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CORRECTIVE ACTION PLAN ADDENDUM ZONE C SITE 30 BUILDING NH46 CNC CHARLESTON SC

9/1/2002

CH2M HILL

Corrective Action Plan Addendum
Zone C, Site 30 Building NH46
Charleston Naval Complex
North Charleston, South Carolina
SCDHEC NO. 01206

Prepared by

CH2M-Jones, LLC.
Charleston Naval Complex
1849 Avenue F
North Charleston, South Carolina 29405
September 2002

Prepared For:

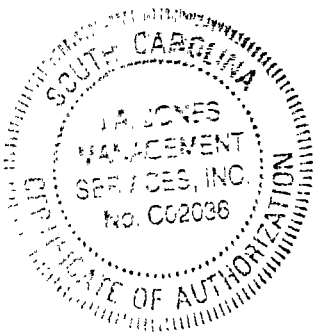
Southern Division Naval Facilities Engineering Command
P.O. Box 190010
North Charleston, South Carolina 29419-9010

CERTIFICATION

I certify that the information contained in this report, is true, and complete to the best of my knowledge, information, and belief.

Approved By: _____ Date: 9/23/02

South Carolina Registration No. 1220



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Charleston Naval Complex
North Charleston, South Carolina

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1.0 INTRODUCTION

1.1 Background

The Charleston Naval Complex is located on the banks of the Cooper River in Charleston County, South Carolina, and lies within the corporate boundaries of the city of North Charleston, approximately 5 miles north of the city of Charleston. The Complex is bounded on the east by the Cooper River and on the north, south, and west by the city of North Charleston.

1.2 General Site Description

The CNC is located in the city of North Charleston, on the west bank of the Cooper River in Charleston County, South Carolina as shown in Figure 4-1. 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 (Tetra Tech, NUS [TTNUS], 2000).

Building NH 46 was part of the Naval Hospital Complex, which was constructed in 1941 on previously undeveloped land. UST's NH46-1, NH46-2, NH46-3, and NH46-4 supplied heating fuel oil for the buildings boiler. The boiler was located on the Eastside of Building NH46 (see figure 4-2) (Tetra Tech NUS, Inc. [TTNUS] Rapid Assessment Report [RA], 2000).

1.3 Objective

The original CAP was submitted to SCDHEC in December 2000 which, proposed to monitor the site over time in order to assess the down gradient plume migration and intrinsic bioremediation/natural attenuation of petroleum hydrocarbons. In conclusion of the sampling plan that was implemented upon approval of the December 2000 CAP, it has been determined that naphthalene levels at the site are above the RBSLs. After further investigation of this site, CH2M-Jones, LLC proposes to inject Oxygen Release Compounds (ORC) into the ground and monitor existing wells as a post-injection sampling plan. This CAP Addendum also provides a post-injection sampling plan (see Section 3.6).

2.0 PROPOSED CORRECTIVE ACTION

This CAP Addendum provides a method for active remediation of the site by injection of Oxygen Releasing Compounds (ORC), which is supplied by Regenesis[tm], intrinsic remediation, and monitoring well abandonment as a corrective action in accordance with SCDHEC Corrective Action Guidance, June 1997. Based on the results of the analytical data from December 2000 to August 2002, CH2M-Jones, LLC plans on implementing ORC injection at this site to remove COCs from groundwater and to reduce contaminate concentrations below RBSLs or action levels approved by SCDHEC. The proposed active remediation plan is described in Section 3.0, and the proposed post-sampling plan in described in Section 3.6.

2.1 Groundwater Remediation

CH2M-Jones, LLC plans on implementing ORC at this site to remove COCs from Groundwater and to reduce contaminant concentrations below SSTLs. Wells CNC30MW01, CNC30MW10, CNC30MW15, and down gradient well CNC30MW16 will be used as the targeted areas for the injection points (see Figure 4-3). All methods used for the ORC injection activities will be pre-approved by SCDHEC before implementing. A copy of the Underground Injection Control permit application is in Appendix A

3.0 PROPOSED ACTIVE REMEDIATION

The proposed Active Remediation for site 30/ NH 46 (01206) is ORC injection. This decision was made based on the fact that the area has been sampled over a long period of time with little evidence that trends of bioremediation activity are occurring at significant rates.

3.1 Oxygen Release Compound Injection

The objective of this remediation effort is to treat the contaminated groundwater with ORC products approved by the SCDHEC, with the objective of cleaning the groundwater to established standards for the targeted COCs in groundwater to RBSL standards in the vicinity of the former UST 46. The proposed treatment procedure for this remediation is the application of ORC through injection wells, which are proposed to be installed in a grid-like pattern approximately twelve feet apart around the contaminate release (Figures 4-3 and 4-4). The highest concentrations of contaminants were found in monitoring wells CNCMW01, CNCMW10, CNC30MW15, and CNC30MW16, which was near the release point. Monitoring wells both up and down gradient of the release have not shown evidence of contamination. This protocol is based upon the assumption that monitoring wells CNC30MW02, CNC30MW03, CNC30MW05, CNC30MW06, CNC30MW07, CNC30MW08, CNC30MW09, CNC30MW11, CNC30MW13D, and CNC30MW14 continue to have shown no contamination, and that the plume is confined within the bounds of the present monitoring wells.

Inoculation will be made from the appropriate release point to cover a volume of groundwater down gradient from the release point, which will be inclusive of the expected volume of the plume. The soil is expected to be silty clay sand, and the hydraulic conductivity of the area is in the range of 4.06 feet per day according to TTNUS's Rapid Assessment Report dated May, 2000. Groundwater is expected to be encountered approximately five (5) feet bls. The contamination is primarily in the saturated zone, and the treatment zone will be targeted to approximately twelve feet below land surface, with a total of one-hundred (100) injection points which will be approximately twelve feet apart covering an area of approximately 50 feet by 230 feet. A total of 2800 lbs. of ORC will be applied at the site. (for more information on the placement of injection points see Appendix A).

3.2 Monitoring Well Installation

No additional permanent monitoring wells are scheduled to be installed at Site 30/ NH46, however, one-hundred (100) injection points (Geoprobe injection wells) will be installed. All Underground Injection Control permits will be obtained prior to installation.

If any wells are unusable or new wells are warranted for any other reason, the wells will be installed to the same specification as existing monitoring wells unless site conditions change and warrant otherwise. The wells will be installed in accordance with South Carolina Well Standards

and Regulations R.61-71. A utility locate will be completed prior to any well installation activities. All necessary permits will be acquired prior to well installation activities.

3.3 Surveying

Surveying of any new well locations, if needed, will be conducted as a part of this CAP.

3.4 Soil Boring Schedule

Soils will not be sampled as a part of this plan.

3.5 System Operation and Maintenance

System operation and maintenance will not be conducted as a part of this CAP addendum.

3.6 Sampling and Analysis Plan

Groundwater samples will be collected prior to injection start-up, once after thirty days of treatment, and once after one hundred-twenty days of treatment. Additional sampling may be performed based on the performance of the treatment process.

The groundwater samples will be submitted to a certified laboratory for analysis of Benzene, Toluene, Ethylbenzene and Total Xylenes (BTEX) and naphthalene by EPA Method 8260, and Polynuclear Aromatic Hydrocarbons (PAHs) by EPA Method 8270.

Groundwater level measurements will be collected from all monitoring wells prior to all groundwater-sampling events. Measurements will be taken with an electrical water level indicator or interface probe if floating product is present. No groundwater samples will be collected if free product is measurable.

Three to six well volumes will be purged from each well prior to groundwater sampling. Field measurements of pH, groundwater temperature, specific conductance, dissolved oxygen, and turbidity will be taken during groundwater sampling events.

All sampling procedures will be conducted in accordance with EPA Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), 1996. Any contaminated groundwater collected during the well sampling events will be containerized in DOT-approved (Specification 7H) 55-gallon drums and disposed of at a later date pending fluid contents analysis.

3.7 Reporting

Monitoring reports will be submitted to SCDHEC immediately after receiving the analytical results from each scheduled sampling event. The reports will summarize and include copies of field and laboratory analytical data. Upon completion of active remediation, a Performance Evaluation Report will also be submitted to SCDHEC that summarizes the remediation activities, evaluate the soil and water quality data, and provide recommendations for the site.

3.8 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 EPA EISOPQAM.

3.9 Sample Handling

Sample handling will be conducted in accordance to the following references: EPA EISOPQAM, Code of Federal Regulations 136, 1990, EPA Users Guide to Contract Laboratory Program, 1988, and the Comprehensive Sampling and Analysis Plan, 1996. The following forms will be completed for packing/shipping process: sample labels, chain-of-custody labels, appropriate labels applied to shipping coolers, and chain-of-custody forms.

3.10 Quality Control

In addition to periodic calibration of field equipment and the completions of the appropriate documentation, 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 EPA 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.

3.11 Field Quality Assurance / Quality Control (QA/QC)

All sampling procedures will be conducted in accordance with EPA EISOPQAM. More information on field QC can be found in **Sections 3.8** through **3.10**.

QA/QC specifications for selected field measurements are summarized below.

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.

3.12 Record keeping

In addition to required sampling documentation (see **Section 3.9**), standardized forms, log sheets and logbooks will be completed during all field activities.

FIGURES

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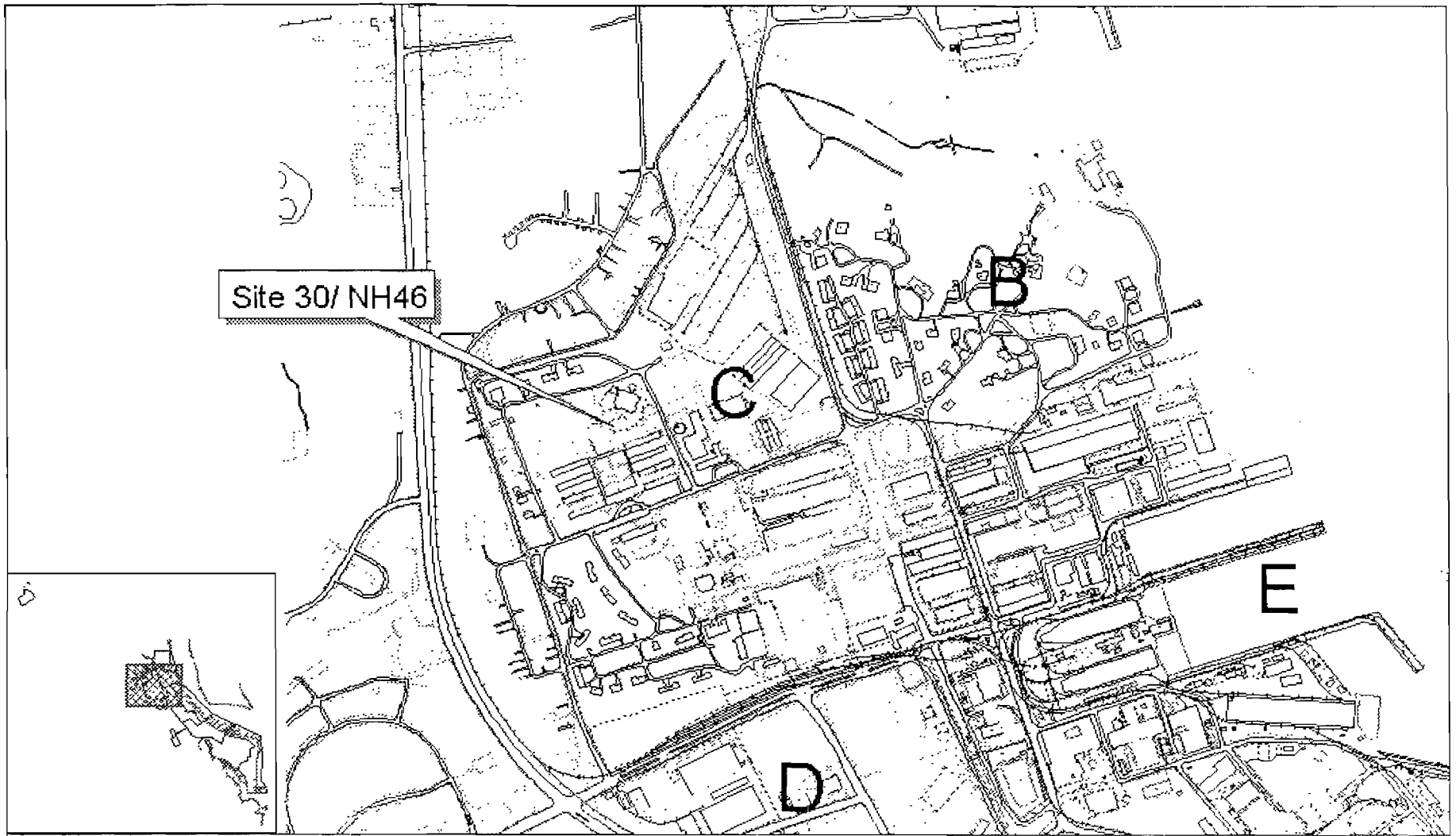

