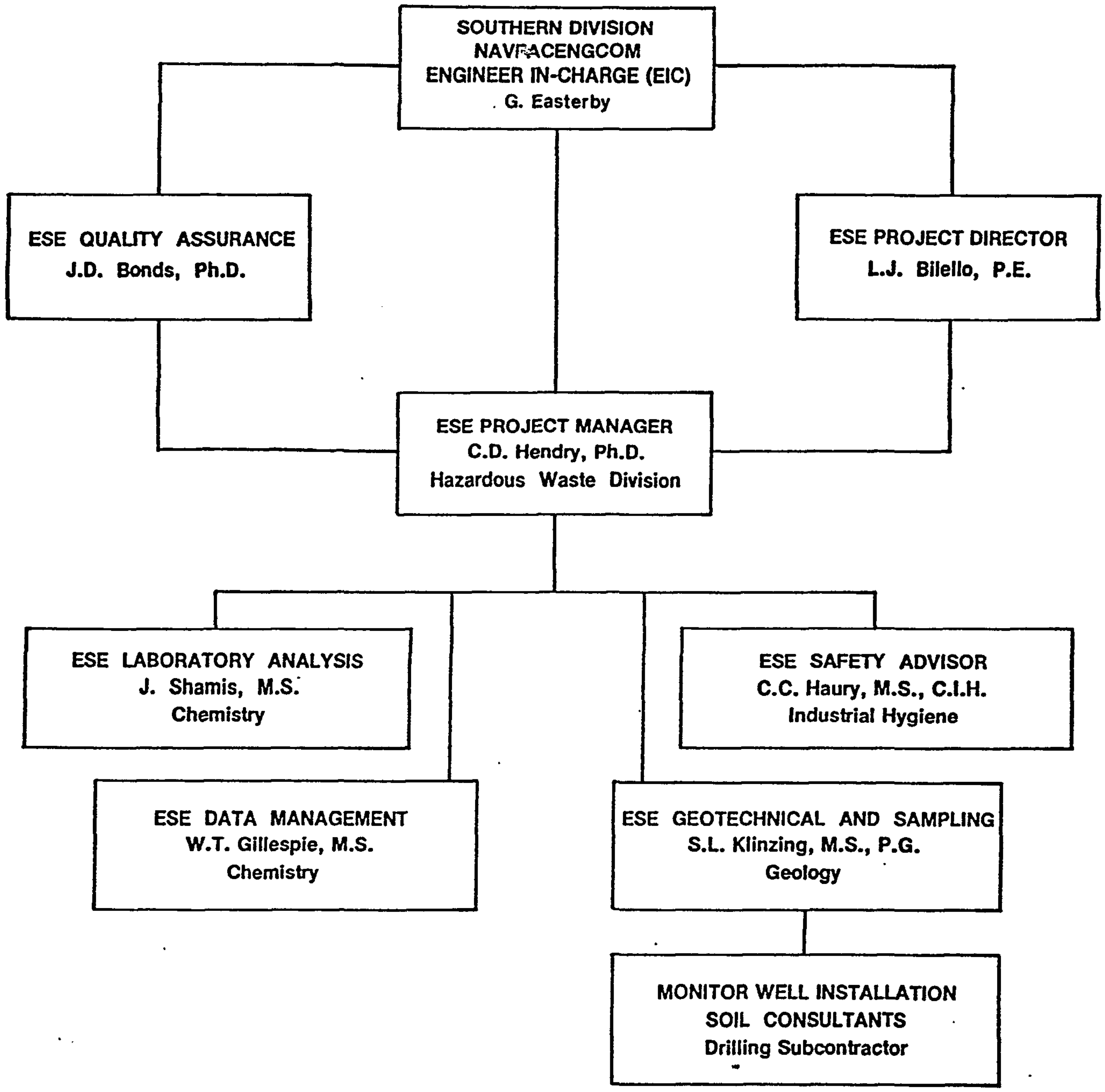
South (NAVBASE Charleston). The Chicora Tank Farm is located west of NAVBASE Charleston on Chicora Avenue, approximately 5 miles north of the City of Charleston (see Figure 1.0-1).

1.4 CONTAMINATION STATUS

Seepage from the tank walls into the pump rooms of tanks 3906-K, 3906-L, and 3906-P has been observed over the past several months. Periodic sampling and analysis of the french drain system provides no evidence of petroleum seepage into the french drain system. Tank capacities and fuel types are listed on Figure 1.0-1.

