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CORRECTIVE ACTION PLAN FOR ZONE F SITE 21 BUILDING 241 SITE IDENTIFICATION
NUMBER 17706 CNC CHARLESTON SC
11/1/2000
J A JONES ENVIRONMENTAL SERVICES

**CORRECTIVE ACTION PLAN
FOR
ZONE F/ SITE 21-BUILDING 241**

SITE IDENTIFICATION # 17706

Charleston Naval Complex
Charleston, South Carolina

**SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND**

Contract Number N62467-99-C-0960

November 2000



23 February 2000

600 Bull Street
Columbia, SC 29201-1708

COMMISSIONER:
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Southern Division NFEC

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P.O. Box 190010
North Charleston, SC 29419-9010

William M. Hull, Jr., MD
Vice Chairman

Attention: Mr. Gabriel Magwood

Mark B. Kent
Secretary

Re: Final Assessment Report dated 20 January 2000
Zone F/Site 21-Building 241 (Site Identification # 17706)
Charleston Naval Complex/Charleston Naval Base
Charleston, SC
Charleston County

Howard L. Brilliant, MD

Brian K. Smith

Rodney L. Grandy

Larry R. Chewning, Jr., DMD

Dear Mr. Magwood:

The author has completed technical review of the referenced document. As submitted, the report provides a narrative and summary of previous assessment activities and analytical results from additional sampling conducted to establish the environmental fate of suspected contamination at the subject property. Analytical results provided indicate that concentrations of PAH and VOC compound(s) were reported in soil and groundwater samples obtained at the subject site. The reported concentrations exceed the RBSL (Risk-Based Screening Levels, SCDHEC *Risk-Based Corrective Action for Petroleum Releases*, 5 January 1998), proposed RBC (Risk-Based Concentrations for Residential Soils, EPA Region III Risk-Based Concentrations Table, 12 April 1999) and established groundwater MCLs (maximum contaminant levels) and/or established health advisories. Available analytical data and applied interpretations appear to indicate that a reasonable delineation and characterization of the extent and severity of soil and groundwater contamination have been developed for the Building 241 site. This information and data were then utilized to develop SSTL (site specific target levels) for CoC (contaminants of concern) in evidential discussion(s) for consideration of employing intrinsic remediation at the subject site.

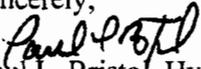
Although the author concurs that active remediation may not be appropriate for this site, reasonable monitoring must be established to demonstrate reclamation of groundwater quality through time. Proposals that incorporate monitored natural attenuation must provide sufficient data to demonstrate the groundwater environment's assimilative capacity to provide for intrinsic biodegradation/natural attenuation for the known contaminants through time. Appropriate and reasonable data must be available/developed to demonstrate contaminant plume stability, contaminant stoichiometry and provide site specific information/data on attenuation (retardation and degradation) rates to verify predictive modeling applied to the site. Associated routine monitoring (groundwater and soil, as necessary) should be sufficient to

Charleston Naval Complex/Charleston Naval Base
23 February 2000
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demonstrate the rate and effectiveness (if any) of predicted degradation processes in effect and able to distinguish the effects of nondestructive processes (advection, dispersion, sorption, etc.) and destructive attenuation processes.

With consideration to the above, the author concurs with the proposed groundwater monitoring program. The facility should develop an appropriate CAP (corrective action plan), including proposed sampling schedule. A schedule for development of the requested CAP should be submitted to my attention by 31 March 2000. Should you have any questions please contact me at (803) 898-3559.

Sincerely,


Paul L. Bristol, Hydrogeologist
Groundwater Quality Section
Bureau of Water

cc: Trident District EQC

**CORRECTIVE ACTION PLAN
FOR
ZONE F/ SITE 21-BUILDING 241**

SITE IDENTIFICATION # 17706

**Charleston Naval Complex
Charleston, South Carolina**

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

**Submitted by:
CH2M-JONES, LLC.
115 Perimeter Center Place NE
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Atlanta, Georgia 30346-1278**

Contract Number: N62467-99-C-0960

November 2000

PREPARED BY:


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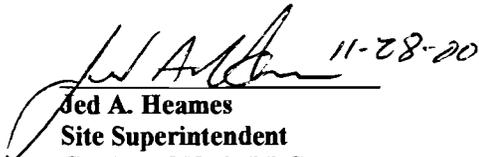

Jed A. Heames
Site Superintendent
CH2M-JONES, LLC.

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FIG 10	GROUNDWATER NAPHTHALENE CONCENTRATION MAP

ACRONYMS AND ABBREVIATIONS

bls	below land surface
BTEX	Benzene, Toluene, Ethylbenzene, and Xylene Isomers
CAP	Corrective Action Plan
CNC	Charleston Naval Complex
EISOPQAM	Environmental Investigations Standard Operating Procedures and Quality Assurance Manual
EPA	Environmental Protection Agency
ft	foot
mg/kg	microgram per kilogram
mg/L	microgram per liter
OVA	Organic Vapor Analyzer
QA	Quality Assurance
QC	Quality Control
RBSL	Risk-Based Screening Level
RDA	Redevelopment Authority
SCDHEC	South Carolina Department of Health and Environmental Control
SOUTHDIV	Southern Division Naval Facilities Engineering Command
SSTL	Site-Specific Target Level
TTNUS	Tetra Tech NUS
UST	Underground Storage Tank

1.0 INTRODUCTION

This Corrective Action Plan (CAP) has been prepared by CH2M-JONES, LLC. The plan is designed for Zone F/ Site 21-Building 241; Underground Storage Tank (UST) 241 located at the Charleston Naval Complex (CNC), Charleston, South Carolina.

The South Carolina Department of Health and Environmental Control (SCDHEC) has designated this site as Identification Number: 17706. This CAP provides methods to further evaluate the applicability of intrinsic remediation and monitoring well abandonment as a corrective action for UST 241 in accordance with SCDHEC Corrective Action Guidance, June 1997.

1.1 General Site Description

The CNC is in the city of North Charleston, on the west bank of the Cooper River in Charleston County, South Carolina as shown in Figure 1. This installation consists of two major areas: an undeveloped dredge materials area on the east bank of the Cooper River on Daniel Island in Berkley County, and a developed area on the west bank of the Cooper River. The developed portion of the base is on the peninsula bounded on the west by the Ashley River and on the east by the Cooper River. The site is located within the developed portion of the base as shown in Figure 2. (Tetra Tech, NUS [TTNUS], Rapid Assessment [RA] for UST 241, 2000).

The area surrounding CNC is “mature urban”, having long been developed with commercial, industrial, and residential land use. Commercial areas are primarily west of CNC; industrial areas are primarily to the north of the base along Shipyard Creek. A site vicinity map, which exhibits adjacent properties and structures, vicinity roads, current utilities, and vicinity surface drainage, is included as Figure 2.

Building 241 served as the Charleston Naval Base Crane Shop after construction was completed in 1987 until base closure. UST 02-241-001, a 6,000 gallon fiberglass tank, was used to store #2 fuel oil for Building 241. During the removal of UST 241, approximately 900 gallons of free product was pumped out of the excavation. The site is situated approximately 800 feet from the Cooper River (TTNUS, 2000)

1.2 Objective

In the Rapid Assessment (RA) completed by Tetra Tech NUS, nine soil samples and nine groundwater samples were collected at the site. Six of the nine soil samples had levels of naphthalene above the Risk Base Screening Levels (RBSLs) and one soil sample had levels of chrysene (a Polynuclear Aeromatic Hydrocarbon [PAH] compound) above RBSL's (see Table 7). Naphthalene was detected above the RBSLs for one groundwater sample. Because the levels of the chemicals of concern did not exceed the SSTLs, the RA recommended an intrinsic CAP for this site.

This CAP presents the groundwater monitoring plan to attempt to demonstrate the ground water's assimilative capacity to provide for intrinsic biodegradation/ natural attenuation for the known contaminants through time in order to validate the assumptions and calculations used in the RA completed by TTNUS 2000.

2.0 RECEPTOR SURVEY

A receptor survey of the site vicinity was conducted by TTNUS to identify potential receptors for petroleum hydrocarbon contamination. Figure 2 depicts the public utilities located within 250 feet of the former UST 241 study area. Specific information concerning the depth of utilities below land surface (bls) is currently unavailable, however, utilities at this site generally are between 2 to 6 feet (ft) bls. The following utility receptors were located:

UTILITY	ON-SITE OR DISTANCE/ DIRECTION FROM SITE	DEPTH TO UTILITY
Gas	N/A	2-6-ft bls
Electrical	east corner of Bldg 241, southeast of Bldg 241	Overhead and 2-6-ft bls
Sewer	exits Bldg 241 on the southeast side	2-6-ft bls

According to the RA report completed by TTNUS, a survey of groundwater users within a 7-mile radius of CNC was conducted by the South Carolina Water Resources Commission to ascertain the extent of any shallow groundwater usage. Results of the water use investigation revealed that no drinking water wells, which utilize the shallow aquifer, are located within a 4 mile radius of CNC. Irrigation wells are not identified within 1,000 feet of the site. Numerous monitoring wells are located within 1,000 feet of the site. The nearest surface water body to the site is the Cooper River located approximately 800 feet from the site (TTNUS, 2000).

2.1 Fate and Transport Modeling

The Dominico model was the fate and transport model used to determine groundwater site-specific target levels (SSTLs) in the risk analysis. The Dominico dilution/attenuation model is presented in the SCDHEC guidance document, *South Carolina Risk-Based Corrective Action for Petroleum Releases* (SCDHEC, 1988). This model is very conservative in that it assumes an infinite mass, aerial source condition through which groundwater flows. The model incorporates biological decay effects through a first-order decay process; however, this mechanism was ignored because SCDHEC guidance specifies that the decay rate must be assumed to be zero if site-specific decay rates have not been determined.