Figure 4-1
CNC
Site 30
Charleston Naval Complex

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File Path: C:\Agi32\CHC\cnc-sg13.apr, Date: 13 Sep 2002 9:34, unknown user, EGIS: Charleston Naval Complex - Figure 4-1 CNC

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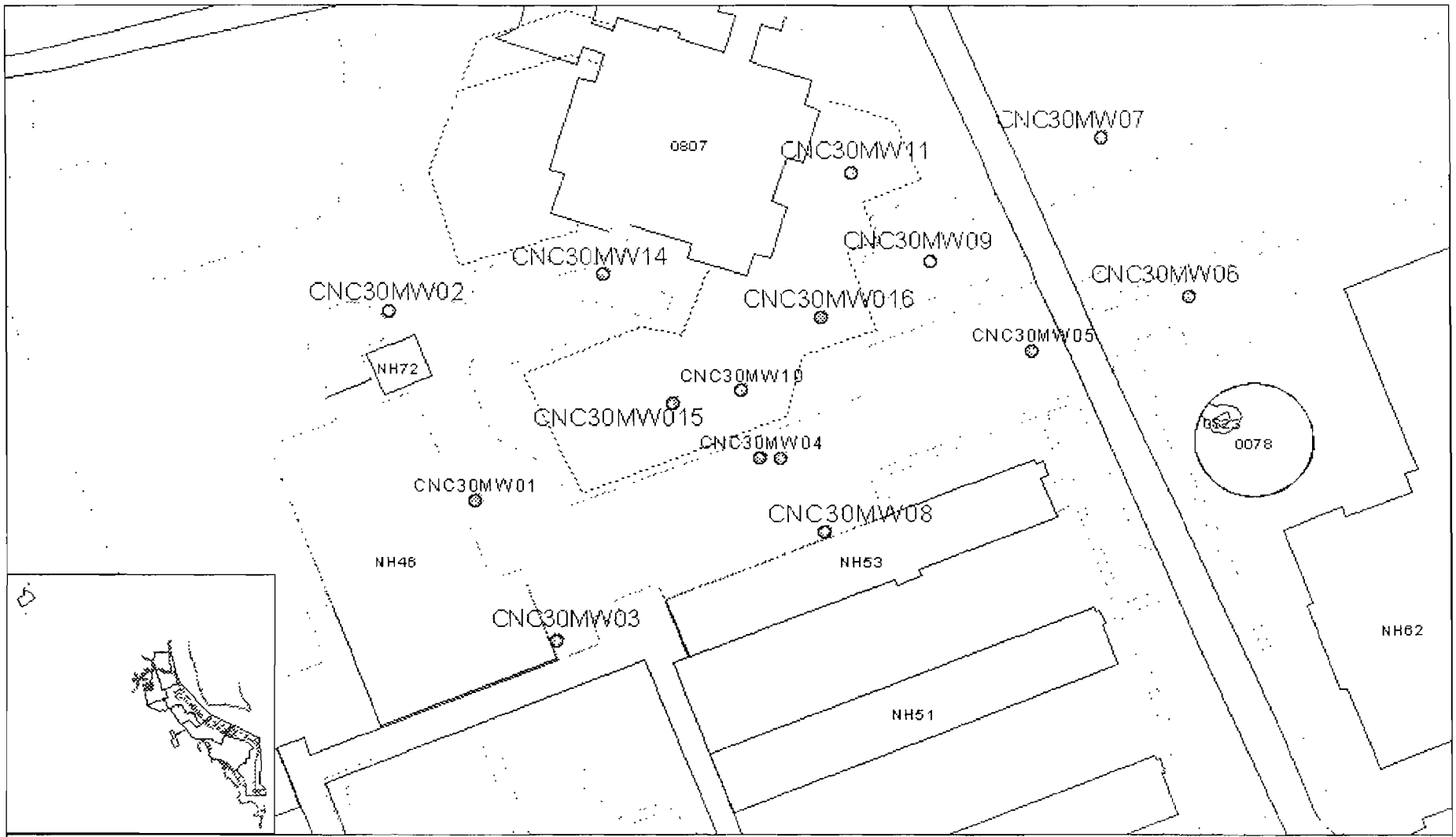

Figure 4-2
Site Location Map
Site 30/ NH46
Charleston Naval Complex

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File Path: c:\my documents\gis\drawing\site 30\4-1.apr, Date: 18 Sep 2002 10:31, unknown user, EGIS: Charleston Naval Complex - Figure 4-2 Site Location Map

NOTE: Original figure created in color

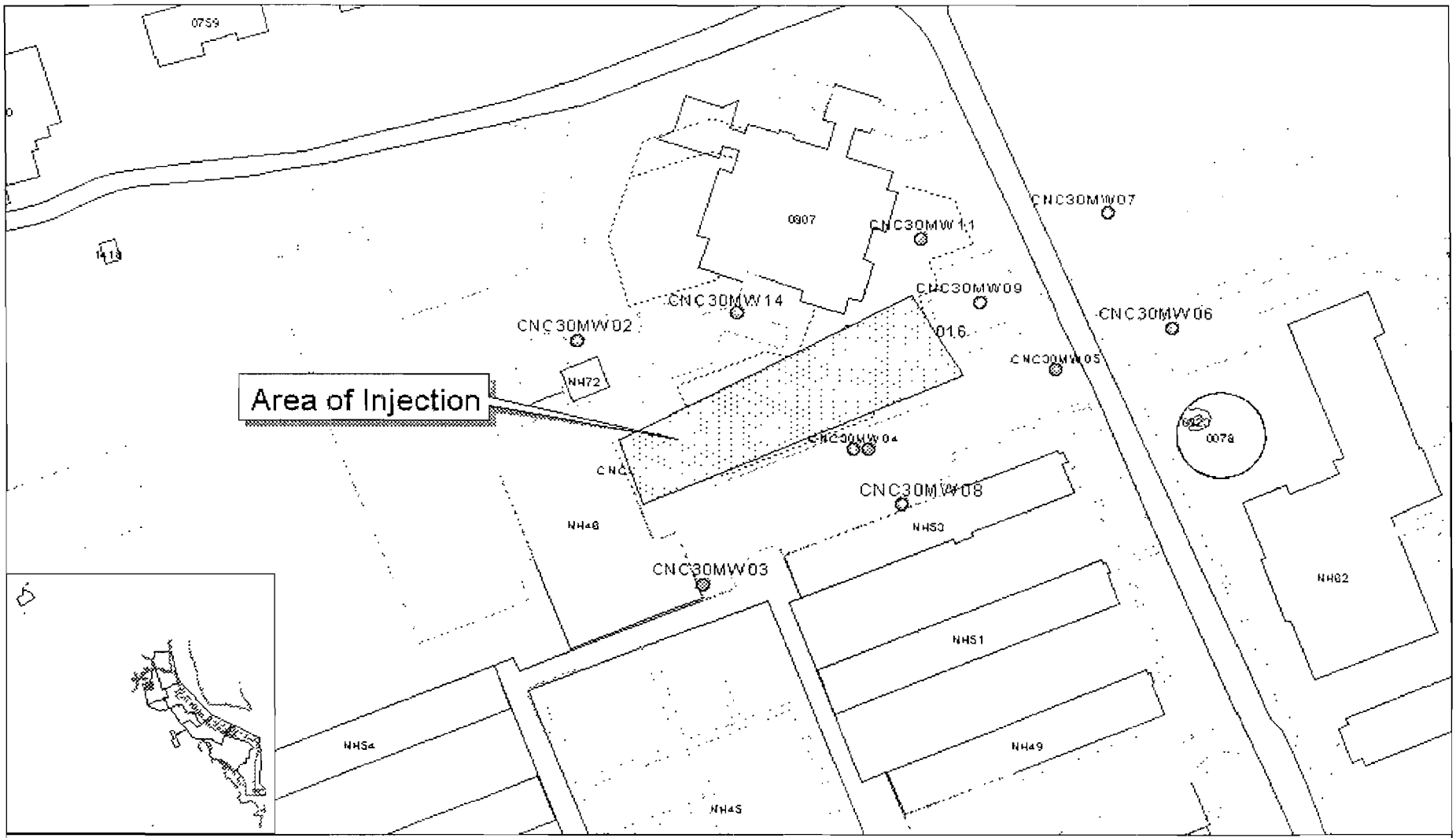

Figure 4-3
Injection Areas
Site 30/ NH 46
Charleston Naval Complex

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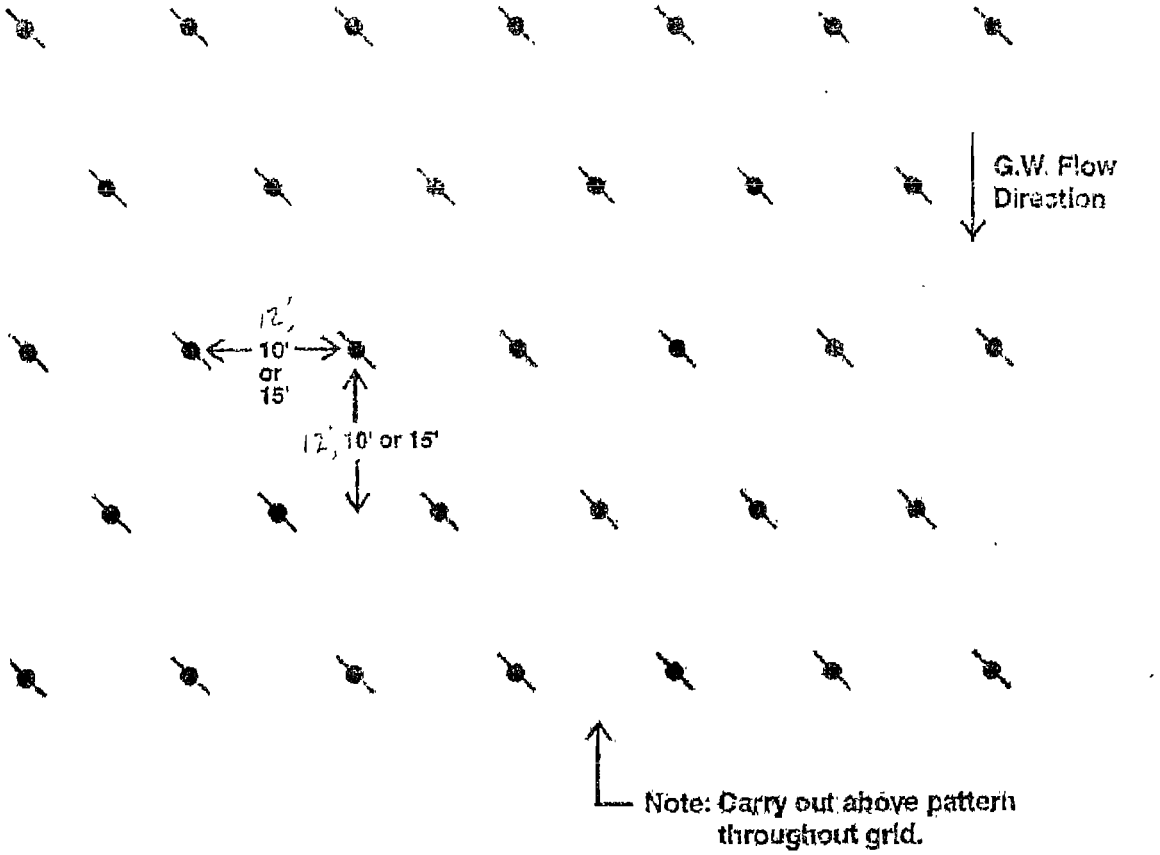
File Path: c:\my documents\gis\drawing\site 30\4 Copy, Date: 13 Sep 2002 10:34, unknown user, EGIS: Charleston Naval Complex - Figure 4-3 Injection Areas

TYPICAL ORC INJECTION GRID LAYOUT



Legend

ORC Injection Point

Note: Do not place injection Points closer than 5 feet to monitoring wells screened in the same interval as the ORC injection interval.

September 2002

Mr. Todd Adams, Permit Coordinator
South Carolina Department of Health and Environmental Control
Bureau of Water, Water Monitoring Assessment & Protection Division
Groundwater Management Section
2600 Bull Street Columbia, SC 29201

Subject: Permit Application- Underground Injection Control
UST/ Corrective Actions
Zone C/ Site 30-NH46 (SCDHEC No: 01206)
Charleston Naval Complex

Dear Mr. Adams:

On behalf of the U.S. Navy Southern Division Naval Facilities Engineering Command, CH2M-Jones, LLC has enclosed a completed Underground Injection Control (UIC) Permit application (Form 1) for use of the Geoprobe[tm] to inject Oxygen Release Compound (ORC) into the shallow water aquifer system at Zone C, Site 30/NH 46, Charleston Naval Complex, as part of the Corrective Actions for this site.

