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INTERIM FINAL RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION WORK PLAN CNC CHARLESTON SC

10/14/1993

ENSAFE

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY CHARLESTON NAVAL SHIPYARD CHARLESTON, SOUTH CAROLINA

INTERIM FINAL RFI WORK PLAN CHARLESTON NAVAL SHIPYARD

Prepared for:

Department of the Navy
Southern Division
Naval Facilities Engineering Command
Washington, DC

SOUTHDIV Contract Number:
N62467-89-D-0318

Prepared by:

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Table of Contents

List of Figures

List of Tables

List of Appendices

EXECUTIVE SUMMARY

An RFI Work Plan is an integral part of the RCRA permitting process as regulated by the U.S. Environmental Protection Agency (EPA). This RCRA Facility Investigation (RFI) work plan for the Charleston Naval Shipyard (NSY), Charleston, South Carolina, has been prepared in accordance with guidelines in USEPA's Interim Final RFI Guidance Document (EPA 530/SW-89-031). The purpose of this document is to develop a plan for characterizing prior or continuing releases from the 36 Solid Waste Management Units (SWMUs) originally identified during the RCRA Facility Assessment (RFA) and subsequent RFA Addendum. **Bold text reflects changes to the Workplan made pursuant comments from USEPA and SCDHEC.** The RFI incorporates the results of previous environmental studies and investigations conducted at the NSY. If any SWMU is suspected to be a source of a contaminant release, then information and data must be developed to sufficiently characterize the nature, extent, and rate of migration of release of hazardous wastes into the environment. The information generated from the RFI is used to determine whether a corrective measures study (CMS) will be necessary and is also key in formulating and implementing appropriate corrective measures at the SWMUs. **The RFI will attempt to assess contaminated media relative to the appropriate background concentrations; however, this may not be possible at all SWMU locations due to the high degree of heterogeneity of fill material at the NSY. Where true background concentrations can not be established, alternative risk based action levels for cleanup will be calculated based on direct soil exposure and/or cross media transfer potential.**

The Work Plan begins with a summary of existing conditions at the Naval Shipyard and surrounding areas including land use, hydrogeographic features, industrial operations and waste generation. Next, the work plan presents detailed descriptions of existing conditions and previous data generated for each of the 36 SWMUs. The descriptions and data are based primarily upon previous studies and assessments completed at the site. The next section identifies remaining data gaps and provides a detailed narrative of proposed investigative activities at 27 SWMUs where contamination from prior releases has not been sufficiently identified and delineated. The following section details quality assurance/quality control procedures to insure the integrity of proposed sampling programs and the validity of analytical data. This section includes a presentation of the proposed project organizational structure and details QA/QC objectives and procedures. In addition, it provides detailed protocols for specific field activities including soil boring and monitoring well installation, sampling procedures, and instrument calibration methods. The RFI then discusses the data management procedures to be utilized during the proposed activities. Included in this section are guidelines for collection and organization of field data. The RFI plan identifies potential receptors of regulated constituents which may have been released from the various SWMUs at NSY. Finally, a Health and Safety Program is presented to insure that all planned RFI activities are conducted using proper procedures and guidelines as required by 29 CFR 1910.120 and the Occupational Health and Safety Administration (OSHA).

Implementation of the RFI will be guided by a Corrective Action Management Plan (CAMP) which will be submitted under separate cover.

1.0 INTRODUCTION

1.1 Objectives

This RCRA Facility Investigation Work Plan (RFI Work Plan) for the Charleston Naval Shipyard (NSY), Charleston, South Carolina, was prepared by WAPORA, Inc. and modified by EnSafe/Allen & Hoshall (E/A&H), Inc. at the direction of Naval Facilities Engineering Command, Southern Division under Contract No. N62467-89-D-0318. The purpose of the project is to develop a plan for characterizing prior or continuing releases of hazardous waste or constituents from solid waste management units (SWMUs) identified during the RCRA Facility Assessment (Ref. 2). The objectives of the RFI are to conduct those investigations necessary to: (1) characterize the facility setting, (2) define the source, degree, and extent of releases of hazardous constituents, and (3) identify actual or potential receptors. The investigation must be of sufficient scope and contain adequate detail to support design of any necessary corrective action.

This document was developed following the guidelines in USEPA's Interim Final RFI Guidance Document (EPA 530/SW-89-031) published in May 1989. It is based on information contained in the RCRA Facility Assessment (RFA) prepared by Ebasco Services, Inc. (Ebasco), RFA Addendum prepared by Southern Division, Naval Facilities Engineering Command (SOUTHDIV) for the U.S. Environmental Protection Agency (EPA), the Part B permit application submitted by the Charleston Naval Shipyard (NSY), and on the prior work of Geraghty and Miller, Inc. (G&M), Environmental Science and Engineering, Inc. (ES&E), Environmental and Safety Designs, Inc. (EnSafe), Davis and Floyd, Inc. (DFI), and Westinghouse Environmental and Geotechnical Services, Inc. (WEGs). Prior reports and other documents referenced throughout are clearly identified in the Reference List, Section 8.

1.2 RCRA Facility Investigation Work Plan

In November 1984, Congress enacted the Hazardous and Solid Waste Amendments (HSWA) amending the Solid Waste Disposal Act (SWDA). SWDA is more commonly known as the Resource Conservation and Recovery Act (RCRA) and will be referred to as RCRA herein. Among the provisions of HSWA are Section 206 which added to RCRA a new subsection 3004(u) (requiring corrective action for releases of hazardous waste or constituents from SWMUs at hazardous waste treatment, storage and disposal (TSD) facilities seeking final RCRA permits) and Section 207 which added a new subsection 3004(v) (compelling corrective action for releases which have migrated beyond the facility property boundary). For any SWMU suspected to be the source of a contaminant release to the environment, information must be available to sufficiently characterize the nature, extent, and rate of migration of releases of hazardous wastes or constituents to soils, groundwater, subsurface gas, air, and surface water. This information is used to determine whether interim corrective measures (ICM) or a corrective measures study (CMS) will be necessary. It is also used in formulating and implementing appropriate corrective measures. Such corrective measures may range from stopping the release through application of source control techniques to full-scale clean up of the affected area. "No action" may also be an appropriate measure. If sufficient information to determine what is most appropriate is lacking prior to the RFI, it must be generated during the RFI. The RFI Workplan identifies needed information and describes procedures for gathering and organizing it during the RFI.

Previous studies in the area have indicated that the NSY could be characterized as having widespread, low-level contaminant concentrations in both the surficial soils and shallow groundwater (Refs. 2, 4 to 9, and 12). This is due in part to past waste handling practices by various NSY operational units (commands). But it may also be due to the method of construction of the NSY site itself. Construction involved primarily fill operations using dredge spoil consisting of contaminated sediments taken from nearby waterways.

Metropolitan Charleston along the Cooper River, in the Harbor area, and along the Ashley River has been heavily industrialized for the past 100 years. Waste disposal practices for much of this period included discharging raw wastes into the nearest surface water body. Much of the NSY site area was originally marshy. Most of the site was built up by placing dredged spoils as fill across the site. Most spoil materials came from the Cooper River, Harbor Area, and Ashley River although the exact location of spoil origin is unknown. Several studies have been performed to determine the background levels of potential contaminants (Refs. 4 to 8). The distribution of background concentrations (especially lead) is erratic. This suggests a heterogeneous mix of spoils having several origins with at least some of the spoil material having been previously contaminated by industrial sources. Sediment contamination is heterogeneous but ubiquitous in the Charleston Area (Refs. 9 and 12).

A detailed description of the land usage, geology and hydrogeology is presented in Section 2. Section 2 of the RFI Work Plan also describes existing conditions at the Charleston Naval Base and summarizes the available data from previous studies of all 36 SWMUs at the Naval Base South. Section 3 identifies data gaps for 27 SWMUs and proposes methods for completing the investigations at these units. This chapter includes a detailed scope-of-work for activities in support of filling the data gaps. Section 4 provides a comprehensive quality assurance/quality control plan covering all activities described in Section 3. Section 5 discusses the data management procedures to be utilized during the RFI. Section 6 identifies potential receptors of regulated constituents which may have been released from various SWMUs at the Naval Base South. Finally, Section 7 is a Health and Safety Plan covering all planned RFI activities. References cited in the RFI are listed in Section 8.

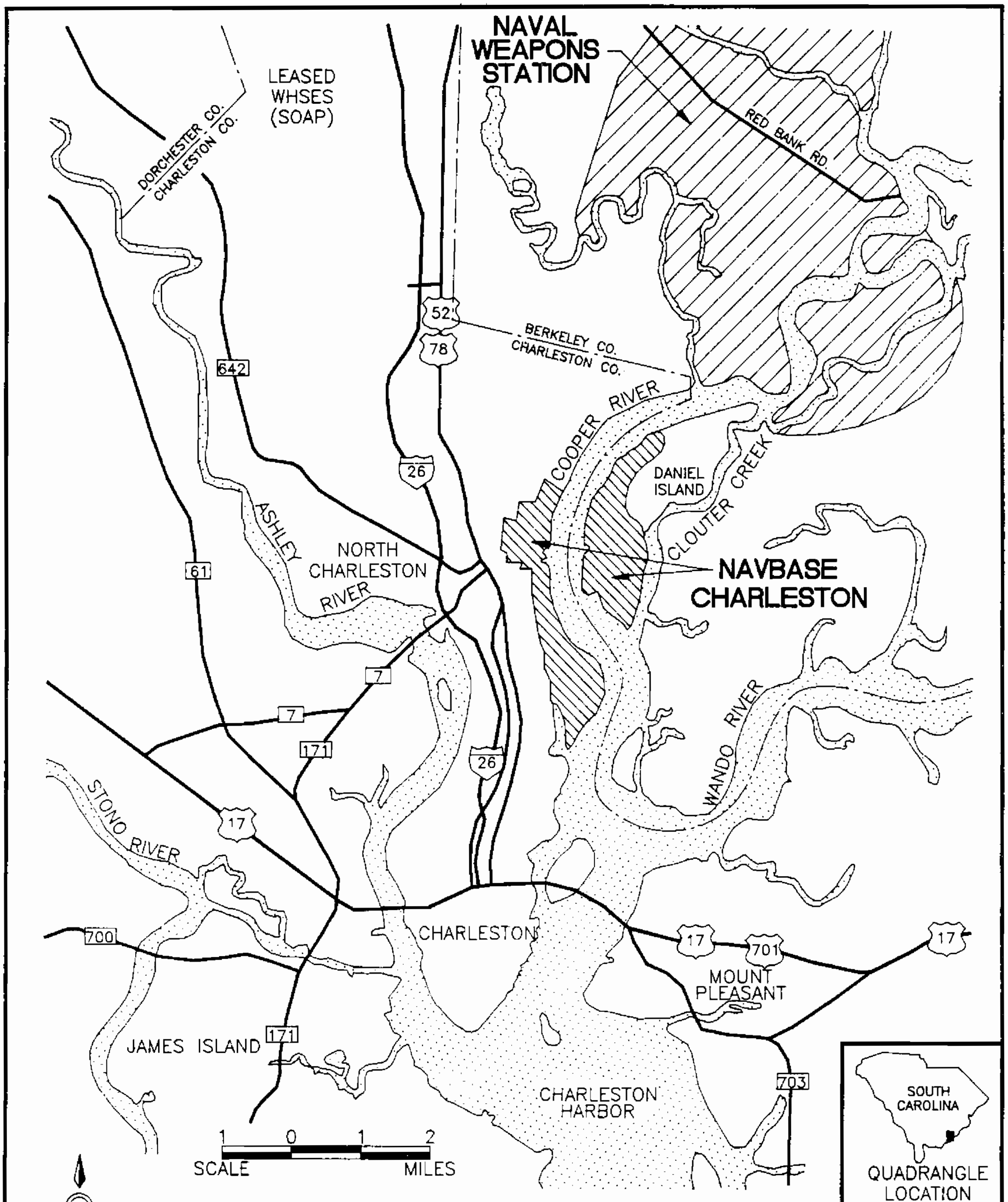
2.0 BACKGROUND INFORMATION

This section provides a detailed description of the environmental setting and current conditions at the Charleston Naval Shipyard. Initial sections describe the **site history**, overall land use, hydrogeographic features, and NSY industrial operations. Section 2.6 focuses on current conditions in each identified SWMU. This characterization includes, for each SWMU, a summary of previous investigations and studies, methods of investigation, plans and tables delineating and summarizing data, interpretation of the data, and identification of data gaps.

2.1 Site History, Location, and Organization

The Charleston Naval Shipyard was established at Charleston, South Carolina in 1901. The primary mission of the shipyard was to repair, overhaul, refuel, convert, and modernize ships, and to provide logistic services in support of Fleet readiness. In 1933, Charleston Naval Shipyard was designated as a new construction yard. During World War II, shipyard activity included ship repair, conversion, and new construction. After World War II, new ship construction was discontinued, but conversion, alteration and repair of ships continued. In 1948, Charleston Naval Shipyard was designated as a submarine repair and overhaul center. In 1961, Charleston Naval Shipyard was given the responsibility to overhaul and modernize nuclear submarines.

Charleston Naval Base is located on various contiguous and discontiguous properties in Charleston and Berkeley counties on South Carolina's central coast (Figure 2-1). The base is divided into two major areas, Naval Weapons Stations and Naval Base South. Only Naval Base South is covered by the RCRA regulatory activities which are the subject of this RFI Work Plan. For purposes of RCRA, that part of Naval Base South situated on the right bank of the Cooper River constitutes a "facility." This part of Naval Base South is referred to as the Naval Shipyard. While the Naval Shipyard proper is only one of several Naval commands owning property at the base, it controls all of the RCRA regulated activity and has been designated by the Base Commander as having responsibility for implementation of RCRA at the "facility" as a whole.



RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 2-1
LOCATION MAP

DWG DATE: 07/29/92 | DWG NAME: 029STMAP

Naval Base South is located on both banks of the Cooper River, approximately five miles north of downtown Charleston. The installation consists of two major areas: an undeveloped area on the east or left bank of the Cooper River consisting of Daniel Island in Berkeley County which is currently used only for the disposal of dredge spoil, and a developed area on the west or right bank of the Cooper River (Figure 2-1). The developed portion of Naval Base South lies on a peninsula, bound on the west by the Ashley River and the east by the Cooper River. This portion of the base (the "facility") is situated on the east side of the Ashley-Cooper or Charleston peninsula and is bounded on the west, for the most part, by Shipyard Creek. This is the area which will be hereafter referred to as the Naval Shipyard even though parts of it, for non-RCRA purposes, are controlled by other Naval commands.

Naval Base South covers approximately 3,300 acres and is divided between or into several distinct activities or "commands." Of these, Naval Shipyard proper is the largest "landholder" having jurisdiction over the spoil area and the majority of the central third of the developed area on the west bank of the river, approximately 1,958 acres. The southern one-third of the developed area of Naval Base South is controlled primarily by the Naval Station. The Naval Supply Center and Naval Station are the major landholders on the northern one-third of the developed area. Other commands control lesser areas of what shall be referred to generically as the Naval Shipyard.

2.2 Land Use

Areas surrounding NSY, like NSY itself, are "mature urban" having been long developed with commercial, industrial, and residential land uses. Commercial areas are located primarily west of NSY; industrial areas lie to the north of NSY and along the west bank of Shipyard Creek.

The west or right bank of Shipyard Creek is concentrated with heavy industry, and has been for many years. Railways have served the area since at least the early 1900s. This, when combined with nearby waterways, has made the area ideal for heavy industry. While ownership has changed from time to time, the land adjacent to NSY remains dedicated to chemical, fertilizer, oil refining, metallurgical, and lumber operations.

The east or left bank of the Ashley River is also dotted with industry. In contrast, the east bank of the Cooper River is undeveloped and contains extensive wetlands, particularly along Clouter Creek and Thomas Island. Active dredge spoil disposal areas are located on Naval property, not part of NSY, between the Cooper River and Clouter Creek (Figure 2-1). Active dredge spoil disposal areas are also located on the southern portion of Daniel Island and on Drum Island.

2.3 Hydrogeographic Features

2.3.1 Topography

NSY is in the lower South Carolina Coastal Plain Physiographic Province, on the Cooper River side of the Charleston Peninsula. The Charleston Peninsula is formed by the confluence of the Cooper and Ashley Rivers. Topography in the area (Figure 2-2) is typical of South Carolina's lower coastal plain, having low relief plains broken only by the meandering courses of sluggish streams and rivers which flow toward the coast past occasional marine terrace escarpments. Topography at NSY is essentially flat. Elevations range from just over 20 feet above mean sea level (msl) in the northwest part of the base to sea level at the Cooper River. Most of the original topography at NSY has been modified by man's activities. The southern end was originally tidal marsh drained by Shipyard Creek and its tributaries, and originally, the other portions of the facility were only slightly higher in elevation. The land surface at NSY has been filled with both solid wastes and dredged spoil (primarily the latter) in increments over the last 70 years. Nonetheless, most of NSY remains within the 100-year flood zone, that is, less than ten feet msl.

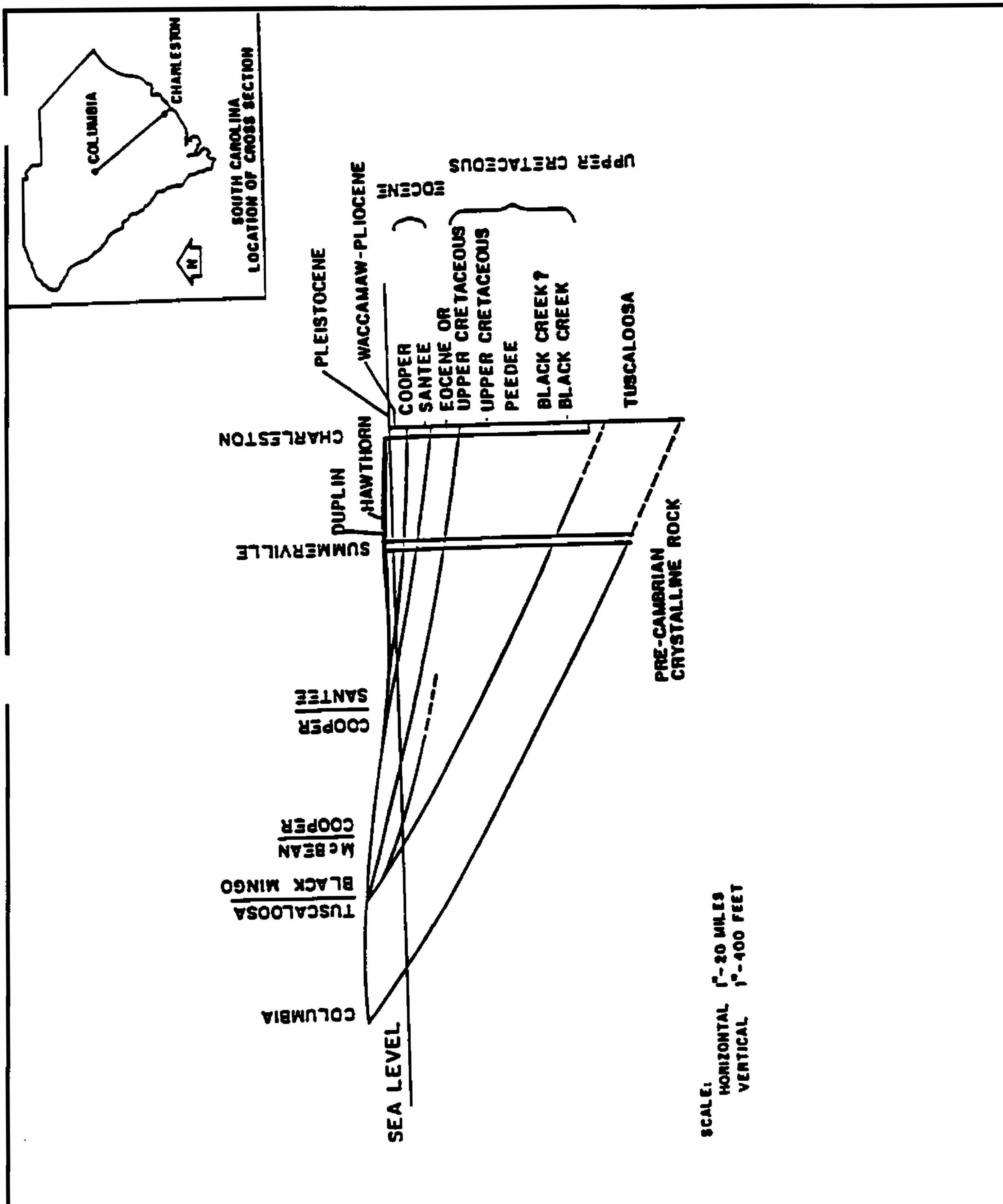
2.3.2 Geology

Geology of the Charleston area is typical of the southern Atlantic Coastal Plain. Cretaceous and younger sediments thicken seaward and are underlain by older igneous and metamorphic basement rock (Figure 2-3). Surface exposures at NSY, in the limited areas which remain undisturbed, consist of recent and/or Pleistocene sands, silts, and clays of high organic content. NSY is underlain by a plastic calcareous clay known as the Cooper Marl. The Cooper Marl is, in turn, underlain by the Santee limestone and sequentially older rocks. A generalized north-south cross section passing through the approximate center of the base is shown in Figure 2-4.

2.3.3 Soil Characteristics

Surface soils at NSY have been extensively disturbed. Aboriginal soils were the fine-grained silts, silty sands, and clay, typical of terrigenous tidal marsh environments. Lithologic descriptions of the soil samples are presented in Appendix A. Sand lenses are present in localized areas; however, these are generally only several feet thick. Much of the material, particularly in the southern portion of the base, has been filled using dredged spoil from the Cooper River and Shipyard Creek. The spoils are an unsorted mixture of sands, silts, and clays. Most of the remainder of the base has been either filled or reworked. Figures 2-5, 2-6, 2-7 and 2-8 are geologic cross-sections (taken from Ref. 12) through the caustic pond, the landfill, and the chemical disposal areas. These depict the nature and distribution of the sediments beneath these areas.

In monitoring well DLF-1, which was drilled to a depth of 62 feet, the top of the Cooper Marl was found at a depth of 45 feet. The sediments between 45 and 62 feet consisted of a hard calcareous, slightly sandy clay. The permeability of the calcareous clay was estimated from the results of consolidation tests performed on two undisturbed samples. From these data, the permeabilities of these samples were calculated to be 1.3×10^{-4} and 3.2×10^{-5} cm/sec (Ref. 12). A consolidation test of the fill material sampled at DLF-1 could not be performed due to the high sand content.

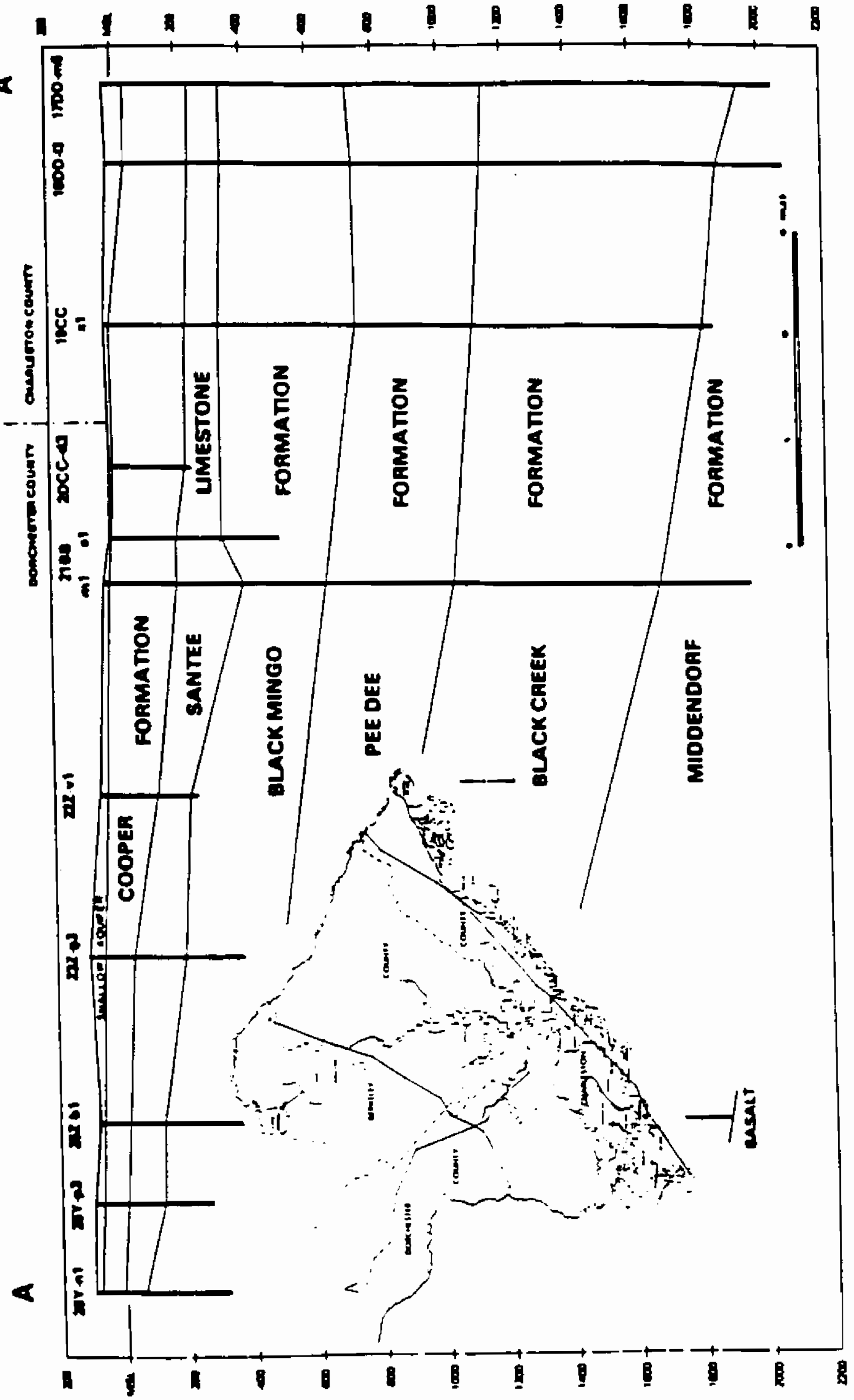


RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 2-3
GEOLOGIC CROSS-SECTION
FROM COLUMBIA TO CHARLESTON,
SOUTH CAROLINA,
INCLUDING NSY

DATE: 08/05/92

DWG NAME: CNSY



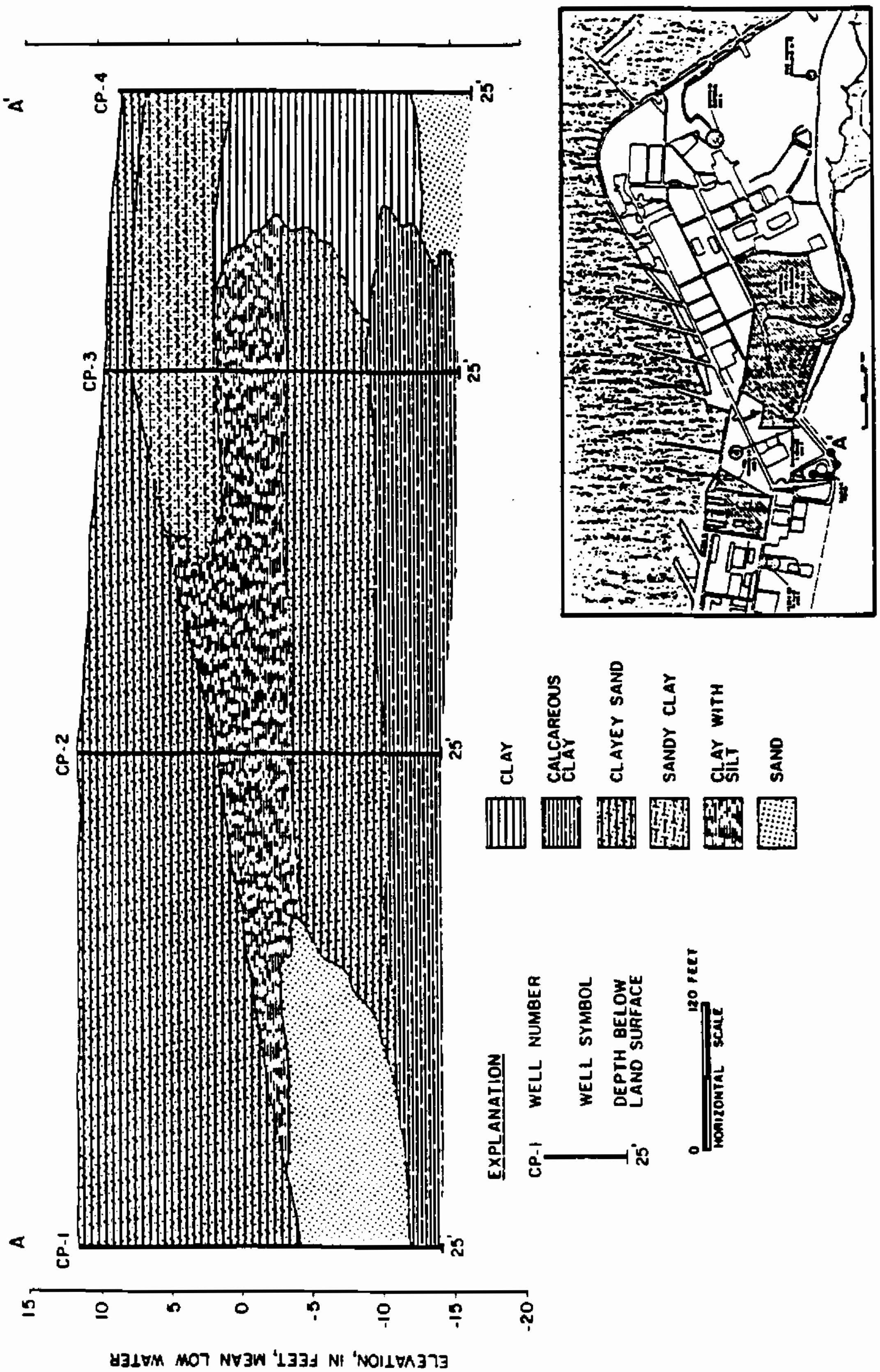
RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 2-4
GEOLOGIC CROSS-SECTION
OF CHARLESTON COUNTY,
SOUTH CAROLINA,
INCLUDING NSY

DATE: 08/05/92

DWG NAME: CNSY

Geraghty & Miller, Inc.



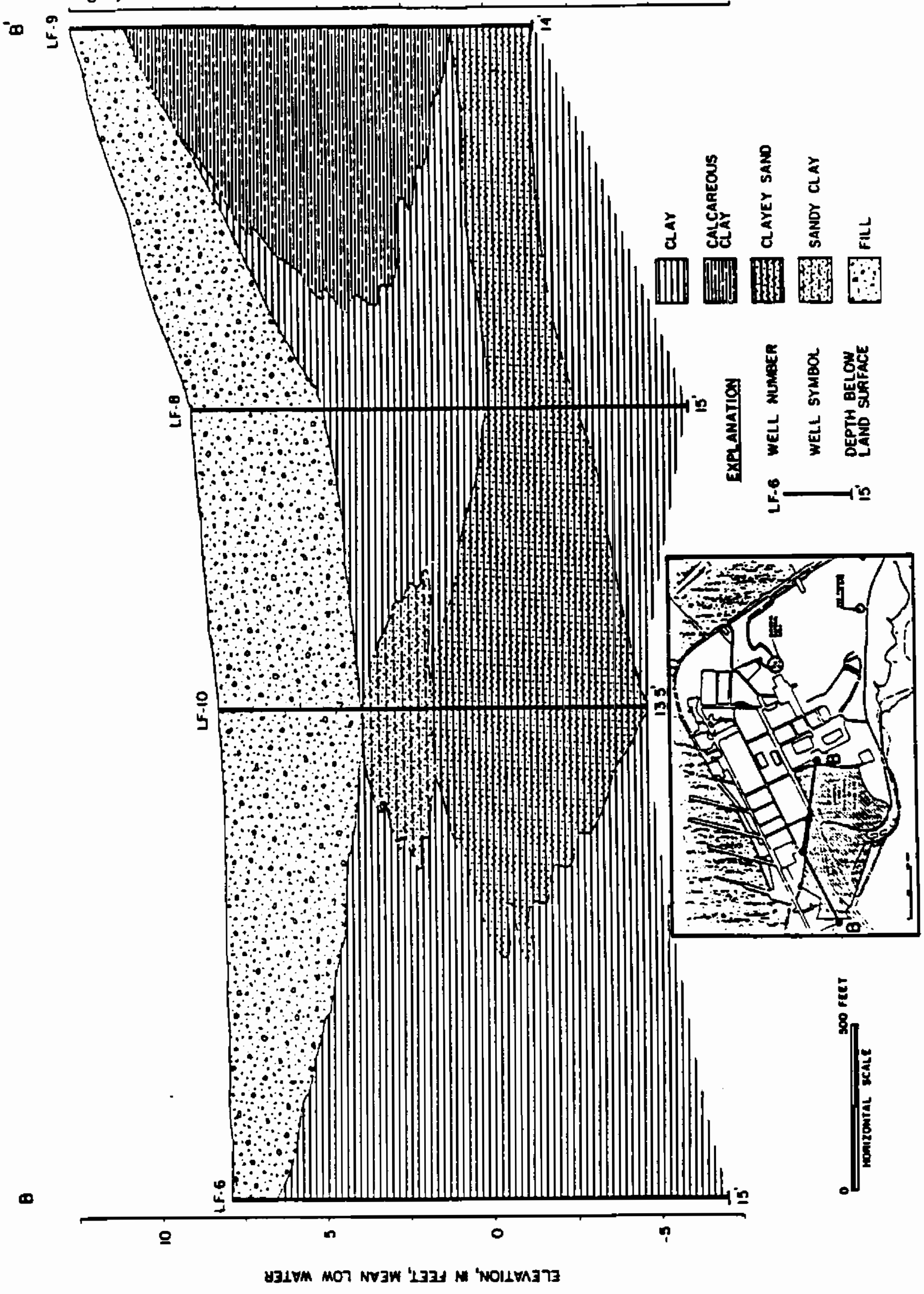
RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 2-5
GEOLOGIC CROSS-SECTION
A-A' THROUGH CAUSTIC POND AREA
(FIGURE FROM REF. 9)

DATE: 08/05/92

DWG NAME: CNSY

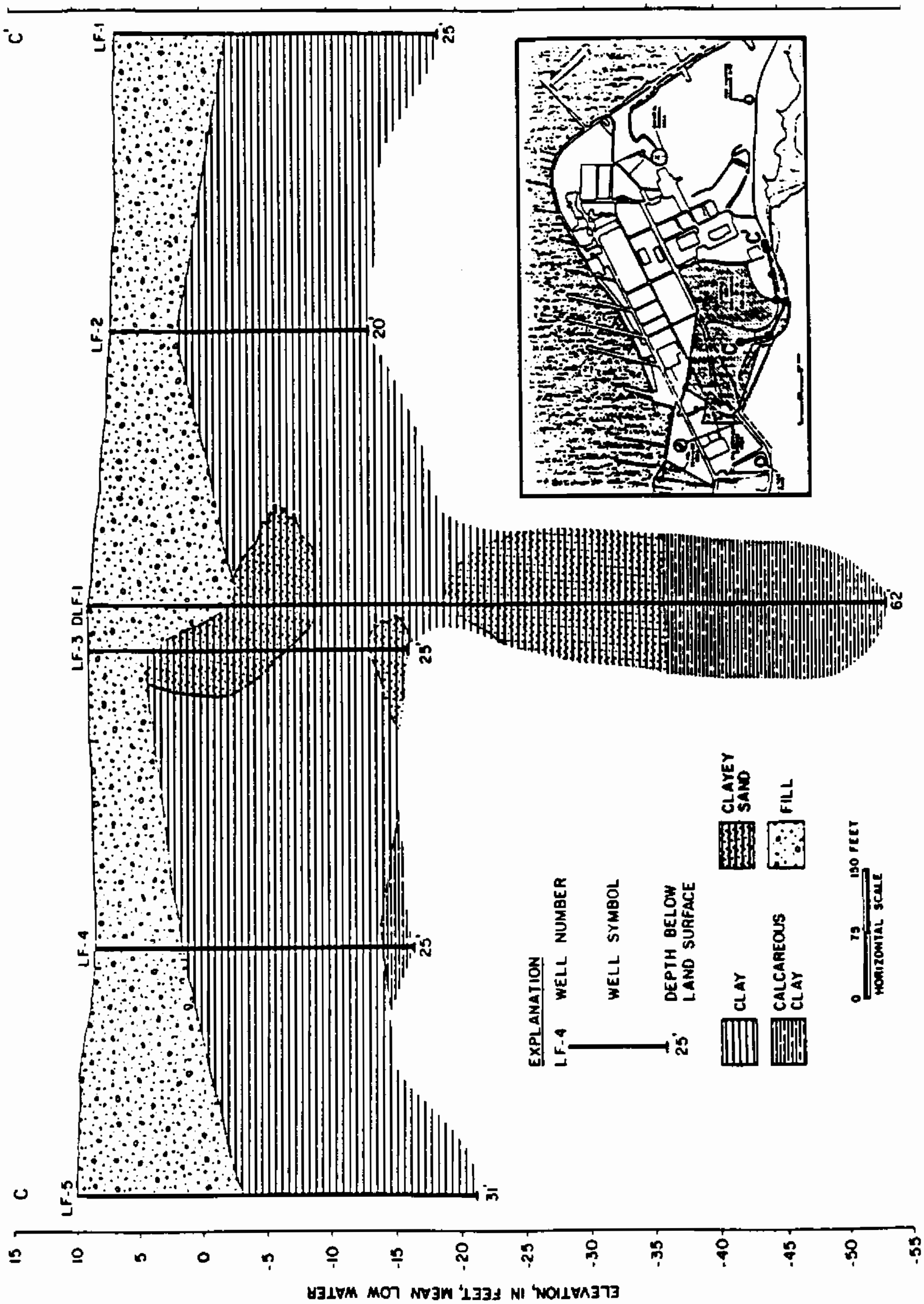
Geraghty & Miller, Inc.



RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 2-6
GEOLOGIC CROSS-SECTION
B-B' THROUGH LANDFILL AREA
(FIGURE TAKEN FROM REF. 9)

DATE: 08/05/92 | DWG NAME: CNSY



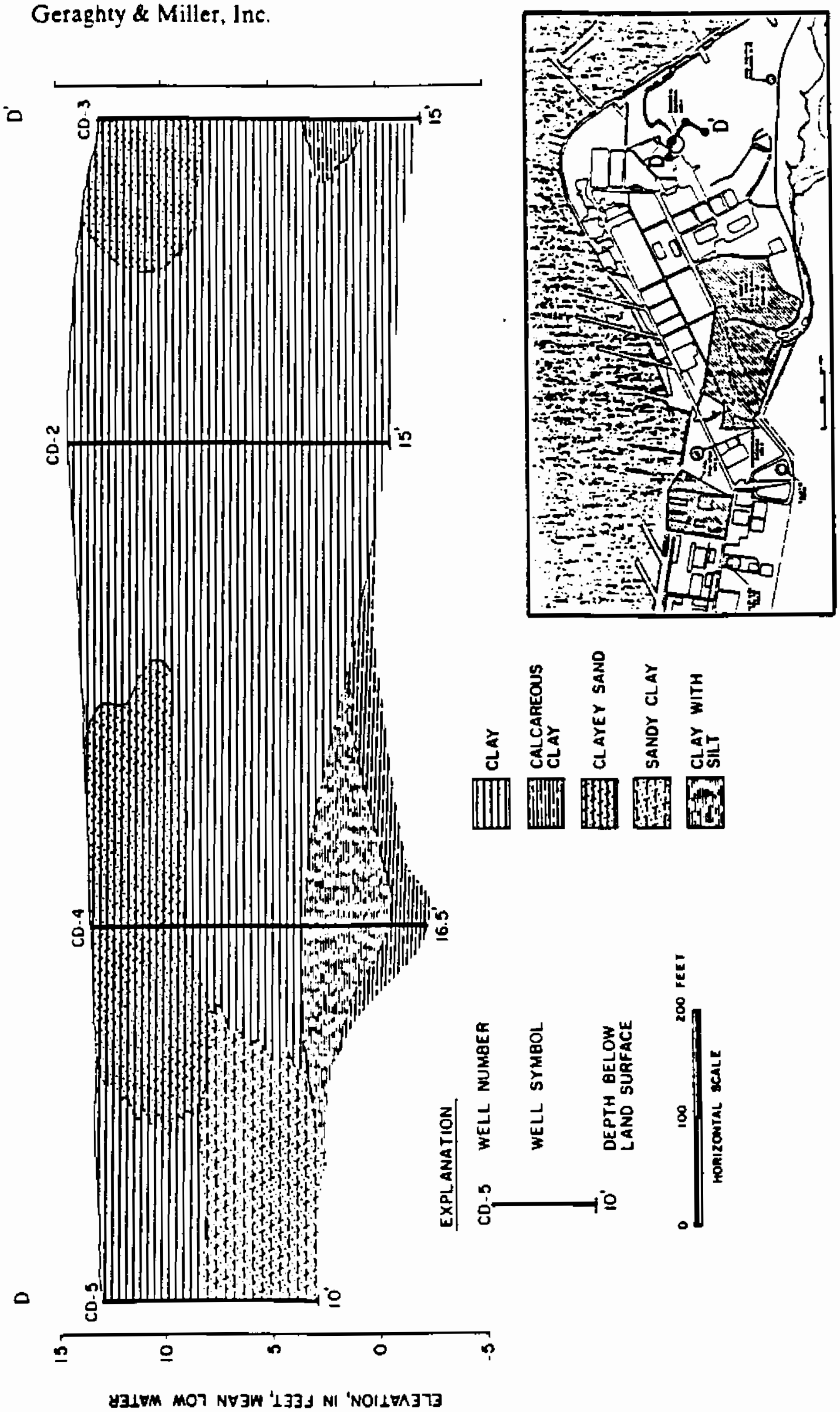
RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 2-7
GEOLOGIC CROSS-SECTION
C-C' THROUGH LANDFILL AREA
(FIGURE TAKEN FROM REF. 9)

DATE: 08/05/92

DWG NAME: CNSY

Geraghty & Miller, Inc.



RFI WORKPLAN CHARLESTON NAVAL SHIPYARD CHARLESTON, S.C.	FIGURE 2-8 GEOLOGIC CROSS-SECTION D-D' THROUGH CHEMICAL DISPOSAL AREA (FIGURE TAKEN FROM REF. 9)
	DATE: 08/05/92 — DWG NAME: CNSY

Sieve analyses were performed on the fill material sampled at monitoring well LF-1 and on a sample of the soft, gray clay that is found throughout the site. The permeabilities were calculated to be 1 x 10^{-2} to 1 x 10^{-3} cm/sec for the fill and 1 x 10^{-6} cm/sec for the gray clay (Ref. 12). The geotechnical data for the surficial soils are presented in Appendix B.

2.3.4 Surface Hydrology

Parts of the southern portion of NSY are drained by Shipyard Creek while some northern areas are drained by Noisette Creek. Both creeks are tributary to the Cooper River. Surface drainage over the remainder of NSY flows directly into the Cooper River. The Cooper discharges into Charleston Harbor.

Shipyard Creek is a small tidal tributary, about two miles in length, which flows to the southeast along the southwestern boundary of NSY to its confluence with the Cooper River, opposite the southern tip of Daniel Island (river mile 9). Docking facilities are located along the western shore of the lower mile of the channel, while the entire length of the eastern shore is bounded by tidal marshland.

Noisette Creek, which transects the northern portion of NSY, is a tidal tributary approximately 2.5 miles long. The creek flows nearly due east from its headwaters in the City of North Charleston and empties into the Cooper River at river mile 13.

2.3.5 Hydrogeology

Two distinct aquifers exist beneath the NSY site, a deep confined aquifer located within the Santee Limestone, and a shallow water table aquifer located within the near surface sediments. Both the shallow aquifer and the Santee Limestone function as potable aquifers in other locations. The shallow aquifer is not significantly developed in the NSY area and is not developed at all at NSY. In addition, the quality of the water from the Santee Limestone (in the vicinity of NSY) is not suitable for potable supply; total dissolved solids (TDS) range from 1,000 to 1,500 parts per million (ppm).

The Cooper Marl, in the Charleston area, is a well documented confining layer for the Santee Limestone (Ref. 24). The top of the Santee Limestone, which occurs at about -250 feet msl in the NSY area, has a groundwater potentiometric elevation of approximately 15 feet msl. The hydraulic gradient is generally towards the southeast. Some wells in the vicinity of NSY are pumping from the Santee for industrial purposes. In July 1981, the water level of a deep water well in the Santee Limestone beneath NSY measured 15 feet msl, indicating that the gradient across the confining Cooper Marl is artesian. Specifically, water from the confined aquifer of the Santee Limestone formation has an upward potential through the Cooper Marl.

Groundwater in the shallow aquifer beneath NSY flows north-northeast into the Cooper River and south-southeast into Shipyard Creek due to the gently sloping topography away from the center of NSY. Groundwaters in the immediate vicinity of Noisette Creek flow into it. The water table is within 3 to 7 feet of the ground surface. The shallow groundwater table continually but slowly discharges to the Cooper River and Shipyard Creek and, to a lesser extent, into Noisette Creek.

2.3.6 Migration Potential

Shallow groundwater beneath NSY eventually discharges to the Cooper River either directly or indirectly via its tributaries. Contaminants, if present in the shallow groundwater system, will eventually discharge into the Cooper River if not immobilized by subsurface soils or degraded or transformed by soil reactions. Flow rate in the shallow system, however, is expected to be rather slow due to the fine-grained nature of the sediments and the low groundwater gradient. Various contaminants, particularly metals, are likely to be attenuated by absorption onto clay minerals while organic compounds will be absorbed by the native organic matter in the soils.

Minimal attenuation is assumed within the surficial aquifer since no data have been collected to identify the degree of attenuation for specific constituents.

No use is made of the shallow groundwater downgradient of NSY since the Cooper River and Shipyard Creek are the base boundaries as well as the downgradient boundaries of the shallow groundwater system. Residential wells using the shallow aquifer upgradient of NSY are unlikely but have not been ruled out. Such wells, if present, would not be threatened by contaminant migration from NSY, since they are upgradient from the base and reversal of the natural gradient by pumpage from shallow residential wells would be extremely unlikely due to the very small capacity of this type of well and aquifer parameters which effectively limit the capture zone of such wells. A survey of groundwater users within a 7-mile radius of the NSY was provided by the South Carolina Water Resources Commission to ascertain the extent, if any, of shallow groundwater usage in the vicinity of the NSY. The survey indicated there are no wells screened in the surficial aquifer being utilized as a source for drinking water within a 4-mile radius of the NSY. Currently, there is no evidence of shallow groundwater usage at the NSY. However, as outlined by the ***Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy*****, Final Draft, December 1986, the shallow groundwater is classified as Class IIB, Potential Source of Drinking Water, and may be subject to stringent clean up levels protective of human health and the environment.**

In summary, potential contaminants from installation operations entering the shallow groundwater system do not threaten the health of on-base personnel, since the shallow system is not developed for use at NSY. Likewise, possible offsite contaminant migration via the shallow groundwater system does not threaten human health, since shallow groundwater flow is intercepted by surface waters at the installation boundaries. Contaminants entering the shallow groundwater system at NSY do, however, represent a potential threat to the environment, since contaminants have the potential to migrate via the shallow system to adjacent surface waters. Although aquatic habitats in the Cooper River, Noisette Creek, and Shipyard Creek may be threatened, human health is not directly threatened by contaminant migration, since these surface bodies do not function as potable supplies. Due to low rates of flow in the surficial aquifer and the much higher rates of flow in adjacent surface waters, only concentrated, high level contamination poses this threat to aquatic habitats.

The deeper aquifer (Santee Limestone) is not threatened by potential contamination from NSY. The permeablities calculated during the Confirmation Study for the uppermost portion of the Cooper Marl indicate this section of the formation is not totally impervious. The Cooper Marl is considered to be essentially impermeable when considering the relative thickness (approximately 250 feet) in the NSY area. In addition, groundwater from the confined aquifer of the Santee Limestone has an upward potential through the Cooper Marl which would also tend to inhibit vertical contaminant migration. Furthermore, metals would likely be absorbed by clays present in the Cooper Marl while organic compounds (such as PCBs) would likely be tightly bound and therefore immobilized by native organic carbon materials abundant in the Cooper Marl. In any case, water in the Santee Limestone aquifer is not of potable quality in the vicinity of NSY; the aquifer is significantly developed only for non-potable uses.

Migration pathways must also be considered for surface contaminants at NSY since constituents could migrate beyond installation boundaries via stormwater drainage. Stormwater is conveyed by natural and manmade drainage channels to the Cooper River or its tidal tributaries. The northern end of the base drains to Noisette Creek or the Cooper River. The heavily industrialized central portion of NSY drains to the Cooper River. Developed portions of NSY drain stormwater to the Cooper River via storm sewers. Undeveloped areas of NSY are drained by surface flow to either the Cooper River or Shipyard Creek, depending on the drainage patterns of the area. Thus, surface contaminants at NSY have the potential to migrate off the installation and into the Cooper River either directly or through its tributaries. Surface contaminants, therefore, represent a potential threat to aquatic habitats in the Cooper River, Noisette Creek, and Shipyard Creek although they do not directly threaten human health.

2.4 Industrial Operations and Waste Generation

NSY is an extensive industrial complex containing virtually all shipyard and dockside operations necessary to provide logistical and labor task force support in conversion, overhaul, repair, alteration, dry docking and outfitting of ships, submarines, and service crafts. Currently NSY operates 18 major industrial shops. Operations performed by these shops and industrial wastes generated from these operations are described in detail in both The Industrial Process and The Waste Treatment Investigation (Ref. 13) and the Initial Assessment Study Report (Ref. 9). The RFA Report (Ref. 2) summarizes the industrial processes, waste generation, and treatment at the facility and should be referred to if further information is needed.

Although the types of wastes generated by industrial operations essentially have remained the same over the years, waste generation rates may have fluctuated as a result of varying production requirements. No historical information is available regarding past generation rates and only the current quantities are identified for most industrial operations in the RFA Report.

NSY has established an Environmental Compliance Inspection (ECI) Program to ensure that all operations are being conducted in compliance with applicable regulations. The program provides a mechanism for periodic inspection of ongoing activities at pertinent areas at the shipyard. These measures were established as a result of a surprise inspection conducted by EPA and south Carolina Department of Health and Environmental Control (SCDHEC) on August 20-22, 1990 which identified 10 additional SWMUs. The ECI program consists of two components: Zone Inspections and Hazardous Waste Storage Area Inspections.

- **Zone Inspections**: The base has been divided into 34 separate zones for inspection. NSY personnel are required to inspect activities and sites in one zone every day. This procedure allows coverage of all zones on a regular basis. The highest priority of inspections will be in zones having immediate or recent problems. In the event a deficiency is identified, a report is written detailing the problem and describing the corrective measures to be undertaken. The report is signed by the manager of the individual shop or unit of concern. The area is then re-inspected on the following day to ensure that corrective measures have been implemented.

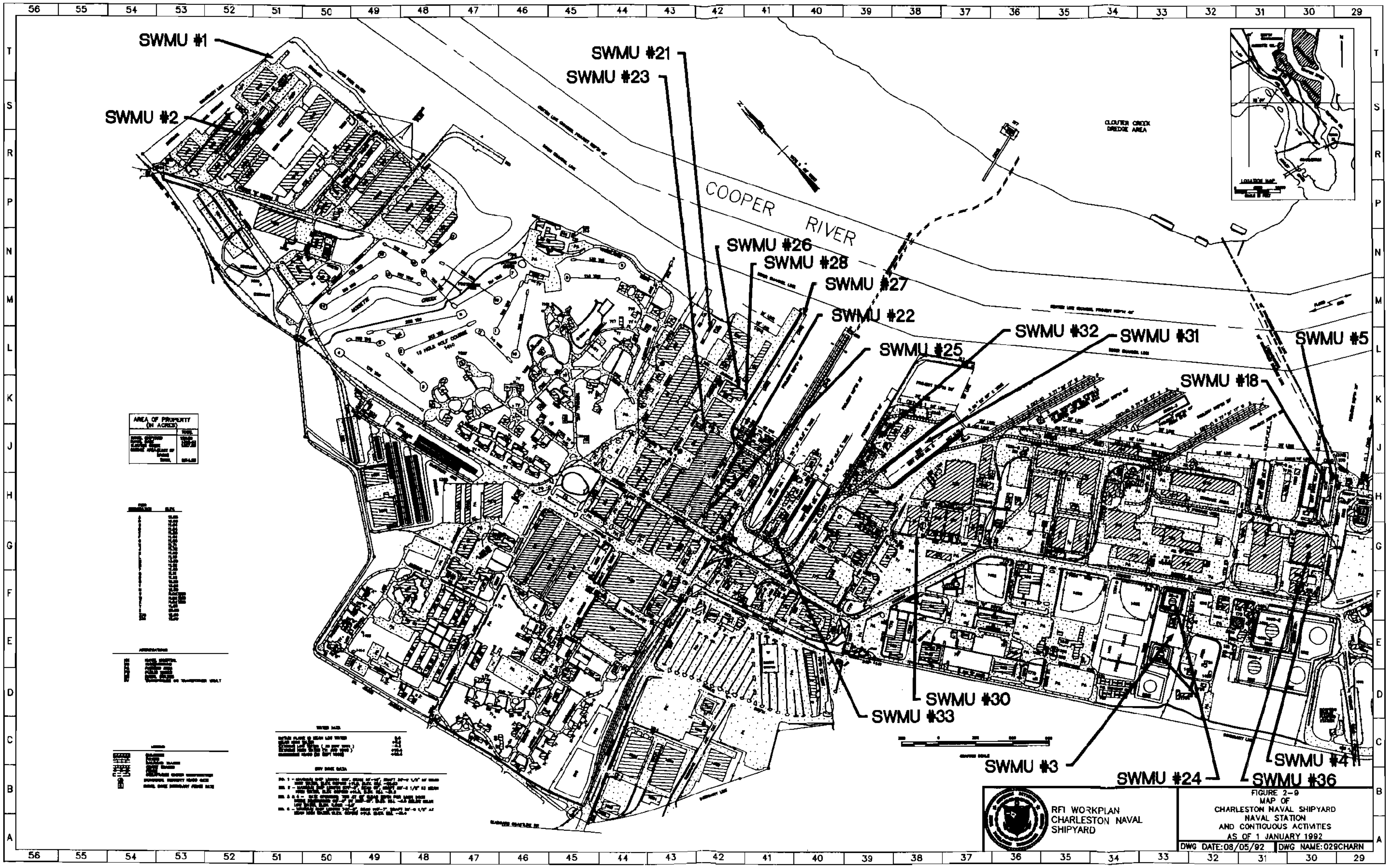
- **Hazardous Waste Storage Area Inspections**: All hazardous waste storage areas and satellite waste accumulation areas are inspected using the procedures described in the Zone Inspections section above. The primary goal at these sites is to ensure that hazardous wastes are properly stored for a time period not exceeding 90 days.

2.5 Nature and Extent of Contamination

There are a total of 36 SWMUs identified in the RFA (Ref. 2), SOUTHDIV's RFA Addendum (Ref. 14), and SOUTHDIV's RFA of Building 68 (Ref. 23). A list of the 36 SWMUs and their operational status is presented in Table 2-1 and the location of each is illustrated in Figures 2-9 and 2-10. Site and waste characteristics of each were described and explained accurately and in detail in the RFA reports (Refs. 2 and 14). The extent and magnitude of contamination from each SWMU were concisely summarized. Additional data, not available for the RFA, and data developed during attempted interim status closure of SWMUs #1, #5, #6, #21 and #22, are discussed in Refs. 4 to 7 and Ref. 16. Sumaries of the previous findings are incorporated into this RFI Work Plan.

2.6 SWMU Descriptions and Interim Corrective Measures

On 4 May 1990 EPA and DHEC issued NSY a RCRA permit which allowed storage of hazardous waste in containers in Building 246 and the DRMO-Building 1606. Consequently, as of 4 June 1990, interim status for all previous interim status facilities (SWMUs #1, #5, #6, #21 and #22) was terminated. The following sections describe each SWMU identified in the RFAs. Completed and ongoing interim corrective measures are also described for each unit. Closure work by EnSafe on SWMUs #1, #5, #6, #21, and #22 is summarized.


SWMU #1
SWMU #2
SWMU #21
SWMU #23
COOPER RIVER
SWMU #26
SWMU #28
SWMU #27
SWMU #22
SWMU #25
SWMU #32
SWMU #31
SWMU #5
SWMU #18
SWMU #30
SWMU #33
SWMU #3
SWMU #24
SWMU #4
SWMU #36
RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
FIGURE 2-9
MAP OF
CHARLESTON NAVAL SHIPYARD
NAVAL STATION
AND CONTIGUOUS ACTIVITIES
AS OF 1 JANUARY 1992
DWG DATE:08/05/92
DWG NAME:029CHARN

Early in this project, SWMUs #1, #5, #6, #21 and #22 were considered to be regulated units under interim status. (SWMUs #5 and #22 were later determined to be elementary neutralization or wastewater treatment units under 40 CFR §270.1(c)(2)(v), 270.2 and 260.10, and hence, not subject to Part 270 permitting requirements.) NSY did not seek to have these units covered by its Part B permit, but rather, attempted clean closure under interim status. Closure plans were developed by EnSafe and approved by DHEC.

Table 2-1
Solid Waste Management Units at Charleston Naval Shipyard

SWMU #1	DRMO Building 1617
SWMU #2	Lead Contaminated Area
SWMU #3	Pesticide Mixing Area
SWMU #4	Pesticide Storage Building
SWMU #5	Battery Electrolyte Treatment Area
SWMU #6	Public Works Storage Yard (Old Corral)
SWMU #7	PCB Transformer Storage Area
SWMU #8	Oil Sludge Pit Area
SWMU #9	Closed Landfill
SWMU #10	Hazardous Waste Storage Facility*
SWMU #11	Caustic Pond
SWMU #12	Old Fire Fighting Training Area
SWMU #13	Current Fire Fighting Training Area*
SWMU #14	Chemical Disposal Area
SWMU #15	Incinerator*
SWMU #16	Paint Storage Bunker
SWMU #17	Oil Spill Area
SWMU #18	PCB Spill Area
SWMU #19	Solid Waste Transfer Station*
SWMU #20	Waste Disposal Area*
SWMU #21	Old Paint Storage Area
SWMU #22	Old Plating Shop Waste Treatment System
SWMU #23	New Plating Shop WWTS*

Table 2-1
Solid Waste Management Units at Charleston Naval Shipyard

SWMU #24	Waste Oil Reclamation Facility*
SWMU #25	Building 44, Old Plating Operation
SWMU #26	Waste Storage Area, Building 64-40, Pier C
SWMU #27	Waste Storage Area, East End, Pier C*
SWMU #28	Waste Paint Storage Area, West End, Pier C
SWMU #29	Building X-10
SWMU #30	Satellite Accumulation Area, Building 13*
SWMU #31	Waste Paint Storage Area, Dry Dock No. 5
SWMU #32	Waste Paint Storage Area, Building 195
SWMU #33	Waste Paint Storage Area, West End, Dry Dock No.2
SWMU #34	MWR, SW of Building X-10
SWMU #35	Building X-12
SWMU #36	Building 68, Battery Shop*

* SWMUs which are still in use.

Implementation of the closure plans resulted in substantial clean up of the most significant contamination. Much of the difficulty in achieving clean closure developed from the way "clean" was defined. For the purposes of these closures, SCDHEC and NSY agreed to define "clean" as within some number of standard deviations of the mean background concentration. The number of standard deviations was set as equal to the Student's *t* value associated with a 95% confidence interval and with the degrees of freedom dependent on the number of background samples collected.

A number of difficulties occurred in using this definition. The most significant difficulty, in the context of this RFI Work plan, concerned determining mean background concentrations. The procedures used to establish background concentrations are presented in EnSafe's reports (Refs. 4 to 8). All five SWMUs are located on land composed of heterogeneous fill. Background samples could not be collected because there was no way to find identical strata sufficiently removed from the sites to preclude contamination. Samples analyzed as background came from soils which were chemically distinct from the SWMU soils.

"Background" pH and concentrations of barium, cadmium, chromium, nickel and silver were near the low end of the range typically found in uncontaminated soils. This lead to the erroneous conclusion that SWMU soils were contaminated when in fact the concentrations observed are typical for naturally occurring soils. Consequently, where soils were involved, clean closure could not be achieved.

A risk assessment and development of health-based soil cleanup goals was performed by Gradient Corporation in June of 1991 at the DRMO Storage Shed (SWMU #1) and the Public Works Storage Yard (SWMU #6, Ref. 16). To achieve clean closure for these two sites, the study assessed metals contamination at each site and developed target average soil concentrations for metals and a geometric mean concentration for lead. The risk assessment is currently in review at USEPA Region IV and South Carolina DHEC and has not been approved.

Because background conditions at CNSY may be difficult to determine (rendering clean up to background unfeasible), an alternative remediation goal will be established by a baseline risk assessment (BRA) based on direct soil exposures and/or soil to groundwater cross media transfer potential. The BRA will be performed for constituents of concern for each SWMU where contamination is present rather than addressing the CNSY as a whole. Where multiple contaminated SWMUs share common or overlapping boundaries, a BRA which addresses the group of SWMUs as a single area of concern will be developed.