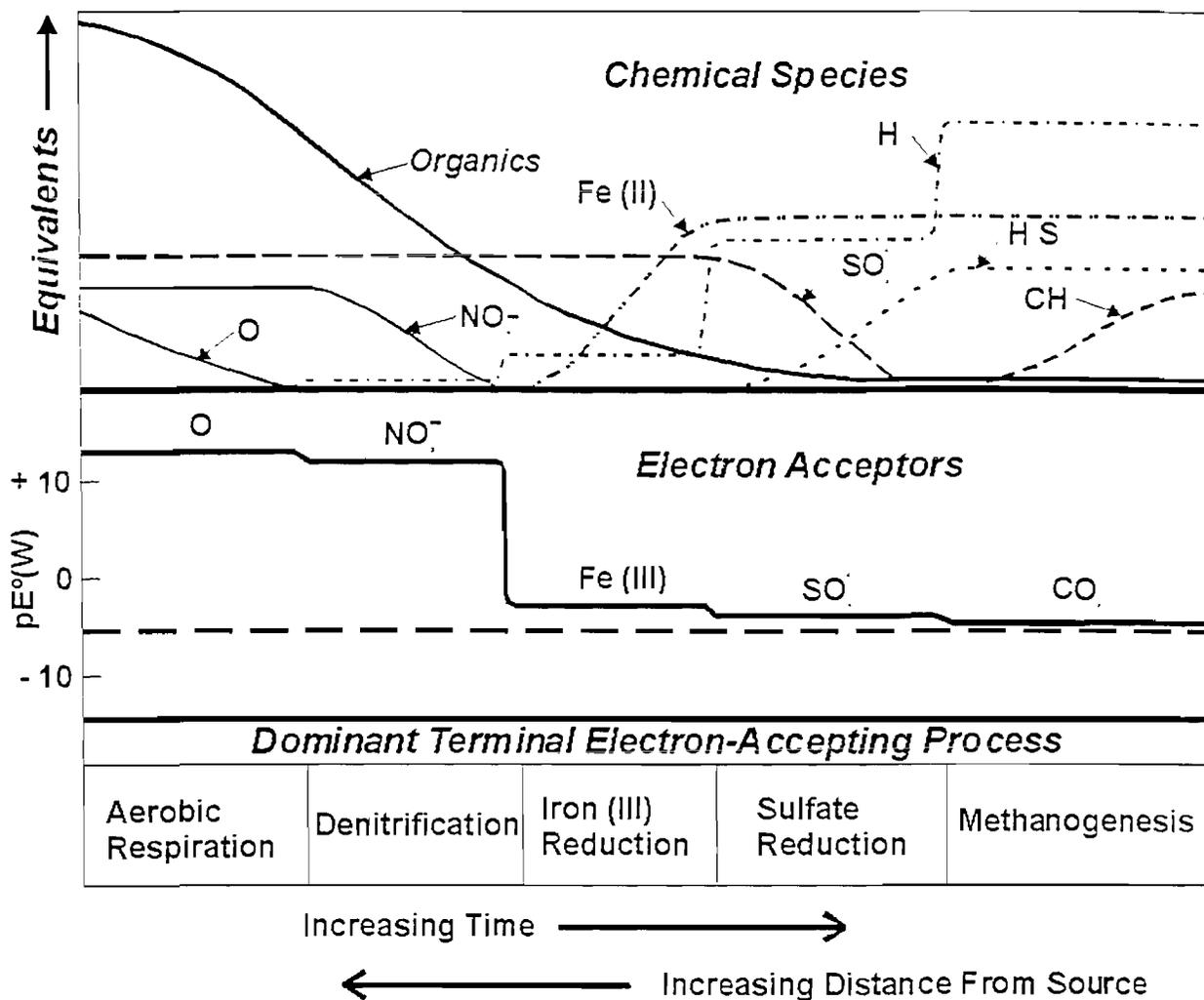
The impacted groundwater source area was modeled as 50 feet (15 meters) wide and 6.56 feet (2 meters) deep; these values are conservative defaults suggested by the American Society for testing and Materials (ASTM) *Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites* (ASTM 1997). The maximum Source concentrations are assumed to exist throughout the source area, further compounding the conservatism of the estimate.

3.0 PROPOSED REMEDIATION TECHNOLOGY

Based on the results of the RA modeling, an Intrinsic Remediation with a monitoring period of 9 months will be performed for the site. The monitoring program will consist of sampling initially a total of eight surrounding wells adjacent to the source point, and only sampling four selected wells thereafter. The proposed monitoring program is described in detail in Sections 4.0 and 5.0 of this plan. In order to support monitored natural attenuation for this site, CH2M-Jones, LLC must provide sufficient data to demonstrate the groundwater environment's assimilative capacity to provide for intrinsic biodegradation/ natural attenuation for the known contaminants through time. As stated in Section 1.2, the known contaminant is naphthalene. All other contaminants are below the RBSLs. In addition to sampling the known contaminant, several other intrinsic parameters will be measured to support intrinsic biodegradation/ natural attenuation. As a general guidance, biodegradation of petroleum hydrocarbons most commonly occurs by means of aerobic, nitrate-reducing, Fe(III)-reducing, sulfate-reducing, and methanogenic respiration as noted in the following tables (Parsons Engineering Science, Inc. and USGS, 1998).

**Trends in Contaminant, Electron Acceptor, and
Metabolic Byproduct Concentrations During Biodegradation**

Analyte	Trend in Analyte Concentrations During Biodegradation	Terminal Electron Accepting Process Causing Trend
Petroleum Hydrocarbons	Decrease	Aerobic respiration, denitrification, Mn (IV) reduction, Fe (III) reduction, sulfate reduction, methanogenesis
Highly Chlorinated Solvents and Daughter Products	Parent compound concentrations decrease, daughter products increase initially and then may decrease	Reductive dechlorination and cometabolic oxidation
Lightly Chlorinated Products	Decrease	Aerobic respiration and Fe (III) reduction (direct oxidation) and cometabolism (indirect oxidation)
Dissolved Oxygen	Decrease	Aerobic respiration
Nitrate	Decrease	Denitrification
Mn (II)	Increase	Mn (IV) reduction
Fe (II)	Increase	Fe (III) reduction
Sulfate	Decrease	Sulfate reduction
Methane	Increase	methanogenesis
Chloride	Increase	Reductive dechlorination or direct oxidation of chlorinated compound
Oxidation/Reduction Potential	Decrease	Aerobic respiration, denitrification, Mn (IV) reduction, Fe (III) reduction, sulfate reduction, methanogenesis and halorespiration
Dissolved Inorganic Carbon	Increase	Aerobic respiration, denitrification, Fe (III) reduction, and sulfate reduction



After: Bouwer and McCarty, 1984

Geochemical Evolution of
 Ground Water Contaminated
 with Petroleum Hydrocarbons

4.0 MONITORING WELL INSTALLATION AND ABANDONMENT

4.1 Monitoring Well Installation

Because of the amount of monitoring wells located in and around this site, no monitoring wells will be installed as part of this plan.

4.2 Monitoring Well Abandonment

Eight monitoring wells will be abandoned at Building 241 following the South Carolina Well Standards and Regulations R.61-71. The well abandonment will include grouting wells, removing stick-ups and removing all guard posts.

4.3 Surveying

Because no monitoring wells will be installed at this site, a new survey will not be conducted.

4.4 Equipment Decontamination

All drilling equipment, augers, well casing and screens, and soil and groundwater sampling equipment involved in field sampling activities will be decontaminated according to the Environmental Protection Agencies (EPA) "Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM).

5.0 PROPOSED GROUNDWATER MONITORING PROGRAM

5.1 Monitoring Frequency and Reporting

The groundwater monitoring program proposed at Building 241 will be performed in accordance with SCDHEC Corrective Action Guidance, June 1997, and consist of the following:

Sampling date or (Quarter)	Monitoring Wells Sampled	Field Measures	Laboratory Analytical
First quarter ¹ 2001	CNC-21-MW01 thru CNC-21 MW08	T°, pH, DO, Conductivity, Depth to water, Total depth, Turbidity	Naphthalene 8260 In addition MW-01, MW-02, MW-07D & MW-08 will be sampled for Nitrate, sulfate, Fe II, Fe III, methane, alkalinity
Second quarter ² 2001	CNC-21-MW-01, MW-02, MW-07D and MW-08	T°, pH, DO, Conductivity, Depth to water, Total depth, Turbidity	Naphthalene 8260 Nitrate, sulfate, Fe II, Fe III, methane, alkalinity
Third quarter ³ 2001	CNC-21-MW-01, MW-02, MW-07D and MW-08	T°, pH, DO, Conductivity, Depth to water, Total depth, Turbidity	Naphthalene 8260 Nitrate, sulfate, Fe II, Fe III, methane, alkalinity

1. First quarter is defined as January February and March.
2. Second quarter is defined as April May and June
3. Third quarter is defined as July, August, and September

- **Frequency:** Initially all monitoring wells at this site will be sampled. Thereafter, groundwater samples will be collected from wells MW-01, MW-02, MW-07D, and MW-08.
- **Reporting:** Semi-annual groundwater monitoring reports will be submitted to SCDHEC.

Included in the semi-annual reports will be field and analytical information from the certified laboratory indicating well numbers, analytical methods used, date sampled, date analyzed, and method detection limits.

At the end of the third quarter 2001 period, (or as necessary) a performance evaluation will be submitted to SCDHEC providing the effectiveness of the intrinsic biodegradation/natural attenuation occurring and any recommendations for the site if needed. It is possible that the levels are not above the RBSLs in the groundwater, which will result in a different approach to the closure of these tanks.

- **Groundwater Sampling**

Prior to any groundwater sampling, each well will be measured for water levels and total depth and each well will be purged in accordance the EPA EISOPQAM.

5.2 Analytical Parameters

The following constituents will be analyzed for each groundwater sample:

- Naphthalene using method 8260

The following parameters will be analyzed in order to evaluate the effectiveness of intrinsic remediation (refer to Section 3.0 for guidance and trends on intrinsics):

- Nitrate (NO^{-3})
- Sulfate (SO^{-4})
- Fe II
- Fe III
- Methane (CH_4)
- Alkalinity

5.3 Field Measurements

The following parameters will be sampled in the field:

- Temperature
- pH
- Dissolved Oxygen
- Depth to water table
- Depth of well
- Turbidity
- Specific Conductance

Field measurements will be recorded in the field book and in field forms.

5.4 Groundwater Level Measurements

Groundwater measurements will be taken from all monitoring wells at the site during each sampling event. All water level measurements will be taken on the same day as anticipated sampling.

Measurements will be taken with an electrical water level meter or interface probe if floating product is present using the highest part of the top of the casing as a reference point for determining depths to water and total depths. Water level measurements will be recorded to the nearest 0.01-foot in the field book.