If you have any questions, comments or require additional information please do not hesitate to contact us.

Sincerely,

CH2M-JONES, LLC.

Brian R. Crawford, R.E.M.
(843) 740-2780

Cc: Tony Hunt, P.E. SOUTHDIV

Attachments A-K to Form 1-Underground Injection Control

Attachment A: Activity for Review

Submit a brief description of the activities to be conducted that require a UIC permit.

CH2M-Jones, LLC. is requesting an Underground Injection Control (UIC) Permit Application (Form 1) for use of Geoprobe™ to inject Oxygen Release Compound (ORC) into the shallow aquifer system at Zone C, Site 30 Building NH46 (SCDHEC ID No: 01206) at the Charleston Naval Complex, as a part of the Corrective Action Plan. The ORC injection is a one-time event that will take place over a short time period, with an extended groundwater-monitoring period before and after injection to monitor changes in aquifer water quality.

Attachment B: Well Construction Details

Submit schematic or other appropriate drawings of the surface and subsurface construction details of the recovery and injection wells.

No permanent recovery or injection wells will be installed during the ORC injection. The Geoprobe™ direct push soil probing rods with well screen will be used for all ORC injections. A high-pressure hose will be attached to the top rod section, and connected to a pump, which will feed liquid ORC into the aquifer. At each injection grid point, the Geoprobe™ will be advanced to the maximum aquifer depth required for injection, and ORC will be pumped in as the probe is withdrawn up the borehole. When injection is completed, the borings will be grouted to the land surface with bentonite/ cement.

Attachment C: Operating Data

Submit the following proposed operating data for each injection well:

1) Average and maximum daily rate and volume of fluid to be injected. In addition, indicate the average and maximum daily rate and volume of fluid to be withdrawn from each recovery well. Verification of the aquifer's hydraulic ability to produce and accept the qualities proposed should be presented.

The ORC will be injected on an intermittent basis in approximately 100 different borings. The rate of injection can be varied between 3 and 10 gallons per minute, and the probe rods are withdrawn at an approximate rate of one foot per minute, requiring approximately 5 to 15 minutes per boring for injection of approximately 28 pounds of ORC per boring. The total amount of ORC proposed for injection during this permit duration is approximately 2800 pounds.

2) Average and maximum injection pressure.

The Geoprobe™ will be connected via high-pressure hose with threaded couplings to a pump. The pump is capable of producing pressures between 200 and 1,500 pounds per square inch (psi). The average injection pressure will be approximately 100 to 500 psi.

3) Pumping schedule

The pump will be used for less than 15 minutes per boring in each of the 100 different Geoprobe™ borings to inject the ORC. Typically, up to 20 injection points can be complete per day.

4) Proposed ranges in the concentration of all contamination constituents within the injection fluid. Include comprehensive groundwater quality data from a "worst case" well sample.

No wastes or contaminated water will be injected during this work.

5) Length of time the project is expected to require injection to complete remediation (to ensure the effective dates of the permit will allow sufficient time to complete the project).

Based upon information presented above, the ORC injection of all 100 locations is expected to require less than three days to complete the fieldwork. It may be necessary to reapply ORC at specific locations up to one year later, depending on the rate of change of groundwater quality observed during post-injection monitoring events.

Attachment D: Monitoring Program

Discuss the planned monitoring program in detail:

1) Include a discussion of monitoring devices, sampling frequency (sufficient to verify treatment system efficiency), sampling protocol, sampling location, parameters to be analyzed, and proposed method(s) of analysis.
2) This plan should indicate how, through monitoring, the proposed contaminate levels in the injectate will be verified.
3) This plan should also clearly illustrate exactly how hydraulic control of the contaminate plume (and injectate, where relevant) will be verified through monitoring (i.e., piezometers, quality analysis, etc.).

As previously indicated, no wastes or contaminated water will be injected during this work. Only a small amount of ORC will be injected on a one-time basis, and will not affect aquifer flow rates or directions requiring hydraulic controls. The effectiveness of the ORC on improving groundwater quality will be monitored after injection with several groundwater-sampling events over a six-month period. Details of the monitoring program are presented in the Corrective Action Plan, already submitted to SCDHEC.

Attachment E: Existing or Pending State/ Federal Permits

List the program and permit number of any existing State or Federal permits for the facility (i.e., NPDES, RCRA, UST, ect.).

Currently, the Charleston Naval Complex and its Annex are considered a large quantity generator under the Resource Conservation and Recovery Act. A revision to the part B permit application to reflect closure of 2 treatment, storage, and disposal facilities was submitted in September 1997 and subsequently approved by SCDHEC in August 1998. The Environmental Protection Agency Identification Numbers for the Charleston Naval Complex and Annex are SC0 170 022 560 and SC0 000 328 906, respectively.

Attachment F: Description of Business

Give a brief description of the nature of the business of the facility and any immediately adjacent facilities.

Limited tenant operations continue at Charleston Naval Complex following April 1, 1996 closure of the facility under the Defense Base Closure and Realignment Act. Building NH46 was used as part of the Naval Hospital in the northern end of the base. Currently Building NH 46 is not being utilized. Adjacent to Building NH46 is a Child Development Center, which is currently in use.

Attachment G: Area of Review

1) The area of review should be a fixed radius of ¼ mile from the injection wells; the outermost injection wells (if a well field).
2) If a fixed radius is not selected, the methods and the calculations used to determine the size of the area of review should be submitted.

As previously indicated, no permit injection wells will be installed. The temporary ORC borings are all located inside the base boundary, and will not adversely impact adjacent land uses.

Attachment H: Maps of Wells and Area of Review

1) Submit a topographic map of the area extending one mile beyond the project property boundaries. The map should show all…
2) A scaled map should be included which shows the name and/ or number and the location of all production, injection, monitoring, abandoned and dry wells within the area of review…

Copies of Figures 1 through 8 are enclosed, which show locations of all existing and proposed CNC monitor wells, and all proposed ORC injection points.

Figure 8: Cross Sections/ Diagrams

1) Geologic cross sections indicating the lithology and stratigraphy of the site and the horizontal and vertical extent of the contaminated plume, should be submitted. At least two cross sections, one parallel and one perpendicular to the horizontal groundwater flow direction...
2) A schematic diagram, in the form of a cross section, showing the proposed remediation system with the components of flow, (above and below ground) and all associated appurtenances (i.e., stripping tower, piping, wells, etc...).

The geologic cross sections are attached. No permanent structures will be installed at the ORC injection sites. The treatment is an "in sutu" process, which accelerates natural bioremediation, and does not require installation of any engineered systems or controls.

Attachment J: Name and Depth of Underground Sources of Drinking Water

Identify and describe all aquifers, which may be affected by the injection.

The ORC will be injected into the uppermost aquifer system at the CNC, comprised of an unconfined (water table) aquifer system within Quaternary-age interbedded sand and clay deposits, with the underlying Ashley Formation acting as a lower bounding unit. Depth to groundwater in the water table aquifer is typically 5-6 feet below land surface in this area. Existing monitor wells were installed in the intermediate and shallow zones of the water table aquifer.

The underlying Ashley Formation is comprised of Tertiary-age silts and clays, and will not be affected by the ORC injection. The Ashley Formation also acts as an upper confining unit for the Santee Limestone, which is under artesian conditions, and is used as a source of potable water. The Santee Limestone will not be affected by the ORC injection.

Because of the heterogeneity of the Quaternary deposits, the hydraulic properties of the shallow (water table) aquifer system vary widely, depending on location and depth. The locally variable hydraulic gradients and hydraulic conductivity measured in wells result in variable groundwater flow rates and directions on a localized scale. Overall, the shallow groundwater flow direction in Zone C is to the north-northeast. Tidal influence on water levels in the shallow aquifer is minimal.

Attachment K: Hydraulic Control

1) Sufficient supporting data (i.e. time/ draw down data, Theis curves and methods, calculations, etc,) used to determine aquifer characteristics to verify complete hydraulic control over the contaminant plume (and injectate, if proposed injectate quality does not conform to classified groundwater standards) during the injection should be submitted. At a minimum, values

should be given for transmissivity, hydraulic conductivity, effective porosity, and specific yield.

2) Demonstrate the presence and magnitude of, or absence of, any vertical hydraulic gradient at the site. If a vertical hydraulic gradient exists, show how its direction and magnitude are incorporated in the calculations demonstrating hydraulic control.
3) groundwater flow computer models (especially 2-D map view with potentiometric flow lines) may be utilized and submitted. All calculations should be in English units. All model-derived data and maps should be properly labeled and keyed so as to be clearly understood.

As stated previously, because of the small amount of ORC to be injected, and the short duration of the field effort, this technology does not require any hydraulic controls on the aquifer system. The natural diffusion, dispersion and flow characteristics of the aquifer will be employed to help distribute the ORC after injection.

Computer modeling is not necessary or applicable to predict the rate and extent of reductive dechlorination of VOCs in shallow groundwater at the injection sites. The continued groundwater-monitoring program is the means by which the ORC effectiveness will be measured.

Form I UIC	D H E C Underground Injection Control Permit Application Ground-Water Protection Division (Collected under the Authority of Title 48 Chapter I of the 1976 South Carolina Code of Laws)	1. EPA ID NUMBER	T/A	C
		U SCD170022560		

Read attached instructions before starting.
For Offical Use Only

Application Approved month day year	Date Received month day year	PermitiWellNumber

Comments

11. Facility Name and Address	111. Owner/Operator and Address
FacilityName: CHARLESTON NAVAL COMPLEX	Owner/OperatorName: US NAVY
Street Address: P.O. BOX 190010	Street Address: P.O. BOX 190010
City: N. CHARLESTON, State: SC, Zip Code: 29419	City: State: Zip Code:

IV. Ownership Status (Marl-, "x")	V. SIC Codes
[X] A. Federal [ ] B State [ ] C. Private [ ] D. Public [ ] E. Other (Explain)	3731

VI. Well Status (Mark "x")

[ ] A. Operating	Date Started month day year	[ ] B. Modification/Conversion	[X] C. Proposed

V11. Type of Permit Requested - Class and Type of Well (see reverse)

A Class(es) enter code(s)	B. Type(s) enter code(s)	C. If class is "other" or type is code 'Y', explain	D. Number of Wells per type
5A	1	—	UP TO 100

V111. Location of Wells or Approximate Center of field or Project

C	A. Latitude 2-314-492.36				B. Longitude 377-5606.20			
I		Deg	Min	Sec		Deg	Min	Sec

IX. Attachments

Complete the following qnestions on a separate sheet(s) and number accordingly; see instructions for Classes 11, 111, and V, complete and submit on a separate sheet(s) attachments A-U as appropriate. Attach maps where required. List attachments by letter which are applicable and include with your application.