Each of the five interim status units is a SWMU in the context of this RFI Work Plan and has been evaluated by standards consistent with those used on other SWMUs by NSY. By these standards, much, but not all, of the reported contamination at the interim status units can be due to the normal elemental composition of uncontaminated soil. Actual contamination exists in the following areas:

- The DRMO (SWMU #1) where lead concentrations exceed normal levels in the surficial strata. This is apparently due to migration from the adjacent lead bin #3 (SWMU #2). The NSY is currently seeking clean closure of this unit under the risk assessment performed by Gradient Corporation (Ref. 16).

- The battery electrolyte treatment area (SWMU #5) where substantial lead contamination has been detected in nearby soils. The horizontal and vertical extent of this contamination has not yet been determined.

- The public works storage yard (SWMU #6) contains three isolated areas near the surface of the ground containing slightly elevated lead levels. This unit is also currently being assessed for clean closure status under the risk assessment (Ref. 16).

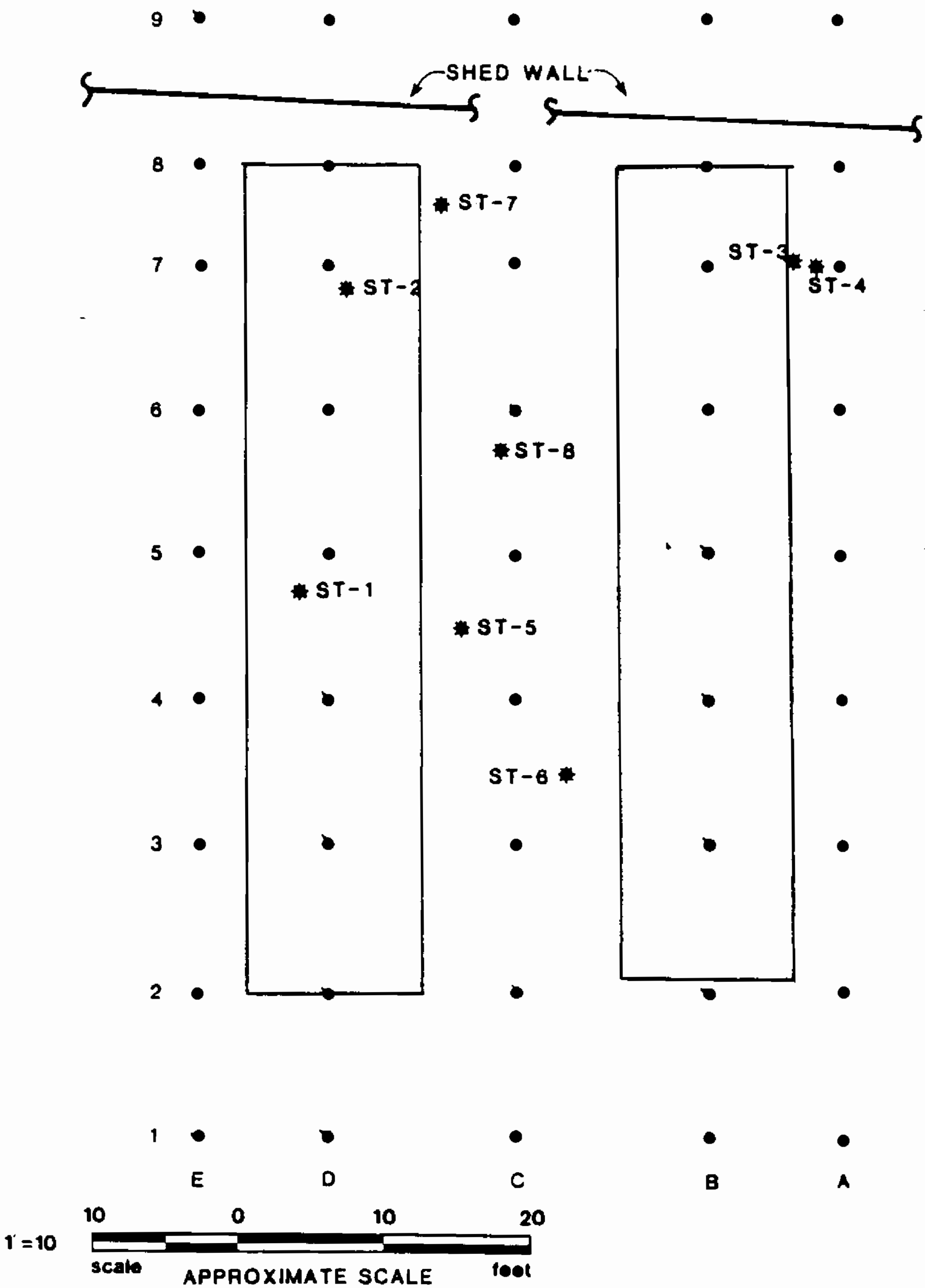
- The waste paint storage pad (SWMU #21) was approved for clean closure by EnSafe after samples of paint chips were collected, analyzed and reported as nonhazardous. An isolated spill and subsequent clean up activities that occurred in the same area sometime later is discussed in Section 2.6.21. However, the clean closure was not approved by DHEC since the soils and groundwater had not been characterized. Soil and groundwater from the surrounding area of this SWMU will require an additional investigation.
- Soils surrounding the old plating treatment system (SWMU #22) have an elevated pH and, in some places, elevated cadmium and chromium levels.

2.6.1 SWMU #1, DRMO Staging Area

This area has been used since 1974 by the Defense Reutilization and Marketing Office (DRMO) to store property. The property is no longer needed for its intended purpose and has been turned in to DRMO by various branches of the Armed Forces within the region of the Naval Base. The stored property handled by DRMO includes some products which cannot be reutilized by other commands and that have consequently become classified as wastes. Those which become hazardous wastes were stored until recently in a covered storage shed formerly known as Building #1617. The storage shed was a wood framed and roofed structure. Part of the floor consisted of an asphalt pad; the remainder of the floor was unpaved. Hazardous wastes were stored in containers and segregated according to waste type.

No spills at the site have been documented. EnSafe conducted two sample events to delineate contamination at the DRMO Storage Shed (Refs. 5 and 7). Fifty-three surface samples (0 to 6 inches) and 159 subsurface samples (1, 2, and 3 feet) were collected and analyzed. Figure 2-11 shows the sample locations at the DRMO Storage Shed and Appendix D presents the analytical data. Samples were assayed for site specific compounds which were known to have been stored at the site. This list of constituents which is presented in Table 2-2 included 20 volatile organic compounds, hydrazine, metals, and four hazardous waste characteristics parameters. Diethyl ether was the only organic compound detected with concentrations ranging as high as 75.8 μg/kg. Except for surface concentrations of lead, metals were detected in most of the samples were at very low concentrations. As presented in the previous section, EnSafe established values from background samples, based on the Student's t test, to determine threshold values for cleanup. Based on the threshold values, clean closure could not be achieved.

To determine what were acceptable concentrations of metals contamination in soils, the EPA's proposed action levels in the Federal Regulations (July 27, 1990 P.30798) were compared with the analytical results for metals in EnSafe's reports. Most of the concentrations of metals were well below the action levels proposed by the EPA except for surface samples ST-1 (barium, 4880 ppm) E8 (chromium, 436 ppm), and E1 (nickel, 2270 ppm). Lead and selenium concentrations are not presented in the proposed action levels. The selenium concentrations were below the level of detection and cleanup criteria for lead have not yet been established.



RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 2-11
DRMO STORAGE SHED
SAMPLE LOCATIONS
(FIGURE TAKEN FROM REF. 5)

DATE: 08/05/92 | DWG NAME: CNSY

Table 2-2
Parameters for Analysis*
Soil Contamination Assessment

GC/MS	METALS (TOTAL)	OTHER
Aminopyridine	Barium	Total cyanides
Carbon tetrachloride	Beryllium	Total sulfides
Chloroform	Cadmium	pH
Cresol	Chromium	Ignitability
Dichlorofluoromethane	Lead	
Diethyl ether	Mercury	
Ethylene dichloride	Nickel	
Ethylene oxide	Selenium	
Formaldehyde	Silver	
Methyl ethyl ketone		
Methyl isobutyl ketone		
Methylene chloride		
Pentachlorophenol		
Pyridine		
Toluene		
Trichloroethane		
Trichloroethylene		
Trichlorofluoroethane		
Trichlorofluoromethane		
Tetrachloroethylene		
Hydrazine		

Table taken from Reference 3

* Analytical methods for all parameters except hydrazine are specified in USEPA Publication SW-846; those methods will be followed. Method 625, specified at 40 CFR 136 under the Clean Water Act will be used for the analysis of hydrazine.

A review of the analytical data indicates that only the surface soils are contaminated. The area has become contaminated with lead dust which spread from nearby salvage bin #3 (SWMU #2). Although lead levels detected in soil samples exhibited a wide range of concentrations, significant concentrations are limited to the near surface (Refs. 4, 5, 6 and 10). The spread of lead dust resulted primarily from vehicular traffic during routine operations at the site. Wind-blown dust may also have contributed to the contamination.

The site was under interim status until DHEC issued the Final RCRA Permit to the NSY. Interim status for the DRMO and other SWMUs was therefore terminated on 4 June 1990.

In September of 1989, the inventory of containers was removed from this site and Building #1617 demolished. Empty drums, which have been triple rinsed, are now stored in this area.

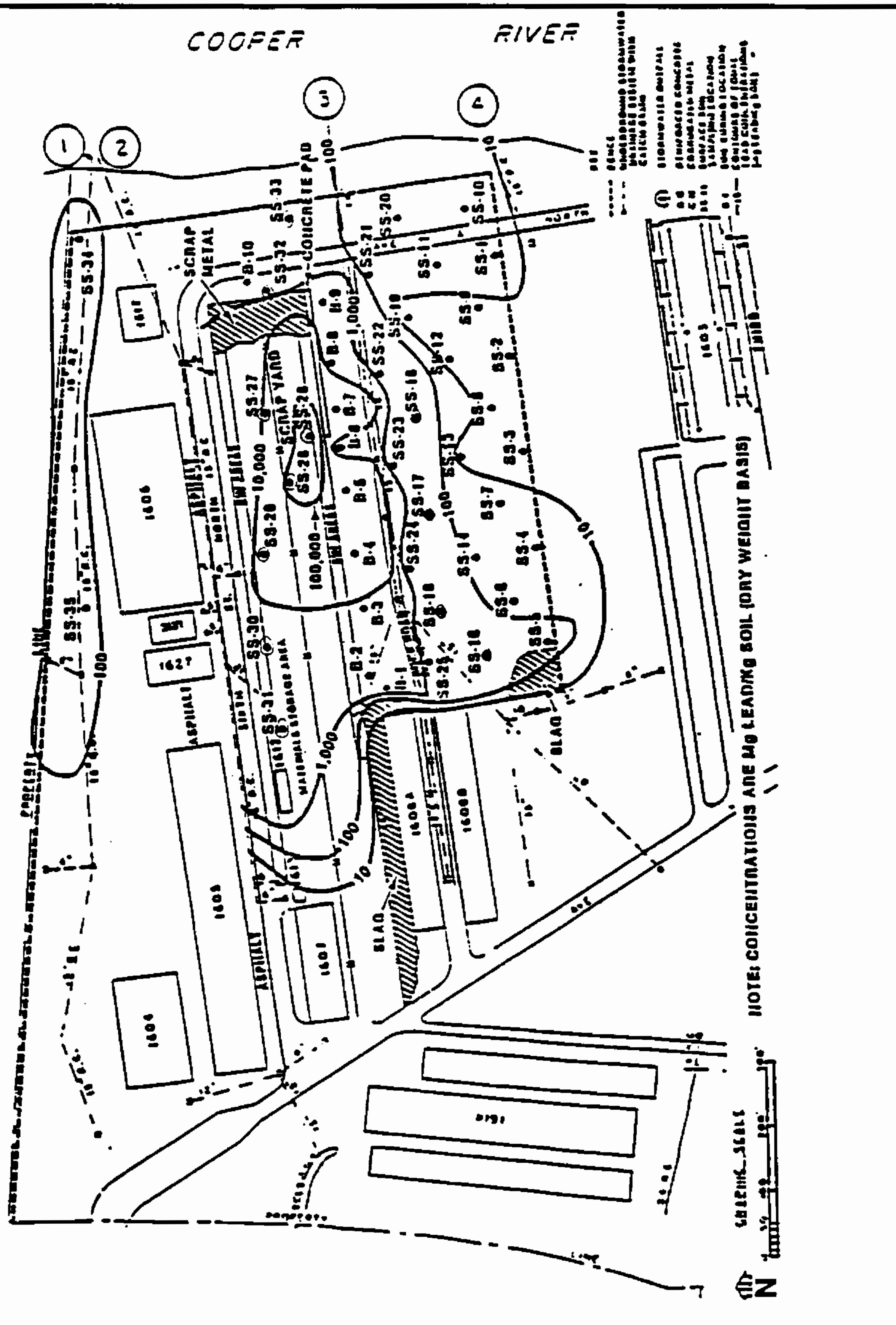
The DRMO is currently under review for clean closure based on the risk assessment (Ref. 16). A geometric mean soil lead level of 481.5 ppm has been proposed for lead at this site. However, this is a mean soil concentration and not referenced as a "not-to-be exceeded" concentration for this site.

The site has been extensively studied in connection with its closure. Because the only significant contamination of SWMU #1 is the lead which migrated from SWMU #2, it would be appropriate to address SWMU #1 as part of SWMU #2 under this RFI Work Plan.

2.6.2 SWMU #2, Lead Contamination Area

The lead contamination area consists of a salvage bin (#3) and adjacent paved ground surface. The area was used to store recovered lead from lead-acid submarine batteries from the mid-1960s until 1984. Electrodes and associated internal metallic components were removed from the battery jars in the battery electrolyte treatment area. Recovered materials were then placed on a railcar and transferred to the DRMO area for storage and eventual sale to a salvage contractor. Lead dust from the recovered materials was released to the salvage bin by handling. Routine activities (vehicular traffic) in the DRMO yard area and natural processes (such as wind and stormwater flow) caused spreading of the lead contamination into an area which eventually encompassed approximately six acres. Extensive studies of soil and groundwater in the area have delineated the extent of lead contamination at the site (Refs. 10 and 11). A soil sampling investigation was conducted during the Contamination and Exposure Assessment for the lead contamination within DRMO. Seventy-one soil samples were collected from the DRMO site; 35 samples consisted of surficial soils (surface to 0.5 feet depth) and the remaining 36 samples were collected at various depth intervals from 10 individual soil borings (total depths of 7.5 to 10 feet below surface). The surficial soil samples were collected across a grid pattern to characterize the areal extent of lead contamination and the soil boring samples were collected to yield information on the extent to which lead had penetrated (migrated) vertically in the soils (Ref. 10). The locations of the soil sampling points in the DRMO Area are shown in Figure 2-12 and analytical results for the surficial soils are given in Table 2-3.

Lead concentrations in surficial soils vary widely, from less than 1.3 to 371,000 mg of lead per kg of soil. The lead data in Table 2-3 were plotted on a site map (Figure 2-12) to show the areal distribution of the lead contamination and to facilitate estimation of the area of contamination. As shown, lead concentrations are greatest in the area adjacent to and in front (north) of the former battery storage bin (sampling location Nos. SS26 to SS31). Lead concentrations decrease to background levels (10 to 100 mg/kg) over a distance of several hundred feet south of the bin area. The current activity (vehicles, etc.) in the materials storage area north of the bin has apparently spread the lead contaminated soil over a large area. The area encompassed by the 1,000 mg/kg isopleth shown in Figure 2-12 is estimated at six acres. Additionally, stormwater runoff of contaminated soil from the immediate vicinity of the former storage bin has spread the lead contamination along a surface drainage way located immediately south of the bin area and toward the stormwater catch basin at the eastern end of Building 1608A.



RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 2-12
SWMU #2
SURFACE SOIL LEAD
CONCENTRATION ISOPLETHS
(FIGURE TAKEN FROM REF. 10)

DATE: 08/05/92

DWG NAME: CNSY

Soil borings were made in order to characterize the vertical extent of lead contamination in the soils. The results of lead analysis of the soil boring samples show the lead contamination is principally confined to the surface soils (surface to 0.5 feet) (Ref. 10). The lead concentration for each sample depth interval averaged over all 10 soil borings is as follows:

Depth Interval	Lead Concentration (mg/kg)
Surface to 0.5 feet	16,103
3 to 4.5 feet	255
6 to 7.5 feet	274
8.5 to 10 feet	509

Detailed and specific analytical results were not available for preparation of this Work Plan. These summary results indicate that, while there are very high lead levels in the surficial soils, the lead apparently is not migrating vertically through the soil column. Due to its ionic nature, lead is strongly adsorbed to soils, especially soils exhibiting a high clay content (Ref. 10).

EP Toxicity tests were conducted on two soil samples with the highest total lead concentrations. The leachate produced from the testing contained lead levels above the regulatory limit of 5 mg/l. The soils in this area are, therefore, characterized as hazardous waste.

Ambient air sampling was conducted during the contamination and exposure assessment for lead contamination within DRMO. Samples were taken outdoors, in the materials storage shed area, and indoors, within seven buildings located within the DRMO site. The results of the ambient air sampling are given in Table 2-4. The lead concentrations are expressed in units of micrograms of lead per cubic meter of air. As shown by the data in Table 2-4, the measured ambient air lead levels did not exceed OSHA, NIOSH, or ACGIH recommended occupational criteria (30 to 50 $\mu g/m^3$). One outdoor Hi-Vol sample (HVD2-1) did exhibit a lead level (2

Table 2-3
Lead Concentrations in Surficial Soil
(surface to 0.5 ft.)
DRMO Area

SAMPLE MATRIX	SOIL SAMPLING LOCATION	LEAD CONCENTRATION (mg lead/kg soil)*
Surficial Soil	SS1	69.2
Surficial Soil	SS2	2.72
Surficial Soil	SS3	<1.3
Surficial Soil	SS4	28.5
Surficial Soil	SS5	137
Surficial Soil	SS6	<1.3
Surficial Soil	SS7	20.7
Surficial Soil	SS8	6.70
Surficial Soil	SS9	8.17
Surficial Soil	SS10	68.7
Surficial Soil	SS11	126
Surficial Soil	SS12	<1.3
Surficial Soil	SS13	<1.3
Surficial Soil	SS14	43
Surficial Soil	SS15	371
Surficial Soil	SS16	286
Surficial Soil	SS17	266
Surficial Soil	SS18	424
Surficial Soil	SS19	<1.3
Surficial Soil	SS20	40.4
Surficial Soil	SS21	54
Surficial Soil	SS22	328
Surficial Soil	SS23	717
Surficial Soil	SS24	488
Surficial Soil	SS25	32.7
Surficial Soil	SS26	371,000
Surficial Soil	SS27	10,500
Surficial Soil	SS28	107,000

Table 2-3 **Lead Concentrations in Surficial Soil** **(surface to 0.5 ft.)** **DRMO Area**		
SAMPLE MATRIX	**SOIL SAMPLING LOCATION**	**LEAD CONCENTRATION (mg lead/kg soil)***
Surficial Soil	SS29	1260
Surfacial Soil	SS30	9320
Surficial Soil	SS31	2810
Surficial Soil	SS32	907
Surficial Soil	SS33	298
Surficial Soil	SS34	533
Surficial Soil	SS35	411

Table taken from Reference 10
* Dry-weight basis

Table 2-4
Lead Concentrations in
Indoor and Outdoor Ambient Air
DRMO Area

SAMPLE MATRIX	SAMPLE NO.	LEAD CONCENTRATION (ug/m^3)
Outside-Air	HVD1-1	<1
Outside-Air	HVD1-2	<1
Outside-Air	HVD2-1	2
Outside-Air	HVD2-2	1
Building-Air	AA1606 (office)	<20
Building-Air	AA1606 (warehouse)	<20
Building-Air	AA1607	<20
Building-Air	AA1608A	<20
Building-Air	AA1612	<20
Building-Air	AA1613	<20
Building-Air	AA1627	<20
Building-Air	AA2521	<20

Table taken from Reference 10

$\mu g/m^3$) slightly above the National Ambient Air Quality Standard (1.5 $\mu g/m^3$). Apparently, lead contaminated dust is being dispersed from the primary contamination source (bin #3) and is accumulating in dust in the adjacent buildings. The levels in the air, however, were (at the time of sampling) within occupational criteria (Ref. 10).

High lead levels in the surficial soils warrant an extended site investigation for this SWMU under the RFI Work Plan. Data gaps in characterizing stormwater runoff, river sediments, and groundwater are addressed in Section 3.7 of the RFI Work Plan.

2.6.3 SWMU #3, Pesticide Mixing Area

The pesticide mixing area was a concrete slab approximately 50 feet by 25 feet in size that was located southwest of and adjacent to the dike which surrounds Tank 39-D of the waste oil reclamation facility. Part of the area (approximately 20 square yards) surrounding the slab was devoid of vegetation when the Confirmation Study was conducted in 1982. However, the bare area was subject to substantial vehicular traffic. This slab has since been removed and Building 249 constructed on top of part of the area of concern. The area which was once denuded is now covered with grass and adjacent to the northwest wall of Building 249. Prior to 1971, pesticides were mixed in a small shed (Building 42-A) south of the denuded area. It was reported that equipment used for spraying and mixing of pesticides was rinsed on the grounds outside. Rinsate was allowed to drain into the soils.

During the Confirmation Study conducted at NSY, water quality analyses were performed at the Pesticide Mixing Area. Water samples were collected from monitoring wells WPA-1 and WPA-2 (Figure 2-13) to determine whether past practices of pesticide mixing and equipment rinsing had affected the shallow groundwater. The samples were analyzed for pesticides, herbicides, PCBs, and arsenic. The laboratory results, which are presented in Appendix E, show that the concentrations of all of the above parameters were below method detection limits and that the pH of the groundwater is approximately six (Ref. 12). A soil sampling program was conducted

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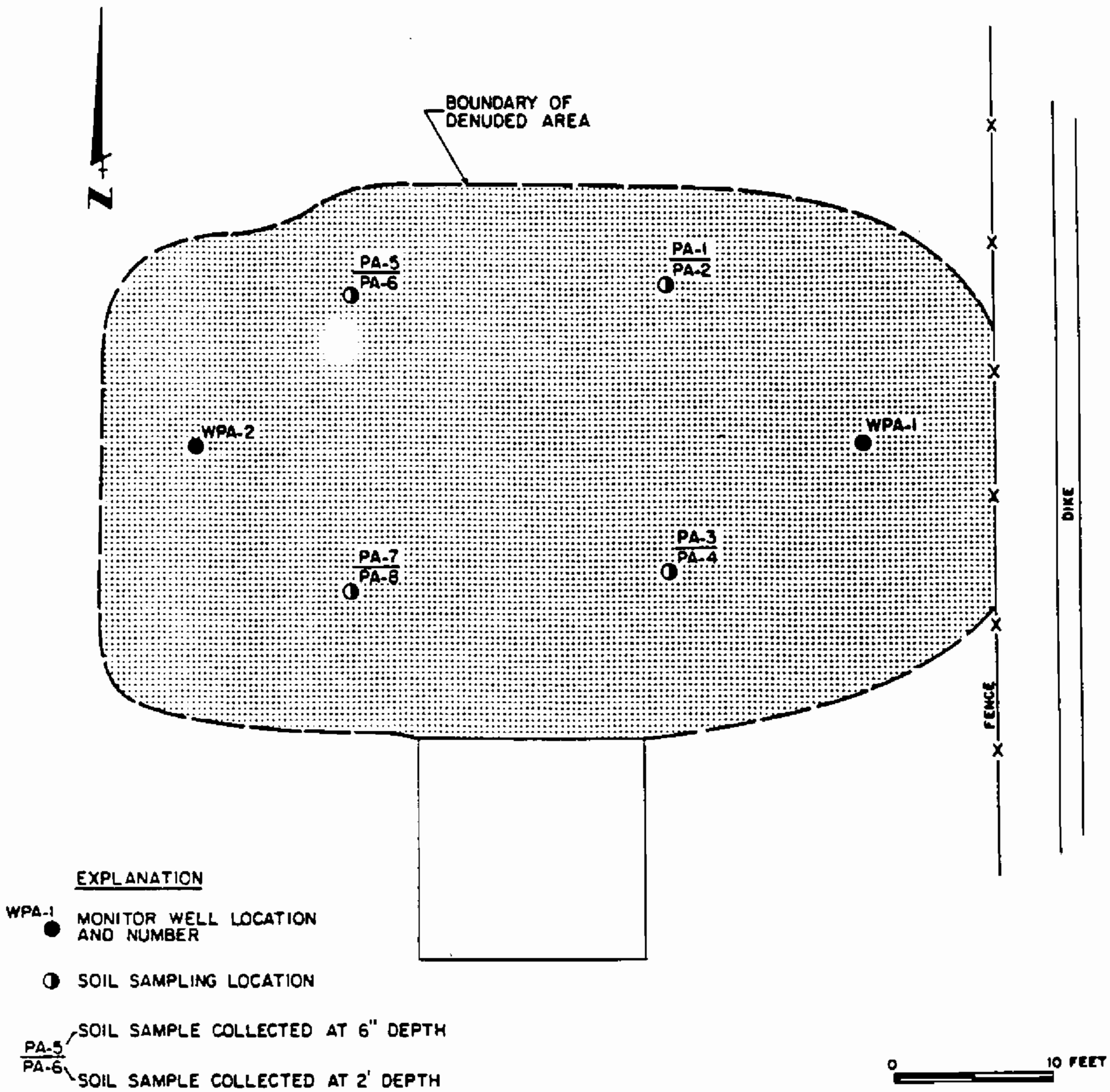


RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 2-13
SWMU #3
MONITORING WELL AND SOIL SAMPLE LOCATIONS
(FIGURE TAKEN FROM REF. 12)

DATE: 08/05/92 | DWG NAME: CNSY

at the pesticide mixing area in February 1982 and the area was found to be contaminated with low concentrations of various pesticides (and associated degradation products) which were handled at the site in the past. Table 2-5 lists pesticides used at the NSY. Eight samples were collected at the four locations shown in Figure 2-13 and analyzed for arsenic, herbicides, pesticides, and PCBs. The results of the analyses are presented in Appendix E. Odd numbered samples were collected at a depth of 6 inches, and even numbered samples were collected at a depth of 2 feet.

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

The eight soil samples were each analyzed for 18 pesticides, and up to six pesticides were detected. Three of the six pesticides are interrelated in that DDD and DDE are metabolites of DDT and are formed during the biodegradation of DDT. The fact that these were found in all eight samples is significant since DDT has not been in general use for about 15 years; therefore, they represent compounds that may have been present in the soil for a long period of time. Three other pesticides were found in samples PA-3 and PA-7, including heptachlor, beta BHC, and delta BHC.

Table 2-5
Pesticides Used at Navbase Charleston

ITEM	PERCENT
Insecticides (Bldg. 381)	
Carbaryl	80 percent WP
Chlordane	72 percent EC
Diazinon	47.5 percent EC
Dichlorvos	5 percent
Dimethoate (Cygon)	23.4 percent EC
Dursban	41.2 percent EC
Malathion	57 percent EC
Malathion	95 percent
Propoxur (Bayfon)	2 percent
Propoxur (Baygon)	15.9 percent EC
Pyrenthrin	6 percent
Pyrenthrin	3 percent
Pentokel	
Repellant	71 percent (2-oz. bottles)
Rodenticides (Bldg. 381)	
Anticogaulant	5 percent
Anticoagulant	3 percent
Calcium cyanide	42 percent
Zinc phosphide	80 percent
Herbicides (Bldg. 1316)	
Bromacil	80 percent WP
Dalapon	85 percent
Diquat	35.3 percent EC
Spike	
2,4-D	4 lb/gal
2,4,5-T	6 lb/gal

Table taken from Reference 9

WP = Wettable Power
llb = Pounds
EC = Emulsifiable Concentrate
gal = gallons
oz = ounce
lb/gal = pounds per gallon

The eight soil samples were also analyzed for seven PCB compounds, and six of the samples were found to contain one of these compounds, Aroclor 1260.

In May 1982, personnel from the Navy collected two samples of the uppermost soil within the pesticide mixing area. The results of 1.48 $\mu g/g$ and 5.3 $\mu g/g$ (Appendix E) indicate that the greatest concentration of DDT in the soil is in shallow surface soils. These data, along with the previous data collected at the pesticide mixing area, show that the concentration of DDT in the soil is highest at land surface and decreases rapidly with depth (Ref. 12). The only contaminants of concern are arsenic and DDT. The actions levels established in the Federal Register (Appendix C) for arsenic is 80 ppm and DDT is 3 ppm. The maximum concentration for arsenic 5.3 ppm is well below the action level. DDT and its metabolites (DDD and DDE) were assayed in 11 soil samples and two water samples.

Only one DDT grab sample collected from the surface (0-2 inches) had a concentration of 5.3 ppm, exceeding the action level. All other samples collected were below 1 ppm. Residual pesticide concentrations in the soil are low and slightly exceed the action level. Also, no contaminants were detected in the groundwater samples.

2.6.4 SWMU #4, Pesticide Storage Building

The pesticide storage building has been used to store various insecticides and rodenticides since 1980. It is a steel building with a concrete floor. The building is equipped with a formulation and mixing room. Sink and floor drains within the building are connected to the sanitary sewer system or to blind sumps (sumps with no outlets). An equipment rinse area/wash rack is located adjacent to the storage administration facility. No evidence of contamination was found or has been reported for this site.

2.6.5 SWMU #5, Battery Electrolyte Treatment Area

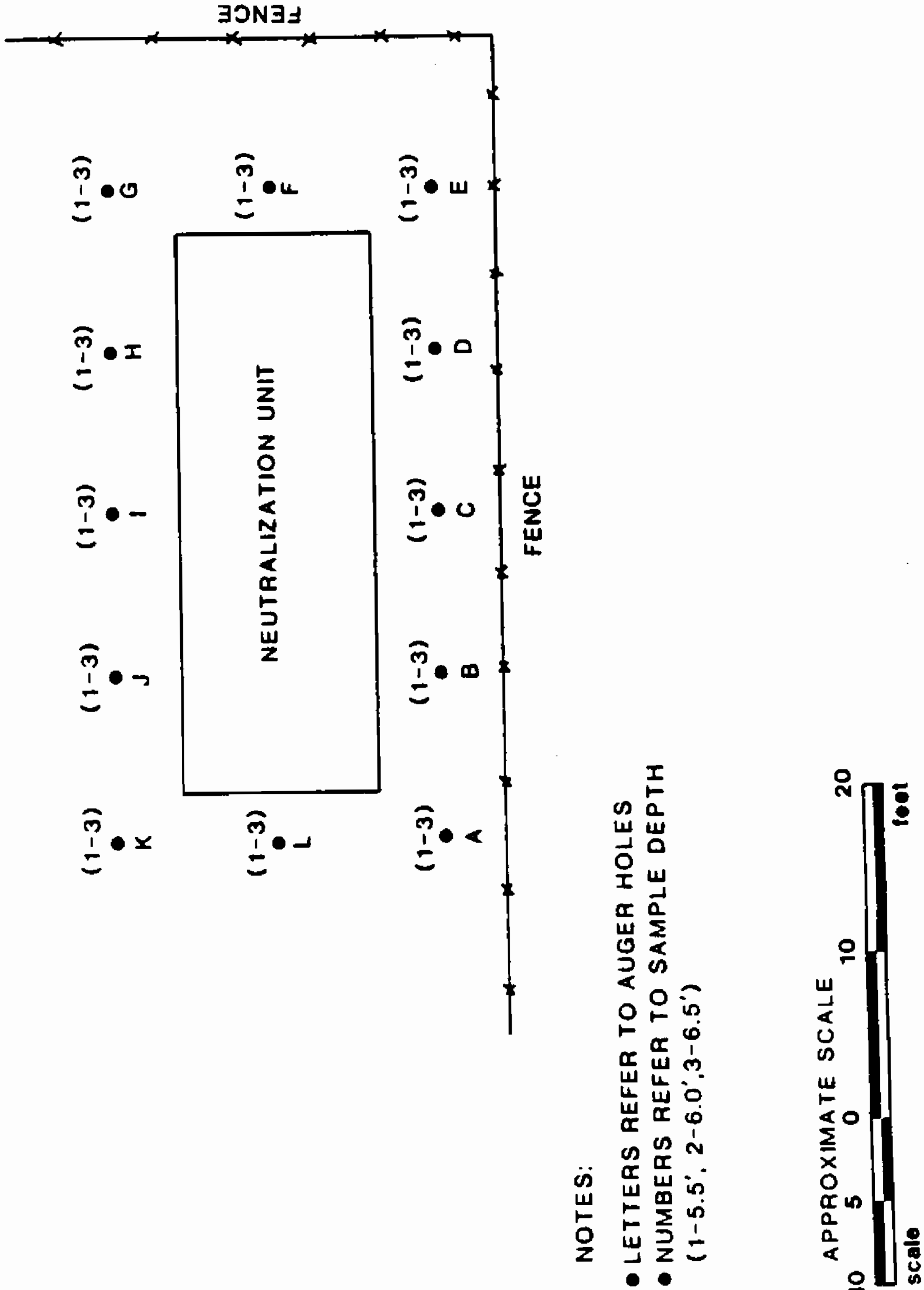
The battery electrolyte treatment unit was part of the battery salvaging, restoring, and recharging operation. It was the unit used for neutralization of submarine battery acid. Current used battery management practices at NSY are limited to shipment of intact batteries offsite for salvage.

The battery electrolyte treatment tank is not required to undergo closure pursuant to 40 CFR Part 265, Subpart G since it was not a regulated unit. It discharged to a Publicly Owned Treatment Works (POTW). However, the battery electrolyte treatment area (soils surrounding the tank) will be included in the RFI since interim status was terminated. Final closure activities for this area will include remediation of contaminated soils.

EnSafe performed a subsurface investigation and tank decontamination in October of 1987. Twelve sample stations were hand augered around the perimeter, to a depth corresponding to that of the floor of the treatment unit (5.5 feet below ground surface). Figure 2-14 shows the soil sample locations. Three vertically successive, 6-inch soil samples were collected from the base of each auger hole, analyzed, and found to contain elevated levels of lead. Results of the analyses are presented in Table 2-6.

Originally, the lead levels were evaluated with the threshold values established by EnSafe from background samples using statistical procedures (Student's *t* test) to determine if the unit could be clean closed. Cleanup levels for lead have not been established under the proposed EPA action levels, nor has a cleanup standard for lead been approved by EPA Region IV. However, high lead concentrations warrant further investigation of soil and groundwater.

The prior investigations in this area focused primarily on the soil adjacent to the treatment tank. To remediate this SWMU and avoid possible recontamination, additional delineation of the surrounding area will be required. In addition, the area identified during the DHEC and EPA



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 2-14
BATTERY ELECTROLYTE NEUTRALIZATION UNIT SAMPLING STATIONS
(FIGURE TAKEN FROM REF. 5)

DATE: 08/05/92 | DWG NAME: CNSY

Table 2-6
Evaluation of Soil Contamination
Battery Electrolyte Treatment Unit
Lead (ppm)

THRESHOLD	146.92	146.92	146.92
STATION	**LEVEL 1***	**LEVEL 2**	**LEVEL 3**
A	241.0 X	222.0 X	253.0 X
B	468.0 X	534.0 X	1056.0 X
C	131.0	91.0	130.0
D	322.0 X	246.0 X	255.0 X
E	386.0 X	245.0 X	477.0 X
F	488.0 X	356.0 X	483.0 X
G	21722.0 X	1629.0 X	150.0 X
H	195.0 X	367.0 X	204.0 X
I	233.0 X	254.0 X	157.0 X
J	211.0 X	304.0 X	424.0 X
K	382.0 X	50.4	106.0
L	502.0 X	856.0 X	847.0 X

Table taken from Reference 5
* Level 1 is at elevation of bottom of tank foundation
X designates results exceeding threshold values

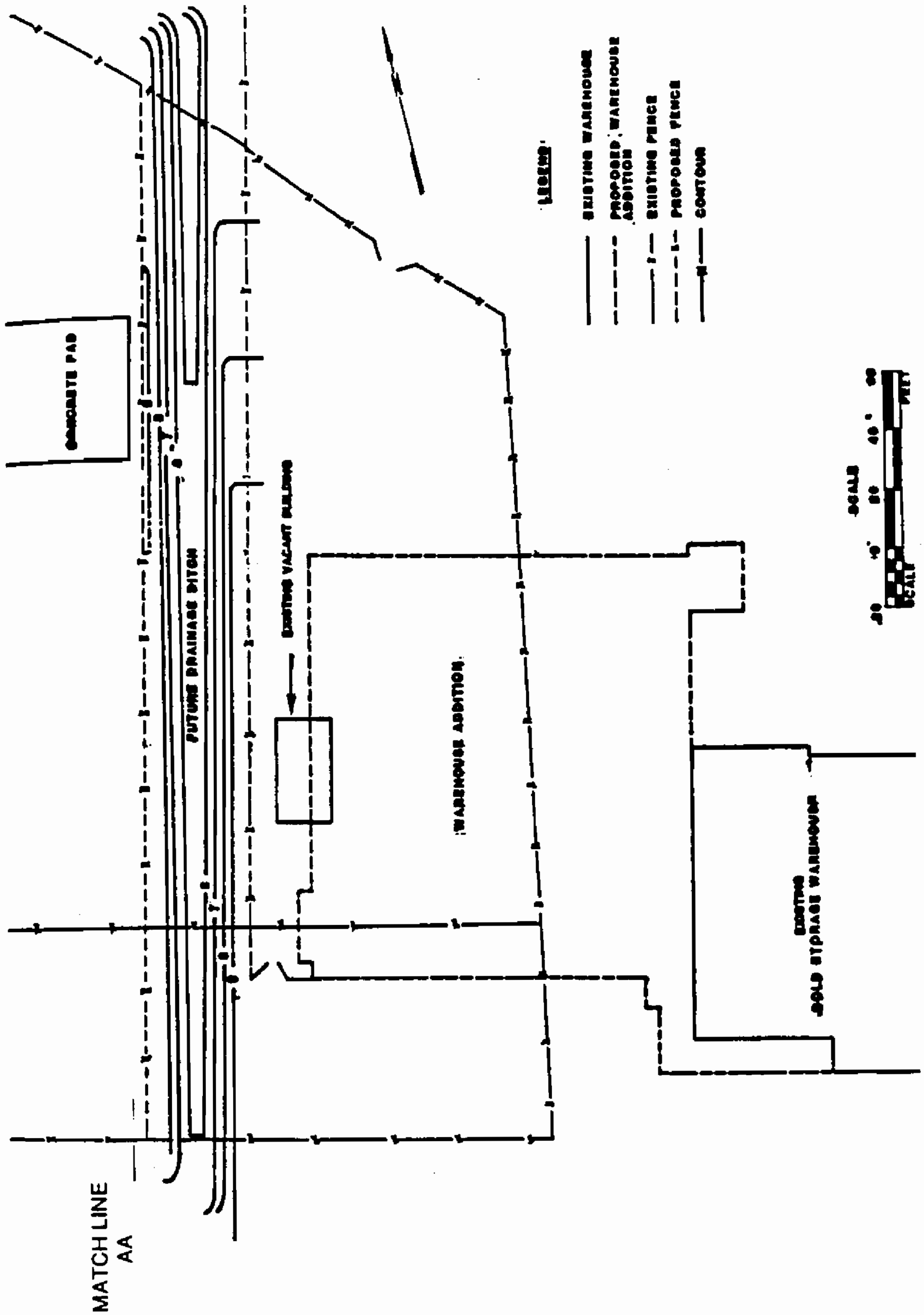
site inspection, where a leaking drum labelled "sulfuric acid" was observed, will be part of the study area. For the purposes of this Work Plan, SWMU #5 is being redefined to include the entire fenced compound within which battery wrecking activities occurred.

During the subsurface investigation, the interior of the tank was decontaminated. Observations as to the integrity of the tank with respect to groundwater infiltration were made over a period of several days. No leakage into the tank had occurred.

2.6.6 SWMU #6, Public Works Storage Yard

The Public Works storage yard, also known as the "old corral area," is a fenced open area where routinely generated, containerized wastes were stored prior to shipment offsite. Among the wastes stored at the site were hazardous wastes generated from vehicle maintenance, building maintenance and pest control operations. Wastes generated by vehicle maintenance consisted of cleaning solvents and waste oil. Spent solvents were disposed of by a contractor. Waste oils were recycled through NSY's waste oil reclamation facility. Building maintenance operations generated paint waste which was disposed of by a contractor along with waste from the paint shop. The storage yard ceased operation as a hazardous waste storage area when construction of the new temporary hazardous waste storage and transfer facility was completed.

A partial closure of this unit was completed in 1986 when a renovation and expansion of the cold storage warehouse (Building #193) was extended into the eastern boundary of the public works storage yard (Figure 2-15). A soil sampling program was completed in March 1986 as part of the requirements for the closure of this unit. Because of the wide variety of hazardous wastes stored within the compound during interim status, it was necessary to perform a screening analysis of each soil sample to identify any contaminants present and to define the extent of soil contamination. Table 2-2 presents the extensive list of compounds analyzed for during the March 1986 sampling event. The soil sampling program is described in the NSY Closure Plans for Interim Status Facilities dated May 27, 1986 (Ref. 3). Results of the analyses indicate that soils in the Public Works Storage Yard are contaminated with metals including barium, cadmium, chromium and lead. Concentrations of PCBs were found to be less than 1 ppm. Results of the soil sampling programs conducted both prior to and subsequent to partial closure activities are presented in Appendix F. Appendix F also contains site sketches of the sampling locations.



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 2-15
PUBLIC WORKS STORAGE YARD
CONSTRUCTION-AFFECTED PORTION
(FIGURE TAKEN FROM REF. 3)

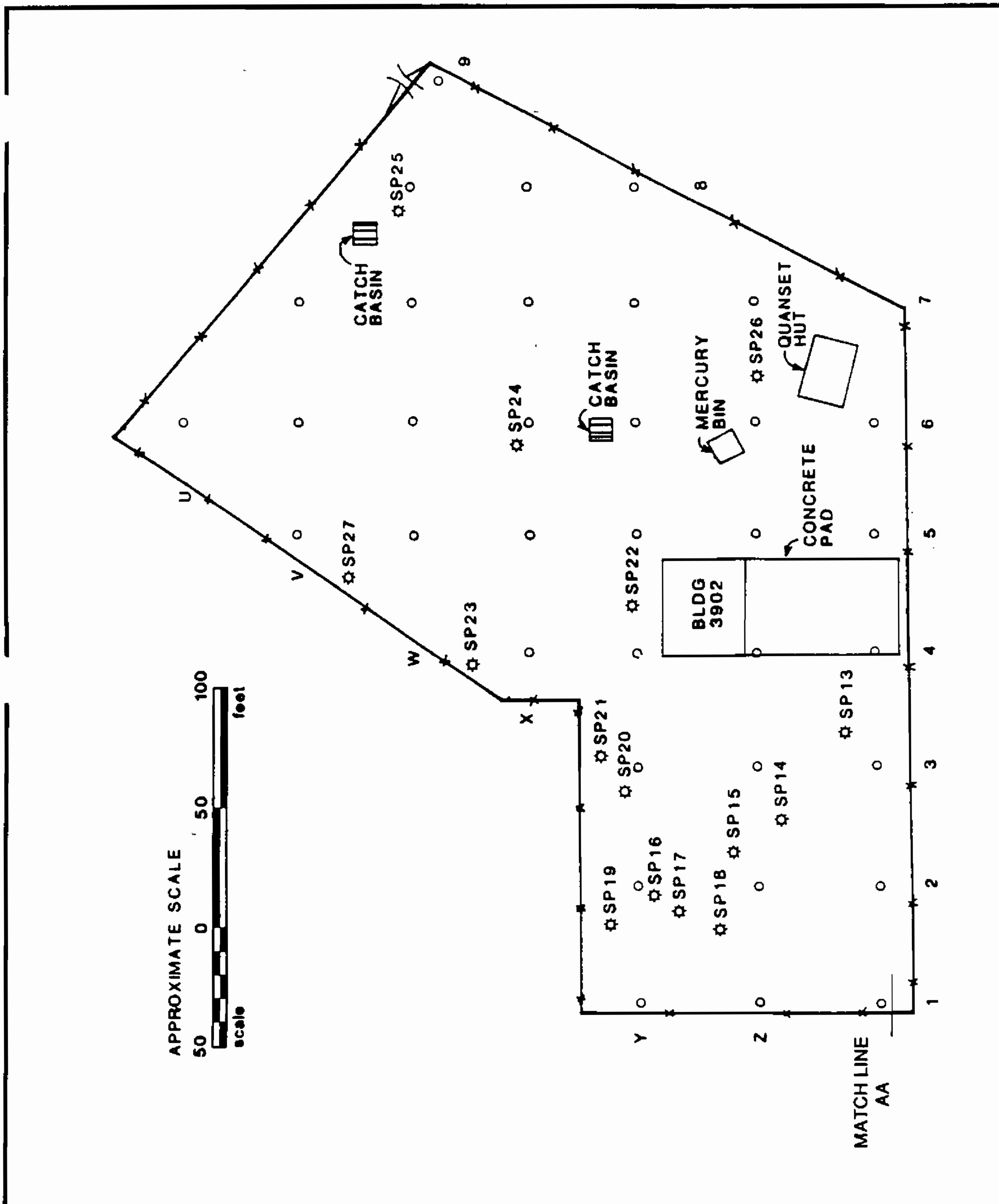
DATE: 08/05/92

DWG NAME: CNSY

Final closure activities in the remaining portion of this unit consisted of removing the final inventory of drums and material, and excavation of any residual contaminated soils. EnSafe implemented a subsurface investigation in 1987. Samples were collected on a 50-foot grid system and areas of obvious staining were independently sampled. The grid system is illustrated in Figure 2-16. Thirty-six sample points were established for sample collection from surface to 6 inches. The new grid system is an extension of the grid established during partial closure of the southern portion of the Public Works Storage Yard. Row AA duplicates row A from the original grid. The soil along row AA was excavated and backfilled during partial closure activities. An investigation by Southern Division and EnSafe representatives identified 15 additional stained areas or areas of suspected spills and leaks (SP-13 to SP-27). The analytical results for samples collected for the final closure activities are also presented in Appendix F as EnSafe's Table 3, "Evaluation of Soil Contamination Public Works Storage Yard." The threshold values for background samples are presented with the metals data. The background samples are identified by the prefix "BK" and were collected from three residential areas within the NSY.

A supplemental sampling phase was added to further define the vertical extent of contamination in subsurface soils to a depth of three feet. Supplemental samples were collected at 1-, 2- and 3-foot intervals, at the 51 stations exhibiting any contamination in the prior surface sampling investigation. The supplemental samples were analyzed for pH and each metal exceeding the threshold limit in surface samples. At 9 of the 51 stations, at least one constituent exceeded the threshold value. Results of this supplemental soil sampling program are also presented in Appendix F along with a figure illustrating sample locations.

In summary, based upon the considerable amount of soil analytical data available from previous sampling events, three limited areas of elevated lead levels were identified (Figure 2-16). The data suggest that contamination attenuated within the upper 3 feet of soils. Please note that the data were previously analyzed in terms of threshold levels.



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 2-16
PUBLIC WORKS STORAGE YARD
SAMPLING STATIONS
(FIGURE TAKEN FROM REF. 5)

DATE: 08/05/92

DWG NAME: CNSY

This unit was undergoing closure under interim status until the RCRA permit was issued on 4 June 1990. Currently, the Public Works Storage Yard has been investigated under a risk assessment (Ref. 16). Approval of the risk assessment by the USEPA and South Carolina DHEC will determine if the soils can be clean closed. However, groundwater has not been characterized for this site. The RFI Work Plan will address the data gaps by characterizing the hydrogeology of this site and determining if groundwater is contaminated.

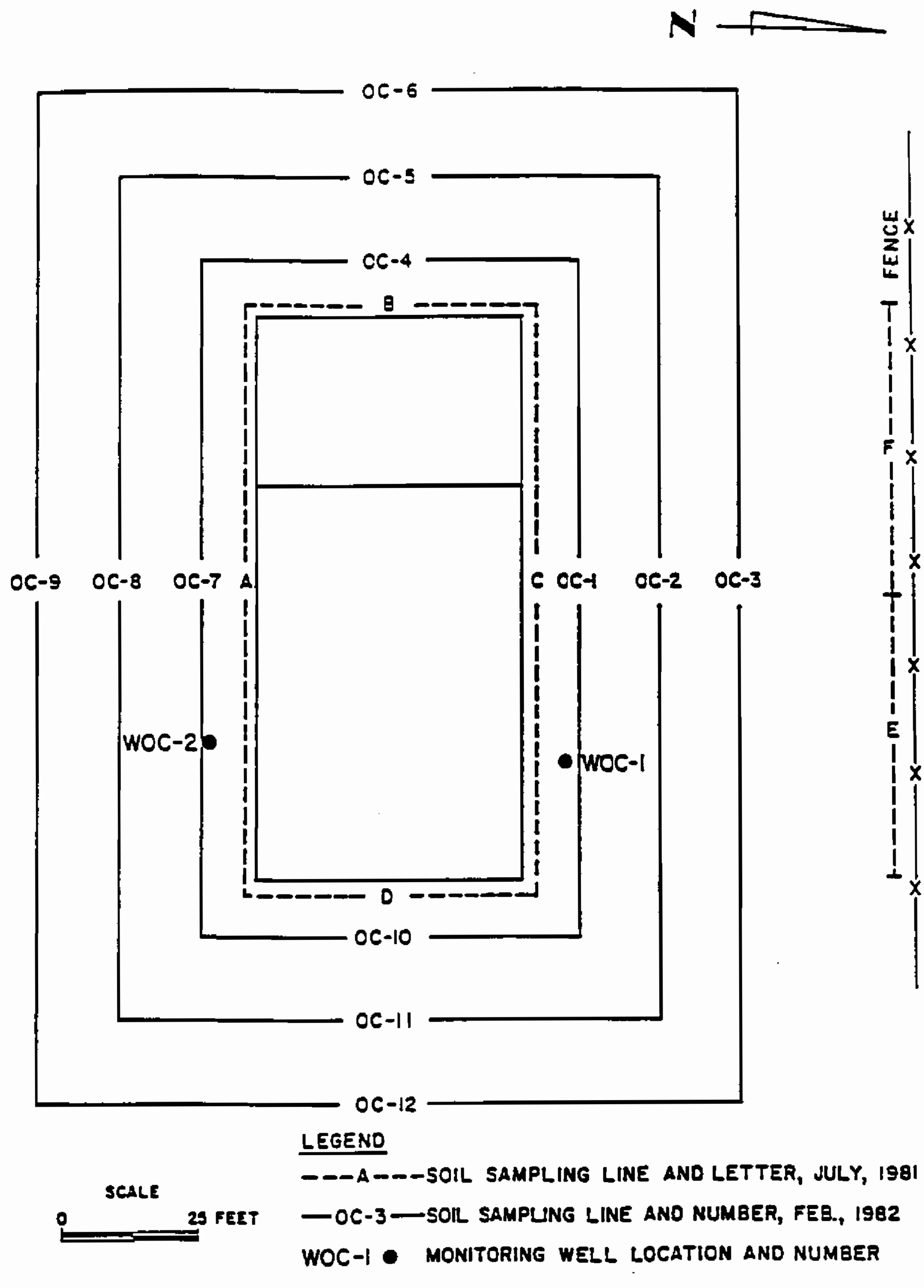
2.6.7 SWMU #7, PCB Transformer Storage Area

The PCB Transformer Storage Area consists of Building 3902 located within the Public Works Storage Yard, the adjacent concrete slab located outside the building, and surrounding areas that were used for storage of transformers and associated electrical equipment. Transformers no longer in service were brought to the concrete pad on the south side of the building prior to transportation off base between 1970 and 1976. Transformers were either sold intact or drained near the concrete pad prior to sale. The area around this concrete pad shows evidence of previous oil spills. The total amount of PCBs released to the soil and the concentrations in particular areas have not been adequately characterized. Transformers have been stored in a new hazardous waste storage and transfer facility since 1986. The site is abandoned with no material storage or activity in the area. The building is locked and a perimeter fence restricts access into the area.

The site was sampled in 1981 and 1982 to determine the presence of contaminants in soil and groundwater. As part of the Confirmation Study two groundwater monitoring wells (WOC-1 and WOC-2) were installed during 1982. The wells were installed to determine whether groundwater quality in the uppermost aquifer has been impacted by previous site activities. Water samples were analyzed for arsenic, pesticides, and PCBs (Appendix G). Water from well WOC-1 contained 19 μg/l of arsenic, 0.2 μg/l of DDT, and 0.2 μg/l of PCB (Aroclor 1260). Water from well WOC-2 contained 13 μg/l of arsenic, 0.1 μg/l of DDT, 1 μg/l each of alpha, beta, and gamma benzene hexachloride (BHC) and 0.6 μg/l of PCB (Aroclor 1260).

During the Confirmation Study, a soil sampling program was also conducted to determine the effects of past storage practices in the area. The sampling program was carried out in two phases. The first phase, conducted in July of 1981, consisted of collecting composite samples along lines running parallel to the sides of Building 3902 and the attached concrete slab (Figure 2-17). Four composite samples, A through D, were collected at a depth of 6 inches, one from each side of the building.

The second sampling phase was conducted in February 1982 to better define the horizontal distribution of PCBs in the soil. Composite soil samples, OC-1 through OC-12, were collected on sampling lines paralleling each side of the building and attached slab at distances of 10 ft, 25 feet, and 40 feet away from the building and slab (Figure 2-17). As in Phase I, these samples were collected every 3 feet at a depth of 6 inches. Twelve composite soil samples, OC-1 through OC-12, were collected in the electrical transformer storage area during Phase II. These samples were analyzed for pesticide content, PCBs, and arsenic (Appendix G). The pesticide and PCB results are presented in Table 2-7.



LEGEND

---A---SOIL SAMPLING LINE AND LETTER, JULY, 1981

—OC-3—SOIL SAMPLING LINE AND NUMBER, FEB., 1982

WOC-1 ● MONITORING WELL LOCATION AND NUMBER

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SHIPYARD
CHARLESTON, S.C.

FIGURE 2-17
SWMU #7
MONITORING WELL AND
SOIL SAMPLE LOCATIONS
(FIGURE TAKEN FROM REF. 12)

DATE: 08/05/92 | DWG NAME: CNSY

Table 2-7
Concentration of PCBs and Pesticides
Electrical Transformer Storage Area

SOIL SAMPLES	PCB µg/gm	PESTICIDES µg/gm
A	<10	—
B	<10	—
C	<10	—
D	<10	—
OC-1	ND	45
OC-2	62	9.4
OC-3	37	3.62
OC-4	.0675	.337
OC-5	.15	.017
OC-6	3.2	1.75
OC-7	3	19
OC-8	1.1	5.2
OC-9	.17	.064
OC-10	.53	16.5
OC-11	11	55.1
OC-12	ND	2.17

Table compiled from Reference 12
ND = Not Detected
Pesticides are DDT, DDE, and DDD combined

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

Residual concentrations of DDT and its daughter compounds were also found in the soil at the site. Samples OC-1, OC-2, OC-3, OC-6, OC-7, OC-8, OC-10, OC-11, and OC-12 all had DDT concentrations in excess of 1 μg/g with the highest concentrations, 28 and 40 μg/g in samples OC-1 and OC-11, respectively.

The soil samples also contained benzene hexachloride compounds (BHC), although the concentrations of these were generally much less than those found for DDT. PCBs and DDT were found at levels that pose a threat to human health or the environment. Arsenic and BHC are constituents that were commonly found in the formulation process of pesticides.

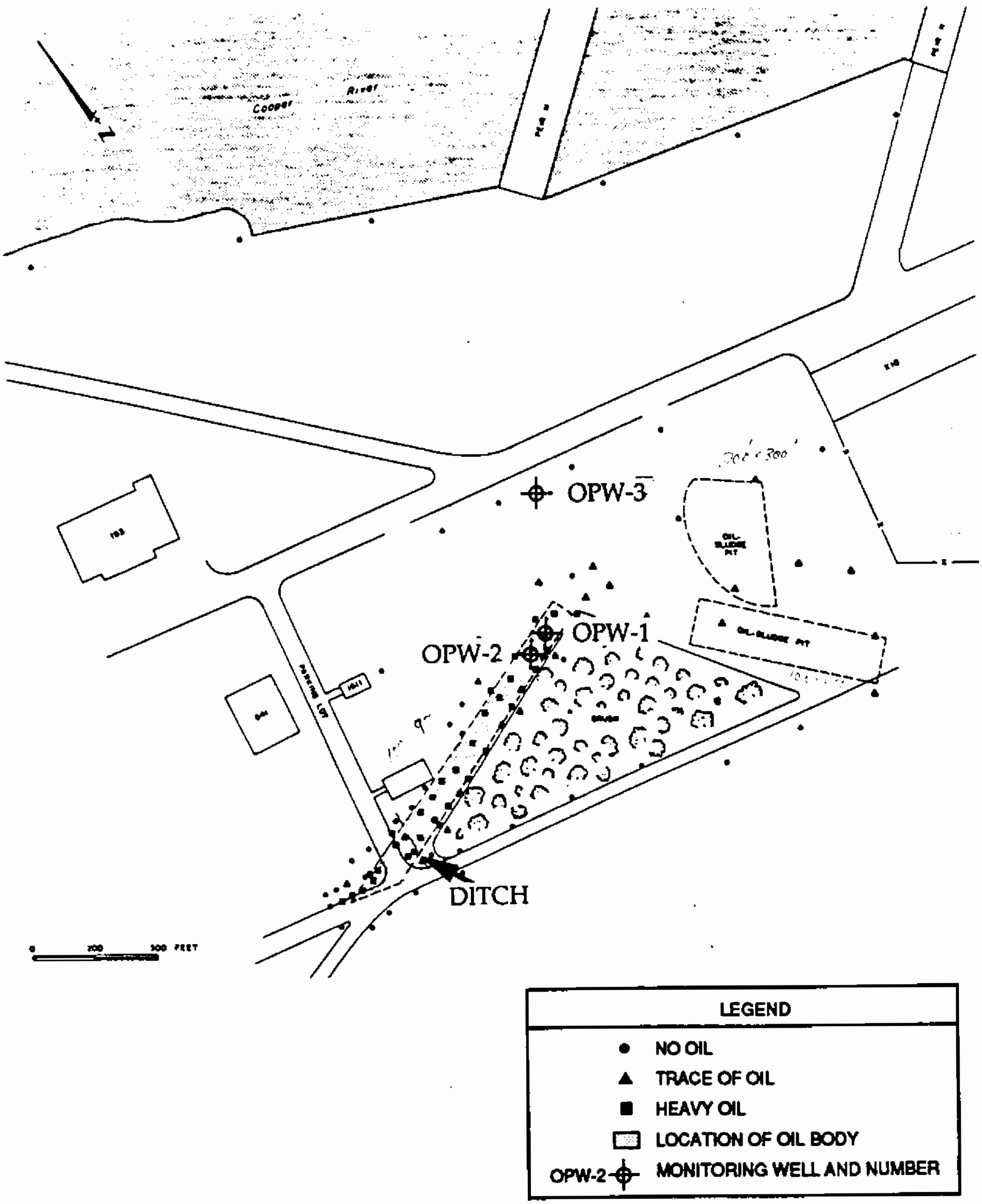
Because the samples were composited over large areas, delineation of the DDT and PCB contamination requires a more detailed sampling of the area prior to selection of an appropriate remedial action. The area east of the concrete pad was remediated during expansion of the cold storage warehouse in 1986 (Section 2.6.6). The necessary additional delineation at this unit is described in Section 3.12 of this RFI Work Plan.

2.6.8 SWMU #8, Oil Sludge Pit

Oil sludges produced by industrial activities at NSY from 1944 to 1971 were disposed of in three unlined pits near the Warehouse Administrative Building. These pits are visible in aerial photographs taken in 1944 and 1951 and are collectively known as SWMU #8. Heavy rains occasionally caused the pits to overflow, creating oil spills in low areas adjacent to the pits. Two of the pits had been covered with fill by 1956, potentially trapping oil within the subsoils. Free oil is known to have been pumped from the remaining pit in 1974. Clean fill was then brought in and compacted within the pit. Portions of the area have now been converted into a parking lot. A ditch dug at this site in 1982 intercepted free oil floating on the water table. The ditch was dammed immediately afterwards and later filled to prevent migration of oil into Shipyard Creek.

During the Confirmation Study, two soil boring investigations were conducted. During Phase I, shallow borings were installed in the reported vicinity of the abandoned oil-sludge pits. The field investigation was expanded during Phase II after oil was discovered in a section of a newly dug ditch located as shown in Figure 2-18.

Monitoring wells were installed by Geraghty and Miller in 1982 to assess the extent of oil in the subsurface (Ref. 12). A substantial quantity of free phase oil was floating on the water table. Water samples were collected from two of the wells installed in the area, wells OPW-1 and OPW-3 (Figure 2-18). Well OPW-2 was not sampled due to the presence of free phase oil. Samples were analyzed for sulfate content, 14 volatile organic compounds, and PCBs (Appendix H). Wells OPW-1 and OPW-3 contained less than 1 and 780 mg/l of sulfate and 0.84 and 0.17 mg/l of methylene chloride, respectively. Methylene chloride is a common laboratory artifact. PCBs were not detected in the water sampled from OPW-3. However, the well OPW-1 sample contained 0.04 μg/l of PCB (Aroclor 1260).



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 2-18
SWMU #8
MONITORING WELL AND BORING LOCATIONS
(FIGURE TAKEN FROM REF. 12)

DATE: 08/05/92

DWG NAME: CNSY

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

From the results of the boring program, it was determined that a long, narrow plume of free oil exists in the southwestern portion of the oil-sludge area. This area is approximately 50 feet wide by 600 feet long and trends in a northeast-southwest direction. Measurements taken in borings and in well OPW-2 indicate that the oil ranges in thickness from about 2 to 4 inches. East of the free floating oil plume is a small area containing oily residues. The remaining portions of the oil-sludge area were found to be free of oil (Ref. 12). Morphology of this plume reflects the shape of the underlying abandoned pit. The low hydraulic gradient, the low permeability of the surrounding soils, and the high viscosity of the oil within the soils may have limited the potential for oil migration.