5.5 Sample Handling

Field procedures and groundwater analysis will follow standard procedures found in the approved Corrective Action Sampling and Analysis Plan (CSAP) portion of the RFI Work Plan (Ensafe, Inc./ Allen & Hoshall, 1996). The CSAP outlines all monitoring procedures to be performed in during the investigation in order to characterize the environmental setting, source, and releases of hazardous constituents. In addition, the CSAP includes the Quality Assurance plan and Data Management Plan to verify that all information and data are valid and properly documented. Unless otherwise noted, the sampling strategy and procedures will be performed in accordance with the EPA Environmental Services Division

Sample Handling will be conducted in accordance with the following references:

EPA EISOPQAM (EPA May, 1996)

Comprehensive Sampling and Analysis Plan(Ensafe/Allen & Hoshall July, 1996)

5.6 Sample Packing and Shipping

The following forms will be compiled to complete the packing/shipping process:

- Sample labels
- Chain-of-custody labels
- Appropriate labels applied to shipping coolers
- Chain-of-custody forms
- Federal express air bills

5.7 Quality Check

Quality Control (QC) samples will be collected during sampling events. QC samples may include field blanks, field duplicates, and trip blanks. Definitions of each can be found below as described by the EISOPQAM:

- **Field Blank:** a sample collected using organic-free water, which has been run over/through sample collection equipment. These samples are used to determine if contaminants have been introduced by contact of the sample medium with sampling equipment. Equipment field blanks are often associated with collecting rinse blanks of equipment that has been field cleaned.
- **Field Duplicates:** Two or more samples collected from a common source. The purpose of a duplicate sample is to estimate the variability of a given characteristic or contamination associated with a population.
- **Trip Blank:** A sample, which is prepared prior to the sampling event in the actual container and is stored with the investigative samples throughout the sampling event. They are often packaged for shipment with the other samples and submitted for analysis. At no time after their preparation are trip blanks to be opened before they reach the laboratory. Trip blanks are used to determine if samples were contaminated during storage and/or transportation back to the laboratory (a measure of sample handling variability resulting in positive bias in contaminant concentration). If samples are to be shipped, trip blanks are to be provided with each shipment but not for each cooler.

5.8 Control Limits

Analysis	Control Parameter	Control Limit	Corrective Action
Air Monitoring	Check Calibration of OVA daily	Calibrate to manufactures specifications	Recalibrate. If unable to calibrate, replace.
pH of water	Continuing calibration check of pH 7.0 buffer	pH= 7.0	Recalibrate. If unable to calibrate, replace electrode.
Specific Conductance of water	Continuing calibration check of standard solution	> 1% of standard	Recalibrate.

5.9 Record keeping

In addition to records kept in logbooks, forms will be kept on log sheets for soil and groundwater.

5.10 Site Management and Base Support

Throughout the investigation activities, work on the CNC will be coordinated through SOUTHDIV and SCDHEC.

The primary contacts for each are as follows:

1. SOUTHDIV point of contact
Gabe Magwood
Southern Division Engineering Command
2155 Eagle Drive
North Charleston, SC 29406
(843) 820-7307

2. SOUTHDIV point of contact
Tony Hunt
Southern Division Engineering Command
2155 Eagle Drive
North Charleston, SC 29406
(843) 820-5525

3. SCDHEC point of contact
Chuck Williams
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, SC 29201
(843) 898-4339

REFERENCES

- Ensafe/ Allen & Hoshall. July, 1996. Comprehensive Sampling and Analysis Plan.
- Parsons Engineering Science, Inc. and United States Geological Survey. September 1998. Technical Guidelines for Evaluating Monitored Natural Attenuation of Petroleum Hydrocarbons and Chlorinated Solvents in Ground Water at Naval and Marine Corps Facilities.
- South Carolina Department of Health and Environmental Control. 1997. Corrective Action Guidance.
- Tetra Tech NUS, Inc.; 2000 Rapid Assessment for Site 21 (Building 241), Charleston, South Carolina.
- United States Environmental Protection Agency. 1990. Code of Federal Regulations 136.
- United States Environmental Protection Agency. 1988. EPA Users Guide to Contract Laboratory Program.
- United States Environmental Protection Agency. 1996. EPA Environmental Investigations Standard Operating Procedures for Quality Assurance Manual.

TABLES

TABLE 1
GROUNDWATER ELEVATIONS
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL BASE COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well #	Total Depth of Well (ft)	Top of Casing Elevation, ft (MSL)	Date Measured	Depth to Water, ft (BTOC)	Depth to Product, ft (BTOC)	Product Thickness (ft)	Groundwater Elevation (MSL)
CNC21-M01	10.00	8.90	8/8/99	5.65	ND	0.00	3.25
CNC21-M02	14.00	8.76	8/8/99	5.56	ND	0.00	3.20
CNC21-M03	14.00	8.84	8/8/99	4.52	ND	0.00	4.32
CNC21-M04	14.00	9.36	8/8/99	5.19	ND	0.00	4.17
CNC21-M05	13.00	8.52	8/8/99	2.98	ND	0.00	5.54
CNC21-M06	13.00	9.25	8/8/99	4.70	ND	0.00	4.55
CNC21-M07D	33.50	8.95	8/8/99	6.77	ND	0.00	2.18
CNC21-M08	12.00	NA	8/8/99	3.95	ND	0.00	NA

Well #	Total Depth of Well (ft)	Top of Casing Elevation, ft (MSL)	Date Measured	Depth to Water, ft (BTOC)	Depth to Product, ft (BTOC)	Product Thickness (ft)	Groundwater Elevation (MSL)
CNC21-M01	10.00	8.90	10/13/99	5.12	ND	0.00	3.78
CNC21-M02	14.00	8.76	10/13/99	5.17	ND	0.00	3.59
CNC21-M03	14.00	8.84	10/13/99	4.14	ND	0.00	4.70
CNC21-M04	14.00	9.36	10/13/99	5.19	ND	0.00	4.17
CNC21-M05	13.00	8.52	10/13/99	2.69	ND	0.00	5.83
CNC21-M06	13.00	9.25	10/13/99	4.71	ND	0.00	4.54
CNC21-M07D	33.50	8.95	10/13/99	6.02	ND	0.00	2.93

Notes:

MSL - Mean Sea Level
 BTOC - Below Top of Casing
 NA - Not Applicable
 ND- Not Detected
 ft - Feet

TABLE 2
GROUNDWATER FIELD MEASUREMENTS
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

W # I.D.	Date Sampled	Purge method	Volume (gallons)	Temp. (° C)	pH	Specific Conductivity (uMHOS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/l)
CNC21-MW02	8/22/99	PP	4.20	27.7	6.87	1.67	1	2.00
CNC21-MW03	8/22/99	PP	5.40	29.8	6.79	0.758	5	1.41
CNC21-MW05	8/22/99	PP	4.92	27.9	6.96	0.817	0	2.74
CNC21-MW08	8/22/99	PP	0.50	25.9	6.77	21.0	70	1.01
CNC21-MW07D	8/22/99	PP	11.40	28.1	7.11	23.0	64	6.87

Notes:

° C - Degrees Celsius

PP - Peristaltic pump, low flow technique

uohms/cm = microohms per centimeter (equivalent to seimenpercentimeter (S/cm))

NTU - Nephelometric turbidity units

mg/l - milligrams per liter

TABLE 3

GROUNDWATER NATURAL ATTENUATION FIELD MEASUREMENTS
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Well I.D.	Date Sampled	Dissolved Oxygen (mg/l)	Alkalinity (mg/l)	Carbon Dioxide (mg/l)	Sulfide (mg/l)	Ferrous Iron (mg/l)	Methane (ug/l)	Manganese (mg/l)	Nitrogen/Nitrate (mg/l)*	Sulfate (mg/l)*
CNC21-MW01	9/8/99	1.20	354	548	0.087	5.10	6,800	4.4	<0.050	5.20
CNC21-MW04	9/8/99	1.48	1,335	720	0.084	5.10	2,700	-0.2	<0.050	53.00
CNC21-MW06	9/8/99	0.49	1,060	670	0.80	3.36	310	0.5	<0.050	64.00

Notes:

mg/l - Milligrams per liter

ug/l - Micrograms per liter

E- Estimated Concentration

NA - Not Analyzed

* Fixed base laboratory analysis

TABLE 4

SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 21, BUILDING 241
ZONE F, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration (ppm)
CNC21-B01	21SSB0102	2	0
	21SSB0108	8	140
	21SSB0111	11	250
CNC21-B02	21SSB0203	3	0
	21SSB0205	5	100
	21SSB0210	10	130
CNC21-B03	21SSB0303	3	17
	21SSB0305	5	80
CNC21-B04	21SSB0405	5	0
	21SSB0406	6	0
	21SSB0407	7	0
	21SSB0408	8	3000
	21SSB0410	10	5000
CNC21-B05	21SSB0504	4	0
	21SSB0507	7	4
	21SSB0512	12	290
CNC21-B06	21SSB0604	4	0
	21SSB0608	8	110
	21SSB0612	12	10
CNC21-B07D	21SSB0704	4	17
	21SSB0706	6	100
	21SSB0708	8	10
CNC21-B08	21SSB0803	3	0
	21SSB0805	5	8
	21SSB0806	6	150
CNC21-B09	21SSB0907	7	38
CNC21-B10	21SSB1003	3	35
	21SSB1009	9	100
CNC21-B11	21SSB1103	3	20
	21SSB1105	5	10
CNC21-B12	21SSB1203	3	40
	21SSB1205	5	40
	21SSB1208	8	170
CNC21-B13	21SSB1303	3	0
CNC21-B14	21SSB1403	3	0
CNC21-B15	21SSB1503	3	0
CNC21-B16	21SSB1603	3	21
	21SSB1607	7	38
CNC21-B17	21SSB1701	1-9	No Recording
CNC21-B18	21SSB1803	3	70
CNC21-B19	21SSB1903	3	60
	21SSB1907	7	20
	21SSB1909	9	60
CNC21-B20	21SSB2003	3	20
	21SSB2007	7	3

TABLE 4 - CONTINUED
SUMMARY OF OVA SOIL SCREENING RESULTS
SITE 21, BUILDING 241
ZONE F, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Total Organic Vapor Headspace Concentration (ppm)
CNC21-B21	21SSB2103	3	36
	21SSB2107	7	310
CNC21-B22	21SSB2201	1-10	No Recording
CNC21-B23	21SSB2301	1-12	No Recording
CNC21-B24	21SSB2401	1-16	No Recording
CNC21-B25	21SSB2501	1-16	No Recording
CNC21-B26	21SSB2601	1-16	No Recording

Notes:

OVA - Organic vapors were analyzer with a flame ionization detector (FID)
ppm - Parts Per Million