1.5 PROJECT ORGANIZATION

The staff organization for the Chicora Tank Farm investigation is presented on Figure 1.5-1. All field sampling was performed by ESE staff. Soil borings were constructed by Soil Consultants, Inc.



SOURCE: ESE, 1986.

Figure I.5-I
PROJECT ORGANIZATION

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2.0 SITE CHARACTERISTICS

2.1 CLIMATOLOGY

Due to the proximity of the ocean, the climate of Charleston is mild and temperate. Daily weather is controlled largely by the movement of pressure systems across the country and by the diurnal effects of the land-sea breeze. Exchanges of air masses are relatively few in summer, when masses of warm, humid, maritime-tropical (mT) air persist for long periods under Bermuda high pressure conditions. Winters are characterized by movements of frontal systems and by replacement of mT air with cool, dry, continental-polar (cP) air.

Average daily temperatures recorded during each month by the National Weather Service at the Charleston Municipal Airport are shown in Table 2.1-1. The coldest month is January, when daily temperatures typically range from approximately 37 to 60 degrees Fahrenheit (°F). In July, the warmest month, the average daily temperature extremes vary between approximately 72 and 90°F. The smaller diurnal temperature variation in summer is due to higher moisture content of the atmosphere on the average day. The record high and low temperatures measured at the airport are 102.9°F and 8.0°F, respectively. Normally, 60 days per year temperatures will be at 90°F or above, while 33 days of the year freezing temperatures will predominate. The average first occurrence of freezing temperatures is 10 October, while the average last occurrence is 19 February (Army, 1976c; USSCS, 1971; NAVFAC, 1976).

The average annual rainfall in Charleston is 49.2 inches, with a summer peak of more than 7.5 inches occurring in July. The four summer months (June through September) experience more than 50 percent of the annual rainfall. Rain storms during the summer are due to strong convective

Table 2.1-1. Annual and Monthly Climatological Data Recorded by the National Weather Service at Charleston Municipal Airport, Charleston, South Carolina

Time Year of Record	Normal Daily Average Temperature, °F Maximum 1947-76	 Minimum 1947-76	Normal Total Precipitation (inches) 1947-76	Prevailing Direction of Winds 1962-76
January	61.2	38.3	2.54	SW
February	62.5	40.4	3.29	NNE
March	68.0	45.4	3.93	SSW
April	76.9	52.7	2.88	SSW
May	83.9	61.8	3.61	S
June	89.2	69.1	4.98	S
July	89.2	72.0	7.71	SW
August	88.8	70.5	6.61	SW
September	84.9	66.2	5.83	NNE
October	77.2	55.1	2.84	NNE
November	67.9	43.9	2.09	N
December	61.3	38.6	2.85	NNE
Annual	75.9	54.5	49.16	NNE

Source: Army, 1976.

atmospheric motions, which trigger 72 percent of the average 57 thunderstorms per year. Rainfall during the winter is generally associated with the interface of cP frontal air masses replacing mT air. With the exception of the 7 inches dropped during the winter storm of 10-11 February 1973, only traces (less than 0.04 inch) of snow are usually experienced, mostly in January and February (Army, 1976c; USSCS, 1971; NAVFAC, 1976).

The mean wind speed recorded at the Charleston Airport is 9 miles per hour, with prevailing wind directions (Table 2.1-1) of north-northeast during the winter months and south-southwest during the summer months (Army, 1976c; USSCS, 1971; NAVFAC, 1976). Figure 2.1-1 represents a ten year average wind direction for Charleston Airport.

2.2 PHYSIOGRAPHY

NAVBASE Charleston is located on the eastern edge of a low, narrow finger of land separating the Ashley and Cooper Rivers . The topography of the area is typical of South Carolina's Lower Coastal Plain, with low relief plains broken only by the meandering courses of the many sluggish streams and rivers flowing toward the coast and by an occasional marine terrace escarpment. Topography at NAVBASE Charleston is essentially flat, with elevations ranging from just over 20 feet in the northwestern part of the base to sea level at the Cooper River. Much of the original topography of NAVBASE Charleston has been modified by man's activities. The southern end of the base originally was a tidal marsh drained by Shipyard Creek and its tributaries. Over the last 70 years, this area has been filled with both solid wastes and dredged spoil. Most of the base is within the 100-year flood zone, which is below +10 feet mean sea level (MSL) in elevation.