This SWMU has been covered with fill and the area is currently being used for a parking lot. However, oil is reportedly trapped in the subsoil and could potentially migrate towards the Cooper River or Shipyard Creek. The data provided by Geraghty and Miller (Ref.12) characterize only the free floating oil in the groundwater. The free floating oil plume, dissolved phase plume, and constituents of the oil from each pit have not been characterized, nor have the site hydrogeologic conditions been adequately defined. Since potential migration of this plume to nearby surface waters could create a sheen in violation of applicable water quality criteria, the soil and groundwater contamination should be delineated and remediated. A soil and groundwater sampling plan designed to accomplish this goal is described in Section 3.13.

2.6.9 SWMU #9, Closed Landfill

From the 1930s until 1973, many solid wastes generated at NSY were disposed of onsite in a landfill located in the southwestern portion of the peninsula. Originally, the area was marshland. Items reportedly disposed of in the landfill include: asbestos, acids, PCBs, waste oils, waste solvents, waste paints, paint sludges, mercury, metal sludge, acid neutralization sludge, various inorganic and organic chemicals, sanitary wastes, office wastes and rubbish. Table 2-8 is a list of the industrial waste disposed of in the closed landfill. The largest volume of wastes consisted of office wastes and rubbish. Liquid wastes were placed in drums before disposal and combustible wastes were burned daily. Residue from the burning was pushed into the marsh as fill along with concrete rubble, metal scrap, and other non-combustible materials. Waste materials were covered with soils when they were available. Soils from onsite building excavations, soil dredged from the river, and bottom ash from the power plant were used as cover materials.

Table 2-8
Industrial Waste Disposed in Closed Landfill

WASTE	ORIGIN	CURRENT ANNUAL GENERATION RATE	YEARS OF DISPOSAL
Asbestos	Boiler Shop	1000 lbs	70
Asbestos	SIMA	2 yds	15
Varnish Sludge	Electrical Shop	300 gal	70
Mercury	Electrical Shop	25 lbs	70
Acid Neutralization Sludge	Electrical Shop	400 gal	70
Paint Sludge	Electronics Shop	200 gal	70
Metal Sludge	Machine Shop 31	50,000 lbs	70
PCB Fluids	Central Tool Shop	None	40
Paint Wastes	Paint Shop	226 tons	70
Toxic NRP Water Chemicals	NSC	1330 lbs	10

Table taken from Reference 9

NSY has installed 17 groundwater monitoring wells in and around the landfill to characterize the chemical quality of the groundwater in the vicinity. Some of the wells were initially sampled during July 1981. The samples were analyzed for several physical and chemical parameters. Additional sampling was performed in February, 1982, and analyses were conducted for inorganic and organic priority pollutants. The complete results of these sampling efforts are reported in Appendix I. Table 2-9 summarizes the data for constituents reported above analytical detection limits in all monitoring wells. Several trace metals and chlorinated organic compounds are present in the groundwater in the vicinity of the landfill. These constituents likely reflect past disposal of metal plating sludges, waste chemicals, and industrial degreasing solvents disposed in the landfill (Ref. 9).

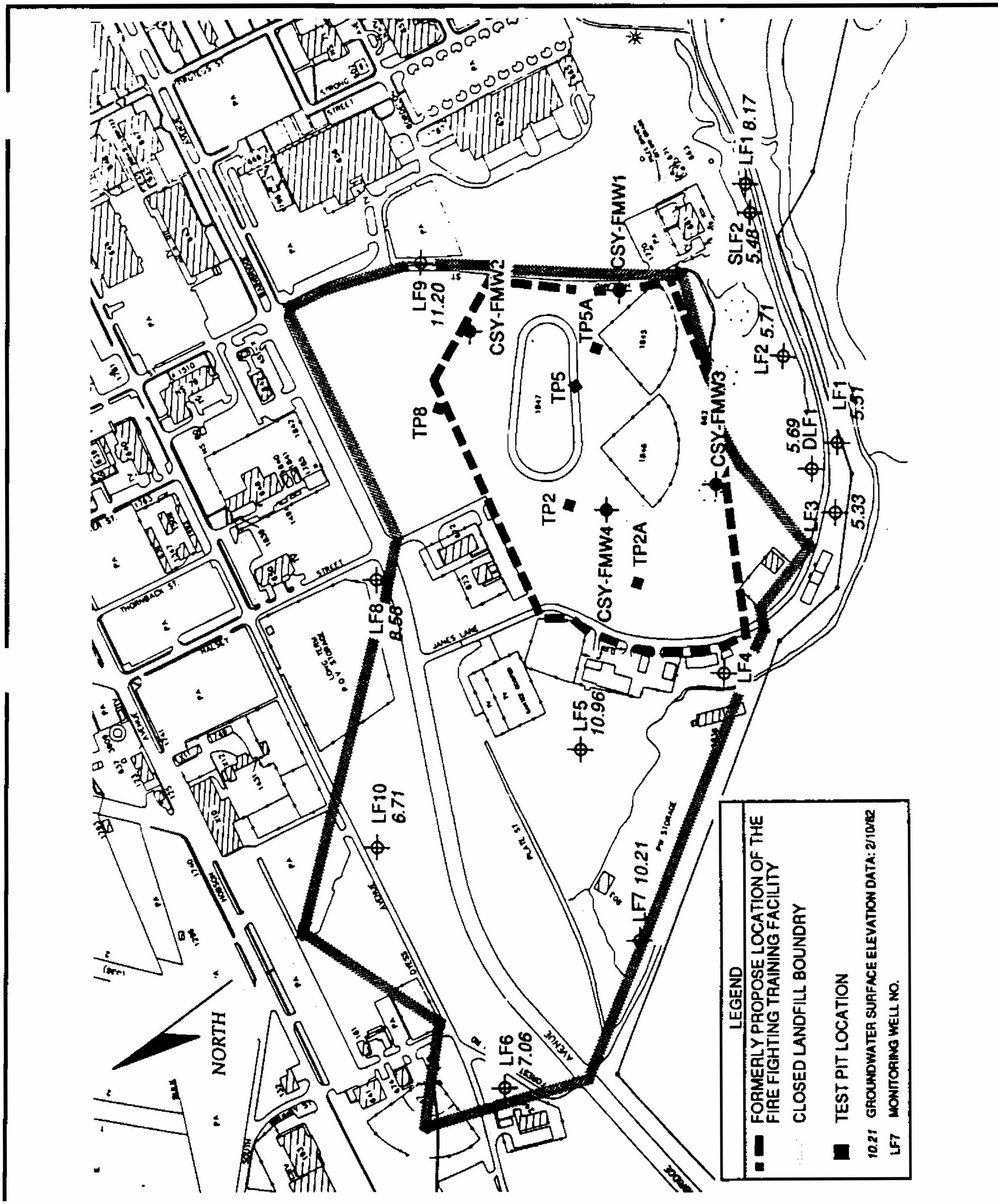
A second geotechnical and environmental investigation for the proposed new Fire Fighting Training Facility was performed by Westinghouse Environmental and Geotechnical Services (Ref. 17) in April 1991. Five test pits and four shallow groundwater monitoring wells were constructed at the proposed new training facility site (Figure 2-19). Soil and groundwater samples were analyzed for volatile organic and semi-volatile organic compounds, RCRA metals, and pH.

The laboratory results of the soil samples indicated elevated levels of some metals and organics in all soil samples collected. A summary of the soil sample results which were identified above the method detection limits can be found in Table 2-10. Appendix I-2 presents the test pit observation logs and analytical data. Lead was found to be elevated in all five samples. Other metals which were found to be elevated included chromium, arsenic and barium. The highest metals concentrations were detected in test pits TP-2 and TP-2A. The other test pits were found to contain only lead, with the exception of test pit TP-8 where 49 mg/kg of chromium were detected. The organics which were detected were, for the most part, petroleum derivatives. In addition, some constituents which are typically found in plastics were also identified. The petroleum constituents which were identified were typical of heavier products. This could

Table 2-9
Summary of Trace Metal and Organic Data Closed Landfill Monitoring Wells

CONSTITUENT	CONCENTRATION RANGE (µg/l)
Metals	
Arsenic (As)	<10 - 70
Barium (Ba)	370 - 4620
Chromium (Cr)	<5 - 8.2
Mercury (Hg)	<0.1 - 0.4
Lead (Pb)	<5 - 22
Acid Organics	
Pentachlorophenol	ND-15
Phenol	--
2,4,6-Trichlorophenol	--
2,4-Dichlorophenol	--
4,6-Dinitro-o-cresol	--
Base/Neutral Organics	
1,4 Dichlorobenzene	--
2,4 Dinitrotoluene	--
N-nitrosodiphenylamine	--
Bis(2-ethylhexyl)phthalate	ND-90
Diethyl phthalate	--
Di-n-butyl phthalate	--
Naphthalene	--
Acenaphthene	--
Anthracene/Phenanthrene	--
Indeno(1,2,3-cd)pyrene	--
Volatile Organics	
Methylene chloride	ND-1600
Chlorobenzene	ND-50
Chloroform	ND-5.4
Dibromochloromethane	ND-3.4

Table taken from Reference 9
µg/l = micrograms per liter
ND = Not Detected
-- = 1 to 9 µg/l



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CHARLESTON NAVAL
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CHARLESTON, S.C.

FIGURE 2-19
CLOSED LANDFILL AREA PLAN
(FIGURE COMPILED FROM REF. 12,17)

DATE: 08/05/92 | DWG NAME: CNSY

Table 2-10
Summary of Soil Sample Results Fire Fighter Training Facility

TEST PIT NUMBER	CONSTITUENT IDENTIFIED ABOVE DETECTION LIMIT	CONCENTRATION
TP-2	Lead	170 mg/kg
	Chromium	11 mg/kg
	Butylbenzlyphthalate	358 μg/l
	1-Methylnaphthalene	380 μg/l
	2-Methylnapgthalene	560 μg/l
	Naphthalene	400 μg/l
	Pyrene	500 μg/l
	Fluoranthene	580 μg/l
TP-5	Lead	15 mg/kg
	p Dichlorobenzene	17.9 μg/l
	Naphthalene	390 μg/l
TP-8	Lead	3210 mg/kg
	Chromium	49 mg/kg
	Chlorobenzene	154 μg/l
	o-Dichlorobenzene	23.3 μg/l
	p-Dichlorobenzene	97.0 μg/l
	Acenaphthene	160 μg/l
	Acenaphthylene	165 μg/l
	Benzo(a)anthracene	260 μg/l
	Benzo(b)fluoranthene	470 μg/l
	Benzo(k)fluoranthene	470 μg/l
	Benzo(a)pyrene	240 μg/l
	Bis(2- Ethylhexyl)phthalate	8690 μg/l
	Buthylbenzylphthalate	3330 μg/l
	Chrysene	420 μg/l
	1,4 Dichlorobenzene	100 μg/l
	Flourene	210 μg/l
	1-Methylnaphthalene	330 μg/l
	2-Methylnaphthalene	630 μg/l
	Naphthalene	580 μg/l
	Phenanthrene	1800 μg/l
	Pyrene	1290 μg/l
	Fluoranthene	1920 μg/l

Table taken from Reference 17

indicate either that the wastes contained heavier product types (fuel oil, waste oil, bilge water, etc.) or that the light constituents (i.e., gasoline) have volatilized over time. The plastics constituents identified are typical of landfilled wastes (plastic bags, rubber, etc.).

The laboratory results of the groundwater samples (Table 2-11) indicated that the groundwater has been impacted. As with the soil samples, most of the organic constituents detected were petroleum derivatives. However, some chlorinated solvents were also detected including 1,1,1-Trichloroethane and Trichloroethene.

Of the organic constituents detected in the groundwater, benzene is of the most concern. Benzene is identified in monitoring wells CSY-FMW-2 (20 μg/l) and CSY-FMW-4 (6.9 μg/l) which are both above the drinking water standard of 5 μg/l. The other organic constituents were found at relatively low levels. Various metals including copper, zinc, antimony nickel, lead, and selenium were detected above the method detection limits in the groundwater samples although none of the established drinking water standards were exceeded.

Monitoring well gauging results from 10 February 1982 suggest that a groundwater ridge exists along an east to west trending axis across the central portion of the site. Hence, groundwater flow appears to be northerly within the northern part of the closed landfill area and southerly over the southern portion of the site (Figure 2-19). A comparison of the landfill soil and groundwater analytical data with the EPA proposed action levels and MCLs shows that most of the constituents are below the proposed action levels. However, the previous investigation was of limited scope. Additional delineation of soil and groundwater contamination is proposed in Section 3.14 of this RFI Work Plan.

Table 2-11
Summary of Groundwater Analyses
Fire Fighter Training Facility

MONITORING WELL	CONSTITUENT IDENTIFIED ABOVE DETECTION LIMIT	CONCENTRATION
CSY-FMW-1	Benzene	1.9 μg/l
	Chlorobenzene	1.7 μg/l
	p-Dichlorobenzene	0.3 μg/l
	Toluene	2.2 μg/l
	Anthracene	1.1 μg/l
	Phenanthrene	1.1 μg/l
	Copper	0.040 mg/l
	Zinc	0.060 mg/l
	Antimony	0.003 mg/l
	Nickel	0.040 mg/l
CSY-FMW-2	Benzene	20.0 μg/l
	Chlorobenzene	13.6 μg/l
	p-Dichlorobenzene	7.5 μg/l
	Ethylbenzene	2.7 μg/l
	Toluene	4.6 μg/l
	1,1,1-Trichloroethane	0.80 μg/l
	Trichloroethene	0.40 μg/l
	Acenaphthene	1.3 μg/l
	1,4-Dichlorobenzene	7.2 μg/l
	Naphthalene	2.2 μg/l
	2 Methylnphathalene	5.5 μg/l
	Copper	0.030 mg/l
	Lead	0.002 mg/l
	Selenium	0.002 mg/l
	Zinc	0.07 mg/l
	Antimony	0.004 mg/l
	Nickel	0.06 mg/l
CNY-FMW-3	Benzene	1.5 μg/l
	Chlorobenzene	7.5 μg/l

Table 2-11
Summary of Groundwater Analyses
Fire Fighter Training Facility

MONITORING WELL	CONSTITUENT IDENTIFIED ABOVE DETECTION LIMIT	CONCENTRATION
	p-Dichlorobenzene	1.1 μg/l
	Toluene	1.7 μg/l
	1,1,1-Thrichloroethane	0.6 μg/l
	Copper	0.020 mg/l
	Zinc	0.06 mg/l
	Nickel	0.04 mg/l

Table taken from Reference 17

2.6.10 SWMU #10, Hazardous Waste Storage Facility

The new hazardous waste container storage and transfer facility was completed in October 1986. The facility was constructed to serve the entire base and is managed by the shipyard. Current status of the unit is that of a permitted storage facility with permission to store wastes for a maximum of 90 days. The building contains seven storage bays. Each bay has separate spill containment berms to allow flexibility in segregating incompatible wastes.

The hazardous waste storage facility is designed to store hazardous materials/wastes until time of proper disposal. A 6-inch high concrete ramp is located at the entrance to each storage bay for spill containment. Storage bays are separated by interior partition walls. A catch basin for spill and storm drainage is located in the exterior load/unload area. Wastes stored in the facility are grouped into eight categories: (1) flammable liquids, (2) acids, (3) alkalis, (4) chlorinated hydrocarbons, (5) oxidizers, (6) reducers, (7) general wastes, and (8) PCBs. These general classifications are reflected on signs used to identify the contents of each storage bay. The unit is constructed of concrete with sloped floors bounded by curbs in order to isolate leaks or spills within each storage bay.

There is no evidence of a release from this unit. No action is planned in this Work Plan to be taken at this unit.

2.6.11 SWMU #11, Caustic Pond

The caustic pond, located near the junction of Bainbridge Avenue and Viaduct Road, was used for the disposal of calcium hydroxide $Ca(OH)_2$ from the early 1940s through the early 1970s. The site and adjoining areas are currently covered with vegetation. No signs of impairment can be observed in the area.

Calcium hydroxide was generated as a byproduct during the reaction of water with calcium carbide to produce acetylene gas. Water saturated with $Ca(OH)_2$ was discharged to and allowed to settle in the pond during operations. Supernatant was discharged to Shipyard Creek. The quantity and areal extent of the original $Ca(OH)_2$ deposits are not precisely known. Soil borings conducted during the initial assessment studies found sludge depths of up to 1 foot (Ref. 9). Water infiltrating into the surficial groundwater through $Ca(OH)_2$ should have a high pH. Samples collected from the monitoring wells around the site, however, show that groundwater is neutral in pH (Ref. 12).

Four monitoring wells were installed in the area of the caustic pond during the Confirmation Study conducted at NSY. Water samples were collected from each of the four monitoring wells (Figure 2-20) to assess the impact of the disposal of calcium hydroxide on the shallow groundwater environment. The samples collected were analyzed in the field for pH and specific conductance and, in a water quality laboratory, for calcium, chloride and sulfate content (Appendix J). The results indicate that the pH is slightly acid to slightly basic, ranging from 6.3 to 7.3. The calcium and chloride contents and specific conductance are somewhat elevated, ranging, respectively, from 101 to 490 mg/l, from 423 to 823 mg/l, and from 1,970 to 7,400 μmhos/cm (micromhos per centimeter). The relatively neutral pH values suggest that the

Geraghty & Miller, Inc.

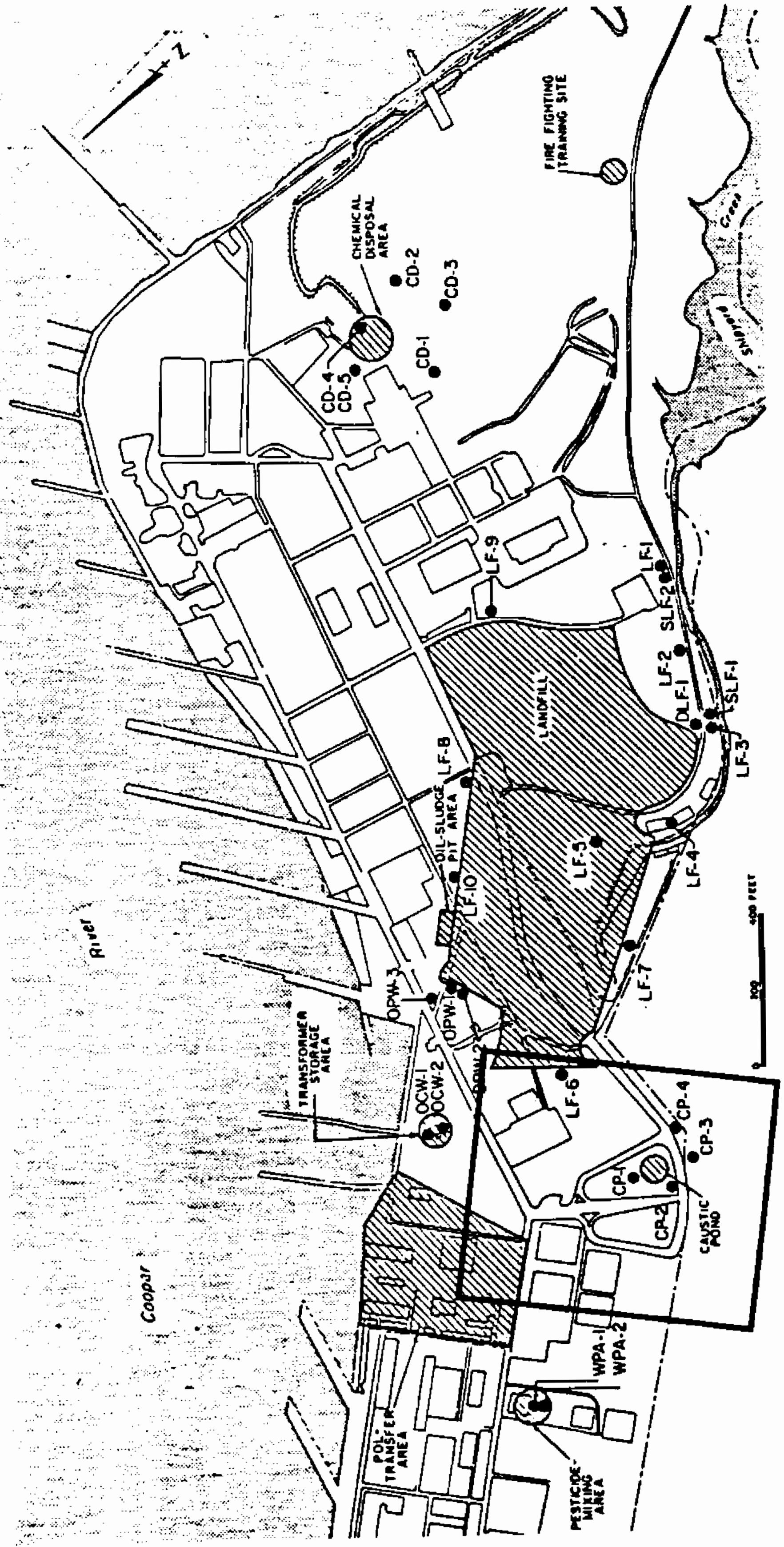

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FIGURE 2-20
CAUSTIC POND AREA
LOCATION OF MONITORING WELLS
(FIGURE TAKEN FROM REF. 12)

DATE: 08/05/92 | DWG NAME: CNSY

normally high pH of the caustic water infiltrating from the pond has been lowered due to the naturally occurring acidic soils at the site (Ref. 12).

Calcium hydroxide does not occur naturally and cannot persist for extended periods when released to the environment. It reacts with carbon dioxide which diffuses from the air or is carried by infiltrating rainwater to form calcium carbonate (limestone). The groundwater data indicate that this process has gone to completion and that no calcium hydroxide remains.

Calcium hydroxide contains no hazardous constituents but is hazardous by definition (40 CFR 261.22(a)(1).) only when it is in solution and causes the pH to be greater than 12.5 standard units. This rarely occurs outside of laboratory conditions but is possible with saturated solutions of relatively pure $Ca(OH)_2$ at temperatures below 23.6° C. In any case, groundwaters beneath SWMU #11 are not even slightly elevated in pH. Consequently, no further investigation is planned at this site.

2.6.12 SWMU #12, Old Fire Fighting Training Area

The old fire fighting training area consisted of a pit located at the southern end of NSY. The pit reportedly measured between 30 and 50 feet in diameter. It was used between 1966 and 1971 for training purposes. Oil, gasoline, and alcohol were poured into the pit, ignited, and subsequently extinguished during fire fighting training exercises.

The pit area is no longer discernible from the surrounding surface topography. The location of the pit is now known only from old aerial photographs. The pit area is currently separated from Shipyard Creek by a dense zone of shrubs, hardwoods, and a roadbed.

The pit was cited by the U.S. Coast Guard in 1971 for an oil spill. The spill occurred following a heavy rainfall which caused the oil in the pit to overflow into Shipyard Creek. The pit was closed, filled with bottom ash, and leveled in 1972.

The approximate location of the pit was determined by NSY personnel. Three soil borings were drilled at the fire fighting pit: one in the center of the pit, and the other two along the road bordering Shipyard Creek (Figure 2-21). Soil samples from the borings showed no visible trace of petroleum contamination (Ref. 12). Additional investigative activities are warranted to substantiate whether or not petroleum contamination exists in soils at this SWMU and are detailed in Section 3.15.

2.6.13 SWMU #13, Current Fire Fighting Training Area

Fire fighting training for both surface and submarine fleet personnel is currently conducted at the Fleet and Mine Warfare Training Center on Dyess Avenue. The training center, in use since 1973, uses approximately 20,000 gallons of No. 2 diesel fuel and 2,000 gallons of gasoline per year in training operations. Training exercises include extinguishing ignited diesel fuel and gasoline. Fuel, floating on water in tanks or sprayed onto mock buildings, is ignited in a controlled area consisting of a paved ground with bermed perimeters.

Wastewater from the area is routed through two gravity oil-water separator, prior to discharge into a sanitary sewer system leading to the North Charleston Consolidated Public Service Department (NCCPSD) sewage treatment plant. Recovered fuels are recycled. Effluent from the operation is well below discharge limits imposed by NCCPSD.

There is no evidence of releases from this unit, however, sampling of the sanitary sewer line will be addressed in Section 3.16 to determine whether hazardous constituents have accumulated in sediments which may be present in the sewer line.

2.6.14 SWMU #14, Chemical Disposal Area

The chemical disposal area is located at the southern end of the active portion of NSY in the vicinity of the skeet and pistol ranges. The precise locations of chemical burials are unknown. Unknown amounts of various chemicals, including Decontaminating Agent Non-Corrosive

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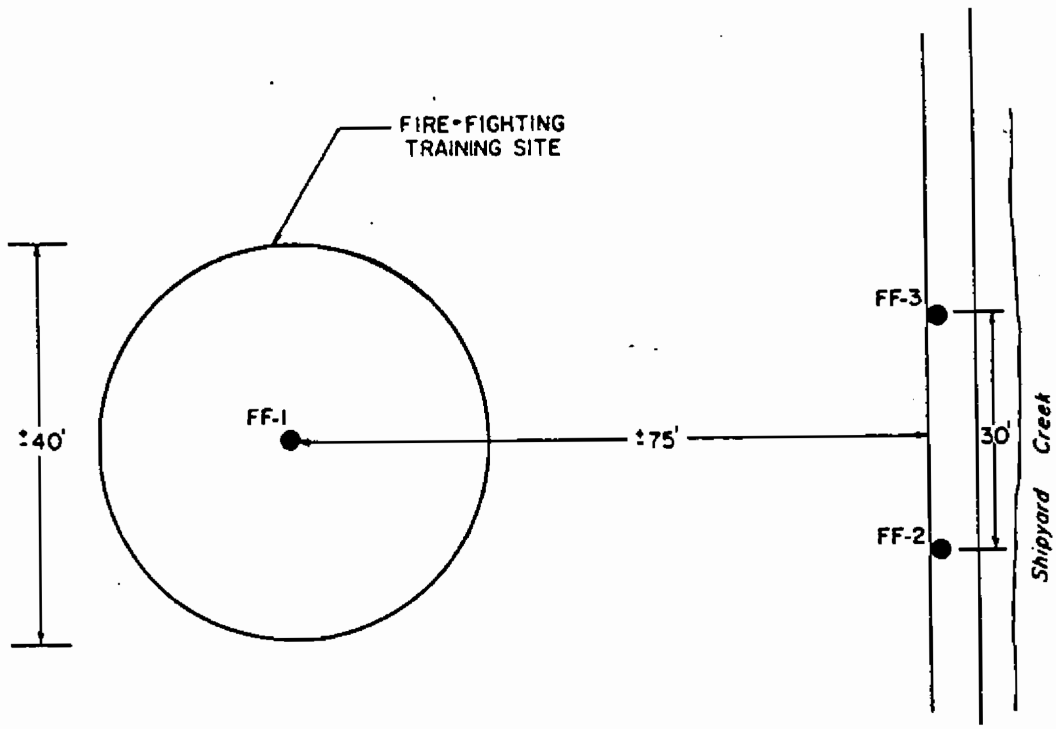
556



EXPLANATION

FF-2 ● SHALLOW BORING LOCATION AND NUMBER

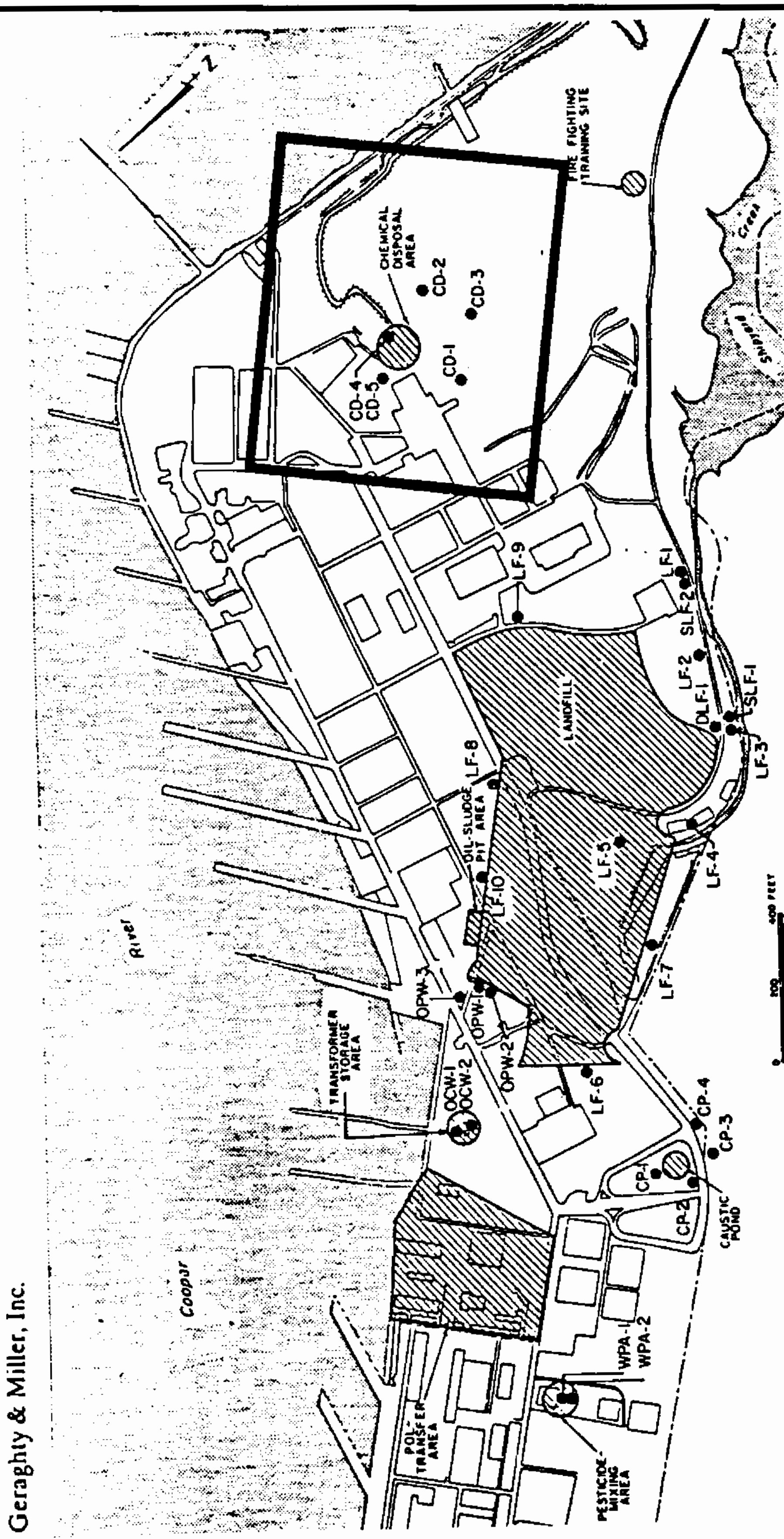
RFI WORKPLAN CHARLESTON NAVAL SHIPYARD CHARLESTON, S.C.	FIGURE 2-21 FORMER FIRE-FIGHTING PIT BORING LOCATIONS (FIGURE TAKEN FROM REF. 12)	
	DATE: 08/05/92	DWG NAME: CNSY

(DANC) and DS-2 have reportedly been disposed of at the site. DANC consists of separately packaged components of tetrachloroethane and dichlorodimethyl-hydrantoin. DS-2 is a mixture of 70% diethylene triamine, 28% methyl cellosolve, and 3% sodium hydroxide. Other chemicals may have been buried either at the skeet range or behind the dike at the pistol range or both. Ten 5-gallon canisters of DS-2 were reported buried at the skeet range in 1977. Construction crews unearthed drums of chemicals at the skeet range in 1972 and 1974. Some workers suffered minor chemical burns in the excavation episodes.

During the Confirmation Study conducted at NSY, 5 groundwater monitoring wells were installed in the vicinity of the chemical disposal area (Figure 2-22). Water samples collected from these wells were analyzed for pH, cadmium, iron, lead, magnesium, mercury, sodium, fluoride, nitrate, sulfate, total organic carbon, specific conductance, chloride, base-neutral compounds and volatile organic compounds. The results of these analyses are presented in Appendix K.

The data show that shallow groundwater in the chemical disposal area has conductivities ranging from 1,900 to 27,000 μmhos/cm, a pH from 6.68 to 8.63, and is mineralized. The levels of cadmium, lead, and mercury were below their detection limits, the iron content was less than 1.2 mg/l, and the fluoride content was less than 1 mg/l. No quantifiable amounts of base-neutral compounds were found except for 15 and 34 μg/l of bis(2-ethylhexyl) phthalate in wells CD-4 and CD-2, respectively. This compound is common around industrial areas and is present in sediments of all rivers receiving municipal or industrial effluent. Either Navy industrial activity or the presence of dredged material could account for its presence (Ref. 12).

The water samples analyzed for volatile organic compounds indicated that chlorobenzene was present at levels of 0.14 and 10.68 mg/l in wells CD-3 and CD-5, respectively. During a second sampling episode, well CD-3 contained 1.5 μg/l of chloroform and methylene chloride was found in all five wells at levels up to 2.0 mg/l. Methylene chloride is frequently used as



RFI WORKPLAN
CHARLESTON NAVAL
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CHARLESTON, S.C.

FIGURE 2-22
CHEMICAL DISPOSAL AREA
LOCATION OF MONITORING WELLS
(FIGURE TAKEN FROM REF. 12)

DATE: 08/05/92

DWG NAME: CNSY

a degreasing agent, and the data suggest that waste materials containing methylene chloride may have also been deposited in the chemical disposal area (Ref. 12).

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

Construction activities are proposed for the site. This area represents a potential safety hazard, because the type, quantity, and exact location of the chemical disposal areas are unknown. Also, the potential for impacts via groundwater pathways has not been adequately characterized. Section 3.17 of this RFI Work Plan includes a description for further investigation to be performed at this site.

2.6.15 SWMU #15, Incinerator

The incinerator is located adjacent to the pistol range and consists of a primary burning chamber and a 30-foot high stack. **The incinerator is fired with propane. Waste material has never been used as a fuel.** The unit is used only for burning of classified documents. Incineration activities occur approximately twice per week. Residues from incineration operations are placed in waste disposal containers and disposed of along with other NSY solid waste. The unit is situated on a concrete pad. Since the incinerator burns only paper, no hazardous residues are generated. No releases have occurred at this unit. No additional investigations are planned for this RFI Work Plan.

2.6.16 SWMU #16, Paint Storage Bunker

The paint storage bunker was used briefly, and without proper authorization, for paint container and miscellaneous material storage piles. It was located at an ammunition magazine adjacent to the Cooper River. The storage piles contained paint, paint thinner, oil containment booms, wooden crates, and buoys (Ref. 2). The site was clean closed on the day it was brought to management attention, during a DHEC site inspection. No additional investigation is planned.

2.6.17 SWMU #17, Oil Spill Area

Building FBM61 was built in 1961 as a Submarine Training Center. Electrical transformers were installed to serve the center at that time. The oil spill area is located beneath Building FBM61 (Figure 2-23). The spill occurred in early June 1987 when an underground pipe supplying No. 5 fuel oil to the boiler in Building FBM61 ruptured, **releasing approximately 14,000 gallons of oil. A small amount of oil was spilled into the basement of the building and the remainder was released to the soil beneath the building. A sump pump designed to remove groundwater under Building FBM61 discharged part of the oil into the storm sewer, and approximately 1000 gallons flowed into the Cooper River. Containment booms were set up at the point of discharge to the river to collect the oily discharge. The storm drainage system was flushed with water from Building FBM61 to the river. Three test holes were dug around the building to find the leak. One oil collection sump was constructed and installed in each of the three pits. The sumps were pumped daily until all recoverable floating oil was removed. Approximately two months after the release occurred, it was estimated 1,000 to 4,000 gallons of fuel oil remained unrecovered.**

Several samples collected from the spill area were found to contain PCBs (Figure 2-23 and Table 2-12). The quantity and source of PCBs beneath the building remain uncertain. PCBs from the transformers were probably released many years ago before the area was paved. Presently the entire area is capped either by the building or an adjacent paved parking lot. Consequently potential for exposure is minimal. However, data gaps exist concerning the full extent of subsurface impacts resulting from the spill. Section 3.18 of this RFI Work Plan describes additional soil and groundwater sampling planned for this unit.

2.6.18 SWMU #18, PCB Spill Area

Two reported PCB spills have occurred at Building 1278. The first such incident took place on 12 June 1987 while a PCB-containing transformer destined for disposal was being loaded onto a truck. The loading accident resulted in discharge of approximately 75 gallons of insulating fluid (Pyranol) from the unit onto unprotected ground. The contractor immediately placed a drip pan under the transformer to catch the flow of additional fluid. Three 55-gallon drums of fluid were drained from the transformer by response personnel. Steps were then taken to contain the spill area via installation of trenches and construction of a clay absorbent berm north of the spill to prevent migration of liquids into the storm drain. The spill area and other features are shown in Figure 2-24. Twenty-two drums of oil saturated soils/absorbents and asphalt were excavated and hauled offsite for disposal. The spill area was covered with plastic sheeting.

Visibly contaminated soils were removed directly after the spill. Subsequent sampling of the area conducted by AmerEco during a site visit 15-17 June 1987 showed additional excavation of soil was necessary. An additional 45,600 pounds of soil were removed from the spill site and disposed of in June 1987. Confirmation samples were collected following this excavation and again revealed unacceptable levels of contamination at five of the sampling points. On 5 August 1987, AmerEco excavated additional soils in the vicinity of the five sample locations that reportedly contained elevated levels of PCBs. Five confirmation samples were once again retrieved and analyzed for PCBs. These results indicated that no PCBs were present in soils above the method detection limit of 10 ppm. These laboratory results are included in Appendix L along with a copy of the Incident Report.

A second spill occurred 14 September 1987 when a pallet loaded on a forklift was jammed up against an insulator on a transformer, and, as a result the seal around the insulator was cracked allowing dielectric fluid containing PCBs to spill out. It was estimated that 2 to 6 gallons of fluid spilled on the asphalt and ground surface. The spill encompassed an area of approximately

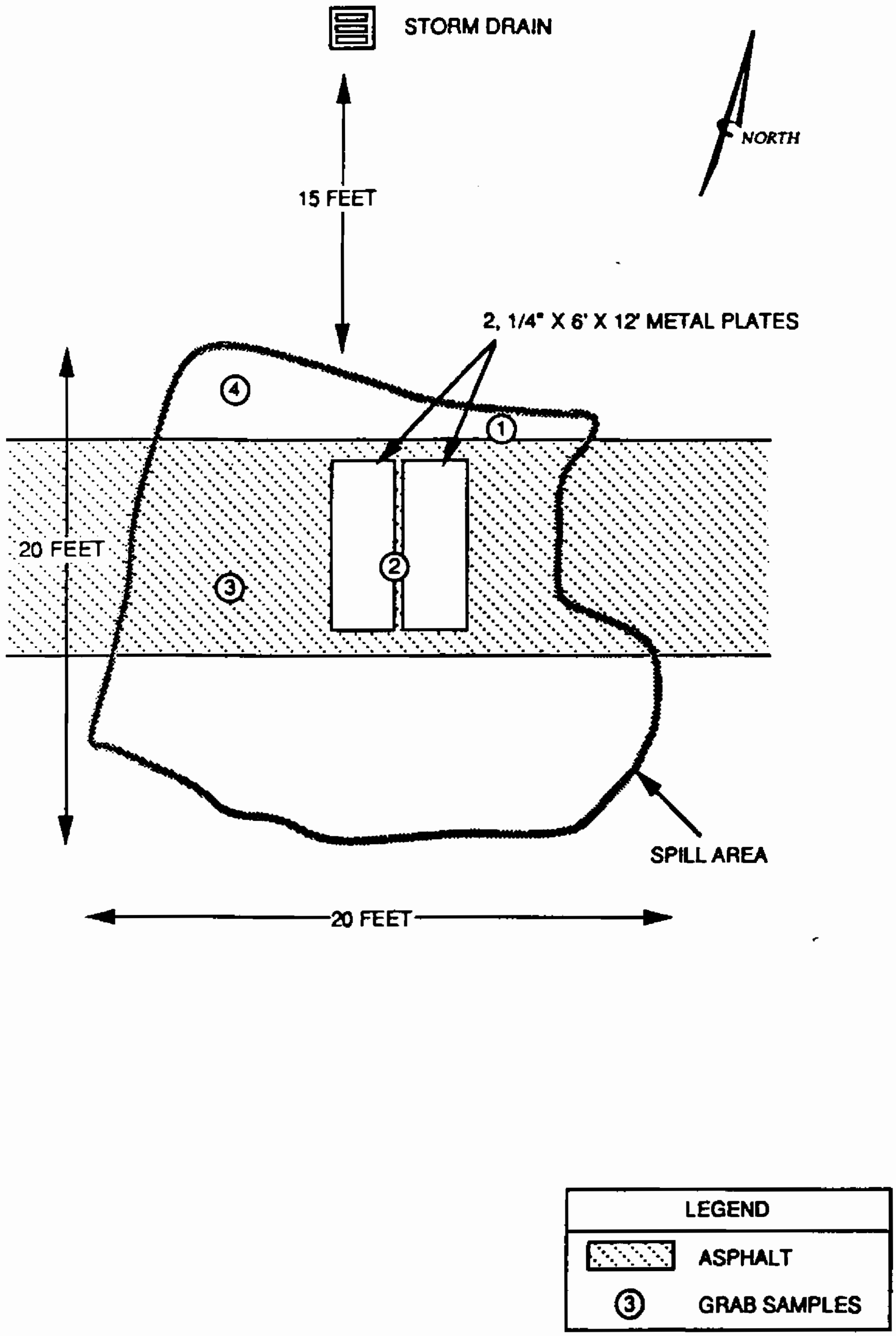

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FIGURE 2-24
SWMU #18
PCB SPILL AREA

DATE: 08/05/92
DWG NAME: CNSY

Table 2-12
Sampling Points and PCB Concentrations
at FBM-61
Oil Spill Area

SAMPLE POINT	PCB CONCENTRATION (ppm)
#65 Tank 25B	<10
#66 NS 600	<10
#67 19B	T 118 B <1
#68 Unknown tank (NSC700)	T 306 B <1
#69 TV north side (soil)	139
#70 Dirt pile southside from digging	1
#71 Drummed dirt from south side digging	6
#72 5800 gal tank car	<1
#73 NSC 700	T 476 B <1
#74 North sump	T 639 B <1
#75 Southeast sump	T <1 B <1
#76 South center sump	T <1 B <1
#77 Southwest sump	T <1 B <1
#78 19B	T 146 B<1
#79 25B	T <1 B <1
#80 NS 600	<1
#81 Drum #1	<1
#82 Drum #2	<1
#83 Drum #3	<1
#84 Drum #4	<1
#85 Drum #5	<1
#86 Drum #6	<1
#87 Drum #7	<1
#88 Drum #8	<1
#89 Drum #9	<1
#90 Drum #10	<1
#91 Drum #11	<1
#92 Drum #12	<1

Table 2-12
Sampling Points and PCB Concentrations
at FBM-61
Oil Spill Area

SAMPLE POINT	PCB CONCENTRATION (ppm)
#93 Drum #13	<1
#94 Drum #14	<1
#95 Drum #15	<1
#96 Chase inside FBM-61	78

Table taken from Reference 2
T = Top layer
B = Bottom layer

25 square feet. The spilled fluid evidently contacted some wooden pallets which were being stored in the vicinity of the spill, and, when the pallets where relocated, an additional area of asphalt was contaminated. The area was excavated on 16 September 1987 and the transformer was decontaminated. The analytical results indicated the contaminated soil and asphalt were successfully removed but additional decontamination of the transformer and cleanup equipment was necessary. Laboratory results from samples collected 21 September 1987 indicated the additional decontamination was successful. All contaminated materials were disposed of through DRMO. A copy of the incident report, analytical results, and a sample location diagram is also included in Appendix L. The site appears to have been completely remediated (Ref. 1) under the Toxic Substances Control Act. No additional sampling of the site is planned under this RFI Work Plan. The area is currently used for storage of empty drums and used oil.

2.6.19 SWMU #19, Solid Waste Transfer Station

The Solid Waste Transfer Station consists of a staging area for temporary storage of solid waste, prior to transport and disposal offsite. The solid waste is compacted after collection and temporarily stored at the site in containers. The typical accumulation time for waste at this site is one to two days. No hazardous wastes have been stored at the site and the unit is only used for temporary storage of solid waste. No releases of hazardous constituents have occurred at this SWMU. No additional investigations are planned for this RFI Work Plan.

2.6.20 SWMU #20, Waste Disposal Area

The Waste Disposal Area occupies an open area adjacent to the solid waste transfer station and has been in operation since 1985. Solid wastes consisting of cardboard boxes, wood, concrete blocks, tree stumps, sandblasting residues, and a small number of vehicle batteries were disposed of in this area. The few batteries disposed of at the site are the sole concern. This SWMU overlies the old sanitary landfill (SWMU #9).

The RFA recommends that this unit be considered part of the sanitary landfill and be addressed accordingly. Groundwater monitoring in the surrounding area has found widespread but low level contamination. The constituents of concern include chlorinated solvents, petroleum derivative VOCs, and metals. No evidence of a release of hazardous constituents to air, water or soil which could be attributed to SWMU #20 was observed (Ref. 2). There is no data to substantiate the validity of this observation; therefore, this area will be included in the investigative activities currently proposed for SWMU #9.

2.6.21 SWMU #21, Old Paint Storage Area

The old paint storage area is located inside the Controlled Industrial Area (CIA) near the waterfront adjacent to the Cooper River. The unit was used for temporary storage of containerized paint wastes from ships returning to NSY and from ship repair and overhaul operations at the base. The waste containers were temporarily stored on a 20 x 180 foot concrete pad to await offsite transport. Sandblasting operations also occurred in this area.

Paint wastes stored at this unit contained cadmium, chromium, lead, cyanide, toluene and tetrachloroethylene. Sandblasting residues containing organo-tin paints were also generated at this unit. These residues were allowed to accumulate on the ground surface. A release from a 55-gallon container was observed during a site inspection by DHEC and EPA in August of 1990.

Leaking material (Oakite-PK144) from a hole in the bottom of the container was identified as kerosene. The spilled material was cleaned up immediately. In 1988, EnSafe decontaminated the concrete pad using scarification (rotary scraper) and sand blasting techniques. The residual sand and paint chips were collected from the pad and surrounding soils and containerized. Samples of the paint chips from the concrete pad and soil areas were analyzed using EP Toxicity characteristic leaching procedures for metals. Results of the sample analysis showed the paint chips were below the EP Toxic limits. Therefore, the material was characterized as non-hazardous and no further action was recommended. Table 2-13 is a summary of results for the EP Toxic metals content in the paint chips.

EnSafe certified that closure of the interim status unit was completed according to the conditions of the Closure Plan. A review of the closure activities by DHEC determined that the unit was not fully characterized and additional delineation would be required. Section 3.20 of the RFI Work Plan includes detail on the additional investigation which will be required to delineate this unit.

Table 2-13
Evaluation of EP Toxic Metals Content
In Waste Paint Storage Pad
(ppm)

	ARSENIC	BARIUM	CADMIUM	CHROMIUM	LEAD	MERCURY	SELENIUM	SILVER
EP TOXICITY THRESHOLD	5.0	100	1.0	5.0	5.0	0.2	1.0	5.0
SAMPLE PAINT CHIPS FROM PAD								
WPP-1	0.002	0.170	0.002	1.020	0.050	0.001	0.002	0.010
WWP-2	0.002	0.230	0.002	0.430	0.050	0.001	0.002	0.010
SAMPLE PAINT CHIPS FROM SURROUNDING SOIL								
PC-3	0.002	0.120	0.002	0.020	0.050	0.001	0.002	0.010
PC-4	0.002	0.350	0.002	.250	0.050	0.001	0.002	0.010

Table taken from Reference 5

2.6.22 SWMU #22, Old Plating Shop Waste Treatment System

The old plating shop waste treatment system is located within the CIA. The unit was constructed in 1972 to process wastewater from the metal plating shop and continued in operation until the new non-cyanide plating process and treatment system were built (Figure 2-25). The treatment facility included two in-ground concrete tanks, one for chromic acid reduction and one for cyanide oxidation. Additional treatment was conducted in a "clarifier" where soda ash was manually added and mixed with the wastewater to adjust the pH to approximately 8.5 and precipitate any chromium or other metals. After settling for 48 hours, the clarified wastewater effluent was discharged to the sanitary sewer. Sludge in the bottom of the clarifier was removed and disposed of at the base sanitary landfill until 1973. After 1973, sludge was transported off base for disposal.

The unit has not been operated since 1982 when the new plating shop waste treatment system (SWMU #23) started up. The waste treatment system has been decontaminated. However, questions remain regarding subsurface contamination. Final rinsate samples were collected from the decontaminated plating waste treatment unit and analyzed for cyanide, cadmium, and chromium. The analytical results are presented in Table 2-14. The results of the rinsate samples indicated that all but one sample exceeded the threshold values established by EnSafe (Ref. 5). Most of the samples also exceed the EPA's maximum contaminant levels (MCLs) in the tables of proposed action levels (Appendix C). The pH values were exceeded in six of the ten samples.

Sixteen soil samples were collected around the perimeter of the treatment tank from directly below the surface of the concrete, as shown in Figure 2-25. The soil samples were analyzed for pH, cadmium, and chromium (Table 2-15). Forty-three of the 48 samples exceeded the threshold values. None of the sample results exceeded the action levels for cadmium or chromium.

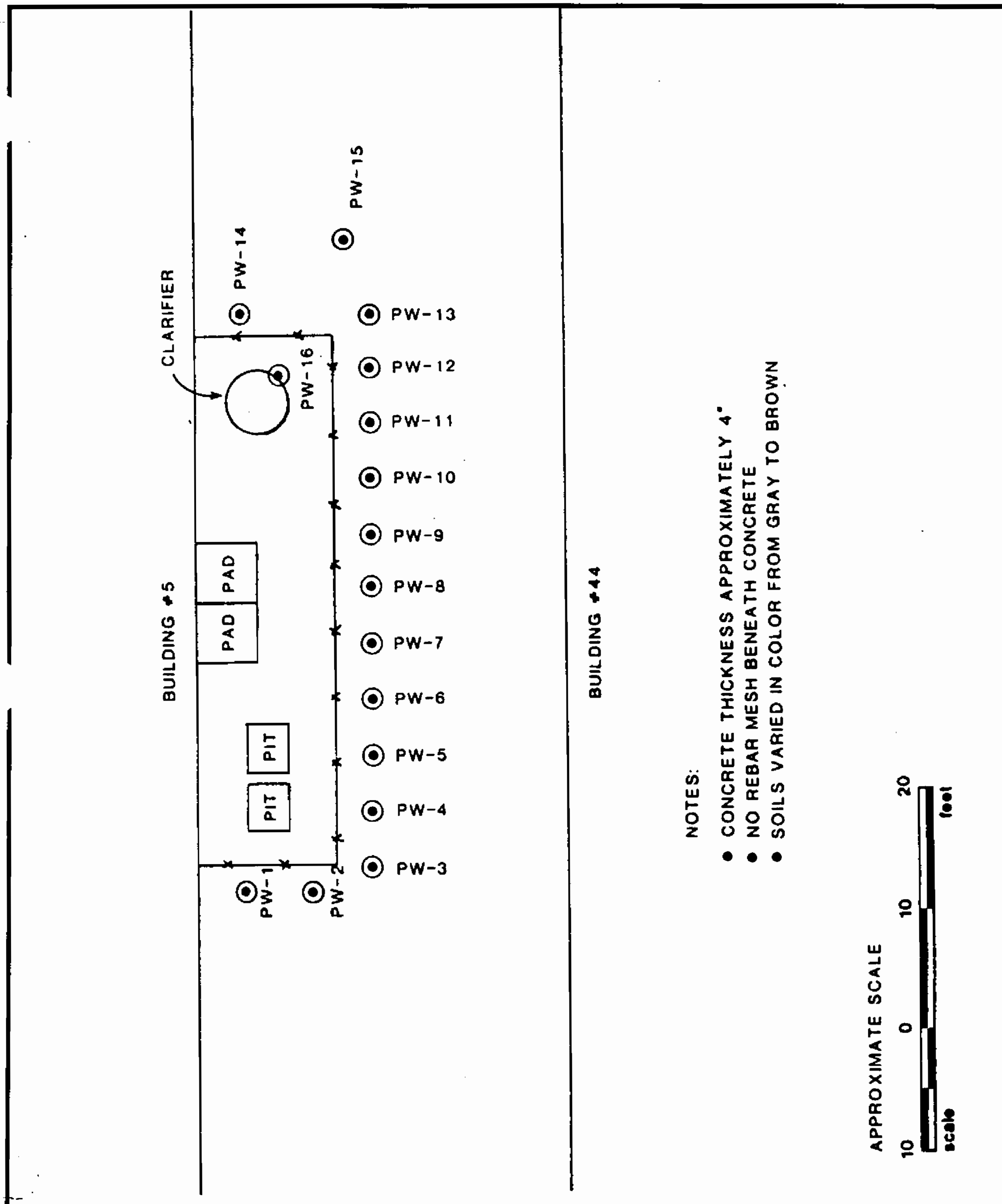

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FIGURE 2-25
PLATING WASTE PRETREATMENT UNIT
SAMPLING STATIONS
(FIGURE TAKEN FROM REFERENCE 5)

DATE: 08/05/92 | DWG NAME: CNSY

Table 2-14
Evaluation of Rinse Waters
Plating Waste Treatment Unit

	pH	CYANIDE(ppm)	CADMIUM(ppm)	CHROMIUM(ppm)
Maximum Contaminant Levels		.7	0.010	0.05
Threshold	7.4 6.3	0.027	0.002	0.02
Plating Waste Treatment Unit (Final Rinse - 10/1/87)				
Cyanide Side	6.9	N/S	2.580 X	0.90 X
Chromium Side	6.6	N/S	0.047 X	13.10 X
Clarifier*	6.5	N/S	0.015 X	1.01 X
Plating Waste Treatment Unit (Followup Rinse - 10/20/87)				
Cyanide Side	5.7 X	1.120 X	N/S	0.26 X
Chromium Side	5.9 X	0.093 X	N/S	20.00 X
Clarifier	6.0 X	0.024	N/S	1.85 X
Pad Rinse 1	1.0 X	N/S	9.830 X	141.00 X
Pad Rinse 2	4.0 X	N/S	0.602 X	5.75 X
Pad Rinse 3	6.0 X	N/S	0.136 X	7.25 X
Followup Rinse	6.4	0.033 X	N/S	3.36 X

Table taken from Reference 5
N/S = Not Sampled
* = No Meter Reading; pH estimated by pH paper
X = Designates results exceeding threshold values

Table 2-15
Evaluation of Soil Contamination
Plating Waste Treatment Unit

	pH	CADMIUM(ppm)	CHROMIUM(ppm)
Action Levels		40.00	400
Threshold	6.5 4.3	1.25	26.51
PW-1	12.3 X	16.00X	56.1 X
PW-2	11.1 X	3.03 X	86.6 X
PW-3	10.8 X	2.43 X	87.0 X
PW-4	8.3 X	3.39 X	46.5 X
PW-5	12.2 X	1.74 X	20.9
PW-6	11.5 X	1.97 X	69.3 X
PW-7	12.0 X	1.69 X	19.8
PW-8	12.1 X	4.10 X	91.4 X
PW-9	12.2 X	1.71 X	32.7 X
PW-10	12.3 X	2.08 X	62.5 X
PW-11	12.4 X	2.87 X	229.0 X
PW-12	12.0 X	5.94 X	278.0 X
PW-13	12.7 X	1.84 X	31.6 X
PW-14	12.4 X	3.97 X	45.6 X
PW-15	12.5 X	0.20	15.1
PW-16	11.1 X	1.46 X	22.9

Table taken from Reference 5
X = designates results exceeding threshold values

Two additional subsurface soil sample investigations delineated the vertical extent of contamination around the plating waste treatment tank. Soil samples were collected from 1 foot to 6 feet below ground surface and analyzed for cadmium, chromium, and total cyanides. The highest concentrations of metals were detected in sample PW 13-2 (2 foot interval). The highest concentration for the constituents are as follows: cadmium, 47.7 ppm; chromium, 143 ppm; and cyanide, 6.28 ppm. Appendix M presents the analytical results.

The sample investigation performed at this SWMU indicates contamination has affected the near surface soils and is still present in the concrete of the treatment unit. However, no information is available on groundwater or subsurface soils beyond the perimeter of this SWMU. In addition, the potential for contamination affecting this area originating from the adjacent Old Plating Operation (SWMU #25) has not been investigated. A site investigation for the Old Plating Operation inside Building 44 has been added to the RFI Work Plan. To avoid duplication of effort for these two complementary units, SWMUs #22 and #25 will be addressed together under SWMU #25 for future investigative and remediation work.

2.6.23 SWMU #23, New Plating Shop Wastewater Treatment System (WWTS)

The new plating shop WWTS unit is located inside the CIA. The system is currently used to treat wastewaters containing lead, chromium, cadmium, and acids or alkalis from metal plating operations. Treated effluent is discharged to a holding tank and tested prior to final discharge into the sanitary sewer system. Underflow from the clarifier is directed to a centrifuge for sludge thickening and then to a plate and frame filter press for dewatering. The sludge is hauled off base for disposal. An inspection of the secondary containment in July 1992 by NSY personnel did not reveal any cracks in the structure through which potential spills could escape. No incident reports pertaining to SWMU #23 have been recorded on file with the NSY since the new plating shop began operation in 1983.

No evidence of a release from this operation has been found and no additional investigations are planned under this RFI Work Plan.

2.6.24 SWMU #24, Waste Oil Reclamation Facility

The waste oil reclamation facility is located in the south-central portion of the shipyard and has been in operation since 1950. This unit consists of two storage/separation tanks identified as Tanks 39-A and 39-D. Waste oils unloaded from ships or from base operations are pumped into this facility via underground pipelines. Gravity oil-water separation occurs inside the tanks which are operated in alternation. The water phase is drawn off and discharged to the sanitary sewer system and the recycled oil is reused at the base. All underground lines are cathodically protected and all lines are annually pressure tested. The tests are performed by applying a positive pressure of 40-60 psi and monitoring the system for two hours for pressure loss. The annual line pressure test results are presented in Appendix N. These results indicate a leak was detected on 4 June 1992 in one of the lines which supplies tank 3906 O located at the Chicora Tank Farm. The spill area at the Chicora Tank Farm was remediated when the contaminated soils were excavated and disposed of offsite. Tank 3906 O is connected to the waste oil reclamation operation, however it is located on a discontiguous property and is not covered under the Part B Permit. Furthermore, the piping which serves the Chicora Tank Farm operates independently of the piping which serves tanks 39-A and 39-D. No additional investigations are planned under this RFI Work Plan.

2.6.25 SWMU #25, Building 44, Old Plating Operation

The old plating operation occupies the northern portion of Building 44. Phased out of operation in 1983, the unit was replaced by a new (non-cyanide process) plating operation (SWMU #23). The interior of this unit still contains all operation equipment from the plating process (tanks, vats, ventilation hoods, mechanical and ancillary equipment). Before the plating operation was deactivated, all vats and tanks were emptied and the waste removed. Areas of concern for this

SWMU are deteriorated concrete flooring, product accumulation around tanks, the floor drainage system, interior surface contamination, subsurface soils and groundwater.

An environmental study of the abandoned Building 44 Electroplating Facility was performed by Davis and Floyd, Inc. in April 1991 (Ref. 15). A copy of this report has been included as Appendix O. The purpose of the study was to determine necessary actions prior to building demolition. Samples were collected primarily from the process tanks so that interim corrective measures to remove the tanks could begin. Several samples were also collected from an overhead structure, wall, floor and floor drain (Figure 2-26).

Sample results for each area contained high levels of metals contamination. These data are included in Appendix O. Total metals analysis ranges are:

Silver	<1.0 to 145 ppm
Cadmium	2.02 to 84340 ppm
Chromium	18 to 11940 ppm
Nickel	0.63 to 2.7 ppm
Mercury	6.7 to 446000 ppm
Lead	<0.08 to 6920 ppm
Cyanide	83 to 129100 ppm

TCLP analysis performed on samples also exceeded the regulatory limits for barium, cadmium, and chromium. Although this extensive sampling program has identified contamination in the building interior, contamination of subsoils and groundwater beneath the area of operation has not yet been documented. Visual observations of the floor and drainage system indicate a high potential for subsurface contamination.