TABLE 5
SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR SOIL
SITE 21, BUILDING 241
ZONE F, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Laboratory Screening Data ⁽¹⁾					
			Benzene (µg/Kg)	Toluene (µg/Kg)	Ethylbenzene (µg/Kg)	Total Xylenes (µg/Kg)	Naphthalene (µg/Kg)	Diesel Range Organics (mg/Kg)
CNC21-B01	21SFB010405	4-5	ND	ND	ND	ND	ND	ND
CNC21-B02	21SFB020405	4-5	ND	ND	ND	ND	ND	ND
CNC21-B03	21SFB030304	3-4	ND	ND	ND	ND	ND	ND
CNC21-B04	21SFB040405	4-5	ND	58.6J	467	1,247E	334	10,400E
CNC21-B05	21SFB050506	5-6	ND	ND	48.8J	441	387	8510
CNC21-B06	21SFB060708	7-8	ND	ND	ND	ND	ND	ND
CNC21-B07	21SFB070506	5-6	ND	ND	ND	647E	465	586
CNC21-B08	21SFB080607	6-7	ND	ND	161	608E	198	1361
CNC21-B09	21SFB090708	7-8	ND	ND	ND	202	228	727
CNC21-B10	21SFB100910	9-10	ND	ND	ND	ND	ND	ND
CNC21-B11	21SFB110506	5-6	ND	ND	30.6	122	108	288
CNC21-B12	21SFB120809	8-9	ND	ND	ND	ND	92.4	ND
CNC21-B13	21SFB130304	3-4	ND	ND	ND	ND	ND	ND
CNC21-B14	21SFB140506	5-6	ND	ND	ND	ND	ND	ND
CNC21-B15	21SFB150304	3-4	ND	ND	ND	ND	ND	ND
CNC21-B16	21SFB160304	3-4	ND	ND	ND	ND	ND	ND
CNC21-B17	21SFB170506	5-6	ND	ND	ND	ND	ND	ND
CNC21-B18	21SFB180304	3-4	ND	ND	ND	ND	ND	ND
CNC21-B19	21SFB190304	3-4	ND	ND	ND	ND	ND	ND
CNC21-B20	21SFB200708	7-8	ND	ND	ND	ND	ND	ND
CNC21-B21	21SFB210708	7-8	ND	ND	ND	ND	ND	ND
CNC21-B22	21SFB220607	6-7	ND	ND	ND	ND	ND	ND
CNC21-B23	21SFB230506	5-6	ND	ND	ND	ND	ND	ND
CNC21-B24	21SFB240506	5-6	ND	ND	ND	ND	ND	ND
CNC21-B25	21SFB250506	5-6	ND	ND	ND	ND	ND	ND
CNC21-B26	21SFB200708	7-8	ND	ND	ND	ND	ND	ND

NOTES:

⁽¹⁾ Laboratory screening data was analyzed using USEPA Method 8020/8015M. Compounds not detected are reported as non-detected (ND)

µg/Kg = micrograms per kilogram

mg/Kg = milligrams per kilogram

J = Estimated value-detection was above the instrument minimum detection level, but below the practical quantification limit.

E = Estimated value-detection exceeded the upper calibration range of the instrument.

TABLE 6

SUMMARY OF MOBILE LABORATORY SCREENING RESULTS FOR GROUNDWATER
SITE 21, BUILDING 241
ZONE F, FORMER CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Sample Location	Sample Identification	Sample Depth (feet)	Laboratory Screening Data ⁽¹⁾					
			Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	Naphthalene (µg/L)	Diesel Range Organics (mg/L)
CNC21-B01	21GFB010612	6-12	ND	ND	ND	ND	ND	ND
CNC21-B02	21GFB020812	8-12	ND	ND	ND	ND	ND	ND
CNC21-B03	21GFB030812	8-12	ND	ND	ND	ND	ND	ND
CNC21-B03	21GFB031016	10-16	ND	ND	ND	ND	ND	ND
CNC21-B04	21GFB040612	6-12	ND	ND	28.0	147.5	537E	190
CNC21-B05	21GFB050712	7-12	ND	ND	61.8	279.7	283E	663E
CNC21-B06	21GFB061220	12-20	ND	ND	ND	ND	ND	ND
CNC21-B07	21GFB071116	11-16	ND	ND	ND	ND	ND	ND
CNC21-B08	21GFB080816	8-16	ND	ND	ND	ND	ND	ND
CNC21-B09	21GFB090612	6-12	ND	ND	ND	46.6	260	26.6
CNC21-B10	21GFB100916	9-16	ND	ND	ND	ND	ND	ND
CNC21-B11	21GFB110608	6-8	ND	ND	13.7	75	98.8	67.2
CNC21-B12	21GFB120912	9-12	ND	ND	ND	ND	ND	ND
CNC21-B13	21GFB130812	8-12	ND	ND	ND	ND	ND	ND
CNC21-B14	21GFB140812	8-12	ND	ND	ND	ND	ND	ND
CNC21-B15	21GFB150508	5-8	ND	ND	ND	ND	10.6	ND
CNC21-B16	21GFB160610	6-10	ND	ND	ND	ND	ND	ND
CNC21-B17	21GFB170810	8-10	ND	ND	ND	3.2J	ND	ND
CNC21-B18	21GFB180912	9-12	ND	ND	ND	ND	ND	ND
CNC21-B19	21GFB190512	5-12	ND	ND	ND	ND	ND	ND
CNC21-B20	21GFB200612	6-12	ND	ND	ND	ND	ND	ND
CNC21-B21	21GFB210912	9-12	ND	ND	ND	ND	ND	ND
CNC21-B22	21GFB220709	7-9	ND	ND	ND	ND	ND	ND
CNC21-B23	21GFB230816	8-16	ND	ND	ND	ND	ND	ND
CNC21-B24	21GFB240616	6-16	ND	ND	ND	ND	ND	ND
CNC21-B25	21GFB251016	10-16	ND	ND	ND	ND	ND	ND
CNC21-B26	21GFB261016	10-16	ND	ND	ND	ND	ND	ND

NOTES:

⁽¹⁾ Laboratory screening data was analyzed using USEPA Method 8020/8015M. Compounds not detected are reported as non-detected (ND)

µg/Kg = micrograms per kilogram

mg/Kg = milligrams per kilogram

J = Estimated value-detection was above the instrument minimum detection level, but below the practical quantification limit.

E = Estimated value-detection exceeded the upper calibration range of the instrument.

TABLE 7
SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN SOIL
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Soil Boring/ Sample No.	Sample Date	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl-benzene (ug/kg)	Xylenes (total) (ug/kg)	Benzo(a) anthracene (ug/kg)	Benzo(b) fluoranthene (ug/kg)	Benzo(k) fluoranthene (ug/kg)	Chrysene (ug/kg)	Dibenzo(a,h) anthracene (ug/kg)	Naphthalene (ug/kg)
RBSL ⁽¹⁾		5	478	364	11119	17667	7042	55930	3146	21265	52
CNC21-B03 / 21SLB030304	18-Aug-99	<7	4(J)	<7	<7	<530	<530	<530	<530	<530	2500
CNC21-B04 / 21SLB040405	23-Jun-99	<6	<6	<6	<6	440	370	200(J)	400	<362	11004(J)
CNC21-B05 / 21SLB050506	23-Jun-99	<7	<7	<7	<7	<330	<330	<330	<330	<330	<7
CNC21-B07 / 21SLB070506	18-Aug-99	<11	<11	<11	<11	<630	<630	<630	<630	<630	7024
CNC21-B08 / 21SLB080607	23-Jun-99	<10	<10	<10	<10	<630	<630	<630	<630	<630	<10
CNC21-B08 / 21SLB080607D	23-Jun-99	<11	<11	<11	<11	<660	<660	<660	<660	<660	7(J)
CNC21-B09 / 21SLB090706	23-Jun-99	<5	<5	<5	<5	4100	4300	1800(J)	4100	<3600	25055
CNC21-B11 / 21SLB110506	18-Aug-99	<10	<10	<10	<10	<560	<560	<560	<560	<560	3724
CNC21-B12 / 21SLB120708	18-Aug-99	<11	<11	<11	<11	<590	<590	<590	<590	<590	6800
CNC21-TL(2) / 21TL00101	18-Aug-99	<5	<5	<5	<5	NA	NA	NA	NA	NA	<5
CNC21-TL(2) / 21TL00201	23-Jun-99	<5	<5	<5	<5	NA	NA	NA	NA	NA	<5

NA - Not analyzed

⁽¹⁾ South Carolina Department of Health and Environmental Control Risk Based Screening Levels for clay-rich soils; depth to groundwater less than 5 feet.

⁽²⁾ Trip blank

⁽³⁾ Indicates presence of analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 8
SUMMARY OF FIXED-BASE LABORATORY ANALYTICAL RESULTS FOR CHEMICALS OF CONCERN IN GROUNDWATER
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Monitoring Well/ Sample No.	Sample Date	Benzene (ug/L)	Ethyl- benzene (ug/L)	Toluene (ug/L)	Xylenes (total) (ug/L)	Naphthalene (ug/L)	Benzo(a) anthracene (ug/L)	Benzo(b) fluoranthene (ug/L)	Benzo(k) fluoranthene (ug/L)	Chrysene (ug/L)	Dibenzo(a,h) anthracene (ug/L)	MTBE (ug/L)
RBSL ⁽¹⁾		5	700	1000	10000	10 ⁽²⁾	10 ⁽²⁾	10 ⁽²⁾	10 ⁽²⁾	10 ⁽²⁾	10 ⁽²⁾	40
CNC21M-01 / 21GLM0101	8-Sep-99	< 5	< 5	< 5	< 5	160	< 10	< 10	< 10	< 10	< 10	< 5
CNC21M-02 / 21GLM0201	22-Aug-99	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5
CNC21M-02 / 21GLM0201D	22-Aug-99	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5
CNC21M-03 / 21GLM0301	22-Aug-99	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5
CNC21M-04 / 21GLM0401	8-Sep-99	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5
CNC21M-05 / 21GLM0501	16-Aug-99	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5
CNC21M-06 / 21GLM0601	22-Aug-99	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5
CNC21M-07 / 21GLM07D01	22-Aug-99	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5
CNC21M-08 / 21GLM0801	22-Aug-99	< 5	< 5	< 5	< 5	< 10	< 10	< 10	< 10	< 10	< 10	< 5

All concentrations are in ug/L.

NA - Not analyzed

⁽¹⁾ South Carolina Department of Health and Environmental Control Risk Based Screening Levels for ground water.

⁽²⁾ The Risk based screening level for individual PAH CoC is 10 ug/l or 25 ug/l for total PAHs.

⁽³⁾ Trip blank

⁽⁴⁾ Indicates presence of analyte at a concentration less than the reporting limit and greater than the detection limit.