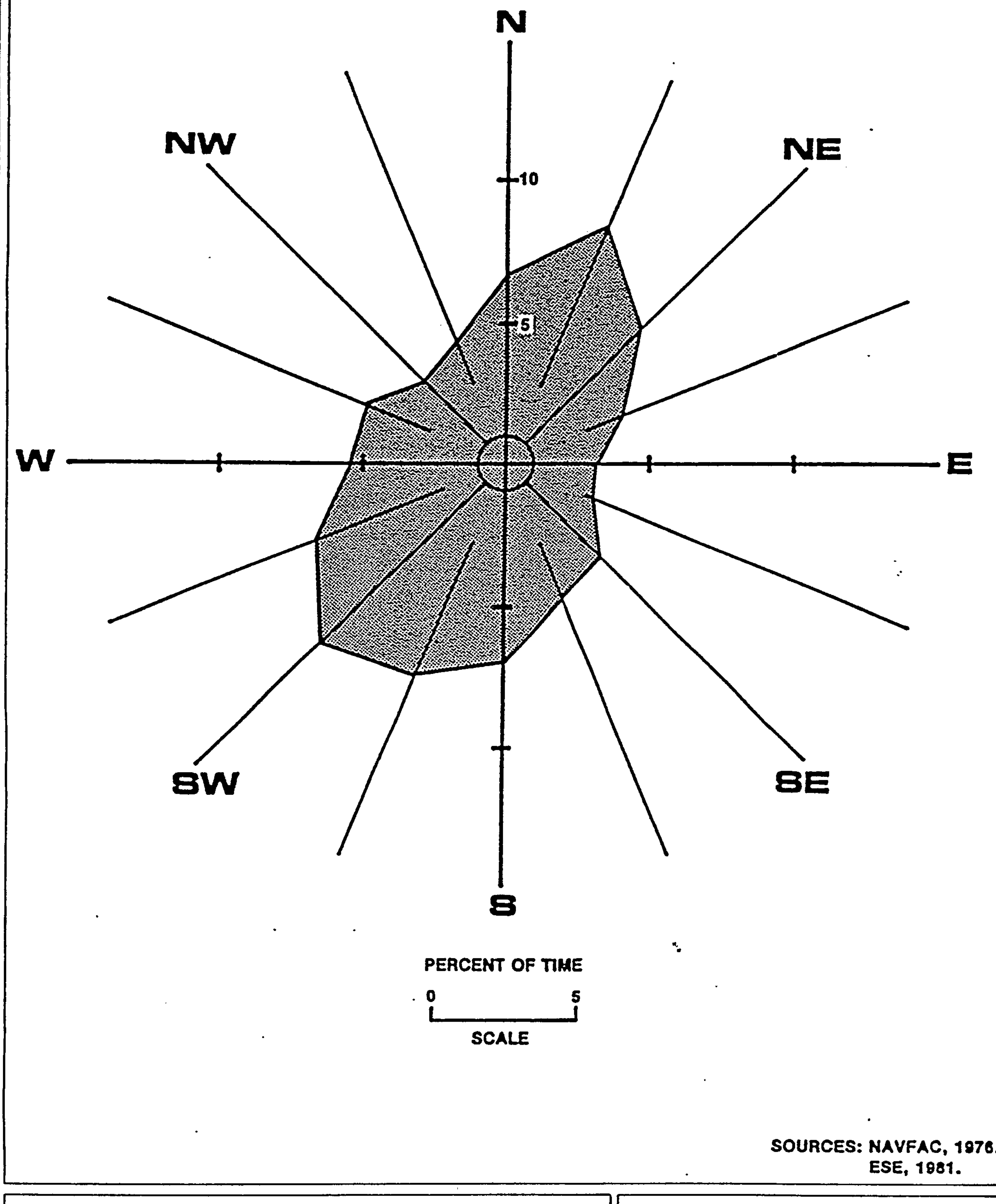

Figure 2.1-1
TEN-YEAR AVERAGE WIND DIRECTION FOR CHARLESTON AIRPORT, SOUTH CAROLINA

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2.3 GEOLOGY

The geology of the Charleston area is characteristic of the southern part of the Atlantic Coastal Plain. A seaward-thickening wedge of Cretaceous and younger sediments is underlain by older igneous and metamorphic basement rock (see Figure 2.3-1).