Subsurface contamination around the waste treatment tank, SWMU #22, revealed high levels of chromium and cadmium contamination (Section 2.6.22). Although the treatment tank is the most

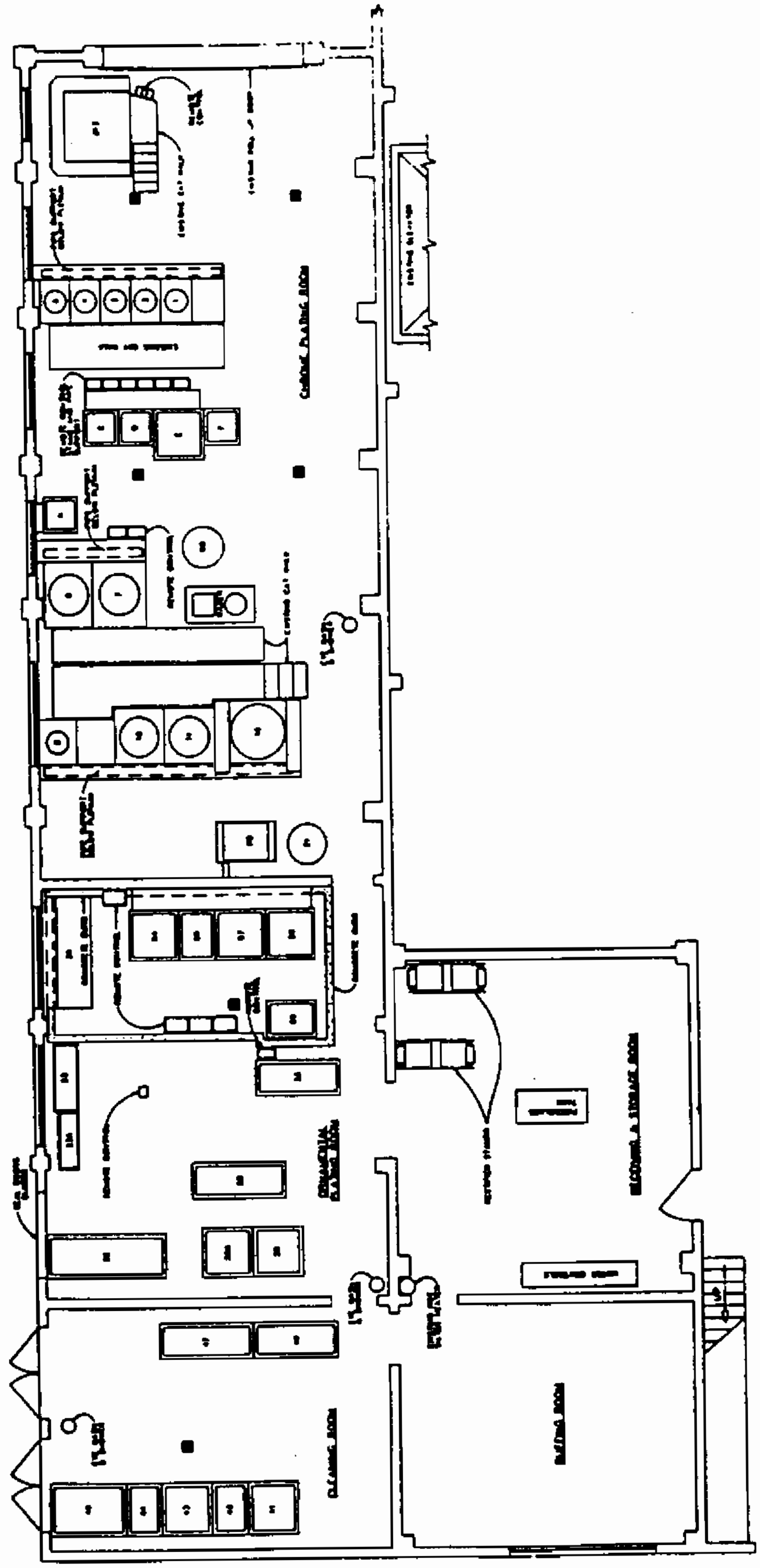

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FIGURE 2-26
BUILDING 44
ELECTRO-PLATING FACILITY
TANK LOCATIONS
(FIGURE TAKEN FROM REF. 15)

DATE: 08/05/92

DWG NAME: CNSY

obvious source, contributing factors may include spillage and leaks from Building 44, underground ancillary piping, or leakage and migration from the floor drain system.

An investigation and building decontamination is proposed for this SWMU. A phased approach delineating potential contamination on the building's concrete floor, subsurface soils, and groundwater will be required to determine the effort required for remediation. This SWMU is fully addressed in Section 3.22 of this RFI Work Plan.

2.6.26 SWMU #26, Waste Storage Area, Building 64-40, Pier C

This area is approximately 100 square feet of asphalt pavement located on the east side of Building 74 in a heavily industrialized area near Pier C. Six 55-gallon drums of waste (seam filler, lead waste, adhesive waste, alcohol rags, and trichloroethane rags) were temporarily stored here without proper authorization. The area was clean closed on the day it was brought to management's attention, during the DHEC and EPA site inspection.

No releases occurred at this unit. No additional investigation is planned.

2.6.27 SWMU #27, Waste Storage Area, East End, Pier C

This paint storage area is a satellite accumulation area located at the east end of Pier C. The unit comprises approximately 200 square feet of the concrete pier. A flammable storage shed and lockers store virgin paints, enamel thinners and fire retardants used for ship repair. Waste containers from the operation are accumulated beneath a canvas tent. The floor is canvas covered plywood surrounded by a berm. Bermed areas at this unit include 55 and 30-gallon drum containers and a storm drain.

During the DHEC and EPA site inspection, containers of hazardous wastes were either not labeled or had no accumulation dates. Also, there were no inspection records for the unit. As a result of the large number of shops and numerous employees in the shipyard, implementation of established hazardous waste procedures for handling waste material have been difficult to implement fully at some of the shops. As previously described in Section 2.4, the NSY Environmental Division has established a zone inspection system to regularly perform site inspections to help monitor hazardous waste handling practices. Incident reports are written up and notification of deficiencies are submitted to the shop heads for corrective action.

Although there are paint stains on the surface, none are in proximity to the storm drain which is actually a grate through which storm runoff falls directly into the Cooper River. The RFI will address sampling of the sediments of the Cooper River beneath the drain grate to determine if a release attributable to this SWMU has occurred.

2.6.28 SWMU #28, Waste Paint Storage Area, West End, Pier C

This unit was used as a one time waste accumulation area unbeknownst to the NSY Environmental Division. The unit is approximately 100 square feet in area and is surrounded by asphalt. Adjacent to the area is an empty flammable liquids storage shed. A storm sewer drain is located 30 feet downgradient of this unit. Paint spills from this accumulation area were confined to the small 100 square foot area.

The inspection by DHEC and EPA observed drums and bags of paint waste, waste thinners, and waste naphtha/alcohol. Standard protocol for labelling, maintenance, and control measures were not being followed in handling the hazardous waste.

The unit was clean closed the day of the inspection. No evidence of a release was observed, however, sampling of the storm sewer will be addressed in Section 3.24.

2.6.29 SWMU #29, Building X-10

This unit is located south of Building X-10, near Building 1431. Used as a waste accumulation area, this unit received waste from submarine maintenance and repair. This area is primarily a large asphalt covered area with some soil and grassy areas to the southwest and northeast. During a site visit by WAPORA personnel, the area was clean and no evidence of surface staining was observed.

The surprise inspection performed by SCDHEC and EPA revealed 11 55-gallon containers (waste paint, waste monoethanolamine, and waste solvents), 26 5-gallon containers of waste monoethanolamine and numerous 5-gallon and smaller containers of paint waste. Also stored in this unit were 20 pallets of waste stock (expired material) labelled corrosive along with other pallets of waste chemicals. Many of the containers failed to have the proper hazardous waste label, date of accumulation, or inspection records. Storage of incompatible waste and evidence of spills were also observed during the inspection. Currently this site is used to store non-hazardous material only. Asphalt and soil from previous spills have been removed and properly disposed of.

Historical information gathered from the past utilization of this area and the visual observations noted during the DHEC and EPA site inspection warrant a preliminary subsurface investigation for this unit under this RFI Work Plan. The investigation of SWMU #29 will be incorporated into the investigation of SWMUs #34 and #35.

2.6.30 SWMU #30, Satellite Accumulation Area, Building 13

The Satellite Accumulation Area is used to receive waste generated from the laboratory in Building 13. Located between Buildings 13 and 187, outside the southeast wall of Building 13, the unit and surrounding area is asphalt with a storm sewer drain 20 feet downgradient.

This accumulation area contains a steel box for storage and containment of pails (5 gallons and smaller), trash bags, and a portable 300-gallon steel waste oil tank. Two 55-gallon drums of oil sludge labelled hazardous waste were also present only at the time of the DHEC and EPA site inspection. Spillage was observed around the drums, apparently the result of someone recently adding waste to the containers. Comments from the SCDHEC and EPA site inspection included containers either did not have accumulation dates, proper labelling, inspection records, or spill control equipment to minimize release of hazardous waste to the environment.

This area is continuing to be used as a satellite accumulation area; therefore, additional construction, operation, and maintenance measures were completed at this unit. These measures included installation of a roof, drip pans, and signs. A waste pickup schedule has also been established and inspection records are maintained for the site. Additional investigation of this SWMU is warranted to evaluate if potential impacts to the environment have occurred.

2.6.31 SWMU #31, Waste Paint Storage Area, Dry Dock No. 5

This unit is a satellite accumulation area located in Dry Dock No. 5. The area, 200 square feet in size, performs the same functions as SWMU #26. Located on the concrete floor of the drydock near the center of the north wall, the unit is used intermittently to service submarines in drydock. A tent is erected over canvas covered plywood with sand bag berms. Paints are thinned and placed in one gallon buckets with plastic liners for transport to the submarine. A trench drain directly behind the unit is part of the intake system to drain the drydock once the ship has entered.

Comments made during the inspection by DHEC and EPA noted two 55-gallon drums of waste paint, solvent rags, and thinners stored onsite without proper labelling, date of accumulation, inspection records, or spill control equipment. Numerous spills were also noted in the unit. Additionally, a storage shed was noted as having a bad solvent odor.

No releases have been reported from this unit; however, hazardous constituents have the potential to migrate to surface waters during filling of the drydock with water to remove the ships. According to the written SOP, these wastes are to be removed from the drydock prior to filling with water. The written SOP requires that the drydock will be maintained in such a manner as to limit the potential for release to surface waters. The potential for migration of the paints and thinners is limited since the paints harden and the thinners volatilize before the drydock is filled anyway.

Even though this unit is no longer operational, sampling of sediments in the Cooper River will be addressed in Section 3.27.1.

2.6.32 SWMU #32, Waste Paint Storage Area, Building 195

This waste paint storage area was used as a one time waste accumulation area (without proper authorization) located along Pier F between Buildings 195 and 1802. The unit encompassed approximately 400 square feet of area 40 feet from the edge of the water. The surface is concrete with asphalt to the south.

At the time of the DHEC and EPA inspection, this area contained five 55-gallon drums of paint waste, lead and thinner waste, numerous 5-gallon containers of paint waste, and trash bags with paint and solvent rags. A shipping container, adjacent to the site, was also being used to store containers of paint. None of the containers had the proper labelling or markings; date of accumulation; lids securely closed; or maintained and operated properly to minimize fire, explosion, or a sudden release of hazardous waste to the environment. In addition, a corroded area in the shipping container allowed liquids to leak from the shipping container into a storm drain.

An inspection of this unit by SOUTHDIV revealed the waste and shipping container had been removed from the area. A subsequent investigation performed by WAPORA confirmed SOUTHDIV's inspection that this area was no longer used for storage.

This unit was a one-time accumulation area and the containers stored here were removed from the area immediately after the investigation. Even though leakage from the container was a one-time event, the nature of the release was such that soils at the site may have been adversely affected, and will be addressed in Section 3.28.

2.6.33 SWMU #33, Waste Paint Storage Area, West End, Dry Dock No. 2

The waste paint storage area was used as a one time waste accumulation area located at the western end of Dry Dock No. 2. This unit covers approximately 200 square feet of concrete pavement and is situated 40 feet from the edge of the dry dock. This heavily industrialized area is primarily asphalt with railroad tracks, overhead cranes, heavy equipment, and elevated offices surrounding the dry dock and SWMU area.

The inspection performed by DHEC and EPA revealed two 55-gallon drums of waste paint and waste thinner, numerous 5-gallon containers of paint waste, and trash bags containing solvent rags and paint waste. Spillage was observed in the area. Operation and maintenance procedures to minimize a release were not followed; labelling, accumulation dates, and securing containers were not performed properly as well.

During the time subsequent investigations were performed by SOUTHDIV and WAPORA, the waste material had been removed from the site. In fact, much of the asphalt and concrete had been excavated to overhaul the railroad tracks servicing the dry dock. The RFI Work Plan will address sampling activities proposed for SWMU #33 in Section 3.29.

2.6.34 SWMU #34, MWR, Southwest of Building X-10

The Morale, Welfare, and Recreation (MWR) building was utilized as a one time waste accumulation area. This fenced compound, southwest of Building X-10, is 70 feet by 50 feet in size and is primarily soil and grass.

During the DHEC and EPA site inspection, four 55-gallon containers of paint were stored in this area. Several of the drums were reported as leaking with spillage apparent on the ground around them. The containers lacked the proper labelling, date of accumulation, inspection logs, and operations and maintenance procedures to guard against fire, explosion, or releases to the environment. A diesel tank in this area was also observed to be leaking. Closure of the diesel tank was completed immediately after the inspection. Diesel fuel contaminated soils and asphalt were removed and properly disposed of.

Although no surface staining or evidence of a release were observed in this area during the latter investigation, a limited soil sampling investigation will be performed in concert with SWMUs #29 and #35. SWMU #34 will be incorporated into SWMU #29 and #35 to cover the area behind buildings X-10 and X-12, since these are adjacent to one another. Runoff from the asphalt storage area behind building X-10 influences both areas.

2.6.35 SWMU #35, Building X-12

The area on the east side of Building X-12 was used as a one time waste accumulation area. The unit measures approximately 100 square feet in size and is covered in gravel.

At the time of the DHEC and EPA site inspection, five 55-gallon containers and numerous smaller containers of waste paint were stored at this unit. None of the containers were properly labelled, had a date of accumulation, or inspection records. Numerous containers did not have secured lids and spill control equipment was not available.

All improperly stored containers were removed immediately after the site inspection. Each container was handled following the established SOP for hazardous waste transportation, storage, and disposal at the Naval Shipyard facility. No new containers had been added to the area or any evidence of spills observed during the subsequent inspections of this unit.

This unit was used as a one-time waste accumulation area and does not exhibit the characteristics of having had routine or systematic releases of hazardous waste to the environment. However, as described above, SWMU #35 will be investigated concurrently with SWMUs #29 and #34.

2.6.36 SWMU #36, Building 68, Battery Shop

The Battery Shop began operation in the early 1940s and is presently in use. The unit is contained inside of building 68 which is approximately 48,000 sf. in size. During normal Battery Shop operations all spills are contained within the building, drained to a holding tank at the south end of the building and pumped to a neutralization pit at Building 1278.

Virgin sulfuric acid and sodium bicarbonate are stored at this site in bulk quantities of thousands of gallons and hundreds of pounds respectively. Various other chemicals are stored in building 68, but in smaller quantities. They are detergents, lacquers, adhesives, penetrating oil, kerosene, dry cleaning solvent, and hydraulic fluid to name a few.

The building's acid tank room floor is elevated about 2 feet above the soil. Drain lines run between the bottom of the floor and the surface of the soil to the edge of the building. From the edge of the building they run below ground to the holding tank.

On two occasions the floor drain to the holding tank separated from the floor allowing approximately 1025 gallons of sulfuric acid to discharge to the soil below the building. Following each spill a sodium carbonate solution was used in an attempt to neutralize the surface below the building.

Further investigation of this facility is warranted to determine if any impacts to the soil and groundwater have occurred due to the acid releases. Details of the investigative activities are outlined in Section 3.31.

3.0 FIELD INVESTIGATION

This portion of the RFI Workplan details proposed field and laboratory investigations to be performed at the Charleston Naval Shipyard. The purpose of this work is to fill in gaps in the existing data, resulting in a sufficiently complete characterization of the site's environmental setting, the nature and extent of contamination, and to assess the risks the site may pose to human health and the environment. To meet this objective, the RFI will be conducted in a phased approach that will allow for a continuation of data collection efforts (if necessary) as an understanding of the site is refined. This approach will include the collection of specific media from those SWMUs outlined in subsequent sections. Phase I of the investigation will be conducted to address data gaps identified at 27 of the 36 SWMUs. Groundwater will only be investigated in Phase I where specified. Phase II of the investigation will be to more specifically characterize the nature and extent of the contamination of both soils and groundwater where necessary. **Slug tests will be performed on a representative number of wells from each site to estimate the hydraulic conductivity and transmissivity within an order of magnitude. If necessary, a constant rate aquifer test will be designed and conducted during implementation of remedial actions.** The sections below address the proposed additional investigations for each SWMU, including plans delineating specific sampling locations.

Investigation work elements will include soil test borings, sediment sampling, test trenching, monitoring well installations, groundwater sampling, geophysical surveys, a soil gas survey, and analytical testing. The geophysical surveys scheduled for SWMUs 9 and 14 have been implemented per previous agreement between SOUTHDIV and USEPA. The RFI work will be performed in accordance with protocols outlined in the EPA Region IV *Standard Operating Procedures and Quality Assurance Manual* (SOP) (Ref. 18) and SW-846 (Ref. 21). Key elements of these protocols are highlighted in Section 4. The analytical program will similarly be implemented in accordance with accepted methods and a strict Quality Assurance/Quality Control program, as detailed in Sections 4 and 5. **All analyses will be SW 846 Methodologies as required by RCRA. At a minimum deliverables will be completed under Data Quality**

Objective (DQO) Level III criteria, which is equivalent to NEESA Level C criteria. Duplicate analyses will be conducted at a frequency of 10% at DQO Level IV (equivalent to NEESA Level D). Section 7 addresses the Health and Safety Plan (HASP), providing health and safety guidance for all RFI site activities.

3.1 Soil Sampling

The RFI at the NSY will incorporate multiple techniques and rationale for sampling at individual SWMUs. Soil sampling techniques will include but not be limited to the use of stainless steel hand augers, a petite ponar dredge (sediment samples), soil borings utilizing split spoon samplers, and stainless steel trowels and scoops. The investigation to be conducted at the individual SWMU identifies specific methodologies. **Unless otherwise specified, soil samples will be collected from soil sample stations and well borings at the 0 to 1 foot interval (to calculate risk based direct soil exposure thresholds); collection of additional samples from the 3 to 5 foot interval and 8 to 10 foot interval will be contingent upon the depth to groundwater. Collection of samples for chemical analysis will be terminated once the water table is encountered. As discussed in Section 2.6, establishing background concentrations (inorganics in particular) may be extremely difficult at a number of SWMUs located in areas filled by dredge spoils. An attempt will be made to identify the SWMUs in question by reviewing historic topographic maps, base maps of the Shipyard date back to the early 1900's, and aerial photographs. The information will be used to direct soil sampling efforts designed to establish background concentrations for contaminants of concern at each SWMU. A statistical analysis of the analytical data will be performed to ascertain whether appropriate background concentrations can be determined. Where possible, this information will be used to assess contaminated media relative to background. If true background conditions do not exist, alternative risk based action levels based on direct soil exposure and/or soil to groundwater cross media transfer potential may need to be developed. Preliminary risk based action levels for the alternative approach were presented in the document *Proposed Risk-Based Action Levels, Charleston Naval Shipyard* prepared by**

E/A&H. In order to meet requirements of the facility Permit (SCO 170022560) and aid in selection of corrective measures, select soil samples will be collected and analyzed for physical/chemical parameters. Analysis will include those parameters listed in Section II.A.2 and 2.B of the Part B Permit, where applicable. Table 3-1 lists the proposed number of samples to be collected and submitted for laboratory analysis during Phase I of the RFI. Additional samples may be submitted for analysis as warranted by field screening or professional judgement.

3.2 Groundwater Sampling

Groundwater samples will be collected from monitoring wells at the outlined SWMUs. Groundwater samples being designated for metals analysis will only be assayed for total metals during Phase I. Complete details of sampling techniques are included in Section 4, the Quality Assurance Plan. **Gauging of the monitoring wells will be conducted on a regular basis, as described in Section 4.7, to allow construction of a series of SWMU-specific groundwater surface contour maps and also more areally extensive maps.**

3.3 Aquifer Tests

As previously outlined, either a constant rate pump test or slug tests will be performed during Phase II in an effort to evaluate physical characteristics of the surficial aquifer beneath the NSY. The following discussion outlines the basic concepts which will be applied during the design of such tests.

Constant Rate Pump Test

Constant rate pump tests are used to determine the specific capacity, transmissivity, and storage values of the surficial aquifer. To derive this information a pumping well and a minimum of two observation wells. The observation wells are typically located at logarithmic distance intervals from the pumping well. The pumping well would be installed so that the screened interval spans

Table 3-1
Proposed Number of Samples
To Be Collected During Phase I of RFI

SWMU	SOIL	GROUNDWATER	SEDIMENT	CONCRETE CORES
1 & 2	60	6	13	--
3	18	3	--	--
4	10	3^	1	--
5	30	4	--	--
6 & 7	88	7	--	--
8	60	6	--	--
9 & 20	22	10+	3	--
12	25+	3	--	--
13	--	--	1	--
14	25+	5	--	--
17	20	4	--	--
21	18	3	3	--
22 & 25	34	5	--	7
27	--	--	1	--
28	--	--	1	--
29 & 34 & 35	20	--	--	--
30	1	4	1	--
31	--	--	2	--
32	3	--	1	--
33	--	--	2	--
36	6	--	--	--

Note: These numbers represent the anticipated number selected to be sent to the lab, but due to the analytical scheme at some sites all samples may not be analyzed if non detectable results are reported for surface intervals.

-- None Proposed

+ additional samples collected as conditions dictate, see workplan at least 80% of the aquifer. The observation wells would be partially penetrating if information regarding vertical conductivity is necessary. Previous studies have indicated the surficial aquifer to be unconfined; therefore, the pumping duration would be a minimum of 72 hours. The recovery of the wells would also be monitored following completion of the test. Elapsed time measurements and water level drawdown in each of the wells would be recorded throughout the pumping and recovery periods using pressure transducers and an electronic data logger.

Slug Tests

Rising and falling head slug tests are performed on wells in order to characterize the hydraulic conductivity of aquifer materials. Before a slug test is started, the static water level in the well is measured using an electronic water level indicator. A stainless steel cylinder is then introduced "instantaneously" into the well, at which time, the water level and the time "T_0" is recorded. Periodically, water level/elapsed time measurements are recorded as the head falls back to the original level. Similarly, a rising head slug test is performed by removing the slug and recording water level/elapsed time measurements as the head rises back to normal. The time required for the slug test to be completed is a function of the hydraulic conductivity of the aquifer. Once again, pressure transducers and an electronic data logger would be used to record water level/elapsed time measurements during the test.

3.4 Ecological

At the present time, insufficient information is known about each of the sites to outline the number of samples required or their precise locations. To address ecological concerns, a phased ecological assessment procedure will be developed to address ecological risks posed by individual sites. Phase I is a habitat and biota survey including a review of site history, a TES survey, wetlands delineation, and sediment mapping within surface water bodies including wetlands. Completion of phase I is necessary to select sampling locations for samples collected in phase II. If contamination warrants further study, complete delineation of the contamination will be accomplished in a third phase. River sediment

and/or surface water samples may need to be collected upstream or downstream of the site. Based on the results of the initial phases, a fourth phase, including toxicity and diversity studies, may be implemented. A fifth phase may be conducted addressing any existing data gaps.

3.5 Corrective Action Management Plan

A corrective action management plan will be submitted under separate cover. The plan provides a detailed time table for implementing the proposed additional investigative activities at each SWMU. In addition, it prioritizes the work schedules so that units having the most significant releases will be addressed first.

3.6 SWMU #1, DRMO Staging Area

As outlined in Section 2.6.1, the South Carolina Hazardous Waste Permitting Section (July 1992) has requested a revision to the closure plan for this unit. **SWMU #1 is being closed under approved closure to health-based concentrations as determined by risk assessment. To verify the data collected during closure, two soil borings will be drilled at the former shed location (Figure 3-1). The soil samples will be analyzed for volatile organics, semi-volatile organics, pesticides, PCBs, and Contract Laboratory Program Target Analyte List (TAL) inorganics (both metals and cyanide) at DQO Level IV.**

To ascertain if groundwater has been impacted from staging operations a groundwater assessment will be implemented. **Because SWMU #1 is encompassed within SWMU #2, the groundwater investigation of SWMU #1 will be conducted concurrently with the groundwater investigation of SWMU #2 as outlined in Section 3.7.**

3.7 SWMU #2, Lead Contamination Area

Environmental conditions in SWMU #2 are described in Sections 2.6.1 and 2.6.2. Pertinent features of this area include a salvage bin (bin #3), surficial dust on adjacent paved areas, contaminated soils adjacent to the paved area, and surface contamination in the soils at SWMU #1 where Building 1617 was formerly located. **Prior site investigations have provided extensive data on total lead concentrations in soil.** Investigations at SWMUs #1 and #2 have included 282 samples of surface and subsurface soils. The NSY is currently seeking clean closure for SWMU #1 under a risk assessment performed in April, 1991 (Ref. 16). Certain areas at the DRMO, however, have not been completely delineated. In addition, the effects of Hurricane Hugo may have expanded the area of contamination or reduced the concentrations of the contaminants.

3.7.1 Soil Sampling

An extended sample investigation (ESI) will be required to complete the delineation of lead contamination at the DRMO facility. Verification soil samples will be collected from areas where high concentrations of lead were previously reported. Samples will also be collected from storm water sewers, storm water outfalls, river sediments, and areas where storm water runoff may have transported contaminants beyond the site boundaries.

Figure 3-1 shows the proposed soil sample locations; the field scientist will have authority to adjust these locations as conditions warrant. A total of 28 soil sample stations are planned (including those borings to be completed as monitor wells). Seven sediment samples from Cooper River and six sediment samples from the storm sewer will also be collected. All samples will be analyzed for **TAL inorganics**.

3.7.2 Groundwater Sampling

Six monitoring wells will be installed around the pad at the locations shown in Figure 3-1. The purpose of these wells is to determine if soil lead contamination has adversely impacted groundwater quality in the surficial aquifer. The monitoring well located northwest of Building 1614 is anticipated to function as an upgradient well. One monitoring well is proposed for the immediate vicinity of SWMU #1. The remaining wells will be placed around the perimeter

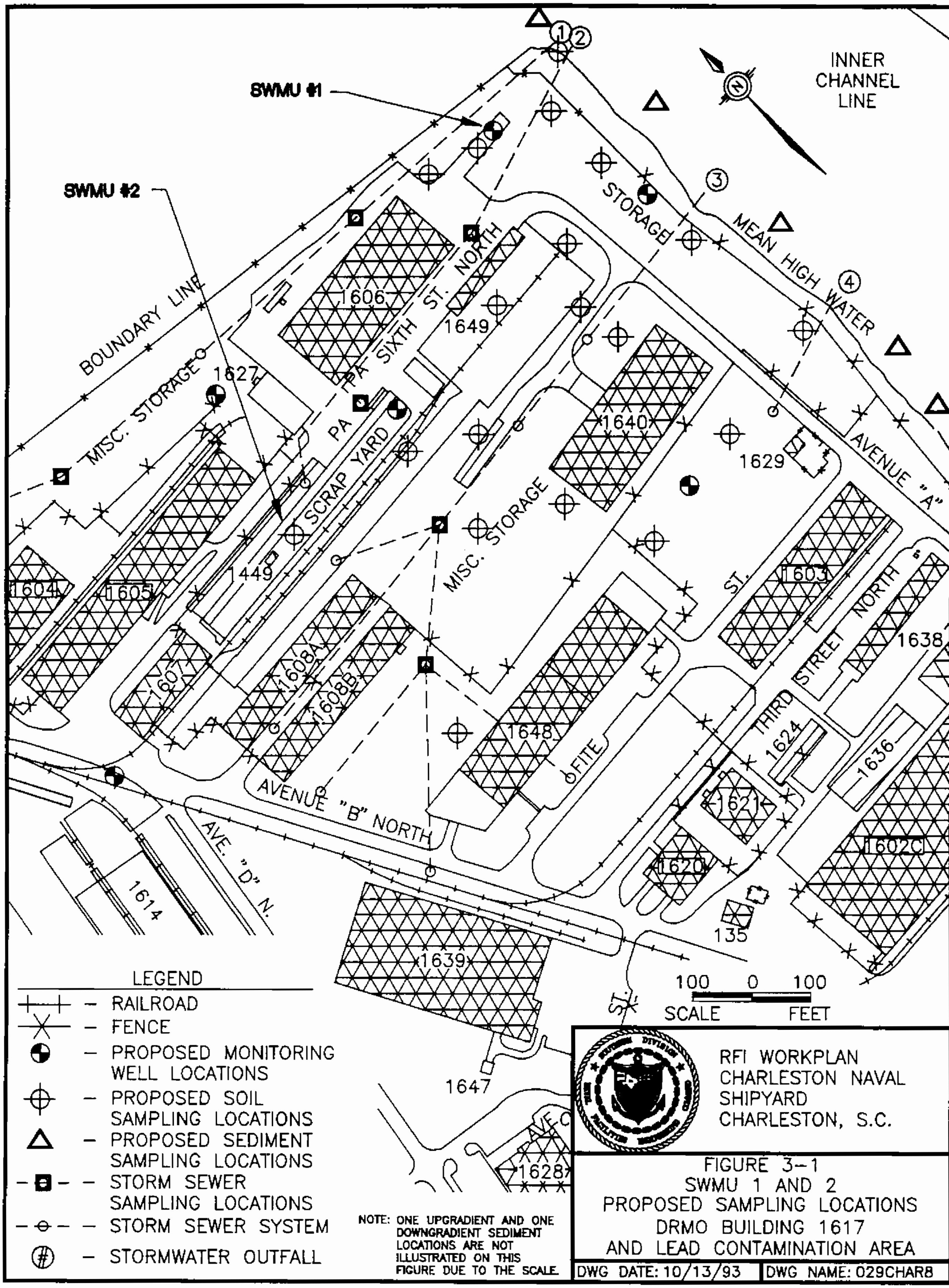


FIGURE 3-1
SWMU 1 AND 2
PROPOSED SAMPLING LOCATIONS
DRMO BUILDING 1617
AND LEAD CONTAMINATION AREA

(north, east and south boundaries) of the site. **With the exception of the samples collected from the monitoring well installed in the immediate vicinity if SWMU #1, groundwater samples will be analyzed for TAL inorganics. Groundwater samples from the SWMU #1 monitoring well will be analyzed at DQO Level IV for volatile organics, semivolatile organics, and pesticides/PCBs in addition to the TAL inorganics.**

The groundwater surface contour maps generated for this site will indicate the directions(s) of groundwater flow in and near SWMU #2. Combining the hydrogeologic data and analytical results should allow a better understanding of the extent and magnitude of any groundwater contamination resulting from the lead contaminated area and the direction and migration rates of potential groundwater plumes. Once this information becomes available, then additional offsite monitoring wells will be proposed, if necessary, to complete the delineation effort.

3.7.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil surface and/or groundwater. Utility construction should be minimized and conducted with the proper preventive measures to prevent physical contact with potential contaminants. Access to the area should be restricted until remedial activities have been completed.

3.8 SWMU #3, Pesticide Mixing Area

SWMU #3 is described in Section 2.6.3 as an area approximately 50 feet by 25 feet which was devoid of vegetation. The previous investigation of this area included the collection of eight soil samples from four sampling locations within the denuded area. The vegetation has since grown back; however, for purposes of this discussion the area will still be referred to as the denuded area. The maximum sampling depth during the previous investigation was two feet below the ground surface.

3.8.1 Soil Sampling

The four sampling locations located in what was the denuded area will be recreated during Phase I of the RFI to further delineate the vertical extent of contamination, **unless the depth to groundwater prevents deeper sampling. Seven additional sampling locations are outside the denuded area; soil samples will also be collected in this area to attempt to delineate the horizontal extent of contamination not defined during the Confirmation Study.**

3.8.2 Groundwater Sampling

Three of the soil borings advanced into the uppermost aquifer will be completed as shallow monitoring wells. All wells will be installed outside of the denuded area as shown on Figure 3-2. **If access conditions necessitate installing the well in or very near the denuded area, a section of surface casing will be installed to isolate potentially contaminated soil prior to advancing the boring past the water table. Soil and groundwater samples will be analyzed for chlorinated pesticides (Table 2-5 compounds for which SW-846 Methods exist), herbicides, and TAL inorganics.** If the two monitoring wells that were previously installed at this location cannot be located, they will not be reinstalled during the RFI. The Confirmation Study indicated these wells were installed within the denuded area which would be a potential source area for groundwater contamination. E/A&H does not recommend installing wells through a potential source.

3.8.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil surface and/or groundwater. Utility construction should be minimized and conducted with the proper preventive measures to prevent physical contact with potential contaminants.

3.9 SWMU #4, Pesticide Storage Building

The pesticide storage building has been used to store various insecticides and rodenticides since 1980. It is a steel building with a concrete floor. The building is equipped with a formulation and mixing room. Sink and floor drains within the building are connected to the sanitary sewer system. An equipment rinse area/wash rack is located adjacent to the storage administration facility. Although no evidence of contamination was found or has been reported for this site confirmatory samples will be collected.

3.9.1 Soil Sampling

The soil sampling program is designed to address surface releases in addition to potential releases to the sanitary sewer. Five hand augers sample locations are outlined for confirmatory sampling. Two shallow hand auger borings will be installed (Figure 3-3) on the northeast side of Building 381. Three hand auger borings will be installed in the drainage swale and a sediment sample collected from the storm sewer to determine if these areas have been adversely impacted. Surface water runoff at this facility is directed either towards a drainage swale on the southwest side of the building or a storm sewer drain located near the northeast corner of the paved parking area serving this building. **Soil samples will be analyzed for chlorinated pesticides (Table 2-5 compounds for which SW-846 methods exist), herbicides, and TAL inorganics.**

3.9.2 Groundwater Sampling

If significant levels of contaminants are identified in soils, three groundwater monitoring wells will be installed during Phase II of the investigation.

3.9.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil surface and/or groundwater. Utility construction should be minimized and conducted with the proper preventive measures to prevent physical contact with potential contaminants.

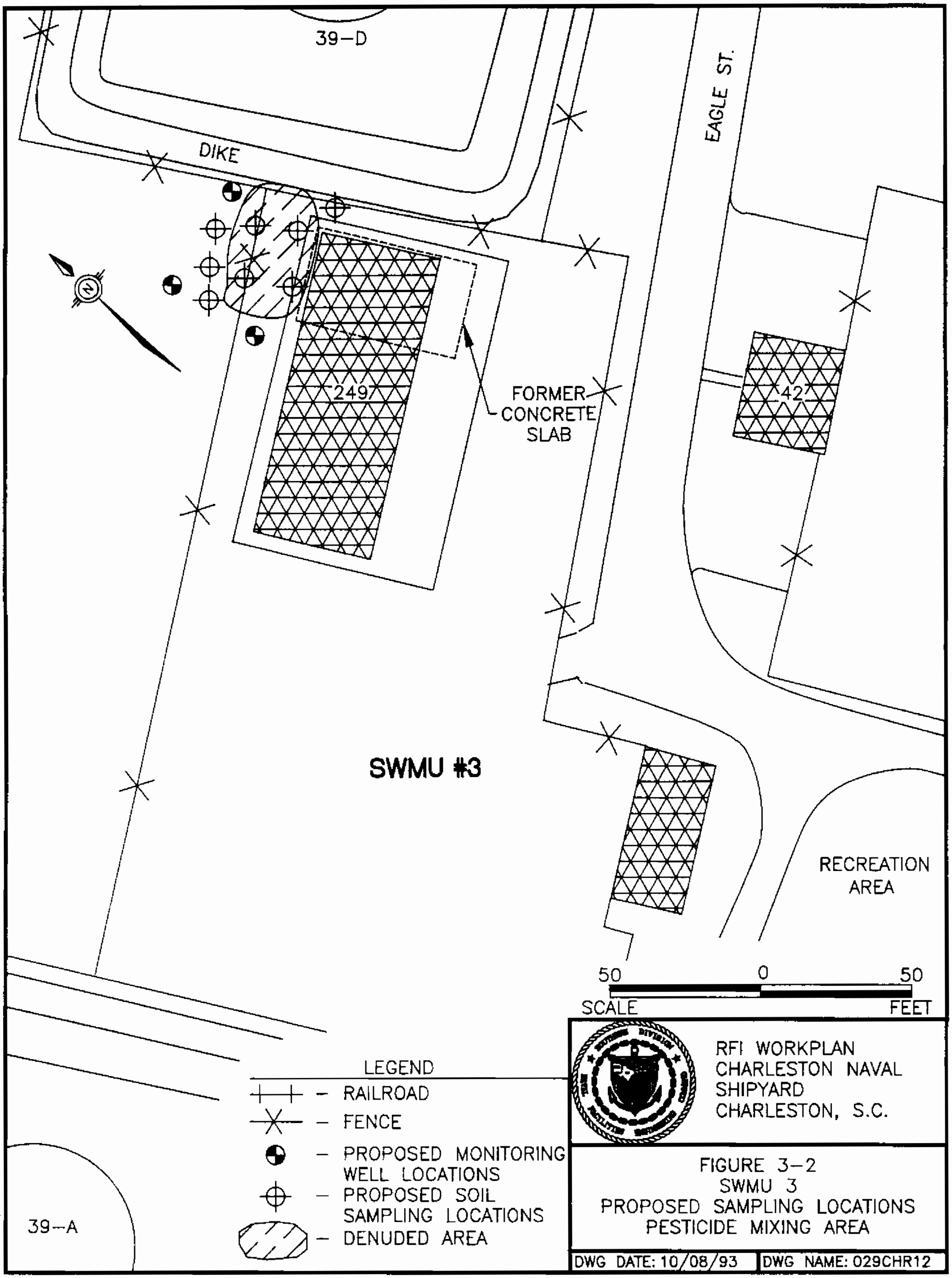


FIGURE 3-2
SWMU 3
PROPOSED SAMPLING LOCATIONS
PESTICIDE MIXING AREA

3.10 SWMU #5, Battery Electrolyte Treatment Area

The battery electrolyte treatment area is primarily the acid waste treatment tank and surrounding soils. A sample investigation of this area conducted by EnSafe (Ref. 5) revealed lead contaminated soils around the treatment tank at a depth equal to the bottom of the tank (5.5 feet below ground surface). However, the investigation encompassed only a 5-foot perimeter around the treatment tank. Under this RFI Workplan, an expanded investigation of the area around the acid waste treatment tank and the area identified during the DHEC and EPA site inspection will be performed. Phase I of the RFI comprises an initial set of borings and monitoring wells to determine site hydrogeologic characteristics and to identify soil and groundwater contamination. Phase II will be implemented to fully delineate the extent of contamination, if necessary.

3.10.1 Soil Sampling

The previous investigation of SWMU #5 included 36 subsurface samples collected 5 feet from the perimeter of the treatment tank. This investigation is designed to expand the prior work by delineating the horizontal and vertical extent of contamination. Shallow soil borings will be installed at a distance of 10 feet, 25 feet and 75 feet from the unit on each side of the acid waste treatment tank (Figure 3-4). Horizontal spacing of proposed sampling points was selected due to enhanced migration rates of metals under low pH conditions. To assist in delineation, field crews will test pH conditions in groundwater and soil samples and adjust sample locations accordingly. One additional soil boring will be advanced near a leaking drum found during the DHEC and EPA site inspection. The soil samples will be analyzed for volatile organics, semivolatile organics, TAL inorganics, and pH.

3.10.2 Groundwater Sampling

Four monitoring wells will be installed in the surficial aquifer at the locations shown in Figure 3-4. The purpose of these wells is to determine if subsurface releases from the acid waste treatment tank have adversely impacted groundwater quality in the surficial aquifer. Field measurement of pH will also be conducted at the time of sample collection.

The groundwater surface contour maps generated for this site will show the directions(s) of groundwater flow in and near SWMU #5. Combining the hydrogeologic data and analytical results should allow a better understanding of the extent and magnitude of any groundwater contamination resulting from the Battery Electrolyte Treatment Area and the transport direction and migration rates of potential groundwater plumes. Once this information becomes available, then additional offsite monitoring wells will be proposed, if necessary, to complete the delineation effort.

The groundwater samples will be analyzed for volatile organics, semivolatile organics, TAL inorganics, and pH.

3.10.3 Temporary Land Use Restrictions

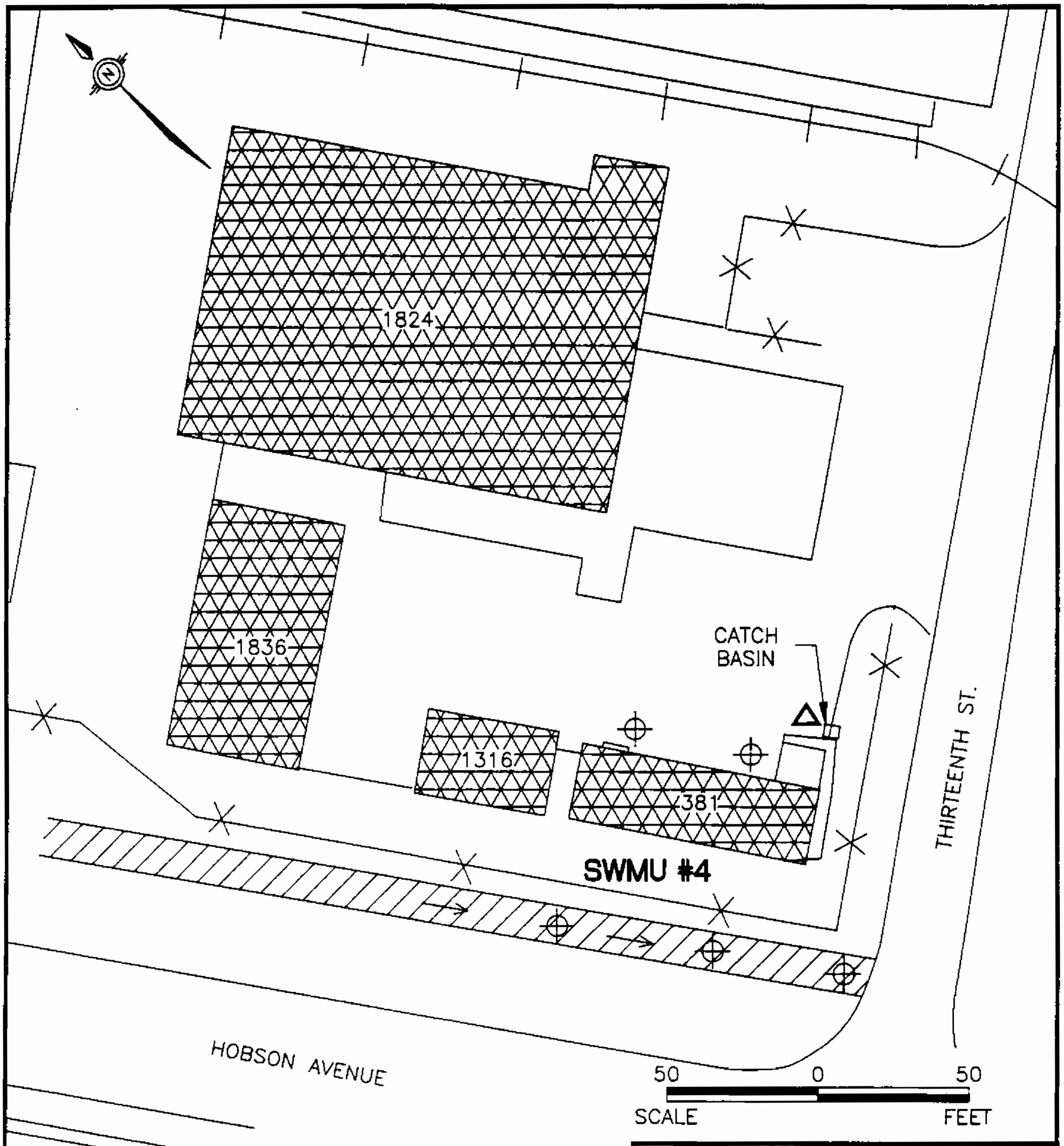
The site activities should be limited to those which do not disturb the soil or groundwater. Utility construction should be minimized and conducted with proper preventive measures to prevent physical contact with potential contaminants.

3.11 SWMU #6, Public Works Storage Yard

The public works storage yard has been extensively investigated since March of 1988. Samples collected for this unit were collected on 50-foot centers to a depth of 3 feet. Results of the sample investigations indicated elevated levels of lead contamination in three areas of the site (Section 2.6.6), which are well defined through previous studies.

3.11.1 Soil Sampling

The areal extent of contamination at SWMU #6 appears to have been delineated. However, additional assessment and/or removal of contaminated soils may be necessary pending approval of the closure plan. Soil samples collected from the well borings will be analyzed for volatile organics, semivolatile organics, pesticides, PCBs, and TAL inorganics.



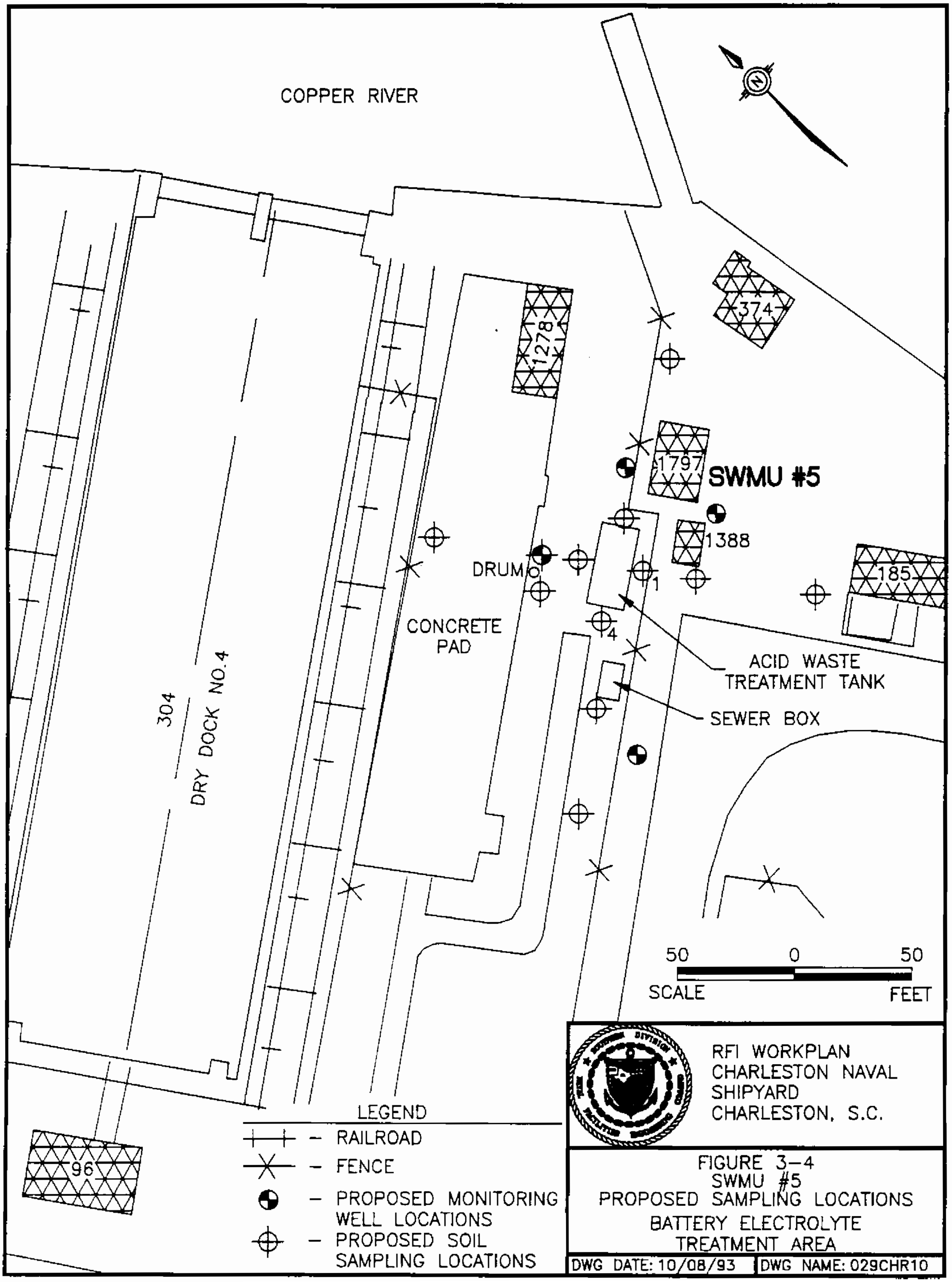
LEGEND

- RAILROAD
- FENCE
- △ – PROPOSED SEDIMENT SAMPLE LOCATIONS
- ⌖ – PROPOSED SOIL SAMPLING LOCATIONS
- DRAINAGE SWALE
- → – DRAINAGE FLOW

RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 3–3
SWMU 4
PROPOSED SAMPLE LOCATIONS
PESTICIDE STORAGE BUILDING

DWG DATE: 08/05/92 | DWG NAME: 029CHR13


COPPER RIVER
N
1278
374
1797
SWMU #5
1388
185
DRUM
1
4
CONCRETE PAD
ACID WASTE TREATMENT TANK
SEWER BOX
304
DRY DOCK NO.4
50
0
50
SCALE
FEET
96
LEGEND
- RAILROAD
- FENCE
- PROPOSED MONITORING WELL LOCATIONS
- PROPOSED SOIL SAMPLING LOCATIONS
RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.
FIGURE 3-4
SWMU #5
PROPOSED SAMPLING LOCATIONS
BATTERY ELECTROLYTE TREATMENT AREA
DWG DATE: 10/08/93
DWG NAME: 029CHR10

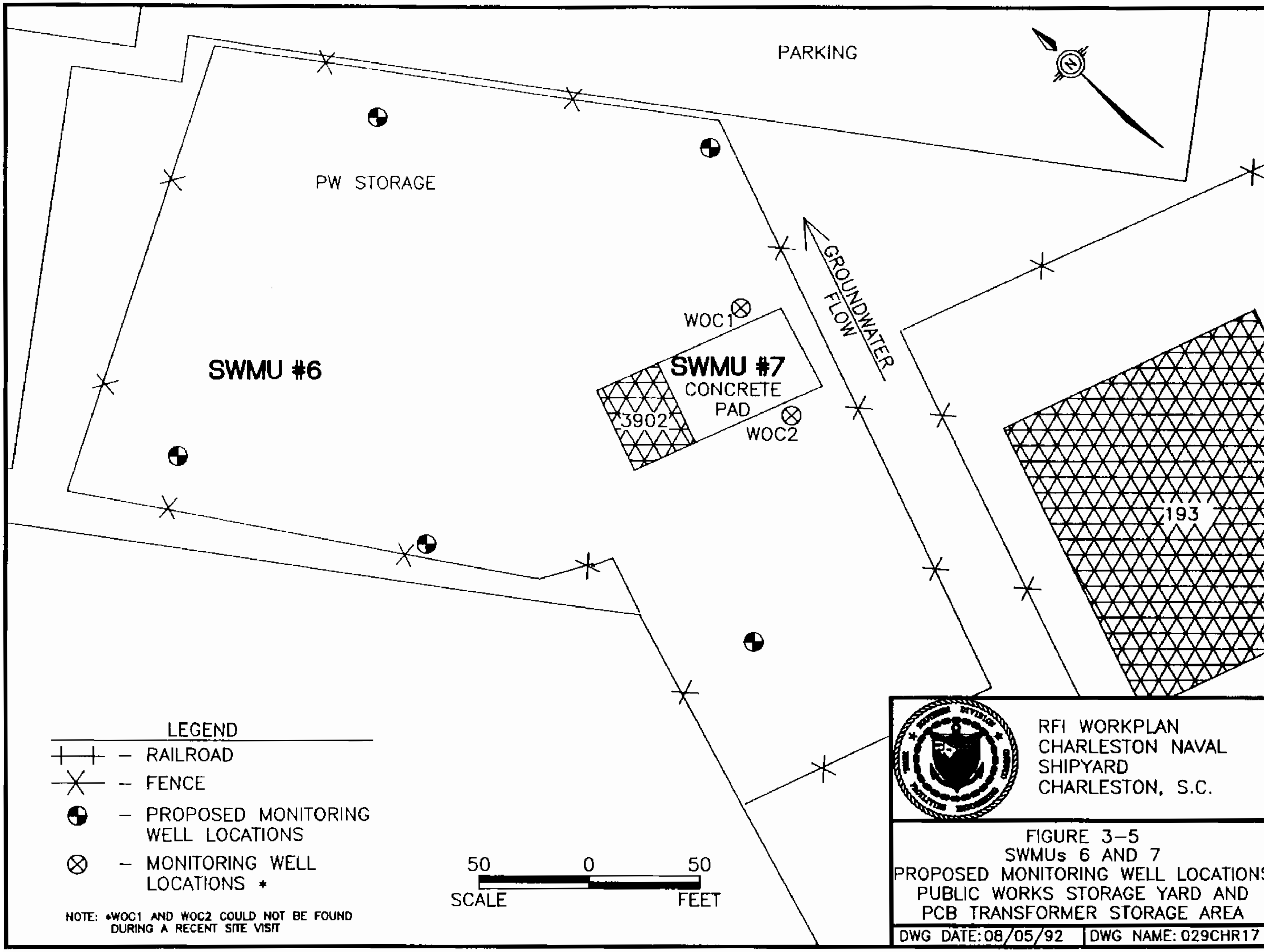
3.11.2 Groundwater Sampling

Seven monitoring wells will be installed during the RFI to assess potential impacts resulting from activities at both SWMUs #6 and #7 (Figure 3-5). Two monitoring wells, WOC-1 and WOC-2, were previously installed during the Confirmation Study in 1982 to assess potential releases from SWMU #7. These wells could not be located during a recent site visit; therefore, they will be replaced in the RFI. Five additional wells are proposed to be installed to further delineate the extent of groundwater contamination already detected at SWMU #7 and to determine if contaminated soils from SWMU #6 have impacted groundwater. The groundwater samples will be analyzed for volatile organics, semivolatile organics, pesticides, PCBs, and TAL inorganics. The proposed analytical parameters are intended to encompass all constituents of concern for both SWMUs #6 and #7.

The groundwater surface contour maps generated for the two SWMUs will show the direction(s) of groundwater flow in and near the site. Water level data obtained from monitoring wells WOC-1 and WOC-2 during the Confirmation Study conducted in 1982 indicated groundwater to be flowing in a northerly direction; however, this is being extrapolated from only two data points and is an estimate of flow direction. Combining the hydrogeologic data and analytical results should allow a better understanding of the extent and magnitude of any groundwater contamination resulting from the Public Works Storage Yard and/or the PCB Transformer Storage Area. The transport direction and migration rates of potential groundwater plumes will also be assessed. Once this information becomes available, additional offsite monitoring wells well be installed during Phase II proposed to complete the delineation effort, if necessary.

3.11.3 Temporary Land Use Restrictions

The site activities should be limited to those which do not disturb the soil or groundwater. Utility construction should be conducted with proper preventive measures to prevent physical contact with potential contaminants.



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 3-5
SWMUs 6 AND 7
PROPOSED MONITORING WELL LOCATIONS
PUBLIC WORKS STORAGE YARD AND
PCB TRANSFORMER STORAGE AREA

DWG DATE: 08/05/92 | DWG NAME: 029CHR17

3.12 SWMU #7, PCB Transformer Storage Area

This unit includes Building 3902 and the attached concrete pad. The site was used to store-out-of-service electrical materials such as rectifiers, transformers, and capacitors. In addition to storage, a number of transformers were drained near the concrete pad on the south side of Building 3902 sometime before 1976. The total amount of PCBs released to the soil is unknown due to the limited scope of prior studies.

Several studies of groundwater and soil contamination at the site have been conducted since 1981 (Section 2.6.7). These studies found contaminants in both groundwater and soils. Detected constituents included PCBs, metals, and several chlorinated hydrocarbons, but except for the PCBs, only trace detections were found. Significant PCB concentrations were detected to the east and south of Building 3902. These significant detections were in composite soil samples collected along lines running parallel to the sides of Building 3902 and the attached concrete slab; therefore, the precise location of contaminated soils and concentrations in particular areas is unknown. Additional soil sampling will be conducted to delineate the extent and magnitude of PCB concentrations in the potentially contaminated area.

3.12.1 Soil Sampling

In order to delineate the magnitude and extent of PCB and pesticide contamination, a hexagonal sampling grid based on equilateral triangles has been prepared using procedures established by the EPA in the Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup (Ref. 22). The proposed grid and soil sample locations are shown in Figure 3-6. The boundaries for the sample grid were expanded using the results of the composite analysis in Ref. 12. Using the formulas established in the Field Manual, a 94-foot sample radius was calculated. The manual recommends that the largest spill areas (i.e. those having a radius >11.3 feet) establish a 37 point grid design.

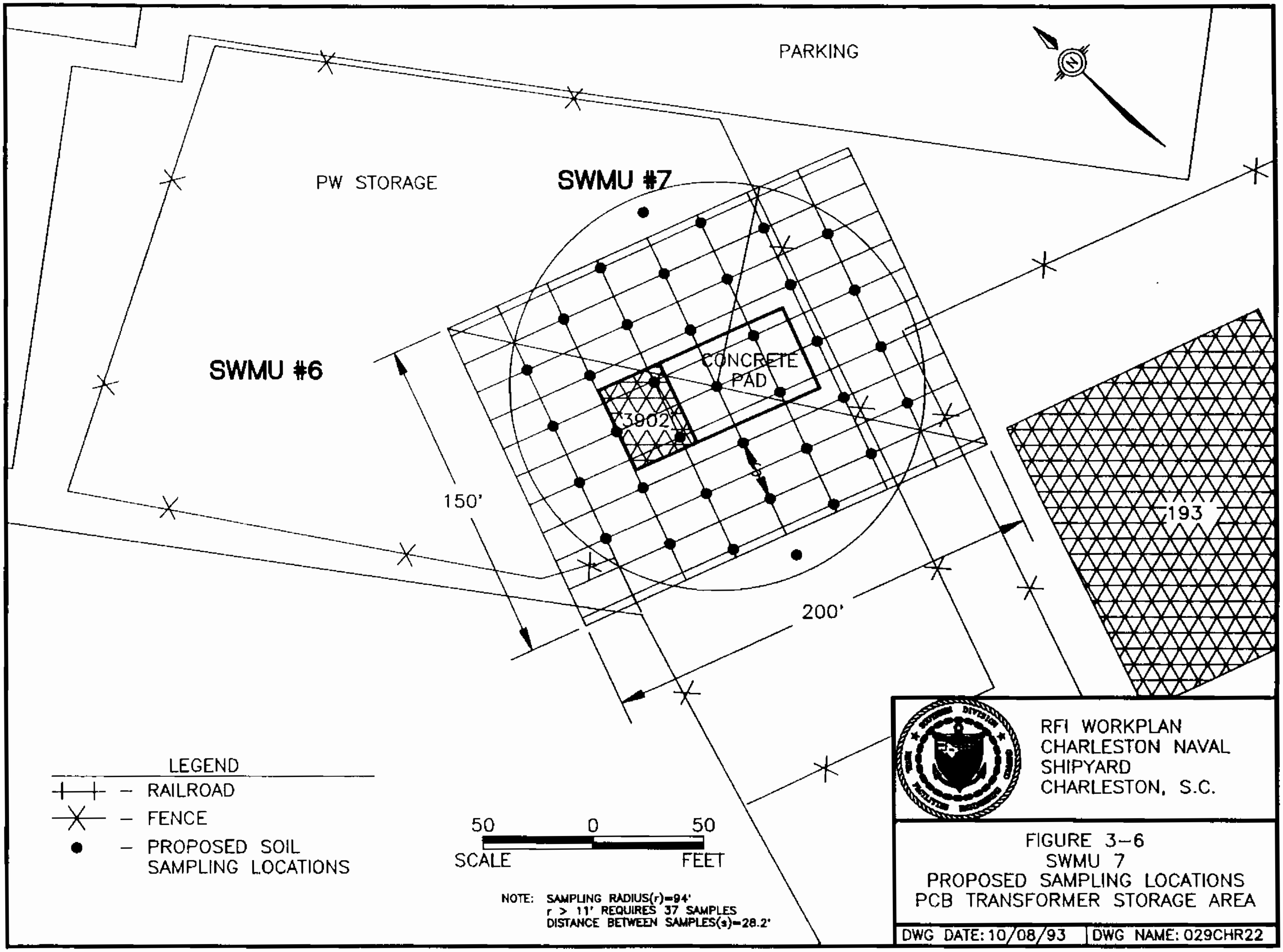


FIGURE 3-6
SWMU 7
PROPOSED SAMPLING LOCATIONS
PCB TRANSFORMER STORAGE AREA

The area east of the fence and concrete pad were previously addressed during sampling activities conducted in February 1987. This sampling event was associated with the partial closure of the southern portion of the Public Works Storage Yard and subsequent construction of the cold storage warehouse (Section 2.6.6). The samples identified as A-1, A-2, Area 2-Sample #1, Area 2-Sample #2, STA.100-Area 1, STA.100-Area 2, STA.100-Area 3, STA.100-Area 4,-STA.100-Area 5, and STA.100-Area 6 in Appendix F correspond to this area. The laboratory report indicates no PCBs were present in any of the samples **above the method detection limit; however, the detection limits ranged from 500 to 1,000 parts per billion. Soil samples will be collected from the area east of the fence and from beneath the concrete pad.**

The total number of soil stations to be sampled is **37. The soil samples will be analyzed for volatile organics, semivolatile organics, pesticides, PCBs, and TAL inorganics.**

3.12.2 Groundwater Sampling

Contaminant migration from the soil to the groundwater has occurred as evident by trace concentrations of arsenic, DDT, PCBs and BHC in monitoring wells WOC-1 and WOC-2. To evaluate the extent of groundwater impacts from SWMU #7, five additional monitoring wells will be installed in SWMU #6 as described in Section 3.11.2. The exact well locations will be selected in the field by a hydrogeologist during installation. Groundwater will be sampled and analyzed for **volatile organics, semivolatile organics**, pesticides, PCBs, and **TAL inorganics.**

3.12.3 Temporary Land Use Restrictions

The site activities should be limited to those which do not disturb the soil or groundwater. Utility construction should be minimized and conducted with proper preventive measures to prevent physical contact with potential contaminants. Restrictive access to the area should be enforced until remedial activities have been completed.