TABLE 9

FATE AND TRANSPORT INPUT PARAMETERS
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Parameter	Domenico Dilution/Attenuation Model ⁽¹⁾
Hydraulic Conductivity [m/sec]	2.61E-07
Hydraulic Gradient [ft/ft]	0.0202
Porosity [cm ³ /cm ³]	0.55
Estimated Plume Length [ft]	NA
Soil Bulk Density ^(a) [g/cm ³]	1.4
Partition Coefficient [L/kg]	chemical specific
Fraction of Organic Carbon in soil [g/g]	1.09E10 ⁻²
First Order Decay Rate [sec ⁻¹]	0
Modeled Plume Length [ft]	NA
Modeled Plume Width [ft]	NA
Source Width ^(b) [m]	15
Source Thickness ^(b) [m]	2
Soluble Mass [kg]	Infinite ^(b)

Notes:

- (1) - *South Carolina Risk-Based Corrective Action for Petroleum Releases*, South Carolina Department of Health and Environmental Control, 1998 (SCDHEC 1998).
- (a) - Determined from Tables C1 and C3 (SCDHEC 1998)
- (b) - Default value

TABLE 10

COMPARISON OF MAXIMUM CONCENTRATIONS TO RBSLS
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Chemical of Concern	Maximum Concentration (Soil) (mg/kg)	RBSLs (Soil) (mg/kg) ^(a)	Maximum Concentration (GW) (mg/L)	Tier 1 RBSLs (GW) (mg/L) ^(b)	RBSLs (GW) Protective of On-Site Construction Worker ^(c)
Benzene	ND	0.005	ND	0.005	0.15
Toluene	0.004 ^(j)	0.478	ND	1	5.38
Ethybenzene	ND	0.364	ND	0.7	6.05
Xylenes (Total)	ND	1.119	ND	10	102.33
Benzo(a)anthracene	4.1	17.687	ND	0.010	-
Benzo(b)fluoranthene	4.3	7.042	ND	0.010	-
Benzo(k)fluoranthene	1.8	5.593	ND	0.010	-
Chrysene	4.1	3.146	ND	0.010	-
Dibenzo(a,h)anthracene	ND	21.265	ND	0.010	-
Naphthalene	25.1	0.052	0.16	0.010	1.63
MTBE	NA	Not Applicable	ND	0.040	1.63

(a) - From Risk-Based Corrective Action for Petroleum Releases, Table B4, Depth to GW - <5 ft, SCDHEC RBCA Guidelines, 1998.

(b) - From Risk-Based Corrective Action for Petroleum Releases, Table B1, SCDHEC RBCA Guidelines, 1998.

(c) - Calculated for dermal, incidental ingestion, and inhalation routes for the on-site construction worker (see Section 3.5.1 of the text and Appendix H).

(j) - Estimated value

GW - Groundwater

RBSLs - Risk Based Screening Levels

ND - Not detected

NA - Not analyzed

Shaded cell indicates the concentration exceeded one of the RBSLs.

MTBE - Methyl Tertiary Butyl Ether

TABLE 11

**EXPOSURE PATHWAY ASSESSMENT - CURRENT USE
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA**

Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure point or Reason for Non-Selection	Data Requirements. (If pathway selected)
Air	Inhalation	No	No volatilization to enclosed space. No explosion hazard.	
	Explosion Hazard	No		
Groundwater	Ingestion	No	No water supply well downgradient or residential basements.	
	Dermal contact	No		
	Inhalation	No		
Surface Water	Ingestion	No	Cooper River approximately 400 feet downgradient. No completed pathway.	No additional data required
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	No impacted surface soil.	
	Dermal contact	No		
	Inhalation	No		
Subsurface Soil	Ingestion	No	No current complete pathway.	
	Dermal contact	No		
	Inhalation	No		
	Leaching to Groundwater	No		

TABLE 12
EXPOSURE PATHWAY ASSESSMENT - FUTURE USE
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Media	Exposure Route	Pathway Selected for Evaluation? (Yes or No)	Exposure point or Reason for Non-Selection	Data Requirements (if pathway selected)
Air	Inhalation	No	No volatilization to enclosed space. No explosion hazard.	
	Explosion Hazard	No		
Groundwater	Ingestion	Yes	Future use of property expected to be industrial or commercial. Sanitary sewer line within close proximity to the site; therefore, construction worker exposure possible.	
	Dermal contact	Yes		
	Inhalation	Yes		
Surface Water	Ingestion	Yes	Cooper River approximately 400 feet downgradient. No completed pathway.	No additional data required
	Dermal contact	No		
	Inhalation	No		
Surficial Soil	Ingestion	No	No impacted surface soil.	
	Dermal contact	No		
	Inhalation	No		
Subsurface Soil	Ingestion	Yes	A sanitary sewer line is within close proximity to the site; therefore, construction worker exposure possible. Inhalation hazard discounted based on low levels of benzene in the soil. Presumed that upon excavating the trench, benzene volatilization from exposed soils will reach equilibrium prior to the construction worker entering the trench.	
	Dermal contact	Yes		
	Inhalation	No		
	Leaching to Groundwater	Yes		

TABLE 13

COMPARISON OF MAXIMUM GROUNDWATER CONCENTRATIONS TO SSTLs
SITE 21, BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

Chemical of Concern	Source Area Concentration (mg/L)	SSTLs Protective of Surface Water (Cooper River)		SSTLs Protective of Construction Workers	Minimum On-Site SSTLs ^(a) (mg/L)
		SSTL _{SOURCE} (mg/L)	SSTL _{COMP} (mg/L)	SSTL _{SOURCE} (mg/L)	
Benzene	ND	0.998	0.943	0.15	0.15
Toluene	ND	199.5	188.5	5.38	5.38
Ethylbenzene	ND	139.7	132	6.05	6.05
Xyl nes	ND	1995	1885	102.33	102.33
Benzo(a) anthracene	4.10				
Benzo(b) fluoranthene	4.30				
Benzo(k)fluoranthene	1.80				
Chrysene	4.10				
Naphthalene	25.10	2	1.89	1.63	1.63

mg/L - milligrams per liter

GW - Groundwater

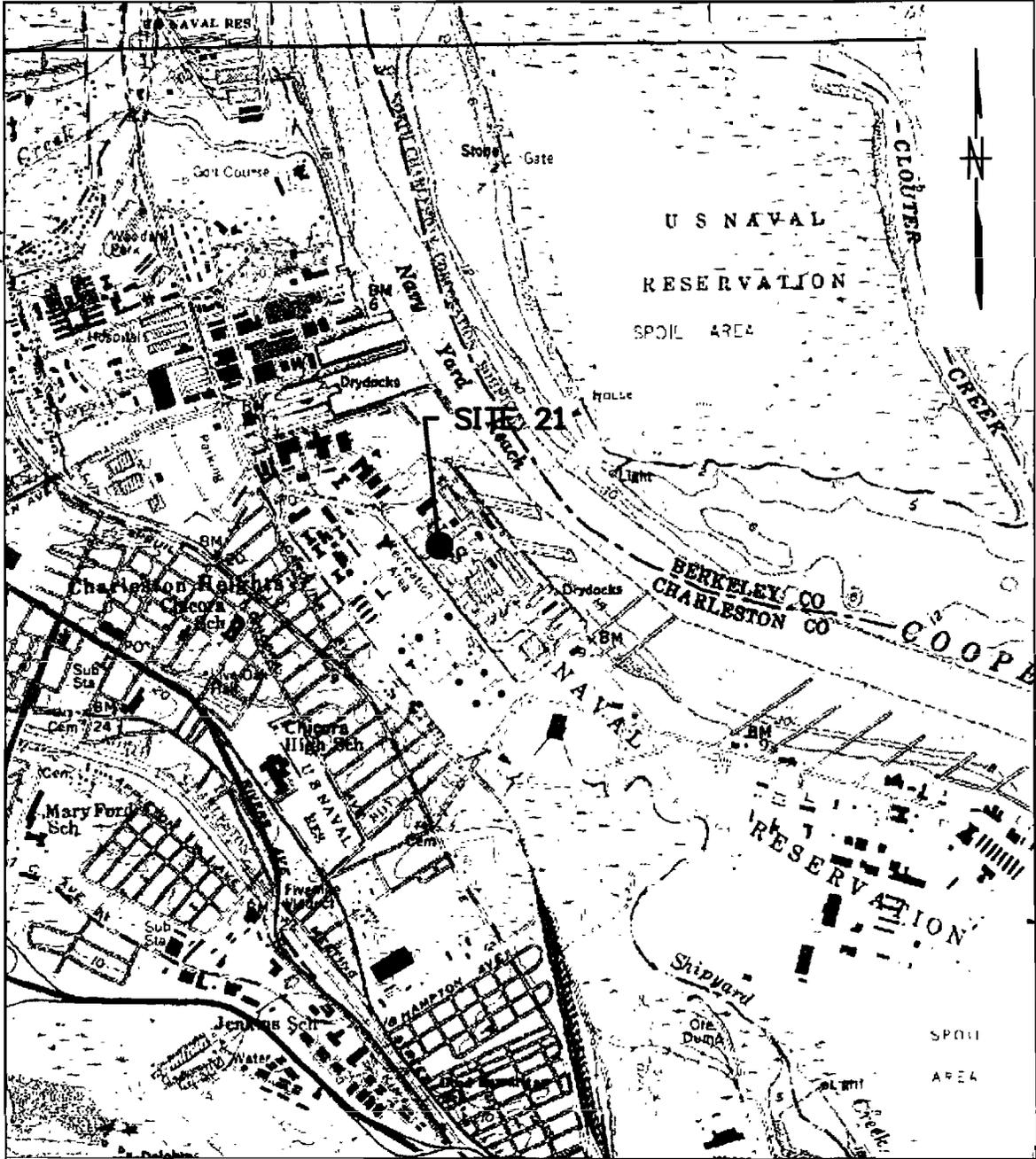
BOLD text indicates the concentration exceeded the SSTL.

ND - Not Detected

(a) The minimum on-site SSTLs are chosen as those SSTLs protective of both surface water (the Cooper River) and the on-site construction worker.