NAVBASE Charleston is underlain by unconsolidated to weakly consolidated Holocene to Miocene clastic sediments, composed of clays, organic-rich clays, silts, and sands (Figure 2.3-2). These materials generally comprise the Talbot Terrace as modified by Cooper River. The thickness of this overburden is known in detail through the compilation of data from extensive drilling. Overburden thickness in the NAVBASE area varies, ranging form a maximum of greater than 82 feet in a north-northeast-trending depression in the surface of the underlying Cooper Formation to the immediate west of Cooper River, to less than 17 feet in isolated areas. Average overburden thickness is approximately 35 feet with thicker zones in the immediate vicinity of Cooper River.

Pleistocene sands, silts, and clays of high organic content are exposed at the surface. These materials are underlain by a plastic calcareous clay known as the Cooper Marl. At NAVBASE Charleston, the Cooper Marl is underlain by the Santee Limestone and older rocks. Figure 2.3-2 shows a generalized north-south cross section along the approximate center of the base. As shown, the installation is underlain by several feet of sands, silts, and fill which are underlain by silts, clays, and the Cooper Marl.

2.4 SURFACE HYDROLOGY

The southern portion of NAVBASE Charleston is drained by Shipyard Creek and the northern portion of Noisette Creek. Both creeks drain into the Cooper River. Surface drainage for most of NAVBASE Charleston is directly into the Cooper River, which empties into Charleston Harbor.