3.13 SWMU #8, Oil Sludge Pit Area

Oil sludge produced from various industrial processes in NSY were disposed of in three unlined pits during the period of 1944 to 1977. Two of the pits were filled before 1955. The remaining pit was filled in 1977.

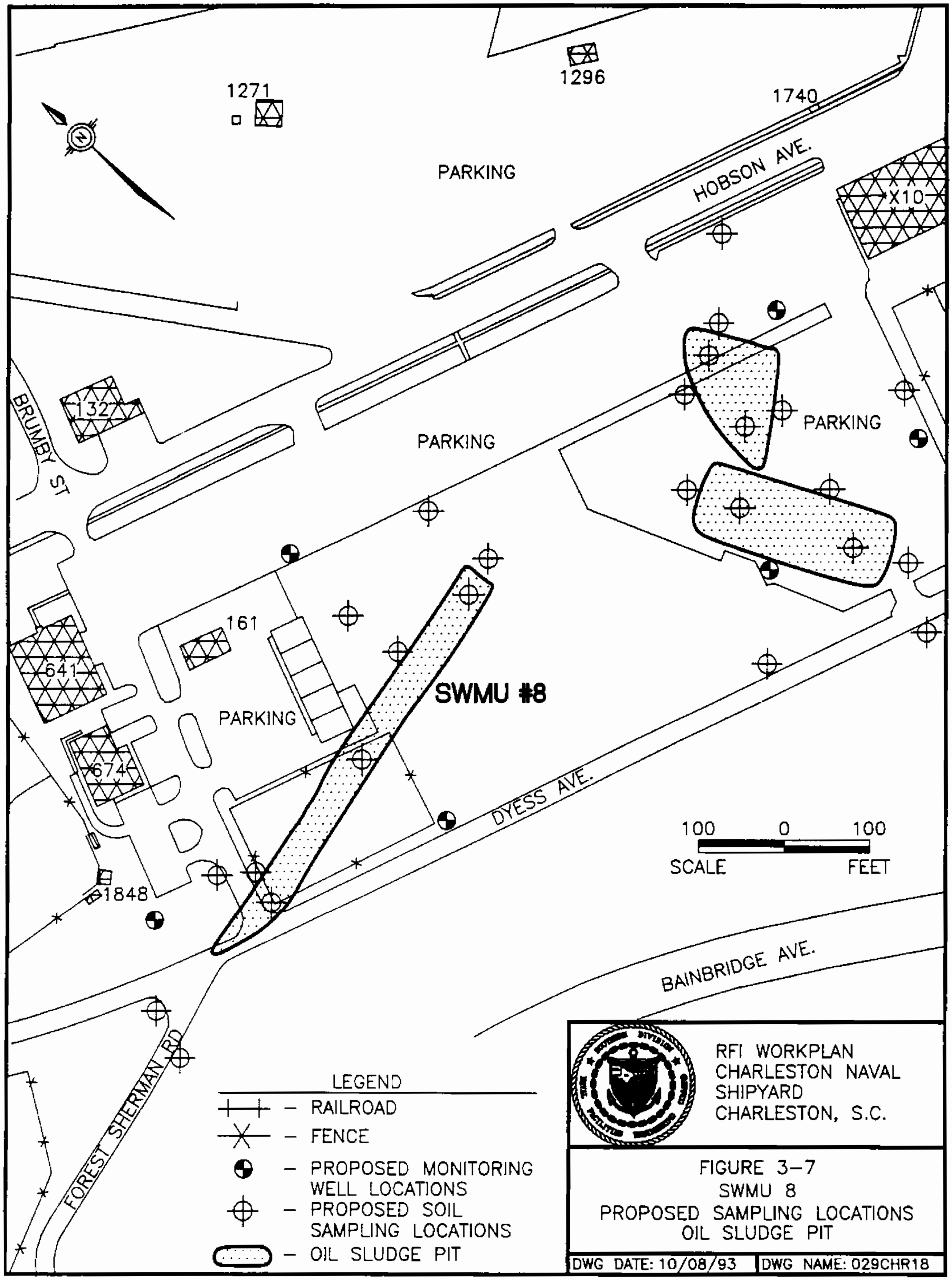
Ninety-three test borings were drilled in this area in 1982 (Section 2.6.8). Many found free-floating oil, particularly in the southwestern portion of the area overlying one of the three pits. The thickness of free-floating oil detected ranged from 2 to 4 inches over this unit at the time and attenuated rapidly with distance from the unit.

Although numerous samples were collected during previous investigations, delineation of the oil contamination was accomplished by field observations and not by laboratory testing. Additionally, the data collected in 1982 may no longer be reliable. Additional borings are planned to determine site hydrogeologic characteristics and identify areas of soil and groundwater contamination.

3.13.1 Soil Sampling

Under the first phase, soil samples will be collected to determine areas of soil contamination. The proposed 31 sample stations have been selected considering areas of trace to heavy concentrations of oil were reported in the previous study. Sample stations are located within and around the perimeter of each pit, as shown in Figure 3-7. Seven of the sample stations are within the perimeter of the three sludge oil pits. Six sample stations will also be used for monitoring well locations.

Soil borings will be installed with a drilling rig and soil samples will be retrieved using a-split-spoon sampler. Conditions may require that hand augering be used to advance and sample soil borings. The soil samples will be analyzed for volatile organics, semivolatile organics,


1271
1296
1740
PARKING
HOBSON AVE.
X10
132
BRUMBY ST
PARKING
PARKING
161
641
SWMU #8
PARKING
674
DYESS AVE.
1848
100 0 100
SCALE FEET
BAINBRIDGE AVE.
FOREST SHERMAN RD
LEGEND
– RAILROAD
– FENCE
– PROPOSED MONITORING WELL LOCATIONS
– PROPOSED SOIL SAMPLING LOCATIONS
– OIL SLUDGE PIT
RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.
FIGURE 3–7
SWMU 8
PROPOSED SAMPLING LOCATIONS
OIL SLUDGE PIT
DWG DATE: 10/08/93
DWG NAME: 029CHR18

pesticides, PCBs, and **TAL inorganics**. The findings from the Phase I investigation will be used to select additional soil sample locations to fully delineate contamination of the site.

3.13.2 Groundwater Sampling

Once the soil sampling program has been completed, six monitoring wells will be installed. Three existing wells could not be located and will not be replaced during the RFI. If during the RFI these wells are discovered, they will be properly abandoned. The purpose of the wells is to determine if subsurface releases from the oil sludge pits have adversely impacted groundwater quality in the surficial aquifer. Groundwater samples will be collected and analyzed for volatile organics, semivolatile organics, **pesticides**, PCBs, and **TAL inorganics**.

Prior to the collection of groundwater elevations and or samples all wells will be monitored for immiscible layers. If immiscible layers are detected, the wells will be gauged using an oil/water interface probe so that the thickness of any free-floating petroleum layer can be determined. The groundwater surface contour maps will indicate the direction of groundwater flow in and near SWMU #8. Combining the hydrogeologic data and analytical results should allow a better understanding of the extent and magnitude of any groundwater contamination resulting from the Oil Sludge Pit Area and the transport direction and migration rates of potential groundwater plumes. Once this information becomes available, additional offsite monitoring wells may be proposed to complete the delineation effort.

3.13.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater. Utility construction should be minimized and conducted with proper preventive measures to prevent release of groundwater contamination. As outlined in Section 2.6.8 the Oil Sludge Pit Area currently is used for parking.

3.14 SWMU #9, Closed Landfill

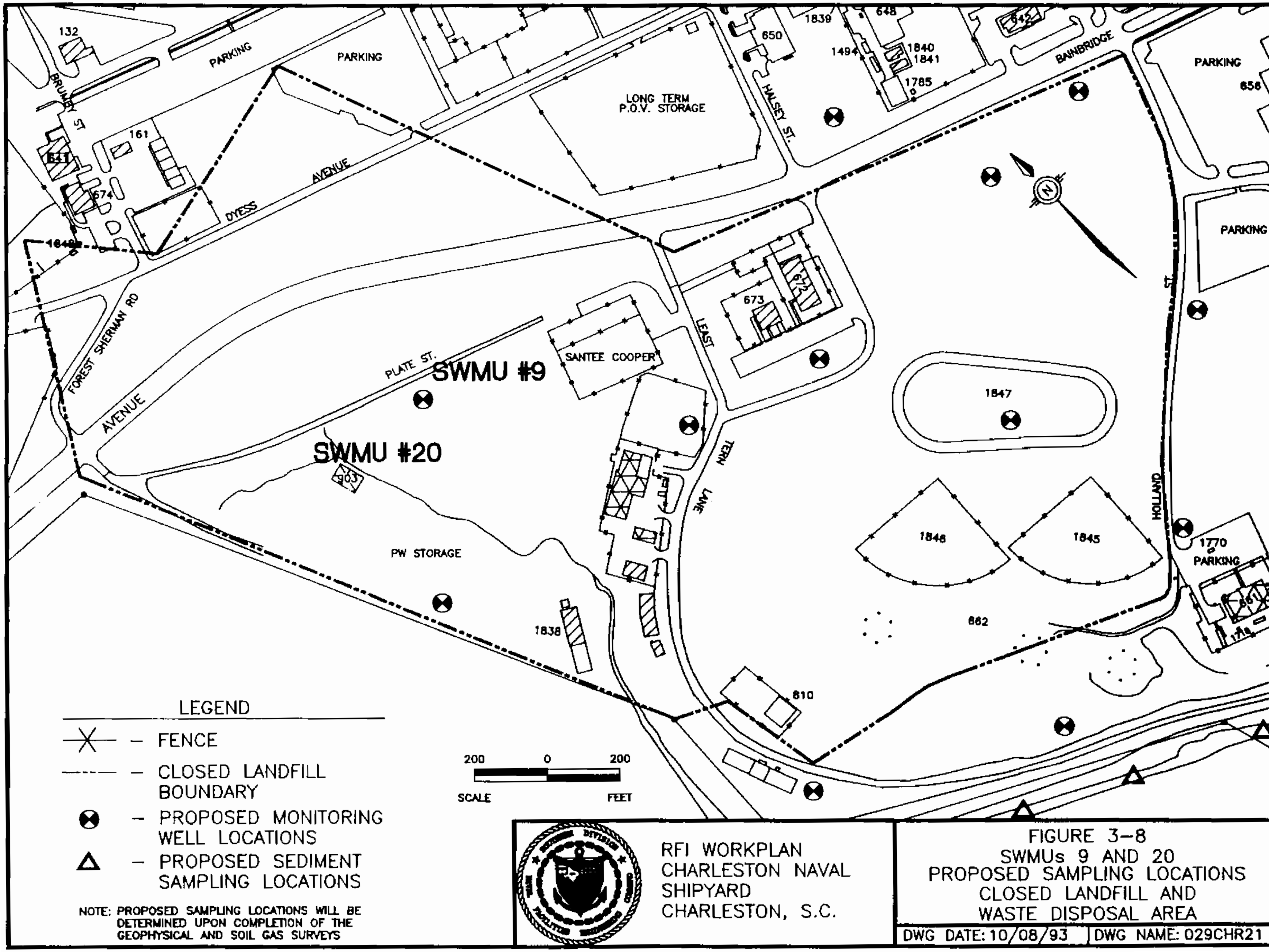
The closed landfill is located at the southwestern part of the peninsula at NSY. Over the period from the 1930s to the early 1970s, various solid wastes generated at NSY operations were disposed of in this landfill. Previous characterization activities of the site have included installation and sampling of 17 monitoring wells and four test pits (Figure 3-8; Section 2.6.9). Analytical data from sampling of the original 13 wells (LF1 to LF10; SLF1 and SLF2; and DLF1) is nearly 10 ten years old. The key issue at the closed landfill is determining the extent and magnitude of groundwater impacts from historical and ongoing discharge of leachate into the surficial aquifer. Groundwater analytical data generated to date have shown the presence of low levels of contamination including volatile and semivolatile organic compounds, and metals. Additional work proposed for this unit should allow an accurate assessment of the closed landfill's impact upon groundwater quality in the area.

3.14.1 Geophysical Surveys

A geophysical survey of SWMU #9 was conducted between May and November of 1992 by E/A&H. The primary objective of the survey was to:

- **Identify the edges of the landfill;**
- **Identify metallic anomalies such as buried drums;**
- **Identify any geophysically detectable leachate plumes originating in the landfill.**

To accomplish the stated objectives, the geophysical methods selected were gradient magnetics and frequency-domain electromagnetics. Since instrument response almost exclusive to ferrous metals makes it suitable for identifying metal drums, gradient magnetics was selected as the primary means of mapping metals within the landfill.


PARKING
PARKING
LONG TERM
P.O.V. STORAGE
HALSEY ST.
BAINBRIDGE
PARKING
PARKING
PARKING
BRUMBY ST
DYESS
AVENUE
FOREST SHERMAN RD
AVENUE
PLATE ST.
SANTEE COOPER
SWMU #9
SWMU #20
LEAST
TERN
LANE
HOLLAND
ST
PW STORAGE
132
161
641
674
1849
650
1839
648
1494
1840
1841
1785
642
656
673
672
1847
903
1846
1845
1770
1838
662
610
LEGEND
— FENCE
— CLOSED LANDFILL BOUNDARY
— PROPOSED MONITORING WELL LOCATIONS
— PROPOSED SEDIMENT SAMPLING LOCATIONS
NOTE: PROPOSED SAMPLING LOCATIONS WILL BE DETERMINED UPON COMPLETION OF THE GEOPHYSICAL AND SOIL GAS SURVEYS
200 0 200
SCALE FEET
RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.
FIGURE 3-8
SWMUs 9 AND 20
PROPOSED SAMPLING LOCATIONS
CLOSED LANDFILL AND
WASTE DISPOSAL AREA
DWG DATE: 10/08/93
DWG NAME: 029CHR21

Due to the expected large quantity of metal debris within the landfill, the survey focused on pattern recognition to help discriminate drum and non-drum sources. Electromagnetics (EM) was selected as a secondary means of attempting to map any leachate plumes existing at the landfill. The general suitability of EM, for mapping potential conductive plumes, was limited by the lack of conductivity contrast between a high TDS plume and the high TDS shallow groundwater.

SWMU #9 was surveyed on a 100 x 100 foot grid using arbitrarily placed east-west baselines, referencing true magnetic north (magnetic declination N3°W). The grid spacing chosen for the survey was 10 x 10 feet over as much of the landfill as practical. The grid spacing was kept constant to facilitate Fourier data processing. Several tests were conducted over limited areas, at tighter grid spacing, to establish the applicability of the 10 x 10 foot spacing. A detailed description of the survey methodologies and results was presented in the report *Draft-Final Preliminary RFI Field Activity (Soil Gas, Geophysics), March 26, 1993* prepared by E/A&H.

3.14.2 Soil Gas Survey

Initial investigation of the closed landfill, included an active soil gas survey conducted to detect areas where volatile organic compounds were present in the subsurface soils. A total of 440 locations were sampled utilizing a 100 x 100 foot grid system employed over the entire landfill. Defined by the geophysical survey and a review of aerial photos. Due to the shallow potentiometric surface elevation of the water table aquifer, the soil gas samples were collected at depths ranging from the vadose zone at depths varing from 1 to 4 feet BGS. The vast majority of the samples were collected from approximately 2 feet BGS. All samples collected were analyzed in the field and subjected to a dual analysis. Samples were analyzed in accordance with EPA Method 601 (Modified), using a gas chromatograph coupled with an electron capture detector (GC/ECD), and in accordance with EPA Method 602 (Modified) using a gas chromatograph equipped with a flame ionization detector

(GC/FID). Specific target analytes for the survey included 1,1-DCE; methylene chloride; trans-1,2-DCE; cis-1,2-DCE; chloroform; 1,1,1 TCA; carbon tetrachloride; TCE; 1,1,2 TCA; PCE; benzene; toluene; ethylbenzene; meta, para, and ortho xylene.

The soil gas survey incorporated in investigation for qualitative purposes, with the results being integrated with the geophysical survey to try to delineate trends in the data. The soil gas survey is discussed in greater detail in the preliminary report referenced in Section 3.14.1 above.

3.14.3 Test Trenching

Information gathered from geophysical and soil gas surveys was confirmed by test trenching in May 1993. The anomalies, identified from the surveys, and suspect areas identified through historical information sources, were investigated by excavating a trench and making visual observations of the subsurface conditions. All excavated material was staged on plastic next to the trench until the excavation was completed and then returned to the trench. An attempt was made to segregate clean "cap" material so it could be placed back on the surface of the repaired excavation; however, additional clean sandy clay fill material, from an offsite source, to adequately cap most of the trenches was needed. A total of 10 areas were investigated. At some areas multiple trenches were excavated in an attempt to intercept the anomalies. Soil samples from each of the trenches were analyzed for volatile organics, semivolatile organics, pesticides/PCBs, and the TAL inorganics. All analyses were performed at DQO Level IV. The results of the trenching activities will be presented in the RFI Report.

3.14.4 Soil Sampling

Soil sampling was initiated during trenching activities and will resume during the installation of groundwater monitoring wells. The purpose of this initial phase was to determine potential soil contamination zones and to develop a second phase to completely

characterize and delineate the horizontal and vertical extent of contamination in the landfill area. A minimum of one soil sample was collected from each test trench and at least one sample per monitoring well boring will be collected during installation of the wells. Based on visual observations during the trenching, the landfill cap material ranges from nonexistent to a maximum of three feet in thickness. At the present time, samples of the landfill refuse will not be sampled unless suspect material is encountered. Based on the proposed soil sampling scheme, it is unlikely soil samples will be collected from below the 0 to 1 foot interval within the landfill boundary, since the depth of the refuse material extends below the water table. Three sediment sampling locations are proposed to be collected from Shipyard Creek.

Soil samples collected will be analyzed for volatile organics, semivolatile organics, pesticides, PCBs and TAL inorganics.

3.14.5 Groundwater Sampling

A site survey conducted in the area of SWMU #9 did not identify all the wells installed under previous investigations. **During the geophysics survey, monitoring wells CSY-FMW2, CSY-FMW4, and LF3 were found. A white PVC pipe found near the location of LF4 is suspected to be the well but has yet to be confirmed. These wells will be used for groundwater level measurements only during phase I and properly abandoned.** Therefore, during the RFI 12 additional wells are proposed to be installed (Figure 3-8). All existing and new monitoring wells will be sampled for volatile organics, semivolatiles organics, pesticides, PCBs, and **TAL inorganics.**

The groundwater surface contour maps generated for this site will show the direction(s) of groundwater flow in and near the closed landfill. Combining the hydrogeologic data and analytical results should provide a better understanding of the extent and magnitude of groundwater contamination resulting from the closed landfill and the direction and migration rates of potential groundwater plumes. If additional borings/monitoring wells are necessary to delineate any contaminant plumes emanating from the landfill they will be incorporated into Phase II of the investigation.

3.14.6 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater. Utility construction activities should be minimized and conducted with proper safety measures to prevent release of potential contamination.

3.15 SWMU #12, Old Fire Fighter Training Area

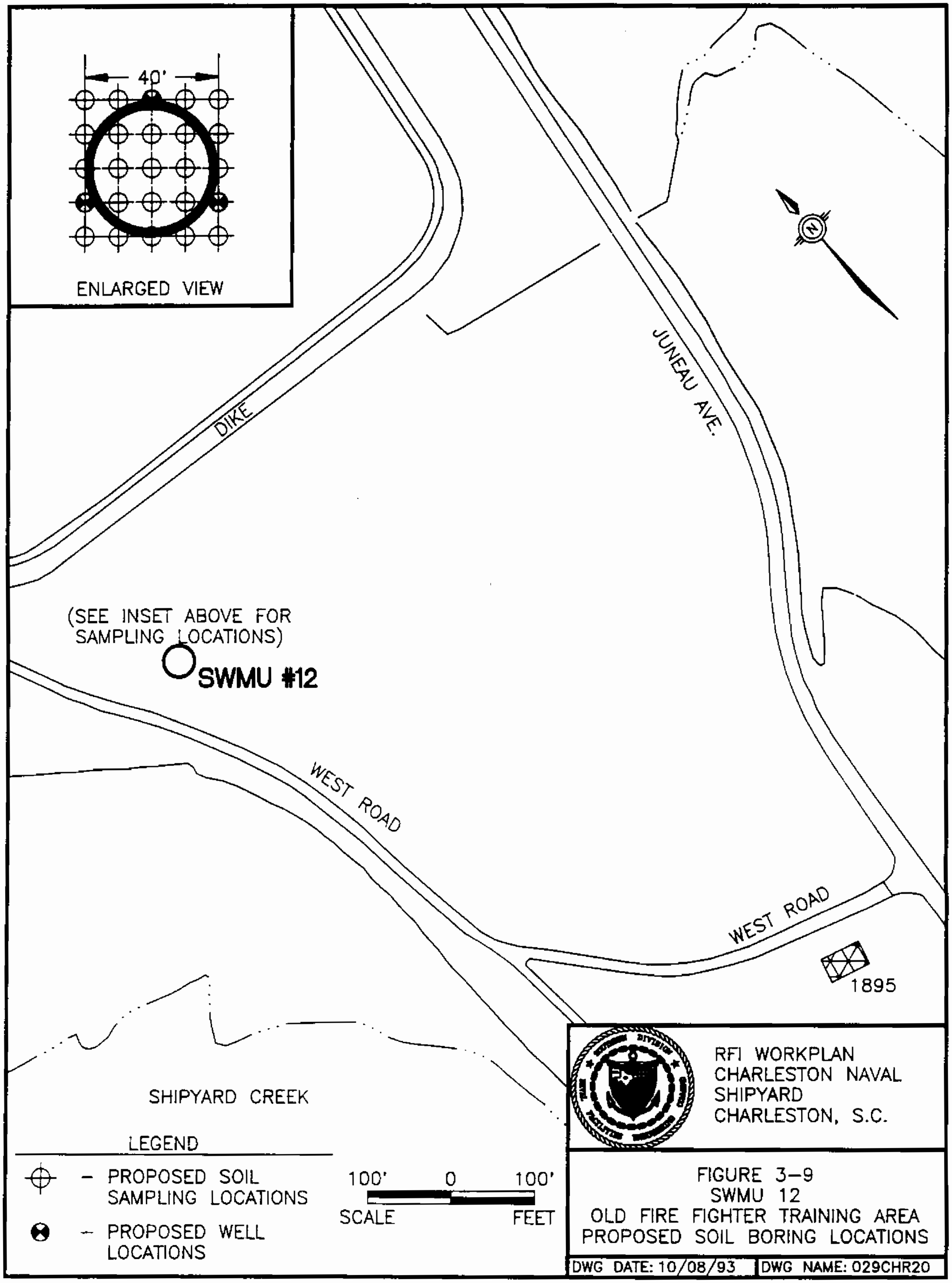
The Old Fire Fighter Training Area consisted of a pit approximately 30 to 50 feet in diameter. The pit was allegedly used between 1966 and 1971. As discussed in Section 2.6.12, during fire fighting training exercises, oil, gasoline, and alcohol were poured into the pit, ignited, then extinguished. In 1971, the pit was cited for an oil spill.

3.15.1 Soil Sampling

A 10-foot grid will be established across the site (Figure 3-9). Soil samples will be collected from each nodal point. **Field personnel will attempt to locate the pit prior to establishing the grid and collecting samples for chemical analysis. The soil samples will be analyzed for volatile organics, semivolatile organics, and TAL inorganics.**

3.15.2 Groundwater Sampling

Three groundwater monitoring wells will be installed, as shown in Figure 3-9. The groundwater samples will be analyzed for volatile organics, semivolatile organics, **TAL inorganics, and TPH**.


40'
ENLARGED VIEW
DIKE
JUNEAU AVE.
(SEE INSET ABOVE FOR SAMPLING LOCATIONS)
SWMU #12
WEST ROAD
WEST ROAD
1895
SHIPYARD CREEK
LEGEND
- PROPOSED SOIL SAMPLING LOCATIONS
- PROPOSED WELL LOCATIONS
100' 0 100'
SCALE FEET
RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.
FIGURE 3-9
SWMU 12
OLD FIRE FIGHTER TRAINING AREA
PROPOSED SOIL BORING LOCATIONS
DWG DATE: 10/08/93
DWG NAME: 029CHR20

3.15.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater. Utility construction activities should be minimized and conducted with proper safety measures to prevent release of potential contamination.

3.16 SWMU #13, Current Fire Fighting Training Area

SWMU #13 has been operational since approximately 1973. Although no releases have been observed the potential for release to the sanitary sewer system may exist from the oil-water separators.

3.16.1 Soil Sampling

To confirm or negate if a release has occurred one sample will be collected from the sewer system at a point downgradient of the oil-water separator (Figure 3-10). If elevated concentrations of contaminants are identified, then soil borings will be completed along the sewer line in Phase II to assess for leakage. **Prior to collecting soil samples, as built construction plans of the line will be reviewed in an attempt to locate joints in the line. Soil sampling points would be located near these joints if possible. Samples will not be collected beyond the juncture of the line which serves the training facility and the main line. The pavement in the area of SWMU #13 will be inspected for cracks. If substantial cracks in the asphalt are identified, then soil samples from beneath the cracks will be collected for chemical analysis.** All samples will be analyzed for volatile organics, semivolatile organics, and **TAL inorganics**, and TPH.

3.16.2 Groundwater Sampling

No groundwater sampling is proposed for this SWMU unless it is determined **from Phase II sampling** that a leak from the sewer line has occurred and soils adjacent to the line have been impacted.

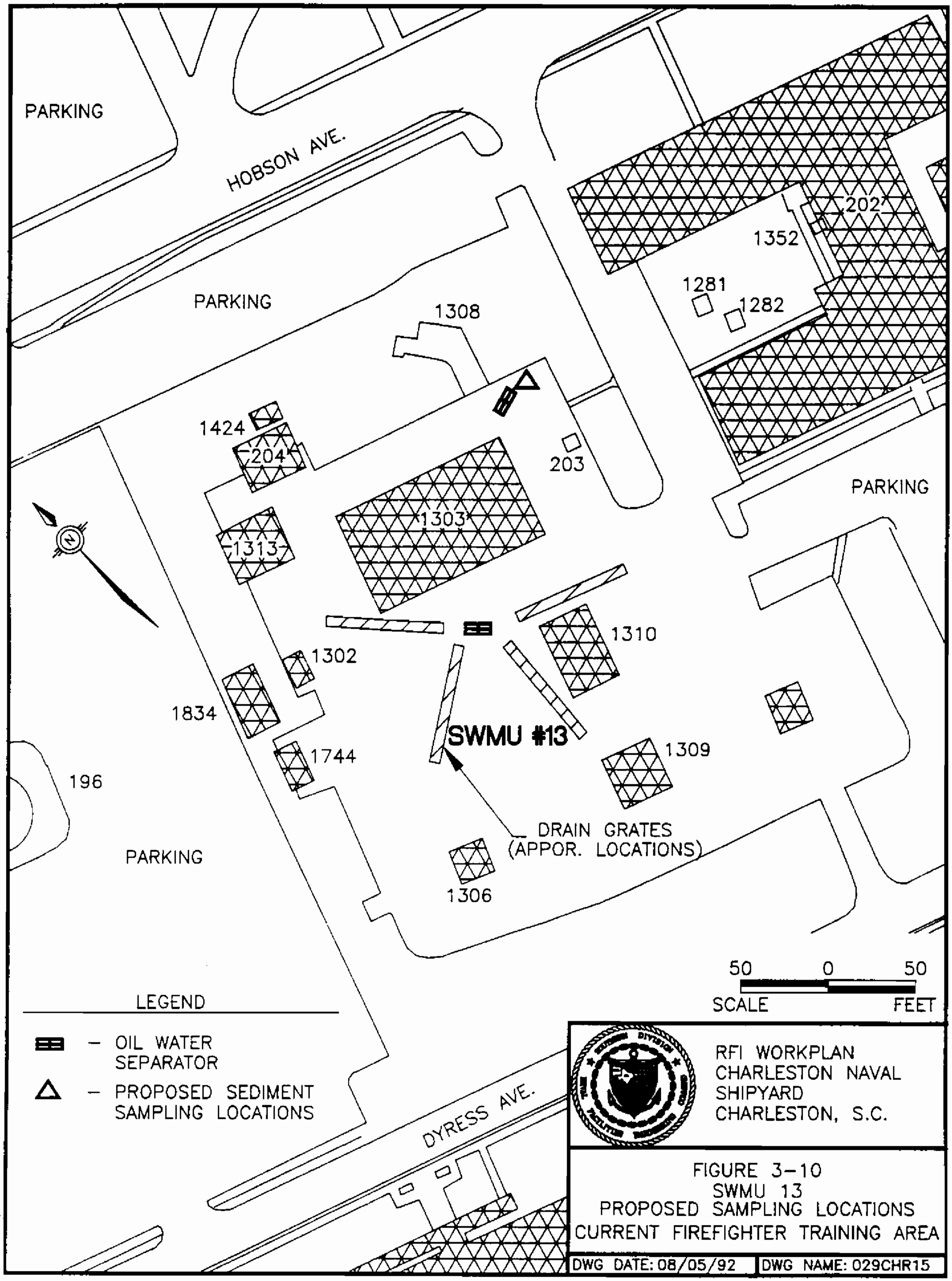


FIGURE 3-10
SWMU 13
PROPOSED SAMPLING LOCATIONS
CURRENT FIREFIGHTER TRAINING AREA

DWG DATE: 08/05/92 | DWG NAME: 029CHR15

3.16.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater. Utility construction activities should be minimized and conducted with proper safety measures to prevent release of potential contamination.

3.17 SWMU #14, Chemical Disposal Area

The chemical disposal area is located at the southern end of NSY in the vicinity of the skeet and pistol ranges. Within this general area, the precise locations of disposal are unknown. Waste materials are thought to have been buried in drums, but may include bagged or bulk wastes.

3.17.1 Geophysical Surveys

A geophysical survey was conducted by E/A&H at SWMU #14 between May and November 1992. The primary objective of the survey was to:

- Identify the location of the chemical disposal area;
- Identify metallic anomalies, such as buried drums and/or pails;
- Identify any geophysically detectable leachate plumes originating from the suspected disposal area;

To accomplish the stated objectives, the geophysical methods selected were gradient magnetics and frequency-domain electromagnetics. Since instrument response almost exclusive to ferrous metals makes it suitable for identifying metal drums, gradient magnetics was selected as the primary means of mapping metals within the landfill. Due to the expected large quantity of metal debris within the landfill, the survey focused on pattern recognition to help discriminate drum and non-drum sources. Electromagnetics (EM) was selected as a secondary means of attempting to map any leachate plumes existing at the landfill. The general suitability of EM, for mapping potential conductive plumes, was limited by the lack of conductivity contrast between a high TDS plume and the high TDS shallow groundwater.

Similar to SWMU #9, SWMU #14 was surveyed on a 100 x 100 foot grid using arbitrarily placed east-west baselines, referencing true magnetic north (magnetic declination N3°W). The grid spacing chosen for the survey was 10 x 10 feet over as much of the landfill as practical. The grid spacing was kept constant to facilitate Fourier data processing. Several tests were conducted over limited areas, at tighter grid spacing, to establish the applicability of the 10 x 10 foot spacing. A detailed description of the survey methodologies and results was presented in the report *Draft-Final Preliminary RFI Field Activity (Soil Gas, Geophysics), March 26, 1993* prepared by E/A&H.

3.17.2 Soil Sampling

The next phase of additional site assessment work will be implementation of a soil boring and sampling program. The purpose of this program is to characterize and delineate the horizontal and vertical extent of soil contamination in the area. The actual scope of this work phase will be largely dependent upon the results of the geophysical surveys. **Twenty-five soil borings are proposed for the initial phase of fieldwork. It is possible additional sampling will need to be conducted based on potential data gaps identified in phase I.** Conditions may require that hand augering be used to advance and sample soil borings. Soil samples will be analyzed for **volatile organics, semivolatile organics**, pesticides, PCBs, and **TAL inorganics**. When assay results are compiled, they will be reported along with the geophysical results and proposed remedial activities.

3.17.3 Groundwater Sampling

A site survey conducted in the area of SWMU #14 did not identify the wells installed under previous investigations. Therefore, during the RFI five soil borings will be completed as new wells (Figure 3-11). **The groundwater samples will be analyzed for volatile organics,**

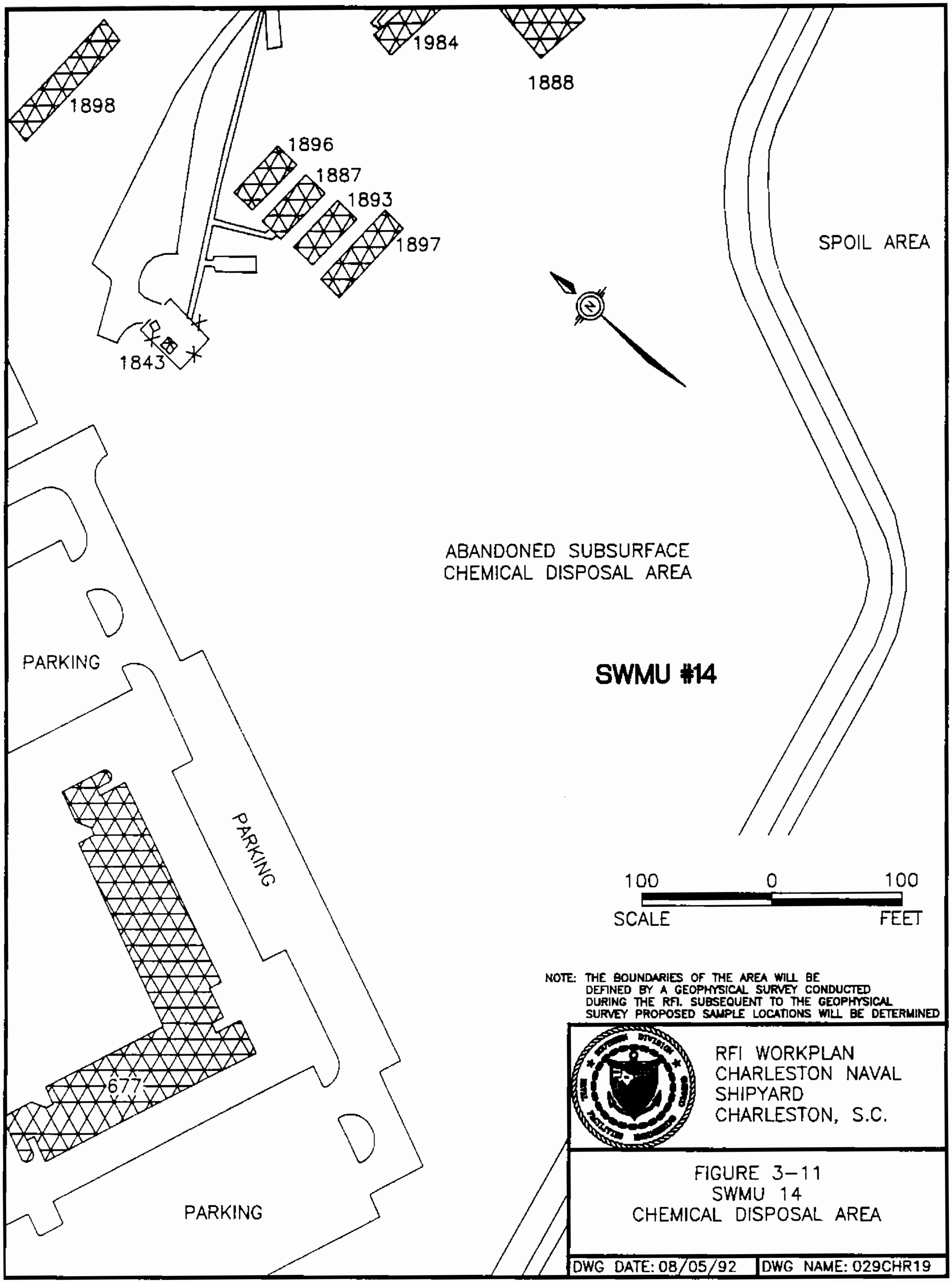


FIGURE 3-11
SWMU 14
CHEMICAL DISPOSAL AREA

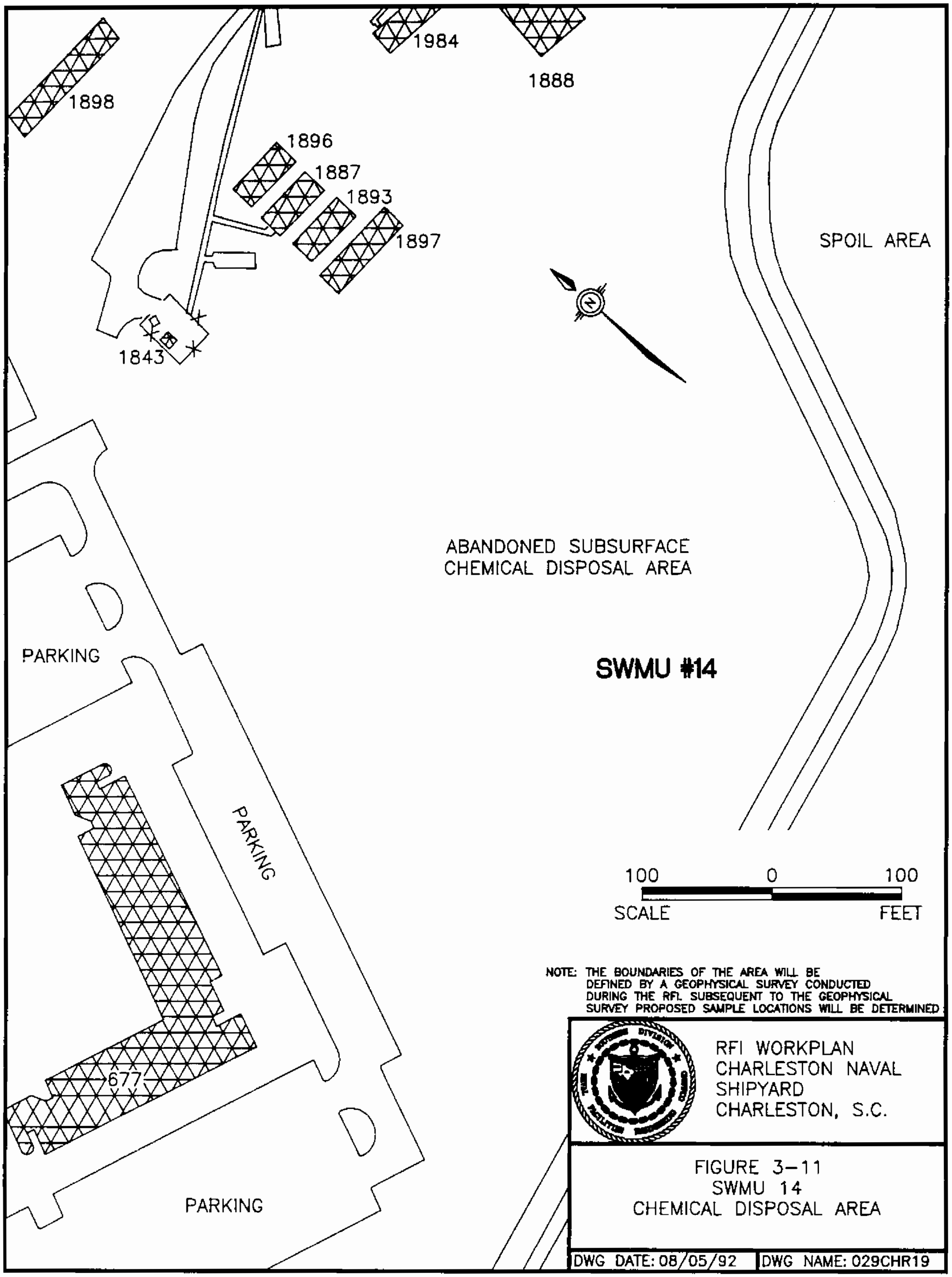


FIGURE 3-11
SWMU 14
CHEMICAL DISPOSAL AREA

semivolatile organics, pesticides, PCBs, and TAL inorganics. The groundwater surface contour maps generated for the site will show the direction(s) of groundwater flow in and near SWMU #14. Combining the hydrogeologic data and analytical results should allow a better understanding of the extent and magnitude of groundwater contamination resulting from the Chemical Disposal Area as well as the direction and migration rates of potential groundwater plumes. Once this information becomes available, additional offsite monitoring wells will be proposed (including a "deep" well), if necessary, to complete the delineation effort.

3.17.4 Temporary Land Use Restrictions

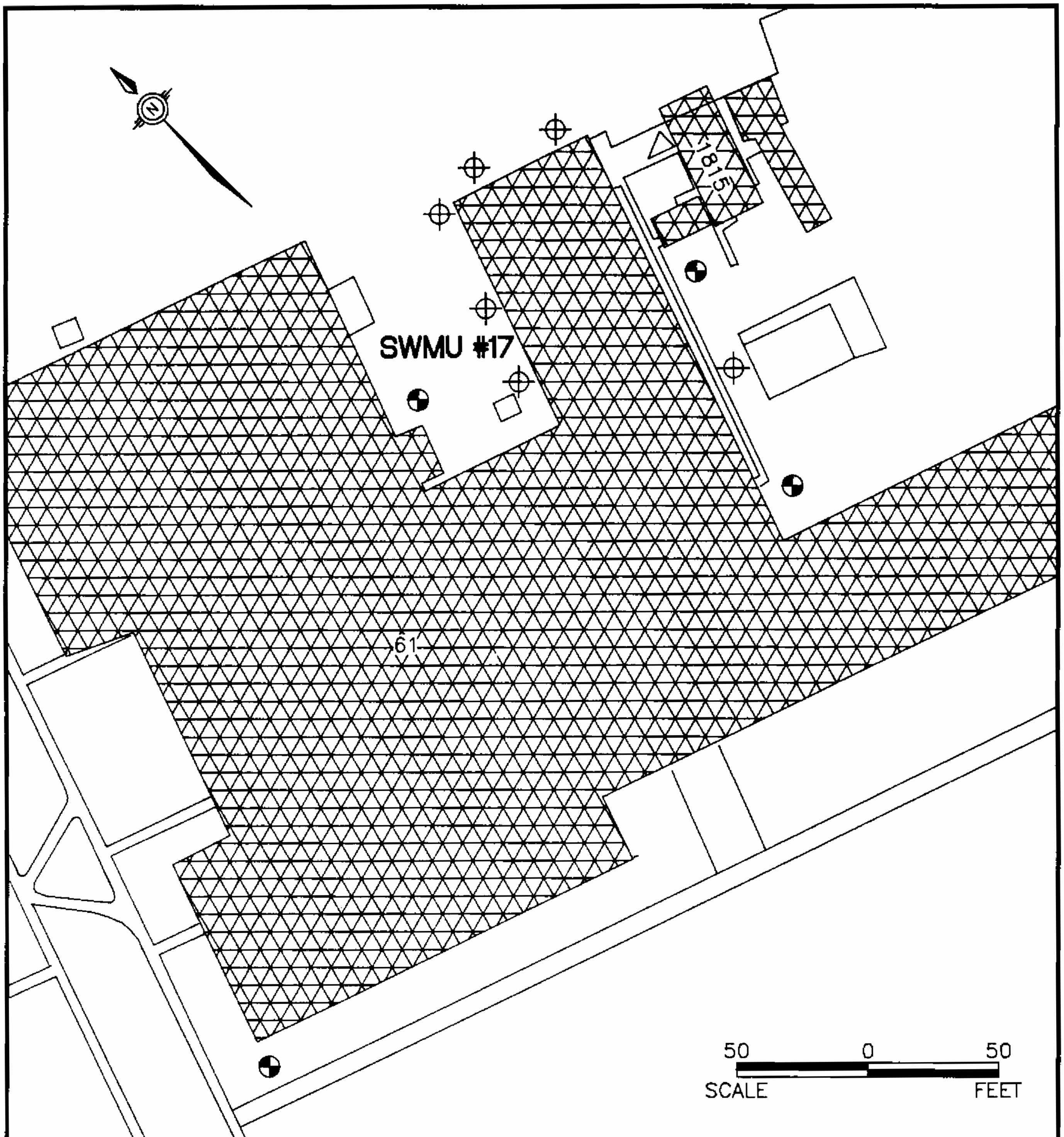
The site's activities should be limited to those which do not disturb the soil or groundwater. Utility construction should not be conducted until the area has been completely assessed. Limited access to the area should be enforced until remedial activities have been completed.

3.18 SWMU #17, Oil Spill Area

This spill occurred in June 1987 when an underground pipe ruptured which supplied No. 5 NSF fuel oil to the boiler in Building No. FBM61 (Figure 3-12). Some samples of oil collected during remediation of the spill contained PCBs. The location of samples with PCBs and their concentrations indicate that the source of the PCBs is beneath Building FBM61. Beyond the initial remedial actions conducted at the time of the spill and subsequent release to the Cooper River, there has not been a soil or groundwater investigation to delineate the extent and magnitude of potential subsurface oil contamination at the site. Available data suggest that the soil contamination produced by the spill remains underneath the building. In order to fill in current data gaps and ensure that migration of contaminants is not occurring beyond the building area, the following soil and groundwater investigation is proposed for the site.

3.18.1 Soil Sampling

Due to the location of the contamination (primarily beneath Building FBM61), a comprehensive soil sampling program is not feasible. However, soil samples will be collected **from six soil**



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 3-12
PROPOSED SAMPLING LOCATIONS
SWMU 17
OIL SPILL AREA

DWG DATE: 10/08/93 | DWG NAME: 029CHR16

LEGEND

- PROPOSED MONITORING WELL LOCATIONS
- PROPOSED SOIL BORING LOCATIONS

borings located adjacent to the building foundation in addition to four proposed monitoring wells. The soil samples will be analyzed for semivolatile organics, PCBs, TAL inorganics, and TPH.

3.18.2 Groundwater Sampling

The migration potential of PCBs at SWMU #17 is believed to be rather limited. The contaminated area has an impermeable cover consisting of the building and surrounding paved areas. Also, PCBs bind tightly to soils, especially those with a high degree of naturally occurring organic content. However, in order to confirm that any remaining constituents are not migrating into surrounding soils and/or groundwater, four monitoring wells are proposed for locations surrounding the building (Figure 3-12). Three proposed monitoring wells are located to bracket the areas where initial samples were taken beyond the confines of the building. One proposed well is located in a presumed upgradient direction from the spill. Monitoring wells will be installed and sampled using the protocols described in Section 4.6. Groundwater samples will be analyzed for **semivolatile organics, PCBs, TAL inorganics, and TPH.**

The groundwater surface contour maps generated for the site will show the direction(s) of groundwater flow in and near SWMU #17. Combining the hydrogeologic data and analytical results should allow a better understanding of the extent and magnitude of any groundwater contamination resulting from the Oil Spill Area. If contaminants are identified in any of the wells additional monitoring wells will be installed during Phase II of the RFI to aid in determining the extent of contamination.

3.18.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater. Utility construction should be minimized and conducted with the proper protection to prevent physical contact with potential contaminants.

3.19 SWMU #20, Waste Disposal Area

The Waste Disposal Area occupies an open area contiguous with SWMU #9 (landfill). Therefore, during the investigation conducted for the landfill one soil boring to be completed as a monitoring well will be installed in the area (Figure 3-8). The well will serve a dual purpose: to identify contaminants which may be migrating from the landfill, and to identify if any releases have occurred in the waste disposal area.

The interpretation of analytical data from SWMU #9 may require the installation of additional monitoring wells at SWMU #20 during Phase II of the RFI. However, if no levels of contaminants are identified in analytical results the proposed well will serve as a "clean" well for both units.

3.19.1 Soil Sampling

Soil samples will be **analyzed for volatile organics, semivolatile organics, pesticides, PCBs, and TAL inorganics.**

3.19.2 Groundwater Sampling

As outlined under the investigation for SWMU #9 a site survey conducted in the area did not identify all the wells installed under previous investigations. Therefore, during the RFI 10 additional wells are to be installed (Figure 3-8). As already stated one of these wells will serve a dual purpose and be incorporated into the study of this unit. The groundwater samples will be analyzed for volatile organics, semivolatile organics, pesticides, PCBs, and TAL inorganics.

3.19.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater. Utility construction should be minimized and conducted with the proper protection to prevent physical contact with potential contaminants.

3.20 SWMU #21, Waste Paint Storage Area

This area was previously used for temporary storage of containerized paint waste and sand-blasting operations. Paint wastes were known to contain cadmium, chromium, lead, cyanide, toluene and tetrachloroethylene. Sand-blasting residues contained organo-tin paint constituents. These materials were stored in containers on a concrete pad. In addition, materials were found in residues directly on the ground surface surrounding the pad (Figure 3-13). Under the previous investigation to clean close this unit, paint chips were tested and passed EP toxicity tests. However, analytical testing of the soil and groundwater surrounding SWMU #21 had not been performed to determine the extent and magnitude of contamination. In order to fill in current data gaps and ensure that migration of contaminants is not occurring beyond the concrete pad area, the following soil and groundwater investigation is proposed for the site.

3.20.1 Soil Sampling

Two phases are envisioned for the soil contamination investigation. In phase I, a series of shallow soil samples or sediment samples will be collected on all four sides of the pad at distances of **1 foot, 10 feet and 25 feet** out from the pad. The 12 sample points are depicted in Figure 3-13. Three samples northeast of the site may have to be collected as sediment samples from the Cooper River. Sediment samples will be collected utilizing a petite ponar dredge, and will only be collected from one interval. **All soil and sediment samples will be analyzed for volatile organics, semivolatile organics, and TAL inorganics.**

3.20.2 Groundwater Sampling

Three monitoring wells will be installed around the pad at the locations shown in Figure 3-13. The purpose of this effort is to ascertain if potential soil contamination has adversely impacted groundwater quality. The potential for groundwater impacts is relatively high due to the shallow water table (2 to 4 feet below grade) in the area. Groundwater samples will be retrieved and analyzed for volatile organics, and semivolatiles, and **TAL inorganics**. Additional wells will

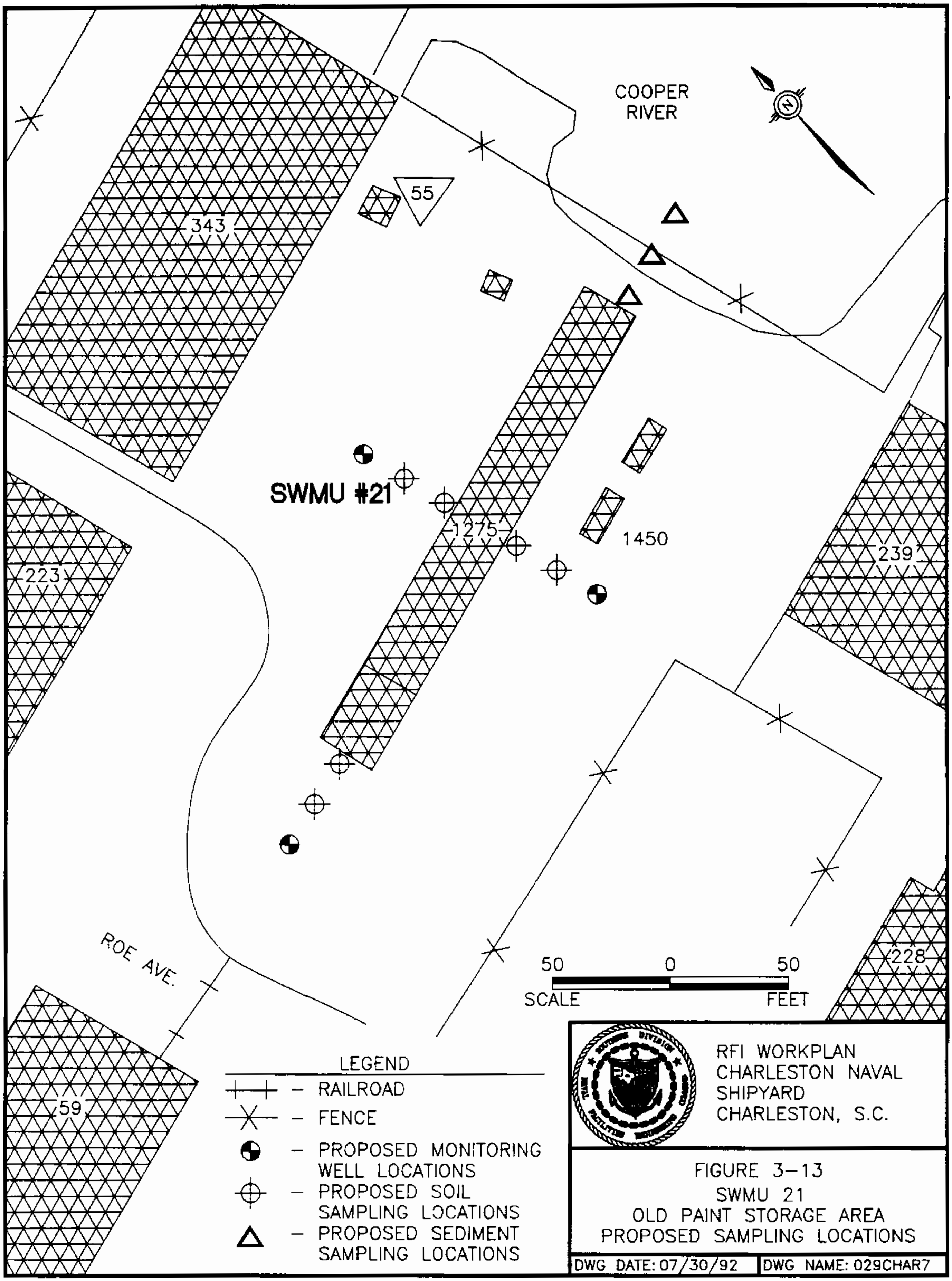


FIGURE 3-13
SWMU 21
OLD PAINT STORAGE AREA
PROPOSED SAMPLING LOCATIONS

be installed and sampled if needed to complete a delineation of potential groundwater contamination.

3.20.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater. Utility construction should be minimized and conducted with the proper protection to prevent physical contact with potential contaminants.

3.21 SWMU #22, Old Plating Shop Waste Treatment System

As outlined in Section 2.6.22 the old plating shop waste treatment system is adjacent to SWMU #25, the plating operation. Although sample investigations have been conducted at this unit, the extent of contamination has not been determined. Soil sample locations and groundwater monitoring wells will be strategically placed to eliminate potential data gaps and delineate the extent of contamination associated with these SWMUs. Five groundwater wells are proposed to investigate SWMUs #22 and #25. The location of the groundwater wells and soil sampling locations are illustrated in Figures 3-14 and 3-14A. A complete breakdown of the investigation is outlined in Section 3.22 below.

3.22 SWMU #25, Old Plating Operation, Building 44

The old plating operation will require a phased approach to delineate contamination and decontaminate the building. Prior investigations revealed the interior surface areas and process tanks to be contaminated with metals. Asbestos was also detected in roof samples. Further evaluation of concrete floors, subsurface soils inside and outside the building, and groundwater will be required. Analytical data gathered for SWMU #22 will be incorporated into the SWMU #25 Workplan. The sampling investigation for this unit will require concrete coring, subsurface, and groundwater samples to delineate contamination at the site. Figures 3-14 and 3-14A present proposed sample locations.

The concrete floor inside the building has deteriorated and the condition of the floor drain piping is questionable. The potential for contaminant migration to groundwater is high, especially with the evidence of low pH conditions. All plating operation equipment is scheduled to be removed by a contractor before the investigation begins.

3.22.1 Core Sampling

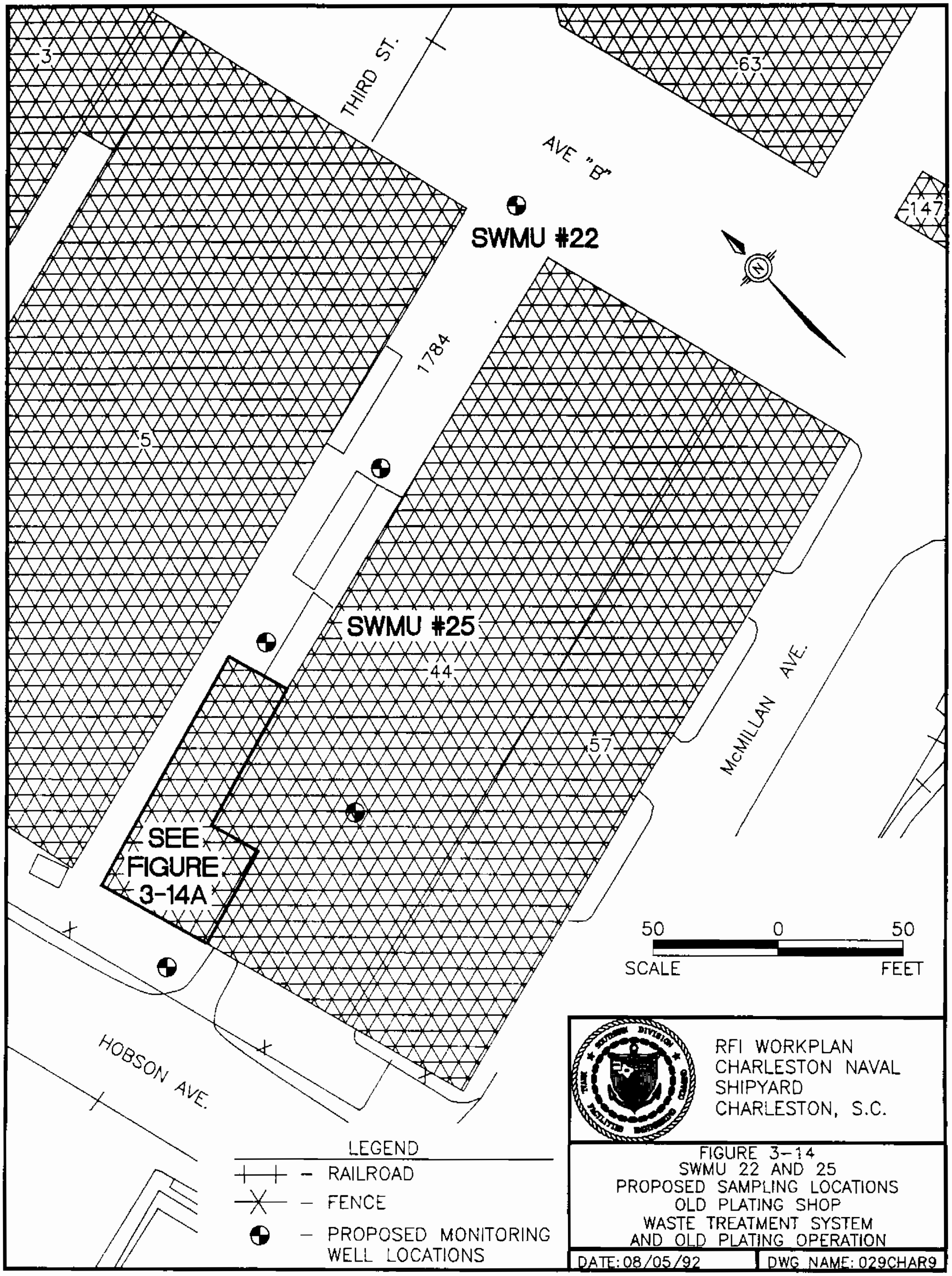
Concrete core samples will be collected inside Building 44 to allow evaluation of the potential for vertical migration of metals contamination into the concrete. Seven 4-inch diameter core samples are proposed to be cored through the concrete. The cores will be divided into 2-inch sections and pulverized for analysis.

3.22.2 Soil Sampling

A 3-inch diameter hand auger will be used to collect subsurface soil samples beneath the concrete from the seven 4-inch diameter holes. For the 0 to 1 sample interval, zero will be considered the top of the soil below the concrete surface. The subsurface soils around the exterior areas of Building 44 will also be sampled. Five sample locations will be selected around the northern and eastern perimeter of Building 44. These sample locations as illustrated on Figure 3-14 are designed to incorporate SWMU #22 above. Soil samples will also be collected from each well boring.