FIGURES

ACAD: 61.29CN62.DWG 86/28/98 HJP



SOURCE: QUADRANGLE MAP SOUTH CAROLINA, REVISED 1978
 QUADRANGLE MAP NORTH CHARLESTON REVISED, 1979

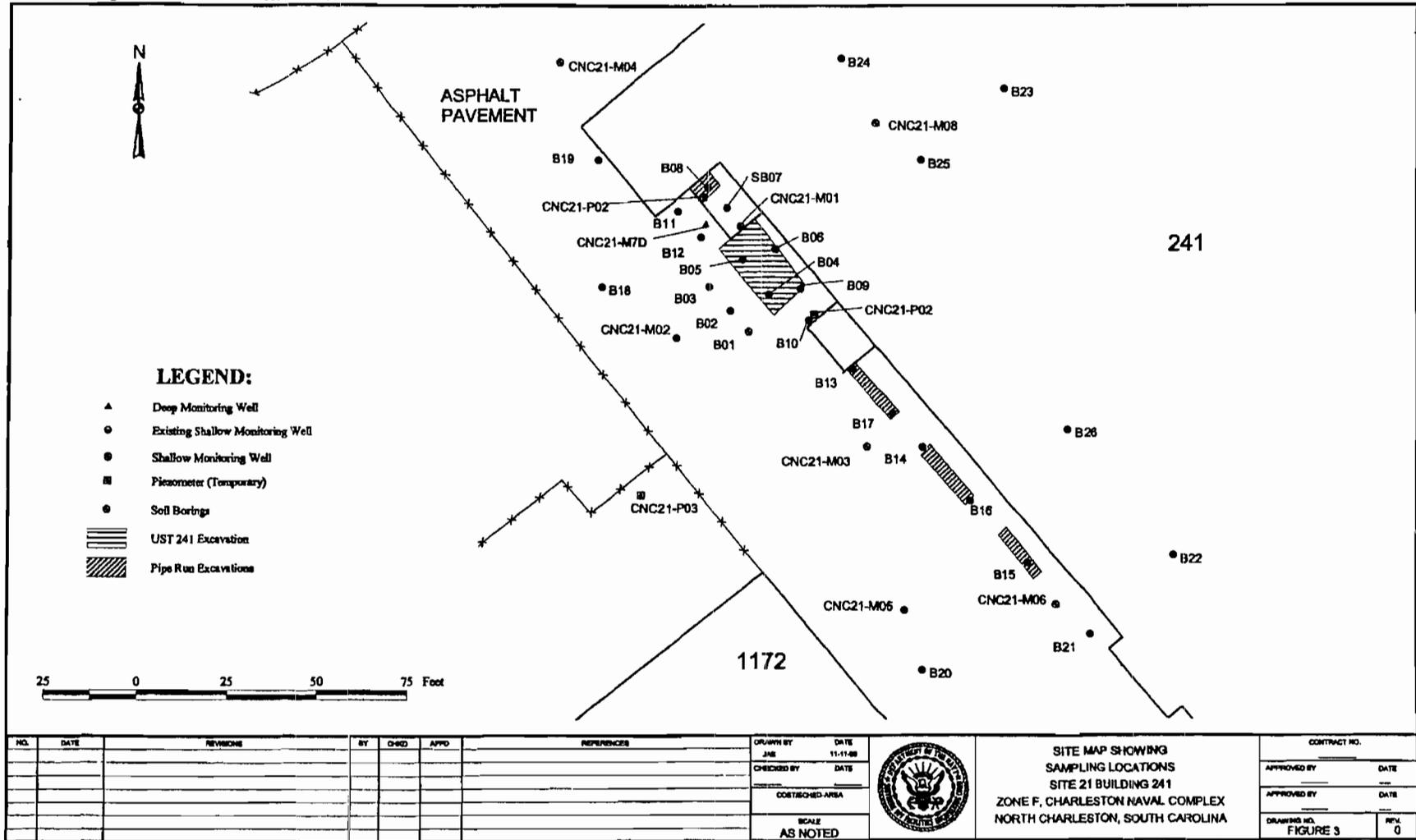


DRAWN BY	DATE
HJP	8/20/99
CHECKED BY	DATE
COST/SCHED-AREA	
SCALE	
AS NOTED	



SITE LOCATION MAP
 SITE 21, BUILDING 241, ZONE F
 CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SC

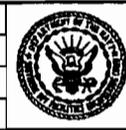
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APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 1	REV. 0



NO.	DATE	REVISIONS	BY	CHKD	APPR

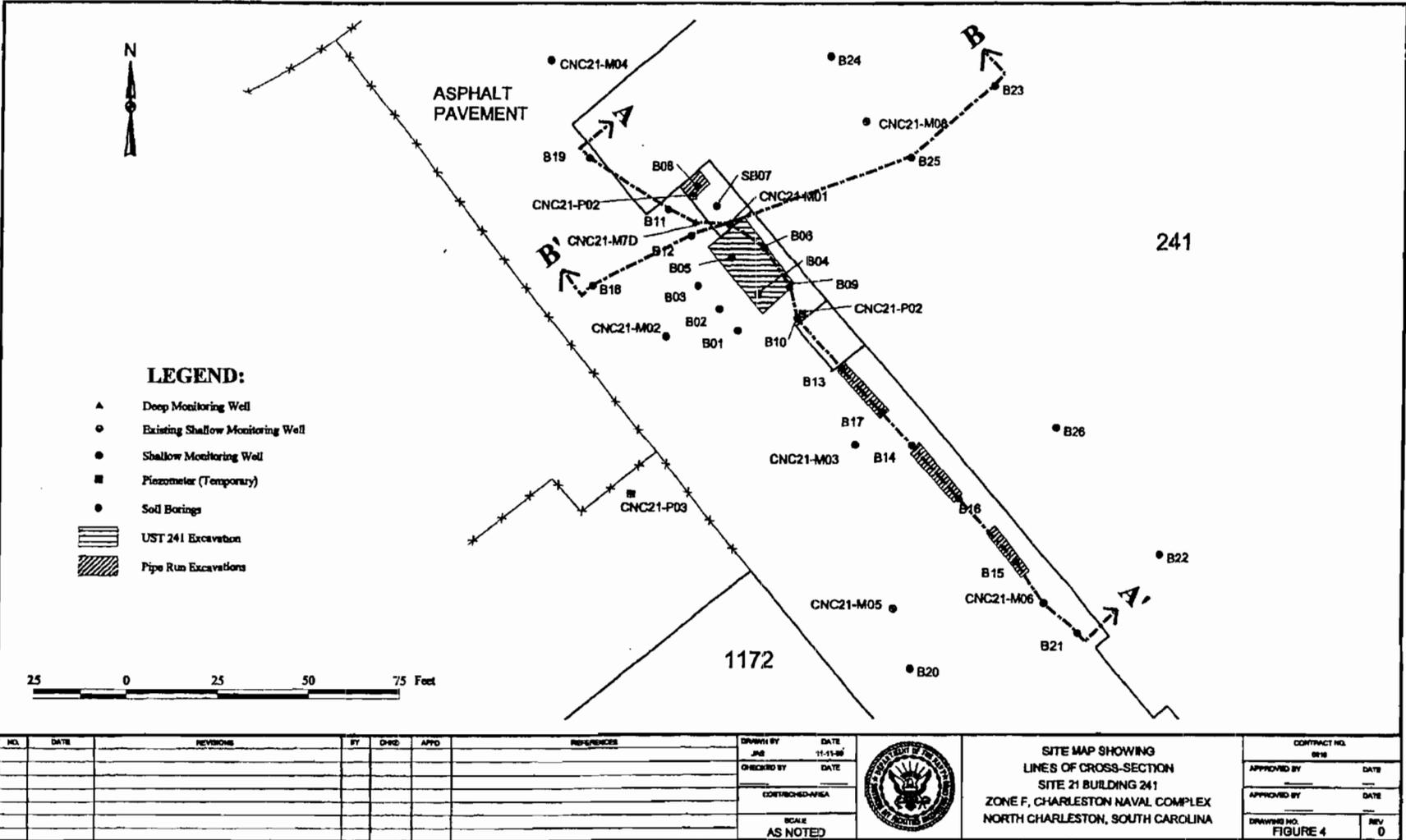
REFERENCES

DRAWN BY JMS	DATE 11-11-99
CHECKED BY	DATE
DESIGNED-ARSA	
SCALE AS NOTED	



SITE MAP SHOWING
SAMPLING LOCATIONS
SITE 21 BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO.	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 3	REV. 0



NO.	DATE	REVISIONS	BY	CHKD	APPD

REFERENCES

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CHECKED BY	DATE
CONTRACED-AUSA	
SCALE AS NOTED	

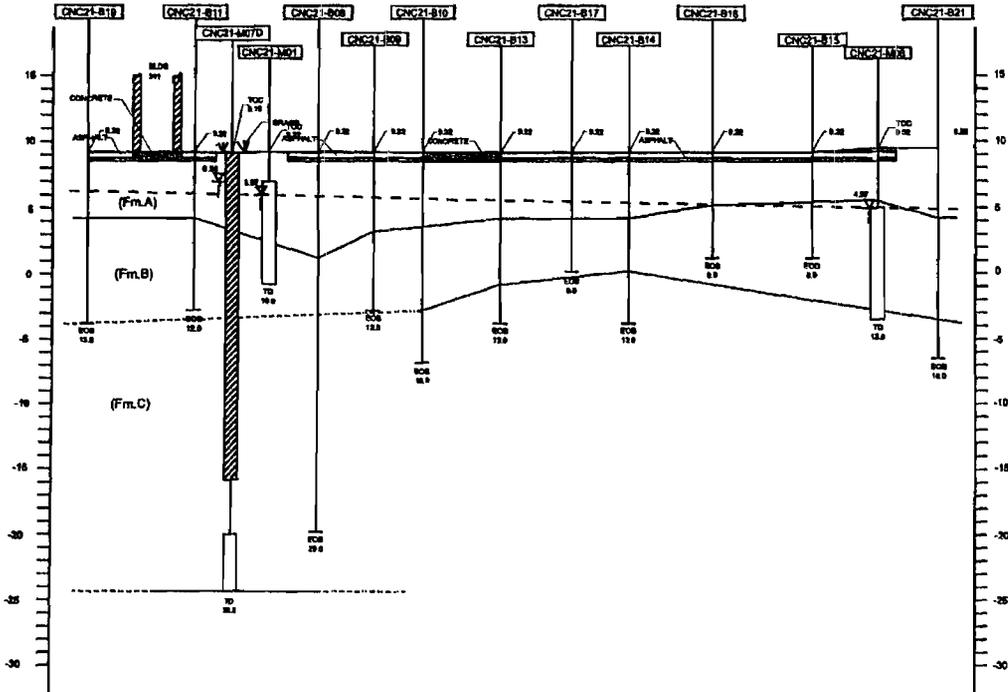


SITE MAP SHOWING
LINES OF CROSS-SECTION
SITE 21 BUILDING 241
ZONE F, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

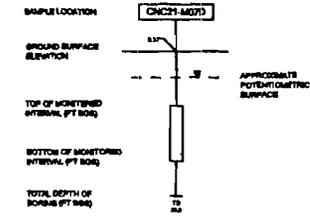
CONTRACT NO. 0818	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO. FIGURE 4	REV 0