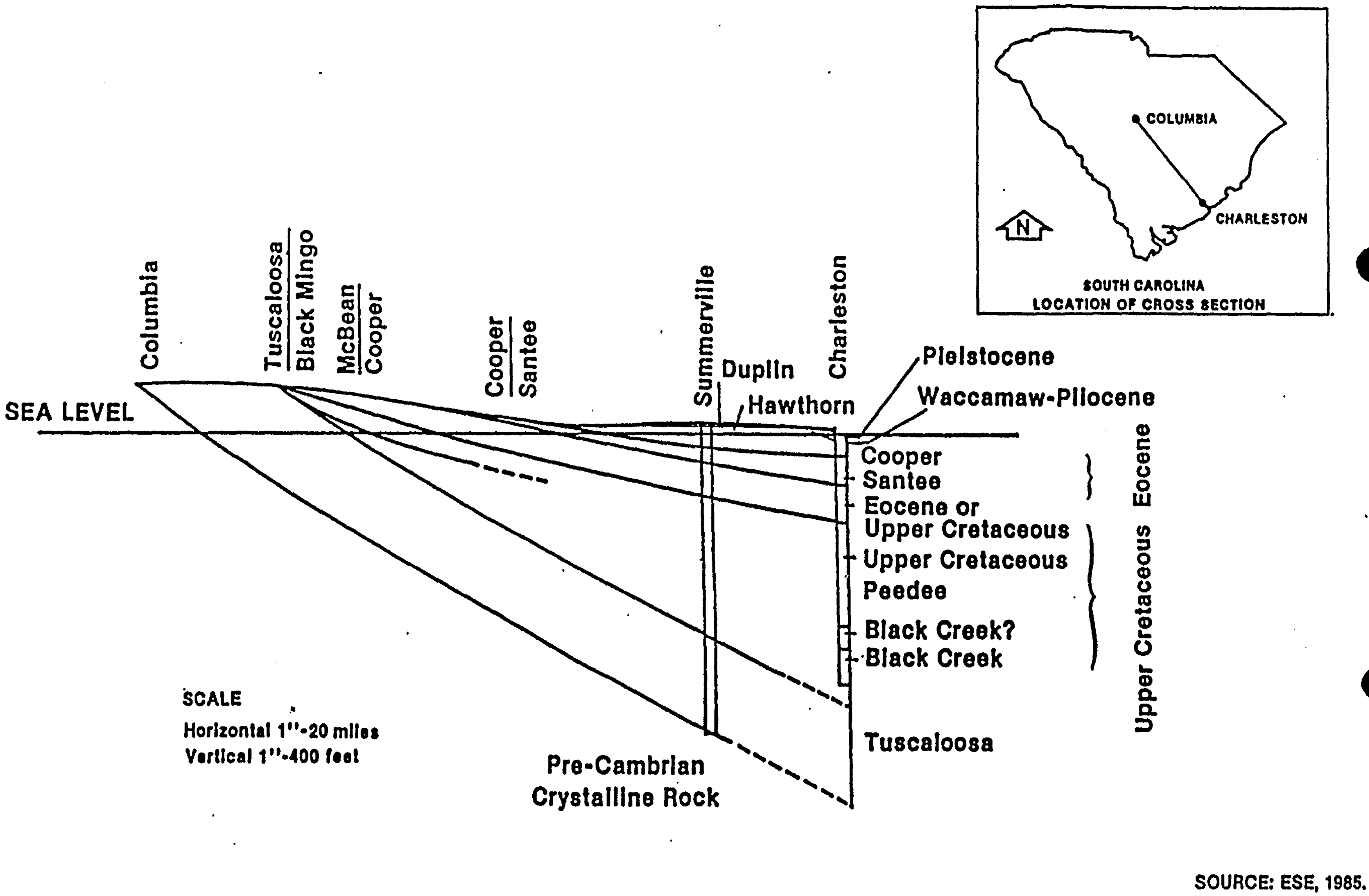

Figure 2.3-1
EAST-WEST GEOLOGIC CROSS SECTION FROM THE COAST INLAND THROUGH CHARLESTON, SOUTH CAROLINA

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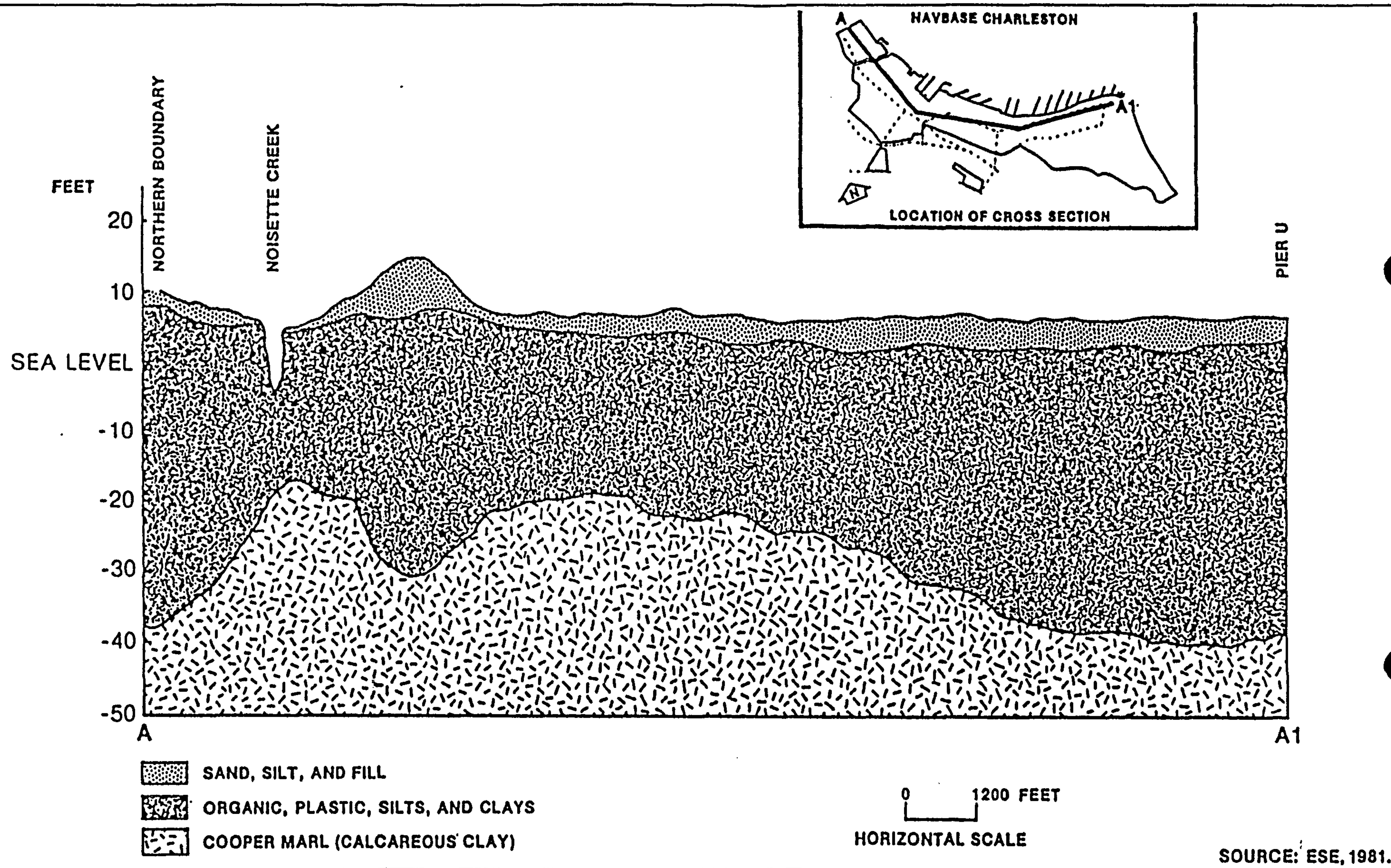