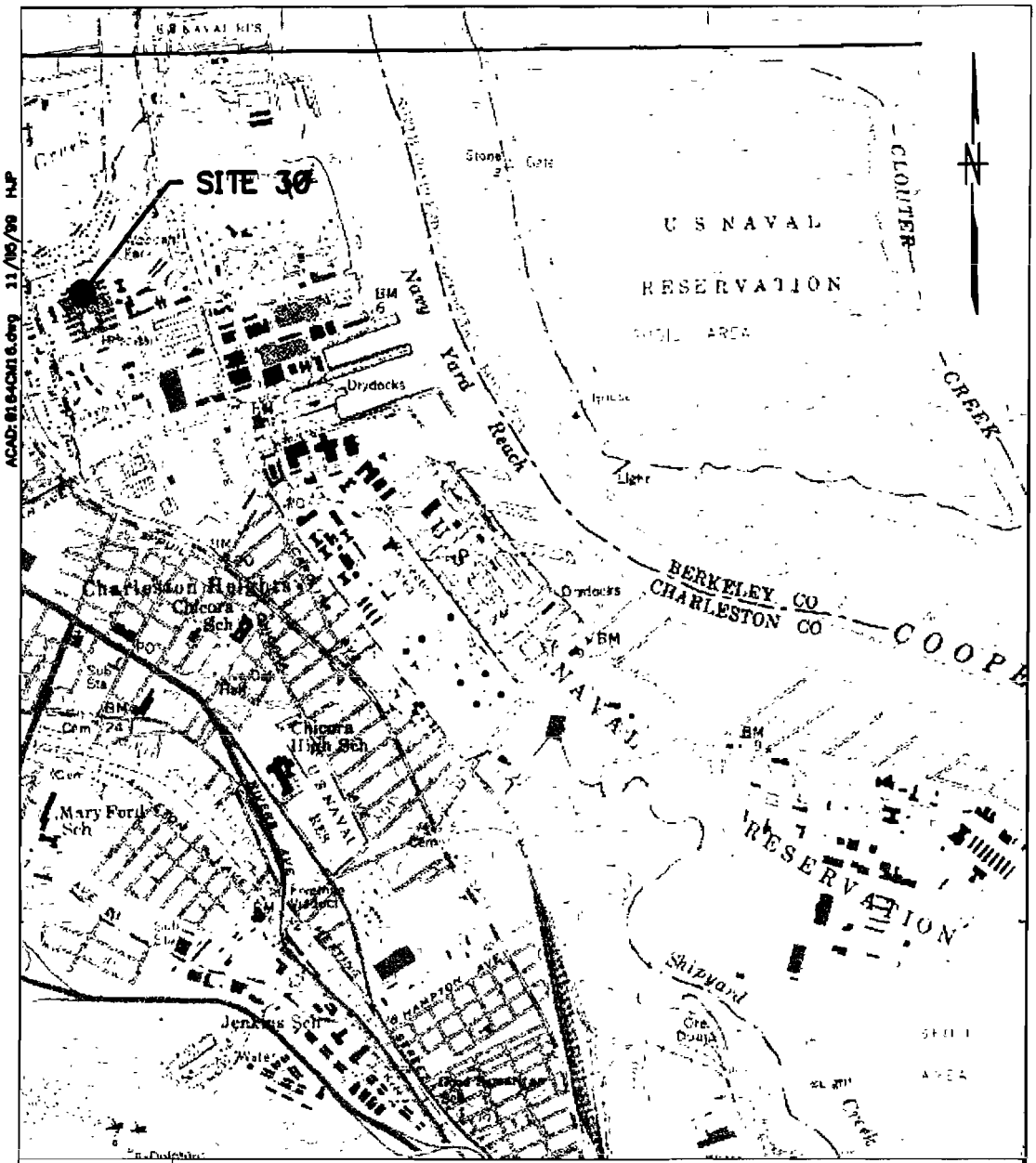
X. Certification

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accnrate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of a fine and imprisonment.

A. Name and Title (Type or Print) (C.A. JONES ENV.)	B. Phone No.
BRIAN R. CRAWFORD	(843) 740-2780
C. Signature BRC	D Date Signed 17 SEPTEMBER 2002

DHEC2502(08/1997)

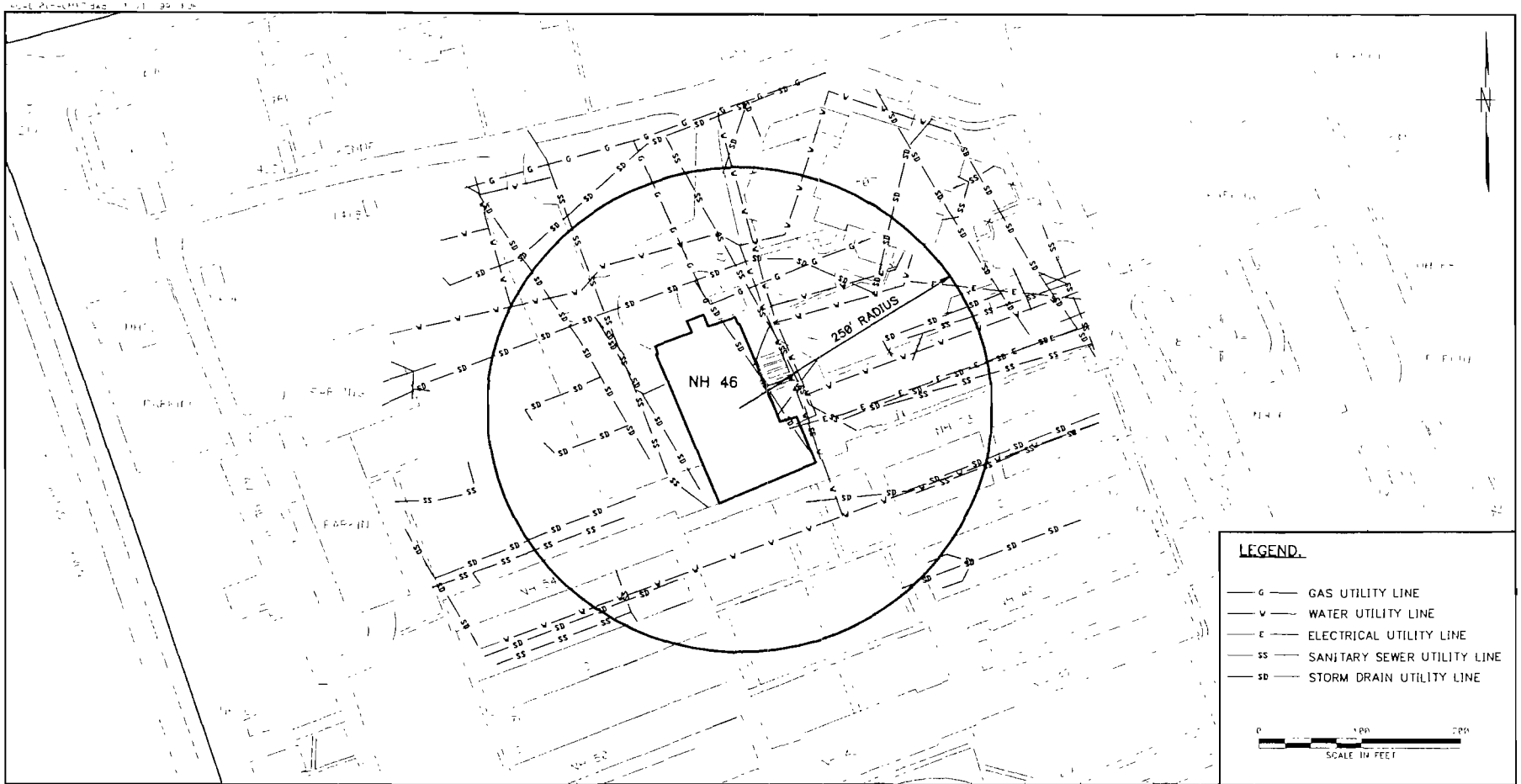
FIGURES



DRAWN BY DATE: HJP 11/5/99	SITE LOCATION MAP SITE 30, BUILDING NH 46 ZONE C, CHARLESTON NAVAL COMPLEX NORTH CHARLESTON, SOUTH CAROLINA	CONTRACT NO. 0164	
CHECKED BY DATE		APPROVED BY DATE	
COST/SCHED-AREA		APPROVED BY DATE	
SCALE: AS NOTED		DRAWING NO. FIGURE 1	REV. 0

ACAD: 0164CN16.dwg 11/05/99 HJP

FORM CADD NO. SURV_AV.DWG - REV 0 - 1/28/98



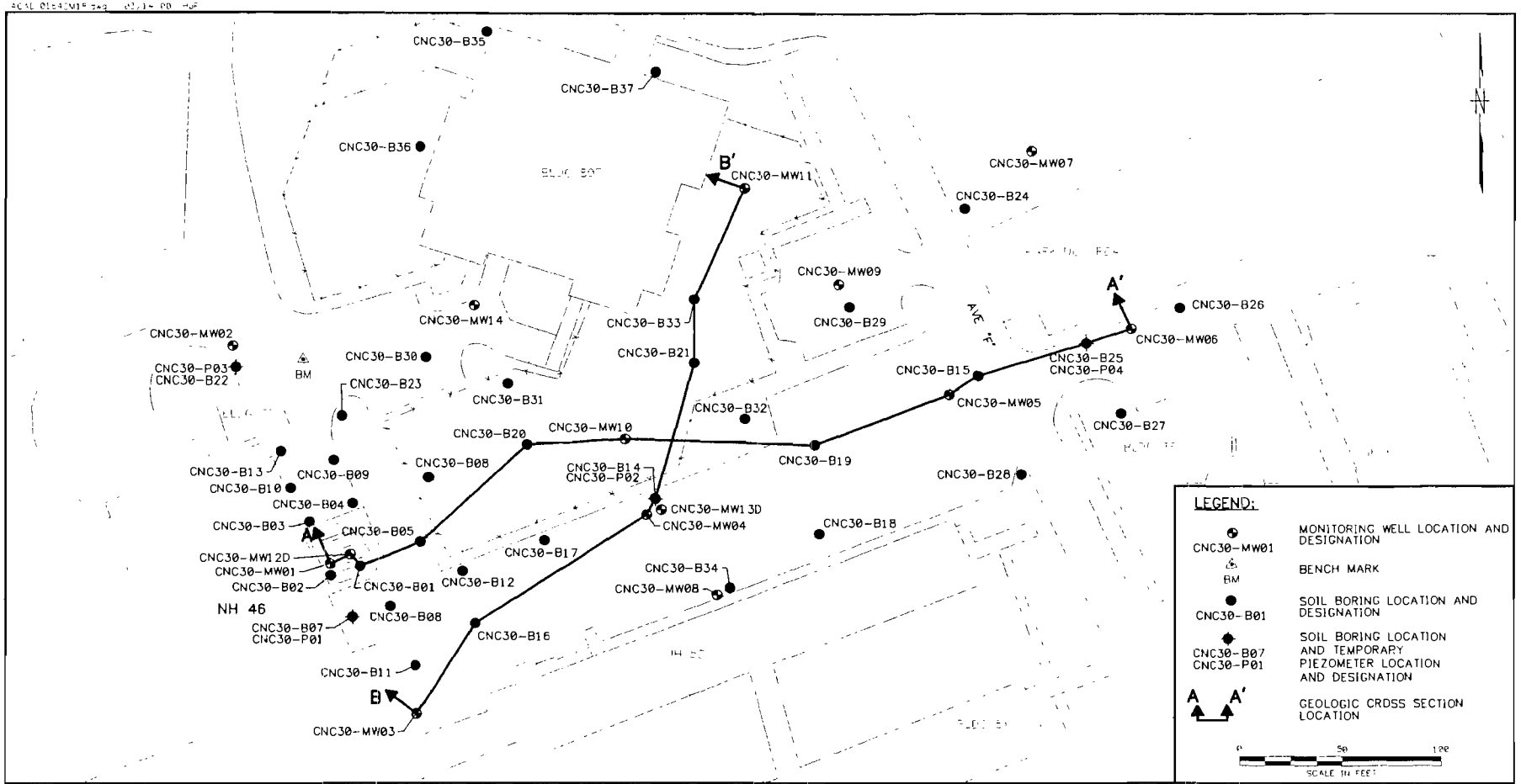
NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 11/5/99
CHECKED BY DATE
COST/SCHED—AREA
SCALE AS NOTED

SITE VICINITY MAP
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 2
REV 0

FORM CADD NO SDIV_BH.DWG - REV 0 - 1/20/98



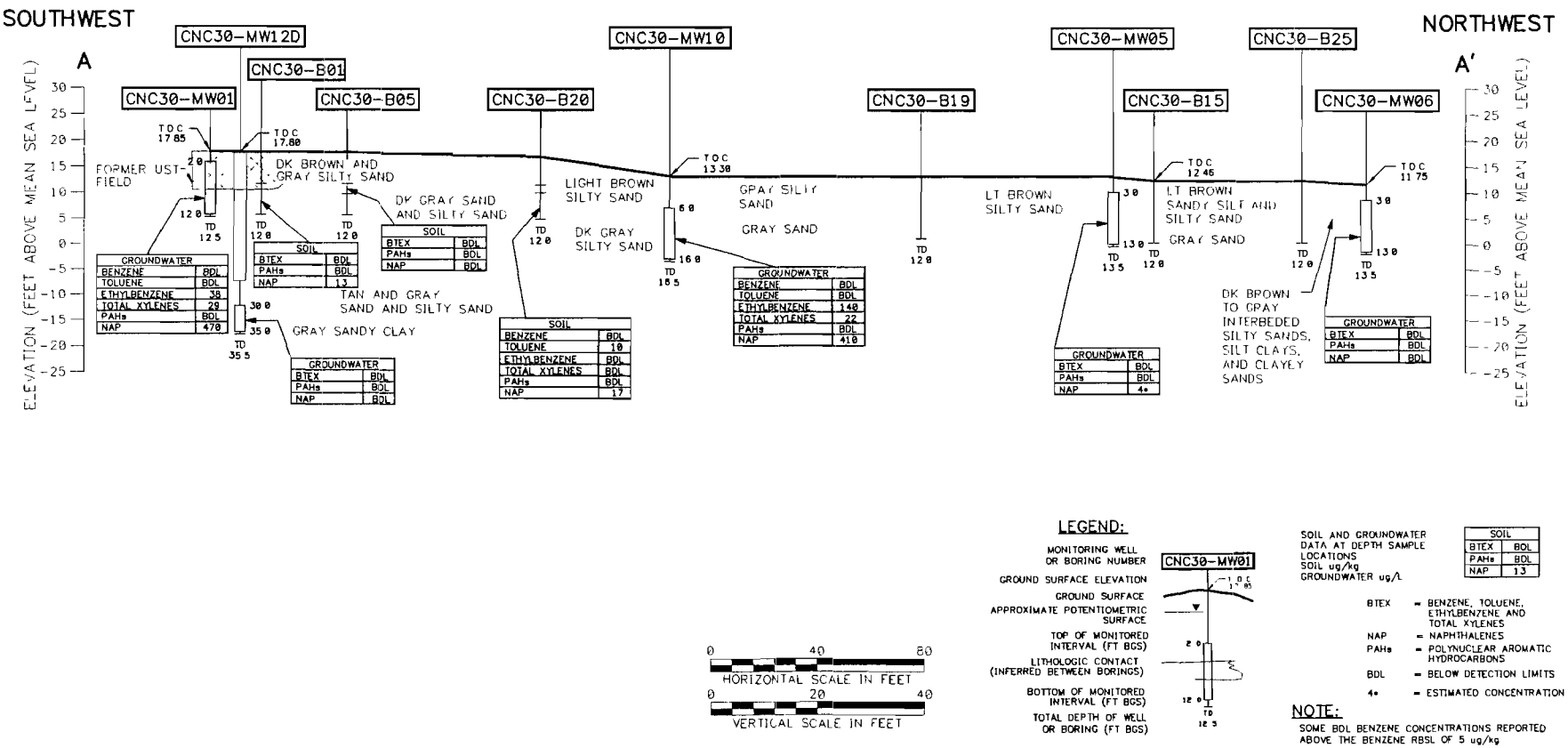
NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES
1	1-28-00	REVISION TO DRAFT RAR	GG		PC	