3.22.3 Groundwater Sampling

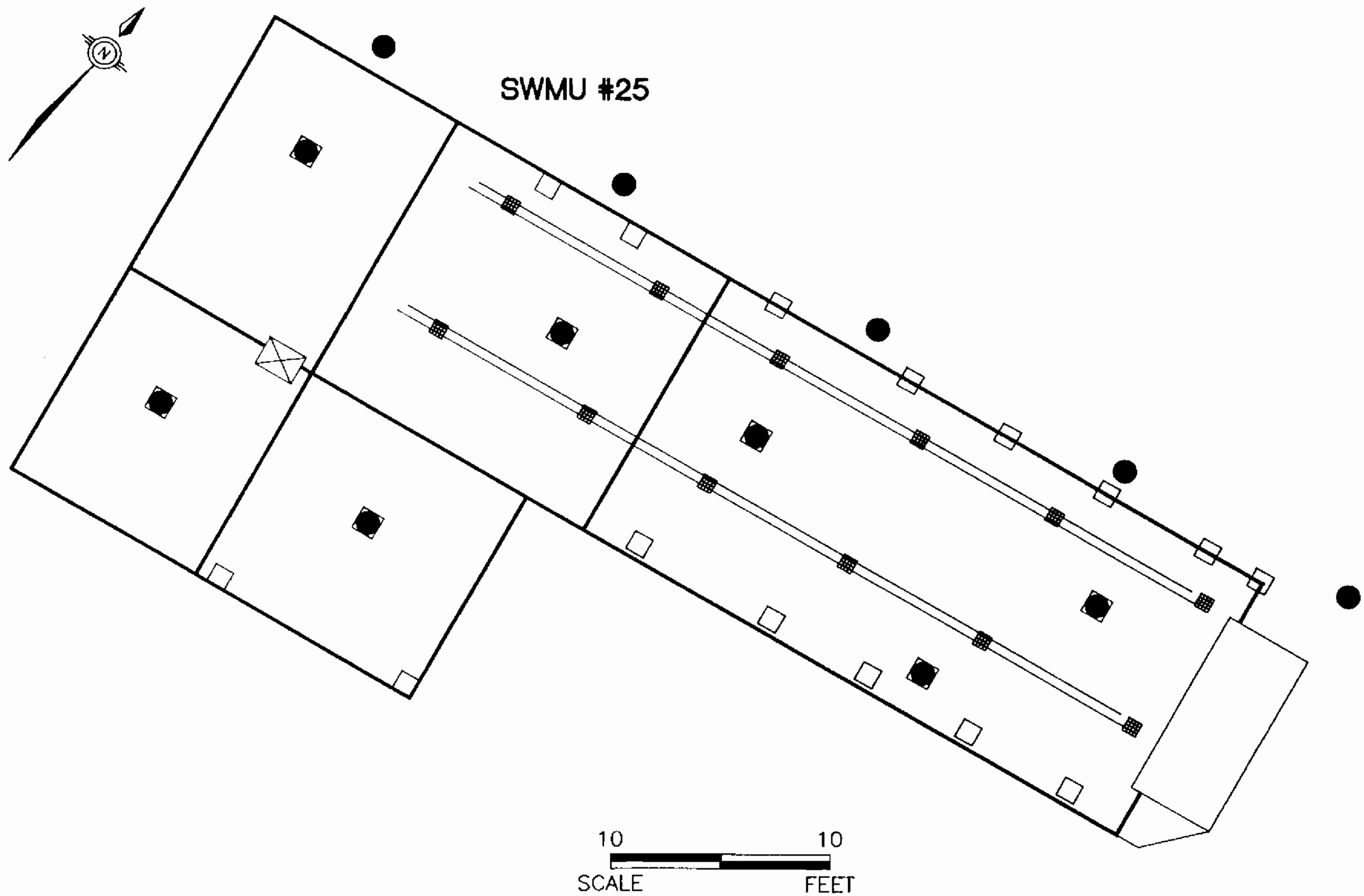
Five monitoring wells are proposed for installation at SWMU #25 and the associated waste treatment system, SWMU #22. **The well locations (Figure 3-14) were chosen in order to make the wells accessible due to numerous underground utilities. Installation of the well inside building 44, the well at the southwest end of the alley between buildings 44 and 5, and the well southwest of building 44 will likely require specialized drilling equipment to facilitate access. The final well locations will be determined in the field, and will be as close**



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 3-14
SWMU 22 AND 25
PROPOSED SAMPLING LOCATIONS
OLD PLATING SHOP
WASTE TREATMENT SYSTEM
AND OLD PLATING OPERATION

DATE: 08/05/92 | DWG NAME: 029CHAR9



LEGEND

● – PROPOSED SOIL SAMPLE LOCATION

■ – CONCRETE CORE SAMPLE LOCATION

RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 3–14A
SWMU 25
PROPOSED SAMPLING LOCATIONS
OLD PLATING SHOP
WASTE TREATMENT SYSTEM
AND OLD PLATING OPERATION

DATE: 08/05/92 | DWG NAME: 029CHR9B

as possible to the proposed locations. The potential for constituents to migrate from the site is somewhat higher than at other units due to the metals in reduced pH (<5) conditions. The age of the plating operation and the presence of conduits for transport via the floor drain piping suggest a potential for significant contamination which further warrants groundwater testing. The five groundwater wells will be installed and sampled using the protocols described in Section 4.6. Monitoring wells will initially be installed to characterize site hydrogeology and groundwater contamination (Phase I). The groundwater samples will be analyzed for volatile organics, semivolatile organics, **and TAL inorganics**. The groundwater surface contour maps generated for this site will show the direction(s) of groundwater flow in and near the site. Combining the hydrogeologic data and analytical results should allow a better understanding of the extent and magnitude of any groundwater contamination resulting from the Old Plating Operations. The transport direction and migration rates of potential groundwater plumes will also be assessed. Once this information becomes available, then additional offsite monitoring wells will be installed during Phase II of the RFI to complete the delineation effort.

3.22.4 Temporary Land Use Restrictions

Access has been restricted in the plating operation area since the operation was shut down. The area between Building 44 and the waste treatment system tank is an industrialized area of the CIA. Temporary land use restrictions should be implemented to restrict any utility construction between the units and minimize construction near these two areas.

3.23 SWMU #27, Waste Storage Area, East End, Pier C

During the site inspection at SWMU #27 paint stains were observed on the east end of Pier C. However, no stains appear to be contiguous with grates within the pier. These grates allow discharge directly to the Cooper River.

3.23.1 Soil Sampling

To facilitate the RFI one sediment sample will be collected from beneath the pier (Figure 3-15). The sediment sample will be collected utilizing a petite ponar dredge. **The pavement in the area of SWMU #27 will be inspected for cracks. If substantial cracks are identified, then soil samples beneath the cracks will be collected for chemical analysis.** The samples will be analyzed for **TAL inorganics**.

3.23.2 Groundwater Sampling

Groundwater sampling is not applicable to this site.

3.23.3 Temporary Land Use Restrictions

There are no land use restrictions to be implemented near the pier. Care should be taken to minimize the potential for further releases.

3.24 SWMU #28, Waste Paint Storage Area, West End, Pier C

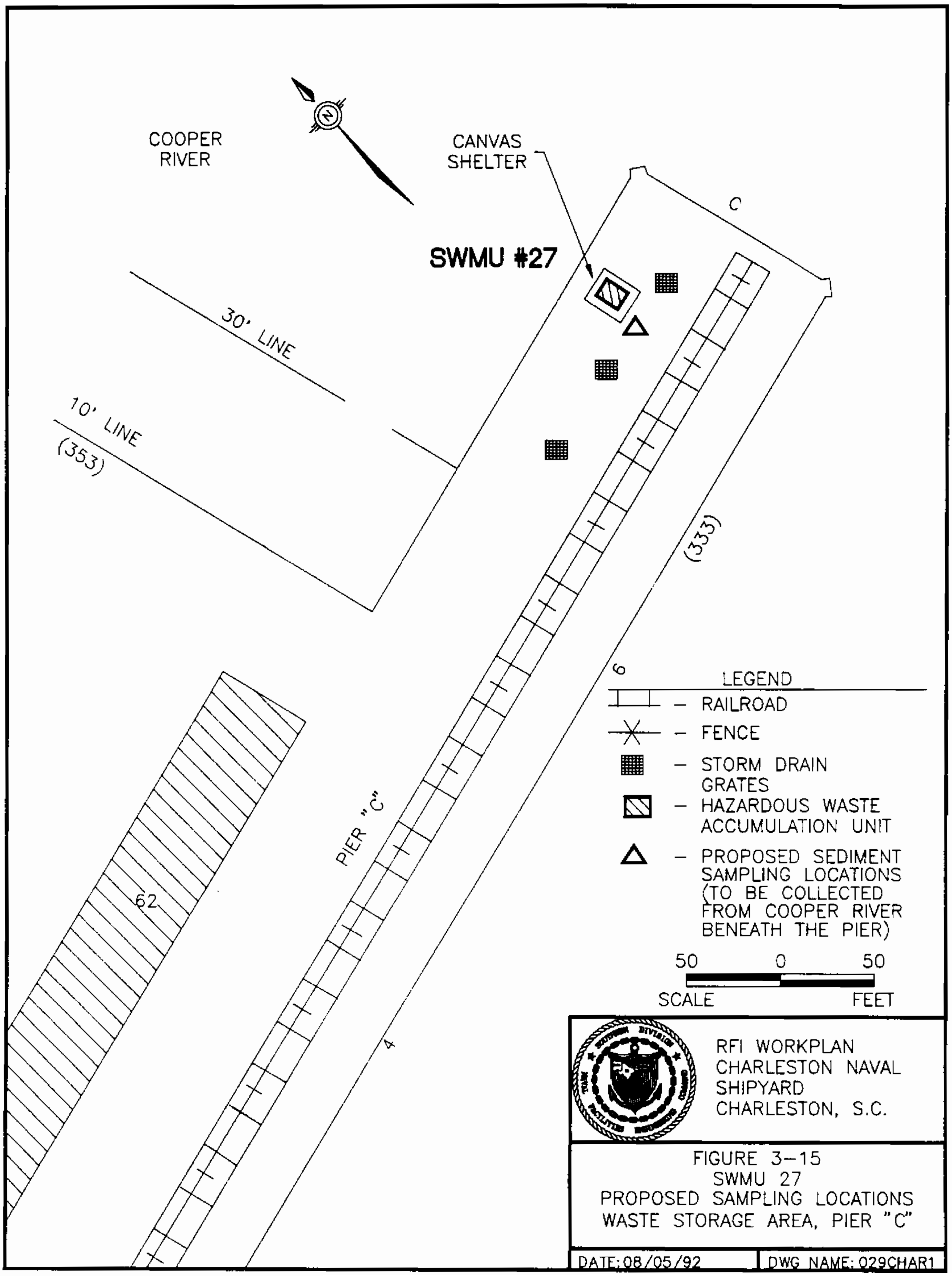
SWMU #28 is a former paint storage locker (Figure 3-16). During the site visit a stain was identified. The shape and dimension of the stain are similar to the former locker; however, further visual inspection revealed no cracks in the asphalt.

3.24.1 Soil Sampling

To ensure that there has been no surface runoff one sediment sample is proposed to be collected in the catch basin in close proximity to the unit. The sample will be analyzed for **TAL inorganics**.

3.24.2 Groundwater Sampling

No groundwater sampling is anticipated to be conducted at this SWMU. However, if conditions encountered during Phase I that indicate an assessment of groundwater is warranted, it will be addressed in Phase II.



RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 3-15
SWMU 27
PROPOSED SAMPLING LOCATIONS
WASTE STORAGE AREA, PIER "C"

DATE: 08/05/92 | DWG NAME: 029CHAR1

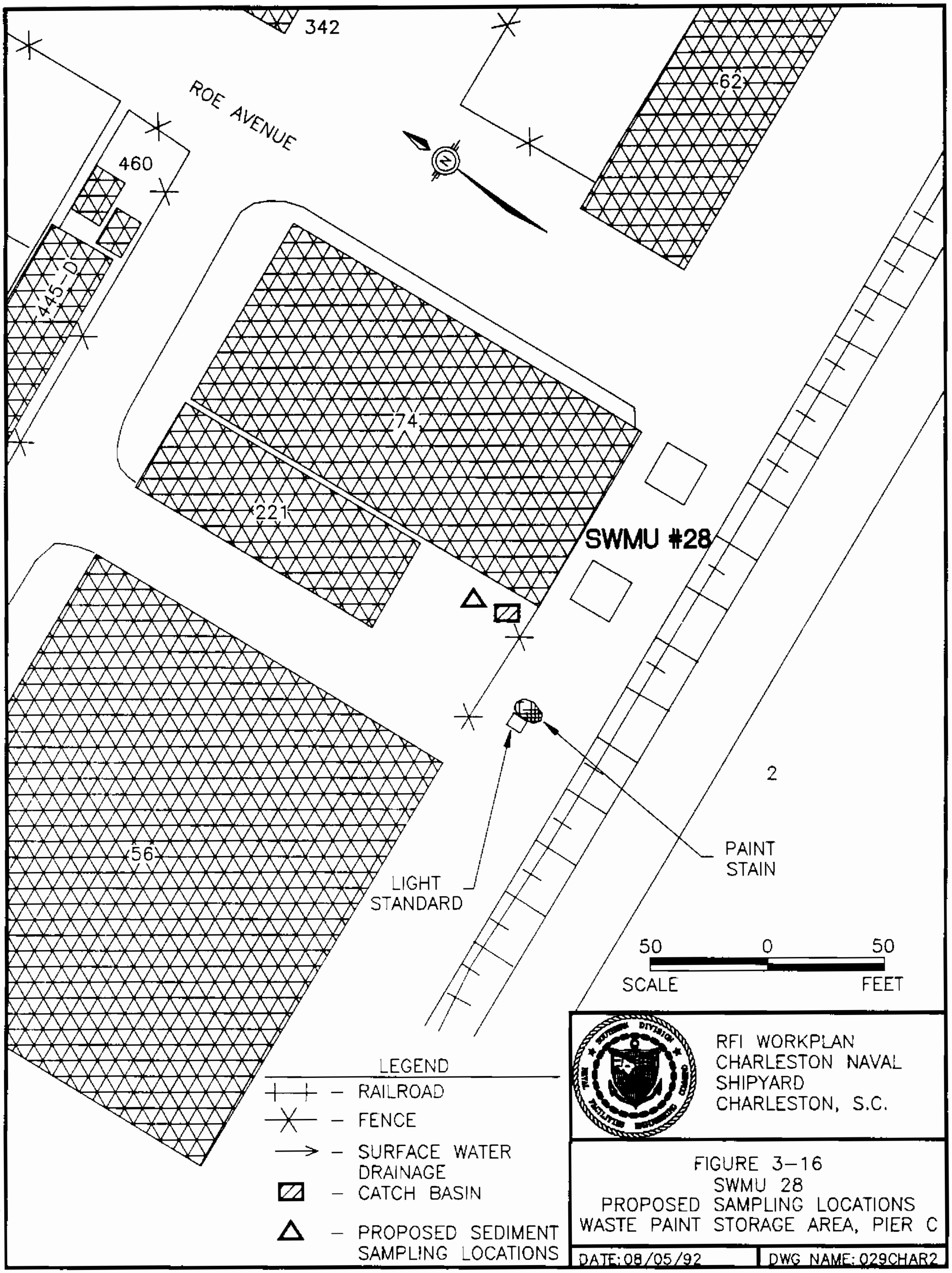


FIGURE 3-16
SWMU 28
PROPOSED SAMPLING LOCATIONS
WASTE PAINT STORAGE AREA, PIER C

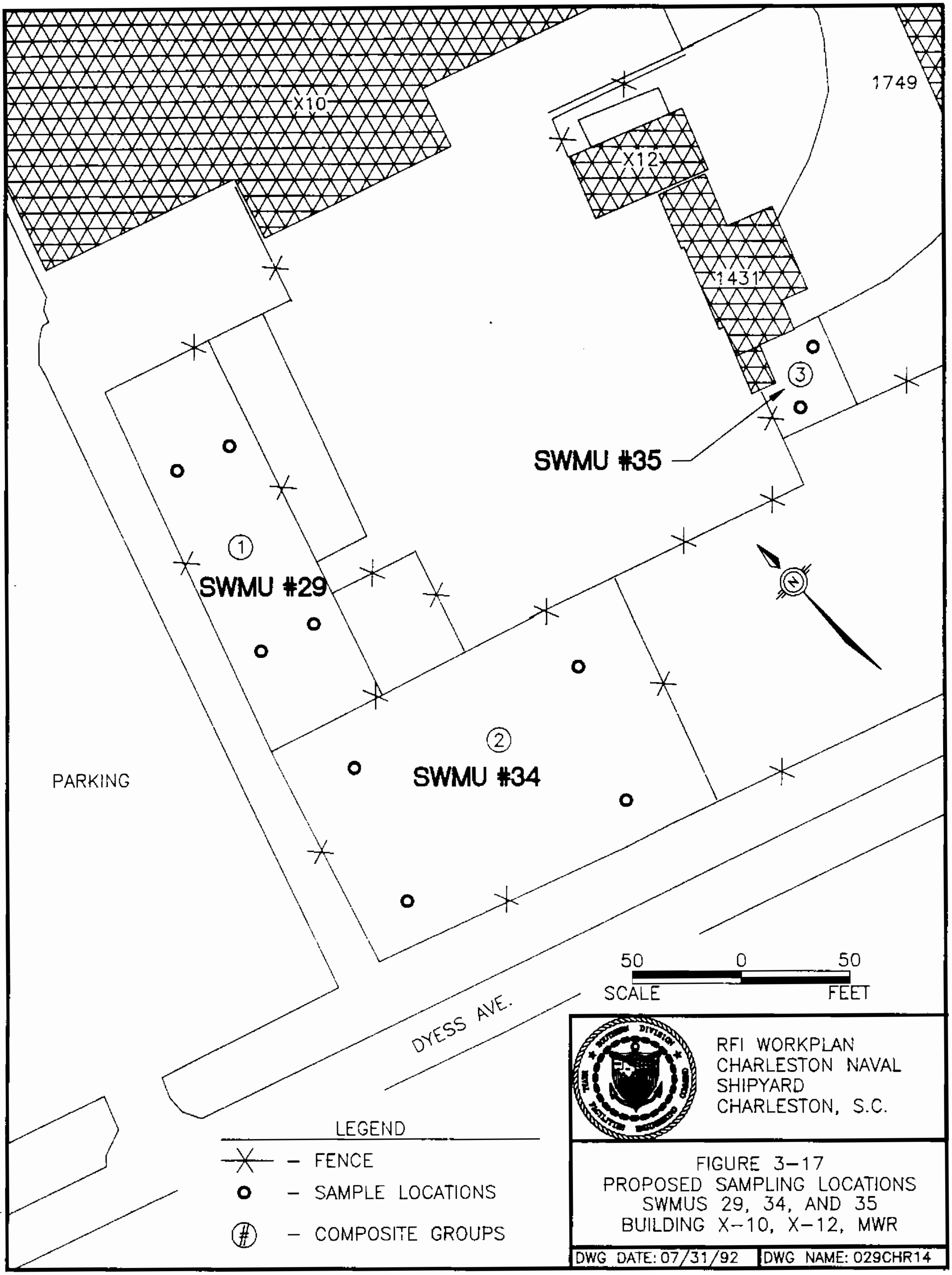


FIGURE 3–17
PROPOSED SAMPLING LOCATIONS
SWMUS 29, 34, AND 35
BUILDING X–10, X–12, MWR

3.24.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater with invasive activities through the asphalt. Utility construction should be minimized and conducted with proper preventive measures to prevent release of groundwater contamination.

3.25 SWMU #29, Building X-10

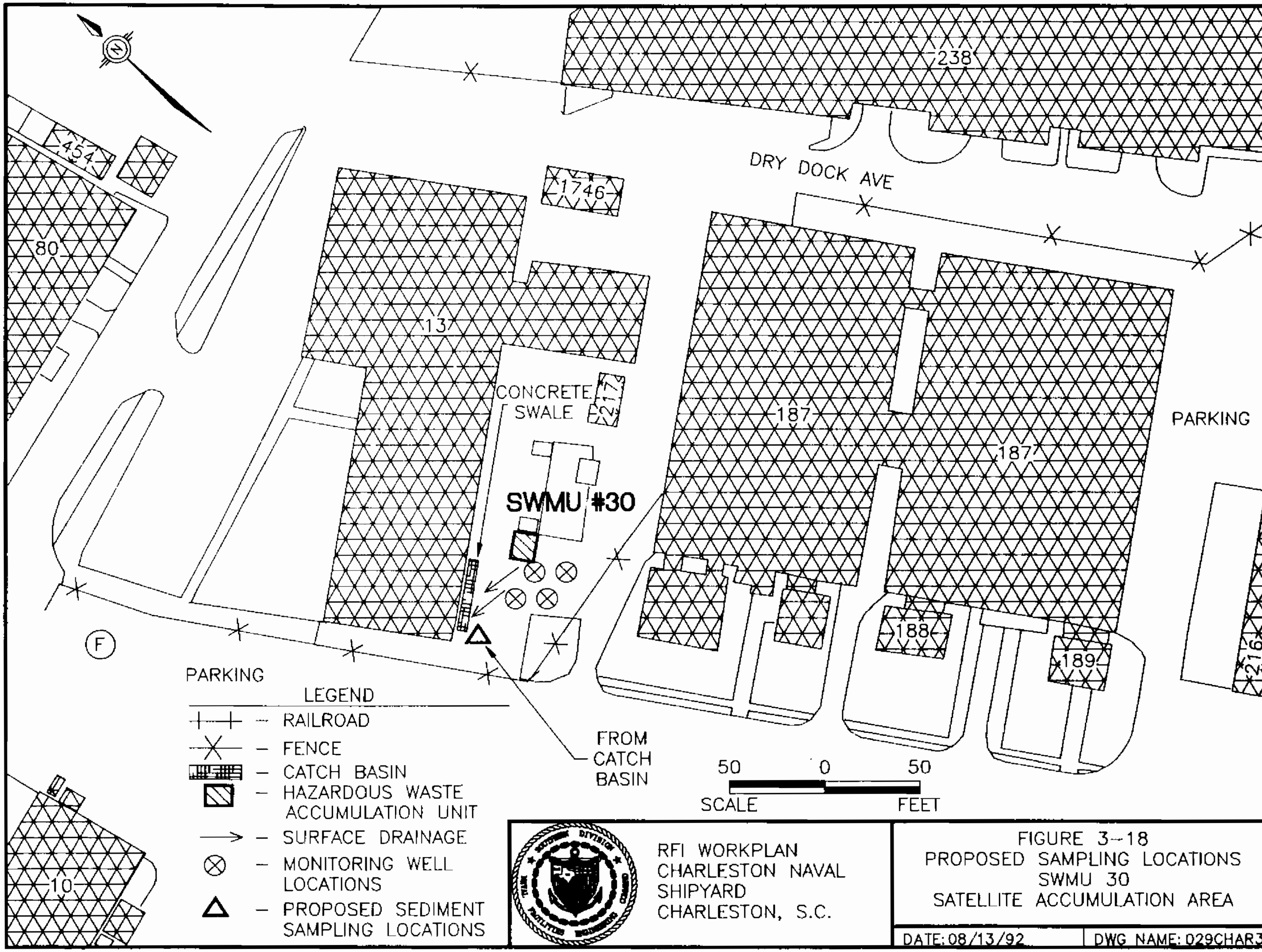
As described earlier, the area south of Building X-10 was used as a waste accumulation area for submarine maintenance and repair. Although the site is almost entirely covered with asphalt, there are signs that spillage may have impacted soil and grassy areas surrounding the site. An initial sample investigation is proposed for this unit to determine if soil contamination is present. SWMU #34 and #35 will be incorporated into this investigation as well.

3.25.1 Soil Sampling

Ten locations have been selected under an initial Phase I investigation to collect subsurface soil samples **from visually impacted areas** as shown in Figure 3-17. **The pavement in the area of SWMUs #29, #34, and #35 will be inspected for cracks. If substantial cracks are identified, soil samples beneath the cracks will be collected for chemical analysis.** All samples will be analyzed for **volatile organics**, semivolatile organics, **TAL inorganics**, and PCBs.

3.25.2 Groundwater Sampling

Groundwater sampling is not presently proposed for this site. Historical data are not available. Until the Phase I sampling program is completed, installation of monitoring wells is not warranted.



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 3-18
PROPOSED SAMPLING LOCATIONS
SWMU 30
SATELLITE ACCUMULATION AREA

DATE: 08/13/92 | DWG NAME: 029CHAR3

3.25.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater. Utility construction should be minimized and conducted with proper preventive measures to prevent release of groundwater contamination.

3.26 SWMU #30, Satellite Accumulation Area, Building 13

The satellite accumulation area is used to receive waste generated from the Building 13 laboratory. The unit and surrounding area are covered with asphalt. **A proposed berm around** SWMU #30 has not yet been constructed. During the inspection of SWMU #30 distinct cracks in the asphalt were observed.

3.26.1 Soil Sampling

One sediment sample is proposed for collection from the catch basin adjacent to the unit (Figure 3-18) and will be analyzed for **volatile organics, semivolatile organics, PCBs, and TAL inorganics. Soil samples will be collected from topographically downgradient areas if significant cracks exist in the asphalt in the area of SWMU #30.**

3.26.2 Groundwater Sampling

There is an apparent underground storage tank (UST) within the area of concern. The UST reportedly was installed to store a calibration fluid but was never used. Four monitoring wells were identified and are presumed to have been installed for monitoring the UST system. **The installation of monitoring wells at SWMU #30 will be dependent on the results of the soil sample analyses. Because construction details of the existing wells are not available, they will not be used for groundwater monitoring. However if monitoring wells become necessary, water levels in the existing wells will be measured to determine groundwater flow direction prior to installation of the new wells. If groundwater samples are collected, they will be analyzed for volatile organics, semivolatile organics, PCBs, and TAL inorganics.**

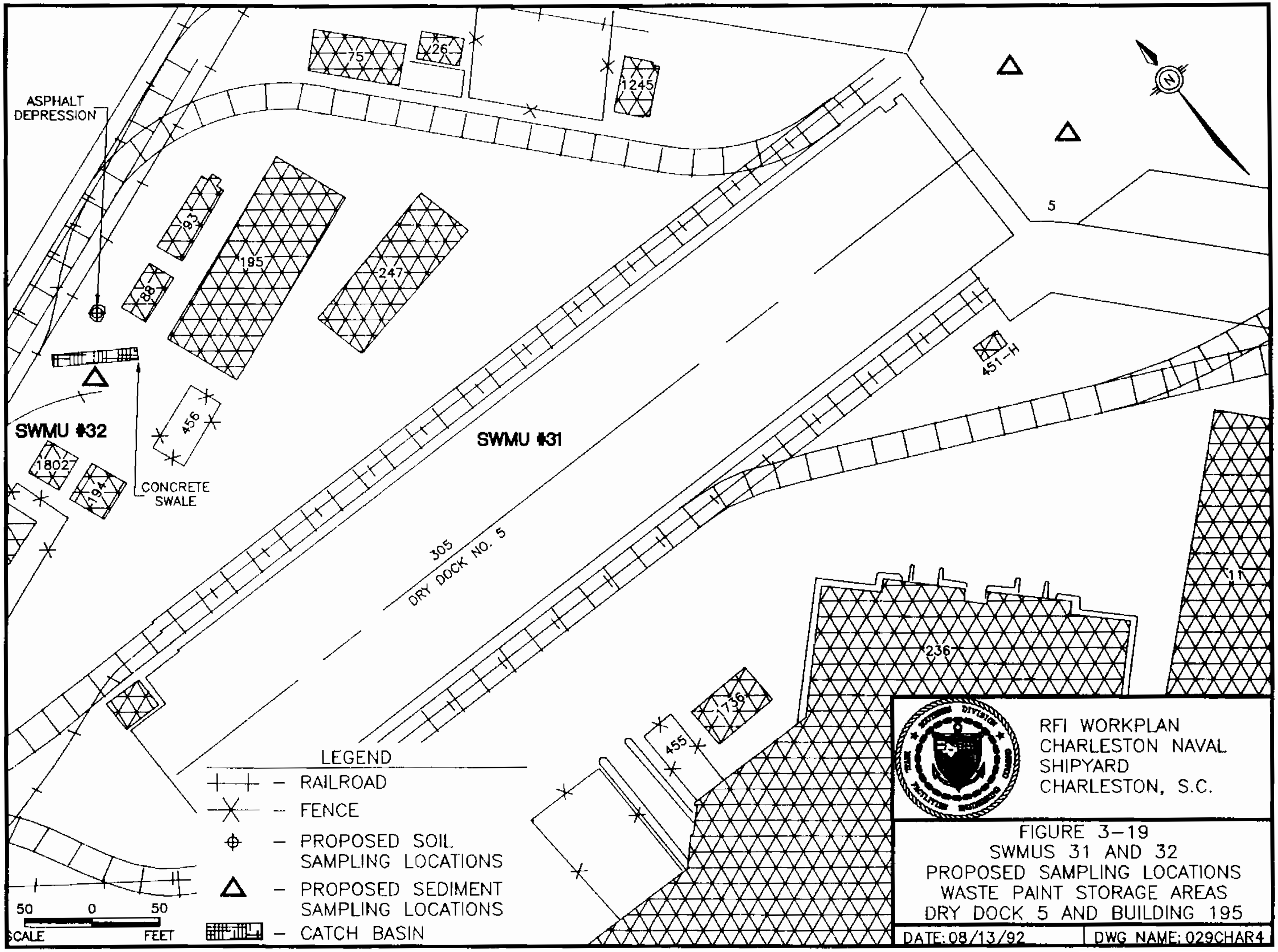


FIGURE 3-19
SWMUS 31 AND 32
PROPOSED SAMPLING LOCATIONS
WASTE PAINT STORAGE AREAS
DRY DOCK 5 AND BUILDING 195

3.26.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater with invasive activities through the asphalt. Utility construction should be minimized and conducted with proper preventive measures to prevent release of groundwater contamination.

3.27 SWMU #31, Waste Paint Storage Area, Dry Dock No. 5

The Waste Paint Storage Area (Dry Dock #5) is located within the confines of the dry dock itself. Normal operating procedures for the dry dock would require a sequence of flooding and discharge as ships are brought in for maintenance. Any accumulated waste material would be discharged to the Cooper River.

3.27.1 Soil Sampling

Two sediment samples are proposed to be sampled from the Cooper River and analyzed for **TAL inorganics** (Figure 3-19). Samples will be collected by utilizing a petite ponar dredge.

3.27.2 Groundwater Sampling

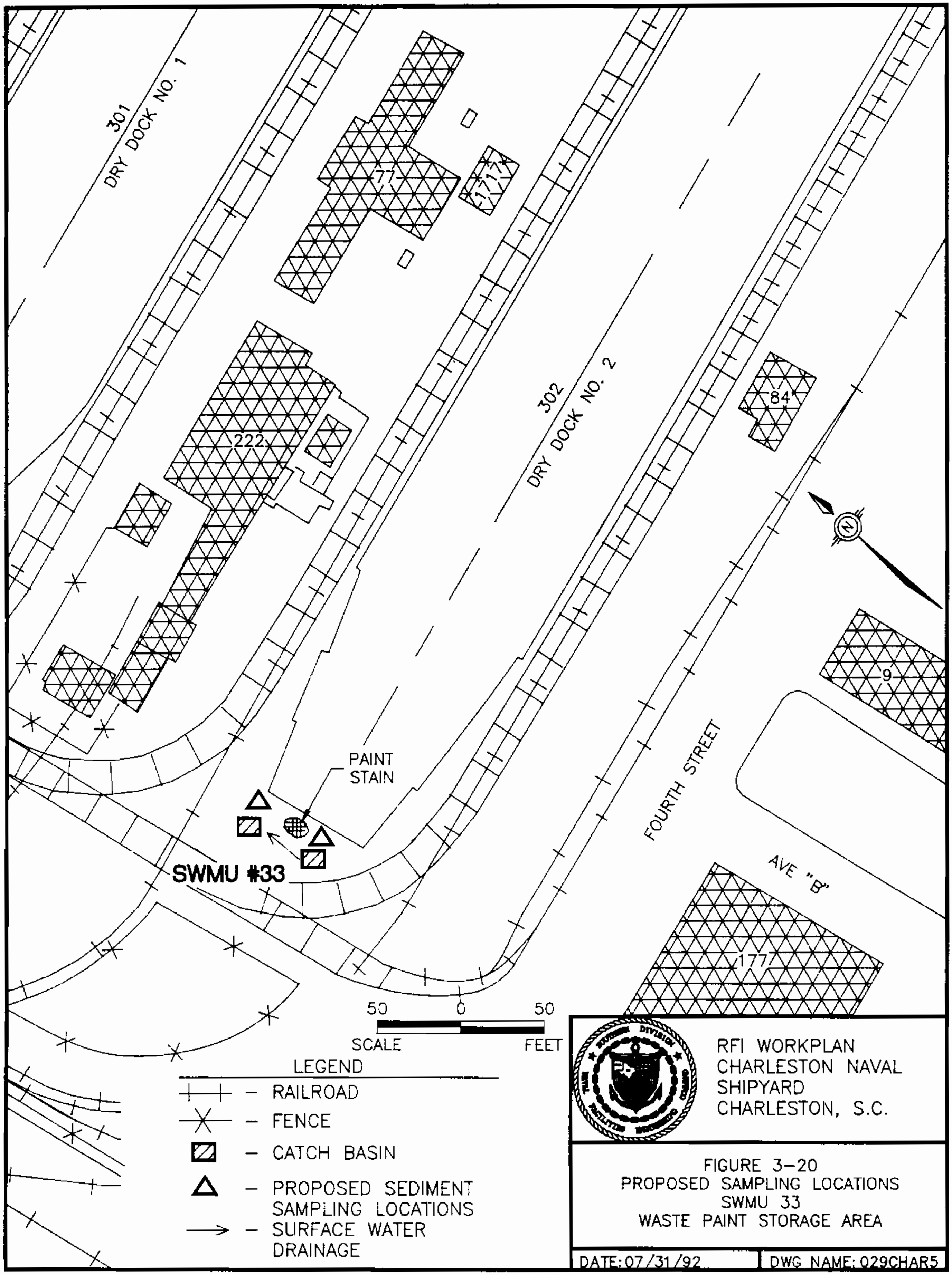
Groundwater sampling is not applicable at this SWMU.

3.27.3 Temporary Land Use Restrictions

There are no land use restrictions to be implemented near the pier. Care should be taken to minimize the potential for further releases.

3.28 SWMU #32, Waste Paint Storage Area, Building 195

The Waste Paint Storage Area (Bldg. 195) was a one time accumulation area (Figure 3-19). Visual inspection of the unit revealed a depressed area in the asphalt that had accumulated sand/dirt.



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.

FIGURE 3-20
PROPOSED SAMPLING LOCATIONS
SWMU 33
WASTE PAINT STORAGE AREA

DATE: 07/31/92 | DWG NAME: 029CHAR5

3.28.1 Soil Sampling

Adjacent to the storage area is a catch basin. Soil samples will be collected within the depressed area to a maximum depth of 3 feet at 1-foot intervals. However, if asphalt or concrete are encountered prior to obtaining the proposed depth, only those samples collected will be submitted for analysis. One sediment sample will be collected from the catch basin and analyzed for **TAL inorganics**. Soil samples will be analyzed for volatiles, semivolatiles, and **TAL inorganics**.

Subsurface soils will be addressed in Phase II only if elevated levels of contaminants are identified during the initial phase of the investigation.

3.28.2 Groundwater Sampling

Groundwater sampling does not appear to be warranted at this time and will be addressed in Phase II only if significant subsurface soil contamination is identified.

3.28.3 Temporary Land Use Restrictions

The site's activities should be limited to those which do not disturb the soil or groundwater with invasive activities through the asphalt. Utility construction should be minimized and conducted with proper preventive measures to prevent release of groundwater contamination.

3.29 SWMU #33, Waste Paint Storage Area, West End Dry Dock No. 2

The Waste Paint Storage Area (West End Dry Dock #2) was also used as a one time waste accumulation area (Figure 3-20). During the site inspection spillage was observed at the west end of the dock. There are two catch basins located east and west of the observed release that will be sampled during the RFI.

3.29.1 Soil Sampling

One sediment sample will be collected from each basin utilizing a stainless steel scoop or hand trowel. Sediment samples will be analyzed for **TAL inorganics**.

3.29.2 Groundwater Sampling

A groundwater assessment does not appear to be warranted at this time and will be addressed in Phase II if necessary.

3.29.3 Temporary Land Use Restrictions

There are no land use restrictions to be implemented near the pier. Care should be taken to minimize the potential for further releases. Furthermore waste accumulation should be limited to designated areas.

3.30 SWMU #34, MWR, Southwest of Building X-10 SWMU #35, Building X-12.

SWMUs #34 and #35 are currently designated to be investigated concurrent with SWMU #29. Figure 3-17 reflects the location of each SWMU and subsequent sampling points. Section 3.25 details the investigative approach.

3.31 SWMU 36, Building 68, Battery Shop

As outlined in Section 2.6.36 the battery shop began operations in the early 1940s and is still in use. On two occasions the floor drain to the holding tank separated from the floor allowing approximately 1025 gallons of sulfuric acid to discharge to the soil below the building. Following each spill a sodium carbonate solution was used in an attempt to neutralize the surface below the building.

The Phase I investigation is designed to determined if the attempts to neutralize the sulfuric acid following the spills were successful and if any contaminants have migrated from under the building. Also, Phase I will be used to determine if the spilled acid washed any lead dust, which may have been present, from the floor through the broken drain to the soil below the building. If the laboratory results from Phase I indicate the presence of contamination then a Phase II sampling program will be conducted to fully define the extent of soil and groundwater contamination.

3.31.1 Soil Sampling

Two soil borings will be installed adjacent to the spill area as shown in Figure 3-21. **Two surface soil samples will also be collected as shown in Figure 3-21.** All soil samples will be analyzed for **TAL inorganics** and pH. If the laboratory results indicate low pH levels and/or high lead levels then a phase II soil sampling program will be conducted.

3.31.2 Groundwater Sampling

If significant soil contamination exists at the lowermost soil sample interval, a series of soil borings converted to shallow monitoring wells will be installed in Phase II of the RFI.

3.31.3 Temporary Land Use Restrictions

The site activities should be limited to those which do not disturb the soil or groundwater. Utility construction should be minimized and conducted with proper preventive measures to prevent physical contact with potential contaminants.


3913
1267
RIVER ROAD
1829
466
SWMU #36
68
69
THIRTEENTH STREET
RARKING
100 0 100
SCALE FEET
1824
1836
1316
381
LEGEND
RAILROAD
FENCE
PROPOSED SOIL SAMPLING LOCATIONS
PROPOSED SURFACE SOIL SAMPLING LOCATIONS
SPILL AREA
RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD
CHARLESTON, S.C.
FIGURE 3-21
SWMU 36
PROPOSED SOIL BORINGS
BUILDING 68, BATTERY SHOP
DATE: 08/05/92
DWG NAME: 029CHR22

4.0 QUALITY ASSURANCE PLAN

4.1 Introduction

This document presents policies, project organization and objectives, functional activities and quality assurance and quality control measures intended to achieve data quality goals of the RCRA Facility Investigation to be performed by EnSafe/Allen & Hoshall at the Charleston Naval Shipyard, Charleston, South Carolina. The project contract number is N62467-89-D-0318.

This document is intended to fulfill requirements for ensuring all work will be conducted in accordance with quality assurance/quality control protocols and field procedural protocols for environmental monitoring and measurement data as established in:

- Naval Energy and Environmental Support Activity. (1988) *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program*, (NEESA 20.2-047B). Port Hueneme, California.

- Naval Energy and Environmental Support Activity. (1985). *Ground-Water Monitoring Guide*, (NEESA 20.2-031A). Port Hueneme, California.

- Southern Division Engineering Command. (1989). SOUTHDIV *Guidelines for Groundwater Monitoring Well Installation*. Charleston, South Carolina.

- **USEPA. (1986). Office of Solid Waste and Emergency Response, *Test Methods For Evaluating Solid Waste — Physical and Chemical Methods*, EPA SW-846. 3rd Revision.**
- USEPA. (1986). *RCRA Ground-Water Monitoring Technical Enforcement Guidance Document*, (OSWER-9950.1). Washington, D.C.

- South Carolina Department of Health and Environmental Control (SCDHEC), (1985). *South Carolina Well Standards and Regulations*, (R.61-71). Columbia, South Carolina.

- USEPA Region IV Environmental Services Division. (1991). *Standard Operating Procedures and Quality Assurance Manual*, Athens, Georgia.

- **USEPA. (1987). *Data Quality Objectives for Remedial Response Activities*, EPA/540/G-87/003.**

Where specific NEESA guidelines do not exist, applicable EPA and/or SCDHEC guidelines and methods will be applied. **The USEPA Region IV Manual (1991) will take precedence over SOUTHNAVFACENGCOM guidance where there is a conflict**. These regulations are referenced in specific sections of this document where applicable.

4.2 Project Description

The RFA and its Addendum for the NSY identified 36 SWMUs. Twenty-seven of these units require further investigation. These units are:

- the lead contamination area (SWMUs #1 and #2);
- the pesticide mixing area (SWMU #3);
- the pesticide storage building (SWMU #4);
- the battery electrolyte treatment area (SWMU #5);
- the public works storage yard (SWMU #6);
- the transformer storage area (SWMU #7);
- the oil sludge pit area (SWMU #8);
- the closed landfill (SWMU #9 and #20);
- the old fire fighting training area (SWMU #12);
- the current fire fighting training area (SWMU #13);

- the chemical disposal area (SWMU #14);
- the oil spill area (SWMU #17);
- the old paint storage area (SWMU #21);
- Building 44 old plating operation (SWMUs #22 and #25);
- the waste storage area, east end, Pier C (SWMU #27);
- the waste paint storage area, west end, Pier C (SWMU #28);
- Building X-10 (SWMUs #29, #34, and #35);
- the satellite accumulation area, Building 13 (SWMU #30);
- the waste paint storage area, Dry dock No. 5 (SWMU #31);
- the waste paint storage area, Building 195 (SWMU #32);
- the waste paint storage area, west end, Dry dock No. 2 (SWMU #33);
- Building 68, Battery Shop (SWMU #36).

Section 2.6 describes the types of hazardous materials likely to be encountered at each unit.

To characterize the nature and extent of contamination, soil, sediment, and groundwater samples will be collected. Sampling protocols and number of samples to be collected are described in Section 3 of this RFI Work Plan. Both sampling and analysis procedures will follow the procedures and protocols as outlined in the documents mentioned in Section 4.1 of this Quality Assurance Plan. The rationale for the particular types of sampling are discussed in Sections 2 and 3 of this RFI Work Plan.

4.3 Project Quality Assurance Objectives

In general, quality assurance objectives of EnSafe/Allen & Hoshall projects conducted as part of the Navy technical services contract are to assess and document the precision, accuracy, representativeness, completeness, and comparability of all sampling and analysis performed. Quality criteria are outlined here to assure the suitability of data obtained during projects for their intended use, and to meet goals established by NEESA. **Laboratory analyses will utilize**

EPA DQO Level III and Level IV quality control criteria, as outlined in EPA/540/G-87/003, *Data Quality Objectives for Remedial Response Activities*, to be applied to site media in the RFI. The following discussion presents the project-specific levels of effort for quality assurance and data quality criteria.

4.3.1 Field Measurements

QA objectives for parameters to be measured in the field by EnSafe/Allen & Hoshall personnel are presented in Table 4-1. Field measurements will include pH, temperature, specific conductance, turbidity, static groundwater level turbidity and photoionization detector (PID)/flame ionization detector (FID) readings.

Table 4-1
Field QA Measurements

Measurements Parameter	Reference	Matrix	Precision (%)	Accuracy % Recovery	Completeness (%)
pH	EPA 150.1[a]	Water	± 0.05 pH	± 0.2 pH	90
Temperature	EPA 170.1[a]	Water	± 0.1° C	± 0.2° C	90
Specific Conductivity	EPA 120.1[a]	Water	± 10%	± 10μmhos/cm (<1000μmhos/cm) ± 100μmhos/cm (>1000μmhos/cm)	90
Static Water Level	SOP[b]	Water	± 0.01 in.	± 0.005 in.	90
PID/FID	SOPc[c]	Air	± 10 ppm	± 20 ppm	90
Turbidity	SOP[d]	Water	0.01 NTU	0.1 NTU	90

Notes:
a - Methods for Chemical Analysis of Water and Wastes, EPA-600/4/79-020, Revised March 1983.
b - Manufacturer's SOP for static water level measurement.
c - Manufacturer's SOP for operation of PID/FID.
d - Manufacturer's SOP for operation of a turbidity meter.

FID = Flame Ionization Detector
PID = Photoionization Detector

4.3.2 Sampling and Analysis for Contamination Level

Project QA objectives of analytical parameters for soil and groundwater will be as stipulated in the respective analytical methods, and as determined by the analytical laboratory's historical data quality evaluation for these methods. The NEESA laboratory approval process will assist in ensuring that the laboratory method QA/QC standards are appropriate to meet the goals for the intended data uses. The subcontracted laboratory's NEESA approved Quality Assurance Plan will be submitted for inclusion as Appendix P.

4.3.3 Precision and Accuracy

Methods of assessing precision and accuracy of the field screening measurements are discussed in Section 4.15 of this document, and summarized in Table 4-1. Precision and accuracy goals for laboratory analytical procedures are also discussed in Section 4.15 and summarized in Table 4-2. Specific method precision and accuracy goals for required QC samples are discussed in subsequent sections.

4.3.4 Representativeness

The goal of this investigation is to assess the extent of any soil and groundwater contamination, and to determine the most appropriate remedial option. By properly collecting soil and groundwater monitoring well samples and measuring well parameters in accordance with NEESA and EPA protocols, samples collected during the investigation will be representative of the areas of concern.

4.3.5 Completeness

Completeness is a measure of the amount of usable data resulting from a data collection activity. The completeness goals take into consideration unavoidable non-attainment of QA goals which may occur over the course of the investigation. Efforts will be made to maintain soil and groundwater data completeness above the 90 percent level.

Table 4-2
Analytical QA Measurements

Parameter	Reference	Matrix	Precision (%)	Accuracy % Recovery	Completeness (%)
Volatile Organic Compounds	EPA Method 8240	Soil	± 35	± 50	90
		Water	± 35	± 50	90
Semivolatile Organic Compounds	EPA Method 8270	Soil	± 40	± 50	90
		Water	± 40	± 50	90
Organochlorine Pesticides/PCBs	EPA Method 8080	Soil	± 35	± 40	90
		Water	± 25	± 40	90
Total Petroleum Hydrocarbons	EPA Method 418.1	Soil	± 35	± 55	90
		Water	± 35	± 55	90
Total Cyanide	EPA Method 9010	Soil	± 20	± 25	90
		Water	± 20	± 25	90
Metals	EPA Method 6010/7000 series	Soil	± 25	± 25	90
		Water	± 25	± 25	90
Organophosphorus Pesticides	EPA Method 8140	Soil	± 35	± 40	90
		Water	± 25	±40	90
Extractable Lead	EPA Method 7421	Soil	± 35	± 45	90
		Water	± 35	± 55	90
Hexavalent, Chromium	EPA Methods 7195-7198	Soil	*	*	90
		Water	*	*	90
Purgeable Non-halogenated Volatile Organics	EPA Method 8015	Soil	± 35	± 50	90
		Water	± 35	± 50	90
Diquat	EPA Method 549	Soil	N/A	N/A	90
		Water	± 35	±40	90
Carbaryl, Propoxur, Bromacil	EPA Method 632	Soil	± 35	± 40	90
		Water	± 35	± 40	90

Note: * Precision and accuracy goals are currently undetermined for Hexavalent Chromium, however, every effort will be made to achieve the 90% completeness goal.

4.3.6 Comparability

Comparability is assured through the use of the established methods of sampling and analysis as specified in NEESA 20.2-031A and NEESA 20.2-047B, as well as other accepted methods by field technicians and the laboratory. These methods are discussed in the project work plan as specified.

4.4 Project Organization and Responsibilities

Overall responsibility for projects conducted in accordance with NEESA regulations will be vested in NEESA (or its approved representatives). Hence, project coordination responsibilities will lie with the Southern Division (SOUTHDIV) Naval Facilities Engineering Command, engineer-in-charge (EIC). The following sub-sections describes the components of the project chain-of-command as established in NEESA 20.2-047B.

4.4.1 Oversight

Project oversight is organized along the following lines of authority.

4.4.1.1 Navy Energy and Environmental Support Activity

NEESA is responsible for ensuring that the quality of laboratory analyses performed during the various steps of CLEAN is acceptable. NEESA is also responsible for managing the NEESA Contract Representative (NCR).

4.4.1.2 Engineering Field Division

The EIC at the EFD provides the site information and history, provides logistical assistance, specifies the sites requiring investigation and reviews results and recommendations. **Linda Martin** with the SOUTHDIV Naval Facilities Engineering Command, Charleston, South Carolina, serves as the EIC for this project.

The EIC is responsible for coordinating procurement, finance, and reporting; for ensuring that all documents are reviewed by the NCR; for communicating comments from the NCR and other technical reviewers to the subcontractors; and for ensuring that the subcontractors address all the comments submitted and take appropriate corrective actions.

4.4.1.3 NEESA Contract Representative

The NCR is responsible for ensuring that each project has appropriate overall QA. The NCR reviews laboratory QA plans and work plans, submits performance sample data, provides field and laboratory audits, and reviews data from the site. The questions from subcontractors and the EIC regarding specific field and laboratory QC practices are directed to the NCR. The NCR also provides evaluation of referee samples. The NCR for this project will be determined prior to initialization of the field investigation.

4.4.1.4 State or Local Oversight

This work plan will be submitted to the EPA Region IV and the SCDHEC for review and approval. Field activities and meetings will be coordinated with these agencies as required.

4.4.2 Investigation Performance

The following individuals or firms will be responsible for the implementation of the NSY RFI Work Plan.

4.4.2.1 Engineering Subcontractor

EnSafe/Allen & Hoshall will serve as the engineering subcontractor for this project. As the engineering subcontractor, EnSafe/Allen & Hoshall is responsible for designing and implementing all RFI activities.

4.4.2.2 Analytical Laboratory

The analytical laboratory must adhere to the laboratory requirements in NEESA 20.2-047B along with other QA and method requirements as specified. The laboratory will be required to prepare and submit a laboratory QA plan, to analyze and submit the results of proficiency testing, to submit to an onsite inspection, and to correct any deficiencies cited during the inspection. The laboratory is required to identify a laboratory QA coordinator (LQAC) who will be responsible for overall quality assurance. The LQACs must not be responsible for scheduling, costs, or personnel other than laboratory QA assistants. It is preferred that the LQACs report to the laboratory director. The LQACs must have the authority to stop work on projects if QC problems arise which can affect the quality of the data produced.

In addition to conforming to all NEESA regulations, all work shall be performed in a manner consistent with:

- The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended.
- The National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 Code of Federal Regulations (CFR), Part 300, as amended.
- Other appropriate federal, state, and local guidelines, rules, regulations, and criteria (where applicable).

4.5 Soil Borings and Sampling

This section is intended to satisfy the basic requirements for drilling and soil sampling as outlined in the appropriate documents referenced in Section 4.1. The soil sampling program outlined in Section 3 of this Work Plan and will be executed in accordance with specific procedures outlined in the following sections.

During the RFI, soil samples will be collected for chemical analysis from a number of areas at the NSY. Collection of soil samples will be accomplished by a variety of methods including soil test borings, hand auger borings, and monitoring well borings. The following section describes methods to be employed for each type of solid media. Variations in the protocols may become necessary due to site conditions.

4.5.1 Soil Sampling Procedures

Soil test borings will be placed in areas of suspected or potential contamination as described in Section 3 of this RFI Work Plan. Each boring will be installed utilizing hollow-stem auger techniques with internal diameters ranging between 3.25-inch to 6.25-inch. Soil samples will be collected ahead of the augers by use of a pre-cleaned split barrel sampler. **Unless otherwise specified, soil samples will be collected at the 0 to 1 foot interval; collection of additional samples from the 3 to 5 foot interval and 8 to 10 foot interval will be contingent upon the depth to groundwater. Collection of samples for chemical analysis will be terminated once the water table is encountered.**

Additional samples may be collected when:

- Visual changes in soil lithology are observed or if evidence of soil contamination is present.
- When PID/FID measurements are observed well above background measurements (for additional volatile samples only).
- The site history indicates a probable existence of some non-volatile contamination.

Each sample will be visually examined and logged by a site geologist using the Unified Soil Classification Scheme (USCS). All field observations and soil descriptions are also to be entered into a dedicated field logbook. Descriptions will include color, texture, grain size, staining, and odor. An example of the boring logs to be used is provided as Figure 4-1.

FIGURE 4-1

NAVY CLEAN
ENSAFE/ALLEN & HOSHALL
(901) 383-9115

JOB NO.	CLIENT	LOCATION
DRILLING METHOD:		BORING NO.
		SHEET OF
SAMPLING METHOD:		DRILLING

LOCATION OF BORING

DATUM ELEVATION

						START TIME	FINISH TIME
WATER LEVEL							
TIME							
DATE						DATE	DATE
CASING DEPTH							

SURFACE CONDITIONS:

SAMPLER TYPE	INCHES DRIVEN / INCHES RECOVERED	DEPTH OF CASING	SAMPLE NO. / SAMPLE DEPTH	BLOWS/FT SAMPLER	VAPOR CONCENTRATIONS (PPM)	DEPTH IN FEET	SOIL GRAPH	
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		
						1		
						2		
						3		
						4		
						5		
						6		
						7		
						8		
						9		
						0		

DRILLING CONTR ______

BY ______ CHK BY ______

DATE ______

028CBORL

Samples to be submitted for volatile organics analysis are to be extracted from the sampling device first and immediately placed in the appropriate containers. The remaining sample will be placed in a stainless steel mixing bowl and homogenized using a stainless steel spoon or spatula. Sample aliquots will be obtained from the homogenized sample for all additional analytical parameters in containers specified in Section 4.11.

During the drilling operations, an FID or PID will be used to monitor organic vapors in the breathing zone and near the auger cuttings. Individual soil samples will be monitored using the headspace technique to assist in locating contaminated zones or areas. Each sample will be scanned for VOCs. The headspace screening process will involve the placement of a representative subsample into a container (approximately three-quarters full). The container will then be sealed and allowed to reach ambient temperature. Only the tip of the instrument probe is to enter the container. Every possible effort shall be made to minimize vapor loss from the container during headspace measurements. All resultant meter readings will be noted in the field logbook. The FID/PID reading shall also be noted and recorded in the field logbook and boring log.

All soil borings will be abandoned by a pressure grouting procedure. The procedure will be accomplished by pumping a cement-bentonite mixture through a tremie pipe starting at the bottom of the boring. Grouting will proceed from the bottom of the boring to the surface in one continuous operation.

4.5.2 Engineering Soil Characteristics Sampling & Analysis

To determine the potential effectiveness of soil remediation alternatives, selected engineering soil characteristics may needed. These characteristics are included in a group called physical soil properties. Analyses of the physical soil properties can provide information about soil properties such as hydraulic conductivity, soil type, density, cation exchange capacity (CEC), total organic carbon (TOC), and porosity.

If undisturbed soil samples for physical soil analyses are deemed to be necessary, these samples will be collected from selected soil borings using a 3-inch diameter Shelby tube. All undisturbed samples will be obtained according to procedures outlined in ASTM D1587, *Standard Practice for Thin-Walled Tube Sampling of Soils* (ASTM Vol. 4.08,1991). Each Shelby tube sample will be analyzed for the full complement of proposed physical analytical parameters according to ASTM/EPA approved methods.

4.5.3 Sediment Samples

The collection of sediment samples will utilize the Ponar dredge. The Ponar dredge allows use in areas where sediments are considered rocky, in very deep waters, or even when the stream velocity is very high. The dredge should be lowered very slowly as it approaches the bottom, as the instrument can displace and miss lighter materials if dropped freely. Once collected, sediment samples are to be handled in a manner similar to soil samples.

4.6 Monitoring Well Installation

The RFI Work Plan proposes the installation of permanent monitoring wells at several SWMUs to evaluate potential adverse impacts to the surficial aquifer beneath the NSY. The SWMUs at which further groundwater investigation is warranted are identified in Section 3 of this RFI Work Plan along with the proposed monitoring well locations. The monitoring wells will be installed in accordance with the SOUTHDIV *Guidelines for Groundwater Monitoring Well Installation*, NEESA 20.2-031A Chapter 5 — Monitoring Well Installation, and the appropriate USEPA and SCDHEC documents referenced in Section 4.1.

4.6.1 Shallow Monitoring Well Installations

The shallow monitoring wells will be installed in the uppermost portion of the surficial aquifer and the total depth of each well will vary depending on site conditions. Each monitoring well will be drilled using hollow stem auger techniques. Techniques, similar to those mentioned above for soil borings are also to be used for monitoring wells. Each well will be screened from approximately 2 feet above the water table to 8 feet below. Each well will typically consist of a 10-foot, 2-inch internal diameter, **NSF Standard 14wc** certified schedule 40 PVC well screen attached to a section of riser pipe comprised of like material. All shallow monitoring wells will be constructed through the annulus of the augers as the augers are slowly retracted. A graded, clean, silica sand filter pack material will be emplaced into the annular space by tremie pipe and extended 2 feet above the screened interval. **The grain size of the sand pack and screen slot size will be determined by the results of one or more grain size analyses conducted for each SWMU.** Filter packs will typically be designed by multiplying the 50 percent retained size of the formation material by a factor of 2 to select the appropriate filter material. The screen slot opening size will be selected to retain between 85 and 100 percent of the filter pack. Once the sand is emplaced, a minimum 2-foot bentonite pellet seal will be placed above the sand pack. The placing of both the sand pack and bentonite seal will occur in increments of 2 feet or less, with the augers withdrawn in similar increments. The hydration time for the bentonite seal will meet the manufacturer's specifications or 8 hours, whichever is greater. Once the bentonite pellets have been allowed to hydrate for the appropriate length of time, the augers will be withdrawn and the remaining annular space will be grouted by tremie pipe utilizing a **high solids, pure bentonite grout**.

4.6.2 Deep Monitoring Well Installations

The installation of deep wells may become necessary to ascertain the vertical extent of potential groundwater at the NSY. For purposes of this investigation "deep" monitoring wells will be considered those which monitor the lower most portion of the surficial aquifer (the top of the Cooper Marl). Well construction will use hollow-stem auger techniques, if underlying lithology permits. If the drilling contractor determines that geological conditions are not feasible for a hollow-stem auger, then mud rotary techniques will be substituted using only a pure bentonite mud as the drilling fluid. Monitoring wells will be constructed in the same manner as was described in the previous section with the exception that all "deep" monitoring wells will be equipped with a 5-foot section of screen.

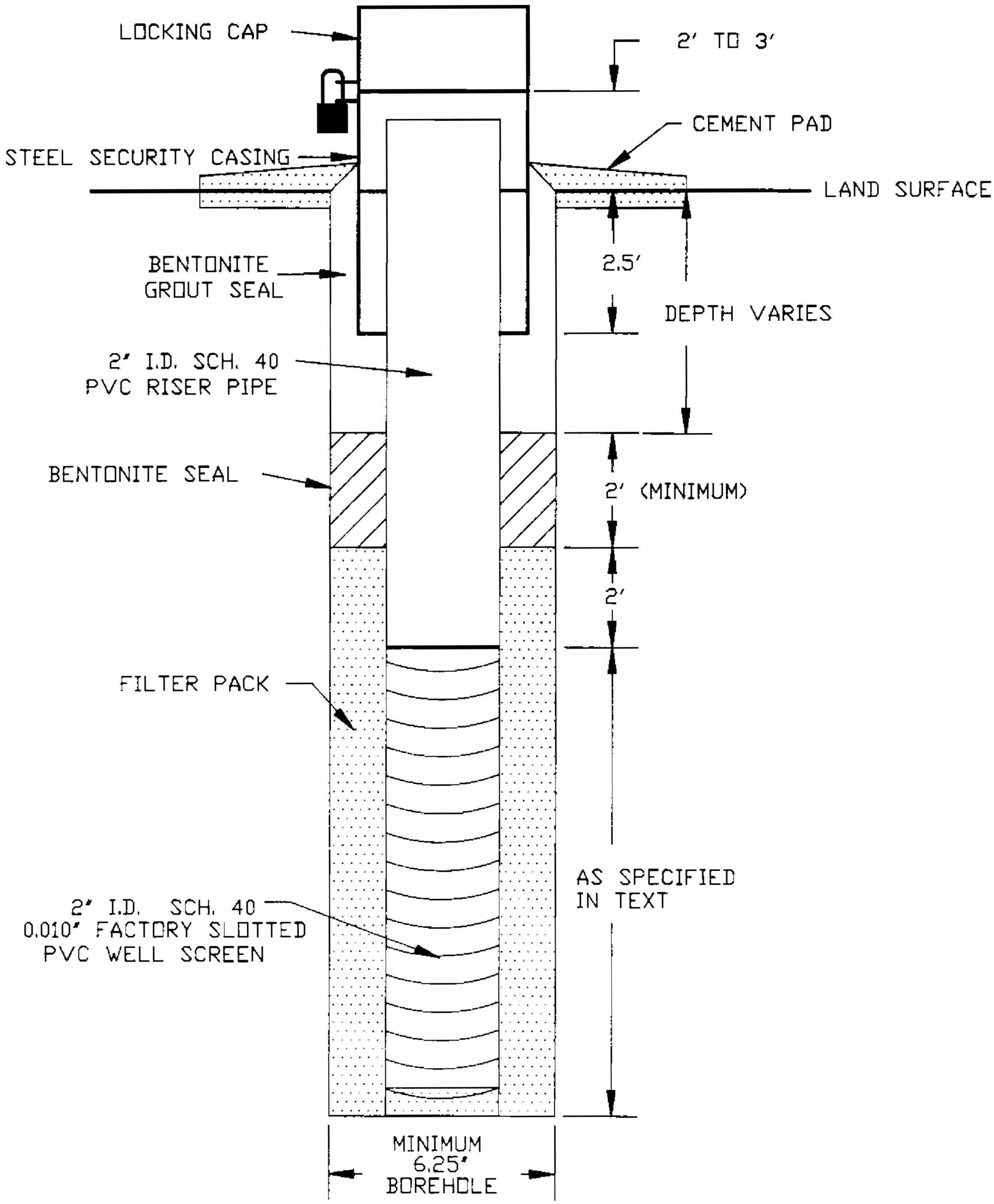
4.6.3 Well Head Completions

Monitoring wells will be completed with a 4-inch, locking, 16-gauge steel protective steel cover. Each well will be surrounded by a 3' x 3' x 6" elevated, outwardly sloping concrete pad. Four steel protective posts (4" diameter, 6' length, 1/4" thickness and concrete filled ASTM A120) will be installed surrounding the well. The protective posts will be painted using a high visibility yellow epoxy paint (AASHTO M220). The protective cover will be marked with the international symbol for monitoring wells. A monitoring well construction diagram is presented in Figure 4-2.

For wells located in areas of high vehicular traffic, flush mounted manholes will be completed with a locking 22-gauge steel, water resistant welded box with a 3/8 inch steel lid locking device and padlock guard. **In accordance with the SCDHEC Monitoring Well Approval Form, written justification will be provided for the installation of each well which must be completed with a flush mount cover.** A brass plate well sign (2" x 3" x 1/8") stamped with the well designation will be attached to each protective cover. All anchors and fasteners will be compatible with the sign.