A
WEST

A'
EAST

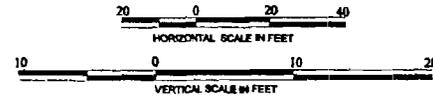


LEGEND



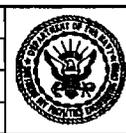
NOTES:
 FORMATION (Fm.)-(Fm.A)-LIGHT TO DARK SILTY SAND TO SANDY CLAY
 (Fm.B)-LIGHT TO DARK GREY TO BLACK INTERSEDED CLAYEY SAND, SILTY CLAY TO CLAY
 (Fm.C)-OLIVE GREEN INTERSEDED SILTY SAND, SILTY CLAY, CLAYEY SAND, CLAY (ASHLEY FORMATION)

ND=NO DATA
 ELEVATION IN FEET ABOVE MEAN SEA LEVEL (FT AMSL)



NO.	DATE	REVISIONS	BY	CNO	APPD	REFERENCES

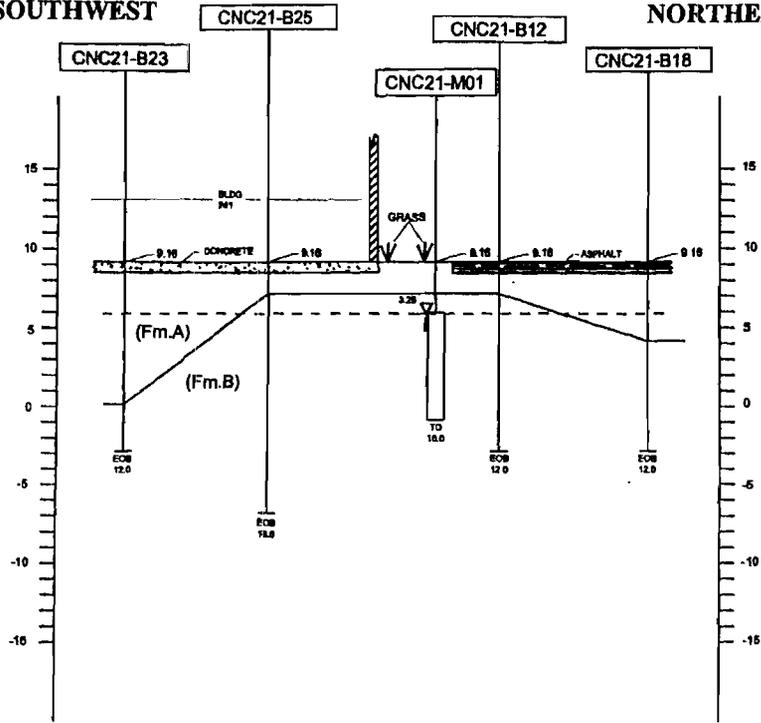
DRAWN BY	DATE
JAS	11-12-99
CHECKED BY	DATE
CORRECTED AREA	
SCALE	
AS NOTED	



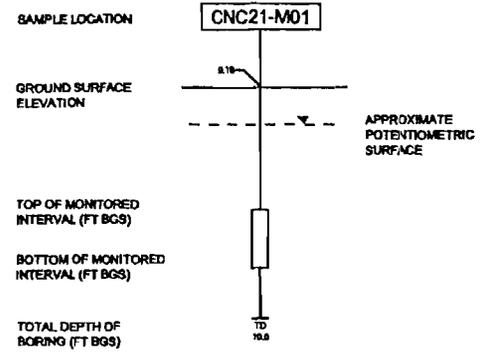
GEOLOGIC CROSS SECTION A - A'
 SITE 21, BUILDING 241
 ZONE F, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO.	
0218	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 5	0

B' SW **B' NE**

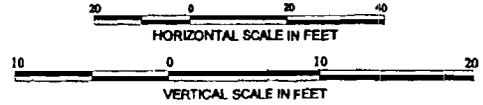


LEGEND



NOTES:
 FORMATION=(Fm.)=(Fm.A)=LIGHT TO DARK BROWN SILTY SAND, TO SANDY CLAY
 (Fm.B)=LIGHT TO DARK GREY TO BLACK INTERBEDDED CLAYEY SAND, SILTY CLAY, TO CLAY

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL (FT AMSL)



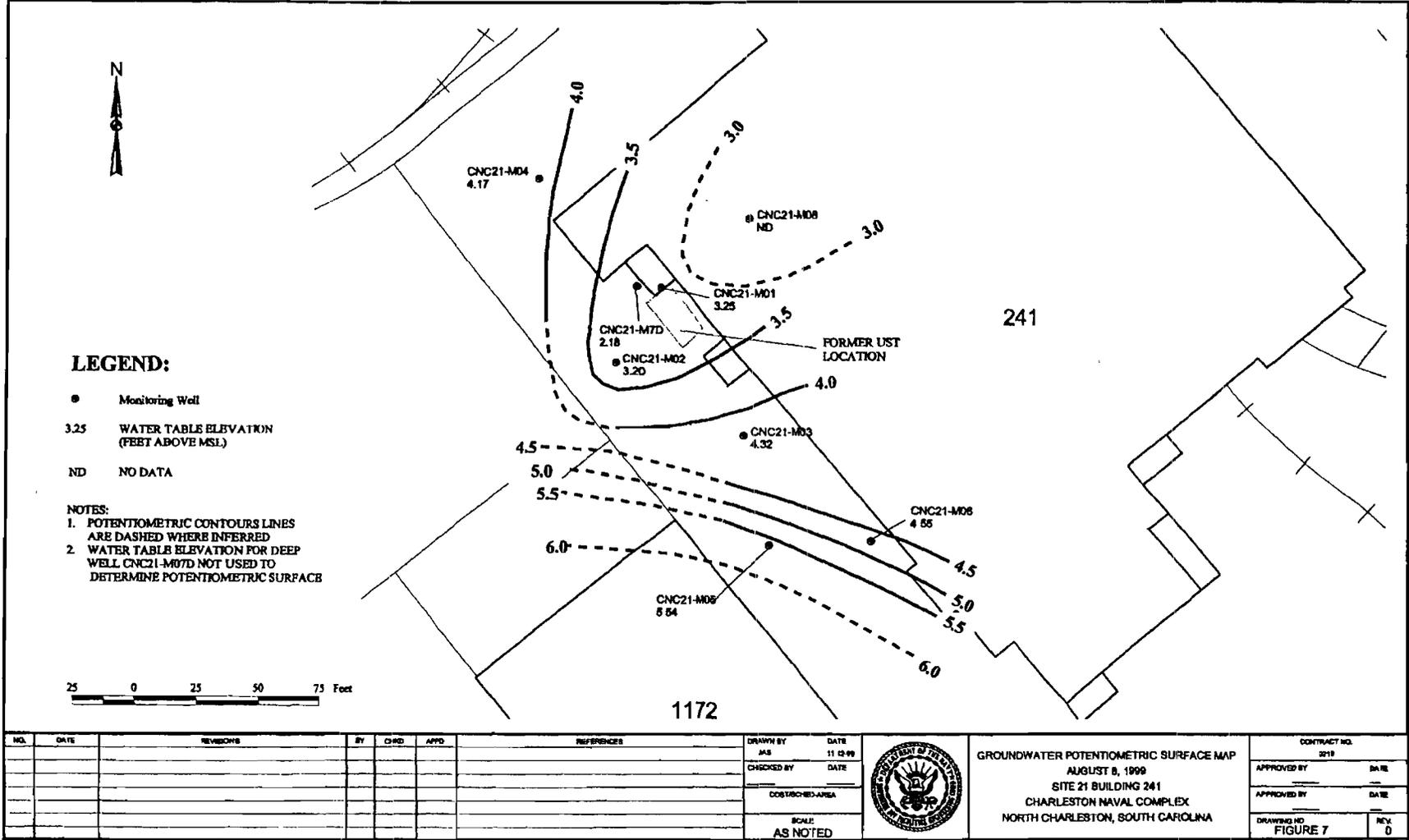
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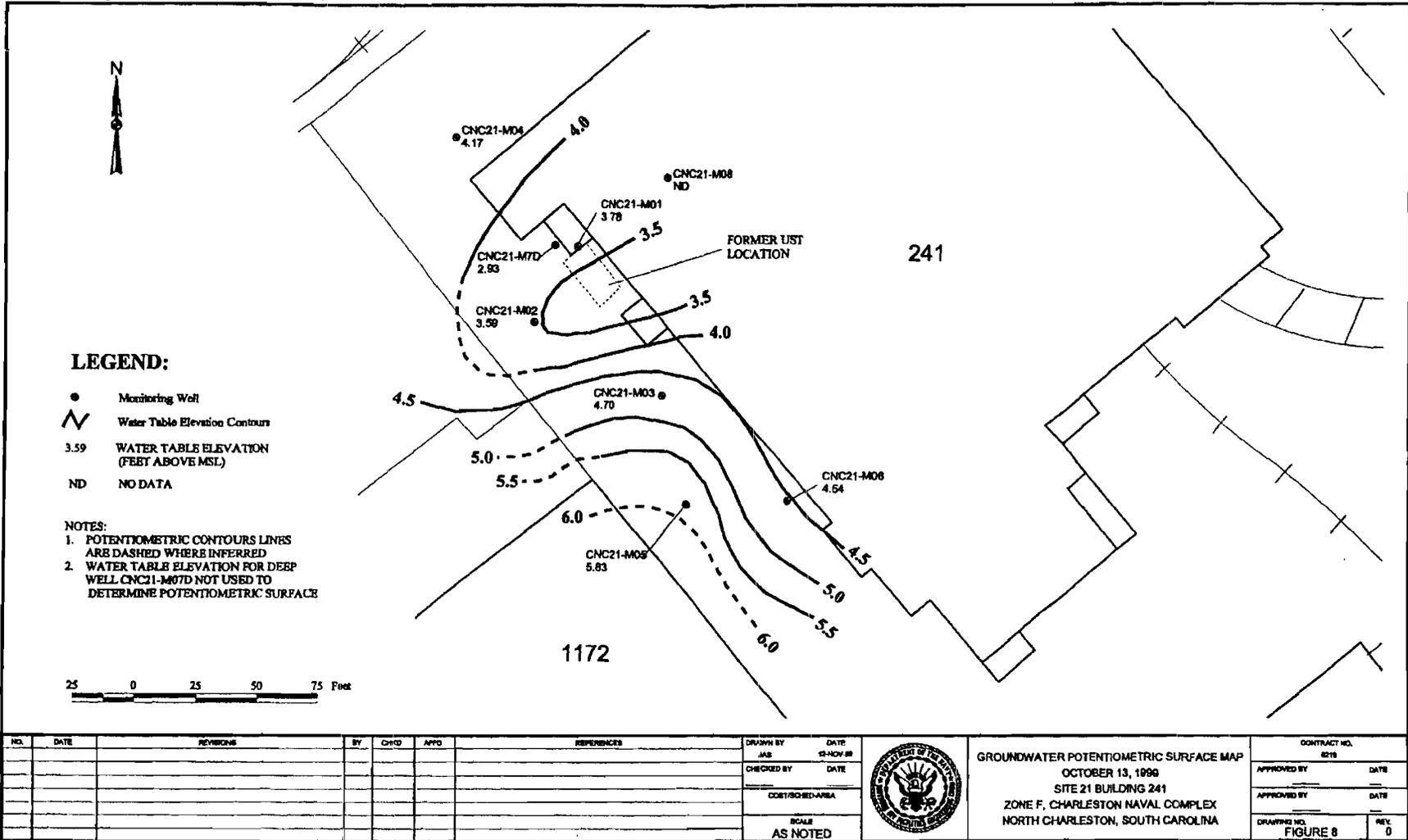
DESIGNED BY	DATE
JAS	11-18-99
CHECKED BY	DATE
CONTRACTED AREA	
SCALE	
AS NOTED	