Figure 2.3-2
GENERALIZED GEOLOGIC CROSS SECTION
THROUGH NAVBASE CHARLESTON

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2.5 GEOHYDROLOGY

Most potable water on the Charleston peninsula is supplied by surface water sources. Although both the Cooper Marl and the Santee Limestone function as aquifers in other areas, neither is significantly developed in the Charleston area. In the vicinity of NAVBASE Charleston, the quality of the water from the Santee is not suitable for potable supply; total dissolved solids (TDS) range from 1,000 to 1,500 parts per million (ppm).

In the shallow aquifer on NAVBASE Charleston, water flows toward the Cooper River or Shipyard Creek, with the water table surface roughly parallel to the topography on the naval base. The water table is within 3 to 7 feet of the ground surface. The shallow ground water continually discharges to the Cooper River and Shipyard Creek. Ground water within the Santee Limestone also flows in a southeasterly direction.

3.0 FIELD INVESTIGATION

3.1 SOIL BORING CONSTRUCTION AND SAMPLING

A total of nine soil borings were constructed at the Chicora Tank Farm, to include three borings constructed around each of the three tanks, as shown on Figure 3.1-1. The soil borings were constructed utilizing a track mounted hollow-stem auger drilling rig with 4-inch diameter soil augers. Prior to consturction of each boring, the auger flights were thoroughly steam cleaned and allowed to air-dry. Each boring was constructed to the soil/water table interface. Soil cuttings were retrieved and described by the ESE site geologist. Soil boring logs are included herein as Appendix A.

One soil sample was collected from each boring at the soil/water interface. The soil samples were collected utilizing a split spoon sampling device. The split-spoon was steam-cleaned and air-dryed prior to collection of each sample. Samples were placed in the appropriate containers (as listed in Table 3.1-1), padded, sealed in zip-lock bags, and packed on ice in plastic coolers for shipment to ESE's laboratory. Sample chain-of-custody forms were completed and included with each shipment.

3.2 FIELD OBSERVATIONS

The soil samples collected during construction of the soil borings around each tank reflect a relatively homogenous stratigraphy composed of medium to fine-grained quartz sands. The minor variability in sand coloration is probably due to the quantity and type of fill material used to cover each of the tanks. Generally, the site is underlain by a 1-foot layer of organic soil, 5 to 7-feet of fine-grained tan sand, and +5-feet of medium to fine-grained brown to gold sand. The water table was encountered from 10 to 15-feet below land surface, with water table depth variability dependant upon the quantity of fill material around each tank. In low lying areas between the tanks, the surface soils were damp to saturated.

Water samples were collected from each boring for visual and olfactory observation. None of the water samples exhibited a petroleum odor. Only the water sample from Boring 3B exhibited a petroleum sheen.