DRAWN BY HJP DATE 11/5/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

SITE MAP AND SAMPLING LOCATIONS
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 3
REV 1

FORM CADD NO SOIL BH DWG - REV 0 - 1/20/98



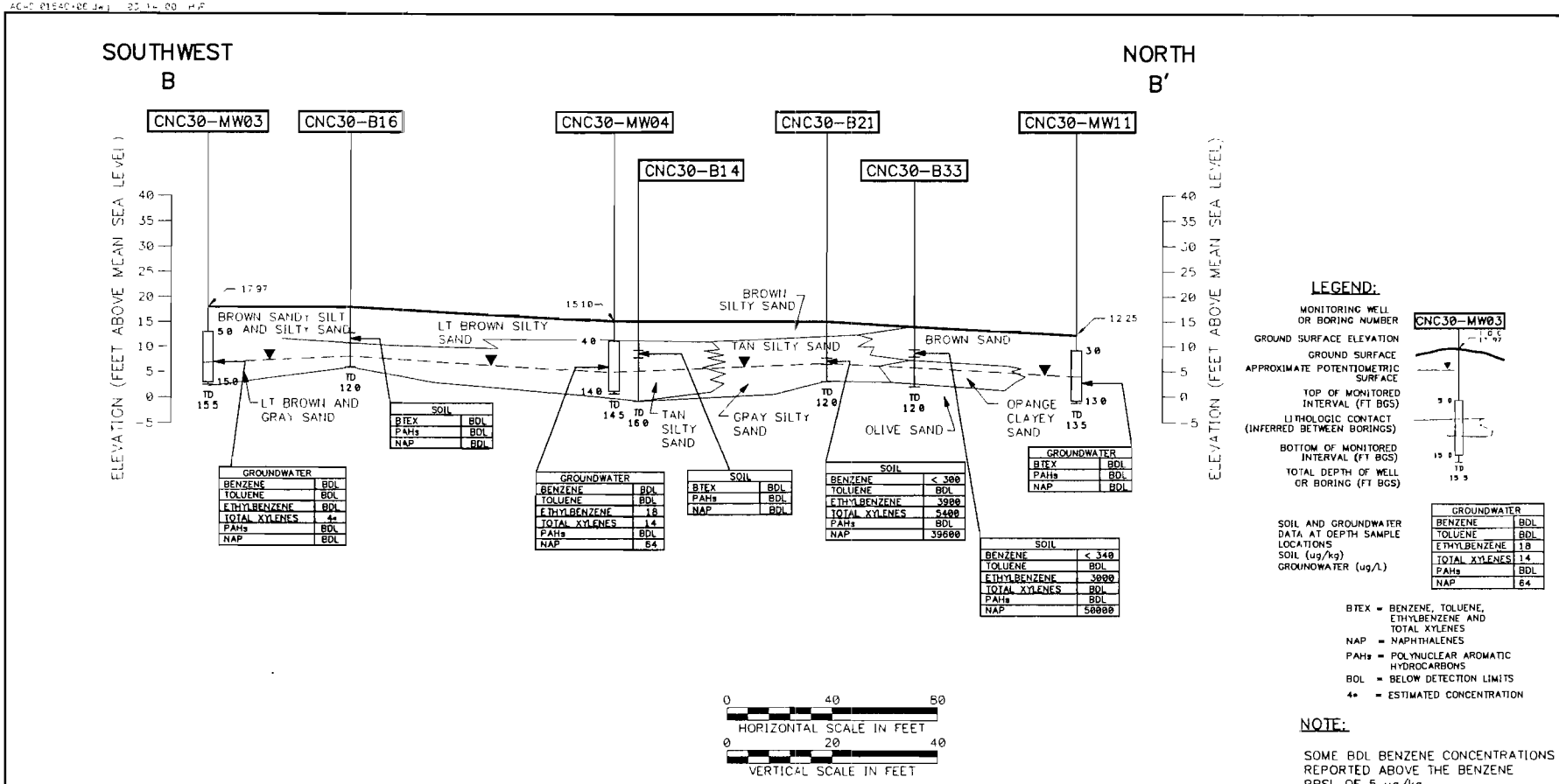
NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES
1	1-28-00	REVISION TO DRAFT RAR	GG		PC	

DRAWN BY HJP 11/9/99 DATE
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

GEOLOGICAL CROSS SECTION A-A'
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 4
REV 1

FORM CADD NO SDIV_BHDWG - REV 0 - 1/20/98



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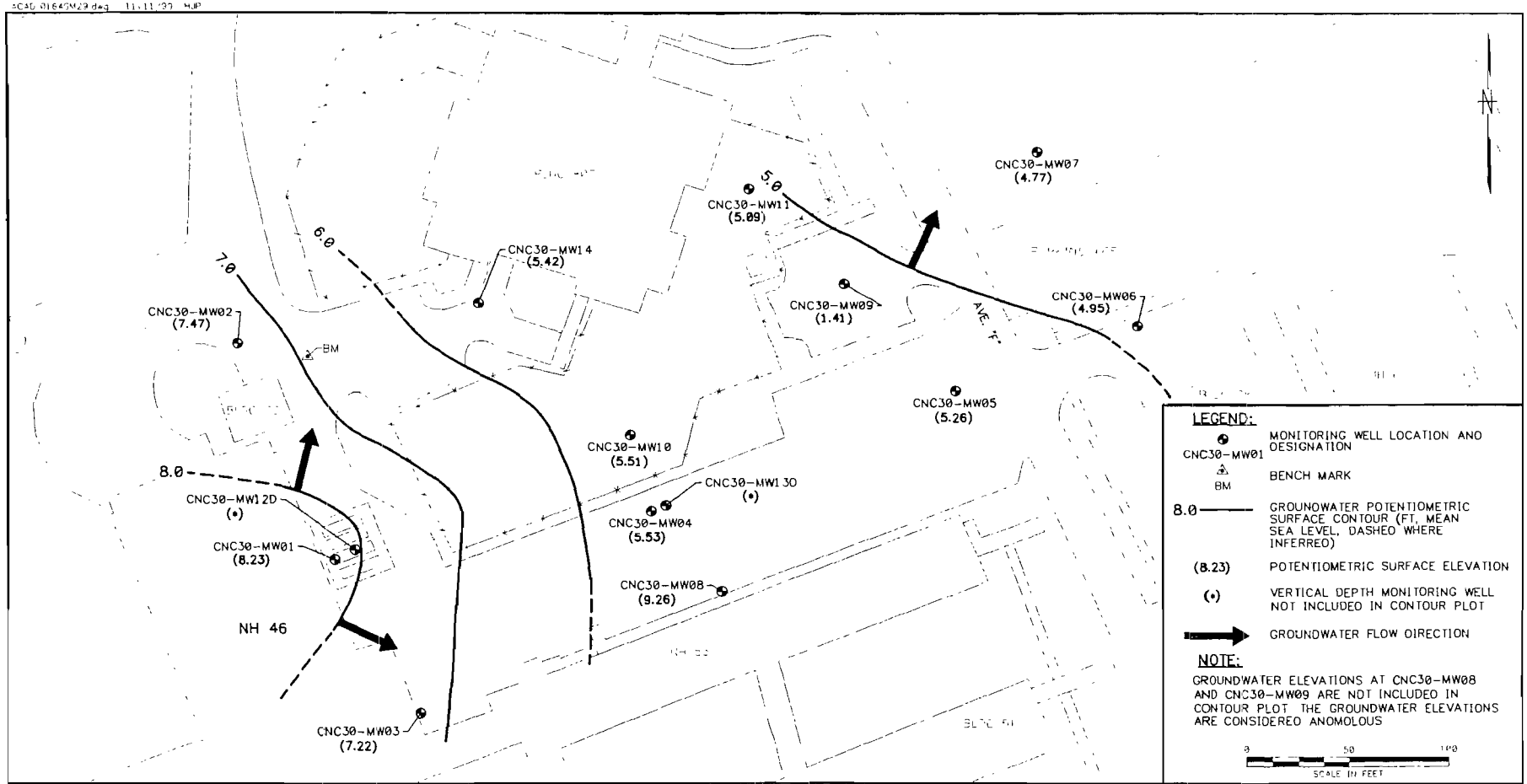
1	1-28-00	REVISION TO DRAFT RAP	CG		PC	

DRAWN BY HJP DATE 11/9/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

GEOLOGICAL CROSS SECTION B-B'
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 5
REV 1

FORM CADD NO SDIV_BHDWG - REV 0 - 1/20/98

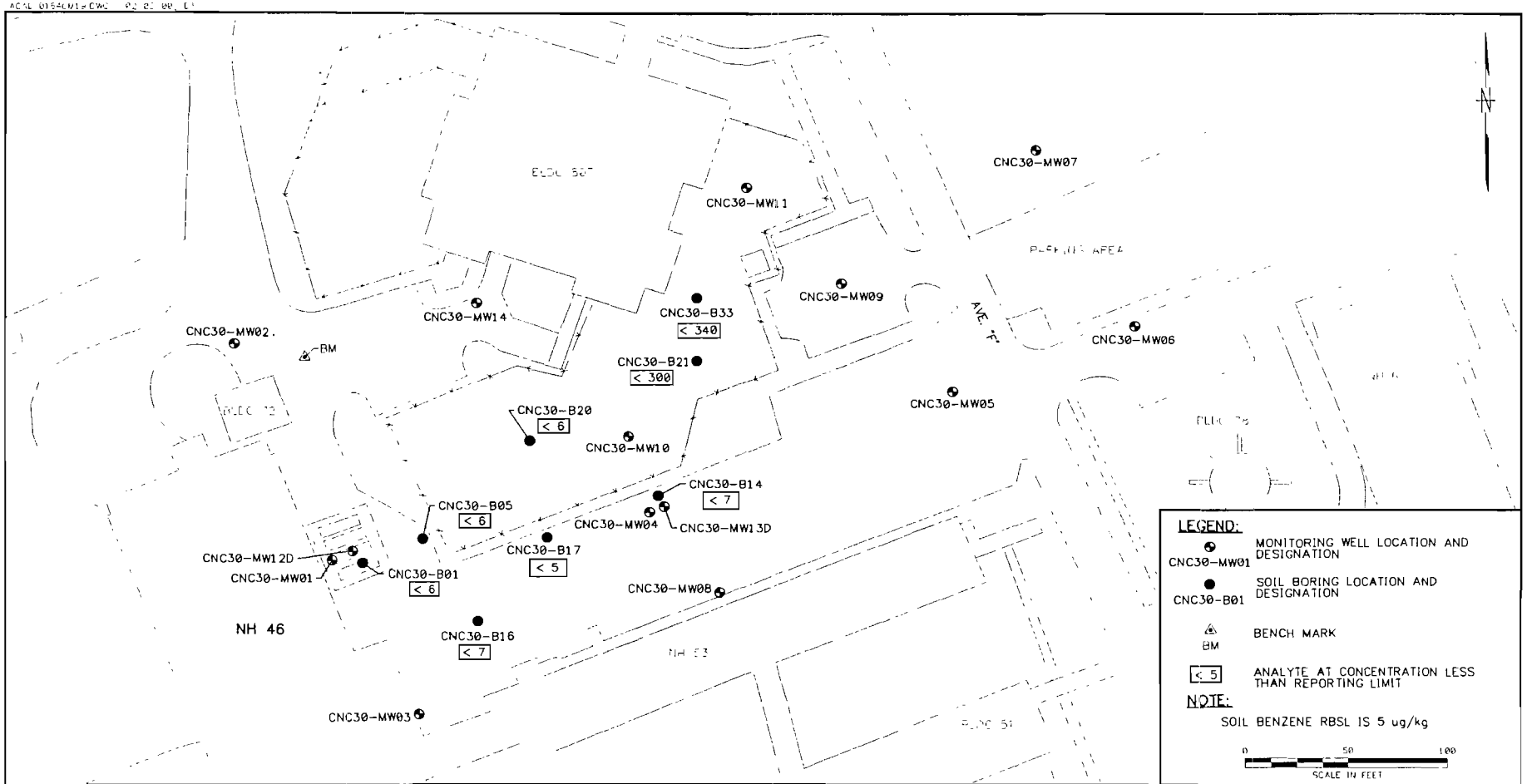


NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 11/5/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