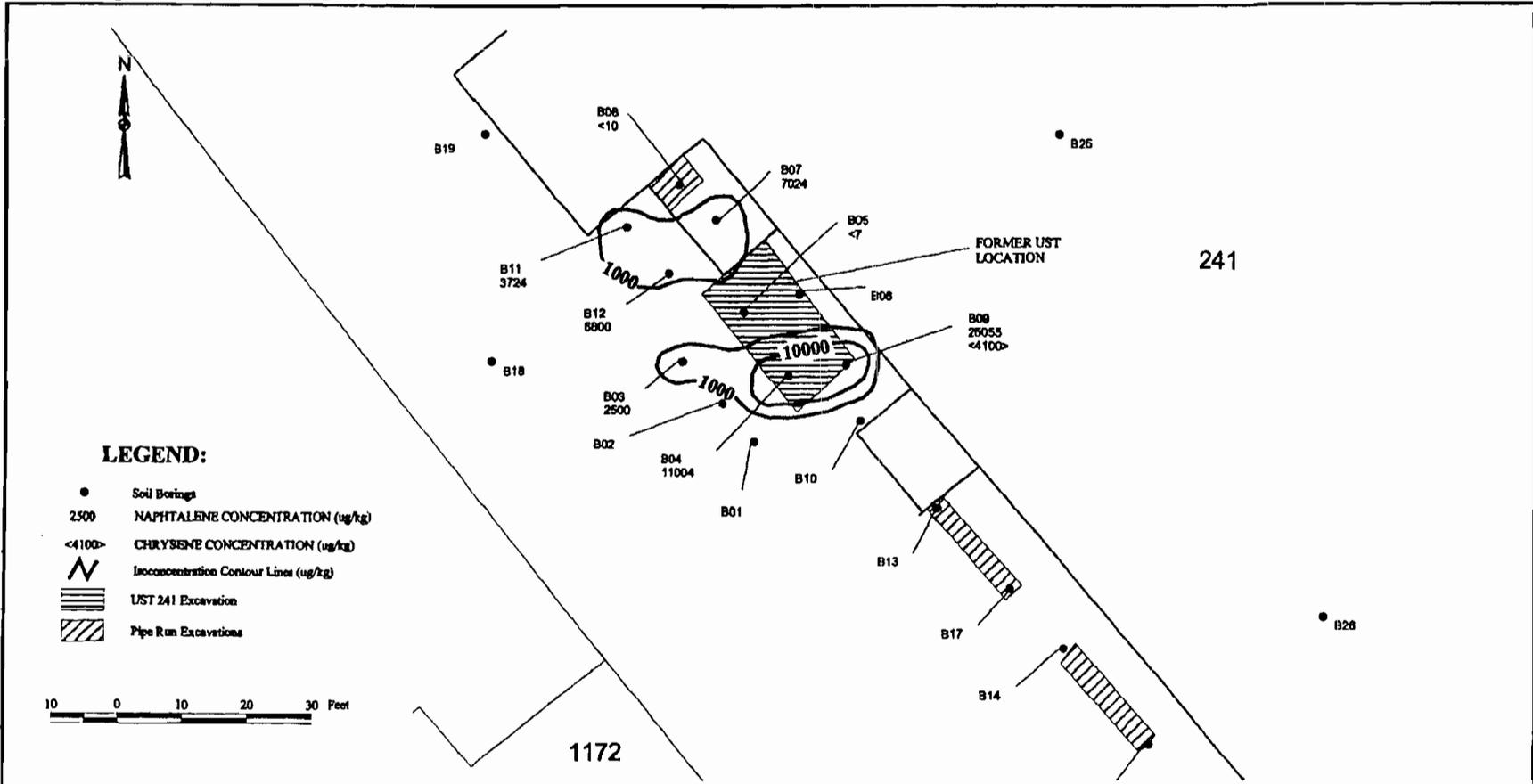


GEOLOGIC CROSS SECTION B - B'
 SITE 21, BUILDING 241
 ZONE F, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO.	
0218	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REV
FIGURE 6	0

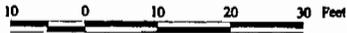






LEGEND:

- Soil Borings
- 2500 NAPHTHALENE CONCENTRATION (ug/kg)
- <4100> CHRYSENE CONCENTRATION (ug/kg)
- ~ Isocentration Contour Lines (ug/kg)
- ▨ UST 241 Excavation
- ▩ Pipe Run Excavations



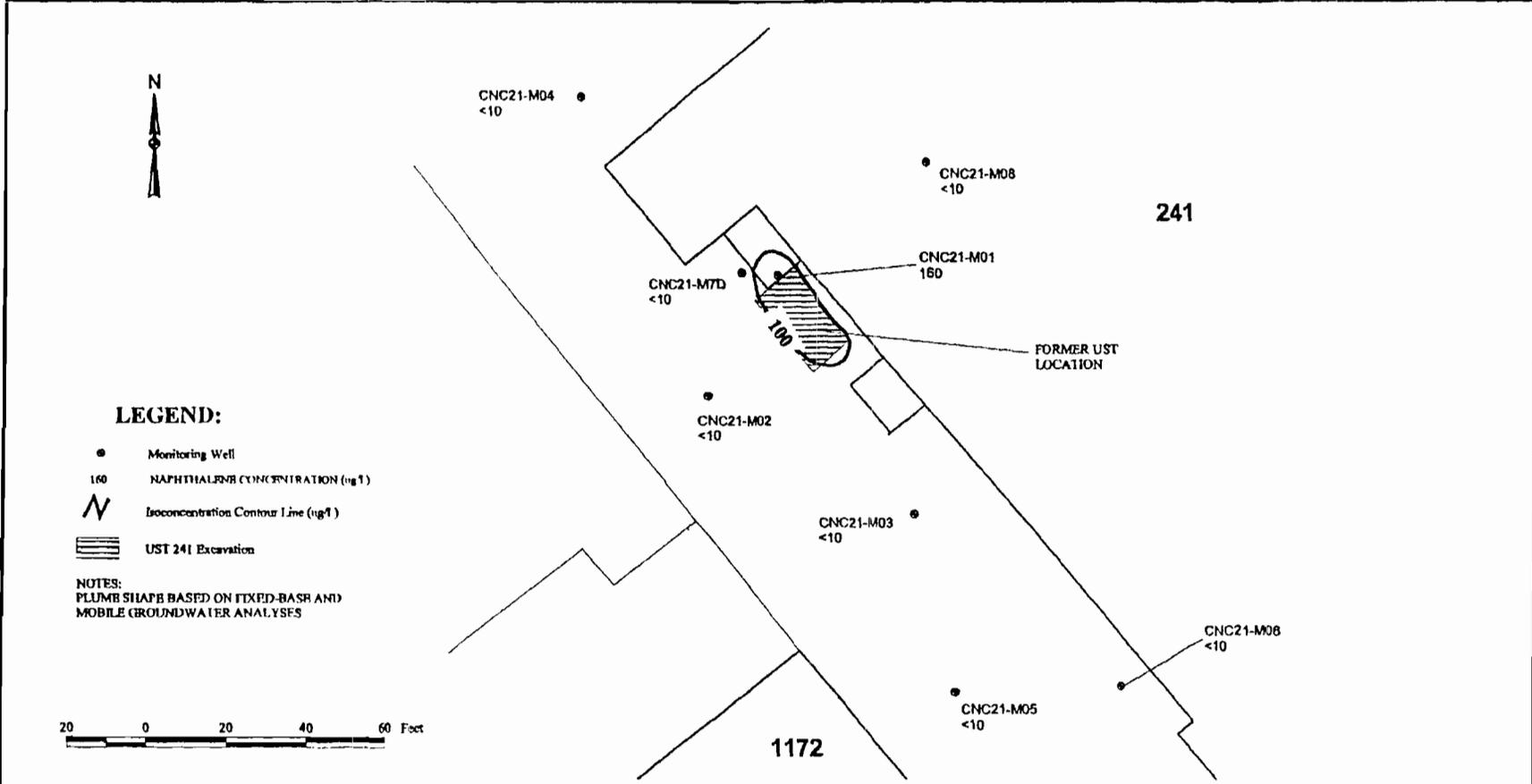
NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY: JAE DATE: 11-16-88
 CHECKED BY: DATE: _____
 CORRECTED AREA: _____
 SCALE: AS NOTED



SOIL NAPHTHALENE
 CONCENTRATION MAP
 SITE 21 BUILDING 241
 ZONE F, CHARLESTON NAVAL COMPLEX
 NORTH CHARLESTON, SOUTH CAROLINA

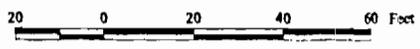
CONTRACT NO.	
APPROVED BY	DATE
APPROVED BY	DATE
DRAWING NO.	REF.
FIGURE 9	0



LEGEND:

- Monitoring Well
- 160 NAPHTHALENE CONCENTRATION (ug/l)
- ~ Isoconcentration Contour Line (ug/l)
- ▨ UST 241 Excavation

NOTES:
 PLUME SHAPE BASED ON FIXED-BASE AND
 MOBILE GROUNDWATER ANALYSES



NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES	DRAWN BY	DATE		CONTRACT NO.		
							JMS	11 NOV 88		GROUNDWATER NAPHTHALENE CONCENTRATION MAP	DD-18	
										SITE 21 BUILDING 241	APPROVED BY	DATE
									CHARLESTON NAVAL COMPLEX	APPROVED BY	DATE	
									NORTH CHARLESTON, SOUTH CAROLINA	DRAWING NO.	REV.	
										FIGURE 10	0	