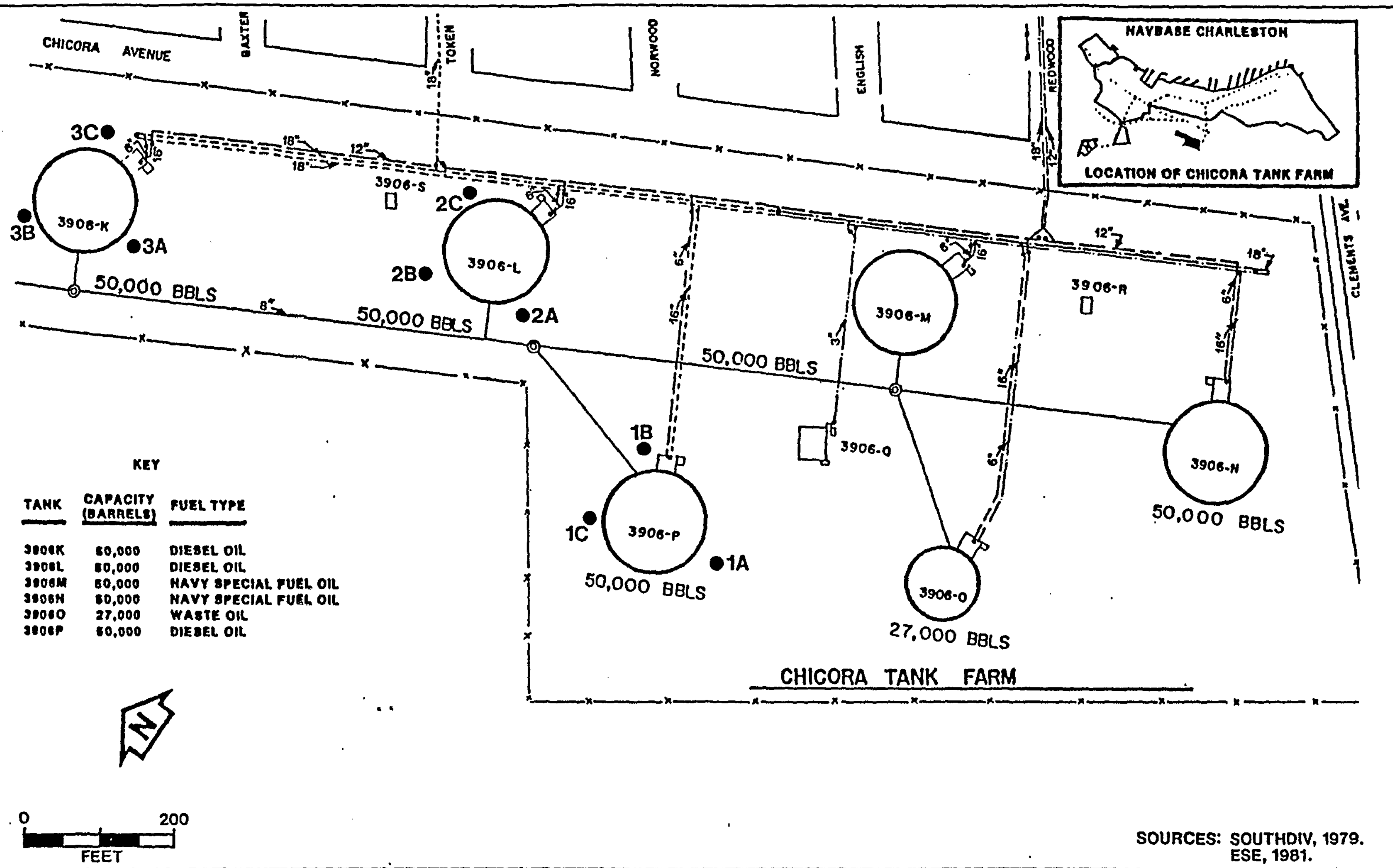

Figure 3.1-1
LOCATIONS OF SOIL BORINGS

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Table 3.1-1. Sample Containers Matrices and Container Cleaning Procedures

Analysis/Parameter	Container Type	Matrix	Cleaning Procedure*
Total Recoverable Petroleum Hydrocarbons	Glass Mason Jar with Teflon®-Lined Cap	Soil/Sediment	1
BTX	Amber Glass Septum Vial with Teflon®-Lined Septum	Soil/Sediment	2

1—Thoroughly wash container with hot detergent and water; triple rinse with tap water; triple rinse with D.I. water; rinse with (nanograde) acetone; rinse with (nanograde) hexane; air-dry.
2—Thoroughly wash container with hot detergent and water; triple rinse with tap water; triple rinse with D.I. water; air-dry; bake at 100°C for several hours. Soak septa for several hours in methanol; bake at 100°C for 10 to 15 minutes.

Source: ESE, 1986.

4.0 CHEMICAL ANALYSIS

4.1 ANALYTICAL METHODS

All soil samples were analyzed utilizing the following methods:

- Benzene, Toluene, Xylene--This is a purge and trap method (EPA Method 602) applicable to the determination of bezene, toluene, and xylene (BTX) concentractions.

- Total Recoverable Petroleum Hydrocarbons--The oil and grease analysis by EPA Method 413.2 does not differentiate between extractables of biological origin and the mineral oils and greases of POL origin; therefore, the EPA Infrared Spectrophotometric Method (EPA Method 418.1) for TRPH concentrations was utilized.

4.2 ANALYTICAL RESULTS

The results of the analysis of soil samples collected from the Chicora Tank Farm are provided in Table 4.2-1. Concentrations of BTX and TRPH are below detectable limits for all nine soil samples analyzed.