GROUNDWATER POTENTIOMETRIC MAP
(SEPTEMBER 11, 1999)
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 6
REV 0



NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES
1	1-28-00	REVISION TO DRAFT RAR	GG		PC	

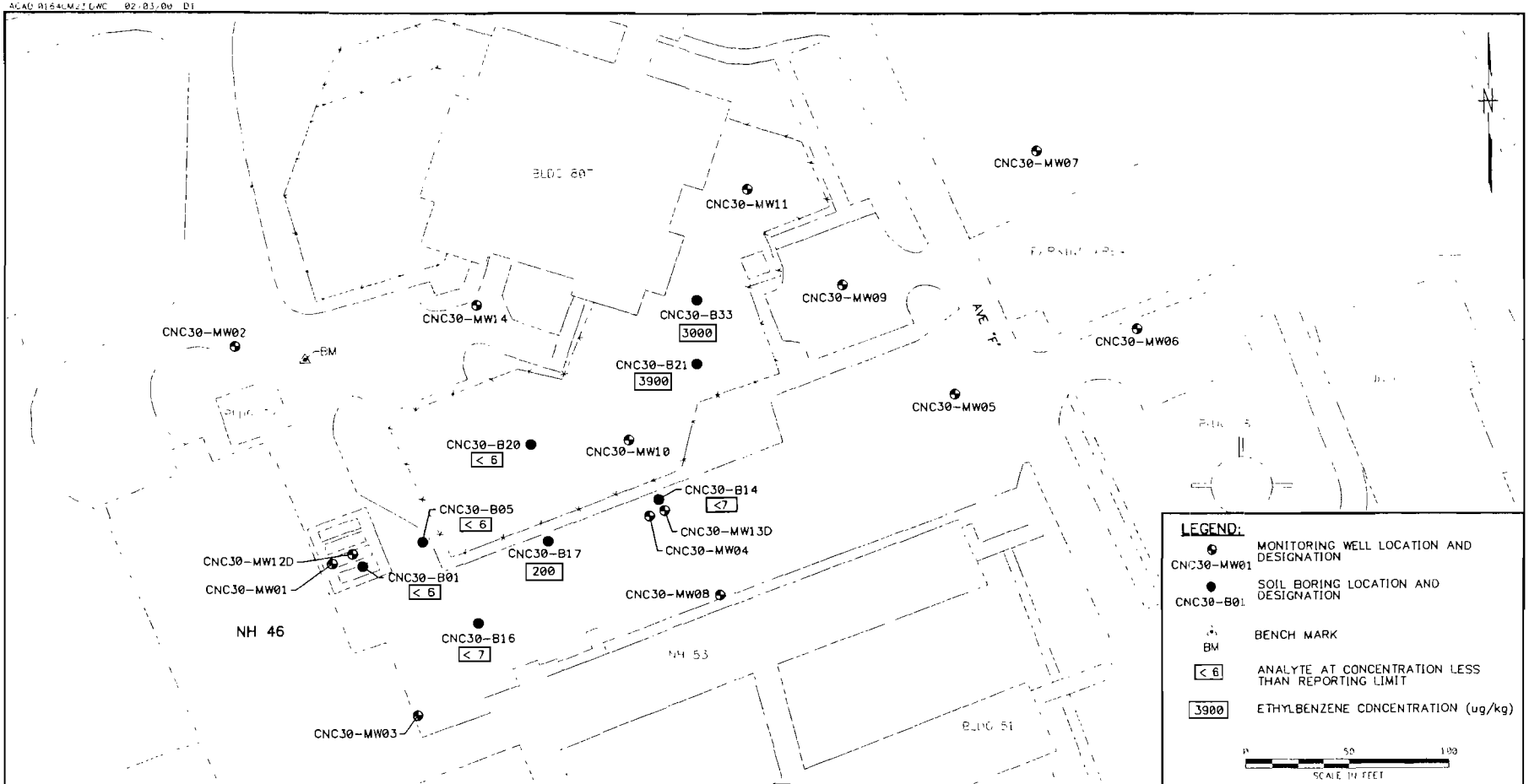
DRAWN BY HJP DATE 11/9/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

BENZENE SOIL CONCENTRATION MAP
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 7
REV 1

FORM CADD NO SDIV_BH.DWG - REV 0 - 1/20/98

ACAD 0164CM23.DWG 02/03/00 DT



NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES
1	1-28-00	REVISION TO DRAFT RAP	GG		PC	

DRAWN BY HJP DATE 11/8/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

ETHYLBENZENE SOIL CONCENTRATION MAP
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 8
REV 1

FORM CADD NO SDIV_BH.DWG - REV 0 - 1/20 98

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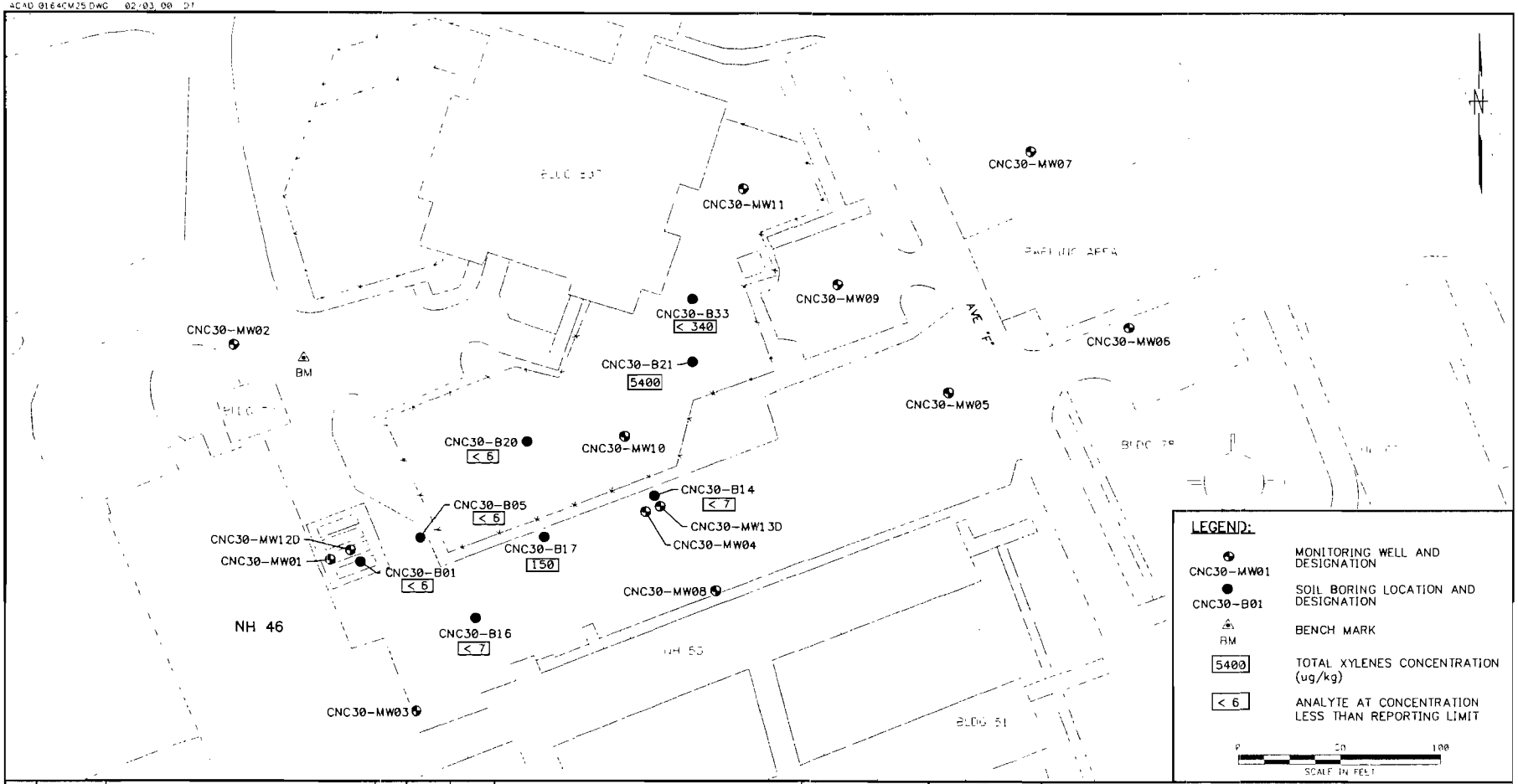


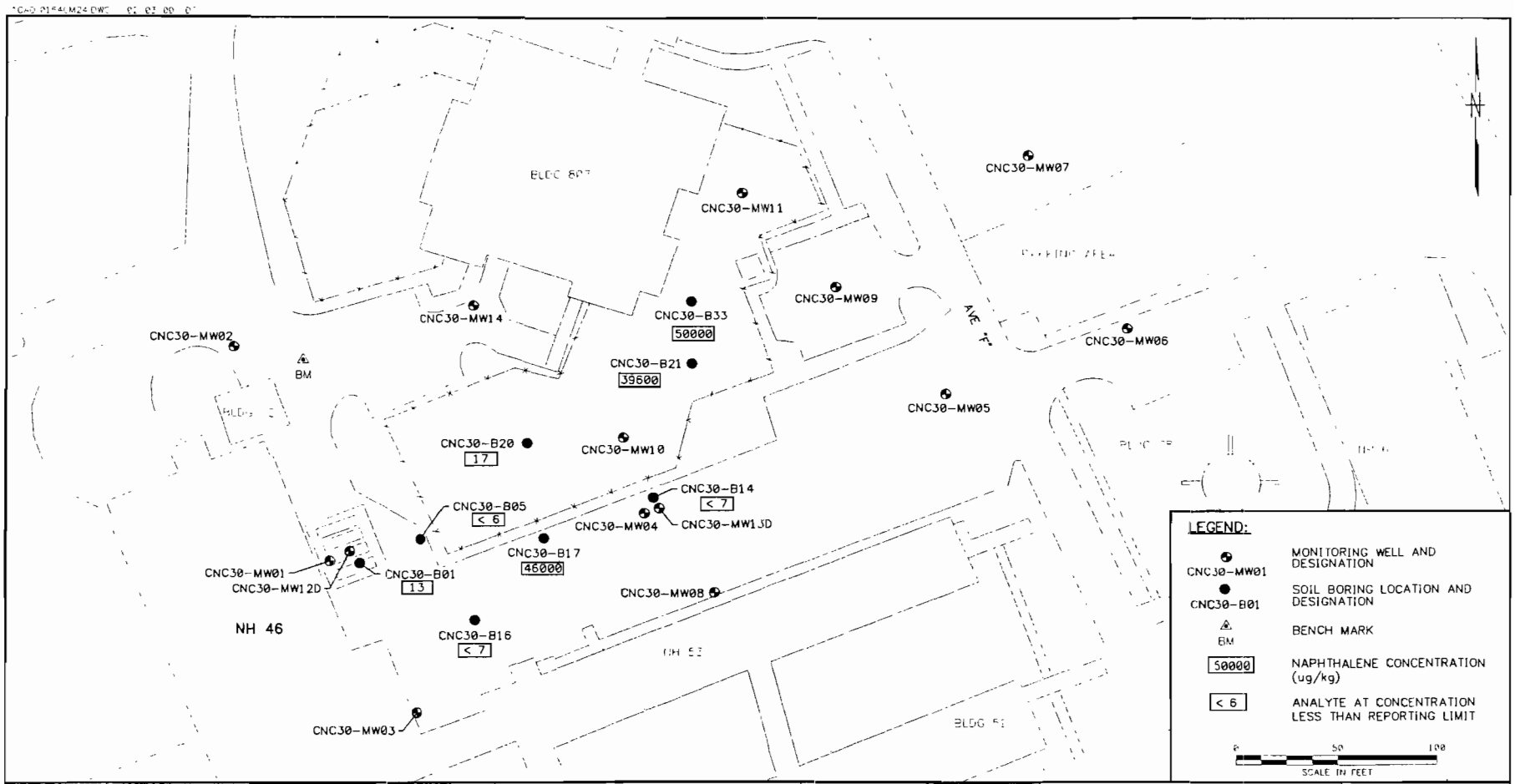
NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES
1	1-28-00	REVISION TO DRAFT RAR	SG		PC	