4.6.4 PVC Justification

Southern Division Naval Facilities Engineering Command (SOUTHNAVFACENGCOM) is committed to using only the most reliable methods of obtaining the data used in its investigations. Therefore, SOUTHNAVFACENGCOM recommends the use of well casings made of polyvinyl chloride (PVC) material for monitoring wells installed at the NSY. After reviewing the literature, SOUTHNAVFACENGCOM has concluded that PVC is a <u>superior</u> well casing material when monitoring a plume consisting of both metals and organics. In Appendix R are three recent publications supportive of the SOUTHNAVFACENGCOM position: "Influence of Casing Materials on Trace-Level Chemicals in Well Water" (Parker, 1990), "Leaching of metal pollutants from four well casing used for ground-water monitoring" (Hewitt,



RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD,
CHARLESTON, S.C.

FIGURE 4–2
TYPE II
MONITORING WELL

DWG DATE:10/08/93 | DWG NAME: 029WLSCH

1989) and "Potential of Common Well Casing Materials to Influence Aqueous Metal Concentrations" (Hewitt, 1992). These studies are included as Appendix R of this document.

SOUTHNAVFACENGCOM requests the USEPA to consider the following information as required in the "Alternate Well Casing Material Justification" form:

1. The Data Quality Objectives (DQO) for the samples to be collected from wells with PVC casing per EPA/540/G-87/003., "Data Quality Objectives for Remedial Response Activities."

Response: The DQOs for the RCRA Facility Investigation (RFI) at Charleston Naval Shipyard are to provide information of sufficient quality to support a Corrective Measures Study (CMS) and a Baseline Risk Assessment. The quality assurance and quality control (QA/QC) procedures are specified within this QA/QC Plan submitted as part of the RFI Work Plan. Sample collection and accompanying QA/QC procedures are designed to meet the NEESA Level C criteria.

2. The anticipated compounds and their concentration range.

Response: The following are the maximum concentrations of compounds identified during previous studies.

Inorganics (μg/l)		Organochlorine Pesticides (μg/l)
As	70.0	BHC 1.0
Ba	4620.0	DDT 0.2
Cr	8.2	
Hg	0.4	
Pb	22	

Volatile Organics (μg/l)		**BNAs (μg/l)**	
Benzene	20.0	Anthracene	1.1
Chlorobenzene	13.6	Acenaphthene	1.3
Chloroform	1.5	Naphthalene	2.2
p-Dichlorobenzene	7.5	2 Methylnaphthalene	5.5
1-4, Dichlorobenzene	7.2	Phenanthrene	1.1
Toluene	4.6	Ethylbenzene	2.7
TCE	0.4	TCA	0.8

3. The anticipated residence time of the sample in the well and the aquifer's productivity.

Response: Each well will be purged immediately before the sample is collected. The anticipated residence time of the water prior to sampling should be less than twenty minutes. Site specific information regarding the aquifer's productivity is not available; however, information pertaining to the surficial aquifer in the Charleston area is described in a State of South Carolina Water Resources Commission report (Ref. ?). Aquifer test data indicate the surficial aquifer has a transmissivity range of approximately 600 ft^2/day and a hydraulic conductivity of 13 ft/day.

4. The reason for not using a hybrid well.

Response: SOUTHNAVFACENGCOM feels that PVC is the preferred material when sampling mixed wastes plumes. Stainless steel may adsorb or absorb heavy metals such as lead, chromium and arsenic. Also, the cutting oils used in the manufacturing of stainless-steel riser and screen are difficult to remove. These oils, if not completely removed by the decontamination cleaning, may contaminate the well. Hybrid wells introduce additional problems, such as, the junction is usually a weak point subject to breakage or is a place for down-hole equipment to become ensnared.

5. Literature on adsorption/desorption characteristics of the compounds and elements of interest for the type of PVC to be used.

Response: Three reprints are attached that evaluate the sorptive characteristics of stainless steel and PVC. The study titled "Influence of Casing Materials on Trace-level Chemicals in Well Water" (Parker, 1990), evaluated a number of the chemicals of concern identified in previous investigations at NSY. However, benzene is one contaminant detected at a concentration above its respective MCL that was not addressed by the studies.

6. If an anticipated increase in thickness of the well thickness will require a larger annular space.

Response: No change in the annular space is required.

7. The type of PVC to be used and if available the manufacturers specifications as well as an assurance that the PVC to be used does not leach, mask, react or otherwise interfere with the contaminants being monitored within the limits of the DQO(s).

Response: The PVC will **meet the requirements of NSF Standard 14wc (equivalent to ASTM F480).**

SOUTHNAVFACENGCOM strongly believes that the quality of data obtained by using PVC well construction materials will be equal to or an improvement over the use of stainless steel as a general purpose well construction material.

4.7 Groundwater Sampling Procedures

Groundwater levels will be measured during each of the quarterly sampling events at both high and low tides to obtain a better understanding of both seasonal and tidal effects on

groundwater flow. Groundwater data will be input into a GIS data management program to facilitate evaluation of groundwater flow on both a local and regional basis. Static groundwater levels will be measured in each monitoring well 24 hours following development. All wells at individual SWMU locations will be gauged on the same day. Well gauging will consist of measuring the depth to water and depth to free-floating product (if present) using a decontaminated oil and water interface probe. The measurements will be made to an accuracy of one-hundredth of a foot. The well depth will be measured using a decontaminated weighted steel tape with an accuracy of at least one-tenth of a foot. All readings will be made at a clearly marked reference point at the top of each well casing. Each well reference point will be surveyed to a common datum and/or mean sea level to allow construction of a groundwater surface contour map.

Permanent monitoring wells will be allowed to recover 2 weeks prior to sampling. Well development **will not be performed within 24 hours of installation.** Each well will be fully developed by surging, bailing and/or pumping techniques. The development process includes the measurements of pH, temperature, conductivity and turbidity. Wells will be considered developed when the water is relatively free of particles and silt and when duplicate measurements satisfy the following criteria:

Temperature:	within ± 1.0°C
pH:	within ± 0.5 standard unit
Conductivity:	within ± 10% from the duplicate
Turbidity:	relatively stable

Defining a criteria for stable turbidity conditions is considered to be nonattainable at this time, but will be determined onsite by the project geologist. Turbidity during well development will initially be quite high. As the development process continues turbidity will be measured to determine an achievable stable value. Ideally, well development is to obtain a turbidity-free groundwater sample. However, due to naturally occurring or contaminant induced particulates mobile in the aquifer, neither development water nor groundwater samples may necessarily achieve a turbidity-free condition.

E/A&H will attempt to begin well sampling at a site with either the upgradient (clean) well or wells which are known or believed to be clean. Sampling then proceeds to increasingly contaminated wells and ends with the most contaminated well. This procedure will help to minimize the potential for cross contamination of wells, especially false positives in clean wells due to insufficient decontamination of field sampling equipment.

The monitoring well sampling procedure begins with placement of a dedicated plastic or aluminum foil sheet around the wellhead before purging and sampling to provide an area where equipment can be placed temporarily without risk of contamination. A PID or FID reading will be taken at each wellhead immediately after removal of the well cap. A new pair of disposable latex gloves will be donned prior to each sampling activity. Disposable gloves will be worn when the possibility exists of contact with samples and/or sampling equipment. Static well water levels will be measured with an electronic water level meter before well sampling procedures begin. An oil or water interface probe will be used if free-floating petroleum is present or suspected in the well. Water and product level measurements will be taken from the same point each time they are measured. The water level measurement is to be recorded in the project field logbook. The description of any free-floating product observed will also be noted in the field notebook. Wells with free products will not be sampled for trace contaminants. The depth of the well will be determined with a pre-cleaned weighted steel tape. All water level measuring devices must be accurate to within one-tenth of a foot or better.

The volume of water in the well casing will be calculated as follows:

V = [(total well depth)-(depth to water level)] x (0.17 for 2" wells <u>or</u> 0.66 for 4" wells) where V represents the volume in gallons per feet.

Purging and sampling of monitoring wells for metals analyses will be conducted with either peristaltic pumps in accordance with Section F.1 of the Environmental Compliance Branch Standard Operating Procedures Quality Assurance Manual EPA SOP/QAM or a Grunfos Redi-Flo II, capable of a very low flow rate. Wells will be purged of at least three well volumes to ensure that the sample retrieved is representative of aquifer water quality. Purged water volume will be measured with graduated buckets or flow rate calculations. The wells will be considered purged and ready for sampling when two consecutive measurements of pH, temperature and conductivity have stabilized to the criteria previously stated for well development. If stabilization has not occurred after purging five well volumes and the well has recovered sufficiently then the wells will be considered purged and a representative groundwater sample will be collected. Purged waters will be retained onsite in 55-gallon drums until laboratory analytical results determine the regulatory status of the water. Investigation derived wastes are discussed in Section 4.21.

Groundwater samples for volatile organics, semivolatile organics, pesticides, and PCB analyses will be collected either with peristaltic pumps or Teflon bailers. If Teflon bailers are used, they will be thoroughly decontaminated, as outlined in Section 4.10. A new, braided nylon rope with a Teflon-coated stainless steel lead line will be used to lower the bailer, and the rope will not be reused following sampling of the well. Duplicate samples will be taken from successively collected bailers. Split samples will be taken successively from the same bailer. If one bailer does not contain enough water to fill both sample bottles, one-half of the bailer contents will be poured into one sample container and one-half into the other. Another bailer of water will then be collected, and the sample containers filled. **Water samples collected with either the peristaltic pump or bailer will be poured directly into the appropriate pre-labeled containers.** Ice and water placed in sealable plastic bags will be used to provide temperature preservation at 4°C in the sample coolers. All sample bottles will be placed in a sample cooler.

4.8 Soil and Groundwater Sample Analyses

All sample analyses will be performed in accordance with SW-846 Test Methods for Evaluating Solid Waste. Soil and groundwater samples will be analyzed for parameters as outlined in Table 4-2.

4.9 Sample Documentation

All samples collected will be documented in accordance with:

- NEESA 20.2-047B, Chapter 3 — Site-Specific QC Requirements, and
- NEESA 20.2-031A, Chapter 6 — Monitoring Well Data Record Requirements, and
- EPA's Environmental Compliance Branch, "Standard Operating Procedures and Quality Assurance Manual," (hereafter referred to as the EPA SOP/QAM) Section 3 — Sample Control, Field Records and Document Control.

Field personnel will use weather-proof bound logbooks for the maintenance of all field records pertaining to the investigation. These records will document all visual observations, calculations, equipment calibrations, weather conditions and location and time of collection for each sample. Every entry will be dated and the time for each entry noted. The logbooks are accountable documents that will be properly maintained and retained as part of the project files.

4.10 Sampling Equipment Decontamination

This section describes procedures for decontamination of field equipment. Drilling augers, split-spoons, stainless steel trowels, bailers, well materials, and groundwater pumps should be decontaminated using the following seven step process:

1. Wash equipment with a hot, high pressure potable water/Liquinox mixture. Use brush where necessary to remove particulate matter or surface films. Follow wash by a high pressure rinse with hot potable water.

2. Rinse thoroughly with tap water.
3. Rinse thoroughly with deionized water.
4. Rinse twice with **pesticide-grade isopropanol.**
5. Rinse thoroughly with **organic-free** water and allow to air dry as long as possible.
6. If analyte-free water is not available, allow equipment to air dry as long as possible.
7. Wrap with aluminum foil, if appropriate, to prevent contamination of equipment to be stored or transported.

PVC well materials will not be steam cleaned or solvent rinsed. A centralized decontamination pad will be constructed adjacent to the fenced compound currently surrounding the office trailer.

4.11 Sample Identification, Containers, Preservation and Labeling

Pre-cleaned sample containers will be provided by the laboratory. E/A&H will receive the containers from an approved laboratory that has followed NEESA 20.2-047B, Chapter 3.5 — Sample Container Cleaning Procedures (and/or other applicable protocol), and the containers will remain in the custody of E/A&H personnel. Labels will be affixed to each sample container filled with soil or groundwater samples. Labels will include site, sample identification, collection time and date, method of sample preservation, sampler identification and analytical methods. An outline of site-specific sample identification system is provided in Section 4.11.2. Sample containers, preservation methods, and holding times are summarized for each method in Table 4-3.

Each sample will be identified by a sample label as shown on the bottom portion of Figure 4-3. When sample containers are filled at a site, the forms mentioned above will be completed.

Table 4-3
Sample Containers, Preservation, and Holding Times

Analytical Method	Sample Matrix	Container Size/Material	Sample Preservation[1]	Holding Times
EPA Method 6010 ICAP Metals	Water	500 ml HDPE Jar	Chill, 4° C Metals - HNO_3 pH<2	Metals - 6 months Mercury - 26 days
	Soil	250 ml HDPE Jar	Chill, 4° C	6 months until analysis
EPA Method 7000 Series GFAA Metals	Water	500 ml HDPE Jar	HNO_3pH<2	6 months until analysis
	Soil	250 ml HDPE Jar	Chill, 4° C	6 Months until analysis
EPA Method 8080 Pesticides/PCBs	Water	1 Liter Amber Glass Jar with Teflon-lined septum	Chill, 4° C[3]	Extract within 7 days, analyze within 40 days
	Soil	500 ml Glass Jar with Teflon-lined septum	Chill, 4° C[3]	Extract within 14 days, analyze within 40 days
EPA Method 8140/8141 Organophosphorus Pesticides	Water	1 Liter Amber Glass Jar with Teflon-lined septum	Chill, 4° C[3]	Extract within 7 days, analyze within 40 days
	Soil	500 ml Glass Jar	Chill, 4° C[3]	Extract within 14 days, analyze within 40 days
EPA Method 8150/8151 Herbicides	Water	1 Liter Amber Glass Jar with Teflon-lined septum	Chill, 4° C[3]	Extract within 7 days, analyze within 40 days
	Soil	500 ml Glass Jar	Chill, 4° C[3]	Extract within 14 days, analyze within 40 days
EPA Method 8240 Volatile Organic Compounds	Water	(4) 40 ml VOA Glass Vials with Teflon-lined septa	Chill, 4° C, HCl[3]	14 days until analysis
	Soil	125 ml Amber Glass Jars with Teflon-lined septa	Chill, 4° C	14 days until analysis
EPA Method 8270	Water	One liter Amber Glass Jar	Chill, 4° C[3]	Extract within 7 days, analyze within 40 days

Table 4-3
Sample Containers, Preservation, and Holding Times

Analytical Method	Sample Matrix	Container Size/Material	Sample Preservation[1]	Holding Times
Semi-Volatile Compounds	Soil	500 ml Glass Jar with Teflon-lined septum	Chill, 4° C	Extract within 14 days, analyze within 40 days
EPA Method 9010 Cyanide	Water	500 ml HDPE Jar	Chill, 4° C, NaOH pH > 12	14 days until analysis
	Soil	250 ml HDPE	Chill, 4° C	14 days until analysis
EPA Method 549 Diquat	Water	1 Liter Amber Glass with Teflon-lined septum	Chill, 4° C	Extract within 7 days, analyze within 40 days
EPA Method 632 Carbaryl, Propoxur, and Bromacil	Water	1 Liter Amber Glass with Teflon-lined septum	Chill, 4° C[3]	Extract within 7 days, analyze within 40 days
	Soil	500 ml Glass Jar with Teflon-lined septum	Chill, 4° C	Extract within 14 days, analyze within 40 days

FRONT

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MEMPHIS, TENNESSEE 38134

BACK

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SITE:	
SAMPLE NUMBER:	
PRESERVATIVES:	
ANALYSIS:	
DATE:	
TIME:	
SAMPLER:	

RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD,
CHARLESTON, S.C.

FIGURE 4-3
SAMPLE TAG

DATE: 08/04/92 | DWG NAME: 029CLTAG

4.11.1 Sample Chain-of-Custody

E/A&H will follow strict chain-of-custody procedures in accordance with NEESA 20.2-047B, Chapter 3.8, and corporate standard operating procedures for chain-of-custody. E/A&H will use chain-of-custody forms, as illustrated in Figure 4-4, for transferring sample shipments to the laboratory. Documentation of all samples will also be kept in a project field logbook. The method of preservation for each sample will be listed in the remarks section of the chain-of-custody form. Upon transfer of custody, the chain-of-custody form will be signed by the E/A&H site QA manager or the field sampling team leader, who will note the date and time the samples were relinquished.

Because common carriers will not sign chain-of-custody forms, the chain-of-custody records will be sealed within each shipping container. As an additional chain-of-custody safeguard, each shipping container will be provided with a custody seal (Figure 4-5), signed and dated by the site QA manager, which will ensure that the shipping container is not opened until it is received by the laboratory. All chain-of-custody forms received by the laboratory must be signed and dated by the laboratory sample custodian and returned to E/A&H following receipt, or as part of the data reporting package. The field sampling team should take measures to ensure that samples are delivered to the analytical laboratory within 24 hours of collection. Due to the time constraints placed upon the field sampling team by courier service schedules, it may not be possible to meet the 24 hour sample delivery time limit. However, under no circumstances will samples be delivered to the laboratory more than 48 hours subsequent to time of collection. If necessary, special arrangements will be made with the laboratory sample custodian to allow for sample acceptance on weekends or holidays.

4.11.2 Sample Identification System

The tracking of a sample from time of collection to the final analytical deliverable will be maintained with the assistance of the sample identification system. The unique sample identification system alters slightly for quality assessment samples. The assessment samples are the field blanks, duplicates, trip blanks, equipment rinsate blanks, etc.

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FIGURE 4-4
CHAIN OF CUSTODY RECORD

PAGE ________ OF ________

CLIENT ____________________ PROJECT MANAGER ____________________

ADDRESS ____________________ TELEPHONE NO. ____________________

PROJECT NAME/NUMBER ____________________ FAX. NO. ____________________

MEDIA STATUS: (A, B, OR C) ____________________ SAMPLERS: (SIGNATURE) ____________________

FIELD SAMPLE NUMBER	DATE	TIME	SAMPLE TYPE	TYPE/SIZE OF CONTAINER	PRESERVATION		NO. OF CONTAINERS	ANALYSIS REQUIRED							REMARKS
					TEMP.	CHEMICAL									

RELINQUISHED BY:	DATE	RECEIVED BY:	DATE	RELINQUISHED BY:	DATE	RECEIVED BY:	DATE
SIGNATURE ________		SIGNATURE ________		SIGNATURE ________		SIGNATURE ________	
PRINTED ________	TIME	PRINTED ________	TIME	PRINTED ________	TIME	PRINTED ________	TIME
COMPANY ________		COMPANY ________		COMPANY ________		COMPANY ________	
REASON ________		REASON ________		REASON ________		REASON ________	

METHOD OF SHIPMENT: ____________________
SHIPMENT NO. ____________________
SPECIAL INSTRUCTION: ____________________

COMMENTS: ____________________

AFTER ANALYSIS, SAMPLES ARE TO BE:
- ☐ DISPOSED OF (ADDITIONAL FEE)
- ☐ STORED (90 DAYS MAX)
- ☐ STORED OVER 90 DAYS (ADDITIONAL FEE)
- ☐ RETURNED TO CUSTOMER

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NAVY CLEAN

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Memphis, Tennessee 38134
(901) 383-9115

OFFICIAL SAMPLE SEAL

SAMPLE #	DATE:
SIGNATURE:	
PRINT NAME & TITLE:	

RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD,
CHARLESTON, S.C.

FIGURE 4-5
CUSTODY SEAL

DATE: 08/04/92 DWG NAME: 029SECSL

Most laboratories will have computer systems which deliver data via computer diskettes. One constraint is that the average analytical laboratory's computer systems will not accept sample identification numbers greater than eight digits. Thus, one constraint to the sample identification system is the alphanumeric eight digit dimension. The system will include the following information:

- site,
- sample matrix,
- QC sample type (when applicable),
- well or boring location number,
- sample interval/depth (when applicable).

A prefix will be attached to the sample identification number with a backslash. The prefix to be used for this particular project will be CNSY, (e.g. CNSY\12345678). The analytical laboratory will not utilize the site specific prefix.

The first three digits, (1, 2, and 3), will signify the sample origin. These digits are alphanumeric and should implement some mnemonic device for the true name of the site. However, the first digit should be an alphabetical letter in order to facilitate data processing. Some examples are given below:

SWMU #9	-	S09
Well #2	-	W02
Background	-	B00

The type of sampling location will be represented by digits 4, 5, and 6. Designations for a well or boring installations will be made by using a "W" or a "B" respectively in the fourth digit, followed by the two-digit sample location identifier. The sample location identifier is a number assigned to the specific well or boring.

The seventh and eighth digits are matrix dependent and will represent sample interval for soil samples or sample identifiers for groundwater samples. For sample identifiers in groundwater samples, each sample will be given a number by sequential collection. Duplicate samples will have a similar sample identification but the duplicate will have the letter "A" in place of the eighth digit. The letter "A" also serves a double purpose, in which duplicate samples will be "blind" samples to the analytical laboratory.

Examples:

A) S11-B09-02 represents a soil sample from SWMU 11, boring #9 at the second sampling interval (i.e. since samples will be collected every 2— feet, the second sampling interval will be the 2"-4" feet range)

B) S12-W07-02 represents the second groundwater sample collected from well #7 at SWMU #12

C) S12-W07-2A represents a duplicate of the sample in example B.

All sample identification information will also be documented in the sampler's field logbook, especially information not incorporated in the sample number.

Quality assessment samples will replace the fourth-digit (well or boring designation), when applicable. Digit 4 will represent the type of Quality Assessment (QA) sample, followed by the month and day it was collected. Samples required to meet this data quality objective are given below with their appropriate code.

F - field blank
R - rinse blank
T - trip blank

These codes will be followed by a four-digit date where the first two digits (5 and 6) indicate the month and the second two digits (7 and 8) indicate the day. For example: August 14 would be written as 0814.

Example: S06-F1025 is the sample identifier for the field blank collected at SWMU #6 on October 25.

4.12 Calibration Procedures and Frequency

The analytical laboratory will complete its instrument calibration in accordance with NEESA 20.2-047B and/or as outlined in the NEESA-approved laboratory QAP. Adherence to proper calibration procedures will be determined by the NCR during the onsite laboratory inspection. All laboratory calibration procedures will be outlined in the laboratory's NEESA-approved QAP manual.

E/A&H will oversee to the calibration of the field equipment measuring pH, temperature, conductivity in accordance with the Environmental Compliance Branch, EPA SOP/QAM, Section 6.3 — Quality Control Procedures. Field equipment for which SOPs are not provide in the EPA SOP/QAM, will be calibrated and operated in accordance with the manufacturer's recommendations. At a minimum, all field instruments will be calibrated or checked at the beginning and end of each work day.

4.13 Analytical Procedures

This investigation will utilize the following analytical procedures.

4.13.1 Field Analyses

Drilling operations for soil borings and monitoring wells will be monitored with an PID or FID for volatile organic compounds. Static water level measurements will be taken on all monitoring wells development, allowing adequate time for well recharge. The wells will be checked with an PID or FID prior to sampling to detect volatile organic vapors.

Monitoring well casings will be surveyed for spatial and horizontal orientation by a State of South Carolina registered land surveyor. The survey measurements will be recorded relative to the USGS NAD '83. All field measurements will be recorded in a dedicated field logbook and/or appropriate E/A&H field activity log (i.e. boring log, well construction log).

4.13.2 Laboratory Analyses

Soil and water samples collected during the course of this investigation will be analyzed by the SW-846 methods listed in Table 4-2. Standard soil and water analyses were chosen in order to assess the nature and extent of potential contaminants in these media and to meet the requirements of the RFI Scope of Work.

4.14 Data Reduction, and Reporting

Laboratory procedures for data reduction and reporting will be conducted according to standard operating procedures as dictated by those outlined in the following:

1. **DQO Level III QC in EPA/540/G-87/003, *Data Quality Objectives for Remedial Response Activities*.**
2. SW-846, Test Methods for Evaluating Solid Waste — Physical and Chemical Methods.
3. The NCR approved laboratory QA plan.

Required internal QC checks and data validation procedures are described in Section 4.15. E/A&H's use of the laboratory will be accomplished by a services agreement. The contract will specify the scope of services to be performed by the laboratory, the specific analytical quality assurance requirements to be met, and the information to be developed and reported.

4.15 Field and Laboratory Quality Control Checks

Internal laboratory control checks used by the laboratory will be conducted in the laboratory by its staff. E/A&H will conduct internal quality control checks of sampling procedures and laboratory analyses. These checks will consist of preparation and submittal of sampler rinsate blanks, trip blanks, field blanks, and field duplicates for analysis, and an evaluation of the laboratory analytical package. The process of data validation will be independent of the laboratory and will be performed by the E/A&H project QA manager. Data validation guidelines presented in NEESA 20.2-031A, Chapter 7.3.2 will be followed in evaluating reported data (for analyses for which these guidelines apply). Exceptions will be made for total petroleum hydrocarbons and any wet chemistry methods employed because specific data validation guidelines are not provided for these methods in NEESA guidance. For these methods, the QA/QC evaluation parameters discussed in Section 4.15.2 will be applied. The usability of data will be determined by evaluating the data packages with respect to these criteria.

Samples of all water sources used in the sampling process (e.g. organic free water and potable water), preservatives, sand, and grout will be analyzed for volatile organics, semivolatile organics, pesticides, PCBs, and TAL inorganics. These samples will be analyzed to meet DQO Level IV objectives.

The types and frequencies of blank and other control check samples will be dictated by the level of QC selected for each project by the Navy EIC. The required control check sample frequencies are outlined in NEESA 20.2-047B, *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program* and illustrated in Table 4-4. For **DQO Level III**, quality control measures can be discussed for sampling and analysis as follows.

4.15.1 Field Data Quality

All field work will be conducted and/or supervised by E/A&H personnel to ensure that proper procedures are followed. Field records will be kept of all activities that take place during the investigation and these records will be maintained at the E/A&H office in Memphis, Tennessee. These records will document any obstacles that may be encountered during the investigation.

Table 4-4
QC Sample Frequencies

Quality Control Sample	Frequency of Collection	Additional Sample Volumes Required
Trip Blank (for volatiles only)	One per sample shipping cooler containing samples to be analyzed for volatiles	(4) 40 ml. glass vials with Teflon-lined septa
Rinsate Blank	One per day per media (to be analyzed every other day unless contaminants are identified)	A
Field Blank	One per groundwater sampling event (analyte-free water)	A
Duplicates	One per 10 water and/or soil samples collected	A,B
Matrix Spike/Matrix Spike Duplicate Samples	One per 20 water and/or soil samples collected; matrix is to be the same sample used for duplicate analysis	A

Notes:

A - Adequate sample volumes should be collected to perform all aqueous analytical methods described for the area of investigation.

B - An identical set of containers should be provided for each soil duplicate dependent upon the area of investigation.

Field samples will be collected per the procedures outlined in Sections 4-5, 4-6, and 4-7 of this document. Precision will be assessed by evaluating the results of the duplicate and matrix spike duplicate samples. Accuracy will be assessed by evaluating the analyses of the field blanks, trip blanks, laboratory matrix and surrogate spikes, and laboratory reagent blanks and blank spike samples.

A duplicate is an identical sample collected from the same location (e.g. well or boring) at the same time under identical conditions. Duplicate samples are analyzed along with the original sample to obtain sample procedure precision and inherent sample source variability. Soil duplicate samples will be collected to assess the heterogeneity of contaminant concentrations within the soil matrix (from a specific location). Due to the potential for loss of volatile parameters during preparation of soil samples, soils which are to be analyzed for volatiles will not be homogenized in the field. Duplicate samples (water and soil) will be collected at a 10 percent frequency. The duplicates will be submitted to the laboratory "blind" to serve as a check to assess the accuracy and precision of the laboratory analytical data.

A field blank is a sample container filled with the source water used in the decontamination of equipment in the field. The field blank is prepared, preserved and stored in the same manner as the other field samples. The field blanks are analyzed along with the field samples for the same constituents of interest to check for contamination imparted to the samples by the sample containers or other exogenous sources. One field blank per sampling event or per source will be prepared.

Rinsate (or equipment) blanks are collected by retaining rinsate from sampling equipment. The equipment is rinsed with analyte free water after full decontamination procedures have been performed. Rinsate samples are collected in containers of the same type and treatment as the sample containers. One rinsate sample will be collected for each analytical method during each day of the field investigation. Rinsate blanks will be analyzed along with the field samples for the same constituents of interest to check for contamination imparted to the samples by the sampling equipment, containers, or other exogenous source. Rinsate blanks will be analyzed at a frequency of one every two sampling days/events unless target compounds or analytes are found at concentrations above the respective method detection limit, in which case the previous rinsate blank will also be analyzed.

A trip blank is a sample container filled with organic-free water that is transported unopened with the sample bottles. It is opened in the laboratory and analyzed along with the field samples for volatile constituents of interest. Trip blanks for all volatile parameters will be prepared and submitted to the laboratory with sample shipping containers at a frequency of one per sample shipment.

4.15.2 Analytical Data Quality

Analytical data quality is assured through the use of NEESA guidelines for QA/QC as set forth in NEESA 20.2-047B (where appropriate) **and EPA DQO Levels as specified in EPA/540/G-87/003, *Data Quality Objectives for Remedial Response Activities*.** The guidelines include analysis and evaluation of matrix spikes.

Matrix spike samples are prepared by the laboratory and are useful in assessing the accuracy of the analytical method and in detecting matrix effects, in which other sample components interfere with the analysis of the contaminant of concern. The method of measuring analytical accuracy is percent recovery. Analysis of matrix spike duplicates will provide a basis for determining method precision specific to the matrix under investigation. Precision is measured as relative percent difference (RPD) between duplicate analyses.

Analytical matrix spikes and matrix spike duplicates will be performed at a rate of one per sample batch (20 samples maximum) per matrix in accordance with NEESA 20.2-047B **and EPA DQO guidelines**.

Surrogate spikes are also used to determine the accuracy of the analytical method with respect to the matrix under investigation. Surrogate spike compounds are compounds similar in chemical nature to the target compounds, but not likely to be found in the affected media (i.e. radioisotopically labelled compounds, etc.). These compounds are introduced into each sample before analysis. By comparing the reported results for these compounds with the quantities introduced, a percent recovery can be determined. This percent recovery data is subsequently used to assess the accuracy of results for target compounds within each specific sample. Surrogate spike analyses will be performed on each sample analyzed for organic parameters. The choice of compounds to be used for matrix and surrogate spike purposes is generally stipulated by the analytical method employed.

4.15.3 Field Data Package

The field data package will include all logbooks, field records and measurements obtained at a site by E/A&H personnel in accordance with **the EPA SOP/QAM,** NEESA 20.2-047B, Chapter 7.2 — Deliverables and NEESA 20.2-031A, Chapter 6 — Monitoring Well Data Record Requirements.

The field data package includes all field records and measurements obtained at the activity by E/A&H sampling personnel. The field data package will be reviewed and validated by the E/A&H project QA manager for completeness and accuracy by conducting the following:

- A review of field data compiled on water and soil sampling logs for completeness. Failure in this area may result in the data being invalidated for litigation or regulatory purposes.

- A verification that field blanks, sampler rinsate blanks, and trip blanks were properly prepared, identified and analyzed. Failure in this area may compromise the analytical data package and result in some data being considered qualitative or invalid.

- A check on field analyses for equipment calibration and condition. Failure in this area may result in the field measurements being invalidated.

- A review of chain-of-custody forms for proper completion, signatures of field personnel and the laboratory sample custodian, and dates. Failure in this area may result in the data being invalidated for litigation or regulatory purposes.

4.15.4 Analytical Data Package

Validation of the analytical data package will be performed by the E/A&H project QA manager (not before completion of field data validation) prior to submittal to the NCR. E/A&H will perform data validation independently of the data review by the laboratory, which will be consistent with the level of effort specified in NEESA 20.2-047B and specific to the laboratory QC level applied. The validation steps will be performed by applying guidelines presented in USEPA *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses*, **R-582-5-01, and USEPA *Laboratory Data Validation Functional Guidelines for Evaluating Inorganic Analyses*, R-582-5-5-01, where applicable. Where these guidelines are not applicable, the EPA precision and accuracy statements for the analytical methods employed will be utilized in the validation of the investigation data.** All EPA DQO Level III data produced during the RFI will be validated in a similar manner.

The analytical data package validation procedures includes, but is not limited to:

- Comparison of the data package to the reporting level requirements designated for the project, to confirm completeness.

- Comparison of sampling dates, sample extraction dates and analysis dates to check that samples were extracted and/or analyzed within the proper holding times. Failure in this area may render the data unusable.

- Review of analytical methods and required detection limits to verify that they agree with the analytical method applied and the laboratory contract. Non-compliance in this area without reasonable justification (i.e. severe matrix interferences) may render the data unusable.

- Field and laboratory blanks will be reviewed to evaluate possible contamination sources. The preparation techniques and frequencies, and the analytical results (if appropriate) will be considered. All internal laboratory QC sample results will also be reviewed as provided for in NEESA 20.2-047B, Chapter 7.3.2.

- Evaluation of all blanks must confirm freedom from contamination at the specified detection limit. All blank contaminants must be explained or the data applicable to those blanks labelled suspect and sufficient only for qualitative purposes.

4.16 Performance and System Audits

Audits will be performed before and during the work to evaluate the capability and performance of the entire system of measurement and reporting. The following parameters are included in the system: experimental design, sampling (or data collection), analysis, and attendant quality control activities.

4.16.1 Field System Audits

The site project manager is responsible for evaluating the performance of field personnel and general field operations and progress. The site project manager will observe the performance of the field operations personnel during each kind of activity such as water-level readings and sampling rounds. The E/A&H site manager will be onsite throughout the duration of field activities, and will continually assess the proficiency of each field sampling team member to ensure compliance with the QAP protocol. Where applicable, these audits will also ensure that field operations are being conducted in accordance with NEESA 20.2-031A guidelines.

4.16.2 Laboratory Systems Audit

A laboratory systems audit is routinely conducted at least annually by the E/A&H QA staff members. These audits test methodology and assure that systems and operational capability is maintained. Audits also verify that quality control measures are being followed as specified in the laboratory written standard operating procedures and quality assurance plans. The systems audit checklist used by the EPA CLP forms the procedural basis for conducting these audits.

Laboratory initiated audits will be conducted in guidance set forth in NEESA 20.2-047B, and the laboratory QA plan as approved by the NCR. Under NEESA 20.2-047B guidelines, the project NCR is also responsible for laboratory inspections to ensure compliance with NEESA laboratory requirements.

4.16.3 Performance Evaluation Audits

A performance evaluation (PE) audit is performed to evaluate a laboratory's ability to obtain an accurate and precise answer in the analysis of known check samples by a specific analytical method. Following the analytical data validation described earlier, a performance evaluation audit of the laboratory may be conducted by E/A&H. This audit may be conducted if it is determined that the quality assurance data provided are outside acceptance criteria control limits. PE audits may include a review of all raw data developed by the laboratory and not reported (laboratory non-reportables) and the submission of blind spiked check samples for the analysis of the parameters in question. These check samples may be submitted disguised as field samples. In this case, the laboratory will not know the purpose of the samples. The samples may also be obvious (known) check samples EPA or National Bureau of Standards (NBS) traceable.

PE audits also may be conducted by reviewing the laboratory's results from round-robin certification testing and/or EPA contract laboratory program evaluation samples. An additional component of PE audits includes the review and evaluation of raw data generated from the analysis of PE samples and actual field samples that may be in question.

4.16.4 Regulatory Audits

It is understood that E/A&H field personnel and subcontract laboratories are also subject to quality assurance audits by the EPA and the NCR. The NCR (under NEESA guidelines) will conduct laboratory inspections prior to approval for certification for participation with any NEESA project and will provide performance samples to the laboratory for approval purposes.

4.17 Preventive Maintenance

The sampling equipment employed by E/A&H during an investigation that may require preventive maintenance will be checked for proper operation before and after each use on a daily basis. These checks will be conducted at the beginning and end of each day. Any replacements or repairs will be made as needed in accordance with manufacturer's instructions. Critical spare parts, maintenance tools and/or replacement instruments will be carried to the site. Equipment or instruments potentially requiring preventive maintenance are listed in Table 4-5. Preventive maintenance consists of following the manufacturer's operating manual. Table 4-6 provides preventive maintenance procedures for field groundwater screening equipment to be used during the monitoring project. All laboratory preventive maintenance will be conducted in accordance with their NEESA-approved QAP and standard operating procedures manuals.

4.18 Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness

Precision is an estimate of the reproducibility of a method and is estimated by several statistical tests: the standard deviation of the error distribution, the coefficient of variation and the relative percent difference between replicate (duplicate) samples. E/A&H will determine the precision of a method by analyzing replicate data.

Table 4-5
Field Equipment

Item	Manufacturer	Model Number	Serial Number	Preventive Maintenance
pH Meter	Fisher	Accumet 956	3218	Manufacturer's Operating Manual
Thermometer	—	Platinum RTD	—	Manufacturer's Operating Manual
Conductivity/pH/ Temperature Meter	YSI	3500	—	Manufacturer's Operating Manual
Photoionization Detector/FID	HNu -	HW-101 -	— —	Manufacturer's Operating Manual
Turbidity Meter	HF Scientific	DRT-15C	—	Manufacturer's Operating Manual

Note:

Items may vary in manufacturer, model number and serial number, but similiar devices will be utilized.

Table 4-6
Preventive Maintenance

Conductivity Meters	**Each Use**	**Quarterly**
	Meter probes are cleaned before and after each with distilled or deionized water. Before and after each use (daily) the instrument should be checked with a commercial conductivity standard for proper calibration. Checked battery for proper charge.	The instrument is inspected on a quarterly basis, whether used during the quarter or not. The inspection consists of a general examination of the electrical system (including batteries) and a calibration check. Instruments not functioning properly are shipped to the manufacturer for repair and calibration.
pH Meters	**Each Use**	**Quarterly**
	Before each use (daily), the probe should be checked for any mechanical and electrical failures. The electrode bulb should be complete filling with electrolyte solution. At the beginning and end of any sampling day, the pH meter must be calibrated using two standard pH buffers. The battery is checked for proper charge.	The instrument is inspected on a quarterly basis whether or not it has been used. The inspection consists of a general examination of the probe, wire, electrical system (battery check) and a calibration check. Any malfunctioning equipment is returned to the manufacturer for repair and recalibration.
Thermometers	**Each Use**	**Bi-annually**
	All thermometers should have been initially calibrated against a National bureau of Standards (NBS) certified thermometer or one tracable to one. Before each use make a visual inspection for no breakages. After use, rinse with deionized or distilled water.	Make a visual inspection for breakages. Should be checked against an NBS certified thermometer for accuracy.
FID	**Each Use**	**As per Manufacturer's recommendations**
	Clean flame chamber before and after each use. Clean the exterior subsequent to each use. Perform a calibration check and calibrate, if necessary.	Clean flame chamber. Calibrate as per manufacturer's recommendations and instructions.
PID	**Each Use**	**As per Manufacturer's recommendations**
	Check battery and if necessary, recharge. Clean the exterior of the instrument after each use with a damp cloth or with mild soap and water. Calibrate before use and perform calibration checks periodically.	Calibrate as per manufacturer's instructions. Clean UV lamp, replace dust filter and clean exterior with a damp cloth or using mild soap and water. Recharge battery.
Turbidity Meter	**Each Use**	**As per Manufacturer's recommendations**
	Check battery and if necessary, recharge. Clean vials with water and mild soap; rinse with deionized water. Calibrate with turbidity NTS standards. Do not use vials which are scratched, unclean or damaged.	Calibrate with turbidity NTS Standards. Wipe clean the turbidity chamber and exterior with a damp cloth. Recharge battery.

Note: Due to varying instrument types, different maintenance requirements will be applied.

Precision is then defined by the coefficient of variation (CV), which expresses the standard deviation as a percentage of the mean. Relative percent difference, an indicator of CV, will serve as a quality criterion for classification of data resulting from this investigation. Specific statistical comparison of duplicate samples (field and laboratory), as a measure of precision evaluating both sample collection procedures and laboratory instrument performance, may be accomplished by first comparing the obtained duplicate results with the published EPA criteria for method precision (relative percent difference).

The accuracy of a method is an estimate of the difference between the true value and the determined mean value. Specific statistical comparison of percent recovery values reported by the laboratory as a measure of method accuracy will be compared with the published EPA criteria for the accuracy of an individual method.

Data completeness will be expressed both as the percentage of total tests conducted and required in the scope of work that are deemed valid. Methods for assessing data precision, accuracy, and completeness by the laboratory will be outlined in the NEESA-approved laboratory QAP.

Records of calibration and maintenance activities for each piece of equipment are contained in logbooks assigned to the equipment. Preventive maintenance to be performed by the analytical laboratory will be in accordance with laboratory SOPs as established in an NCR-approved QA plan.

4.19 Corrective Action

During the course of any investigation, field personnel are responsible for seeing that field instruments and equipment are functioning properly and that work progresses satisfactorily. The field personnel are also responsible for ensuring performance of routine preventive maintenance and quality control procedures, thereby ensuring collection of valid field data. If a problem is detected by the field personnel, the project manager shall be notified immediately, at which time problem correction will begin. Similarly, if a problem is identified during a routine audit by the project QA manager, the regulatory QA manager, or NCR, an immediate investigation will be undertaken and corrective action deemed necessary will be taken as early as possible.

Potentially out-of-control situations include field instrument breakdown, mislabelling or loss of samples, inadvertent contamination of samples, or circumstances which preclude performance of field activities in accordance with the QAP (or other work plan documents). If an out-of-control event occurs, field sampling personnel shall make appropriate contacts and document any remedial efforts taken to bring field activities under control. All variances or changes from QAP guidance are subject to approval by the E/A&H site manager, the site QA manager or their designated representative. If circumstances arise which require substantive changes in the protocols, methods, or techniques outlined in the work plan (and QAP), the EIC will be contacted and all alterations will be documented and implemented with the EIC's written consent. A detailed description of the out-of-control event and remedial actions will be entered into the field logbook and the Field Change Request Form (Figure 4-6) along with justification for the change.

If corrective action is required by the analytical laboratory, it should be conducted in accordance with the laboratory's NCR-approved QA plan following guidelines provided in NEESA 20.2 - 047B, Chapter 4.5 — Out-of-Control Events.

4.20 Quality Assurance Reports to Management

Quality assurance reports will be submitted to E/A&H management and SOUTHDIV in accordance with the following sections.

4.20.1 Internal Reports

The E/A&H project QA team will provide status reports to the project manager during the course of the project.

FIG. 4-6

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FIELD CHANGE REQUEST

E/AH PROJECT NO. ______ FIELD CHANGE NO. ______

TO ______ LOCATION ______ DATE ______

DESCRIPTION:

______

REASON FOR CHANGE:

______

RECOMMENDED DISPOSITION:

______

FIELD MANAGER (SIGNATURE) ______ DATE ______

DISPOSITION:

______

SITE MANAGER ______ DATE ______

DISTRIBUTION: E/A & H PROJECT MANAGER
QUALITY ASSURANCE MANAGER
NAVY EIC
FIELD MANAGER

OTHERS AS REQUIRED ______

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The reports address the following as applicable:

- Quality assurance activities and quality of collected data.
- Equipment and calibration and preventive maintenance activities.
- Results of data precision and accuracy calculations.
- Evaluation of data completeness.
- QA problems and recommended and/or implemented corrective actions. Results of corrective action taken.

The laboratory is required to submit a monthly QC progress report to the NCR. The contents of the monthly report will be as outlined in NEESA 20.2-047B, Chapter 8 — Maintaining Laboratory Approval, and the NEESA-approved laboratory QAP.

4.20.2 Quality Assurance Reports to Management

The E/A&H project QA manager will report to the E/A&H project manager concerning the performance of measurement systems and data quality. The final contamination assessment report will include a separate QA section summarizing all data quality information, significant quality assurance problems, if any, recommended solutions, and the outcome of any corrective actions. A copy this report will be forwarded to the SCDHEC, EPA, and NSY QA offices. E/A & H also will compile laboratory quality assurance reports and include them in its report. The nature and content of laboratory QA reports will be described in NEESA-approved laboratory's QA/QC Plan.

4.21 Investigation Derived Waste

4.21.1 Introduction

Investigation derived wastes (IDW) produced during investigation activities will be handled according to the guidelines provided in the guidance document 9345.3-02 - *Guide to the Management of Investigation Derived Wastes* published by the EPA. The IDW will likely include soils produced during the installation of hand auger borings, soil borings and monitoring wells; groundwater derived from the completion and purging of the monitoring wells; disposable personal protective equipment and sampling utensils; decontamination fluids generated from the cleaning of personal protective equipment, sampling equipment, and drilling equipment. The RFI will be conducted by EnSafe/Allen & Hoshall as a contractor to the U.S. Navy. Therefore, the Navy will be the generator of the investigative derived waste. The Navy and the Defense Reutilization and Marketing Office (DRMO) will also be the responsible parties for the transportation and destination of all IDW.

The IDW management plan described below is designed to establish a practicable means of identifying what contaminants may be present in the wastes and ultimately how the wastes will be disposed of.

4.21.2 Accumulation Areas

All IDW will initially be **containerized** and stored within the boundaries of the respective SWMU from which it was generated. **Drums which are located in high traffic areas and are subject to damage that may cause leakage of the contents will be transported to the hazardous waste storage facility or a designated storage area. Drums in low traffic areas will remain within the boundary of the respective SWMU at a location providing adequate protection**. Movement of wastes within the respective AOC will be allowable as long as the actions do not constitute placement or land disposal. If IDW are determined to be a RCRA listed or characteristic hazardous waste, the 90 day storage limit will begin on the day the waste is classified as a hazardous waste **and the waste will be transported immediately to a permitted hazardous waste storage facility**. Typically, this will be the day that analytical data for the contents of the drum are received at the work site by the IDW Coordinator.

4.21.3 Waste Identification

To properly deal with IDW from the RFI, it is necessary to ascertain whether IDW are either RCRA listed or characteristic hazardous wastes. The methods by which this determination may be made include analytical testing and applying best professional judgement. Application of best professional judgement may take into account any available information about the site such as manifests, storage records, data from previous studies, data from field screening, etc. IDW contaminated with PCBs will be managed in accordance with the Toxic Substances Control Act.

If from the analytical data, the waste does not exhibit any of the characteristics of a hazardous waste (40 CFR part 261) and the waste does not contain any of the listed hazardous wastes or they are present but at such low concentrations that the appropriate regulatory levels could not possibly be exceeded, the waste will not be defined as a "hazardous waste," as defined in RCRA Subtitle C. If analytical data indicate that individual analytes are in concentrations significantly close to or above regulatory levels, then the SOUTHDIV Engineer-in-Charge (EIC) will determine whether the waste should be analyzed by the Toxicity Characteristic Leaching Procedures (TCLP) or if other measures are appropriate.

4.21.4 Handling of IDW

A key element of the IDW management plan involves the segregation of wastes. Wastes derived from different SWMUs will not be mixed. Likewise, the various types of IDW (e.g. soil cuttings, purged waters) which may be generated at each individual SWMU will not be mixed. This procedure will be followed to minimize the amount of waste generated which may have to be disposed of as a RCRA hazardous waste.

During the RFI, it is anticipated that all soils, groundwater, and decontamination fluids which are RCRA nonhazardous will be disposed of onsite within the AOC from which they were generated. Contaminated soils may be left within the delineated AOC unit from which they were generated provided professional judgement determines the soil will not at any rate affect human health or the environment. The AOC concept does not, however, apply to aqueous IDW which have been determined to be RCRA hazardous wastes by the methods outlined in Section 4.21.2. Any wastes believed to be highly potential hazardous wastes will be containerized in an appropriately labeled 55-gallon drum. Hazardous wastes will be managed in accordance with the guidelines established below.

4.21.5 IDW Management Organization

While the Navy will have the ultimate authority and responsibility for management of IDW, the Navy, E/A&H and subcontracting personnel will implement the IDW management plan. Also, both the Navy and E/A&H will provide onsite supervision. E/A&H will be responsible for the proper containerizing of the solid waste, waste inventory management at accumulation areas, and assisting in loading the waste for offsite transfer. The Navy will choose the means of transportation of the waste to a properly permitted waste management facility.

The E/A&H site manager, team leader and/or IDW Coordinator at each individual investigation site will be responsible for the proper containerization of IDW including:

1. Notifying the site IDW Coordinator of any new waste generated.

2. Using field PID/FID readings to segregate the waste generated into the approved containers.

3. For AOC accumulation in 55-gallon drums, placing the IDW label (Figure 4-7) on the drum at the beginning of the AOC accumulation and dating the container when accumulation is initiated.

4. Placing the sample number labels on the drums so that the contents of the drum can be correlated to the analytical data generated.

5. Establishing an appropriate AOC at each SWMU.

INVESTIGATIVE
DERIVED
WASTE

ACCUMULATION
START DATE ____________________

CONTENTS (CIRCLE) SOIL WATER PPE

HANDLE WITH CARE!!!

RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD,
CHARLESTON, S.C.

FIGURE 4–7
DRUM LABEL

DATE: 08/07/92 | DWG NAME: 029IDHW

The E/A&H IDW Coordinator will only be responsible for the proper management of the AOC and IDW associated with the RFI activity. The responsibilities of the IDW Coordinator include:

1. Supervising daily IDW management at all points of generation.

2. Ensuring that IDW containers are properly labeled and stored in an appropriate manner and that incompatible wastes are segregated.

3. Maintaining operating logs, performing inspections, and scheduling maintenance.

4. Informing the Navy IDW manager (or EIC) of IDW inventory and accumulation time deadlines.

The NAVY IDW Coordinator will be responsible for the entire management system of all IDW, including:

1. Assuring that hazardous waste management personnel are trained in the proper storage and handling of potentially hazardous IDW.

2. Working with the E/A&H IDW Coordinator in providing technical information and assistance with regard to IDW management and to the DRMO.

3. Making all final decisions regarding the transportation and disposal of IDW, in addition to selecting any alternatives to IDW disposal, such as IDW treatment or storage.

4. Assuring that appropriate hazardous waste accumulation storage time allowances are not exceeded.

5. Supervising the disposal of IDW and function as liaison with the disposal vendor.

6. Assuring that appropriate records (manifests, inspections, exception reports, etc.) are maintained.

IDW will be managed at each accumulation area in accordance with the following criteria:

1. Each AOC may store only IDW generated from that area.

2. The IDW container must be properly labeled.

3. The waste will be kept in containers that are compatible with the waste.

4. The waste will be stored in containers that are in good condition. If the container begins to show signs of stress, the waste will be transferred to another container or over packed immediately.

5. Containers will be closed at all times except when it is necessary to add or remove waste.

6. Each container will be marked with the words "Investigation Derived Waste" until laboratory test results indicate otherwise.

7. Each container will be labelled with the sample number(s) which corresponds to its contents (Figure 4-8).

8. Hazardous waste containers intended for shipment will have the appropriate manifest number noted on the container (Figure 4-9) prior to shipment.

SAMPLE IDENTIFICATION

SAMPLE ID NO. ______________________________

SAMPLE ID NO. ______________________________

SAMPLE ID NO. ______________________________

SAMPLE ID NO. ______________________________

SAMPLE ID NO. ______________________________

SAMPLE ID NO. ______________________________

SAMPLE ID NO. ______________________________

SAMPLE ID NO. ______________________________

SAMPLE ID NO. ______________________________

SAMPLE ID NO. ______________________________

RFI WORKPLAN
CHARLESTON NAVAL SHIPYARD, CHARLESTON, S.C.

FIGURE 4-8
SAMPLE IDENTIFICATION

DATE: 08/04/92

DWG NAME: 029SAMID

HAZARDOUS WASTE

FEDERAL LAW PROHIBITS IMPROPER DISPOSAL

IF FOUND, CONTACT THE NEAREST POLICE, OR
PUBLIC SAFETY AUTHORITY, OR THE
U.S. ENVIRONMENTAL PROTECTION AGENCY

PROPER D.O.T.
SHIPPING NAME________________________ UN OR NA#________

GENERATOR INFORMATION:

NAME____

ADDRESS_____________________________________

CITY______________________ STATE__________ ZIP________

EPA
ID NO.__________________ EPA
WASTE NO.__________________

ACCUMULATION
START DATE__________________ MANIFEST
DOCUMENT NO.__________________

HANDLE WITH CARE!

CONTAINS HAZARDOUS OR TOXIC WASTES

STYLE WM 6

Printed by LABELMASTER, Div. of AMERICAN LABELMARK CO CHICAGO, IL 60646

RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD
CHARLESTON, S.C.

FIGURE 4-9
HAZARDOUS WASTE LABEL

DATE: 08/05/92 | DWG NAME: CNSY

9. Containers will be arranged so that the identification label is visible and there is adequate space between containers for inspection.

10. The containers will be inspected periodically (Figure 4-10) for signs of leaks or deterioration caused by corrosion and other factors.

11. Containerized hazardous waste will be segregated in storage by hazard class. Incompatible wastes must be stored in areas segregated by dikes, berms, walls, or other devices.

12. An accumulation inventory record (Figure 4-11) will be kept noting the type and amount of wastes placed in the container.

13. A designated emergency coordinator will be available at all times in accordance with the health and safety plan.

14. All employees involved in hazardous waste management will be trained in their hazardous waste handling and emergency duties in accordance with the health and safety plan.

15. A contingency plan stating the actions to be taken in the event of a fire, spill or other hazard that could threaten human health or the environment may need to be generated.

16. All hazardous waste shipments will be manifested. Copies of signed manifests, annual reports, exception reports and analytical test results must be maintained for three years.

IDW DAILY INSPECTION SHEET

DATE	TIME	LOCATION	CONTAINER ID	LEAKS (Y/N)	SEALED (Y/N)	DAYS SINCE INITIAL ACCUMULATION	REMARKS

RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD,
CHARLESTON, S.C.

FIGURE 4-10
IDW DAILY
INSPECTION SHEET

DATE: 08/04/92 | DWG NAME: 029IDWDI

IDW INVENTORY RECORD

CONTAINER ID	LOCATION	CONTENTS (SOIL/WATER/PPE)	ACCUMULATION START DATE	SAMPLE ID#'S

RFI WORKPLAN
CHARLESTON NAVAL
SHIPYARD,
CHARLESTON, S.C.

FIGURE 4-11
IDW INVENTORY
RECORD

DATE: 08/04/92

DWG NAME: 029IDWIR

4.21.6 Waste (TSD) Facilities

Within 90 days of being classified as a hazardous waste by the IDW Coordinator, containers of hazardous waste will be transferred to a properly permitted hazardous waste treatment, storage or disposal facility. The facility will be selected by the Navy in conjunction with the DRMO, will also make arrangements for the shipment of the hazardous waste with a yet to-be-determined third party. The Navy's designated IDW Manager will confirm the transporter selected is a licensed
hazardous waste transporter. At the time of loading, either the Navy's IDW Manager or the E/A&H IDW Coordinator will assure that the vehicle contains all appropriate placards.

For non-aqueous hazardous waste, the Navy's designated IDW Manager will determine what Land Disposal Restrictions will apply to the waste prior to shipment. Also, assurances
will be made for all LDR reporting requirements are met. The Navy will also be responsible for assuring the facility is properly permitted for the specific types of solid waste. The designated IDW Manager will also be responsible all record-keeping and manifesting requirements in accordance with RCRA.

5.0 DATA MANAGEMENT PROCEDURES

The objective of this portion of the RFI Work Plan is to describe methods E/A&H will utilize throughout the RFI project to manage collected data.

5.1 General Documentation Procedures

Each field team will have at least one person, generally the site supervisor, who is thoroughly familiar with the appropriate documentation procedures. This person will personally perform or will directly oversee the completion of the documents which accompany the task. Documentation tasks will be performed on a sample-by-sample or item-by-item basis throughout the day. However, items such as shipping containers and sample tags will be prepared in advance.

5.2 Field Documentation

Sample possession will be traceable from the time the sample is collected to its delivery at the laboratory. In order to identify samples and manage the information, samples will be numbered sequentially by SWMU site and type (i.e., soil, groundwater). The following sections describe records and forms to be used to provide documentation and quality control.

5.2.1 Field Log Books

Permanently bound field notebooks will be used to record data and activities performed at each SWMU site. Entries will be described in as much detail as practical. Each notebook will be identified by the project specific document number. The notebook cover will include: project name and number, book number, start and end dates, and the name of the field team whose activities are recorded in the book.

At the beginning of each entry, the date, start time, weather, field personnel present, and activity will be recorded. Additional entries may include geologic logs, drilling records, sample records, and additional data as may be appropriate. Each entry will be initialled by the person making the entry.

5.2.2 Sample Tags

Sample tags will be filled out and attached to each collected sample prior to the time of collection. Label information will be recorded in the Field Log Book as a cross-reference at the time of collection.

5.2.3 Chain-Of-Custody Records

The chain-of-custody record will contain a summary of the contents of the shipment, dates, times, sample numbers, tag numbers, number and volume of containers, and signatures for the transferral of samples.

5.2.4 Subsurface Boring Logs

The subsurface boring logs will be prepared as each boring is advanced. Items to be recorded include materials encountered, depth to water, obvious contamination areas, and any other necessary or appropriate information. A general log also will be recorded in the Field Log Book as a cross-reference.

5.2.5 Monitoring Well Schematic

The monitoring well schematic will provide a summary of pertinent monitoring well information including location, date drilled, drilling method, well depth, screen location, and construction data. A general log also will be recorded in the Field Log Book as a cross-reference.

5.3 Other Related Data

Other related data will include illustrations, graphs, meeting summaries, audit reports, and laboratory results. This information will be compiled and reviewed for report presentation.

5.3.1 General Data

Meeting Summaries, Telephone Conversations, and Notes

These items will be recorded in the field notebooks along with the dates, time, and names of persons involved. These notes will be available for photo copies if requested by the NSY project manager. Meetings and conversations with a substantial impact on the project will be described in a memorandum to the NSY project manager.

Illustrations, Computation, and Engineering Data

Original illustrations and graphics will be initialed and dated by the person originating the document. A second person will check these documents for completeness and needed corrections. All maps, calculations, and data will be reported or prepared to normally accepted standards and confidence levels.

5.3.2 Reports

Progress Report

These will be prepared periodically by the project manager and will include: the number of samples collected, sites investigated, monitoring wells installed, deviations from approved field or laboratory procedures, if any, and other appropriate information. These reports will be directed to the NSY's project manager.

RFI Report

This report will be written following sampling and completion of laboratory testing. The report will consolidate and summarize the collected data and document the SWMU site evaluations. An initial draft report will be submitted for comment by the NSY, USEPA, and DHEC. Where appropriate, the comments will be incorporated into the final document.

Interim reports may be necessary or appropriate to describe significant divergence of site conditions from those anticipated, to secure concurrence on the need for emergency or interim corrective measures, or to gain regulatory input on unanticipated issues.

Data obtained from sampling and analysis procedures will be summarized and presented in a logical tabular format for each of the SWMUs. These tables will be supported by the raw laboratory reports included as an appendix. The reduction of the laboratory data into tables will be performed by a technician and reviewed by the Project QA Officer.

Graphical presentation of the sampling results will be in several formats. Isopleth (isoconcentration) maps will be developed for each of the soil and groundwater parameters at each SWMU. In addition, maps showing the sample locations labeled with the sampling results will be developed for each SWMU. For sites where groundwater contamination is a concern, groundwater surface contours will be displayed on the site base maps. Groundwater flow direction will be determined from these maps. The maps used for reporting results will be similar to those found in Section 3 of this Work Plan showing proposed sampling locations. Cross-sectional plots may also be employed if it is determined that their use will enhance understanding of the site specific geologic environment.

Soil boring logs from drilling operations will be included as an appendix. The logs will be constructed from sample descriptions made by the onsite geologist.

The interpretation of all the accumulated data and analytical results will be performed as a project team effort. The expertise of each project team individual will be utilized to develop proper conclusions and recommendations. The final decision on interpretation of data for the RFI Report will lie with the Project Manager.

6.0 IDENTIFICATION OF POTENTIAL RECEPTORS

Potential receptors of constituents released at NSY would include users of the surficial aquifer, biota in adjacent surface waters and wetlands (primarily at locations where the surficial aquifer discharges to surface water) and NSY personnel. Biological receptors will be evaluated only if significant contaminant levels are identified within specific migration pathways as outlined in Section 3.1.

Potential exposure of NSY personnel is limited to specific locations at or in the vicinity of SWMUs. For example, personnel at the DRMO (SWMU #2) maybe exposed to airborne lead dust. The risk of exposure, however, is low due to the small volume and periodic nature of site activities. This judgement is somewhat confirmed by the results of medical surveillance programs which have not detected lead accumulations in site workers. However, surface lead concentrations in this area exceed generally applied standards. Lead contaminated areas are also present at SWMU #6. However, the potential risk for dermal or inhalation exposure is extremely low since the lead contaminated areas are small localized hot spots where current operations are limited.

The highest potential risk for exposure via a dermal or inhalation pathway is SWMU #25. The building may contain heavy metal residues on interior surfaces which are the due to the old plating operation. To limit exposure of personnel in this area, the NSY has secured the building allowing access only when accompanied by proper authorization. The investigation proposed for this site in the RFI Work Plan will provide additional data necessary to design a building decontamination and remediation program.

The potential for dermal exposure to various soil contaminants during earth moving activities is also quite remote but more difficult to quantify. At SWMUs #5, #7, #14, and #29, peak constituent concentrations and their precise locations have not yet been fully determined. In the case of SWMU #29, the identity of constituents has not been sufficiently studied. These data gaps and deficiencies will be addressed through the RFI process, as detailed in this Work Plan, and remediation programs will be proposed, as necessary.