Table 4.2-1. Analytical Results

Parameters	Units	Method	3906-P 1A	3906-P 1B	3906-P 1C	3906-L 2A	3906-L 2B	3906-L 2C	3906-K 3A	3906-K 3B	3906-K 3C
Moisture	%Wet Wt	70320	22.0	21.2	27.0	20.9	18.0	24.3	24.7	22.0	24.3
TRPH	µg/g-dry	98233	<35.3	<34.9	<37.7	<34.8	<33.5	<36.3	<36.5	<35.3	<36.3
Benzene	µg/kg-dry	34237	<171	<169	<183	<167	<162	<176	<177	<170	<175
Chlorobenzene	µg/kg-dry	34304	<171	<169	<183	<167	<162	<176	<177	<170	<175
Dichlorobezene Tot.	µg/kg-dry	98578	<171	<169	<183	<167	<162	<176	<177	<170	<175
Ethylbenzene	µg/kg-dry	34374	<171	<169	<183	<167	<162	<176	<177	<170	<175
Toluene	µg/kg-dry	34483	<171	<169	<183	<167	<162	<176	<177	<170	<175
Xylenes, Total	µg/kg-dry	45510	<171	<169	<183	<167	<162	<176	<177	<170	<175

Source: ESE, 1986

5.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the analytical results presented in Section 4.2, Tanks 3906-K, 3906-L, and 3906-P do not appear to be releasing diesel oil into the soil surrounding the tanks. Since the concrete walls within the pump rooms are not supported by soil, it is possible that the structural integrety of these walls will deteriorate more rapidly than the remaining portions of the tanks. However, ESE recommends that the tank walls be inspected by a concrete specialist to determine the potential for further structural deterioration. In addition, ESE recommends that the TRPH analysis (EPA Method 418.1) be utilized to analyze samples collected from the french drain system. The TRPH analysis has a lower limit of detection and will more accurately identify petroleum product seepage. It may also be appropriate to install shallow groundwater monitor wells downgradient of each of the tanks. The monitor wells should be sampled quarterly and samples analyzed for TRPH concentrations.

APPENDIX A

BORING LOGS

Boring Log - 3906P-1A

Depth Feet Below Land Surface	Lithology
0-5	Sand, tan, fine grained.
5-11.5	Sand, tan, fine grained. Water table at approximately 10 feet.

Boring Log - 3906P-1B

Depth Feet Below Land Surface	Lithology
0-5	Sand, tan to brown, medium-grained, damp.
5-10	Same as above.
10-14	Sand, tan, fine-grained. Water table at appproximately 14 feet.

Boring Log - 3906P-1C

Depth Feet Below Land Surface	Lithology
0-5	Sand, tan to brown medium-grained.
5-10	Sand, tan to brown, grading to tan; fine-grained. Water table at approximately 10 feet.

Boring Log - 3906L-2A

Depth Feet Below Land Surface	Lithology
0-5	Sand, tan to brown, medium to fine-grained; damp.
5-8	Sand, tan, fine-grained.
8-10	Sand, gold, medium to fine-grained. Water table at approximately 10 feet.

Boring Log - 3906L-2B

Depth Feet Below Land Surface	Lithology
0-5	Sand, tan to brown, medium to fine-grained; damp.
5-7	Same as above.
7-10	Sand, tan, fine-grained. Water table at approximately 10 feet.

Boring Log - 3906L-2C

Depth Feet Below Land Surface	Lithology
0-5	Sand, tan to brown, medium-grained.
5-10	Same as above.
10-15	Sand, tan, fine. Water table at approximately 13 feet.

Boring Log - 3906K-3A

Depth Feet Below Land Surface	Lithology
0-5	Sand, tan to brown, medium to fine-grained.
5-12	Same as above.
12-15	Sand, tan, fine-grained. Water table at approximately 14 feet.

Boring Log - 3906K-3B

Depth Feet Below Land Surface	Lithology
0-5	Sand, tan to brown, medium to fine-grained.
5-10	Sand, tan, fine-grained.
10-15	Sand, tan to gold, fine-grained. Water table at approximately 15 feet. Sheen on water.

Boring Log - 3906K-3C

Depth Feet Below Land Surface	Lithology
0-5	Sand, tan to brown, medium to fine-grained.
5-10	Sand, tan, fine-grained. Water table at approximately 10 feet.