DRAWN BY HJP DATE 11/5/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

TOTAL XYLENES SOIL CONCENTRATION MAP
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 9
REV 1

FORM CADD NO SDIV_BH.DWG - REV 0 - 1/20/98



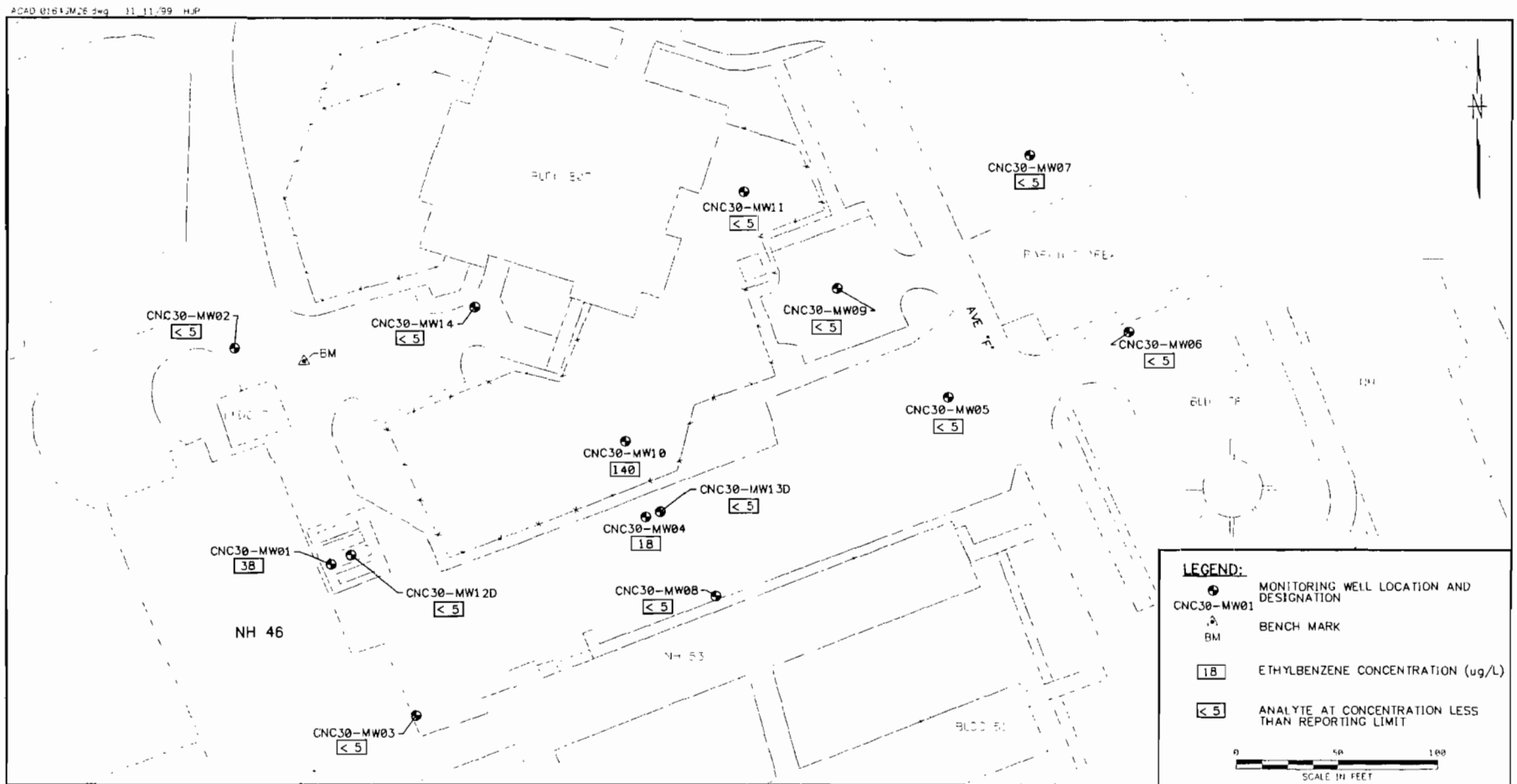
NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES
1	1-28-00	REVISION TO DRAFT RAR	C G		P C	

DRAWN BY HJP 11/5/99 DATE
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

NAPHTHALENE SOIL CONCENTRATION MAP
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 10
REV 1

FORM CADD NO SDN_BM.DWG - REV 0 - 1/20/98



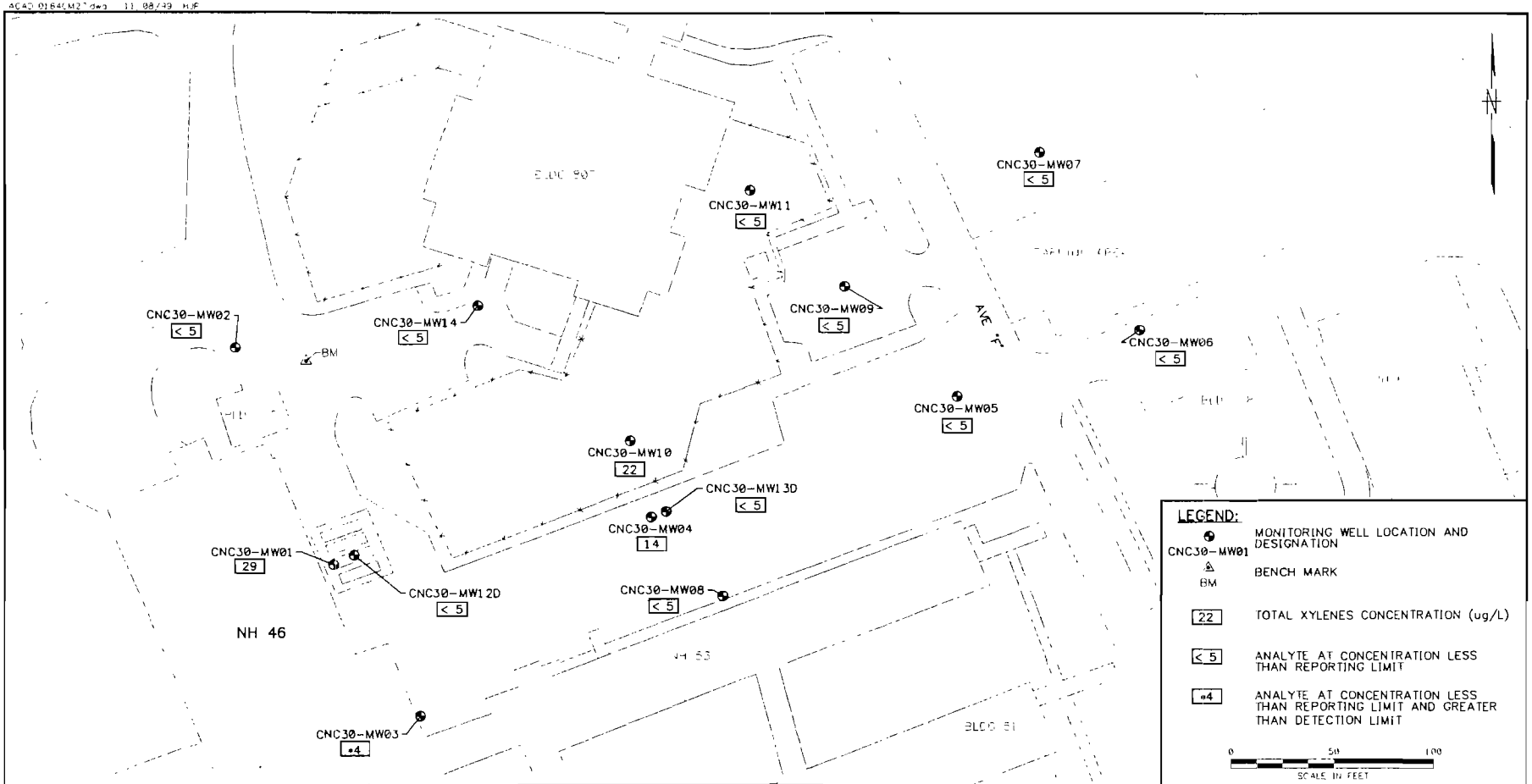
NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 11/5/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

ETHYLBENZENE GROUNDWATER CONCENTRATION MAP
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 11
REV 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98



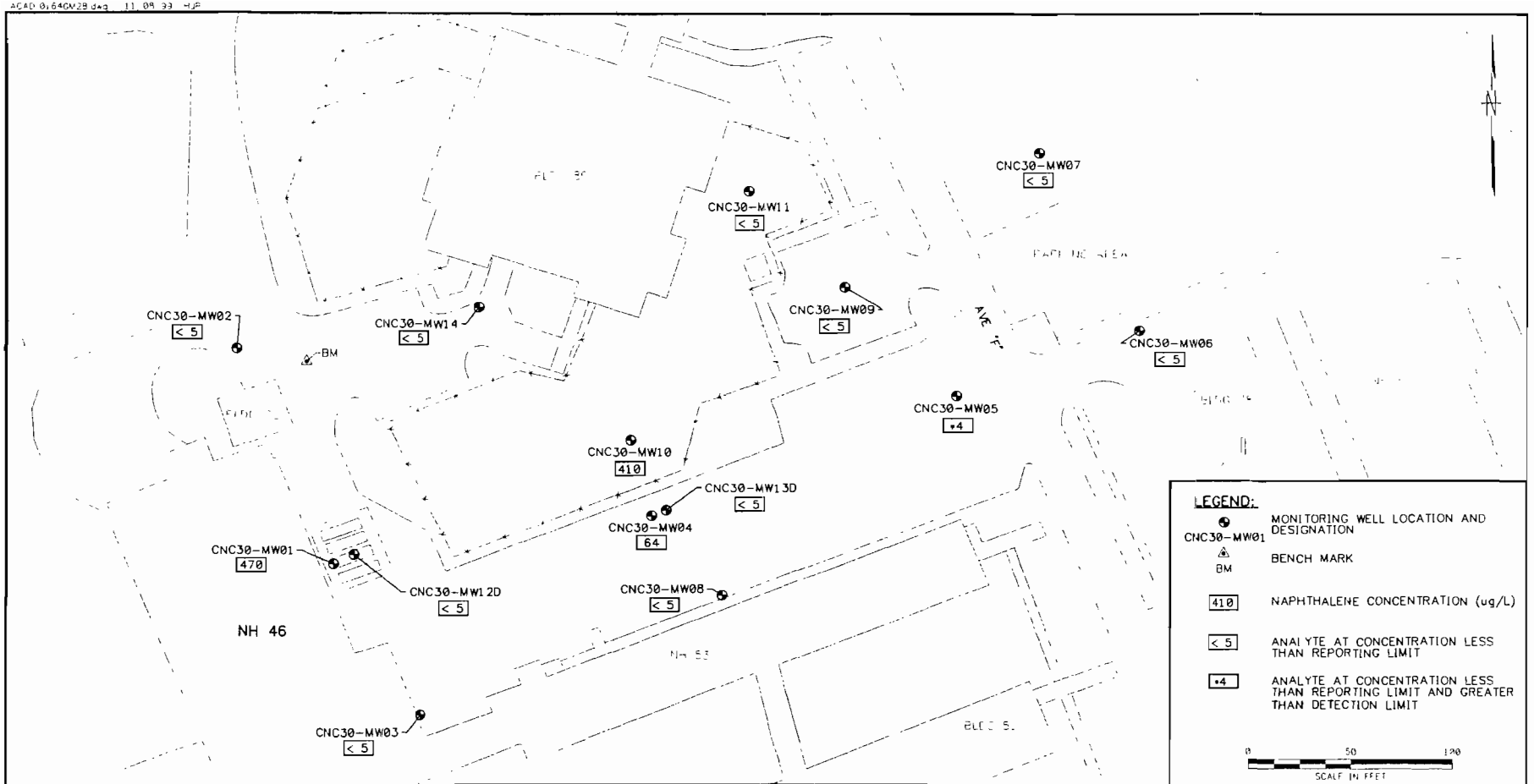
NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 11/5/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