Another major potential receptor in the area would be existing or potential users of groundwater removed from the surficial aquifer. A survey of water well users in the area has indicated that there are no potable water wells within a 4-mile radius of the shipyard. In fact, the surficial aquifer does not constitute a usable aquifer for potable water supplies. NSY can ensure that there is no future use of the surficial aquifer through the simple expedient of making a notation on its master engineering site plan. If required, a deed restriction on groundwater use could be recorded. In any case, while direct groundwater use is a potential exposure route at the NSY, in reality the potential is minimal to non-existent.

Groundwater from the surficial aquifer is thought to continuously discharge to wetlands and surface water bodies within and at the boundary of NSY. Significant impacts to potentially affected ecological communities can and should be eliminated. However, as discussed in Section 2, most conditions at NSY present little or no potential for significant impacts to ecological communities due to a nearly flat hydraulic gradient, low values of aquifer hydraulic conductivity, and soil properties which prevent or attenuate movement of constituents.

7.0 HEALTH AND SAFETY PLAN

7.1 Introduction

This Health and Safety Plan is written for field operations to be conducted at 27 of the 36 SWMUs located at the Charleston Naval Shipyard, Charleston, South Carolina. The Navy project contract number with EnSafe/Allen & Hoshall is N62467-89-D-0318. The monitoring program is being conducted to assess the nature and extent of contamination (if present) at the site and to determine if follow up action is required to maintain compliance with environmental regulations.

Applicability

The provisions of this plan are mandatory for all onsite personnel engaged in the environmental assessment who will be exposed or have the potential to be exposed to onsite hazardous substances. All personnel will operate in accordance with the most current requirements of 29 CFR 1910.120, *Standards for Hazardous Waste Workers and Emergency Responders*. These regulations include the following provisions for employees exposed to hazardous substances, health hazards or safety hazards: training as described in 120(e), medical surveillance as described in 120(f), and personal protective equipment described in 120(g). All field personnel assigned to field activities for the project must read this plan and sign the plan acceptance form before the start of site activities. At a minimum, all provisions of the E/A&H health and safety plan will be followed.

E/A&H will suspend the site work and will instruct the subcontractor to evacuate the area under the following conditions: If inadequate safety precautions are taken by the subcontractor or DOD oversight personnel, **or** if it is believed that the subcontractor or DOD oversight personnel are or may be exposed to an immediate health hazard.

Copies of Health and Safety training certificates for all E/A&H employees who may visit the site are kept on file onsite. Current OSHA refresher training certificates will be available onsite for all employees involved in field activities whose refresher course requirements come up for renewal before the project begins. All subcontractors, DOD oversight personnel, and any other site visitors must provide Health and Safety certification with appropriate refresher course documentation prior to site entry.

7.2 Site Characterization

7.2.1 Work Areas

Site control will be established and maintained according to the recommendations in the EPA's *Interim Standard Operating Safety Guides*, Revised September, 1982. Three general zones of operation will be established to reduce the potential for contaminant migration and risk of personnel exposure:

- The exclusion zone.
- The contamination reduction zone.
- The support zone.

The exclusion zone will be located so that the area between the decontamination station and the work area entrances will be included. The contamination reduction zone will include the decontamination station and the support zone will be located beyond the contamination reduction zone. Only authorized personnel with a minimum of 40 hours health and safety training meeting the requirements of OSHA 29 CFR 1910.120 are permitted within the exclusion and contamination reduction zones.

The exclusion zone is the area known or suspected of being contaminated with hazardous substances. Where level D or modified level D PPE is specified the exclusion zone will be defined locally but is suggested to be within 20 feet of either side or the rear of the drill rig and fully encompass the work area. Where level C PPE is specified the exclusion zone shall fully encompass all work within a 50-foot diameter circle clearly delineated by barricades and "Caution" tape. Where level B PPE is specified (SWMU #9 - Closed Landfill) for the trenching operations the exclusion zone shall fully encompass the work area (approximately 200 feet in diameter) and shall be clearly delineated using barricades and "Caution" tape. All personnel within the exclusion zone must use the prescribed level of personal protection. A checkpoint will be established at the edge of the exclusion zone to regulate the flow of personnel and equipment in and out of the area. All personnel crossing the hotline into the exclusion zone must use the buddy system.

The person entering the exclusion zone must be accompanied by a person who is able to:

- Provide his or her partner with assistance.
- Observe his or her partner for signs of chemical or heat exposure.
- Periodically check the integrity of his or her partner's protective clothing.
- Notify the shift supervisor, his representative or others if emergency help is needed.

Additionally, at least one person shall remain outside the exclusion zone and have available at least the same level of personal protective equipment (PPE) as the buddies who are entering the exclusion zone. The person outside the exclusion zone will act as the safety observer and perform the security duties described in the next section which is labeled Work Area Access.

The contamination reduction zone serves as a buffer between the exclusion zone and the support zone and is intended to prevent the spread of contaminants from the work areas. All decontamination procedures will be conducted in this area. Personnel will leave the support zone and enter the contamination reduction zone through a controlled access point. They must wear the prescribed PPE. Exiting the contamination reduction zone requires the removal of all contaminants through compliance with established decontamination procedures. Decontamination reduction areas for activities with levels D and C PPE specified will be located at an upwind location at the perimeter of the exclusion zone. Where site activities require decontamination of heavy equipment and personnel (SWMU #9 - Closed Landfill) the decontamination area will be located near an existing water supply and a temporary decontamination pad will be constructed at the perimeter of the exclusion area.

The support zone is the outermost area and is considered a non-contaminated or clean area. The support area will be equipped with an appropriate first-aid which includes a first-aid kit, emergency eye wash equipment, and a mobile telephone for contacting emergency personnel. The support zone will also be equipped to perform gross decontamination of equipment.

7.2.2 Work Area Access

All personnel entering the site exclusion zone must:

1. Check in with the E/A&H Field Project Manager or representative.
2. Provide the shift supervisor with the following information:
   - The names of individuals entering the site work area.
   - Destination in the site work area.
   - Activity to be performed at that location.
   - Duration of the planned activity.
3. The Field Project Manager will inform persons entering the site work area of the location of other activities taking place during the scheduled entry. If the Field Project Manager determines it is not safe for the scheduled entry, he or she can reschedule the entry or stop all other activities to perform the specific task.
4. When leaving the site work area, proceed directly to the decontamination station and check out with the Field Project Manager or his representative. All exits from the site work area must be made through the contamination reduction zone.
5. Perform all necessary decontamination before leaving the contamination reduction zone.

7.3 Site Activities

The activities to be performed during the investigation include the installation of monitoring wells and soil borings, hand auger sampling, and sediment sampling. Subsequent activities will include well purging, development, and sampling as required. Field work descriptions are provided in the Sampling and Analysis Plan (SAP) by E/A&H. Table 7-1 lists potential chemical hazards and levels of personal protection for each site.

7.3.1 Site Descriptions

SWMU #1, DRMO Staging Area. This area has been used since 1974 by the DRMO to store property. The property is no longer needed for its intended purpose and has been turned in to DRMO by various branches of the Armed Forces within the region of the Naval Base. The stored property handled by DRMO includes some products which cannot be reutilized by other commands and that have consequently become classified as wastes.

SWMU #2, Lead Contamination Area. The lead contamination area consists of a salvage bin (#3) and adjacent paved ground surface. The area was used to store recovered lead from lead-acid submarine batteries from the mid-1960s until 1984. Electrodes and associated internal metallic components were removed from the battery jars in the battery electrolyte treatment area. Recovered materials were then placed on a railcar and transferred to the DRMO area for storage and eventual sale to a salvage contractor. Lead dust from the recovered materials was released to the salvage bin by handling.

Anticipated hazards in the DRMO Building (SWMU #1) and the lead contamination area (SWMU #2) include the chemical hazards of working around lead dust and lead contaminated water and the physical hazards associated with the investigative measures to be conducted. Until the corrective measures are completed, all surfaces in the area should be considered to be contaminated with lead. Soils adjacent to paved areas should be considered as lead contaminated until delineation work is completed.

Table 7-1
Potential Site Chemicals and Appropriate PPE

SWMU	Ba	Cr	Ni	Pb	Heptachlor	BHC	DDD	DDE	DDT	PCB	Arsenic	Sulfuric Acid	Methylene Chloride	Sulfate	TCE	TCA	Benzene	Cu	Zn	Al	Calcium Hydroxide	Gasoline	Diesel	Fe
1	x	x	x	x																				
2				x																				
3					x	x	x	x	x	x	x													
4																								
5				x								x												
6	x	x		x						x														
7						x			x	x	x													
8										x			x	x										
9	x	x	x	x							x				x	x	x	x	x	x				
12																								
13																						x	x	
14												x												
17										x														x
20		x	x	x									x				x						x	x
21		x		x																				
22		x																						
25	x	x	x	x																				
27																								
28																								
29																								
30																								
31																								
32													x											
33													x											
34													x											x
35																								
36												x												

Table 7-1(cont'd)
Potential Site Chemicals and Appropriate PPE

SWMU	Fluoride	Phthalate	Chloro-Benzene	Chloroform	Kerosene	CN	Toluene	Tetrachloroethylene	Cd	Ag	Hg	Acetone	MEK	Nitric Acid	HCL	Se	PPE
1																	C
2																	C
3																	Modified D
4																	Modified D
5																	Modified D
6									x								Modified D
7																	Modified D
8																	Modified D(G)
9																x	B, C
12																	D
13																	Modified D(G)
14	x	x	x	x	x												B, C, D
17																	Modified D(G)
20										x							Modified D(G)
21						x	x	x	x	x							Modified D(G)
22							x			x							D
25							x			x	x	x					C
27																	D
28																	D
29																	D
30																	D
31																	D
32								x					x	x			Modified D(G)
33								x					x	x			Modified D(G)
34								x					x	x			Modified D(G)
35																	D
36																	D

SWMU #3, Pesticide Mixing Area. The pesticide mixing area is approximately 50 feet by 25 feet in size. Part of the area (approximately 20 square yards) is devoid of vegetation. However, the bare area is subject to substantial vehicular traffic. The area is contaminated with low concentrations of various pesticides (and associated degradation products) which were handled at the site in the past.

SWMU #4, Pesticide Storage Building. The pesticide storage building has been used to store various insecticides and rodenticides since 1980. It is a steel building with a concrete floor. The building is equipped with a formulation and mixing room. Sink and floor drains within the building are connected to the sanitary sewer system or to blind sumps (sumps with no outlets). An equipment rinse area/wash rack is located adjacent to the storage administration facility. No evidence of contamination was found or have been reported for this site. The building and concrete floor have since been removed and the area is now a paved parking lot.

SWMU #5, Battery Electrolyte Treatment Area. The battery electrolyte treatment unit was part of the battery salvaging, restoring, and recharging operation. It was the unit used for neutralization of submarine battery acid. Current used battery management practices at NSY are limited to shipment of intact batteries offsite for salvage.

Chemical and physical hazards exist around the battery electrolyte treatment area. Lead and low pH levels in the soils around the waste acid treatment tank are anticipated hazards for this unit. An expanded soil sampling program increases the potential for chemical exposure when collecting samples in areas where contamination is undefined.

SWMU #6, Public Works Storage Yard. The Public Works storage yard, also known as the "old corral area," is a fenced open area where routinely generated, containerized wastes were stored prior to shipment offsite. Among the wastes stored at the site were hazardous wastes generated from vehicle maintenance, building maintenance and pest control operations. Wastes generated by vehicle maintenance consisted of cleaning solvents and waste oil. Spent solvents were disposed of by a contractor. Waste oils were recycled through NSY's waste oil reclamation facility. Building maintenance operations generated paint waste which was disposed of by a contractor along with waste from the paint shop. The storage yard ceased operation as a hazardous waste storage area when construction of the new temporary hazardous waste storage and transfer facility was completed.

SWMU #7, PCB Transformer Storage Area. The PCB Transformer Storage Area consists of Building 3902 located within the Public Works Storage Yard, the adjacent concrete slab located outside the building, and surrounding areas that were used for storage of transformers and associated electrical equipment. Transformers no longer in service were brought to the concrete pad on the south side of the building prior to transportation off base between 1970 and 1976. Transformers were either sold intact or drained near the concrete pad prior to sale. The area around this concrete pad shows evidence of previous oil spills. The total amount of PCBs released to the soil and the concentrations in particular areas have not been adequately characterized. Transformers have been stored in a new hazardous waste storage and transfer facility since 1986. The site is abandoned with no material storage or activity in the area. The building is locked and a perimeter fence restricts access into the area.

SWMU #8, Oil Sludge Pit. Oil sludges produced by industrial activities at NSY from 1944 to 1971 were disposed of in three unlined pits near the Warehouse Administrative Building. These pits are visible in aerial photographs taken in 1944 and 1951 and are collectively known as SWMU #8. Heavy rains occasionally caused the pits to overflow, creating oil spills in low areas adjacent to the pits. Two of the pits had been covered with fill by 1956, potentially trapping oil within the subsoils. Free oil is known to have been pumped from the remaining pit in 1974. Clean fill was then brought in and compacted within the pit. Portions of the area have now been converted into a parking lot. A ditch dug at this site in 1982 intercepted free oil floating on the water table. The ditch was dammed immediately afterwards and later filled to prevent migration of oil into Shipyard Creek.

SWMU #9, Closed Landfill. From the 1930s until 1973, many solid wastes generated at NSY were disposed of onsite in a landfill located in the southwestern portion of the peninsula. Originally, the area was marshland. Items reportedly disposed of in the landfill include: asbestos, acids, PCBs, waste oils, waste solvents, waste paints, paint sludges, mercury, metal sludge, acid neutralization sludge, various inorganic and organic chemicals, sanitary wastes, office wastes and rubbish. The largest volume of wastes consisted of office wastes and rubbish. Liquid wastes were placed in drums before disposal and combustible wastes were burned daily. Residue from the burning was pushed into the marsh as fill along with concrete rubble, metal scrap, and other non-combustible materials. Waste materials were covered with soils when they were available. Soils from onsite building excavations, soil dredged from the river, and bottom ash from the power plant were used as cover materials.

A geophysical survey of this area indicated the presence of metallic materials (i.e., drums) buried in a large area of the closed landfill. Trenching procedures will be performed in this area to determine the nature and extent of the anomaly.

SWMU #12, Old Fire Fighting Training Area. The old fire fighting training area consisted of a pit located at the southern end of NSY. The pit reportedly measured between 30 and 50 feet in diameter. It was used between 1966 and 1971 for training purposes. Oil, gasoline, and alcohol were poured into the pit, ignited, and subsequently extinguished during fire fighting training exercises.

The pit area is no longer discernible from the surrounding surface topography. The location of the pit is now known only from old aerial photographs. The pit area is currently separated from Shipyard Creek by a dense zone of shrubs, hardwoods, and a roadbed.

The pit was cited by the U.S. Coast Guard in 1971 for an oil spill. The spill occurred following a heavy rainfall which caused the oil in the pit to overflow into Shipyard Creek. The pit was closed, filled with bottom ash, and leveled in 1972.

SWMU #13, Current Fire Fighting Training Area. Fire fighting training for both surface and submarine fleet personnel is currently conducted at the Fleet and Mine Warfare Training Center on Dyess Avenue. The training center, in use since 1973, uses approximately 20,000 gallons of No. 2 diesel fuel and 2,000 gallons of gasoline per year in training operations. Training exercises include extinguishing ignited diesel fuel and gasoline. Fuel, floating on water in tanks or sprayed onto mock buildings, is ignited in a controlled area consisting of a paved ground with bermed perimeters.

Wastewater from the area is routed through a gravity oil-water separator, prior to discharge into a sanitary sewer system leading to the North Charleston Consolidated Public Service Department (NCCPSD) sewage treatment plant. Recovered fuels are recycled. Effluent from the operation is well below discharge limits imposed by NCCPSD.

SWMU #14, Chemical Disposal Area. The chemical disposal area is located at the southern end of the active portion of NSY in the vicinity of the skeet and pistol ranges. The precise locations of chemical burials are unknown. Unknown amounts of various chemicals, including Decontaminating Agent Non-Corrosive (DANC) and DS-2 have reportedly been disposed of at the site. DANC consists of separately packaged components of tetrachloroethane and dichlorodimethyl-hydrantoin. DS-2 is a mixture of 70% diethylene triamine, 28% methyl cellosolve, and 3% sodium hydroxide. Other chemicals may have been buried either at the skeet range or behind the dike at the pistol range or both. Ten 5-gallon canisters of DS-2 were reported buried at the skeet range in 1977. Construction crews unearthed drums of chemicals at the skeet range in 1972 and 1974. Some workers suffered minor chemical burns in the excavation episodes.

SWMU #17, Oil Spill Area. The oil spill area is located beneath Building FBM61. The spill occurred in June 1987 when an underground pipe supplying No. 2 diesel fuel to the boiler in Building FBM61 ruptured, spilling a small amount of its contents into the basement of the building and several thousand gallons into soils beneath the building. Some of the oil entered drainage sumps beneath the building, entered the storm drainage system, and discharged into the Cooper River. The resulting slick was promptly contained.

SWMU #20, Waste Disposal Area. The Waste Disposal Area occupies an open area adjacent to the solid waste transfer station and has been in operation since 1985. Solid wastes consisting of cardboard boxes, wood, concrete blocks, tree stumps, sandblasting residues, and a small number of vehicle batteries were disposed of in this area. The few batteries disposed of at the site are the sole concern. This SWMU overlies the old sanitary landfill (SWMU #9).

SWMU #21, Old Paint Storage Area. The old paint storage area is located inside the Controlled Industrial Area (CIA) near the waterfront adjacent to the Cooper River. The unit was used for temporary storage of containerized paint wastes from ships returning to NSY and from ship repair and overhaul operations at the base. The waste containers were temporarily stored on a 20 x 180 feet concrete pad to await offsite transport. Sandblasting operations also occurred in this area.

Paint wastes stored at this unit contained cadmium, chromium, lead, cyanide, toluene and tetrachloroethylene. Sandblasting residues containing organo-tin paints were also generated at this unit. These residues were allowed to accumulate on the ground surface posing the potential hazard of metal dusts and possible release of volatile organic vapors.

SWMU #22, Old Plating Shop Waste Treatment System. The old plating shop waste treatment system is located within the CIA. The unit was constructed in 1972 to process wastewater from the metal plating shop and continued in operation until the new non-cyanide plating process and treatment system were built (Figure 2-23). The treatment facility included two in-ground concrete tanks, one for chromic acid reduction and one for cyanide oxidation. Additional treatment was conducted in a "clarifier" where soda ash was manually added and mixed with the wastewater to adjust the pH to approximately 8.5 and precipitate any chromium or other metals. After settling for 48 hours, the clarified wastewater effluent was discharged to the sanitary sewer. Sludge in the bottom of the clarifier was removed and disposed of at the base sanitary landfill until 1973. After 1973, sludge was transported off base for disposal.

The unit has not been operated since 1982 when the new plating shop waste treatment system (SWMU #23) started up. The waste treatment system has been decontaminated.

SWMU #24, Waste Oil Reclamation Facility. The waste oil reclamation facility is located in the south-central portion of the shipyard and has been in operation since 1950. This unit consists of two storage/separation tanks identified as Tanks 39-A and 39-D. Waste oils unloaded from ships or from base operations are pumped into this facility via underground pipelines. Gravity oil-water separation occurs inside the tanks which are operated in alternation. The water phase is drawn off and discharged to the sanitary sewer system and the recycled oil is reused at the base. All underground lines are cathodically protected and all lines are annually pressure tested.

SWMU #25, Building 44, Old Plating Operation. The old plating operation occupies the northern portion of Building 44. Phased out of operation in 1983, the unit was replaced by a new (non-cyanide process) plating operation (SWMU #23). The interior of this unit still contains all operation equipment from the plating process (tanks, vats, ventilation hoods, mechanical and ancillary equipment). Before the plating operation was deactivated, all vats and tanks were emptied and the waste removed. Areas of concern for this SWMU are deteriorated concrete flooring, product accumulation around tanks, the floor drainage system, interior surface contamination, subsurface soils and groundwater.

SWMU #27, Waste Storage Area, East End, Pier C. This paint storage area is a satellite accumulation area located at the east end of Pier C. The unit comprises approximately 200 square feet of the concrete pier. A flammable storage shed and lockers store virgin paints, enamel thinners and fire retardants used for ship repair. Waste containers from the operation are accumulated beneath a canvas tent. The floor is canvas covered plywood surrounded by a berm. Bermed areas at this unit include 55 and 30-gallon drum containers and a storm drain.

SWMU #28, Waste Paint Storage Area, West End, Pier C. This unit was used as a one time waste accumulation area unbeknownst to the NSY Environmental Division. The unit is approximately 100 square feet in area and is surrounded by asphalt. Adjacent to the area is an empty flammable liquids storage shed. A storm sewer drain is located 30 feet downgradient of this unit. Paint spills from this accumulation area were confined to the small 100 square foot area.

SWMU #29, Building X-10. This unit is located south of Building X-10, near Building 1431. Used as a waste accumulation area, this unit received waste from submarine maintenance and repair. This area is primarily a large asphalt covered area with some soil and grassy areas to the southwest and northeast. There is no evidence of surface staining.

SWMU #30, Satellite Accumulation Area, Building 13. The Satellite Accumulation Area is used to receive waste generated from the laboratory in Building 13. Located between Buildings 13 and 187, outside the southeast wall of Building 13, the unit and surrounding area is asphalt with a storm sewer drain 20 feet downgradient.

This accumulation area contains a steel box for storage and containment of pails (5 gallons and smaller), trash bags, and a portable 300-gallon steel waste oil tank. Two 55-gallon drums of oil sludge labelled hazardous waste are also present. Spillage is visible around the drums, the result of someone recently adding waste to the containers.

SWMU #31, Waste Paint Storage Area, Dry Dock No. 5. This unit is a satellite accumulation area located in Dry Dock No. 5. The area, 200 square feet in size, performs the same functions as SWMU #26. Located on the concrete floor of the drydock near the center of the north wall, the unit is used intermittently to service submarines in drydock. A tent is erected over canvas covered plywood with sand bag berms. Paints are thinned and placed in one gallon buckets with plastic liners for transport to the submarine. A trench drain directly behind the unit is part of the intake system to drain the drydock once the ship has entered.

SWMU #32, Waste Paint Storage Area, Building 195. This waste paint storage area was used as a one time waste accumulation area (without proper authorization) located along Pier F between Buildings 195 and 1802. The unit encompassed approximately 400 square feet of area 40 feet from the edge of the water. The surface is concrete with asphalt to the south.

SWMU #33, Waste Paint Storage Area, West End, Dry Dock No. 2. The waste paint storage area was used as a one time waste accumulation area located at the western end of Dry Dock No. 2. This unit covers approximately 200 square feet of concrete pavement and is situated 40 feet from the edge of the dry dock. This heavily industrialized area is primarily asphalt with railroad tracks, overhead cranes, heavy equipment, and elevated offices surrounding the dry dock and SWMU area.

SWMU #34, MWR, Southwest of Building X-10. The Morale, Welfare, and Recreation (MWR) (SWMU #34) was utilized as a one time waste accumulation area. This fenced compound, southwest of Building X-10, is 70 feet by 50 feet in size and is primarily soil and grass.

SWMU #35, Building X-12. The area on the east side of Building X-12 was used as a one time waste accumulation area. The unit measures approximately 100 square feet in size and is covered in gravel.

SWMU #36, Building 68, Battery Shop. The Battery Shop began operation in the early 1940's and is presently in use. The unit is contained inside of building 68 which is approximately 48,000 SF. in size. During normal Battery Shop operations all spills are contained within the building, drained to a holding tank at the south end of the building and pumped to a neutralization pit at Building 1278.

Virgin sulfuric acid and sodium bicarbonate are stored at this site in bulk quantities of thousands of gallons and hundreds of pounds respectively. Various other chemicals are stored in building 68, but in smaller quantities. They are detergents, lacquers, adhesives, penetrating oil, kerosene, dry cleaning solvent, and hydraulic fluid to name a few.

The building's acid tank room floor is elevated about 2 feet above the soil. Drain lines run between the bottom of the floor and the surface of the soil to the edge of the building. From the edge of the building they run below ground to the holding tank.

On two occasions the floor drain to the holding tank separated from the floor allowing approximately 1025 gallons of sulfuric acid to discharge to the soil below the building. Following each spill a sodium carbonate solution was used in an attempt to neutralize the surface below the building.

7.4 Chemical Hazards

Previous sampling operations reveal the potential for exposure to numerous chemical substances. Table 7-2 lists exposure guidelines for expected site chemicals.

Table 7-2
Exposure Guidelines For Expected Site Chemical Hazards

Chemical Name	Odor Threshold (ppm)	OSHA PEL (ppm)	ACGIH TLV (ppm)	NIOSH REL (ppm)	Auto-ignition Temp.	Flammable range (% by volume)
Benzene	4.68	5 STEL	10 Suspect Human Carc.	0.1 1 STEL Potential Occ. Carcinogen	1096	1.3 to 7.1%
Toluene	40.0	100	100	100	996.5	1.3 to 7.1%
1,1,1-Trichloroethylene	N.A.	50 200 STEL	50 200 STEL	25 Potential Occ. Carcinogen	770	11 to 41%
Chlorobenzene	N.A.	75	10	Not Listed	1184	1.3 to 9.6%
Polychlorinatedbiphenyls (PCB) (54% Chlorine)	N.A.	0.5 mg/m3 Skin	0.5 mg/m3	0.001 mg/m3	N.A.	N.A.
Lead	N.A.	0.05 mg/m3	0.05 mg/m3	0.1mg/m3	N.A.	N.A.
Chromium II and III	N.A.	0.5 mg/m3	0.5 mg/m3	0.5 mg/m3	N.A.	N.A.
Cadmium	N.A.	0.2mg/m3 (0.6mg/m3 Ceiling)	0.05mg/m3	Potential Occ. Carcinogen	N.A.	N.A.
Arsenic	N.A.	0.01mg/m3	0.2mg/m3	.002mg/m3 Ceiling Potential Occ. Carcinogen	N.A.	N.A.

Table 7-2
Exposure Guidelines For Expected Site Chemical Hazards

Chemical Name	Odor Threshold (ppm)	OSHA PEL (ppm)	ACGIH TLV (ppm)	NIOSH REL (ppm)	Auto-ignition Temp.	Flammable range (% by volume)
Cyanide	N.A.	5mg/m3	5mg/m3 Skin	5mg/m3 Ceiling	N.A.	N.A.
Mercury	N.A.	0.05mg/m3 Skin	0.1mg/m3 Skin	0.05mg/m3	N.A.	N.A.
Chloroform	205	2	10 Suspected Human Carc.	2 STEL Potential Occ. Carcinogen	N.A.	N.A.
Tetrachloroethylene	N.A.	25	50 200 STEL	Lowest Feasible Concentration Potential Occ. Carcinogen	N.A.	N.A.
Barium	N.A.	0.5mg/m3	0.5 mg/m3	0.5 mg/m3	N.A.	N.A.
Nickel	N.A.	1mg/m3	1mg/m3	0.015mg/m3 Potential Occ. Carcinogen	N.A.	N.A.
Heptachlor	N.A.	0.5mg/m3 Skin	0.5mg/m3 Skin	Potential Occ. Carcinogen	N.A.	N.A.
Bis Hydroxycoumarin (BHC) or Lindane	N.A.	0.5 mg/m3 Skin	0.5 mg/m3	0.5 mg/m3 Skin	N.A.	N.A.
DDD	N.A.	Not Listed	Not Listed	Not Listed	N.A.	N.A.

Table 7-2
Exposure Guidelines For Expected Site Chemical Hazards

Chemical Name	Odor Threshold (ppm)	OSHA PEL (ppm)	ACGIH TLV (ppm)	NIOSH REL (ppm)	Auto-ignition Temp.	Flammable range (% by volume)
DDE	N.A.	Not Listed	Not Listed	Not Listed	N.A.	N.A.
DDT	N.A.	1mg/m3 Skin	1mg/m3	0.5mg/m3 Potential Occ. Carcinogen	N.A.	N.A.
Sulfuric Acid	>1	1mg/m3	1mg/m3 3mg/m3 STEL	1mg/m3	N.A.	N.A.
Dichloromethane (Methylene Chloride)	214	500 1000 Ceiling	50 Suspected Human Carc.	Potential Occ. Carcinogen	1184	12 to 19%
Sulfate	N.A.	Not Listed	Not Listed	Not Listed	N.A.	N.A.
111-Trichloroethane	100	350 450 STEL	350	350 Ceiling	932	N.A.
Copper	N.A.	0.1mg/m3 (fume) 1mg/m3 (dust)	0.2mg/m3 (fume) 1mg/m3 (dust)	0.1mg/m3 (fume) 1mg/m3 (dust)	N.A.	N.A.
Zinc	N.A.	Not Listed	Not Listed	Not Listed	N.A.	N.A.
Antimony	N.A.	0.5mg/m3	0.5mg/m3	0.5mg/m3	N.A.	N.A.
Calcium Hydroxide	N.A.	Not Listed	5mg/m3	Not Listed	N.A.	N.A.

Table 7-2
Exposure Guidelines For Expected Site Chemical Hazards

Chemical Name	Odor Threshold (ppm)	OSHA PEL (ppm)	ACGIH TLV (ppm)	NIOSH REL (ppm)	Auto-ignition Temp.	Flammable range (% by volume)
Gasoline	N.A.	300 500 STEL	300 500 STEL	Potential Occ. Carcinogen	535.7	1.4 to 7.4%
Diesel Fuel	N.A.	Not Listed	Not Listed	Not Listed	120	0.5 to 7.5%
Iron	N.A.	Not Listed	Not Listed	Not Listed	N.A.	N.A.
Fluoride	N.A.	2.5 mg/m3	Not Listed	2.5 mg/m3	N.A.	N.A.
Bis(2-Ethylhexyl)Phthalate	N.A.	5mg/m3 10mg/m3 STEL	5mg/m3 10mg/m3 STEL	Potential Occ. Carcinogen	735	0.3
Kerosene	1	Not Listed	Not Listed	100mg/m3	444	0.7 to 5.0%
Silver	N.A.	0.01mg/m3	0.1mg/m3	0.01 mg/m3	N.A.	N.A.
Acetone	100	750 1000 STEL	750 1000 STEL	250	869	2.6 to 12.8
2-Butanone (Methyl Ethyl Ketone; MEK)	10	200 300 STEL	200 300 STEL	200	960	1.8 to 11.5%
Nitric Acid	N.A.	2 4 STEL	2 4 STEL	2	N.A.	N.A.
Hydrochloric Acid	N.A.	5 Ceiling	5 Ceiling	5 Ceiling	N.A.	N.A.

7.5 Operations and Physical Hazards

Heavy equipment and drill rig operations will be conducted in accordance with the procedures outlined in Appendix S *E/A&H Health and Safety Manual, Drilling Safety Guide*. Prior to initiating drilling at any site, Charleston NSY Engineering will be notified to assure locations of underground utilities. Overhead powerlines shall be avoided with minimum clearances as indicated in the *E/A&H Drilling Safety Guide*. Personnel conducting drill rig operations shall keep clear of all moving parts. When conducting operations or survey work on foot, personnel will walk at all times. Running greatly increases the probability of slipping, tripping, and falling. When working in areas that support habitat for poisonous snakes, personnel shall wear protective chaps made of a heavy material designed to prevent snake bites to the legs.

7.6 Employee Protection

Employee protection for this project includes standard safe work practices, personal protective equipment, personal decontamination procedures and equipment for extreme weather conditions, work limitations, and exposure evaluation.

Standard Safe Work Practices:

- Eating, drinking, chewing gum or tobacco, smoking or any activity that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited in any area designated as contaminated, unless authorized by the Site Health and Safety Officer.
- Hands and face must be thoroughly washed upon leaving the work area.
- No contact lenses will be worn in work areas while invasive actions are conducted.
- Whenever decontamination procedures for outer garments are in effect, the entire body should be thoroughly washed as soon as possible after the protective garment is removed.
- Contact with contaminated or suspected contaminated surfaces should be avoided. Whenever possible, do not walk through puddles, leachate or discolored surfaces, or lean, sit, or place equipment on drums, containers, or on soil suspected of being contaminated.

- Medicine and alcohol can exacerbate the effects from exposure to toxic chemicals. Prescribed drugs should not be taken by personnel on cleanup or response operations where the potential for absorption, inhalation or ingestion of toxic substances exists unless specifically approved by a qualified physician. Consumption of alcoholic beverages are prohibited.
- Due to the possible presence of overhead power lines, adequate side and overhead clearance should be maintained to insure that the drill rig boom does not touch or pass close to any overhead lines.
- Due to the possible presence of underground utilities (including electric, natural gas, water, sewer, telephone, etc.), the activity and local utility representatives should be contacted and requested to identify all lines at the ground surface using characteristic spray paint or labeled stakes. A 3-yard buffer zone should be maintained during all subsurface investigations.
- Due to the flammable properties of the potential chemical hazards, all spark or ignition sources should be bonded and/or grounded or mitigated before soil boring advancement or other site activities begin.

Charleston NSY General Rules of Conduct:

- Liquor, firearms, narcotics, tape recorders, and other contraband items are not permitted on the premises.
- Any violation of local, state, or federal laws, or conduct which is outside the generally accepted moral standards of the community is prohibited.
- Violation of the Espionage Act, willfully hindering or limiting production or sabotage is not permitted.
- Willfully damaging or destroying property, or removing government records is forbidden.
- Misappropriation or unauthorized altering of any government records is forbidden.
- Securing government tools in a personal or contractors tool box is forbidden.
- Gambling in any form, selling tickets, articles, taking orders, soliciting subscriptions, taking up collections, etc. is forbidden.

- Doing personal work in government shop or office, using government property or material for unauthorized purposes, or using government telephones for unnecessary or unauthorized local or long distance telephone calls is forbidden.
- Compliance with posted signs and notices is required.
- Boisterousness and noisy or offensive work habits, abusive language, or any verbal, written, symbolic, or other communicative expression which tends to disrupt the work of others or morale is forbidden.
- Fighting or threatening bodily harm to another is forbidden.
- Defacing any government property is forbidden.
- Wearing shorts of any type and/or offensive logos, pictures, or phrases on clothing is forbidden. Shirts, shoes and pants or slacks or coverall-type garments will be worn at all times on government property.
- All persons operating motor vehicles will obey all Charleston NSY traffic regulations.

7.6.1 Personal Protective Equipment

The selection of personal protective equipment (PPE) is based on information collected from Sections 2 and 3 of this work plan. Table 7-3 lists potential site constituents and appropriate levels of protection. All activities in SWMUs 12, 22, 27 through 31, 35, and 36 will be conducted in Level D protection. Activities in SWMUs 3 through 8, 13, 17, 20, 21, 32, 33, and 34 will be conducted in Modified Level D protection. See Table 7-4 for a description of Level D and Modified Level D protection. Modified Level D protection consists of work coveralls (full length sleeves and pants), hard hat, appropriate chemical-resistant gloves (vinyl or nitrile), eye protection, and chemical-resistant, steel-toed and shank boots. These protection levels were selected because concentrations of the constituents at the respective areas are not expected to reach the action levels prescribed for these sites (50 percent of TLV-TWA per constituent).

Table 7-3
Potential Site Chemicals and Appropriate PPE

SWMU	Ba	Cr	Ni	Pb	Heptachlor	BHC	DDD	DDE	DDT	PCB	Arsenic	Sulfuric Acid	Methylene Chloride	Sulfate	TCE	TCA	Benzene	Cu	Zn	Al	Calcium Hydroxide	Gasoline	Diesel	Fe
1	x	x	x	x																				
2				x																				
3					x	x	x	x	x	x	x													
4																								
5				x								x												
6	x	x		x						x														
7						x			x	x	x													
8										x			x	x										
9	x	x	x	x							x				x	x	x	x	x	x				
12																								
13																						x	x	
14												x												
17										x														x
20		x	x	x									x				x						x	x
21		x		x																				
22		x																						
25	x	x	x	x																				
27																								
28																								
29																								
30																								
31																								
32													x											
33													x											
34													x											x
35																								
36												x												

Table 7-3(cont'd)
Potential Site Chemicals and Appropriate PPE

SWMU	Fluoride	Phthalate	Chloro-Benzene	Chloroform	Kerosene	CN	Toluene	Tetrachloroethylene	Cd	Ag	Hg	Acetone	MEK	Nitric Acid	HCL	Se	PPE
1																	C
2																	C
3																	Modified D
4																	Modified D
5																	Modified D
6									x								Modified D
7																	Modified D
8																	Modified D(G)
9																x	B, C
12																	D
13																	Modified D(G)
14	x	x	x	x	x												B, C, D
17																	Modified D(G)
20										x							Modified D(G)
21						x	x	x	x	x							Modified D(G)
22							x			x							D
25							x			x	x	x					C
27																	D
28																	D
29																	D
30																	D
31																	D
32								x					x	x			Modified D(G)
33								x					x	x			Modified D(G)
34								x					x	x			Modified D(G)
35																	D
36																	D

Activities scheduled for SWMUs 1, 2, 14, and 25 shall be initiated in Level C PPE. See Table 7-4 for a description of Level C PPE. These areas possess the potential for high lead dust levels becoming airborne by ground disturbing operations (i.e., drilling, borings, vehicular movement). Level C PPE consists of chemical resistant clothes, coveralls, long sleeves (hood optional); full-facepiece, air purifying respirator equipped with cartridges suitable for the hazard; hard hat; inner gloves and chemical resistant outer gloves; steel toe and shank boots; and disposable outer boots. An upgrade to Level B will be initiated if airborne concentrations in the breathing zone exceed background levels by 50ppm. If background levels in the breathing zone are below 5ppm, a downgrade to Modified Level D will occur.

Activities in SWMU 9 will be initiated in level B PPE. See Table 7-4 for a description of Level B PPE. Level B PPE consists of a two-piece chemical splash suit, one-piece chemically resistant coveralls, long sleeves; pressure demand, full-facepiece, self-contained breathing apparatus (SCBA)/ supplied air system; hard hat; inner gloves and chemical resistant outer gloves; steel toe and shank boots; and disposable outer boots. A previous geophysical study of SWMU 9 identified several metal anomalies which may be metal drums containing hazardous materials.

Air monitoring for volatile organic compounds will be performed continuously during all sampling activities. Air monitoring instrumentation will be continuous reading. Work being performed in Level D will upgrade to Level C if airborne concentrations exceed 5 ppm above the background concentrations in the breathing zone. Level B will be initiated if concentrations of any contaminant exceed 50 percent of the OSHA Permissible Exposure Limit (PEL). See Table 7-4 for the specific criteria for use and equipment for each level of protection.

Selection of Personal Protective Equipment

It is important that personal protective equipment be appropriate to protect against the potential or known hazards at each investigation site. Protective equipment will be selected based on the types, concentrations, and routes of personal exposure that may be encountered. In situations

Table 7-4
Level of Protection and Criteria

Level of Protection	Criteria for Use	Equipment
Level A	• When atmospheres are "immediately dangerous to life and health" (IDLH in the NIOSH/OSHA Pocket Guide to Chemical Hazards or other guides.) • When known atmospheres or potential situations exist that would affect the skin or eyes or be absorbed into the body through these surfaces. Consult standard references to obtain concentrations hazardous to skin, eyes or mucous membranes. • Potential situations include those where immersion may occur, vapors may be generated or splashing may occur through site activities. • Where atmospheres are oxygen with the conditions above. • When the type(s) and or potential concentration of toxic substances are not known.	• Positive pressure-demand full facepiece self contained breathing apparatus or positive pressure demand supplied air respirator with escape SCBA • Totally-encapsulating chemical protective suit • Chemical-resistant inner and outer gloves • Steel toe and shank chemical resistant boots • Hard hat under suit • Two-way radios worn inside suit • Optionally: coveralls, long cotton underwear, disposable protective suit, gloves and boots, work over fully encapsulating suit
Level B	• When work areas contain less than 19.5 percent oxygen • When performing trenching operations (SWMU 9) to determine nature and extent of anomalies • When direct reading instrumentation indicates VOC concentrations in excess of 50 ppm.	• Two-piece chemical splash suit, one-piece chemical resistant coveralls, long sleeves, hooded • Full-faced positive-pressure self-contained breathing apparatus (SCBA) or Supplied-air system with a 5 minute escape bottle • Hard hat • Inner gloves and chemical resistant gloves • Steel toe and shank boots • Disposable outer boots
Level C	• When airborne particulates (dust) warrant respiratory protection • When work areas contain at least 19.5 percent oxygen • When direct reading instrumentation indicates VOC concentrations in excess of 5 ppm.	• Chemical resistant clothes, long sleeves, hood optional, one or two pieces • Full-faced piece, air purifying respirator equipped with cartridges suitable for the hazard • Hard hat • Inner gloves and chemical resistant gloves • Steel toe and shank boots • Coveralls and disposable outer boots

Table 7-4
Level of Protection and Criteria

Level D (or Modified Level D)	• When level B or C is not indicated • When airborne particulates do not warrant respiratory protection • When work areas contain at least 19.5 percent oxygen	• Inner gloves and chemical-resistant gloves (for Modified Level D) needed to handle soil or water samples • Chemical protective clothing (for Modified Level D) • Steel toe and shank boots • Hard hat (ANSI Z891-1969 standard) • Eye protection (ANSI Z87.1-1968) standard • Optionally: coveralls and disposable outer boots

Notes:

Level A protection will be selected when the highest available level of respiratory, skin, and eye protection is needed. Level A protection will be required in Area A of the exclusion zone.

Contraindications for use of Level A:
- Environmental measures contiguous to the site indicate that air contaminants do not represent a serious dermal hazard.
- Reliable, accurate historical data do not indicate the presence of severe dermal hazards.
- Open, unconfined areas.
- Minimal probability of vapors or liquids (splash hazards) present which could affect or be absorbed through the skin.
- Total vapor readings indicate 500 ppm to 1,000 ppm.

Level B protection will be selected when the highest level of respiratory protection is needed,but cutaneous exposure to the small unprotected areas of the body, (neck and back of head) is unlikely, or where concentrations are not known to be within acceptable standards. Additionally, the permissible limit for exposure to mixtures of all site gases will be checked using the requirements of 1910.1000(d)(2)(i) to ensure that PEL is not exceeded. If the value calculated using this method exceeds 1.0, Level B PPE is required.

Level C protection will be selected when the types and concentrations of inseparable material are known, or reasonably assumed to be no greater than the protection factors associated with air-purifying respirators, and exposure to the unprotected areas of the body is unlikely to cause harm.
Dust concentrations require Level C PPE, where the respirable fractions exceed the PEL of 5 mg/m3 or the total concentrations exceed the PEL of 15 mg/m3.

Level D protection will be chosen when measurements of atmospheric concentrations are at background levels and work functions preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of any chemicals.

where the types of materials and possibilities of contact are unknown or the hazards are not clearly identifiable, a more subjective determination must be made of the personal protective equipment required, based on past experiences and sound safety practices.

The appropriate level of protection will be determined prior to the initiation of work based on the best available information. Subsequent information, (e.g., sampling results and site observations), may require changes in the original level selected.

7.6.2 Procedures and Equipment for Extreme Weather Conditions

Field activities for this investigation are scheduled to last approximately four weeks. The seasonal climate in South Carolina can be expected to be hot with high relative humidity, therefore heat stress will be of concern for all personnel. Adverse weather conditions are important considerations in planning and conducting site operations. Extremes in hot weather can cause physical discomfort, loss of efficiency and personal injury.

Heat Stress

Heat stress can result when the protective clothing decreases natural body ventilation even when temperatures are moderate. Working under various levels of personal protection may require wearing low permeability disposable suits, gloves and boots. This clothing will prevent most natural body ventilation. Discomfort due to increased sweating and body temperature (heat stress) will be expected at the work site.

Heat stress is the metabolic and environmental heat to which an individual is exposed. The manifestations of heat strain are the adjustments made by an individual in response to the stress. The three most important categories of heat-induced illness are: heat exhaustion, heat cramps, and heat stroke. These disorders can occur when the normal responses to increased sweat production are not adequate to meet the needs for body heat loss or when the temperature regulating mechanisms fail to function properly.

Heat exhaustion is a state of collapse brought about by an insufficient blood supply to the cerebral cortex portion of the brain. The crucial event is low blood pressure caused by inadequate heart output and widespread expansion of blood vessels.

Heat Exhaustion Factors — Factors which can lead to heat exhaustion are as follows:

- Increased expansion of blood vessels which causes a decreased capacity of circulation to meet the demands for heat loss to the environment, exercise, and digestive activities.
- Decreased blood volume due to dehydration.
- Reduced blood volume due to lack of physical training, infection, intoxication (from industrial contaminants as well as from drinking alcohol), or heart failure.

Heat Exhaustion Symptoms — The symptoms include extreme weakness or fatigue, dizziness, nausea, or headache. More severe cases may also involve vomiting and possible unconsciousness. The skin becomes clammy and moist, the complexion pale, and the oral temperature stays normal or low but the rectal temperature is usually elevated (99.5°F - 101.3°F). Workers who are unacclimated run the highest risk.

Heat Exhaustion Treatment — In most cases, treatment of heat exhaustion is fairly simple. The victim will be moved to a cool place. If the victim is unconscious, medical assistance must be sought. Mild cases may experience immediate recovery, however, more severe cases may require several days care. No permanent effects have ever been reported.

Heat cramps result when the working muscles go into painful spasms. This may occur in those who perspire profusely in heat and who drink large quantities of water, but who fail to replace their bodies' low salt. It is the low salt content in the blood that causes the cramping. The abdominal muscles as well as the muscles in the arms and legs may be affected. The cramps may appear during or even after work hours. Persons on a low sodium diet should not be given salt. A physician must be consulted on the care of people with this condition.

Heat stroke is the most serious of the health problems that arise while working in hot environments. It is caused by the breakdown of the thermo-regulatory system under stress. When this happens, perspiration stops and the body can no longer regulate its own temperature.

Heat Stroke Symptoms — A heat stroke victim may be identified by hot, dry, and usually red or spotted skin. The body core temperature can exceed 105°F. Mental confusion, irritability and chills are common. These are all early warning signs of heat stroke; if the sufferer is not removed from the hot environment at once, more severe symptoms can follow, including unconsciousness, delirium, and convulsions, possibly ending in death.

Heat Stroke Treatment — Heat stroke victims must be treated as a major medical emergency; medical assistance must be summoned immediately.

Additional treatment:

- First aid must be administered.
- Individual must be moved to a cool location.
- Individual must be cooled through wetting, fanning, or immersion.

Care should be taken to avoid over-cooling and treatment for shock by raising the legs. Early recognition and treatment of heat stroke are the only means of preventing permanent brain damage or death.

To reduce the potential for heat strokes:

- Drink plenty of fluids (to replace loss through sweating).
- Wear cotton undergarments to act as a wick to absorb moisture.
- Make adequate shelter available for taking rest breaks to cool off.

Additional Measures for Extremely Warm Weather:

- Wear cooling devices to aid in ventilation. (NOTE: the additional weight may affect efficiency.)
- Install portable showers or hose down facilities to cool clothing and body.
- Shift working hours to early morning and early evening. Avoid the hottest time of the day.
- Frequently rotate crews wearing the protective clothing (if required).

7.6.3 Personal Decontamination

A decontamination zone will be established immediate to each sounding/sampling site and will include an area for sampling equipment and personal decontamination. Decontamination reduction areas for activities with levels D and C PPE specified will be located at an upwind location at the perimeter of the exclusion zone. Where site activities require decontamination of heavy equipment and personnel (SWMU #9 - Closed Landfill) the decontamination area will be located near an existing water supply and a temporary decontamination pad will be constructed at the perimeter of the exclusion area. The decontamination zone will consist of a 20-feet by 20-feet sheet of 6-mil polyethylene with specific stations that will accommodate the removal and disposal of the protective clothing, boot covers, gloves and respiratory protection if required.

All equipment will be decontaminated using a soap and clean water wash solution. All equipment decontamination will be completed by personnel in Level D PPE except for SWMU 9 where heavy equipment decontamination will be performed in Level C PPE. In the event of inclimate weather (i.e. lightning) or an emergency requiring immediate evacuation, all contaminated equipment will be wrapped and taped in 6-mil polyethylene sheeting and tagged as "contaminated" for later decontamination.

7.6.3.1 Personal Decontamination Procedures

The decontamination procedures, based on Modified Level D and Level C protection, will consist of the following:

- Brushing heavily soiled boots and rinsing outer gloves and boots with soap and water.
- Removing outer gloves and depositing them in a plastic lined container.
- Remove outer chemical protective clothing
- Wash and rinse inner gloves
- Wash and rinse APR and surrounding skin
- Remove APR
- Hard hats and eye protection should also be washed thoroughly at the end of each work day with a soap and water solution.
- Disposable gloves and any disposable clothing will be disposed of in sealable bags and placed in a dumpster for disposal at a landfill.
- All field personnel are to be instructed to shower as soon as possible after leaving the site.

Decontamination procedures for SWMU 9 where Level B PPE will consist of the following:

- Outer boot covers and gloves will be washed and rinsed
- Outer boot covers and glove seals will be un-taped and outer protective coveralls, boot covers and gloves will be removed and placed in a lined container.
- Wash and rinse splash suit, safety boots, and SCBA
- Remove SCBA backpack, **do not** remove facepiece
- Remove splash suit
- Wash and rinse inner gloves
- Wash and rinse facepiece and surrounding skin
- Remove facepiece
- Remove inner gloves.

Decontamination procedures will be conducted at the lunch break and at the end of each work day. If higher levels of personal protection equipment are needed, adjustments will be made to these procedures and an amendment will be made to this health and safety plan.

All wastes (soil and water) generated during personal decontamination will be collected in 55-gallon drums. The drums will be labeled by E/A&H personnel for final disposal by the Navy.

7.6.3.2 Closure of the Personal Decontamination Station

All disposable clothing and plastic sheeting used during site activities will be double-bagged and disposed in a refuse container. Decontamination and rinse solutions will be placed in a lined 55-gallon drum for later analysis and disposal. All washtubs, pails, buckets, etc. will be washed, rinsed and dried at the end of each workday.

7.6.4 Work Limitations

All site activities will be conducted during daylight hours only. All personnel scheduled for these activities will have completed initial health and safety training and actual field training as specified in 29 CFR 1910.120(e). All supervisors must complete an additional eight hours of training in site management. All personnel must complete an eight-hour refresher training course on an annual basis in order to continue working at the site.

7.6.5 Exposure Evaluation

All personnel scheduled for site activities have had a baseline physical examination which includes a stressing exam of the neurologic, cardiopulmonary, musculoskeletal and dermatological systems, pulmonary function testing, multi-chemistry panel and urinalysis and have been declared fit for duty. An exposure history form will be completed for each worker participating in site activities. An examination and updated occupational history will be repeated on an annual basis and upon termination of employment as required by 29 CFR 1910.120(f). The content of the annual or termination examination will be the same as the baseline physical.

A qualified physician will review the results of the annual examination and exposure data and request further tests or issue medical clearances as appropriate.

After any job-related injury or illness, there will be a medical examination to determine fitness for duty or any job restrictions. The site health and safety manager will review the results with the examining physician before releasing the employee for work. A similar examination will be performed if an employee has missed at least three days of work due to a non-job related injury or illness requiring medical attention. Medical records shall be maintained by the employer or the physician for at least 30 years following the termination of employment.

7.7 Air Monitoring

Air monitoring will be accomplished using a photoionization detector (PID) and a combustible gas indicator (CGI) during all borings, groundwater well installations, or any ground disturbing operations. The PID will be field calibrated to measure volatile organic compounds relative to an isobutylene standard. Background (ambient) PID and CGI readings in the breathing zone will be collected before each day's field activities begin. This value will be recorded in the field logbook. If volatile organic compounds concentrations (in the breathing zone) exceed background (ambient) readings by <u>five ppm or more</u> in areas where Level D ppe (or Modified Level D ppe) are required, field activities will immediately cease. When site activities stop, the Field Project Manager must contact the Health and Safety Officer. The Health and Safety Officer will be responsible for reassessing the hazards and prescribing revised health and safety requirements as necessary including upgraded personal protective equipment requirements, revised work schedules, and revised decontamination procedures.

Where Level C PPE is specified during drilling operations, specifically at SWMU 9 Closed Landfill and SWMU 14 Chemical Disposal Area, the air will be monitored using continuously operating, direct reading PID. If concentrations of VOC at the drill rig operator's breathing zone indicates greater than 50 ppm VOC, the operation shall immediately cease and PPE upgraded to Level B. Air samples for volatile organics will be collected from the operator's breathing zone to determine VOC constituents using NIOSH Approved Methods.

A geophysical survey at SWMU 9 Closed Landfill indicated a large anomaly that would suggest buried metallic barrels or similar. The nature and extent of this anomaly is to be determined using trenching techniques. Because the materials potentially contained by these barrels are of unknown nature, those activities will be completed in Level B PPE. If concentrations of VOC at the trenching machine operator's breathing zone exceeds 500 ppm, the operation will cease immediately and the procedures reviewed. Air samples for volatile organics will be collected from the operator's breathing zone to determine VOC constituents using NIOSH Approved Methods.

Field technicians will be made aware that they must report any unusual odors or soil discolorations. Each instrument shall be calibrated daily before site activities begin and checked for proper operation during the day. At the end of each work day and before calibration, each instrument shall be checked to ensure that it is free from surface contamination.

7.8 Authorized Personnel

Personnel anticipated to be onsite at various times during site activities include:

- E/A&H Principal-In-Charge — Mr. Paul Stoddard
- E/A&H Task Order Manager — Mr. Paul Stoddard
- E/A&H Site Manager — **Mr. Todd Haverkost**
- E/A&H Site Health & Safety Officer — Mr. John Borowski
- SOUTHDIV, Engineer-in-Charge — **Ms. Linda Martin**
- Charleston Naval Shipyard Site Contact — **Mr. Ron DeWitt**
- Drilling Subcontractor — **Environmental Technology and Engineering**
- Laboratory Subcontractor — **Savannah Laboratories**

7.8.1 Responsibilities of E/A&H Site Manager

The Field Project Manager will direct the site investigation and operation. He has the primary responsibility for assuring that all personnel are aware of:

- Names of personnel and alternates responsible for site safety and health
- Safety, health and other hazards present on the site
- Use of personal protection equipment and assuring that the equipment is available
- Work practices by which the employee can minimize risks from hazards
- Safe use of engineering controls and equipment on the site
- Medical surveillance requirements including recognition of symptoms and signs which might indicate over exposure to hazards
- Site control measures, decontamination procedures, site standard operating procedures and the contingency plan and responses to emergencies including the necessary PPE.

The Field Project Manager is also responsible for assuring that all employees have received at least 40 hours of health and safety instruction, off the site, and actual field experience under the direct supervision of a trained experienced supervisor. Workers who may be exposed to unique or special hazards shall be provided additional training.

The Field Project Manager also monitors the performance of personnel to ensure that mandatory health and safety procedures are being performed and corrects any performances that do not comply with the Health and Safety Plan. (Copies of health and safety training certificates must be available for review by the E/A&H Project Manager and Site Safety Officer.)

Additional responsibilities extend to ensuring that all field personnel employed on the site are covered by a medical surveillance program as required by 29 CFR 1910.120(f):

- Consulting with the Health and Safety Officer and/or other personnel
- Preparation and submittal of any and all project reports— includes progress, accident, incident, contractual, etc.

- Monitoring personnel decontamination to ensure that all personnel are complying with the established decontamination procedures.

7.8.2 Responsibilities of E/A&H Site Health and Safety Officer

- Assuring that a copy of the Health and Safety Plan is maintained onsite during all field activities.
- Advising the Field Project Manager on all health and safety related matters involved at the site.
- Directing and ensuring that the safety program is being correctly followed in the field, including the proper use of personal protective and site monitoring equipment.
- Ensuring that the field personnel observe the appropriate work zones and decontamination procedures.
- Reporting any safety violations to the Project Manager.
- Conducting safety briefings during field activities.

The Site Health and Safety Officer will be a person trained in safety and industrial hygiene. After the project begins and the Site Health and Safety Officer has had time to evaluate actual hazardous site conditions, he/she may determine that a member of the project team may assume the duties of the Site Health and Safety Officer.

The person responsible for daily health and safety will be trained to use the air monitoring equipment, interpret the data collected with the instruments, and be familiar with symptoms of heat stress and cold exposure and the location and use of safety equipment onsite. He will also be familiar with this health and safety plan.

The following criteria outline when the Site Health and Safety Officer will be replaced: (1) termination of employment, (2) sickness, (3) end of shift, (4) injury, or (5) death. It should be noted that under site work schedules only one shift will be working. As a result, the Site

Health and Safety Officer will be responsible for the day shift. If circumstances arise that require work during other periods, an alternate Site Health and Safety Officer will be designated.

7.8.3 Responsibilities of Onsite Field Personnel

- All personnel going onsite must be thoroughly briefed on anticipated hazards and trained on equipment to be worn, safety procedures to be followed, emergency procedures and communications.
- Required respiratory protective devices and clothing must be worn by all personnel going into areas designated for wearing protective equipment.
- Personnel must be fit-tested before using respirators.
- No facial hair which intrudes on the sealing surface of the respirator is allowed on personnel.
- Personnel on site must use the buddy system when wearing respiratory protective equipment. As a minimum, a third person, suitably equipped as a safety backup, is required during initial entries.
- Visual contact must be maintained between pairs onsite and site safety personnel. Field personnel should remain close together to assist each other during emergencies.
- All field personnel should make use of their senses to alert themselves to potentially dangerous situations which they should avoid, e.g., presence of strong and irritating or nauseating odors.
- Personnel should practice unfamiliar operations prior to doing the actual procedure in the field.
- Field personnel shall be familiar with the physical characteristics of the site, including:
  - — wind direction in relation to contamination zones
  - — accessibility to associates, equipment and vehicles
  - — communications
  - — operation zones

  - — site access
  - — nearest water sources

- The number of personnel and equipment in the contaminated area must be kept to a minimum, consistent with effective site operations.
- Procedures for leaving a contaminated area must be planned and implemented before going onsite in accordance with the Site Health and Safety Plan.
- All visitors to the job site must comply with the Health and Safety Plan procedures. Personal protection equipment may be modified for visitors depending on the situation. Modifications must be approved by the Site Health and Safety Officer.

7.9 Emergency Information

All hazardous waste site activities present a potential risk to onsite personnel. During routine operations, risk is minimized by establishing good work practices, staying alert and using proper personal protective equipment. Unpredictable events such as physical injury, chemical exposure or fire may occur and must be anticipated.

If any situation or unplanned occurrence requires outside or support service, Bill Book, NSY site contact, will be informed and the appropriate contact from the following list will be made:

Contact	Agency or Organization	Telephone
Ron DeWitt	Charleston Naval Shipyard Site Contact	(803) 743-5519
Linda Martin	SOUTHDIV Engineer-in-Charge	(803) 743-0574
Law Enforcement	NAVBASE Security	(74) 3-5555
Fire Department	NAVBASE Fire Department	(74) 3-5333
Ambulance Service	NAVBASE Ambulance	(74) 3-5444

Poison Control Center		(800) 922-1117
Health Department	South Carolina Department of Health and Environmental Control	(803) 253-6488
Paul Stoddard	EnSafe/Allen & Hoshall 5724 Summer Trees Drive Memphis, TN 38134	(901) 372-7962
John Borowski	EnSafe/Allen & Hoshall 5724 Summer Trees Drive Memphis, TN 38134	(901) 372-7962

Linda Martin, SOUTHDIV Engineer-in-Charge will be contacted after appropriate emergency measures have been initiated onsite.

7.9.1 Site Resources

Cellular telephones will be used for emergency use and communication/coordination with Charleston NSY. First aid and eye wash equipment will be available at the work area.

7.9.2 Emergency Procedures

Conditions which may constitute an emergency include if any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while on site or if a condition is discovered that suggests the existence of a situation more hazardous than anticipated.

The following emergency procedures should be followed:

- Site work area entrance and exit routes will be planned and emergency escape routes delineated by the Site Safety Officer.
- If any member of the field team experiences any effects or symptoms of exposure while on the scene, the entire field crew will immediately halt work and act according to the instructions provided by the Site Safety Officer.

- For applicable site activities, wind indicators visible to all onsite personnel will be provided by the Site Safety Officer to indicate possible routes for upwind escape.
- The discovery of any conditions that would suggest the existence of a situation more hazardous than anticipated will result in the suspension of work until the Safety Officer has evaluated the situation and provided the appropriate instructions to the field team.
- If an accident occurs, the Field Project Manager is to complete an accident report form for submittal to the managing principal-in-charge of the project.
- If a member of the field crew suffers a personal injury, the Site Health and Safety Officer will call 743-5444 (serious injury) to alert appropriate emergency response agencies or administer on-site first aid (minor injury) as the situation dictates. An Accident Report Form will be completed for any such incident.
- If a member of the field crew suffers a chemical exposure, the affected areas should be flushed immediately with copious amounts of clean water, and if the situation dictates, the Site Health and Safety Officer should alert appropriate emergency response agencies, or personally ensure that the exposed individual is transported to the nearest medical treatment facility for prompt treatment. (See Appendix **T** for directions to the emergency medical facility.) An Accident Report Form will be completed for any such incident.

Additional information on appropriate chemical exposure treatment methods is provided in the MSDS **that will be maintained onsite for each of the constituents of concern.** Directions to the nearest emergency medical facility capable of providing general emergency medical assistance and treating chemical burns are provided in Appendix **T**.

7.10 Forms

The following forms will be used in implementing this Health and Safety Plan:

Plan Acceptance Form
Plan Feedback Form
Exposure History Form

The Plan Acceptance Form will be filled out by all employees working on the site before site activities begin. The Plan Feedback Form will be filled out by the Site Safety Officer and any other onsite employee who wishes to fill one out. The Exposure History Form will be completed by both the Field Project Manager and the individual(s) for whom the form is intended. Examples of each form are provided in Appendix U.

All completed forms must be returned to the Task Order Manager at EnSafe/Allen & Hoshall, Memphis, Tennessee.