TOTAL XYLENES GROUNDWATER CONCENTRATION MAP
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 12
REV 0

ACAD 0164GM28.dwg 11.09.33 HJP



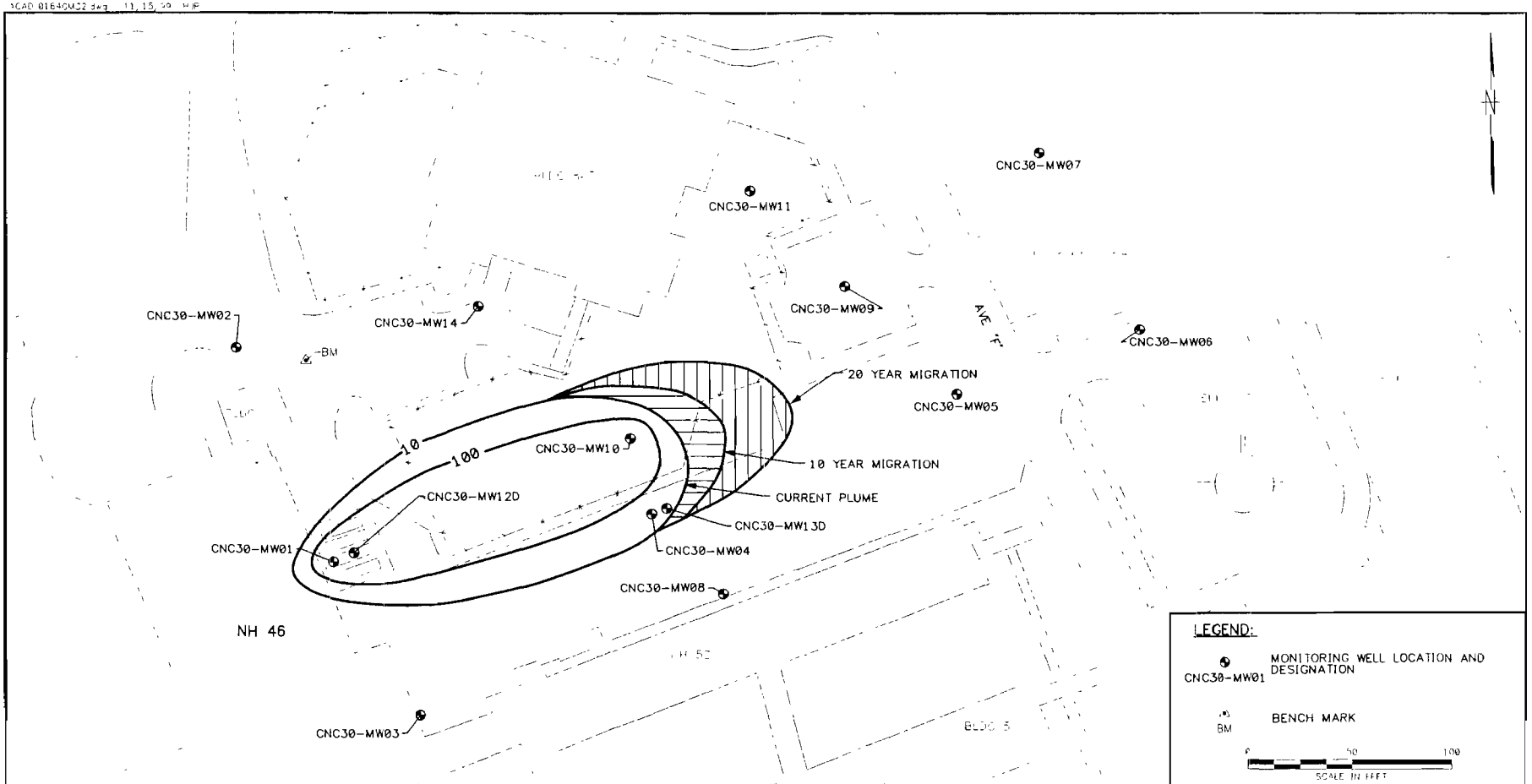
NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY HJP DATE 11/5/99
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

GROUNDWATER NAPHTHALENE CONCENTRATION MAP
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO 0164
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO FIGURE 13
REV 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98



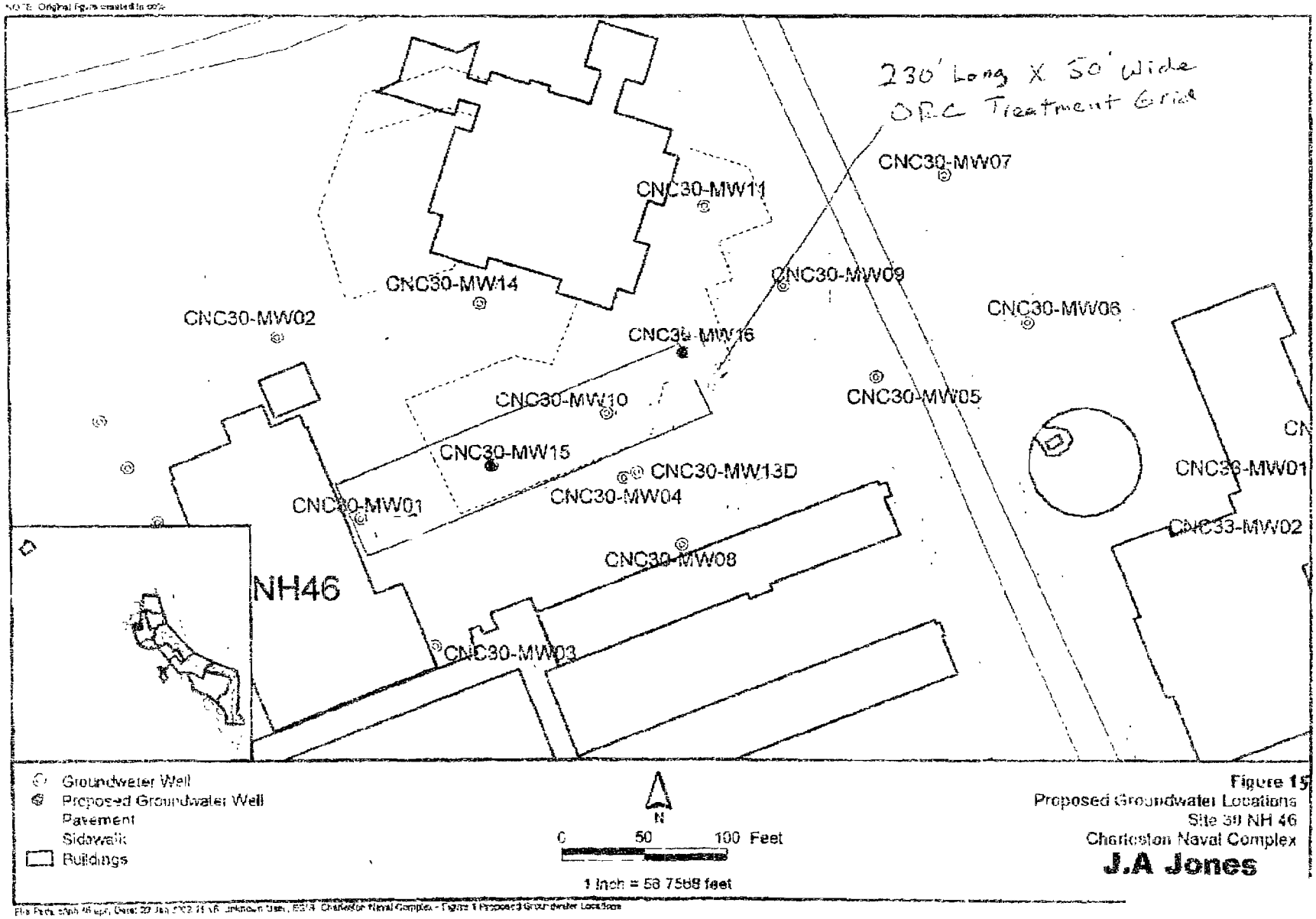
NO	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DATE: HJP 11/12/99
CHECKED BY DATE:
COST/SCHED-AREA:
SCALE: AS NOTED

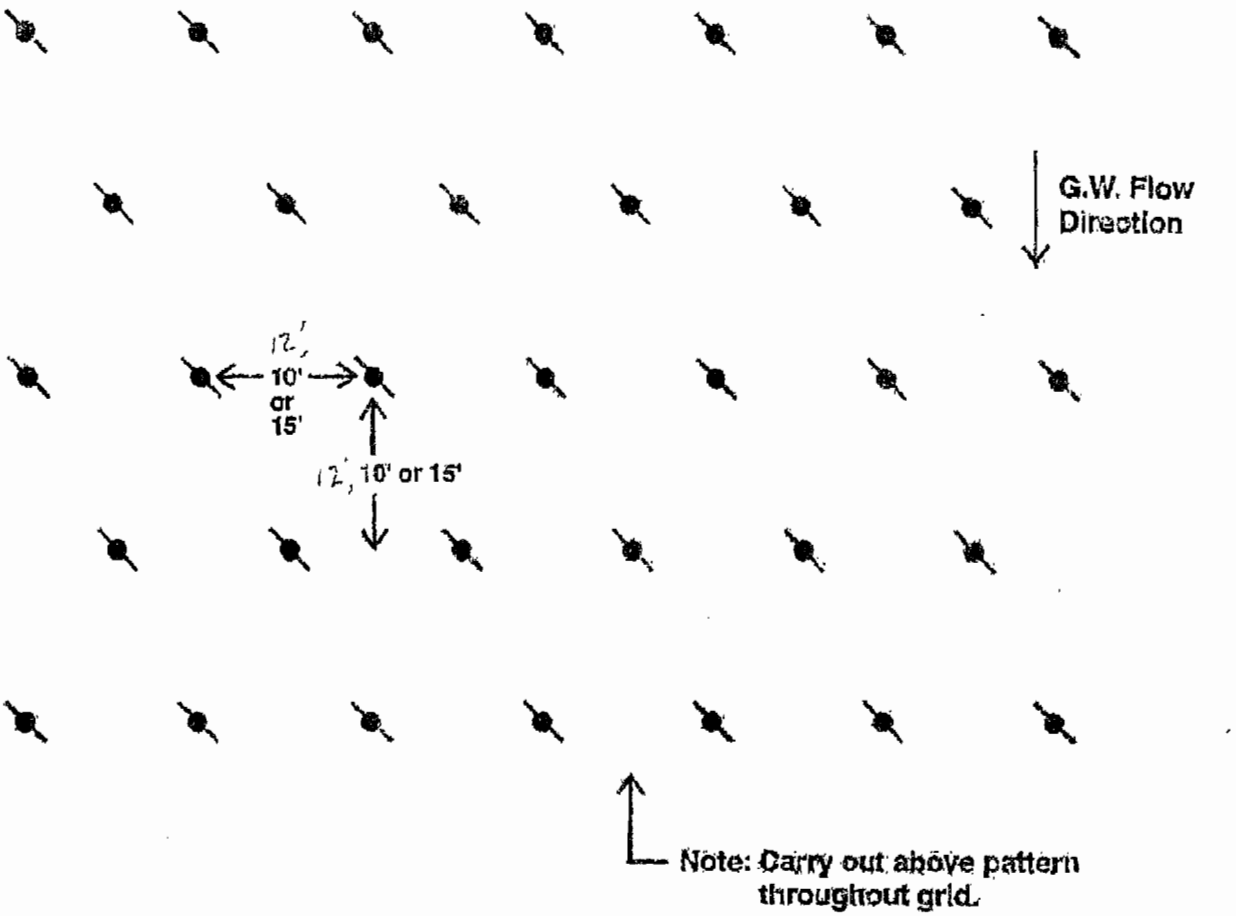
10-YEAR AND 20-YEAR PLUME MIGRATION
PREDICTION OF NAPHTHALENE
SITE 30, BUILDING NH 46
ZONE C, CHARLESTON NAVAL COMPLEX
NORTH CHARLESTON, SOUTH CAROLINA

CONTRACT NO: 0164
APPROVED BY DATE:
APPROVED BY DATE:
DRAWING NO: FIGURE 14
REV: 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98


230' Long X 50' Wide
ORC Treatment Grid
CNC30-MW07
CNC30-MW11
CNC30-MW14
CNC30-MW09
CNC30-MW02
CNC30-MW06
CNC30-MW16
CNC30-MW10
CNC30-MW05
CNC30-MW15
CNC30-MW13D
CNC30-MW01
CNC30-MW04
CNC33-MW02
CNC30-MW08
NH46
CNC30-MW03
Groundwater Well
Proposed Groundwater Well
Pavement
Sidewalk
Buildings
N
0 50 100 Feet
1 Inch = 58.7588 feet
Figure 15
Proposed Groundwater Locations
Site 39 NH 46
Charleston Naval Complex
J.A Jones

TYPICAL ORC INJECTION GRID LAYOUT



Legend

ORC Injection Point

Note: Do not place Injection Points closer than 5 feet to monitoring wells screened in the same interval as the ORC injection interval.